88

PONTIAC

Service Manual

S-88 VD-2

1988 FIREBIRD SERVICE MANUAL

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This manual applies to the 1988 Pontiac Firebird Models. It contains the latest product information available at the time of publication approval. Information pertaining to the operation of the vehicle is contained in the Owner's Manual which accompanies each vehicle. The right is reserved to make changes at any time without notice.

Any references to brand names in this manual is intended merely as an example of the types of lubricants, tools, materials, etc. recommended for use in servicing 1988 Pontiac Models. In all cases, an equivalent may be used.

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GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

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CAUTION

To reduce the chance of personal injury and/or property damage, the following instructions must be carefully observed:

Proper service and repair are important to the safety of the service technician and the safe, reliable operation of all motor vehicles. If part replacement is necessary, the part must be replaced with one of the same part number or with an equivalent part. Do not use a replacement part of lesser quality.

The service procedures recommended and described in this service manual are effective methods of performing service and repair. Some of these procedures require the use of tools specially designed for the purpose.

Accordingly, anyone who intends to use a replacement part, service procedure or tool, which is not recommended by the vehicle manufacturer, must first determine that neither his safety nor the safe operation of the vehicle will be jeopardized by the replacement part, service procedure or tool selected.

It is important to note that this manual contains various 'Cautions' and 'Notices' that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these 'Cautions' and 'Notices' are not exhaustive, because it is impossible to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

SECTION 0A

GENERAL INFORMATION

CONTENTS

GENERAL DESCRIPTION

Only general information appears in this section. Detailed specifications on major units are given at the end of each respective section of this manual.

BODY NUMBER PLATE

The Body Number Plate (Fig. 1) is attached to the front tie bar behind either the right or left headlamp in the engine compartment on all models. The Body Number Plate identifies numerous items as outlined in Figure 1.

VEHICLE IDENTIFICATION NUMBER

The Vehicle Identification Number (VIN) Plate is located on top of the instrument panel at the lower left of the windshield, see Figure 2. Refer to Figure 3 for detailed "VIN" code information. For Engine V.I. N. Location, refer to Figure 4.

METRIC FASTENERS

Pontiac models are primarily dimensioned in the metric system. Most fasteners are metric and are very close in dimension to well-known customary fasteners in the inch system. It is most important that replacement fasteners be of the correct nominal diameter, thread pitch and strength.

Original equipment metric fasteners (except "beauty" bolts, such as exposed bumper bolts, and cross recess head screws) are identified by a number

1 — BODY STYLE
2 — ASSEMBLY PLANT
3 — UNIT NUMBER
4 — PAINT TYPE
5 — ROOF OPTION
6 — SEAT OPTION
7 — TRIM COMBINATION
8 — UPPER BODY
9 — UPPER COLOR
10 — LOWER BODY
11 — REMAINING LINES
— AVAILABLE FOR
— PLANT USE
12 — LOWER COLOR
13 — MODEL YEAR
14 — TIME BUILD CODE
15 — DIVISION
16 — BODY TYPE

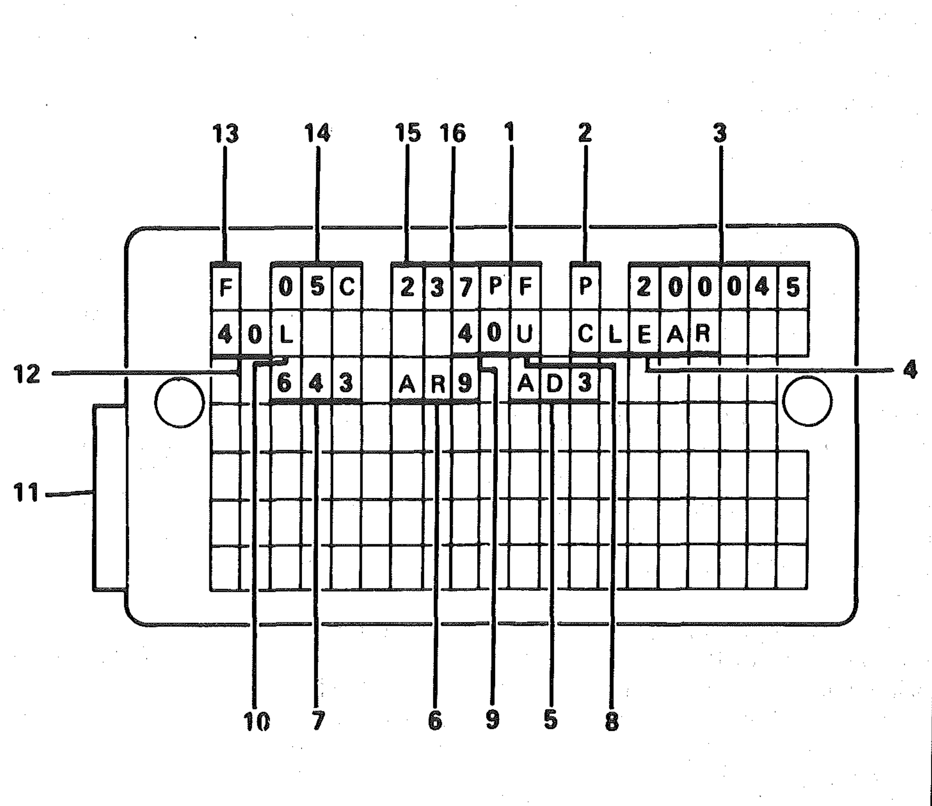


Fig. 1 Body Number Plate

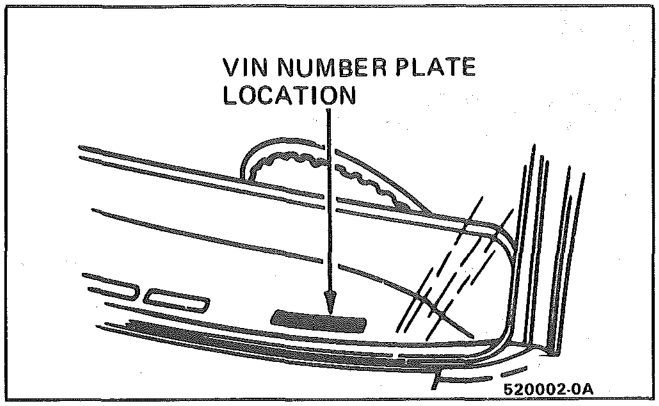


Fig. 2 Vehicle Identification Number Plate Location

marking indicating the strength of the material in the fastener as outlined below. Metric cross recess screws are identified by a Posidriv or Type 1A cross recess as shown in Figure 8. Either a Phillips head or Type 1A cross recess screwdriver can be used in Posidriv recess screw heads, but Type 1A cross recess screwdrivers will perform better.

NOTICE: Most metric fasteners have a blue color coating. However, this should not be used as a positive way of identifying as some metric fasteners are not color coated.

General Motors Engineering Standards, along with other North American Industries, have adopted a portion of the standard metric fastener sizes defined by ISO (International Standards Organization). This was done to reduce the number of fastener sizes used and yet retain the best strength qualities in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.0 X 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is shown in Figure 9.

FASTENER STRENGTH IDENTIFICATION

Most commonly used metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with radial line identification embossed on each bolt head (i.e., grade 7 bolt will exhibit 5 embossed radial lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. Figure 12 shows the different strength markings.

When replacing metric fasteners, be careful to use bolts and nuts of the same strength or greater than the original fasteners (the same number marking or higher) .It is also important to select replacement fasteners of the correct size. Correct replacement bolts and nuts are available through the parts division. Many metric fasteners available in the after-market parts channels were designed to metric standards of countries other than the United States. These fasteners may be of a lower strength, different thread pitch and may not have the numbered head marking system. The metric fasteners used on GM products are designed to new, international standards that may not be used by some nondomestic bolt and nut suppliers. In general, except for special applications, the common sizes and pitches are:

M 6.0 X 1	M 8 x 1.25
M 10 X 1.5	M 12 X 1.75
	M 14 X 2

PREVAILING TORQUE FASTENERS

A prevailing torque nut is designed to develop an interference between the nut and bolt threads. This is most often accomplished by distortion of the top of an all-metal nut or by using a nylon patch on the threads in the middle of the hex flat. A nylon insert may also be used as a method of interference between nut and bolt threads (Fig. 11).

A prevailing torque bolt is designed to develop an interference between bolt and nut threads, or the threads of a tapped hole. This is accomplished by distorting some of the threads or by using a nylon patch or adhesive (Fig. 11).

RECOMMENDATIONS FOR FASTENER REUSE:

1. Clean, unrusted prevailing torque nuts and bolts may be reused as follows:
   a. Clean dirt and other foreign material off nut or bolt.
   b. Inspect nut or bolt to insure there are no cracks, elongation, or other signs of abuse or overtightening. (If there is any doubt, replace with a new prevailing torque fastener of equal or greater strength.)
   c. Lightly coat bolt & nut with engine oil. Assemble parts and hand start nut or bolt.
   d. Observe that before fastener seats, it develops torque per the chart in Figure 10. (If there is any doubt, replace with a new prevailing torque fastener of equal or greater strength.)
   e. Tighten fastener to torque specified in appropriate section of this manual.
2. Bolts and nuts which are rusty or damaged should be replaced with new parts of equal or greater strength.

VEHICLE LIFTING PROCEDURES

NOTICE: When jacking or lifting vehicle from frame side rails, be certain lift pads do not contact catalytic converter as damage to converter will result.

Many dealer service facilities and service stations are equipped with a type of automotive hoist which must bear upon some part of the frame in order to lift the vehicle. Figures 14 and 15 indicate the recommended areas for hoist contact for Pontiac Sunbird models.

If any other hoist methods are used, special care must be used not to damage the fuel tank, filler neck, exhaust system or underbody.

event Date
6-21-88

1G2FW21F7JL256356

PONTIAC VIN SYSTEM IDENTIFICATION

1 G 2 F W 1 1 8 6 J P 1 2 3 4 5 6

PLANT SEQUENCE NUMBER

PLANT CODE

GM PLANT CODES (V.I.N. POSITION #11)	
A	Lakewood
C	Lansing B
L	Van Nuys
N	Norwood
P	Pontiac
T	Tarrytown
W	Willow Run
X	Fairfax
1	Oshawa
2	St. Therese
7	Lordstown

NATION OF ORIGIN	
1.	U.S.A.
2.	Canada

MANUFACTURER	
G	General Motors

MAKE AND TYPE	
2.	Pontiac

SERIES CODE

SERIES/MODEL TABLE (V.I.N. POSITION #4 & #5)

SERIES POS #4	MODEL POS #5	PONTIAC
A	F	6000
A	G	6000 LE
A	E	6000 S/E
A	H	6000 STE
F	L	Safari
F	S	Firebird
F	W	Trans Am
G	J	Grand Prix
G	K	Grand Prix LE
G	P	G.P. Brougham
H	X	Bonneville
H	Z	Bonneville LE
J	B	Sunbird
J	D	Sunbird SE
J	U	Sunbird GT
N	E	Grand Am
N	V	Grand Am LE
N	W	Grand Am SE
P	E	Fiero Coupe
P	F	Fiero SE Coupe
P	G	Fiero GT Coupe
P	M	Fiero Sport Coupe
T	L	1000

MODEL YEAR	
B	1981
C	1982
D	1983
E	1984
F	1985
G	1986
H	1987
J	1988
K	1989
L	1990

CHECK DIGIT

ENGINE CODES (V.I.N. POSITION #8)

V.I.N. CODE	R.P.O. CODE	ENGINE TYPE	CARBURETION	DISPL. (LITRES)
A	LD5	V6	2BBL	3.8
C	L17	L4	2BBL	1.6
F	LB9	V8	MPFI	5.0
G	L69	V8	4BBL	5.0
H	LG4	V8	4BBL	5.0
K	LT2	L4	TBI	2.0
L	LN7	V6	MPFI	3.0
M	LT3	L4	MPFI Turbo	2.0
R	LR8	L4	TBI	2.5
S	LB8	V6	MPFI	2.8
U	L68	L4	TBI	2.5
W	LB6	V6	MPFI	2.8
Y	LV2	V8	4BBL	5.0
Z	LB4	V6	TBI	4.3
3	LG3	V6	SFI	3.8
8	L98	V8	TPI	5.7
9	L44	V6	MPFI	2.8

BODY TYPES (V.I.N. POSITION #6)

VIN CODE	BODY TYPE	DESCRIPTION
2	08	Sedan 2 Door Plain Back (Hatchback)
5	19	Sedan 4 Door 6 Window Notchback
1	27	Coupe 2 Door Notchback
8	35	Station Wagon 4 Door
1	37	Coupe 2 Door Notchback Special
3	67	Coupe 2 Door Convertible
6	68	Sedan 4 Door 6 Window Plain Back
5	69	Sedan 4 Door 4 Window Notchback
2	77	Coupe 2 Door Plain Back Hatchback
2	87	Coupe 2 Door Plain Back Special
1	97	Coupe 2 Door Notchback Sport

RESTRAINT SYSTEM (V.I.N. POSITION #7)

CODE	DESCRIPTION
1	Manual Belts
2	Manual Belts With Built-In Safety
3	Manual Belts With Built-In Safety (Driver Only)
4	Automatic Belts

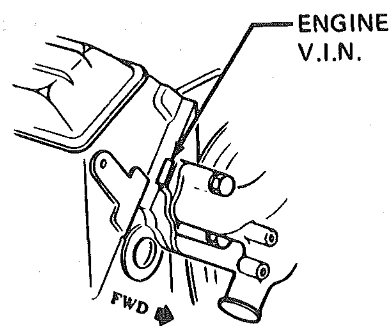
H20001-0A

Fig. 3 Vehicle Identification Number Data

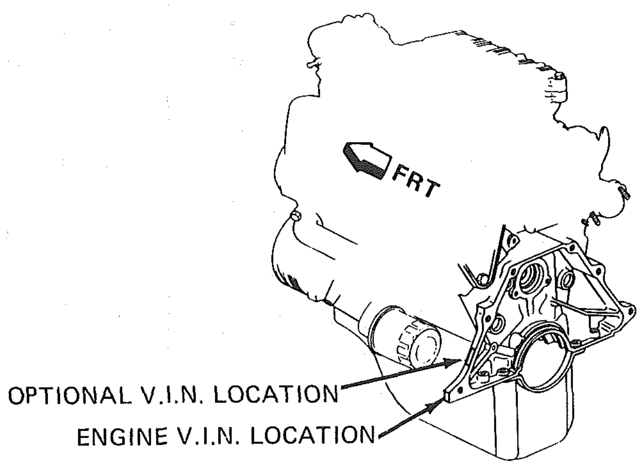
VEHICLE COMPONENT IDENTIFICATION NUMBER LOCATION

Component	Type	Location
Transmission	Automatic	Refer to Fig. 0A-6.
	5-Speed (77mm)	Drivers side, metal tag attached to extension housing bolt
Rear Axle Number	All	On right or left axle tube adjacent to carrier
Generator	All	On top drive end frame
Starter	All	Stamped on outer case, toward rear
Battery	All	On cell cover segment, top of battery

Fig. 0A4 -- Component I.D. Location



ENGINE CODES: "E", "F", "8"



ENGINE CODE: "S"

Fig. 0A-5 -- Engine V.I.N. Location

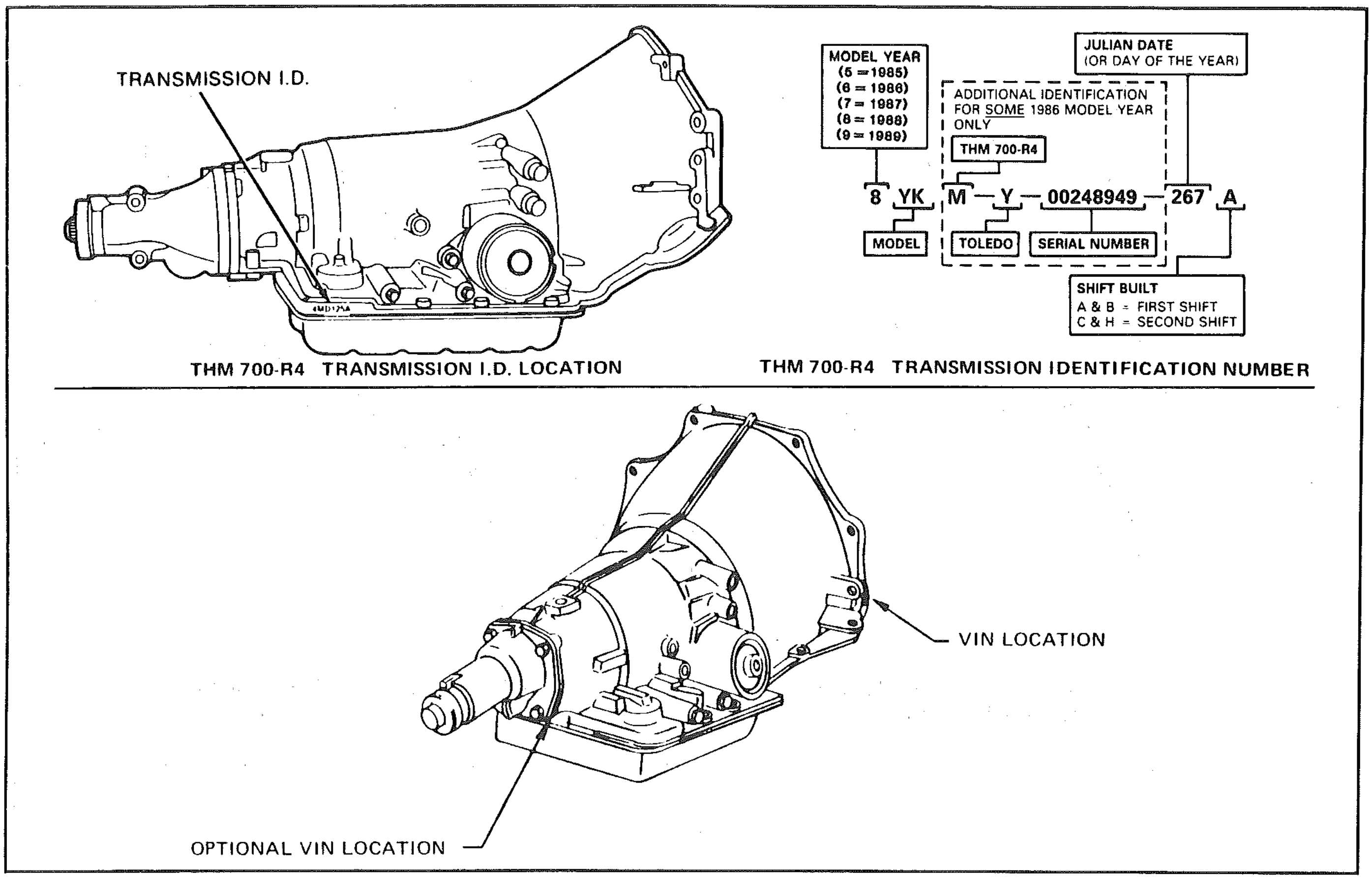


Fig. 0A-6 -- Transmission VIN Location

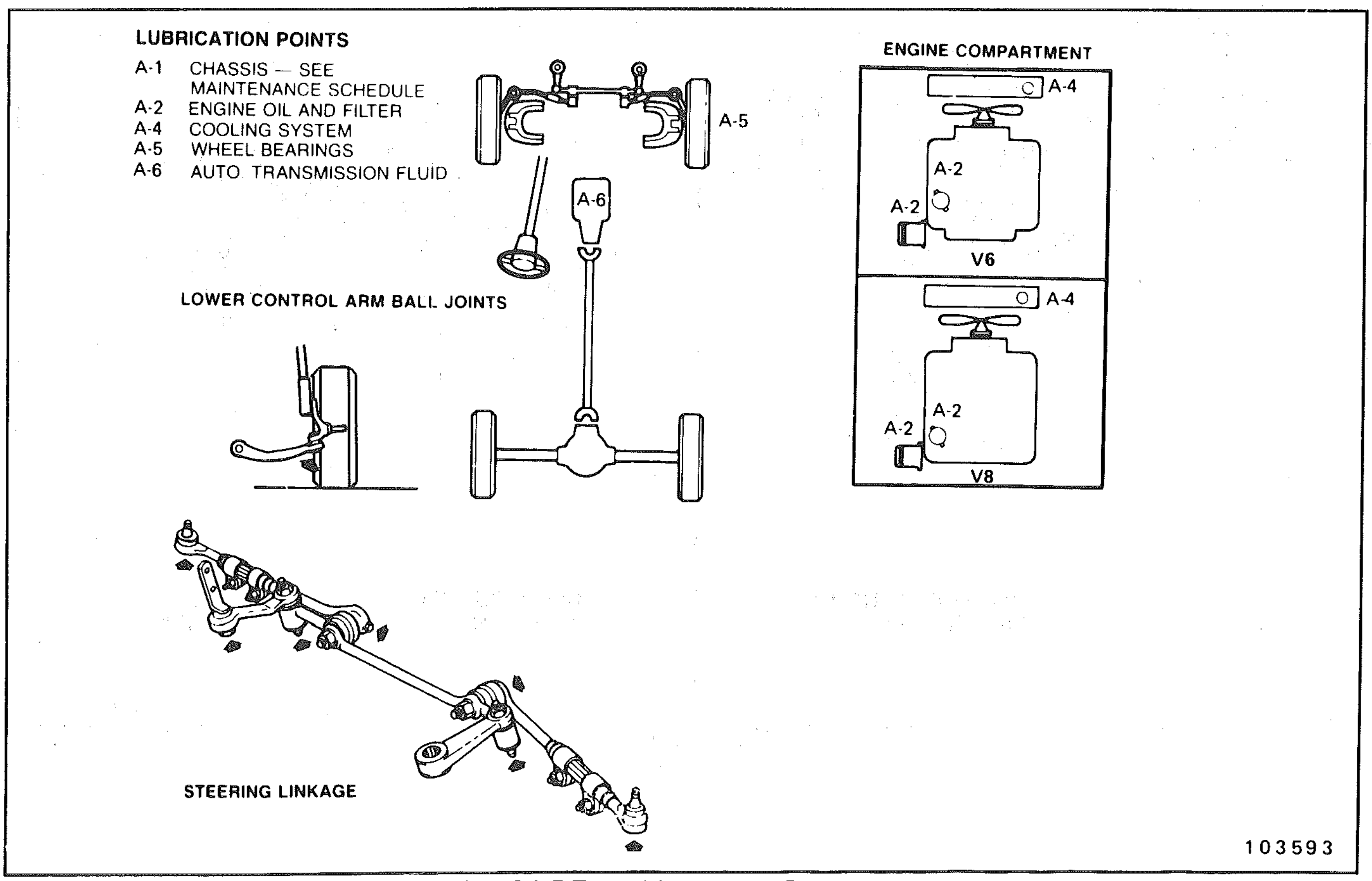


Fig. 0A-7 Typical Lubrication Points

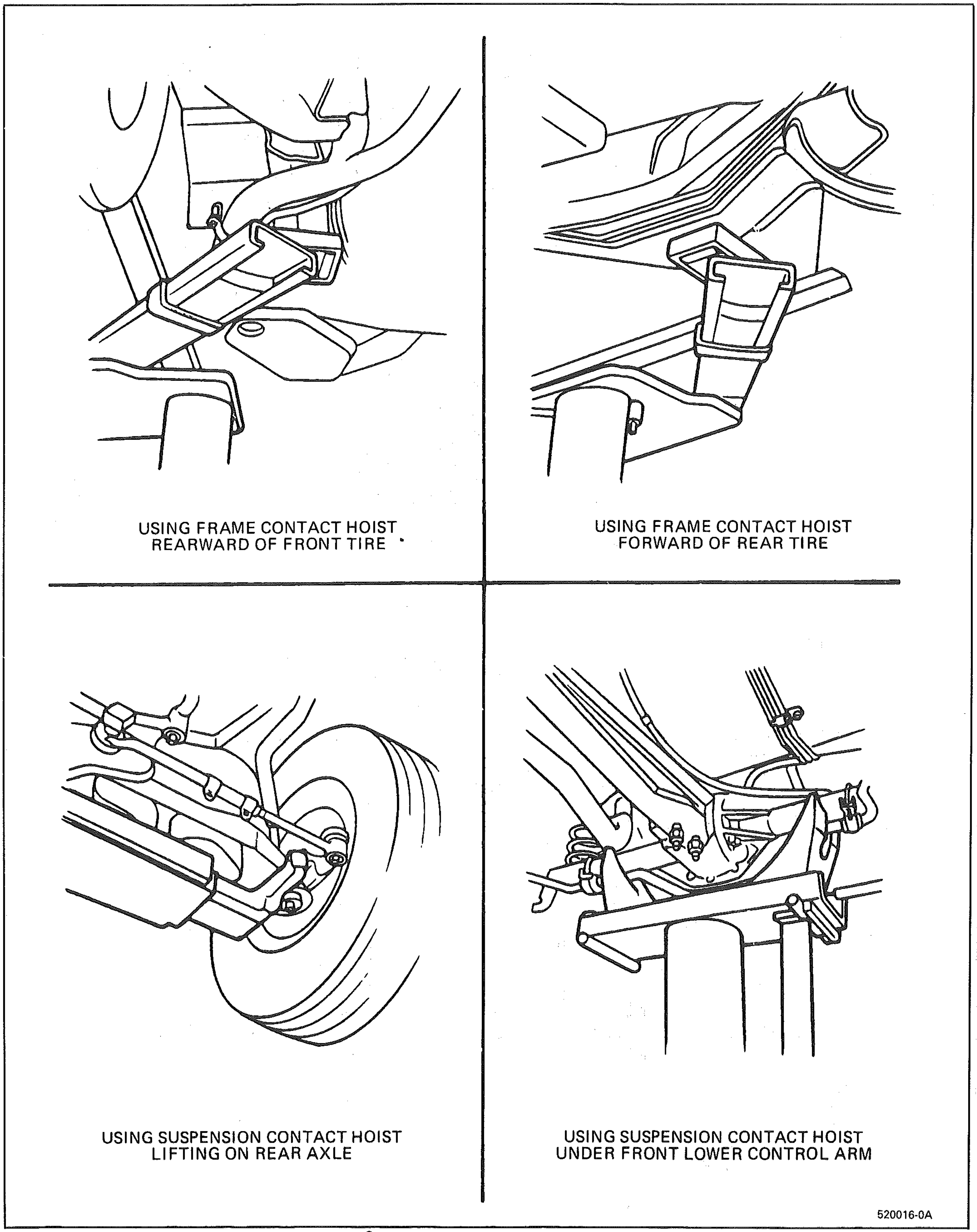


Fig. 8 Vehicle Lifting Points "F" Model

APPROXIMATE CAPACITIES

Fuel Tank	Metric	U.S.
Fuel Injected Models	60.2L	15.9 Gal.

CRANKCASE

Engine Code	Engine	Metric	U.S.
S	2.8L V6	3.8L*	4.0 Qts.*
E,F,8	5.0L V8 Oil Change Oil and Filter Change	3.8L 4.7L	4.0 Qts. 5.0 Qts.

*Approximate capacity with or without oil filter change.

Crankcase capacities shown are approximate refill capacities. After refill, recheck oil as outlined in the Owner's Manual.

COOLING SYSTEM

Engine Code	Engine	Metric	U.S.
S	2.8L V6 Without A/C With A/C	11.7L 11.7L	12.5 Qts. 12.5 Qts.
E	5.0L V8 Without A/C With A/C	14.5L 14.8L	15.3 Qts. 15.6 Qts.
F ,8	5.0L V8 Without A/C With A/C	16.1L 16.1L	17.0 Qts. 17.0 Qts.

Fig. 0A-9 Fluid Capacties

USE OF METRIC AND CUSTOMARY NUTS, BOLTS AND SCREWS

Some vehicles present special service requirements to the technician due to the use of both metric and customary (inch) type nuts, bolts and screws. Many are metric and some are very close in dimension to customary nuts, bolts and screws in the inch system. Mismatched or incorrect nuts, bolts and screws can result in damage, malfunction or possible personal injury. Nuts, bolts and screws removed from the vehicle should be saved for re-use whenever possible. If they are not re-usable, care should be taken to select a replacement that matches the original.

General Motors Engineering Standards have adopted a portion of the standard metric fastener sizes defined by SI (Systeme International). This was done to reduce the number of sizes used and yet retain the best strength characteristics in each thread size. For example, the customary 1/4-20 and 1/4-28 screws are replaced by the metric M6.3 x 1 screw which has nearly the same diameter and 25.4 threads per inch. The thread pitch is in between the customary coarse and fine thread pitches.

Metric and customary thread notation differ slightly. The difference is illustrated below.

CUSTOMARY	METRIC
1/4	M6.3
Thread Major Diameter in Inches	Thread Major Diameter in Millimeters
20	1
Number of Threads per Inch	Distance Between Threads in Millimeters

Care should be taken when servicing the vehicle to guard against cross threading or improper retention due to interchanged metric and inch nuts and bolts.

When obtaining metric or customary nuts, bolts, and screws locally for servicing the vehicle, care must be exercised in selecting parts that are equivalent to the original parts in dimensions, strength, and pitch of threads.

Fig. 0A-10 -- Metric Information, Chart A

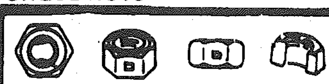
REUSE OF PREVAILING TORQUE NUT(S) AND BOLT(S)

PREVAILING TORQUE NUTS ARE THOSE NUTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN NUT AND BOLT THREADS INTERFERENCE IS MOST COMMONLY ACHIEVED BY DISTORTING TOP OF ALL-METAL NUT, BUT ALSO MAY BE ACHIEVED BY DISTORTING AT MIDDLE OF HEX FLAT, BY NYLON PATCH ON THREADS, BY NYLON WASHER INSERT AT TOP OF NUT AND BY NYLON INSERT THROUGH NUT.

PREVAILING TORQUE BOLTS ARE THOSE BOLTS WHICH INCORPORATE A SYSTEM TO DEVELOP AN INTERFERENCE BETWEEN BOLT AND NUT OR TAPPED HOLE THREADS. INTERFERENCE IS ACHIEVED BY DISTORTING SOME OF THE THREADS (SEVERAL METHODS EXIST), BY APPLYING A NYLON PATCH OR STRIP OR BY ADHESIVE COATING ON THREADS.

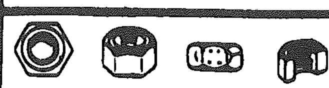
PREVAILING TORQUE NUTS

TOP LOCK MANY TYPES

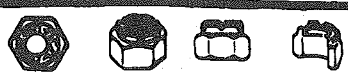


CENTER LOCK

NYLON INSERT

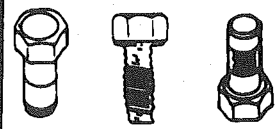


NYLON PATCH

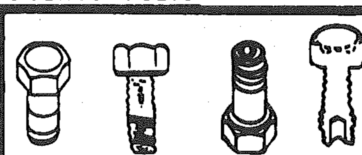


NYLON WASHER INSERT

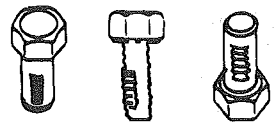
PREVAILING TORQUE BOLTS



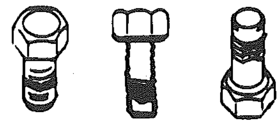
DRY ADHESIVE COATING



OUT OF ROUND THREAD AREA



NYLON STRIP OR PATCH



THREAD PROFILE DEFORMED

RECOMMENDATIONS FOR REUSE

A. CLEAN, UNRUSTED PREVAILING TORQUE BOLTS AND NUTS MAY BE REUSED AS FOLLOWS:

1. CLEAN DIRT AND OTHER FOREIGN MATERIAL OFF NUT AND BOLT.
2. INSPECT BOLT AND NUT TO ASSURE THERE ARE NO CRACKS, ELONGATION OR OTHER SIGNS OF ABUSE OR OVERTIGHTENING. LIGHTLY LUBRICATE THREADS. (IF ANY DOUBT, REPLACE WITH NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH.)
3. ASSEMBLE PARTS AND START BOLT OR NUT.
4. OBSERVE THAT BEFORE FASTENER SEATS, IT DEVELOPS PREVAILING TORQUE PER CHART BELOW. (IF ANY DOUBT, INSTALL NEW PREVAILING TORQUE FASTENER OF EQUAL OR GREATER STRENGTH).
5. TIGHTEN TO TORQUE SPECIFIED IN SERVICE MANUAL.

B. BOLTS AND NUTS WHICH ARE RUSTY OR DAMAGED SHOULD BE REPLACED WITH NEW PARTS OF EQUAL OR GREATER STRENGTH.

METRIC SIZES

		6 & 6.3	8	10	12	14	16	20
NUTS AND ALL METAL BOLTS	N•m	0.4	0.8	1.4	2.2	3.0	4.2	7.0
	In. Lbs.	4.0	7.0	12	18	25	35	57
ADHESIVE OR NYLON COATED BOLTS	N•m	0.4	0.6	1.2	1.6	2.4	3.4	5.6
	In. Lbs.	4.0	5.0	10	14	20	28	46

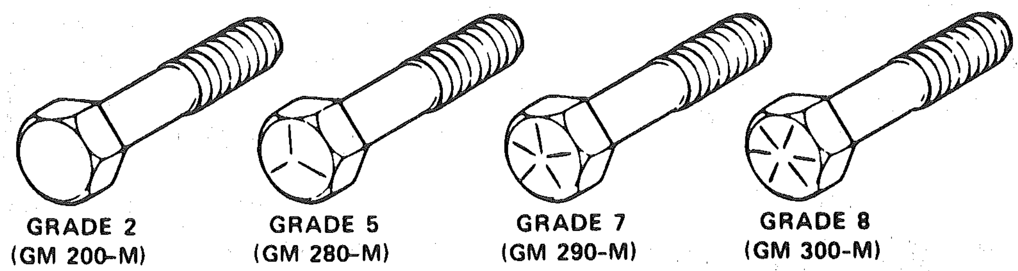
INCH SIZES

		.250	.312	.375	.437	.500	.562	.625	.750
NUTS AND ALL METAL BOLTS	N•m	0.4	0.6	1.4	1.8	2.4	3.2	4.2	6.2
	In. Lbs.	4.0	5.0	12	15	20	27	35	51
ADHESIVE OR NYLON COATED BOLTS	N•m	0.4	0.6	1.0	1.4	1.8	2.6	3.4	5.2
	In. Lbs.	4.0	5.0	9.0	12	15	22	28	43

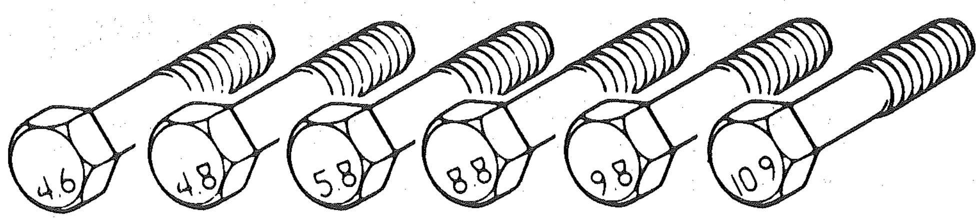
Fig. 0A-11 -- Metric Information, Chart B

METRIC BOLT AND NUT IDENTIFICATION

Common metric fastener strength property classes are 9.8 and 10.9 with the class identification embossed on the head of each bolt. Customary (inch) strength classes range from grade 2 to 8 with line identification embossed on each bolt head. Markings correspond to two lines less than the actual grade (i.e. grade 7 bolt will exhibit 5 embossed lines on the bolt head). Some metric nuts will be marked with single digit strength identification numbers on the nut face. The following figure illustrates the different strength markings.



Customary (inch) bolts - Identification marks correspond to bolt strength - Increasing numbers represent increasing strength.



Metric Bolts - Identification class numbers correspond to bolt strength - Increasing numbers represent increasing strength.

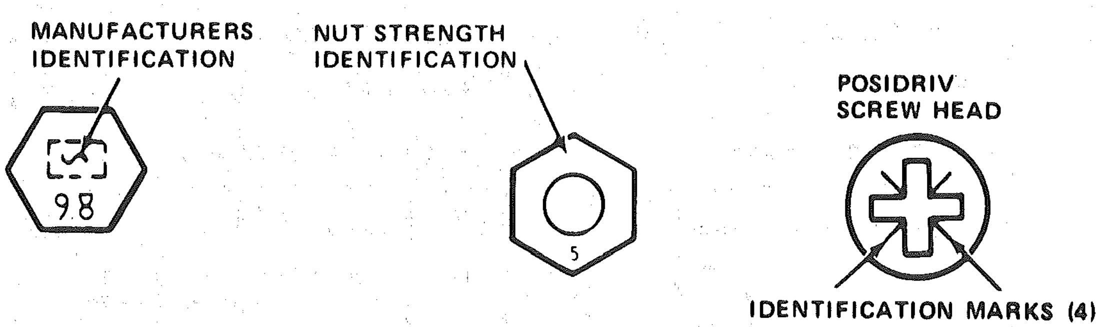
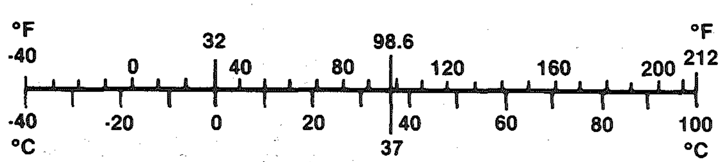


Fig. 0A-12 -- Metric Information, Chart C

SI METRIC-CUSTOMARY CONVERSION TABLE

Multiply	by	to get equivalent number of:
LENGTH		
Inch	25.4	millimeters (mm)
Foot	0.304	meters (m)
Yard	0.914	meters
Mile	1.609	kilometers (km)
AREA		
Inch²	645.2	millimeters² (mm²)
	6.45	centimeters² (cm²)
Foot²	0.092	meters² (m²)
Yard²	0.836	meters²
VOLUME		
Inch³	16 387.	mm³
	16.387	cm³
	0.016	liters (l)
Quart	0.946	liters
Gallon	3.785	liters
Yard³	0.764	meters³ (m³)
MASS		
Pound	0.453	kilograms (kg)
Ton	907.18	kilograms (kg)
Ton	0.907	tonne (t)
FORCE		
Kilogram	9.807	newtons (N)
Ounce	0.278	newtons
Pound	4.448	newtons
TEMPERATURE		
Degree Fahrenheit	(°F-32) ÷ 1.8	degree Celsius (C)



Multiply	by	to get equivalent number of:
ACCELERATION		
Foot/sec²	0.304	meter/sec² (m/s²)
Inch/sec²	0.025	meter/sec²
TORQUE		
Pound-inch	0.112	newton-meters (N-m)
Pound-foot	1.355	newton-meters
POWER		
Horsepower	0.746	kilowatts (kW)
PRESSURE OR STRESS		
Inches of mercury	3.377	kilopascals (kPa)
Pounds/sq. in.	6.895	kilopascals
ENERGY OR WORK		
BTU	1 055.	joules (J)
Foot-pound	1.355	joules
Kilowatt-hour	3 600 000. or 3.6×10^6	joules (J = one W's)
LIGHT		
Foot candle	10.764	lumens/meter² (lm/m²)
FUEL PERFORMANCE		
Miles/gal	0.425	kilometers/liter (km/l)
Gal/mile	2.352	liters/kilometer (l/km)
VELOCITY		
Miles/hour	1.609	kilometer/hr. (km/h)

Fig. 0A-13 -- Metric Information, Chart D

DECIMAL AND METRIC EQUIVALENTS

Fractions	Decimal In.	Metric MM.	Fractions	Decimal In.	Metric MM.
1/64	.015625	.39688	33/64	.515625	13.09687
1/32	.03125	.79375	17/32	.53125	13.49375
3/64	.046875	1.19062	35/64	.546875	13.89062
1/16	.0625	1.58750	9/16	.5625	14.28750
5/64	.078125	1.98437	37/64	.578125	14.68437
3/32	.09375	2.38125	19/32	.59375	15.08125
7/64	.109375	2.77812	39/64	.609375	15.47812
1/8	.125	3.1750	5/8	.625	15.87500
9/64	.140625	3.57187	41/64	.640625	16.27187
5/32	.15625	3.96875	21/32	.65625	16.66875
11/64	.171875	4.36562	43/64	.671875	17.06562
3/16	.1875	4.76250	11/16	.6875	17.46250
13/64	.203125	5.15937	45/64	.703125	17.85937
7/32	.21875	5.55625	23/32	.71875	18.25625
15/64	.234375	5.95312	47/64	.734375	18.65312
1/4	.250	6.35000	3/4	.750	19.05000
17/64	.265625	6.74687	49/64	.765625	19.44687
9/32	.28125	7.14375	25/32	.78125	19.84375
19/64	.296875	7.54062	51/64	.796875	20.24062
5/16	.3125	7.93750	13/16	.8125	20.63750
21/64	.328125	8.33437	53/64	.828125	21.03437
11/32	.34375	8.73125	27/32	.84375	21.43125
23/64	.359375	9.12812	55/64	.859375	21.82812
3/8	.375	9.52500	7/8	.875	22.22500
25/64	.390625	9.92187	57/64	.890625	22.62187
13/32	.40625	10.31875	29/32	.90625	23.01875
27/64	.421875	10.71562	59/64	.921875	23.41562
7/16	.4375	11.11250	15/16	.9375	23.81250
29/64	.453125	11.50937	61/64	.953125	24.20937
15/32	.46875	11.90625	31/32	.96875	24.60625
31/64	.484375	12.30312	63/64	.984375	25.00312
1/2	.500	12.70000	1	1.00	25.40000

Fig. 0A-14 -- Metric Information, Chart E

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

A - Ampere(s)
A-6 - Axial 6 Cyl. A/C Compressor
A/C - Air Conditioning
ACC - Automatic Climate Control
Adj. - Adjust
A/F - Air/Fuel (As in Air Fuel Ratio)
AIR - Air Injection Reaction System
ALC - Automatic Level Control
ALCL - Assembly Line Communications Link
Alt. - Altitude
APT - Adjustable Part Throttle
AT - Automatic Transmission
ATC - Automatic Temperature Control
ATDC - After Top Dead Center

BARO - Barometric Absolute Pressure Sensor
Bat. - Battery
Bat. + - Positive Terminal
Bbl. - Barrel
BHP - Brake Horsepower
BP - Back Pressure
BTDC - Before Top Dead Center

Cat. Conv. - Catalytic Converter
CC - Catalytic Converter
- Cubic Centimeter
- Converter Clutch
CCC - Computer Command Control
C-4 - Computer Controlled Catalytic Converter
CB - Citizens Band (Radio)
CCOT - Cycling Clutch (Orifice) Tube
CCP - Controlled Canister Purge
C.E. - Check Engine
CEAB - Cold Engine Airbleed
CEMF - Counter Electromotive Force
CID - Cubic Inch Displacement
CLOOP - Closed Loop
CLCC - Closed Loop Carburetor Control
CLTBI - Closed Loop Throttle Body Injection
Conv. - Converter
CP - Canister Purge
Cu. In. - Cubic Inch
CV - Constant Velocity
Cyl. - Cylinder(s)

DBB - Dual Bed Bead
DBM - Dual Bed Monolith
DEFI - Digital Electronic Fuel Injection
DFI - Digital Fuel Injection
Diff. - Differential
Distr. - Distributor

EAC - Electric Air Control Valve
EAS - Electric Air Switching Valve
ECC - Electronic Comfort Control
ECM - Electronic Control Module
ECS - Emission Control System
ECU - Engine Calibration Unit
EEC - Evaporative Emission Control
EEVIR - Evaporator Equalized Valves in Receiver
EFE - Early Fuel Evaporation
EFI - Electronic Fuel Injection
EGR - Exhaust Gas Recirculation
ELC - Electronic Level Control
EMF - Electromotive Force
EMR - Electronic Module Retard
EOS - Exhaust Oxygen Sensor
ESC - Electronic Spark Control
EST - Electronic Spark Timing
ETC - Electronic Temperature Control
ETCC - Electronic Touch Comfort Control
ETR - Electronically Tuned Receiver
Exh. - Exhaust

FMVSS - Federal Motor Vehicle Safety Standards
Ft. Lb. - Foot Pounds (Torque)
FWD - Front Wheel Drive
- Four Wheel Drive
4 x 4 - Four Wheel Drive

HD - Heavy Duty
HEI - High Energy Ignition
Hg. - Mercury
Hi. Alt. - High Altitude
HVAC - Heater-Vent-Air Conditioning
HVACM - Heater-Vent-Air Conditioning Module
HVM - Heater-Vent-Module

IAC - Idle Air Control
IC - Integrated Circuit
ID - Identification
- Inside Diameter
ILC - Idle Load Compensator
I/P - Instrument Panel
ISC - Idle Speed Control

km - Kilometers
km/hr - Kilometers Per Hour
KV - Kilovolts (Thousands of Volts)
km/L - Kilometers/Liter (mpg)
kPa - Kilopascals

L - Liter
L-4 - Four Cylinder In-Line (Engine)
L-6 - Six Cylinder In-Line (Engine)
LF - Left Front
LR - Left Rear

Man. Vac. - Manifold Vacuum
MAP - Manifold Absolute Pressure
MAT - Manifold Air Temperature Sensor
M/C - Mixture Control
MPG - Miles Per Gallon
MPH - Miles Per Hour
MT - Manual Transmission

N·m - Newton Metres (Torque)

OD - Outside Diameter
OHC - Overhead Cam
OL - Open Loop
OXY - Oxygen

PAIR - Pulse Air Injection Reaction System
P/B - Power Brakes
PCV - Positive Crankcase Ventilation
PECV - Power Enrichment Control Valve
P/N - Park, Neutral
PROM - Programmable, Read Only Memory
P/S - Power Steering
PSI - Pounds Per Square Inch
Pt. - Pint
PTO - Power Takeoff

Qt. - Quart

R - Resistance
R-4 - Radial Four Cyl. A/C Compressor
RF - Right Front
RPM - Revolutions Per Minute
RR - Right Rear
RTV - Room Temperature Vulcanizing (Sealer)
RVR - Response Vacuum Reducer
RWD - Rear Wheel Drive

SAE - Society of Automotive Engineers
SI - System International
Sol. - Solenoid

TAC - Thermostatic Air Cleaner
TACH - Tachometer
TBI - Throttle Body Injection
TCC - Transmission Converter Clutch
TCS - Transmission Controlled Spark
TDC - Topdead Center
TPS - Throttle Position Sensor
TURB - Turbocharger
T/V - Throttle Valve
TVBV - Turbocharger Vacuum Bleed Valve
TVRS - Television & Radio Suppression
TVS - Thermal Vacuum Switch

UJT - Universal Joint

V - Volt(s)
V-6 - Six Cylinder Engine - Arranged in a "V"
V-8 - Eight Cylinder Engine - Arranged in a "V"
Vac. - Vacuum
VATS - Vehicle Anti-Theft System
VIN - Vehicle Identification Number
VIR - Valves in Receiver
VSS - Vehicle Speed Sensor
VMV - Vacuum Modulator Valve

W/ - With
W/B - Wheel Base
W/O - Without
WOT - Wide Open Throttle

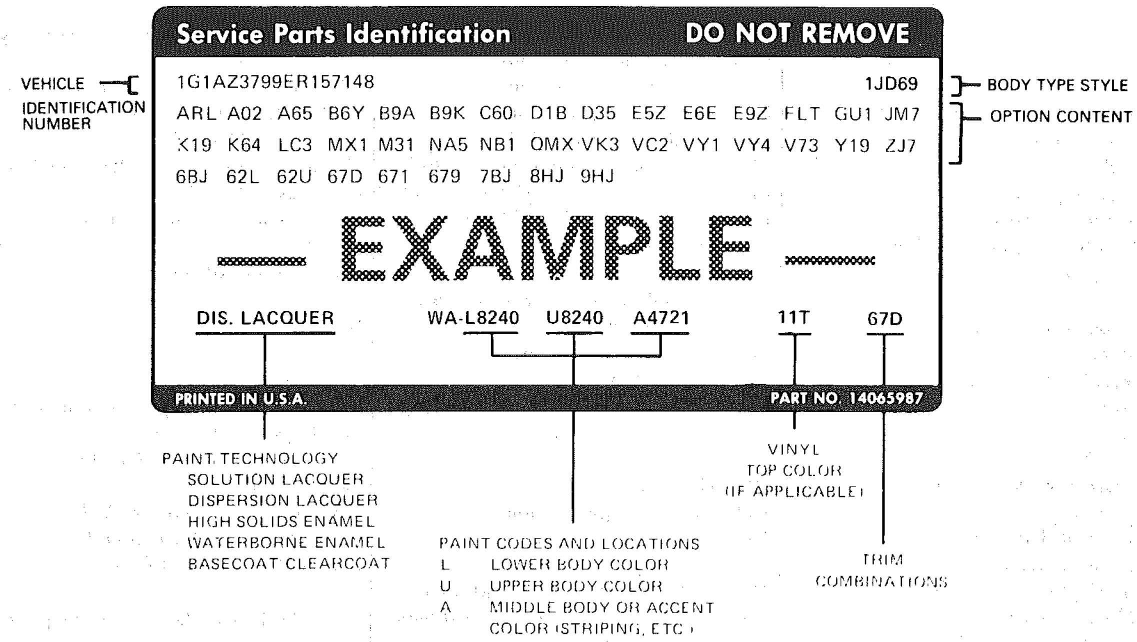
X-Valve - Expansion Valve

Fig. 0A-15 -- Common Abbreviations

SERVICE PARTS IDENTIFICATION LABEL

The Service Parts Identification Label provides identification of vehicle equipment to assist in servicing and determining replacement parts. Included on this label will be regular production options (RPO's) as well as standard and mandatory options. The label will be affixed to the inside of each passenger car vehicle at the assembly plant.

For additional information on the Service Parts Identification Label, see a GM Parts Catalog.



LABEL LOCATION

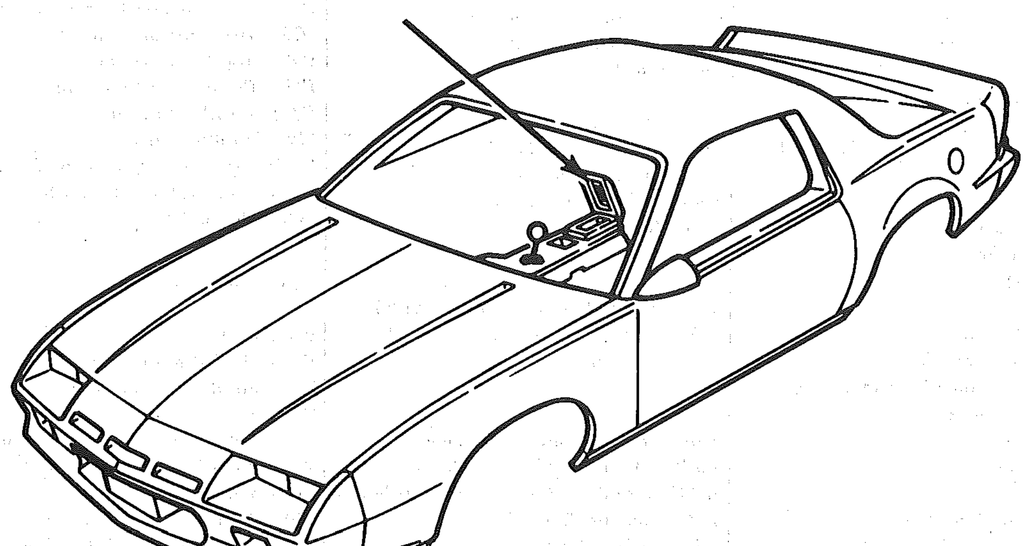


Fig. 0A-16 Service Parts Identification Label

SECTION 0B

MAINTENANCE AND LUBRICATION

CONTENTS

PASSENGER CAR MAINTENANCE SCHEDULE VEHICLES WITH GASOLINE ENGINE

NORMAL CAR USE

The maintenance services contained in Schedules I and II are based on the assumption that your car will be used as designed:

- To carry passengers and cargo within the limits shown on the Tire Placard located on the edge of the driver's door.
- On reasonable road surfaces within legal driving limits.
- On unleaded gasoline.

EXPLANATION OF SCHEDULED MAINTENANCE SERVICES

The services listed in Maintenance Schedules I and II are further explained below. When the following maintenance services are performed, make sure all parts are replaced and all necessary repairs are done before driving your car. Be sure to use the proper fluid and lubricants as shown in Figure 0B-2.

ITEM 1

Engine Oil and Oil Filter Change*

ALWAYS USE SF/CC OR SF/CD ENERGY CONSERVING OILS OF PROPER VISCOSITY — Also, always change oil and filter as soon as possible after driving in a dust storm. See your Owner's Manual for further details.

ITEM 2

Chassis Lubrication

Lubricate all grease fittings in suspension and steering linkage. Lubricate transmission/transaxle shift linkage, parking brake cable guides, underbody contact points and linkage. Also lubricate clutch cross shaft lever every 30,000 miles (50 000 km) on rear-wheel-drive cars only.

ITEM 3

Carburetor Choke and Hoses*

If your car is equipped with a carburetor, verify that choke and vacuum break work properly and are within specifications. Correct any binding caused by damage or gum on the choke shaft. Inspect hoses for proper hookup, cracks, chafing or decay. Correct as necessary.

ITEM 4

Carburetor or Throttle Body Mounting Bolt Torque*

Check torque of mounting bolts and/or nuts.

ITEM 5

Engine Idle Speed Adjustment*

(Engines without Idle Speed Control or Idle Air Control) — Adjust to specifications shown on the underhood label. If no specifications are shown on the label, no adjustment is necessary. Calibrated test equipment must be used.

ITEM 6

Tire and Wheel Rotation

To equalize wear and obtain maximum tire life, rotate in accordance with patterns shown in Owner's Manual.

ITEM 7

Vacuum or A.I.R. Pump Drive Belt Inspection*

When a separate belt is used to drive the vacuum or A.I.R. pump, inspect it for cracks, fraying, wear and proper tension. Adjust or replace as needed.

ITEM 8

Cooling System Service*

Drain, flush and refill system with new coolant. See your Owner's Manual for further details.

ITEM 9

Wheel Bearing Repack (Rear-Wheel-Drive Cars Only Except Corvette)

Clean and repack front wheel bearings at each brake relining or 15,000 miles (25 000 km), whichever comes first, when car is used in such service as police, taxi or door-to-door delivery. If you do not use your car in such service, clean and repack bearings at each brake relining or 30,000 miles (50 000 km), whichever comes first. Corvette models do not require wheel bearing repack.

**An Emission Control Service*

Select and follow Schedule I or Schedule II based on how you use your car:

SCHEDULE I

Follow Schedule I if your car is mainly operated under one or more of the following conditions:

- When most trips are less than 4 miles (6 kilometers).
- When most trips are less than 10 miles (16 kilometers) and outside temperatures remain below freezing.
- Idling and/or low speed operation in stop-and-go traffic.
- Towing a trailer.
- Operating in dusty areas.

Schedule I should also be followed if the car is used for delivery service, police, taxi or other commercial applications.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 48,000 miles (80 000 km) are to be performed after 48,000 miles at the same intervals.															
		MILES (000)	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
		KILOMETERS (000)	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80
1	Engine Oil & Oil Filter Change*	Every 3,000 miles (5 000 km) or 3 months	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Chassis Lubrication	Every other oil change		●		●		●		●		●		●		●		●
3	Carburetor Choke & Hose Inspection* (if equipped)††	At 6,000 miles (10 000 km), and then every 30,000 miles (50 000 km)		●								●						
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 6,000 miles (10 000 km) only		●														
5	Engine Idle Speed Adjustment (Some Models)*			●														
6	Tire & Wheel Rotation	At 6,000 miles (10 000 km) and then every 15,000 miles (25 000 km)		●					●					●				
7	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 miles (50 000 km) or 24 months										●						
8	Cooling System Service*											●						
9	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	See Explanation for Service Interval.																
10	Transmission Transaxle Service																	
11	Spark Plug Service*	Every 30,000 miles (50 000 km)										●						
12	Spark Plug Wire Insp. (Some Models)*											●						
13	PCV Valve Inspection* ††											●						
14	EGR System Service* ††	Every 30,000 miles (50 000 km) or 36 months										●						
15	Air Cleaner & PCV Filter Replacement*											●						
16	Engine Timing Check*	Every 30,000 miles (50 000 km)										●						
17	Fuel Tank, Cap & Lines Inspection* ††											●						
18	Thermostatically Controlled Air Cleaner Inspection*											●						

SCHEDULE II

Follow Schedule II **only** if none of the driving conditions specified in Schedule I apply.

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	The services shown in this schedule up to 45,000 miles (75 000 km) are to be performed after 45,000 miles at the same intervals					
		MILES (000)	7.5	15	22.5	30	37.5	45
		KILOMETERS (000)	12.5	25	37.5	50	62.5	75
1	Engine Oil Change*	Every 7,500 miles (12 500 km) or 12 months	●	●	●	●	●	●
	Oil Filter Change*	At first and then every other oil change or 12 months	●		●		●	
2	Chassis Lubrication	Every 7,500 miles (12 500 km) or 12 months	●	●	●	●	●	●
3	Carburetor Choke & Hose Inspection* (if equipped)††	At 7,500 miles (12 500 km) and then every 30,000 miles (50 000 km)	●			●		
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 7,500 miles (12 500 km) only	●					
5	Engine Idle Speed Adjustment (Some Models)*		●					
6	Tire & Wheel Rotation	At 7,500 miles (12 500 km) and then every 15,000 miles (25 000 km)	●		●		●	
7	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 miles (50 000 km) or 24 months				●		
8	Cooling System Service*					●		
9	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	Every 30,000 miles (50 000 km)				●		
10	Transmission Transaxle Service	See Explanation for Service Interval.						
11	Spark Plug Service*	Every 30,000 miles (50 000 km)				●		
12	Spark Plug Wire Insp. (Some Models)*					●		
13	PCV Valve Inspection* ††					●		
14	EGR System Service* ††	Every 30,000 miles (50 000 km) or 36 months				●		
15	Air Cleaner & PCV Filter Replacement*					●		
16	Engine Timing Check* (Some Models)	Every 30,000 miles (50 000 km)				●		
17	Fuel Tank, Cap & Lines Inspection* ††					●		
18	Thermostatically Controlled Air Cleaner Inspection*					●		

FOOTNOTES:

**An Emission Control Service*

††The U.S. Environmental Protection Agency has determined that the failure to perform this maintenance item will not nullify the emission warranty or limit recall liability prior to the completion of vehicle useful life. General Motors, however, urges that all recommended maintenance services be performed at the indicated intervals and the maintenance be recorded in section C of the owner's maintenance schedule.

Figure 0B-1 Maintenance Schedules I and II — Gasoline Vehicles

ITEM 10

Transmission/Transaxle Service

The manual transmission or transaxle fluid does not require changing. (Corvette only.) Change fluid in overdrive unit every 30,000 miles (50 000 km).

For automatic transmissions or transaxles, change both the fluid and filter every 15,000 miles (25 000 km) if the car is mainly driven under one or more of these conditions:

- In heavy city traffic where the outside temperature regularly reaches 90°F (32°C) or higher.
- In hilly or mountainous terrain.
- Frequent trailer pulling.
- Uses such as found in taxi, police car or delivery service.

If you do not use your car under any of these conditions, change both the fluid and filter every 100,000 miles (160 000 km). See you Owner's Manual for further details.

ITEM 11

Spark Plug Service*

Replace spark plugs with type listed in your Owner's Manual.

ITEM 12

Spark Plug Wire Inspection*

Clean wires and inspect for burns, cracks or other damage. Check the wire boot fit at distributor and at spark plugs. Replace wires as needed.

ITEM 13

Positive Crankcase Ventilation (PCV) Valve Inspection*

Inspect valve for proper function. Replace valve if necessary as well as any worn, plugged or collapsed hoses.

ITEM 14

EGR System Service*

Conduct EGR System Service as referenced in the EGR System Chart shown in the appropriate 6E Section. Also, refer to your GM maintenance schedule booklet for specific applications.

ITEM 15

Air Cleaner and PCV Filter Replacement*

On 1.6 and 2.0 liter engines, replace every 50,000 miles (80 000 km). On all other engines, replace every 30,000 miles (50 000 km). Replace more often under dusty conditions. Ask your dealer for the proper replacement interval for your driving conditions.

**An Emission Control Service*

ITEM 16

Engine Timing Check*

Adjust timing to underhood label specifications. If no specifications are shown, no adjustment is needed.

ITEM 17

Fuel Tank, Cap and Lines Inspection*

Inspect fuel tank, cap and lines (including fuel rails and injection assembly, if so equipped) for damage or leaks. Inspect fuel cap gasket for an even filler neck imprint or any damage. Replace parts as needed.

ITEM 18

Thermostatically Controlled Air Cleaner Inspection*

If your car is equipped, inspect all hoses and ducts for proper hookup. Make sure valve works properly.

OWNER INSPECTIONS AND SERVICES

Listed below are inspections and services which should be made by either you or a qualified technician at the intervals shown to help ensure proper safety, emission performance and dependability of your car. Take any problems promptly to your dealer or another qualified technician for service advice. Whenever repairs are necessary, have them completed at once. For your safety and that of others, any safety-related parts that could have been damaged in an accident should be inspected and all needed repairs should be done before operating your car. Be sure to use the proper fluids and lubricants as shown in Figure 0B-2.

WHILE OPERATING YOUR VEHICLE

Automatic transmission/transaxle shift indicator operation — Make sure the indicator points to the gear chosen.

Horn operation — Blow the horn occasionally to make sure it works. Check all button locations.

Brake system operation — Be alert to abnormal sounds, increased brake pedal travel or repeated pulling to one side when braking. Also, if a brake warning light comes on or flashes, or the anti-lock warning light (if equipped) comes on or remains on, something may be wrong with part of the brake system. Have it inspected and repaired at once.

Exhaust system operation — Be alert to any changes in the sound of the system or any smell of fumes. These are signs the system may be leaking or overheating. Have it inspected and repaired at once. Also see "Engine Exhaust Gas Caution (Carbon Monoxide)" and "Catalytic Converter" in your Owner's Manual.

Tire and wheel operation — Be alert to a vibration of the steering wheel or seat at normal highway speeds. This may mean a wheel balance is needed. Also, a pull right or left on a straight, level road may show the need for a tire pressure adjustment or wheel alignment.

Steering system operation — Be alert to changes in steering action. An inspection is needed when the steering wheel is harder to turn or has too much free play or if unusual sounds are noted when turning or parking.

Headlight aim operation — Take note of light pattern occasionally. If beam aim doesn't look right, headlights should be adjusted.

AT EACH FUEL FILL

Engine oil level check — Check engine oil level and add if necessary. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Engine coolant level and condition — Check engine coolant level in coolant reservoir tank and add if necessary. Replace if dirty or rusty. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Windshield washer fluid level check — Check washer fluid level in container and add if necessary.

Hood latch operation — When opening hood on cars equipped with hoods that open from the front, note the operation of secondary latch. It should keep hood from opening all the way when primary latch is released. Make sure that hood closes firmly.

AT LEAST MONTHLY

Tire and wheel inspection and pressure check — Check tires for abnormal wear or damage. Also, check for damaged wheels. Keep pressures as shown on Tire Placard on the driver's door (include spare unless it is a stowaway). Pressure should be checked when tires are "cold". See "Tires" in Owner's Manual for further information.

Light operation check — Check operation of license plate light, side-marker lights, headlights including high beams, parking lights, taillights, brake lights, turn signals, backup lights, instrument panel and interior lights and hazard warning flashers.

Fluid leak check — After the car has been parked for a while, inspect the surface beneath the car for water, oil, fuel or other fluids. Water dripping from the air conditioning system after use is normal. If you notice fuel leaks or fumes, the cause should be found and corrected at once.

AT LEAST TWICE A YEAR (FOR EXAMPLE, EVERY SPRING AND FALL)

Power steering pump fluid level check — Check power steering pump fluid level in accordance with Owner's Manual instructions and keep at proper level.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Brake master cylinder reservoir fluid level check — Check fluid and keep at proper level. Note: It is normal for the brake fluid level to go down slightly as the brake pads wear — so be sure to keep reservoir filled.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Clutch system service — manual transmission/transaxle — For cars equipped with hydraulic clutch system, check the reservoir fluid level and add fluid as required. All others, check clutch pedal free travel and adjust as necessary. See your Owner's Manual for further details.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Weatherstrip Lubrication — Clean surface and then apply a thin film of silicone grease with a clean cloth.

EACH TIME OIL IS CHANGED

Automatic and manual transmission/transaxle fluid level check — Check transmission/transaxle fluid level and add as required. (Corvette only) if equipped with manual transmission — check fluid in the overdrive unit and add as required.

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Brake systems inspection — For convenience, the following should be done when wheels are removed for rotation: Inspect lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. Inspect disc brake pads for wear and rotors for surface condition. Also inspect drum brake linings for wear and cracks. Inspect other brake parts, including drums, wheel cylinders, parking brake, etc. at the same time. Check parking brake adjustment.

INSPECT BRAKES MORE OFTEN IF DRIVING HABITS OR CONDITIONS RESULT IN FREQUENT BRAKING.

Steering, suspension and front drive axle boot and seal inspection — Inspect front and rear suspension and steering system for damaged, loose or missing parts, signs of wear or lack of lubrication. Inspect power steering lines and hoses for proper hookup, binding, leaks, cracks, chafing, etc. (On cars equipped with manual steering gear, check for seal leakage.) On front-wheel-drive cars, clean then inspect drive axle boot seals for damage, tears or leakage. Replace seals if necessary.

Exhaust system inspection — Inspect complete system. Inspect body near the exhaust system. Look for broken, damaged, missing or out-of-position parts as well as open seams, holes, loose connections or other conditions which could cause a heat buildup in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle linkage inspection — Inspect for interference, binding, damaged or missing parts.

Engine drive belts inspection — Inspect all belts for cracks, fraying and wear. Adjust or replace as needed.

Rear axle service (if equipped) — Check gear lubricant level and add if needed. For cars equipped with a limited slip rear axle, fluid does not require changing (except Caprice and Corvette — change fluid and required additive at first 7,500 miles (12 500 km). See your Owner's Manual or "Recommended Fluids & Lubricants Chart" in this section.

IF YOU USE YOUR CAR TO PULL A TRAILER, CHANGE GEAR LUBRICANT EVERY 7,500 MILES (12 500 KM).

NOTICE: A large loss in this system may indicate a problem. Have it inspected and repaired at once.

Power antenna — Clean and then lubricate power antenna mast. The proper lubricant as shown in Figure OB-2 should be used.

AT LEAST ONCE A YEAR

Lap and shoulder belts condition and operation — Inspect belt system, including webbing, buckles, latch plates, retractors, guide loops and anchors.

Moveable head restraint operation — On cars with moveable restraints, make sure restraints stay in the desired position. (See adjustment instructions in your Owner's Manual.)

Seatback latch and recliner operation on cars equipped with recliner seat — Be sure seatbacks latch on those cars with folding seats using mechanical latches. Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined. See your Owner's Manual for seat operating information.

Spare tire and jack storage — Be alert to rattles in rear of car. Make sure the space tire, all jacking equipment, any tire inflator and any covers or doors are securely stowed at all times. Oil jack ratchet or screw mechanism after each use.

Key lock service — Lubricate key lock cylinder at least annually.

Body lubrication service — Lubricate all body door hinges including the tailgate or hatchback lid (if equipped). Also lubricate the body hood, fuel door and rear compartment hinges and latches including interior glove box and counsel doors, and any folding seat hardware.

Transmission/transaxle neutral or clutch start switch operation

CAUTION: Before performing the following safety switch check, be sure to have enough room around the car. Then, firmly apply both the parking brake (see your Owner's Manual for procedure) and the regular brakes. Do not use the accelerator pedal. If the engine starts, be ready to turn off the ignition promptly. Take these precautions because the car could move without warning and possibly cause personal injury or property damage. On automatic transmission/transaxle cars, try to start the engine in each gear. The starter should crank only in "Park" or "Neutral." On manual transmission/transaxle cars, place the shift lever in "Neutral," push the clutch halfway and try to start. The starter should crank only when the clutch is fully depressed.

Steering column lock operation — While parked, try to turn key to "Lock" in each gear range. The key should turn to "Lock" only when gear is in "Park" on automatic or "Reverse" on manual transmission/transaxle. On cars with key release lever, try to turn key to "Lock" without depressing the lever. The key should turn to "Lock" only with the key lever depressed. On all vehicles, the key should come out only in "Lock."

Parking brake and transmission/transaxle "Park" mechanism operation

CAUTION: Before checking the holding ability of the parking brake and automatic transmission/transaxle "Park" mechanism, park on a fairly steep hill with enough room for movement in the downhill direction. To reduce the risk of personal injury or property damage, be prepared to apply the regular brakes promptly if the car begins to move.

To check the parking brake, with the engine running and transmission/transaxle in "Neutral," slowly remove foot pressure from the regular brake pedal (until the car is held by only the parking brake).

To check the automatic transmission/transaxle "Park" mechanism holding ability, release all brakes after shifting the transmission/transaxle to "Park."

Underbody flushing — At least every spring, flush from the underbody with plain water any corrosive materials used for ice and snow removal and dust control. Take care to thoroughly clean any areas where mud and other debris can collect. Sediment packed in closed areas of the vehicle should be loosened before being flushed.

Engine cooling system service — Inspect coolant and freeze protection. If dirty or rusty, drain, flush and refill with new coolant. Keep coolant at the proper mixture as specified in your Owner's Manual. This provides proper freeze protection, corrosion inhibitor level and engine operating temperature. Inspect hoses and replace if cracked, swollen or deteriorated. Tighten hose clamps. Clean outside of radiator and air conditioning condensor. Wash radiator filler cap and neck. To help ensure proper operation, a pressure test of both the cooling system and cap is also recommended. (See maintenance schedule charts in Figure OB-1 for the recommended coolant change interval.)

NOTE: Fluids and lubricants identified below by name, part number or specification may be obtained from your GM dealer.

USAGE	FLUID/LUBRICANT
Engine Oil	GM Goodwrench Motor Oil or equivalent for API Service, SF/CC or SF/CD of the recommended viscosity
Engine Coolant	Mixture of water and good quality ethylene glycol base antifreeze conforming to GM spec. 1825M (GM Part No. 1052753)
Brake and Hydraulic Clutch Systems	Delco Supreme 11 Fluid (GM Part No. 1052535) or DOT-3 Fluid
Parking Brake Cables	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Power Steering System	GM power steering fluid, Part No. 1052884 or equivalent.
Manual Steering Gear (recirculating ball)	Use lubricant meeting requirements of GM-4673M (GM Part No. 1052182)
Automatic Transmission/Transaxle and 5 Speed Manual Transmissions	DEXRON®-II Automatic Transmission Fluid (GM Part No. 1051855) Camaro and Firebird (5 Speed)
Manual Transmission (rear-wheel-drive) 4 Speed	Corvette overdrive unit — DEXRON®-II. All others SAE-80W-90 GL-5 gear lubricant (GM Part No. 1052271)
Manual Transmission/Transaxle Shift Linkage	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Key Lock Cylinders	Black Key Lock Cylinders — light oil (GM Part No. 1052949) All other Key Lock Cylinders — silicone lubricant (GM Part No. 1052277)
Automatic Transmission/Transaxle Shift Linkage	Engine Oil
Clutch Linkage Pivot Points	Engine Oil
Floor Shift Linkage	Engine Oil
Power Antenna Mast (3-mast section-type only)	Light Oil (GM Part No. 1052949)
Chassis Lubrication	Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Standard Differential Rear Axle	SAE 80W or SAE 80W-90 GL-5 (SAE 80W GL-5 in Canada) gear lubricant (GM Part No. 1052271)
Limited-Slip Differential Rear Axle	**For Camaro only** — Use SAE 80W/90 GL-5+ Hypoid Oil (GM Part No. 1050010), if equipped w/5.7L (L98) Engine **or** 5.0L (LB9) engine w/5-speed manual transmission and disc brakes. **All other applications** — Use SAE 80W or SAE 80W-90 GL-5 Gear Lubricant (GM Part No. 1052271).
Windshield-Washer Solvent	GM Optikleen Washer Solvent (GM Part No. 1051515) or equivalent
Hood Latch Assembly a) Pivots and Spring Anchor b) Release Pawl	 a) Engine Oil b) Chassis grease meeting requirements of GM-6031M (GM Part No. 1052497)
Front Wheel Bearings (rear-wheel-drive)	Lubricant GM Part No. 1051344 grease or equivalent
Hood and door hinges, station wagon tailgate hinge or hatchback lid and linkage, headlight door assemblies, station wagon rear folding seat, fuel door hinge, rear compartment lid hinges	Engine Oil
Weatherstrips	Silicone Grease (GM Part No. 1052863) or equivalent

Figure 0B-2 Recommended Fluids and Lubricants

SECTION 1A

HEATING AND VENTILATION

CONTENTS

GENERAL DESCRIPTION

The base heater system is designed to provide heating, ventilation, windshield defrosting and on some cars, side window defogging. Ram air ventilation is provided on some cars by two (2) outboard vent valves installed in the plenum. These vent valves are controlled by push-pull controls mounted in the instrument panel. When either of these valves are opened, air will enter the passenger compartment from the pressurized plenum and be directed to the floor of the vehicle.

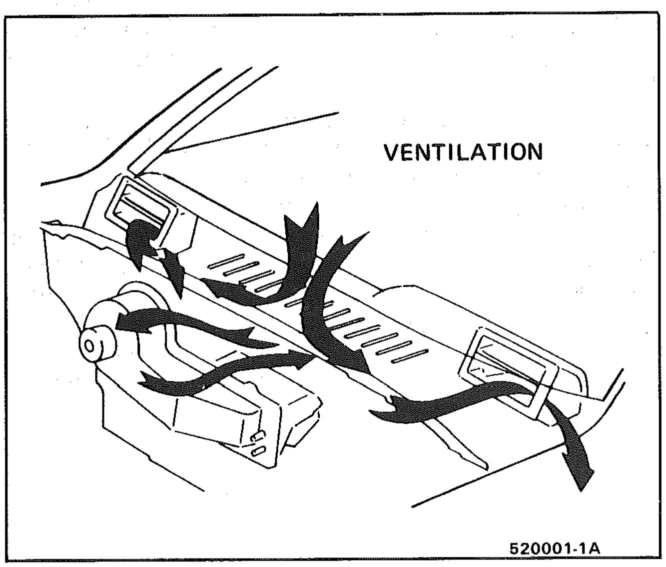


Fig. 1 Ventilation

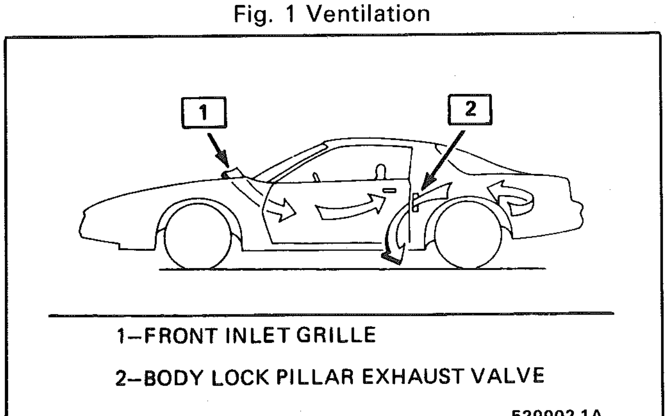


Fig. 2 Interior Body Air & Exit - Typical Hatchback Models

The power-vent, heat, and defrost provisions of the base system are controlled within the heater module. The module itself is composed of two (2) components - a blower air inlet and a heater defroster. The blower air inlet is mounted to the front of the cowl and the heater defroster assembly is mounted to the rear of the cowl. A gasket is used between the two to prevent air, water and noise entrance into the passenger compartment. Air distribution is through a heater outlet, defroster duct, power-vent duct work and outlets.

The three modes of the base heater system (vent, heat, defrost) are controlled by the functional assemblies within the heater module. These assemblies are defined below:

1. Motor & Fan Assembly (Blower).
   Provides and regulates air flow from the air inlet for further processing and/or distribution.
2. Heater Core.
   Transfers heat from engine coolant to inlet air, heating the inlet air.
3. Temperature Valve.
   Regulates the amount of air passing through the heater core, controlling the temperature and mix of heated and ambient air.
4. Mode (Defroster) Valve.
   Regulates the flow and distribution of processed air to the distribution (heater or defroster) ducts.
5. Vent Valve.
   Regulates the flow of non-processed (outside) air into the passenger compartment.

The operation of these assemblies is controlled by the levers and switch on the control head. Depending on model application, two (2) or three (3) indexed snap-in cables are attached to the module and control levers.

The temperature cable has the slider-type, self-adjust feature. As the temperature lever of the control head is cycled through its full range of travel, the cable clip will assume a position assuring that the temperature valve will seat in both extreme positions. The vent and/or defrost cables also have the

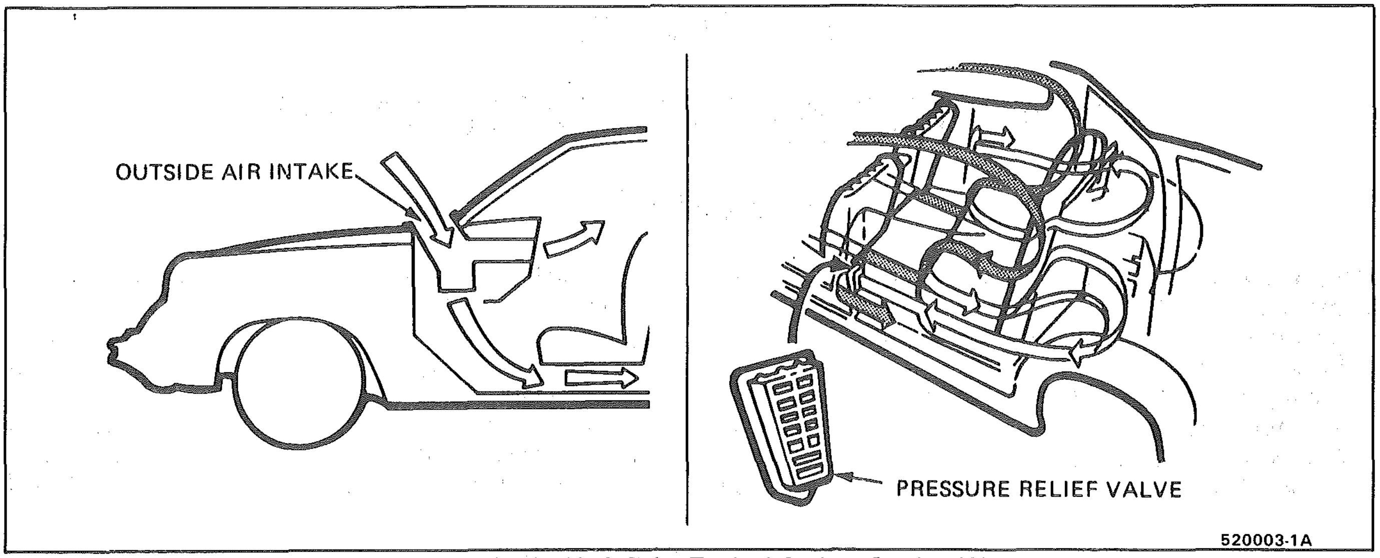


Fig. 3 Interior Body Air & Exit - Typical Sedan, Station Wagon

self-adjusting feature. Blower speeds are controllable in all modes (VENT, HEAT, DEFROST) by the switch on the control head.

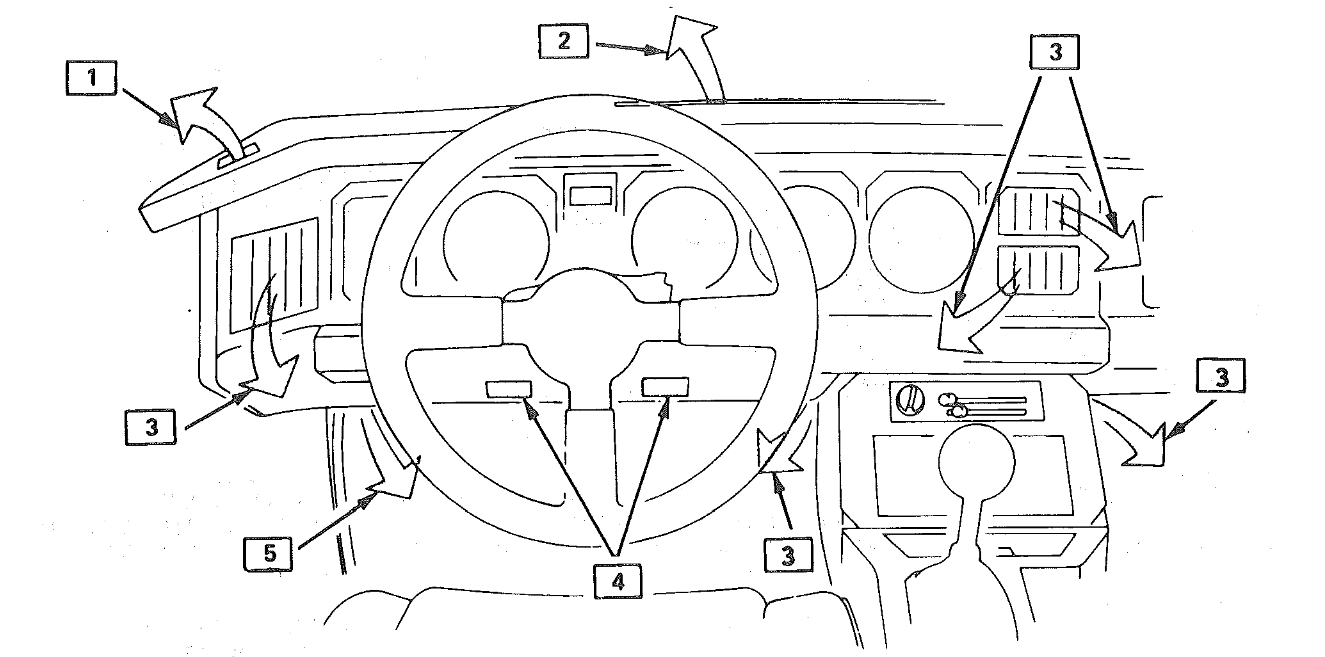
The power-vent ventilation feature is available in the vent mode. Outside air enters the plenum and is driven by the blower to the temperature valve. In the cold position of the temperature valve, air bypasses the heater core to the vent valve opening and enters the passenger compartment through the vent duct and outlets in the center of the instrument panel. If some heated air is desired, the temperature valve may be opened. This allows mixed (tempered) air to flow out the center vent opening. Blending air between modes can be done by varying the mode selector.

Varying the selector between "Heat" and "Defrost" will allow more air or less air to be directed out either the defroster outlet or the heater outlet. The closer the mode selector is positioned to the "Heater" position, the larger the amount of air coming out the heater outlet. The closer the mode selector is positioned to "Defrost," the larger the amount of air going to the windshield. The temperature of this air is governed by the temperature lever position.

Side window defogging, if so equipped, is provided via ducts in the outboard corners of the instrument panel. Maximum air flow from these vents will be in "Heater" mode with reduced air flow in "Defrost" mode.

Varying the mode selector between "Heater" and "Vent" positions varies the proportion of air coming out the heater outlet and the center vent outlets. With the selector in some midway position, air coming out the center vent outlets will be ambient temperature, while air out the heater outlet will be mixed warm air, its temperature depending on temperature lever position.

In the heat and defrost mode, outside air is driven by the blower to the temperature valve which, depending upon its position as controlled by the operator, distributes all or some portion of the inlet air through the heater core. The vent valve will prevent air entry into the vent duct and direct this ambient air to the mix portion of the heater module. The air is thus heated, mixed, and then directed into either the defroster duct or the heater outlet by the position of the mode valve and control lever. A small amount of air is bled to the side window defogger system.



1. LEFT AND RIGHT SIDE WINDOW DEFOG OUTLETS*
2. LEFT AND RIGHT DEFROSTER OUTLETS
3. POWER VENT/HEAT OUTLETS
4. RAM AIR VENT CONTROLS*
5. LEFT AND RIGHT RAM AIR VENT OUTLETS*

* NOT ON ALL MODELS

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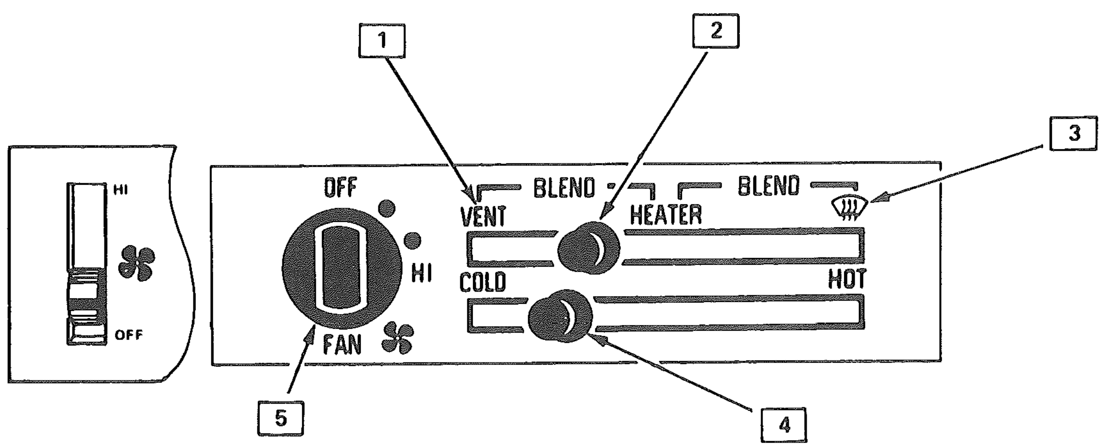
Fig. 4 Heater Ventilation System - Typical



1–THIS POSITION ALLOWS OUTSIDE AIR FLOW TO FLOOR OUTLET. (ADDITIONAL VENTED AIR CAN BE DISTRIBUTED INSIDE CAR BY OPERATING VENT KNOBS.)

2–POSITION OF THIS SYSTEM SELECTOR LEVER DETERMINES AIR FLOW FROM FLOOR, INSTRUMENT PANEL OR WINDSHIELD OUTLET – IN "HEATER", FLOW IS ABOUT 80% TO FLOOR AND 20% TO WINDSHIELD OUTLETS (AND SIDE WINDOW DEFOGGERS).

3–THIS POSITION ALLOWS ABOUT 80% AIR FLOW TO WINDSHIELD AND 20% TO FLOOR.

4–TEMPERATURE LEVER POSITION WILL REGULATE OUTLET AIR TEMPERATURE BY BLENDING THE INCOMING OUTSIDE AIR THROUGH/AROUND THE HEATER CORE.

5–THE FAN CONTROL LEVER (OFF - HI) PROVIDES SPEED CONTROL OF THE FAN.

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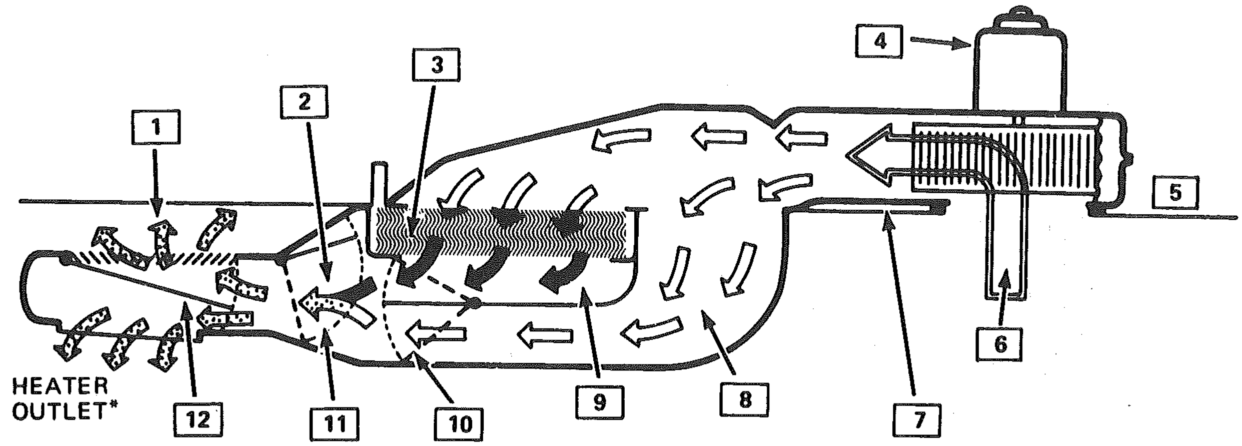
Fig. 5 Heater Control - Typical



1—DEFROSTER OUTLET

2—BLENDED AIR

3—HEATER CORE

4—BLOWER

5—DASH PANEL

6—OUTSIDE AIR FROM COWL PLENUM CHAMBER

7—PURGE DOOR OPENS TO ALLOW AIR FLOW INTO CAR UNDER I.P. WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF"

8—UNTEMPERED AIR

9—WARMED AIR

10—TEMPERATURE DOOR MOVES BY OPERATION OF TEMPERATURE LEVER ON HEATER CONTROL

11—AIR DOOR CLOSES OFF HEATER AND DEFROSTER OUTLETS WHEN SYSTEM SELECTOR LEVER IS MOVED TO "OFF"

12—DEFROSTER DOOR MOVES BY OPERATION OF HEATER CONTROLS SYSTEM SELECTOR LEVER

*ON SOME MODELS ALSO SUPPLIES SIDE WINDOW DEFOGGING DUCTS.

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Fig. 6 Typical Heater System Air Flow

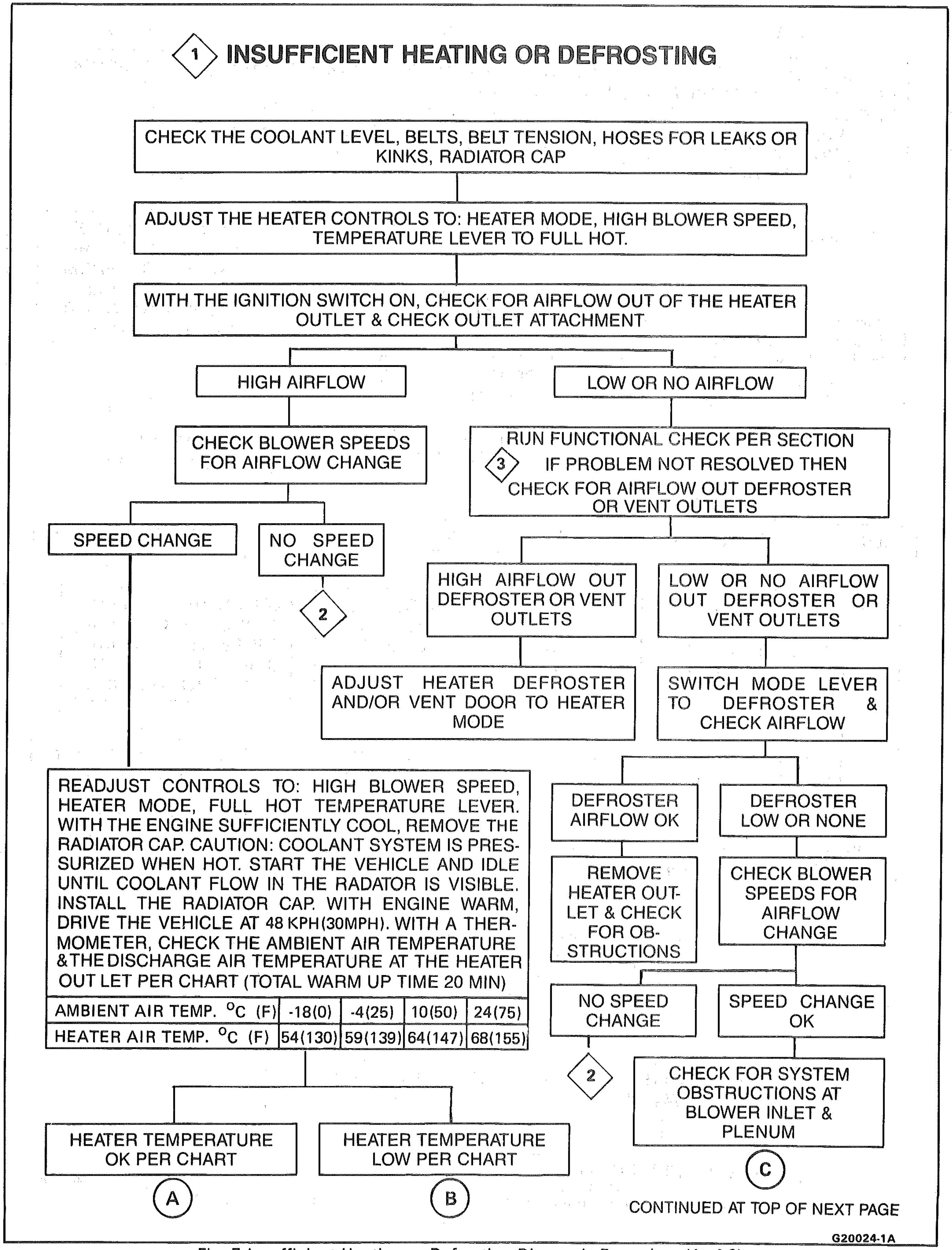

Fig. 7 Insufficient Heating or Defrosting Diagnosis Procedure (1 of 2)

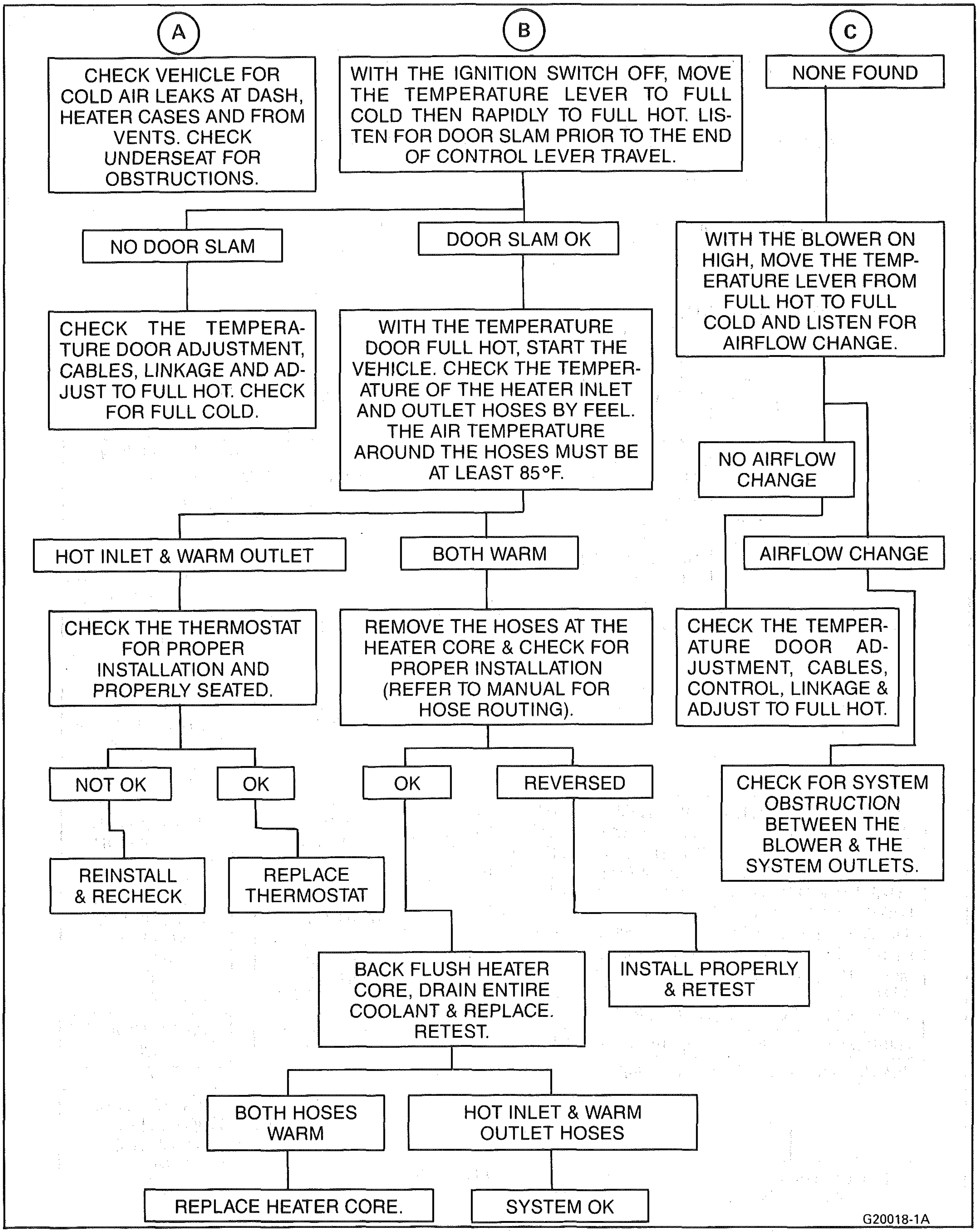

Fig. 8 Insufficient Heating or Defrosting Diagnosis Procedure (2 of 2)

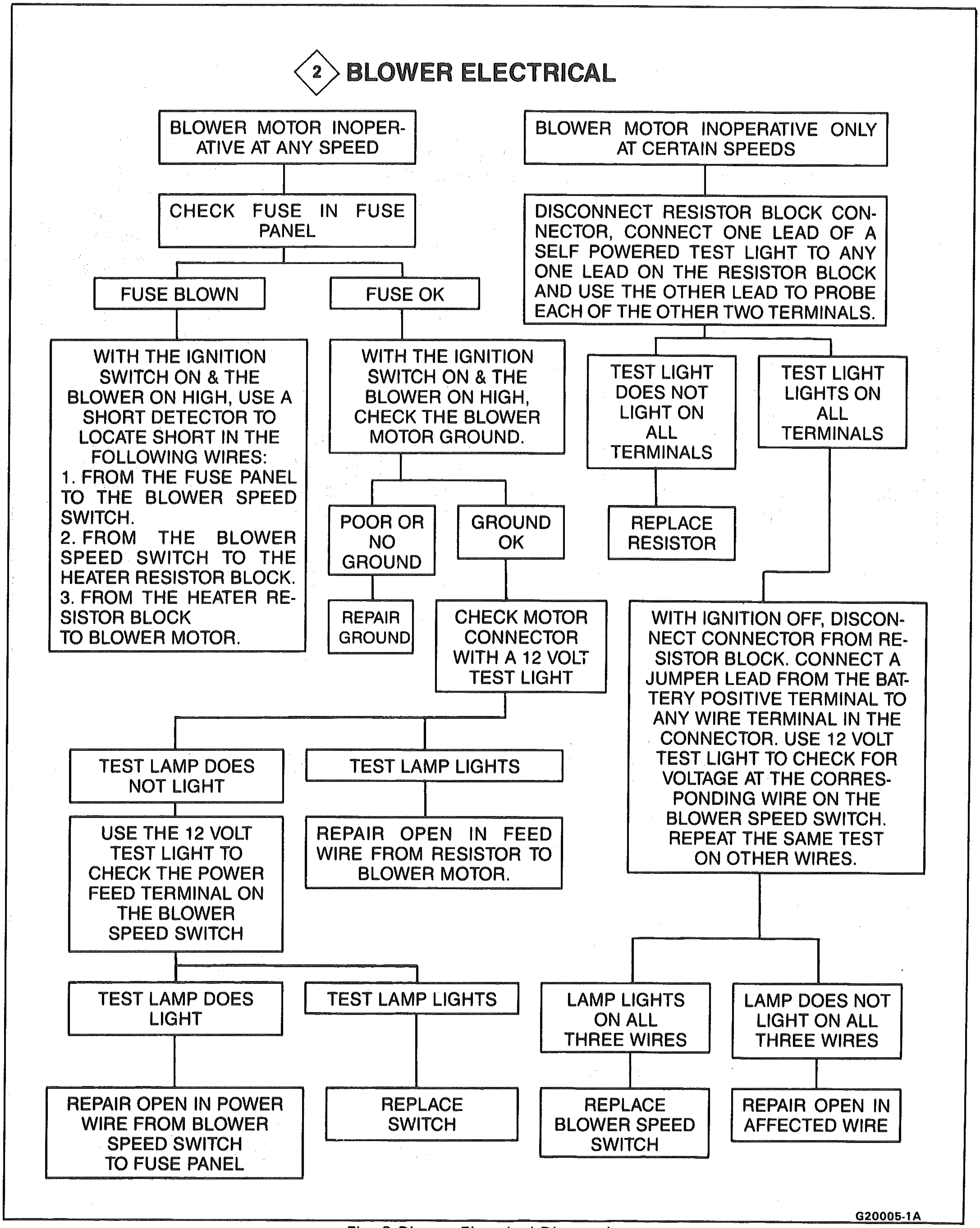

Fig. 9 Blower Electrical Diagnosis

3 IMPROPER AIR DELIVERY OR NO MODE SHIFT

WITH THE VEHICLE ON AND THE ENGINE WARM, RUN THE FOLLOWING FUNCTIONAL CHECKS. CHECK CABLES FOR EXCESSIVE EFFORT OR BINDING.

MODE	TEMP LEVER	FAN SWITCH	BLOWER SPEED	POWER VENT OUTLET	HEATER OUTLET	DEFR. OUTLET	SIDE WINDOW DEFOGGER OUTLET
VENT	COLD	OFF	OFF	NO AIRFLOW	NO AIRFLOW	NO AIRFLOW	NO AIRFLOW
VENT	COLD	HIGH	HIGH	AMBIENT AIRFLOW	NO AIRFLOW	NO AIRFLOW	NO AIRFLOW
HEATER	COLD TO HOT	HIGH	HIGH	NO AIRFLOW	COLD TO HOT AIRFLOW	MINIMUM COLD TO HOT AIRFLOW	MINIMUM COLD TO HOT AIRFLOW
DEFROSTER	COLD TO HOT	HIGH	HIGH	NO AIRFLOW	MINIMUM COLD TO HOT AIRFLOW	COLD TO HOT AIRFLOW	MINIMUM COLD TO HOT AIRFLOW

CHECK DOOR EFFECTED AT UNIT FOR CABLE CONNECTED & CABLE SHEATH RETAINED

- OK
  - DISCONNECT CABLE AT DOOR &CHECK DOOR TRAVEL & EFFORT
    - NOT OK
      - REPAIR AS NECESSARY
    - OK
      - CHECK BOWDEN CABLE TRAVEL BY MOVING CONTROL LEVER
        - TRAVEL OK
          - REINSTALL & RECHECK
        - NO TRAVEL
          - CHECK CABLE ATTACHMENT AT CONTROL & CHECK FOR BROKEN CONTROL. REPAIR AS NECESSARY.
- NOT OK
  - REPAIR AS NECESSARY

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Fig. 10 Improper Air Delivery Or No Mode Shift Diagnosis

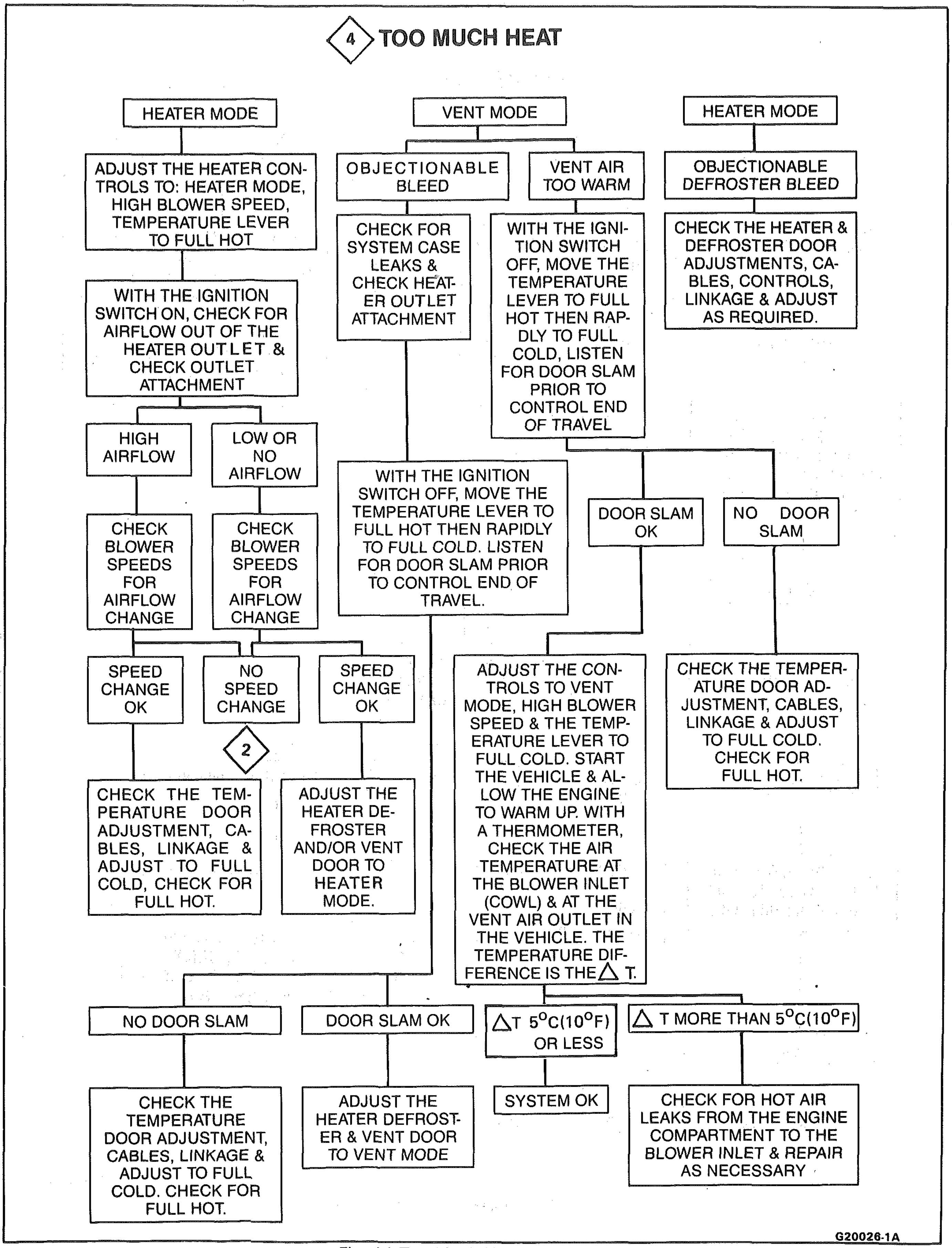

Fig. 11 Too Much Heat Diagnosis.

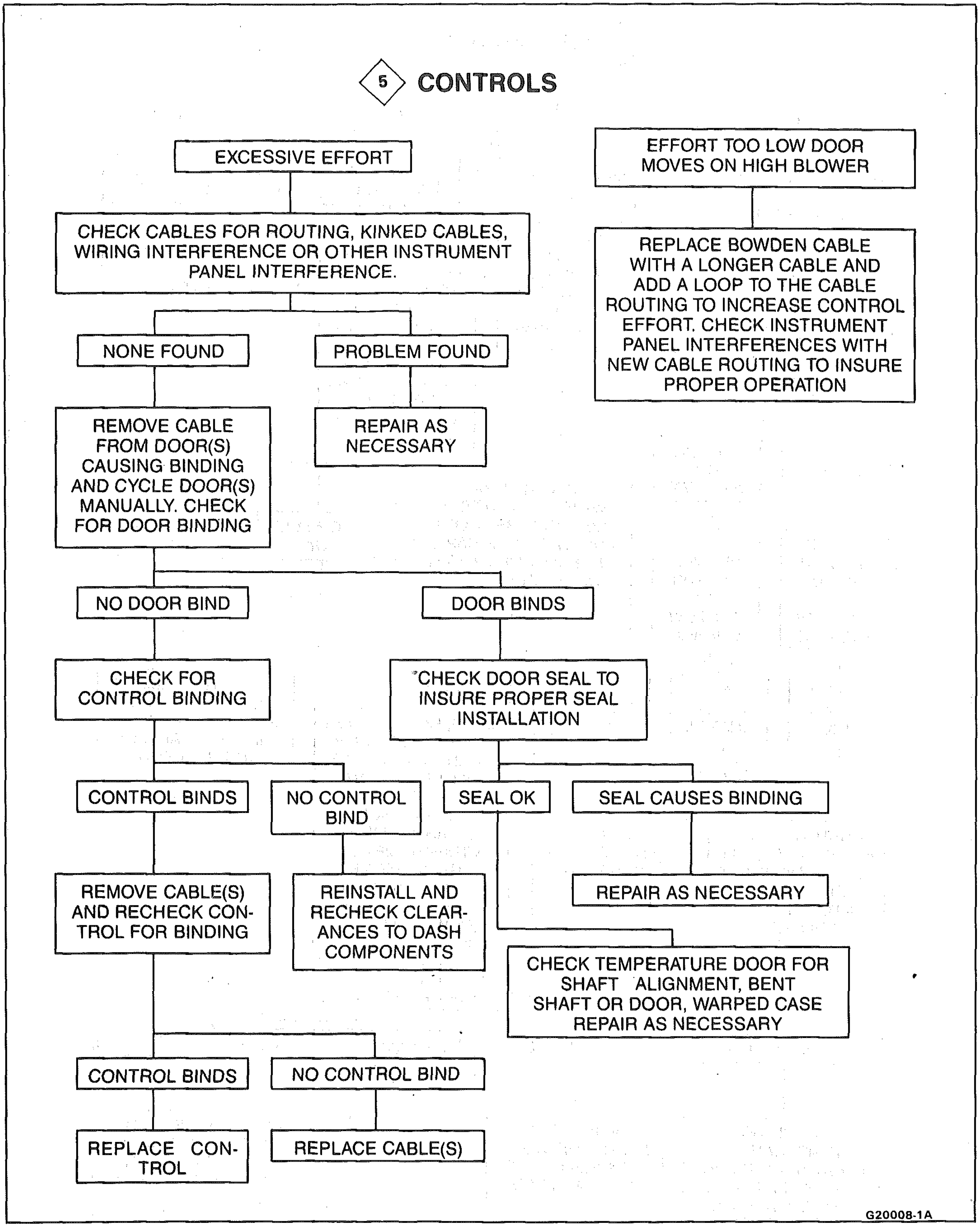

Fig. 12 Heater Controls Diagnosis

6 BLOWER NOISE

CHECK ALL ELECTRICAL CONNECTIONS AND GROUNDS FOR PROPER CONNECTIONS. IF IN DOUBT, USE A VOLTMETER TO CHECK FOR CONSTANT VOLTAGE AT THE BLOWER MOTOR.

SIT IN THE VEHICLE WITH THE DOORS AND WINDOWS CLOSED. WITH THE IGNITION ON AND THE ENGINE OFF, START WITH THE BLOWER ON HIGH, IN VENT MODE AND THE TEMPERATURE LEVER ON FULL COLD. CYCLE THROUGH BLOWER SPEEDS, MODES AND TEMPERATURE DOOR POSITIONS TO FIND WHERE THE NOISE OCCURS AND WHERE THE NOISE DOES NOT OCCUR. TRY TO DEFINE THE TYPE OF NOISE: AIR RUSH, WHINE, TICK/CLICK, SQUEAL/SCREECH, FLUTTER, RUMBLE OR SCRAPING NOISE. CHART BELOW SHOULD BE COMPLETELY FILLED IN AT COMPLETION.

A CONSTANT AIR RUSH NOISE IS TYPICAL OF ALL SYSTEMS ON HIGH BLOWER. SOME SYSTEMS AND MODES (USUALLY DEFROSTER) MAY BE WORSE THAN OTHERS. CHECK ANOTHER VEHICLE IF POSSIBLE (SAME MODEL) TO DETERMINE IF THE NOISE IS TYPICAL OF THE SYSTEM AS DESIGNED.

INDICATE THE TYPE OF NOISE AND WHERE IT OCCURS:

	VENT		HEATER		DEFROST	
	FULL COLD	FULL HOT	FULL COLD	FULL HOT	FULL COLD	FULL HOT
LOW BLOWER						
M2						
M3						
HIGH BLOWER						

A—WHINE, B—CLICK/TICK, C—SQUEAL/SCREECH, D—FLUTTER, E—RUMBLE,
F—SCRAPING, G—AIR RUSH, H—OTHER, DESCRIBE ____________________

1. NOISE IS CONSTANT BUT LESSENS WITH BLOWER SPEED REDUCTION. TYPICAL NOISES ARE WHINE, TICK/CLICK FLUTTER OR SCRAPING NOISE.

2. NOISE IS AT START-UP ONLY OR IS INTERMITTANT. MAY OCCUR AT COLD AMBIENTS AND LOW BLOWER SPEEDS. TYPICAL NOISE IS AN OBJECTIONABLE SQUEAL/SCREECH.

3. NOISE IS CONSTANT AT HIGH BLOWER SPEEDS WITH SOME DOOR COMBINATIONS BUT CAN BE ELIMINATED AT LOWER BLOWER SPEEDS OR WITH OTHER DOOR COMBINATIONS. TYPICAL NOISES ARE FLUTTER OR RUMBLE

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Fig. 13 Blower Noise Diagnosis (1 of 2)

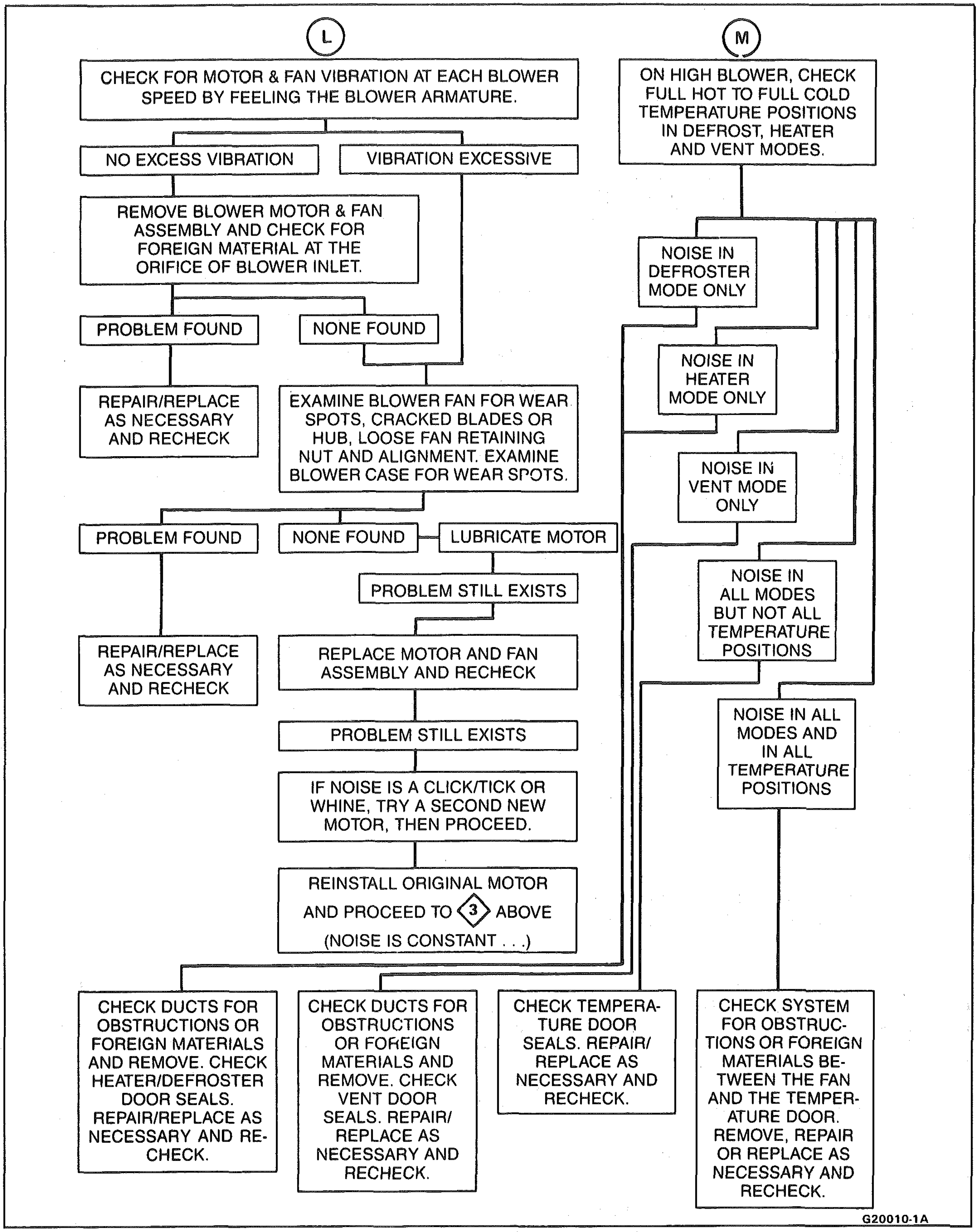


Fig. 14 Blower Noise Diagnosis (2 of 2)

ON-VEHICLE SERVICE

HEATER ELECTRICAL WIRING

The heater wiring diagrams are shown in Electrical Diagnosis, Section 8A, and should be referred to for diagnosis of electrical problems in the heater system.

HEATER CONTROL ASSEMBLY AND BLOWER SWITCH

←→ Remove or Disconnect

1. Negative battery cable.
2. Control/radio console trim plate.
3. Three (3) controller retaining screws and pull controller out from console.
4. Control cables and electrical connections.
5. Blower switch from controller if either switch or controller requires replacement. If controller is being replaced, transfer blower switch to new controller.

→← Install or Connect

1. When installing controller, install lower right screw first to properly align controller in console.
2. Blower switch to controller.
3. Control cables and electrical connections.
4. Three (3) controller retaining screws and controller to console.
5. Control/radio console trim plate.
6. Negative battery cable.

TEMPERATURE CONTROL, POWER VENT, HEATER DEFROST CABLE

←→ Remove or Disconnect

1. Hush panel(s) (see Section 8C):
   a. Temperature cable - R.H. hush panel.
   b. Heater/defrost cable - R.H. hush panel.
   c. Vent cable - L.H. hush panel.
2. Control/radio console trim plate.
3. Three (3) controller retaining screws and pull controller out from console.
4. Control cable requiring replacement at control end.
5. Cable at mode control end (temperature cable: remove cable link cover at crank location).

→← Install or Connect

1. When installing controller, install right lower screw first to align control in console.
2. Cable at mode control end (temperature cable: install cable link cover at crank location).
3. Control cable at control end.
4. Three (3) controller retaining screws and contoller in console.
5. Control/radio console trim plate.
6. Hush panel(s) (see Section 8C).
7. Fully cycle controls to adjust cables and check for proper operation.

HEATER CORE

←→ Remove or Disconnect

1. Battery ground cable.
2. Drain cooling system.
3. Heater inlet and outlet hoses from heater core.
4. Right lower hush panel (see Section 8C).
5. ECM attaching screw and move aside.
6. Right lower I.P. trim panel (see Section 8C).
7. Lower right I.P. carrier-to-cowl screw.
8. Four (4) heater case cover screws. Upper left screw may be reached with a long socket extension through the I.P. openings exposed by removal of the lower right I.P. trim panel. Carefully lift the lower right corner of the I.P. to align socket extension.
9. Heater case cover.
10. Core support plate and baffle screws.
11. Heater core, support plate and baffle from case.

→← Install or Connect

1. Heater core, support plate and baffle to case.
2. Core support plate and baffle screws.
3. Heater case cover.
4. Four (4) heater case cover screws.
5. Lower right I.P. carrier-to-cowl screw.
6. Right lower I.P. trim panel (see Section 8C).
7. ECM.
8. Right lower hush panel (see Section 8C).
9. Heater inlet and outlet hoses to heater core.
10. Refill cooling system and check for leaks.
11. Battery ground cable.

VENT CONTROL CABLE (RAM VENT)

←→ Remove or Disconnect

1. Hush panel(s) (see Section 8C). R.H. cable replacement will require removal of both L.H. and R.H. hush panels.
2. Two (2) retaining screws and individual vent control.
3. Unclip cable control clamp at vent duct and disengage formed end of cable from door lever.

→← Install or Connect

1. Cable control clamp at vent duct and install formed end of cable on door lever.
2. Two (2) retaining screws and individual vent control.
3. Hush panel(s) (see Section 8C).
4. Cycle control fully and check for proper operation.

HEATER CONTROL WIRING

←→ Remove or Disconnect

1. Negative battery cable.

2. Control/radio console trim plate and hush panels.
3. Three (3) screws holding controller in console and pull controller out far enough to disconnect electrical connectors.
4. Blower motor and blower resistor electrical connections.
5. Carefully pull cowl grommet from cowl and pull wiring harness through cowl hole into engine compartment.

→← Install or Connect

1. When reinstalling controller, install lower right screw first to align controller.
2. Cowl grommet on cowl and wiring harness.
3. Blower motor and blower resistor electrical connections.
4. Three (3) screws holding controller in console and connect electrical connectors.
5. Control/radio console trim plate and hush panels.
6. Negative battery cable.

HEATER/VENTILATION/DEFROSTER DUCTS

See section 8C for removal.

LOWER (FLOOR) HEATER OUTLET

←→ Remove or Disconnect

1. Console (see Section 8C).
2. L.H. and R.H. hush panels. (see Section 8C).
3. Two (2) floor outlet retaining screws.
4. Floor outlet from core case.

→← Install or Connect

1. Floor outlet to core case.
2. Two (2) floor outlet retaining screws.
3. L.H. and R.H. hush panels.
4. Console.

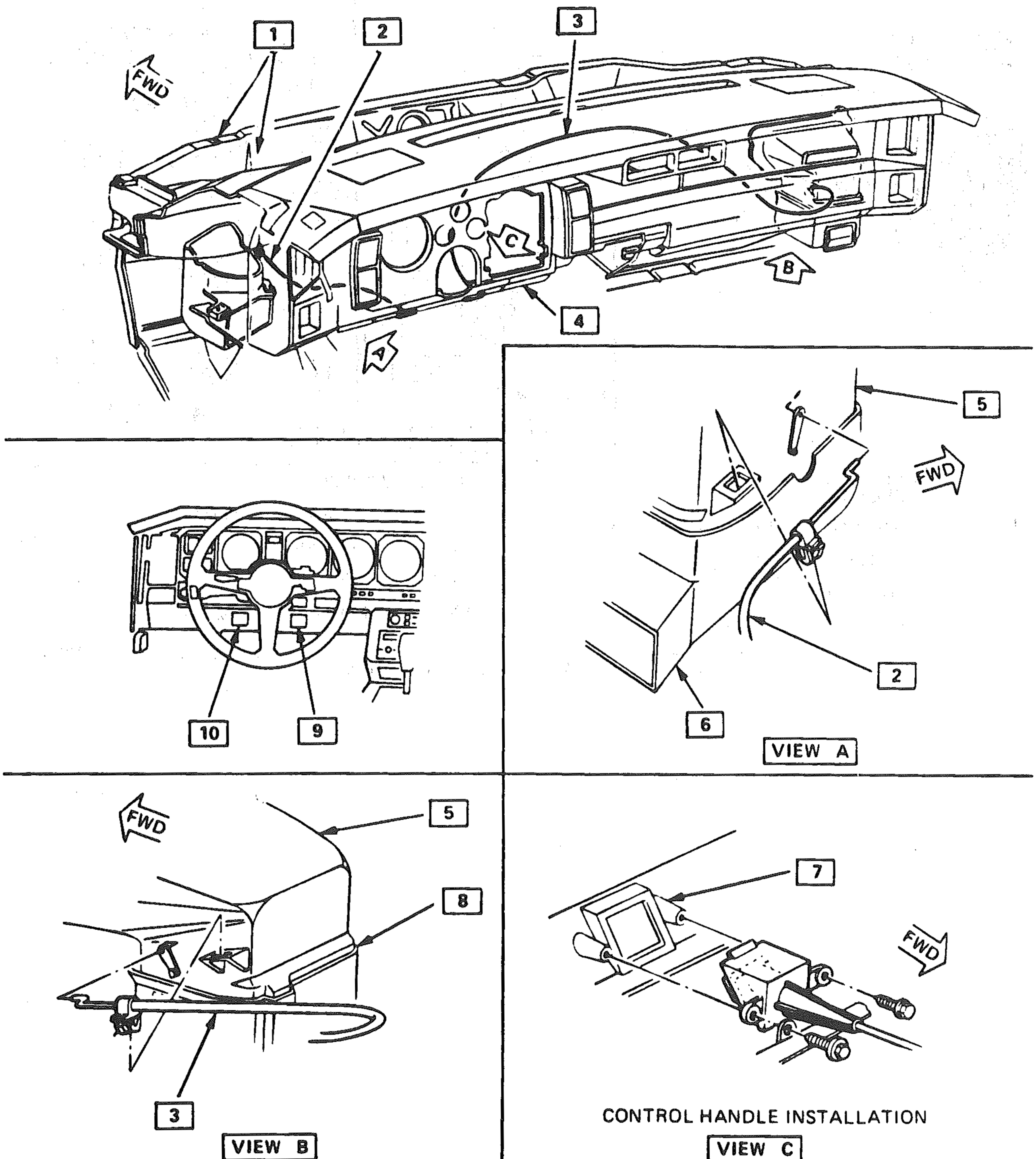
BLOWER MOTOR

←→ Remove or Disconnect

1. Negative battery cable.
2. Electrical connections at blower motor and blower resistor.
3. Blower motor cooling tube.
4. Blower motor retaining screws and remove motor/cage assembly from case.
5. Holding blower motor cage, remove cage retaining screw and slide cage from motor shaft.

→← Install or Connect

1. Blower motor cage and retaining screw.
2. Blower motor retaining screws and motor/cage assembly in case.
3. Blower motor cooling tube.
4. Electrical connections at blower motor and blower resistor.
5. Negative battery cable.
6. Reinstall radio capacitor in proper location, if so equipped.



1–UPPER DASH PANEL AND PLENUM CHAMBER
2–CONTROL CABLE ASSEMBLY LEFT-HAND
3–CONTROL CABLE ASSEMBLY RIGHT-HAND
4–INSTRUMENT PANEL ASSEMBLY
5–DUCT AND VALVE ASSEMBLY
6–VENT DUCT LEFT-HAND
7–STEERING COLUMN COVER
8–VENT DUCT RIGHT-HAND
9–RIGHT-HAND VENT CONTROL
10–LEFT-HAND VENT CONTROL

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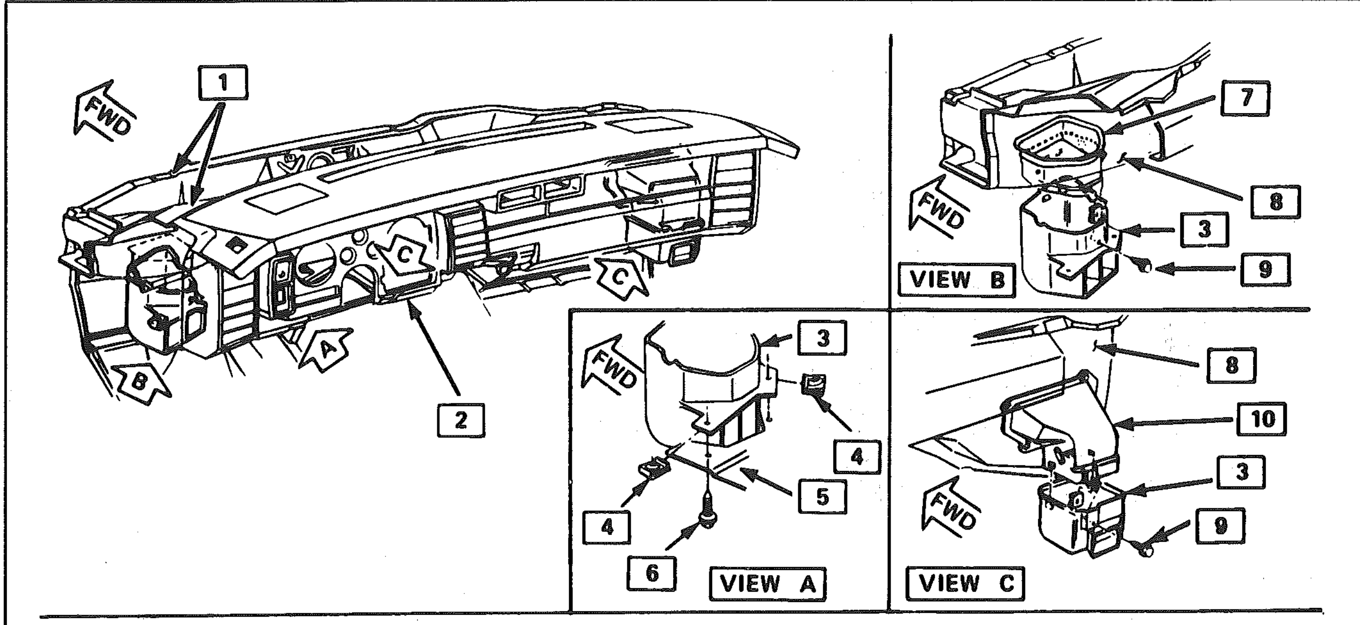
Fig. 601 Ram Vent Control



1–UPPER DASH PANEL AND PLENUM CHAMBER
2–INSTRUMENT PANEL ASSEMBLY
3–EXTENSION - SIDE VENT DUCT
4–"U" NUT
5–INSULATOR ASSEMBLY
6–BOLT/SCREW
7–DUCT AND VALVE ASSEMBLY
8–PLENUM CHAMBER
9–FASTENER
10–DUCT AND BAFFLE ASSEMBLY

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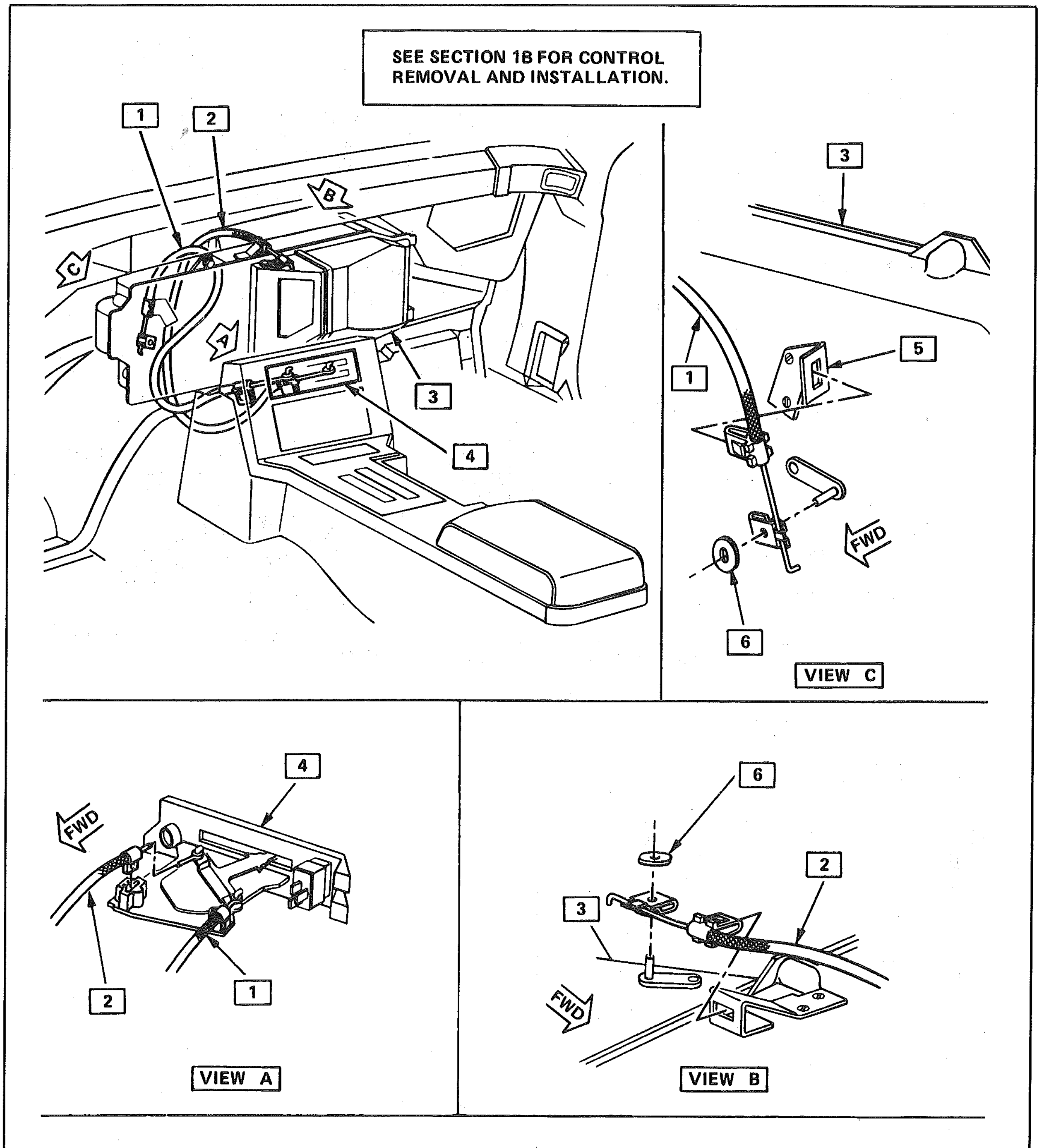
Fig. 602 Ram Vent System Duct Work



1–CABLE ASSEMBLY - DEFROSTER

2–CABLE ASSEMBLY - VENT

3–HEATER AND DEFROSTER ASSEMBLY

4–CONTROL ASSEMBLY

5–BRACKET (HEATER AND DEFROSTER ASSEMBLY)

6–PUSH NUT

Fig. 603 Heater Controller and Mode Cables

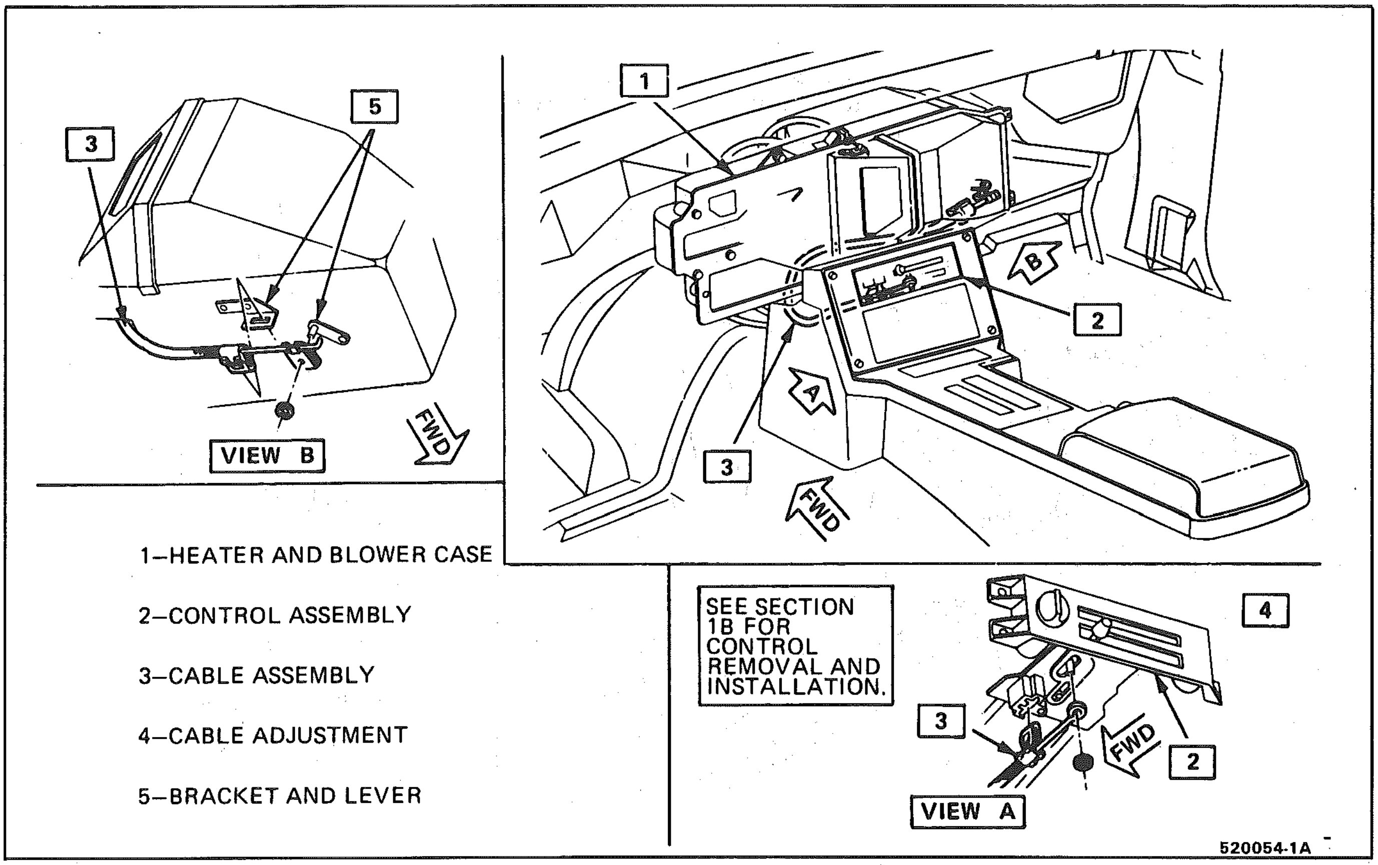


Fig. 604 Heater Temperature Control Cable

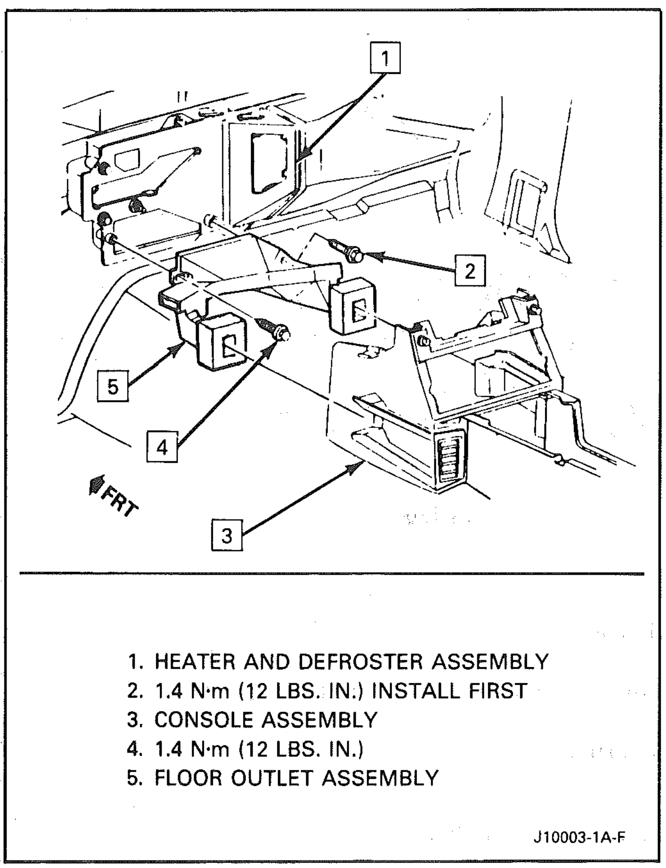


Fig. 605 Heater Floor Outlet

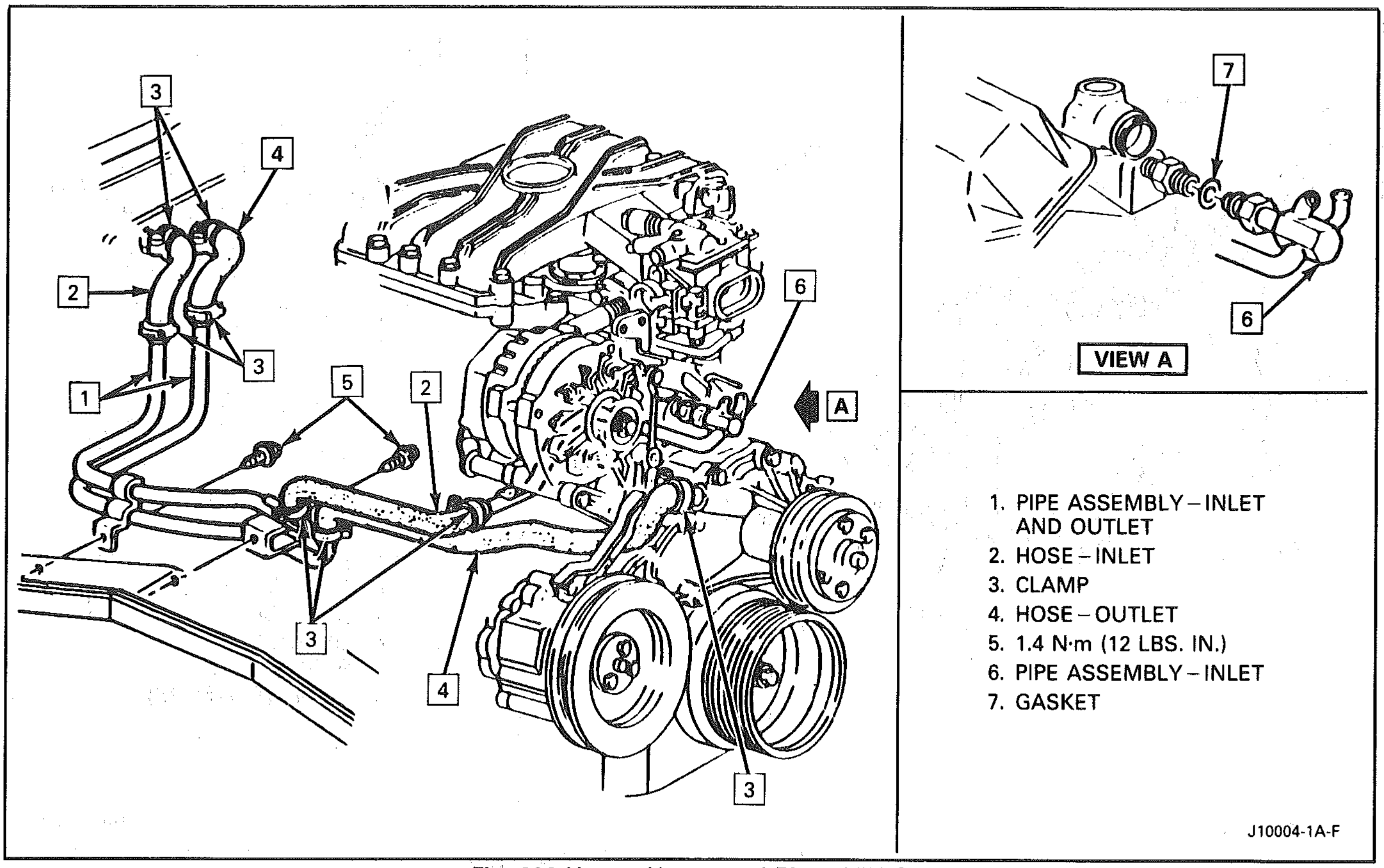


Fig. 606 Heater Hoses and Pipes VIN S

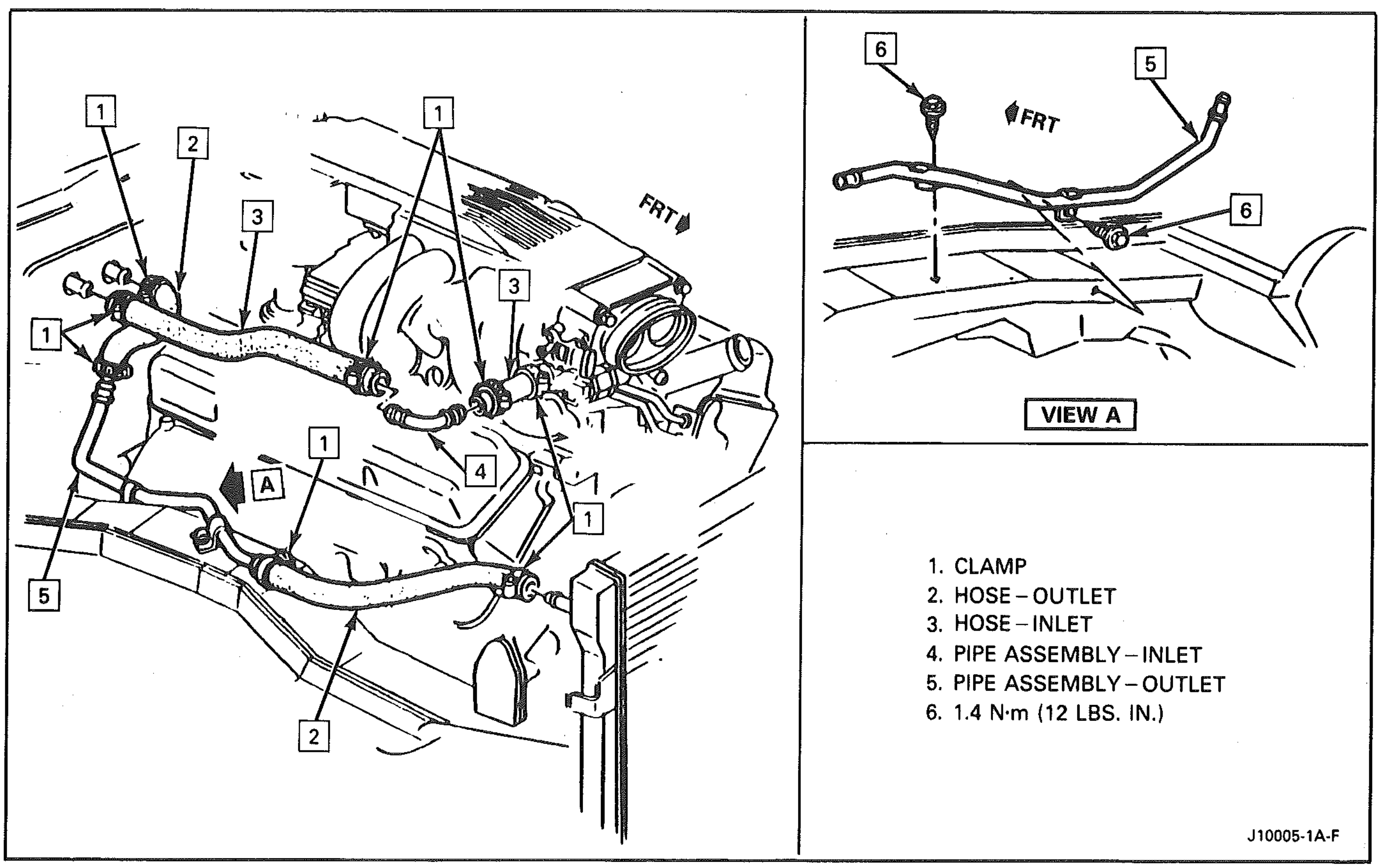


Fig. 607 Heater Hoses and Pipes VIN F & 8

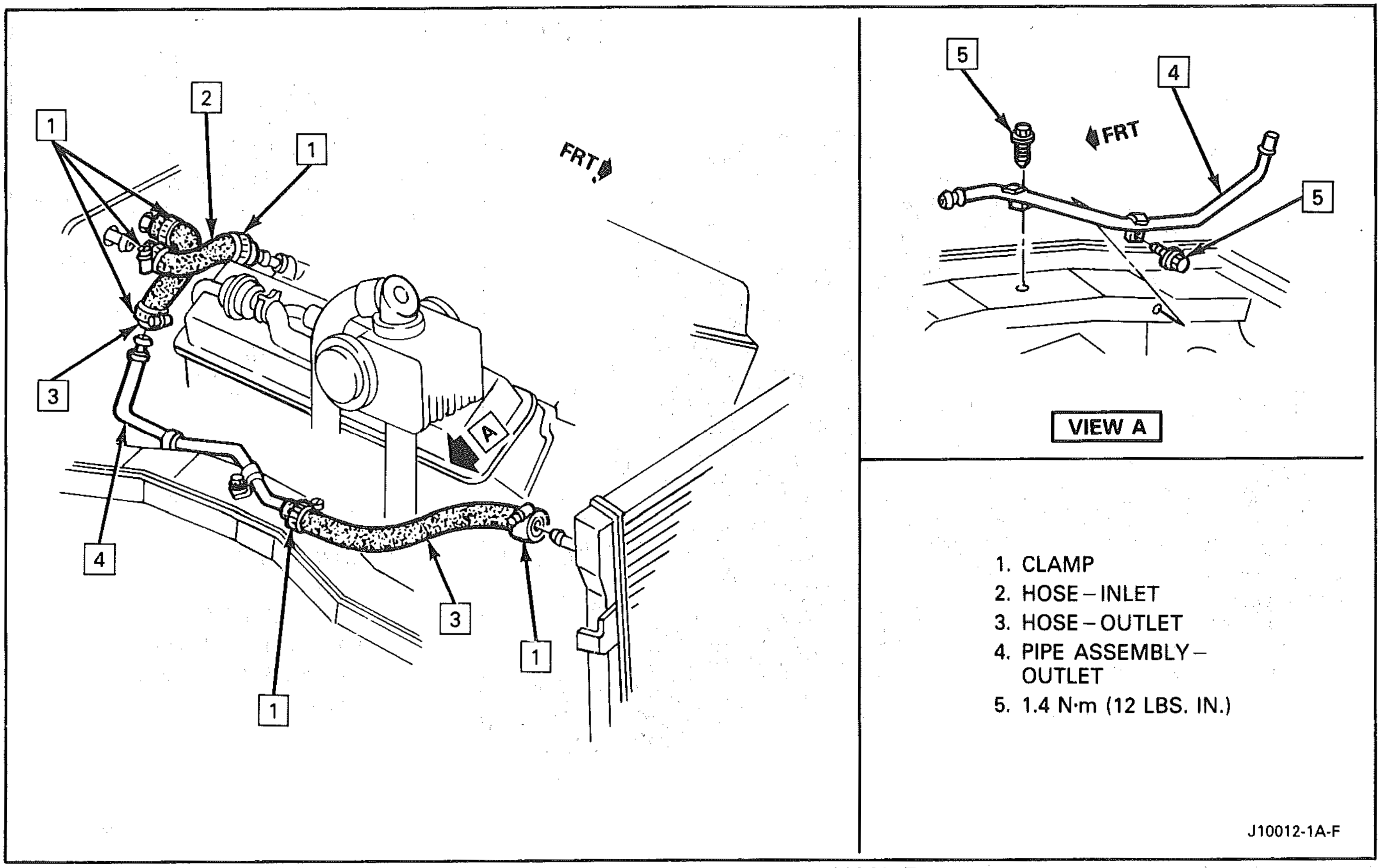


Fig. 608 Heater Hoses and Pipes V.I.N. E

SECTION 1B

AIR CONDITIONING

When performing air conditioning diagnosis on vehicles equipped with a catalytic converter, it will be necessary to WARM the engine to a NORMAL operating temperature BEFORE attempting to idle the engine for periods greater than five (5) minutes. Once the engine attains normal idle, diagnosis and adjustments can be made.

CONTENTS

GENERAL DESCRIPTION

All engines are equipped with a fixed displacement (R-4) air conditioning compressor. This compressor may cycle on and off under normal air conditioning demand.

All air conditioning systems that use the fixed displacement R-4 compressor are referred to as C.C.O.T. (Cycling Clutch, Orifice Tube) type systems. This is the same system that has been used on all General Motors vehicles in the past several years.

The C.C.O.T. A/C System

The Cycling Clutch Orifice Tube (C.C.O.T.) refrigeration system is designed to cycle a compressor on and off to maintain desired cooling and to prevent evaporator freeze. Passenger compartment comfort is maintained by the temperature lever on the controller.

Control of the refrigeration cycle (on and off operation of the compressor) is done with a switch which senses low-side pressure as an indicator of evaporator temperature. The pressure cycling switch is the freeze protection device in the system and senses refrigerant pressure on the suction side of the system. This switch is located on a standard Schrader-type valve low-side fitting. During air temperatures over 10°C (50°F), the equalized pressures within the charged A/C system will close the contacts of the pressure switch. When an air conditioning mode (max, norm, bi-level, defrost) is selected, electrical energy is supplied to the compressor clutch coil. As the compressor reduces the evaporator pressure to approximately 175 kPa (25 psi), the pressure switch will open, de-energizing the compressor clutch. As the system equalizes and the pressure reaches approximately 315 kPa (46 psi), the pressure switch contacts close, re-energizing the clutch coil. This cycling continues and maintains average evaporator discharge air temperature at approximately 1°C (33°F). Because of this cycling, some slight increases and decreases of engine speed/power may be noticed under certain conditions. This is normal as the system is designed to cycle to maintain desired cooling, thus preventing evaporator freeze-up.

SYSTEM COMPONENTS — FUNCTIONAL

Compressor

All compressors are belt driven from the engine crankshaft through the compressor clutch pulley. The compressor pulley rotates without driving the compressor shaft until an electromagnetic clutch coil is energized. When voltage is applied to energize the clutch coil, the clutch plate and hub assembly is drawn rearward toward the pulley. The magnetic force locks the clutch plate and pulley together as one unit to drive the compressor shaft.

As the compressor shaft is driven, it compresses the low-pressure refrigerant vapor from the evaporator into a high-pressure, high-temperature vapor. Carried with the refrigerant is the refrigerant oil which is used to lubricate the compressor. Complete compressor overhaul procedures can be found in Section 1D of the General Service Manual.

Pressure Relief Valve

The compressor is equipped with a pressure relief valve which is placed in the system as a safety factor. Under certain conditions, the refrigerant on the discharge side may exceed the designed operating pressure. To prevent system damage, the valve is designed to open automatically at approximately 3036 kPa (440 psi). Conditions that might cause this valve to open (defective high pressure cut-off switch, inoperative electric cooling fan, etc.) should be corrected, and the refrigerant oil and refrigerant should be replaced as necessary.

Muffler

A muffler is used on some refrigerant systems to reduce compressor noises from high or low pressure vibrations.

Condenser Core

The condenser assembly in front of the radiator is made up of coils which carry the refrigerant TO cooling fins to provide rapid transfer of heat. The air passing through the condenser cools the high-pressure refrigerant vapor causing it to condense to a liquid.

Expansion (Orifice) Tube

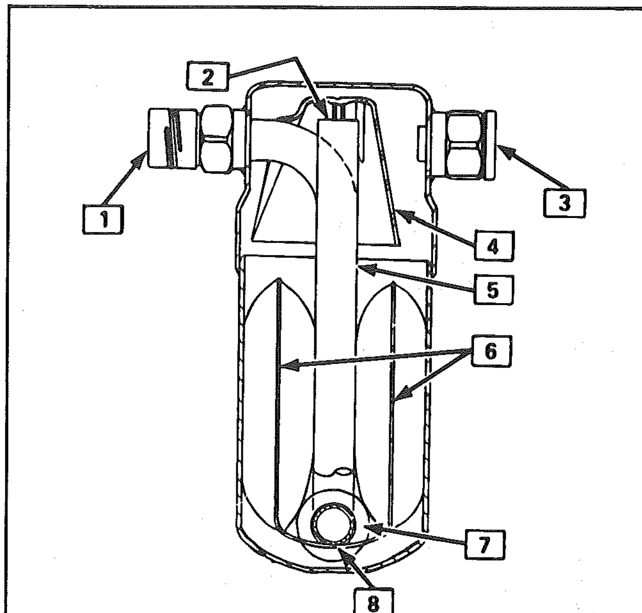
The plastic expansion tube, with its mesh screen and orifice, is located in the evaporator inlet pipe at the liquid line connection. It provides a restriction to the high-pressure liquid refrigerant in the liquid line, metering the flow of refrigerant to the evaporator as a low-pressure liquid. The expansion tube and orifice are protected from contamination by filter screens on both inlet and outlet sides. The tube is serviced only as a replacement assembly.

When the engine is turned "OFF" with the A/C system operating, the refrigerant in the system will flow from the high-pressure side of the expansion tube (orifice) to the low-pressure side until the pressure is equalized. This may be detected as a faint sound of liquid flowing (hissing) for 30 to 60 seconds and is a normal condition.

Evaporator Core

The evaporator is a device which cools and dehumidifies the air before it enters the car. High-pressure liquid refrigerant flows through the expansion tube (orifice) into the low-pressure area of the evaporator. The heat in the air passing through the evaporator core is transferred to the cooler surface of the core, thereby cooling the air. As the process of heat transfer from the air to the evaporator core surface is taking place, any moisture (humidity) in the air condenses on the outside surface of the evaporator core and is drained off as water.

Accumulator



1–OUTLET
2–REFRIGERANT VAPOR INLET
3–INLET
4–BAFFLE
5–INTERNAL TUBE
6–DESICCANT BAG ASSEMBLY
7–FILTER ASSEMBLY
8–OIL BLEED HOLE LOCATION IN TUBE

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Figure 1 Accumulator — Interior Parts

Connected to the evaporator outlet pipe, the sealed accumulator assembly acts as a refrigerant storing container receiving vapor and some liquid and refrigerant oil from the evaporator.

At the bottom of the accumulator is the desiccant which acts as a drying agent for moisture that may have entered the system. An oil bleed hole is also located near the bottom of the accumulator outlet pipe to provide an oil return path to the compressor.

A low-side pressure Schrader valve service fitting is located near the top of the accumulator. A similar Schrader fitting may be provided for mounting the pressure cycling switch. It is not necessary to discharge the system to replace the switch. The accumulator is serviced only as a replacement assembly.

Heater Core

The heater core heats the air before it enters the car. Engine coolant is circulated through the core to heat the outside air passing over the fins of the core. The core is functional at all times (no water valve) and may be used to temper conditioned air in A/C mode, as well as heat or vent mode.

SYSTEM COMPONENTS — CONTROL

Controller

The operation of the A/C system is controlled by the switches and the lever on the control head. The compressor clutch and blower are connected electrically to the control head by a wiring harness. The blower circuit is open in the off mode and air flow is provided by the four blower speeds available in the remaining modes. Cooled and dehumidified air is available in the max, normal, bi-level and defrost modes.

Temperature is controlled by the position of the temperature lever on the control head. A cable connects this lever to the temperature door which controls air flow through the heater core. As the temperature lever is moved through its range of travel, a sliding clip on the cable at the temperature valve connection should assume a position assuring that the temperature door will seat in both extreme positions. Temperature door position is independent of mode selection. The temperature cable attaches to the right side of the air conditioning module. The temperature door on some models is controlled electrically, thereby eliminating the need for the temperature cable.

The electric engine cooling fan on some cars is not part of the A/C system; however, the fan is operational any time the A/C control is in Max., Norm, or Bi-Level modes. Some models provide for engine cooling fan operation when the controller is in the defrost mode. This added feature is part of the A/C controller function and is aimed at preventing excessive compressor head temperatures. It also allows the A/C system to function more efficiently. On some models during road speed (above 35 mph) conditions when air flow through the condenser coil is adequate for efficient cooling, the engine cooling fan will be turned off. The operation of the cooling fan is controlled by the ECM through the cooling fan relay.

Complete wiring diagrams and diagnosis for the A/C Electrical System are in Section 8A. Section 8A also contains additional diagnostic information regarding air flows and vacuum logic.

Vacuum Lines

Vacuum lines are molded to a connector which is attached to a vacuum control switch on the control head assembly.

In case of leakage or hose collapse, it will not be necessary to replace the entire harness assembly. Replacement can be made by cutting the hose and inserting a plastic connector. If an entire hose must be replaced, cut all hoses off at the connector and then attach hoses directly to the control head vacuum switch. (NOTE: The Fiero uses an electric motor to control mode selection. Therefore, it will not have a vacuum harness.)

Vacuum Tank

During heavy acceleration, the vacuum supply from the carburetor drops. A check valve in the vacuum tank maintains vacuum so that, under load conditions, vacuum will be available for continuous use.

RELAYS AND SWITCHES

High-Pressure Compressor Cut-Off Switch

The high-side, high-pressure cut-off switch in the rear head of the compressor is a protective device intended to prevent excessive compressor head pressures and reduce the chance of refrigerant escape through a safety relief valve. Normally closed, this switch will open the circuit at a high-side pressure of approximately 2700 kPa (430 psi ± 20 psi) and reclose the circuit at approximately 1379 kPa (200 psi ± 50 psi).

Low-Pressure Cut-Off Switch

Compressor protection is provided on some cars by a low-pressure cut-off switch which will open in the event of a low-charge condition. This switch can be located in the liquid line or in the rear head of the compressor. This switch will also keep the compressor from running during cold weather.

Pressure Cycling Switch

The refrigeration cycle (on and off operation of the compressor) is controlled by a switch which senses the low-side pressure as an indicator of evaporator temperature. The pressure cycling switch is the freeze protection device in the system and senses refrigerant pressure on the suction side of the system. This switch is located on a standard Schrader-type valve low-side fitting. This switch also provides compressor cut-off during cold weather.

Additional compressor protection results from the operating characteristics of the low-side pressure cycling system. If a massive discharge occurs or the orifice tube becomes plugged, low-side pressures could be insufficient to close the contacts of the pressure switch. In the event of a low charge, insufficient cooling accompanied by rapid compressor clutch cycling will be noticed at high air temperatures.

If replacement of the pressure cycling switch is necessary, it is important to note that this may be done without removing the refrigerant charge. A Schrader-type valve is located in the pressure switch fitting. During replacement of the pressure switch, a new oiled O-ring must be installed and the switch assembled to the specified torque of 6-13 N•m (5-10 lb. ft.).

Power Steering Cut-Off, or Anticipate Switch

Engine idle quality on some cars is maintained by cutting off the compressor (switch normally closed) when high power steering loads are imposed. On other cars the switch (normally open) provides a signal to the ECM to allow engine control systems to compensate for high-power steering loads.

Wide-Open Throttle (WOT) Compressor Cut-Out Switch

A switch located on the throttle controls of some carburetor equipped cars opens the circuit to the compressor clutch during full throttle acceleration. The switch activates a relay that controls the compressor clutch.

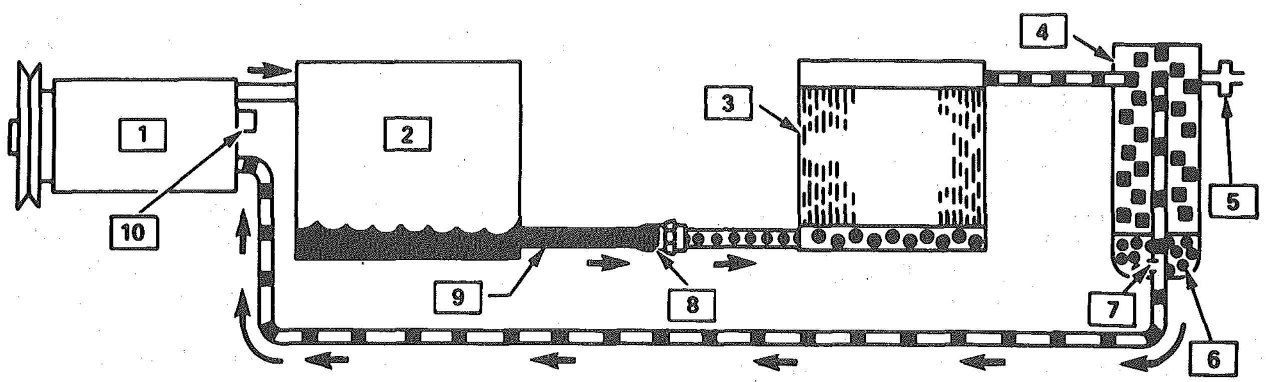
During full throttle acceleration on cars equipped with TBI or EFI, the TPS sends a signal to the ECM, thereby controlling the compressor clutch.

Air Conditioning Time Delay Relay

This relay on some cars controls the current to the entire air conditioning system and provides a short delay of air conditioning operation upon start-up.

Constant Run Relay

Engine idle quality on some cars is maintained by a "constant run" system (constant run relay) that eliminates compressor cycling during engine idle for a predetermined time after the vehicle has come to rest from road speed. If the idle period continues for an extended time, the A/C system may return to a conventional C.C.O.T. mode for a short time to prevent system freeze-up. The A/C control relay and constant run relays are both controlled by the Electronic Control Module (ECM) which determines operating conditions by evaluating input from the distributor (engine speed), vehicle speed sensor, air sensor and A/C compressor "on" signal.



1–COMPRESSOR
2–CONDENSER
3–EVAPORATOR
4–ACCUMULATOR
5–PRESSURE CYCLING SWITCH
6–DESSICANT BAG
7–OIL BLEED HOLE
8–EXPANSION TUBE (ORIFICE)
9–LIQUID LINE
10–PRESSURE RELIEF VALVE

●●● LOW PRESSURE LIQUID
■■■ LOW PRESSURE VAPOR
HIGH PRESSURE LIQUID
HIGH PRESSURE VAPOR

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Figure 2 A/C System — Typical

DIAGNOSIS

TESTING THE REFRIGERANT SYSTEM

If a malfunction in the refrigerant system is suspected, check the following:

1. Check outer surfaces of radiator and condenser cores to be sure air flow is not blocked by dirt, leaves or other foreign material. Be sure to check between the condenser and radiator as well as the outer surfaces.
2. Restrictions or kinks in the condenser core, hoses, tubes, etc.
3. Blower fan operation (see Section 8A).
4. Check all air ducts for leaks or restrictions. Low air flow rate may indicate a restricted evaporator core.
5. Compressor clutch slippage.
6. Improper drive belt tension.
7. See C.C.O.T. A/C system diagnostic procedures.

Insufficient Cooling "Quick-Check" Procedure

The following "HAND-FEEL" procedure can be used to approximate whether or not the A/C system has the proper charge of Refrigerant-12 (providing air temperature is above 21°C [70°F])on most models. This check can be made in a matter of minutes and may simplify system diagnosis by pinpointing the problem to the amount of R-12 charge in the system or by eliminating low charge possibility from the overall checkout.

1. Engine must be warm(CHOKE OPEN and OFF FAST IDLE SPEED CAM) and at normal idle speed.
2. Hood and body doors open.
3. Selector (mode) button set at "NORM."
4. Temperature lever at full COLD.
5. Blower on "HI."
6. "Hand-Feel" temperature of evaporator inlet pipe after orifice, and accumulator surface, with compressor engaged.

   BOTH SAME TEMPERATURE AND BOTH SAME DEGREE COOLER THAN AMBIENT — Proper condition: check for other problems; (see Testing the Refrigerant System).

   - Leak check. If leak found, discharge and repair as required. Evacuate and recharge.
   - If no leak found, see A/C System Diagnostic Procedures.

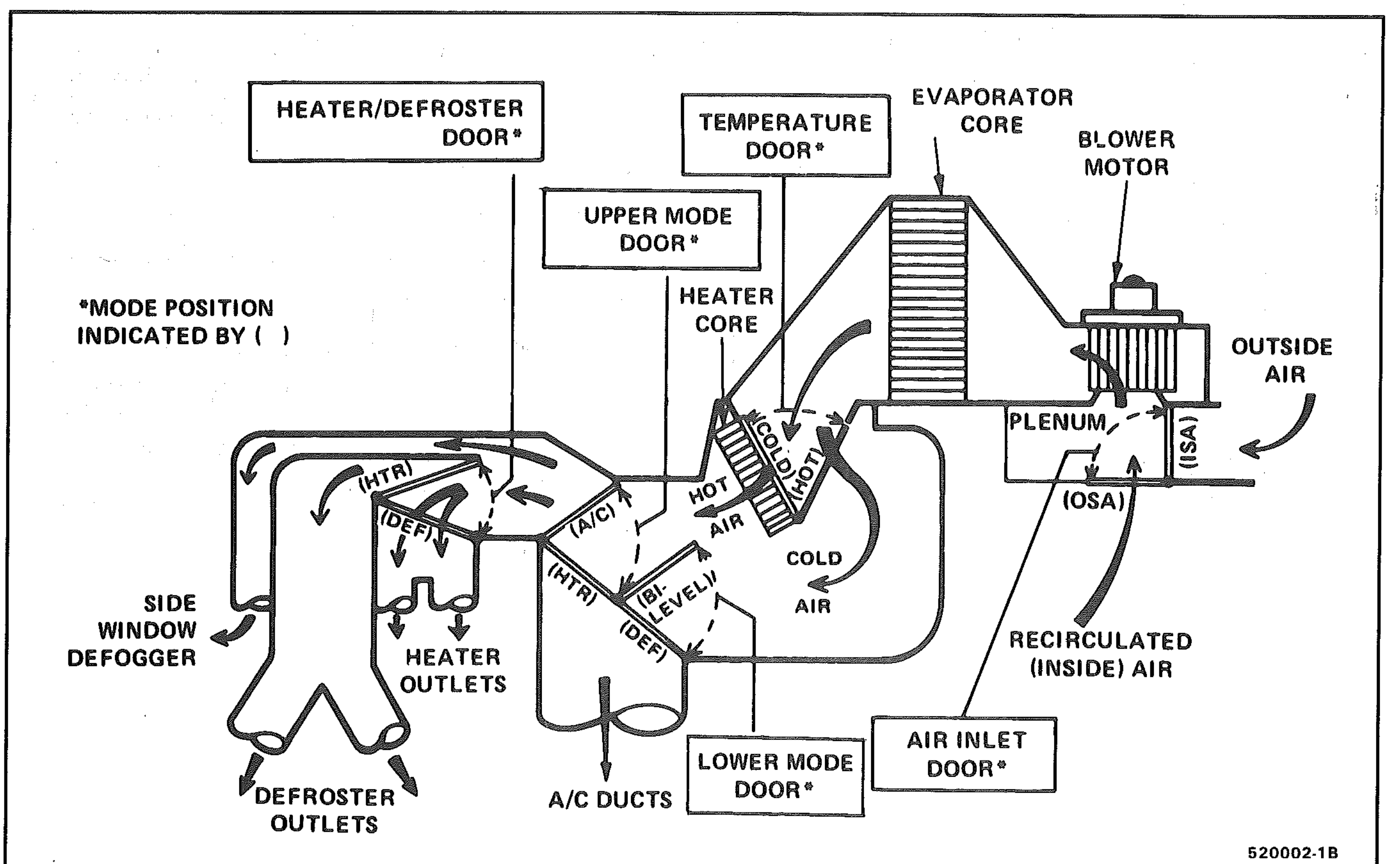
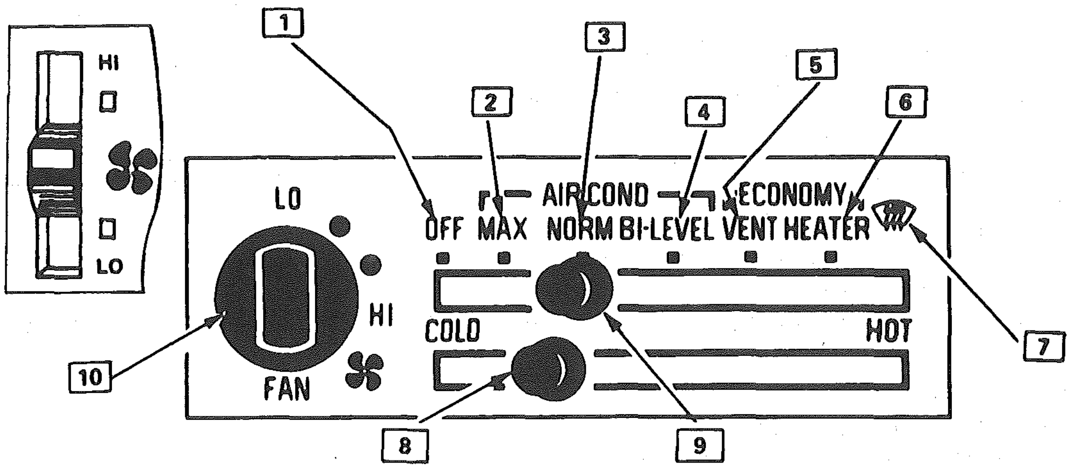


Figure 3 A/C Air Flow — Typical



1—NO BLOWER OPERATION WITH MODE LEVER IN "OFF" POSITION
2—IN THIS MODE LEVER POSITION, MAXIMUM COOLING IF OFFERED WITH THE CONDITIONED AIR DISTRIBUTED THROUGH I.P. OUTLET AND SLIGHT AMOUNT TO FLOOR AT ANY BLOWER SPEED
3—CONDITIONED AIR IS DIRECTED THROUGH I.P. AND FLOOR DISTRIBUTOR OUTLETS WITH SOME ALSO TO WINDSHIELD
4—CONDITIONED AIR IS DIRECTED THROUGH I.P. AND FLOOR DISTRIBUTOR OUTLETS WITH SOME ALSO TO WINDSHIELD
5—A NON-COMPRESSOR OPERATING POSITION, WITH OUTSIDE AIR DELIVERED THROUGH I.P. OUTLETS
6—A NON-COMPRESSOR OPERATING POSITION WITH OUTSIDE AIR DISTRIBUTED ABOUT 80% TO FLOOR (AND 20% TO WINDSHIELD AND SIDE WINDOWS - SOME MODELS)
7—CONDITIONED AIR DISTRIBUTED ABOUT 80% TO WINDSHIELD AND SIDE WINDOWS, AND 20% TO FLOOR
8—TEMPERATURE LEVER POSITION REGULATES TEMPERATURE OF THE AIR ENTERING THE PASSENGER COMPARTMENT BY CABLE OPERATION OF THE HEATER CORE TEMPERATURE DOOR
9—VACUUM OPERATED SYSTEM SELECTOR (MODE) LEVER
10—FAN CONTROL (DESIGN VARIES WITH MODEL)

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Figure 4 A/C Controller — Typical

	CONTROL SETTINGS			SYSTEM RESPONSE			
STEP	MODE CONTROL	TEMPERATURE CONTROL	FAN SWITCH	BLOWER SPEED	HEATER OUTLETS	A/C OUTLETS	DEFROSTER OUTLETS
1	OFF	COLD	LO	OFF	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW
2	MAX	COLD	LO	LOW	NO AIR FLOW	AIR FLOW	NO AIR FLOW
3	MAX	COLD	LO TO HI	LOW TO HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
4	NORM	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
5	BI-LEVEL	COLD	HI	HIGH	AIR FLOW	AIR FLOW	NO AIR FLOW
6	VENT	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW
7	HEATER	HOT	HI	HIGH	AIR FLOW	NO AIR FLOW	MINIMUM AIR FLOW
8	DEF	HOT	HI	HIGH	MINIMUM AIR FLOW	NO AIR FLOW	AIR FLOW

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Figure 5 A/C Functional Testing

REFRIGERANT — 12
PRESSURE — TEMPERATURE
RELATIONSHIP

The table below indicates the pressure of Refrigerant — 12 at various temperatures. For instance, a drum of Refrigerant at a temperature of 80°F (26.6°C) will have a pressure of 84.1 PSI (579.9 kPa). If it is heated to 125°F (51.6°C), the pressure will increase to 167.5 PSI (1154.9 kPa). It also can be used conversely to determine the temperature at which Refrigerant — 12 boils under various pressures. For example, at a pressure of 30.1 PSI (207.5 kPa), Refrigerant — 12 boils at 32°F (0°C).

(°F)	(°C)	(PSIG)	(kPa)	(°F)	(°C)	(PSIG)	(kPa)
−21.7	−29.8C	0(ATMOSPHERIC PRESSURE)	0(kPa)	55	12.7C	52.0	358.5
				60	15.5C	57.7	397.8
−20	−28.8C	2.4	16.5	65	18.3C	63.7	439.2
−10	−23.3C	4.5	31.0	70	21.1C	70.1	482.7
−5	−20.5C	6.8	46.9	75	23.8C	76.9	530.2
0	−17.7C	9.2	63.4	80	26.6C	84.1	579.9
5	−15.0C	11.8	81.4	85	29.4C	91.7	632.3
10	−12.2C	14.7	101.4	90	32.2C	99.6	686.7
15	−9.4C	17.7	122.0	95	35.0C	108.1	745.3
20	−6.6C	21.1	145.5	100	37.7C	116.9	806.0
25	−3.8C	24.6	169.6	105	40.5C	126.2	870.2
30	−1.1C	28.5	196.5	110	43.3C	136.0	937.7
32	0C	30.1	207.5	115	46.1C	146.5	1010.1
35	1.6C	32.6	224.8	120	48.8C	157.1	1083.2
40	4.4C	37.0	255.1	125	51.6C	167.5	1154.9
45	7.2C	41.7	287.5	130	54.4C	179.0	1234.2
50	10.0C	46.7	322.0	140	60.0C	204.5	1410.0

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Figure 6 Pressure-Temperature Relationship of R-12

RELATIVE HUMIDITY (%)	AMBIENT AIR TEMP °F	°C	LOW SIDE PSIG	ENGINE SPEED (rpm)	CENTER DUCT AIR TEMPERATURE °F	°C	HIGH SIDE PSIG
20	70	21	29	2000	40	4	150
	80	27	29		44	7	190
	90	32	30		48	9	245
	100	38	31		57	14	305
30	70	21	29	2000	42	6	150
	80	27	30		47	8	205
	90	32	31		51	11	265
	100	38	32		61	16	325
40	70	21	29	2000	45	7	165
	80	27	30		49	9	215
	90	32	32		55	13	280
	100	38	39		65	18	345
50	70	21	30	2000	47	8	180
	80	27	32		53	12	235
	90	32	34		59	15	295
	100	38	40		69	21	350
60	70	21	30	2000	48	9	180
	80	27	33		56	13	240
	90	32	36		63	17	300
	100	38	43		73	23	360
70	70	21	30	2000	50	10	185
	80	27	34		58	14	245
	90	32	38		65	18	305
	100	38	44		75	24	365
80	70	21	30	2000	50	10	190
	80	27	34		59	15	250
	90	32	39		67	19	310
90	70	21	30	2000	50	10	200
	80	27	36		62	17	265
	90	32	42		71	22	330

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Figure 7 A/C System Performance Test

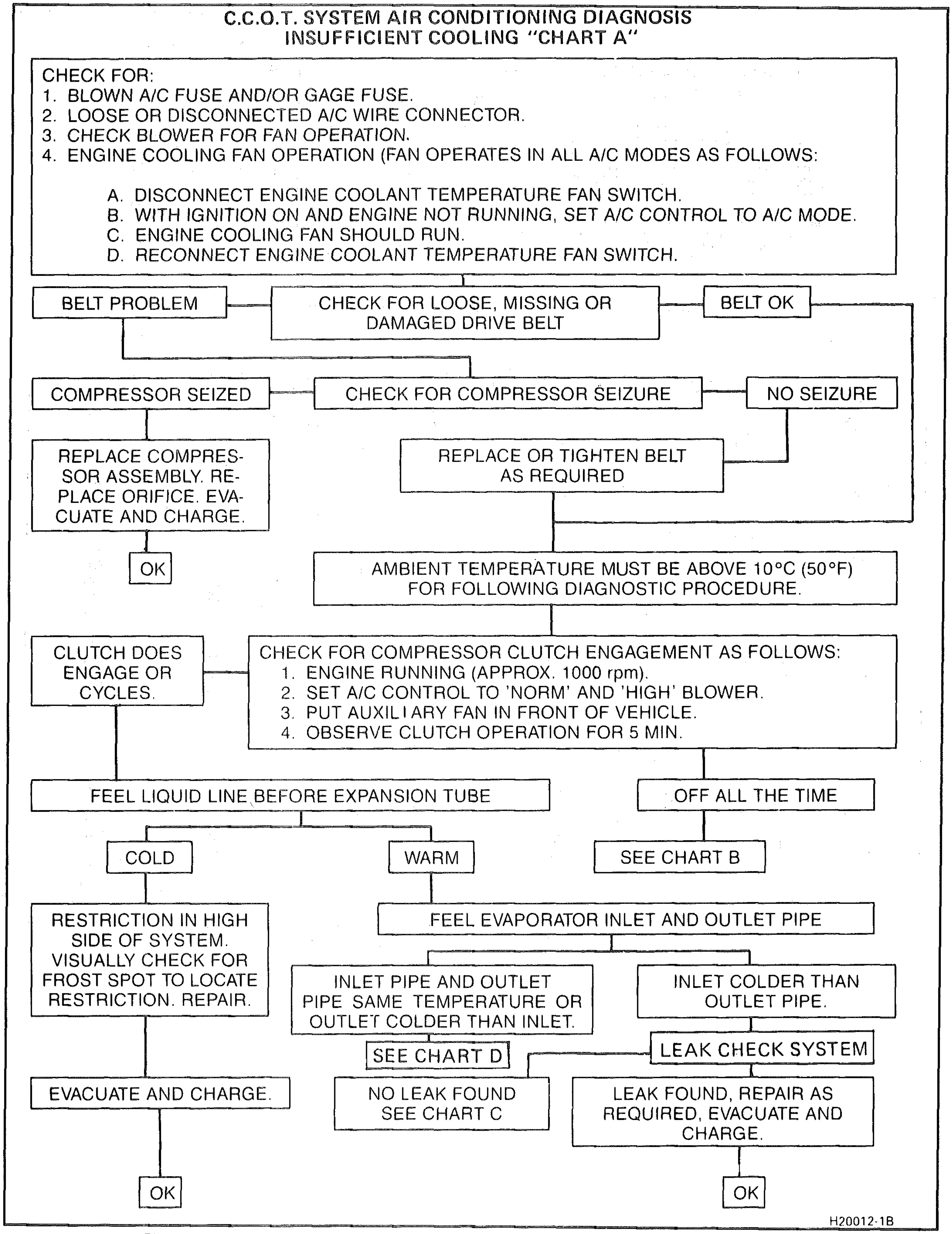


Figure 8 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (1 of 4)

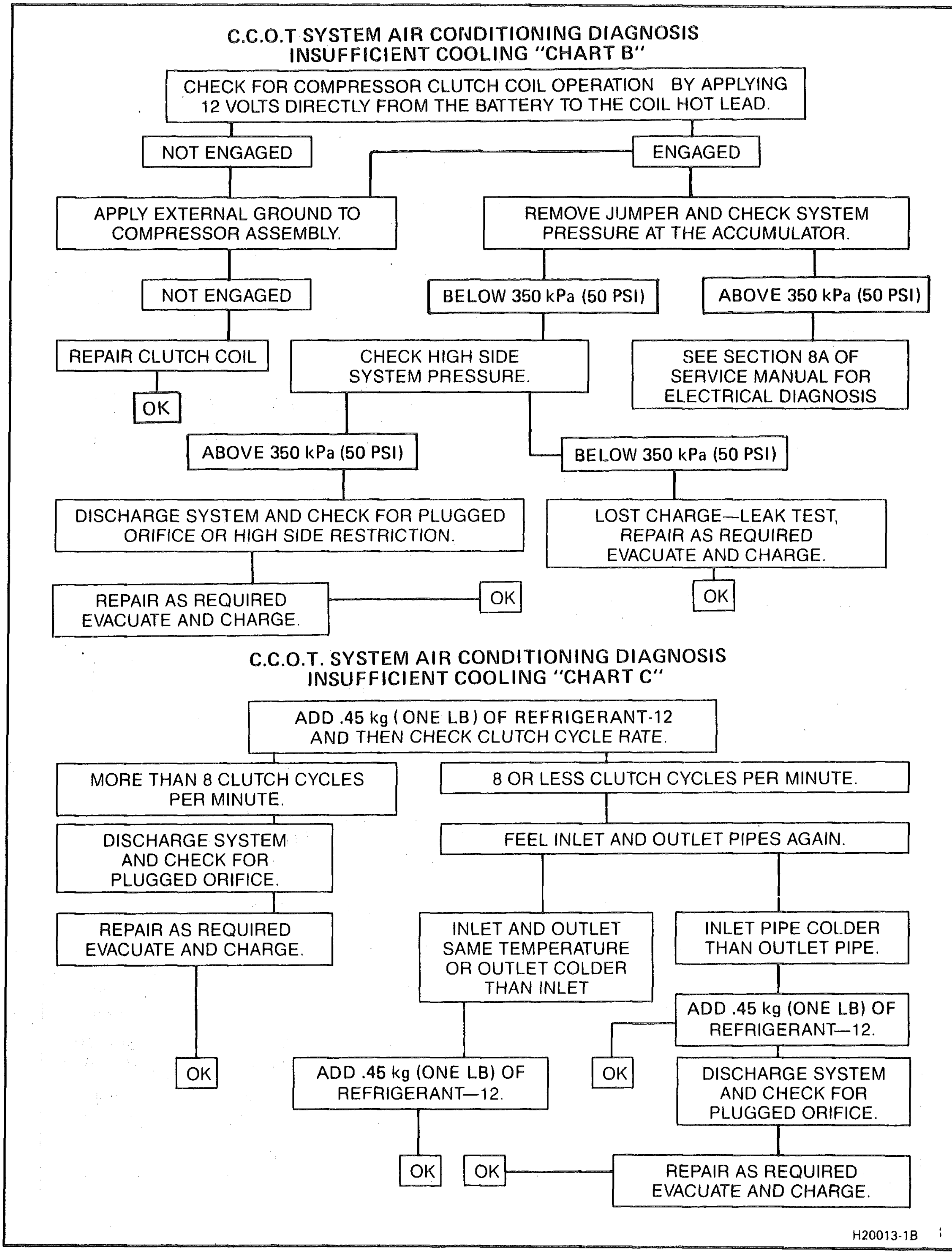
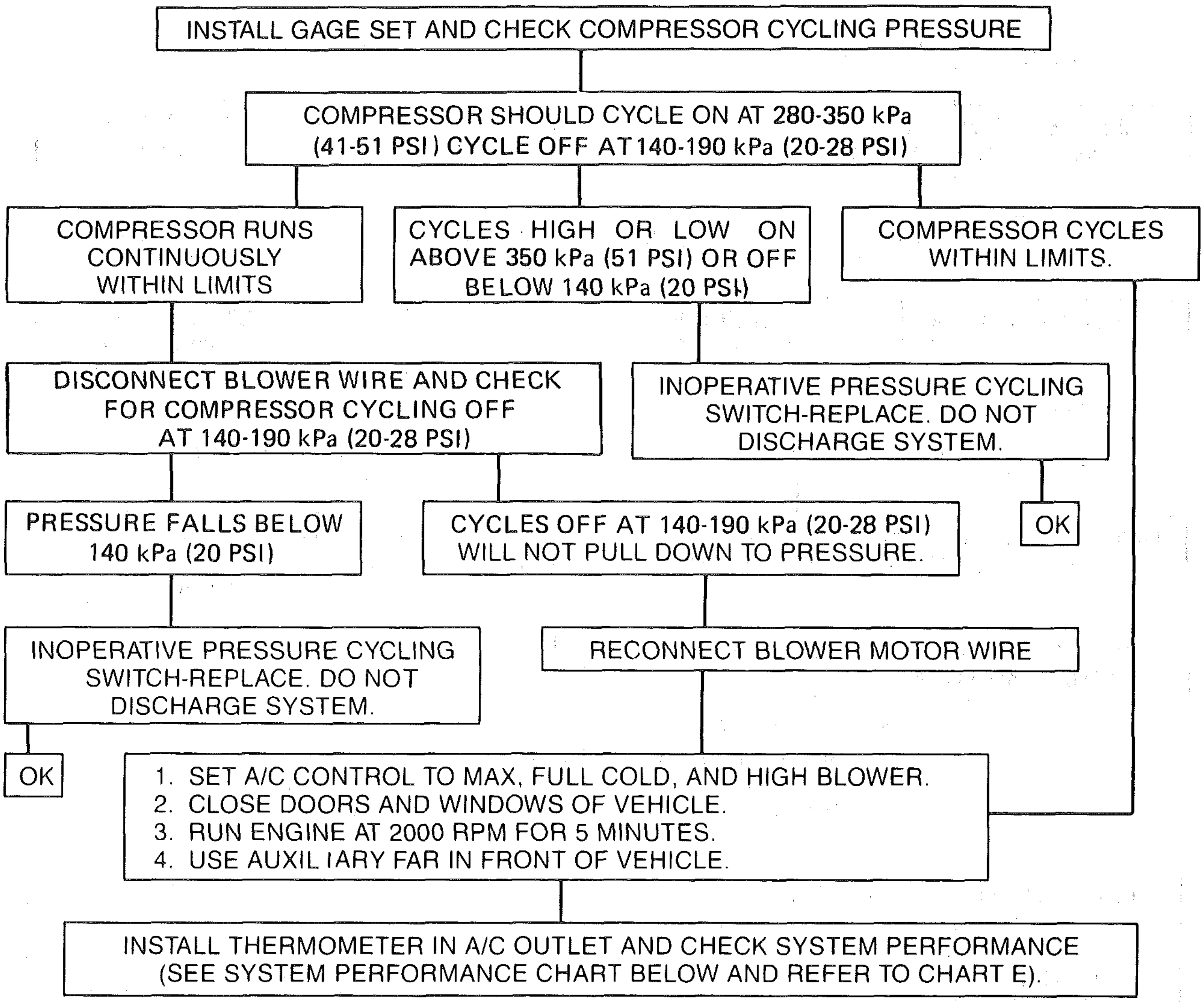


Figure 9 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (2 of 4)

C.C.O.T. SYSTEM AIR CONDITIONING DIAGNOSIS
INSUFFICIENT COOLING "CHART D"



PERFORMANCE CHART FOR C.C.O.T. SYSTEMS

TEMPERATURE OF AIR ENTERING CONDENSER	°F (°C)	70 (21)	80 (27)	90 (32)	100 (38)
COMPRESSOR OUT PRESSURE	PSI (KPA)	135-170 (950-1200)	165-200 (1150-1400)	200-245 (1400-1700)	245-300 (1700-2050)
ACCUMULATOR PRESSURE	PSI (KPA)	22-28 (150-193)	22-29 (150-200)	26-35 (180-240)	30-40 (205-275)
AVERAGE A/C AIR DISCHARGE	°F (°C)	36-43 (2.2-6.0)	36-43 (2.2-6.0)	36-43 (2.2-6.0)	42-48 (5.5-9.0)

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Figure 10 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (3 of 4)

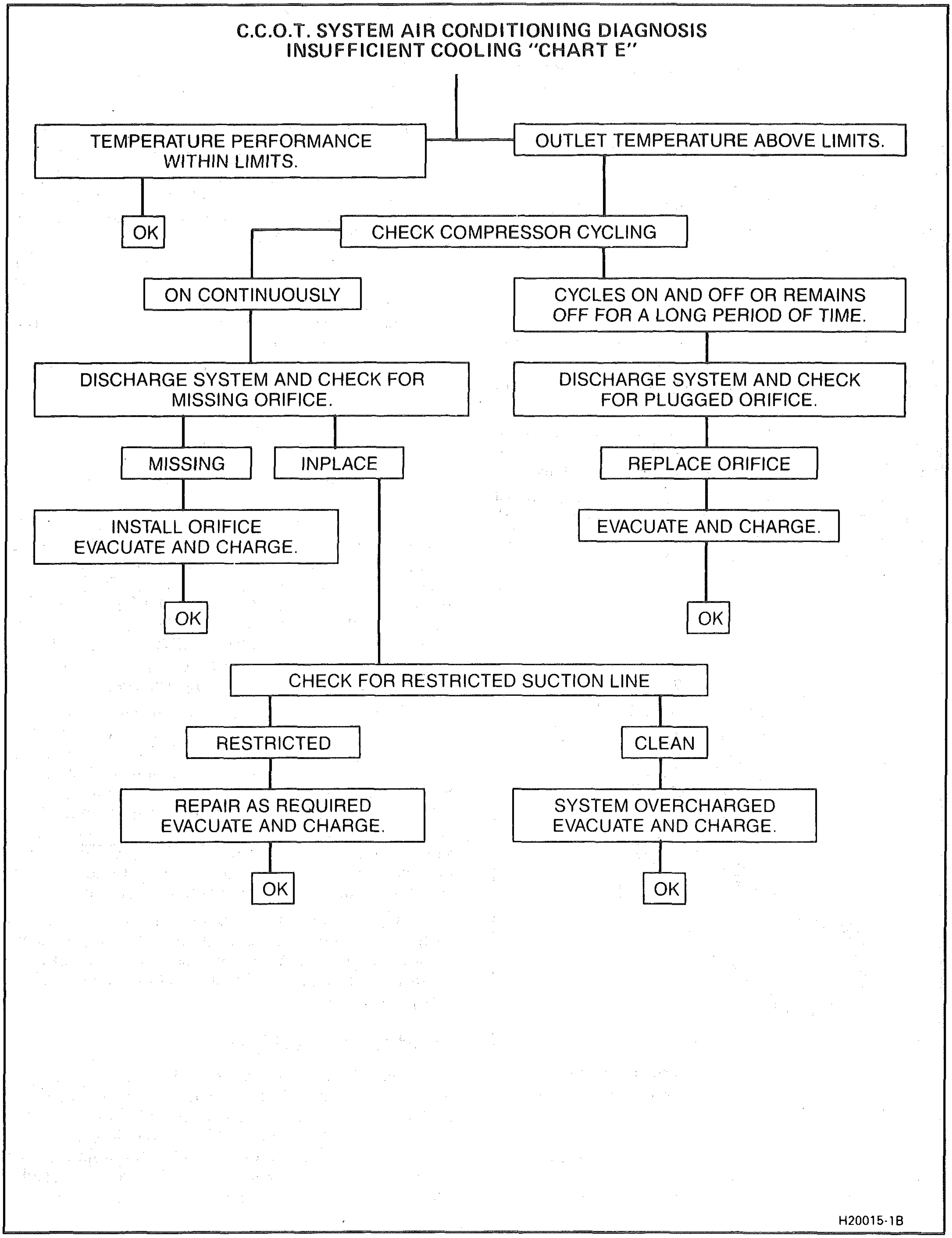


Figure 11 C.C.O.T. A/C System Insufficient Cooling Diagnostic Procedure (4 of 4)

ELECTRICAL/VACUUM SYSTEM DIAGNOSIS

When diagnosing problems in the electrical systems of the air conditioning system, consult section 8A.

LEAK TESTING THE REFRIGERANT SYSTEM

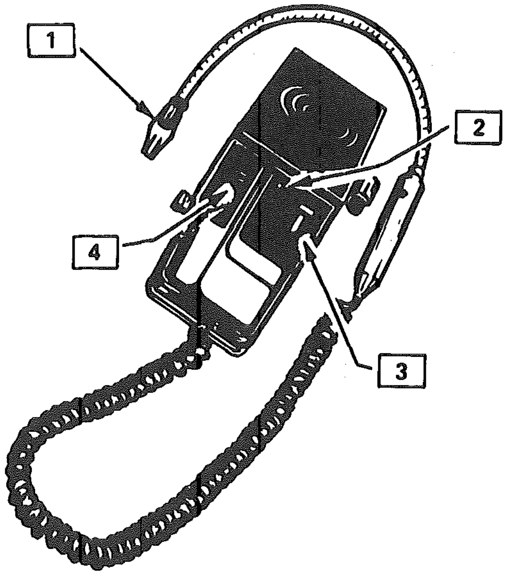
Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks.

Liquid Leak Detectors

There are a number of locations (fittings, valves, etc.) on the air conditioning system where a liquid leak detector solution may be used to pinpoint refrigerant leaks.

By applying test solution to the area in question with the swab that is attached to the bottle cap, bubbles will form within seconds if there is a leak.

For restricted access areas, such as sections of the evaporator and condenser, an electronic leak detector, such as J-29547 or equivalent, is more practical for determining and locating leaks.



1–PROBE
2–HI-LOW SWITCH
3–LOW BATTERY INDICATOR
4–BALANCE CONTROL

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Figure 12 Electronic Leak Detector J-29547

ELECTRONIC LEAK TESTERS

(Figure 12)

Electronic leak testers can accurately determine leaks in areas that are difficult to test with liquid leak detectors due to poor visibility or inaccessibility.

The H-10 Leak Detector J-26934 is a 110-volt, A/C powered tester while the Refrigerant Leak Detector J-29547 is a portable, battery operated model. Both models provide visual and/or audible signals to indicate leak detection.

The successful use of electronic leak detectors depends upon carefully following the manufacturer's instructions regarding calibration, operation and maintenance. Battery condition is especially important to the accuracy of the portable battery powered model J-29547 and is monitored by a low battery indicator.

SERVICE PROCEDURES

Before attempting any service which requires opening of refrigerant lines or components, the person doing the work should be thoroughly familiar with the information under HANDLING REFRIGERANT-12, HANDLING REFRIGERANT LINES AND FITTINGS AND MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM. Very carefully follow the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS instructions given on the following pages for the unit being serviced.

Sealing caps should be removed from subassemblies just prior to making connections for final assembly. Use a small amount of clean 525 viscosity refrigerant oil on all tube and hose joints. Always use new O-rings dipped in the clean 525 viscosity refrigerant oil when assembling joints. The oil will aid in assembly and help provide a leak-proof joint. When tightening joints, use a second wrench to hold stationary part of connection so that a solid feel can be attained. This will indicate proper assembly.

Tighten all tubing connections as shown in torque chart (Figure 13). Insufficient or excessive torque when tightening can result in loose joints or deformed joint parts. Either condition can result in refrigerant leakage.

O-RING REPLACEMENT

Install new G.M. approved service replacement air conditioning "O" rings whenever a joint or fitting is disassembled, except when provided on new components. Even though an "O" ring may look the same, it is extremely important that only recommended service replacement air conditioning "O" rings be used or excessive leakage of Refrigerant 12 may occur.

METAL TUBE OUTSIDE DIAMETER	THREAD AND FITTING SIZE	STEEL TUBING TORQUE LB. FT.	N•m	ALUMINUM OR COPPER TUBING LB. FT.	N•m	NOMINAL TORQUE WRENCH SPAN
1/4	7/16	10-15	14-20	5-7	7-9	5/8
3/8	5/8	30-35	41-48	11-13	15-18	3/4
1/2	3/4	30-35	41-48	15-20	20-27	7/8
5/8	7/8	30-35	41-48	21-27	29-37	1-1/16"
3/4	1-1/16"	30-35	41-48	28-33	38-45	1-1/4"

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Figure 13 Pipe & Hose Connection Torque Chart

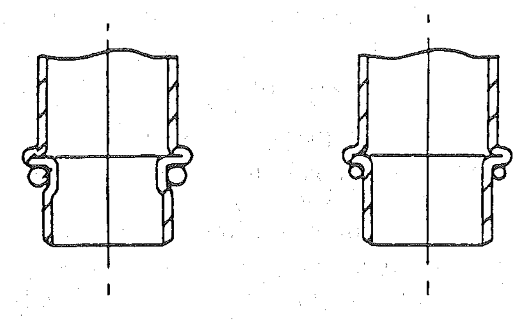


Figure 14 O-Ring Designs

When replacing "O" rings on an air conditioning components or joint connections, the fitting design should be carefully identified to ensure installation of correct air conditioining service replacement "O" rings. Some joint connections and components will implement a "captured" "O" ring design fitting that uses a groove to retain the "O" ring, while others do not have a groove and uses a "non-captured" or "standard" "O" ring.

Assembly and tightening procedures are the same for both designs, however, the "O" rings are different. Some "O" rings are color coated to ease indentification and assembly. The following is a list showing the color applications for the currently serviced air conditioning "O" rings:

A. Red — Captured (Grooved Male Fitting End Form) "O " Ring Design.

B. Blue — Non-captured/Standard (Straight Male Fitting End Form) "O" Ring Design.

C. Yellow — "O" rings used on different types of air conditioning switches.

These colored "O" rings are available in various sizes for each application. "O" rings should be coated with 525 viscosity refrigerant oil, prior to installation, but must not be soaked. Soaking color coated "O" rings will cause them to swell.

NOTICE: Do not soak the new teflon coated "O" ring seals in refrigerant oil, it can cause refrigerant leakage due to improper joint assembly. Prolonged exposure, such as soaking, may swell them large enough to prohibit joint assembly. **ALWAYS SLIP THE "O" RING ONTO THE FLANGE TUBE TO ENSURE PROPER LOCATION AND SEALING.**

Also, prior to installation, verify that both "O" rings and fittings have not been nicked or deformed. Deformed or nicked parts must be replaced. Failure to use the proper service replacement parts and procedures may result in excessive Refrigerant 12 leakage.

HANDLING REFRIGERANT-12

Air conditioning systems contain Refrigerant-12. This is a chemical mixture which requires special handling procedures to avoid personal injury.

Always wear goggles and wrap a clean cloth around fittings, valves, and connections when performing work that involves opening the refrigerant system. **Always work in a well ventilated area and avoid breathing any refrigerant fumes.** Do not weld or steam clean on or near any car-installed air conditioning lines or components.

If Refrigerant-12 should come in contact with any part of the body, flush the exposed area with water.

All Refrigerant-12 drums are shipped with a heavy metal screw cap. The purpose of the cap is to protect the valve and safety plug from damage. It is good practice to replace the cap after each use of the drum.

If it is necessary to transport or carry any container of Refrigerant-12 in a vehicle, do not carry it in the passenger compartment. If the occasion arises to fill a small Refrigerant-12 drum from a large one, never fill the drum completely. Space should always be allowed above the liquid for expansion.

HANDLING OF REFRIGERANT LINES AND FITTINGS

Tighten all tubing connections as shown in torque chart (Figure 13). INSUFFICIENT OR EXCESSIVE TORQUE WHEN TIGHTENING CAN RESULT IN LOOSE JOINTS OR DEFORMED JOINT PARTS. Either condition can result in refrigerant leakage.

All metal tubing lines should be free of dents or kinks to prevent loss of system capacity due to line restriction.

- The flexible hose lines should never be bent to a radius of less than four (4) times the diameter of the hose.
- The flexible hose lines should never be allowed to come within a distance of 63.5mm (2-1/2″) of the exhaust manifold.
- Flexible hose lines should be inspected regularly for leaks or brittleness and replaced with new lines if deterioration or leaking is found.
- When disconnecting any fitting in the refrigeration system, the system must first be discharged of all Refrigerant-12. Proceed very cautiously regardless of gauge readings. Open very slowly, keeping face and hands away so that no injury can occur if there happens to be liquid Refrigerant-12 in the line. If pressure is noticed when fitting is loosened, allow it to bleed off as described under DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS.
- In the event any refrigerant line is opened to the atmosphere, it should be immediately capped or taped to prevent entrance of moisture and dirt, which can cause internal compressor wear or plugged lines, in the condenser and evaporator core and expansion (orifice) tubes or compressor inlet screens.
- The use of the proper wrenches when making connections on O-ring fittings is important. The opposing fitting should always be backed up with a wrench to prevent distortion of connecting lines or components. When connecting the flexible hose connections, it is important that the swaged fitting and the flare nut, as well as the coupling to which it is attached, be held at the same time using three (3) different wrenches to prevent turning the fitting and damaging the ground seat.
- O-rings and seats must be in perfect condition. A burr or piece of dirt may cause a refrigerant leak. When replacing the O-ring, first dip it in clean 525 viscosity refrigeration oil.

MAINTAINING CHEMICAL STABILITY IN THE REFRIGERATION SYSTEM

The efficient operation and life of the air conditioning system is dependent upon the chemical stability of the refrigeration system. When foreign materials, such as dirt, air, or moisture, contaminate the refrigeration system, they will change the stability of the Refrigerant-12 and 525 viscosity compressor oil. They will also affect pressure-temperature relationship, reduce efficient operation and possibly cause interior corrosion and abnormal wear of moving parts.

The following general practices should be observed to insure chemical stability in the system:

1. Before disconnecting a refrigerant connection, wipe away any dirt or oil at and near the connection to reduce the possibility of dirt entering the system. Both sides of the connection should be capped, plugged or taped as soon as possible to prevent the entry of dirt, foreign material and moisture.
2. Keep tools clean and dry. This includes the manifold gauge set and replacement parts.
3. When adding 525 viscosity refrigerant oil (see ADDING OIL in the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS, the transfer device and container should be clean and dry to assure that refrigeration oil remains as moisture-free as possible.
4. When it is necessary to "open" an A/C system, have everything needed ready and handy so that as little time as possible will be required to perform the operation. Do not leave the A/C system open any longer than is necessary.
5. Any time the A/C system has been "opened," it should be properly evacuated before recharging with Refrigerant-12 according to the DISCHARGING, ADDING OIL, EVACUATING & CHARGING PROCEDURES FOR A/C SYSTEMS.

All service parts are dehydrated and sealed prior to shipping. They should remain sealed until just prior to making connections. All parts should be at room temperature before uncapping. (This prevents condensation of moisture from the air entering the system.) If, for any reason, caps are removed but the connections are not made, parts should be resealed as soon as possible.

DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS

The refrigerant system may be discharged, evacuated and charged using air conditioning service charging station J-23500-01 or equivalent, or the manifold and gauge set J-23575-01 and 420ml (14 oz.) disposable cans of Refrigerant-12 (Figure 16).

Charging lines from the charging station or manifold and gauge set require the use of gauge adapters to connect to the system service fitting. A straight gauge adapter J-5420 and a 90° angle gauge adapter J-9459 are available (see A/C Special Tools).

Always wear goggles and wrap a clean cloth around fittings and connections when doing work that involves opening the refrigeration system. Always work in a well ventilated area and avoid breathing any refrigerant fumes. If liquid refrigerant comes into contact with the eyes, injury may result.

- Before removing and replacing any of the air conditioning refrigeration lines or components, the system must be completely discharged of Refrigerant-12.
- Always use service valve and pressure gauge sets during evacuation and charging procedures.
- Always discharge system at low-side service fitting and perform the entire evacuate and charging procedure through the low-side service fitting.
- Do not connect high-pressure line or any line to the high-side service fitting during discharging and charging procedures.

CAUTION: Never remove a gauge line from its adapter when line is connected to A/C system. Always remove the line adapter from the service fitting to disconnect a line. Do not remove charging hose at gauge set while attached to service low-side fitting. This will result in complete discharge of system due to the depressed Schrader valve in service low-side fitting and may cause personal injury due to escaping Refrigerant-12.

Discharging the A/C System

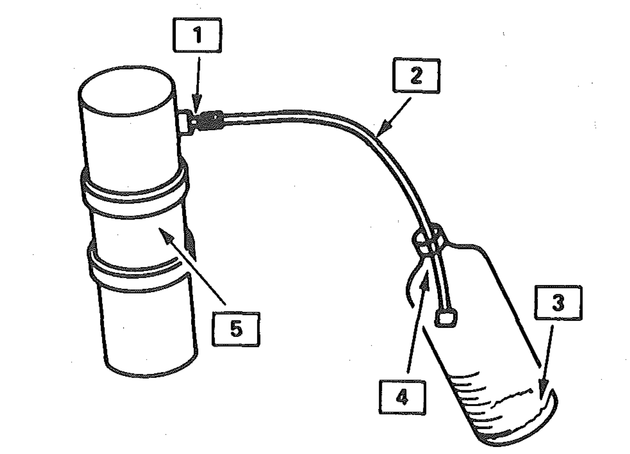
In replacing any of the air conditioning refrigeration components, the system must be completely discharged of Refrigerant-12.

ALWAYS DISCHARGE SYSTEM AT LOW-SIDE SERVICE FITTING.

1. With ignition turned "OFF," remove protective cap from LOW-SIDE service fitting (on most models) on Accumulator and connect charging station J-23500-01 or equivalent gauge set. If charging station J-23500-01 or equivalent is not being used, discharge system by slowly connecting a gauge hose to low-side service fitting on accumulator and discharging into oil bottle (Figure 15). As hose is slowly tightened down onto Schrader valve, Refrigerant-12 will begin to discharge from the system into the container. If no discharge occurs, check for missing or defective Schrader depressor in hose fitting.
2. With the low-side of system fully discharged, check high-side system fitting (on liquid line or muffler) for remaining pressure.
3. If pressure is found, attempt to discharge high-side using same procedure as used for low-side. (This condition indicates a restriction on the high-side and the cause must be diagnosed and corrected before evacuating and charging the system.)
4. When the system is completely discharged (no vapor escaping with hose fully tightened down), measure, record amount, and discard the collected refrigerant oil. If the measured quantity is 15ml (1/2 fl. oz.) or more, this amount of new 525 viscosity refrigerant oil must be added to system, plus any quantity in removed parts before system evacuation and charging with Refrigerant-12 (see REFRIGERANT OIL DISTRIBUTION for specific quantity of oil normally retained in removed parts).

Adding Oil to the Air Conditioning Refrigerant System

ADDING OIL TO THE A/C SYSTEM should take place AFTER discharge and BEFORE evacuation procedures by removing the refrigeration suction hose at the accumulator outlet pipe connection, pouring the correct quantity of new refrigerant oil into the hose or pipe and then properly reconnecting hose to pipe (see REFRIGERANT OIL DISTRIBUTION for specific quantity instructions).



1—USING J 5420 ADAPTER
2—GAGE HOSE
3—OIL
4—REFRIGERANT OIL BOTTLE UNCAPPED TO ALLOW GAS TO ESCAPE
5—ACCUMULATOR

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Figure 15 Discharging the A/C System Without Charging Station

Refrigerant Oil Distribution

New 525 viscosity refrigerant oil must be added to the system when components are replaced, as follows:

A. All Compressors
   - If less than 30 ml (1 fl. oz.) is drained — add 60 ml (2 fl. oz.).
   - If more than 30 ml (1 fl. oz.) is drained — add same amount.

B. Accumulator dehydrator
   - Add 105 ml (3.5 fl. oz.) to new accumulator

C. Evaporator
   - Add 90 ml (3 fl. oz.) oil

D. Condenser
   - Add 30 ml (1 fl. oz.) oil

Refrigerant oil loss due to a large leak

If the refrigerant charge is aburptly lost due to a large refrigerant leak, approximately 90 ml (3 fl. oz.) of refrigerant oil will be carried out of the system suspended in the refrigerant. Any failure that caused an abrupt refrigerant discharge will experience this oil loss. Failures that allow the refrigerant to seep or bleed off over time do not experience this oil loss.

Upon replacement of a component which caused a large refrigerant leak, add 90 ml (3 fl. oz.) of new 525 viscosity refrigerant oil plus the required amount of oil for the particular component (as outlined above).

Add the oil directly to the replaced component if possible. If the oil cannot easily be added to the replaced part, add the oil to the accumulator.

Evacuating and Charging the A/C System

If the system has been opened for any repair, or the Refrigerant-12 charge lost, the system must be evacuated prior to charging.

Evacuating and charging is a combined procedure, and all gauge lines must be purged with R-12 prior to charging.

There are three evacuate and charge procedures.

1. J 23500-01 Charging Station Method
2. Disposable Can Method
3. Drum Method

NOTICE: Under no circumstances should alcohol be used in the system in an attempt to remove moisture. Damage to the system components could occur.

Gauge Calibration

Prior to evacuation, check the low-pressure gauge for proper calibration and determine if vacuum system is operating properly.

With the gauge disconnected from the refrigeration system, be sure that the pointer indicates to the center of "0". Lightly tap gauge a few times to be sure pointer is not sticking. If necessary, calibrate as follows:

1. Remove cover from gauge.
2. Holding gauge pointer adjusting screw firmly with one hand, carefully force pointer in the proper direction to position pointer at the "0" position. Tap gauge a few times to be sure pointer is not sticking. Replace gauge cover.

Vacuum System Check

Before connecting vacuum pump to the A/C system, run pump connected to the low-pressure gauge to determine the vacuum pump capability. If the vacuum system is unable to reach 711.2-736.6mm (28"-29") or more vacuum, the system should be checked for leaks. If no leaks are found, the vacuum pump may require repair.

J-23500-01 OR EQUIVALENT CHARGING STATION METHOD.

Follow charging instructions provided with the J-23500-01 Charging Station or equivalent in use with the following exceptions:

1. Do not connect the high-pressure line to the air conditioning system.
2. Keep the high-pressure valve on the charging station closed at all times.
3. Perform the entire evacuate and charge procedure through the accumulator low-side pressure service fitting.
4. Following these procedures will prevent accidental high-side vehicle system pressure being subjected to the charging station in the event an error is made in valve sequence during compressor operation to pull in the Refrigerant-12 charge.

DISPOSABLE CAN OR REFRIGERANT DRUM METHOD.

If the Refrigerant-12 drum is used, place it on a scale and note the total weight before charging. Watch the scale during charging to determine the amount of R-12 used.

If disposable 420ml (14 ounce) R-12 cans are used, close the tapping valve and then attach can(s) following instructions included with the tapping valve or tapping manifold adapter.

1. Connect manifold gauge set J-23575-01 as follows. Also see Figure 16.
   a. Low-pressure gauge to accumulator fitting.
   b. Gauge set center hose to Refrigerant-12 source.
   c. High-pressure gauge to vacuum pump.
2. To begin evacuation of the A/C system with manifold gauge set and vacuum pump as illustrated in Figure 16, slowly open high- and low-side gauge valves and begin vacuum pump operation. Pump the system until the low-side gauge reaches 711.2-736.6mm (28"-29") vacuum. Note that in all evacuation procedures, the specification of 711.2-736.6mm (28"-29") vacuum is used. This specification can only be reached at or near sea level. For each 304.8m (1,000 feet) above sea level, specification should be lowered by one inch vacuum. At 1524m (5,000 feet) elevation, only 584.2-609.6mm (23"-24") of vacuum is required.

If prescribed vacuum cannot be reached, close vacuum control valve, shut off pump and look for a leak at connections or pump.

3. When gauge reaches prescribed vacuum, the system is fully evacuated. Close the high-side gauge set valve and turn off the vacuum pump.
4. Watch low-side gauge to be sure vacuum holds for five (5) minutes. If vacuum is held, disconnect vacuum hose at gauge set and then proceed to charging.
5. If vacuum does not hold for five (5) minutes, charge system with 420ml (1/2 pound) Refrigerant-12 and leak check. Discharge system again and repair leak as necessary. Repeat evacuation procedure.

To Begin Charging of the A/C System

1. Start engine and set A/C mode control button on "OFF."
2. With the Refrigerant-12 drum or 420ml (14 ounce) can(s) inverted, open R-12 source valve(s) and allow 480ml (1 pound) or one 420ml (14 oz.) can of liquid R-12 to flow into system through low-side service fitting.
3. As soon as 480ml (1 lb.) or one 420ml (14 oz.) can of R-12 has been added to system, immediately engage the compressor by setting the A/C control button to NORM and blower speed on HI, to draw in the remainder of the R-12 charge. See specifications for total R-12 charge.

The charging operation can be sped up by using a large volume fan to pass air over the condenser. If condenser temperature is maintained below charging cylinder temperature, Refrigerant-12 will enter the system more rapidly.

4. Turn off R-12 source valve and run engine for 30 seconds to clear lines and gauges.
5. With the engine running, remove the charging low-side hose adapter from the accumulator service fitting. Unscrew rapidly to avoid excess R-12 escape from system.

CAUTION: NEVER REMOVE A GAGE LINE FROM ITS ADAPTER WHEN LINE IS CONNECTED TO A/C SYSTEM. ALWAYS REMOVE THE LINE ADAPTER FROM THE SERVICE FITTING TO DISCONNECT A LINE. DO NOT REMOVE CHARGING HOSE AT GAGE SET WHILE ATTACHED TO ACCUMULATOR. THIS WILL RESULT IN COMPLETE DISCHARGE OF SYSTEM DUE TO THE DEPRESSED SCHRADER VALVE IN SERVICE LOW-SIDE FITTING, AND MAY CAUSE PERSONAL INJURY DUE TO ESCAPING REFRIGERANT-12.

6. Replace protective cap on accumulator fitting.
7. Turn engine off.
8. Leak check system with electronic leak detector J-29547 or equivalent (see Diagnosis).
9. Start engine.
10. With system fully charged and leak-checked, continue to operate system performance.

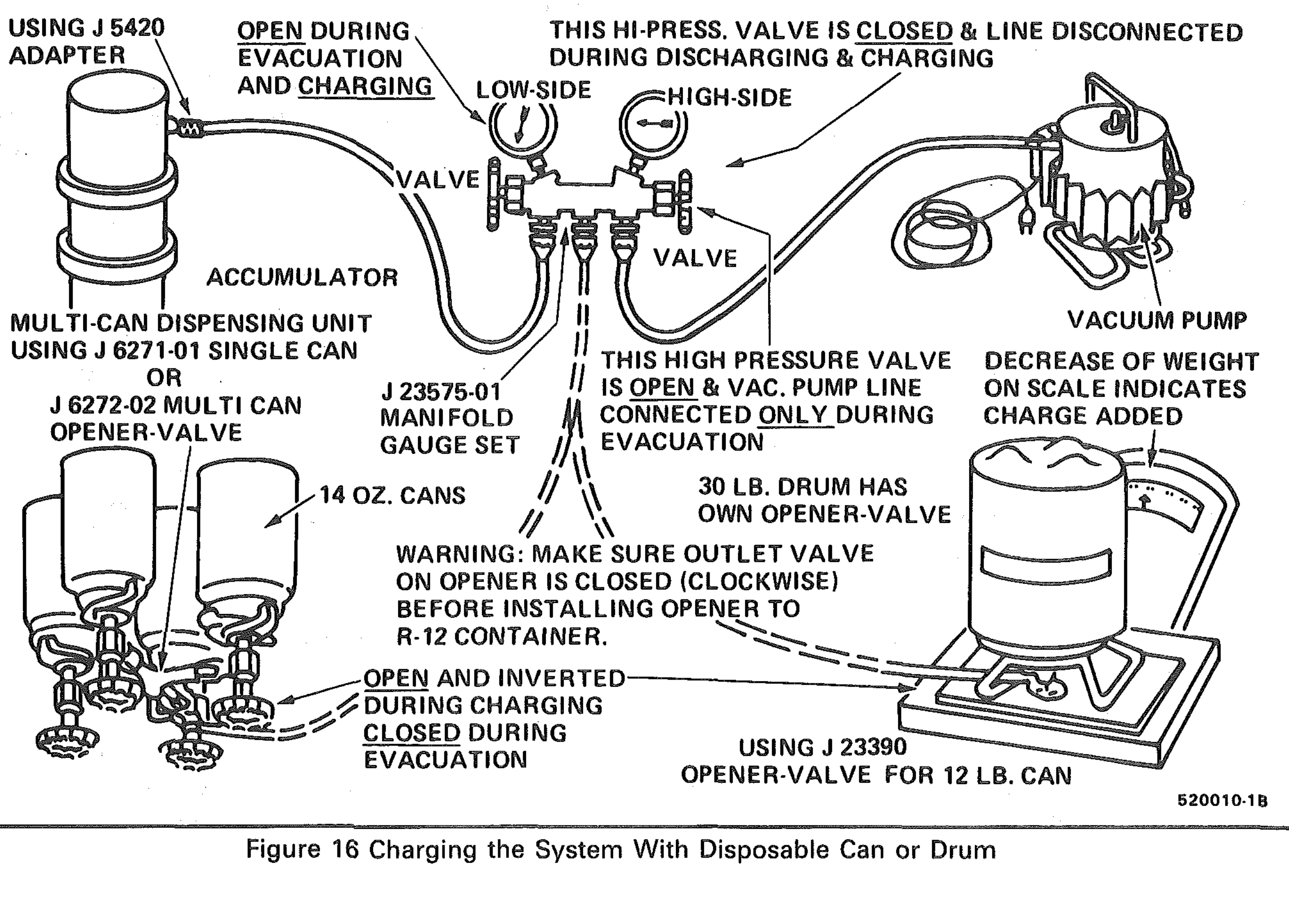


Figure 16 Charging the System With Disposable Can or Drum

LIQUID LINE FILTER INSTALLATION

Figures 17, 17a, and 17b

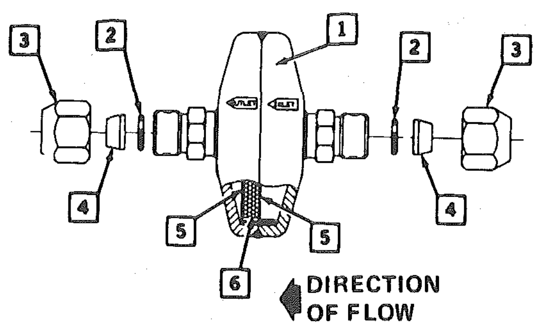
The liquid line filter eliminates the need for R-11 flushing. The filter should be installed after repeated orifice tube plugging or when replacing a seized compressor.

The filter contains a screen and a filter pad. The screen catches larger particles and retains the filter pad. The filter pad catches the smaller particles and filters the refrigerant oil.

The filter must be installed in the A/C evaporator line (liquid line) between the condenser and the evaporator. There are two types of filters:

1. Filter without orifice:
   - Used when filter is being installed on the high pressure side of the orifice tube.
2. Filter with orifice:
   - Used when filter is being installed on the low pressure side of the orifice. **The original orifice tube must be removed when this filter is used.**

The filter without orifice is preferred if space permits.



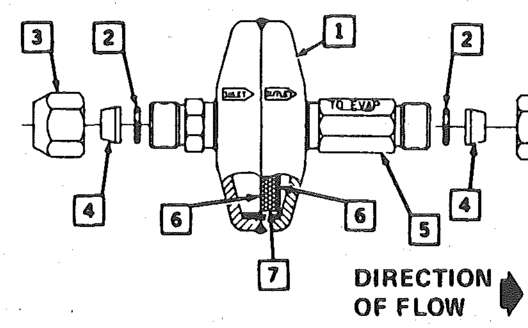
1. FILTER ASSEMBLY
2. "O" RING
3. NUT – 15 N•m (11 LBS. FT.)
4. FERULE
5. SCREEN
6. FILTER PAD

J36973-1B

Figure 17 Liquid Line Filter Without Orifice

Remove or Disconnect

1. Determine proper amount of tubing:
   - Filter without orifice — 50mm (2")
   - Filter with orifice — 68mm (2.75")
2. Cut end of tube square with tubing cutter.
3. Remove external burrs with a file.
4. Carefully cut out internal burrs so that shavings do not drop into tubing.
   - When cutting fixed vertical tubes, burrs falling into the tube may be eliminated by



1. FILTER ASSEMBLY
2. "O" RING SEAL
3. NUT – 15 N•m (11 LBS. FT.)
4. FERRULE
5. ORIFICE LOCATION
6. SCREEN
7. FILTER PAD

J36972-1B

Figure 17a Liquid Line Filter With Orifice

wedging a small cloth ball into the tube. Loose particles are swept away as the cloth is removed.

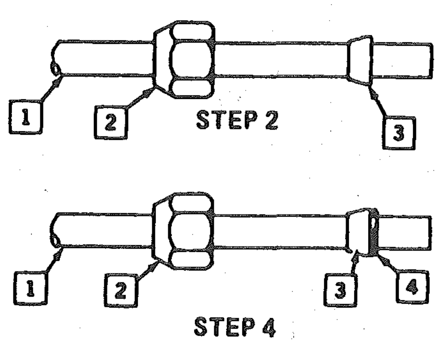
NOTICE: High side particles may be caught in the drier screen or the expansion devise screen. But under no circumstances should foreign material enter the low side plumbing.

Important

- Do not install "O" ring seals until Step 6.
- Do not oil threads of fittings.

Install or Connect

1. Place the nut over the tubing.
2. Install the ferrule with the small end toward the nut. **Do not install "O" ring.** (See figure 17b)



1. LIQUID LINE
2. NUT – 15 N•m (11 LBS. FT.)
3. FERRULE
4. "O" RING SEAL

J36974-1B

Figure 17b Liquid Line Filter Ferrule and "O" Ring Location

3. Push the tube into the fitting, bottoming it out.

Tighten

- Torque nut to 15 N•m (11 lbs. ft.).

4. Dissasemble the joint.
5. Lubricate the "O" ring with clean 525 viscosity refrigerant oil.
6. Install the "O" ring on the tube. (See figure 17b)
7. Reassemble joint.

Tighten

- Torque nut to 15 N•m (11 lbs. ft.).

8. Evacuate, charge, and leak test the system.

EXPANSION TUBE (ORIFICE) SERVICE

Remove or Disconnect

1. Discharge system.
2. Loosen fitting at liquid line to evaporator inlet pipe and remove tube carefully with needle nosed pliers or Tool J-26549-C or equivalent.

Install or Connect

1. Install new orifice tube with shorter screen end in first.
2. Install liquid line and torque to proper specification.
3. Evacuate and charge system.

In the event that difficulty is encountered during the removal of a restricted or plugged expansion tube (orifice tube), the following procedure is recommended:

1. Remove as much of any impacted residue as possible.
2. Carefully apply heat with heat gun (hair drier, epoxy drier or equivalent) approximately 1/4 inch from dimples on inlet pipe. Do not overheat pipe.

NOTICE: If the system has a pressure switch near the orifice tube location, it should be removed prior to heating the pipe to avoid damage to switch.

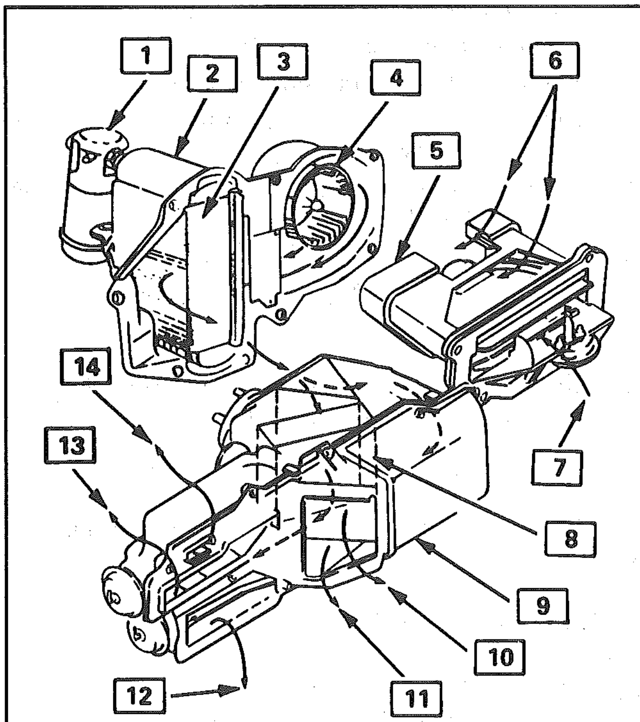
3. While applying heat, use orifice removal tool J-26549-C to grip the orifice tube. Use a turning motion along with a push-pull motion to loosen to the impacted orifice tube and remove it.
4. Swab inside of evaporator inlet pipe with R-11.
5. Add 1 oz. of 525 viscosity refrigerant oil to system.
6. Lubricate new orifice tube and O-ring with 525 viscosity refrigerant oil and insert into inlet pipe. Install in proper direction (smaller screen first).

ACCUMULATOR ASSEMBLY SERVICE

The accumulator assembly for the refrigerant system has a service replacement which includes two (2) O-rings (for the inlet and outlet connections). The desiccant within the shell is NOT serviced separately — it is part of the sealed accumulator assembly. See REFRIGERANT OIL DISTRIBUTION for conditions when the accumulator must be removed from the vehicle to measure the amount of oil present inside the accumulator.

The accumulator assembly should ONLY be replaced when:

1. A physical perforation to the accumulator is found, resulting in a leak.
2. If the system is open to air for an extended period of time (due to a front-end collision, removed parts, ect.). The desiccant bag will be saturated with moisture.



1—ACCUMULATOR
2—EVAPORATOR BLOWER ASSEMBLY
3—EVAPORATOR CORE
4—BLOWER ASSEMBLY
5—AIR INLET ASSEMBLY
6—OUTSIDE AIR
7—INSIDE AIR
8—HEATER CORE
9—CORE & CASE ASSEMBLY
10—A/C AIR
11—BI-LEVEL UPPER AIR
12—HEATER AIR
13—DEFROST AIR
14—SIDE WINDOW DEFOG AIR

520125-1B

Figure 18 Functional Components

DO NOT REPLACE the accumulator assembly when:

1. Merely a dent is found in the outer shell of the accumulator.
2. A vehicle is involved in a collision and no physical perforation to the accumulator is found.

ON-VEHICLE SERVICE

R-12 CHARGING CAPACITIES

R-4 Model ...... 1075ml (36 fl. oz.), 1.02 kg (2.25 lbs.)

The 420ml (14 fl. oz.) disposable can of R-12 refrigerant is equivalent to .399 kg (.88 lb.).

BLOWER MOTOR

Remove or Disconnect

1. Disconnect negative battery cable.
2. Remove motor cooling tube.
3. Disconnect electrical connections.
4. Remove blower motor attaching screws, remove motor and case assembly.
5. Loosen retaining nut and remove blower cage from motor shaft.
6. Inspect blower cage for broken vanes, etc. Replace if necessary.

Install or Connect

1. Reverse removal procedure to reinstall. Replace seals or sealant as required.

HI-BLOWER RELAY

Relay is a plug-in type with connector mounted on top of the evaporator case.

BLOWER RESISTOR

Remove or Disconnect

1. Disconnect negative battery cable.
2. Disconnect electrical connections.
3. Remove two (2) screws, remove resistor.

Install or Connect

1. Reverse removal procedure to reinstall.

CONTROLLER, BLOWER SWITCH OR VACUUM VALVE

Remove or Disconnect

1. Disconnect negative battery cable.
2. Remove A/C control-radio console trim plate.
3. Remove three (3) A/C control retaining screws.
4. Pull A/C control out and disconnect electrical and vacuum connections and remove temperature cable.
5. Remove A/C control and replace vacuum valve or blower switch as required.

Install or Connect

1. Reverse removal procedure to reinstall. Install lower right screw in controller first to align controller in console.

TEMPERATURE CONTROL CABLE, VACUUM HARNESS

Remove or Disconnect

1. Remove the following hush panel(s):
   a. Vacuum Harness — R.H. and L.H. hush panel.
   b. Temperature Cable — R.H. hush panels.
2. Remove controller/radio console trim plate.
3. Remove three (3) controller screws and pull controller partially out of console.
4. Disconnect controller end(s) of temperature cable and/or vacuum harness.
5. Disconnect component end(s) of temperature cable and/or vacuum harness.

Install or Connect

1. Reverse removal procedure to reinstall. When installing controller, install lower right screw first to align controller location. Replace any retaining straps, etc. removed.
2. Perform functional check of controller.

CONTROL WIRING HARNESS

Remove or Disconnect

1. Disconnect negative battery cable.
2. Remove control/radio console trim plate and hush panels (see Section 8C).
3. Remove three (3) screws holding control in console and pull control out far enough to disconnect electrical and vacuum connector. Remove controller.
4. Remove instrument panel carrier (see Section 8C).
5. Remove heater case covers (core and mode door sides).
6. Remove two (2) interior screws and one (1) exterior nut holding case to cowl. Pull left side of case back to gain access to harness at cowl. *Case will still be retained by one (1) screw behind the evaporator core — do not attempt complete removal of case.*
7. Loosen cowl grommet and disconnect purple vacuum line.

8. Disconnect blower motor and blower resistor electrical connection.
9. Remove hi-blower relay connector from evaporator case.
10. Carefully pull cowl grommet from cowl and pull wiring harness into engine compartment.

Install or Connect

1. Reverse removal procedure to reinstall. When reinstalling controller, install lower right screw first to align controller.

AC/VENTILATION/DEFROSTER DUCTS

See section 8C for removal.

HEATER CORE

Remove or Disconnect

1. Negative battery cable.
2. Drain cooling system.
3. Remove heater inlet and outlet hoses from heater core.
4. Remove right lower hush panel (see Section 8C).
5. Remove right lower I.P. trim panel (see Section 8C).
6. Remove lower right I.P. carrier to cowl screw.
7. Remove ECM attaching screws and move to the side.
8. Remove four (4) heater case cover screws. Upper left screw may be reached with a long 3/8" socket extension through the I.P. openings exposed by removal of the lower right I.P. trim panel. Carefully lift the lower right corner of the I.P. to align socket extension.
9. Remove heater case cover.
10. Remove core support plate and baffle screws.
11. Remove heater core, support plate and baffle from case.

Install or Connect

1. Reverse removal procedure to reinstall. Restore all seals and/or sealant disturbed during removal procedure.
2. Refill cooling system and check for leaks.

LOWER (FLOOR) HEATER OUTLET

Remove or Disconnect

1. Console. (See Section 8C.)
2. L.H. and R.H. hush panels.
3. Two (2) floor outlet retaining screws.
4. Floor outlet from core case.

Install or Connect

1. Floor outlet to core case.
2. Two (2) floor outlet retaining screws.
3. L.H. and R.H. hush panels.
4. Console.

HEATER MODULE (CASE)

Remove or Disconnect

1. Disconnect negative battery cable.
2. Drain cooling system.
3. Remove hush panels and instrument panel carrier (see Section 8C).
4. Remove lower heater outlets.
5. Disconnect control cables and vacuum hoses at module and controller.
6. Remove heater core.
7. Remove two (2) interior screws and one (1) exterior nut holding case to cowl.
8. Remove evaporator core.
9. Remove screw holding case to cowl from engine compartment side.
10. Remove case (module).
11. Transfer usable parts to new case (module).

Install or Connect

1. Reverse removal procedure to reinstall.
2. Refill coolant system.
3. Recharge A/C system.
4. Inspect A/C and cooling system for leaks.

A/C PRESSURE CYCLING SWITCH

Do not discharge A/C system. Pressure cycling switch is mounted on a Schrader-type valve.

Remove or Disconnect

1. Disconnect switch electrical connection.
2. Remove switch.

Install or Connect

1. Reverse removal procedure to reinstall. Tighten switch to 4-5.5 N•m (35-49 in. lb.).

A/C CONTROL VACUUM TANK

Remove or Disconnect

1. Disconnect vacuum hoses.
2. Remove vacuum tank attaching screws, remove tank.

Install or Connect

1. Reverse removal procedure to reinstall.

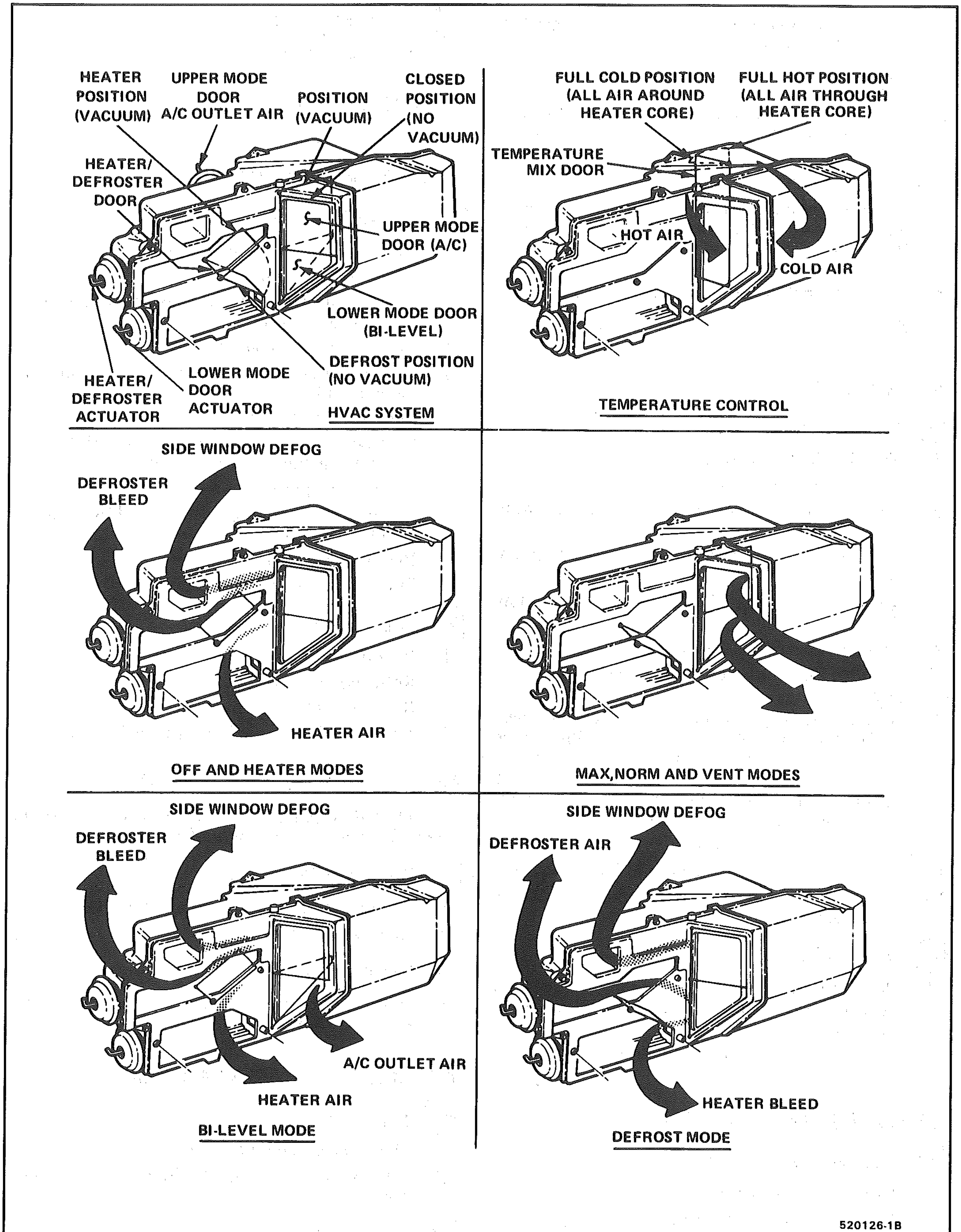
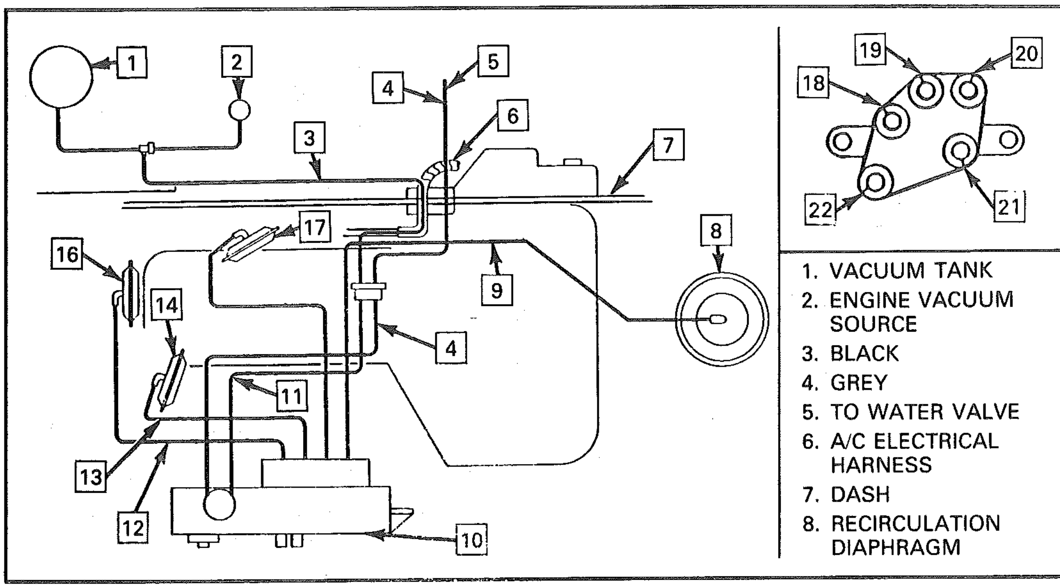


Figure 19 Air Flow Direction In Each Operating Mode



1. VACUUM TANK
2. ENGINE VACUUM SOURCE
3. BLACK
4. GREY
5. TO WATER VALVE
6. A/C ELECTRICAL HARNESS
7. DASH
8. RECIRCULATION DIAPHRAGM
9. ORANGE
10. CONTROL
11. VIOLET
12. BLUE
13. TAN
14. LOWER MODE DIAPHRAGM
15. RED
16. DEFROST DIAPHRAGM
17. UPPER MODE DIAPHRAGM
18. RECIRCULATION (ORANGE)
19. INPUT (VIOLET)
20. DEFROST (BLUE)
21. LOWER MODE (TAN)
22. UPPER MODE (RED)

J10251-1B-F

Figure 20 A/C Vacuum Diagram

A/C LIQUID LINE

Remove or Disconnect

1. Discharge A/C system.
2. Disconnect liquid line couplings at evaporator and condenser connections.
3. Remove clip holding line to right frame rail.
4. Remove liquid line.

Install or Connect

1. Reverse removal procedure to reinstall. Use new O-rings lubricated with 525 viscosity refrigerant oil.
2. Recharge and test system for proper operation.

COUPLED A/C HOSE ASSEMBLY

Remove or Disconnect

1. Discharge A/C system.
2. Disconnect hose assembly at accumulator, condenser, and at rear of compressor head.
3. Disconnect clamps or straps that hold hose assembly in position if so equipped, remove coupled hose assembly.

Install or Connect

1. Reverse removal procedure to reinstall. Use new O-rings lubricated with 525 viscosity refrigerant oil.
2. Recharge and test system for proper operation.

A/C ACCUMULATOR

Remove or Disconnect

1. Discharge A/C system.
2. Disconnect electrical connection at pressure cycling switch and remove switch.
3. Disconnect hose and evaporator fittings.
4. Loosen accumulator clamp-bracket screw.
5. Remove accumulator.

Install or Connect

1. Reverse removal procedure to reinstall. Use new O-rings lubricated with 525 viscosity refrigerant oil.
2. Recharge and test system for proper operation.

EVAPORATOR CORE

Remove or Disconnect

1. Discharge A/C system.
2. Remove accumulator.
3. Remove two (2) screws and remove hi-blower relay terminal.
4. Remove upper case screws.
5. Relocate wiring harness and remove dipstick.
6. Disconnect liquid line fitting.
7. Remove upper case and lift evaporator core out of case (retain foam wedge).

Install or Connect

1. Reverse removal procedure to reinstall.
2. Recharge and test system for proper operation.

EVAPORATOR CASE

Remove or Disconnect

1. Remove accumulator.
2. Remove blower motor.
3. Remove evaporator core.
4. Remove lower case to cowl screws (three driven from engine compartment, three driven from interior).
5. Remove case from cowl.

Install or Connect

1. Reverse removal procedure to reinstall. Reinstall or replace gaskets, seal and sealant removed during disassembly.
2. Recharge and test system for proper operation.

A/C COMPRESSOR (TYPICAL)

Remove or Disconnect

1. Discharge A/C system.
2. Remove fitting block (coupled hose assembly) bolt at rear of compressor.
3. Remove mounting bracket bolt(s).
4. Remove drive belt (route lower loop behind harmonic balancer to gain additional slack if required).
5. Remove compressor. If complete compressor is to be replaced, transfer usable switches, etc. to new compressor.

Install or Connect

1. Reverse removal procedure to reinstall. Use new O-rings lubricated with 525 viscosity refrigerant oil. Refer to Section 6B for drive belt tension.
2. Evacuate and recharge system.

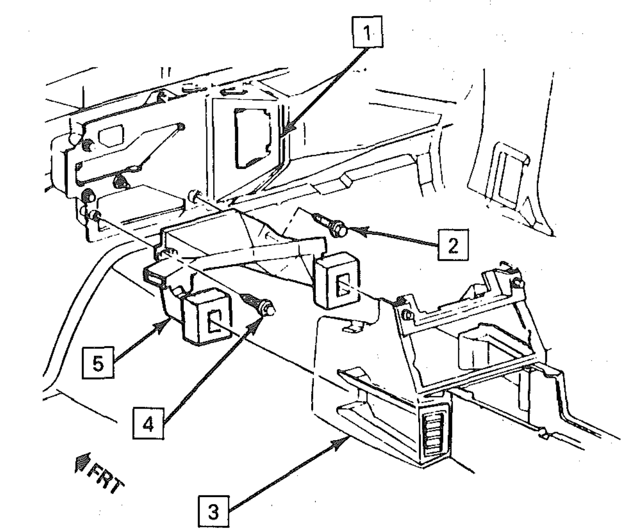
CONDENSER

Remove or Disconnect

1. Discharge A/C system.
2. Disconnect coupled hose and liquid line fittings.
3. Remove screws retaining top radiator shield.
4. Remove top condenser retaining screws.
5. Carefully move (tilt) radiator rearward and lift condenser out of radiator support.
6. Transfer brackets and mounts to new condenser if replacement is necessary.

Install or Connect

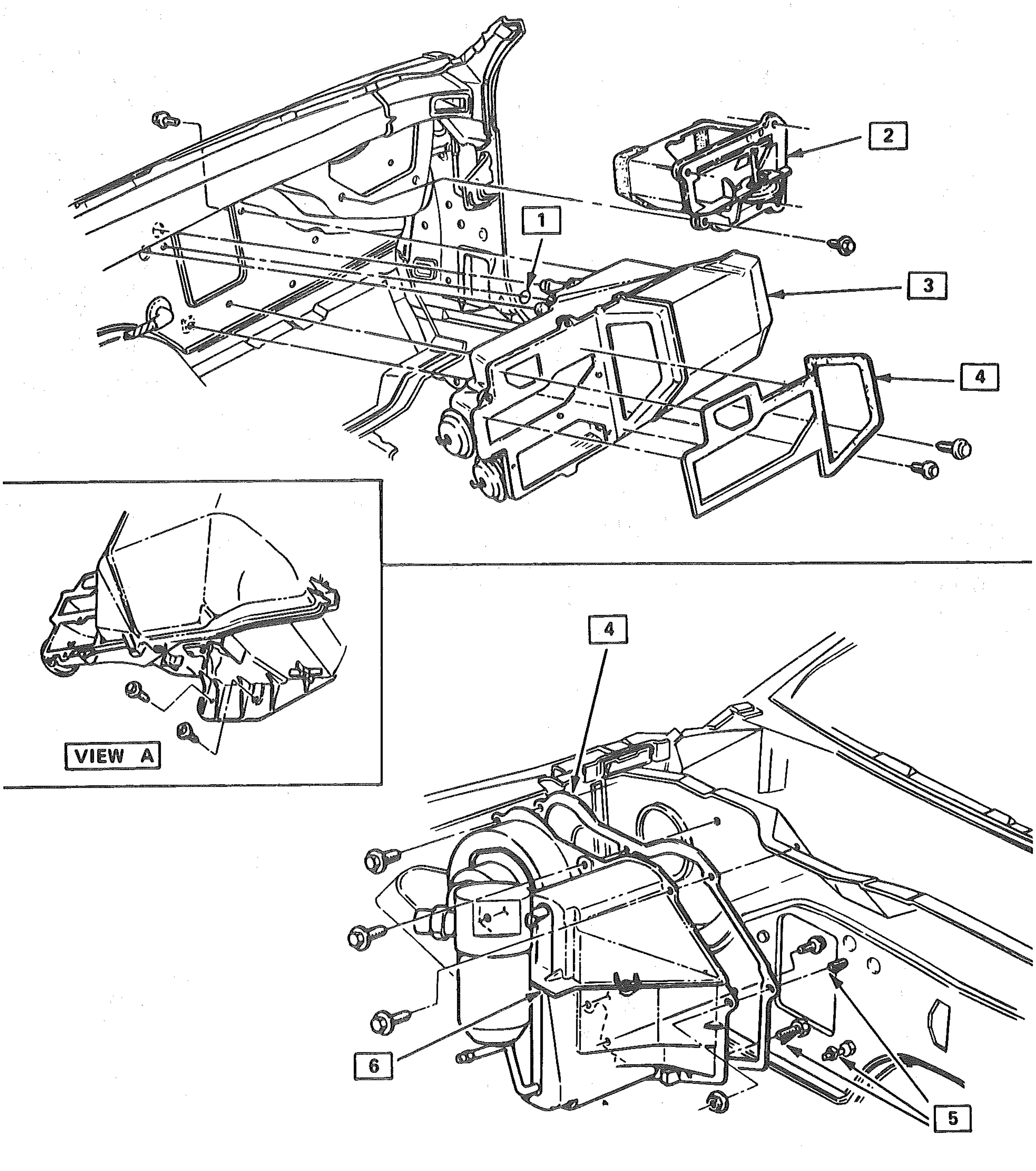
1. Reverse removal procedure to reinstall. Use new O-rings lubricated with 525 viscosity refrigerant oil.
2. Recharge and test system for proper operation.



1. HEATER AND DEFROSTER ASSEMBLY
2. 1.4 N·m (12 LBS. IN.) INSTALL FIRST
3. CONSOLE ASSEMBLY
4. 1.4 N·m (12 LBS. IN.)
5. FLOOR OUTLET ASSEMBLY

J10003-1A-F

Figure 21 Floor Outlet



1–STUD, PART OF CORE CASE ASM.

2–AIR INLET ASM.

3–R.H. SECTION OF CASE REMOVABLE FOR HEATER CORE REPLACEMENT

4–GASKET

5–STUDS PART OF CORE CASE ASSEMBLY

6–UPPER SECTION OF CASE REMOVABLE FOR EVAPORATOR CORE REPLACEMENT

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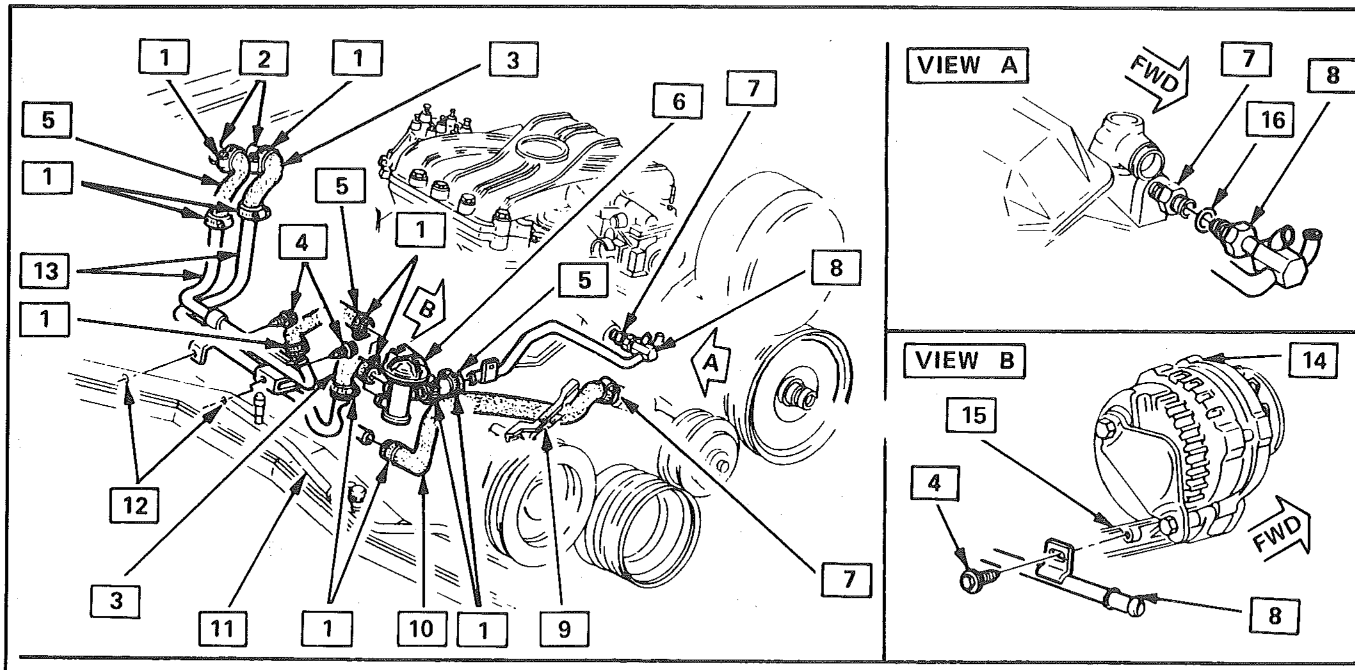
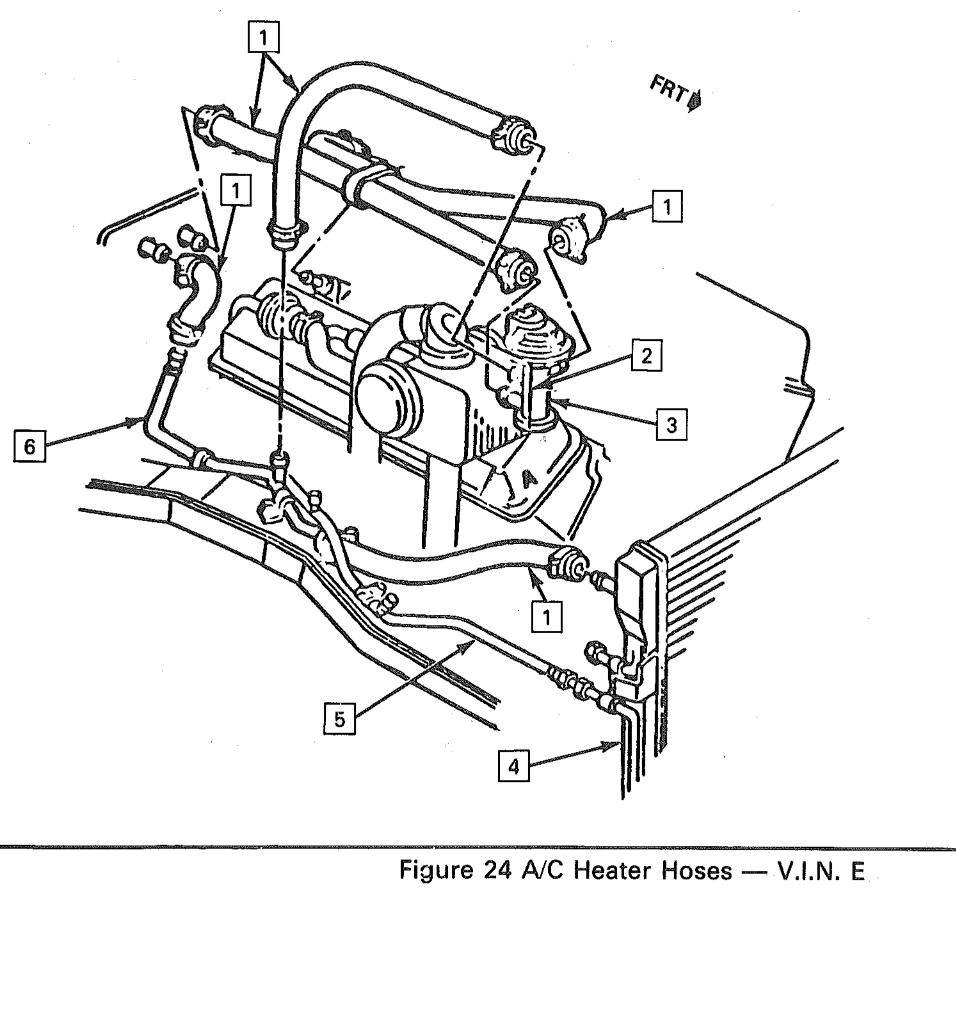
Figure 22 A/C Module and Case Installation



1–CLAMP
2–PIPES (HEATER)
3–HOSE - OUTLET
4–BOLT/SCREW
5–HOSE - INLET
6–VALVE ASM - HTR WAT BYPASS
7–FITTING (ENGINE)
8–PIPE ASM - HTR INLET
9–A.I.R. PUMP BRACKET
10–HOSE - HTR OUTLET
11–A/C EVAP TUBE ASM
12–HOLES (SIDE RAIL)
13–PIPE ASM - INLET & OUTLET
14–GENERATOR
15–GEN BRACKET
16–GASKET

H20044-1B

Figure 23 A/C Heater Hoses — V.I.N. S



1. HOSE
2. A.I.R. VALVE
3. WATER VALVE
4. RADIATOR
5. A/C EVAPORATOR TUBE
6. PIPE

J10253-1B-F

Figure 24 A/C Heater Hoses — V.I.N. E

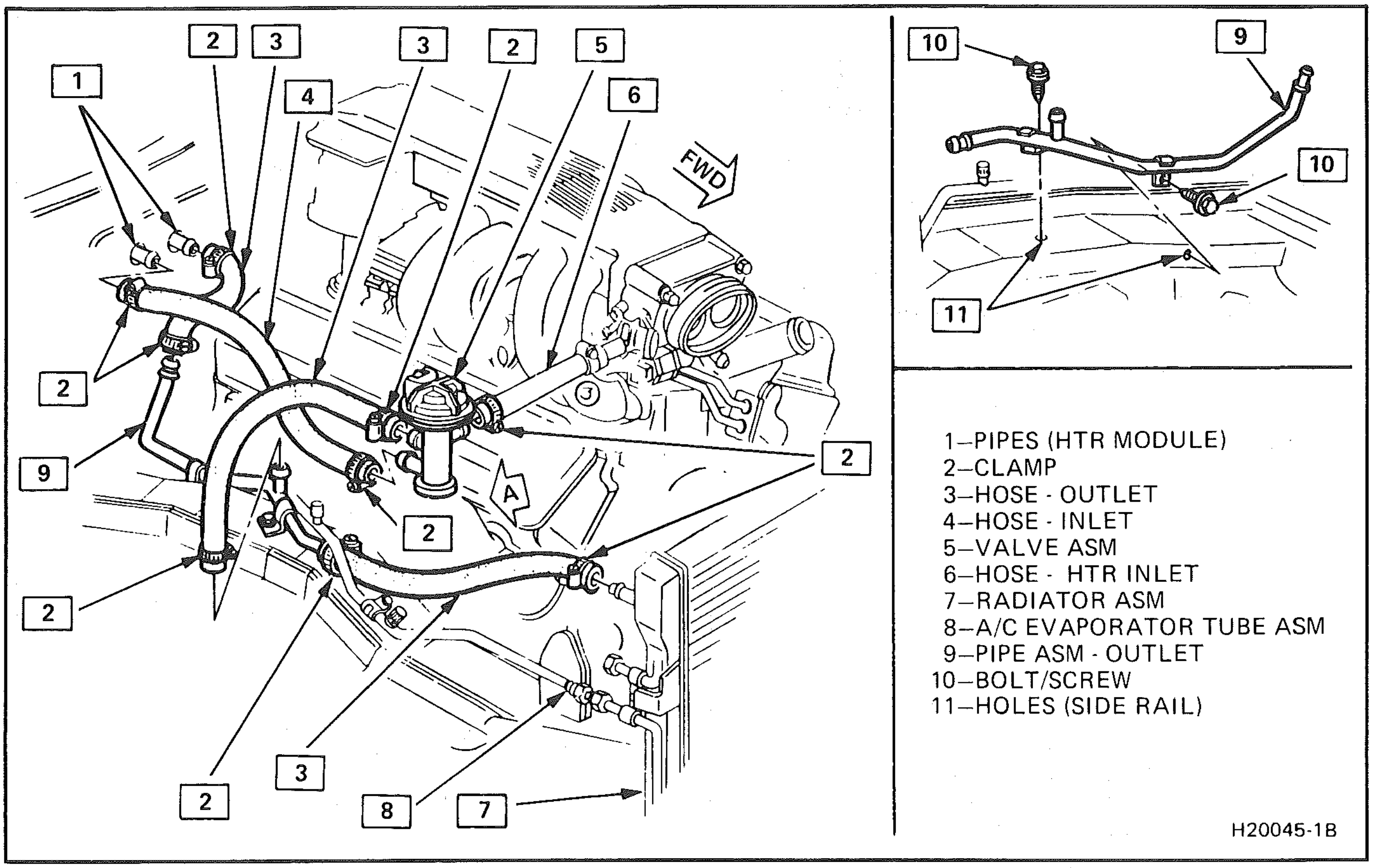


Figure 25 A/C Heater Hoses — V.I.N. F and 8

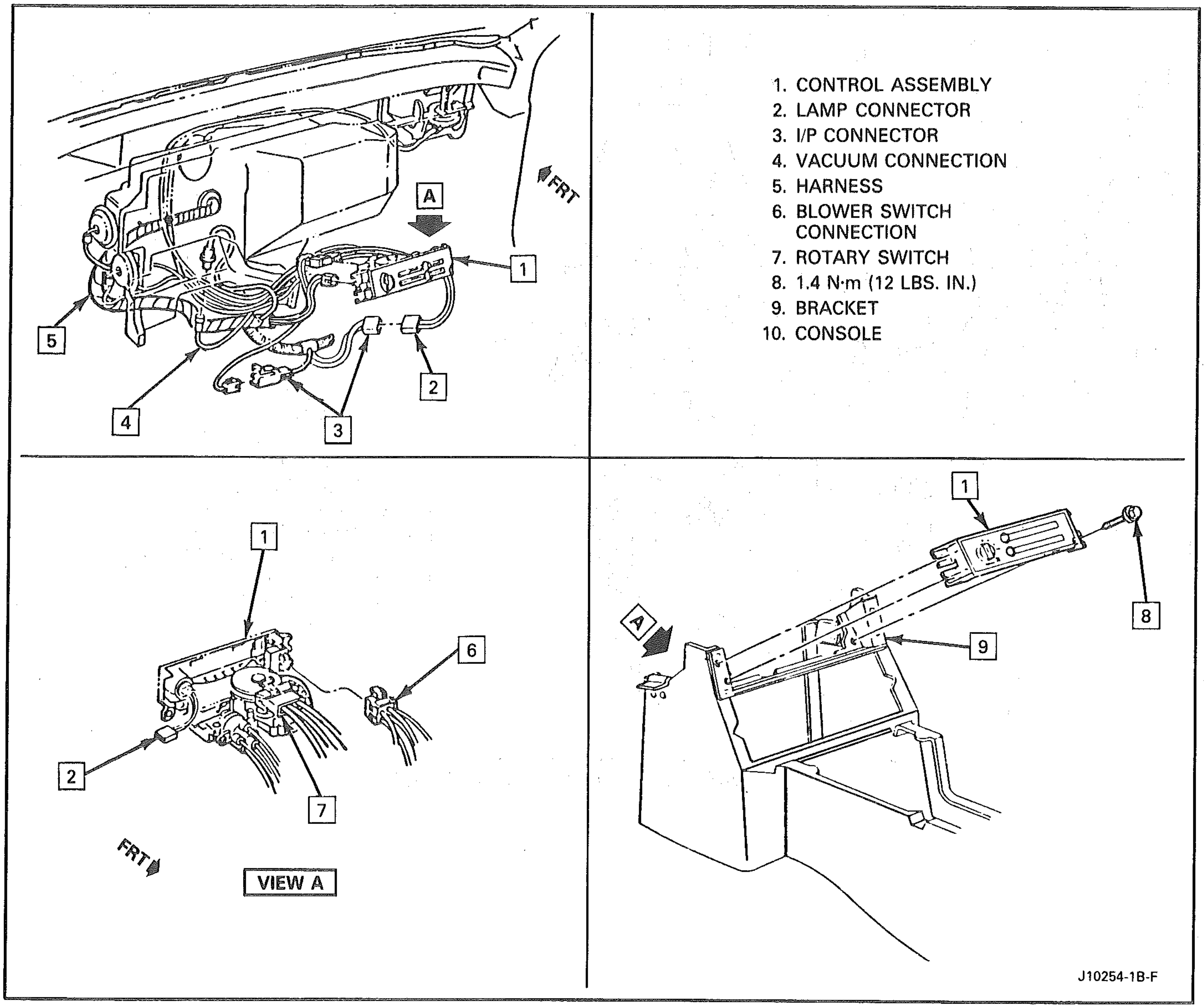
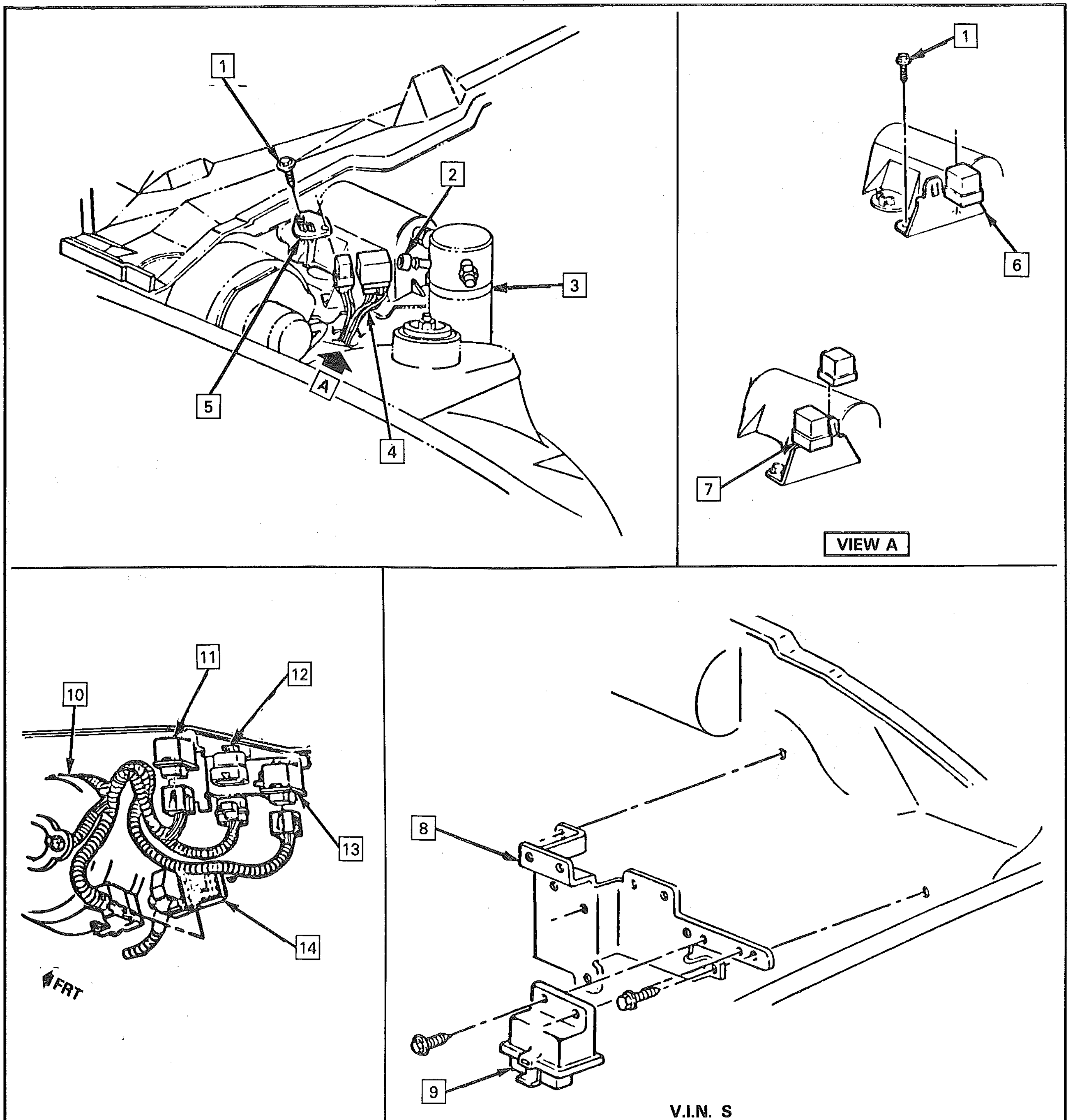


Figure 26 A/C Control Wiring



1. 1.5 N·m (13 LBS. IN.)
2. SWITCH
3. ACCUMULATOR
4. HARNESS
5. BLOWER RESISTOR
6. HI BLOWER RELAY
7. BLOWER RELAY
8. BRACKET
9. A/C COMPRESSOR RELAY
10. BRAKE BOOSTER
11. FUEL PUMP RELAY
12. FAN RELAY
13. A/C CONTROL RELAY
14. BULK HEAD

J10255-1B-F

Figure 27 A/C Module and Cowl Wiring

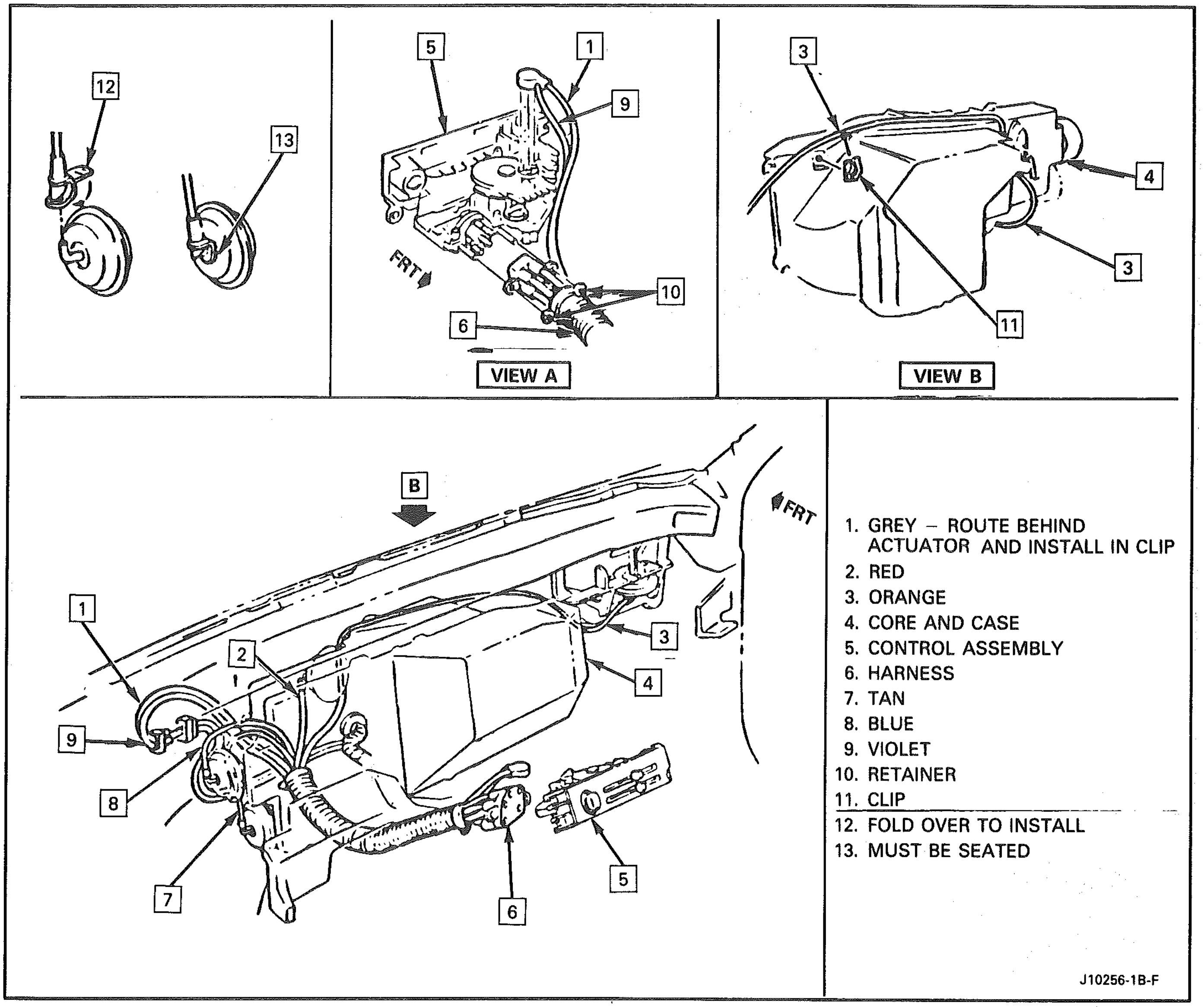
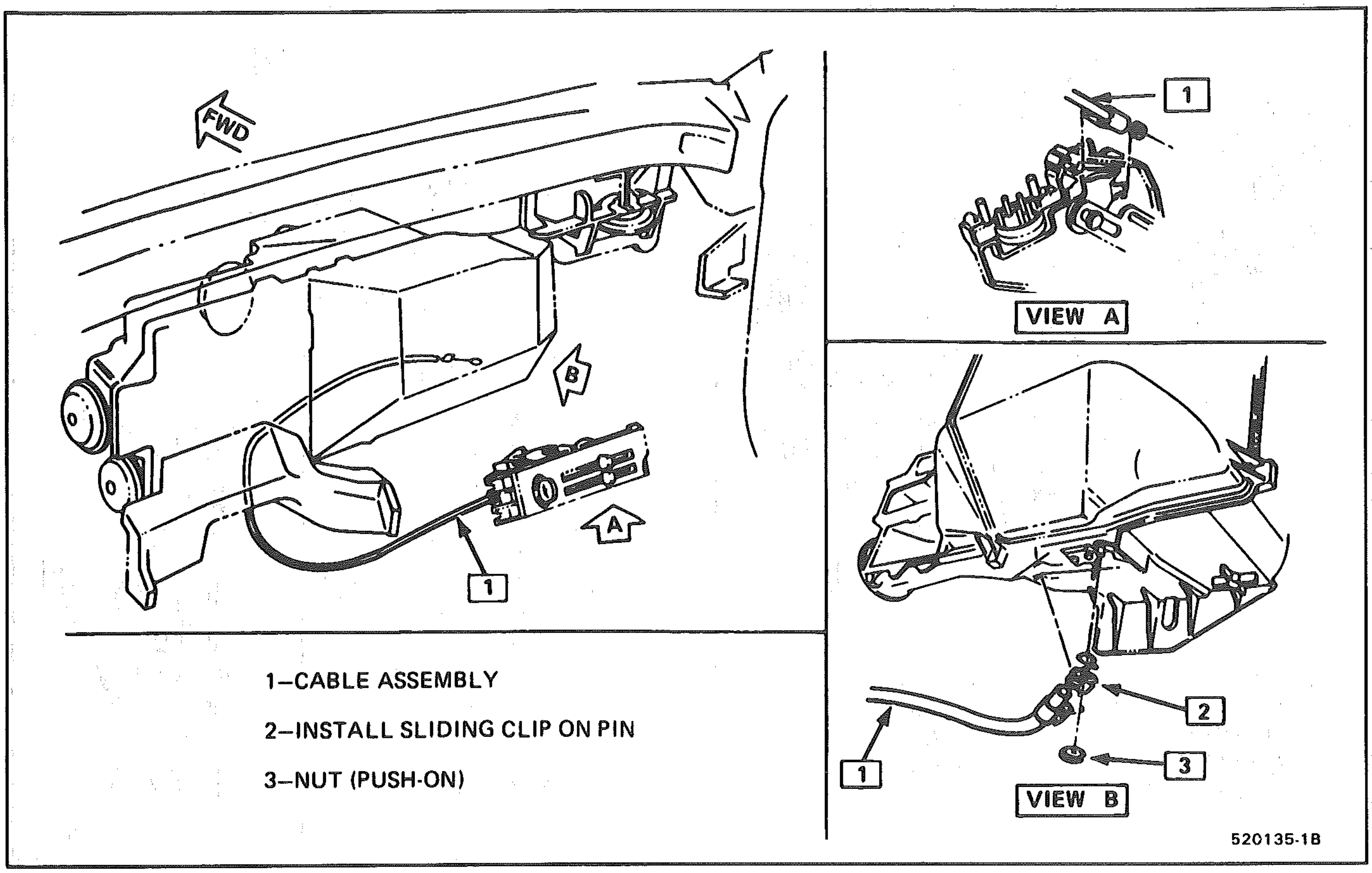
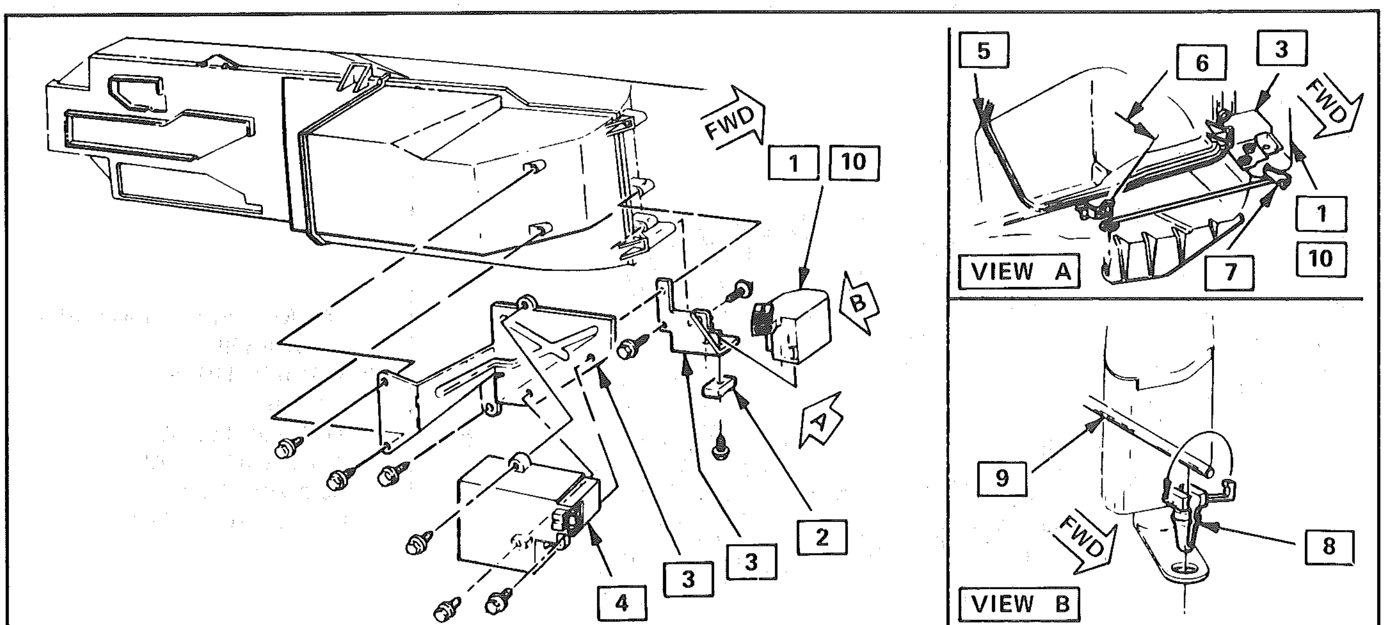


Figure 28 A/C Control Vacuum Harness



1–CABLE ASSEMBLY
2–INSTALL SLIDING CLIP ON PIN
3–NUT (PUSH-ON)

Figure 29 A/C Temperature Control Cable



1–ACTUATOR ASM.
2–BUMPER
3–BRACKET
4–MODULE ASM.
5–HEATER ASM.
6–"MAX. COLD" POSITION ROTATE FULL CLOCKWISE AS VIEWED FROM BELOW
7–TEMP. VALVE LEVER (ACTUATOR ASM.) - IN "MAX. COLD" POSITION
8–CONNECTOR
9–LINK-TEMP. VALVE
10–TEMPERATURE VALVE LINK INSTALLATION:
–ASSEMBLE LINK 9 TO HEATER TEMP. VALVE LEVER.
–MOVE TEMP. VALVE LEVER TO MAXIMUM COLD POSITION UNTILDOOR SEALS.
–SNAP THREADED END OF LINK 9 INTO PLASTIC CONNECTOR 8 ON MOTOR LEVER. H20049-1B

Figure 30 Actuator & Module Assembly — Temperature Valve

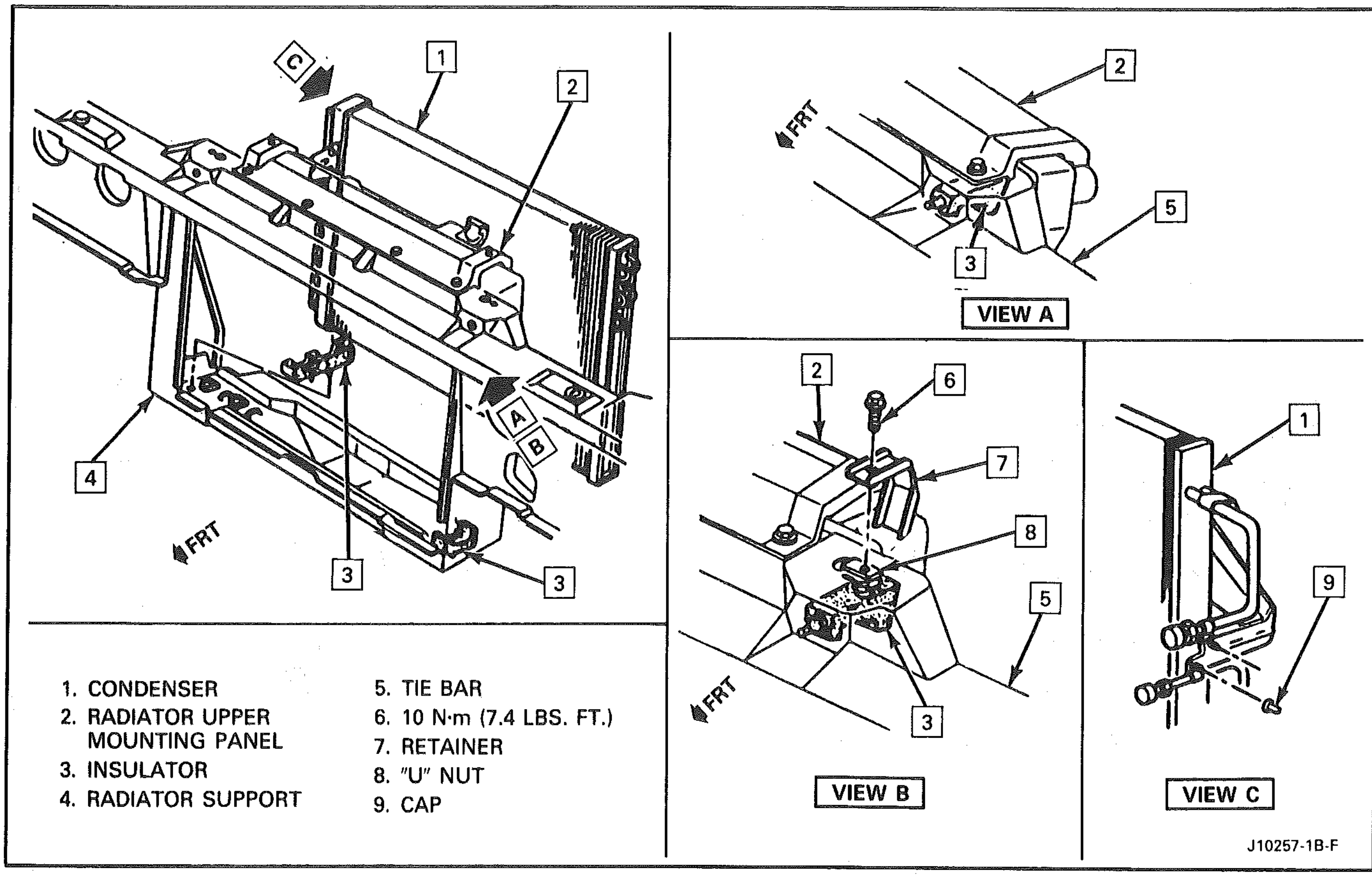


Figure 31 A/C Condenser Installation

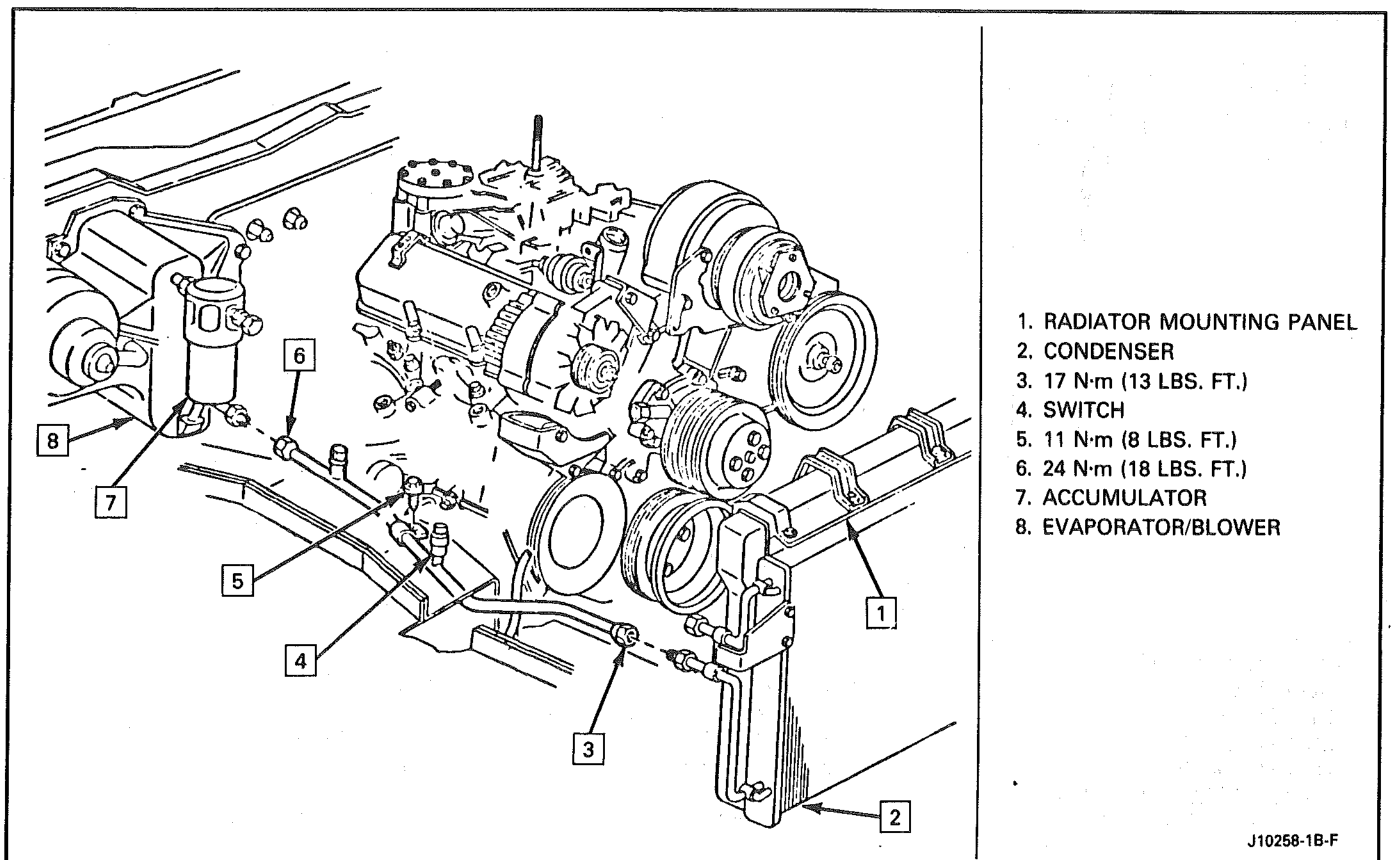


Figure 32 Condenser to Accumulator Hose and Pipe Assembly (ALL)

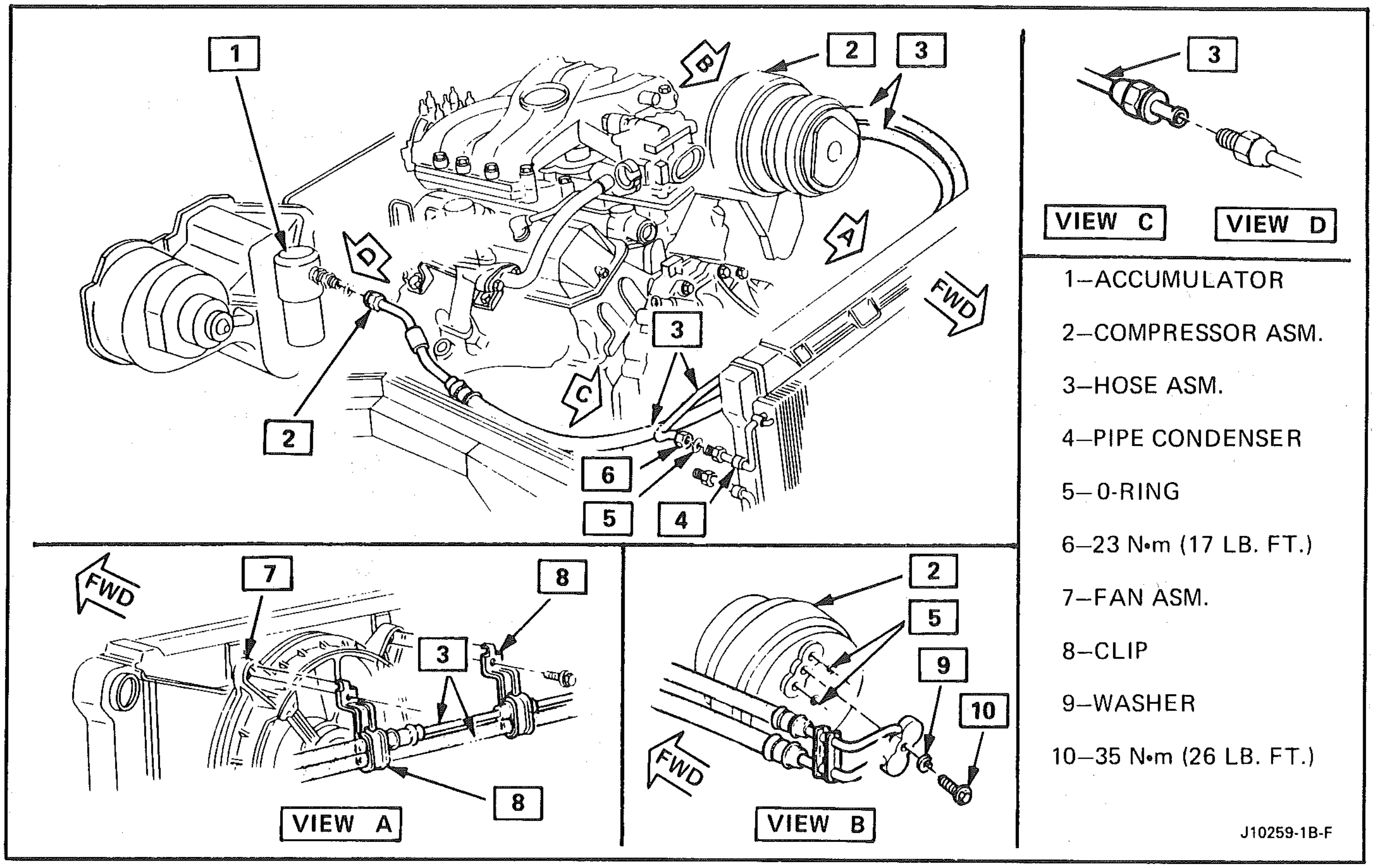


Figure 33 A/C Compressor & Condenser Hoses — V.I.N. S

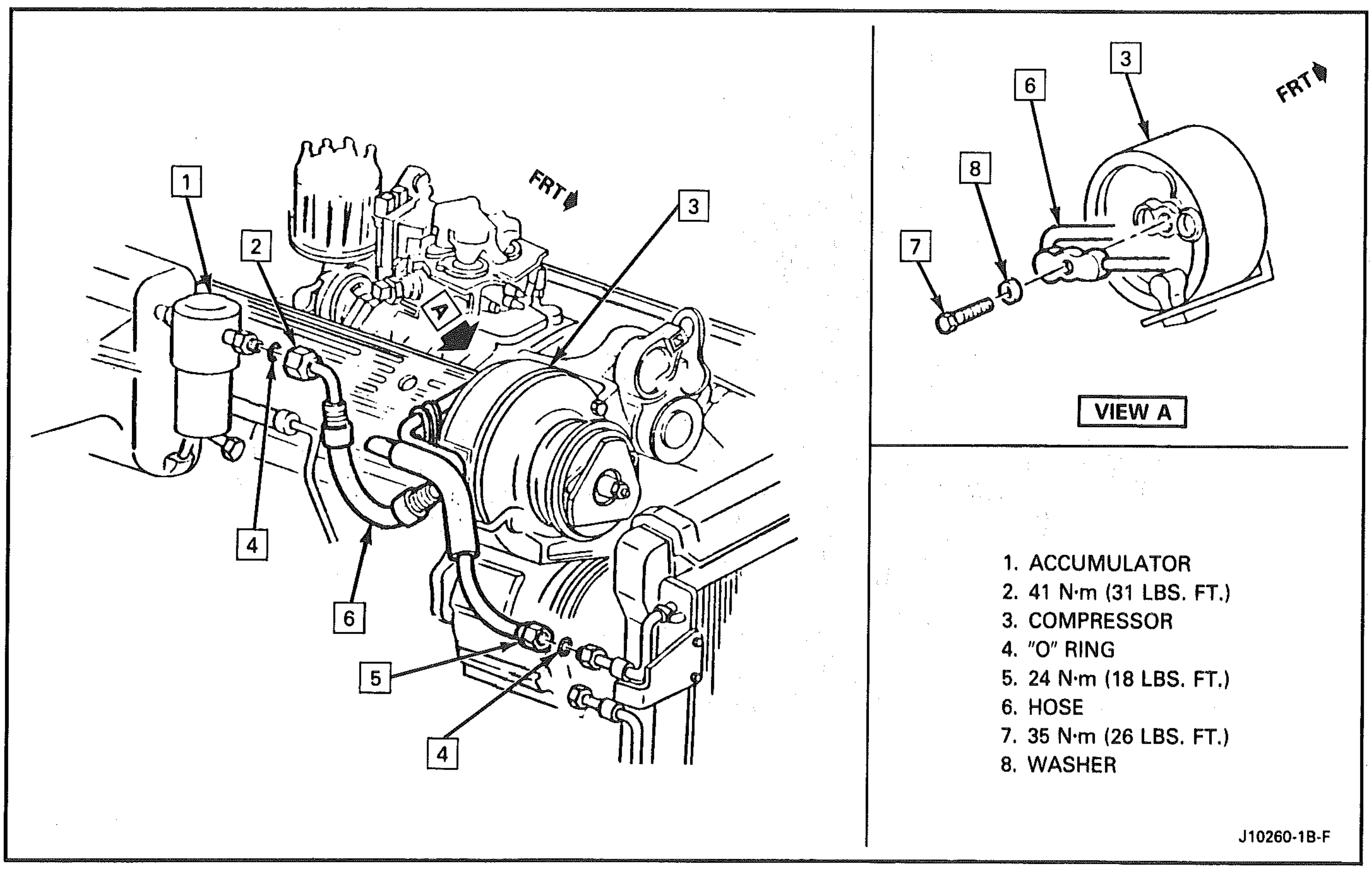
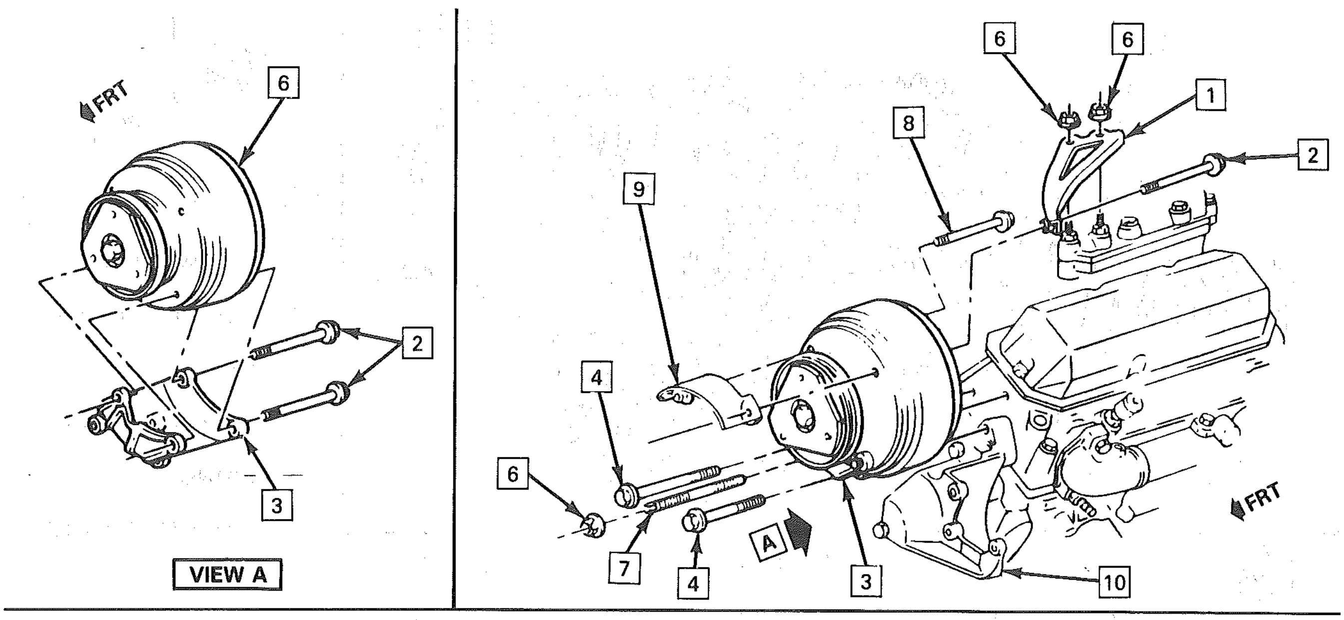


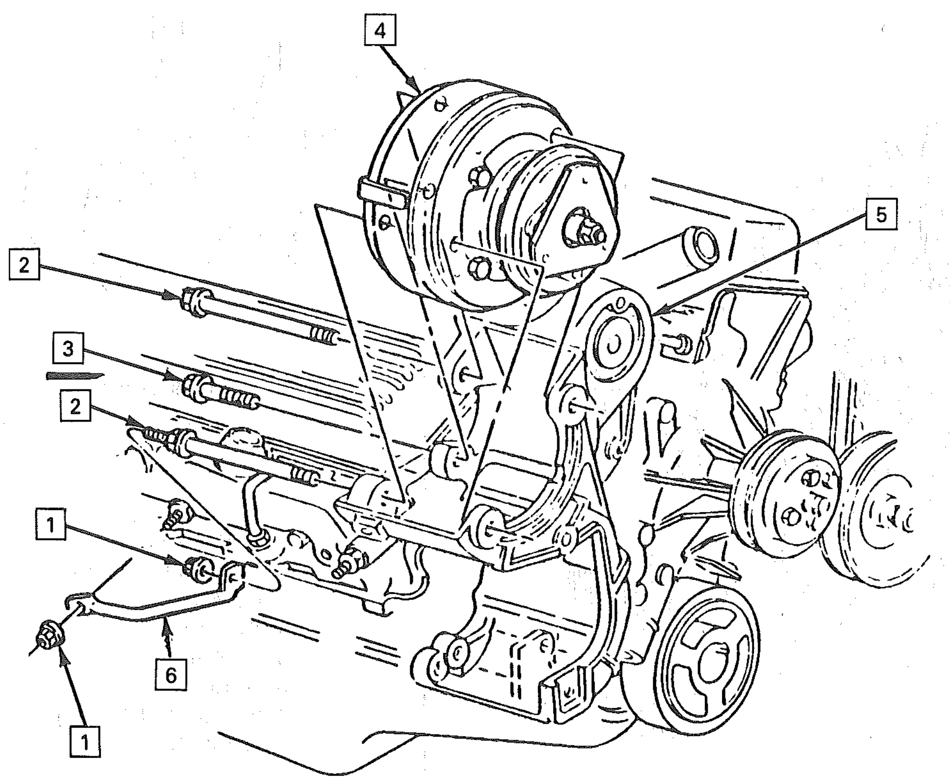
Figure 34 A/C Compressor & Condenser Hoses — V.I.N. E, F and 8



1. BRACE
2. BOLT/SCREW 40-50 N·m (29-37 FT. LBS.)
3. BRACKET
4. BOLT/SCREW 40-60 N·m (29-44 FT. LBS.)
5. COMPRESSOR ASM
6. NUT 20-30 N·m (15-22 FT. LBS.)
7. STUD
8. BOLT SCREW
9. SHIELD ASM FUEL FEED
10. P/S BRACKET

J10261-1B-F

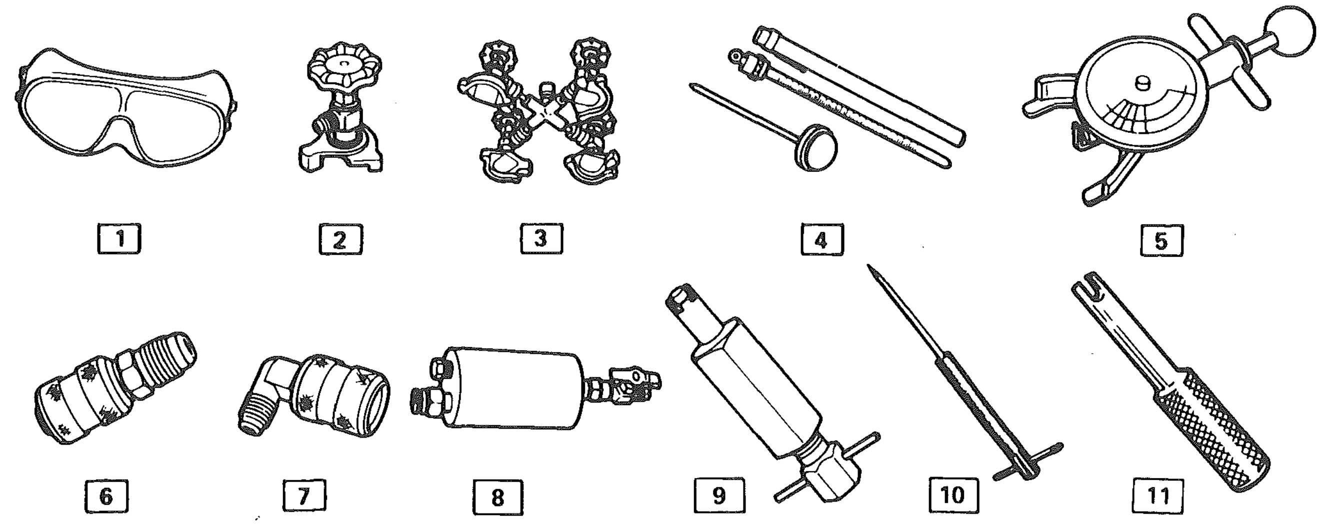
Figure 35 A/C Compressor Mounting — V.I.N. S



1. 33 N·m (24 LBS. FT.)
2. 50 N·m (37 LBS. FT.)
3. 83 N·m (61 LBS. FT.)
4. COMPRESSOR
5. BRACKET
6. BRACE

J10262-1B-F

Figure 36 A/C Compressor Mounting — V.I.N. E, F and 8



1—J-5453 GOGGLES

2—J-6271-01 REFRIGERANT CAN ADAPTER

3—J-6272-02 REFRIGERANT MULTI-CAN ADAPTER

4—J-5421-02 POCKET THERMOMETER
(25° TO 220°F, WHITE BACKGROUND) GLASS

J-22555 POCKET THERMOMETER
(-50° TO +120°F YELLOW BACKGROUND) GLASS

J-23640 THERMOMETER
DIAL TYPE (0° TO 220°F)

J-6742-03 THERMOMETER
DIAL TYPE (25° TO 125°F)

5—J-23600-B BELT TENSION GAUGE

6—J-5420 7/16" - 20 STRAIGHT ADAPTER
J-25498 3/8" - 24 STRAIGHT ADAPTER

7—J-9459 7/16" - 20 90° ELBOW ADAPTER
J-25499 3/8" - 24 90° ELBOW ADAPTER

8—J-7605-03 COMPRESSOR OIL INJECTOR

9—J-26549-C ORIFICE TUBE REMOVER

10—J-26549-10 ORIFICE TUBE EXTRACTOR
(USE COLLAR NUT FROM J-26549-C)

11—J-34611 A/C VALVE CORE TOOL

520277-1B

Figure 37 A/C Special Tools

SECTION 1D1

R-4 AIR CONDITIONING COMPRESSOR OVERHAUL

For Compressor REMOVAL AND INSTALLATION, see Air Conditioning Section 1B. For DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS, see Air Conditioning Section 1B.

CONTENTS

GENERAL DESCRIPTION

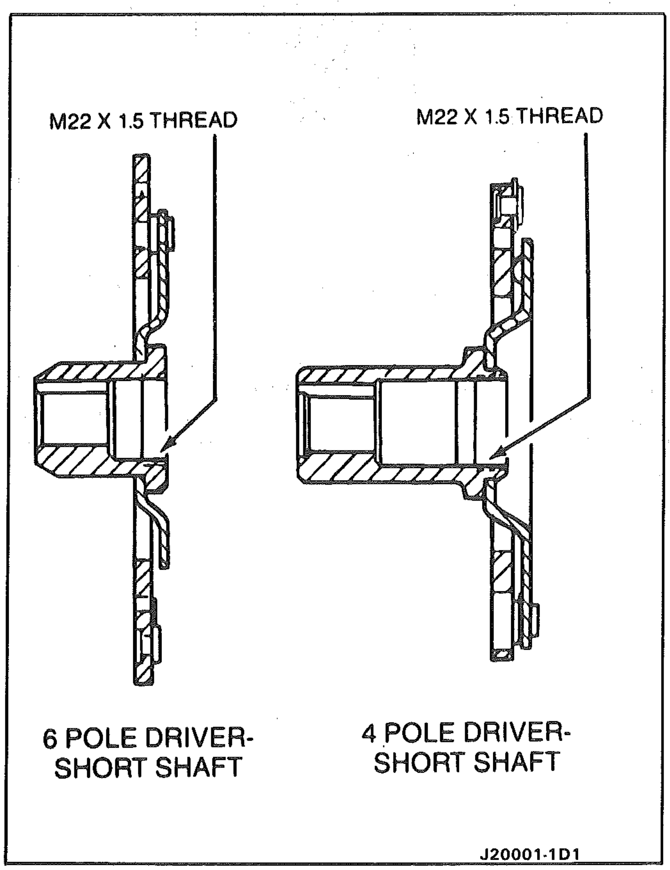


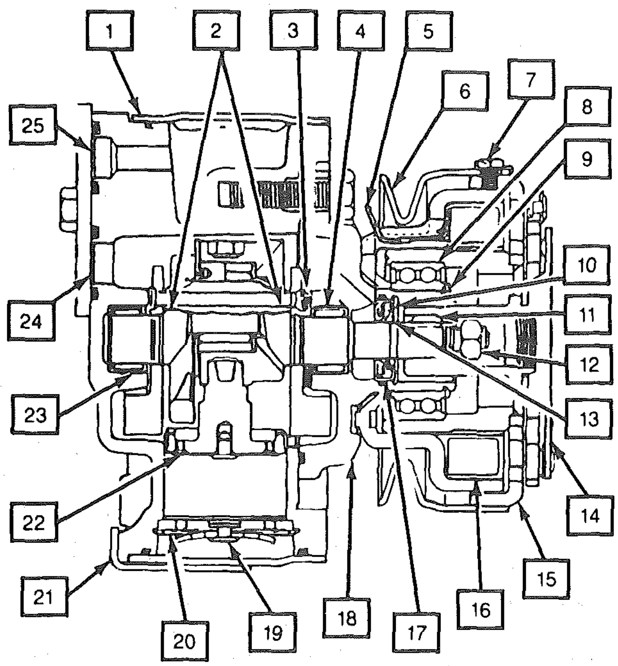
Fig. 1 R-4 Compressor Clutch Drives - Short Shaft Design

Two clutch drivers are used on the R-4 air conditioning compressor that incorporate a short shaft design. They are a four-pole driver and a six-pole driver, both of which have M22 X 1.5 threads (past models had 7/8-14 UNF threads). Figure 2 shows a cross section of the short shaft shaft design. The type of clutch driver should be identified prior to starting overhaul procedures.

When servicing the compressor, it is essential that steps be taken to prevent dirt or foreign material from getting on or into the compressor parts and system during disassembly or reassembly. Clean tools and clean work area are very important for proper service. The compressor connection areas and the exterior of the compressor should be cleaned off as much as possible prior to any "on car" repairs or removal of the compressor for workbench service. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with trichloroethane, naphtha, stoddard solvent, kerosene or equivalent solvent and blown dry with dry air. When necessary to use a cloth on any part, it should be of a nonlint producing type.

Although certain service operations can be performed without completely removing the compressor from the vehicle, the operations described are based on bench over-haul with the compressor removed from the vehicle. They have been prepared in order of accessibility of the components. If compressor is removed from brackets but not disconnected from lines and hoses, the system is not discharged. Pad fender skirt and secure compressor near top of fender skirt with wire, rope, etc. when performing on-car service.

When the R-4 compressor is removed from the vehicle for servicing, the amount of oil remaining in the compressor should be drained, measured and recorded. This oil



4 POLE CLUTCH-
SHORT SHAFT

1. COMPRESSOR SHELL
2. ROLL PINS
3. THRUST AND BELLEVILLE WASHER
4. MAIN BEARING-FRONT
5. CLUTCH COIL TERMINALS
6. PULLEY RIM
7. PULLEY RIM MOUNTING SCREW AND LOCKWASHER
8. ROTOR BEARING
9. ROTOR BEARING RETAINER
10. SEAL SEAT RETAINER
11. SHAFT KEY
12. SHAFT NUT
13. SHAFT SEAL
14. CLUTCH DRIVE ASSEMBLY
15. ROTOR AND HUB ASSEMBLY
16. CLUTCH COIL AND HOUSING ASSEMBLY
17. SEAL SEAT O-RING
18. FRONT HEAD
19. VALVE PLATE ASEMBLY
20. VALVE PLATE RETAINING RING
21. SHELL RETAINER
22. PISTON ASSEMBLY
23. MAIN BEARING - REAR
24. SUCTION PORT
25. DISCHARGE PORT

J20002-1D1

Fig. 2 R-4 Compressor Cross Section Shaft Design

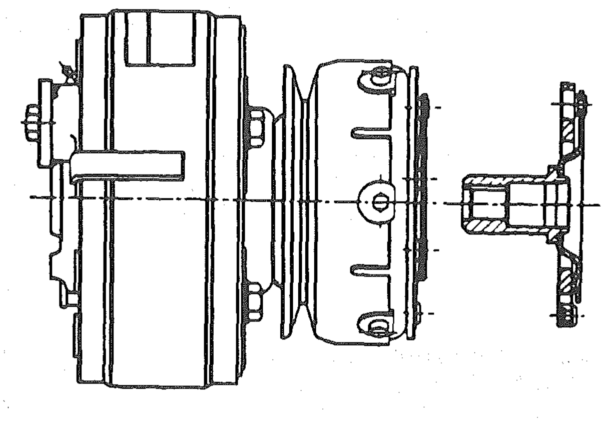


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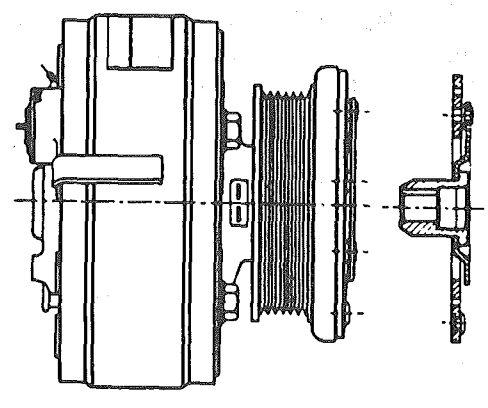
Fig. 3 R-4 Compressor With Four-Pole Clutch



H20004-1D1

Fig. 4 R-4 Compressor With Six-Pole Clutch

should then be discarded and the same amount of new 525 viscosity refrigerant oil added to the compressor (See Refrigerant Oil Distribution" in the Air Conditioning Section 1B).

1–RETAINER RING
2–SHAFT SEAL
4–O-RING, SEAL SEAT
5–SHAFT SEAL KIT
6–SCREW AND WASHER ASSEMBLY FRONT HEAD MOUNTING
7–FRONT HEAD
8–MAIN BEARING
9–RING SEAL, FRONT HEAD TO CYLINDER
10–SHELL
11–O-RING, CYLINDER TO SHELL
12–THRUST WASHER
13–BELLEVILLE WASHER
14–THRUST WASHER KIT
15–CYLINDER AND SHAFT ASSEMBLY
16–RETAINER RING
17–VALVE PLATE
18–SHIPPING PLATE
19–SCREW
20–O-RING SUCTION-DISCHARGE PORTS
21–PRESSURE RELIEF VALVE
22–O-RING, PRESSURE RELIEF VALVE
23–SHAFT NUT
24–CLUTCH HUB KEY
25–CLUTCH DRIVE ASSEMBLY
26–RETAINER RING
27–ROTOR
28–ROTOR BEARING
29–ROTOR AND BEARING ASSEMBLY
30–COIL AND HOUSING ASSEMBLY
31–PULLEY RIM MOUNTING SCREW
32–PULLEY RIM

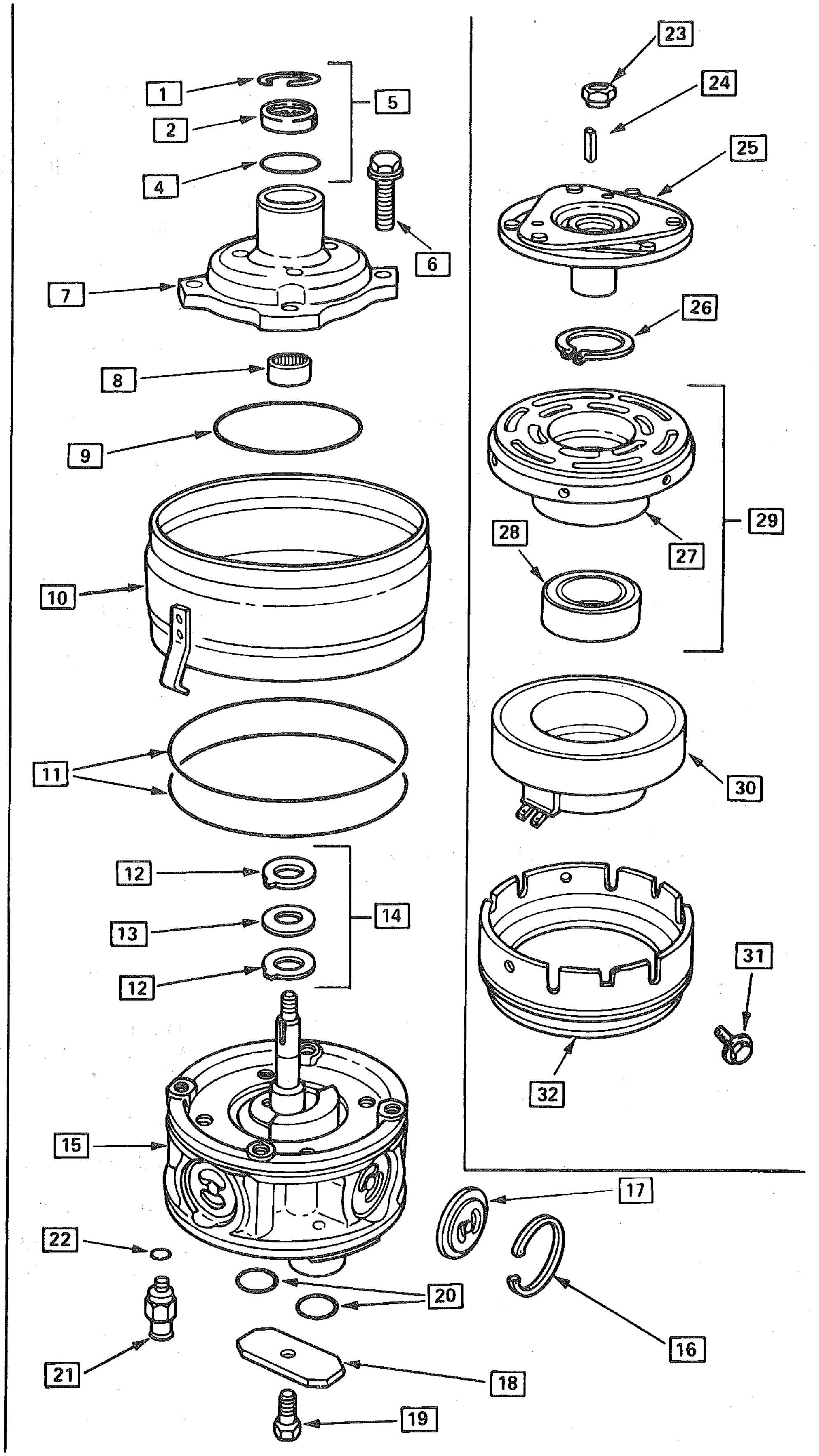


Fig. 5 R-4 Compressor Disassembled View

SERVICE PROCEDURES

MINOR REPAIR PROCEDURES

THE FOLLOWING OPERATIONS TO THE R-4 COMPRESSOR CLUTCH PLATE AND HUB, ROTOR AND BEARING, AND COIL & PULLEY RIM ARE COVERED AS "MINOR" BECAUSE THEY MAY BE PERFORMED WITHOUT FIRST DISCHARGING THE SYSTEM OR REMOVING THE COMPRESSOR FROM THE VEHICLE.

The two types of drive systems used on the R-4 Compressor (V-groove type and poly-groove type) affect only minor repair procedures and are so noted where required. Major repair procedures are not affected by the type of drive system.

The Compressor Shaft Seal assembly, and Pressure Relief Valve may also be serviced WITHOUT REMOVING THE COMPRESSOR from the vehicle but these operations are covered later in this section as MAJOR REPAIR PROCEDURES because the system must be discharged, evacuated and recharged to complete service.

Illustrations used in describing these operations show the compressor removed from the vehicle only to more clearly illustrate the various operations.

When servicing the compressor, remove only the necessary components that preliminary diagnosis indicates are in need of service. Refer to the AIR CONDITIONING section and Fig. 4 and Fig. 5 for information relative to parts nomenclature and location.

Removal and installation of external compressor components and disassembly and assembly of internal components must be performed on a clean workbench. The work area, tools and parts must be kept clean at all times.

CLUTCH PLATE AND HUB ASSEMBLY

Fig. 6 thru 10

CLUTCH PLATE AND HUB ASSEMBLY INSTALLATION AND REMOVAL PROCEDURES FOR THE SIX-POLE CLUTCH ARE THE SAME AS THE FOUR-POLE CLUTCH WITH THE EXCEPTION OF THE CLUTCH HUB HOLDING TOOL. FOR FOUR-POLE CLUTCH USE J-25030. FOR SIX-POLE CLUTCH USE J-33027.

Remove or Disconnect

1. If compressor is on the car, loosen compressor mounting brackets, disconnect the compressor drive belt and reposition the compressor for access, if necessary. If compressor has been removed from the car, attach the compressor to Holding Fixture J-25008-A and clamp the Holding Fixture in a vise.
   - Compressor mounting holes are metric. Use proper metric bolts with holding fixture J-25008-A.

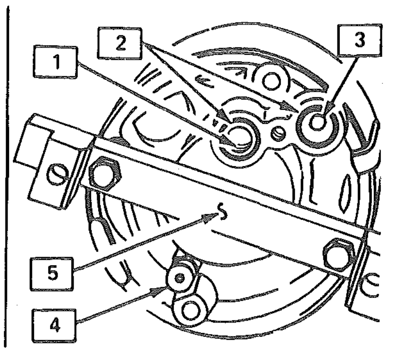


Fig. 6 Compressor In Holding Fixture

2. Keep the clutch hub from turning with the Clutch Hub Holding Tool J-25030/J-33027 remove, and discard the shaft nut, using Thin Wall Socket J-9399.

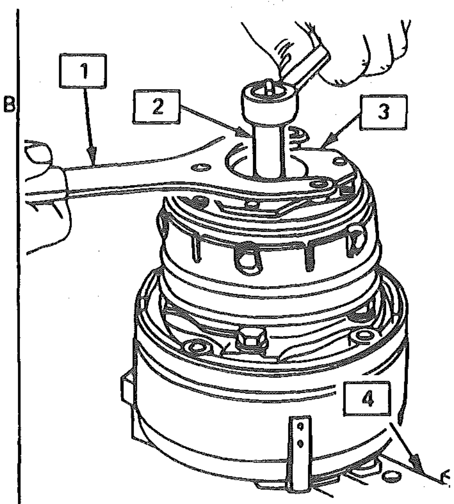


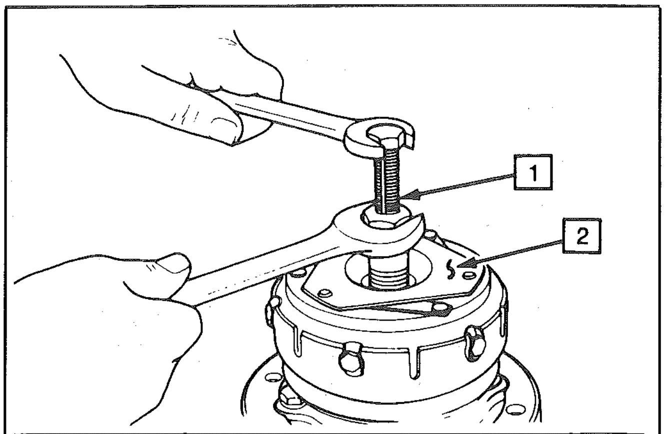
Fig. 7 Removing Shaft Nut

3. Thread the Clutch Plate and Hub Assembly Remover J-33013-B into the hub. Hold the body of the Remover with a wrench and turn the center screw into the Remover body to remove the Clutch Plate and Hub assembly.
4. Shaft key

Install or Connect

1. Shaft key in hub key groove. Allow the key to project approximately 4.8mm (3/16") out of keyway.

   The shaft key is curved slightly to provide an interference fit in the shaft key groove of the hub.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the Clutch Plate and Hub assembly.
3. Align the shaft key with the shaft keyway and place the Clutch Plate and Hub assembly onto the compressor shaft.



1 J-33013-B HUB AND CLUTCH DRIVE PLATE ASSEMBLY REMOVER

2 CLUTCH PLATE AND HUB ASSEMBLY

H60070-1D1-D

Fig. 8 Clutch Plate And Hub Assembly Removal

1–DRIVE PLATE INSTALLER J-9480-B

2–DRIVE PLATE INSTALLER BEARING

3–AIR GAP (.020"-.040")

4–CLUTCH PLATE AND HUB ASM.

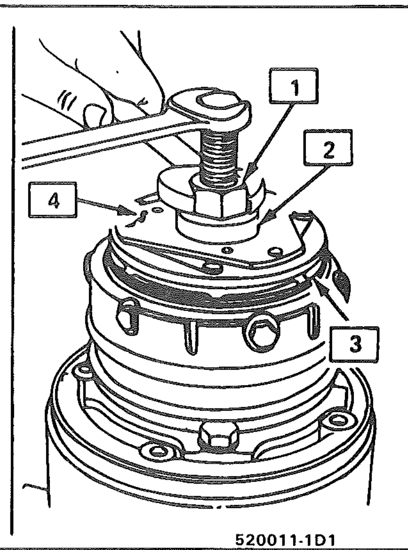


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Fig. 10 Installing Clutch Plate & Hub Asm.

1–CLUTCH PLATE AND HUB ASSEMBLY

2–CLUTCH ROTOR

3–SHAFT KEY

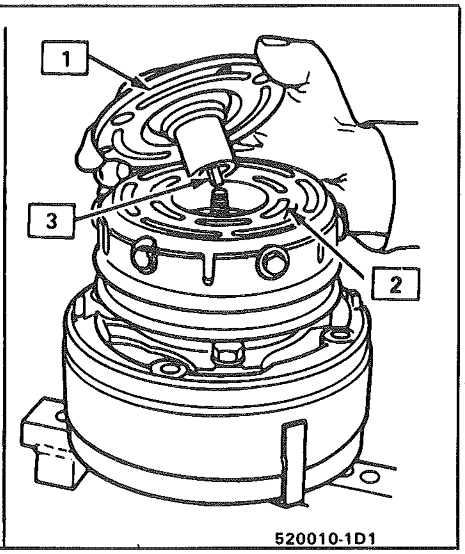

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Fig. 9 Installing Shaft Key

NOTICE: To avoid internal damage to the compressor, do not drive or pound on the clutch hub or shaft.

4. Install the Clutch Plate and Hub Installer J-9480-B.
5. Hold the hex portion of the Installer Body J-9480-B with a wrench and tighten the center screw to press the hub onto the shaft until there is a .5mm - 1.0mm (.020"-.040") inch air gap between the frictional surfaces of the clutch plate and clutch rotor.
6. Install a new shaft nut with the small diameter boss of the nut against the crankshaft shoulder, using Thin Wall Socket J-9399. Hold the Clutch Plate and Hub assembly with Clutch Hub Holding Tool J-25030/J-33027 and tighten to 14 N·m (10 lb. ft.) torque, using a 0-60 N·m (0-25 lb.ft.) torque wrench.
7. If operation is performed with compressor on car, connect drive belt, tighten mounting brackets and adjust belt tension.

CLUTCH ROTOR AND BEARING:FOUR POLE CLUTCH

Fig. 11 thru 20

←→ Remove or Disconnect

1. Clutch Plate and Hub assembly
2. Rotor and Bearing assembly retaining ring, using Snap Ring Pliers J-6083. Mark the location of the clutch coil terminals.

1–J 6083 PLIERS

2–CLUTCH ROTOR

3–RETAINER RING

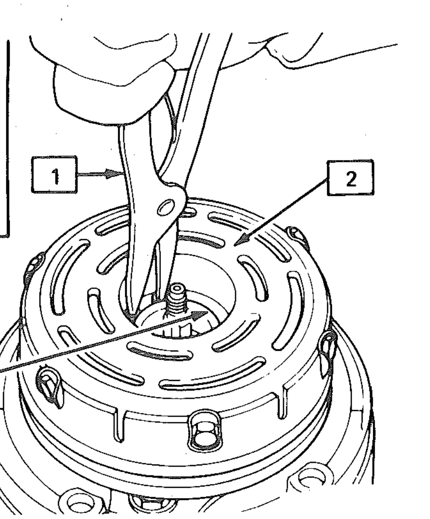

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Fig. 11 Removing Rotor & Bearing Asm. Retainer Ring

If only the Clutch Rotor and/or Rotor Bearing are to be replaced, bend the lockwashers away from the pulley rim mounting screws, andremove the six mounting screws and special lock washers before proceeding with Step 3. Discard the lock washers.

3. Install Rotor and Bearing Puller J-25031 down into the rotor until the Puller arms engage the recessed edge of the rotor hub. Hold the Puller and arms in place and tighten the Puller screw against the Puller Guide to remove the Clutch

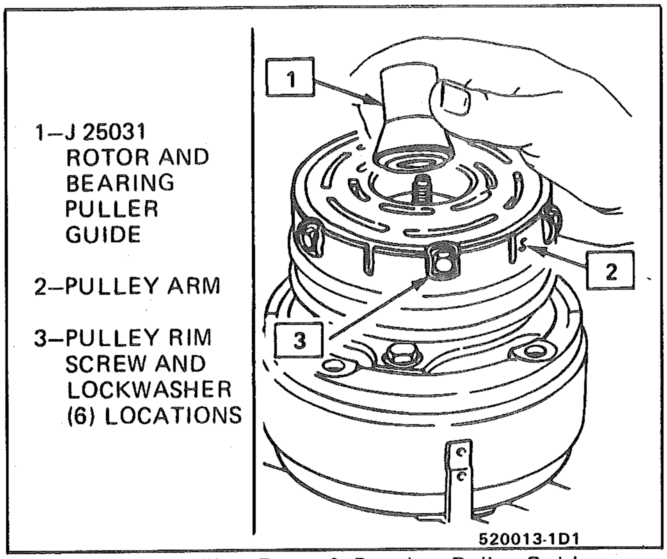


Fig. 12 Installing Rotor & Bearing Puller Guide

Rotor and Bearing assembly, being careful not to drop the Puller Guide.

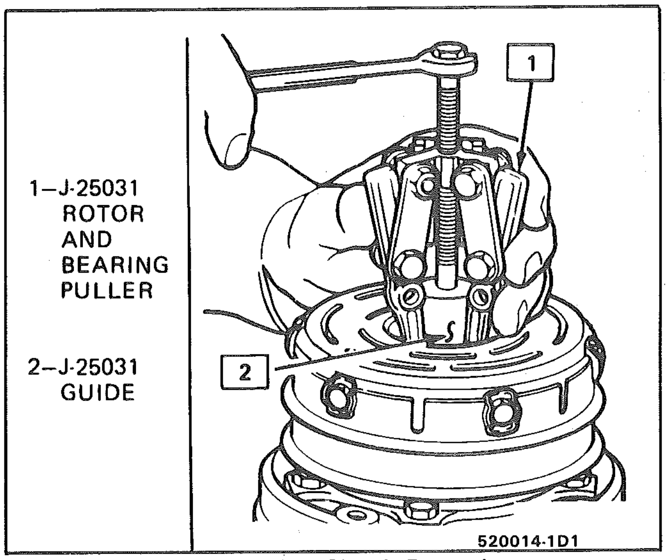


Fig. 13 Removing Clutch Rotor Asm.

4. If the pulley rim mounting screws and washers were removed in Step 2, only the Clutch Rotor and Bearing assembly will be removed for replacement. The Clutch Coil and Housing assembly is pressed onto the Front Head of the compressor and will not be removed unless the pulley rim mounting screws are left securely in place and the pulley rim pulls the Coil and Housing assembly off with the total Clutch Rotor and Pulley Rim Assembly.

5. Place the Rotor and Bearing assembly on blocks. Drive the bearing out of the rotor hub with Rotor Bearing Remover J-9398-A.

It is not necessary to remove the staking at the rear of the rotor hub to remove the bearing. However, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore, or the bearing may be damaged.

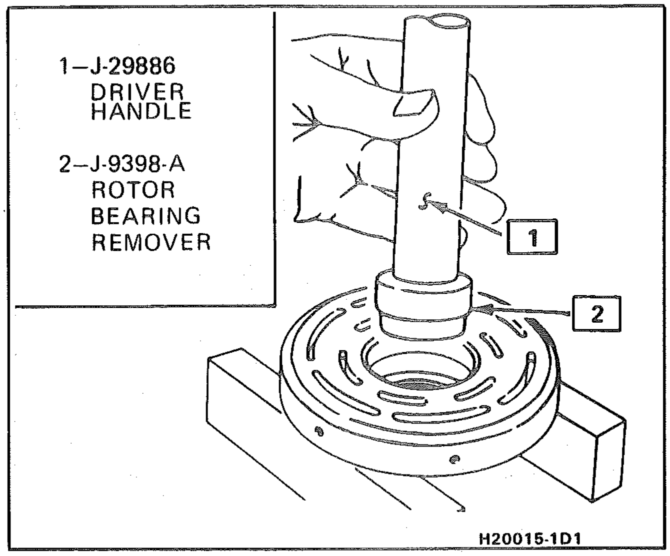


Fig. 14 Clutch Rotor Bearing Removal

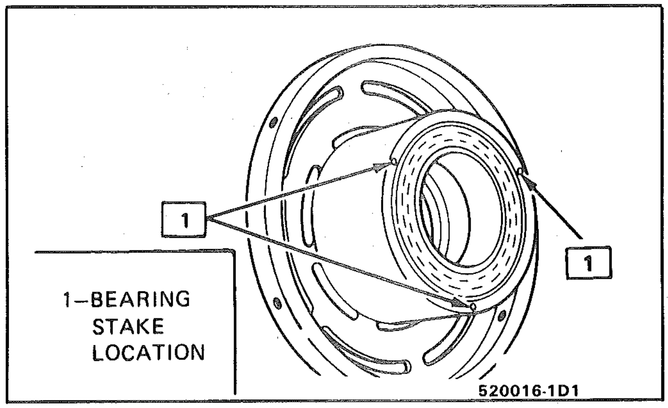


Fig. 15 Rotor & Bearing Asm.

Install or Connect

1. Place the Rotor and Hub assembly face down on a clean, flat and firm surface.
2. Align the new bearing squarely with the hub bore and using Pulley and Bearing Installer J-9481-A with Universal Handle J-29886, drive the bearing fully into the hub. The Installer will apply force to the outer race of the bearing if used as shown.
3. Using a center punch with a 45° angle point, stake 1.1 - 1.4mm (.045"-.055" deep) the bearing in three places 120° apart, but do not stake too deeply to avoid distorting the outer race of the bearing.
4. Replace rotor and bearing assembly.

On Car

A. Position the Rotor and Bearing assembly on the front head.
B. With Rotor & Bearing Installer J-26271-A (without driver handle) in position and Rotor and Bearing assembly aligned with the Front Head, drive the assembly part way onto the head.
C. Plug clutch coil connector onto Clutch Coil.
D. Position the Clutch Coil so the three locating tabs will align with the holes in the head and continue to drive the Rotor and Bearing assembly onto the front head.

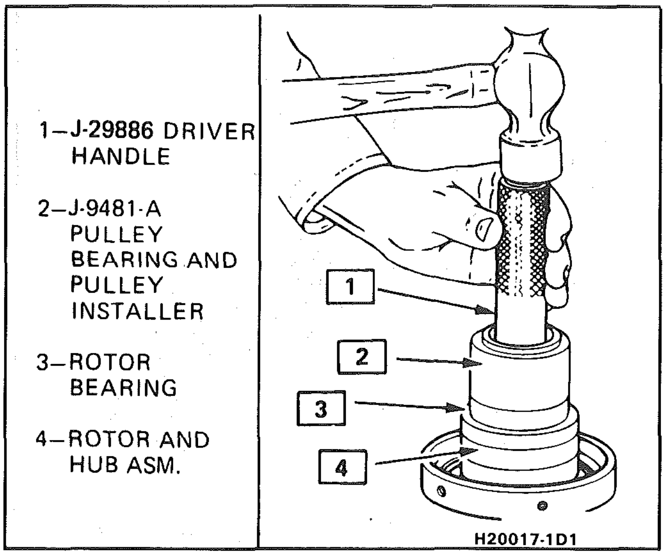


Fig. 16 Installing Clutch Rotor Bearing

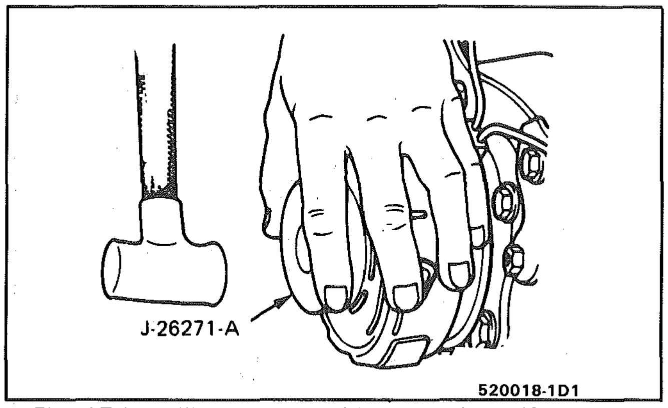


Fig. 17 Installing Rotor and Bearing Asm. (On Car)

E. Install the retainer ring.

F. Reassemble the Clutch Plate and Hub with the shaft key onto the shaft with Installer J-9480-B until .5 to 1.0mm (.020" to .040") air gap is obtained.

G. Install shaft lock nut. Torque to 14 N·m (10 lb. ft.).

On Bench

Reassemble the Rotor and Bearing assembly to the front head of the compressor using Rotor & Bearing Installer J-26271-A. With Installer assembled to the Universal Handle, J-29886, force will be applied to the inner race of the bearing and the face of the rotor when installing the assembly onto the front head of the compressor.

5. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J-6083.
6. Apply sealer (Loctite RC-75, Loctite 601 or equivalent) to threads of pulley rim mounting screws. Install screws and new special lock washers but do not torque the screws.
7. Rotate the pulley rim and rotor to insure that pulley rim is rotating "in-line." If pulley rim is distorted (does not rotate in-line), adjust or replace pulley rim.

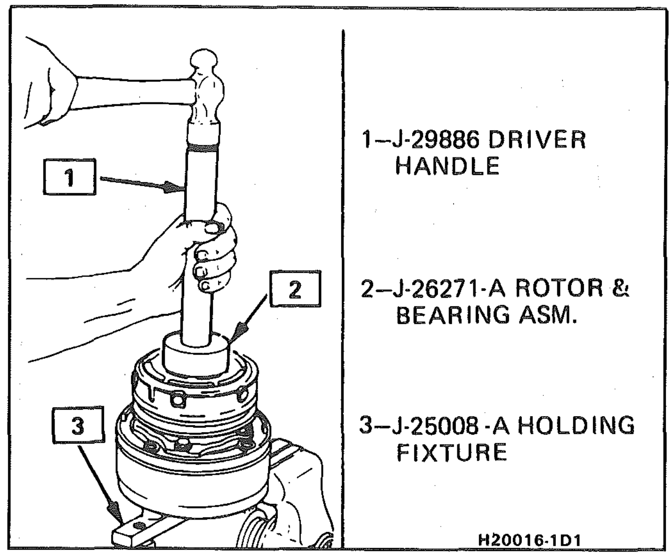


Fig. 18 Installing Rotor & Bearing Asm. V-Groove Type

8. Tighten pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock screw heads in place by bending special lock washers, similar to original crimp and lock bends on washers.
9. Reinstall Clutch Plate and Hub assembly as described in "Clutch Plate and Hub" Replacement procedures.

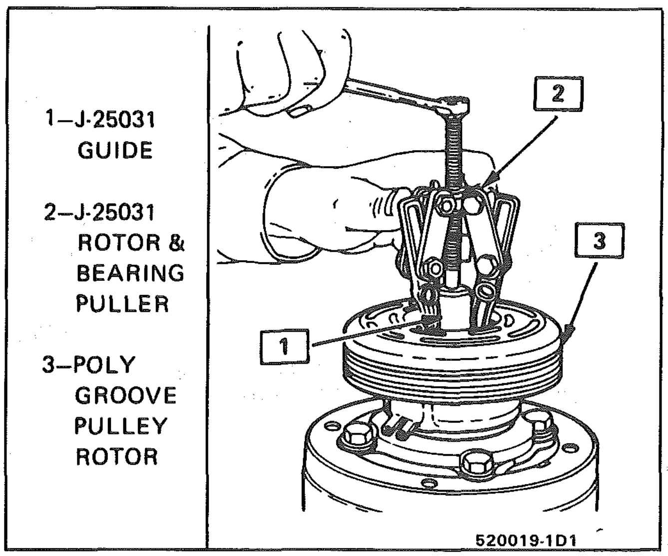


Fig. 19 Removing Clutch Rotor Asm. - Poly-Groove Drive

CLUTCH ROTOR AND BEARING:SIX POLE CLUTCH

Fig. 21 thru 28

←→ Remove or Disconnect

1. Clutch plate hub assembly
2. Rotor and bearing assembly retaining ring using Snap Ring Pliers J-6083
3. Install Pulley Rotor and Puller Guide J-25031 to the front head and install J-33020 Pulley Rotor and Bearing Puller down into the inner circle of slots in the rotor. Turn the J-33020 puller clockwise in the slots to engage the puller tangs with the segments between the slots in the rotor.

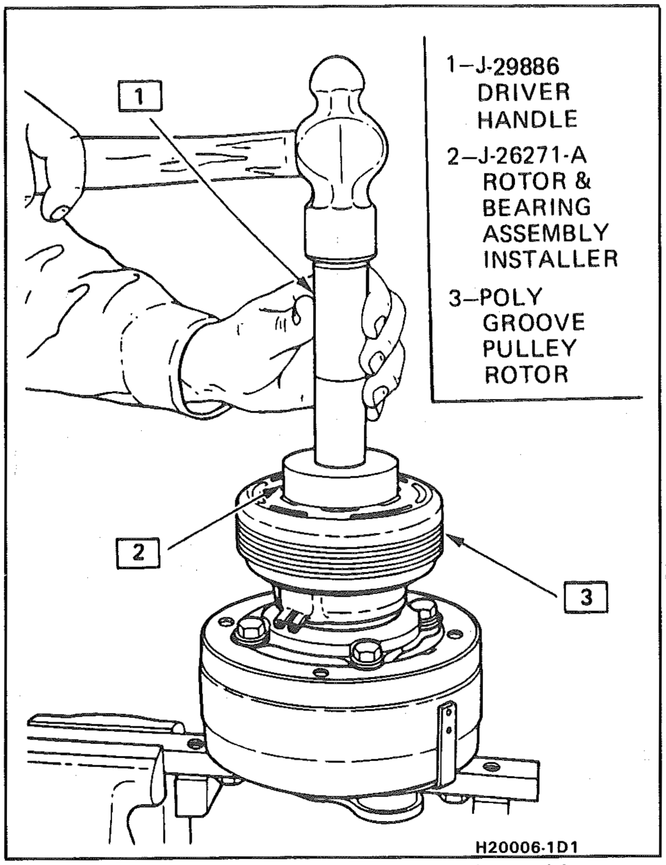


Fig. 20 Installing Rotor & Bearing Assembly, Poly-Groove Type (On Bench)

4. Hold the J-33020 Puller in place and tighten the puller screw against the Puller Guide to remove the pulley rotor and bearing assembly.

5. To prevent damage to the pulley rotor during bearing removal, the rotor hub must be properly supported.

   Remove the forcing screw from J-33020 Puller and with the puller tangs still engage in the rotor slots, invert the assembly onto a solid flat surface or blocks.

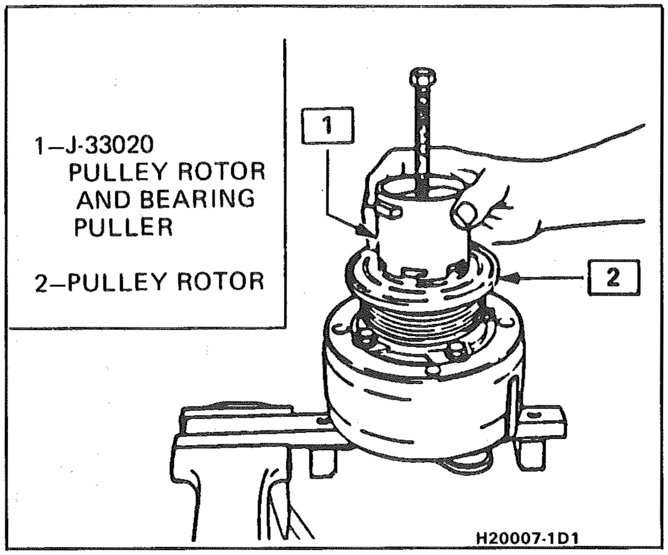


Fig. 22 Pulley Rotor and Bearing Puller Installation

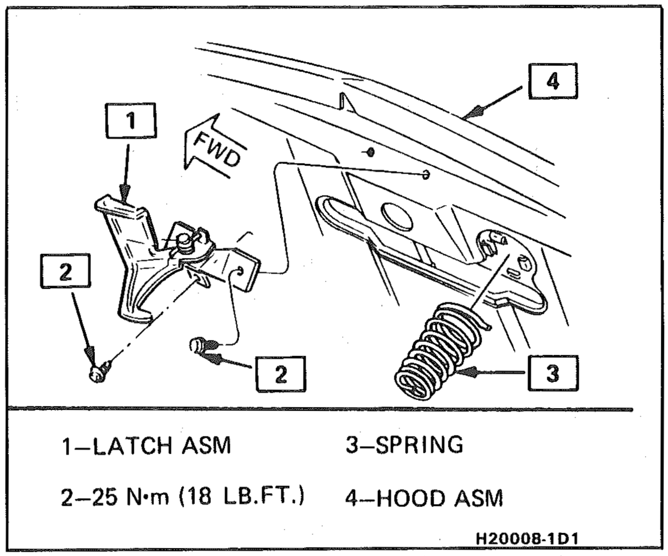


Fig. 23 Pulley Rotor and Bearing Removal

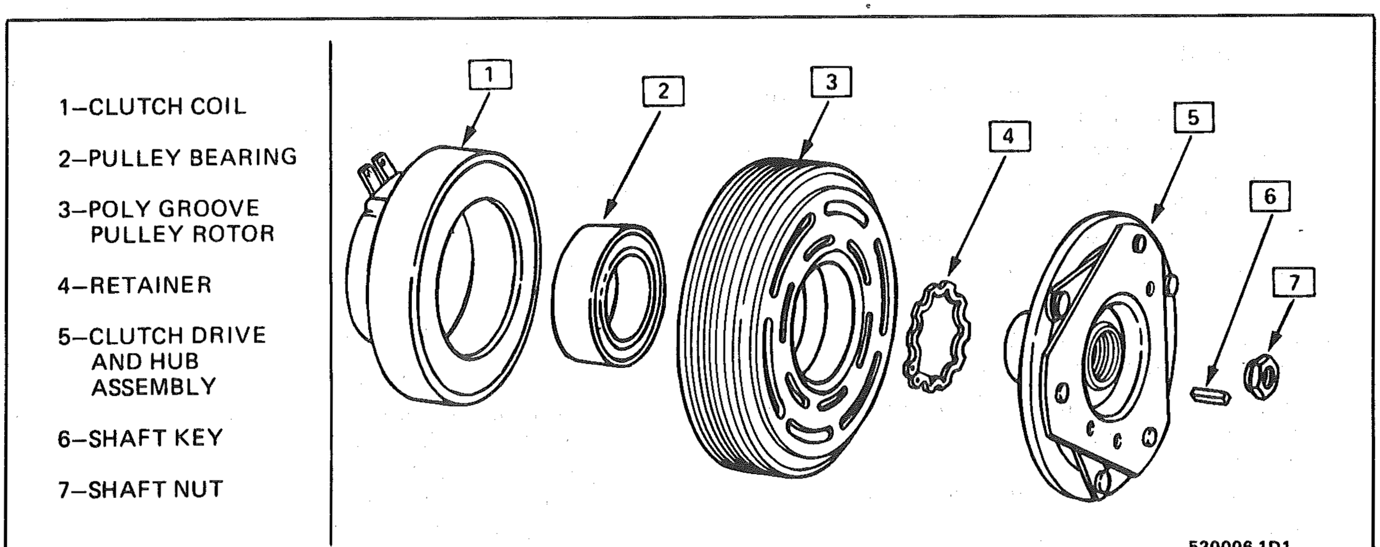


Fig. 21 Disassembled View of Poly Groove Pulley Drive

6. Drive the bearing out of the rotor hub with Rotor Bearing Remover J-9398-A and J-29886 Universal Handle.
   It is not necessary to remove the staking in front of the bearing, however, it will be necessary to file away the old stake metal for proper clearance for the new bearing to be installed into the rotor bore or the bearing may be damaged.

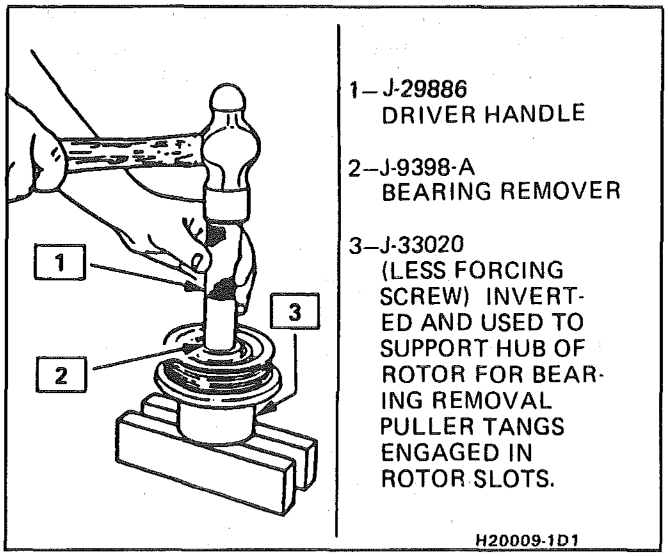


Fig. 24 Bearing Removal

Install or Connect

1. Place the Pulley Rotor on the J-21352-A Support Block to fully support the rotor hub during bearing installation. **Do not** support the rotor by resting the pulley rim on a flat surface during the bearing installation or the rotor face will be bent.
2. Align the new bearing squarely with the hub bore and using Puller and Bearing Installer J-9481-A with with Universal Handle J-29886, drive the bearing fully into the hub. The Installer will apply force to the outer race of the bearing is used as shown.

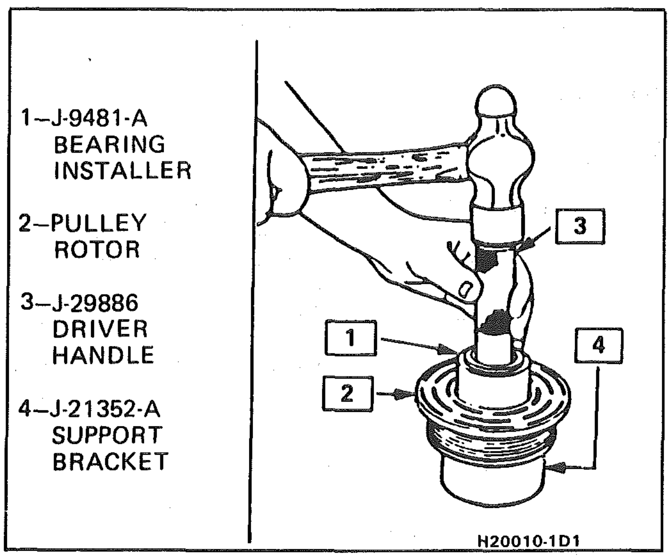


Fig. 25 Bearing Installation

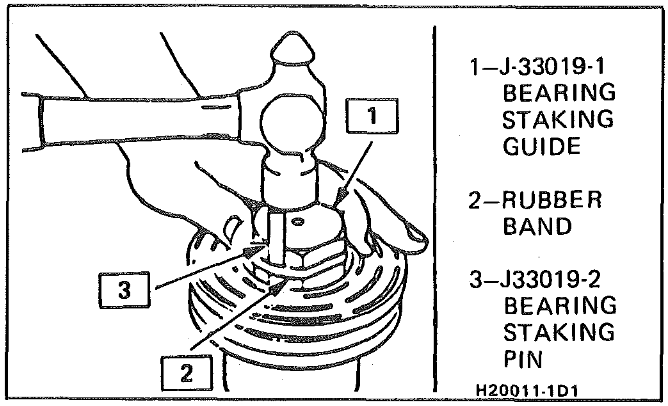


Fig. 26 Bearing Staking

3. Place Bearing Staking Guide J-33019-1 and Bearing Staking Pin J-33019-2 in the hub bore. Shift the rotor and bearing assembly on the J-21352-A Support Block to give full support of the hub under the staking pin location. A heavy duty rubber band may be used to hold the stake pin in the guide, and the stake pin should be properly position in the guide after each impact on the pin.

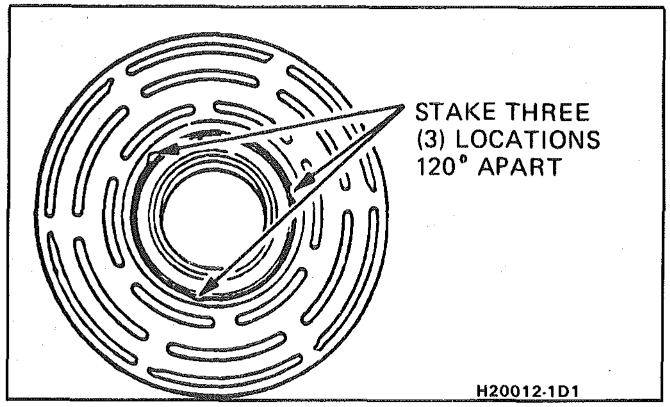


Fig. 27 Staking Location

4. Using care to prevent personal injury, strike the staking pin with a hammer until a metal stake, similar to the original, is formed down to, but not touching, the bearing. Stake three places 120 degrees apart.

NOTICE: The stake metal should not contact the outer race of the bearing to prevent the possibility of distorting the outer race.

5. With the compressor mounted to the J-25008-A Holding Fixture, position the Rotor and Bearing Assembly on the front head. Using Rotor and Bearing Installer J-9481-A and Universal Handle J-29886 drive the rotor and bearing assembly onto the front head. With the Installer assembled to the Handle, force will be applied to the inner race of the bearing when installing the assembly onto the front head of the compressor.
6. Install rotor and bearing assembly retainer ring, using Snap Ring Pliers J-6083.
7. Reinstall clutch plate and hub assembly as described previously.

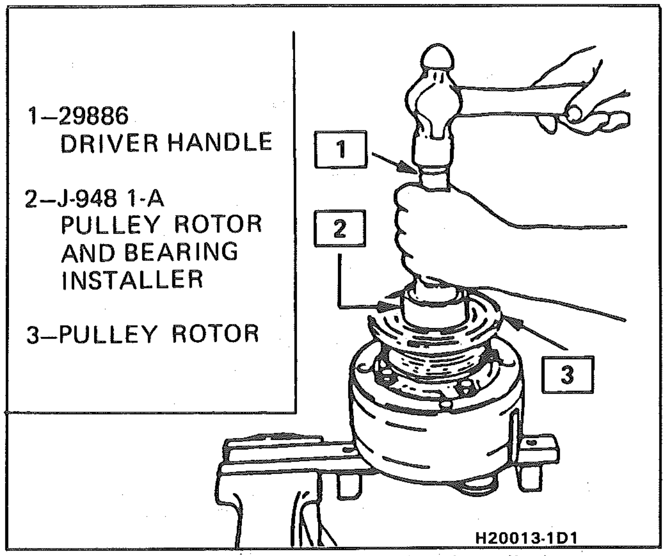


Fig. 28 Pulley Rotor and Bearing Installation

CLUTCH COIL AND PULLEY RIM

Fig. 29 thru 34

Clutch coil and pulley rim installation and removal procedures for the six-pole clutch are the same as the four-pole clutch with the exception of Steps 1 through 4 of the clutch rotor and/or bearing - Six-Pole Clutch, removal or disconnect must be used.

V-Groove Drive

Remove or Disconnect

1. Perform Steps 1 through 4 of CLUTCH ROTOR AND BEARING removal procedure but do not loosen or remove the pulley rim mounting screws until the Clutch Rotor, Coil and Pulley Rim assembly have been removed from the Front Head. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
2. Remove the pulley rim mounting screws and special lock washers. Discard the lock washers and screws.
3. Slide the pulley rim off the Rotor and Hub assembly. The Pulley Rim and the Clutch Coil are replaceable at this point.

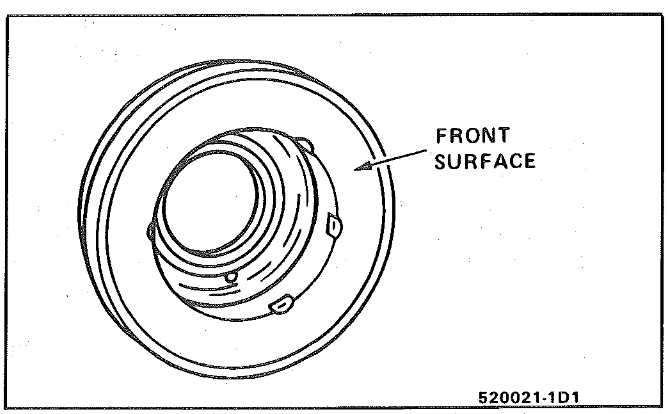


Fig. 29 Clutch Coil Asm.

Poly-Groove Drive

Remove or Disconnect

1. Clutch plate and hub assembly
2. Pulley rotor and bearing assemblyusly. Mark the location of the clutch coil terminals on the compressor.
3. Install Rotor and Bearing Puller Guide J-25031 to the front head and install Puller J-8433 with Poly-V-Belt Puller Leg Set J-24092 and remove the clutch coil from the front head. Clutch coil may also be removed by using rotor and bearing puller guide J-25031 with puller tool J-25287.

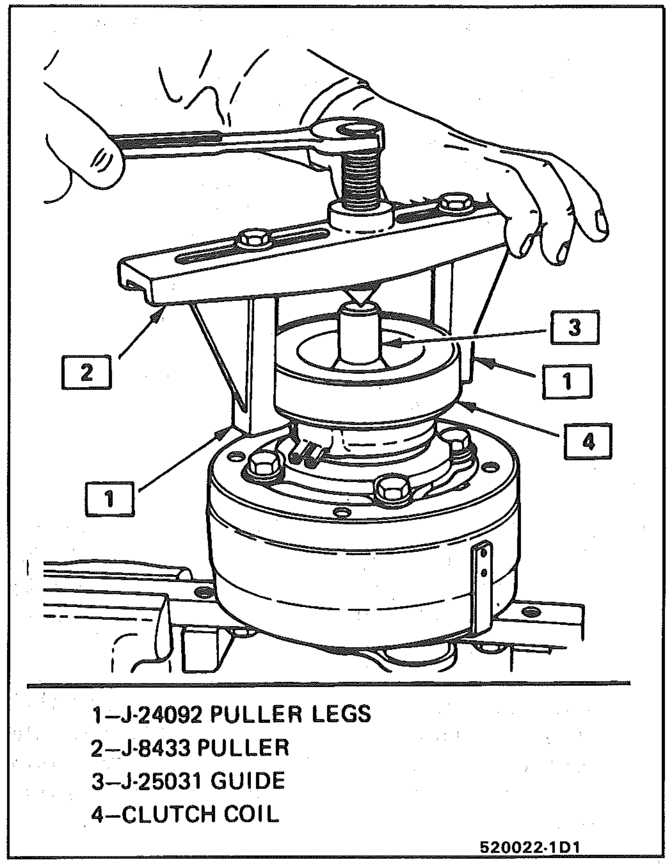


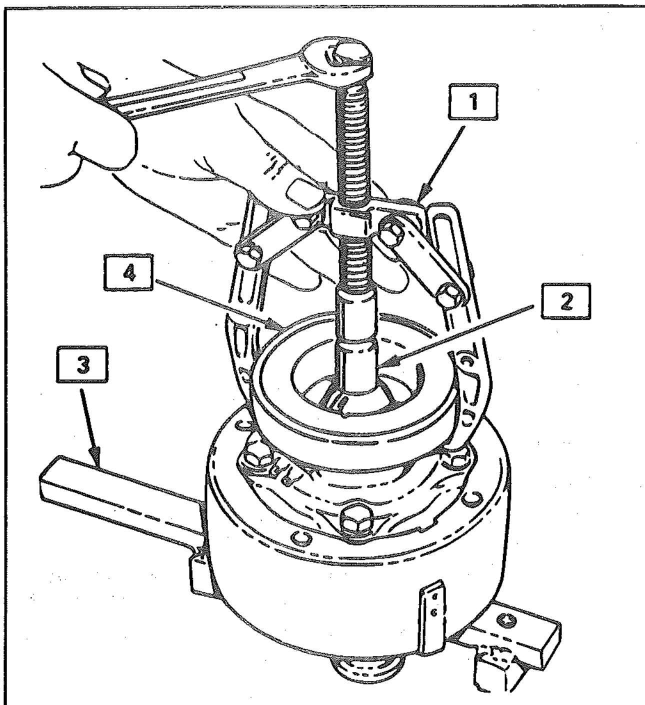
Fig. 30 Removing Poly-Groove Clutch Coil

V-Groove Drive

Install or Connect

1. Assemble the Clutch Coil, Pulley Rim and the Clutch Rotor and Bearing assembly. Use new screws and special lock washers and apply sealer (Loctite RC-75, Loctite 601, or equivalent) to screw threads but do not lock the screws in place.
2. Place the assembly on the neck of the Front Head and seat into place using Rotor & Bearing Installer J-26271-A.

   Before fully seating the assembly on the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.



1–J-25287 CLUTCH COIL PULLER
2–J-25031 GUIDE
3–J-25008-A HOLDING FIXTURE
4–CLUTCH COIL

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Fig. 31 Removing Poly-Groove Clutch Coil (Optional Method)

1–CLUTCH COIL AND HOUSING ASM.
2–PULLEY RIM

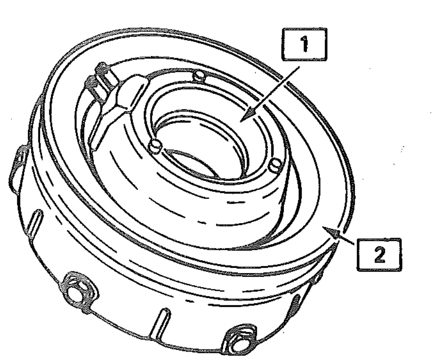

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Fig. 32 Assembling Clutch Coil, Pulley Rim, Rotor & Bearing

3. Install the rotor and bearing assembly retaining ring and reassemble the Clutch Plate and Hub assembly as described in "Clutch Plate and Hub Assembly" Replacement procedure. Check to see that the clutch plate to clutch rotor air gap is .5 to 1.0mm (.020 to .040 inches).

   Rotate the Pulley Rim and Rotor to be sure the Pulley Rim is rotating "in-line" and adjust or replace as required.

4. Tighten the pulley rim mounting screws to 11 N·m (100 inch-pounds) torque and lock the screw heads in place by bending lock washers similar to original crimp and lock bends on washers.

Install or Connect

1–MOUNTING NOTCHES (3)
2–MOUNTING HOLES (3)

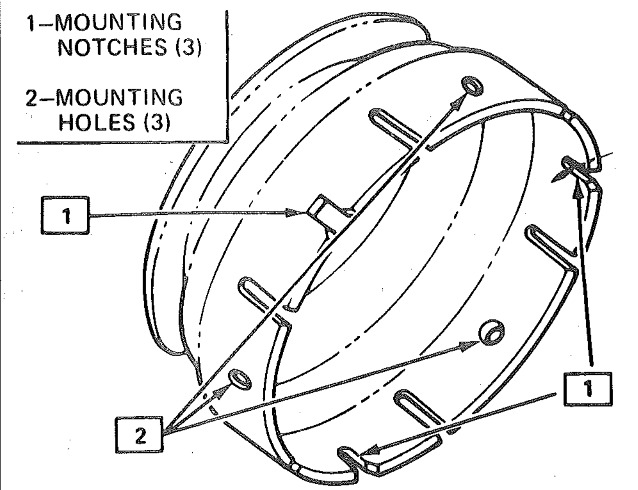

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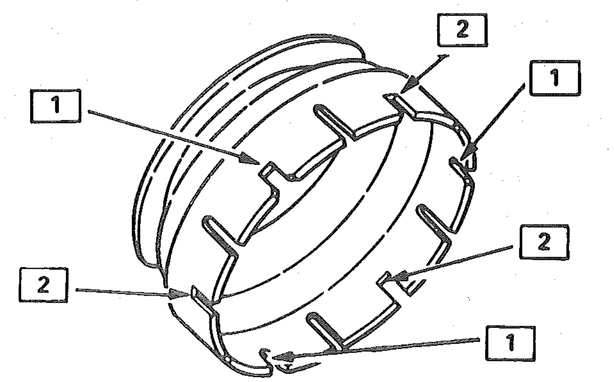
Fig. 33 Pulley Rim Mounting Location Detail



1– MOUNTING NOTCHES
2– MOUNTING SLOTS

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Fig. 34 Pulley Rim Mounting Location Detail - Optional Design

Poly-Groove Drive

1. Place the clutch coil assembly on the neck of the front head with clutch coil terminals in line with mark scribed in Step 2 of the removal procedure.

2. Place the pulley rotor and bearing assembly on the neck of the front head and seat the clutch coil and pulley rotor in place using Rotor and Bearing Installer J-26271-A.

   Before fully seating the assembly on the front head, be sure the clutch coil terminals are in proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil housing align with the locator holes in the front head.

3. Install the pulley-rotor and bearing assembly retaining ring and reassemble the clutch plate and hub assembly as described in "Clutch Plate and Hub Assembly - Replace."

4. Check to see that the clutch plate to clutch rotor air gap is 0.5 - 1.0mm (0.020" - 0.040").

MAJOR REPAIR PROCEDURES

Service repair procedures to the Compressor Shaft Seal, Pressure Relief Valve or disassembly of the Internal Compressor Cylinder and Shaft Assembly are considered "MAJOR" SINCE THE REFRIGERATION SYSTEM MUST BE DISCHARGED, EVACUATED AND RECHARGED to complete service and/or because major internal operating and sealing components of the compressor are being disassembled and serviced.

When replacing the shaft seal assembly or pressure relief valve, even if the compressor remains on the vehicle during the operation, it will be necessary to discharge the system of refrigerant (see Section 1B). Other than clutch repair procedures, the same holds true for any disassembly of the compressor.

If the compressor shell, front head or cylinder and shaft assembly are to be serviced or replaced, the oil in the compressor must be drained, measured and replaced (see Section 1B) to determine addition of proper oil quantity to new assembly.

A clean workbench, preferably covered with a sheet of clean paper, orderliness in the work area and a place for all parts being removed and replaced is of great importance, as is the use of the proper, clean service tools.

NOTICE: Any attempt to use make-shift or inadequate equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservation process and packaged in a manner which will eliminate the necessity of cleaning, washing or flushing of the parts. The parts can be used in the internal assembly just as they are removed from the service package. *Seals and protective packaging should be left intact until just prior to installation.*

SHAFT SEAL

Fig. 35 thru 40

Shaft Seal Design

The shaft seal is a one piece design.

Seal Leak Detection

A shaft seal should not be changed because of an oil-line on the hood insulator. The Seal is designed to seep some oil for lubrication purposes. Only change a Shaft Seal when a leak is detected by evidence of oil sprayed in large amounts and then only after actual refrigerant leakage is found by using an approved leak Detector such as J-29547 or equivalent.

Should an R-4 compressor shaft seal ever have to be replaced, the accumulator in this R-4 system must also be removed from the vehicle. The oil in the accumulator then must be drained, measured and replaced according to the directions in Section 1B to determine oil loss.

On-Car

Remove or Disconnect

1. Discharge A/C system
2. Loosen and reposition compressor in mounting brackets
3. Clutch Plate and Hub assembly
4. Shaft seal seat retainer ring, using Snap Ring Pliers J-5403-A
5. Thoroughly clean inside of compressor neck area and O-ring groove surrounding the shaft, the exposed portion of the seal seat and the shaft itself. Any dirt or foreign material getting into compressor may cause damage.
6. Remove Lip Seal:
   - Fully engage the knurled tangs of Seal Remover-Installer J-23128-A into the recessed portion of the Seal by turning the handle clockwise. Remove the Seal from the compressor with a rotary-pulling motion. Discard the Seal. The handle must be hand-tightened securely. Do not use a wrench or pliers.
7. Discard the seal seat O-ring from the compressor neck using O-Ring Remover J-9553-01.
8. Recheck the shaft and inside of the compressor neck and O-ring groove for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

Inspection

Seals should not be reused. Always use a new specification service seal kit on rebuild. Care should be taken to prevent damage to the lip of the one piece seal. Make sure that the Seal Seat and Seal Lip are free of lint and dirt that could damage the seal surface or prevent sealing.

On-Car

Install or Connect

1. Dip the new seal O-ring in clean 525 viscosity refrigerant oil and assemble onto O-Ring Installer J-33011.
2. Insert the O-Ring Installer J-33011 completely down into the compressor neck until the Installer "bottoms." Lower the moveable slide of the O-Ring Installer to release the O-Ring into the seal seat O-ring lower groove. (The compressor neck top groove is for the shaft seal retainer ring.) Rotate the Installer to seat the O-ring and remove the Installer.
3. Prepare Lip Seal:
   - Assemble seal to Seal Installer J-23128-A, by turning handle clockwise, and then push Seal Protector J-34614, into seal lip. The stamped steel case side of the lip seal must be engaged with knurled tangs of installer so that flared-out side of lip seal is facing and installed towards the compressor.
4. Install Lip Seal:

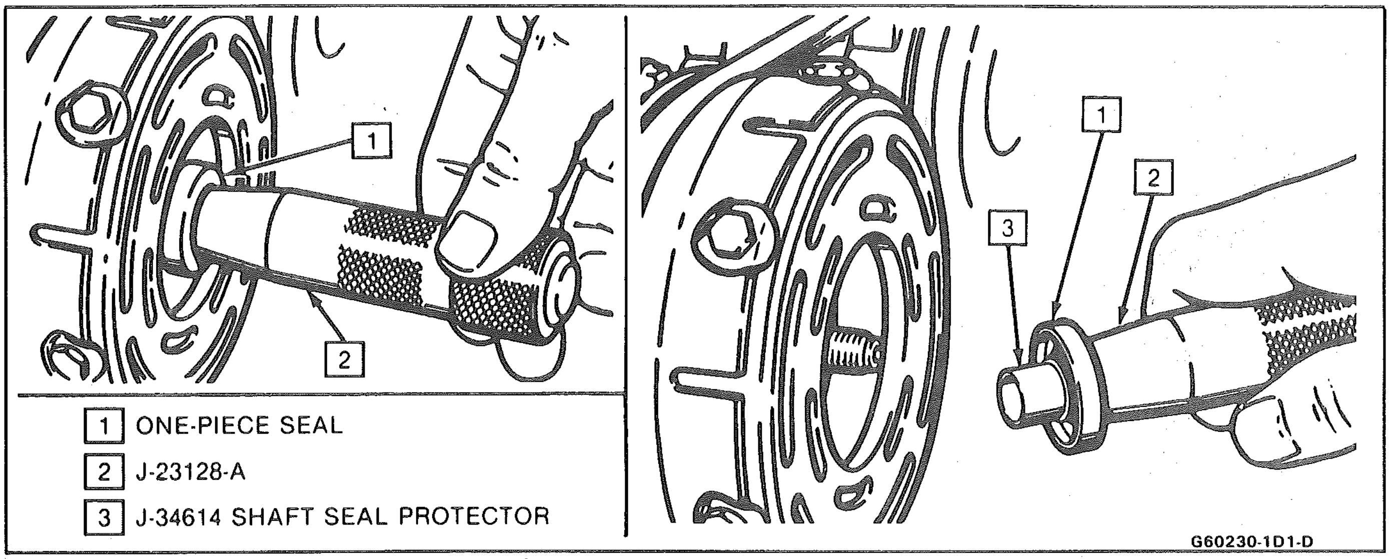


Fig. 35 Removing and Installing Seal

- Place seal protector J-34614 over end of compressor shaft and slide new seal onto the shaft until it stops. Disengage in

NOTICE: HANDLING AND CARE OF SEAL PROTECTOR IS IMPORTANT. IF SEAL PROTECTOR IS NICKED OR THE BOTTOM FLARED, THE NEW SEAL MAY BE DAMAGED DURING INSTALLATION.

5. Install the new seal seat retainer ring with its flat side against the Seal Seat, using Snap-Ring Pliers J-5403. Use the sleeve from O-Ring Installer J-33011 to press in on the seal seat retainer ring so that it snaps into its groove.
6. For Leak Test, pressurize suction side (low-pressure side) of compressor on vehicle with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the Seal and correct any leak found. Remove, discard and later replace the shaft nut.
7. Remove any excess oil, resulting from installing the new seal parts, from the shaft and inside the compressor neck.
8. Install the Clutch Plate and Hub assembly as described in minor repair procedures.
9. Reinstall compressor belt and tighten bracketry.
10. Evacuate and Charge the Refrigerant System according to directions in Section 1B.

Off-Car

Install or Connect

1. Follow applicable on-car procedures.
2. To Leak Test, install leak Test Fixture J-9625 on rear head of compressor and connect gage charging lines, or pressurize suction side (low pressure side) of compressor on car with Refrigerant-12 vapor to equalize pressure to the drum pressure. Temporarily install the shaft nut and, with compressor in horizontal position and using a wrench, rotate the compressor shaft in normal direction of rotation several times by hand. Leak test the seal and correct any leak found. Remove, discard and later replace with a new shaft nut.

PRESSURE RELIEF VALVE

Fig. 41

The Pressure Relief Valve, located in the compressor rear head casting, should only be replaced after purging the system of refrigerant. A new valve and O-ring coated with 525 viscosity refrigerant oil should be installed.

HIGH PRESSURE CUT-OFF SWITCH

Fig. 42

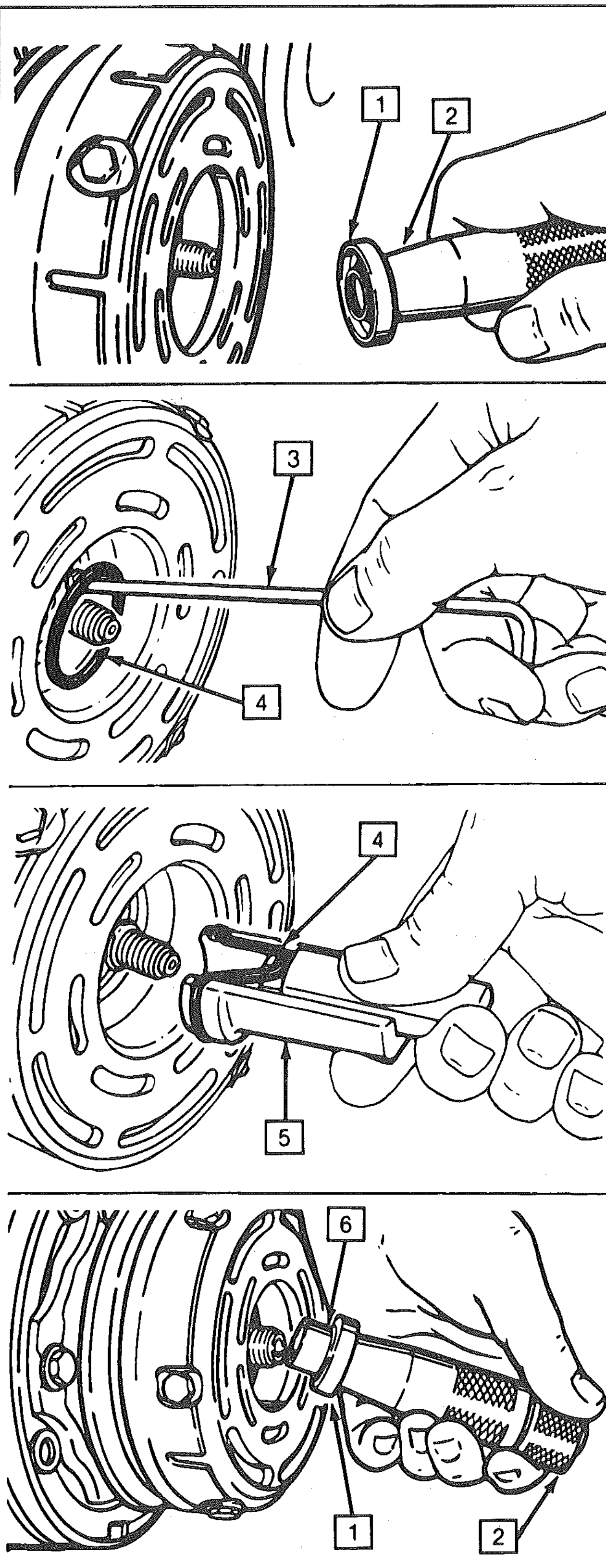
Remove or Disconnect

1. Discharge A/C system
2. Electrical connector at switch
3. Switch retaining ring using J-5403-A internal snap ring pliers.
4. Switch from compressor by pulling on terminal housing.
5. Old O-ring seal from switch cavity using J-9553-01 O-ring removal tool or equivalent.

If high pressure cut-off switch will be reinstalled in compressor, a new O-ring seal must be used and preferably a new retainer ring should also be used. A new switch kit has the O-ring and retainer ring included.

Install or Connect

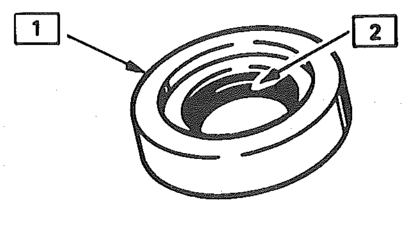
1. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary. Install new O-ring coated with clean 525 viscosity refrigerant oil into groove in switch cavity.
2. Lubricate the high pressure cut-off switch housing with clean 525 viscosity refrigerant oil



1 SEAL
2 J-23128-A
3 J-9553-01
4 O-RING
5 J-33011
6 J-34614

G60240-1D1-D

Fig. 36 Removing and Installing Seal and O-Ring



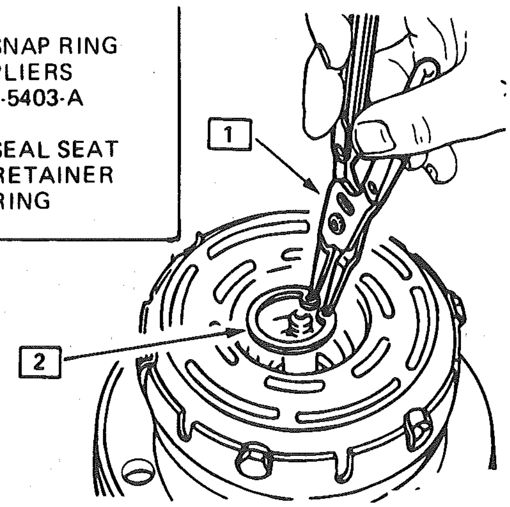
1–STEEL SHELL
2–LIP SEAL

520033-1D1

Fig. 37 One Piece Shaft Seal

1–SNAP RING PLIERS J-5403-A

2–SEAL SEAT RETAINER RING



520035-1D1

Fig. 38 Removing and Installing Shaft Seal Seat Retaining Ring

and carefully insert switch into switch cavity until switch bottoms in cavity.

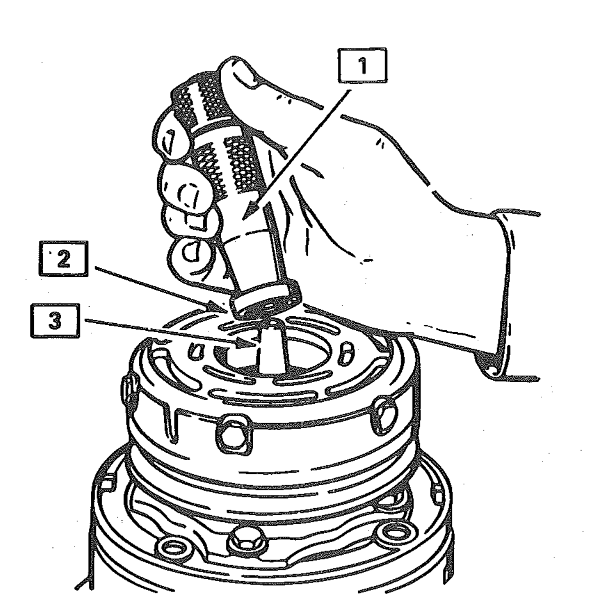
3. Using J-5403-A snap ring pliers, install switch retaining ring with high point of curved sides adjacent to the switch housing. Be sure retaining ring is properly seated in the switch cavity retainer ring groove.

FRONT HEAD AND O-RING

Fig. 43,44

←→ Remove or Disconnect

1. Discharge the Refrigerant System according to the directions in Section 1B.
2. Perform steps 1 through 4 of CLUTCH ROTOR AND BEARING removal procedure, but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
3. Remove and discard the Shaft Seal parts as described in SHAFT SEAL removal procedure
4. Before removing front head, mark the cylinder next to the narrow front head leg position.
5. Remove the four front head mounting screws and remove the Front Head assembly.



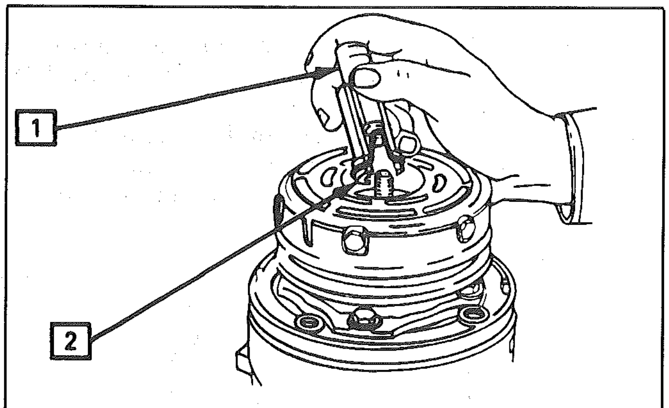
1–J-23128-A

2–ONE-PIECE SEAL

3–J-34614 - SHAFT SEAL PROTECTOR

520036-1D1

Fig. 39 Removing & Installing One Piece Seal (Off Car)



1 J-33011 O-RING INSTALLER

2 SEAL SEAT O-RING

G60280-1D1-D

Fig. 40 Installing Seal Seat O-Ring (Off Car)

6. Remove and discard the front head O-ring.

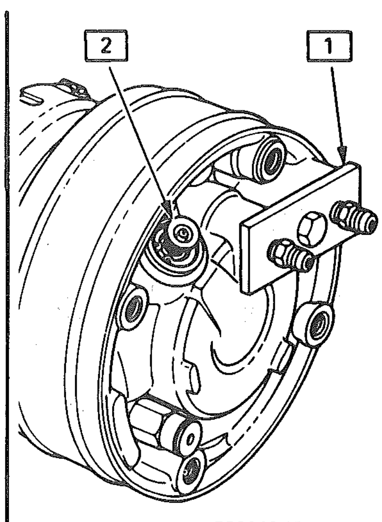
Install or Connect

1. Check the Front Head and compressor cylinder area for any dirt, lint, etc. and clean if necessary. Install a new Service thrust washer kit, if required, as described in THRUST AND BELLEVILLE WASHERS REMOVAL AND REPLACEMENT procedures.
2. Dip the new front head O-ring in clean 525 viscosity refrigerant oil and install in the seal groove on the front head.

1–LEAK TEST ADAPTER J 9625

2–HIGH PRESSURE CUT-OFF SWITCH

NOTICE: HIGH PRESSURE CUT-OFF SWITCH INSULATORS ARE COLORED RED



520040-1D1

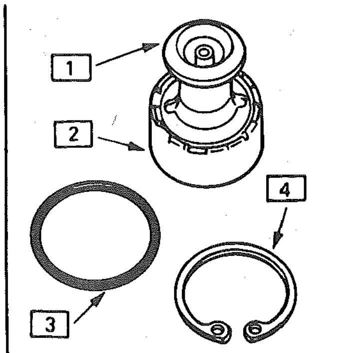
Fig. 41 Compressor Leak Testing Fixture

1–RED INSULATOR

2–HIGH PRESSURE CUT-OFF SWITCH

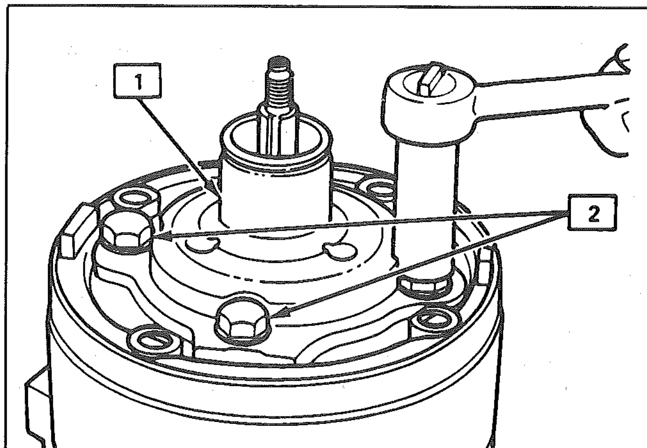
3–"O" RING

4–SWITCH RETAINING RING



520041-1D1

Fig. 42 High Pressure Cut-Off Switch and Retainer



1–FRONT HEAD 2–MOUNTING SCREWS (4)

520042-1D1

Fig. 43 Removing Front Head Mounting Screws

3. Position the Front Head narrow leg, to the marking previously made on cylinder, and tighten the front head mounting screws to 27 N·m (20 lb. ft.) torque.
4. Install new specification Service Shaft Seal kit as described in SHAFT SEAL REPLACEMENT PROCEDURE.

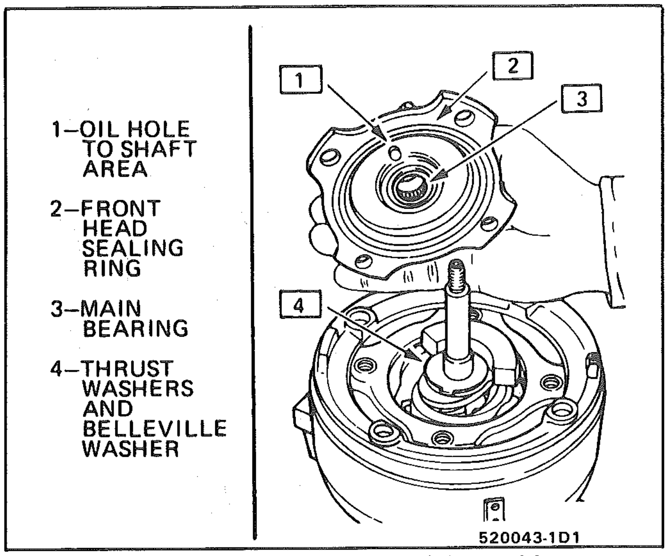


Fig. 44 Removing Front Head Assembly

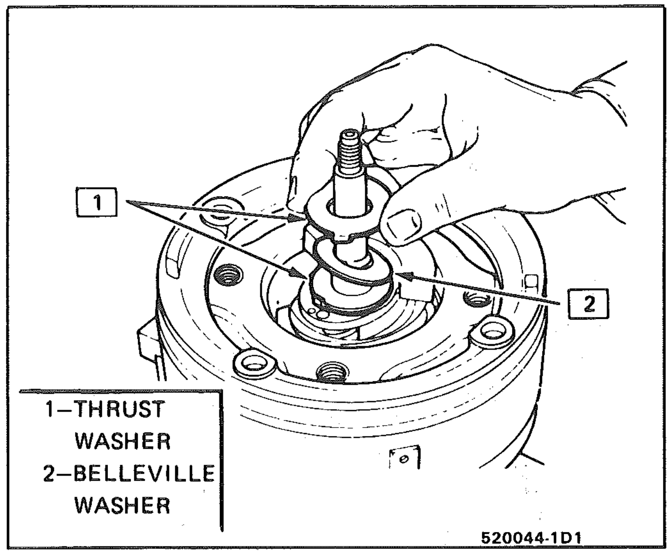


Fig. 45 Replacing Thrust and Belleville Washers

5. Install the Clutch Rotor and Bearing assembly, Clutch Coil and Pulley Rim assembly to the Front Head, using Rotor and Bearing Installer J-26271-A.

   Before fully seating the assembly onto the Front Head, be sure the clutch coil terminals are in the proper location in relation to the compressor and that the three protrusions on the rear of the clutch coil align with the locator holes in the Front Head.
6. Install the rotor and bearing assembly retainer ring and reassemble the Clutch Plate and Hub assembly as described in CLUTCH PLATE AND HUB" replacement procedure. Check to see that the clutch plate to clutch rotor gap is .5 - 1.0mm (.020 - .040 inches).
7. Evacuate and charge the refrigerant system according to the directions in Section 1B.

THRUST AND BELLEVILLE WASHERS

Fig. 45

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Remove the Front Head assembly as described in "Front Head Removal Procedure." Remove and discard the front head O-ring seal.
3. Remove the two thrust washers and one belleville washer from the compressor shaft. Note the assembled position of the washers.

Install or Connect

1. Install a new thrust washer on the compressor shaft with the thrust washer tang pointing "UP"
2. Install the new belleville washer on the shaft with the high center of the washer "UP."
3. Install the remaining thrust washer on the shaft with the tang pointing "DOWN".
4. Lubricate the three washers with clean 525 viscosity refrigerant oil and assemble the Front Head and new O-ring onto the compressor as described in FRONT HEAD replacement procedure.

MAIN BEARING

Fig. 46,47

Remove or Disconnect

1. Discharge the refrigerant system according to the direction in Section 1B.
2. Remove the Front Head assembly as described in FRONT HEAD REMOVAL PROCEDURE. Discard front head O-ring.
3. Place the Front Head assembly on two blocks, as shown in Fig. 46, and use Main Bearing Remover J-24896 to drive the Main Bearing out of the Front Head.

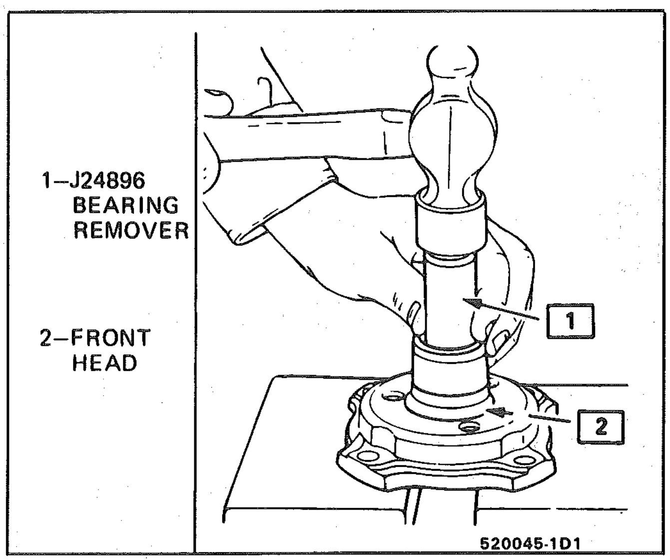


Fig. 46 Removing Main Bearing

Install or Connect

1. Place the Front Head "with neck-end down" on a flat, solid surface.

2. Align the new Main Bearing and the Bearing Installer J-24895 squarely with the bearing bore of the Front Head and drive the bearing into the Front Head. The Installer J-24895 must seat against the Front Head to insert the bearing to the proper clearance depth.

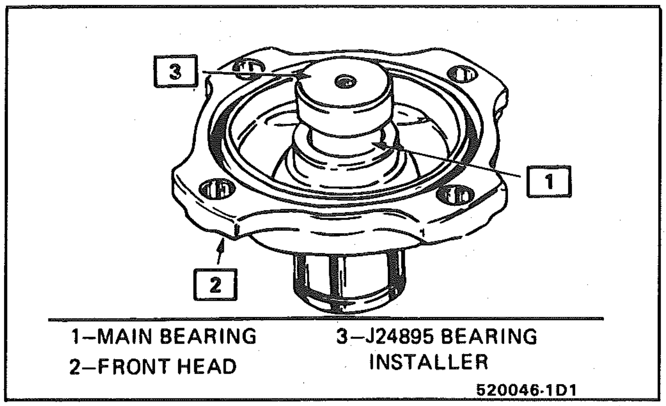


Fig. 47 Installing Main Bearing

3. Assemble the Front Head to the cylinder, using a new O-ring as described in FRONT HEAD replacement procedure.
4. Evacuate and charge the refrigerant system according to the directions in Section 1B.

SHELL AND O-RINGS

Fig. 48 thru 50

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Thoroughly clean exterior of compressor to prevent dirt from getting into compressor during shell removal.
3. Remove the Clutch Plate and Hub assembly as described in CLUTCH PLATE AND HUB removal procedures.
4. Perform Steps 1 through 4 of CLUTCH ROTOR AND BEARING removal procedure but do not loosen or remove the pulley rim mounting screws so as to remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as a total assembly. Be careful not to drop the Puller Guide J-25031 when removing the assembly.
5. Pry the shell retaining strap away from the cylinder and position the strap high enough to clear the cylinder as the Shell is removed.
6. Remove Compressor Holding Fixture J-25008-A, and reverse Holding Fixture with step block protrusions engaging the compressor Shell. Install the medium-length metric thread mounting bolts through the Holding Fixture and thread them finger-tight on both sides into the compressor cylinder until the step of the fixture protrusions contact the compressor Shell. Check to be sure the step protrusions do not overlap the cylinder but will pass both sides. Allow compressor to cool to room temperature before removing compressor shell.

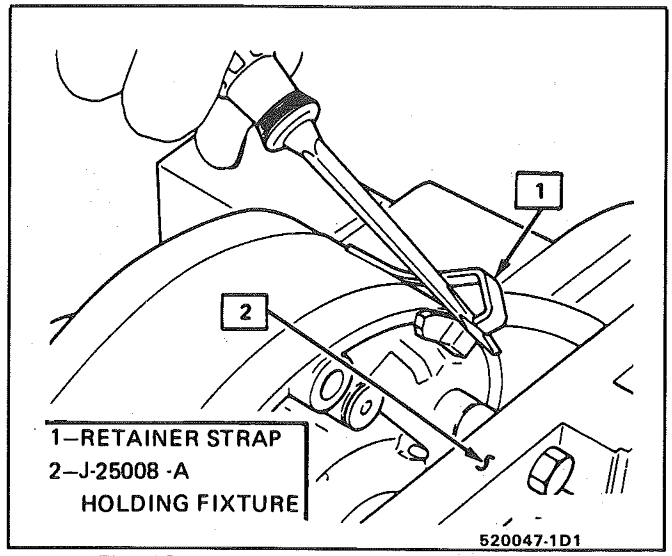


Fig. 48 Releasing Shell Retaining Strap

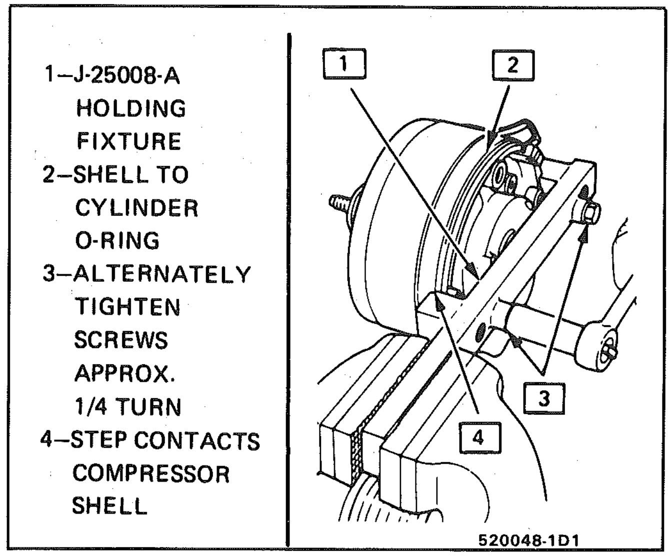


Fig. 49 Removing Shell

7. Alternately tighten each bolt approximately 1/4 turn to push the Shell free of the O-rings on the cylinder.

   If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the Shell will be cocked and made more difficult to remove. Normal removal does not require much force on the wrench if the screws are kept in-step while turning. The Shell can be removed by hand as soon as the Shell is free of the shell to cylinder O-rings. Do not turn the screws any further than necessary to release the Shell.

8. Remove the compressor Shell and remove the Holding Fixture J-25008-A from the compressor. Reverse the Holding Fixture to again hold the compressor by the opposite side, using the short-length screws with metric threads.

9. Remove and discard both cylinder to Shell O-rings.

Install or Connect

1. Check the compressor cylinder assembly and interior of the compressor Shell to be sure they are free of lint, dirt, etc.
2. Dip a new cylinder-to-shell O-ring in clean 525 viscosity refrigerant oil and install in the rear O-ring groove of the cylinder. Be careful in moving the O-ring across the cylinder surface to prevent damaging the O-ring.
3. Dip the remaining cylinder-to-shell O-ring in the 525 oil and install it in the front O-ring groove of the cylinder.
4. Also coat inner O-ring surface of compressor Shell with oil. Place the compressor Shell on the cylinder and rotate the retaining strap to its original location.
5. Attach the Shell Installing Fixture J-25008-A to the Holding Fixture J-25008-A, using the long-bolts and plate washers of the set. Align the step projections of the Installing Fixture J-25008-A, to contact the compressor Shell evenly on both sides.
6. Push the compressor shell as close to the O-ring as possible by hand and check for equal alignment of the shell around the cylinder. Tighten the Fixture screws finger tight.

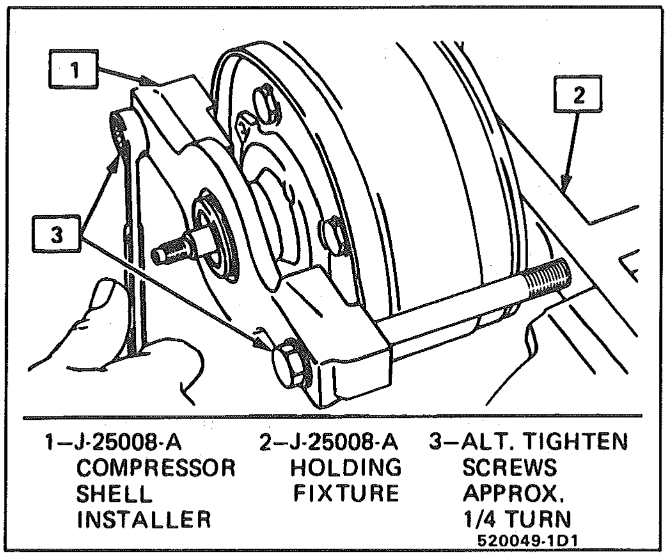


Fig. 50 Installing Shell

7. Alternately tighten each bolt approximately 1/4 turn to push the compressor Shell over the O-rings and back against the shell stop flange at the rear of the compressor cylinder.

   If one screw appears to require more force to turn than the other, immediately turn the other screw to bring the screw threading sequence in-step or the shell will be cocked and made more difficult to install. Normal installation does not require much force on the wrench if the screws are kept in-step while turning.
8. When the shell is seated against the stops, bend the shell retaining strap down into place by tapping gently with a hammer. Remove the Shell Installing Fixture J-25008-A.
9. Reinstall Clutch Rotor and Bearing Asm., Clutch Coil and Pulley Rim as an assembly with Installer J-26271-A, and the Clutch Plate and Hub Assembly with Installer J-9480-B.
10. "Evacuate and Charge the Refrigerant System" according to the directions in Section 1B.

DISCHARGE VALVE PLATE AND RETAINER

Fig. 51,52

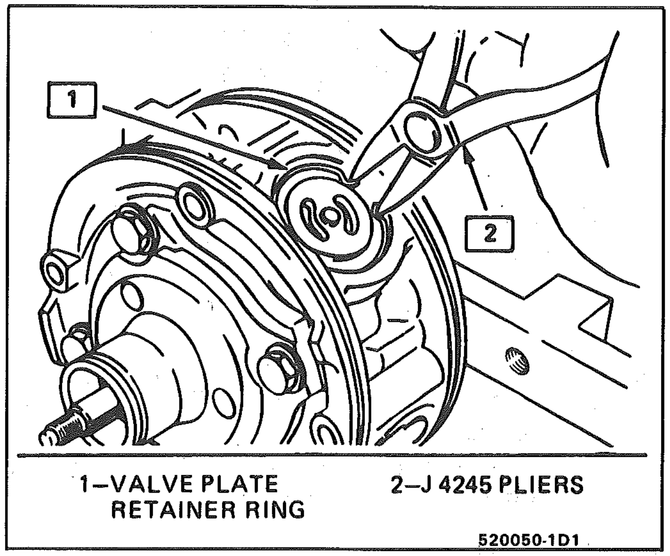


Fig. 51 Replacing Valve Plate Retainer

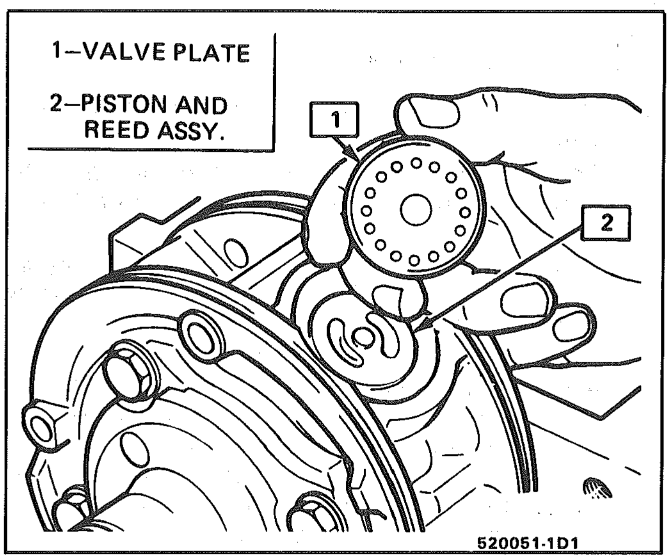


Fig. 52 Replacing Discharge Valve Plate

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Perform Steps 1 through 9 of SHELL AND O-RINGS removal procedure.
3. Remove valve plate retainer ring, using Internal Snap Ring Pliers J-4245. Remove Compressor Discharge Valve Plate for valve plate replacement and/or piston inspection.

   Repeat this operation for additional valve plates and retainer rings. If all four valve plates and retainers are to be removed, remove two sets and then rotate compressor and Holding Fixture J-25008-A in vise for access to the remaining two valve plates and retainers.

Install or Connect

1. Install Discharge Valve Plates and/or Retainers. Reposition compressor and Holding Fixture in vise as necessary for access. **Valve plates must be tight following retainer assembly.**
2. Reinstall compressor Shell as described in SHELL AND O-RINGS replacement procedures.
3. Evacuate and charge the refrigerant system according to the directions in Section 1B.

CYLINDER AND SHAFT ASSSEMBLY

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B.
2. Remove the Clutch Plate and Hub assembly as described in CLUTCH PLATE AND HUB removal procedure.
3. Perform Steps 1 through 4 of CLUTCH ROTOR AND BEARING removal procedure but do not loosen or remove the pulley rim mounting screws. Remove the Clutch Rotor and Bearing, Clutch Coil and Pulley Rim as an assembly. Be careful not to drop the Puller Guide J-25031, when removing the assembly.
4. Remove the shaft seal as described in SHAFT SEAL removal procedure.
5. Remove the front head as described in FRONT HEAD REMOVAL procedure.
6. Remove the thrust and belleville washers as described in THRUST AND BELLEVILLE WASHERS removal procedures.
7. Remove the compressor shell as described in SHELL removal procedure.
8. Remove the discharge valve plate and retainer as described in DISCHARGE VALVE PLATE AND RETAINER removal procedure.
9. Remove the high pressure relief valve as described in HIGH PRESSURE RELIEF VALVE REMOVAL PROCEDURE.

Install or Connect

1. Replace above parts in opposite order.
2. Evacuate and charge the refrigerant system according to the directions in Section 1B.

LEAK TESTING (EXTERNAL AND INTERNAL)

Bench-Check Procedure

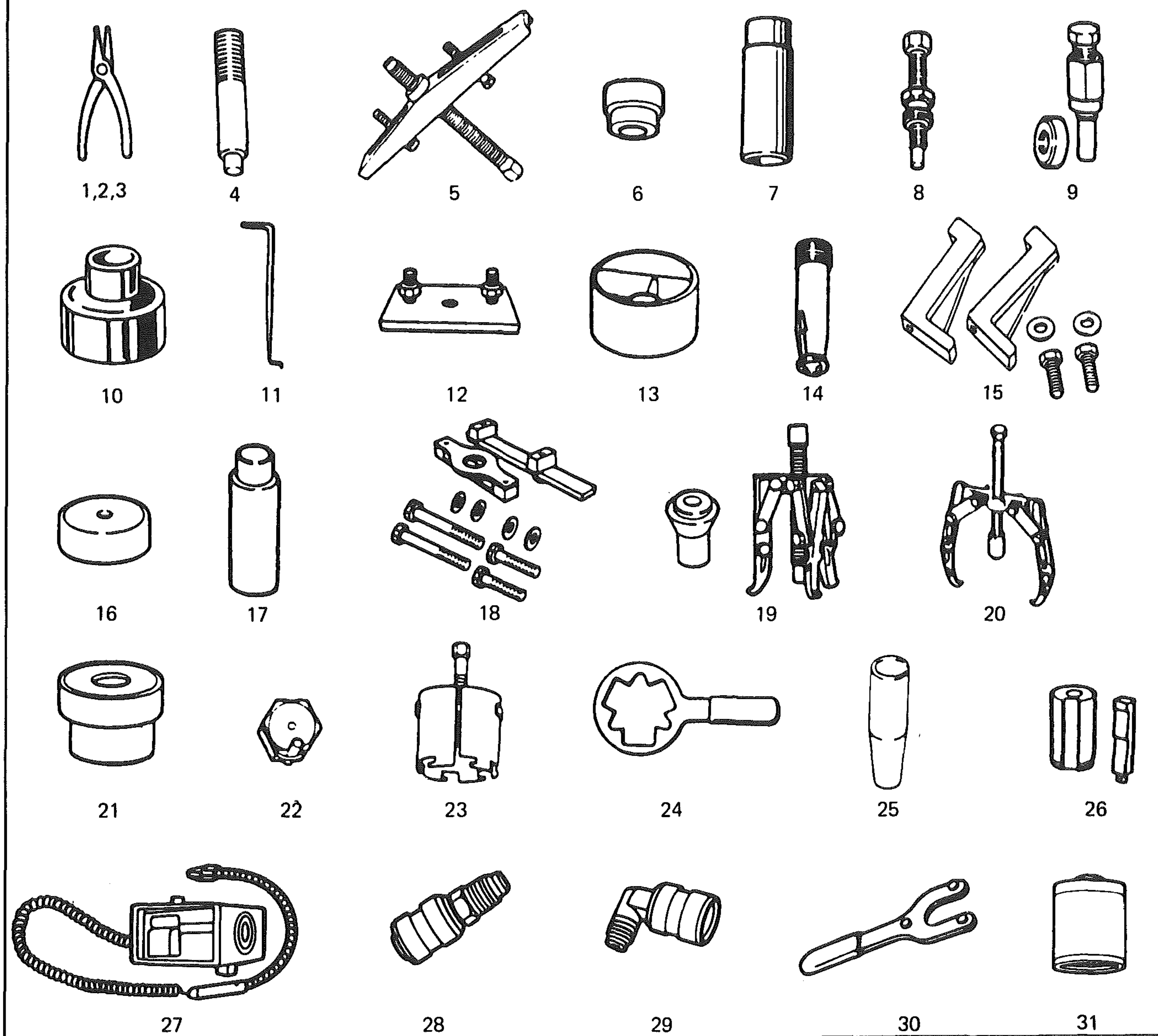
1. Install Test Plate J-9625-A on Rear Head of compressor.
2. Attach center hose of Manifold Gage Set on Charging Station to a refrigerant drum standing in an upright position and open valve on drum.
3. Connect Charging Station high and low pressure lines to corresponding fittings on Test Plate J-9625-A, using J-5420 Gage Adapters if hoses are not equipped with valve depressors.
   - Suction port (low-side) of compressor has large internal opening. Discharge port (hi-side) has smaller internal opening into compressor.
4. Open low-pressure control, high-pressure control and refrigerant control on Charging Station to allow refrigerant vapor to flow into compressor.
5. Using a Leak Detector, check for leaks at Pressure Relief Valve, compressor shell to cylinder, compressor front head seal, and compressor Shaft Seal. After checking, shut off low pressure control and high pressure control on Charging Station.
6. If an external leak is present, perform the necessary corrective measures and recheck for leaks to make certain the leak has been corrected.
7. Loosen the Manifold Gage hose connections to the Gage Adapters J-5420 connected to the low and high sides and allow the vapor pressure to release from the compressor.
8. Disconnect both Gage Adapters J-5420 from the Test Plate J-9625-A.
9. Rotate the complete compressor assembly (not the crankshaft or drive plate hub) slowly several turns to distribute oil to all cylinder and piston areas.
10. Install a shaft nut on the compressor crankshaft if the drive plate and clutch assembly are not installed.
11. Using a box-end wrench or socket and handle, rotate the compressor crankshaft or clutch drive plate on the crankshaft several turns to ensure piston assembly to cylinder wall lubrication.
12. Connect the Charging Station high pressure line or a high pressure gage and Gage Adapter J-5420 to the Test Plate J-9625-A high side connector.
13. Attach an Adapter J-5420 to the suction or low pressure port of the Test Plate J-9625-A to open the Schrader-type valve.
    Oil will drain out of the compressor suction port adapter if the compressor is positioned with the suction port downward.
14. Attach the compressor to the Holding Fixture J-25008-A using metric mounting screws. Clamp the compressor Holding Fixture in a vise so that the compressor can be manually turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten complete revolutions at a speed of approximately one-revolution per second.
    Turning the compressor at less than one-revolution per second can result in a lower pump-up pressure and disqualify a good pumping compressor.
16. Observe the reading on HIGH pressure gage at the completion of the tenth revolution of the compressor. The pressure reading for a good pumping compressor should be 344.75 kPa (50 p.s.i.) or above. A pressure reading of less than 310.275 kPa (45 p.s.i.) would indicate one or more

suction and/or discharge valves leaking, an internal leak or an inoperative valve, and the compressor should be disassembled and checked for cause of leak. Repair as needed, reassemble and repeat the pump-up test. Externally leak test.

17. When the pressure pump-up test is completed, release the air pressure from the HIGH side and remove the Gage Adapters J-5420 and Test Plate J-9625-A.

18. On the R-4 compressor, tilt the compressor so that the compressor suction and discharge ports are down. Drain the oil from the compressor.

19. Allow the compressor to drain for 10 minutes, then charge with the proper amount of oil. The oil may be poured into the suction port.
    If further assembly or processing is required, a shipping plate or Test Plate J-9625-A should be installed to keep out air, dirt and moisture until the compressor is installed.



1-J-4245	SNAP RING PLIERS (#23 INTERNAL)
2-J-5403	SNAP RING PLIERS (#21 INTERNAL)
3-J-6083	SNAP RING PLIERS (#24 INTERNAL)
4-J-29886	DRIVER HANDLE
5-J-8433	COMPRESSOR PULLEY PULLER
6-J-9398-A	ROTOR BEARING REMOVER
7-J-9399	9/16" THIN WALL SOCKET
8-J-33013-B	HUB AND DRIVE PLATE ASSEMBLY REMOVER
9-J-9480-B	HUB AND DRIVE PLATE ASSEMBLY INSTALLER
10-J-9481-A	PULLEY BEARING AND PULLEY INSTALLER
11-J-9553-01	O-RING REMOVER
12-J-9625-A	PRESSURE TEST CONNECTOR
*13-J-21352-A	COMPRESSOR SUPPORT BLOCK
14-J-23128-A	SEAL REMOVER AND INSTALLER
15-J-24092	PULLEY HUB ADAPTER SET (USED WITH J-8433)
16-J-24895	BEARING INSTALLER (FRONT END)
17-J-24896	BEARING REMOVER (FRONT HEAD)
18-J-25008-A	COMPRESSOR HOLDING FIXTURE
19-J-25031	ROTOR AND BEARING PULLER WITH GUIDE
20-J-25287	CLUTCH COIL PULLER
21-J-26271-A	ROTOR AND BEARING INSTALLER (WITHOUT HANDLE)
22-J-33019	BEARING STAKING TOOL
*23-J-33020	PULLEY PULLER
24-J-33027	CLUTCH HUB HOLDING TOOL
25-J-34614	SHAFT SEAL PROTECTOR
26-J-33011	SEAL SEAT O-RING INSTALLER
27-J-29547	ELECTRONIC LEAK DETECTOR
28-J-5420	7/16"-20 STRAIGHT ADAPTER
28-J-25498	7/16"-20 x 3/8"-24 STRAIGHT ADAPTER
29-J-9459	7/16"-20 90° ELBOW ADAPTER
29-J-25499	7/16"-20 x 3/8"-24 90° ELBOW ADAPTER
30-J-25030	CLUTCH HUB HOLDING TOOL
31-J-33024	CLUTCH COIL INSTALLER ADAPTER

*Indicates tools used only on the 6 pole clutch

H20020-1D1

Fig. 53 Special Tools, R-4 A/C Compressor Overhaul

SECTION 2B

BUMPERS

NOTICE: These fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

NOTICE: The anti-theft label on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask MUST be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

GENERAL DESCRIPTION

The bumpers on all Pontiac automobiles are designed so that the vehicle can withstand a collision into a fixed barrier at 5 mph. After absorbing the energy of a collision, the bumpers restore themselves to their original position.

The front and rear bumper fascias are made of urethane. Urethane will withstand minor impact and return to its original shape. Some front bumper fascias are integral with the front end panel.

Some models use both steel and aluminum bumper reinforcements. Usage is based on EPA weight class requirements.

BUMPER FASCIA RUB STRIPS

Some front and rear fascia rub strips are made of a shiny plastic material. If a rub strip of this type loses its lustre, the original shine can be restored by using GM Plastic Cleaner or its equivalent. Follow directions on the label.

SERVICE PROCEDURES

RUB STRIPS

Remove and Replace

Some plastic rub strips have an adhesive tape backing (similar to a body side molding) and some have studs or retaining tabs. In order to properly remove the adhesive tape and avoid paint damage to the fascia, use either a release agent or a heat lamp to soften the bond of the adhesive tape to the fascia. In some cases, it will be necessary to replace the rub strip with a new rub strip instead of reusing the old one.

If the old rub strip is salvagable, remove all tape from the back side of the rub strip as previously described. Wipe strip clean with a wax and adhesive remover. Install new tape (double-coated neoprene foam type) to the back side of the rub strip.

After rub strip is installed, roll along entire surface with a roller in order to insure a good bond.

FRONT BUMPER FASCIA (FRONT END PANEL)

Removal

Place a jack stand under fascia assembly before removing bolts to prevent it from dropping down when fascia attaching bolts are removed. Fascia will pivot on the opposite end when one end is disconnected. Do not rotate energy absorber any more than necessary to align mounting holes.

1. Remove fascia attaching bolts and fascia to fender attaching screws on right and left side, and remove fascia and spacers.
2. If energy absorber is to be replaced, remove the bolts and nuts from the front of the unit and the nut from the stud at the rear.

Installation

1. Install energy absorber if removed.
2. Support fascia during installation to prevent rotation of energy absorbers.
3. Install spacers and bolts at fascia to energy absorber brackets.
4. Install fascia to fender attaching screws.
5. Check for proper clearance.
6. If adjustment is required to align fascia, loosen energy absorber mounting bolts and position as required (holes are slotted). Adjustment side to side can be made by loosening fascia bracket bolts. Torque all bolts and nuts. (See Specifications.)

REAR BUMPER FASCIA

Removal

Place a jack stand under fascia before removing bolts to prevent it from dropping down when fascia attaching bolts are removed. Fascia will pivot on the opposite end when one end is disconnected. Do not rotate energy absorber any more than necessary to align mounting holes.

1. Remove fascia attaching bolts and fascia to fender attaching screws on right and left side, and remove fascia and spacers.
2. If energy absorber is to be replaced, remove the bolts and nuts from the front of the unit and the nut from the stud at the rear. The stud at the rear of the absorber is attached to a bracket in the frame. Remove the bolt holding this bracket in the frame to remove the absorber.

Installation

1. Install energy absorber if removed.
2. Support fascia during installation to prevent rotation of energy absorbers.
3. Install spacers and bolts at fascia to energy absorber brackets.
4. Install fascia to fender attaching screws.
5. Check for proper clearance.
6. If adjustment is required to align the fascia, use shims as necessary. Vertical and lateral adjustment can be made at slots in fascia and absorber brackets. Torque all bolts and nuts. (See Specifications.)

FRONT BUMPER

Removal

1. Remove front end fascia as shown in Section 2C.
2. Remove bumper bar/energy absorber assembly from body.
3. If energy absorber must be replaced, drill out pop rivets, and install new absorber with nuts, bolts, and locking washers.
4. To install, reverse above procedure.

REAR BUMPER

Removal

1. Remove left hand rear quarter trim panel.
2. Remove right hand rear quataer trim panel.
3. Remove spare tire assembly.
4. Remove rear center trim panel.
5. Remove right tail light assembly.
6. Remove left tail light assembly.
7. Remove tail light center piece.
8. Remove bumper cover lower retainers.
9. Remove right side bumper cover fasteners from inside of compartment.
10. Remove left side bumper cover fasteners from inside of compartment.
11. Remove bumper cover upper retainers.
12. Remove cover.
13. To dissasemble impact bar, proceed as follows:
    a. Remove bolts attataching impact bar to rear end panel.
    b. Remove rivets retaining pad to impact bar.
14. To install, reverse above procedure.

BUMPER ENERGY ABSORBING UNITS

The absorbing capability for both front and rear bumper systems is achieved through two energy absorbing devices in each bumper. These units convert the energy of an impact into heat and restoration. The energy absorbing device consists of two main subassemblies: the piston tube assembly and the cylinder tube assembly. The piston tube assembly is filled with an inert gas under pressure and consists of a bumper bracket, piston tube, orifice, seal, piston seal, piston, and stop-ring. The cylinder tube assembly is filled with a hydraulic fluid and consists of a frame bracket, cylinder tube, mounting stud, and metering pin.

Upon impact, as the energy absorber is collapsed, the hydraulic fluid in the cylinder tube is forced into the piston tube through the orifice. The metering pin controls the rate at which this fluid passes from the cylinder tube through the orifice and into the piston tube. This controlled passage of fluid provides the energy absorbing action.

The hydraulic fluid that is forced from the cylinder tube into the piston tube displaces the floating piston, compressing the gas behind the floating piston. After impact, the pressure of the compressed gas behind the floating piston forces the hydraulic fluid back into the cylinder tube assembly, extending the unit to its normal position.

Some front and rear bumpers (J and F Models) use a plastic honeycomb pad energy absorber (except J wagon rear bumper). This energy absorber will compress on impact, and both the energy absorber and the urethane fascia will return to their original shape. The energy absorber pad has no moving parts.

The J wagon rear bumper system uses a hydraulic energy absorbing unit, more commonly known as a "minisorber".

TESTING FRONT OR REAR ENERGY ABSORBER OPERATION

The right and left energy absorbing devices are to be diagnosed separately. The following checks are to be made on each unit:

1. Leakage

Some oil wetting may be visible due to the grease packed in the crimp recess. Therefore, a stain or trace of oil on the piston tube near the crimp is normal. However, if oil is dripping continuously from the crimp or the stud end of the unit, a leak is indicated and the unit should be replaced.

2. Damage

Check the bumper bracket, piston tube, frame bracket and cylinder tube for evidence of visible distortion. Scuffing of the piston tube will occur when the unit is stroked, and this is considered normal.

If there is obvious damage to the unit, it should be replaced.

3. On-Bench Test

a. Position energy absorber lengthwise in arbor press.

b. Using a suitable measuring device, note original position of unit, then use press to compress unit at least 3/8".

c. Release pressure and determine whether unit has returned to original position. If not, discard unit.

4. Inspection After Collision

If the collision was so severe that the bumper did not return to its original position, the energy absorber(s) will require replacing.

a. Stand clear of the bumper.

b. Provide a positive restraint, such as a chain or cable to hold the bumper in position.

c. **WEARING SAFETY GLASSES,** drill a small hole in the piston tube near the bumper bracket, Fig. 2, to relieve gas pressure.

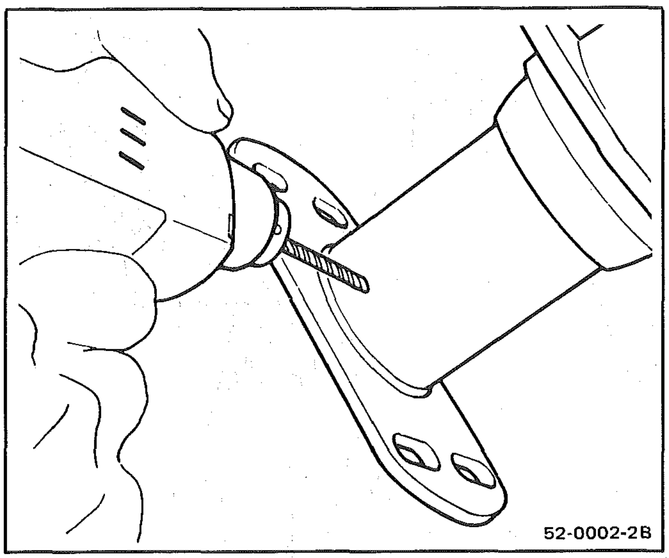


Fig. 2 Scrapping Energy Absorber

d. Remove the energy absorber(s) after gas pressure has been relieved.

CAUTION: Failure to observe the following procedures when handling energy absorbing devices may result in personal injury.

1. Do not apply heat to unit.
2. Do not weld near unit.
3. Do not attempt to repair a damaged unit. Always replace it with a new unit.
4. If a unit is bound-up as a result of a collision such that it cannot extend, take precautions to avoid spring-back when bending sheet metal.
5. If a unit is to be scrapped, relieve the gas pressure prior to disposal of the unit. Make an indentation with a center punch in the small cylinder section of the energy absorber, Fig. 1. Use a 1/8 inch drill to penetrate the small cylinder wall.

Alternate Scrapping Procedure

The following alternate procedure for deactivating the energy absorber may be used ONLY IF the absorber is in the extended position.

1. Mount energy absorber frame bracket in vise.
2. Using a 5/32" drift pin punch, drive sealing ball inward.

BE SAFE. PROTECT YOUR EYES. **WEAR APPROVED SAFETY GLASSES.**

1–STOP RING
2–SEAL
3–FLOATING PISTON
4–HYDRAULIC FLUID FILLED CYLINDER TUBE ASSEMBLY
5–MOUNTING STUD
6–METERING PIN
7–CYLINDER TUBE
8–ORIFICE
9–PISTON SEAL
10–FRAME BRACKET
11–PISTON TUBE
12–BUMPER BRACKET
13–SEALING BALL
14–GAS-FILLED PISTON TUBE ASSEMBLY
15–STOP RING
16–CYLINDER TUBE ASSEMBLY
17–HYDRAULIC FLUID
18–PISTON TUBE ASSEMBLY
19–FLOATING PISTON
20–DRILL AREA TO RELIEVE GAS PRESSURE
21–GAS

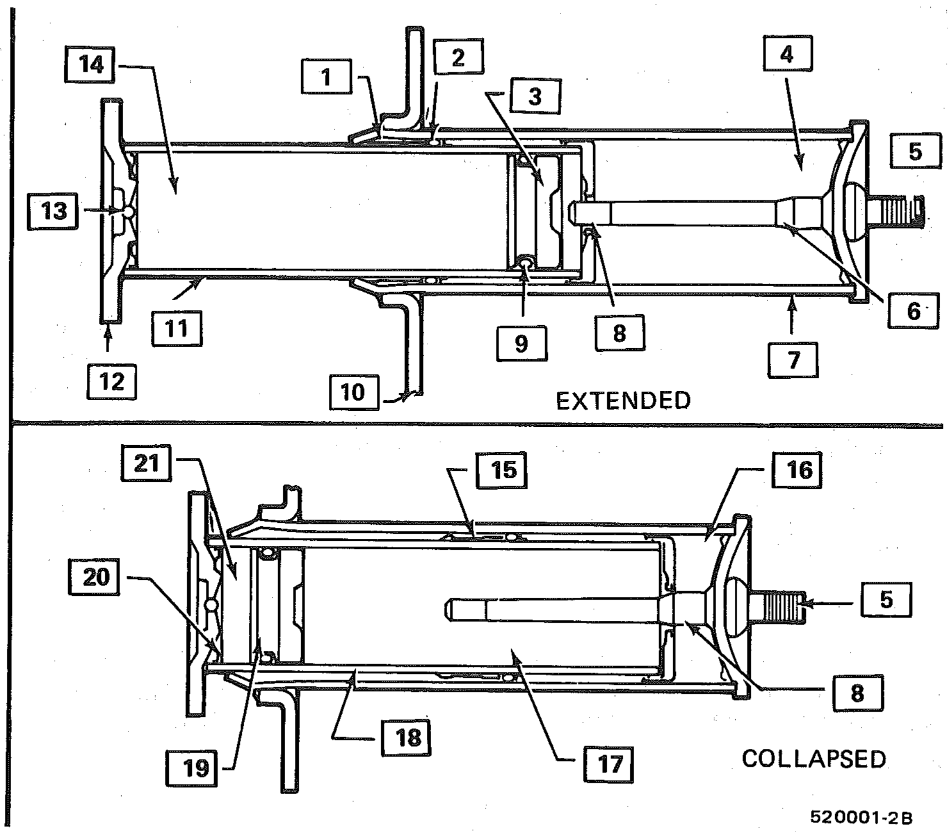


Fig. 1 Energy Absorbing Device

ON-VEHICLE SERVICE

1–PLATE ASM

2–BAR ASM

3–NUT

4–SHIM

5–RIVET

6–ABSORBER

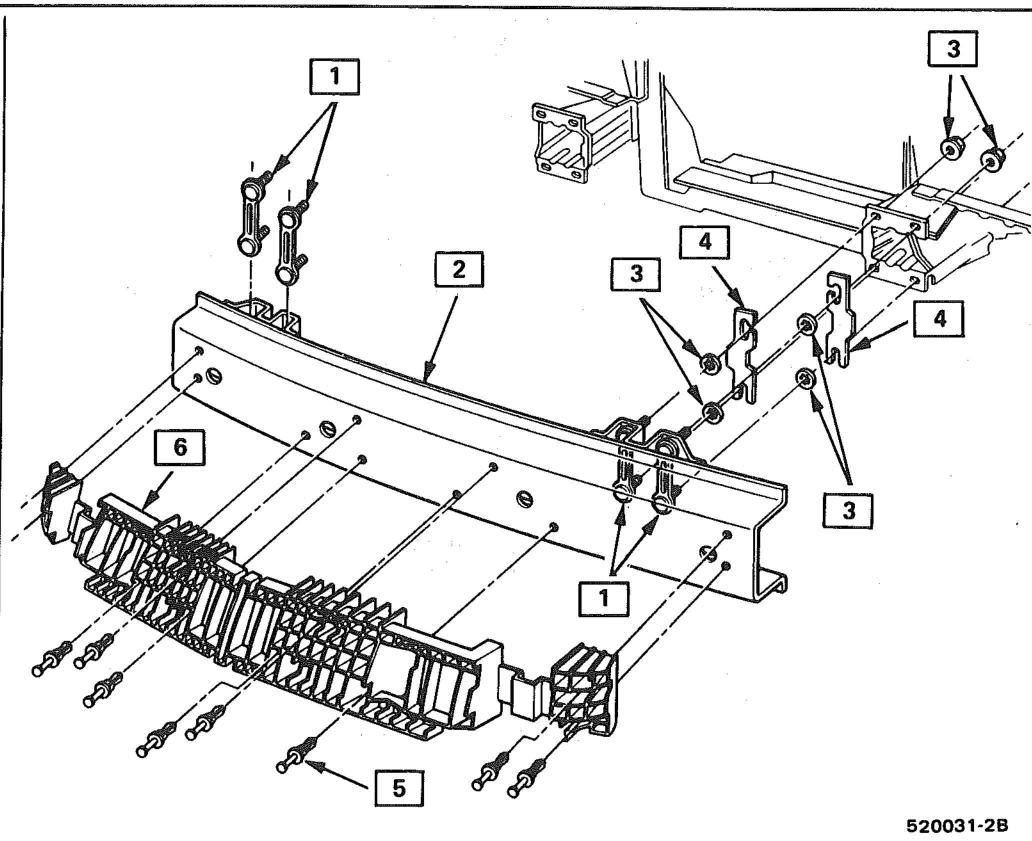


Fig. 601 Absorber and Bar Asm.

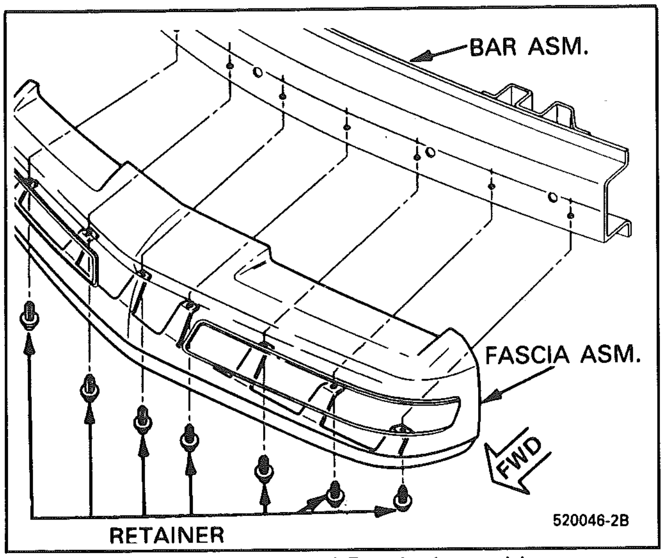


Fig. 602 Front End Fascia Assembly

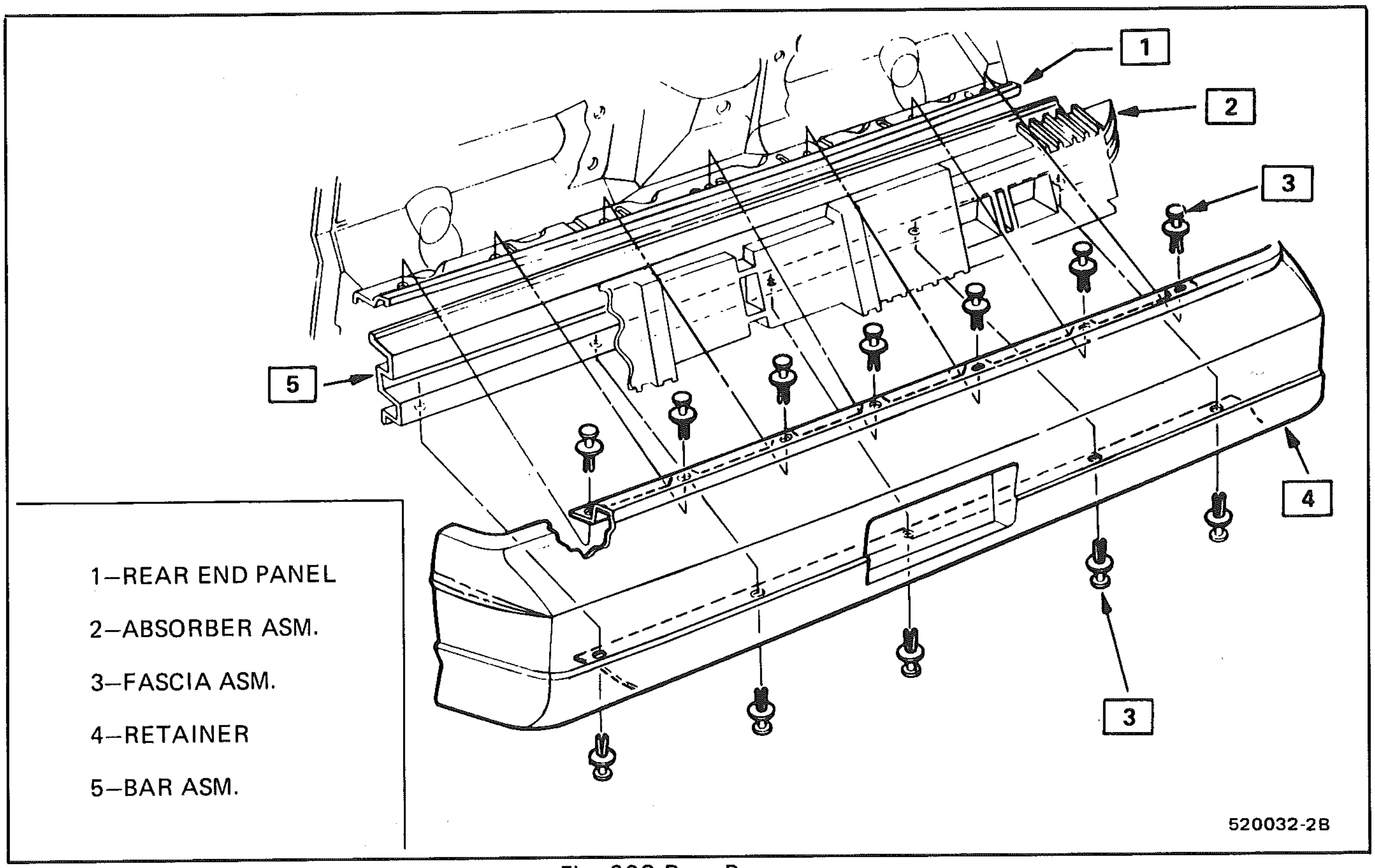


Fig. 603 Rear Bumper

TORQUE SPECIFICATIONS

Rear bumper fascia to quater panel	6 N•m (4.5 lb.ft.)
Front and rear bumper bar to body	27 N•m (20 lb.ft.)

SECTION 2C

CHASSIS SHEET METAL

NOTICE: These fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 0A.

CONTENTS

GENERAL DESCRIPTION

FASTENERS

Many aluminum components are used in the current models. Aluminum in contact with steel may corrode rapidly if not protected by means of special finishes or isolators.

Many of the fasteners used in the front sheet metal area have the new GM 6174M finish which will provide adequate protection. In some places, however, special fasteners are used in conjunction with aluminum components. These special fasteners are argent silver in order to more easily identify them from the standard metric fasteners which are a medium blue in color.

When replacing fasteners in the front sheet metal area, it is advisable to avoid substitution of otherwise similar fasteners in locations which should use GM 6174M type fasteners or special fasteners for aluminum components.

NOTICE: Failure to follow this precaution may result in premature corrosion of the sheet metal in the areas mentioned above.

ANTI-CORROSION MATERIALS

Anti-corrosion materials have been applied to the interior surfaces of some metal panels to provide rust resistance. When servicing these panels, areas on which these materials have been disturbed should be properly recoated with service-type anti-corrosion material.

SERVICE PROCEDURES

HOOD ASSEMBLY

The hood is composed of a single outer panel and an inner panel reinforcement. The hood may be either steel or aluminum.

Adjust

Figure 1

Slotted holes are provided at all hood hinge attaching points for proper adjustment — both vertically and fore and aft. Vertical adjustment at the front may be made by adjusting rubber bumpers up and down. For best appearance, make one adjustment at a time.

TO RAISE OR LOWER THE REAR corners of the hood for proper alignment to the fenders, and to insure contact with the hood side wedges, proceed as follows:

1. Loosen hinge-to-hood attaching screws.
2. Reposition hood assembly.
3. Tighten hinge-to-hood attaching screws to specifications.
4. If necessary, repeat procedure on opposite side of hood.

TO RAISE OR LOWER THE FRONT corners for proper alignment, proceed as follows:

1. Close hood firmly.
2. Determine the amount of adjustment necessary.
3. Open hood.
4. Raise or lower the adjustable hood bumpers as required.

FORE AND AFT adjustment can be accomplished as follows:

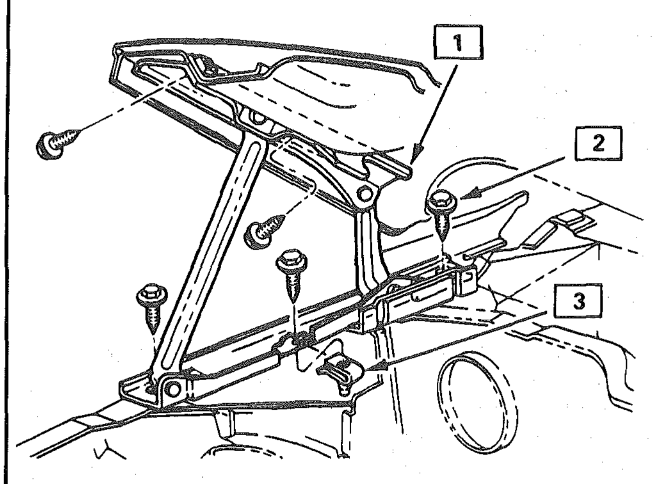
1. Loosen hinge to fender attaching screws.
2. Reposition hinge assembly.
3. Tighten hinge to fender attaching screws to specifications.
4. If necessary, repeat procedure on opposite side of hood.

HOOD HINGE

Figure 1

Hood hinges are fastened to the fender panel.

The hold-open position is provided by a hood hinge spring assist linkage assembly. This spring assist linkage is comprised of a single-arm elbow joint assembly combined with a small coil spring.



1–HINGE ASM.

2–BOLT/SCREW

3–NUT

520001-2C

Figure 1 Hood Hinge — Typical

Remove or Disconnect

1. Open hood.
2. Scribe line on hood inner panel and fender panel to indicate original hinge position.
3. Block hood on side where hinge is to be removed.
4. Prop hood open.
5. Remove hinge-to-hood attaching screws and hinge-to-fender attaching screws.
6. Carefully remove hinge and strut assembly.

Install or Connect

1. Mount new hinge on fender using scribed line for location, and tighten attaching screws.
2. Position hinge to hood using scribed line for location, install attaching screws and tighten.
3. Carefully close hood and check for proper alignment.
4. If hood is misaligned, measure amount of misalignment.
   a. Open hood.
   b. Loosen hinge at hood or fender and reposition to correct misalignment.
   c. Tighten hood-to-hinge attaching screws to specifications and repeat alignment procedure if necessary.

HOOD LATCH

The hood latch is a cable released, positive locking hood latch assembly located in the radiator support and baffle assembly, and locks with the hood-mounted striker. The hood release handle is located inside the car at the left side of the plastic shroud kick panel. After the release handle has been pulled, the hood can be fully opened by releasing the hand catch on the hood underside.

1. Using a 13mm (1/2″) socket and ratchet with 1/4″ drive, reach up between the outboard side of the radiator and grille, and remove the two hood release latch assembly retaining screws.
2. With the two screws removed, raise the hood.
3. With the hood up, the hood release latch assembly can be removed.
4. Reassemble the hood latch assembly to the radiator support assembly.
5. Replace or repair the hood release cable as necessary.

After proper positioning of the hood bumpers, hood height is automatically controlled by the vertically self-adjusting hood latch assembly. Proper hood alignment is essential for ease of latch operation.

Adjust

1. Loosen latch attaching bolts to finger-tight.
2. Push down on hood, holding the hood closed while pulling the release lever.

3. Allow hood to open, and tighten latch bolts in new location.

FENDER PANEL

An outer fender panel with a plastic inner panel is used. Care should be used in handling raw fenders due to the lack of fender rigidity prior to installation.

MOLDING REPLACEMENT

Body surfaces at molding areas must be cleaned thoroughly with suitable organic solvent immediately prior to installation to ensure adhesion. Do not allow adhesive surface of molding to come in contact with wet solvent, dirt, or foreign matter.

NOTICE: If heat source is used to condition moldings prior to installation, the source is to provide uniform heating, not to exceed 85°F.

Application is to be made in a clean area with ambient and body surface temperatures of at least 65°F.

The moldings are to be secured with two applications of a force of 20 pounds for the full length of each section using a roller or other suitable tool.

Any section of molding removed once in contact with the body surface must be replaced.

ALUMINUM PANEL REPAIR PROCEDURES

An aluminum hood (inner and outer panel) is used on some vehicles. An aluminum panel can be identified by checking it with a magnet, preferably in the front corners to avoid any possible damage to the paint. Aluminum will not attract a magnet.

Aluminum panels can be repaired successfully with only slight changes of materials and techniques commonly used to refinish steel panels. The necessary modifications fall into two categories: 1) metal preparation; and 2) painting.

Metal Preparation

1. Because aluminum is relatively easy to grind, care must be taken not to use overly coarse abrasive discs or excessive grinder speeds (greater than 2,000 rpm), both of which will cause excessive heat and unnecessary metal removal.
2. Surface scratches should normally be removed with 180 or 120 grit paper with scalloped edges. Hand sanding with 80 grit paper will usually be sufficient to remove excessive body filler or heavy scratches, again followed with 180 grit paper.

   NOTICE: Avoid scratching aluminum when sanding with 80 grit paper by hand.

3. Foam backed pads are recommended for grinders used on aluminum, rather than the stiffer rubber pads used for mounting abrasive discs used on steel. The foam pad helps to reduce heat build-up and improves blending for feathering.
4. Localized heat, generated by grinding, can be minimized by the use of a grease stick, such as Formax F-160 or equivalent. This does, however, tend to load up the grinding discs quickly, which should be periodically cleaned by rotating them against a brush wetted with solvent.
5. If out-dings or minor convex defects need to be filed, it is recommended to use a round edge, double cut, flexible file with 22 teeth per inch overlaid with 52 teeth per inch (such as Nicholson #50-412 or equivalent).

   NOTICE: Keep file clean so that chips do not scratch aluminum.

The use of heat is not recommended, since the structural characteristics of aluminum are noticeably affected by heat. A bent or buckled aluminum hood, which exhibits strain cracks either before or after straightening, should be replaced.

Both steel and aluminum panels can be metal prepped and repaired with two-part polyester filler materials in the same number of operations. The only differences are that less aggressive type files and abrasive discs should be used, with care being taken not to overheat the aluminum.

Painting

Painting procedures for aluminum panels differ very little from those used on steel panels. Two precautions should, however, be observed:

1. Alkaline base paint removers are not recommended and should not be used.
2. Aluminum also requires a chemical cleaner such as DuPont 225S, Ditzler DX-533, or equivalent be used on bare metal to remove contaminants and corrosion. After cleaning, a conversion coating such as DuPont 226S, Ditzler DX-503 or equivalent should be applied to promote adhesion.

Beyond these considerations, painting aluminum panels should present no increases in difficulty or changes in procedure and technique.

PAINTING AND REPAIRING NONMETAL EXTERIOR PARTS

Fiberglass/ABS Plastic Panel Repair

A Plastic Solder Repair Kit can be used to repair cracks, dents, or pits in fiberglass or ABS panels. A Glass Woven Cloth should be installed on the under side of a crack in the panel to structurally reinforce the panel. The following procedure can be used to repair the panels:

1. With a lacquer removing solvent, remove paint from damaged area down to the fiberglass or ABS material.
2. Scuff-sand area surrounding damaged area to provide a good bonding surface.

3. Clean area to be repaired.
4. Mix and apply the repair material by using a putty knife or rubber squeegee.
5. Work the material into the repair and build up the desired contour. For deep filling, and on vertical surfaces, several layers may be required.
6. Feather-sand damaged area with No. 200 sandpaper and finish-sand with No. 320 sandpaper.
7. Prepare repaired area for refinishing. Refinish with acrylic lacquer as described below.

PAINTING FIBERGLASS/ABS PLASTICS

1. THOROUGHLY CLEAN the entire surface area, using Naphtha or equivalent solvent, to insure a surface free of contamination.
2. To promote paint adhesion, a light scuff-sanding of the surface with #400-grit sandpaper is recommended.
3. Repeat cleaning of the surface.
4. Color coat with acrylic lacquer for proper color match.
5. Allow to dry thoroughly, rub out and polish.

PAINT REFINISHING PROCEDURES FOR URETHANE, P.V.C. AND T.P.R. SURFACES

Urethane material will withstand minor impact and the resultant damage, such as occurs in parking lots, by recovering its original shape. Its Endura paint film responds to impact in a similar manner without cracking or splitting. If, however, an area of damage in the Urethane bumper or panel does not recover its shape, or the surface is punctured, gouged or torn, a repair system has been developed to restore the original shape and appearance of the urethane-base material.

CAUTION: There are a number of paint systems available for service use; however, many require additives containing isocyanates. It is essential that all recommendations and warnings listed on the container label for materials selected be followed.

CAUTION: If the paint system selected specifies an additive containing isocyanates, it is mandatory that adequate respiratory protection be worn. An example of such protection is an air line respirator with a full hood or half mask. If not avaiable, use a vapor/particulate respirator that the respirator supplier recommends as effective for isocyanate vapors and mists (unless local regulations prevail).

Such protection should be worn during the entire painting process. Persons with respiratory problems, or those allergic to isocyanates must not be exposed to isocyanate vapors or spray mist.

REPAIRING & REFINISHING URETHANE BUMPERS AND FRONT END PANELS

Required Materials:

1. 3M No. 8101 Structural Adhesive, or equivalent.
2. Color Coat — Dexlar (DuPont) Flexible Finish Enamel Color Coat, or Ditzler Elastomeric Enamel Color Coat or equivalent.
3. Additive — DuPont 792S Centari Hardener, or Ditzler DXR-80 Delthane Additive or equivalent.
4. Thinner — DuPont 3608S Acrylic Lacquer Thinner, or Ditzler Delstar DTR 601 Acrylic Enamel Reducer or equivalent.

NOTICE: Use the same brand name materials for the color coat, additive, and thinner.

5. A wax and adhesive cleaner.

Equipment Needed:

1. Wooden spatula (enclosed in repair package).
2. Heat lamp.
3. 36 grit 180-A, 240-A, and 320-A grit disc sandpaper.
4. Random orbital-type sander.
5. Body repair tape.
6. Suction spray gun (same nozzle and air cap combination as used for acrylic).

Repair Procedure

There are three types of repairable damage on urethane material. They are a puncture, a gouge and a tear.

Following is the basic repair procedure for repairing these types of damages.

1. Clean the damaged area with 3M #8984 General Purpose Adhesive Cleaner or equivalent. If the damage is through the thickness of the part, clean both sides.

   Grind away damaged material with a 36 grit disc. Feather edge the paint around the damage using a 180A grit disc.
2. If the part has a puncture or tear, file or rout out the area where joint line will be. Bevel the edge of the part with the open edge towards the side to be filled (fill from the side with easiest access). Clean the repair area with a clean dry rag.
3. Apply 3M #6935 Auto Body Repair Tape, or equivalent, to the underside of the repair area to backup the repair material.

NOTICE: Before going to the next step, be sure all of the paint (both topcoat and primer) has been removed from the area where the structural adhesive is to be applied.

4. Mix 3M #05900 Structural Adhesive, or equivalent, according to instructions on package. For best results, use a 2-step application. First, mix only enough for a thin coat.

   Mix adhesive thoroughly with mixing stick enclosed in package, or a putty knife. HINT: If you use the mixing stick, bevel the edge to form a straight, rather than a rounded surface.
5. Apply adhesive over entire area with a rubber squeegee. Step A: Apply a light coat over entire area and allow to dry. Step B: Mix and apply the contour. Spread from edges of repair towards center, filling all low areas.
6. Hand level with surrounding area using a 240-A grit disc. Check for voids and low areas. If necessary mix up more adhesive and apply to low areas.

   Allow each coat of adhesive to dry before applying subsequent coats. Drying can be quickened by application of low heat (for example, a low power heat lamp). DO NOT OVERHEAT. After final coat, sand using a 320-A grit disc.
7. Scuff-sand entire panel with a 320 grit disc by hand or with a random orbital type sander. Wipe entire area to be painted with a clean dry cloth and/or tack cloth per paint manufacturer's instructions.
8. Paint panel using Inmont R-M Alpha-Cryl, or with R-M 891 Urethane Catalyst Flex Agent, or the Ditzler Elastomeric Enamel Flexible Paint System (DE type), or equivalent urethane paint systems. Follow label directions.

Coloring Procedure:

1. THOROUGHLY CLEAN the entire surface area with 3919S Prepsol (DuPont) or equivalent solvent to insure a surface free of contamination.
2. To promote paint adhesion and insure a smooth surface, a light scuff-sanding with #400-grit sandpaper (wet or dry) is recommended.
3. Repeat cleaning of the surface.
4. Mask off areas of car not to be painted using masking tape and paper.
5. Thoroughly mix the color coat, additive and thinner as suggested on the label directions.

   NOTICE: Mix only that which is needed, noting that pot life is 2-3 hours.
6. Using 35 lbs. of pressure at the gun, spray panel with 2 or 3 coats (depending on the need) allowing 2-3 minutes flash time between each coat. Use a final mist coat for metallics.
7. Allow paint to cure 2-4 hours before handling.
8. COMPOUNDING reduces the gloss. For this reason rubbing compound should be used **only if a reduction of gloss is desired.**

PAINT COLOR MATCHING

If a color coat mismatch between the original color and the repair material is encountered during paint repair, a closer color match can be accomplished by following these recommendations. Assistance may also be solicited from the manufacturing representative of the paint supplier.

1. Stir the paint thoroughly both before and after thinning.
2. If the repair is too light and metallic looking after spraying a couple of coats, it can be darkened by spraying several wet coats. One or more of the following adjustments can be made to produce a wetter spray:
   a. Open fluid feed valve more.
   b. Reduce size of pattern.
   c. Decrease gun distance.
   d. Slow down stroke.
   e. Allow less flash time between coats.
   f. Care should be taken to prevent flooding and mottling.
3. If the repair is too dark, spray several coats that are lighter and more metallic looking. Reverse the above adjustments using one or more of the following:
   a. Close fluid valve slightly.
   b. Increase the size of the pattern.
   c. Increase gun distance.
   d. Speed up stroke.
   e. Increase flash time between coats.
   f. Care should be taken, as dry spray increases orange peel.
4. When matching a difficult color that has a line of definition, such as a panel or spot repair on an edge, blend the fourth and fifth coats into the adjacent panel.
5. Experienced painters generally have the ability to tint colors for incorrect color hue. Tinting guides are available from the various paint manufacturers for those who have the base tinting colors and the ability to tint colors to match.

REMEMBER — The true color of metallics will not come through until the finish has been compounded and buffed.

Painting Primed Service Replacement Urethane Panels

Follow Steps 1 thru 8 under "Coloring Procedure."

PROPER IDENTIFICATION AND PAINTING OF INTERIOR PLASTIC TRIM

Interior plastic trim parts are normally supplied in only one color. It is necessary to paint most parts. Most vinyl headlinings and soft vinyl seat cushion and back cover assemblies are furnished in colors.

Instructions on how to identify each paintable plastic part, and how to apply the available paint materials are as follows:

Paintable plastic trim components, as used on General Motors interiors, can be divided into three general types:

- Polypropylene Plastic
- ABS Plastic
- Vinyl Plastic

Excluding the soft vinyl seat cushion and seat back trim cover assemblies, the plastic used most widely on the interior of bodies is "POLYPROPYLENE" and, as noted later, requires special refinishing materials and procedures. Therefore, it is important for a painter to be able to identify each plastic in order to paint it satisfactorily. The purpose of the following tests is to determine the identity of a given plastic so that the proper paint procedure and refinishing materials will be used.

TEST PROCEDURE

Polypropylene, ABS or Vinyl Plastic

1. From a hidden backside portion of the part, remove a sliver of plastic with a sharp blade.
2. Holding the sliver with needle-nose pliers, put it to a flame and observe whether or not any smoke is given off when burning.
3. ABS PLASTIC will give off a HEAVY BLACK SMOKE, and POLYPROPYLENE will burn clean.
4. However, if a sliver gives off OTHER THAN HEAVY BLACK SMOKE, it is either DIRTY POLYPROPYLENE OR IS VINYL. To determine which it is, the following burn test should be made with the hot tip of a clean copper wire.
5. Heat the tip of the copper wire to a "red-glow" with a propane (gas) torch.
6. Touch the heated wire to a hidden portion of the plastic in question, to get some of the plastic on the wire.
7. Return the wire, with its now plastic-coated tip, to the flame and observe for flame color.
8. If the flame given off from the wire is of the GREEN-TURQUOISE-BLUE RANGE, then the PLASTIC IS VINYL. (Any other color flame would indicate the material is dirty polypropylene.)

PAINTING INTERIOR PLASTIC PARTS

Before painting, always check the body number plate of the car for the correct trim code color number for that model year. The body number plate is located on the upper horizontal surface of the shroud. Interior color is color keyed to this "Trim Combination Number" (TR) on the body plate. Each paint supplier provides an interior color chart which identifies their stock number, color name, gloss factor and trim combination number for each "conventional" interior color. Charts listing "vinyl" interior colors are also provided.

"CONVENTIONAL" interior acrylic colors are designed for use only on hard trim parts, such as:

1. Steel parts (primer or sealer required on new service parts).
2. Hard POLYPROPYLENE plastic ("Special Primer" required — See GM Parts Catalog).
3. Hard ABS plastic (NO primer necessary).

"VINYL" interior colors are designed for soft and/or flexible trim parts, such as instrument panel cover pad assemblies, upper door trim pad assemblies, molded headlining panels, head rests and assist handles. These colors require a final top coat of clear vinyl spray, with instrument panel pads requiring a "nonglare" clear final top coat. Other trim parts require a degree of gloss to match similar adjacent parts.

POLYPROPYLENE PLASTIC PARTS

The system for painting polypropylene parts involves the use of a special primer. It is essential that the service part be first primed with a coating of special POLYPROPYLENE PRIMER (Detroit Autobody #PP-2250, or equivalent) according to factory recommendations on the can. Because the primer acts as a bonding agent between the plastic and acrylic lacquer, failure to use it will result in color coat "lifting" and/or "peeling" problems. After priming, the part can be color coated with conventional interior acrylic lacquer.

PROCEDURE

1. Wash part thoroughly with a cleaning solvent ("Acryli-Clean," "Prep-Sol," or equivalent) that will not leave any greasy film.
2. Apply a thin, wet coat of the special polypropylene primer according to label directions on can.

   Wetness of primer is best determined by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges. Allow the primer to flash dry ONE (1) MINUTE MINIMUM and TEN (10) MINUTES MAXIMUM. (If the flash period before color coating should extend beyond ten minutes, the primer MUST be reapplied to avoid previously mentioned adhesion problems.)

3. During the above flash time period (1 to 10 minutes), apply appropriate "conventional" interior acrylic lacquer color as required and allow painted part to dry for 4 to 5 hours before installing on car.

RIGID OR HARD ABS PLASTIC PARTS

Rigid or hard ABS plastic requires no primer. "Conventional" interior acrylic lacquers adhere satisfactorily to hard ABS plastics.

Procedure

1. Wash part thoroughly with a cleaning solvent (Acrylic-Clean, Pre-Kleano, Prep-Sol or equivalent) to remove any dirt or grease.
2. Apply appropriate "conventional" interior acrylic lacquer color. Apply only sufficient color for proper hiding to avoid washout of "grain" effect.
3. Allow to dry and then install part.

VINYL AND FLEXIBLE (SOFT) ABS PLASTIC PARTS

The outer cover or skin material of "flexible" instrument panel cover (pad) assemblies is made of an ABS/PVC plastic blend. The same is true of many "padded" door trim assemblies. The soft cushion padding under the I.P. skin is urethane foam plastic. The most widely used "flexible" vinyls (poly vinyl chloride) are coated fabrics, such as used in seat trim, some door trim assemblies, molded headlining panels and sun visors. Most head rests are "flexible" vinyls. Examples of "hard" vinyls are: door and front seat back assist handles and coat hooks.

The paint system of vinyl and flexible ABS plastic involves the use of interior "vinyl" color and a clear vinyl top coat.

Procedure

1. Wash part thoroughly with a vinyl cleaning and preparation solvent ("Vinyl Press" — Ditzler, "Vinyl Prep Conditioner" — Detroit Autobody or equivalent) to remove greasy film or silicone. Wipe off cleaner while still wet with clean, lint-free cloth.
2. Immediately after wiping face dry, apply interior "vinyl" color in wet coats allowing sufficient flash time between coats (see label directions on can). Use proper "vinyl" color as designated by interior trim combinations. Apply only sufficient color for proper hiding to avoid washout of "grain" effect. No primer or primer-sealer is required.
3. Before the final vinyl color coat has dried, apply two coats of clear vinyl top coat spray (instrument panels will require the "nonglare" clear top coat). Do not allow the first spray coat to completely dry before spraying on the second. Use top coat with appropriate gloss level to match adjacent similar components. This clear coat is necessary to control the gloss requirement and prevent "cracking" (rubbing-off) of the color coat after drying.
4. Allow to dry according to label directions before installing part.

ON-VEHICLE SERVICE

CONCEALED HEADLIGHTS

The concealed headlights used on this model are electrically operated. When the headlights are turned on, solid state circuitry activates the actuators. This same circuitry senses when the actuators stop moving and removes the ground to deactivate the actuators. When the headlights are turned off, the actuators run in opposite direction closing the headlight doors.

Should an electrical failure occur in the headlight circuit, they may be raised manually by rotating the knob on the actuator in a counterclockwise direction until the headlights are fully open. The headlights may be lowered by rotating the knob on the actuator in a clockwise direction until the headlights are fully closed.

For electrical circuit information and diagnosis, refer to Section 8A of this manual.

If it is desired to raise the headlights with the lights off, either of the following procedures may be used:

1. Turn the lights on. After the headlights are open, disconnect the electrical connections at the actuator connectors. Turn the lights off. The headlights will now remain in the open position.
2. Turn the parking lights on. Depress the headlight rocker switch lightly. The headlights may then be raised "up" fully with the lights off.

Adjust

Because of the number of adjustments possible and the number of attaching points of the concealed headlight body assembly (9), only those attachments which control the adjustment desired should be loosened. Make one adjustment at a time.

NOTICE: The headlight door does NOT have slotted mounting holes and therefore is not adjustable by itself. This insures proper clearance between the headlight door and the hood and fenders in both the raised and lowered positions. The entire headlight body assembly must be adjusted to achieve the desired appearance and fit. Care should be exercised when adjusting the headlight body assembly. Severe hammer blows could damage the die cast aluminum headlight body assembly.

TO RAISE OR LOWER the headlight body assembly, proceed as follows:

1. Open hood.
2. Raise headlights.

3. Remove headlight bezel.
4. If necessary, move battery rearward to gain access to rear screw.
5. Lower headlights.
6. Loosen two body screws and adjust headlight body.
7. If a satisfactory appearance is still not obtained, remove lower air deflector to gain access to number 1 and number 2 screws.
8. Loosen two body screws and adjust headlight body.
9. Repeat procedure, if necessary, to obtain a satisfactory appearance.
10. Re-position battery and tighten hold-down screw to specifications.
11. Install lower air deflector.
12. Install headlight bezel.

TO SET FRONT TO REAR GAP between headlight door and hood, proceed as follows:

1. Open hood.
2. Raise headlights.
3. Remove headlight bezel.
4. Lower headlights.
5. Loosen two body assembly screws and adjust headlight body assembly.
6. If a satisfactory appearance is still not obtained, remove lower air deflector to gain access to two lower screws.
7. Loosen two lower screws and adjust headlight body assembly.
8. Repeat procedure, if necessary.
9. Install lower air deflector.
10. Install headlight bezel.

TO SET SIDE-TO-SIDE GAP between headlight door and hood and headlight door and fender, proceed as follows:

1. Open hood.
2. Raise headlights.
3. Remove headlight bezel.
4. If necessary, move battery rearward to gain access to rear screw.
5. Lower headlights.
6. Loosen three body screws and adjust headlight body.
7. If a satisfactory appearance is still not obtained, remove lower air deflector to gain access to two lower screws.
8. Loosen two lower screws and adjust headlight body.
9. Repeat procedure, if necessary.
10. Re-position battery and tighten hold-down screw to specifications.
11. Install lower air deflector.
12. Install headlight bezel.

TO SET CONTOUR of headlight door to hood, proceed as follows:

1. Open hood.
2. Raise headlights.
3. Remove headlight bezel.
4. Lower headlights.
5. Loosen two (2) screws and adjust headlight body assembly.
6. If a satisfactory appearance is still not obtained, remove lower air deflector to gain access to two lower screws.
7. Loosen two lower screws and adjust headlight body assembly.
8. Repeat procedure, if necessary.
9. Install lower air deflector.
10. Install headlight bezel.

HEADLIGHT BODY ASSEMBLY

Remove or Disconnect

1. Rear headlight door attaching screws.
2. Raise headlight doors.
3. Headlight bezel attaching screws.
4. Front headlight door attaching screws and remove headlight door.
5. Electrical connection at bulb.
6. Lower air deflector (one side only).
7. Headlight body assembly attaching screws and disconnect electrical connection at actuator connector.
8. Link.
9. Actuator crank arm.
10. Actuator retaining screws and remove actuator.
11. Unhook headlight capsule lower retaining spring and remove headlight capsule assembly.
12. Headlight body assembly attaching brackets and fasteners.

Install or Connect

1. Headlight body assembly attaching brackets and fasteners.
2. Headlight capsule lower retaining spring and install headlight capsule
3. Acuator retaining screws and install actuator.
4. Actuator crank arm.
5. Link.
6. Headlight body assembly attaching screws and connect electrical connection at actuator connector.
7. Lower air deflector (one side only).
8. Electrical connection at bulb.
9. Front headlight door attaching screws and install headlight door.

10. Headlight bezel attaching screws.
11. Lower headlight doors.
12. Rear headlight door attaching screws.

ACTUATOR

Remove or Disconnect

1. Battery.
2. Raise headlight door manually.
3. Headlight bezel attaching screws.
4. Pry off link assembly.
5. Actuator crank arm attaching screw. Support the crank arm during removal so as not to damage the actuator.
6. Actuator electrical connector.
7. Actuator attaching screws and remove actuator.

Install or Connect

1. Actuator attaching screws and install actuator.
2. Actuator electrical connector.
3. Actuator crank arm attaching screw.
4. Link assembly.
5. Headlight bezel attaching screws.
6. Battery.

HOOD HINGE

Hood hinges are fastened to the fender panel. Two gas struts are used (one at each hinge); both ends of which are fastened to the front portion of the hinge assembly. This construction provides hold-open power. Several struts are used depending upon hood material and configuration. Make certain both struts have the same color coding if the struts are to be replaced.

FENDER PANEL

An outer fender panel with a plastic inner panel is used. Care should be used in handling raw fenders due to the lack of fender rigidity prior to installation. See the illustrated service procedures for installation.

Remove or Disconnect

1. Raise car part way on hoist.
2. Lower air deflector attaching screws and push-in retainer to wheelhouse and remove both sides of air deflector.
3. Fascia to fender attaching nuts.
4. Wheelhouse to fender inner panel attaching screws.
5. Lower fender brace attaching screws.
6. Lower rear fender attaching screw.
7. Hood hinge to fender attaching screws and prop hood open.
8. The upper fender attaching screws.
9. Antenna escutcheon from fender.
10. Side marker lamp electrical connection and remove the fender from the vehicle.
11. Strip the fender of the side marker lamp, fender wheelhouse, fasteners and moldings.

Install or Connect

To install, reverse removal procedure.

FRONT END PANEL

Remove or Disconnect

1. Raise car part way on hoist.
2. Lower air deflector attaching screws and push-in retainer to wheelhouse and remove both sides of air deflector.
3. Fascia to fender attaching nuts.
4. Fascia to reinforcement push-in retainers.
5. Lower car.
6. Parking lamp attaching screws.
7. Upper reinforcement attaching screws and remove front end panel.
8. Left and right grilles.
9. Front end panel reinforcement attaching screws and fasteners from fascia.

Install or Connect

To install, reverse removal procedure.

FIREBIRD AERO ACCESSORIES

DOOR LOWER AIR DEFLECTOR

Remove or Disconnect

1. All door trim pad hardware.
2. Loosen bottom and sides of door trim pad. Do not remove pad.
3. Gently lift bottom of door trim pad to gain access to nuts.
4. Three nuts (#1) from inside door panel.
5. Two external nuts (#2) from door panel.
6. Deflector.

NOTICE: If studs that are attached to the deflector come out with the nut, they can be reinstalled in the deflector. Remove nut from stud and reinstall stud in deflector.

Install or Connect

To install, reverse removal procedure.

ROCKER PANEL AIR DEFLECTOR

Remove or Disconnect

1. Five top screws (#1).
2. Hoist car.
3. Seven bolts holding rocker panel rubber air deflector (#2) and remove.
4. Seven screws holding rocker deflector to bottom of rocker panel (#3).
5. Two screws holding rear rocker deflector to rear wheel opening (#4).
6. Five push type fasteners at the lower rear of the wheel well splash shield, lift shield to gain access to the two forward nuts.
7. Two nuts (#5) from rocker deflector front to fender.
8. Rocker deflector.
9. Nine screws holding rocker panel deflector support.
10. Support.

Install or Connect

To install, reverse removal procedure.

REAR BUMPER FASCIA EXTENSION

Remove or Disconnect

1. Hoist car.
2. Drill out eight fascia extension to fascia rivets (#1) (four each side).
3. Four bolts from fascia extension to lower quarter panel (#2).
4. Five (each side) push clips from fascia to support (#3).
5. Four screws from rear fascia extension to fender (#4).
6. Lower car.
7. Right side trunk trim and spare tire.
8. Rear trim panel.
9. Left trim panel.
10. Right and left side fascia and fascia extension nuts (six each side) (#5).
11. Right and left tail lamp wing nuts and remove housing.
12. Seven fascia push nuts and disconnect electrical connector for license plate (#6).
13. Rear bumper fascia from car.
14. Twelve (six each side) fascia extension to fascia retaining nuts and remove fascia extension (#7).

Install or Connect

To install, reverse removal procedure.

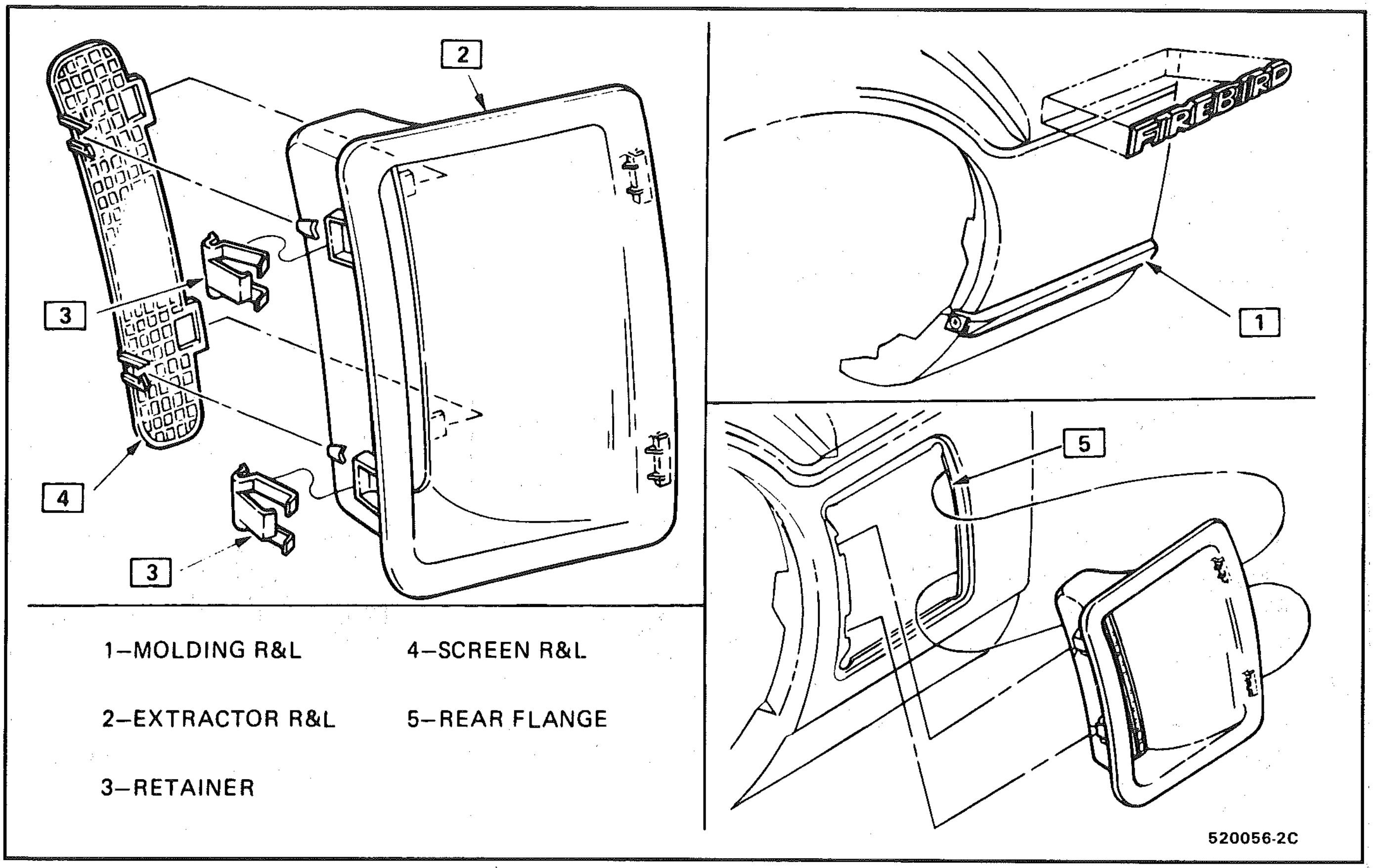


Figure 2 Front Fender Ornamentation

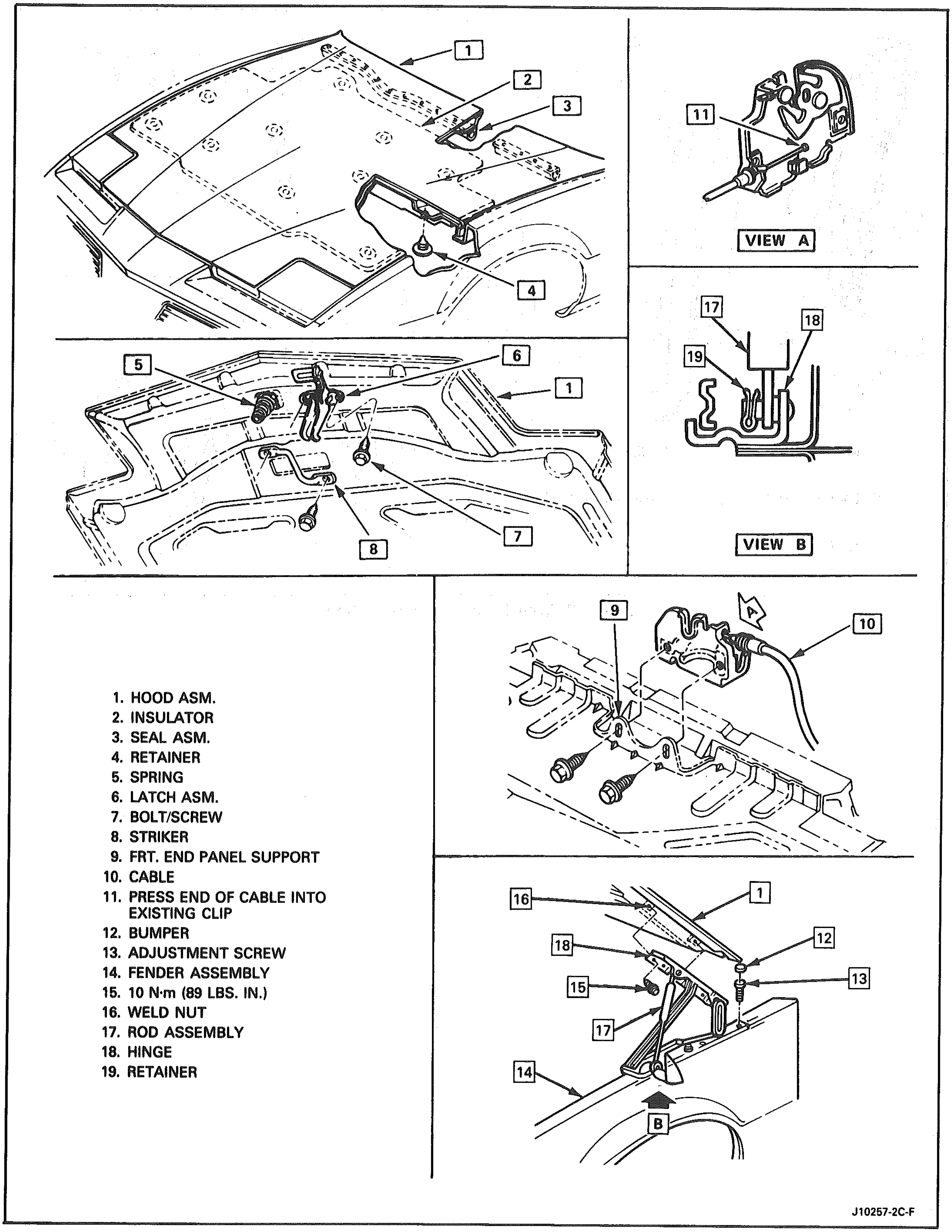
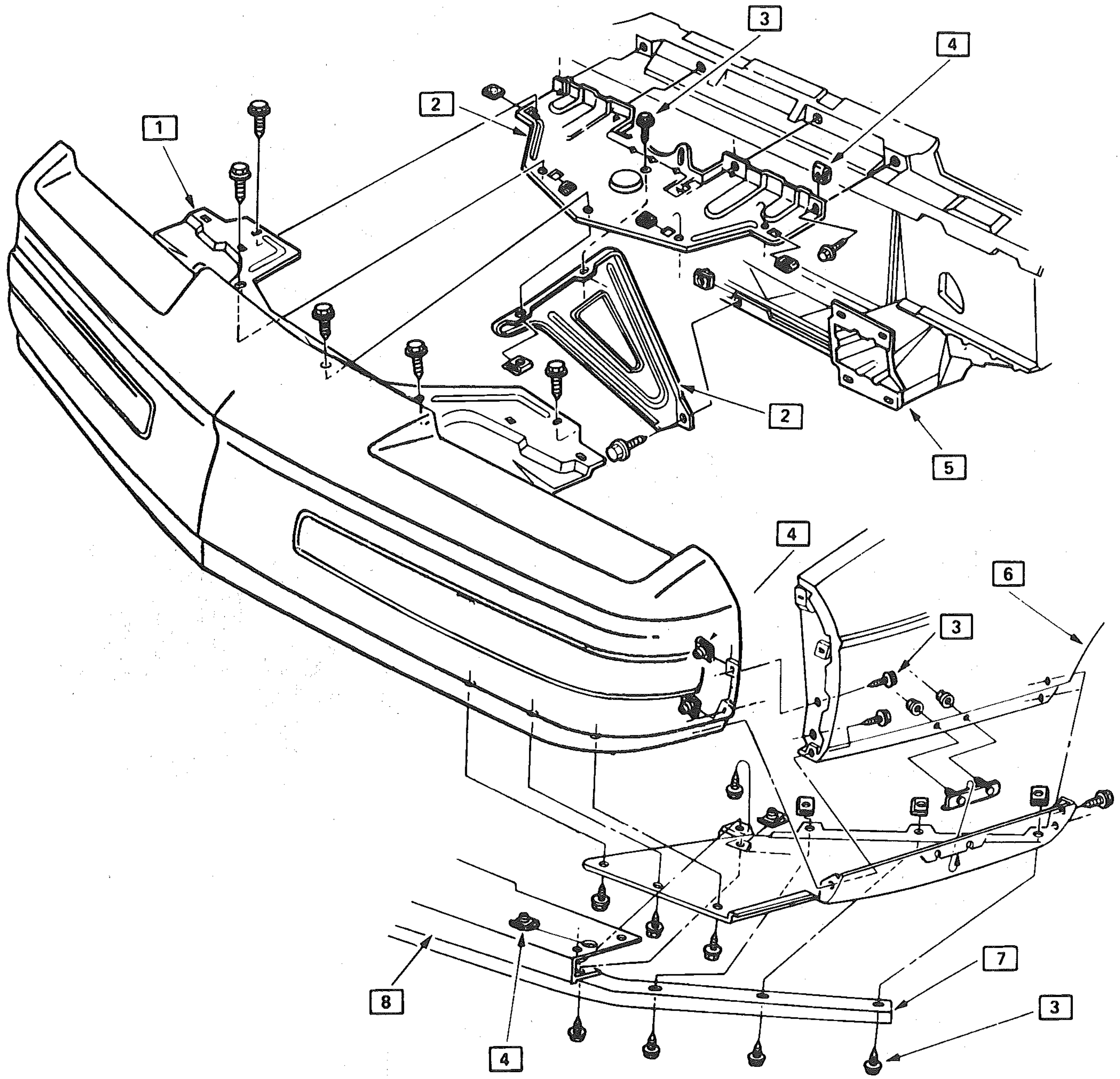


Figure 3 Hood and Fenders



1—REINFORCEMENT ASM.
2—SUPPORT
3—BOLT/SCREW
4—NUT
5—FRAME
6—FRONT FENDER ASM.
7—LOWER DEFLECTOR
8—FRONT DEFLECTOR
9—FASCIA,
FRONT END PANEL ASM.

J10258-2C-F

Figure 4 Front End Trim

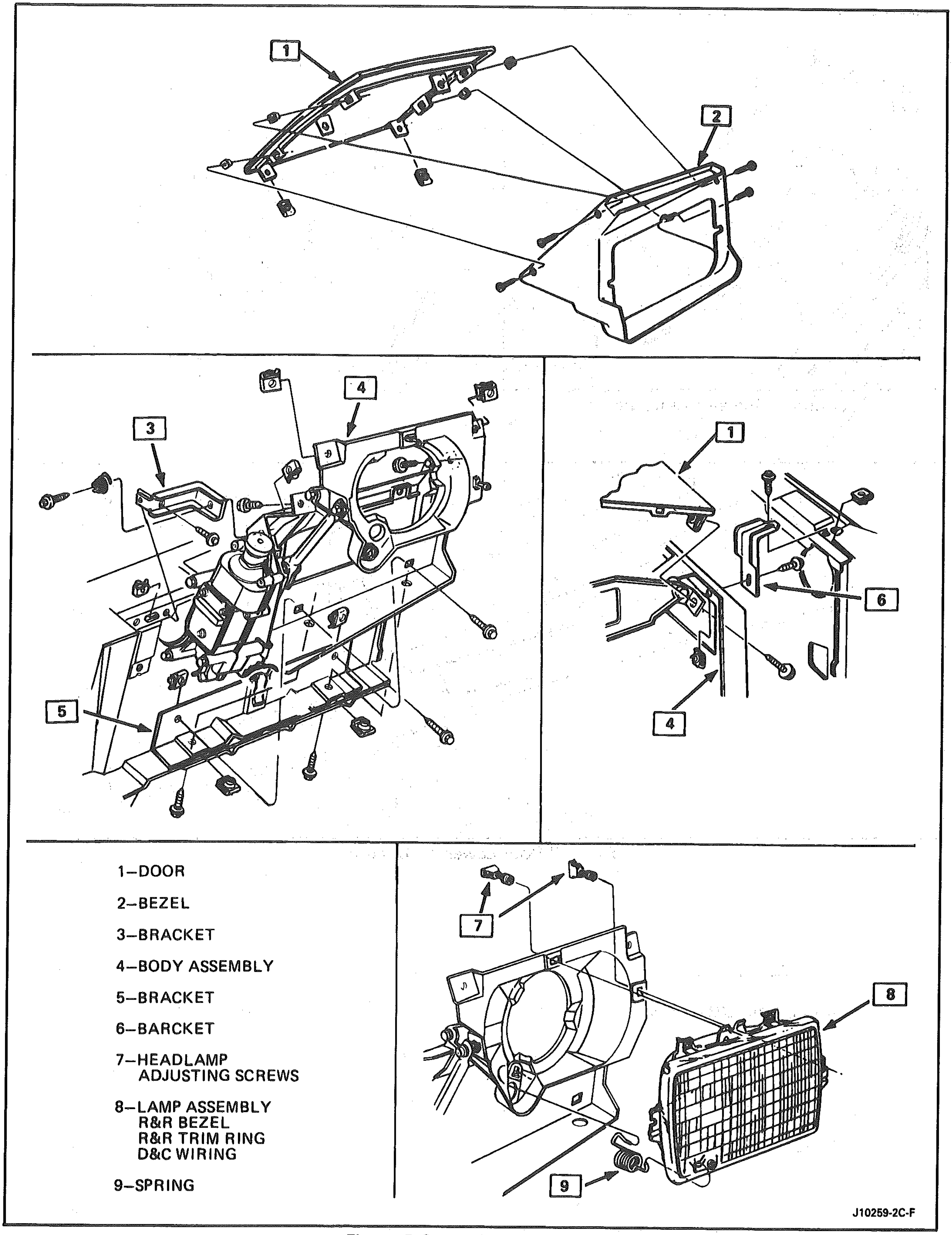


Figure 5 Concealed Headlights

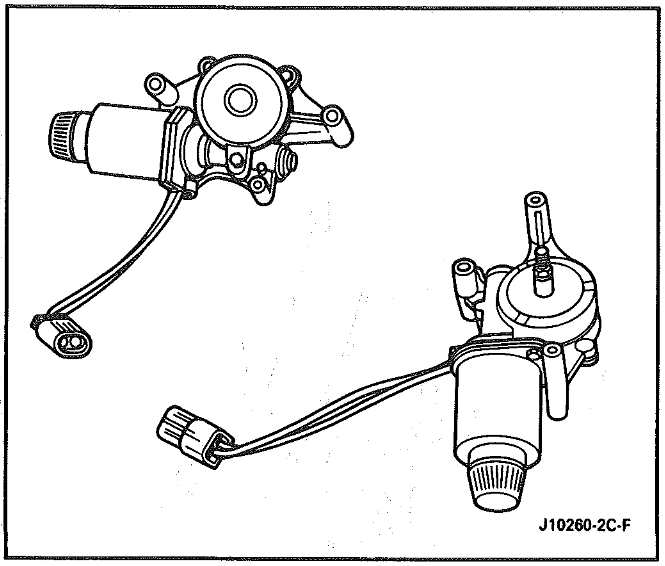


Figure 6 Actuator Assembly

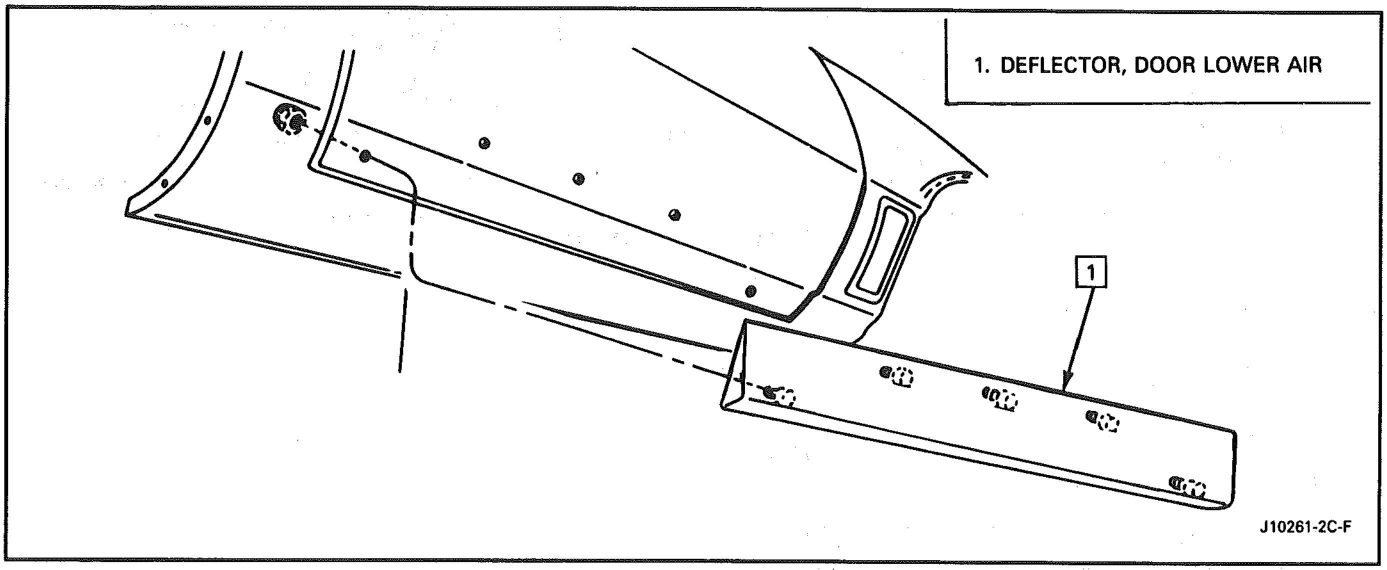


Figure 7 Door Lower Air Deflector

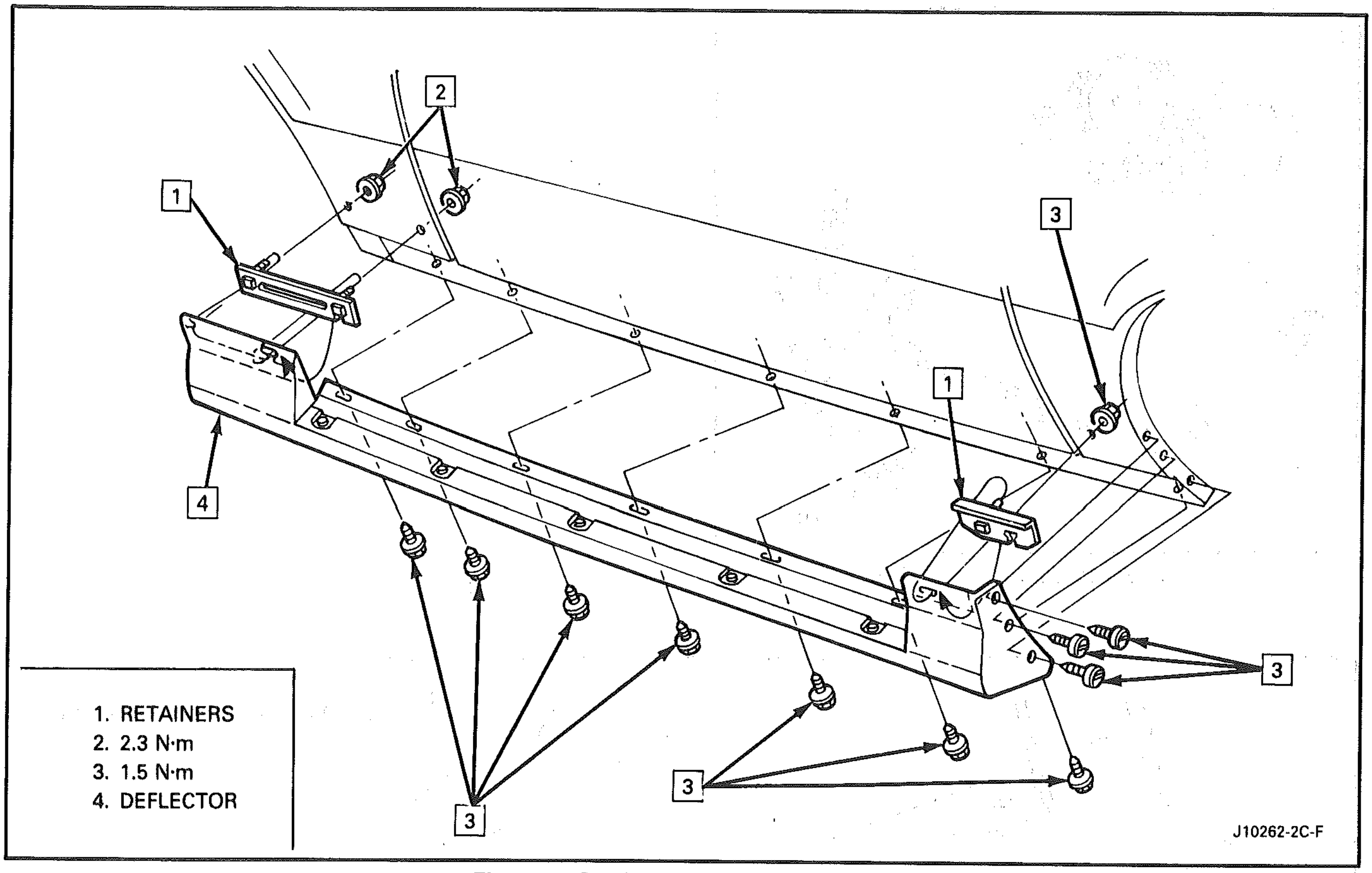


Figure 8 Rocker Panel Air Deflector

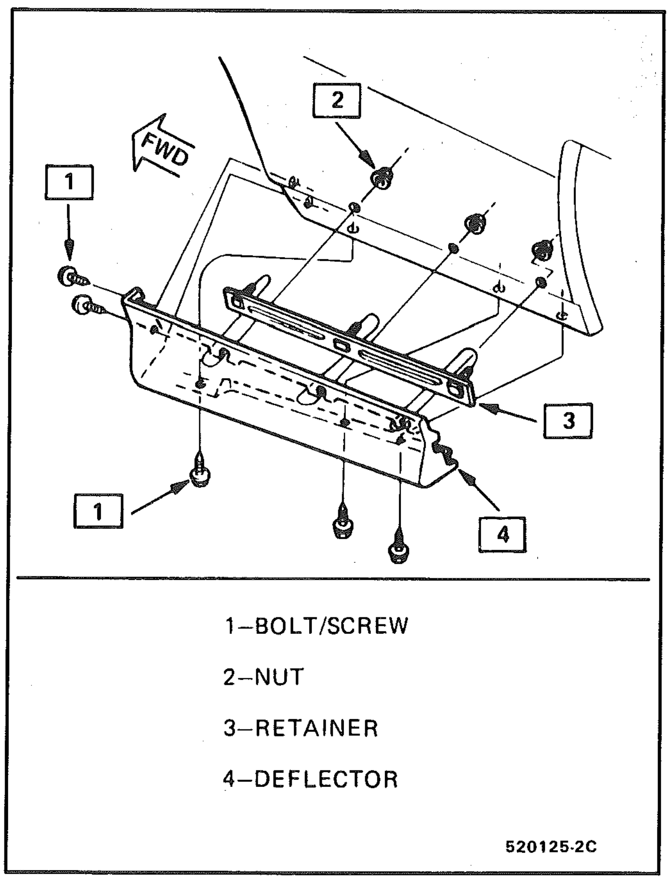


Figure 9 Rear Bumper Fascia Extension

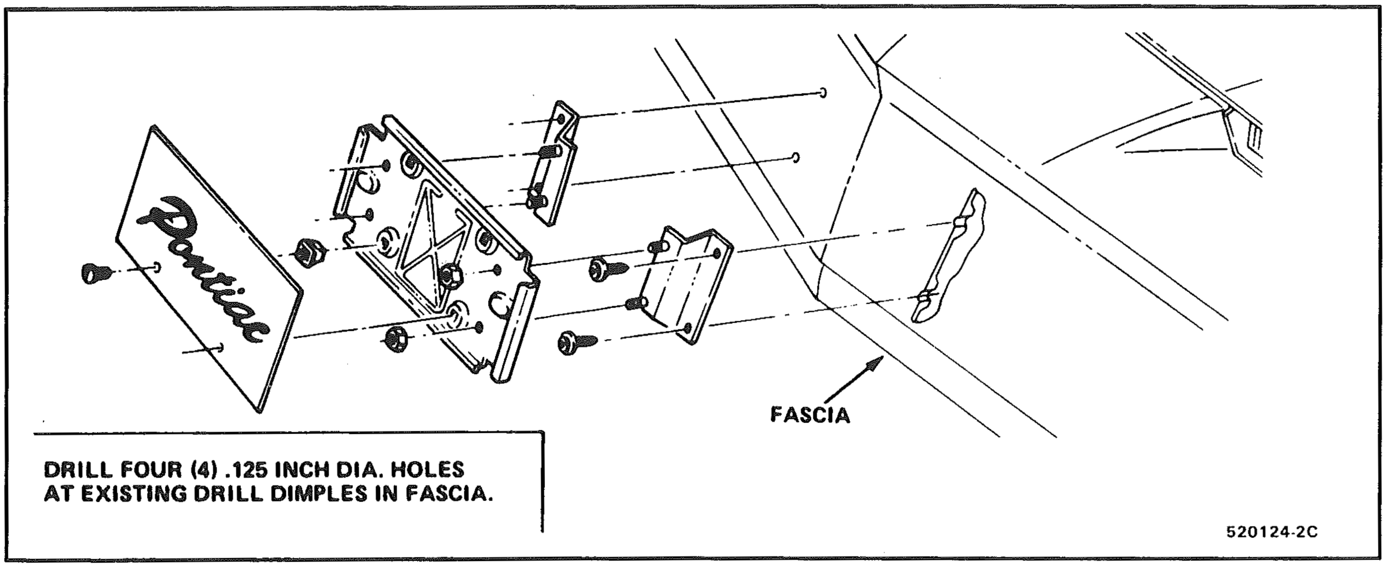


Figure 10 License Plate Bracket Mounting

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS

DIAGNOSIS

CONTENTS

GENERAL INFORMATION

Since the problems in steering, suspension, tires and wheels involve several systems, they must all be considered when diagnosing a complaint. To avoid using the wrong symptom, always road test the car first. Proceed with the following preliminary checks and correct any substandard conditions which are found.

Inspect

- Tires for wrong pressure and uneven wear
- Joints from the column to the steering gear for loose connectors or wear
- Front and rear suspension, and the steering gear or linkage for loose or damaged parts
- Out-of-round or out-of-balance tires, bent wheels, and loose and/or rough wheel bearings
- Power steering system for leaks. Also check the power steering fluid level and the pump drive belt tension

GENERAL DIAGNOSIS

Car Pulls (Leads)

Inspect

- Mismatched or uneven tires
- Broken or sagging springs
- Radial tire lateral force
- Front-wheel or rear-wheel alignment
- Steering gear valve off center (unbalanced)
- Front brakes dragging

Abnormal or Excessive Tire Wear

Inspect

- Front-wheel or rear-wheel alignment
- Sagging or broken springs
- Tire out of balance
- Worn strut dampener or shock absorber
- Hard driving
- Overloaded car
- Not rotating tires

Scuffed Tires

Inspect

- Toe incorrect
- Excessive speed on turns
- Suspension arm bent or twisted

Wheel Tramp

Inspect

- Blister or bump on tire
- Improper strut dampener or shock absorber action

Shimmy, Shake or Vibration

Inspect

- Tire or wheel out of balance
- Worn wheel bearings
- Worn tie rod ends
- Worn lower ball joints

- Excessive wheel runout
- Blister or bump on tire
- Excessive loaded radial runout of tire and wheel assembly

Hard Steering (Power)

Inspect

- Hydraulic system – Make test with gage J 5176 or J 25323
- Steering gear adjustment
- Bind or catch in steering gear
- Loose steering gear mounting
- Steering gear pressure port check valve (800 series)

Too Much Play In Steering

Inspect

- Wheel bearings worn
- Loose steering gear mounting
- Joints from column to steering gear loose or worn
- Steering gear adjustment

Poor Returnability (Power)

Inspect

- Lack of lubrication – ball joints and tie rod ends
- Bind in ball joints
- Bind in steering column
- Front-wheel alignment
- Steering gear adjustment
- Sticking valve
- Steering gear adjustment
- Lower coupling binding on steering gear

Abnormal Noise, Front End

Inspect

- Lubrication – ball joints and tie rod ends
- Damaged suspension components
- Worn control arm bushings or tie rod ends
- Loose stabilizer shaft
- Loose wheel nuts
- Loose suspension bolts
- Wheel covers
- Steering gear adjustment
- Worn strut dampener, shock absorbers or mountings
- Spring improperly positioned

Wander or Poor Steering Stability

Inspect

- Mismatched or uneven tires
- Lubrication – ball joints and tie rod ends
- Worn strut dampeners or shock absorbers
- Loose stabilizer shaft
- Broken or sagging springs
- Steering gear adjustment
- Front-wheel or rear-wheel alignment

Erratic Steering When Braking

Inspect

- Wheel bearings worn
- Broken or sagging springs
- Leaking wheel cylinder or caliper
- Warped rotors
- Incorrect or uneven caster

Low Or Uneven Trim Height

Inspect

- Broken or sagging springs
- Overloaded car
- Incorrect or weak springs

Ride Too Soft

Inspect

- Worn strut dampeners or shock absorbers
- Incorrect or sagging springs

Ride Too Harsh

Inspect

- Incorrect strut dampeners or shock absorbers
- Incorrect springs

Body Leans Or Sways In Corners

Inspect

- Loose stabilizer shaft
- Worn strut dampeners, shock absorbers or mounting
- Broken or sagging springs
- Overloaded car

Suspension Bottoms

Inspect

- Overloaded car
- Worn strut dampeners or shock absorbers
- Incorrect, broken or sagging spring

"Dog" Tracking

Inspect

- Damaged rear suspension arm or worn bushings
- Bent rear axle
- Frame or underbody alignment incorrect

Steering Wheel Kick-Back (Power)

Inspect

- Air in system
- Loose steering gear mounting
- Joints from column to steering gear loose or worn
- Tie rod ends loose
- Worn or missing check valve (800 series)
- Wheel bearings worn
- See "Too Much Play In Steering" for other possible causes.

Steering Wheel Surges Or Jerks (Power)

Inspect

- Hydraulic system – Make pressure test with gage J 5176-D or J 25323
- Sluggish steering gear valve
- Loose pump drive belt

Cupped Tires

Inspect

- Front-wheel or rear-wheel alignment
- Strut dampeners or shock absorbers weak
- Wheel bearing worn
- Excessive tire or wheel runout
- Worn ball joint
- Loose steering gear adjustment

POWER RECIRCULATING BALL STEERING GEAR DIAGNOSIS

Hissing Noise

There is some noise in all power steering systems. One of the most common is a hissing sound when the steering wheel is turned and the car is not moving. This noise will be most evident when turning the wheel while the brakes are applied. There is no relationship between this noise and steering performance. Do not replace the valve unless the "hissing" noise is extremely objectionable. A replacement valve will also have a slight noise, and is not always a cure for the condition. Check that the intermediate shaft joints are not loose.

Rattle or Chucking Noise

Inspect

- Pressure hose grounding out
- Tie rod ends loose
- Steering gear attachment loose
- Loose pitman shaft "over-center" adjustment.

  A slight rattle may occur on turns because of increased clearance off the "high point". This is normal and clearance must not be reduced below specified limits to eliminate this slight rattle.

Poor Return of Steering Wheel to Center

Inspect

- Front-wheel alignment
- Wheel bearing worn
- Tie rod end binding
- Ball joint binding
- Steering wheel rubbing against turn signal housing
- Steering gear adjustments
- Tight or frozen intermediate steering shaft
- Sticky or plugged spool valve

Momentary Increase in Effort When Turning Wheel Fast to Right or Left

Inspect

- High internal leakage

Steering Wheel Surges or Jerks When Turning With Engine Running Especially During Parking

Inspect

- Insufficient pump pressure
- Sticky flow control valve

Excessive Wheel Kickback or Loose Steering

Inspect

- Air in system
- Steering gear attachment loose
- Tie rod ends loose
- Wheel bearings worn
- Steering gear flexible coupling loose on shaft or rubber disc mounting nuts loose
- Loose thrust bearing preload adjustment
- Excessive "over-center" lash
- Worn pressure port check valve

Hard Steering or Lack of Assist (Especially During Parking)

Inspect

- Brakes applied while turning steering wheel
- Intermediate shaft damaged or worn
- Sticky flow control valve
- Insufficient pump pressure
- Excessive internal pump leakage
- Excessive internal steering gear leakage

STEERING LINKAGE DIAGNOSIS

Excessive Play or Looseness in Steering System

Inspect

- Worn upper ball joints
- Steering gear worm bearings loosely adjusted

- Excessive pitman shaft to ball nut lash in steering gear
- Worn intermediate rod or tie rod sockets

Excessive Looseness in Tie Rod or Intermediate Rod Pivots, or Excessive Vertical Lash in Idler Support

Inspect

- Seal damage and leakage resulting in loss of lubricant, corrosion and excessive wear

Hard Steering

Inspect

- Tight or frozen intermediate rod, tie rod or idler socket
- Steering gear adjusted too tight

POWER STEERING PUMP DIAGNOSIS

Foaming, Milky Power Steering Fluid, Low Fluid Level, and Possible Low Pressure

This can be caused by air in the fluid, and loss of fluid due to internal pump leakage causing overflow. Check for leak and correct. Bleed the system. Extremely cold temperatures will cause air bubbles in the system if the fluid level is low. If the fluid level is correct and pump still foams, remove pump from car and separate reservoir from housing. Check soft plug and housing for cracks. If housing is cracked, replace housing.

Low Pressure Due to Steering Pump

Inspect

- Flow control valve stuck or inoperative
- Pressure plate not flat against cam ring
- Extreme wear of cam ring
- Scored pressure plate, thrust plate or rotor
- Vanes sticking in rotor slots
- Cracked or broken thrust or pressure plate
- High internal leakage

Low Pressure Due To Steering Gear

Inspect

- Scored housing bore
- Leakage at valve rings or seals

Growling Noise in Steering Pump

Inspect

- Excessive back pressure in hoses or steering gear caused by restriction
- Scored pressure plates, thrust plate or rotor
- Worn cam ring

Groaning Noise in Steering Pump

Inspect

- Air in the fluid
- Low fluid level
- Pump mounting loose

Rattling Noise in Steering Pump

Inspect

- Vanes sticking in rotor slots
- Vane improperly installed
- Damaged ball bearing

Swishing Noise in Steering Pump

Inspect

- Damaged flow control valve

Whining Noise in Steering Pump

Inspect

- Pump shaft bearing scored
- Scored pressure plates and vanes

STEERING COLUMN DIAGNOSIS

LOCK SYSTEM

Will Not Unlock

Inspect

- Shear flange on sector shaft collapsed
- Damaged lock bolt
- Damaged lock cylinder
- Damaged housing
- Damaged sector
- Damaged rack
- Damaged park lock cable

Will Not Lock

Inspect

- Lock bolt spring broken or worn
- Damaged sector
- Damaged lock cylinder
- Burr on lock bolt
- Damaged housing
- Improper shift linkage adjustment
- Damaged rack
- Interference between bowl and rack coupling
- Ignition switch stuck
- Actuator rod restricted
- Sector installed incorrectly
- Park lock cable damaged

High Lock Effort

Inspect

- Lock cylinder damaged
- Ignition switch damaged
- Rack preload spring broken or deformed
- Burrs on sector, rack, housing, support or actuator rod coupling
- Bent sector shaft
- Damaged rack
- Extreme misalignment of housing to cover
- Distorted coupling slot in rack
- Bent actuator rod
- Ignition switch mounting bracket bent
- Actuator rod restricted
- Improper shift linkage adjustment

Will Stick In "Start"

Inspect

- Actuator rod deformed
- Check items under "High Lock Effort"

Key Cannot Be Removed in "Off-Lock"

Inspect

- Ignition switch is not set correctly
- Damaged lock cylinder
- Linkage mis-adjusted

Lock Cylinder Can Be Removed

Inspect

- Lock cylinder retaining screw missing

High Effort In Lock Cylinder Between "Off" and "Off-Lock"

Inspect

- Distorted rack

Lock Bolt Hits Shaft Lock In "Off" Position and "Park"

Inspect

- Ignition switch is not set correctly

COLUMN

Noise In Column

Inspect

- Joints from the column to the steering gear loose
- Column not correctly aligned
- Horn contact ring not lubricated
- Lack of grease on bearings
- Loose sight shields
- Lower or upper steering shaft bearing worn or broken
- Shaft lock snap ring not seated
- Spherical joint not lubricated

High Steering Shaft Effort

Inspect

- Column assembly misaligned
- Improperly installed or deformed dust seal
- Damaged upper or lower bearing
- Flash on I.D. of shift tube
- Tight intermediate steering shaft universal joint

High Shift Effort (Automatic with Column Shift)

Inspect

- Column not aligned correctly in car
- Wave washer with burrs
- Improperly installed dust seal
- Lack of grease on seal or bearing
- Improper screws used for ignition switch
- Burr on upper or lower end of shift tube
- Lower bowl bearing not assembled correctly

Improper Shifting (Automatic with Column Shift)

Inspect

- Sheared shift tube joint or lower shift lever weld
- Improper or loose linkage adjustment
- Loose shift lever
- Improper gate plate

Lash In Steering Column

Inspect

- I.P.-to-column upper and lower bracket mounting bolts loose
- Broken weld nuts on jacket
- I.P. upper bracket capsule sheared
- Loose shoes in housing
- Loose tilt head pivot pins
- Loose shoe lock pin in support
- Loose support screws
- Column upper and lower bracket-to-jacket bolts loose
- Loose lower bracket-to-adapter and bearing assembly mounting screws
- Loose I.P.-to-jacket mounting bolts

Housing Scraping On Bowl

Inspect

- Bowl bent or not concentric with hub
- Cover and housing end cap not properly installed

Steering Wheel Loose

Inspect

- Excessive clearance between holes in support or housing and pivot pin diameters
- Damaged or missing anti-lash spring in spheres
- Upper bearing not seated in housing
- Upper bearing inner race seal missing
- Loose support screws
- Bearing preload spring missing or broken

Steering Wheel Loose (Every Other Tilt Position)

Inspect

- Loose fit between shoe and shoe pivot pin
- Shoe not free in slot

Steering Column Not Locking In Any Tilt Position

Inspect

- Shoe seized on its pivot pin
- Shoe grooves may have burrs or dirt
- Shoe lock spring weak or broken

Steering Wheel Fails To Return To Top Tilt Position

Inspect

- Pivot pins are bound up
- Wheel tilt spring is broken or weak
- Turn signal switch wires too tight

Noise When Tilting Column

Inspect

- Upper tilt bumpers worn
- Tilt spring rubbing in housing

TURN SIGNAL SWITCH

This diagnosis covers mechanical problems only. See Section 8A for turn signal switch electrical diagnosis.

Turn Signal Will Not Stay In Turn Position

Inspect

- Foreign material or loose parts impeding movement of yoke
- Broken or missing detent or cancelling spring
- None of the above, replace switch

Turn Signal Will Not Cancel

Inspect

- Loose switch mounting screws
- Switch or anchor bosses broken
- Broken, missing or out of position detent, return or cancelling spring
- Worn cancelling cam

Turn Signal Difficult To Operate

Inspect

- Turn signal switch arm loose
- Yoke broken or distorted, replace switch
- Loose or misplaced springs
- Foreign parts and/or material
- Loose turn signal switch mounting screws

Turn Signal Will Not Indicate Lane Change

Inspect

- Broken lane change pressure pad or spring hanger
- Broken, missing or misplaced lane change spring
- Jammed base or wires

Hazard Switch Cannot Be Turned Off

Inspect

- Foreign material between hazard support cancelling leg and yoke
- If no foreign material is found, replace turn signal switch.

Hazard Switch Will Not Stay On or Difficult To Turn Off

Inspect

- Loose turn signal switch
- Interference with other components
- Foreign material interference
- None of the above, replace turn signal switch

No Turn Signal Lights

Inspect

- Electrical failure in chassis harness
- Inoperative turn signal flasher
- Loose chassis-to-column connector. Disconnect column-to-chassis connector and connect new turn signal switch to chassis and operate switch by hand.
  - A. If car lights now operate normally, turn signal switch is inoperative.
  - B. If car lights do not operate, refer to Section 8A for electrical diagnosis.

Turn Indicator Lights On, But Not Flashing

Inspect

- Inoperative turn signal flasher
- Loose chassis-to-column connection
- Inoperative turn signal switch

- To determine if turn signal switch is inoperative, substitute new turn signal switch into circuit and operate switch by hand. If the car's lights operate normally, turn signal switch is inoperative.

Front Or Rear Turn Signal Lights Not Flashing

Inspect

- Burned-out or damaged turn signal bulb
- High resistance conection to ground at bulb socket
- Loose chassis-to-column connector. Disconnect column-to-chassis connector and connect new turn signal switch into system and operate switch by hand.
  - A. If turn signal lights are now on and flashing, turn signal switch is inoperative.
  - B. If car lights do not operate, refer to Section 8A for electrical diagnosis.

Turn Indicator Panel Lights

Inspect

Burned out bulbs or opens, grounds in the wiring harness from the front turn signal bulb socket to the indicator lights. Refer to Section 8A for electrical diagnosis.

Stop Light Not On When Turn Indicated

Inspect

- Loose column-to-chassis connection
- Disconnect the column-to-chassis connector and connect the new turn signal switch into the system and operate the switch by hand.
  - A. If the brake lights work when the switch is in the turn position, the turn signal switch is inoperative.
  - B. If the brake lights do not work, refer to Section 8A for electrical diagnosis.

Turn Signal Lights Flash Very Slowly

Inspect

- Loose chassis-to-column connection
- Disconnect the column-to-chassis connector and connect a new turn signal switch into the system and operate the switch by hand.
  - A. If the lights flash at a normal rate, the turn signal switch is inoperative.
  - B. If the Lights still flash very slowly, refer to Section 8A for electrical diagnosis.

Hazard Signal Lights Will Not Flash - Turn Signal Functions Normally

Inspect

- Blown fuse
- Inoperative hazard warning flasher
- Loose chassis-to-column connection
- Disconnect the column-to-chassis connector and connect a new turn signal switch into the system, then press in the hazard warning button and watch the hazard warning lights.
  - A. If the lights now work normally, the turn signal switch is inoperative.
  - B. If the lights do not flash, check the wiring harness. Refer to Section 8A for electrical diagnosis.

IGNITION SWITCH

Electrical System Will Not Function

Inspect

- Damaged ignition switch
- Ignition switch not adjusted properly
- Loose connector at the ignition switch

Switch Will Not Turn

Inspect

- Damaged ignition switch

Switch Cannot Be Set Correctly

Inspect

- Switch actuator rod deformed
- Sector to rack engaged in wrong tooth

KEY REMINDER

Figs. 1 through 11

Reminder Continues To Operate With Key Out, But Stops When Driver's Door Is Closed

Inspect

- Chips, foreign material in lock cylinder bore
- Sticky lock cylinder actuator tip
- Damaged or broken reminder switch

Reminder Does Not Sound With Key Fully Inserted In Lock Cylinder And The Driver's Door Open

Inspect

1. Power not available to reminder. Refer to Section 8A for electrical diagnosis.
2. Open in chassis wiring. Check by separating chassis-to-column connector. Connect terminals "E" and "F" female contacts on the chassis connector (a bent paper clip will work). If the reminder sounds, repair chassis wiring. If the reminder does not sound, go to Step A.
   - A. Connect a continuity meter (light) to the male "E" and "F" column connector contacts. Push the key all the way into the lock cylinder. If the light is on when the key

is in, and off when the key is out, the function is normal. If the light is not on, the fault is in the column. Go to Step B.

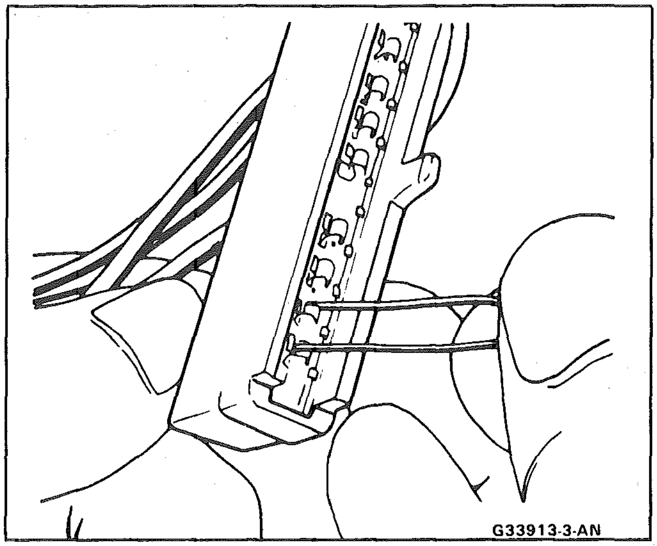


Fig. 1 Checking Reminder at Chassis Connector

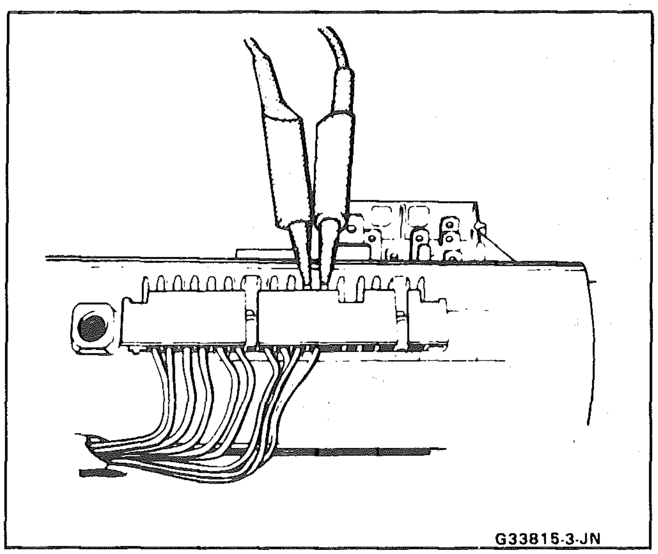


Fig. 2 Checking Reminder at Column Connector

B. Disassemble the upper end of the column until the turn signal switch mounting screws have been removed. Lift the turn signal switch and check the probes of the reminder switch to ensure good contact with the pads on the signal switch. Bend the probes, if needed, then replace the turn signal switch and tighten the three screws. Check the function as in Step A.

3. Short or fault in the turn signal switch wiring. Connect male "E" and "F" contacts of column connector with jumper. Check key reminder switch pads on turn signal switch with continuity meter. If there is continuity, the function is normal. If not, replace the turn signal switch.

4. If the problem has not been found, connect a continuity meter (light) to the reminder switch probes on the switch. Fully insert and remove the key from the lock cylinder. If the light is on when the key is in the lock cylinder, and off when the key is out, the function is normal. Retrace the diagnostic steps starting at Step A. If the light is not on, the fault is in the lock cylinder or reminder switch.

5. Chips, burrs, or foreign material in the lock cylinder preventing actuator tip function. Remove chips, burrs, etc. Reassemble and recheck (Step 4). The key must be removed, or the cylinder must be in the "Run" position, before the lock cylinder can be removed.

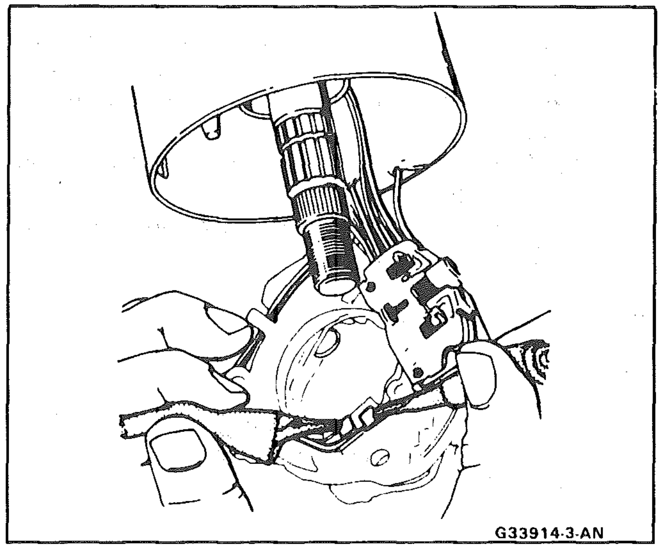


Fig. 3 Checking Reminder Switch Pads

6. Damaged lock cylinder. With the lock cylinder removed, push the key all the way in, then remove it. The lock cylinder actuator tip should extend and retract smoothly. Total extension of tip should be 1.27 mm (.050"). If not, replace the lock cylinder. Remove and clean as required. Reassemble and recheck per Step 4.

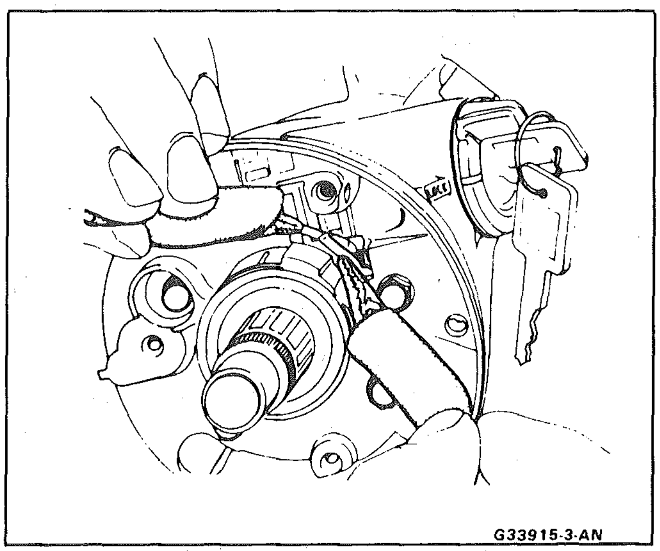


Fig. 4 Checking Reminder Switch

7. Switch appears good but will not operate. Connect continuity meter leads to the reminder switch probes on the switch. Press on the actuator

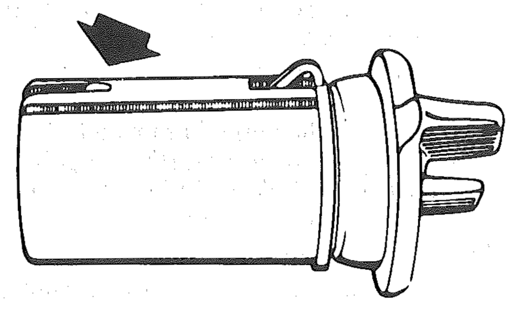


Fig. 5 Lock Cylinder Actuator – Key Removed

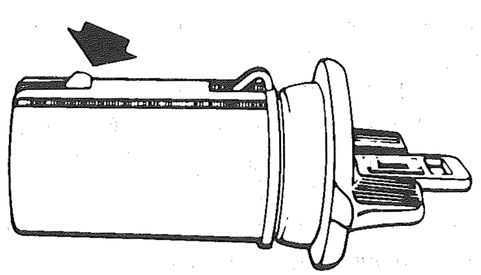


Fig. 6 Lock Cylinder Actuator – Key in Place

pad until the switch points contact. If contact is not made, replace reminder switch.

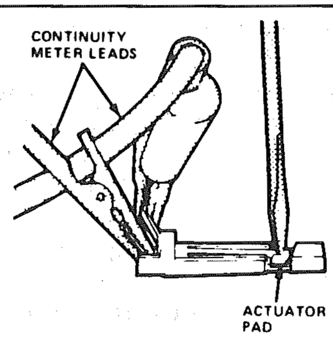


Fig. 7 Checking Key Reminder Switch Continuity

8. Check the switch contact gap by pressing a 0.8 mm (.030") wire-type plug gage with a flat piece of stock onto the actuator pad. If contact is not made, decrease the switch contact gap until positive contact is made. Use a continuity meter (light).

9. With positive contact at 0.8 mm (.030"), use a 0.6 mm (.025") plug gap wire beneath the flat stock. No contact should occur. If contact is made, increase the switch contact gap. When the switch will make contact with the 0.8 mm (.030") wire but not with the 0.6 mm (.025") wire, the switch is set properly.

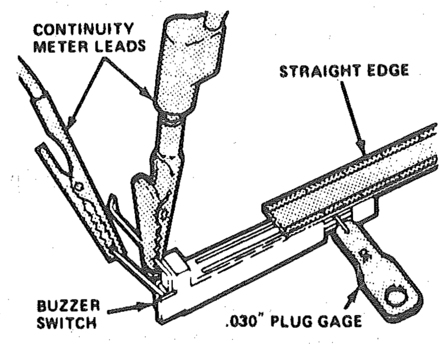


Fig. 8 Checking Contact Gap

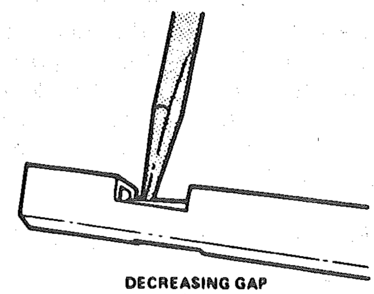


Fig. 9 Decreasing Switch Contact Gap

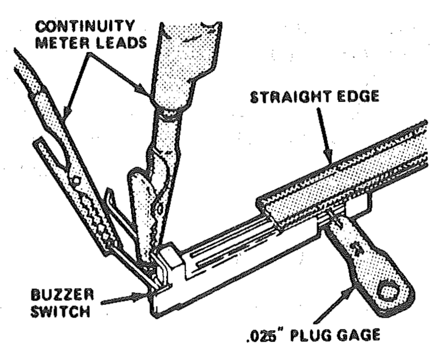


Fig. 10 Checking Contact Gap

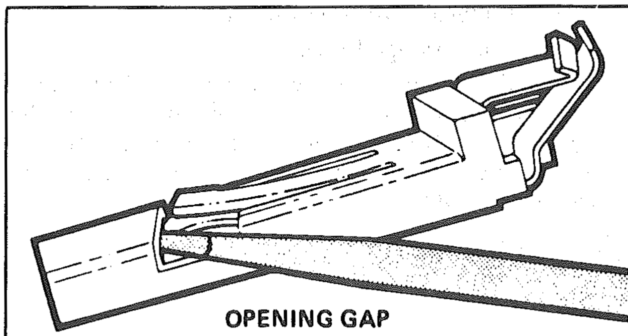


Fig. 11 Increasing Switch Contact Gap

Reminder Keeps Operating With Key In Lock Cylinder, Driver's Door Open Or Closed; Ceases When Key Is Removed

Inspect

- Door jamb switch on driver's side misadjusted or inoperative.
- Wire from signal switch to door jamb switch shorted.
  A. This condition indicates the lock cylinder or the reminder switch is at fault. To verify, check for continuity at the "E" and "F" male column connector contacts, with the key removed from the lock cylinder. If continuity exists, the fault is in the column.
  B. Insert the key into the lock, then turn the lock toward the "Start" position. If the reminder stops when the key is in the "Run" position or when it is turned past "Run" toward "Start," the problem is a sticky lock cylinder actuator.

COLUMN-MOUNTED DIMMER SWITCH

No "Low" or "High" Beam

Inspect

- Loose connector at dimmer switch
- Improper adjustment
- Internally damaged or worn switch. Check the continuity on the switch at the lt. green and at the tan switch terminals by pushing in the plunger all the way. A click should be heard. If there is no continuity, replace the dimmer switch. If there is continuity, refer to Section 8A for electrical diagnosis.

PIVOT AND SWITCH ASSEMBLY

Switch Inoperative: No "Low," "High" and/or "Wash"

Inspect

- Loose body-to-switch connector
- Broken or damaged switch
- Internally damaged or worn switch. Connect a new switch without removing the old one. If the system functions, replace the switch. If the system doesn't function, refer to Section 8A for electrical diagnosis.

STEERING GEAR AND PUMP LEAKS

General Procedure

Inspect

- Overfilled reservoir
- Fluid aeration and overflow
- Hose connections
- Verify exact point of leakage

  Example: Torsion bar, stub shaft and adjuster seals are close together; the exact spot where the system is leaking may not be clear.

  Example: The point from which the fluid is dripping is not necessarily the point where the system is leaking; fluid overflowing from the reservoir, for instance.
- When service is required:
  A. Clean leakage area upon disassembly.
  B. Replace leaking seal.
  C. Check component sealing surfaces for damage.
  D. Reset bolt torque to specifications, where required.
- Some complaints about the power steering system may be reported as:
  A. Fluid leakage on garage floor
  B. Fluid leaks visible on steering gear or pump
  C. Growling noise, especially when parking or when engine is cold
  D. Loss of power steering when parking
  E. Heavy steering effort

When troubleshooting these kinds of complaints, check for an external leak in the power steering system.

For further diagnosis of leaks, refer to External Leakage Check in this section.

External Leakage Check

Fig. 12

The purpose of this procedure is to pinpoint the location of the leak.

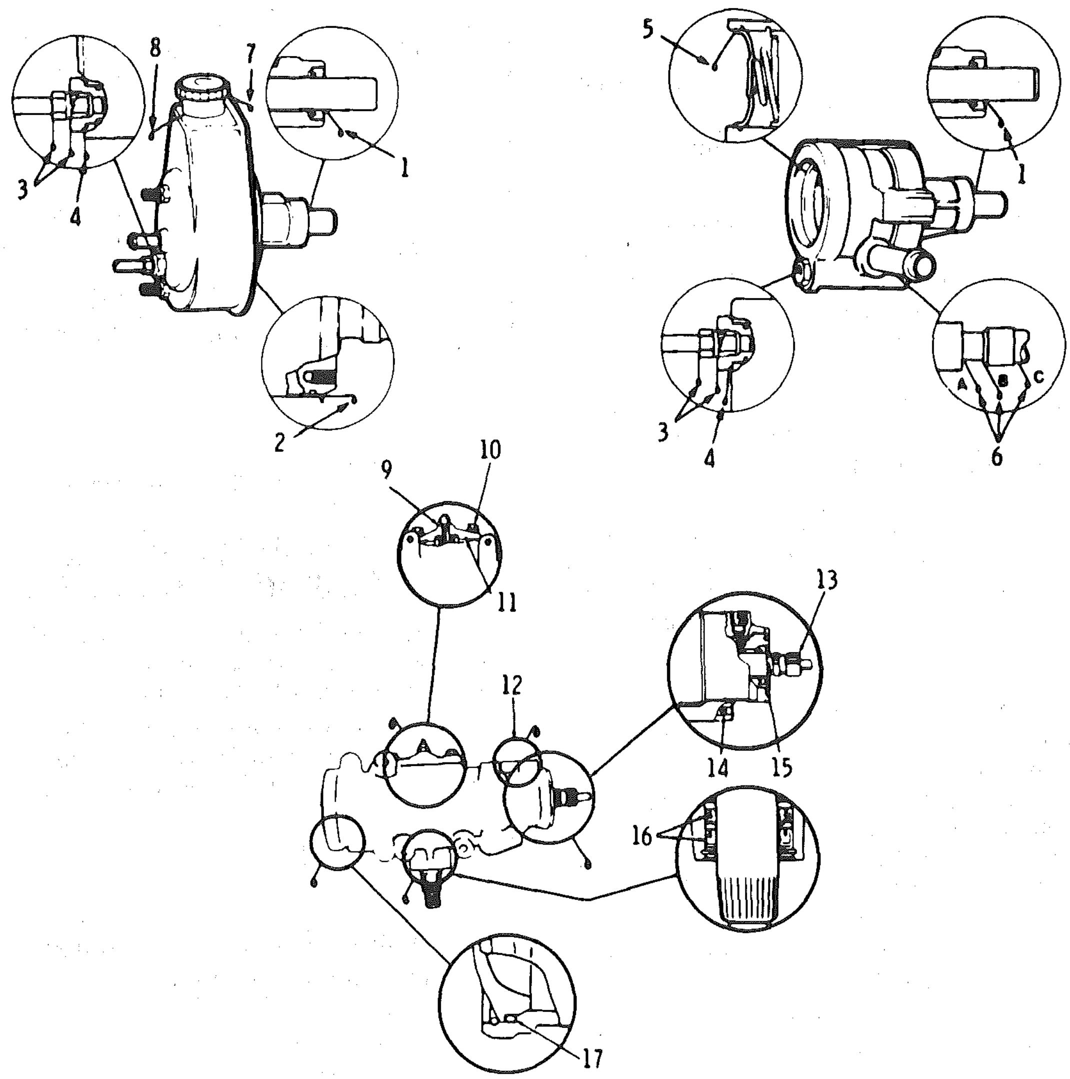
In some cases, the leak can easily be located. But, seepage-type leaks may be more difficult to isolate. To locate seepage leaks, use the following method.

1. With the engine off, wipe dry the complete power steering system.
2. Check the fluid level in the pump's reservoir. Add fluid if necessary.
3. Start the engine, then turn the steering wheel from stop to stop several times. Do not hold it at a stop for any length of time, as this can damage the power steering pump. It is easier if someone else operates the steering wheel while you search for the seepage.
4. Find the exact area of the leak and repair leak.

SEAL REPLACEMENT RECOMMENDATIONS

Lip seals, which seal rotating shafts, require special treatment. This type of seal is used on the steering gear and on the drive shaft of the pump. When there is a leak in one of these areas, always replace the seal(s), after inspecting and thoroughly cleaning the sealing surfaces. Replace the shaft only if very severe pitting is found. If the corrosion in the lip seal contact zone is slight, clean the surface of the shaft with crocus cloth. Replace the shaft only if the leakage cannot be stopped by first smoothing with crocus cloth.

GEAR AND PUMP LEAK DIAGNOSIS



1. REPLACE DRIVE SHAFT SEAL. MAKE CERTAIN THAT DRIVE SHAFT IS CLEAN AND FREE OF PITTING IN SEAL AREA.
2. REPLACE RESERVOIR O-RING SEAL
3. TORQUE HOSE FITTING NUT TO 35 N·m (25 FT. LBS.) IF LEAKAGE PERSISTS, REPLACE O-RING SEAL
4. TORQUE FITTING TO 75 N·m (55 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE O-RING SEAL
5. REPLACE O-RING SEAL.
6. IF LEAKAGE IS OBSERVED AT (A), FOLLOWING MANUFACTURER'S DIRECTIONS, APPLY LOCTITE 75559 SOLVENT AND LOCTITE 290 ADHESIVE, OR EQUIVALENT, TO TUBE-HOUSING CONNECTION. IF LEAKAGE IS COMING FROM (B), REPLACE RETURN TUBE. IF COMING FROM (C), REPLACE HOSE OR CLAMP.
7. CHECK OIL LEVEL, IF LEAKAGE PERSISTS WITH THE LEVEL CORRECT AND CAP TIGHT, REPLACE THE CAP
8. IF A CRACKED OR BENT RESERVOIR IS DETECTED, REPLACE RESERVOIR
9. TORQUE NUT TO 48 N·m (35 FT. LBS.) REPLACE NUT IF LEAKAGE PERSISTS
10. TORQUE SIDE COVER BOLTS TO 60 N·m (45 FT. LBS.) REPLACE SIDE COVER SEAL IF LEAKAGE PERSISTS
11. REPLACE SIDE COVER O-RING SEAL.
12. TORQUE HOSE FITTING NUT TO 27 N·m (20 FT. LBS.). IF LEAKAGE PERSISTS, REPLACE O-RING SEAL
13. REPLACE ROTARY VALVE ASSEMBLY
14. SEAT BALL FLUSH WITH PUNCH AND RESTAKE IF SEEPAGE PERSISTS, REPLACE HOUSING
15. REPLACE ADJUSTER PLUG SEALS
16. REPLACE BOTH PITMAN SHAFT SEALS
17. REPLACE END PLUG O-RING SEAL

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Fig. 12 Steering Gear and N & P Series Pump Leak Diagnosis

POWER STEERING SYSTEM TEST PROCEDURE

Fig. 13

1. Disconnect pressure hose at pump. Use a small container to catch any fluid which might leak.
2. Connect a spare pressure hose to pump.
3. Connect pressure gage J 5176-D to both hoses.
   - The power steering system may be tested using J 5176-D as described here. It can also be tested with available tool J 25323 Power Steering Analyzer, which will measure flow rate as well as pressure.
4. Open valve on gage.
5. Start the engine. Allow the system to reach operating temperature, then check the fluid level and add fluid if required.
6. When the engine is at normal operating temperature, the pressure reading on the gage (valve open) should be in the 552-862 kPa (80-125 psi) range. If the pressure is more than 1 380 kPa (200 psi), check the hoses for restrictions and the poppet valve on the steering gear for proper assembly.
7. Fully close the valve 3 times. (Do not leave the valve fully closed for more than 5 seconds, as the pump could be damaged.) Record the pressure reading each time the valve is closed. Each reading should show at least 6 895 kPa (1,000 psi), or at least 8 619 kPa (1,250 psi) on the TC series pumps. The three readings should be within 345 kPa (50 psi) of each other.
   A. If the pressure readings are high enough, and are within 345 kPa (50 psi) of each other, the pump is functioning properly.
   B. If the pressure readings are high enough, but are not within 345 kPa (50 psi) of each other, the flow control valve in the pump is sticking. Remove the valve; clean it and remove any burrs using crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the steering gear must be completely disassembled, cleaned and reassembled.
   C. If the pressure readings are less than 6 895 kPa (1,000 psi), or are less than 8 619 kPa (1,250 psi) on the TC series pumps, replace the flow control valve and recheck. If the pressures are still low, replace the rotor and vanes.
8. If the pump checks to specification, leave the valve open and turn (or have turned) the steering wheel to both stops. Record the highest pressures and compare with the highest pump pressure recorded. If the pressure at both stops is not the same as the maximum pressure, the steering gear is leaking internally and must be disassembled and repaired.
9. Turn off the engine, then remove the testing gage and the spare hose. Reconnect the pressure hose, check the fluid level or make needed repairs.

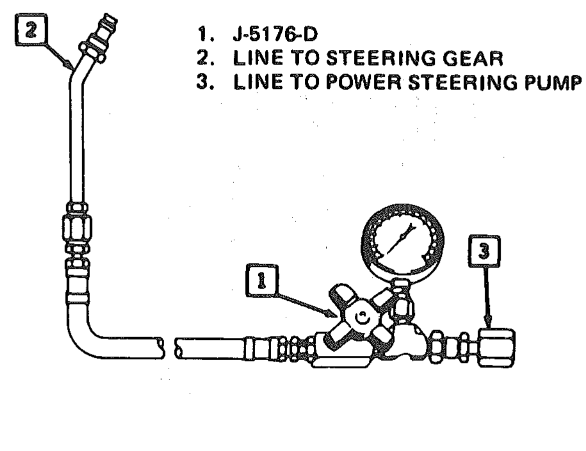

Fig. 13 Power Steering Pressure Gage

STRUT DAMPENER AND SHOCK ABSORBER DIAGNOSIS

The strut dampener is basically a shock absorber. Strut dampeners are easier to extend and retract by hand than are shock absorbers.

The following procedure includes both on-car and bench checks to be done when evaluating the performance of strut dampeners and shock absorbers.

ON-CAR CHECKS

Weak

For struts, follow Steps 1 through 4.

1. Check and adjust tire pressures to the pressures shown on the Tire Placard.
2. Note the load conditions under which the car is normally driven.
3. If practical, ride with the owner to be sure you understand the complaint before proceeding to next step.
4. Test each strut dampener/shock in turn by quickly pushing down, then lifting up, the corner of the bumper nearest the strut dampener/shock being checked. Use the same amount of effort on each test and note the resistance on compression and rebound. Compare this with a similar car having acceptable ride quality. Both strut dampeners/shocks should provide the same feeling of resistance.

   If there is much difference between the right and left rear shocks, go to the next step.
5. Support the rear axle at least enough to unload the shock mounts.
6. Disconnect the lower shock mountings. Stroke the shocks at various rates of speed, through maximum travel in both directions. Compare the two sides for rebound and compression resistance. Rebound resistance is normally stronger than compression (about 2 to 1). The right and left shocks must feel comparable. Differences between front and rear are normal. If

in doubt about the condition, compare with a shock known to be good.

Noisy

For struts, follow Steps 1 through 3.

1. Check all mountings for proper torque. A loose mounting will cause a noise.
2. If all mountings are intact, bounce the car as in Step 4 (weak) to isolate the suspected unit.
3. If practical, ride with the owner to be sure you understand the complaint, before proceeding to next step.
4. If one of the rear shocks is noisy, the rear axle should be supported at least enough to unload the shock mounts. Disconnect the lower mounting of the suspected shock. Quickly push the shock all the way in, then all the way out. A hissing noise is normal.
5. Other objectionable noises may be detected by stroking. Any sound other than hissing is abnormal; replace the shock.

Leaks

1. Fully extend the strut/shocks (wheels unsupported) to expose the seal cover area for inspection.
2. Look for signs of leaks in the seal cover area.
3. A slight trace of fluid is NOT cause for replacement; the seal permits some seepage to lubricate the piston rod. There is a built in fluid reserve to allow for seepage.
4. A leaking strut dampener/shock can easily be found because there will be fluid around the seal cover and an excessive amount of fluid on the strut dampener/shock. A leaking strut dampener/shock must be replaced.

BENCH CHECKS

Strut Dampeners and Regular Shock Absorbers (Standard and Firm Ride)

Regular strut dampeners/rear shocks use a gas-filled cell in the fluid reservoir. Aeration or foaming of the fluid is eliminated, as the gas and the fluid cannot mix.

Proceed with the actual bench check as follows:

1. Clamp the strut dampener/shock UPSIDE DOWN in the vise. Do not clamp on the reservoir tube or the mounting threads. If a lag is noticed when it is stroked, it means the gas-filled cell has ruptured and replacement is necessary.
2. Pump strut dampener/shock by hand at various rates of speed and note the resistance.
3. Rebound resistance normally is stronger than compression resistance by about 2 to 1. However, the resistance should be smooth and constant for each stroking rate.
4. Compare with a strut dampener/ shock known to be good.
5. It is normal to hear a hissing noise. The following symptoms are abnormal and are reason for replacement.
   A. A skip or lag at reversal near mid-stroke.
   B. A seize (except at either extreme end of travel).
   C. A noise (such as a grunt or squeal) after completing one full stroke in both directions.
   D. A clicking noise at fast reversal.
   E. Fluid leakage.

TIRE DIAGNOSIS

Irregular and Premature Wear

Figs. 14 and 15

Irregular and premature tire wear has many causes. Some of them are: incorrect inflation pressures, lack of regular rotation, driving habits, or improper wheel alignment. If wheel alignment is reset due to a tire wear condition, always reset toe as close to zero degrees as the specification allows.

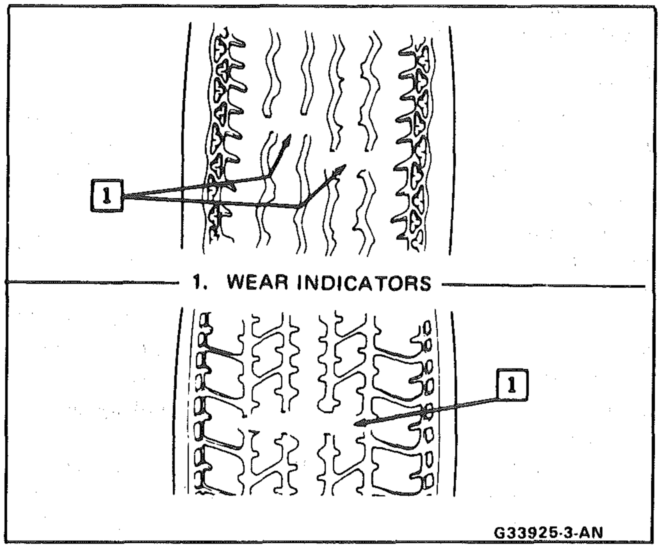

Fig. 14 Tire Wear Indicator

If the following conditions are noted, rotate the tires:

- Front tire wear is different from rear.
- Uneven wear exists across the tread of any tire.
- Left and right front tire wear is unequal.
- Left and right rear tire wear is unequal.

Check wheel alignment if the following conditions are noted:

- Left and right front tire wear is unequal.
- Wear is uneven across the tread of any front tire.
- Front tire treads have a scuffed appearance with "feather" edges on one side of the tread ribs or blocks.

Wear Indicators

Fig. 16

The original equipment tires have built-in tread wear indicators to show when the tires should be replaced. These indicators will appear as 12.7 mm (1/2") wide bands when the tire tread depth becomes 1.6 mm (2/32"). When the indicators appear in 2 or more grooves at 3 locations, replace the tire.

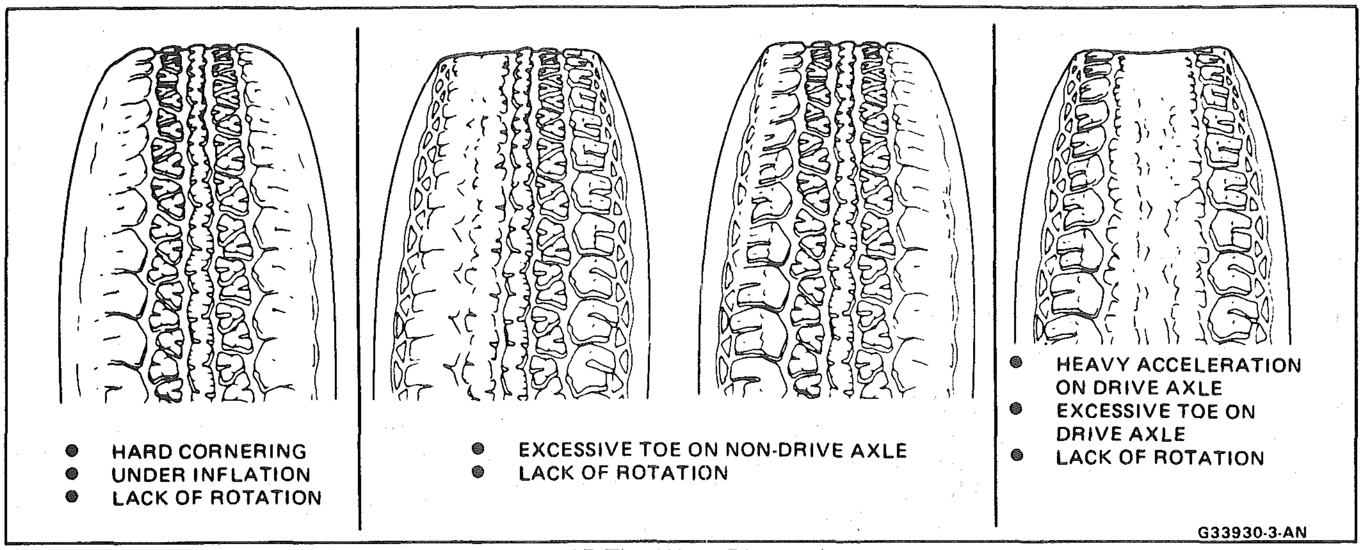

Fig. 15 Tire Wear Diagnosis

Radial Tire Waddle

Fig. 17

Waddle is side-to-side movement at the front and/or rear of the car. It can be caused by the steel belt not being straight within the tire, or by excessive lateral runout of the tire or wheel. It is most noticeable at low speed, about 8 to 48 km/h (5 to 30 mph). It may also appear as a ride roughness at 80 to 113 km/h (50 to 70 mph).

The car can be road tested to see which end of the car has the faulty tire. If the tire causing the waddle is on the rear, the rear end of the car will "waddle." From the driver's seat, it feels as if someone is pushing on the side of the car.

If the faulty tire is on the front, the waddle is more easily seen. The front sheet metal appears to be moving back and forth. It feels as if the driver's seat is the pivot point in the car.

Another more time-consuming method of determining the faulty tire is substituting tire and wheel assemblies that are known to be good. Follow these steps:

1. Drive the car to determine if the waddle is coming from the front or rear.
2. Install tire and wheel assemblies known to be good (from a similar car) in place of those on the end of the car which is waddling. If the waddle cannot be isolated to front or rear, start with the rear tires.
3. Road test again. If improvement is noted, install the original tire and wheel assemblies one at a time until the faulty tire is found. If no improvement is noted, install tires known to be good in place of all four. Then, install the originals one at a time until the faulty tire is found.

Radial Tire Lead/Pull

Fig. 18

"Lead/Pull" is the deviation of the car from a straight path, on a level road with no pressure on the steering wheel.

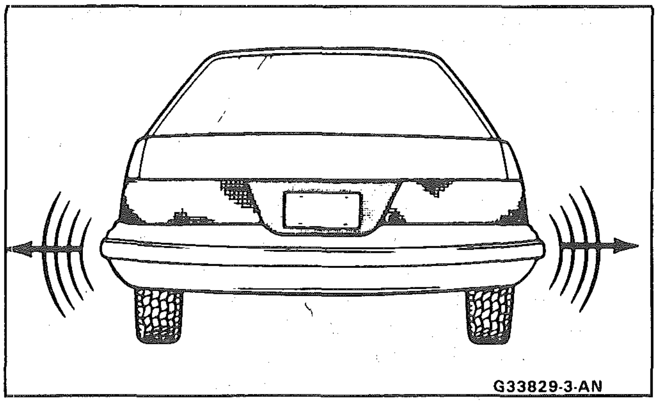

Fig. 16 Tire Waddle

Lead is usually caused by:

1. Tire construction.
2. Uneven brake adjustment.
3. Wheel alignment.

The way in which a tire is built can produce lead in a car. An example of this is placement of the belt. Off-center belts on radial tires can cause the tire to develop a side force while rolling straight down the road. The tire will tend to roll like a cone.

The Radial Tire Lead/Pull Correction Chart should be used to make sure that front wheel alignment is not mistaken for tire lead.

Rear tires will not cause lead.

VIBRATION DIAGNOSIS

See Figs. 19 through 21 for vibration diagnosis.

TAPERED ROLLER BEARING DIAGNOSIS

See Figs. 22 and 23 for Tapered Roller Bearing Diagnosis.

TRIM HEIGHT DIAGNOSIS

See Fig. 24 for Trim Height Diagnosis.

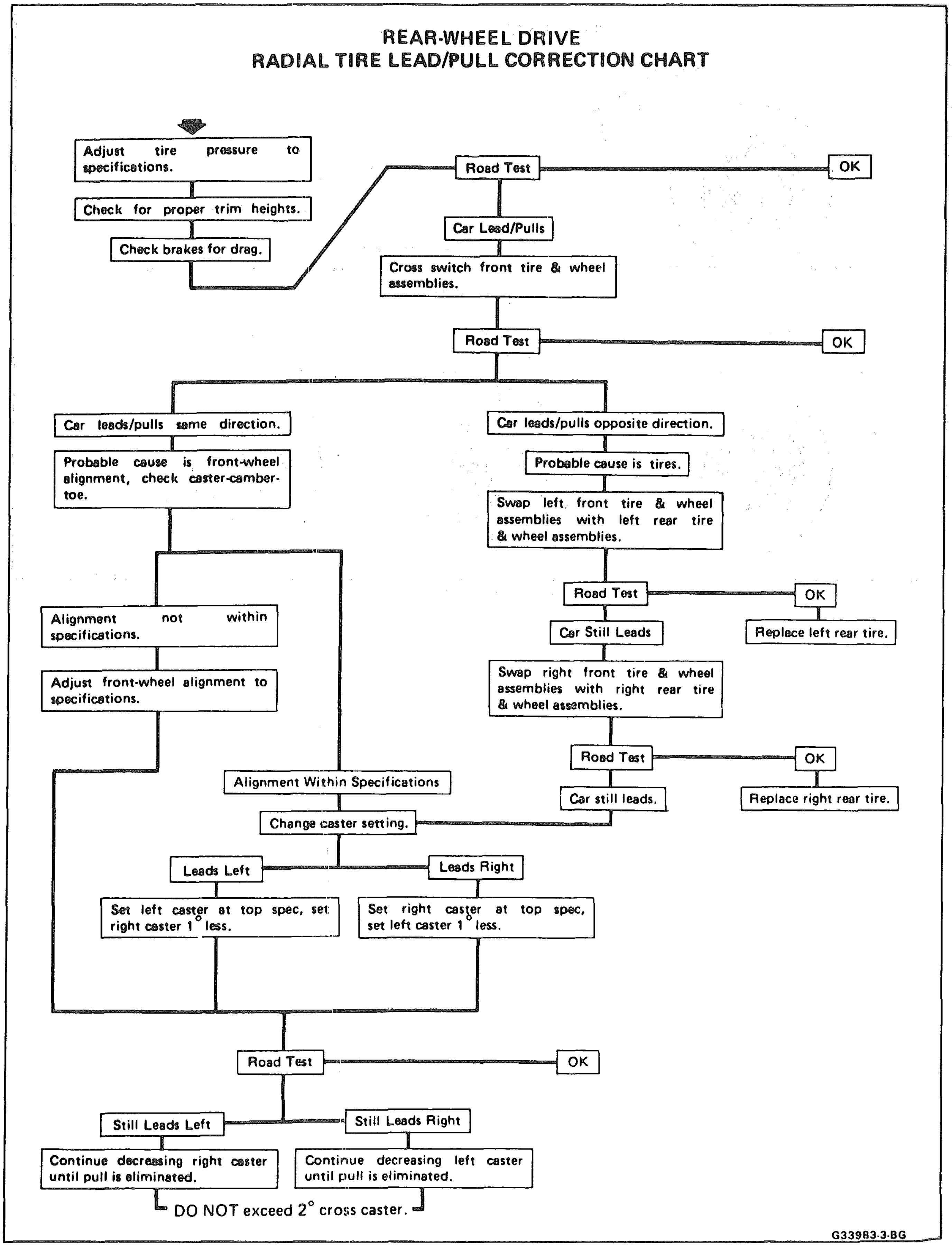

Fig. 17 Radial Tire Lead/Pull Diagnosis – Rear-Wheel Drive

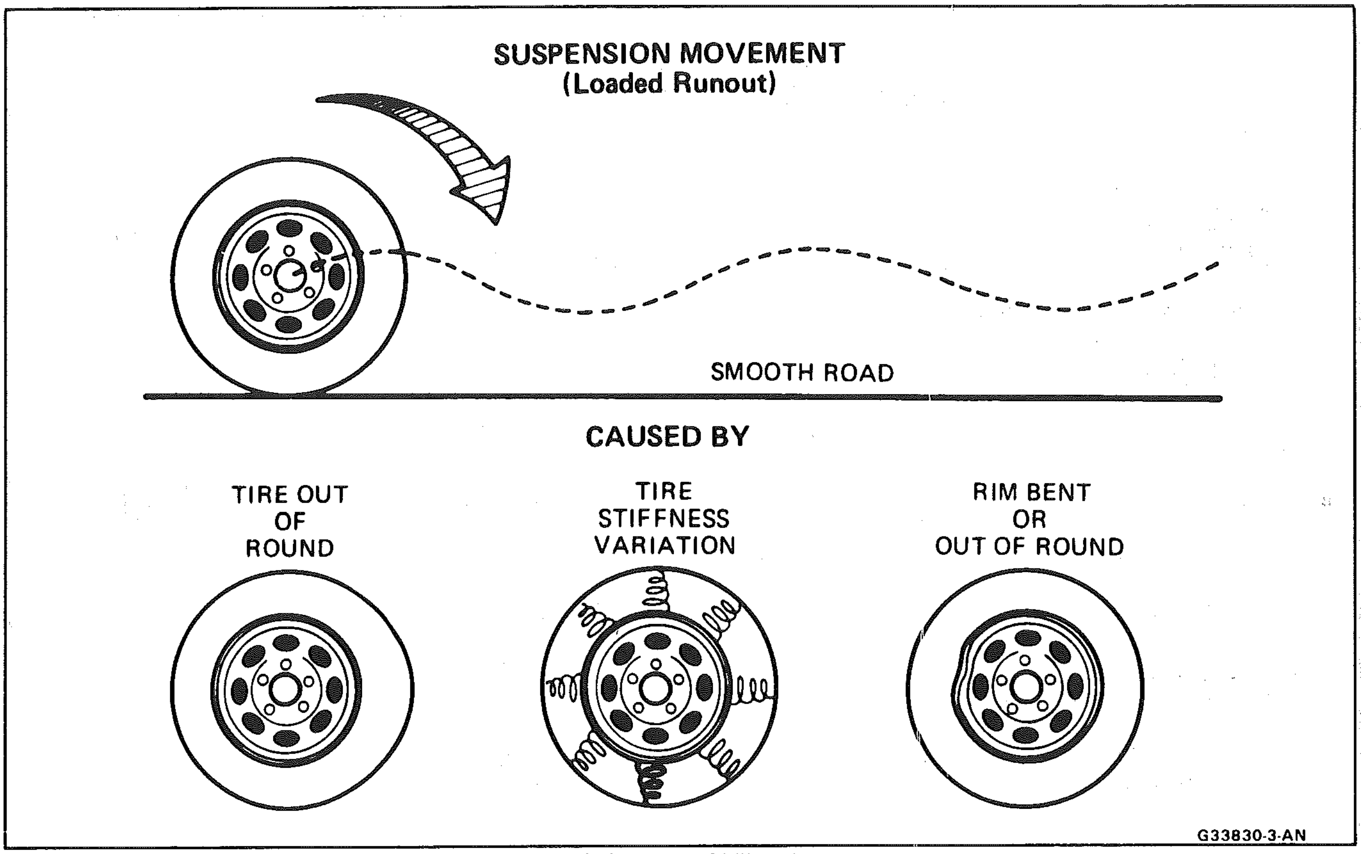

Fig. 18 Causes of Vibrations

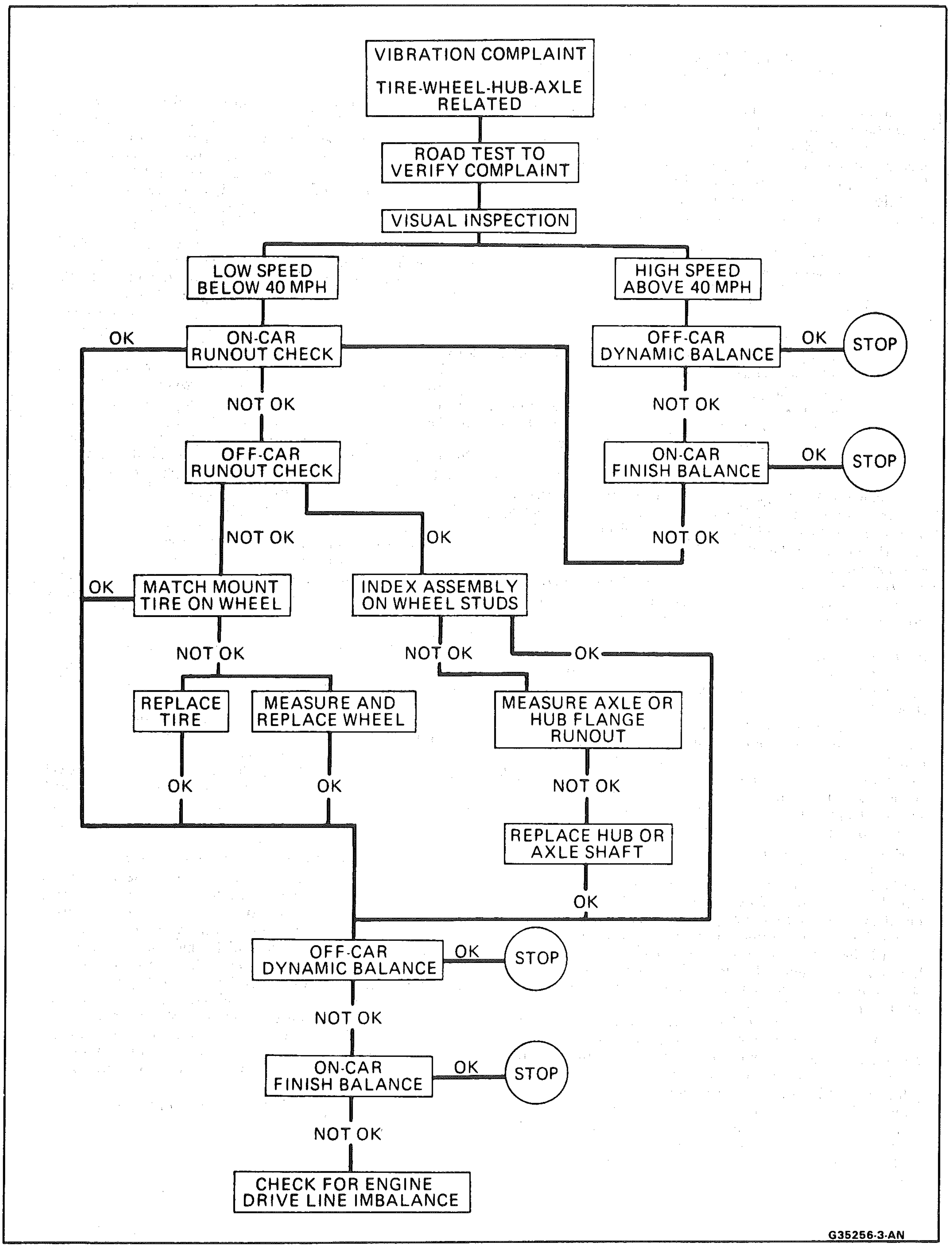

Fig. 19 Vibration Complaint Chart (1 of 2)

VIBRATION COMPLAINT TIRE-WHEEL-HUB-AXLE RELATED

Vibrations that are tire or wheel induced can be caused by two factors: imbalance or runout.

Low-speed vibrations, those less than 40 mph, are usually runout related. Highway speed vibrations, those above 40 mph, can be caused by either imbalance or runout.

Prior to performing any work, always road test the car and perform a careful visual inspection for:

- Obvious tire and wheel runout.
- Obvious drive axle or propeller shaft runout.
- Proper inflation pressure.
- Wrong trim height.
- Bent wheels.
- Debris build-up on the tire or wheel.
- Loose or missing wheel weights or wheel nuts.
- Irregular or excessive tire wear.
- Proper tire bead seating on rim.
- Damaged tires, such as tread distortions, separations, or bulges from impact damage. Slight sidewall indentations are normal and will not affect ride quality.

Balance is the easiest procedure to perform and should, therefore, be done first if the vibration occurs at highway speeds. An off-car two-plane dynamic balance should first be performed. This will correct any imbalance in the tire and wheel assembly.

An on-car finish balance may also be required. This will correct any brake drum, rotor, or wheel cover imbalance. Follow the balancing procedures outlined in Section 3E.

If balance does not correct the highway speed vibration, or if the vibration is at low speeds, runout is the probable cause. Runout can be caused by the tire, wheel, or the way the wheel attaches to the car. The following procedure should be used:

A. If runout is suspected, the free runout of the tire and wheel assembly should first be measured on the car. A dial indicator with a roller wheel is preferable, but a dial indicator with button end may be used. Lateral runout (side to side) should be measured on the tire's sidewall as close to the tread shoulder as possible. Radial runout (up and down) should be measured on the center tread rib. Some tread designs may require tightly wrapping a piece of tape around the center tread circumference for better dial indicator contact. For measuring wheel runout follow the "Measuring Wheel Runout" procedure in Section 3E. Whether measuring radial or lateral runout, disregard any instantaneous indicator needle jumps due to sidewall depressions, tread blocks, etc. Record the total indicator reading, and the location of the high point of runout. The total tire and wheel on-car runout should be less than .060", if either measurement exceeds .060", proceed to Step B.

B. If the on-car radial or lateral runout measured in Step A exceeds .060", mount the tire and wheel assembly on a dynamic balance machine and again measure the amount of runout. Locate on the machine by the wheel's inside center pilot hole. Using the same procedure as in Step A, record the amount of tire and wheel runout and its high point location. Next, measure wheel runout, see Section 3E. If the wheel exceeds specifications replace the wheel. If the tire and wheel radial or lateral runout exceeds .050" at the tire tread, proceed to Step C.

C. If the off-car tire and wheel radial or lateral runout measured in Step B exceeds .050", match mount the high radial runout point of tire to low radial runout point of wheel. Reinflate, mount on the dynamic balance machine, and again measure and record the radial and lateral runout and its location, as done in Step B. In many cases, match mounting the tire on the wheel will bring the assembly's runout into the acceptable range of less than .050".

D. If the runout of the tire and wheel assembly is within limits when measured off the car, yet exceeds the limits when measured on the car, the attachment of the tire and wheel assembly to the hub is the probable cause. Rotate the assembly two wheel studs and recheck the runout. Several positions may have to be tried to find the best location.

E. If the assembly runout cannot be reduced to an acceptable level, remove the tire and wheel assembly and measure wheel stud runout with a dial indicator. Zero the dial indicator button on one stud. Lift button gently off stud and rotate flange to position next stud against dial indicator button. Record the runout on all studs. Dial indicator should read zero when repositioned on first stud that was checked. If runout exceeds .030", the hub or axle shaft should be replaced.

Whenever a tire is rotated on the wheel, or a tire or wheel is replaced, the assembly must be rebalanced.

In addition to balance and tire and wheel free runout, tire stiffness variation (loaded radial runout) can also cause a vibration. However, this is impossible to measure without a TPD (Tire Problem Detector) or a loaded radial runout buffer.

The TPD is a roller drum that slowly rotates the tire while under load and mounted on the car. Tire stiffness variation causes wheel spindle movement which can be measured.

The loaded radial runout buffer is a more automated machine that slowly rotates the tire and wheel off the car under load with a roller drum and measures the tire's stiffness variation. It will then "match" the tire to the wheel by buffing off small amounts of rubber from the outer tread rows at the stiff spot. This procedure is usually effective, especially when used as a measuring device and for fine buffing only.

The TPD and loaded radial runout buffer are two methods that will measure or correct tire stiffness variation, tire runout, and wheel runout at the same time. However, because such equipment is not always available, and both have their disadvantages, the more basic procedure of measuring free runout with a dial indicator, as previously detailed, is usually more practical. The free runout of the tire will usually correspond with the tire's stiff spot.

The substitution method of vibration diagnosis can also be used. Install a known good set of tire and wheel assemblies. If these correct the vibration, the original assemblies should be reinstalled one at a time until the vibration returns. This will point out the tire with excess stiffness variation.

Tire stiffness variation will be higher or lower depending on the direction of tire rotation.

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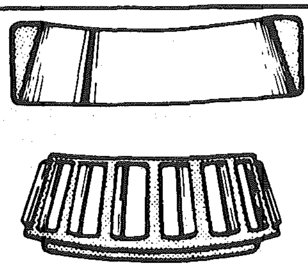
Fig. 20 Vibration Complaint Chart (2 of 2)

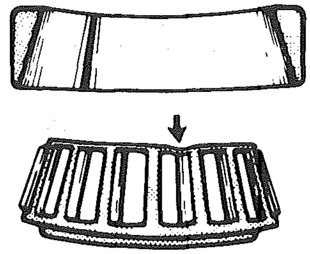
TAPERED ROLLER BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



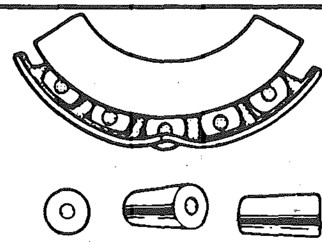
GOOD BEARING



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

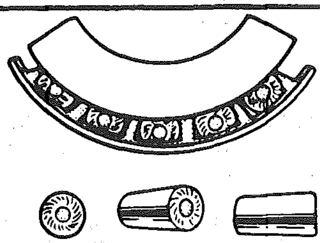
REPLACE BEARING.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

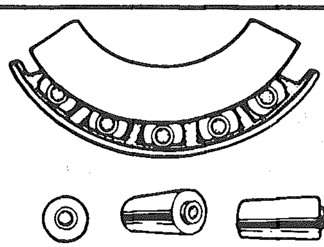
REPLACE BEARING.



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD.

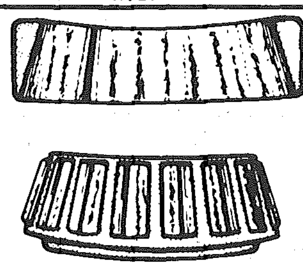
REPLACE BEARING – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

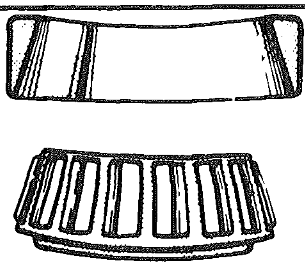
CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.

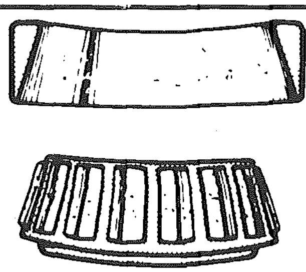
REPLACE BEARINGS – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



MISALIGNMENT

OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.

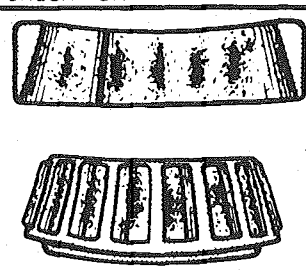
CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.



INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.



FATIGUE SPALLING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.

REPLACE BEARING – CLEAN ALL RELATED PARTS.

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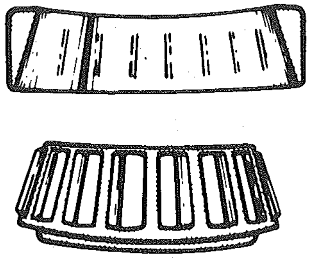
Fig. 21 Tapered Roller Bearing Diagnosis (1 of 2)

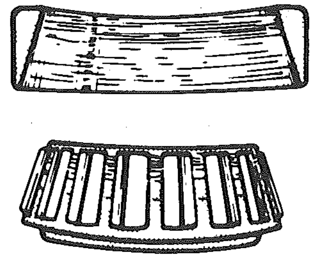
TAPERED ROLLER BEARING DIAGNOSIS - CONT'D



BRINELLING

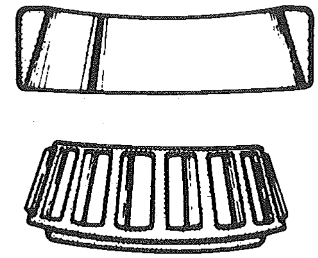
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.



CAGE WEAR

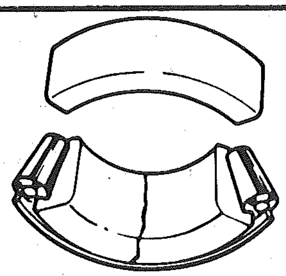
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

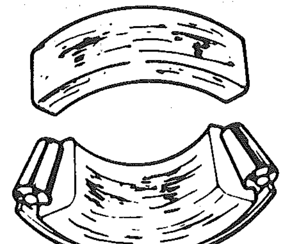
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

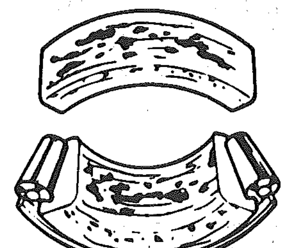


SMEARS

SMEARING OF METAL DUE TO SLIPPAGE, SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FIT AND LUBRICATION.

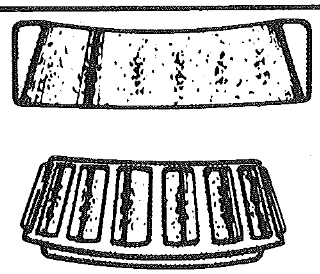
REPLACE SHAFT IF DAMAGED.



FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



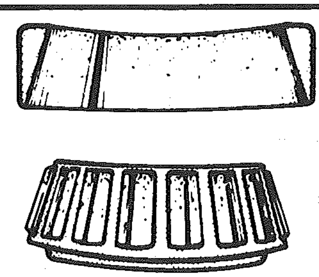
HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.



STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.

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Fig. 22 Tapered Roller Bearing Diagnosis (2 of 2)

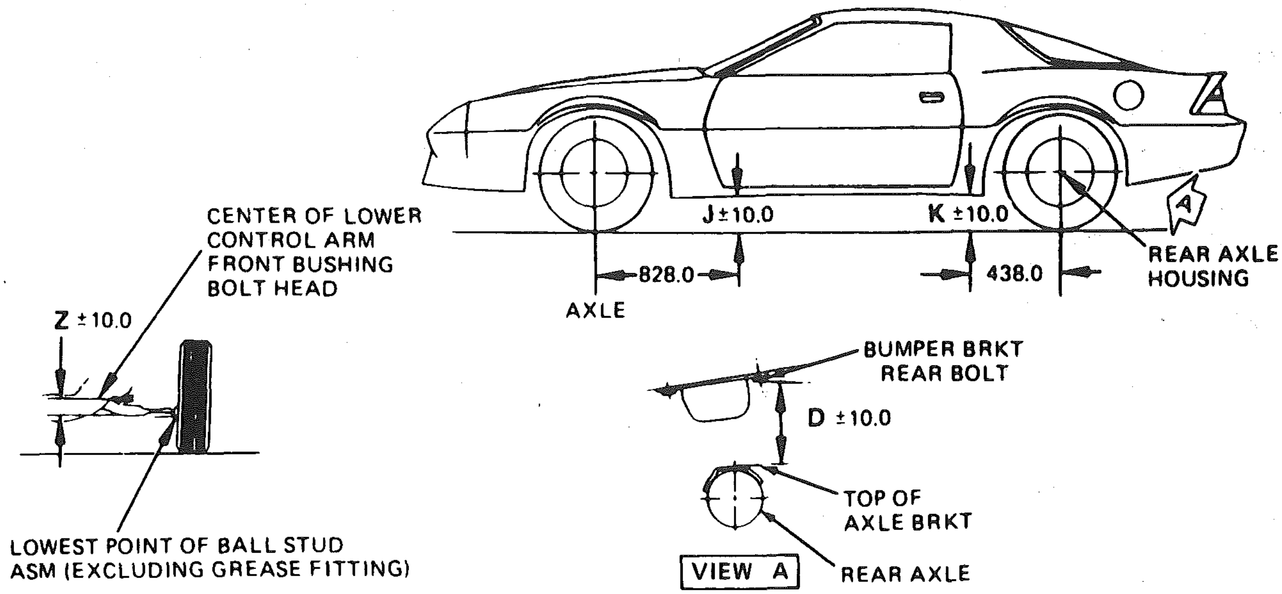
TRIM HEIGHTS (@ CURB WEIGHT)

The following procedure should be followed before making any trim height measurement.

1. "Z" & "J" DIMENSIONS
   a. Lift vehicle up approximately 1-1/2" at the front bumper and gently remove hands allowing vehicle to settle on its own. Repeat this lifting operation twice for a total of three times. Measure the "Z" & "J" heights in the settled position after the third lift.
   b. Push vehicle down approximately 1-1/2" at the front bumper and gently remove hands allowing vehicle to settle on its own. Repeat this pushing down operation twice for a total of 3 times. Measure the "Z" & "J" heights in the settled position after the third push.
   c. The true "Z" & "J" height is the average of (a) and (b) for each side.

"D" & "K" DIMENSIONS

NOTE: Follow the same pattern as stated above for the "Z" & "J" dimensions when measuring the "D" "K" dimensions except: Lift and push on the rear bumper.



TIRE SIZE	SUSPENSION	ENGINE	Z	D	J	K
P215/65R15	STD	2.8L	29			
P215/65R15	STD	5.0L	28	111		
P215/65R15	F41	2.8L				
P215/65R15	F41	5.0L	29			
P245/50VR16	FE2	ALL V-8	33	115	209	210
P215/65R15	F41	Firebird 5.0L	29	111		
P215/65R15	F41	Trans Am 5.0L	30	112 / 113		
P245/50VR16	FE2	All V-8	34	115		

Dimensions shown in mm/1mm = 0.039 in.

F41 = Special Heavy Duty. ① = Multi Port Injection.

FE2 = Touring Pkg. Susp. ② = Tuned Port Injection.

NOTE:
TIRE PRESSURE SHOULD BE AS SHOWN ON TIRE PRESSURE STICKER AND VEHICLE SHOULD HAVE A FULL TANK OF GASOLINE BEFORE MAKING TRIM HEIGHT CHECKS.

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Fig. 23 Trim Height Diagnosis

SECTION 3A

WHEEL ALIGNMENT

NOTICE: These fasteners are important attaching parts, in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing torque Nut(s) and Bolt(s)" chart in Section 0.

CONTENTS

GENERAL DESCRIPTION

Wheel alignment refers to the angular relationship between the wheels, the suspension attaching parts and the ground.

CASTER

Figure 1

Caster is the amount the top of the strut is tilted forward or rearward from the vertical. When the strut tilts rearward, the center is "positive" (+). The amount of tilt is measured in degrees from vertical.

CAMBER

Figure 1

Camber is the tilting of the wheels from the vertical when viewed from the front of the car. When the wheels tilt outward at the top, the camber is said to be positive (+). When the wheels tilt inward at the top, the camber is said to be negative (-). The amount of tilt is measured in degrees from the vertical and this measurement is called the camber angle.

TOE

Figure 1

Toe is a measurement of how much the front of the wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is "positive" (+). When the wheels are turned out, toe is "negative" (-). The actual amount of toe-in is normally only a fraction of a degree. The purpose of a toe specification is to ensure parallel rolling of the wheels (excessive toe-in or toe-out may increase tire wear). Toe also serves to offset the small deflections of the wheel support system which occur when the car is rolling forward. In other words, even when the wheels are set to toe-in slightly when the car is standing still, they tend to roll parallel on the road when the car is moving.

PRELIMINARY CHECKS PRIOR TO ADJUSTING ALIGNMENT

Steering and vibration complaints are not always the result of improper alignment. Another possibility is tire "lead" due to worn or improperly manufactured tires. "Lead" is the deviation of the car from a straight path on a level road without hand pressure on the steering wheel. Section 3 of this manual contains a procedure for determining the presence of a tire lead problem.

Before making any adjustment affecting wheel alignment, make the following checks to ensure correct alignment readings and alignment adjustments:

1. Check all tires for proper inflation pressures and approximately the same tread wear.
2. Hub and bearing assemblies for excessive wear; correct if necessary.
3. Ball joints and tie rod ends; if they are excessively loose, correct them before adjusting.
4. Run-out of wheels and tires.
5. Car trim height; if out of limits and a correction is to be made, do so before adjusting alignment. Refer to Section 3 for trim height specifications.
6. Strut dampeners for proper operation.
7. Control arms for loose bushings.
8. Loose or missing stabilizer bar attachments.

Consideration must be given to excess loads, such as tool boxes, sample cases, etc. If these items are normally carried in the car, they should remain in the car during alignment adjustments. Consideration should also be given to the condition of the equipment used to adjust alignment. Be sure to follow the equipment manufacturer's instructions. Regardless of

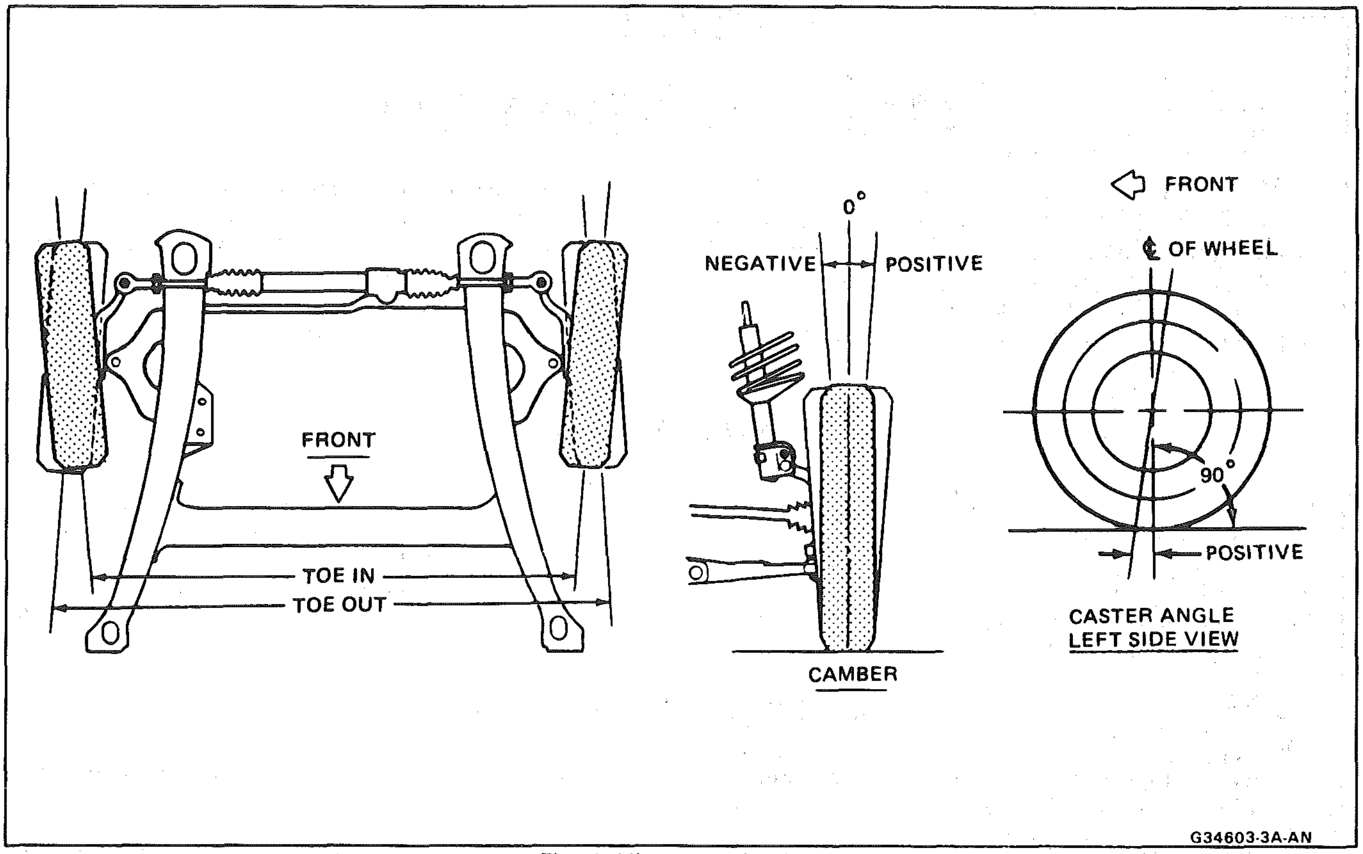


Fig. 1 Alignment Angles

the equipment used to adjust alignment, the car must be on a level surface, both fore-and-aft and sideways.

ON-CAR SERVICE

CASTER AND CAMBER ADJUSTMENT

Before adjusting caster and camber angles, the front bumper should be raised and released twice to allow vehicle to return to its normal height. See "Trim Heights."

Caster and camber can be adjusted by moving the position of the upper strut mount assembly, as shown in Fig. 601. Moving the mount forward/rearward adjusts caster; movement inboard/outboard adjusts camber.

The position of the mount can be changed after loosening the three nuts shown in Fig. 601. The weight of the vehicle will normally cause the strut assembly to move to the full inboard position.

Install Tool J-29724 and tighten the turnbuckle until the proper camber reading is obtained. Then, if an adjustment in caster is required, the mount can be tapped forward or rearward with a rubber mallet. Tighten the three (3) nuts to specifications.

TOE-IN ADJUSTMENT

Tie rod adjuster parts often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 9.0 N·m (80 lb. in.), discard the nuts and bolts. Apply penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

Toe-in can be increased or decreased by changing the length of the tie rods. A threaded sleeve is provided for this purpose.

When the tie rods are mounted ahead of the steering knuckle they must be decreased in length in order to increase toe-in.

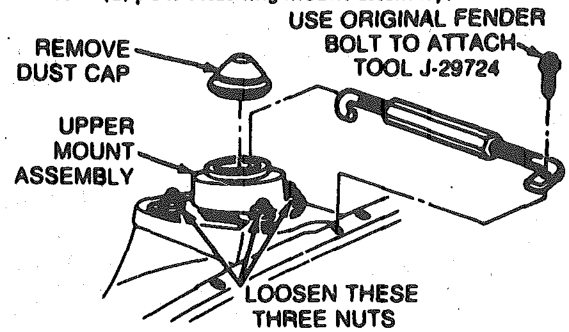
1. Loosen the clamp bolts at each end of the steering tie rod adjustable sleeves.

2. With steering wheel set in straight ahead position, turn tie rod adjusting sleeves to obtain the proper toe-in adjustment.

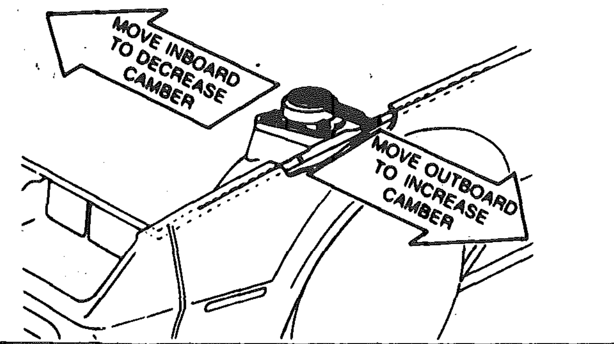
3. When adjustment has been completed according to the recommended specifications, check to see that the number of threads showing on each end of sleeve are equal and that the tie rod end housings are at the right angles to steering arm. Position tie rod clamps and sleeves. Torque nuts.

An alignment verification label on the upper mount-to-wheelhouse tower verifies the accuracy of camber and caster adjustment. If a steering problem exists, it is important to check other possible causes before adjusting camber or caster.

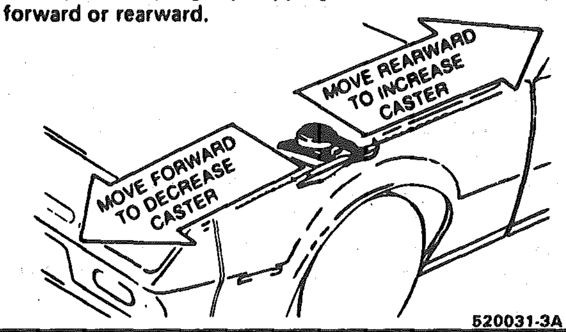
(1) Remove dust cap and fender bolt. Attach J-29724, using original fender bolt. Tighten the turnbuckle. Loosen (3) nuts attaching mount assembly.



(2) Using reliable alignment equipment, follow the manufacturer's instructions to obtain camber and caster readings. Adjust the camber by rotating the turnbuckle on J-29724 to allow the mount assembly to move inboard or outboard.



(3) After obtaining the correct camber reading, caster can be adjusted by lightly tapping the mount assembly forward or rearward.



(4) When the correct camber and caster readings are obtained, tighten the (3) nuts attaching the mount assembly to 28 N·m. Remove J-29724. Install the fender bolt and dust cap.

Fig. 601 Caster and Camber Adjustment

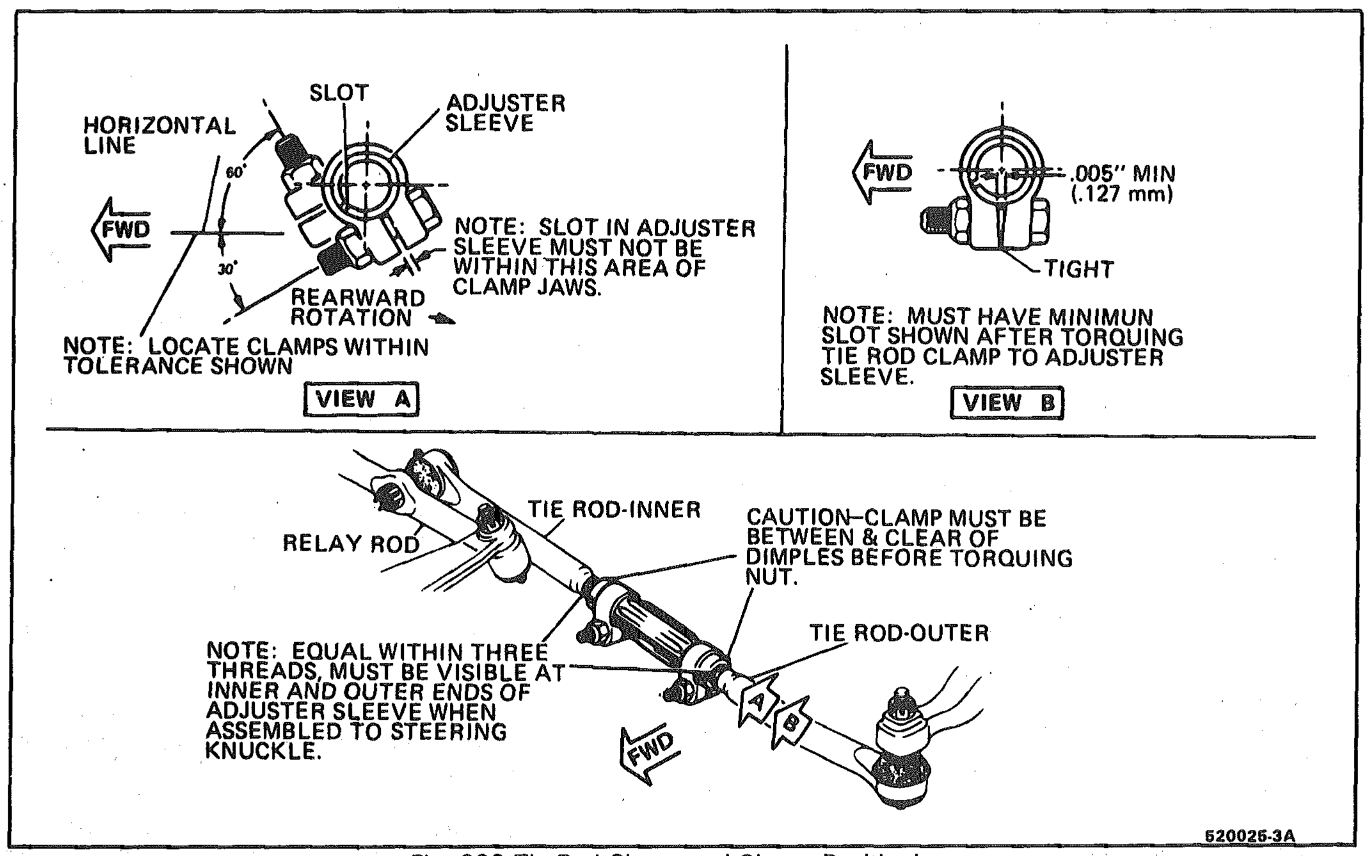


Fig. 602 Tie Rod Clamp and Sleeve Positioning

AXLE HOUSING ALIGNMENT

If rear tire wear indicates that the axle housing may be bent, the alignment can be checked as follows:

1. Back the car squarely onto an alignment machine. The actual toe-out will be read on the scale as toe-in. However, if the toe-out is checked with a tram gage, disregard this notice.
2. If a tram is used for checking toe out, it will still be necessary to perform Steps 1 and 2 in order to check camber.

The necessary straightening operations may be performed using frame straightening equipment without removing the axle housing from the car. This procedure will allow checks during the straightening operation to determine when the housing is within the prescribed limits.

SPECIFICATIONS

ALIGNMEN ANGLE		SERVICE CHECKING	SERVICE SETTING
TOE			
	DEG(PER WHEEL)	0°±0.1°	0°
CAMBER		0°±0.5°	A 0°
CASTER		+5.0±0.5°	B +5.0°

- Z & D trim height dimensions to be held while checking/ setting alignment specs.
- Vehicle must be jounced three times before checking alignment, to eliminate false geometry readings.
- Toe adjustment to be set separately per wheel, with steering wheel held in "straight-ahead" position within +_5.0-.

A - Left & right side to be equal within 0.7°

B - Left & right side to be equal within 1.0° when checking/

Fig. 603 Wheel Alignment Specs

SECTION 3B5
STEERING WHEELS AND COLUMNS

NOTICE: All steering wheel and column fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

For prevailing torque nut(s) and bolts(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 0A.

CONTENTS

GENERAL DESCRIPTION

STEERING COLUMN

The function locking energy absorbing steering column includes three important features in addition to the steering function:

1. The column is energy absorbing, designed to compress in a front-end collision to minimize the possibility of an injury to the driver of the car.
2. The ignition switch and lock are mounted conveniently on this column.
3. With the column mounted lock, the ignition and steering operations can be locked to inhibit theft of the car.

The turn signal lever provides for control of headlight beams, windshield washer and wipers.

The column may be easily disassembled and reassembled. To insure the energy absorbing action, it is important that only the specified screws, bolts, and nuts be used as designated and that they are tightened to the specified torque.

When the column assembly is removed from the car, special care must be taken in handling it. Use of a steering wheel puller other than the one recommended in this manual, a sharp blow on the end of the steering shaft or shift lever, leaning on the assembly, or dropping the assembly could shear or loosen the plastic fasteners which maintain column rigidity.

MAINTENANCE AND ADJUSTMENTS

Steering Wheel Alignment and High Point Centering

1. Set front wheel in straight ahead position. This can be checked by driving vehicle a short distance on a flat surface to determine steering wheel position at which vehicle follows a straight path.

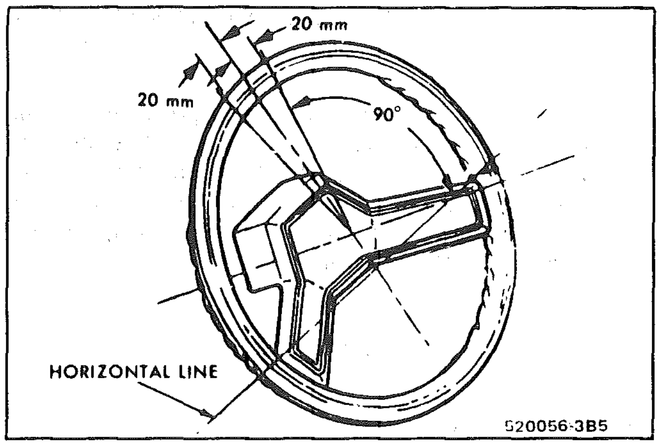


Fig. 3B5-1 Steering Wheel Alignment Typical

2. With front wheels set straight ahead, check position of flat on wormshaft designating steering gear high point. This flat should be at the top side of the shaft at 12 o'clock position.
3. If gear has been moved off high point when setting wheels in straight ahead position, loosen adjusting sleeve clamps on both left and right hand tie rods, then turn both sleeves an equal number of turns in the same direction to bring gear back on high point.

NOTICE: Turning the sleeves an unequal number of turns or in different directions will disturb the toe-in setting of the wheels.

4. Readjust toe-in as outlined in Section 3A (if necessary).

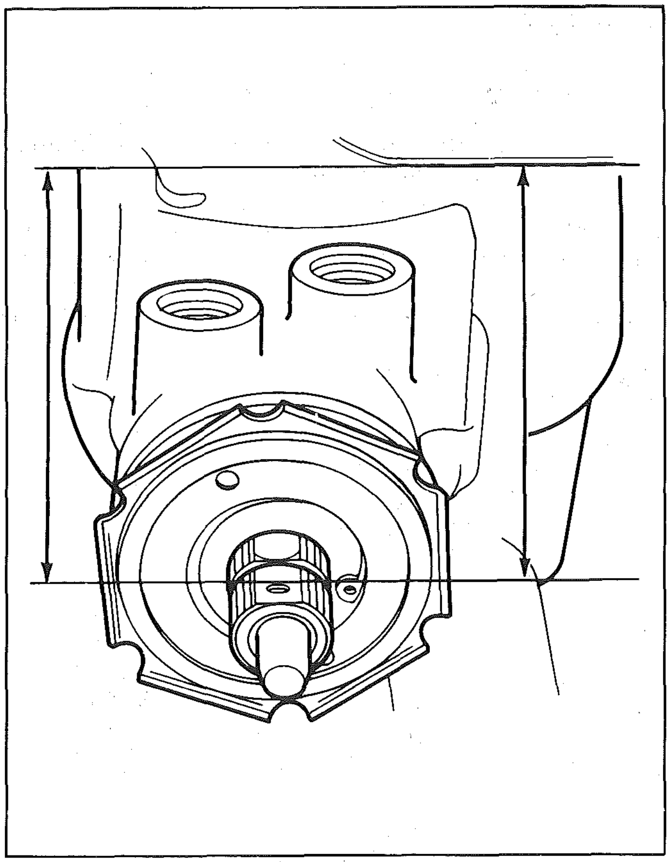


Fig. 3B5-2--The Flat on Worm Shaft

5. With wheels in a straight ahead position and the steering gear on highpoint, check the steering wheel alignment (Fig. 1). If the spokes are not within the limits specified, the wheel should be removed and centered. (See steering wheel removal in this section).

ON-CAR SERVICE

STEERING COLUMN

To perform service procedures on the steering column upper end components, it is not necessary to remove the column from the vehicle.

The steering wheel, horn components, directional signal switch, ignition lock cylinder and ignition key warning switch may be removed with the column remaining in the vehicle as described earlier in this section.

NOTICE: The outer mast jacket shift tube, steering shaft and instrument panel mounting bracket are designed as energy absorbing units. Because of the design of these components, it is absolutely necessary to handle the column with care when performing any service operation. Avoid hammering, jarring, dropping or leaning on any portion of the column.

NOTICE: When reassembling the column components, use only the specified screws, nuts and bolts and tighten to specified torque. Care should be exercised in using over-length screws or bolts as they may prevent a portion of the column from compressing under impact.

COLUMN REMOVAL AND INSTALLATION

The front of dash mounting plates must be loosened whenever the steering column is to be lowered from the instrument panel.

Refer to Fig. 3B5-3 for view of column attachment provisions.

1. Remove nut and bolt from upper intermediate shaft coupling. Separate coupling from lower end of steering column. See Figure 3B5-4.
2. Disconnect shift linkage from lower shift lever.
3. Disconnect all electrical connectors from column assembly.
4. Remove screws securing toe pan cover to floor.
5. Remove nuts securing bracket to instrument panel.

ON-CAR SERVICE

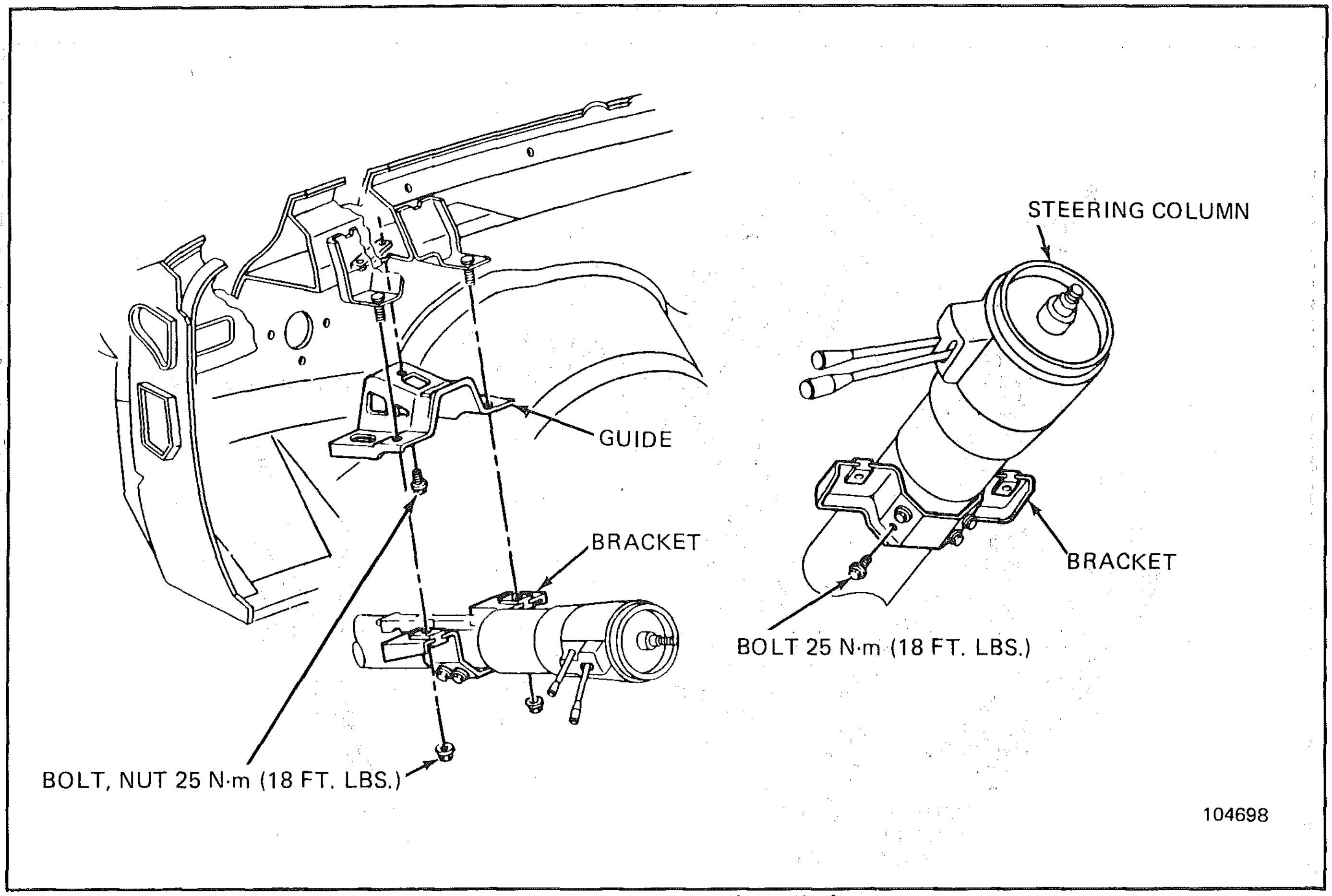


Fig. 3B5-3 -- Column Installation

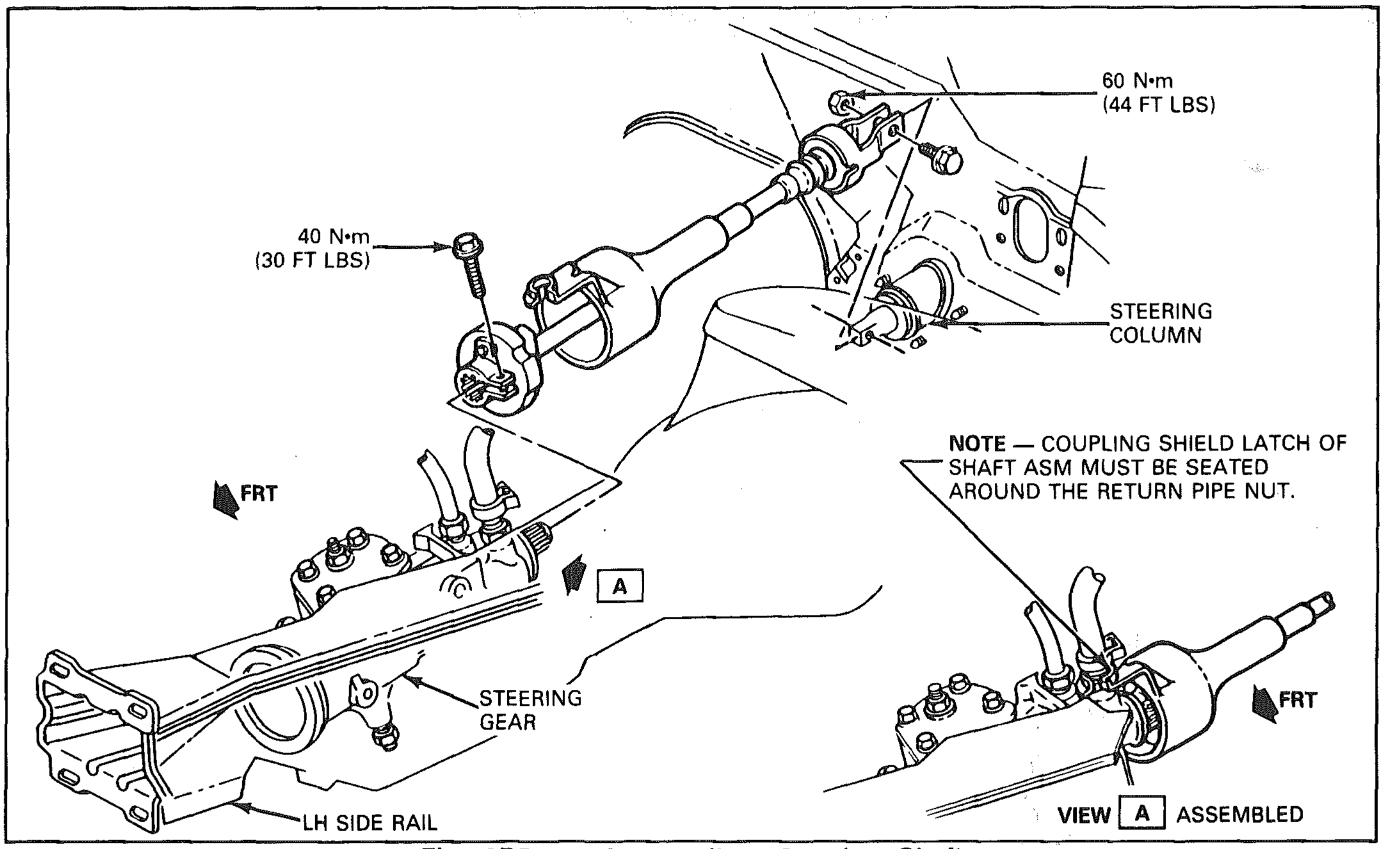


Fig. 3B5-4 -- Intermediate Steering Shaft

ON-CAR SERVICE

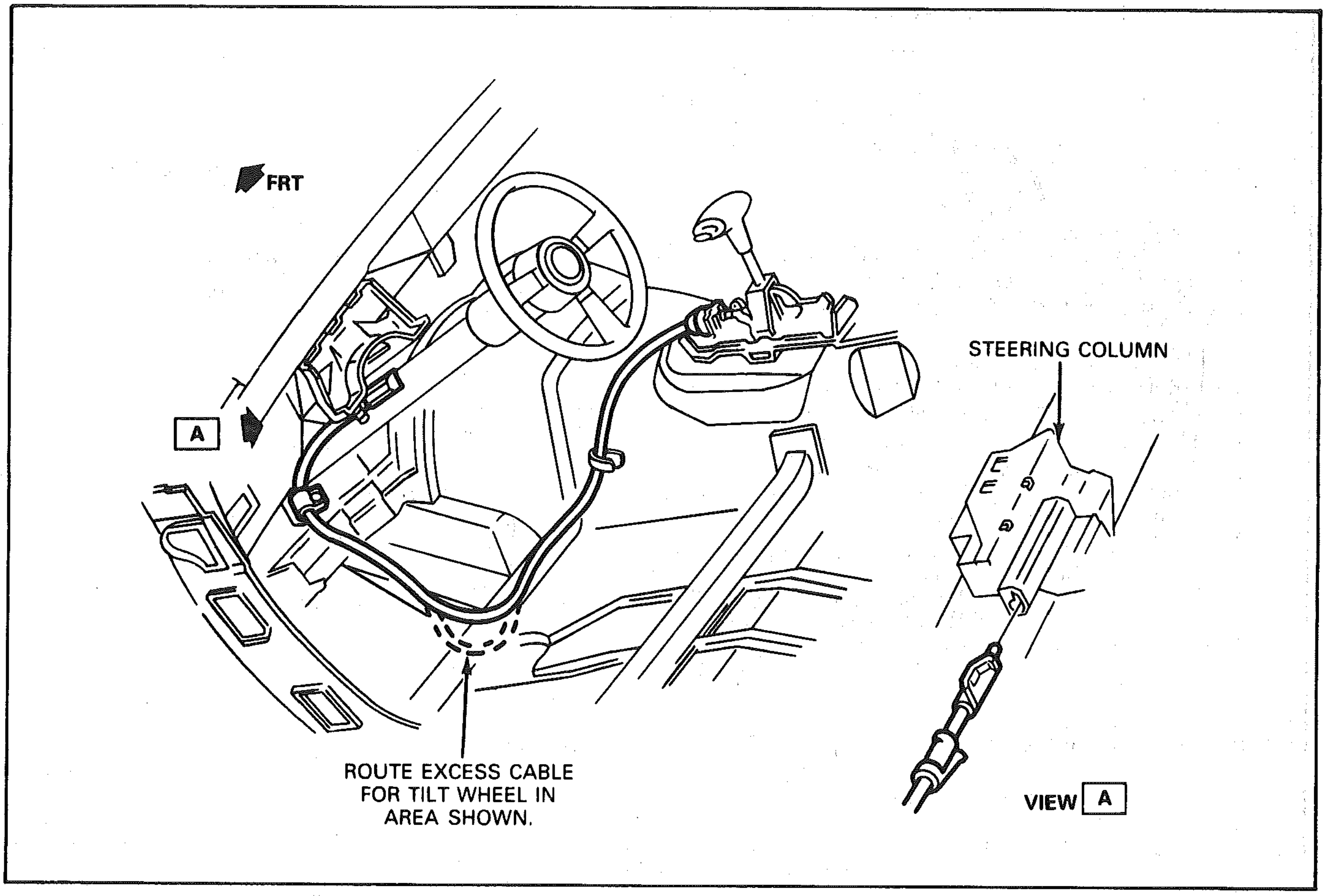


Fig. 3B5-5 -- Park Lock Cable

CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

Cars involved in accidents resulting in frame damage, major body or sheet metal damage, or where the steering column has been impacted may also have a damaged or misaligned steering column.

CHECKING PROCEDURE

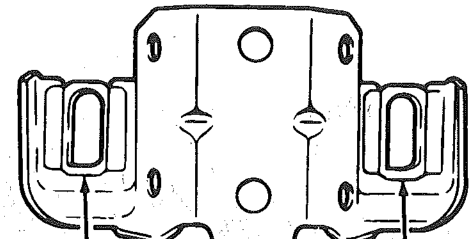
1. Check capsules on steering column bracket assembly; all should be within 1.59mm (1/16") from the bottom of the slots. (View A) If not, bracket should be replaced.

2. Check contact surface "A". (View B) The bolt head must not contact surface "A" or shear load would be increased. If contact is made, replace bracket.

3. On cars with column shift, check operation of the shift lever. If you are able to move lever to "Park" position without raising lever, it is an indication that the upper shift tube plastic bearing is broken.

4. Check for jacket collapse by measuring the distance from edge of the back-up switch window to the lower edge of upper jacket. (Refer to View C for dimensions.) If jacket dimensions are not within specifications a NEW jacket must be installed. Visually inspect for sheared injected plastic in the shift tube (View D), and the steering shaft (View E). If either one, or both are sheared replace with NEW parts.

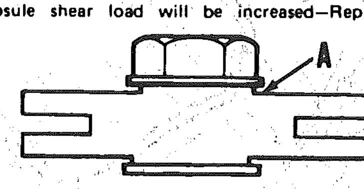
5. Any frame damage that could cause a bent steering shaft must have steering shaft runout checked in the following manner: Remove intermediate shaft. Hold ruler against lower end of steering shaft and have steering wheel rotated. Runout must not exceed 1.59mm (1/16"). Dial indicator may be used instead of a ruler.



Capsules must be within 1.59mm (1/16") from bottom of slots if not, replace bracket assembly.

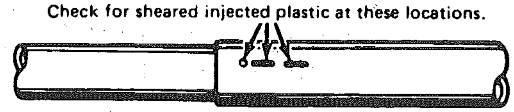
View A

The bolt head must not contact surface "A". If contact is made, the capsule shear load will be increased—Replace bracket.



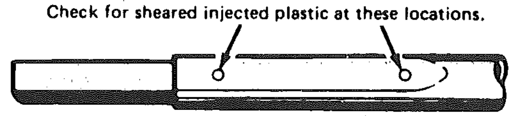
View B

Check for sheared injected plastic at these locations.



View D

Check for sheared injected plastic at these locations.



View E

METHOD TO DETERMINE COLUMN COLLAPSE
MEASURE DISTANCE BETWEEN ARROWS OF ILLUSTRATION.

View C

520055-3B5

Fig 3B5-6 -- Checking for Column Collapse

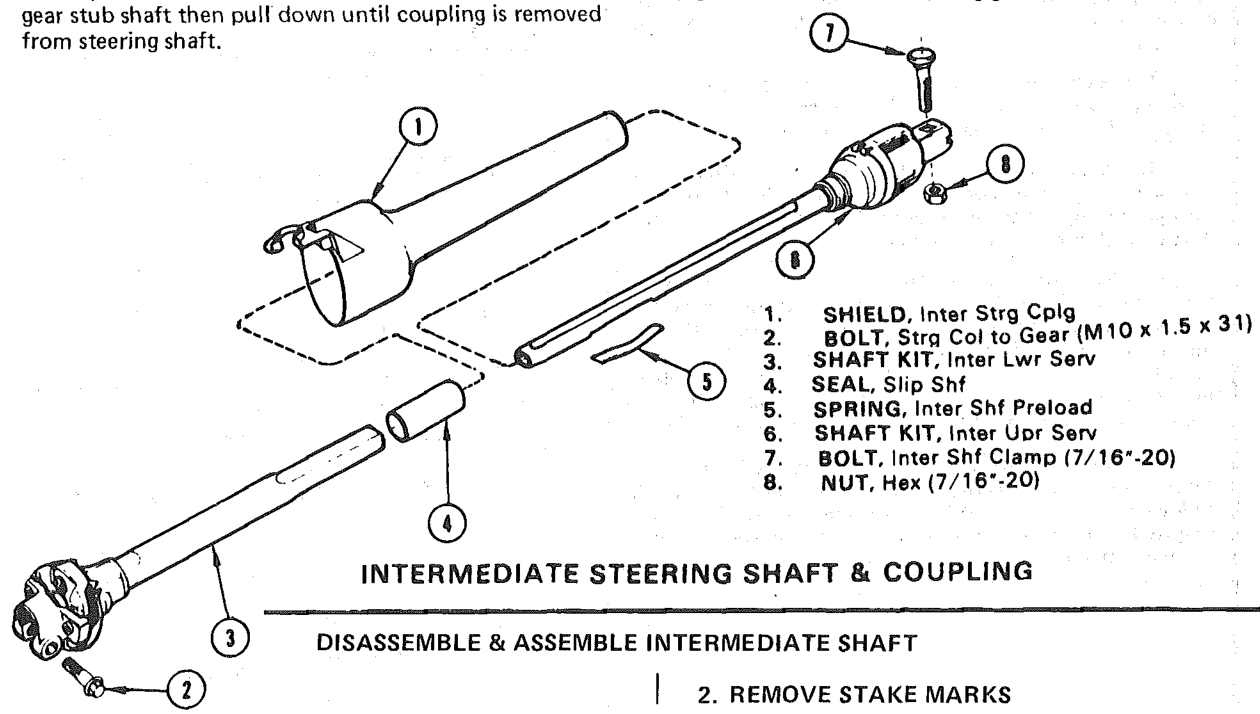
INTERMEDIATE SHAFT ASSEMBLY

REMOVE

1. Disengage stone shield from boss on steering gear housing or adapter. Remove pinch bolt from flexible coupling.
2. Remove coupling clamp to steering shaft attaching bolt and nut.
3. Push up on intermediate shaft to remove from steering gear stub shaft then pull down until coupling is removed from steering shaft.

INSTALL

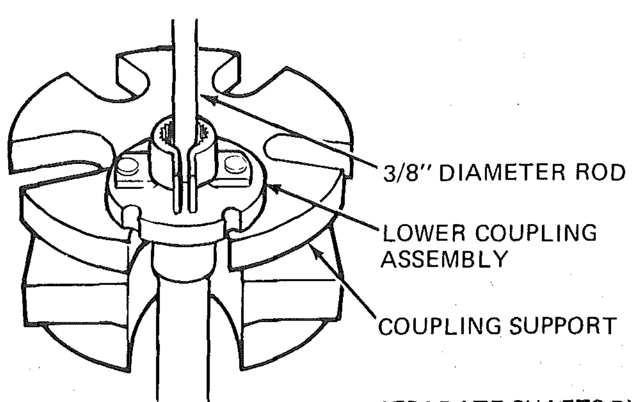
1. Install intermediate shaft on steering shaft and install bolt and nut and torque nut to 60 N·m (44 ft. lbs.)
2. Pull down on intermediate shaft to install on steering gear stub shaft. Coupling mut be fully seated so splines are not visable between coupling and gear. 40 N·m (30 ft. lbs.).
3. Engine stone shield on steering gear return hose nut.



INTERMEDIATE STEERING SHAFT & COUPLING

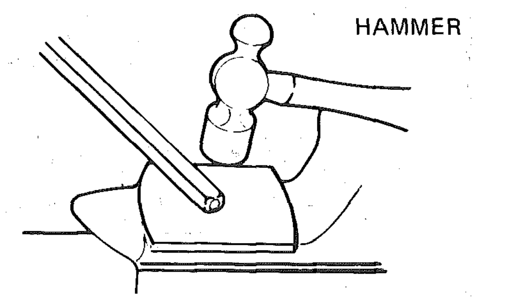
DISASSEMBLE & ASSEMBLE INTERMEDIATE SHAFT

1. SEPARATE UPPER & LOWER INTERMEDIATE SHAFT



SEPARATE SHAFTS BY PRESSING THROUGH FLEXIBLE COUPLING WITH ROD.

2. REMOVE STAKE MARKS



3. ASSEMBLE SLIP SHAFT

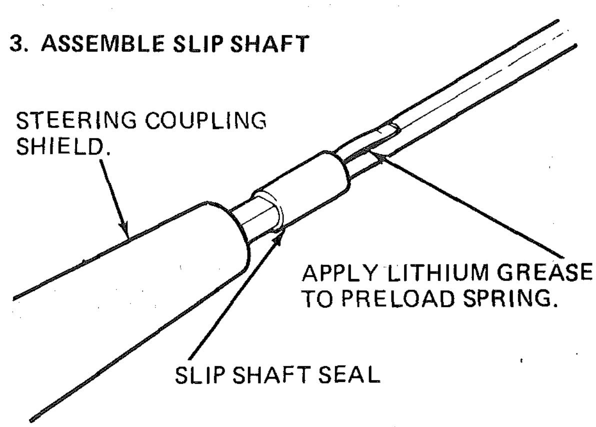


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Fig. 3B5-7--Intermediate Shaft

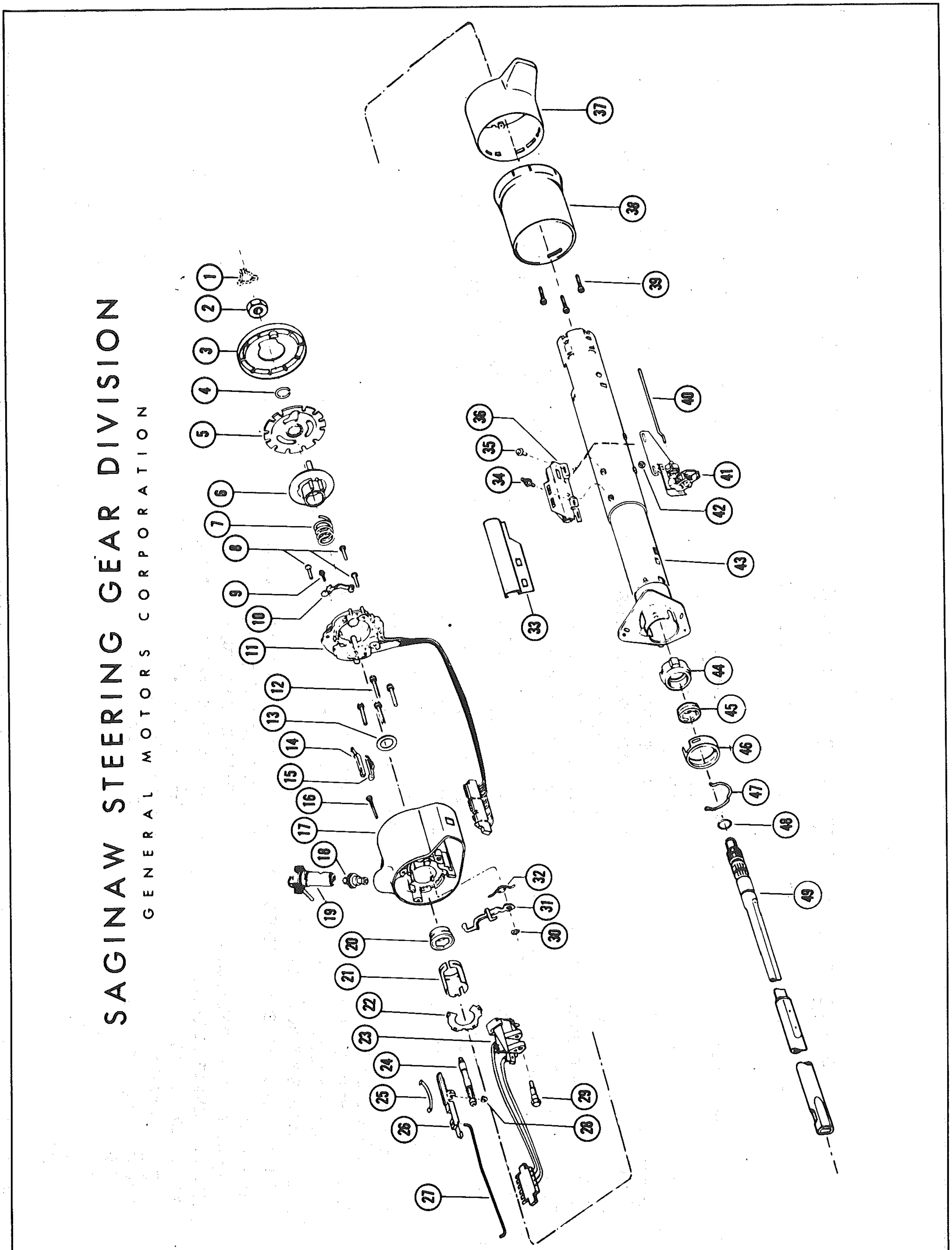


FIGURE 3B5-8 -- KEY RELEASE STANDARD COLUMN
(MANUAL TRANS)

SAGINAW STEERING GEAR DIVISION

GENERAL MOTORS CORPORATION

Key No. Part Name

1 - RETAINER
2 - NUT, HEXAGON JAM
3 - COVER, SHAFT LOCK
4 - RING, RETAINING
5 - LOCK, STEERING SHAFT
6 - CAM ASM, TURN SIGNAL CANCELLING
7 - SPRING, UPPER BEARING
8 - SCREW, BINDING HEAD CROSS RECESS
9 - SCREW, ROUND WASHER HEAD
10 - ARM ASM, ACTUATOR SWITCH
11 - SWITCH ASM, TURN SIGNAL
12 - SCREW, HEX WASHER HEAD TAPPING
13 - WASHER, THRUST
14 - SWITCH ASM, BUZZER
15 - CLIP, BUZZER SWITCH RETAINING
16 - SCREW, LOCK RETAINING
17 - HOUSING, STEERING COLUMN
18 - SECTOR ASM, SWITCH ACTUATOR
19 - LOCK CYLINDER SET, STEERING COLUMN
20 - BEARING ASM
21 - BUSHING, BEARING RETAINING
22 - RETAINER, UPPER BEARING
23 - SWITCH ASM, PIVOT &
24 - BOLT ASM, SPRING &
25 - SPRING, RACK PRELOAD

Key No. Part Name

26 - RACK, SWITCH ACTUATOR
27 - ROD, SWITCH ACTUATOR
28 - WASHER, SPRING THRUST
29 - PIN, SWITCH ACTUATOR PIVOT
30 - WASHER, WAVE
31 - LEVER, KEY RELEASE
32 - SPRING, KEY RELEASE
33 - PROTECTOR, WIRING
34 - STUD, DIMMER AND IGNITION SWITCH MOUNTING
35 - SCREW, WASHER HEAD
36 - SWITCH ASM, IGNITION
37 - BOWL, FLOOR SHIFT
38 - SHROUD, SHIFT BOWL
39 - SCREW, BINDING HEAD CROSS RECESS
40 - ROD, DIMMER SWITCH ACTUATOR
41 - SWITCH ASM, DIMMER
42 - NUT, HEXAGON
43 - JACKET ASM, STEERING COLUMN
44 - ADAPTER, LOWER BEARING
45 - BEARING ASSEMBLY
46 - RETAINER, BEARING ADAPTER
47 - CLIP, LOWER BEARING ADAPTER
48 - RING, RETAINING
49 - SHAFT ASM, STEERING

Key No. Part Name

ASSEMBLIES

0 - COLUMN ASM, E/A STEERING
101 - BRACKET ASM, COLUMN DASH

SERVICE KITS

201 - HOUSING ASM SERVICE KIT, STEERING COLUMN
202 - SHAFT REPAIR KIT, INJECTION STEERING
203 - SECTOR SERVICE KIT, IGNITION SWITCH ACTUATOR

FIGURE 3B5-9 -- KEY RELEASE STANDARD COLUMN (MANUAL TRANS)

SUB SECTION A

INCLUDES: SHAFT LOCK, TURN SIGNAL CANCELLING CAM, UPPER BEARING SPRING, TURN SIGNAL SWITCH, BUZZER SWITCH, AND CYLINDER LOCK SET

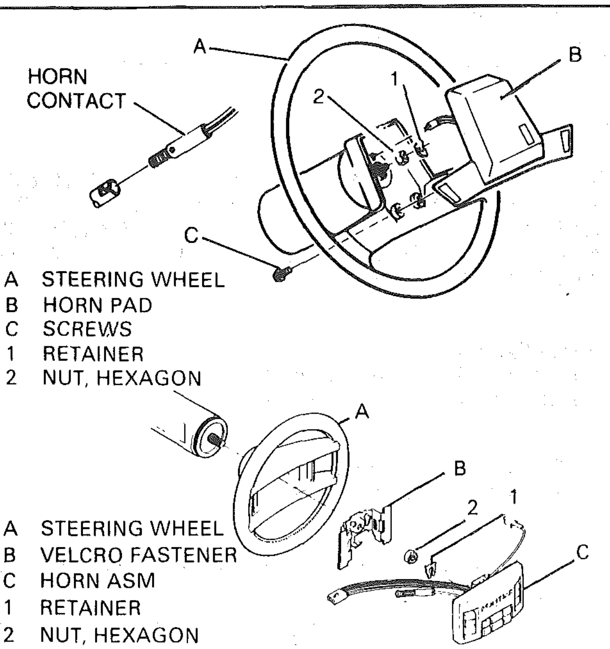
Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

Remove or Disconnect (Figure 2,3,4,5,6,7,8,9)

NOTICE: Wheels of car must be straight ahead. Failure to do so may cause improper alignment of some components *during installation, resulting in column malfunction.*

Key in "Lock" position. Failure to do so will cause steering wheel to turn, (see above).

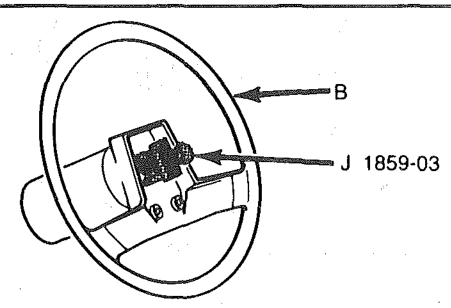
CAUTION: Disconnect battery. Failure to do so may cause electrical shock when working with wiring.



A STEERING WHEEL
B HORN PAD
C SCREWS
1 RETAINER
2 NUT, HEXAGON

A STEERING WHEEL
B VELCRO FASTENER
C HORN ASM
1 RETAINER
2 NUT, HEXAGON

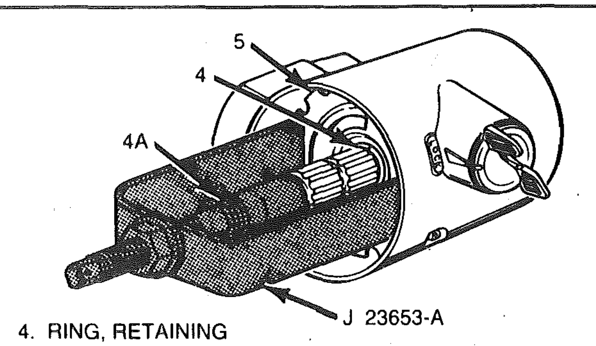
Figure 2. Removing Horn Pad, Retainer, and Jam Nut



B. STEERING WHEEL

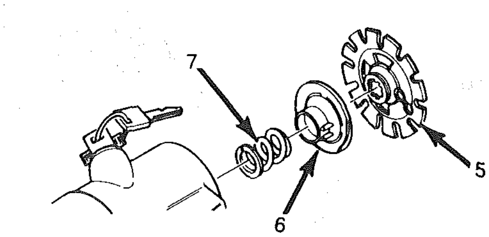
Figure 3. Remove Steering Wheel

1. Horn Pad
2. Electrical Connectors
3. Retainer (1) and jam nut (2)
4. Steering wheel, using J 1859-03, and cover
5. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
6. Shaft lock (5)
7. Turn signal cancelling cam (6)
8. Upper bearing spring (7)



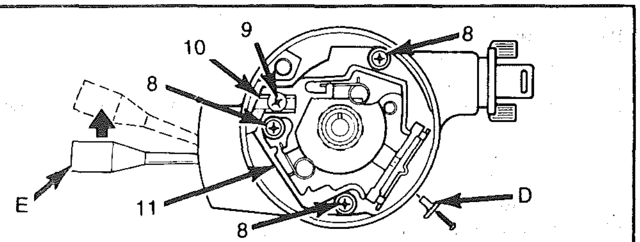
4. RING, RETAINING
5. LOCK, SHAFT
4A. EXTRA RINGS

Figure 4. Removing Shaft Lock Retaining Ring



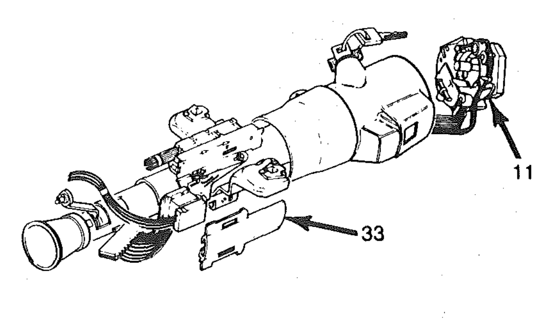
5. LOCK, SHAFT
6. CAM ASSY, TURN SIG CANCELLING
7. SPRING, UPPER BEARING

Figure 5. Remove Upper Shaft Components



8. SCREW, BINDING HD CROSS RECESS
9. SCREW, RD WASH. HD (M4.2X1.41)
10. ARM, SIGNAL SWITCH
11. SWITCH ASM, TURN SIGNAL
D. HAZARD KNOB
E. MULTI-FUNCTION LEVER

Figure 6. Turn Signal Switch Removal Preparation



11. SWITCH ASM, TURN SIGNAL
33. PROTECTOR, WIRING

Figure 7. Turn Signal Switch Removal

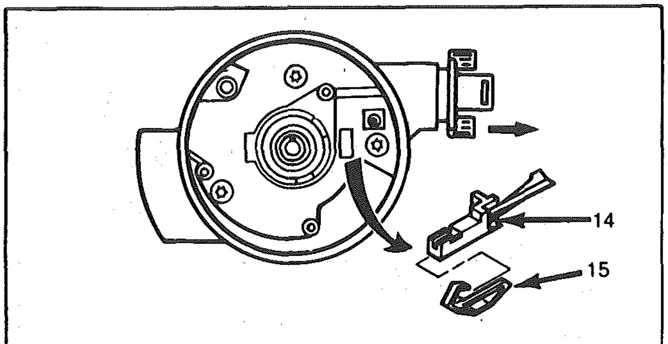


Figure 8. Buzzer Switch Removal

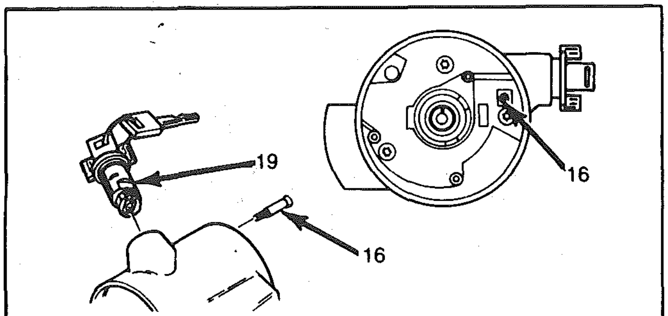


Figure 9. Removing Lock Cylinder Set

9. Turn signal in "Right Turn" position
10. Screw (9) and crossover arm (10)
11. Turn signal lever
12. Screws (8)
13. Turn signal switch (11). Let switch hang freely if removal is not necessary.
    To remove:
    A. Wire harness protector (33)
    B. Gently pull wire harness through column
14. Key from lock cylinder set (19)
15. Buzzer switch (14) and clip (15)
16. Reinsert key
17. Lock retaining screw (16)
18. Lock cylinder set (19)

Install or Connect (Figure 2,3,4,5,6,7,8,9,10)

1. Lock cylinder set (19)
2. Lock retaining screw (16)
3. Key in "Run" position
4. Clip (15) and buzzer switch (14)
5. Turn signal switch (11)
6. Screws (8)
7. Crossover arm (10) lubricated with lithium grease and screw (9)
8. Upper bearing spring (7)
9. Turn signal cancelling cam (6)
10. Shaft lock (5)
11. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
12. Cover (3)
13. Steering wheel

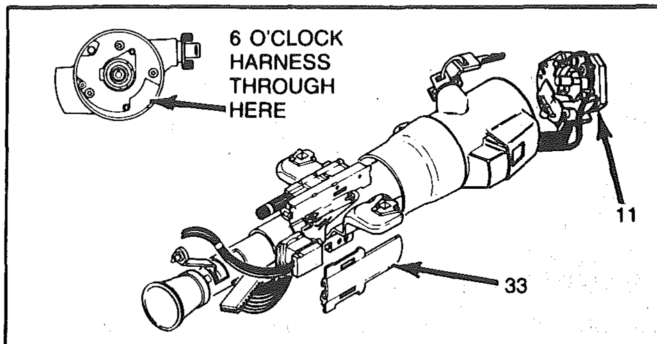


Figure 10. Wire Harness Through Column

14. Jam nut (2) and retainer (1)
15. Turn signal lever
16. Wire harness protector (33)
17. Horn pad and screws to back of steering wheel

SUB SECTION B

INCLUDES: DIMMER SWITCH, IGNITION SWITCH, LOCK HOUSING, COVER SHROUD, KEY RELEASE LEVER, SWITCH ACTUATOR RACK, SWITCH ACTUATOR SEGMENT, LOCK BOLT, PIVOT AND SWITCH ASSEMBLY, AND UPPER BEARING

Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

Remove or Disconnect (Figure 2 thru 15)

1. Perform steps 1 thru 18, Remove or Disconnect, Sub Section A

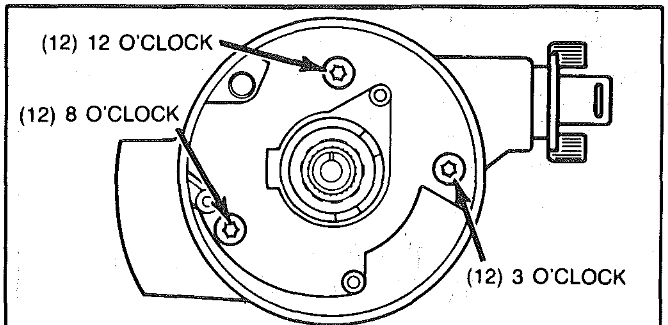
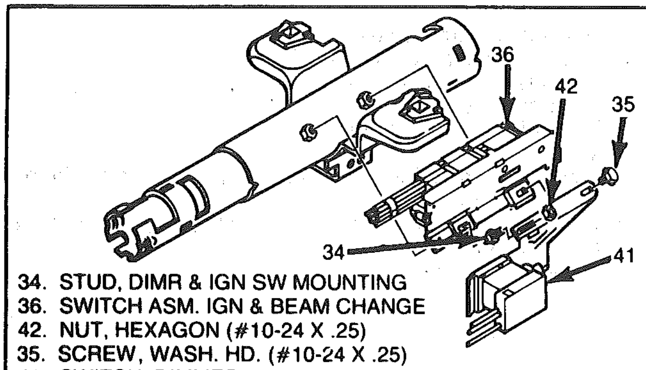


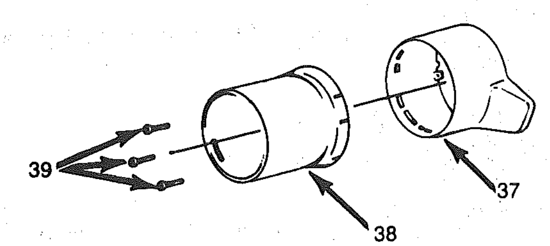
Figure 11. Lock Housing Cover Screw Positions

2. Thrust washer (13)
3. Screws (12)
4. Mounting bolt (35)
5. Hex nut (42)
6. Dimmer switch (41)
7. Dimmer switch rod (40)
8. Mounting stud (34)
9. Ignition switch (36)



34. STUD, DIMR & IGN SW MOUNTING
36. SWITCH ASM. IGN & BEAM CHANGE
42. NUT, HEXAGON (#10-24 X .25)
35. SCREW, WASH. HD. (#10-24 X .25)
41. SWITCH, DIMMER

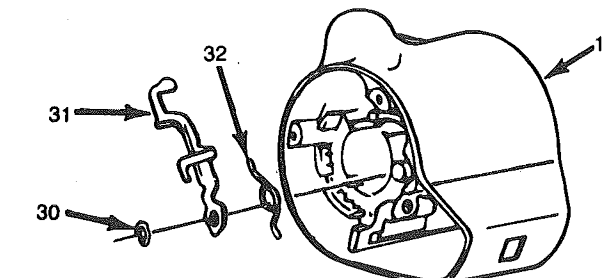
Figure 12. Ignition Switch and Dimmer Switch Removal



37. BOWL, FLOOR SHIFT
38. SHROUD, SHIFT BOWL
39. SCREWS

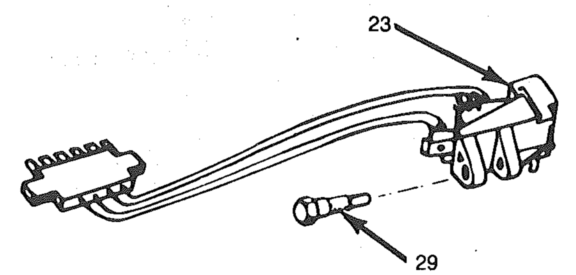
Figure 13. Shroud From Gear Shift Bowl

10. Lock housing cover (17) and shroud (38) assembly
11. Screws (39)
12. Shroud (38) from lock housing cover (17)
13. Upper bearing retainer (22)
14. Wave washer (30)
15. Key release lever (31)
16. Key release spring (32)
17. Switch actuator rod (27) and rack (26) assembly
18. Lock bolt (24)
19. Switch actuator pivot pin (29)
20. Pivot and switch assembly (23)
21. Bearing retaining bushing (21)
22. Switch actuator segment (18)
23. Upper bearing (20)



17. HOUSING, STEERING COLUMN
30. WASHER, WAVE
31. LEVER, KEY RELEASE
32. SPRING, KEY RELEASE

Figure 14. Key Release Lever Assembly

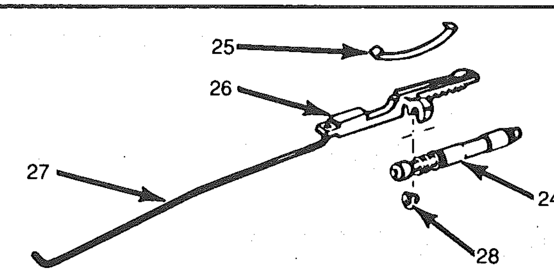


23. SWITCH ASM, PIVOT &
29. PIN, SWITCH ACTUATOR PIVOT

Figure 15. Removing Pivot and Switch Assembly

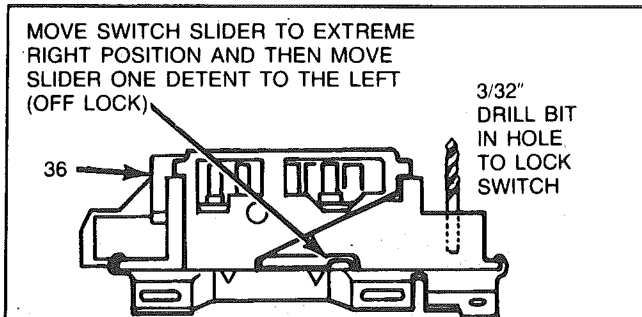
Install or Connect (Figure 2 thru 18)

1. Upper bearing (20)
2. Switch actuator segment (18)
3. Bearing retaining bushing (21)
4. Pivot and switch assembly (23)
5. Switch actuator pivot pin (29)
6. Lock bolt (24) and switch actuator rod (27) and rack (26) assembly
7. Key release spring (32)
8. Key release lever (31)
9. Wave washer (30)
10. Upper bearing retainer (22)



24. BOLT ASM, SPRING &
25. SPRING, RACK PRELOAD
26. RACK, SWITCH ACTUATOR
27. ROD, SWITCH ACTUATOR
28. WASHER, SPRING THRUST

Figure 16. Lock Bolt, Switch Actuator Rod, and Rack Assembly



36. SWITCH ASM, IGN & BEAM CHANGE

Figure 17. Adjust Ignition Switch

11. Shroud (38) to lock housing cover (17)
12. Screws (39)
13. Lock housing cover (17) and shroud (38) assembly to column
14. Screws (12)
15. Ignition switch (36) and mounting stud (34)

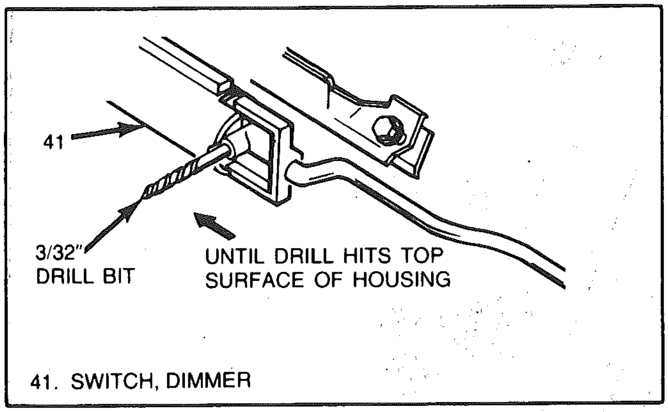


Figure 18. Adjust Dimmer Switch

16. Dimmer switch rod (40)
17. Dimmer switch (41) and hex nut (42). Adjust dimmer switch
18. Thrust washer (13)
19. Perform steps 1 thru 17, Install or Connect, Sub Section A

SUB SECTION C

INCLUDES: SHAFT AND LOWER BEARING ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

Remove or Disconnect (Figures 2,3,4,5,19)

1. Perform steps 1 thru 4, Remove or Disconnect, Sub Section A

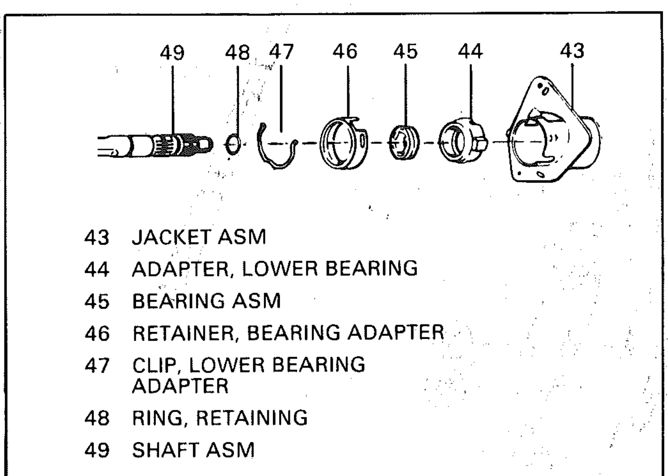


Figure 19. Lower Bearing Assembly

2. Steering column from car
3. Lower bearing adapter clip (47)
4. Retainer, bearing adapter (46)
5. Bearing ASM (45)
6. Lower bearing adapter (44)
7. Cover (3)
8. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
9. Shaft lock (5), turn signal cancelling cam (6), and upper bearing spring (7)
10. Shaft (49)

Install or Connect (Figure 2,3,4,5,19)

1. Shaft (49)
2. Upper bearing spring (7)
3. Turn signal cancelling cam (6)
4. Shaft lock (5)
5. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
6. Cover (3)
7. Lower bearing adapter (44)
8. Lower bearing ASM (45)
9. Lower bearing adapter retainer (46)
10. Clip (47)
11. Steering column to car
12. Perform steps 13 thru 17, Install or Connect, Sub Section A

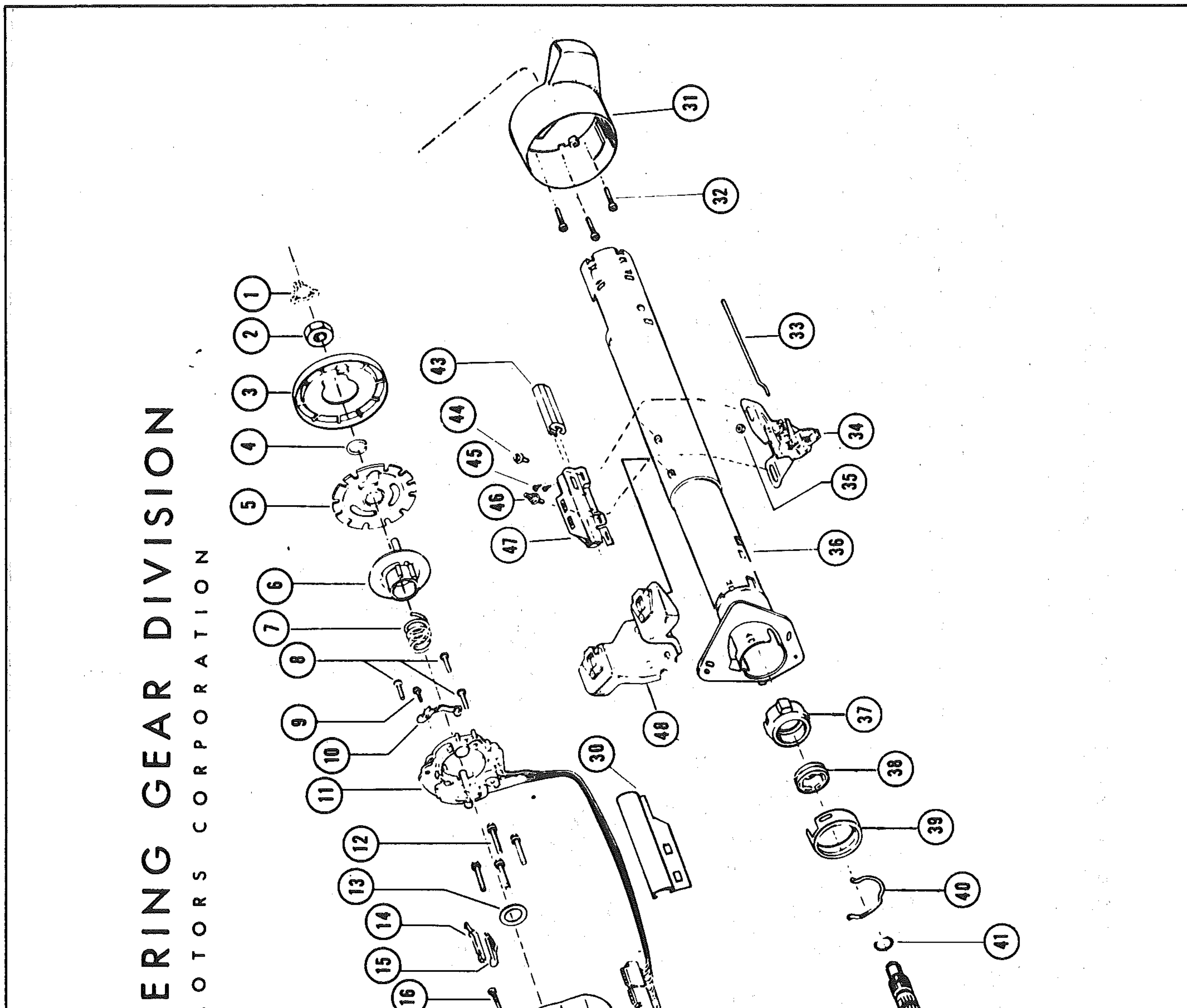


FIGURE 3B5-10 -- STANDARD STEERING COLUMN (AUTO TRANS)

SAGINAW STEERING GEAR DIVISION

GENERAL MOTORS CORPORATION

Key No.	*Part Name*
1	RETAINER
2	NUT, HEXAGON JAM
3	COVER, SHAFT LOCK
4	RING, RETAINING
5	LOCK, STEERING SHAFT
6	CAM ASM, TURN SIGNAL CANCELLING
7	SPRING, UPPER BEARING
8	SCREW, BINDING HEAD CROSS RECESS
9	SCREW, ROUND WASHER HEAD
10	ARM ASM, SWITCH ACTUATOR
11	SWITCH ASM, TURN SIGNAL
12	SCREW, HEX WASHER HEAD TAPPING
13	WASHER, THRUST
14	SWITCH ASM, BUZZER
15	CLIP, BUZZER SWITCH RETAINING
16	SCREW, LOCK RETAINING
17	HOUSING, STEERING COLUMN
18	SECTOR, SWITCH ACTUATOR
19	LOCK CYLINDER SET, STEERING COLUMN
20	BEARING ASM
21	BUSHING, BEARING RETAINING
22	RETAINER, UPPER BEARING
23	SWITCH ASM, PIVOT &
24	BOLT, LOCK
25	SPRING, RACK PRELOAD
26	RACK, SWITCH ACTUATOR
27	ROD, SWITCH ACTUATOR
28	WASHER, SPRING THRUST
29	PIN, SWITCH ACTUATOR PIVOT
30	PROTECTOR, WIRING

Key No.	*Part Name*
31	BOWL, FLOOR SHIFT
32	SCREW, BINDING HD CROSS RECESS
33	ROD, DIMMER SWITCH ACTUATOR
34	SWITCH ASM, DIMMER
35	NUT, HEXAGON
36	JACKET ASM, STEERING COLUMN
37	ADAPTER, LOWER BEARING
38	BEARING ASM
39	RETAINER, BEARING ADAPTER
40	CLIP, LOWER BEARING ADAPTER
41	RING, RETAINING
42	SHAFT ASM, STEERING
43	HOUSING ASM, IGN SWITCH
44	SCREW, WASHER HEAD
45	SCREW, PAN HD
46	STUD, DIMR & IGN SW MOUNTING
47	SWITCH ASM, IGNITION
48	BRACKET ASM. STRG. COL. SUPPORT

ASSEMBLIES

- 0 - COLUMN ASM, E/A STEERING
- 101 - BOLT ASM, SPRING &
- 102 - BOWL ASM, GEARSHIFT LEVER
- 103 - JACKET ASM, STEERING COLUMN
- 104 - SWITCH ASM, COLUMN LOCK & IGN

SERVICE KITS

- 201 - HOUSING ASM SERVICE KIT STEERING COLUMN
- 202 - SECTOR SERVICE KIT, IGNITION SWITCH ACTUATOR
- 203 - SHAFT REPAIR KIT INJ. STEERING

FIGURE 3B5-11 -- STANDARD STEERING COLUMN (AUTO TRANS)

SUB SECTION A

INCLUDES: SHAFT LOCK, TURN SIGNAL CANCELLING CAM, UPPER BEARING SPRING, SHAFT ASSEMBLY, AND LOWER BEARING ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

Remove or Disconnect (Figures 2,3,4,5,6)

NOTICE: *Wheels of car must be straight ahead. Failure to do so may cause improper alignment of some components during installation, resulting in column malfunction.*

Key in "Lock" position. Failure to do so will cause steering wheel to turn, (see above).

CAUTION: Disconnect battery. Failure to do so may cause electrical shock when working with wiring.

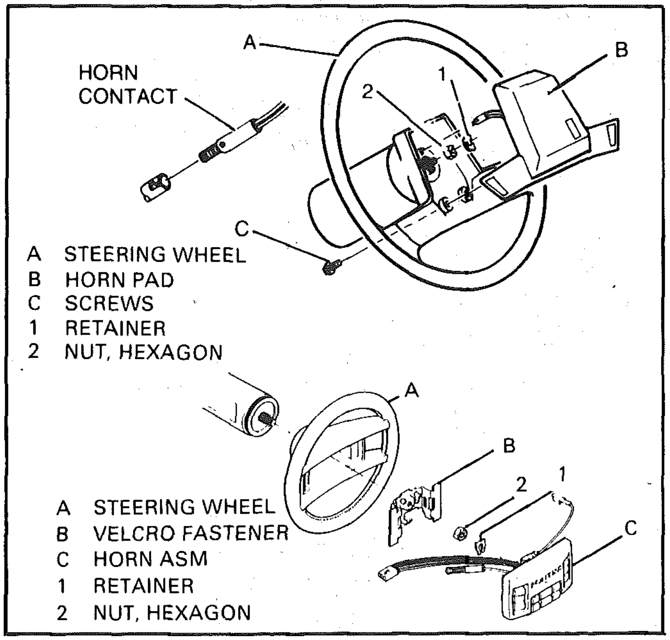


Figure 2. Removing Horn Pad, Retainer, and Jam Nut

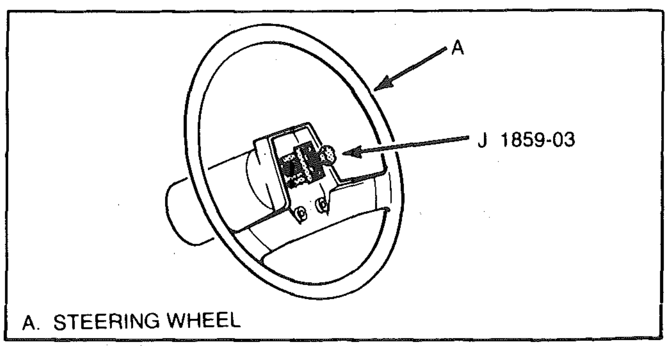


Figure 3. Removing Steering Wheel

1. Horn pad and electrical connectors
2. Retainer (1) and jam nut (2)
3. Steering wheel using J 1859-03
4. Column from car if removing/repairing shaft assembly (42) or lower bearing assembly (37-40)
5. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
6. Shaft lock (5) and cover (3)
7. Turn signal cancelling cam (6)

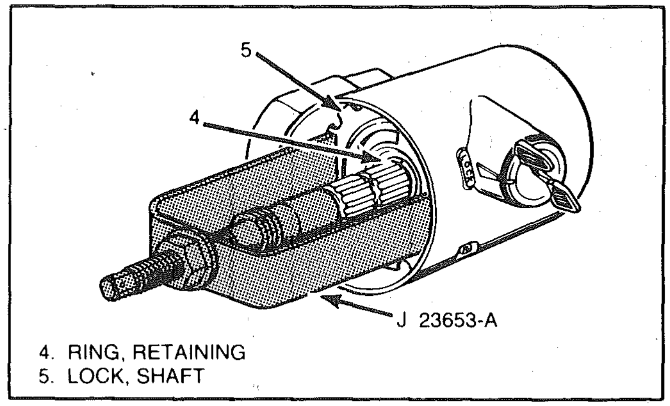


Figure 4. Removing Shaft Lock Retaining Ring

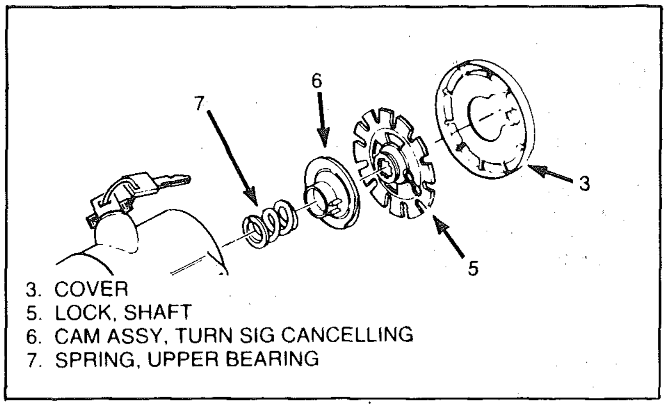


Figure 5. Removing Components from Upper Shaft

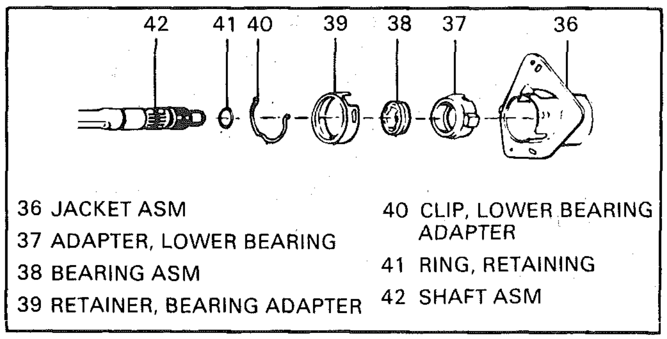


Figure 6. Lower Bearing Assembly and Shaft Removal

8. Upper bearing spring (7)
9. Shaft (42)
10. Clip, lower bearing adapter (40)
11. Retainer, bearing adapter (39)
12. Bearing ASM (38)
13. Adapter, lower bearing (37)

Install or Connect (Figures 2 thru 6)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Adapter, lower bearing (37)
2. Bearing ASM (38)
3. Retainer, bearing adapter (39)
4. Clip, lower bearing adapter (40)

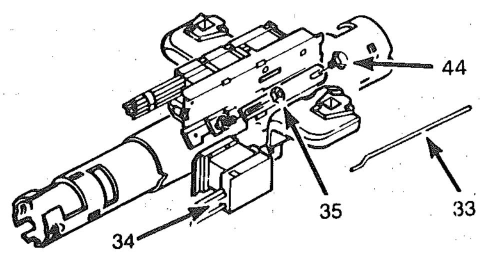
5. Shaft assembly (42) to column
6. Bearing spring (7)
7. Turn signal cancelling cam (6)
8. Shaft lock (5) and cover (3)
9. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
10. Column to dash
11. Steering wheel
12. Jam nut (2)
13. Retainer (1)
14. Horn pad

SUB SECTION B

INCLUDES: DIMMER SWITCH, IGNITION SWITCH, AND DIMMER SWITCH ROD

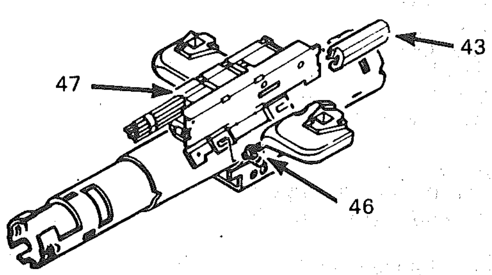
Remove or Disconnect (Figures 7,8)

1. Hex nut (35)
2. Mounting bolt (44)
3. Dimmer switch (34)
4. Dimmer switch rod (33)
5. Mounting stud (46)
6. Ignition switch (47)



33. ROD, DIMMER SWITCH ACTUATOR
34. SWITCH ASM, DIMMER
35. NUT, HEXAGON
44. SCREW, WASHER HEAD

Figure 7. Dimmer Switch Assembly



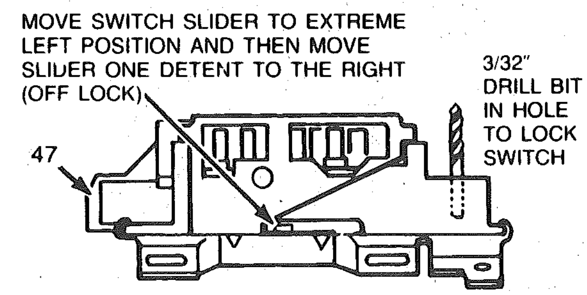
43 HOUSING ASM, IGN SWITCH
46 STUD, DIMR & IGN SW MOUNTING
47 SWITCH ASM, IGNITION

Figure 8. Ignition Switch Assembly

Install or Connect (Figures 7,8,9,10)

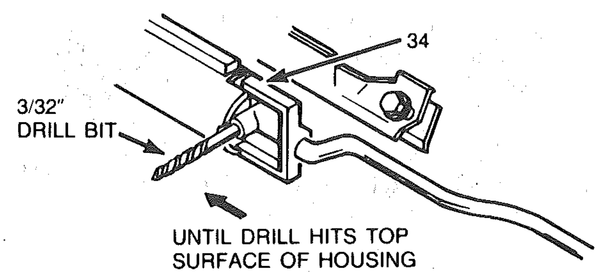
NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Key in "Lock" position
2. Ignition switch (47)
3. Mounting stud (46)
4. Dimmer switch rod (33)
5. Dimmer switch (34), adjust
6. Hex nut (35)
7. Mounting bolt (44)



47. SWITCH ASM, IGN & BEAM CHANGE

Figure 9. Adjusting Ignition Switch



34. SWITCH, DIMMER

Figure 10. Adjusting Dimmer Switch

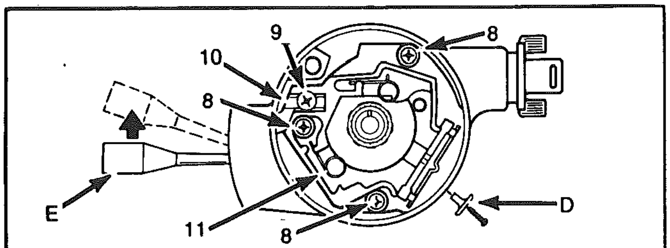
SUB SECTION C

INCLUDES: TURN SIGNAL SWITCH, BUZZER SWITCH, AND CYLINDER LOCK SET

Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

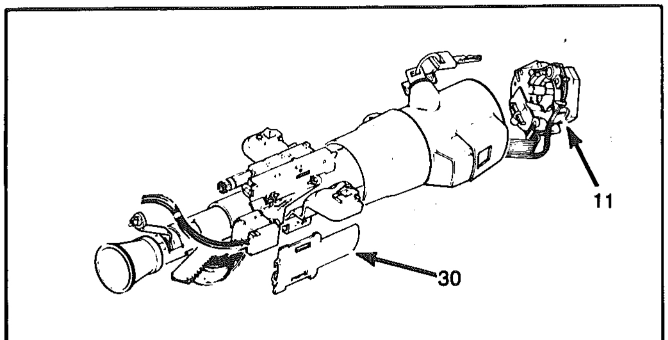
Remove or Disconnect (Figures 2,3,4,5,6,7,8,9,10,11,12,13)

1. Perform steps 1 thru 8, Remove or Disconnect, Sub Section A



8. SCREW, BINDING HD CROSS RECESS
9. SCREW, RD WASH HD (M4.2X1.41)
10. ARM, SIGNAL SWITCH
11. SWITCH ASM, TURN SIGNAL
D. HAZARD KNOB
E. MULTI-FUNCTION LEVER

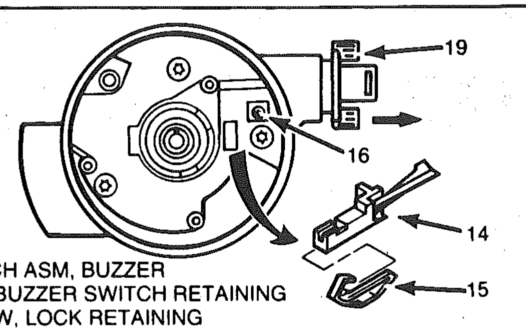
Figure 11. Turn Signal Switch Removal Preparation



11. SWITCH ASM, TURN SIGNAL
30. PROTECTOR, WIRING

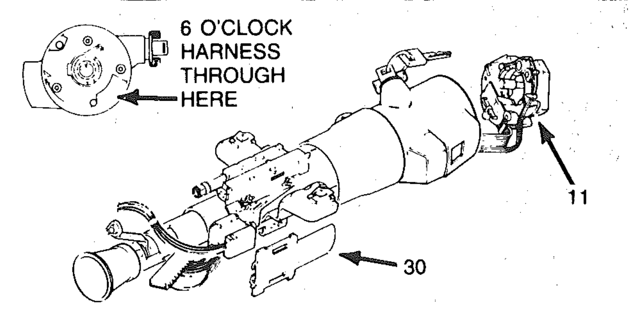
Figure 12. Turn Signal Switch Removal

2. Turn signal in "Right Turn" position
3. Hazard knob
4. Screw (9) and signal switch arm (10)
5. Screws (8)
6. Turn signal switch (11). Let switch hang freely if removal is not necessary.
   To remove:
   A. Clip and wire harness protector (30)
   B. Gently pull wire harness through column
7. Key from lock cylinder (19)
8. Buzzer switch (14) and clip (15)
9. Lock retaining bolt (16)
10. Reinsert key in lock cylinder (19)
11. Lock cylinder set (19)



14. SWITCH ASM, BUZZER
15. CLIP, BUZZER SWITCH RETAINING
16. SCREW, LOCK RETAINING
19. LOCK CYLINDER SET, STEERING COLUMN

Figure 13. Lock Cylinder Set and Buzzer Switch Removal



11. SWITCH ASM, TURN SIGNAL
30. PROTECTOR, WIRING

Figure 14. Wire Harnesses Through Column

Install or Connect (Figures 2 thru 14)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder set (19)
2. Key in "Run" position
3. Lock retaining bolt (16)
4. Clip (15) and buzzer switch (14)
5. Turn signal switch (11)
6. Screws (8)
7. Signal switch arm (10) and screw (9)
8. Hazard knob
9. Perform steps 4 thru 15, Install or Connect, Sub Section A

SUB SECTION D

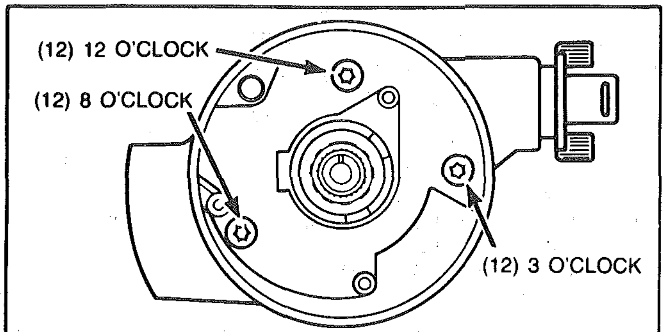
INCLUDES: LOCK HOUSING COVER, SHROUD, UPPER BEARING, ACTUATOR ROD/RACK ASSEMBLY, LOCK BOLT, AND PIVOT AND SWITCH ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 1859-03 Steering Wheel Puller

Remove or Disconnect (Figures 2 thru 16)

1. Perform steps 1 thru 8, Remove or Disconnect, Sub Section A
2. Perform steps 1 thru 6, Remove or Disconnect, Sub Section B

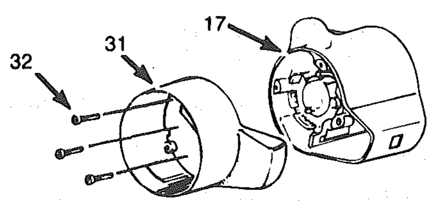
3. Perform steps 1 thru 11, Remove or Disconnect, Sub Section C



12. SCREW, PAN HD 6-LOBED SOC TAP

Figure 15. Lock Housing Cover Screw Positions

4. Screws (12)
5. Shroud bowl assembly (31) and lock housing cover (17)
6. Screws (32)
7. Lock housing cover (17) and bowl (31)
8. Upper bearing retainer (22)
9. Actuator rod assembly (26,27) and lock bolt (24)
10. Horn circuit contact and bearing retaining bushing (21)
11. Thrust washer (13)
12. Upper bearing (20)
13. Switch actuator pivot pin (29)
14. Pivot and switch assembly (23)
15. Actuator sector (18)



17. HOUSING, STEERING COLUMN
31. BOWL, FLOOR SHIFT
32. SCREW, BINDING HD CROSS RECESS

Figure 16. Lock Housing Cover and Floor Shift Bowl

Install or Connect (Figures 2 thru 16)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Horn circuit contact and bearing retaining bushing (21) to lock housing cover (17)
2. Pivot and switch assembly (23) to lock housing cover (17)
3. Switch actuator pivot pin (29)
4. Actuator sector (18)
5. Lock bolts (24,28) and actuator rod/rack assembly (26,27)
6. Upper bearing retainer (22)
7. Bowl (31) to lock housing cover (17)
8. Screws (32)
9. Cover assembly (17,31) to column
10. Screws (14). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 4 o'clock position third. Torque in same order to 9.0 N·m (89 Lbs.In.)
11. Perform steps 1 thru 8, Install or Connect, Sub Section C
12. Perform steps 4 thru 15, Install or Connect, Sub Section A
13. Perform steps 1 thru 7, Install or Connect, Sub Section B

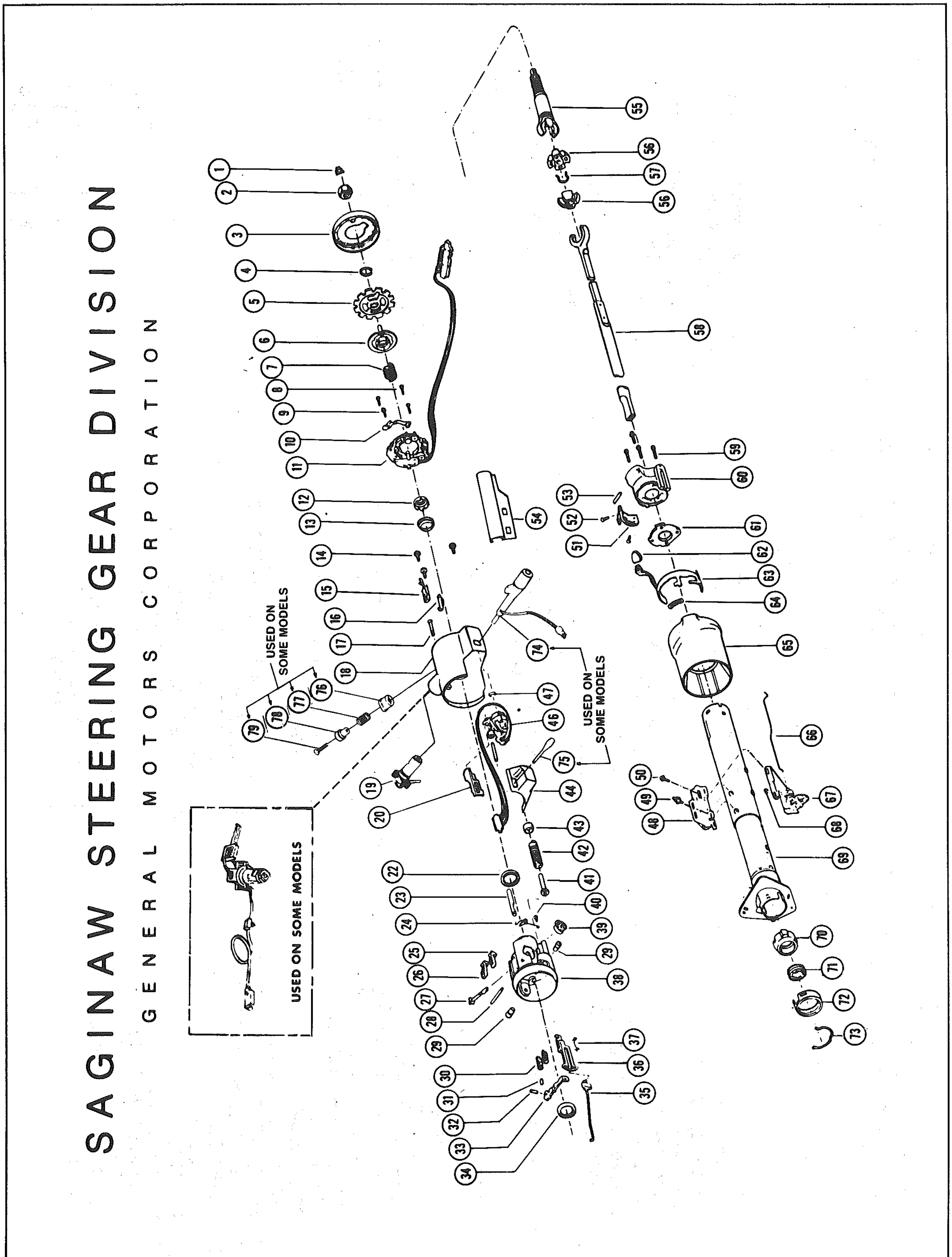


FIGURE 3B5-12 -- KEY RELEASE TILT WHEEL STEERING COLUMN
(MANUAL TRANS)

SAGINAW STEERING GEAR DIVISION

GENERAL MOTORS CORPORATION

1 - RETAINER
2 - NUT, HEXAGON JAM
3 - COVER, SHAFT LOCK
4 - RING, RETAINING
5 - LOCK, SHAFT
6 - CAM ASM, TURN SIGNAL CANCELLING
7 - SPRING, UPPER BEARING
8 - SCREW, BINDING HEAD CROSS RECESS
9 - SCREW, ROUND WASHER HEAD
10 - ARM ASM, SIGNAL SWITCH
11 - SWITCH ASM, TURN SIGNAL
12 - SEAT, UPPER BEARING INNER RACE
13 - RACE, INNER
14 - SCREW, PAN HEAD CROSS RECESS
15 - SWITCH ASM, BUZZER
16 - CLIP, BUZZER SWITCH RETAINING
17 - SCREW, LOCK RETAINING
18 - COVER, LOCK HOUSING
19 - LOCK CYLINDER SET, STEERING COLUMN
20 - ACTUATOR, DIMMER SWITCH ROD
21 - THIS NUMBER NOT USED
22 - BEARING ASM
23 - BOLT, LOCK
24 - SPRING, LOCK BOLT
25 - SHOE, STEERING WHEEL LOCK
26 - SHOE, STEERING WHEEL LOCK
27 - SHAFT, DRIVE
28 - PIN, DOWEL
29 - PIN, PIVOT
30 - SPRING, SHOE
31 - SPRING, RELEASE LEVER
32 - PIN, RELEASE LEVER
33 - LEVER, SHOE RELEASE
34 - BEARING ASM
35 - ACTUATOR ASM, IGNITION SWITCH
36 - RACK, SWITCH ACTUATOR
37 - SPRING, RACK PRELOAD
38 - HOUSING, STEERING COLUMN
39 - SECTOR, SWITCH ACTUATOR
40 - SCREW, HEX WASHER HEAD
41 - GUIDE, SPRING
42 - SPRING, WHEEL TILT
43 - RETAINER, SPRING
44 - CAP, COLUMN HOUSING COVER END
45 - PIN, SWITCH ACTUATOR PIVOT
46 - SWITCH ASM, PIVOT &
47 - SPRING, PIN PRELOAD
48 - SWITCH ASM, IGNITION
49 - STUD, DIMMER & IGNITION SWITCH MOUNTING
50 - SCREW, WASHER HEAD
51 - PLATE, SHROUD RETAINING
52 - SCREW, OVAL HEAD CROSS RECESS
53 - PIN, DOWEL
54 - PROTECTOR, WIRING
55 - SHAFT ASM, RACE & UPPER
56 - SPHERE, CENTERING
57 - SPRING, JOINT PRELOAD
58 - SHAFT ASM, LOWER STEERING
59 - SCREW, SUPPORT
60 - SUPPORT, STEERING COLUMN HOUSING
61 - PLATE, LOCK
62 - FINGER PAD, RELEASE LEVER
63 - LEVER, KEY RELEASE
64 - SPRING, KEY RELEASE
65 - SHROUD, STEERING COLUMN HOUSING
66 - ROD, DIMMER SWITCH
67 - SWITCH ASM, DIMMER
68 - NUT, HEXAGON
69 - JACKET ASM, STEERING COLUMN
70 - ADAPTER, LOWER BEARING
71 - BEARING ASM
72 - RETAINER, BEARING ADAPTER
73 - CLIP, LOWER BEARING ADAPTER
74 - LEVER ASM, T/S MULTIFUNCTION
75 - LEVER ASM, TILT RELEASE
76 - KNOB, HAZARD WARNING SWITCH
77 - SPRING, HAZARD WARNING
78 - BUTTON, HAZARD WARNING
79 - SCREW, OVAL HEAD

ASSEMBLIES

0 - COLUMN ASM, E/A STEERING
101 - COVER ASM, LOCK HOUSING
102 - HOUSING ASM, STEERING COLUMN
103 - SHAFT ASM, STEERING
104 - SUPPORT ASM, STEERING COLUMN HOUSING

FIGURE 3B5-13 -- KEY RELEASE TILT WHEEL STEERING COLUMN (MANUAL TRANS)

SUB SECTION A

INCLUDES: SHAFT LOCK, TURN SIGNAL CANCELLING CAM, UPPER BEARING SPRING, UPPER BEARING SEAT, INNER RACE TURN SIGNAL SWITCH, BUZZER SWITCH, AND LOCK CYLINDER SET

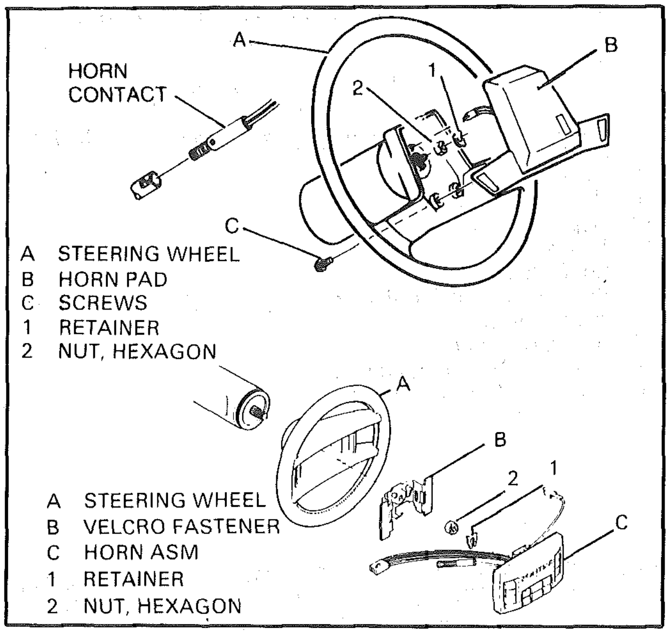
Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover

←→ Remove or Disconnect (Figure 2,3,4,5,6,7,8,9)

NOTICE: Wheels of car must be straight ahead. Failure to do so may cause improper alignment of some components during installation, resulting in column malfunction.

Key in "Lock" position. Failure to do so will cause steering wheel to turn, (see above).

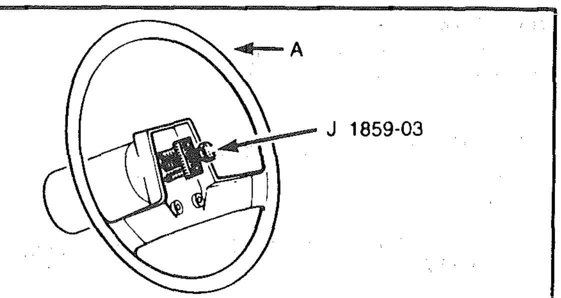
CAUTION: Disconnect battery. Failure to do so may cause electrical shock when working with wiring.



A STEERING WHEEL
B HORN PAD
C SCREWS
1 RETAINER
2 NUT, HEXAGON

A STEERING WHEEL
B VELCRO FASTENER
C HORN ASM
1 RETAINER
2 NUT, HEXAGON

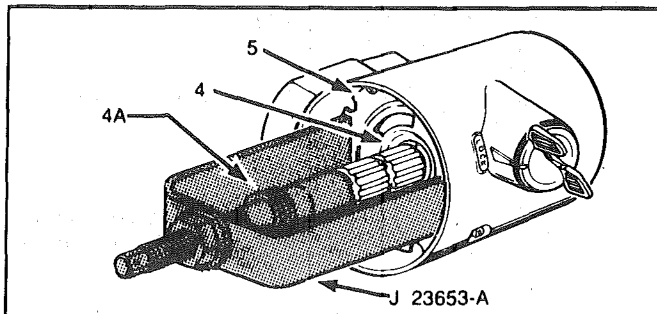
Figure 2. Removing Horn Pad, Retainer, and Jam Nut



A. STEERING WHEEL

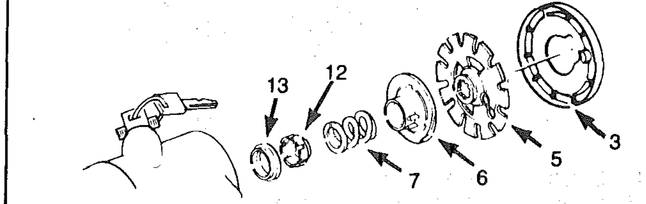
Figure 3. Remove Steering Wheel

1. Horn pad and electrical connectors
2. Retainer (1) and jam nut (2)
3. Steering wheel using J 1859-03
4. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
5. Shaft lock (5) and shaft lock cover (3)
6. Turn signal cancelling cam (6)
7. Upper bearing spring (7)
8. Upper bearing seat (12)
9. Inner race (13)



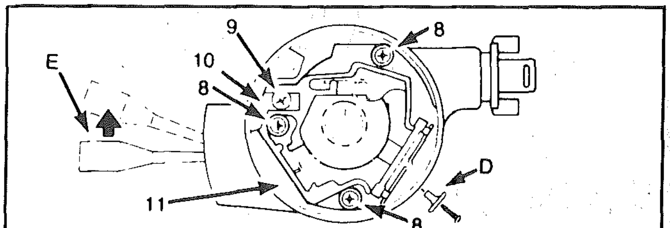
4. RING, RETAINING
5. LOCK, SHAFT
4A. EXTRA RINGS

Figure 4. Removing Shaft Lock Retaining Ring



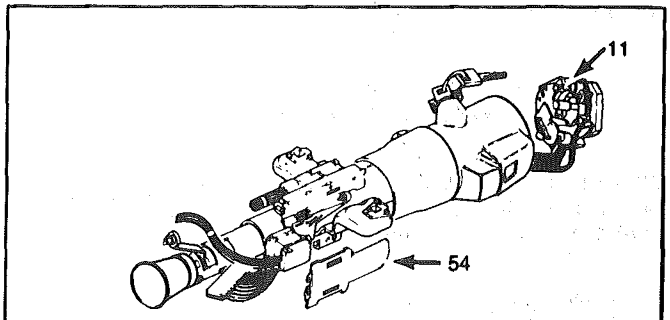
3. COVER, SHAFT LOCK
5. LOCK, SHAFT
6. CAM ASM, TURN SIG CANCELLING
7. SPRING, UPPER BEARING
12. SEAT, UPPER BEARING INNER RACE
13. RACE, INNER

Figure 5. Removing Components from Upper Shaft



8. SCREW, BINDING HD CROSS RECESS
9. SCREW, RD WASH. HD (M4.2X1.41)
10. ARM, SIGNAL SWITCH
11. SWITCH ASM, TURN SIGNAL
D. HAZARD KNOB
E. MULTI-FUNCTION LEVER

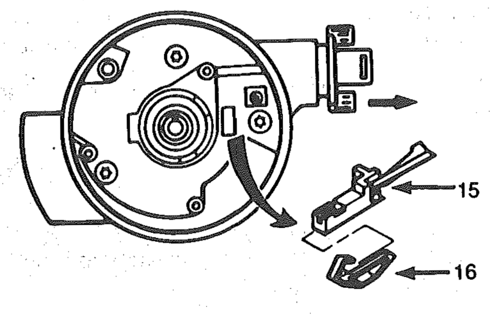
Figure 6. Turn Signal Switch Removal Preparation



11. SWITCH ASM, TURN SIGNAL
54. PROTECTOR, WIRING

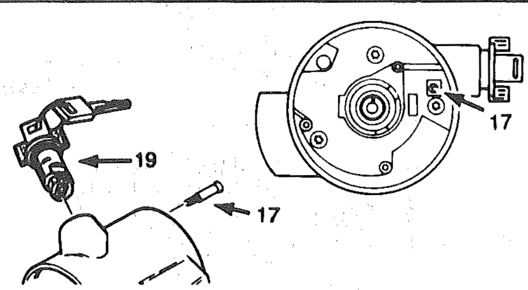
Figure 7. Turn Signal Switch Removal

10. Turn signal to "Right Turn" position
11. Screw (9) and signal switch arm (10)
12. Screws (8)
13. Turn signal switch (11). Allow switch to hang freely if removal is not necessary.
    To remove:
    A. Wiring protector (54)
    B. Hazard knob
    C. Gently pull wire harness through column housing shroud (65), column housing (38), and lock housing cover (18)



15. SWITCH ASM, BUZZER
16. CLIP, BUZZER SWITCH RETAINING

Figure 8. Buzzer Switch Removal



17. SCREW, LOCK RETAINING
19. LOCK CYLINDER SET, STRG COLUMN

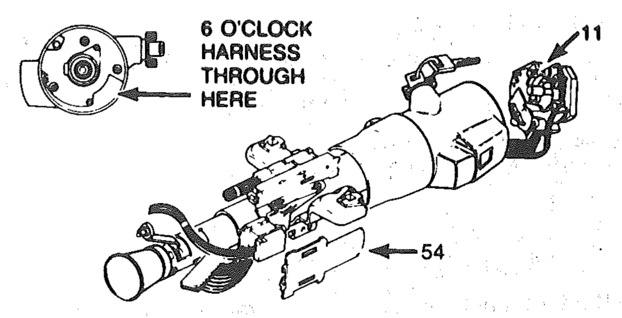
Figure 9. Removing Lock Cylinder Set

14. Key from lock cylinder set (19)
15. Buzzer switch (15) and clip (16)
16. Reinsert key in lock cylinder set (19)
17. Key in "Lock" position
18. Lock retaining screw (17)
19. Lock cylinder set (19)

Install or Connect (Figures 2,3,4,5,6,7,8,9,10)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder set (19)
2. Lock retaining screw (17) and torque to 2.0-3.0 N·m (17.7-26.55 Lbs.In.)
3. Key in "Run" position
4. Buzzer switch (15) and clip (16)



11. SWITCH ASM, TURN SIGNAL
54. PROTECTOR, WIRING

Figure 10. Wire Harness Through Column

5. Turn signal switch (11) wire harness through lock housing cover (18), column housing (38), and column housing shroud (65)
6. Turn signal switch (11) and screws (9) and torque to 2.8-4.0 N·m (24.78-35.4 Lbs.In.)
7. Signal switch arm (10) and screw (9) and torque to 1.7-2.8 N·m (15.05-24.78 Lbs. In.)
8. Inner race (13)
9. Upper bearing seat (12)
10. Upper bearing spring (7)
11. Turn signal cancelling cam (6)
12. Shaft lock (5)
13. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
14. Steering wheel
15. Jam nut (2) and retainer (1)
16. Screws to back of steering wheel, horn pad
17. Wiring protector (54)

SUB SECTION B

INCLUDES: LOCK HOUSING COVER, COVER END CAP, PIVOT AND SWITCH ASSEMBLY, DIMMER SWITCH ROD ACTUATOR, AND TILT SPRING ASSEMBLY

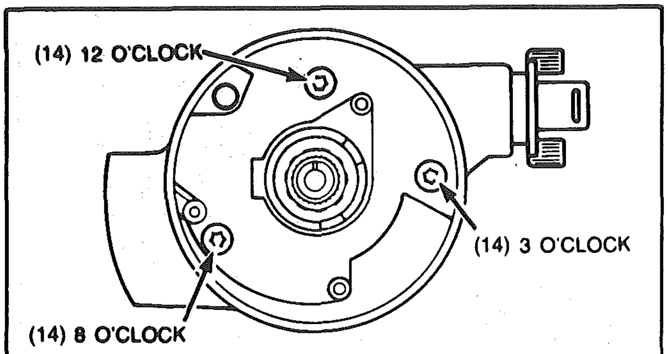
Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover

Remove or Disconnect (Figure 2,3,4,5,6,7,8,9,10,11,12,13,14)

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Screws (14)
3. Lock housing cover (18)
4. Tilt release lever (75)
5. Housing cover end cap (44), and dimmer switch rod actuator (20)

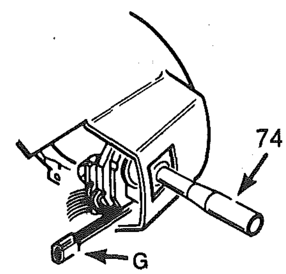
Important

Cruise control equipped columns: Unplug cruise control connector and remove multifunction lever (74).



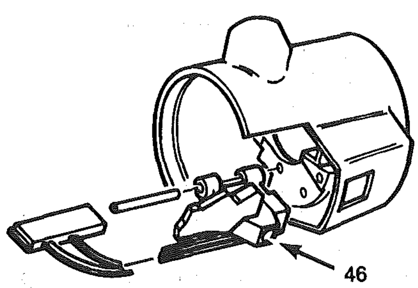
14. SCREW, PAN HD 6-LOBED SOC TAP

Figure 11. Lock Housing Cover Screw Positions



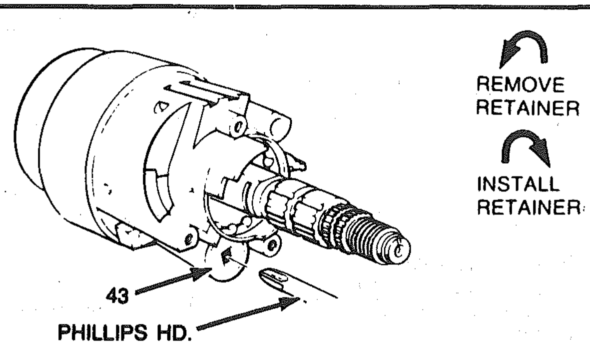
74. LEVER ASM, T/S MULTIFUNCTION
G. CRUISE CONTROL PLUG

Figure 12. Removing Lock Housing Cover



46. SWITCH ASM, PIVOT &

Figure 13. Pivot and Switch Removal



43. RETAINER, SPRING

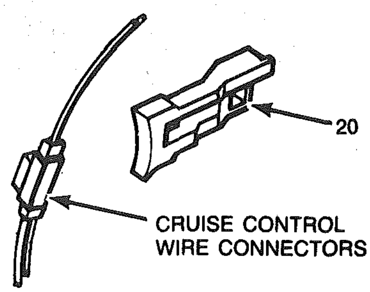
Figure 14. Tilt Spring Assembly Removal

6. Gently pull wire harness through column housing (38) and column housing shroud (65)
7. Pivot pin
8. Pivot and switch assembly (46)
9. Spring retainer (43)
10. Spring (42) and spring guide (41)

Install or Connect (Figures 2,3,4,5,6,7,8,9,10,11,12,13,14,15)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Spring guide (41) and spring (42) coated with lithium grease
2. Spring retainer (43)
3. Pivot and switch assembly (46)
4. Pivot pin
5. Pivot and switch assembly (46) wire harness through column housing shroud (65) and column housing (38)



20. ACTUATOR, DIMMER SWITCH ROD

Figure 15. Dimmer Switch Actuator/ Cruise Control Connectors

6. Dimmer switch rod actuator (20). Bottom edge of dimmer switch rod actuator (20) should rest on bend in dimmer switch rod (66)
7. Cover housing end cap (44)

Important

Cruise control equipped columns: Plug cruise control connectors together and install multifunction lever (74).

8. Lock housing cover (18)
9. Screws (14). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 4 o'clock position third. Torque in the same order to 7.0-11.0 N·m (61.95-97.35 Lbs.In.)
10. Perform steps 1 thru 17, Install or Connect, Sub Section A

SUB SECTION C

INCLUDES: COLUMN HOUSING, LOCK SHOES, ACTUATOR SECTOR ASSEMBLY, SWITCH ACTUATOR RACK, BEARINGS, AND LOCK BOLT ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover
J 21854-01 Pivot Pin Remover

Remove or Disconnect (Figure 2 thru 18)

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Perform steps 1 thru 10, Remove or Disconnect, Sub Section B

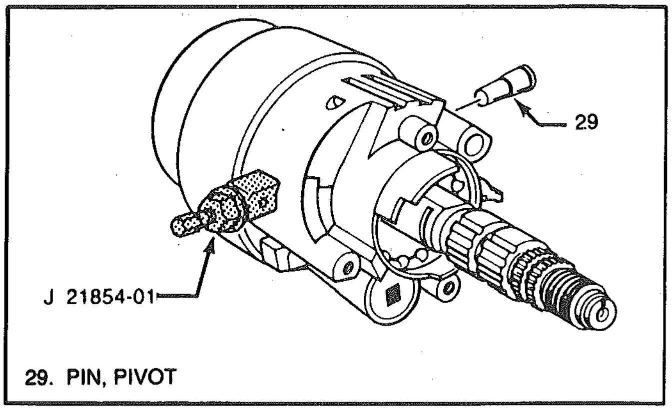


Figure 16. Removing Pivot Pins

3. Pivot pins (29) using J 21854-01
4. Reinstall tilt release lever (75)
5. Column housing assembly (38). Pull back on tilt release lever and pull housing (38) down and away from column

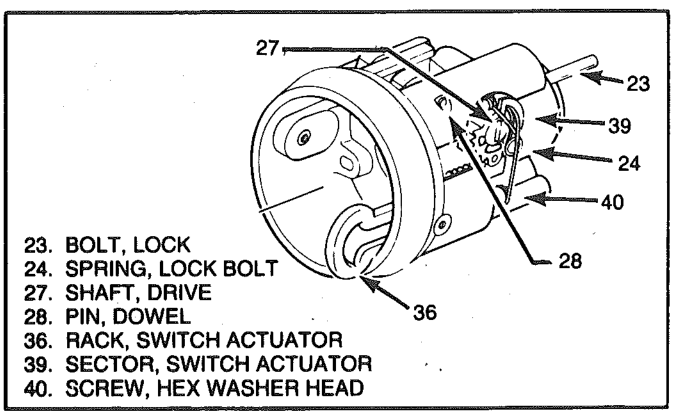


Figure 17. Lock Housing Cover Assembly, Exterior

6. Drive shaft (27)
7. Switch actuator sector (39)
8. Switch actuator rack (36) and rack preload spring (37)

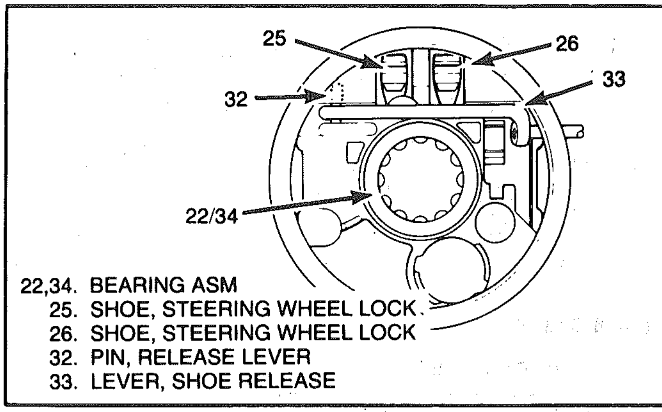


Figure 18. Lock Housing Cover Assembly, Interior

9. Release lever pin (32)
10. Shoe release lever (33)
11. Release lever spring (31)
12. Dowel pin (28)
13. Lock shoes (25,26)
14. Lock shoe springs (30)
15. Bearings (22,34)
16. Hex head bolt (40)
17. Lock bolt spring (24)
18. Lock bolt (23)

Install or Connect (Figures 2 thru 19)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Bearings (22,34) to column housing (38)
2. Drive shaft (27)
3. Switch actuator sector (39)
4. Lock shoes (25,26)
5. Dowel pin (28)
6. Lock shoe springs (30)
7. Release lever spring (31)
8. Shoe release lever (33)

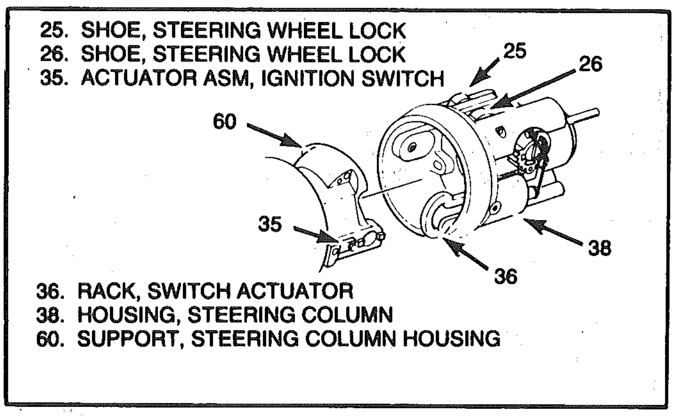
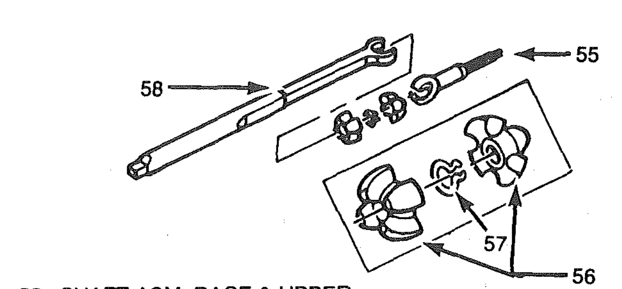


Figure 19. Column Housing to Column Support

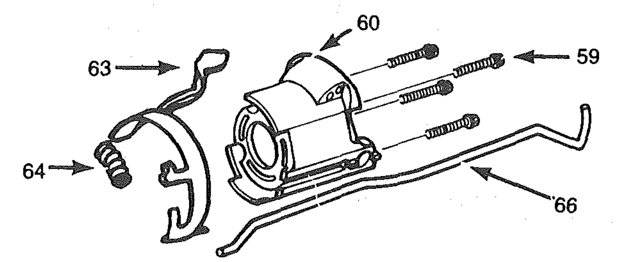
9. Release lever pin (32)
10. Rack preload spring (37)
11. Switch actuator rack (36) to switch actuator sector (39)
12. Lock bolt (23)
13. Lock bolt spring (24)
14. Hex head bolt (40)

15. Column housing assembly (38) to column. Position column housing assembly (38) and align switch actuator rack (36) with pin on end of actuator rod (35). Pull back on tilt release lever (90), pushing column housing assembly (38) onto column housing support assembly (60). Release tilt release lever to lock shoes (25,26)
16. Remove tilt release lever (75)
17. Pivot pins (29) lubricated with lithium grease
18. Perform steps 1 thru 10, Install or Connect, Sub Section B
19. Perform steps 1 thru 17, Install or Connect, Sub Section A



55. SHAFT ASM, RACE & UPPER
56. SPHERE, CENTERING
57. SPRING, JOINT PRELOAD
58. SHAFT ASM, LOWER STEERING

Figure 21. Shaft Assembly



59. SCREW, SUPPORT
60. SUPPORT, STEERING COLUMN HOUSING
63. LEVER, KEY RELEASE
64. SPRING, KEY RELEASE
66. ROD, DIMMER SWITCH

Figure 22. Column Housing Support Assembly

SUB SECTION D

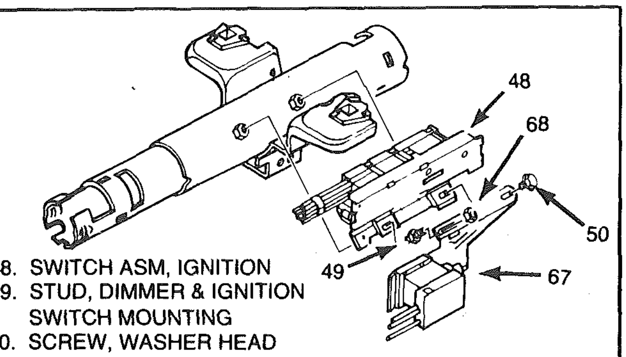
INCLUDES: SHAFT ASSEMBLY, COLUMN HOUSING SUPPORT, SHIFT TUBE ASSEMBLY, IGNITION SWITCH, DIMMER SWITCH, AND LOWER BEARING ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover
J 21854-01 Pivot Pin Remover

Remove or Disconnect (Figure 2 thru 23, 27)

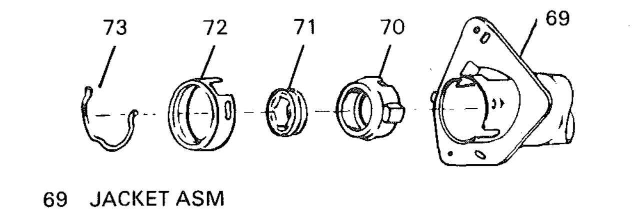
NOTICE: If car has been in an accident, remove column from car and inspect for damage (Figure 27).

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Perform steps 1 thru 10, Remove or Disconnect, Sub Section B
3. Perform steps 1 thru 18, Remove or Disconnect, Sub Section C



48. SWITCH ASM, IGNITION
49. STUD, DIMMER & IGNITION SWITCH MOUNTING
50. SCREW, WASHER HEAD
67. SWITCH ASM, DIMMER
68. NUT, HEXAGON

Figure 23. Ignition and Dimmer Switches



69 JACKET ASM
70 ADAPTER, LOWER BEARING
71 BEARING ASM
72 RETAINER, BEARING ADAPTER
73 CLIP. LOWER BEARING ADAPTER

Figure 20. Lower Bearing Assembly

4. Remove column from car

NOTICE: Once steering column is removed from car, the column is extremely susceptible to damage. Dropping column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity.

Leaning on column assembly could cause jacket to bend or deform. Any of the above damage could impair column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain column rigidity.

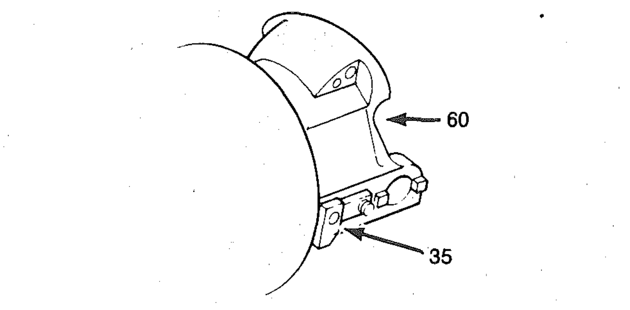
5. Clip, lower bearing adapter (73)
6. Retainer, bearing adapter (72)

7. Lower bearing ASM (71)
8. Lower bearing adapter (70)
9. Shaft assembly (55-58)
10. Lower shaft (58)
11. Sphere (56) from upper shaft (55)
12. Preload spring (57) from sphere (56)
13. Screws (59)
14. Housing support assembly (60) and dimmer switch rod (66)
15. Key release lever (63) and spring (64)
16. Hex nut (68) and hex head bolt (50)
17. Dimmer switch (67)
18. Mounting stud (49)
19. Gear shift lever bowl (65)

Install or Connect (Figure 2 thru 26)

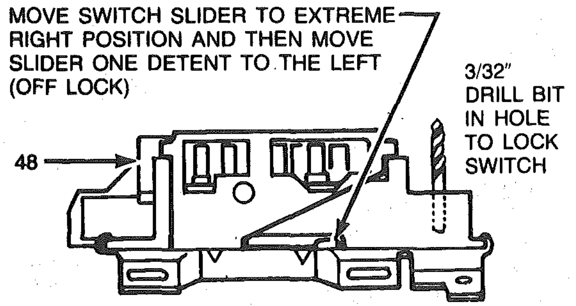
NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Column housing shroud (65) to jacket (69)
2. Dimmer switch rod (66) to housing support (60)
3. Key release lever (63) and spring (64)
4. Housing support assembly (60) and screws (59) and torque to 5.5-12.0 N·m (48.68-106.2 Lbs.In.)
5. Actuator rod assembly (35) to track in housing support (60)



35. ACTUATOR ASM, IGNITION SWITCH
60. SUPPORT, STRG COL HSG

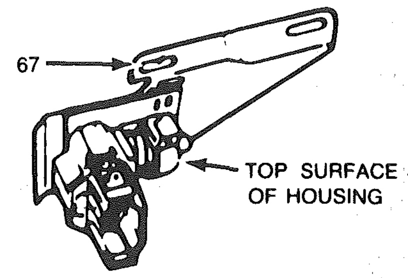
Figure 24. Actuator Rod to Housing Support



48. SWITCH ASM, IGN & BEAM CHANGE

Figure 25. Ignition Switch Adjustment

6. Ignition switch (48) and mounting stud (49)
7. Preload spring (57) and sphere (56) to upper shaft (55)
8. Lower shaft (58) to upper shaft (55). block tooth on shaft end of upper shaft (55) at 12 o'clock position; notch at end of lower shaft (58) at 4 o'clock position
9. Shaft assembly (55-58), lubricated with lithium grease, to column
10. Column housing assembly (38) to column. Position column housing assemby (38) and align switch actuator rack (36) with pin on end of actuator rod (48). Pull back on tilt release lever (75), pushing column housing assembly (38) onto column housing support assembly (60). Release tilt release lever (75) to lock shoes (25,26)
11. Remove tilt release lever (75)
12. Lower bearing adapter (70)
13. Bearing, ASM (71)
14. Retainer (72)
15. Clip (73)



67. SWITCH, DIMMER

Figure 26. Dimmer Switch Adjustment

17. Dimmer switch (67), hex nut (68), and hex head bolt (50). Adjust dimmer switch (67)
18. Column to car dash
19. Tilt release lever (75)
20. Perform steps 1 thru 17, Install or Connect, Sub Section C
21. Perform steps 1 thru 10, Install or Connect, Sub Section B
22. Perform steps 1 thru 17, Install or Connect, Sub Section A

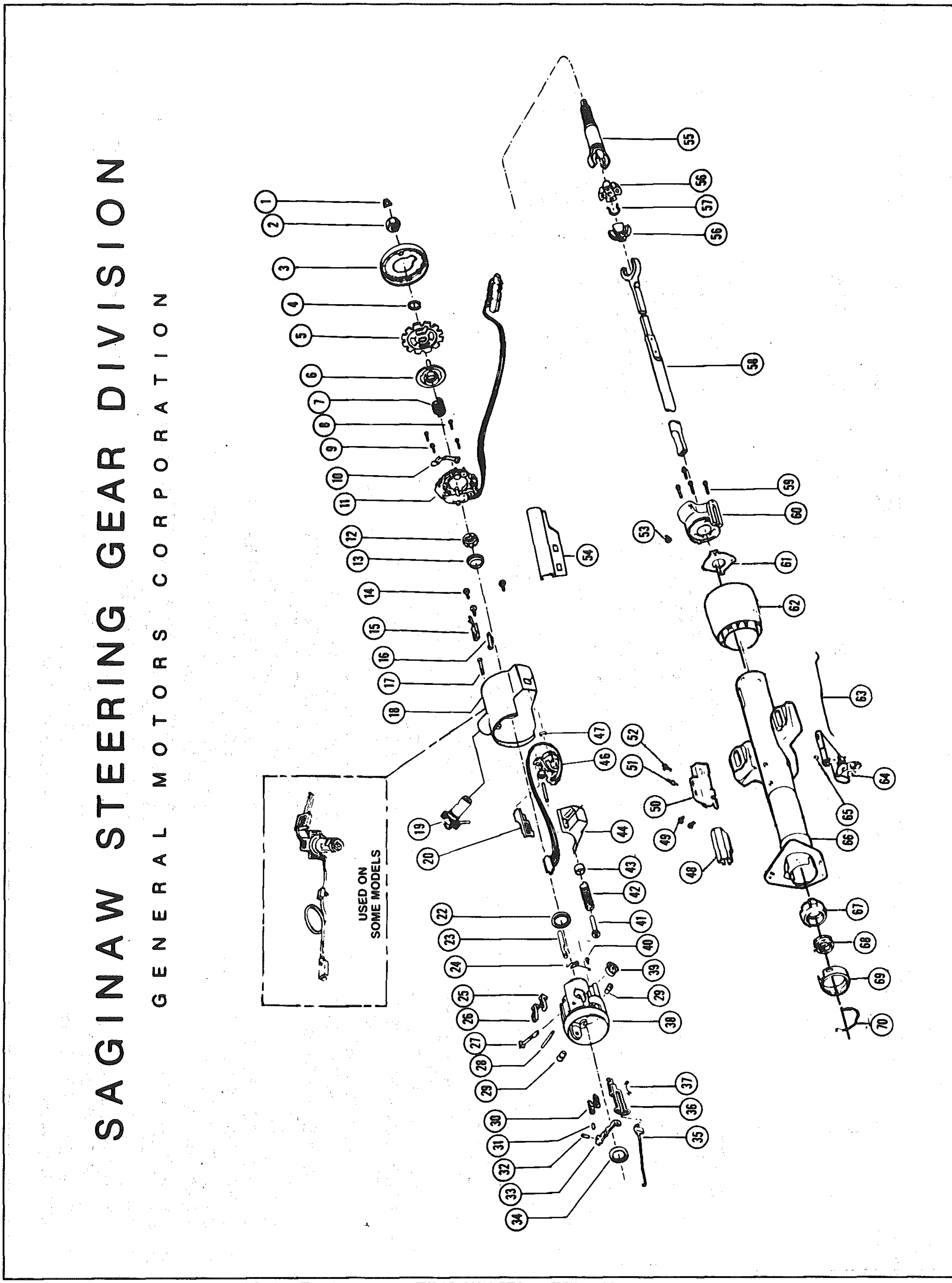


FIGURE 3B5-14 -- TILT WHEEL STEERING COLUMN
(AUTO TRANS)

SAGINAW STEERING GEAR DIVISION

GENERAL MOTORS CORPORATION

1 - RETAINER
2 - NUT, HEXAGON JAM
3 - COVER, SHAFT LOCK
4 - RING, RETAINING
5 - LOCK, SHAFT
6 - CAM ASM, TURN SIGNAL CANCELLING
7 - SPRING, UPPER BEARING
8 - SCREW, BINDING HEAD CROSS RECESS
9 - SCREW, ROUND WASHER HEAD
10 - ARM ASM, SIGNAL SWITCH
11 - SWITCH ASM, TURN SIGNAL
12 - SEAT, UPPER BEARING INNER RACE
13 - RACE, INNER
14 - SCREW, PAN HEAD CROSS RECESS
15 - SWITCH ASM, BUZZER
16 - CLIP, BUZZER SWITCH RETAINING
17 - SCREW, LOCK RETAINING
18 - COVER, LOCK HOUSING
19 - LOCK CYLINDER SET, STEERING COLUMN
20 - ACTUATOR, DIMMER SWITCH ROD
21 - THIS NUMBER NOT USED
22 - BEARING ASM
23 - BOLT, LOCK
24 - SPRING, LOCK BOLT
25 - SHOE, STEERING WHEEL LOCK
26 - SHOE, STEERING WHEEL LOCK
27 - SHAFT, DRIVE
28 - PIN, DOWEL
29 - PIN, PIVOT
30 - SPRING, SHOE
31 - SPRING, RELEASE LEVER
32 - PIN, RELEASE LEVER
33 - LEVER, SHOE RELEASE
34 - BEARING ASM
35 - ACTUATOR ASM, IGNITION SWITCH
36 - RACK, SWITCH ACTUATOR
37 - SPRING, RACK PRELOAD
38 - HOUSING, STEERING COLUMN
39 - SECTOR, SWITCH ACTUATOR
40 - SCREW, HEX WASHER HEAD
41 - GUIDE, SPRING
42 - SPRING, WHEEL TILT
43 - RETAINER, SPRING
44 - CAP, COLUMN HOUSING COVER END
45 - PIN, SWITCH ACTUATOR PIVOT
46 - SWITCH ASM, PIVOT &
47 - SPRING, PIN PRELOAD
48 - HOUSING, IGN SWITCH INHIBITOR
49 - SCREW, WASHER HEAD
50 - SWITCH, IGNITION
51 - SWITCH, PIVOT & PULSE
52 - SCREW, OVAL HEAD CROSS RECESS
53 - PIN, DOWEL
54 - PROTECTOR, WIRING
55 - SHAFT ASM, RACE & UPPER
56 - SPHERE, CENTERING
57 - SPRING, JOINT PRELOAD
58 - SHAFT ASM, LOWER STEERING
59 - SCREW, SUPPORT
60 - SUPPORT, STEERING COLUMN HOUSING
61 - PLATE, LOCK
62 - SHROUD, STEERING COLUMN HOUSING
63 - ROD, DIMMER SWITCH
64 - SWITCH ASM, DIMMER
65 - NUT, HEXAGON
66 - JACKET ASM, STEERING COLUMN
67 - ADAPTER, LOWER BEARING
68 - BEARING ASM
69 - RETAINER, BEARING ADAPTER
70 - CLIP, LOWER BEARING ADAPTER

ASSEMBLIES

0 - COLUMN ASM, E/A STEERING
101 - COVER ASM, LOCK HOUSING
102 - HOUSING ASM, STEERING COLUMN
103 - SHAFT ASM, STEERING
104 - SUPPORT ASM, STEERING COLUMN HOUSING

FIGURE 3B5-15 -- TILT WHEEL STEERING COLUMN (AUTO TRANS)

SUB SECTION A

INCLUDES: SHAFT LOCK, TURN SIGNAL CANCELLING CAM, UPPER BEARING SPRING, UPPER BEARING SEAT, INNER RACE TURN SIGNAL SWITCH, BUZZER SWITCH, AND LOCK CYLINDER SET

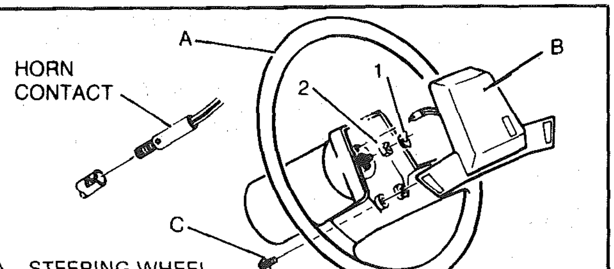
Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover

Remove or Disconnect (Figure 2,3,4,5,6,7,8,9)

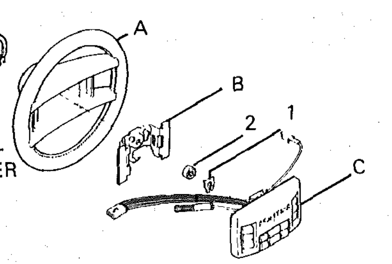
NOTICE: Wheels of car must be straight ahead. Failure to do so may cause improper alignment of some components during installation, resulting in column malfunction.

Key in "Lock" position. Failure to do so will cause steering wheel to turn, (see above).

CAUTION: Disconnect battery. Failure to do so may cause electrical shock when working with wiring.

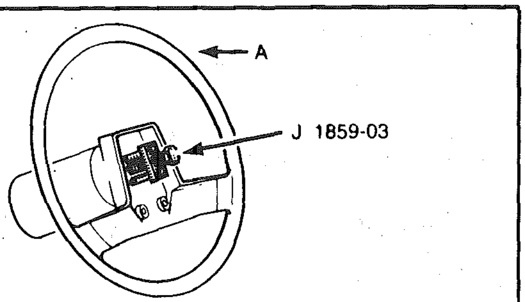


A STEERING WHEEL
B HORN PAD
C SCREWS
1 RETAINER
2 NUT, HEXAGON



A STEERING WHEEL
B VELCRO FASTENER
C HORN ASM
1 RETAINER
2 NUT, HEXAGON

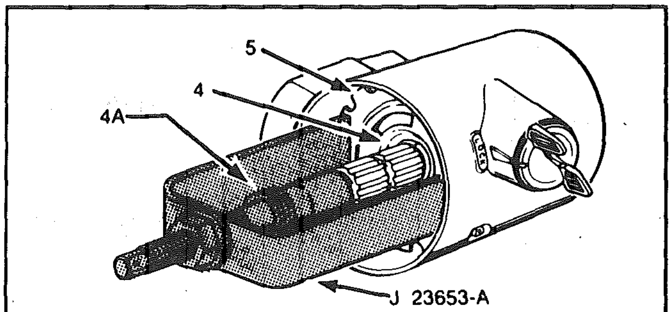
Figure 2. Removing Horn Pad, Retainer, and Jam Nut



A. STEERING WHEEL

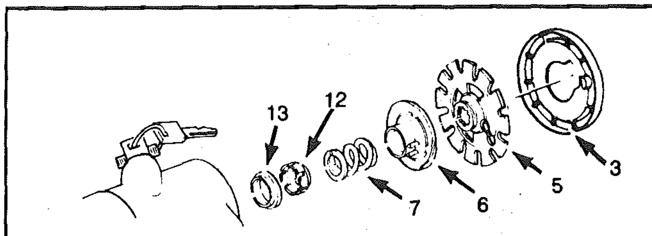
Figure 3. Remove Steering Wheel

1. Horn pad and electrical connectors
2. Retainer (1) and jam nut (2)
3. Steering wheel using J 1859-03
4. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
5. Shaft lock (5) and shaft lock cover (3)
6. Turn signal cancelling cam (6)
7. Upper bearing spring (7)
8. Upper bearing seat (12)
9. Inner race (13)



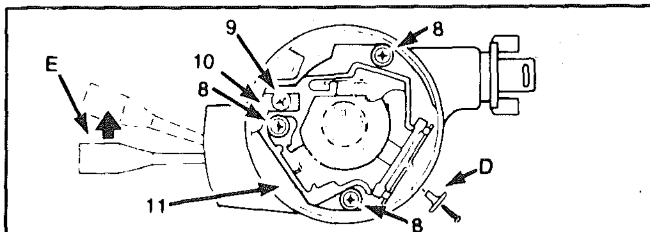
4. RING, RETAINING
5. LOCK, SHAFT
4A. EXTRA RINGS

Figure 4. Removing Shaft Lock Retaining Ring



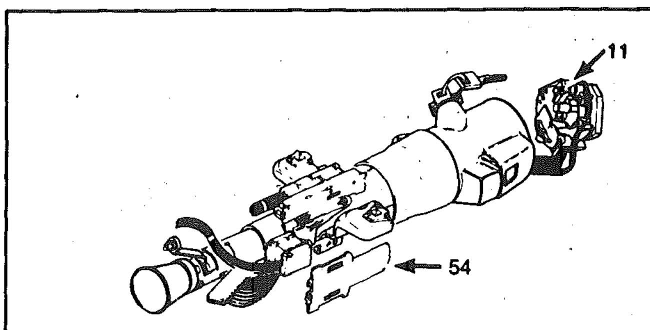
3. COVER, SHAFT LOCK
5. LOCK, SHAFT
6. CAM ASM, TURN SIG CANCELLING
7. SPRING, UPPER BEARING
12. SEAT, UPPER BEARING INNER RACE
13. RACE, INNER

Figure 5. Removing Components from Upper Shaft



8. SCREW, BINDING HD CROSS RECESS
9. SCREW, RD WASH. HD (M4.2X1.41)
10. ARM, SIGNAL SWITCH
11. SWITCH ASM, TURN SIGNAL
D. HAZARD KNOB
E. MULTI-FUNCTION LEVER

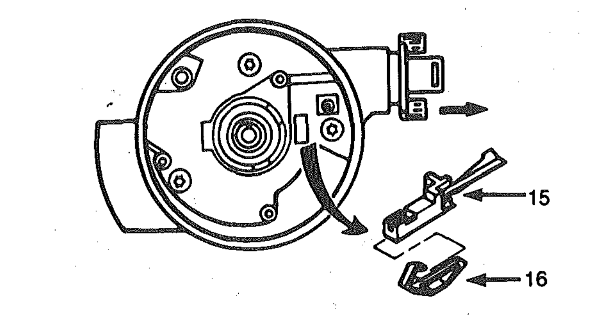
Figure 6. Turn Signal Switch Removal Preparation



11. SWITCH ASM, TURN SIGNAL
54. PROTECTOR, WIRING

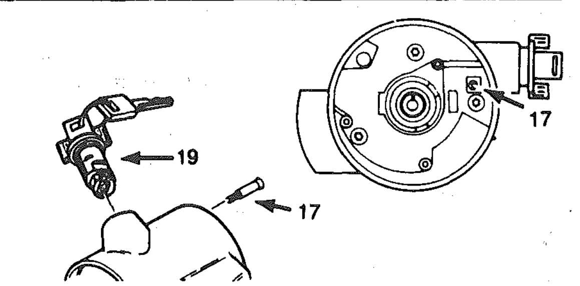
Figure 7. Turn Signal Switch Removal

10. Turn signal to "Right Turn" position
11. Screw (9) and signal switch arm (10)
12. Screws (8)
13. Turn signal switch (11). Allow switch to hang freely if removal is not necessary.
    To remove:
    A. Wiring protector (54)
    B. Hazard knob
    C. Gently pull wire harness through column housing shroud (62), column housing (38), and lock housing cover (18)



15. SWITCH ASM, BUZZER
16. CLIP, BUZZER SWITCH RETAINING

Figure 8. Buzzer Switch Removal



17. SCREW, LOCK RETAINING
19. LOCK CYLINDER SET, STRG COLUMN

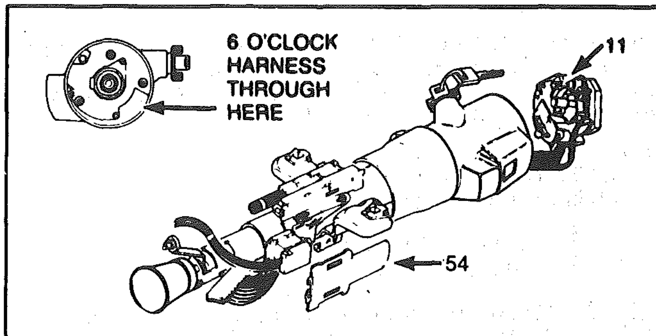
Figure 9. Removing Lock Cylinder Set

14. Key from lock cylinder set (19)
15. Buzzer switch (15) and clip (16)
16. Reinsert key in lock cylinder set (19)
17. Key in "Lock" position
18. Lock retaining screw (17)
19. Lock cylinder set (19)

Install or Connect (Figures 2,3,4,5,6,7,8,9,10)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Lock cylinder set (19)
2. Lock retaining screw (17) and torque to 2.0-3.0 N·m (17.7-26.55 Lbs.In.)
3. Key in "Run" position
4. Buzzer switch (15) and clip (16)



11. SWITCH ASM, TURN SIGNAL
54. PROTECTOR, WIRING

Figure 10. Wire Harness Through Column

5. Turn signal switch (11) wire harness through lock housing cover (18), column housing (38), and column housing shroud (62)
6. Turn signal switch (11) and screws (9) and torque to 2.8-4.0 N·m (24.78-35.4 Lbs.In.)
7. Signal switch arm (10) and screw (9) and torque to 1.7-2.8 N·m (15.05-24.78 Lbs. In.)
8. Inner race (13)
9. Upper bearing seat (12)
10. Upper bearing spring (7)
11. Turn signal cancelling cam (6)
12. Shaft lock (5)
13. Shaft lock retaining ring (4) using J 23653-A to depress shaft lock (5)
14. Steering wheel
15. Jam nut (2) and retainer (1)
16. Screws to back of steering wheel, horn pad
17. Wiring protector (54)

SUB SECTION B

INCLUDES: LOCK HOUSING COVER, COVER END CAP, PIVOT AND SWITCH ASSEMBLY, DIMMER SWITCH ROD ACTUATOR, AND TILT SPRING ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover

Remove or Disconnect (Figure 2,3,4,5,6,7,8,9,10,11,12,13,14)

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Screws (14)
3. Lock housing cover (18)
4. Tilt release lever
5. Housing cover end cap (44), and dimmer switch rod actuator (20)

Important

Cruise control equipped columns: Unplug cruise control connector and remove multifunction lever

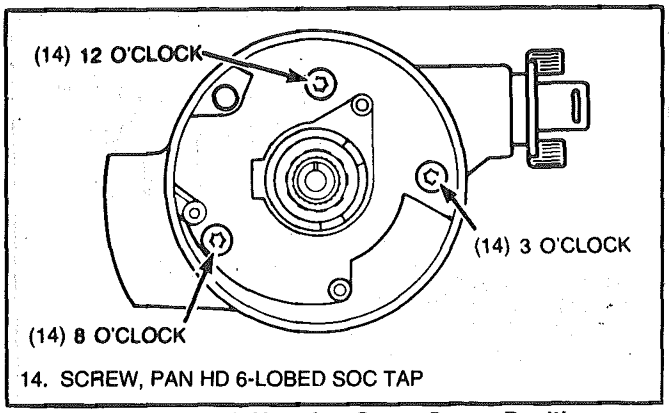


Figure 11. Lock Housing Cover Screw Positions

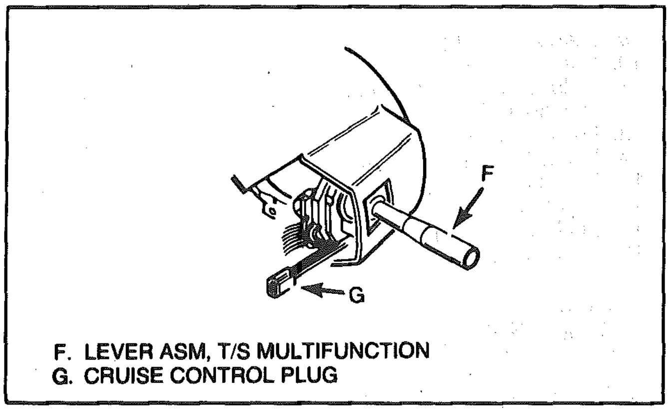


Figure 12. Removing Lock Housing Cover

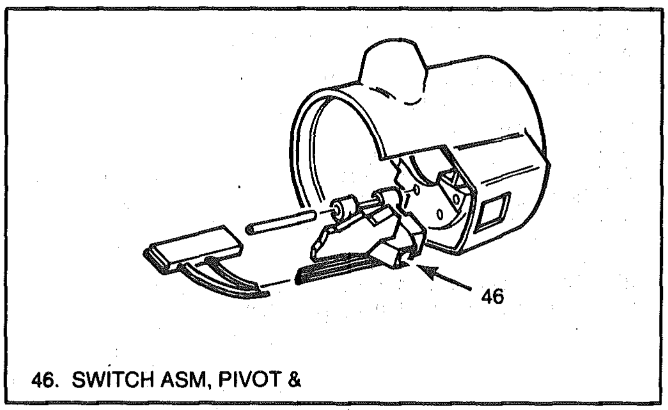


Figure 13. Pivot and Switch Removal

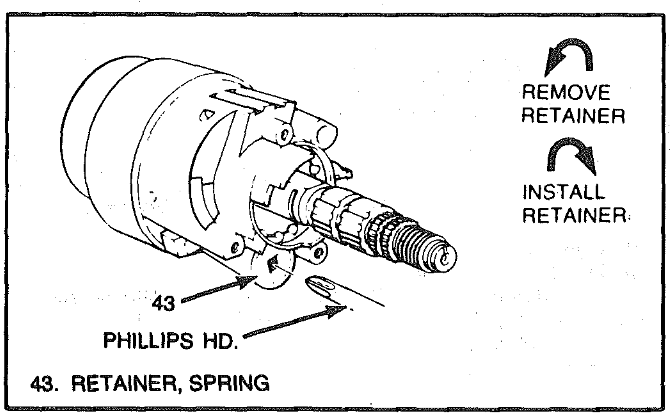


Figure 14. Tilt Spring Assembly Removal

6. Gently pull wire harness through column housing (38) and column housing shroud (62)
7. Pivot pin
8. Pivot and switch assembly (46)
9. Spring retainer (43)
10. Spring (42) and spring guide (41)

Install or Connect
(Figures 2,3,4,5,6,7,8,9,10,11,12,13,14,15)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Spring guide (41) and spring (42) coated with lithium grease
2. Spring retainer (43)
3. Pivot and switch assembly (46)
4. Pivot pin
5. Pivot and switch assembly (46) wire harness through column housing shroud (62) and column housing (38)

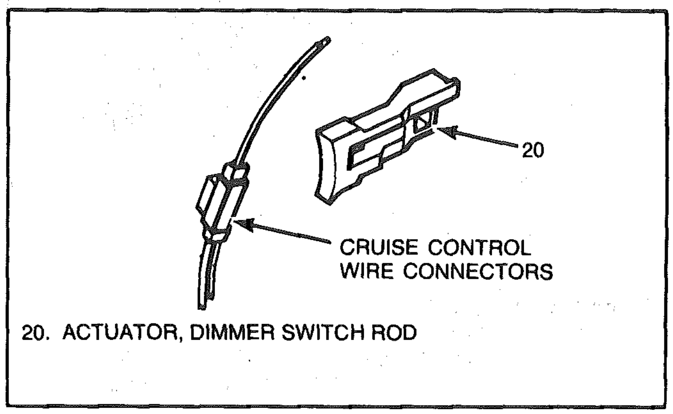


Figure 15. Dimmer Switch Actuator/ Cruise Control Connectors

6. Dimmer switch rod actuator (20). Bottom edge of dimmer switch rod actuator (20) should rest on bend in dimmer switch rod (63)
7. Cover housing end cap (44)

Important

Cruise control equipped columns: Plug cruise control connectors together and install multifunction lever (89).

8. Lock housing cover (18)
9. Screws (14). Tighten screw in 12 o'clock position first, screw in 8 o'clock position second, and screw in 4 o'clock position third. Torque in the same order to 7.0-11.0 N·m (61.95-97.35 Lbs.In.)
10. Perform steps 1 thru 17, Install or Connect, Sub Section A

SUB SECTION C

INCLUDES: COLUMN HOUSING, LOCK SHOES, ACTUATOR SECTOR ASSEMBLY, SWITCH ACTUATOR RACK, BEARINGS, AND LOCK BOLT ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover
J 21854-01 Pivot Pin Remover

Remove or Disconnect (Figure 2 thru 18)

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Perform steps 1 thru 10, Remove or Disconnect, Sub Section B

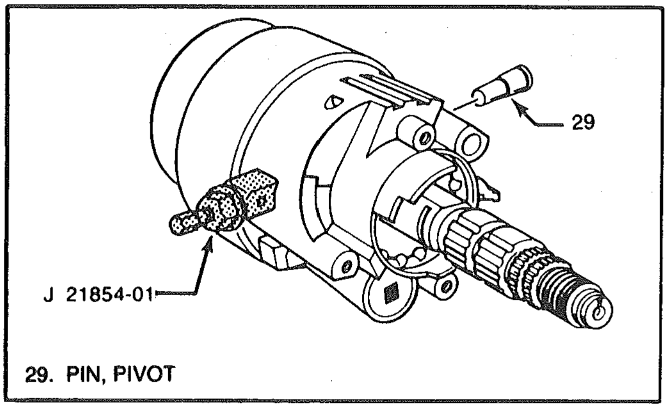


Figure 16. Removing Pivot Pins

3. Pivot pins (29) using J 21854-01
4. Reinstall tilt release lever
5. Column housing assembly (38). Pull back on tilt release lever and pull housing (38) down and away from column

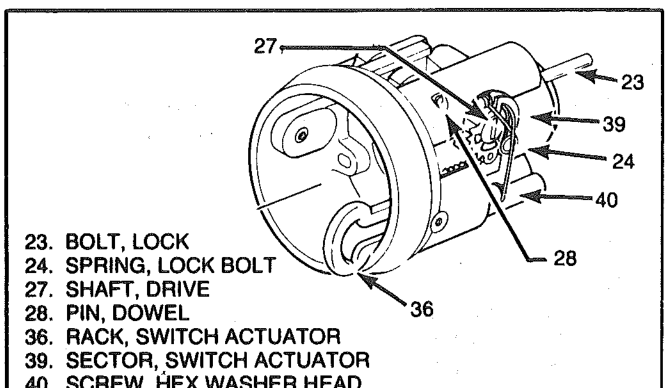


Figure 17. Lock Housing Cover Assembly, Exterior

6. Drive shaft (27)
7. Switch actuator sector (39)
8. Switch actuator rack (36) and rack preload spring (37)

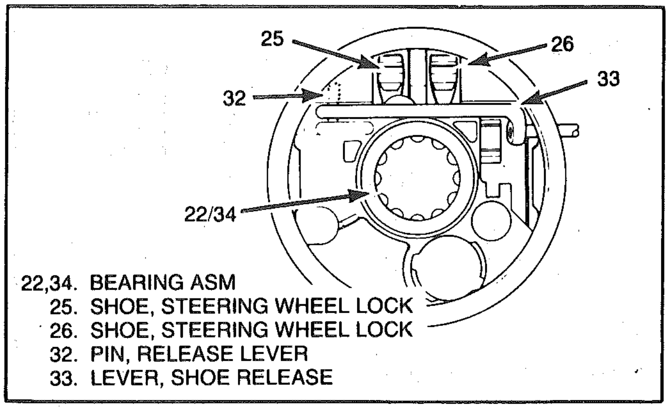


Figure 18. Lock Housing Cover Assembly, Interior

9. Release lever pin (32)
10. Shoe release lever (33)
11. Release lever spring (31)
12. Dowel pin (28)
13. Lock shoes (25,26)
14. Lock shoe springs (30)
15. Bearings (22,34)
16. Hex head bolt (40)
17. Lock bolt spring (24)
18. Lock bolt (23)

Install or Connect (Figures 2 thru 19)

NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Bearings (22,34) to column housing (38)
2. Drive shaft (27)
3. Switch actuator sector (39)
4. Lock shoes (25,26)
5. Dowel pin (28)
6. Lock shoe springs (30)
7. Release lever spring (31)
8. Shoe release lever (33)

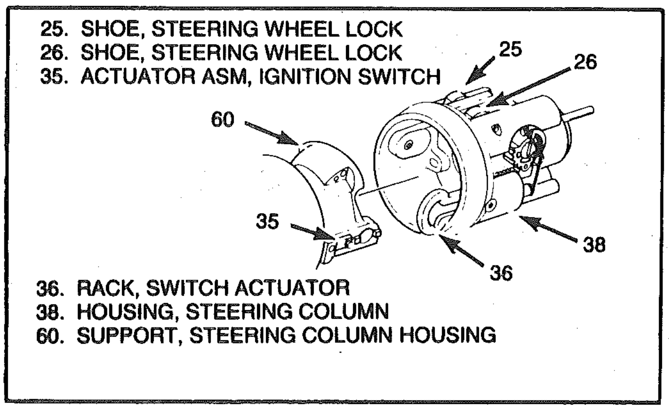


Figure 19. Column Housing to Column Support

9. Release lever pin (32)
10. Rack preload spring (37)
11. Switch actuator rack (36) to switch actuator sector (39)
12. Lock bolt (23)
13. Lock bolt spring (24)
14. Hex head bolt (40)

15. Column housing assembly (38) to column. Position column housing assembly (38) and align switch actuator rack (36) with pin on end of actuator rod (35). Pull back on tilt release lever pushing column housing assembly (38) onto column housing support assembly (60). Release tilt release lever to lock shoes (25,26)
16. Remove tilt release lever
17. Pivot pins (29) lubricated with lithium grease
18. Perform steps 1 thru 10, Install or Connect, Sub Section B
19. Perform steps 1 thru 17, Install or Connect, Sub Section A

SUB SECTION D

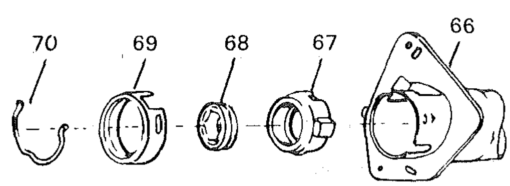
INCLUDES: SHAFT ASSEMBLY, COLUMN HOUSING SUPPORT, SHIFT TUBE ASSEMBLY, IGNITION SWITCH, DIMMER SWITCH, AND LOWER BEARING ASSEMBLY

Tools Required:
J 23653-A Lock Plate Compressor
J 35689-A Terminal Remover
J 21854-01 Pivot Pin Remover

Remove or Disconnect (Figure 2 thru 23, 27)

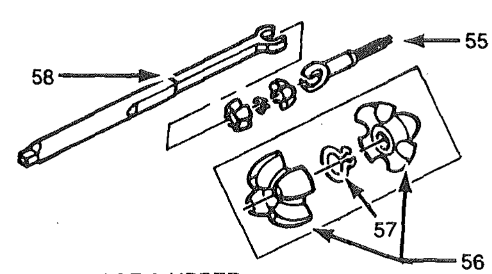
NOTICE: If car has been in an accident, remove column from car and inspect for damage (Figure 27).

1. Perform steps 1 thru 19, Remove or Disconnect, Sub Section A
2. Perform steps 1 thru 10, Remove or Disconnect, Sub Section B
3. Perform steps 1 thru 18, Remove or Disconnect, Sub Section C



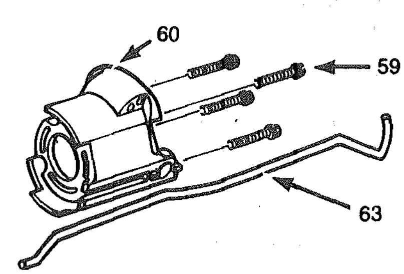
66 JACKET ASM
67 ADAPTER, LOWER BEARING
68 BEARING ASM
69 RETAINER, BEARING ADAPTER
70 CLIP, LOWER BEARING ADAPTER

Figure 20. Lower Bearing Assembly



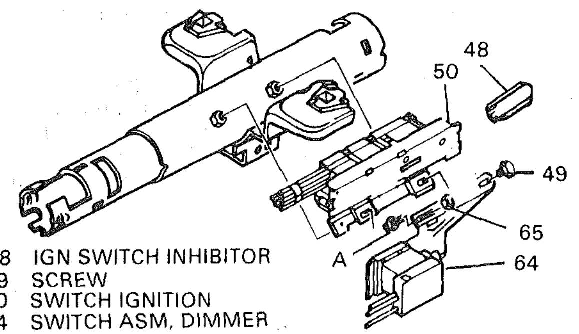
55. SHAFT ASM, RACE & UPPER
56. SPHERE, CENTERING
57. SPRING, JOINT PRELOAD
58. SHAFT ASM, LOWER STEERING

Figure 21. Shaft Assembly



59. SCREW, SUPPORT
60. SUPPORT, STEERING COLUMN HOUSING
63. ROD, DIMMER SWITCH

Figure 22. Column Housing Support Assembly



48 IGN SWITCH INHIBITOR
49 SCREW
50 SWITCH IGNITION
64 SWITCH ASM, DIMMER
65 NUT, HEXAGON
A STUD

Figure 23. Ignition and Dimmer Switches

4. Remove column from car

NOTICE: Once steering column is removed from car, the column is extremely susceptible to damage. Dropping column assembly on its end could collapse steering shaft or loosen plastic injections which maintain column rigidity.

Leaning on column assembly could cause jacket to bend or deform. Any of the above damage could impair column's collapsible design. If it is necessary to remove steering wheel, use only the specified steering wheel puller. Under no conditions should the end of shaft be hammered on as hammering could loosen plastic injections which maintain column rigidity.

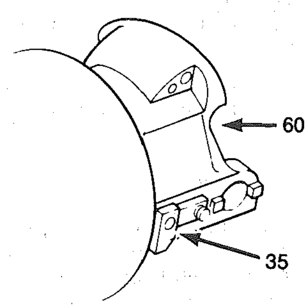
5. Clip, lower bearing adapter (70)
6. Retainer, bearing adapter (69)
7. Bearing ASM (68)
8. Adapter, lower bearing (67)

9. Shaft assembly (55-58)
10. Lower shaft (58)
11. Sphere (56) from upper shaft (55)
12. Preload spring (57) from sphere (56)
13. Screws (59)
14. Housing support assembly (60) and dimmer switch rod (63)
15. Hex nut (65) and hex head bolt
16. Dimmer switch (64)
17. Mounting stud
18. Shroud, column housing (62)

Install or Connect (Figure 2 thru 26)

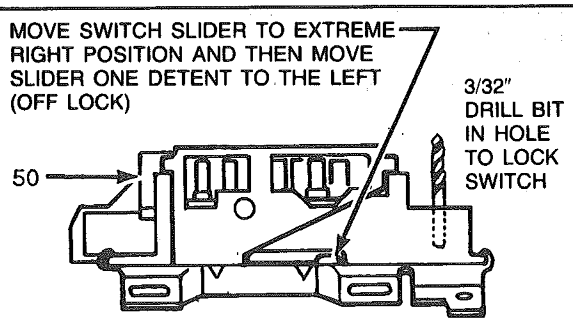
NOTICE: Ensure all fasteners are securely seated before applying required torque. Failure to do so may result in component damage or malfunctioning of steering column.

1. Column housing shroud (62) to jacket (66)
2. Dimmer switch rod (63) to housing support (60)
3. Housing support assembly (60) and screws (59) and torque to 5.5-12.0 N·m (48.68-106.2 Lbs.In.)
4. Actuator rod assembly (35) to track in housing support (60)



35. ACTUATOR ASM, IGNITION SWITCH
60. SUPPORT, STRG COL HSG

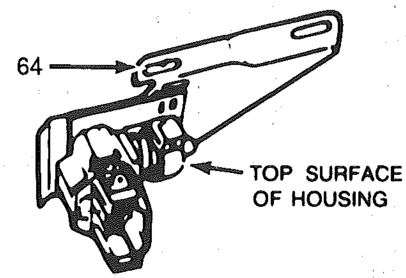
Figure 24. Actuator Rod to Housing Support



50 SWITCH ASM, IGN & BEAM CHANGE

Figure 25. Ignition Switch Adjustment

5. Ignition switch (50) and mounting stud
6. Preload spring (57) and sphere (56) to upper shaft (55)
7. Lower shaft (58) to upper shaft (55). block tooth on shaft end of upper shaft (55) at 12 o'clock position; notch at end of lower shaft (58) at 4 o'clock position
8. Shaft assembly (55-58), lubricated with lithium grease, to column
9. Column housing assembly (38) to column. Position column housing assemby (38) and align switch actuator rack (36) with pin on end of actuator rod (35). Pull back on tilt release lever pushing column housing assembly (38) onto column housing support assembly (60). Release tilt release lever to lock shoes (25,26)
10. Remove tilt release lever
11. Lower bearing (71) and screws (72), inner surface lubricated with lithium grease
12. Lower bearing adapter (67)
13. Lower bearing ASM (68)
14. Retainer, bearing adapter (69)
15. Clip, lower bearing adapter (70)



64 SWITCH, DIMMER

Figure 26. Dimmer Switch Adjustment

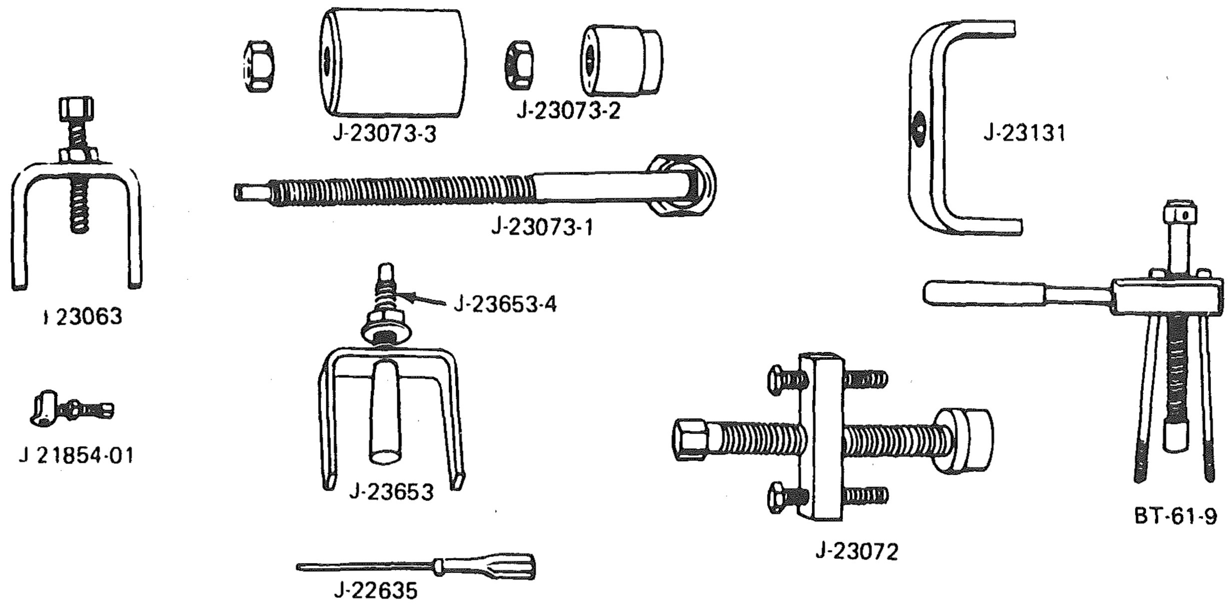
17. Dimmer switch (67), hex nut (68), and hex head bolt (50). Adjust dimmer switch (67)
18. Column to car dash
19. Tilt release lever
20. Perform steps 1 thru 17, Install or Connect, Sub Section C
21. Perform steps 1 thru 10, Install or Connect, Sub Section B
22. Perform steps 1 thru 17, Install or Connect, Sub Section A

TORQUE SPECIFICATIONS

APPLICATION	N·m	FT-LBS
Steering Wheel to Shaft Nut	42	31 Ft. Lbs.
Turn Signal Switch Attaching Screws	4.0	35 In. Lbs.
Ignition Switch Attaching Screws	4.0	35 In. Lbs.
Bracket to Steering Column Support Nuts	34	25 Ft. Lbs.
Toe-Pan to Dash Screws	5.0	45 In. Lbs.
Toe-Pan Clamp Screws	7.0	60 In. Lbs.
Bracket to Steering Column Bolt	40	30 Ft. Lbs.
Cover to Housing Screws	11	100 In. Lbs.
Clamp to Steering Shaft Nut	70	55 Ft. Lbs.
Support to Lock Plate Screws	7.0	60 In. Lbs.
Flex Coupling Nuts	27	20 Ft. Lbs.
Flex Coupling to Shaft Bolt	40	30 Ft. Lbs.

520071-3B5

Fig. 3B5-16 Specifications Chart



BT-61-9	STEERING WHEEL PULLER	J-23072	SHIFT TUBE REMOVER
J-21854-01	PIVOT PIN REMOVER	J-23073-1-2-3	SHIFT TUBE INSTALLER
J-22635	LOCK SHOE & RELEASE LEVER REMOVER & INSTALLER	J-23131	LOCK PLATE COMPRESSOR
J-23063	LOCK PLATE COMPRESSOR	J-23653 & J-23653-4	LOCK PLATE COMPRESSOR

520072-3B5

Fig. 3B5-17– Special Tools

SECTION 3B6

STEERING LINKAGE

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as Notice indicated at appropriate locations by the terminology "See Caution on Page 1 of this Section".

NOTICE: These fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

CONTENTS

GENERAL DESCRIPTION

A parallelogram type steering linkage connects both front wheels to the steering gear through the pitman arm. The right and left tie rods are attached to the steering arms and to the relay rod by ball studs. The left end of the relay rod is supported by the pitman arm, which is driven by the steering gear. The right end of the relay rod is supported by the idler arm which pivots on a support attached to the frame rail. The pitman arm and idler arm remain parallel to each other while they move through symmetrical arcs. See Fig. 3B6-2.

MAINTENANCE AND ADJUSTMENTS

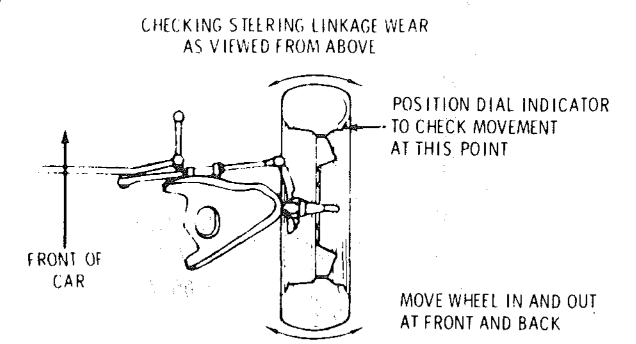


Fig. 3B6-1--Checking Linkage Wear

SUSPENSION AND STEERING LINKAGE CHECK

1. Raise car on one side at frame torque box located directly behind the front wheel so that tire is approximately one inch off the floor.
2. Position dial indicator as shown in Fig. 3B6-1.
3. Position steering wheel so that it is in the locked position.
4. Grasp front wheel as shown in Fig. 3B6-1. With wheels in straight ahead position, move wheel back and forth without moving steering wheel. Gage reading should not exceed 2.74 mm (.108").
5. If gage reading is not within specifications, a check should be made of all suspension and linkage gears.

RELAY ROD HEIGHT ADJUSTMENT

The relay rod position can be adjusted at the idler arm attachment. It is important for the height adjustment to be equal from side-to-side. If not adjusted properly, right-hand turns and left-hand turns could exhibit different characteristics in handling. This is sometimes called "orbital steer." Refer to Fig. 3B6-5 for setting relay rod height.

LUBRICATION

The steering linkage should be lubricated with any water resistant EP type chassis lubricant at specified intervals. Lubrication points and additional information on chassis lubrication can be found in Section 0B.

ADJUSTMENTS

Toe-In Adjustment

Adjust the steering linkage for proper toe-in setting as outlined in Section 3A.

ON-CAR SERVICE

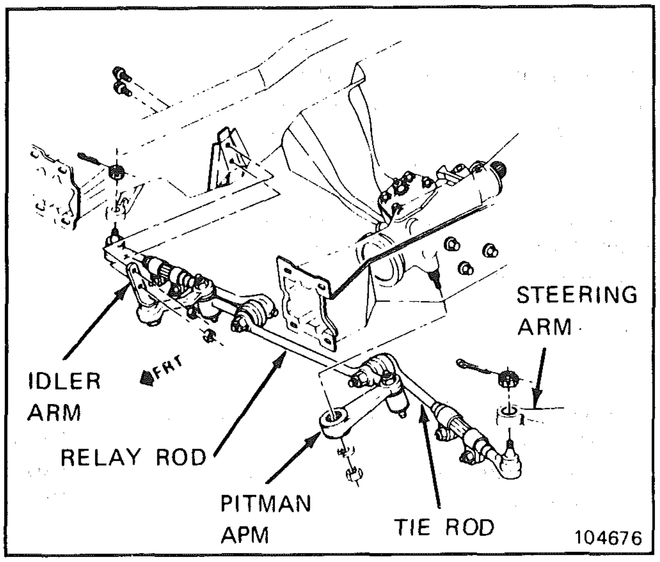


Fig. 3B6-2--Series Linkage Components

TIE RODS

There are two tie rod assemblies. Each assembly is of five piece construction, consisting of a sleeve, two clamps and two tie rod ends. The ends are threaded into the sleeve and locked with the clamps. Right and left hand threads are provided to facilitate toe-in adustment and steering gear centering.

The tie rod ends are self-adjusting for wear and require no attention in service other than periodic lubrication and occasional inspection to see that ball studs are tight.

Tie rod adjuster components often become rusted in service. In such cases, it is recommended that if the torque required to remove the nut from the bolt after breakaway exceeds 9 N·m (7 lb. ft.), discard the nuts and bolts. Apply any penetrating oil between the clamp and tube and rotate the clamps until they move freely. Install new bolts and nuts having the same part number to assure proper clamping at the specified nut torque.

Removal

1. Raise vehicle on hoist.
2. Remove cotter pins and nuts from ball studs.
3. To remove outer ball stud, use a tool such as J-24319-01, or J-6627 as shown in Fig. 3B6-3.

   NOTICE: Do not attempt to disengage the joint by driving a wedge between the joint and the knuckle, because seal damage could result.
4. Remove inner ball stud from relay rod using same procedure as described in Step 3.
5. To remove tie rod ends from tie rods, loosen clamp bolts and unscrew end assemblies.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in step 4.

1. If the tie rod ends were removed, lubricate the tie rod threads with any EP type Chassis lube and install ends on tie rod making sure both ends are threaded an equal distance from the tie rod.
2. Make sure that the threads on the ball stud and in the ball stud nuts are clean and smooth. If threads are not clean and smooth, ball studs may turn in tie rod ends when attempting to tighten nut. In addition tapered surfaces should be clean and free from grease. Install seals on ball studs.
3. Install ball studs in steering arms and relay rod.
4. Torque nuts to 48 N·m (35 lb. ft.). Then tighten nuts enough to align the slot in the nut with the hole in the stud. Install cotter pins. Lubricate tie rod ends.
5. Lower vehicle to floor.

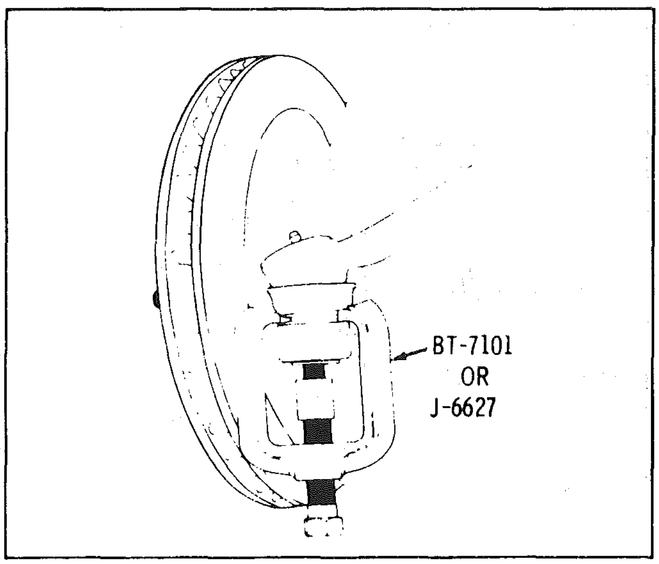


Fig. 3B6-3--Freeing Ball Stud

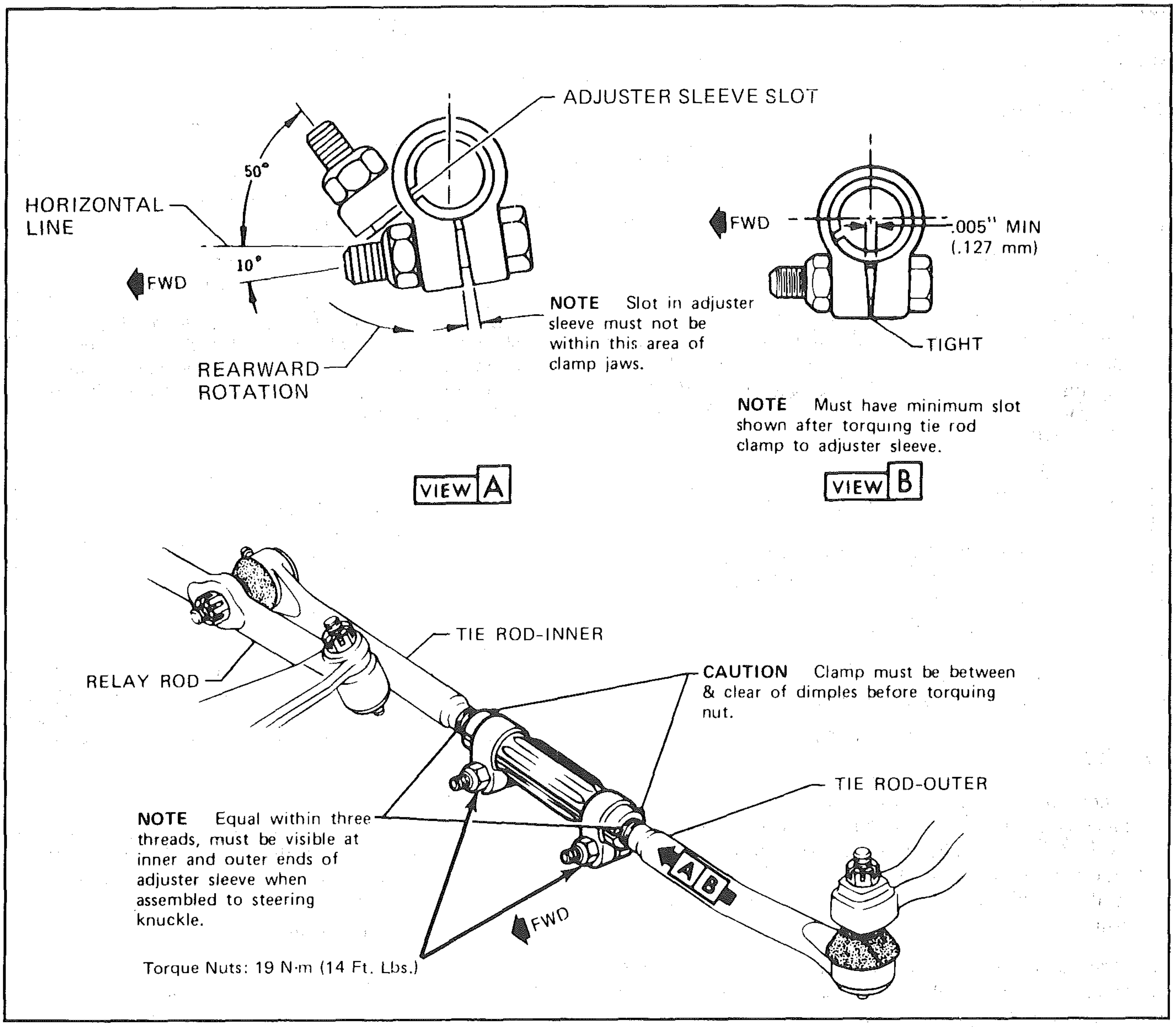


Fig. 3B6-4--Tie Rod Clamp and Sleeve Orientation

6. Adjust toe-in as described in Section 3A.

Before tightening the tie rod adjusting sleeve clamp bolts, be sure that the following conditions have been met:

a. The sleeve clamps must be positioned between the locating dimples at either end of the sleeve.

b. The clamps must be positioned within the angular travel indicated in Figure 3B6-4 for the proper vehicle.

c. The relationship of the clamp slot with the slit in the sleeve should be maintained as shown in Figure 3B6-4.

d. Both inner and outer tie rod ends must rotate for their full travel. The position of each tie rod end must be maintained as the clamps are tightened to ensure free movement of each joint.

e. All procedures for alignment, adjustment and assembly of tie rods applies to both left and right side.

RELAY ROD

During production, the installed position of the relay rod is carefully controlled to assure that the rod is at the proper height. Both the left end and the right end of the relay rod MUST be held at the same height. The side-to-side height is controlled by adjusting the position of the idler arm.

Whenever **disconnecting** the relay rod assembly, it is important to first scribe the position of the idler arm-to-frame, and to reinstall the idler arm in the same position. Be sure to prevent the idler support from turning in the bushing, since that motion could result in improper relay rod height.

Whenever **replacing** the relay rod, or the idler arm, or the pitman arm, it is mandatory to establish the correct height by following the procedure shown in Fig. 3B6-5.

Removal

1. Raise vehicle on hoist.
2. Remove inner ends of tie rods from relay rod as described under Tie Rod - Removal.
3. Remove nut from relay rod ball stud attachment at

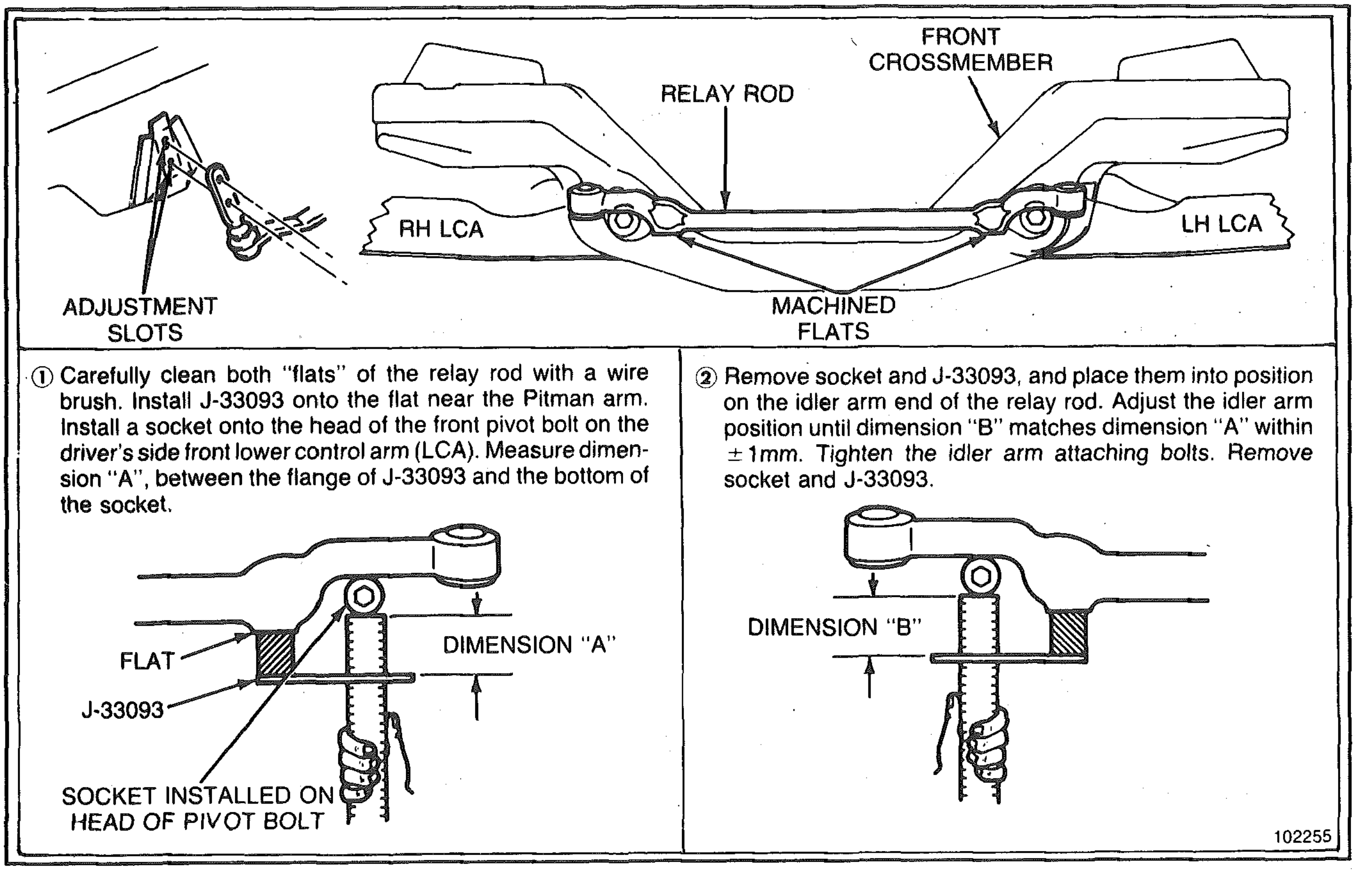


Fig. 3B6-5--Setting Relay Rod Height

pitman arm.

4. Detach relay rod from pitman arm by using tool such as J-24319-01. Shift steering linkage as required to free pitman arm from relay rod.
5. Remove nut from idler arm and remove relay rod from idler arm.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 2, 3 and 4.

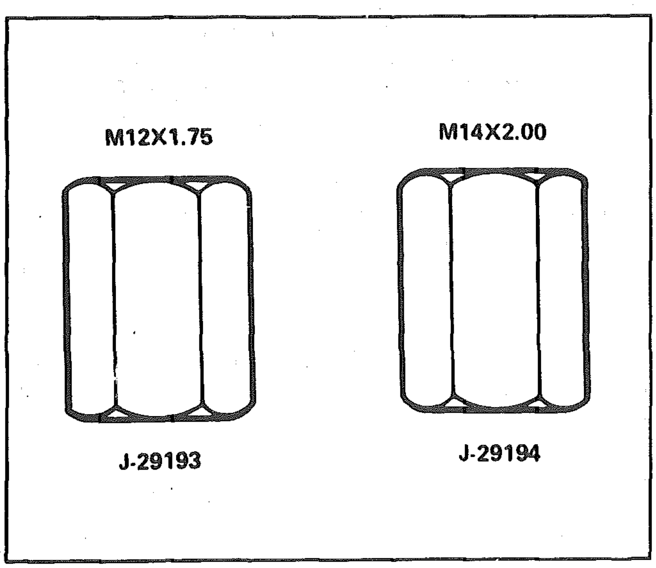


Fig. 3B6-6--Special Tools Used to Seat the Tapers

1. Install relay rod to idler arm, making certain idler stud seal is in place. Use J-29193 or J-29194 as shown in Fig. 3B6-6 to seat the tapers. A torque of 20 N·m is required. With the tapers seated, remove the tool, then install a prevailing torque nut, and tighten to 48 N·m (35 ft. lbs.).
2. Raise end of rod and install on pitman arm. Use J-29193 or J-29194 as shown in Fig. 3B6-6 to seat the tapers. A torque of 20 N·m is required. With the tapers seated, remove the tool, then install a prevailing torque nut, and tighten to 48 N·m (35 ft. lbs.).
3. Install tie rod ends to relay rod as previously described under Tie Rods. Lubricate tie rod ends.
4. Install damper if equipped and torque to specifications.
5. Refer to 3B6-5 for setting relay rod height.
6. Lower vehicle to floor.
7. Adjust toe-in (see Section 3A) and align steering wheel as described in Section 3B4 under Steering Wheel Alignment and High Point Centering.

IDLER ARM

Use of the proper diagnosis and checking procedure is essential to prevent needless replacement of good idler arms.

The proper checking procedure is as follows:

1. Raise the vehicle in such a manner as to allow the front wheels to rotate freely and the steering mechanism freedom to turn. Position the wheels in the straight ahead position.

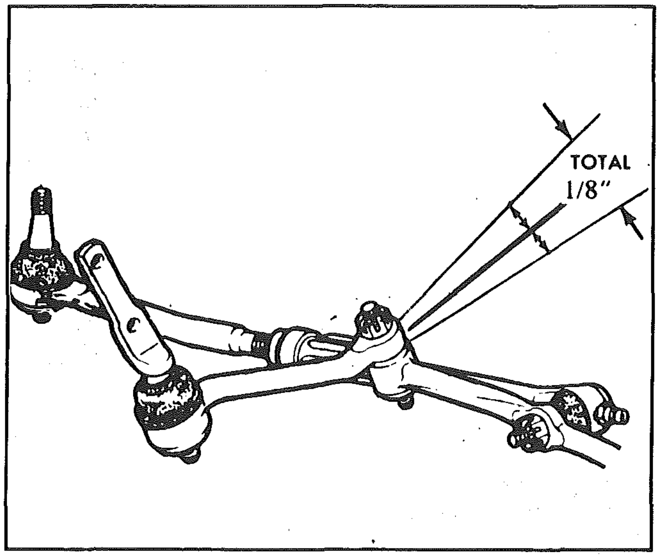


Fig. 3B6-7--Checking Idler Movement

2. As near the relay rod end of the idler arm as possible, exert a 110 Newton (25 pound) force upward and then downward while noticing the total distance the end of the arm moves. This distance should not exceed a total acceptable movement of 1/8 inch (Fig. 3B6-7). It is necessary to ensure that the correct load is applied to the arm since it will move more when higher loads are applied. It is also necessary that a scale or ruler be rested against the frame and used to determine the amount of movement because the actual movement can be over-estimated when a scale is not used. The idler arm should always be replaced if it fails this test.

Jerking the right wheel and tire assembly back and forth, thus causing an up and down movement of the idler arm, is NOT an acceptable method of checking because there is no control on the amount of force being applied.

Caution should be used in assuming shimmy complaints are caused by loose idler arms. Before suspecting suspension or steering components, technicians should eliminate shimmy excitation factors, such as dynmamic imbalance, runout or force variation of wheel and tire assemblies and road surface irregularities.

Removal

Refer to procedure for RELAY ROD REMOVAL, and to Fig. 3B6-5 before removing idler arm.

1. Raise vehicle on hoist.
2. Remove idler arm to frame nuts, washers, and bolts.
3. Remove nut from idler arm to relay rod ball stud.
4. Remove relay rod from idler arm by using J-24319-01 or similar puller.
5. Remove idler arm.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1 and 2.

1. Position idler arm on frame and LOOSELY install mounting bolts, washers and nuts.
2. Install relay rod to idler arm, making certain seal is on stud. Use J-29193 or J-29194 as shown in Fig. 3B6-6 to seat the tapers. A torque of 20 N·m is required. With the tapers seated, remove the tool, then install a prevailing torque nut, and tighten to 48 N·m (35 ft. lbs.).
3. Follow the procedure in Fig. 3B6-5 to set the relay rod height. Torque the idler arm-to-frame mounting bolts to specifications.
4. Lower vehicle to floor.

PITMAN ARM

Refer to procedure for RELAY ROD REMOVAL, and to Fig. 3B6-5 before removing pitman arm.

Removal

1. Raise vehicle on hoist.
2. Remove nut from pitman arm ball stud.
3. Remove relay rod from pitman arm by using a tool such as J-24319-01. Pull down on relay rod to remove from stud.
4. Remove pitman arm nut from pitman shaft and mark relation of arm position to shaft.
5. Remove pitman arm with Tool J-5504 or Tool J-6632, as seen in Fig. 3B6-8. DO NOT HAMMER ON PULLER.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 2 and 3.

1. Install pitman arm on pitman shaft, lining up the marks made upon removal.
2. Install pitman shaft nut and torque to specifications.
3. Position relay rod on pitman arm. Use J-29193 or J-29194 as shown in Fig. 3B6-6 to seat the tapers. A torque of 20 N·m is required. With the tapers seated, remove the tool, then install a prevailing torque nut, and tighten to 48 N·m (35 ft. lbs.).
4. Follow the procedure in Fig. 3B6-5 to set the relay rod height. Torque the idler arm-to-frame mounting bolts to specifications.
5. Lower vehicle to floor.

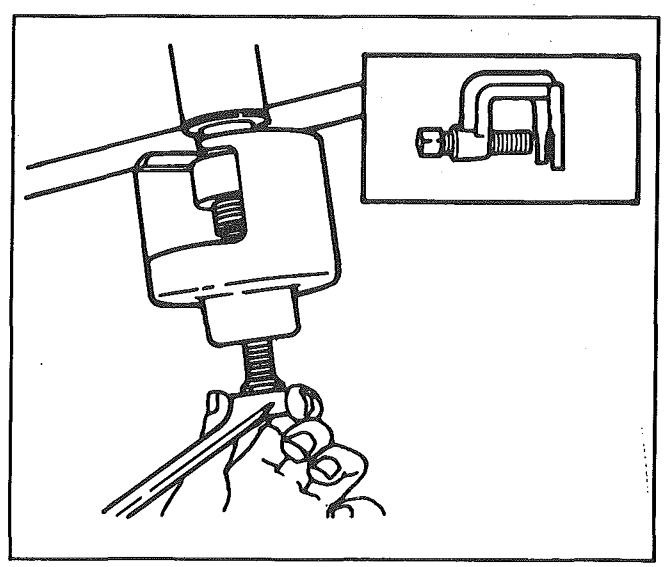


Fig. 3B6-8--Removing Pitman Arm

STEERING LINKAGE TORQUE SPECIFICATIONS	N·m	Ft-Lbs
Steering Knuckle to Tie Rod End Nut	48	35
Tie Rod Clamp Nuts	19	14
Tie Rod to Intermediate Rod Nut	48	35
Pitman Arm to Intermediate Rod Nut	48	35
Pitman Arm to Steering Gear Nut	250	180
Idler Arm to Intermediate Rod Nut	48	35
Idler Arm to Frame Nut	70	50

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Fig. 3B6-9--Specification Chart

CAUTION

USE THE PROPER TOOL TO SEPARATE ALL TIE ROD AND BALL JOINTS.

SECTION 3B7

POWER STEERING GEAR AND PUMP

The following notice applies to one or more steps in the assembly procedure of components in this portion of the manual as indicated at appropriate locations. "See Notice on Page 1 of this Section".

NOTICE: Steering column fasteners are important attaching parts in that they may affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts. For prevailing torque nut(s) and bolt(s), refer to the "Reuse of Prevailing Torque Nut(s) and Bolt(s)" chart in Section 10.

CONTENTS

MAINTENANCE AND ADJUSTMENTS

BLEEDING HYDRAULIC SYSTEM

1. Fill fluid reservoir to proper level and let remain undisturbed for at least two minutes.
2. Start engine and run momentarily.
3. Shut engine off to add fluid.
4. Repeat above procedure until fluid level remains constant after running engine.
5. Raise front end of vehicle so that wheels are off the ground.
6. Start engine and increase engine speed to approximately 1500 rpm.
7. Turn the wheels (off ground) right and left, lightly contacting the wheel stops.
8. Lower the car and turn wheels right and left on the ground.
9. Shut engine off, check fluid level and refill as required.
10. If fluid is extremely foamy, allow vehicle to stand a few minutes with engine off while you run through the following:
    a. Check belt tightness and check for a bent or loose pulley. (Pulley should not wobble with engine running.)
    b. Check to make sure hoses are not touching any other parts of the car, particularly sheet metal and exhaust manifold.
    c. Check fluid level, filling to proper level if necessary. Air in the fluid is the most frequent cause of objectionable pump noise.
    d. When air is present, bleed system as described in operations 1 through 10. If the pump will not bleed after a few trials, proceed as outlined under Hydraulic System Checks.

FLUID LEVEL

1. Check fluid level in the reservoir by checking the dip stick when fluid is at operating temperature.
2. Fill, if necessary, to proper level with GM Power Steering Fluid, or equivalent.

POWER STEERING GEAR ADJUSTMENTS

Adjustment of the power steering gear in the vehicle is discouraged because of the difficulty involved in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. The steering gear adjustment is made only as a correction and not as a required periodic adjustment.

The effect of improperly adjusted worm thrust bearings or an improperly adjusted over-center preload could cause a handling stability complaint.

To properly adjust the power steering gear, the assembly MUST be removed from the vehicle and adjustments performed as outlined.

For removal of the power steering gear assembly see "Power Steering Gear".

DRIVE BELT TENSION

All drive belt tension specifications can be found in the Engine Cooling Section 6B.

When adjusting a power steering pump belt, never pry against the pump reservoir or pull against the filler neck. Two systems are used for belt adjustment. On some models, the pump is loosened from the bracket and moved outward to increase the tension. On other models, a half-inch square drive hole is located in the bracket, and this hole is used to rotate the pump-and-bracket assembly outward to increase belt tension.

Place belt tension gage, J-23600 or equivalent midway between the pulleys on drive belt being checked.

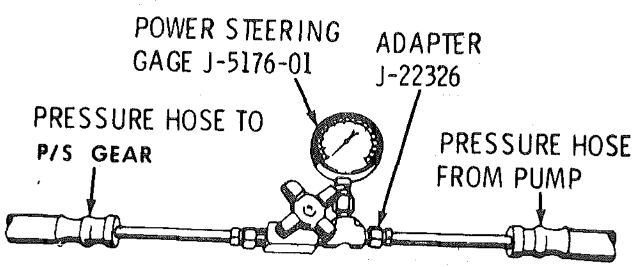


Figure 3B7-1 Test Gage Installation

To adjust pump:

1. Loosen the pump attaching bolts and adjust the belt to correct tension by moving the pump outward, away from the engine.
2. Snug all pump mounting bolts and remove pry bar.
3. Tighten all pump mounting bolts to specified torque.
4. Check belt tension using the tension gage.

NOTICE: Do not move pump by prying against reservoir or by pulling on filler neck, or damage may occur.

HYDRAULIC SYSTEM CHECKS

The following procedure outlines methods to identify and isolate power steering hydraulic circuit difficulties. The test provides means of determining whether power steering system hydraulic parts are actually defective.

Before performing hydraulic circuit test, carefully check belt tension, fluid level and condition of driving pulley.

HYDRAULIC SYSTEM TEST

(Figure 3B7-1)

Fluid must be at normal operating temperature. Check front tires for correct pressure. All tests are made with engine idling. If necessary, adjust engine idle speed to correct specifications listed in Section 6C and proceed as follows:

1. Stop engine, disconnect pressure hose from pump and install Tool J-5176 using a spare pressure hose between gage and pump. Gage must be between shut-off valve and pump. Open shut-off valve.
2. Remove filler cap from pump reservoir and check fluid level. Fill pump reservoir to full mark on dip stick. Start engine and, momentarily holding steering wheel against stop, check connections at Tool J-5176 for leakage.
3. Bleed system as outlined under Maintenance and Adjustments.
4. Insert thermometer (Tool J-5421) in reservoir filler opening. Move steering wheel from stop to stop several times until thermometer indicates that hydraulic fluid in reservoir has reached temperature of 150° to 170°F (65° to 77°C).

   NOTICE: To prevent scrubbing flat spots on tires, do not turn steering wheel more than five times without rolling vehicle to change tire-to-floor contact area. Front end of vehicle can be lifted for this test.

5. Start engine and check fluid level, adding fluid if required. When engine is at normal operating temperature, the initial pressure read on the gage (valve open) should be in the 80-125 psi (550-860 kPa) range. Should this pressure be in excess of 200 psi (1380 kPa) - check the hoses for restrictions and the poppet valve for proper assembly.
6. Close gate valve fully 3 times. Record the highest pressures attained each time.

   NOTICE: Do not leave valve fully closed for more than 5 seconds as the pump could be damaged internally.

   a. If the pressures recorded are within the listed specs and the range of readings are within 50 psi (345 kPa), the pump is functioning within specs.
   b. If the pressures recorded are high, but do not repeat within 50 PSI (345 kPa), the flow controlling valve is sticking. Remove the valve, clean it and remove any burrs using

crocus cloth or fine hone. If the system contains some dirt, flush it. If it is exceptionally dirty, both the pump and the gear must be completely disassembled, cleaned, flushed and reassembled before further usage.

c. If the pressures recorded are constant, but more than 100 PSI (690 kPa), below the minimum spec., replace the flow control valve and recheck. If the pressures are still low, replace the rotating group in the pump.

7. If the pump checks within specifications, leave the valve open and turn (or have turned) the steering wheel into both corners. Record the highest pressures and compare with the maximum pump pressure recorded. If this pressure cannot be built in either (or one) side of the gear, the gear is leaking internally and must be disassembled and repaired. See "Unit Repair" at the end of this section.
8. Shut off engine, remove testing gage, spare hose, reconnect pressure hose, check fluid level and/or make needed repairs.

ON-VEHICLE SERVICE

POWER STEERING GEAR

(Figure 3B7-2)

Removal

Place drain pan below, then disconnect pressure and return hoses from the steering gear housing. Cap both hoses and steering gear outlets to prevent foreign material from entering the system. After service is performed and steering gear is installed, connect the pressure and return hoses to the steering gear housing. Install coupling shield. Bleed system as outlined under "Maintenance and Adjustments".

1. Disconnect battery ground cable and remove coupling shield.
2. Remove retaining nuts, lock washers, and bolts at steering coupling to steering shaft flange.
3. Remove pitman arm nut and washer from pitman shaft and mark relation of arm position to shaft.
4. Remove pitman arm with Tool J-6632.
5. Remove screws securing steering gear to frame and remove gear from vehicle.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in steps 1, 2 and 3.

1. Place gear into position so that steering coupling mounts properly to flanged end of steering shaft. Secure gear to frame with washers and bolts. Torque all gear to frame fasteners.

NOTICE: Be sure the coupling is bottomed on the wormshaft so that the coupling bolt passes through the undercut on the wormshaft, or damage may occur.

2. Secure steering coupling to flanged end of steering column with lock washers, and nuts. Maintain coupling adjustments shown in Section 3B5, under "Installation of Steering Column". Torque nuts.
3. Install pitman arm, aligning marks made during removal. Install washer and retaining nut. Torque nut.
4. Install coupling shield and connect battery ground cable.

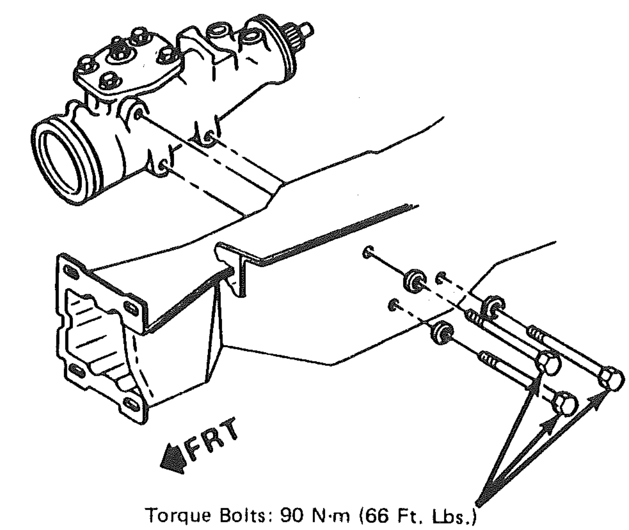


Figure 3B7-2 Steering Gear Mounting

PITMAN SHAFT SEAL

(Figure 3B7-3)

Replacement

A defective seal may be replaced without removal of steering gear from vehicle by removing pitman arm as outlined under Maintenance and Adjustments - Steering Gear Adjustments. Proceed as follows:

1. Clean end of housing to prevent contamination.
2. Remove retaining ring with snap ring pliers J-4245.
3. With rear wheels off the ground, start the engine, turn the steering wheel all the way left. Hydraulic pressure will force the pitman shaft seal out of the housing. Catch the seal and fluid in a pan.
4. Stop engine, install a new seal using J-6219.
5. Install seals/washers/snap rings.

6. Reinstall pitman arm as described earlier. Add fluid as required, check and bleed system until correct fluid level is obtained.

POWER STEERING PUMP

Removal

1. Place drain pan below, then disconnect hoses at pump or steering gear. When hoses are disconnected, secure ends in raised position to prevent drainage of fluid.
2. Install caps at hose fittings to prevent loss of fluid from pump.
3. Remove drive belt.

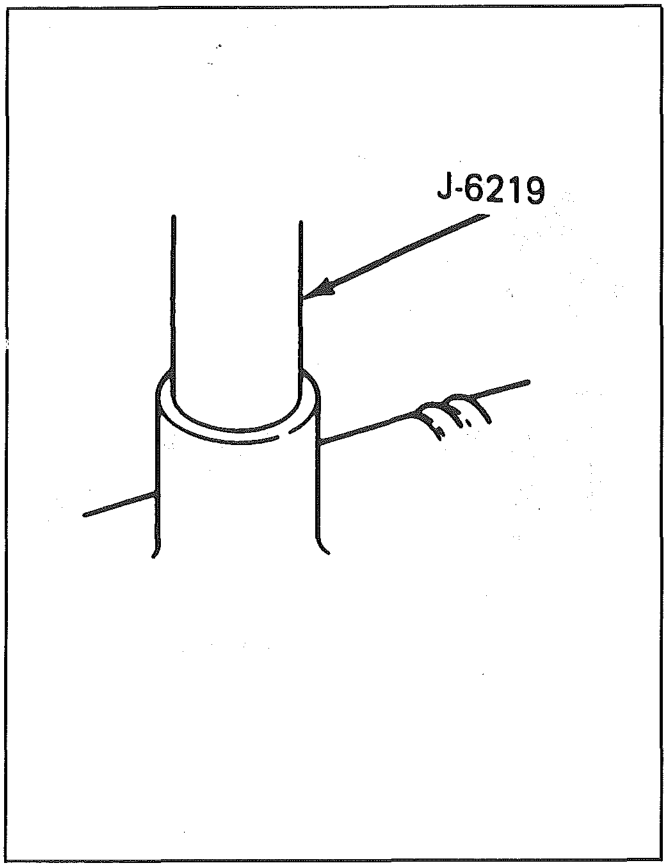


Figure 3B7-3 Pitman Shaft Seal Replacement

4. Remove pump from vehicle.

Installation

1. Position pump assembly on vehicle and install attaching parts loosely.
2. Connect and tighten hose fittings.
3. Fill reservoir. Bleed pump by turning pulley backward (counter-clockwise as viewed from front) until air bubbles cease to appear.
4. Install drive belt over pulley.
5. Tension belt as outlined under "Maintenance and Adjustments". Do not pry on pump reservoir.
6. Bleed as outlined under "Bleeding Power Steering Systems".

POWER STEERING HOSES AND PIPES

It is important that the power steering hoses and pipes be installed correctly. Hoses and pipes installed out of position may be subjected to chafing or other abuses during high pump pressure. Always make installations with the front wheels in straight ahead position. Do not twist hoses unncessarily during installation.

NOTICE: Do not start engine with any power steering hose or pipe disconnected. After connecting the power steering hoses, make sure that ample clearance has been provided between the hoses and the drive belt, sheet metal or any other components where hose rub or interference could result. If the return hose or pipe connections are removed for any reason at either connection, replace the existing "crimped" clamp with a "worm drive" clamp for proper sealing.

PUMP PULLEY

(Figure 3B7-4)

Removal

1. Install tool as shown in Figure 3B7-4. Be sure pilot bolt bottoms in the pump shaft by turning nut to the top of the pilot bolt.
2. Install puller jaws and retainer sleeve.
3. Remove pulley by holding pilot bolt and turning nut counterclockwise.

Installation

1. Place pulley on end of pump shaft and install tool as shown in Figure 3B7-4. Be sure pilot bolt bottoms in shaft by turning nut to the top of the pilot bolt.
2. Install pulley by holding pilot bolt and turning nut clockwise.

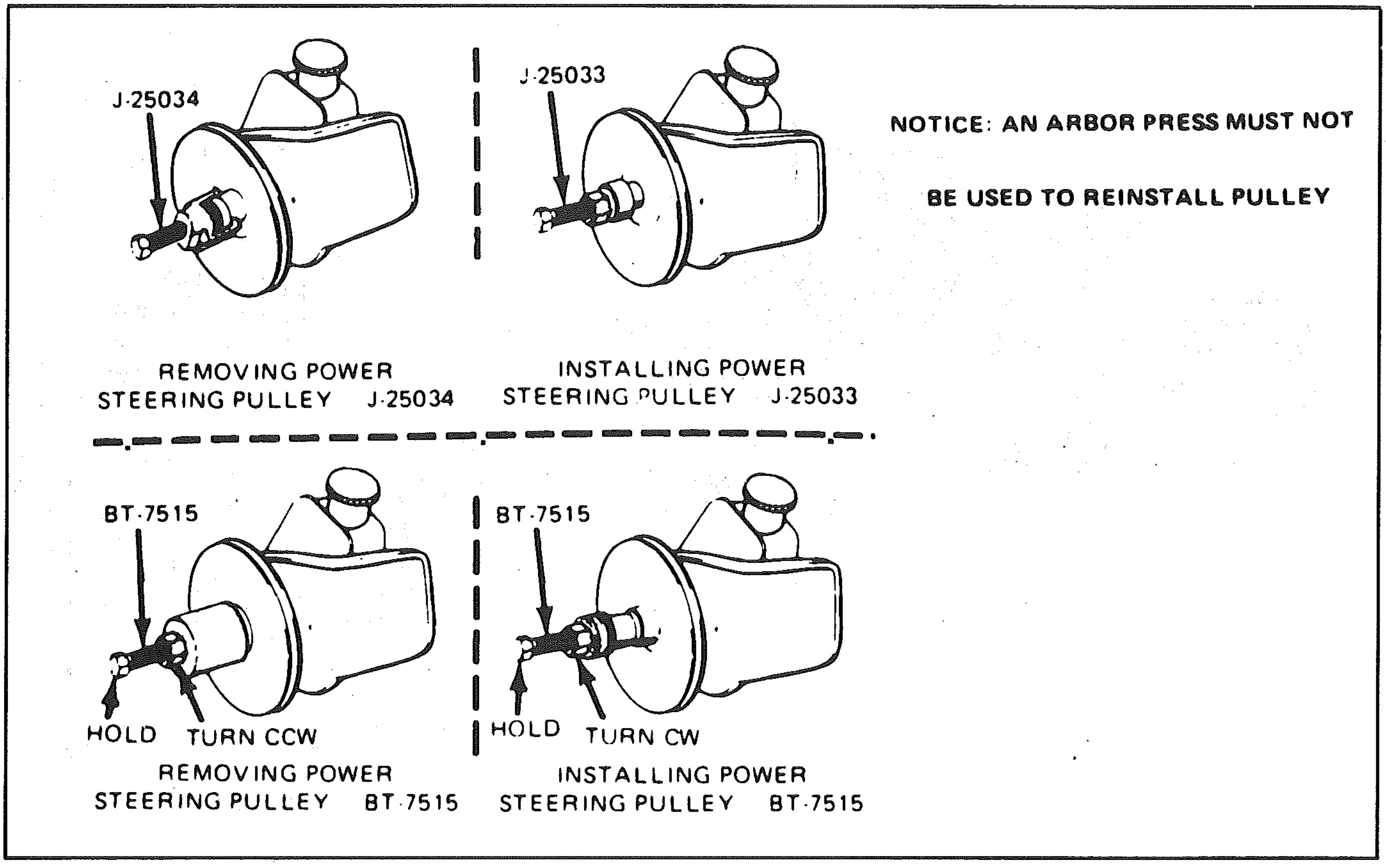


Figure 3B7-4 Removing/Installing Drive Pulley

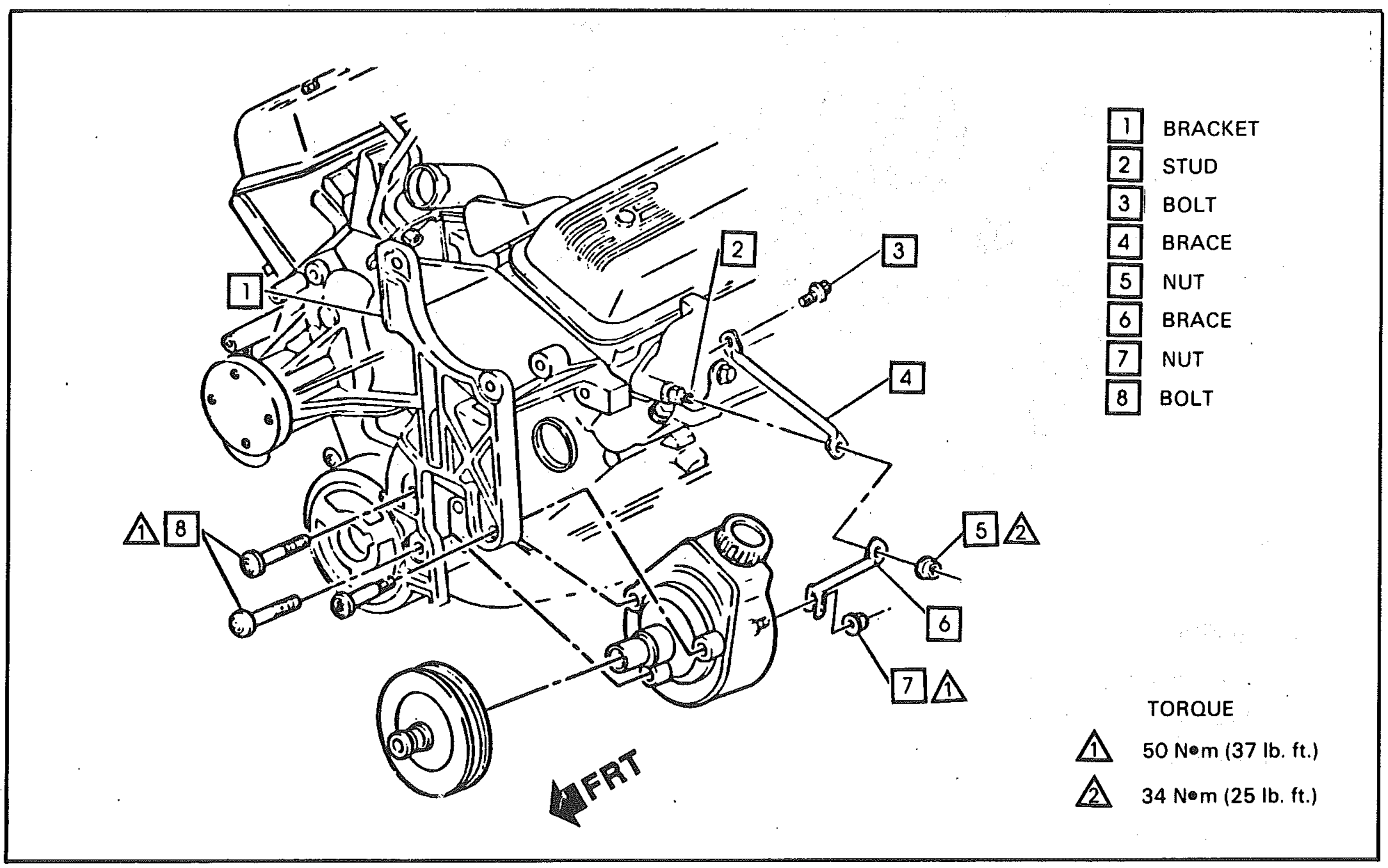


Figure 3B7-5 Power Steering Pump Mounting for Engines LO3/LB9/L98

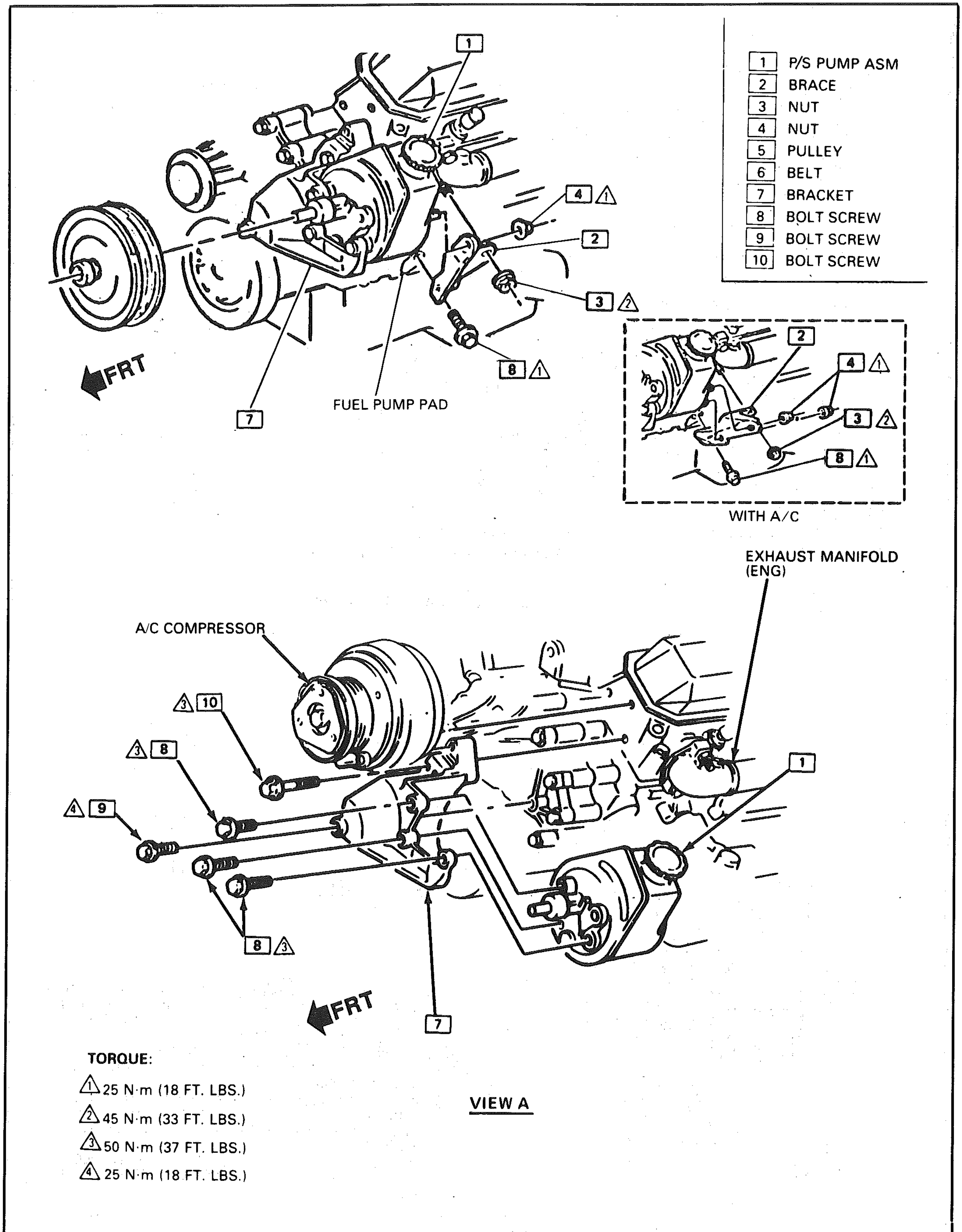
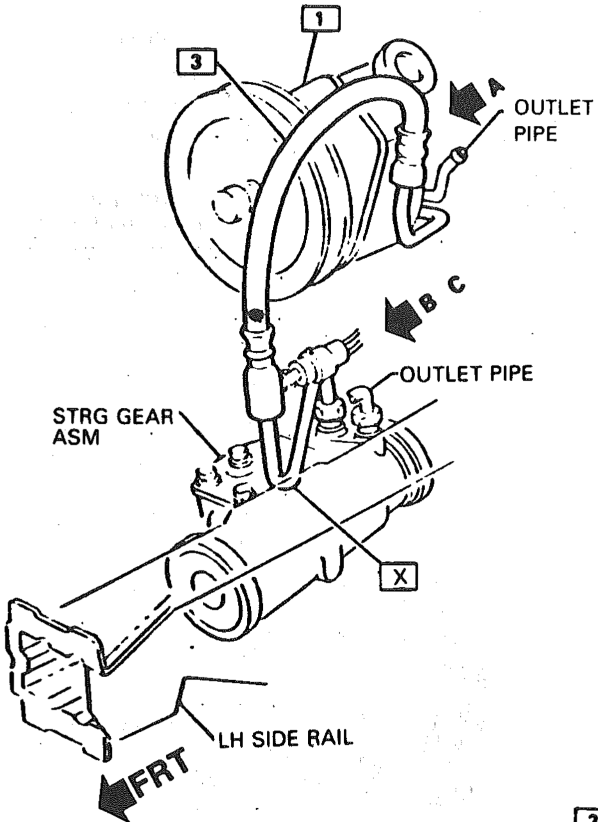
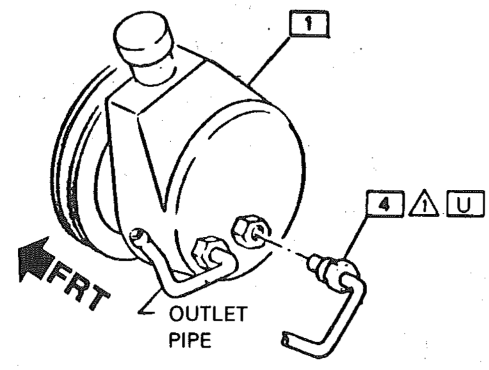


Figure 3B7-6 P/S Pump Bracket With A/C for Engine LB8

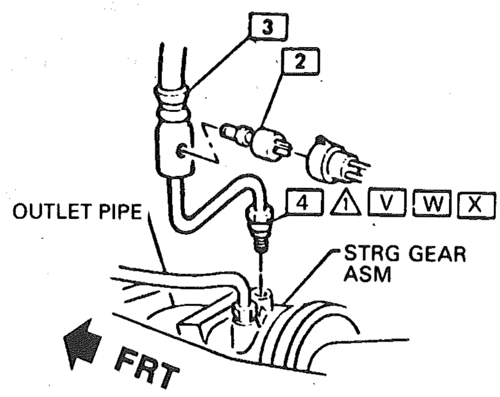


1	P/S PUMP ASM
2	SWITCH
3	INLET HOSE ASM
4	FITTING

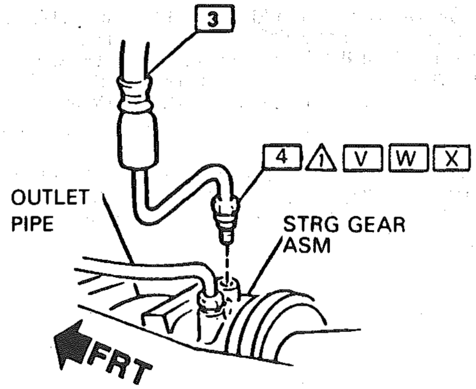
TORQUE:
⚠ 27 N·m (20 FT. LBS.)



VIEW A



VIEW B



VIEW C

U HOSES MUST BE INSTALLED TO CLEAR EACH OTHER AND ALL SURROUNDING PARTS. MIN. CLEARANCE 12.7 (HOSE MUST NOT BE TWISTED DURING INSTALLATION.) HOSE ENDS MUST BE KEPT FREE OF DIRT AND OTHER CONTAMINANTS.

V DO NOT BEND OR DISTORT PIPES TO FACILITATE INSTALLATION.

W FOR LEAK REPAIR UNSCREW NUT AND REPLACE O-RING SEAL. REINSTALL AND TIGHTEN NUT TO SPECIFIED TORQUE. DO NOT OVERTIGHTEN NUT TO REPAIR LEAKS.

X INSTALLATION ANGLE TO BE SET BY ROTATING PIPE TO CONTACT STEERING GEAR HOUSING COVER.

Figure 3B7-7 P/S Hose-Pipe Assy. for LB9/LO3/L98 Engines

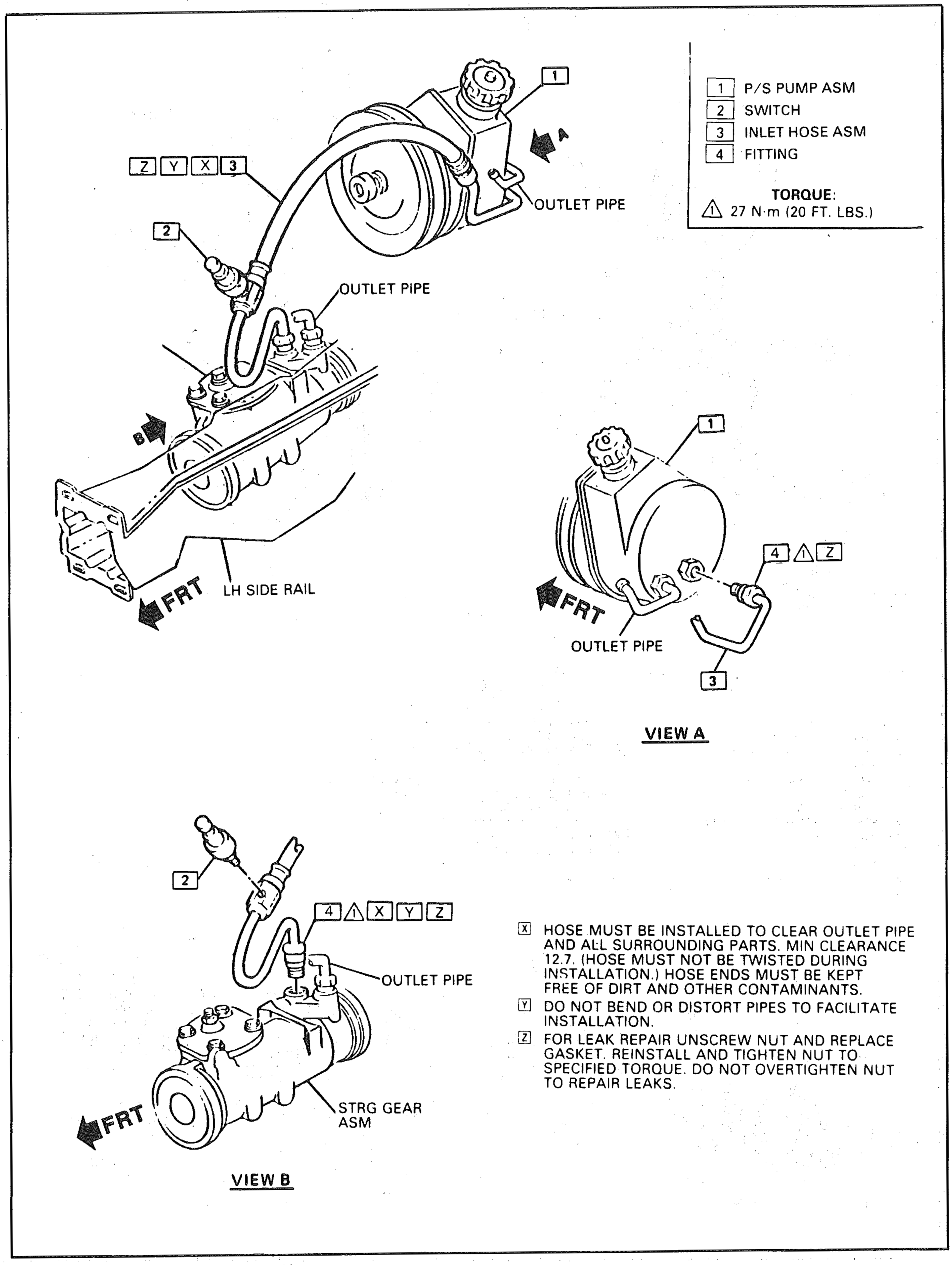


Figure 3B7-8 P/S Pump Hose LB8 Engine

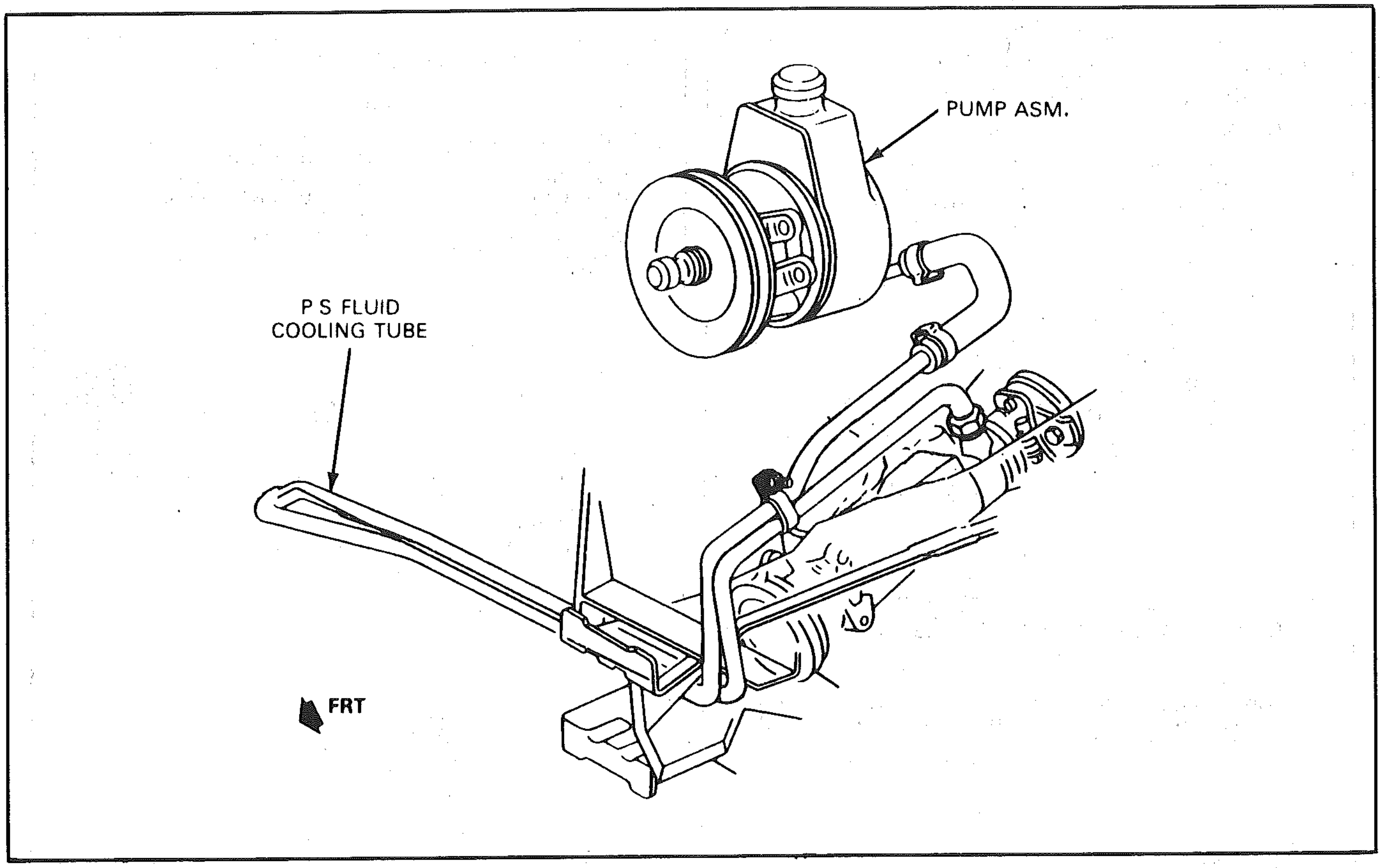


Figure 3B7-9 Power Steering With Cooling Tube

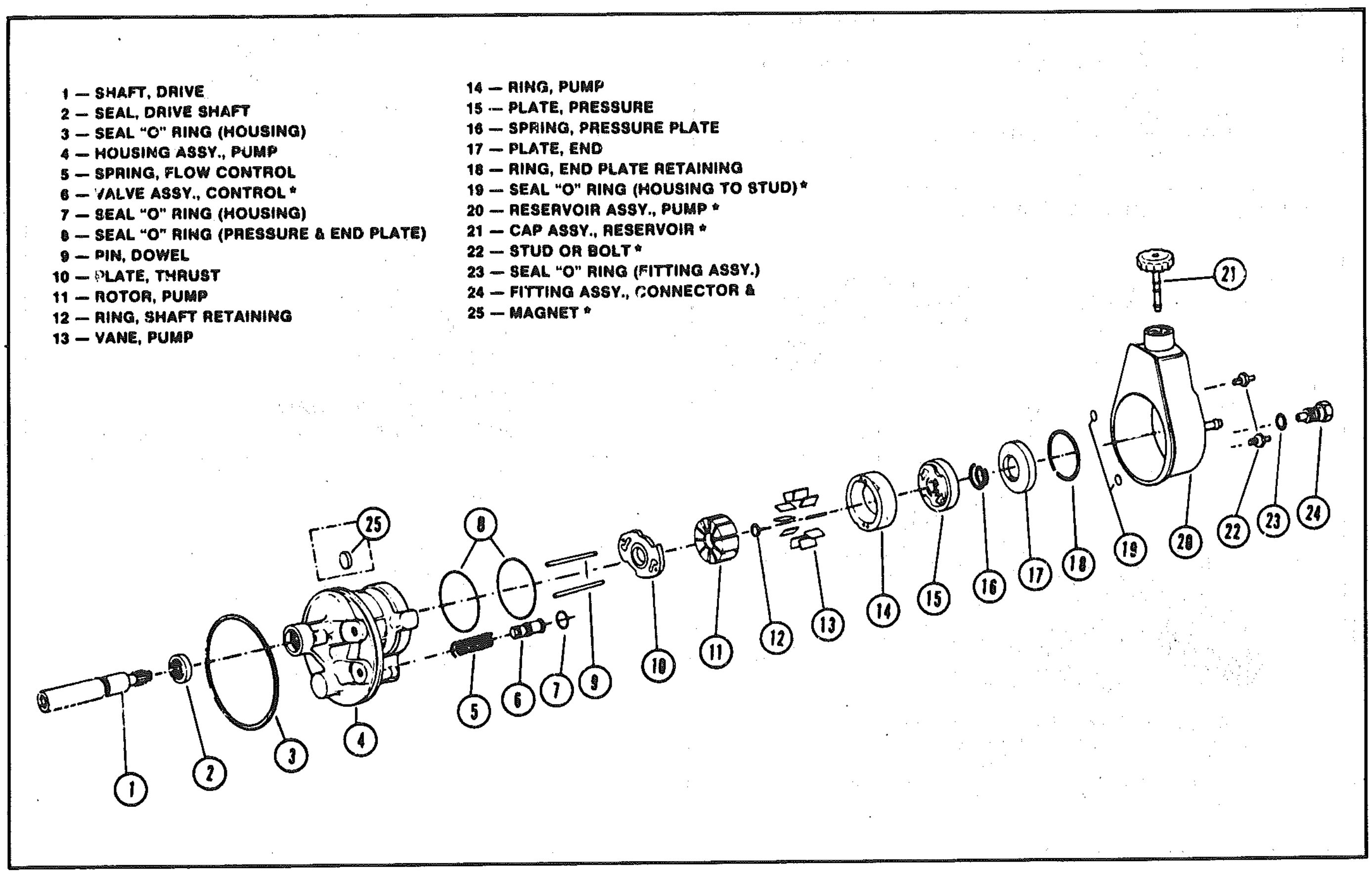


Figure 3B7-10 Power Steering Pump Assembly

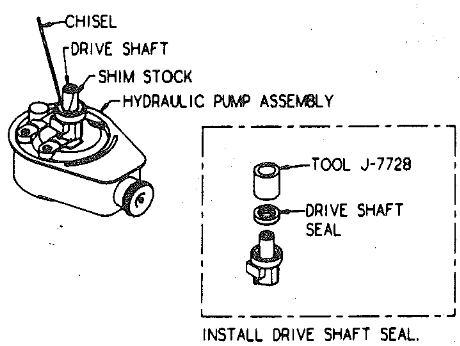
1. REMOVE AND INSTALL DRIVE SHAFT SEAL WITHOUT DISASSEMBLING THE PUMP.

REMOVE

1. PROTECT DRIVE SHAFT WITH SHIM STOCK.
2. USE CHISEL TO CUT SEAL AND REMOVE.

INSTALL

1. COAT DRIVE SHAFT SEAL WITH HYDRAULIC PUMP FLUID. REFER TO INSET FOR DRIVE SHAFT SEAL INSTALLATION.



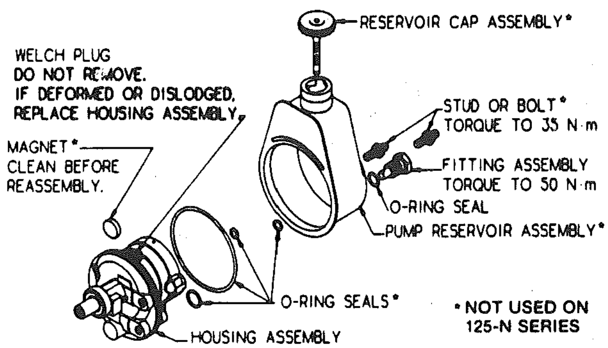
2. REMOVE AND INSTALL PUMP RESERVOIR ASSEMBLY

REMOVE

1. DRAIN OIL FROM RESERVOIR ASSEMBLY BEFORE REMOVAL.
2. REMOVE PARTS AS SHOWN.

INSTALL

1. USE ALL NEW SEALS AND LUBRICATE WITH POWER STEERING FLUID BEFORE INSTALLATION.
2. INSTALL PARTS AS SHOWN.



* NOT USED ON 125-N SERIES

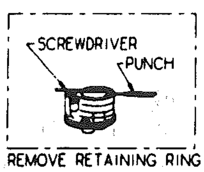
3. REMOVE AND INSTALL END PLATE.

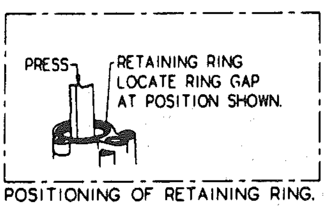
REMOVE

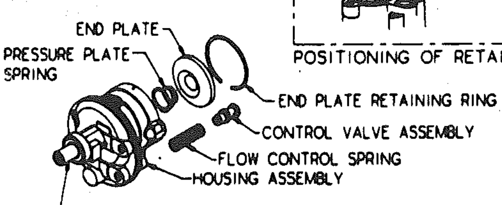
1. REFER TO INSET FOR RETAINING RING REMOVAL.

INSTALL

1. LUBRICATE END PLATE AND RETAINING RING, INSTALL PARTS AS SHOWN. REFER TO INSET FOR POSITIONING OF RETAINING RING IN HOUSING.







NOTICE : BEFORE PROCEEDING, EXAMINE THIS PART OF THE DRIVE SHAFT. IF IT IS CORRODED, CLEAN WITH CROCUS CLOTH BEFORE REMOVING. THIS WILL PREVENT DAMAGE TO THE SHAFT BUSHING WHICH MIGHT REQUIRE REPLACEMENT OF THE ENTIRE HOUSING.

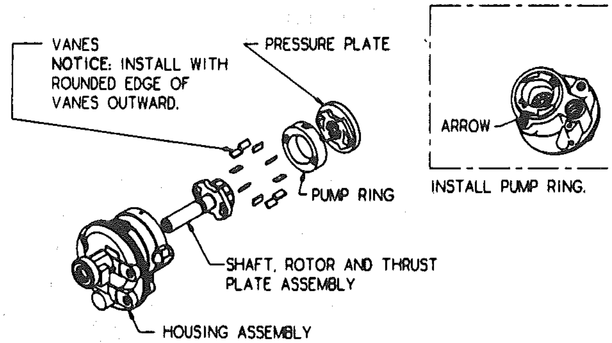
4. REMOVE AND INSTALL ROTATING GROUP.

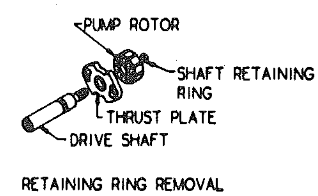
REMOVE

1. USING A RUBBER MALLET, TAP LIGHTLY ON DRIVE SHAFT UNTIL PRESSURE PLATE IS FREE.
2. REMOVE RETAINING RING FROM DRIVE SHAFT AND DISCARD. REMOVE PARTS AS SHOWN.

INSTALL

1. INSTALL PARTS AS SHOWN ON DRIVE SHAFT. INSTALL NEW RETAINING RING ON DRIVE SHAFT AND INSTALL IN PUMP HOUSING.
2. REFER TO INSET FOR POSITIONING OF PUMP RING IN HOUSING.





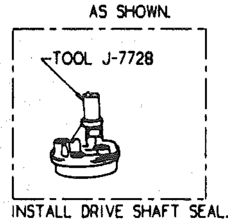
5. REMOVE AND INSTALL DRIVE SHAFT AND O-RING SEALS.

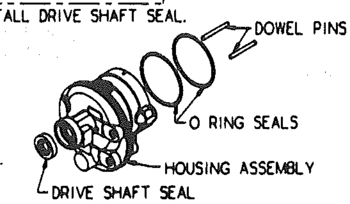
REMOVE

1. REMOVE PARTS AS SHOWN.

INSTALL

1. REFER TO THE INSET FOR DRIVE SHAFT SEAL INSTALLATION. USE ALL NEW SEALS AND LUBRICATE SEALS WITH POWER STEERING FLUID BEFORE INSTALLATION.
2. INSTALL PARTS AS SHOWN.





125-P

BENCH REPAIR

Figure 3B7-11 Power Steering Pump Overhaul

POWER STEERING GEAR (800 MODEL)

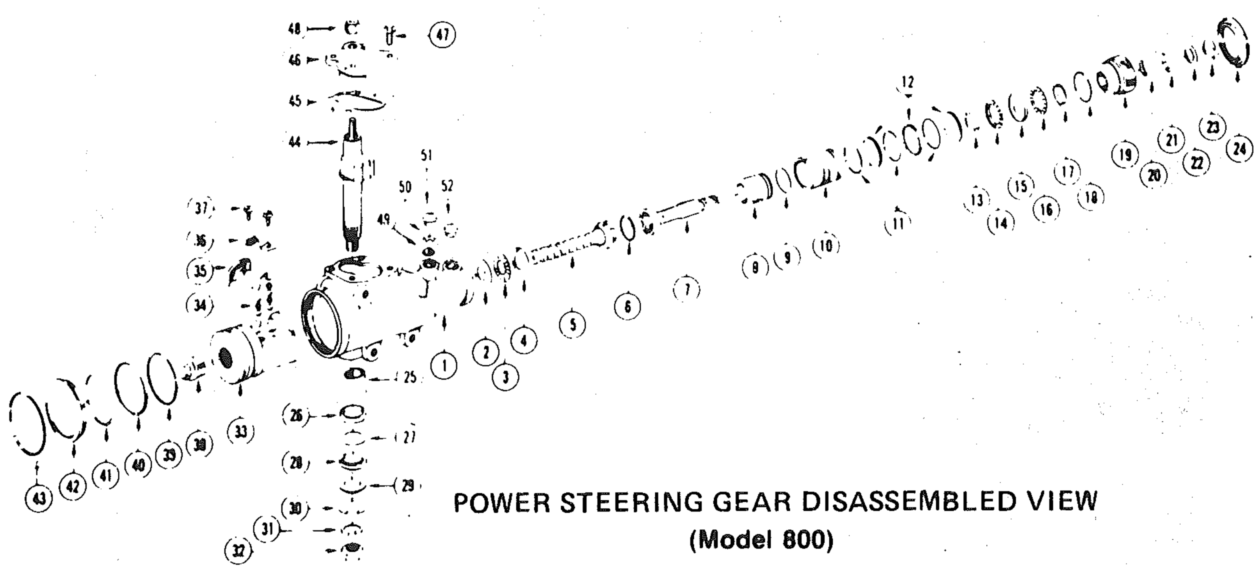
GENERAL DESCRIPTION

These Integral Power Steering Gears have a control valve which directs oil to either side of the rack piston. The rack piston converts hydraulic power into mechanical force. This force is transmitted to the mating pitman shaft teeth, through the pitman shaft to the steering linkage.

The model 800 incorporates a recirculating ball system in which steel balls act as a rolling thread between a steering worm-shaft and the rack-piston.

Whenever a part which forms a sealing surface for an "O" ring is removed, the "O" ring seal should also be removed and replaced with a new seal. Whenever one of the Pitman shaft or stub shaft seals are removed all adjacent seals should be removed and replaced with new seals. Lubricate all new seals with power steering fluid to ease assembly.

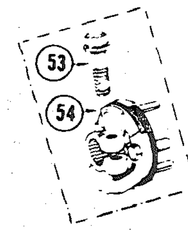
Key No.	Part Name
1	HOUSING, STEERING GEAR
2	RACE, THRUST BEARING (WORM)
3	BEARING ASSY., ROLLER THRUST (WORM)
4	RACE, THRUST BEARING (WORM)
5	WORM, STEERING
6	SEAL, "O" RING (STUB SHAFT)
7	SHAFT, STUB
8	SPOOL, VALVE
9	SEAL, "O" RING (SPOOL)
10	BODY, VALVE
11	RING, VALVE BODY (3)
12	SEAL, "O" RING (VALVE BODY) (3)
13	RETAINER, BEARING (ADJUSTER)
14	SPACER, THRUST BEARING
15	RACE, UPPER THRUST BEARING (SMALL)
16	BEARING, UPPER THRUST
17	RACE, UPPER THRUST BEARING (LARGE)
18	SEAL, "O" RING (ADJUSTER)
19	PLUG, ADJUSTER
20	BEARING, NEEDLE
21	SEAL, STUB SHAFT
22	SEAL, STUB SHAFT DUST
23	RING, RETAINING
24	NUT, ADJUSTER PLUG LOCK
25	BEARING ASSY., NEEDLE (PITMAN SHAFT)
26	SEAL, PITMAN SHAFT (SINGLE LIP)
27	WASHER, SEAL BACK-UP (PITMAN SHAFT)
28	SEAL, PITMAN SHAFT (DOUBLE LIP)
29	WASHER, SEAL BACK-UP (PITMAN SHAFT)
30	RING, RETAINING (PITMAN SHAFT SEAL)
31	WASHER, PITMAN SHAFT LOCK
32	NUT, PITMAN SHAFT
33	NUT, RACK PISTON
34	BALL
35	GUIDE, BALL RETURN (2)
36	CLAMP, BALL RETURN GUIDE
37	SCREW ASSY., LOCKWASHER & (2)
38	PLUG, RACK PISTON
39	SEAL, "O" RING (RACK PISTON)
40	RING, RACK PISTON
41	SEAL, "O" RING (HOUSING END PLUG)
42	PLUG, HOUSING END
43	RING, RETAINING (HOUSING END PLUG)
44	GEAR ASSY., PITMAN SHAFT
45	SEAL ASSY., GASKET
46	COVER ASSY., HOUSING SIDE
47	BOLT, HEX HEAD SIDE COVER (4)
48	NUT, LASH ADJUSTER
49	SPRING, CHECK VALVE
50	POPPET, CHECK VALVE
51	CONNECTOR, INVERTED FLARE
52	CONNECTOR, INVERTED FLARE

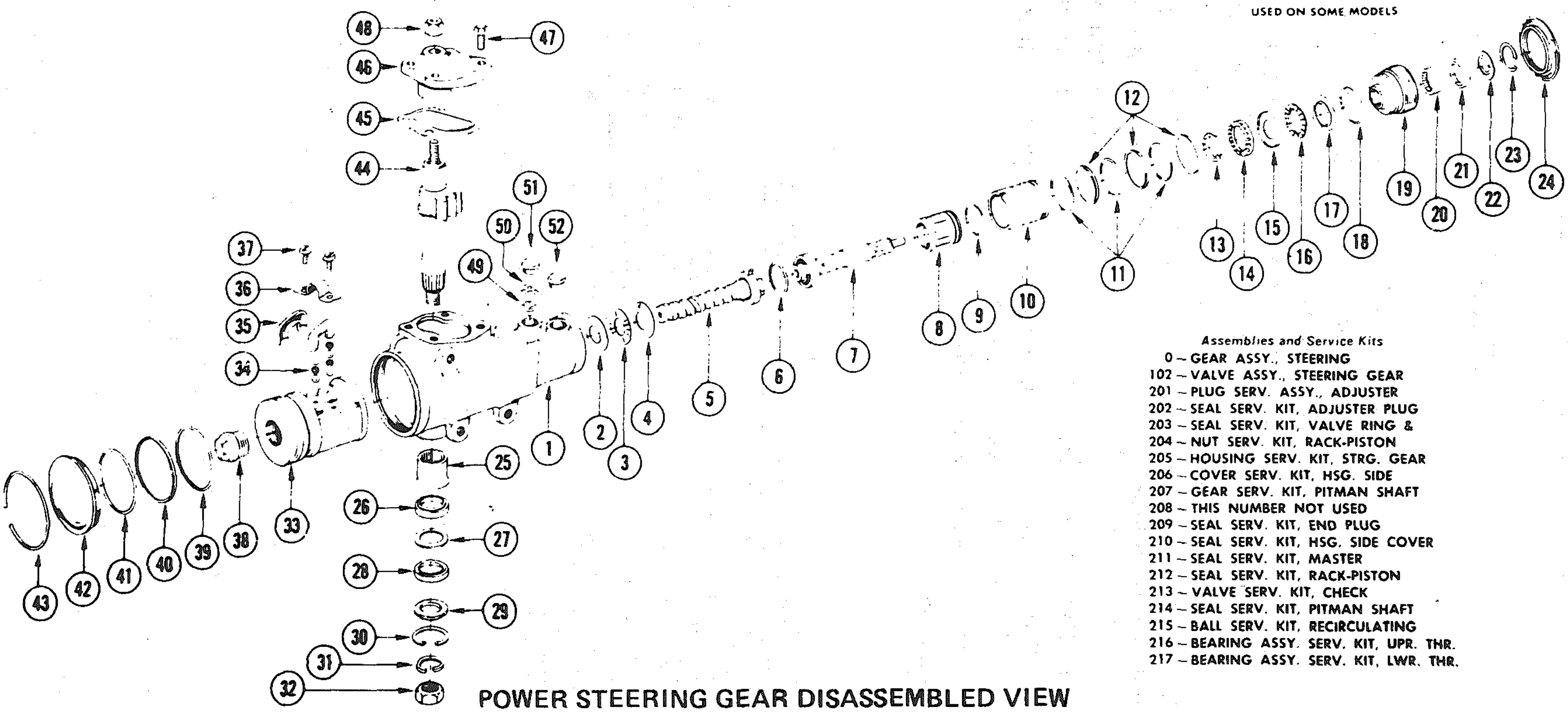


POWER STEERING GEAR DISASSEMBLED VIEW
(Model 800)

Figure 3B7-12 Overhaul 800/808 Gear, Chart A

Key No.	Part Name
1	HOUSING, STEERING GEAR
2	RACE, THRUST BEARING (WORM)
3	BEARING ASSY., ROLLER THRUST (WORM)
4	RACE, THRUST BEARING (WORM)
5	WORM, STEERING
6	SEAL, "O" RING (STUB SHAFT)
7	SHAFT, STUB
8	SPOOL, VALVE
9	SEAL, "O" RING (SPOOL)
10	BODY, VALVE
11	RING, VALVE BODY (3)
12	SEAL, "O" RING (VALVE BODY) (3)
13	RETAINER, BEARING (ADJUSTER)
14	SPACER, THRUST BEARING
15	RACE, UPPER THRUST BEARING (SMALL)
16	BEARING, UPPER THRUST
17	RACE, UPPER THRUST BEARING (LARGE)
18	SEAL, "O" RING (ADJUSTER)
19	PLUG, ADJUSTER
20	BEARING, NEEDLE
21	SEAL, STUB SHAFT
22	SEAL, STUB SHAFT DUST
23	RING, RETAINING
24	NUT, ADJUSTER PLUG LOCK
25	BEARING ASSY., NEEDLE (PITMAN SHAFT)
26	SEAL, PITMAN SHAFT (SINGLE LIP)
27	WASHER, SEAL BACK-UP (PITMAN SHAFT)
28	SEAL, PITMAN SHAFT (DOUBLE LIP)
29	WASHER, SEAL BACK-UP (PITMAN SHAFT)
30	RING, RETAINING (PITMAN SHAFT SEAL)
31	WASHER, PITMAN SHAFT LOCK
32	NUT, PITMAN SHAFT
33	NUT, RACK PISTON
34	BALL
35	GUIDE, BALL RETURN (2)
36	CLAMP, BALL RETURN GUIDE
37	SCREW ASSY., LOCKWASHER & (2)
38	PLUG, RACK PISTON
39	SEAL, "O" RING (RACK PISTON)
40	RING, RACK PISTON
41	SEAL, "O" RING (HOUSING END PLUG)
42	PLUG, HOUSING END
43	RING, RETAINING (HOUSING END PLUG)
44	GEAR ASSY., PITMAN SHAFT
45	SEAL ASSY., GASKET
46	COVER ASSY., HOUSING SIDE
47	BOLT, HEX. HEAD (SIDE COVER) (4)
48	NUT, LASH ADJUSTER
49	SPRING, CHECK VALVE
50	POPPET, CHECK VALVE
51	CONNECTOR, INVERTED FLARE
52	CONNECTOR, INVERTED FLARE
53	BOLT, COUPLING PINCH
54	COUPLING, STEERING SHAFT





Assemblies and Service Kits

0 – GEAR ASSY., STEERING
102 – VALVE ASSY., STEERING GEAR
201 – PLUG SERV. ASSY., ADJUSTER
202 – SEAL SERV. KIT, ADJUSTER PLUG
203 – SEAL SERV. KIT, VALVE RING &
204 – NUT SERV. KIT, RACK-PISTON
205 – HOUSING SERV. KIT, STRG. GEAR
206 – COVER SERV. KIT, HSG. SIDE
207 – GEAR SERV. KIT, PITMAN SHAFT
208 – THIS NUMBER NOT USED
209 – SEAL SERV. KIT, END PLUG
210 – SEAL SERV. KIT, HSG. SIDE COVER
211 – SEAL SERV. KIT, MASTER
212 – SEAL SERV. KIT, RACK-PISTON
213 – VALVE SERV. KIT, CHECK
214 – SEAL SERV. KIT, PITMAN SHAFT
215 – BALL SERV. KIT, RECIRCULATING
216 – BEARING ASSY. SERV. KIT, UPR. THR.
217 – BEARING ASSY. SERV. KIT, LWR. THR.

POWER STEERING GEAR DISASSEMBLED VIEW

Figure 3B7-13 Overhaul 800/808 Gear, Chart B

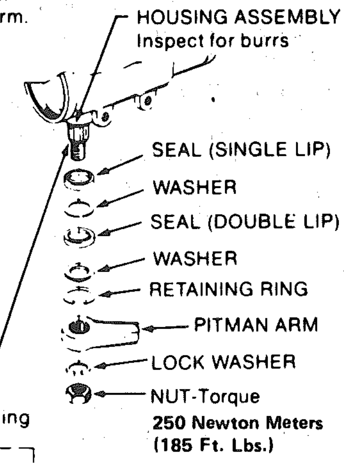
1. REMOVE AND INSTALL PITMAN SHAFT SEALS IN CAR

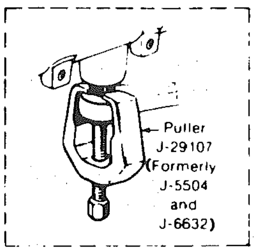
REMOVE

1. Clean exposed end of pitman shaft and end of housing after removing pitman arm.
2. Remove retaining ring with snap ring pliers J-4245.
3. Start engine and turn wheels fully to the left to force seals and washer out.
4. Turn off engine.
5. Inspect housing and shaft.

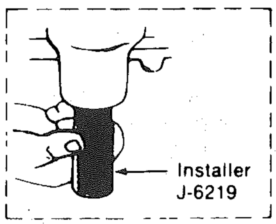
INSTALL

1. Install parts as shown.





Remove Pitman Arm



Install Seals

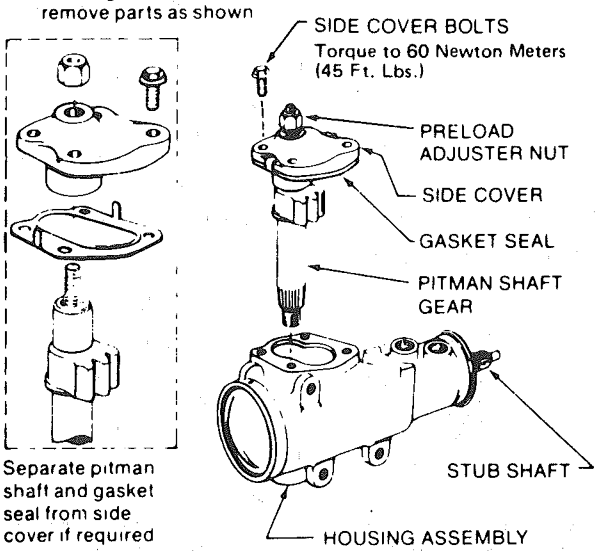
2. REMOVE AND INSTALL PITMAN SHAFT AND SIDE COVER

REMOVE

1. If pitman shaft and side cover are to be separated, remove preload adjuster nut
2. Rotate stub shaft to center gear, then remove parts as shown

INSTALL

1. If removed, install gasket seal by bending tabs around cover edges
2. Install parts as shown



Separate pitman shaft and gasket seal from side cover if required

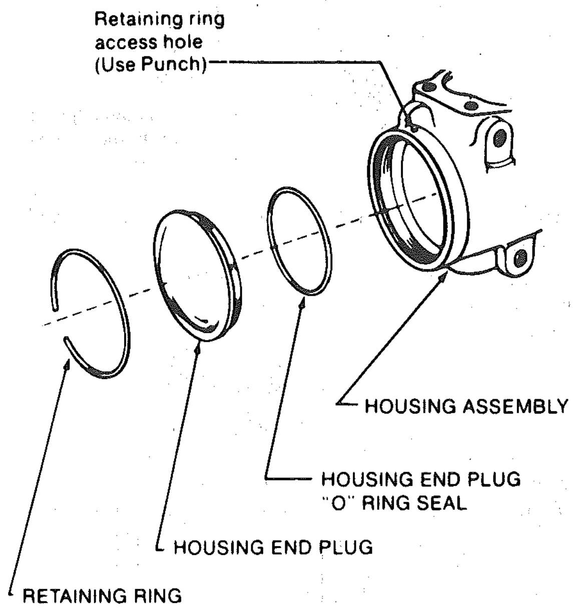
3. REMOVE AND INSTALL HOUSING END PLUG

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown. Open end of retaining ring to be approx. 25 mm (1 inch) from access hole.



4. REMOVE AND INSTALL RACK PISTON

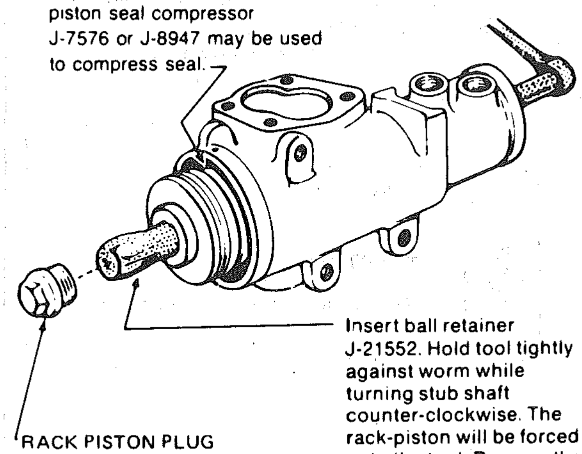
REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.

When installing rack, care should be taken not to cut teflon seal, rack piston seal compressor J-7576 or J-8947 may be used to compress seal.



Insert ball retainer J-21552. Hold tool tightly against worm while turning stub shaft counter-clockwise. The rack-piston will be forced onto the tool. Remove the rack-piston and ball retainer from the gear housing together.

Figure 3B7-14 Overhaul 800/808 Gear, Chart C

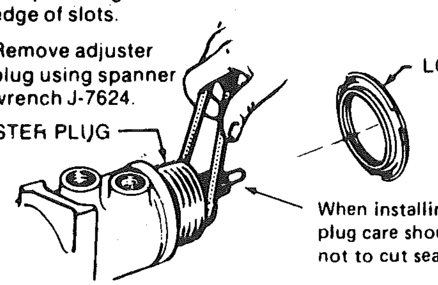
5. REMOVE AND INSTALL ADJUSTER PLUG ASSEMBLY

REMOVE

1. Loosen lock nut. Use punch against edge of slots.
2. Remove adjuster plug using spanner wrench J-7624.

INSTALL

1. Install parts as shown.



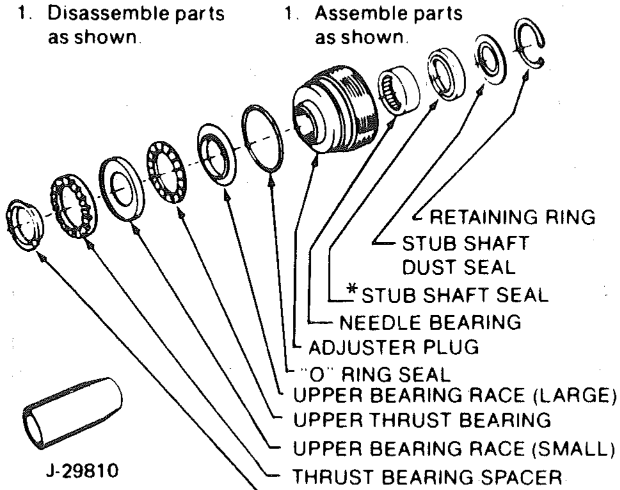
6. DISASSEMBLE AND ASSEMBLE ADJUSTER PLUG ASSEMBLY

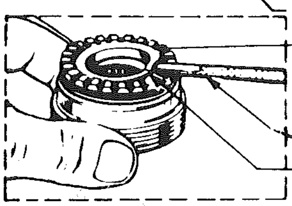
DISASSEMBLE

1. Disassemble parts as shown.

ASSEMBLE

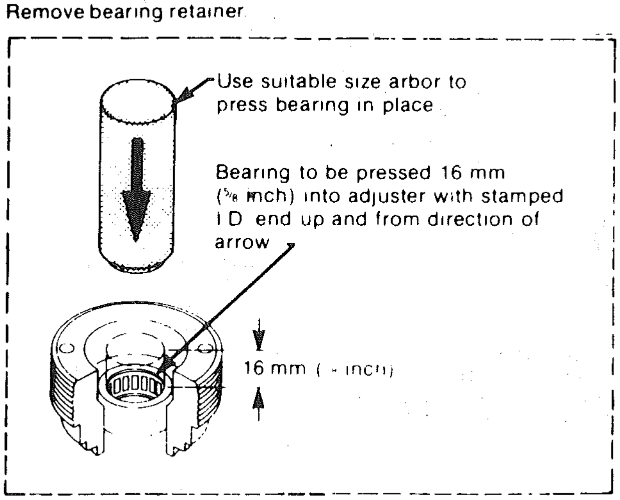
1. Assemble parts as shown.





* Use stub shaft seal protector J-29810 on stub shaft when installing stub shaft seal.

Remove bearing retainer



Install bearing

7. REMOVE AND INSTALL BEARING, WORM, AND VALVE ASSEMBLY

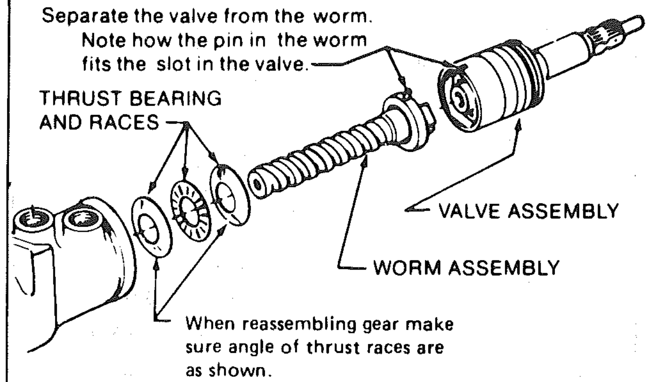
REMOVE

1. Grasp stub shaft and remove valve and worm assembly as a unit.

INSTALL

1. Install parts as shown.

Separate the valve from the worm.



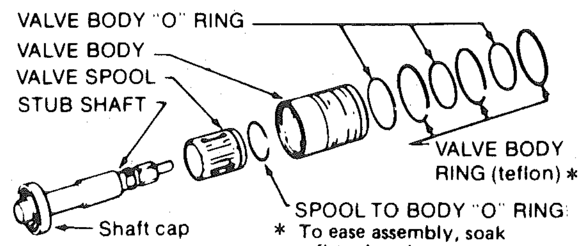
8. DISASSEMBLE AND ASSEMBLE VALVE

DISASSEMBLE

1. Disassemble parts as shown.

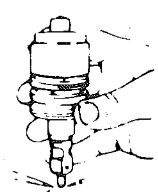
ASSEMBLE

1. Assemble parts as shown.

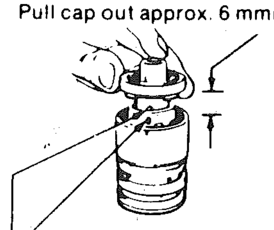


* To ease assembly, soak teflon rings in warm water.

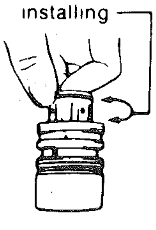
A. Loosen shaft cap



B. Remove and install stub shaft.



C. Remove and install spool



Lubricate spool and body with power steering fluid.

D. Engage stub shaft

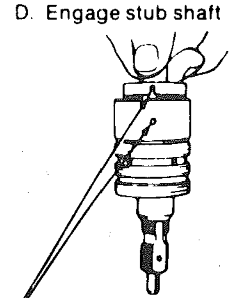


Figure 3B7-15 Overhaul 800/808 Gear, Chart D

9. DISASSEMBLE AND ASSEMBLE RACK PISTON

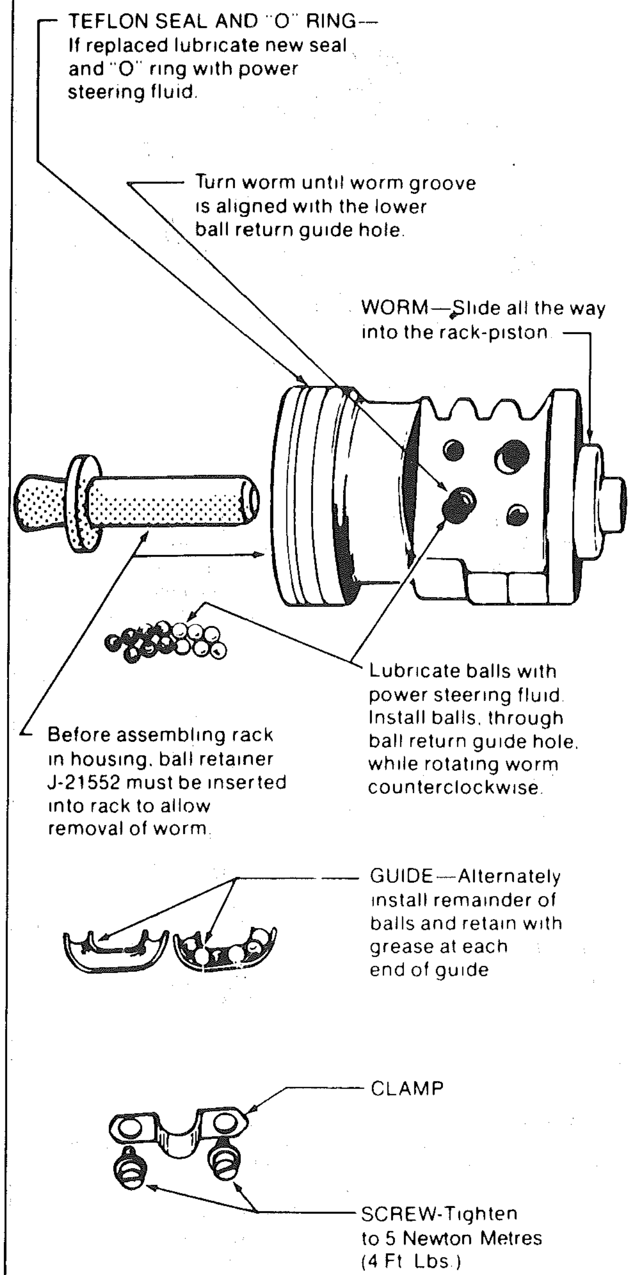
DISASSEMBLE

1. Disassemble parts as shown.
2. Clean and inspect all parts for excessive wear.

ASSEMBLE

1. Assemble parts as shown.

The black balls are smaller than the silver balls. The black and silver balls must be installed alternately into the rack-piston and return guide to maintain rack piston to worm gear preload.



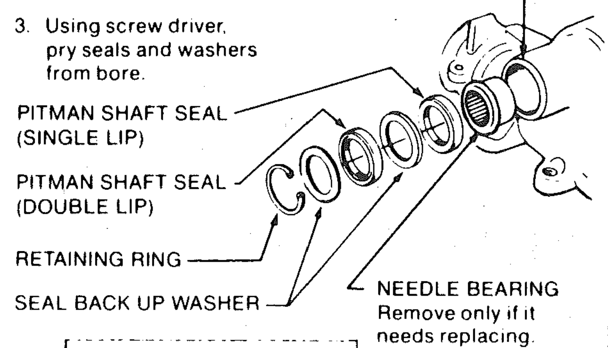
10. REMOVE AND INSTALL PITMAN SHAFT SEALS AND BEARING

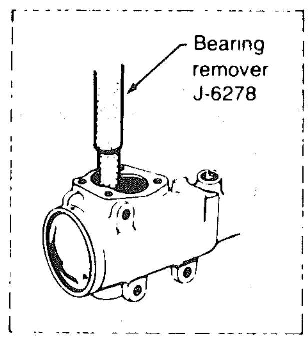
REMOVE

1. Clean end of housing thoroughly to prevent dirt from entering and be extremely careful not to score the housing bore.
2. Remove retaining ring with snap ring pliers J-4245.
3. Using screw driver, pry seals and washers from bore.

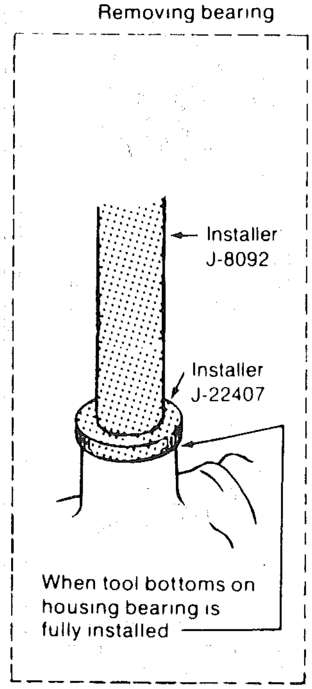
INSTALL

1. Coat seal lip and washer face with anhydrous calcium grease.
2. Install parts as shown.

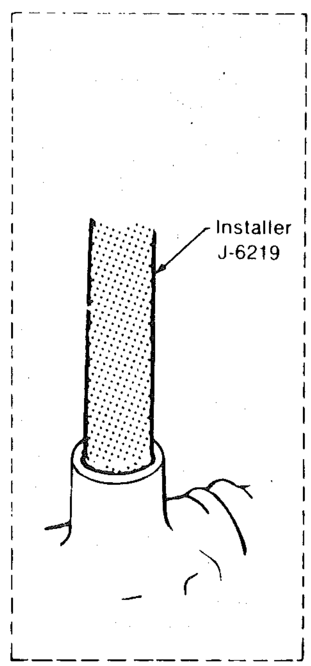




Removing bearing



Install Pitman shaft bearing.

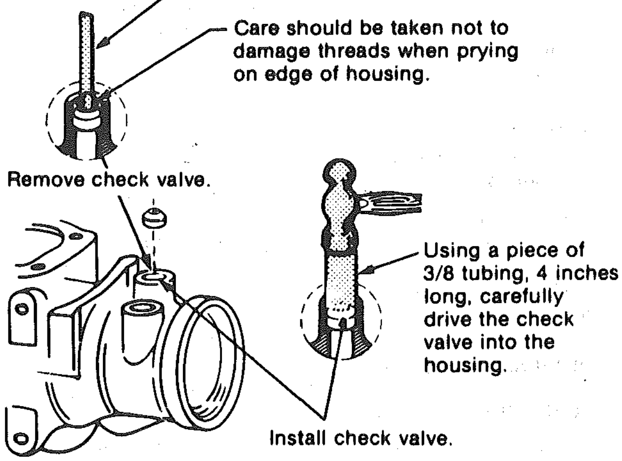


Install Pitman shaft seals.

Figure 3B7-16 Overhaul 800/808 Gear, Chart E

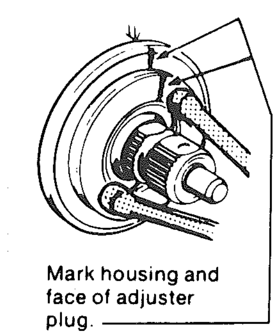
11. REMOVE AND INSTALL CHECK VALVE

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.

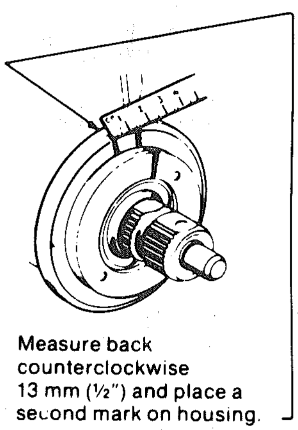


12. ADJUST THRUST BEARING PRELOAD

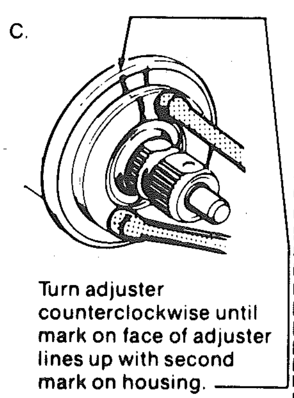
A. Using spanner wrench J-7624, tighten adjuster plug until thrust bearing is firmly bottomed, 27 Newton Metres (20 Ft. Lbs.)



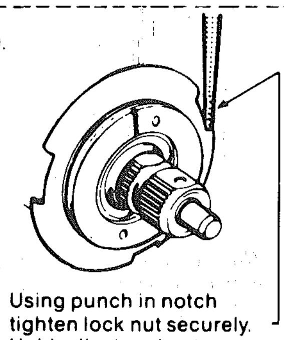
B.



C.

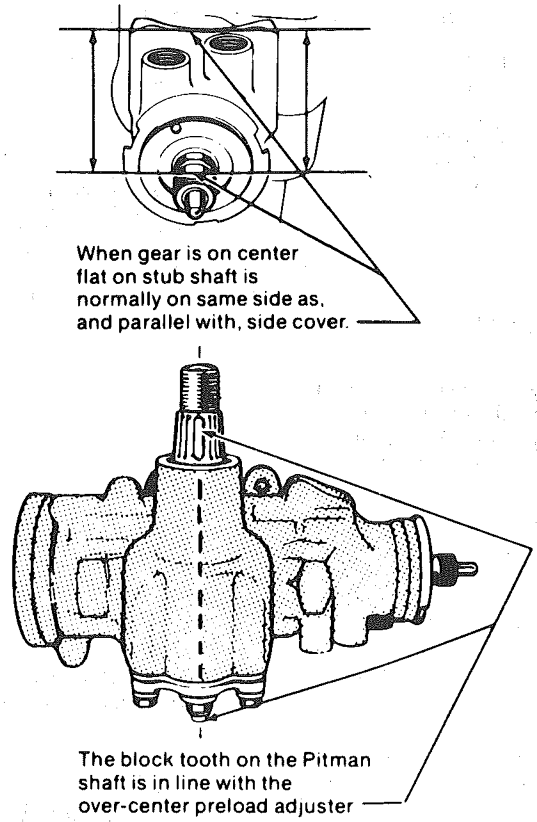


D.

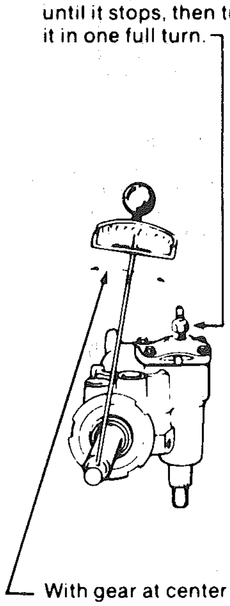


13. PITMAN SHAFT "OVER-CENTER" SECTOR ADJUSTMENT

A.



B. Back off preload adjuster until it stops, then turn it in one full turn.



C. Turn adjuster in until torque to turn stub shaft is 0.6 to 1.2 Newton Metres (6 to 10 in. Lbs.) more than reading #1.

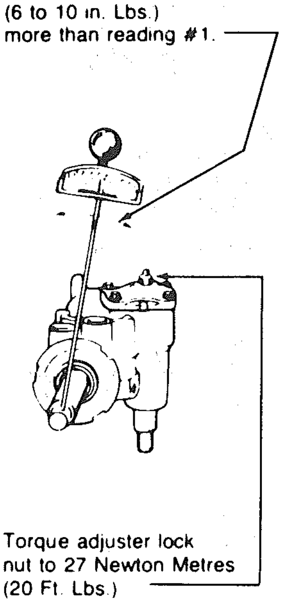
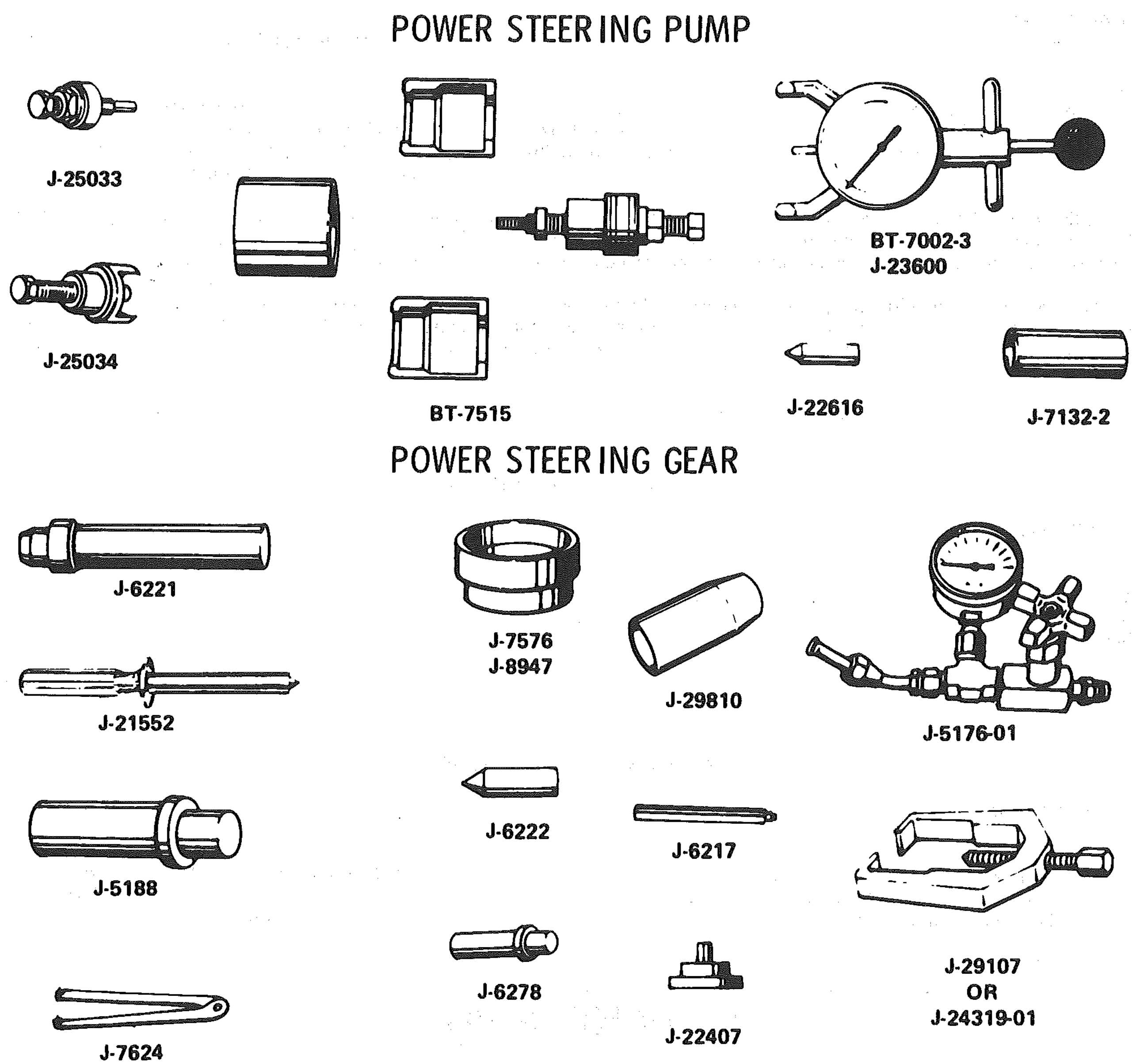


Figure 3B7-17 Overhaul 800/808 Gear, Chart F



J-5176-01	Pressure Testing Manifold
J-5188	End Cover Seal and Needle Bearing Installer
J-6217	Hose Connector Installer
J-6221	Bearing Installer
J-6222	End Cover Seal Protector (Used for Installing Adjuster Plug)
J-6278	Pitman Shaft Bearing Remover and Installer
J-6278-2	Adapter (Used with J-6278 for Installing Pitman Shaft Seals and Bearing)
BT-7002-3	Belt Tension Gage
J-7132-2	Seal Installer
BT-7515	Pulley Remover and Installer
J-7576	Rack-Piston Teflon Ring Compressor
J-7624	Spanner Wrench
J-8947	Rack-Piston Teflon Ring Compressor
J-21552	Ball Retainer
J-24319-01	Puller
J-22407	Pitman Bearing Installer
J-22616	Seal Protector
J-23600	Belt Tension Gage
J-25033	Power Steering Pump Pulley Installer
J-25034	Power Steering Pump Pulley Remover
J-29107	Pitman Arm Puller
J-29810	Stub Shaft Seal Protector

Figure 3B7-18 Special Tools

GENERAL SPECIFICATIONS

LUBRICATION

Lubricant . . . . Power Steering Fluid No. 1050017 or equivalent

ADJUSTMENTS

Valve Assembly and Seal Drag . . . . 0.1 to 0.4 N•m (1 to 4 in. lbs.)
Thrust Bearing Pre-load . . . . 0.3 to 0.4 N•m (3 to 4 in. lbs.) in excess of valve assembly and seal drag.
Overcenter Adjustment . . . . 0.6 to 1.2 N•m (6 to 10 in. lbs.) (new gear) 0.4 to 0.5 N•m (or 4 to 5 in. lbs.) (used gear) in excess of combined thrust bearing pre-load.

Adjustment of the steering gear in the car is not recommended because of the difficulty encountered in adjusting the worm thrust bearing preload and the confusing effects of the hydraulic fluid in the gear. Since a gear adjustment is made only as a correction and not as a periodic adjustment, it is better to take the extra time and make the adjustment correctly the first time.

Since a handling stability complaint can be caused by improperly adjusted worm thrust bearings as well as an improper gear over-center adjustment, it is necessary that the steering gear assembly be removed from the car and both thrust bearing and over-center preload be checked and corrected as necessary. An in-car check of the steering gear will not show a thrust bearing adjustment error.

TORQUE SPECIFICATIONS

POWER STEERING PUMP	N•m	FT. LBS.
Reservoir Bolt	48	35
Flow Control Fitting	48	35
Pressure Hose	27	20

GENERAL SPECIFICATIONS

POWER STEERING

LUBRICATION

Lubricant	Power Steering Fluid No. 1050017 or equivalent	
Capacity- Complete System	1-1/4 Liters	1-1/4 Qts.
Capacity - Pump Only	1/2 Liter	1/2 Qts.

STEERING GEAR
RECOMMENDED TORQUE SPECIFICATIONS

	NEWTON METERS	FOOT-POUNDS
Gear to Frame Bolts	95	70
High Pressure Line Fitting (At Gear)	27	20
Oil Return Line Fitting (At Gear)	27	20
Adjusting Screw Locknut	27	20
Side Cover Bolts	60	45
Adjuster Plug Locknut	110	80
Coupling Flange Nuts	27	20
Return Guide Clamp Screws	5	4
Rack-Piston Plug	100	75
Pitman Shaft Nut	240	185
Coupling Flange Bolt	40	30

Figure 3B7-19 Specifications

SECTION 3C

FRONT SUSPENSION

NOTICE: All front suspension fasteners are an important attaching part in that it could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

NOTICE: Never attempt to heat, quench or straighten any front suspension part. Replace it with a new part or damage to the part may result.

CONTENTS

GENERAL INFORMATION

The front suspension is designed to allow each wheel to compensate for changes in the road surface level without appreciably affecting the opposite wheel. Each wheel is independently connected to the frame by a steering kunckle, strut assembly, ball joint, and lower control arm. The steering knuckles move in a prescribed three dimensional arc. The front wheels are held in proper relationship to each other by two tie rods which are connected to steering arms on the knuckles and to the relay rod assembly.

Coil chassis springs are mounted between the spring housings on the front crossmember and the lower control arms. Ride control is provided by double, direct acting strut assemblies. The upper portion of each strut assembly extends through the fender well and attaches to the upper mount assembly with a nut.

Side roll of the front suspension is controlled by a spring steel stabilizer shaft. It is mounted in rubber bushings which are held to the frame side rails by brackets. The ends of the stabilizer are connected to the lower control arms by link bolts and are isolated by rubber grommets.

The inner ends of the lower control arms have pressed in bushings. Bolts (passing through the bushings) attach the arm to the suspension crossmember. The lower ball joint assembly is a press fit in the arm and attaches to the steering knuckle with a torque prevailing nut.

Rubber grease seals are provided at ball socket assemblies to keep dirt and moisture from entering the joint and damaging bearing surfaces.

ON-CAR SERVICE

WHEEL BEARINGS

The proper functioning of the front suspension cannot be maintained unless the front wheel tapered roller bearings are correctly adjusted. The bearings must be a slip fit on the spindle and the inside diameter of the bearings should be lubricated to insure proper operation. The spindle nut must be a free-running fit on the threads.

Adjustment

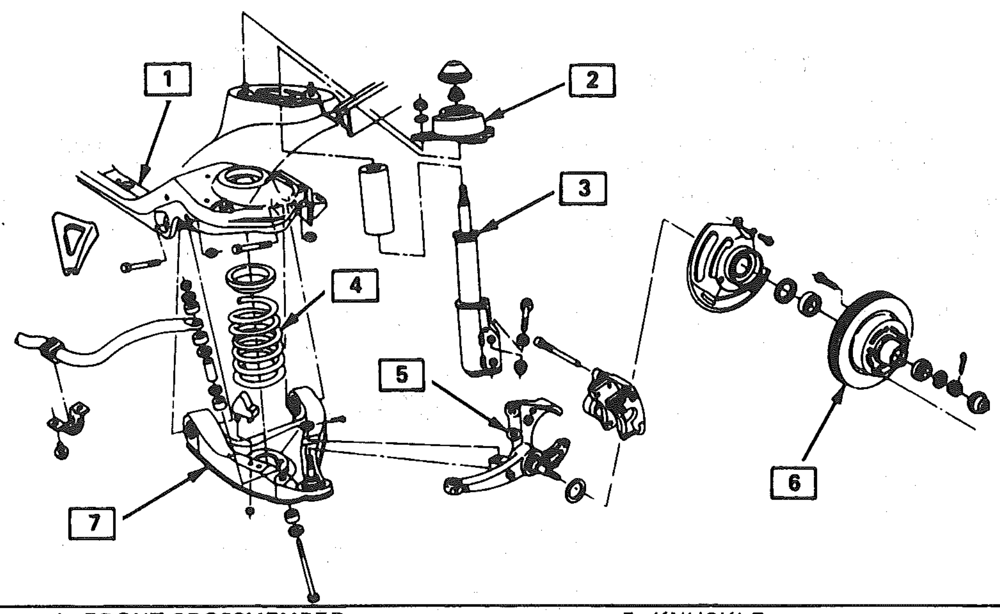
Figure 602

NOTICE: See NOTICE on Page 3C-1 of this section.

1. Remove dust cap from hub.
2. Remove cotter pin from spindle and spindle nut.
3. Tighten the spindle nut to 16 N·m (12 lb. ft.) while turning the wheel assembly forward by hand to fully seat the bearings. This will remove any grease or burrs which could cause excessive wheel bearing play later.
4. Back off the nut to the "just loose" position.
5. Hand tighten the spindle nut. Loosen spindle nut until either hole in the spindle lines up with a slot in the nut. Not more than 1/2 flat.
6. Install new cotter pin. Bend the ends of the cotter pin against nut, cut off extra length to ensure ends will not interfere with the dust cap.
7. Measure the looseness in the hub assembly. There will be from .03 to .13mm (.001 to .005 inches) end play when properly adjusted.
8. Install dust cap on hub.

FRONT SUSPENSION

Refer to Fig. 610 for illustration of attachment provisions for the bolted-on front suspension suspension crossmember.



1–FRONT CROSSMEMBER
2–UPPER MOUNT
3–STRUT
4–COIL SPRING
5–KNUCKLE
6–HUB AND DISC
7–LOWER CONTROL ARM

520082-3C

Fig. 601 Front Suspension

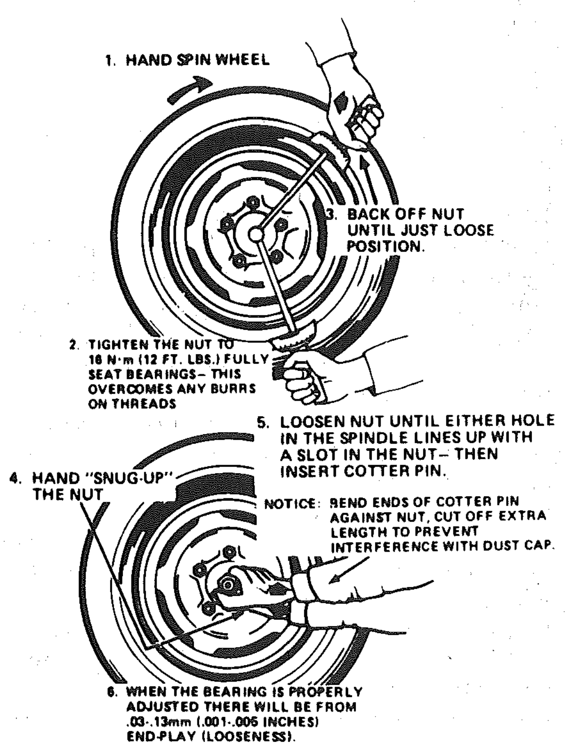


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Fig. 602 Wheel Bearing Adjustment

Stabilizer Shaft—Replacement

1. Raise vehicle on hoist.
2. Remove link bolt, nut, grommets, spacer and retainers.
3. Remove insulators and brackets.
4. Remove stabilizer shaft.
5. Install parts in reverse order of removal. Hold stabilizer shaft as shown in box when tightening insulators to side rails.
6. Lower vehicle.

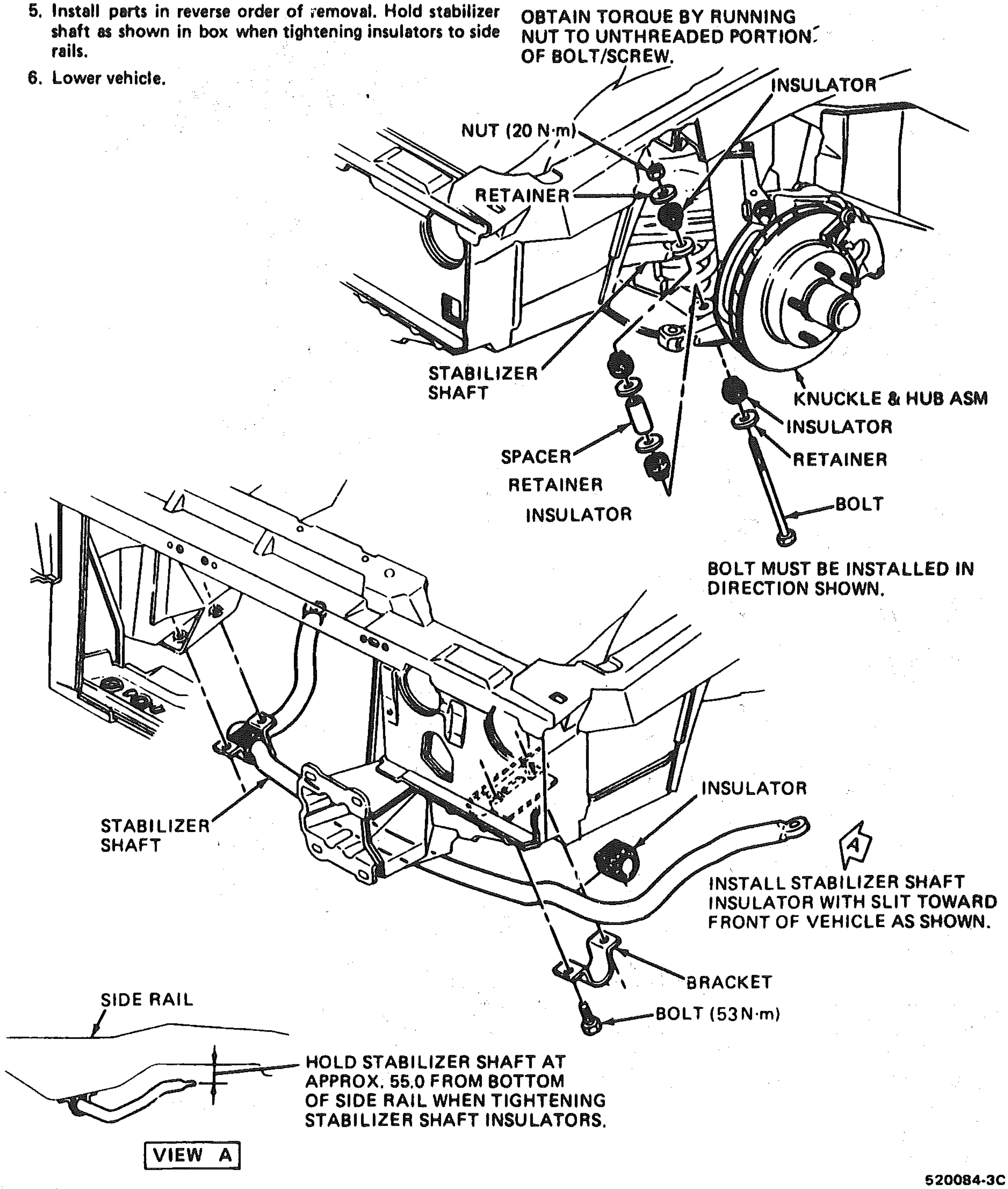

Fig. 603 Removing and Installing Stabilizer

Strut—Replacement

1. Raise vehicle.
2. Remove wheel-and-tire.
3. Support LCA with jackstand.
4. Remove brake hose bracket.
5. Remove two strut-to-knuckle bolts.
6. Remove cover from upper mount ass'y.
7. Remove nut from upper end of strut.
8. Remove strut and shield.
9. Reverse order of removal to replace strut.

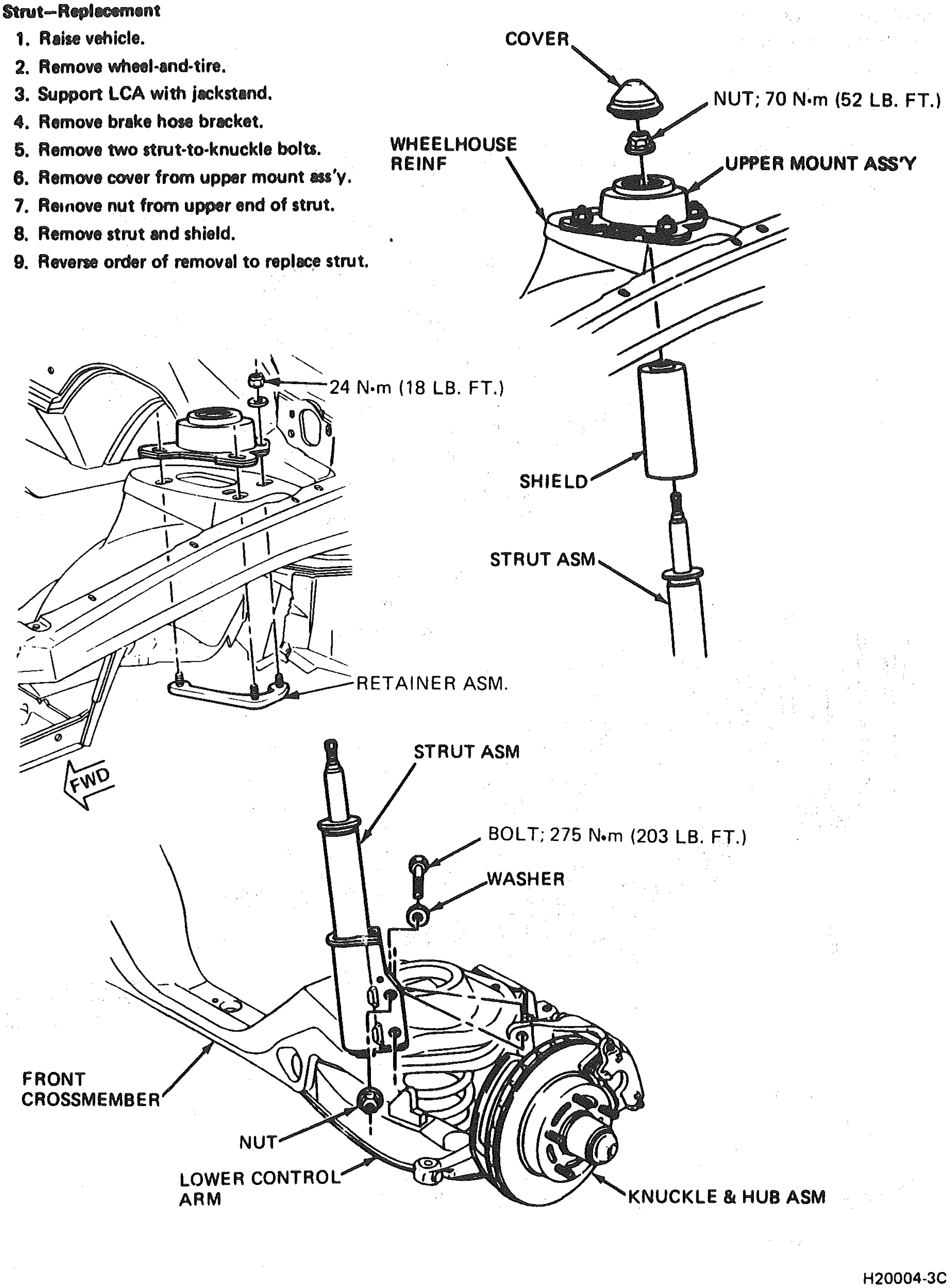

Fig. 604 Removing and Installing Strut

CALIPER

Removal

NOTICE: See "Notice" on Page 3C-1 of this section.

1. Remove two thirds of the total fluid capacity from the master cylinder reservoir that supplies fluid to the systems(s) being serviced. Removal of the fluid is necessary to prevent reservoir overflow when the caliper piston is pushed back in its bore to remove the caliper. Discard the brake fluid removed.
2. Raise the vehicle on a hoist and remove the wheel covers and wheel assemblies, Position a 7" "C" clamp on the caliper so that solid side of the clamp rests against the metal part of the outboard shoe. Tighten the "C" clamp until the caliper moves away from the vehicle far enough to push the piston to the bottom of the piston bore. This will allow the shoes to back off from the rotor surfaces. Remove the "C" clamp.
3. It is not necessary to disconnect the brake lines. Remove the two mounting bolts which attach the caliper to the support bracket. Lift caliper off the rotor. Support caliper.

Caliper Installation

1. Position the caliper over the rotor, lining up the holes in the caliper ears with the holes in the mounting bracket.

   NOTICE: When reinstalling caliper be sure you have not turned it over, end over end. This would cause a severe twist in the brake hose. After positioning caliper on disc, observe brake hose being sure it is not twisted.
2. Start the bolts through the sleeves in the inboard caliper ears and through the mounting bracket, making sure that the ends of the bolts pass under the retaining ears on the inboard shoe. Push bolts on through to engage the holes in the outboard shoes and the outboard caliper ears at the same time, threading the bolts into the mounting bracket. Torque the bolts to 47 N·m (35 lb. ft.).

   NOTICE: See "Notice" on Page 1 of this section.
3. Add fresh approved brake fluid to the master cylinder reservoirs to bring the level up to within 3mm (1/8") of the top.
4. Pump brake pedal to seat linings against rotor.
5. Recheck the brake system.

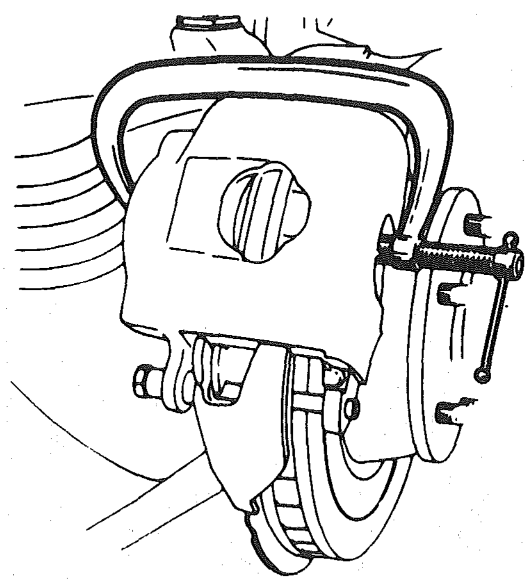

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Fig. 605 Removing and Installing Caliper

Ball Joint—Replacement

1. Raise car, support with floor stands under frame.
2. Remove tire and wheel assembly.
3. Place floor jack under control arm spring seat.

   CAUTION: Floor jack must remain under control arm spring seat during removal and installation to retain spring and control arm in position.
4. Remove cotter pin, and loosen castellated nut. Use J-24292A to break ball joint loose from knuckle. Remove tool, and separate joint from knuckle.
5. Guide lower control arm out of opening in splash shield with a putty knife or similar tool.
6. Remove grease fittings, and install tools as shown below. Press ball joint out of lower control arm.

Inspection—Steering Knuckle

Inspect the tapered hole in the steering knuckle. Remove any dirt. If out-of-roundness, deformation or damage is noted, the knuckle MUST be replaced.

Inspection—Ball Joint

Ball joint seals should be carefully inspected for cuts and tears. Whenever cuts or tears are found, the ball joint MUST be replaced.

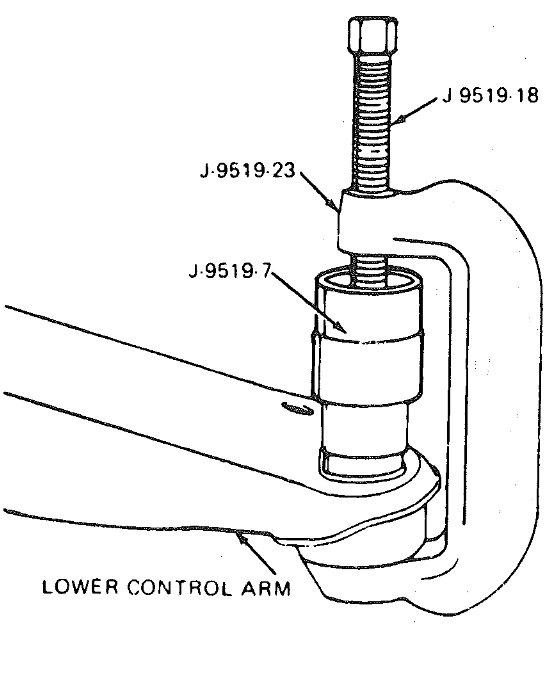
Installation

See NOTICE on Page 3C-1 of this section.

1. Position ball joint into lower control arm and press in until it bottoms on the control arm, using tools as illustrated below.

   Grease purge on seal must be located facing inboard.
2. Place ball joint stud in steering knuckle.
3. Torque ball stud nut to 120 N·m (90 lb. ft.). Then tighten an additional amount enough to align slot in nut with hole in stud. Install cotter pin.
4. Install and lubricate ball joint fitting until grease appears at the seal.
5. Install tire and wheel assembly.
6. Check front alignment as described in Section 3A. Reset as required. Lower car.

REMOVING BALL JOINT



INSTALLING BALL JOINT

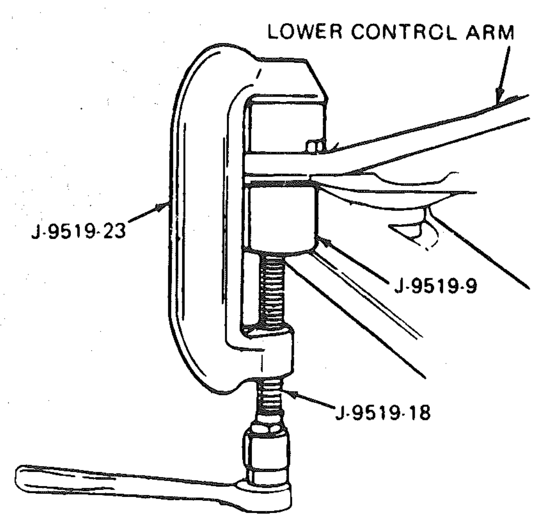


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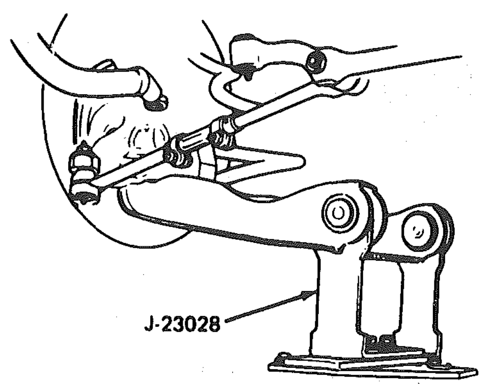
Fig. 606 Removing and Installing Ball Joint

Lower Control Arm/Coil Spring—Replacement

1. Raise vehicle using a hoist.
2. Remove wheel and tire.
3. Remove stabilizer link and bushings at L.C.A.
4. Remove pivot bolt nuts. DO NOT remove pivot bolts at this time.
5. Install J-23028 adaptor to jack and place into position with J-23028 supporting bushings.
6. Install jackstand under outside frame rail on opposite side of vehicle.
7. Raise J-23028 enough to remove both pivot bolts.
8. Lower J-23028 carefully, as shown below.
9. Remove spring and insulator tape insulator to spring.
10. Remove ball joint from knuckle using J-24292A as outlined earlier.
11. Replace bushings in L.C.A.
12. Install parts in reverse order of removal.



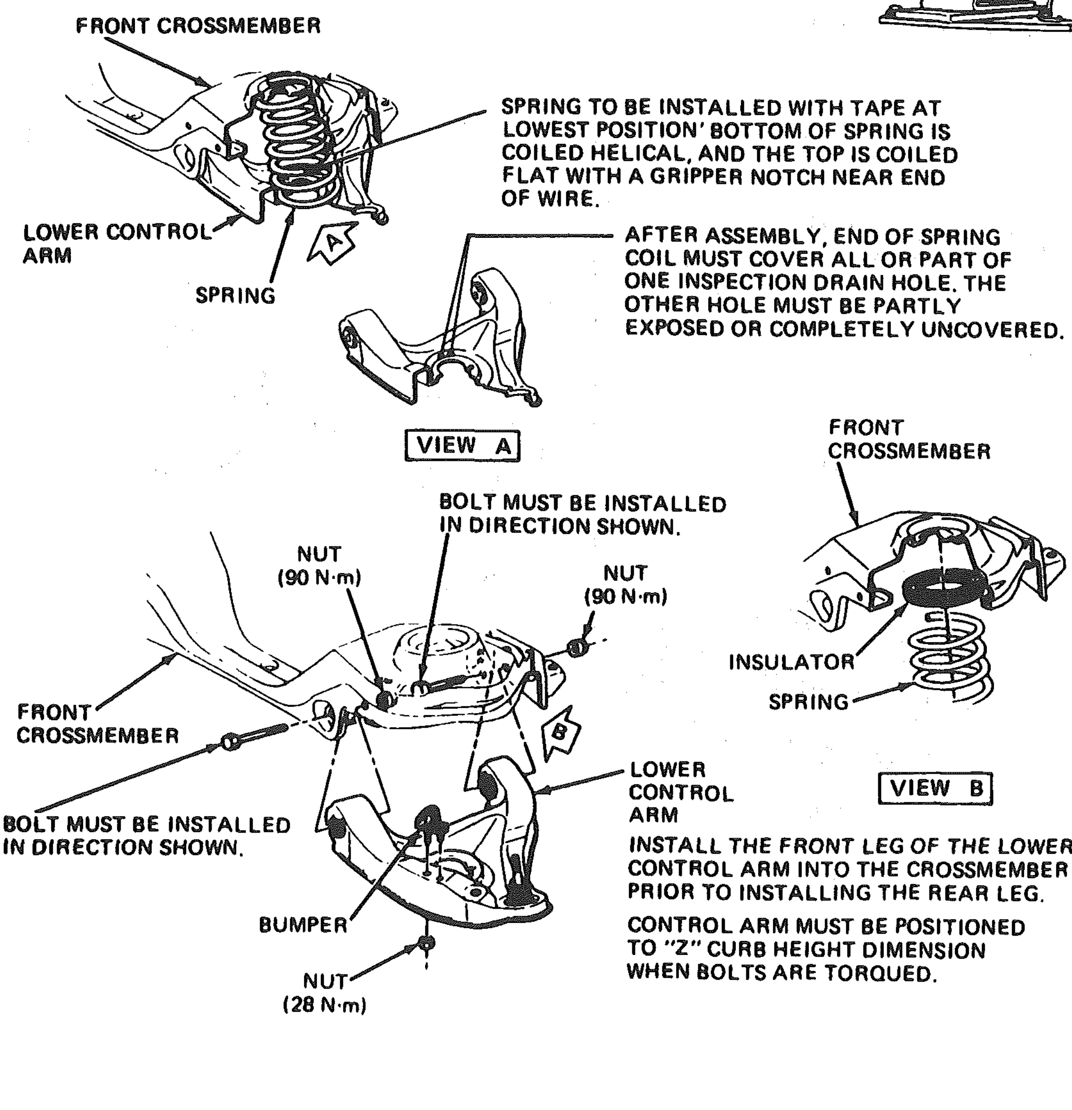


Fig. 607 Removing and Installing Coil Spring/LCA

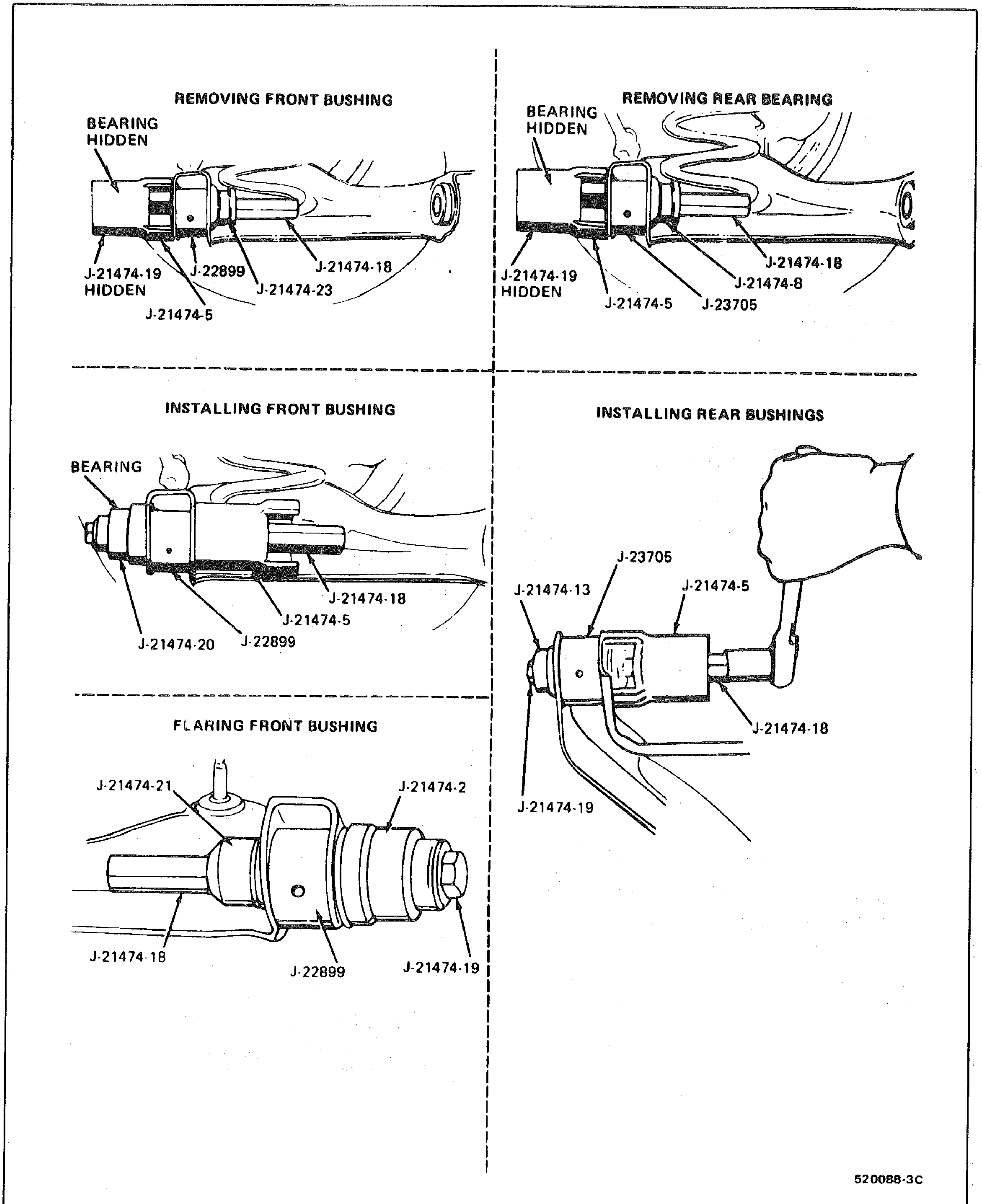


Fig. 608 Removing and Installing Control Arm Bushings

KNUCKLE, HUB-AND-DISC—REPLACEMENT

1. Siphon master cylinder.
2. Raise vehicle.
3. Remove wheel-and-tire.
4. Remove brake hose from strut.
5. Remove caliper support safely.
6. Remove hub-and-disc.
7. Remove splash shield.
8. Disconnect tie rod from knuckle.
9. Support lower control arm.
10. Disconnect ball joint from knuckle, using J-24292A.
11. Remove two bolts attaching strut to knuckle, and remove knuckle.
12. Reverse order of removal to install.

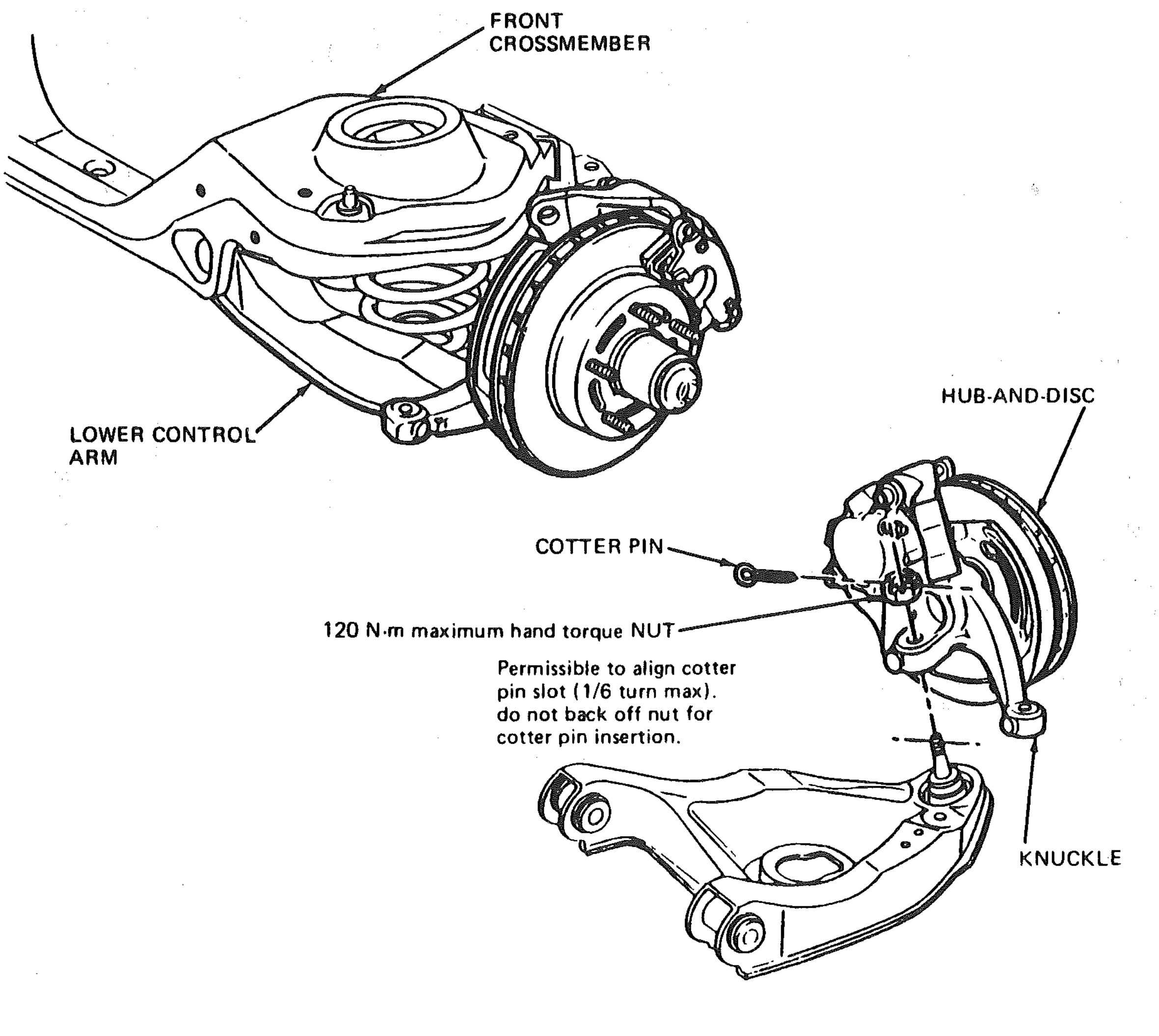


Fig. 609 Removing and Installing Knuckle

1–SIDE RAIL

2–CROSSMEMBER

3–WASHER

4–BOLT (105 N•m)

5–LOCATING PIN

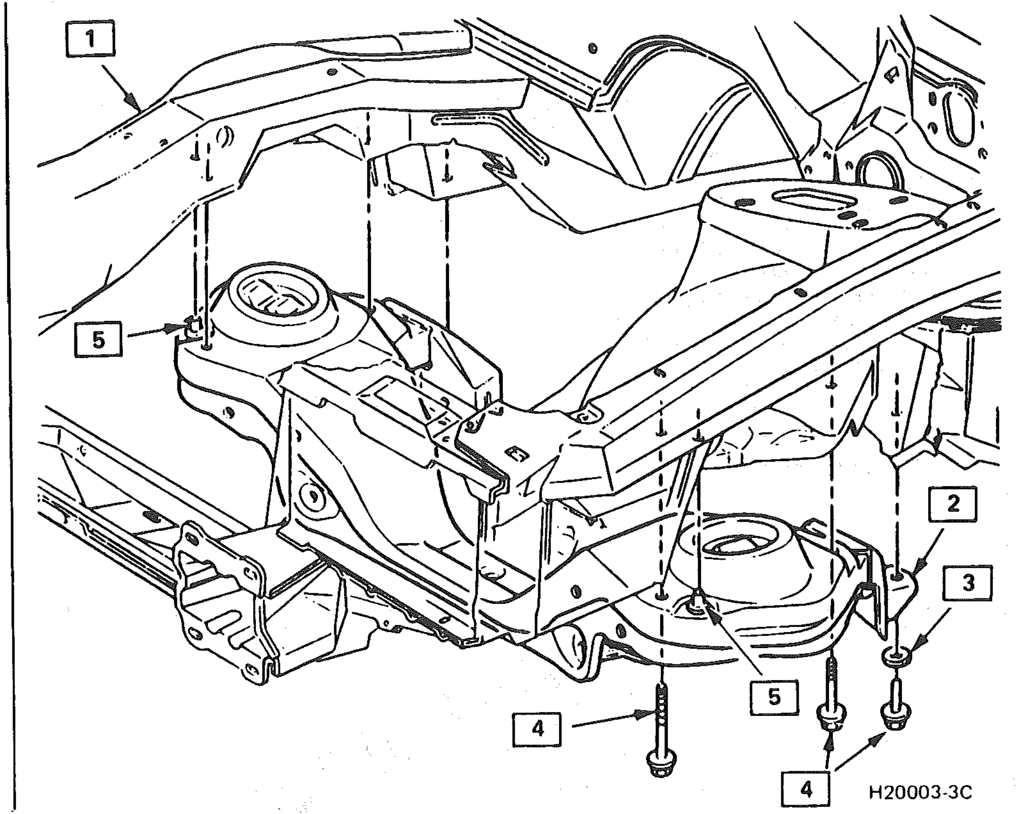


Fig. 610 Front Suspension Crossmember

SPECIFICATIONS

	N·m	Ft. Lbs.
Strut Assembly		
Strut-to-Knuckle Bolts	275	203
Strut-to-Upper Mount Nut	70	52
Upper Mount-to-Wheelhouse Tower	28	20
Lower Control Arm		
Pivot Bolt Nuts	90	67
Bumper-to-LCA	28	20
LCA Ball Joint-to-Knuckle	120	90
Knuckle		
Strut-to-Knuckle Bolts	275	203
LCA Ball Joint-to-Knuckle	120	90

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Fig. 611 Specifications

SECTION 3D

REAR SUSPENSION

NOTICE: All rear suspension fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. There is to be no welding as it may result in extensive damage and weakening of the metal.

CONTENTS

GENERAL INFORMATION

The rear axle assembly is attached to the vehicle through a link type suspension system. The axle housing is connected to the body by two lower control arms and a track bar. A single torque arm is used in place of upper control arms. It is rigidly mounted to the rear axle housing at the rear and through a rubber bushing to the transmission at the front. Coil springs are used to support the weight of the car, and ride control is provided by shock absorbers mounted to the rear of the axle housing. A stabilizer shaft is optional.

The shock absorbers are mounted at the bottom with a bolt and nut to brackets welded to the axle housing, and at the top to the reinforced body area with a nut. The only service the shock absorbers require is replacement if they have lost their resistance, are damaged, or are leaking fluid.

ON-CAR SERVICE

SHOCK ABSORBERS

Fig. 602

←→ Remove or Disconnect

1. Hoist car and support rear axle.
2. From above, pull back carpeting and remove shock absorber upper mounting nut.

NOTICE: Axle assembly must be supported before removing upper shock absorber nut to avoid possible damage to brake lines, track bar and prop shaft.

3. Loosen and remove shock absorber lower mounting nut from shock absorber. Remove shock.

→← Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

1. Position shock absorber through body mounting hole and loosely install the lower shock absorber mounting nut.
2. From above, install the upper shock absorber retainer and nut. Torque nut.
3. Torque lower shock absorber nut.
4. Remove rear axle support and lower car.

COIL SPRINGS AND INSULATORS

Fig. 603

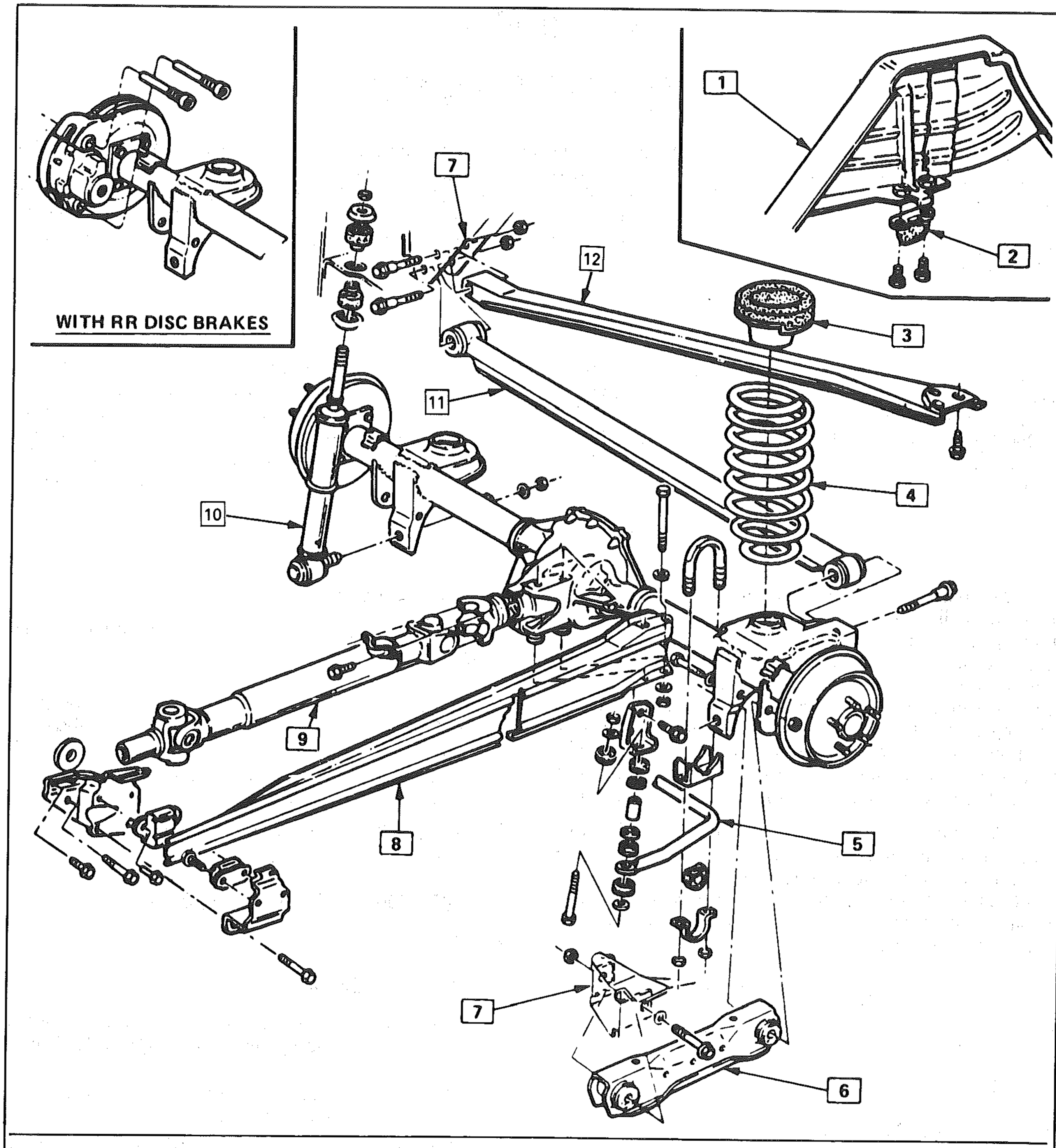
←→ Remove or Disconnect

1. Hoist car on non twin post-type hoist and support rear axle assembly with an adjustable lifting device.
2. Track bar mounting bolt at axle assembly. Loosen track bar bolt at body brace.
3. Rear brake hose clip at underbody to allow additional axle drop.
4. Right and left shock absorber lower attaching nuts.
5. Carefully lower rear axle and remove spring(s) and or insulator(s).

NOTICE: DO NOT suspend rear axle by brake hose. Damage to hose could result.

→← Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.



1. RAIL
2. JOUNCE BUMPER
3. SPRING INSULATOR ASSEMBLY
4. COIL SPRING
5. OPTIONAL STABILIZER BAR
6. LOWER CONTROL ARM
7. UNDERBODY
8. TORQUE ARM
9. PROP SHAFT
10. SHOCK ABSORBER
11. TRACK BAR
12. TRACK BAR BRACE

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Fig. 601 Rear Axle and Suspension Assembly

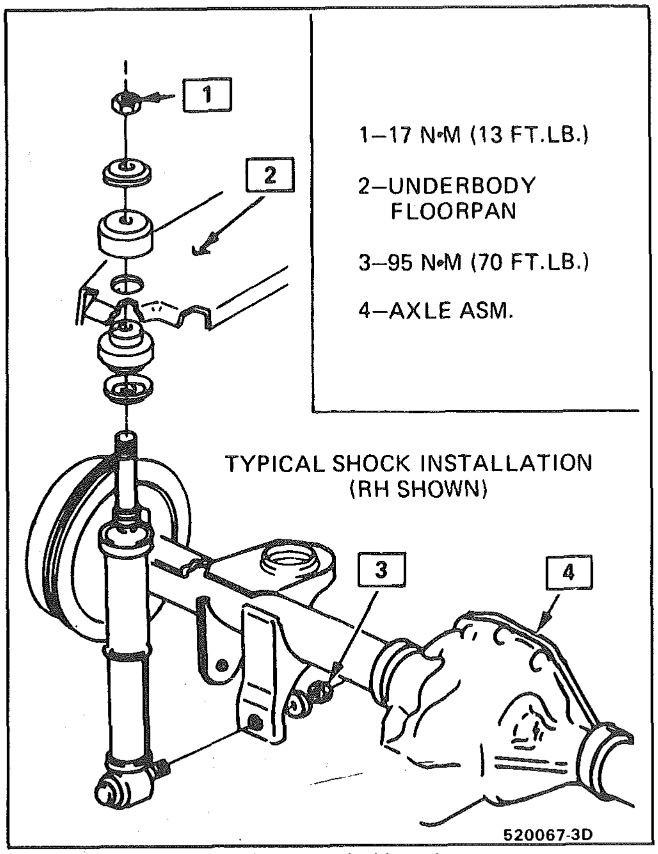


Fig. 602 Shock Absorber

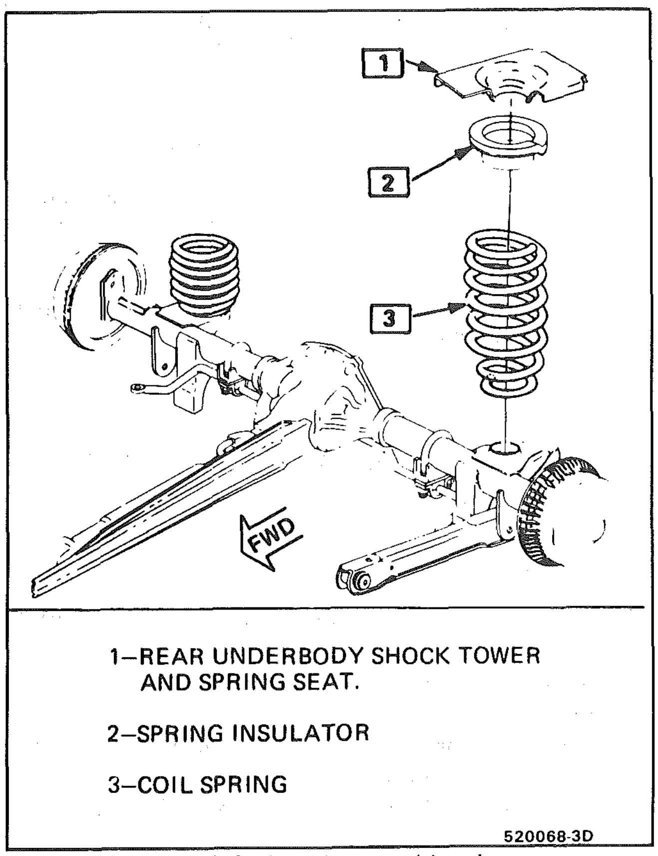


Fig. 603 Coil Springs and Insulator

1. Position springs and insulators in spring seats and raise rear axle until rear axle supports weight of vehicle at normal curb height position.
2. Shocks to rear axle. Torque nuts.
3. Thoroughly clean track bar-to-axle assembly bolt and nut as outlined under Recommendation for Reuse of Prevailing Torque Fasteners in Section 0A.
4. Track bar mounting bolt at axle and torque nut. Torque track bar to body bracket nut.
5. Brake line clip to underbody.
6. Remove adjustable lifting device from beneath axle and lower car.

TRACK BAR

Fig. 604

Remove or Disconnect

1. Hoist car and support rear axle, at curb height position.
2. Track bar mounting bolt and nut at rear axle, and at body bracket.
3. Track bar.

Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

1. Position track bar in body bracket and loosely install bolt and nut.
2. Thoroughly clean track bar to axle assembly bolt and nut as outlined under Recommendations for Reuse of Prevailing Torque Fasteners in Section 0A.
3. Position track bar at axle. Install bolt and nut. Torque bolt.
4. Torque track bar nut at body bracket to 78 N·m (58 lb.ft.).
5. Remove rear axle support and lower car.

TRACK BAR BRACE

Fig. 604

Remove or Disconnect

1. Hoist car and support rear axle.
2. Heat shield screws from track bar brace.
3. Three track bar brace to body brace screws.
4. Nut and bolt at body bracket. Remove track bar brace.

Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

1. Position track bar brace and loosely install nut and bolt at body bracket.
2. Position other end of track bar brace at body bracket. Install three screws and torque screws.
3. Torque track bar nut at body brace.

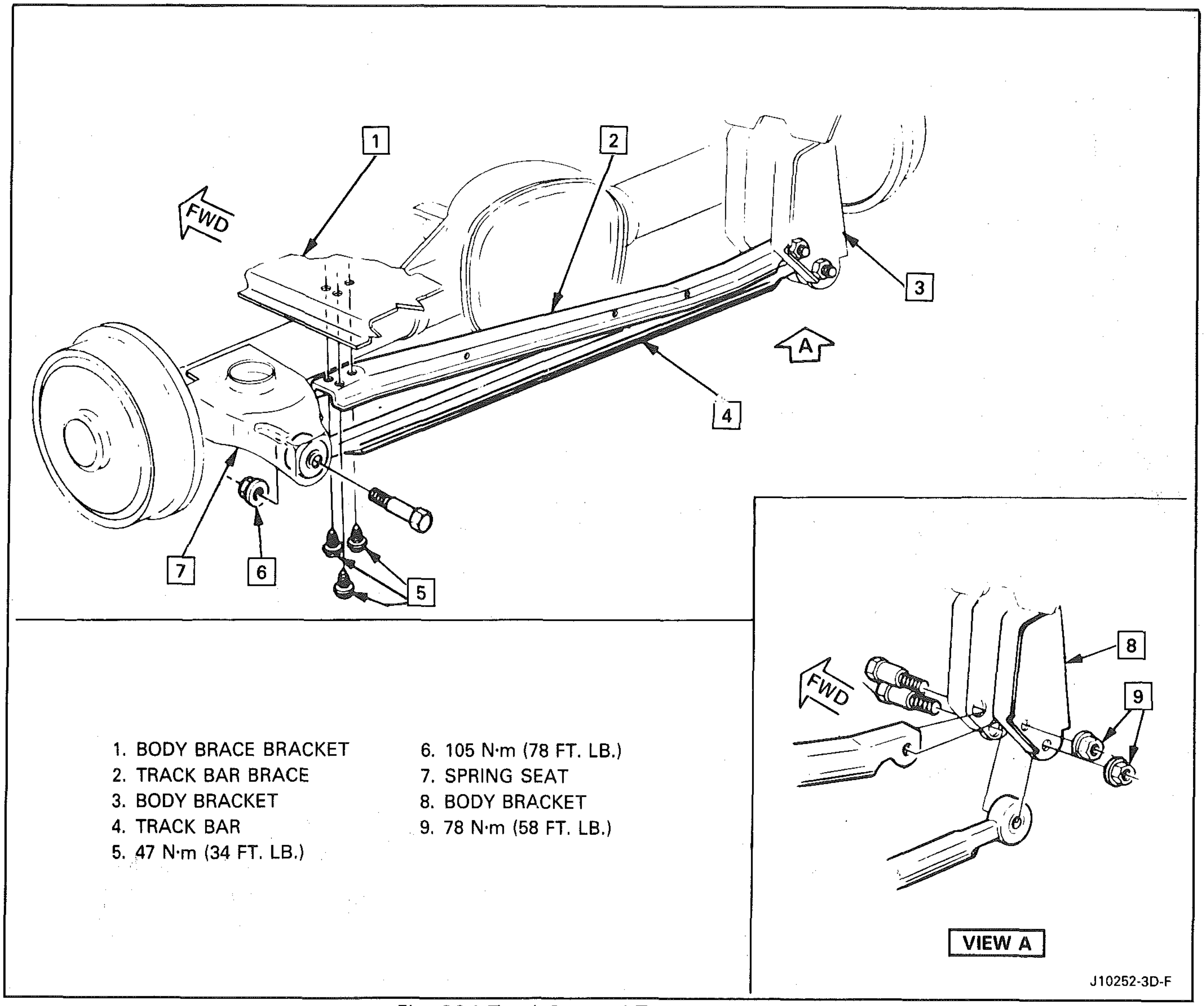


Fig. 604 Track Bar and Track Bar Brace

4. Heat shield screws to track bar brace.
5. Remove rear axle support and lower car.

REAR LOWER CONTROL ARM

Fig. 605

NOTICE: If both control arms are being replaced, remove and replace one control arm at a time to prevent the axle from rolling or slipping sideways making replacement difficult.

←→ Remove or Disconnect

1. Hoist car and support rear axle at curb height position.
2. Lower control arm to axle housing bolt and control arm to underbody bolt.
3. Control arm.

→← Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

1. Position control arm and install front and rear nuts and bolts.
2. Torque front and rear bolts.
3. Rear axle support and lower car.

BUSHING (REAR LOWER CONTROL ARM)

Fig. 606 and 607

←→ Remove or Disconnect

1. Control arm as specified in Rear Lower Control Arm Removal Procedure.
2. Place receiver J-25317-2 over flanged side of bushing.
3. Use an arbor press to force the bushing out of the arm, using large O.D. of a driver such as J-21465-8 contacting O.D. of bushing outer sleeve.

→← Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

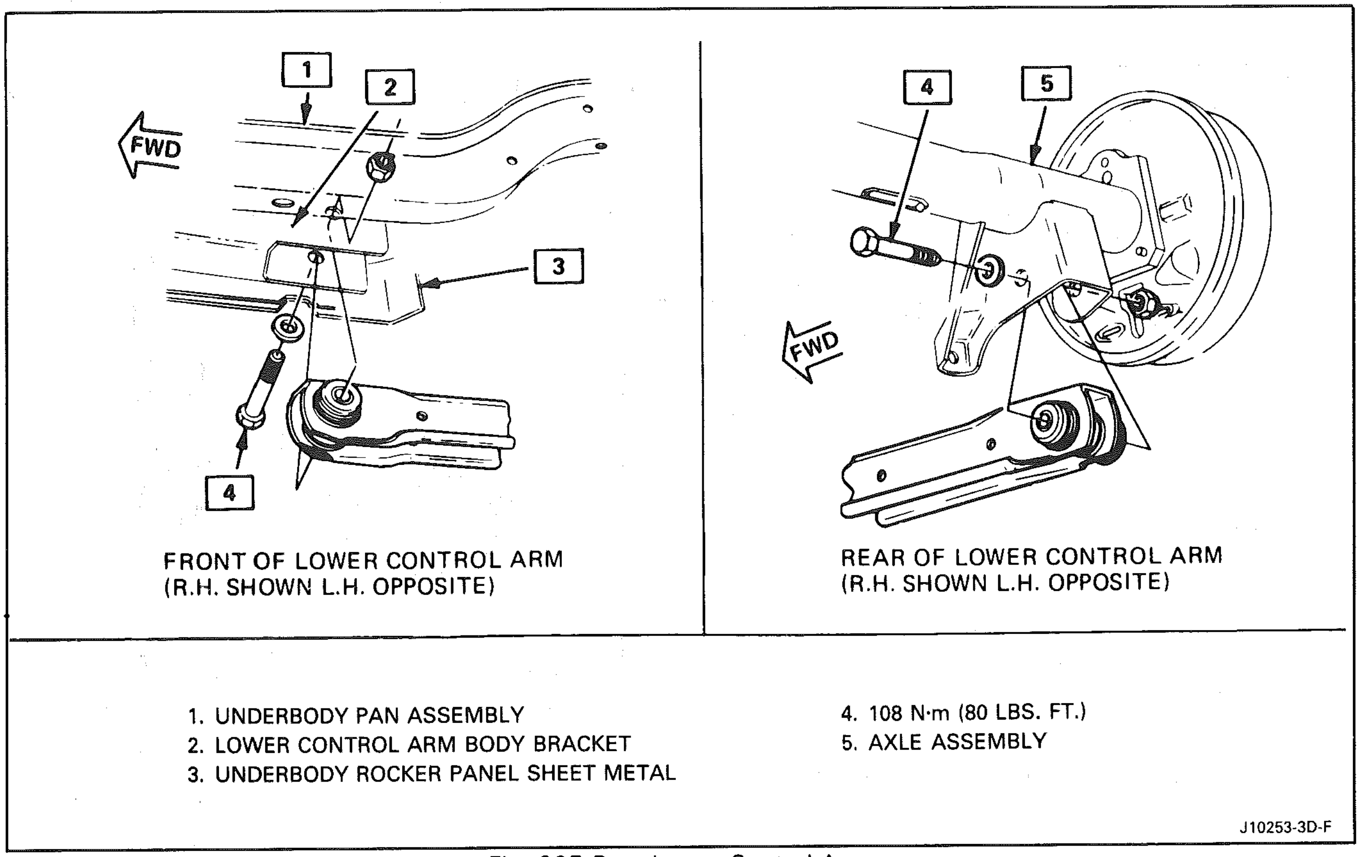


Fig. 605 Rear Lower Control Arm

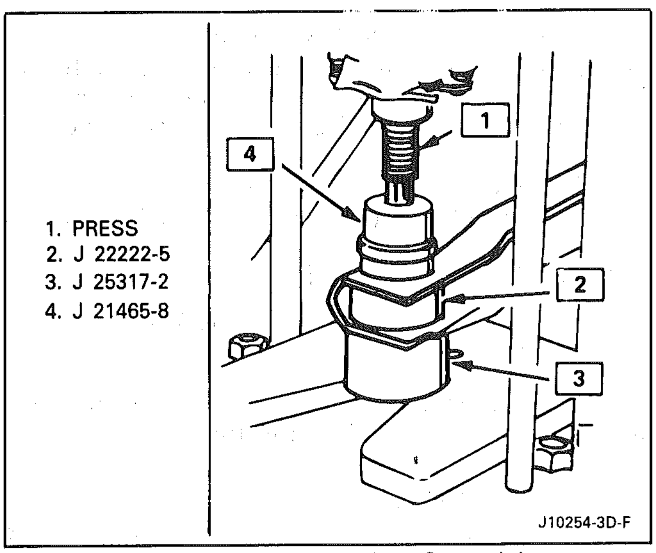


Fig. 606 Removing Bushing; Control Arm

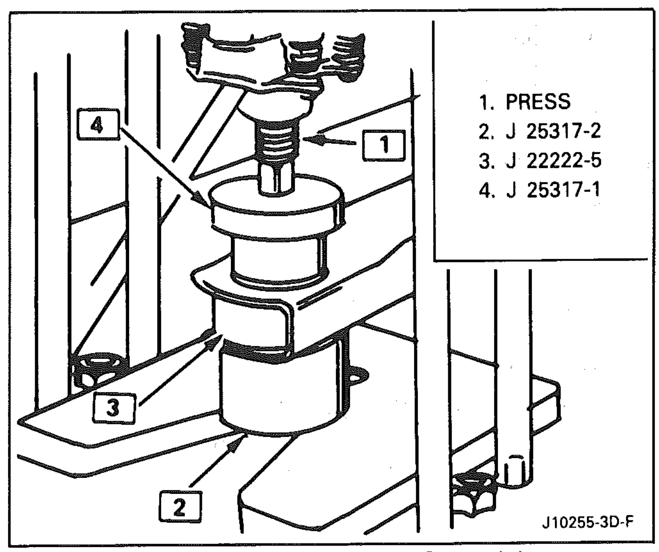


Fig. 607 Installing Bushing; Control Arm

To install the bushing, reverse the tool as shown in Fig. 607 and push bushing into position. Connect the rear control arms as outlined in Rear Lower Control Arm Installation procedure.

TORQUE ARM

Fig. 608 and 609

NOTICE: Coil springs must be removed before removing torque arm to avoid rear axle forward twist which may cause axle to shift position and damage vehicle.

Remove or Disconnect

1. Hoist car on a non twin post-type hoist and support rear axle assembly with an adjustable lifting device.
2. Track bar mounting bolt at axle assembly and loosen track bar bolt at body brace.
3. Rear brake hose clip at underbody to allow additional axle drop.
4. Right and left shock absorber lower attaching nuts.
5. Carefully lower rear axle. Remove coil springs.

NOTICE: DO NOT suspend rear axle by brake hose. Damage to hose could result.

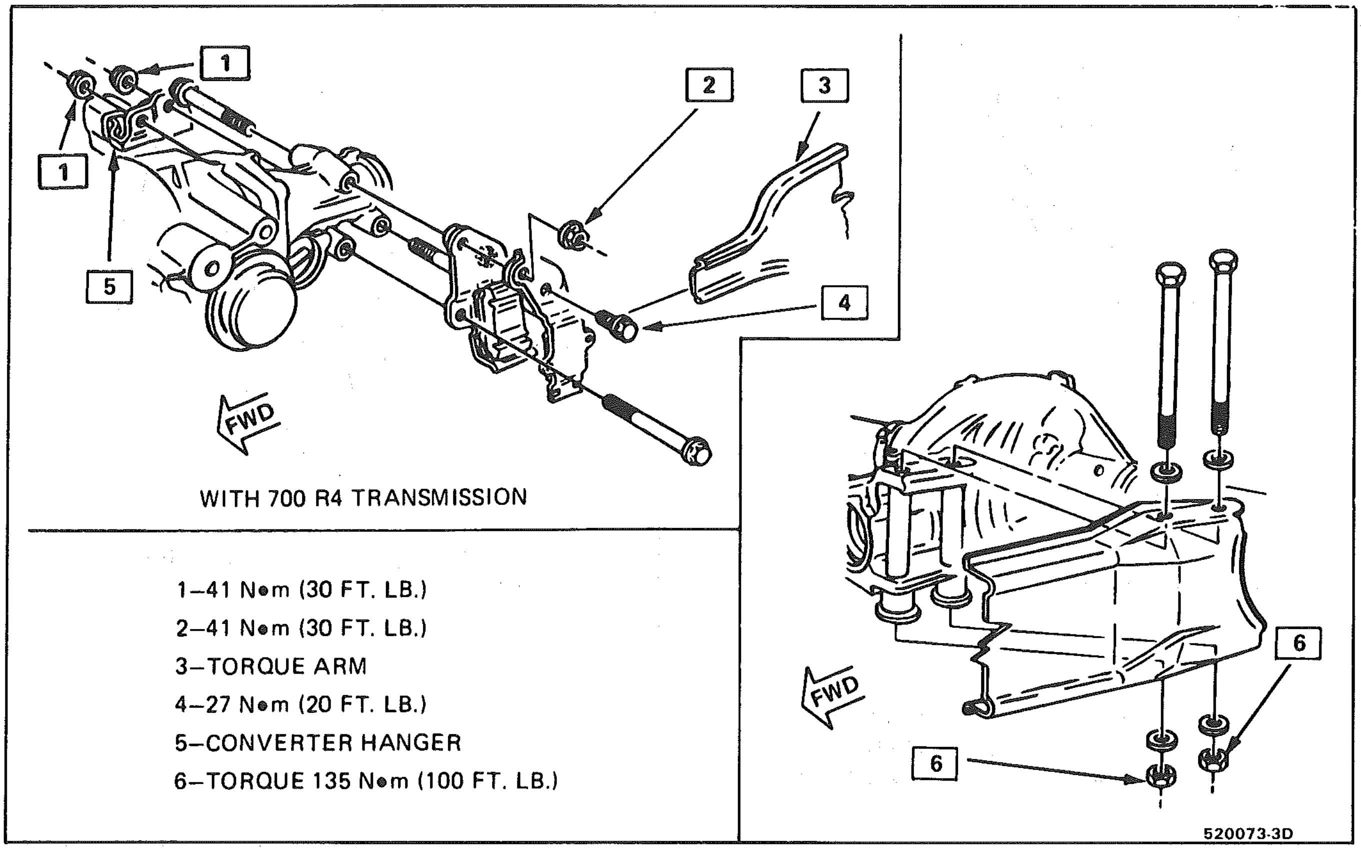


Fig. 608 Torque Arm Attachment; Auto. Trans.

6. Torque arm rear attaching bolts.
7. Front torque arm outer bracket and remove torque arm.

Install or Connect

NOTICE: See NOTICE on Page 3D-1 of this section.

1. Position torque arm and loosely install rear torque arm bolts.
2. Install front torque arm bracket and torque nuts to 27 N·m (20 lb.ft.) specifications as outlined in Figs. 608 and 609.
3. Torque rear torque arm nuts.
4. Position springs and insulators in spring seats and raise rear axle until rear axle supports weight of vehicle at normal curb height position.
5. Shocks to rear axle. Torque nuts.
6. Thoroughly clean track bar to axle assembly bolt and nut as outlined under Recommendations for Reuse of Prevailing Torque Fasteners in Section 0A.
7. Brake line clip to underbody.
8. Remove adjustable lifting device and lower car.

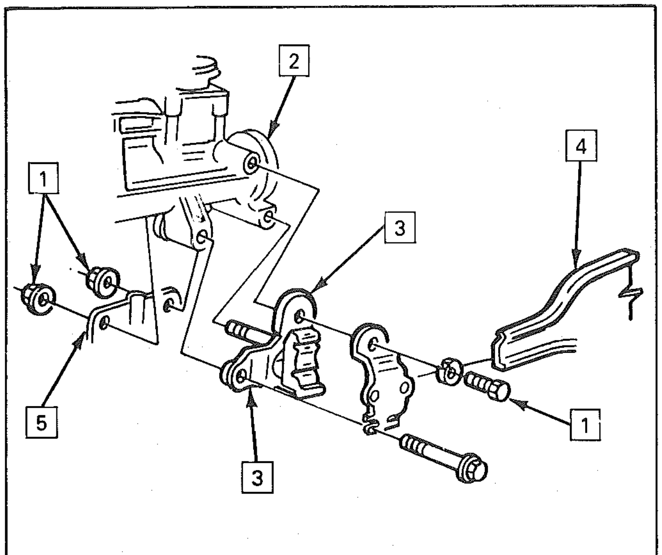
REAR STABILIZER SHAFT

NOTICE: See NOTICE on Page 3D-1 of this section.

The rear stabilizer shaft is available on some models and attaches as shown in Fig. 610.

BUMPER (RUBBER)

The rear axle bumper is located on the top of the axle housing as shown in Fig. 611.



1. 41 N·m (30 LBS. FT.)
2. TRANSMISSION
3. BRACKET
4. TORQUE ARM
5. CONVERTER HANGER

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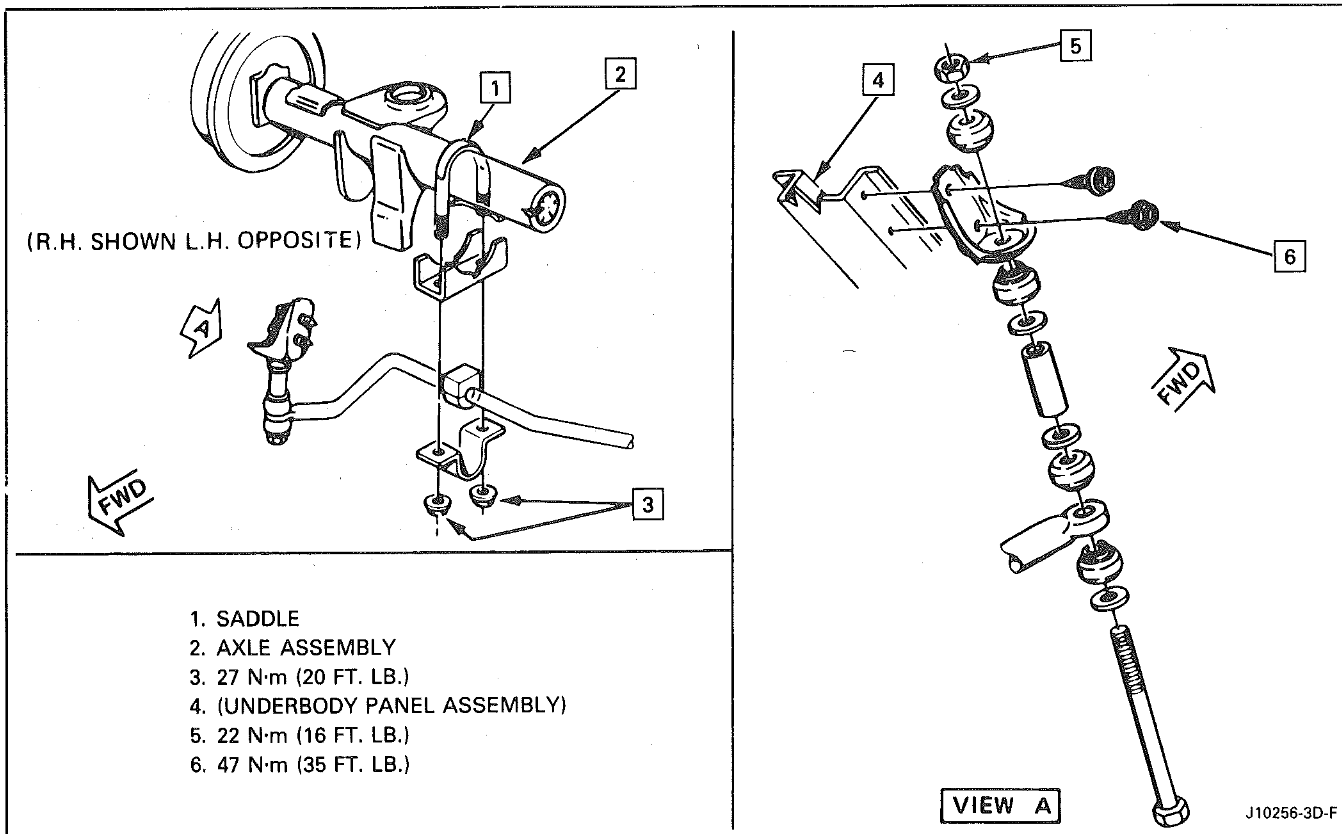
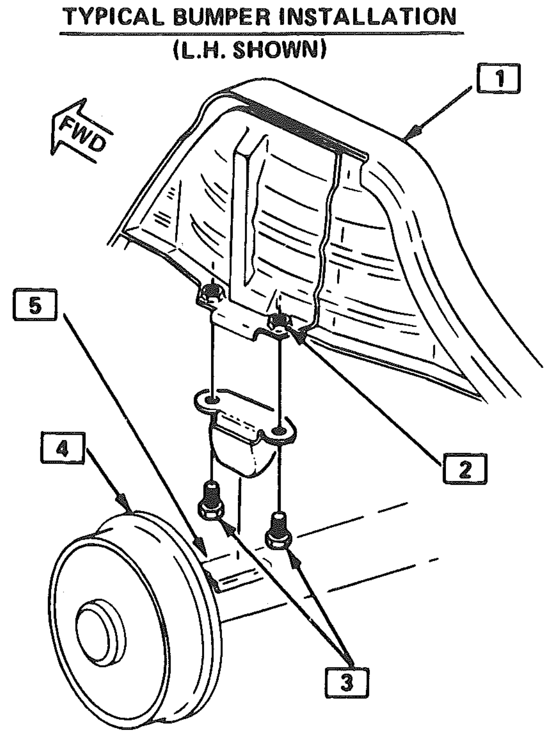
Fig. 609 Torque Arm Attachment; Manual Trans.



1. SADDLE
2. AXLE ASSEMBLY
3. 27 N·m (20 FT. LB.)
4. (UNDERBODY PANEL ASSEMBLY)
5. 22 N·m (16 FT. LB.)
6. 47 N·m (35 FT. LB.)

Fig. 610 Stabilizer Shaft



1–LONGITUDINAL REINFORCEMENT

2–WELD NUTS

3–27NM (20 FT.LB.)

4–AXLE ASM.

5–JOUNCE STOP REINF.

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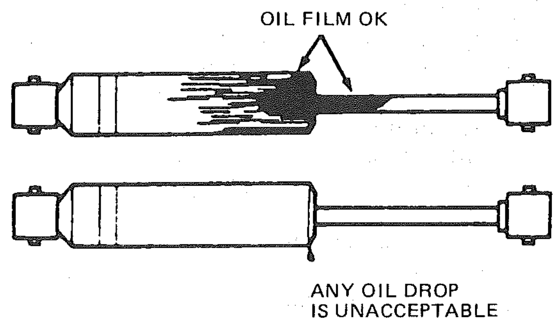
Fig. 611 Rubber Bumper Assembly

Leakage Diagnosis

The appearance of oil film on the shock absorber body or piston rod is normal. Any dripping of oil is unacceptable.



Disposal

Due to the high pressure of gas it is advised that, upon scraping or disposal of these shock absorbers, the pressure be released. This is carried out as follows:

a. Clamp shock in vise with piston rod pointing down.

b. Measure approx. 10-15 mm (0.5 in.) from bottom of shock and drill an approx. 5 mm hole so the gas can escape.

c. Measure approx. 140-150 mm (5.5-6.0 in.) from first hole and drill an approx. 5 mm hole to facilitate drainage of oil.

d. Drain oil from shock and then dispose of shock.

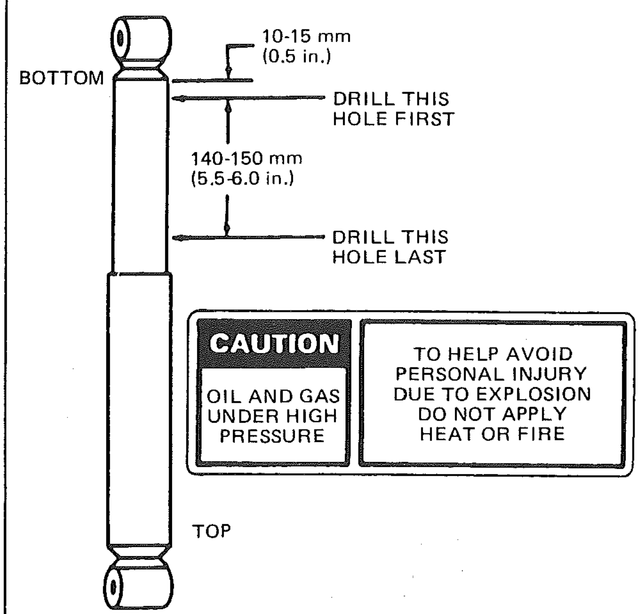


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Fig. 612 Gas Shock

Torque Specifications

Nut, Shock Absorber to Upper Mount	17 N·m (150 lb.in.)
Nut, Shock Absorber to Axle	95 N·m (70 lb.ft.)
Bolt, Track Bar to Axle	80 N·m (59 lb.ft.)
Nut, Track Bar to Body Bracket	105 N·m (78 lb.ft.)
Nut, Track Bar Brace to Body Bracket	105 N·m (78 lb.ft.)
Screws, Track Bar Brace to Body Brace Bracket	47 N·m (34 lb.ft.)
Bolt, Control Arm to Rear Axle	108 N·m (80 lb.ft.)
Bolt, Control Arm to Underbody	108 N·m (80 lb.ft.)
Bolt, Torque Arm Outer Bracket	42 N·m (31 lb.ft.)
Nut, Torque Arm to Rear Axle Differential	135 N·m (100 lb.ft.)
Bolt, Stabilizer Shaft to Body Bracket	22 N·m (16 lb.ft.)
Screw, Stabilizer Bracket to Body	47 N·m (35 lb.ft.)
Nut, Stabilizer Shaft Clamp to U-Bolt	27 N·m (20 lb.ft.)
Bolt, Axle Bumper Bracket to Underbody	27 N·m (20 lb.ft.)

SECTION 3E

TIRES AND WHEELS

NOTICE: All wheel bolt and nut fasteners are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

CONTENTS

GENERAL INFORMATION

The factory installed tires and wheels are designed to operate satisfactorily with loads up to and including the full rated load capacity when inflated to the recommended inflation pressures.

Correct tire pressures, wheel alignment and driving techniques have an important influence on tire life. Heavy cornering, excessive rapid acceleration, and heavy braking will increase tire wear.

REPLACEMENT TIRES

Fig. 1

A Tire Performance Criteria (TPC) specification number is molded in the sidewall near the tire size of all original equipment tires. This specification number assures that the tire meets GM's performance standards for traction, endurance, dimensions, noise, handling, rolling resistance, and others. Usually, a specific TPC number is assigned to each tire size.

When replacing tires, only the size, load range, and construction as originally on the car are recommended. This can best be accomplished by replacing with tires of the same TPC specification number. Use of any other tire size or construction type may seriously affect ride, handling, speedometer/odometer calibration, car ground clearance and tire clearance to the body and chassis. This does not apply to the spare furnished with the car.

It is recommended that new tires be installed in pairs on the same axle. If it is necessary to replace only one tire, it should be paired with the tire having the most tread, to equalize braking traction.

Although they may appear different in tread design, tires built by different manufacturers with identical TPC specification numbers, can be intermixed on the same car.

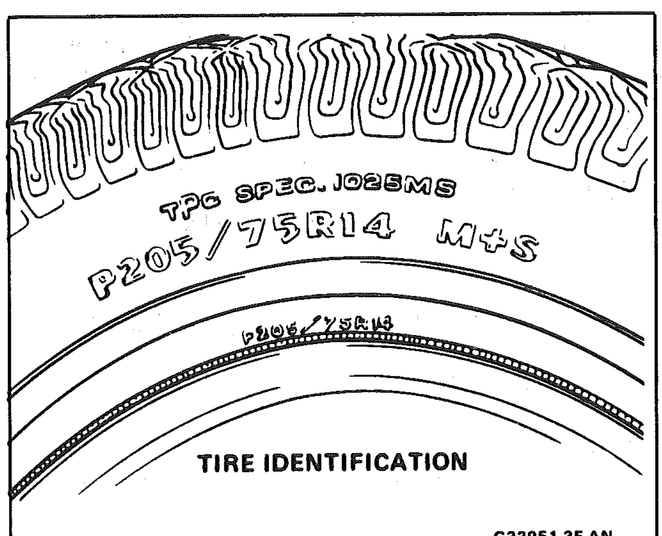

Fig. 1 Tire Identification

P-METRIC SIZED TIRES

Figs. 1 through 4

All GM cars now use P-metric sized tires. P-metric tires are available in two load ranges, standard load (35 psi max) and extra load (41 psi max). Most passenger car tires are standard load.

Most P-metric tire sizes do not have exact corresponding alpha-numeric tire sizes. For example, a P205/75R15 is not exactly equal in size and load carrying capacity to an FR78-15. For this reason, replacement tires should be of the same TPC specification number (same size, load range, construction) as those originally on the car. If P-metric tires must be replaced with other sizes, a tire dealer should be consulted. Tire companies can best recommend the closest match of alpha-numeric to P-metric sizes within their own tire lines.

The metric term for tire inflation pressure is the kilopascal (kPa). Tire pressure may be printed in both kPa and psi. One psi equals 6.9 kPa.

See the tire placard or Section 0B for tire inflation specifications.

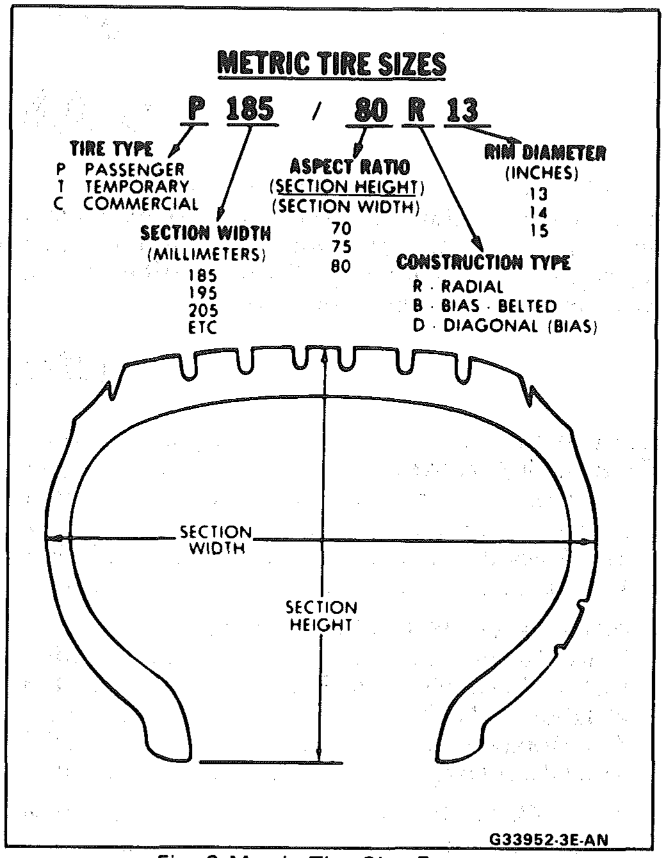

Fig. 2 Metric Tire Size Format

TIRE PLACARD

Fig. 4

The tire placard is permanently located on the rear face of the driver's door, and should be referred to for tire information. The placard lists the maximum car load, tire size (including spare), and cold inflation pressure (including spare).

WHEELS

Wheels must be replaced if they are bent, dented, have excessive lateral or radial runout, leak air through welds, have elongated bolt holes, if wheel nuts won't stay tight, or if they are heavily rusted. Wheels with excessive runout may cause objectional vibrations.

Replacement wheels must be equivalent to the original equipment wheels in load capacity, diameter, rim width, offset, and mounting configuration. A wheel of improper size or type may affect wheel and bearing life, brake cooling, speedometer/odometer calibration, car ground clearance, and tire clearance to the body and chassis.

Steel wheels can be identified by a two or three-letter code stamped into the rim near the valve stem. Aluminum wheels have the code, part number, and manufacturer ID cast into their back side.

INFLATION PRESSURE CONVERSION CHART (KILOPASCALS TO PSI)

kPa	psi	kPa	psi
140	20	215	31
145	21	220	32
155	22	230	33
160	23	235	34
165	24	240	35
170	25	250	36
180	26	275	40
185	27	310	45
190	28	345	50
200	29	380	55
205	30	415	60

Conversion: 6.9 kPa = 1 psi

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Fig. 3 Inflation Pressure Conversion

MAINTENANCE AND ADJUSTMENTS

WHEEL REPAIR

Wheel repairs that use welding, heating, or peening are not approved. An inner tube is not an acceptable repair for leaky wheels or tires. Porosity in aluminum wheels can be repaired, see Aluminum Wheel Porosity Repair.

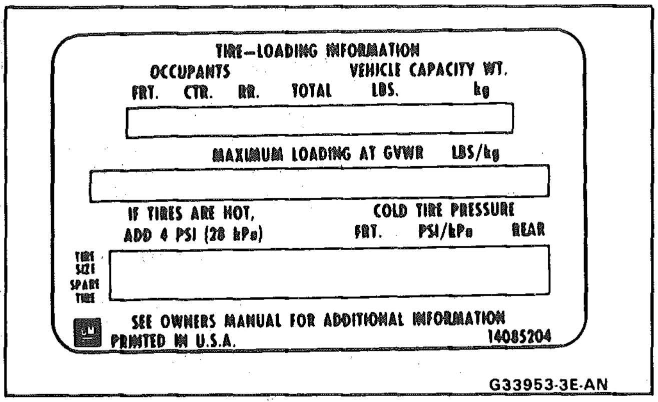


Fig. 4 Tire Placard

METRIC WHEEL NUTS AND STUDS

Some models use metric wheel nuts and wheel studs. The nut will have the word "metric" stamped on its face and the stud will have the letter "M" stamped into the threaded end. The word "metric" is stamped on its head.

The thread size of the metric wheel nuts and wheel studs are "M12 x 1.5". These stand for:

M = Metric
12 = Diameter in millimeters
1.5 = Millimeters per thread

If a broken stud is found, see Section 3C (Front Suspension) or Section 3D (Rear Suspension) for replacement procedure.

INFLATION OF TIRES

The pressure recommended for any model is carefully calculated to give a satisfactory ride, handling, tread life and load carrying capacity.

Tire pressure, with tires cold, (after car has set for three hours or more, or driven less than one mile) should be checked monthly or before any extended trip and set to the specifications on the tire placard located on rear face of driver's door. Tire inflation pressure is also given in Section 0B.

Valve caps or extensions should be on the valves to keep dust and water out.

1. **For sustained driving at speeds up to 85 mph (140 km/h),** in countries where such speeds are allowed by law, your tires should be set at the pressures recommended on your tire placard. **Sustained driving at speeds faster than 85 mph (140 km/h), where permitted by law, is not advised** unless your car has special high speed tires available from many tire dealers.
2. Tire pressures may increase as much as 6 psi when hot.
3. Higher than recommended pressure can cause:
   - Hard ride
   - Tire bruising or carcass damage
   - Rapid tread wear at center of tire
4. Lower than recommended pressure can cause:
   - Tire squeal on turns
   - Hard steering
   - Rapid and uneven wear on the edges of the tread
   - Tire rim bruises and rupture
   - Tire cord breakage
   - High tire temperatures
   - Reduced handling
   - High fuel consumption
5. Unequal pressure on same axle can cause:
   - Uneven braking
   - Steering lead
   - Reduced handling
   - Swerve on acceleration

TIRE ROTATION

Fig. 5

To equalize wear, rotate tire and wheel assemblies at intervals specified in Section 0B. In addition to scheduled rotation, the tire and wheel assemblies should also be rotated whenever uneven tire wear is noticed.

Due to their design, radial tires tend to wear faster in the shoulder area particularly in front positions. Radial tires in non-drive locations may develop an irregular wear pattern that can increase tire noise if not rotated. This makes regular rotation especially necessary.

After rotation, be sure to check wheel nuts for specified torque.

On F Carline with P245/50VR16 tires and 16" wheels, special rotation provisions must be followed. Since the tires are directional, and the front and rear wheels have different offsets, the tires must be dismounted from the wheels for rotation. Remove the tires from the wheels, and mount on the appropriate wheel, as shown in the rotation diagram. Be sure the arrows on the tires point in the direction the tire turns. Rebalance the tire/wheel assemblies using nylon-coated weights. Adjust F/R tire pressures, and torque wheel nuts to specifications.

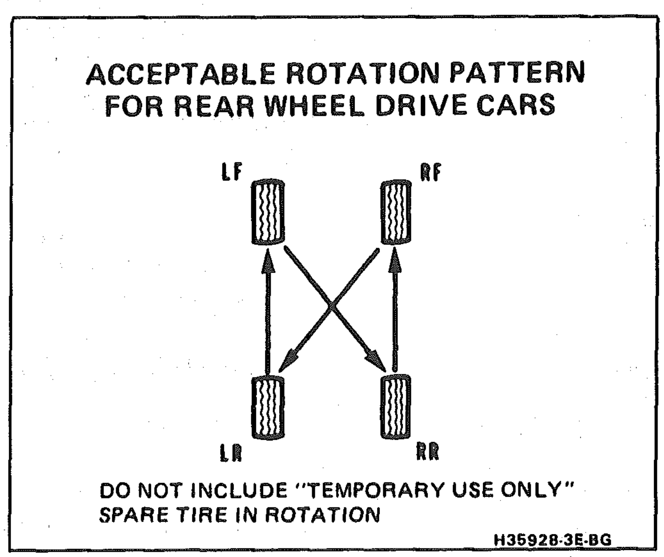


Fig. 5 Tire Rotation – Rear-Wheel Drive

TIRE CHAIN USAGE

Fig. 6

Due to limited tire-to-body clearance on certain cars, tire chain usage recommendations have been published in the Owner's Manual. When chains are to be used, most current GM cars require SAE Class "S" tire chains. These may also be designated as 1100 Series, Type PL tire chains. These chains are specially designed to limit the "fly off" effect that occurs when the wheel rotates.

Manufacturers of tire chains have a specific chain size for each tire size to ensure proper fit when installed. Therefore, be sure to purchase the correct chains for the tires on which they are to be used. Rubber adjusters should not be used to take up slack or clearance in chains which are loose due to incorrect size. Always follow the chain manufacturers installation instructions.

Use of chains may adversely affect car handling. When using chains:

- Adjust speed to road conditions
- Avoid sharp turns
- Avoid locked-wheel braking

In general, to help prevent chain damage to your car:

- Install the chains on the drive tires as tightly as possible, then tighten them again after driving 1/4 to 1/2 mile (0.4 to 0.8 kilometer). The use of chains on the non-drive tires is not recommended; the chains may contact and possibly damage the car. If you intend to use chains on the non-drive tires, be sure there is enough clearance.
- Do not exceed 45 mph (70 km/h), or the chain manufacturer's speed limit, if lower.
- Drive in a restrained manner and avoid large bumps, potholes, severe turns and other maneuvers which could cause the tires to bounce up and down.
- Follow any other instructions of the chain manufacturer which do not disagree with the above.

Additional specific information is published in the Owner's Manual.

SERVICE OPERATIONS

WHEEL REMOVAL

Fig. 7A

Sometimes wheels can be difficult to remove from the car due to foreign material or a tight fit between the wheel center hole and the hub or rotor. These wheels can be removed without damage as follows:

1. Tighten all wheel nuts on the affected wheel, then loosen each wheel nut two turns.
2. Lower car onto floor.
3. Rock the car from side to side as hard as possible using one or more person's body weight to loosen the wheel, and/or rock the car from "Drive" to "Reverse" allowing car to move several feet in each direction. Apply quick, hard jabs on the brake pedal to loosen the wheel.

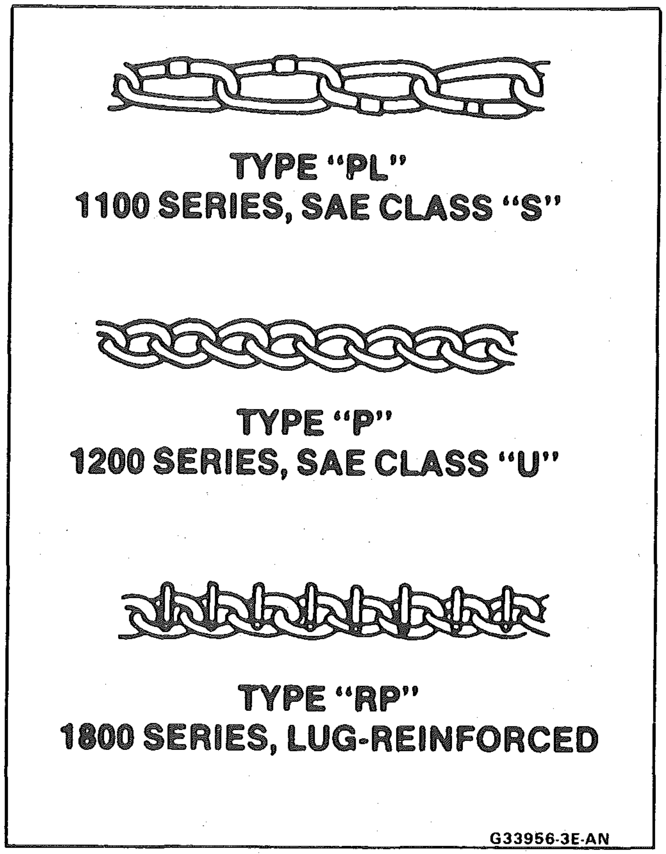


Fig. 6 Examples of Passenger Car Tire Chains

4. Raise the car. Remove the wheel nuts and the wheel.

Penetrating oil has not been found to be effective in removing tight wheels, however, if it is used, it should be applied sparingly to the wheels center hole area only. **Do not** allow the penetrating oil to get on the vertical surfaces between the wheel and the drum (or rotor) because penetrating oil in this area could cause the wheel to work loose as the car is driven causing loss of control.

NEVER use heat to loosen a tight wheel because the application of heat to the wheel can shorten the life of the wheel, wheel bolts and/or wheel bearings.

Excessive force such as hammering the wheel or tire can also cause damage and is not recommended. Slight tapping of the tire side wall, such as with one's hand or a rubber mallet, is normally acceptable.

Before installing wheels, remove any build up of corrosion on the wheel mounting surface and brake drum or rotor mounting surface by scraping and wire brushing. Installing wheels without good metal-to-metal contact at the mounting surfaces can cause wheel nuts to loosen, which can later allow the wheel to come off causing loss of control.

Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake drum or rotor.

OPTIONAL 16" WHEEL

Fig. 7

Firebirds equipped with optional 16" cast aluminum wheels and cast iron brake drums will require a spacer between the rear wheel and the cast iron brake drum.

NOTICE: This spacer is not required on vehicles equipped with four wheel disc brakes or cast aluminum brake drums.

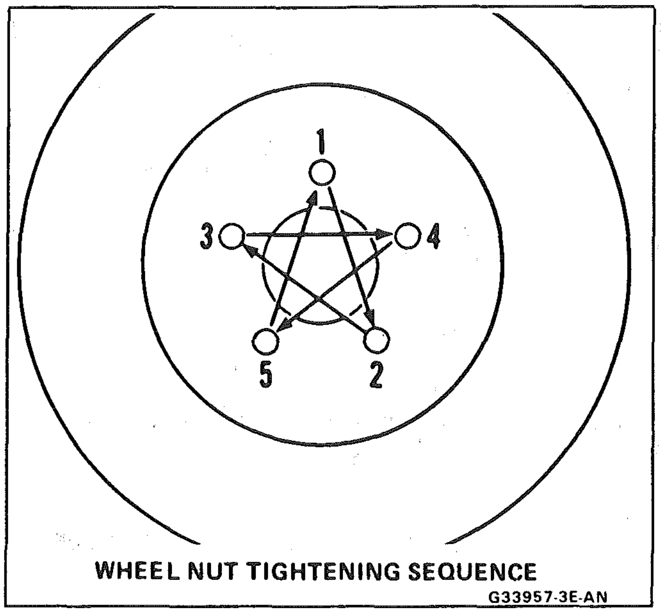


Fig. 7A Hole Wheel Nut Tightening Sequence

TIRE MOUNTING AND DISMOUNTING

FIG. 8

Use a tire changing machine to mount or dismount tires. Follow the equipment manufacturer's instructions. Do not use hand tools or tire irons to change tires as they may damage the tires bead or wheel rim.

Rim bead seats should be cleaned with a wire brush or coarse steel wool to remove lubricants, old rubber, and light rust. Before mounting or dismounting a tire, the bead area should be well lubricated with an approved tire lubricant.

After mounting, inflate until beads are seated, but never exceed 275 kPa (40 psi) to seat the beads.

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

Install valve core and inflate to proper pressure. Check the locating ring of the tire to be sure it shows around the rim flanges on both sides.

TIRE REPAIR

There are many different materials and techniques on the market to repair tires. Tire manufacturers have published detailed instructions on how and when to repair their tires. These instructions can be obtained from the tire manufacturer.

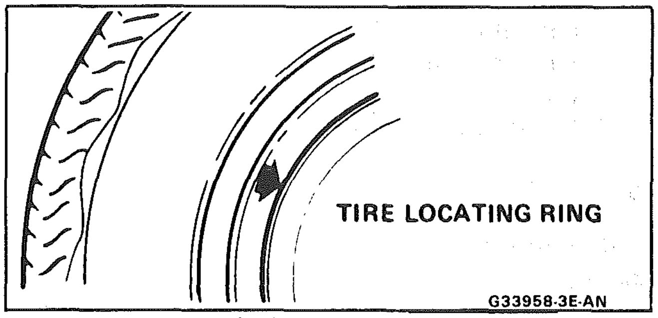


Fig. 8 Tire Locating Ring

Due to the thin 3.2 mm (4/32") tread depth on temporary spare tires, tire repair is not recommended.

WADDLE

Waddle is side-to-side movement at the front and/or rear of the car. It can be caused by the steel belt not being straight within the tire, or by excessive lateral

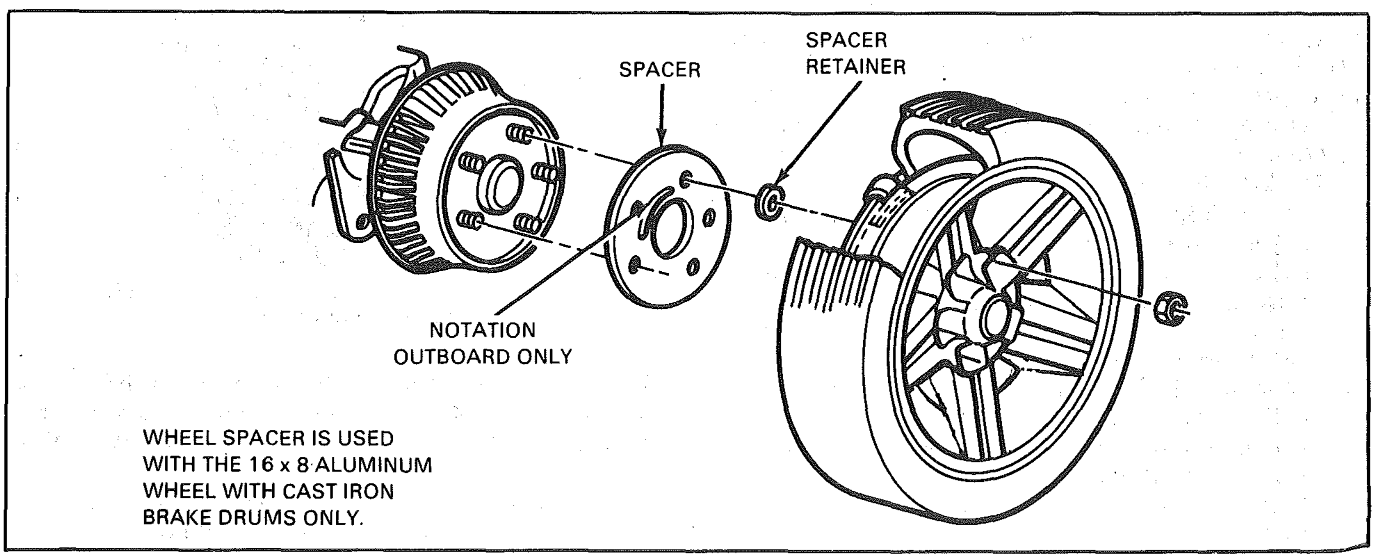


Fig. 7 16" Rear Wheel Spacers

runout of the tire or wheel. Use a dial indicator on the tire's sidewall and on the rim's flange to determine if there is excessive lateral runout.

MEASURING WHEEL RUNOUT

Fig. 9

Wheel runout should be measured with an accurate dial indicator. Measurements may be taken with the wheel installed on the car or off the car using an accurate mounting surface such as on a wheel balancer. Measurements may also be taken with or without the tire mounted on the wheel.

Radial runout and lateral runout should be measured on both the inboard and outboard rim flanges. With the dial indicator firmly in position, slowly rotate the wheel one revolution and record the total indicator reading. If any measurement exceeds specifications, and there is a vibration that wheel balancing will not correct, the wheel should be replaced. Disregard any indicator readings due to welds, paint runs, scratches, etc.

- STEEL WHEELS
  Radial runout .040"
  Lateral runout .045"
- ALUMINUM WHEELS
  Radial runout .030"
  Lateral runout .030"

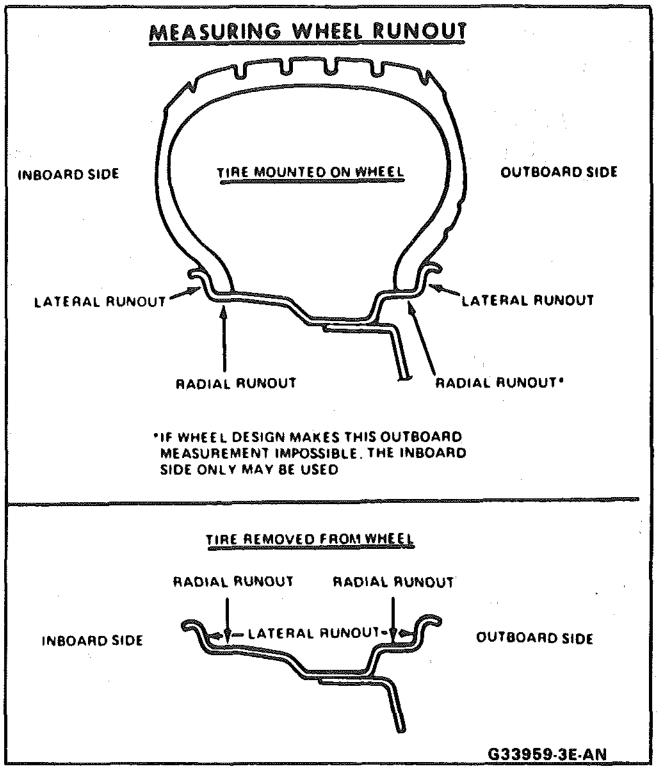


Fig. 9 Wheel Runout

SPARE TIRE

Compact Spare

Fig. 10

Some models will be equipped with a high pressure compact spare. The compact spare uses a narrow 4-inch wide rim, although the wheel diameter is usually one inch larger than the road wheels.

The compact spare wheel should not be used with standard tires, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the car may occur. The compact spare should be used only on cars which offered it as original equipment.

Inflation pressure of the compact spare must be periodically checked and maintained at 415 kPa (60 psi). It can be mounted and dismounted from its wheel using present tire changing equipment and procedures. As with other tires, the beads should completely seat at 275 kPa (40 psi). The tire may then be safely inflated to 415 kPa (60 psi).

CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.

Stowaway Spare

Fig. 11

Some models will be equipped with an inflatable stowaway spare.

The stowaway spare uses a pressurized tire inflator filled with CO^2 (carbon dioxide), and is refillable after use. Use J 26696-A to refill inflator.

The stowaway spare wheel should not be used with standard tires, snow tires, wheel covers or trim rings. If such use is attempted, damage to these items or other parts of the car may occur. The stowaway spare should be used only on cars which offered it as original equipment.

If service is needed on a stowaway spare, contact an authorized retailer of the tire manufacturer.

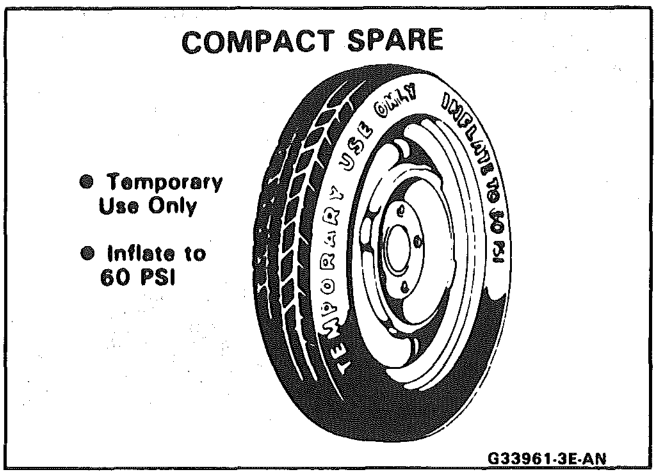


Fig. 10 Compact Spare

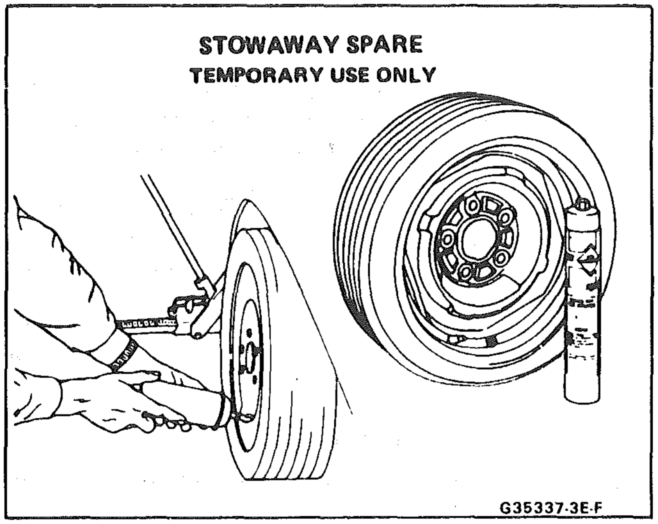


Fig. 11 Stowaway Spare

MATCH MOUNTING

Fig. 12

Tires and wheels are "match-mounted" at the assembly plant. This means that the radially stiffest part of the tire, or "high spot", is matched to the smallest radius or "low spot" of the wheel.

The "high spot" of the tire is originally marked by a yellow paint mark or adhesive label on the outboard sidewall.

The "low spot" of the wheel will be at the location of the valve stem.

Before dismounting a tire from its wheel, a line should be scribed on the tire at the valve stem to assure that it is remounted in the same position.

Replacement tires and wheels that are of original equipment quality will have their "high and low spot" marked in the same manner.

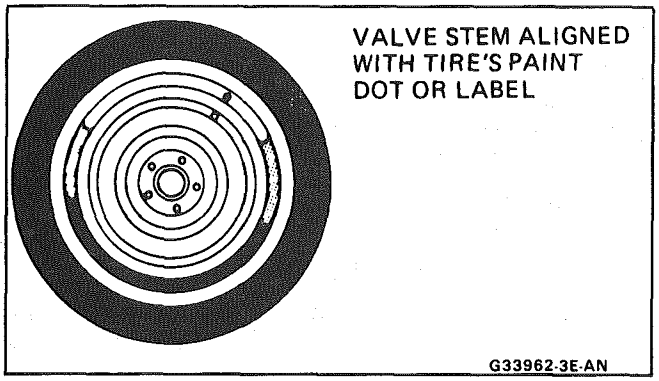


Fig. 12 Matched Tires and Wheels

BALANCING TIRE AND WHEEL

Figs. 13 and 14

There are two types of tire and wheel balancing, static and dynamic. Static balance is the equal distribution of weight around the wheel. Assemblies that are statically unbalanced cause a bouncing action called wheel tramp. This condition will eventually cause uneven tire wear.

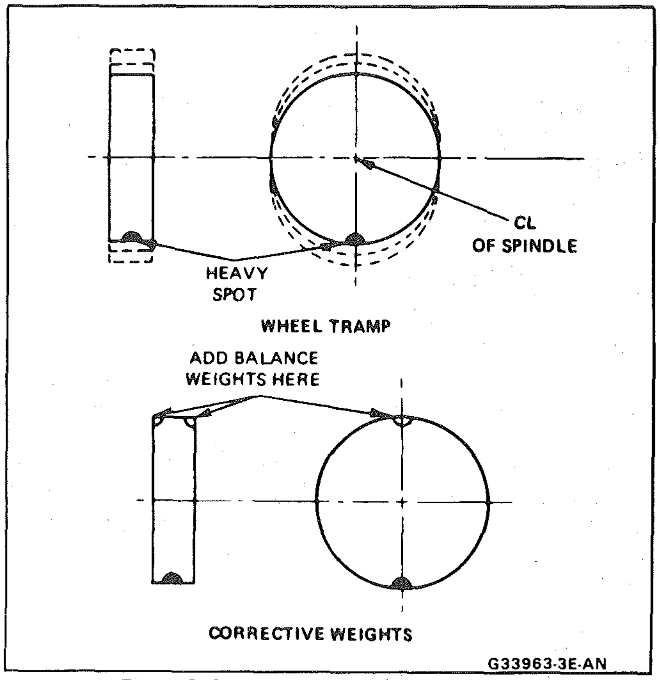


Fig. 13 Static Unbalance Correction

Dynamic balance is the equal distribution of weight on each side of the centerline so that when the assembly spins there is no tendency for it to move from side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

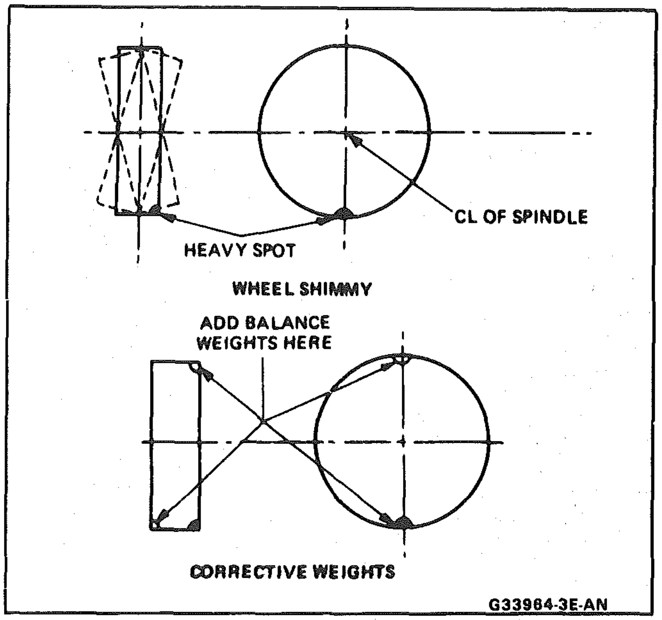


Fig. 14 Dynamic Unbalance Correction

General Balance Precautions

Deposits of foreign material must be cleaned from the inside of the wheel. Stones should be removed from the tread in order to avoid operator injury during spin balancing and to obtain a good balance. The tire should be inspected for any damage, then balanced according to the equipment manufacturer's recommendations.

Whenever a heavier, solid locking wheel nut is used to replace a standard nut, it should be installed nearest the valve stem, and a 1/2 ounce balance weight should be added 180° opposite the locking nut on the wheel's inboard side.

When rotating tires, always re-install the locking nut nearest the tire valve stem so that it remains opposite the 1/2 ounce balance weight. This procedure will improve the on-car wheel balance by compensating for the heavy locking wheel nut.

Off-Car Balancing

Most electronic off-car balancers are more accurate than the on-car spin balancers. They are easy to use and give a dynamic (two plane) balance. Although they do not correct for drum or rotor unbalance as does on-car spin balancing, this is overcome by their accuracy (usually to within 1/8 ounce). When balancing off-car, the wheel should locate on the balancer with a cone through the back side of the center pilot hole (not by the wheel stud holes).

On-Car Balancing

When needed, on-car balancing will help correct vibrations due to brake drum, rotor, and wheel cover imbalance.

When balancing on car, do not remove the balance weights from the off-car dynamic balance. If more than one ounce of additional weight is required, it should be split between the inner and outer rim flange.

NOTICE: The driven tire and wheel assemblies should be spun using the engine. Limit speed as stated in the following Caution.

CAUTION: Do not spin the drive wheels faster than 35 mph (55 km/h) as indicated by the speedometer. This limit is necessary because the speedometer indicates only one-half of the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Personal injury and damage may result from high speed spinning.

CAUTION: On cars equipped with limited slip rear axles, do not attempt to balance a tire on a drive wheel with the other drive wheel on the ground. The car may drive through this wheel and cause the car to move unexpectedly, resulting in personal injury and property damage.

To distinguish between standard rear axle and limited slip, raise rear of car so both tires are clear of ground. With the transmission in park (in gear with manual transmission), attempt to turn one wheel by hand. If the wheel can be turned, it is a standard rear axle; if the wheel cannot be turned, it is a limited slip rear axle. Also, check for Limited Slip (G80) on Service Parts Identification label.

Wheel Weights

Fig. 15

If more than 27 grams (1.0 oz.) are needed, the wheel weights should be split as equal as possible between the inboard and outboard flanges.

Balancing of assemblies with factory aluminum wheels requires the use of special nylon coated clip-on type wheel weights. These weights are designed to fit over the thicker rim flange of the aluminum wheel and should be installed with a plastic tipped hammer.

Adhesive wheel weights are also available. Use the following procedure to install adhesive wheel weights.

Adhesive Wheel Weight Installation

1. Clean wheel by sanding to bare aluminum where wheel weight is to be located.
2. Wipe wheel weight attachment area with a mixture of half Isopropyl alcohol and half water. A clean cloth or paper towel must be used for this operation.
3. Dry the attachment area with hot air. Surface of wheel should be warm to the touch.
4. The adhesive backing on wheel weights must be warmed to room temperature.
5. Remove tape from back of weights. Do not touch the adhesive surface.
6. Apply wheel weight and press on with hand pressure.
7. Secure wheel weight with a 70-110 N (16-25 lb) force applied with a roller.

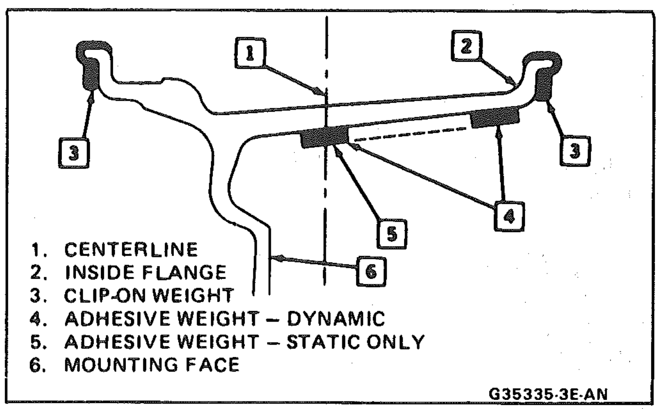


Fig. 15 Aluminum Wheel Weight Placement

CORRECTING NON-UNIFORM TIRES

There are two ways to correct tires which cause a vibration even though they are properly balanced. One method uses an automatic machine which loads the tire and buffs small amounts of rubber from high spots on the outer two tread rows. Correction by this method is usually permanent and, if done properly, does not significantly affect the appearance or tire tread life. Tire truing with a blade-type machine is not recommended as this reduces the tread life substantially and often does not permanently correct the problem.

Another method is to dismount the tire and rotate it 180 degrees on the rim. *It is important that* this be done on tire and wheel assemblies which are known to be causing a vibration as it is just as likely to cause good assemblies to vibrate.

Refer to Section 3, "Vibration Diagnosis" for more details.

ALUMINUM WHEEL CLEANING

Aluminum wheels should be cleaned and waxed regularly. Do not use abrasive cleaners, as they could damage the protective coating.

ALUMINUM WHEEL HUB CAP

←→ Remove or Disconnect

1. Tire and wheel assembly
2. Place a block of wood approximately 2″ in diameter with a squared off end against the back surface of the cap. A sharp hammer blow on the block of wood will remove the cap.

→← Install or Connect

1. Place cap into position at wheel opening and place a block of wood at least three inches in diameter against cap face. Install cap by striking block of wood with hammer.
2. Tire and wheel assembly

NOTICE: Failure to hit cap squarely without the load distributed evenly could result in permanent damage to the cap.

ALUMINUM WHEEL POROSITY REPAIR

1. Remove tire and wheel assembly.
2. Locate leaking areas by inflating tire to 345 kPa (50 psi) and dipping tire and wheel assembly into a water bath.
3. Mark leak areas and remove tire from wheel.
4. Scuff inside surface at leak area with 80 grit sandpaper and clean area with general purpose cleaner such as 3M #08984 or equivalent.
5. Apply 1/8″ thick layer of adhesive/sealant P/N 1052366 or equivalent to leak area and allow twelve hours of drying time.
6. Mount tire on wheel, pressurize to 345 kPa (50 psi) and check for leaks.

   CAUTION: To avoid serious personal injury, do not stand over tire when inflating. Bead may break when bead snaps over safety hump. Do not exceed 275 kPa (40 psi) pressure when inflating any tire if beads are not seated. If 275 kPa (40 psi) pressure will not seat beads, deflate, relubricate the beads and reinflate. Overinflation may cause the bead to break and cause serious personal injury.
7. Adjust tire pressure to meet specifications.
8. Balance tire and wheel assembly.
9. Install tire and wheel assembly.

ALUMINUM WHEEL REFINISHING

A protective clear or color coating is applied to the surface of original equipment cast aluminum wheels. A surface degradation condition can begin to develop if frequent, repeated automatic car wash cleaning abrades or wears off the factory applied protective coating. This can happen at some automatic car wash facilities using aggressive silicon carbide tipped tire brushes to clean white walls and tires. Once the protective coating is damaged, exposure to caustic cleaners and/or road salt further causes surface degradation. The following procedure details how to strip, clean and recoat aluminum wheels that are affected by these conditions.

Required Materials:

- Amchem Alumi Prep #33 – stock #DX533 or equivalent – cleaning and conditioning chemical for aluminum.
- Amchem Alodine #1001 – stock #DX50T or equivalent – coating chemical for aluminum.
- Ditzler Delclear Acrylic Urethane Clear – stock #DAU-75 or equivalent.
- Ditzler Delthane Ultra-Urethane Additive – stock DXR-80 or equivalent.

Service Procedure:

1. Mark wheel and wheel stud for position on car.
2. Remove tire and wheel assembly from car.
3. Mark location of outboard weights and remove.
4. Wash wheel inside and out with water base all purpose cleaner. Remove grease and oil with solvent cleaner.
5. Mask off tire prior to painting.
6. Select and follow the correct procedure, "Aluminum Damage on Wheel Surface" or "Clear Coat Damage on Unpainted Wheels".
7. Replace wheel weights with nylon coated weights.
8. Install tire and wheel assembly on car and tighten wheel nuts to proper torque.

Accent Color Preparation

1. Sand over painted areas that will not require recoloring with 400 grit (wet or dry) to promote adhesion of clear coat.

Aluminum Damage on Wheel Surface

1. Mount tire and wheel on brake lathe and spin slowly.
2. Sand wheel with backing block or pad by holding abrasive flat to surface of wheel and moving slowly back and forth from center to outer edge to remove damage. Use the following sandpaper grits in the order listed.
   A. Sand with 80 grit
   B. Sand with 150 grit
   C. Sand with 240 grit
3. Continue with "Recoating Procedure."

Clear Coat Damage on Unpainted Wheels

1. Apply chemical stripper. Use small 1/4" detail brush dipped in stripper to apply material around perimeter and spoke-like areas.
2. Remove stripper following manufacturers recommendations.
3. Sand wheel with 240 grit while rotating wheel on a slow spinning brake lathe or by mounting on car and spinning by hand. This will restore the machined appearance and promote adhesion.

   CAUTION: Do not use engine power to rotate wheel while sanding to avoid serious personal injury.
4. Continue with "Recoating Procedure."

Recoating Procedure

1. Clean surface of contaminants.
2. Soak wheel with Amchem #33 or equivalent from 1 to 3 minutes, then rinse with water and blow dry.
3. Soak wheel with Amchem #1001 or equivalent for 1 to 3 minutes, then rinse with water and blow dry.
4. Finish with Ditzler Delclear Acrylic Urethane and Ditzler Ultra-Urethane Additive or equivalent using three coats.

   1st Coat – Light mist coat, let flash

   2nd Coat – Light, let flash

   3rd Coat – Heavy double wet coat

   CAUTION: To avoid serious personal injury when applying any two part component paint system, follow the specific precautions provided by the paint manufacturer. Failure to follow these precautions may cause lung irritation and allergic respiratory reaction.
5. Let dry for 24 hours – (or flash for 30 minutes, force dry at 140° for 30 minutes, and allow to cool for 30 minutes before mounting.

WHEEL NUT TORQUE

F Carline – M12X1.5 .... 110 N·m (80 lbs. ft.)

SECTION 4A

PROPELLER SHAFT

NOTICE: The propeller shaft to pinion flange or slip yoke fasteners are important attaching parts in that they may affect the performance of vital components and systems, which may result in a major repair expense. They must be replaced with one of the same part number or with an equivalent part, if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

CONTENTS

GENERAL DESCRIPTION

Figure 4A-1

All F Model vehicles use a one piece propeller shaft.

A universal joint and splined slip yoke are located at the transmission end of the propeller shaft, where they are held in alignment by a bushing in the transmission extension housing. The slip yoke permits fore and aft movement of the propeller shaft, as the differential assembly moves up and down. The spline is lubricated internally by transmission fluid. A seal in the transmission extension housing prevents fluid leakage and protects the slip yoke from dust, dirt, and other harmful material.

A second universal joint is used where the propeller shaft connects to the rear axle pinion companion flange.

The universal joints are lubricated for life and cannot be lubricated while on the vehicle. If it becomes necessary to replace a universal joint, the entire propeller shaft must be removed from the vehicle. Care should be taken to avoid jamming, bending or over-angulating of any parts of the assembly.

On vehicles with steel propeller shafts, production universal joint bearing caps are retained by nylon injected rings. Aluminum propeller shafts and all service replacement universal joints use snap rings to retain the bearing caps.

If a vehicle is to be undercoated, the propeller shaft must be kept completely free of undercoating material. Undercoating material or any other foreign material will upset the propeller shaft balance and produce serious vibration.

DIAGNOSIS

Figures 4A-2 and 4A-3

Objectional vibration, roughness, rumble or boom can be caused by the input from a number of systems. The following diagnostic charts provide a systematic approach to finding the vehicle problem.

To determine whether the propeller shaft is causing the problem, drive the vehicle through speed range and note at which vehicle speed the problem is most pronounced. Shift the transmission into a lower gear range and drive the vehicle at the same speed as when problem was most pronounced.

If the problem is still present at the same vehicle speed, the propeller shaft may be at fault. Refer to the propeller shaft diagnostic charts.

ON-VEHICLE SERVICE

PROPELLER SHAFT RUN-OUT MEASUREMENT

Figure 4A-4

If a noise or vibration is present at high speed it might be caused by a bent shaft, or if a shaft has been damaged through handling or a collision, it may be checked for straightness as follows:

1. Raise vehicle on a twin post hoist so that the rear is supported on the rear axle housing with wheels free to rotate.
2. Mount a dial indicator on a movable support that is high enough to permit contact of the indicator button with the propeller shaft or mount dial indicator to a magnetic base and attach to a suitable smooth place on the underbody of the vehicle. Readings are to be taken at points indicated, as shown.
3. With transmission in neutral, check for runout by turning a rear wheel to rotate the propeller shaft.

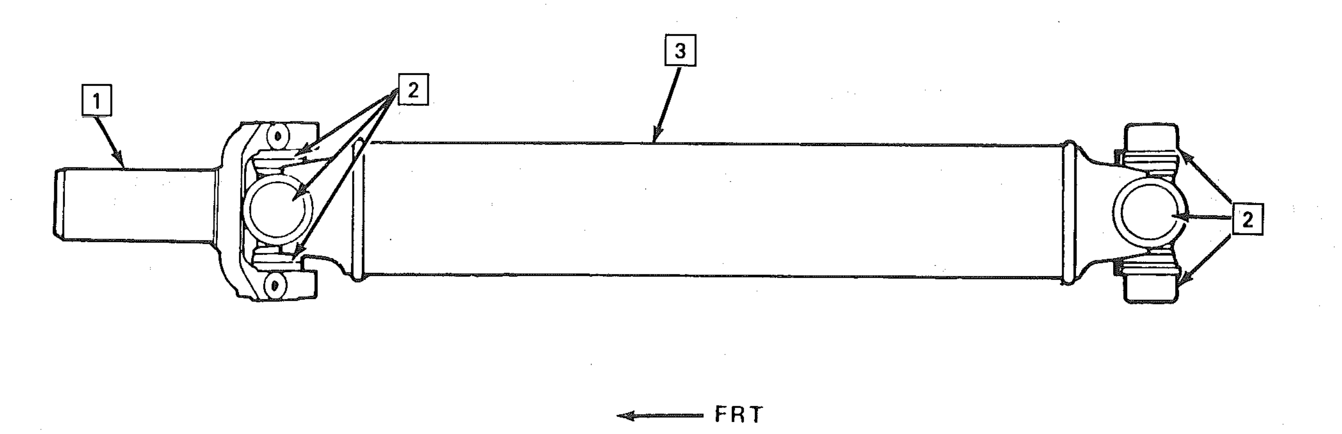


Figure 4A-1 Propeller Shaft

Leak at front slip yoke. (An occasional drop of lubricant leaking from splined yoke is normal and requires no attention.)	1. Rough outside surface on slip yoke.	1. Replace seal if cut by burrs on yoke. Minor burrs can be smoothed by careful use of crocus cloth or honing with a fine stone. Replace yoke if outside surface is rough or burred badly.
	2. Defective transmission rear oil seal.	2. Replace transmission rear oil seal. 3. Bring transmission oil up to proper level after correction.
Knock in drive line clunking noise when car is operated under float condition at 10 mph in high gear or "Neutral".	1. Worn or damaged universal joints.	1. Replace.
	2. Side gear hub counterbore in differential worn oversize.	2. Replace differential case and/or side gears as required.
Ping, snap, or click in drive line.	1. Loose upper or lower control arm bushing bolts.	1. Tighten bolts to specified torque.
	2. Worn or damaged universal joints.	2. Replace.
Scraping noise.	Slinger rubbing on rear axle carrier.	Straighten slinger to remove interference.

J 10002-4A-F

Figure 4A-2 Propeller Shaft Diagnostic Chart 1

NOTICE: Care must be taken not to include indicator variation caused by ridges, flat spots or other variations in the tube.

4. If runout exceeds specifications, reindex the propeller shaft 180° at the rear axle companion flange and recheck runout.

5. If runout is still over specifications, check rear axle companion flange for run-out.

COMPANION FLANGE RUN-OUT MEASUREMENT

Figure 4A-5

Check companion flange run-out using Tool J-35819 and J-8001 Dial Indicator Set or equivalent. Instructions are included with tool. Record run-out and mark high and low points of companion flange.

A. If companion flange run-out is 0.15mm (.006 in.) or less, remove companion flange balance weight, if used. No further action is required.

B. If companion flange run-out is over 0.15mm (.006 in.) but less than 0.28mm (.011 in.) and balance weight is at or near low point of companion flange run-out, no further action is required.

If balance weight is not at or near low point of companion flange run-out, remove weight.

C. If companion flange run-out is over 0.28mm (.011 in.), but no greater than 0.38mm (.015 in.) and balance weight is at or near low point of companion flange run-out, no further action is required.

If balance weight is not at or near low point of companion flange runout, remove weight and reindex companion flange until run-out is 0.25 mm (.010 in.) or less.

If impossible to achieve 0.25mm (.010 in.) or less run-out, install a new companion flange and recheck for 0.25mm (.010 in.) or less run-out.

Service replacement companion flanges are not equipped with balance weights and no weights should be added.

UNIVERSAL JOINT ANGLE MEASUREMENT

When torque is transmitted through any ordinary universal joint, the driven yoke fluctuates slightly in speed. In other words, although the driving yoke rotates at a constant speed, the driven yoke speeds up and slows down twice per revolution. This flucutation of the driven yoke is in direct proportion to the angle through which the universal joint is operating; the greater the angle, the greater the fluctuation.

Whenever two universal joints are used, this fluctuation effect can be eliminated by staggering the joints so that the two driving yokes are 90 degrees apart provided the two joints are transmitting torque through the same angle.

Therefore, when two universal joints are used, the angles through which they operate must be very nearly the same. This allows the alternate acceleration and deceleration of one joint to be offset by the alternate acceleration and deceleration of the second joint. When the two joints do not run at approximately the same angle, operation is rough and an objectionable vibration is produced.

The actual optimum angles desired must take into consideration the effects of various passenger loadings and rear axle windup during acceleration; therefore, it is unlikely that the front and rear universal joint angles will be found to be the same in actual practice.

In addition, universal joints are designed to operate safely and efficiently within certain angles. If the designed angle is exceeded, the joint may be broken or otherwise damaged.

The front universal joint angle is actually the angle between the engine-transmission centerline and the propeller shaft centerline. This angle is determined by the design of the frame assembly and may be altered by adding or removing shims between the transmission and the transmission mount.

Adding one shim at the transmission mount will decrease the transmission universal joint angle by 1/2° and increase differential universal joint angle by 1/4°. If one shim is removed the tranmission angle will increase 1/2° and decrease differential angle 1/4°. The production transmission mount bolt is an M10-1.5 x 35 mm. When installing two or more shims, an M10-1.5 x 50 mm bolt must be used.

All complaints of propeller shaft vibrations should be accompanied by rear trim height measurements at curb weight. An incorrect trim height may cause some vibration. If vibration is severe enough, removal or installation of spring shims may be required. If any irregular roughness or vibration is detectable in the drive line, the front and rear universal joint angles should be checked. Should the vehicle become involved in a severe rear end collision, or should the rear axle carrier be replaced, the rear universal joint angle should be checked and control arms should be replaced if necessary.

Inclinometer Method

Figure 4A-6

This method can be used with the vehicle over a pit or on a drive-on platform hoist, as long as the vehicle is at curb weight with a full tank of gasoline. Bounce vehicle up and down to assure curb height. Before universal joint angles can be checked, the measurements specified (the distance between the top of the axle tube and the bottom of the frame) must be met. To insure an accurate measurement, weight may have to be added to the vehicle to reach these specifications.

Readings should be taken at the following locations in the following manner.

Angle Measurement at Rear Universal Joint

Figures 4A-7 and 4A-8

1. Place inclinometer J 23498-A on rear propeller shaft bearing cap. Center bubble in sight glass and record measurement. Bearing cap must be straight up and down and free of dirt or other foreign material to obtain an accurate measurement.
2. Rotate propeller shaft 90 degrees and place inclinometer on the companion flange bearing cap. Center bubble in sight glass and record measurement.
3. Subtract smaller figure from larger figure to obtain existing rear universal joint angle.

Angle Measurement at Front Universal Joint

Figures 4A-9 and 4A-10

1. Place inclinometer on front propeller shaft bearing cap. Center bubble in sight and record measurement.
2. Rotate propeller shaft 90 degrees and place inclinometer on the slip yoke bearing cap. Center bubble on sight glass and record measurement.
3. Substract smaller figure from larger figure to obtain existing front universal joint angle.

PROPELLER SHAFT BALANCING

Hose Clamp Method

Figures 4A-11 thru 4A-13

1. Place the vehicle on a twin post hoist so that the rear of the vehicle is supported on the rear axle housing and the rear wheels are free to rotate. Remove both rear wheel assemblies and reinstall wheel lug nuts with flat sides next to drums/discs.
2. Mark and number propeller shaft at four (4) points 90 degrees apart at rear of shaft just forward of balance weight, as shown.
3. Install two (2) hose clamps on the rear of the propeller shaft and slide them rearward until the clamps stop at the nearest balance weight welded to the tube. Align both clamps at any one of the four marks made on shaft in Step 2 and tighten. Be sure sufficient clearance is maintained so that clamp heads do not contact floor pan of vehicle when axle is in contact with rebound bumper in frame. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.
4. Run the vehicle through the speed range to 80-90 MPH (130-145 Km/h) and note amount of imbalance.

   CAUTION: All persons should stay clear of universal joint and balance weight areas to avoid possible injury. Do not run on hoist for extended periods due to the danger of overheating the transmission or engine.
5. Loosen clamps and rotate clamp heads 90 degrees to the next mark on a propeller shaft. Tighten clamps and repeat Step 4.
6. Repeat Step 5 until car has been run with clamp heads located at all four marks on shaft.
7. Position clamps at point of least imbalance. Rotate the clamp heads away from each other 45 degrees (one on each side of the position), as shown. Run the vehicle and note if imbalance has improved.

   In some cases it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance. Replace shaft if three hose clamps do not improve the imbalance.
8. Continue to rotate the clamps apart in smaller angular increments until the imbalance is at its minimum.
9. Reinstall wheel assemblies and road test the vehicle for final check of balance. A minimal vibration felt in the vehicle on the hoist may not show up during a road test.

Strobe Light Method

Figures 4A-11, 4A-14, and 4A-15

If a wheel balancer of the strobe light type is available, the use of such a unit will facilitate the balancing of the propeller shaft. The balance pick-up unit should be placed directly under the nose of the rear axle carrier and as far forward as possible.

1. Place the vehicle on a twin post hoist so the rear of the vehicle is supported on the rear axle housing and the rear wheels are free to rotate. Lower rear hoist and allow axle to rest on jackstands. The groove in the rear hoist fixture could clamp the axle and destroy the sensitivity of the operation. Remove both rear wheel assemblies and reinstall wheel lug nuts with flat sides next to the drums/rotors.
2. Mark and number drive shaft at 4 points 90 degrees apart at rear of shaft just forward of balance weights, as shown.
3. Place the strobe light wheel balancer pick-up under the nose of the carrier.
4. Run vehicle in gear at the speed where the distrubance is at its peak, allow the driveline to stabilize by holding at a constant speed. Point strobe light up at the spinning propeller shaft and note position of one of the reference numbers. Shut off engine and position the propeller shaft so the reference numbers will be in the same position as was noted while the shaft was rotating.

   When strobe light flashed, the heaviest point of the shaft was at the bottom (6 o'clock). To balance the propeller shaft, it would be necessary to apply the balancing weights (hose clamps) 180 degrees away from the heaviest point or at the top of the propeller shaft (12 o'clock).
5. Install two screw-type hose clamps on the propeller shaft as close to the rear as possible. Position both clamp heads 180 degrees from the heaviest point of drive shaft as indicated by strobe light. Tighten clamps.

   NOTICE: Be sure sufficient clearance is maintained so clamp heads do not contact floor pan of vehicle when axle is in contact with rebound bumper on frame. In order to gain sufficient clearance, it may be necessary to position the clamps over the balance weights.
6. Run vehicle through the speed range 80-90 M.P.H. (130-145 Km/h). If disturbance is gone, nothing further need be done on the hoist. If the disturbance is not gone and the strobe light shows the clamp heads at the bottom (6 o'clock) of the shaft, go to Step 7. If the strobe light shows the two clamp heads at the top of the shaft, add one more hose clamp and recheck. If the strobe light shows the three clamp heads at the top of the shaft, remove the propeller shaft and reindex it 180 degrees on the rear axle pinion companion flange. Recheck with no clamps. Repeat balance starting with Step 5. If the shaft still needs more than three hose clamps at the same clock position, replace it. If the clamps are also 180 degrees from their original position after the propeller shaft was reindexed 180 degrees, the rear axle pinion companion flange is out of balance and must be replaced. DO NOT use more than three hose clamps to balance the shaft. If the strobe light shows the hose clamps at the bottom of the shaft, but the disturbance still exists, go to Step 7.

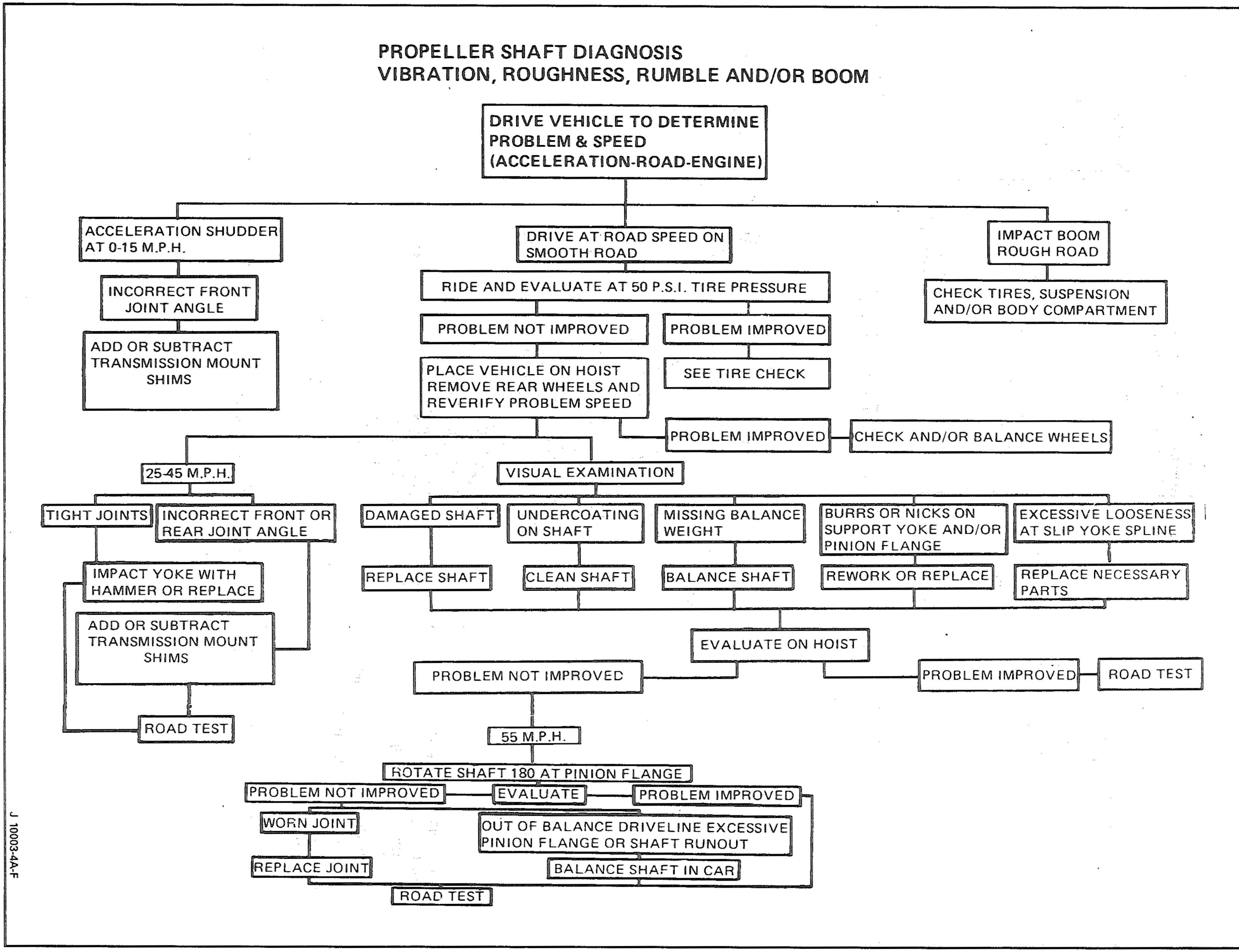


Figure 4A-3 Propeller Shaft Diagnostic Chart 2

J 10003-4A-F

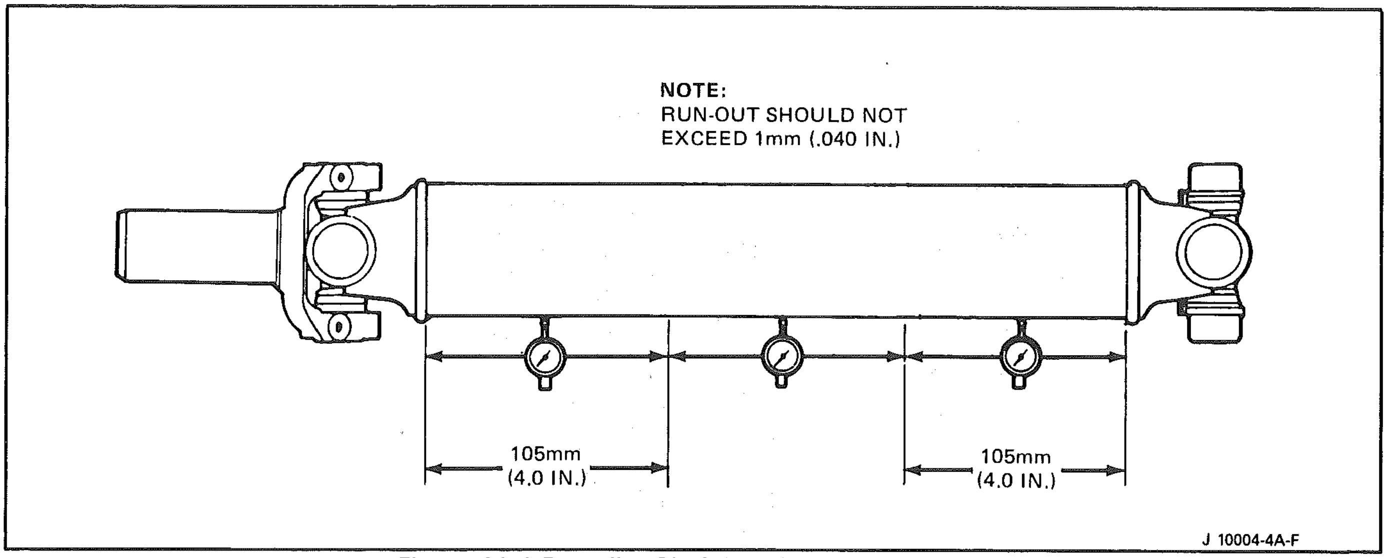
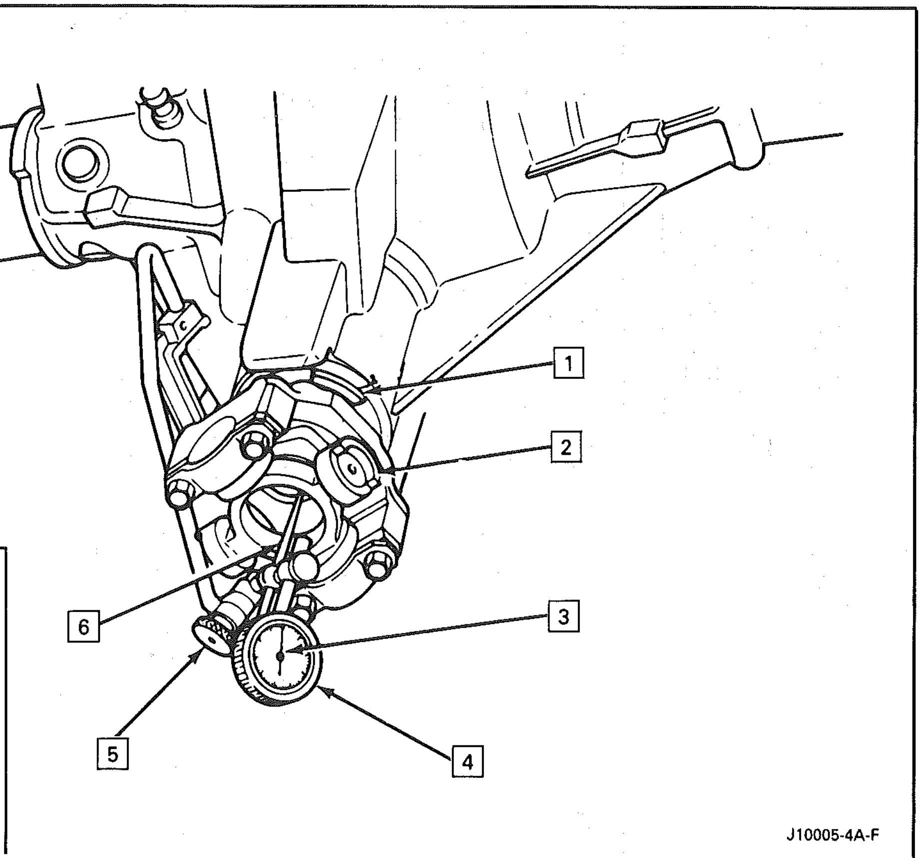


Figure 4A-4 Propeller Shaft Run-Out Measurement

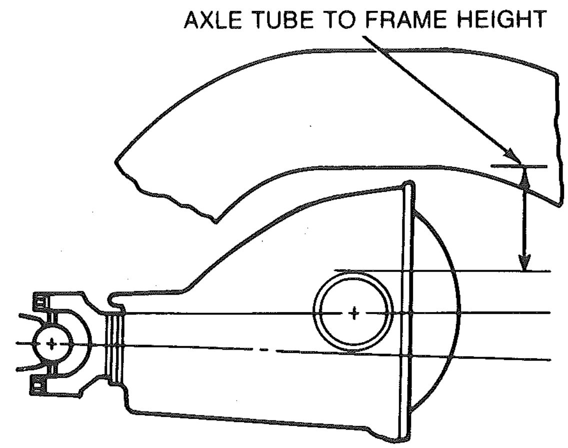


1. COMPENSATING WEIGHT LOCATION
2. J 35819 FLANGE RUN-OUT GAGE
3. MAXIMUM INDICATOR READING
4. J 8001-3 DIAL INDICATOR
5. J 8001-2 SWIVEL
6. J 8001-4

Figure 4A-5 Companion Flange Run-Out Measurement

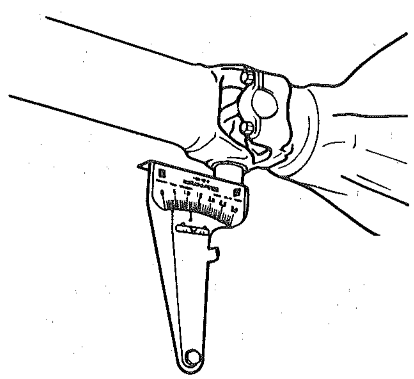
ALL F SERIES		
AXLE TUBE TO FRAME HEIGHT*	UNIVERSAL JOINT ANGLES	
	FRONT	REAR
119 mm	1.1°	1.5°

* WEIGHT MAY HAVE TO BE ADDED TO VEHICLE TO REACH THIS DIMENSION.



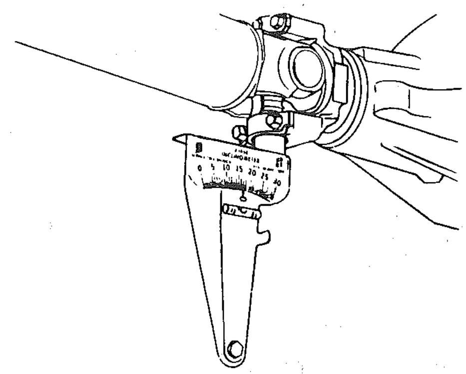
J 10006-4A-F

Figure 4A-6 Propeller Shaft Angles/Frame Height



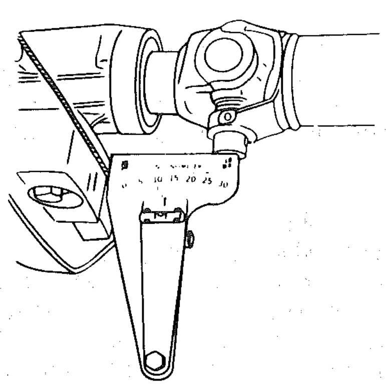
J 10007-4A-F

Figure 4A-7 Angle Measurement at Rear Prop. Shaft Brg. Cap



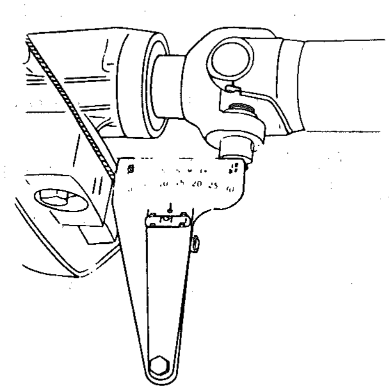
J 10008-4A-F

Figure 4A-8 Angle Measurement at Comp. Flange Brg. Cap



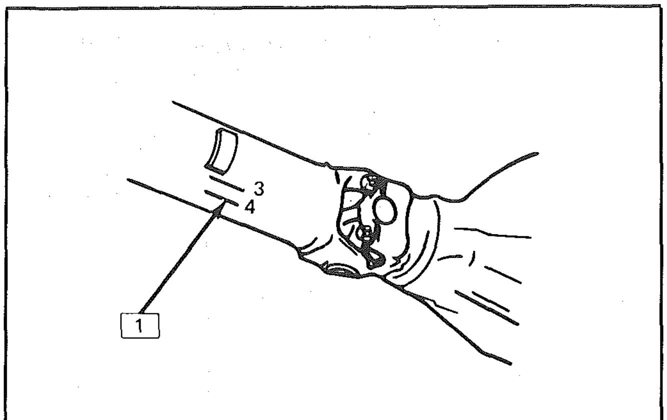
J 10009-4A-F

Figure 4A-9 Angle Measurement Frt. Prop. Shaft Brg. Cap



J 10010-4A-F

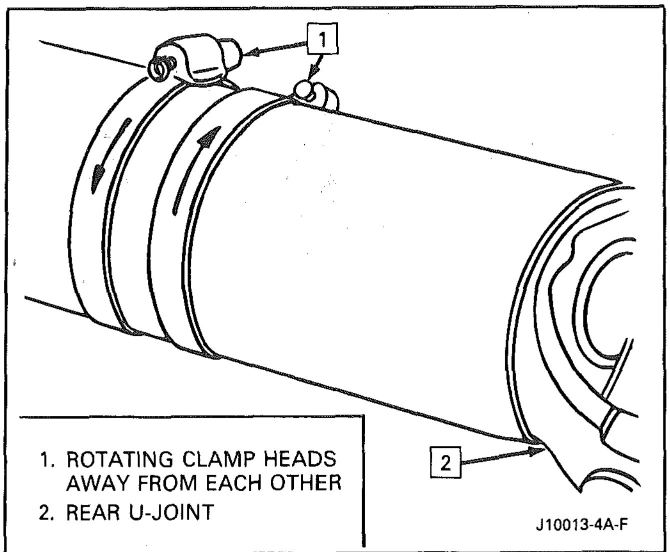
Figure 4A-10 Angle Measurement at Slip Yoke Brg. Cap



1. REFERENCE MARKS

J10011-4A-F

Figure 4A-11 Reference Marks on Propeller Shaft



1. ROTATING CLAMP HEADS AWAY FROM EACH OTHER
2. REAR U-JOINT

J10013-4A-F

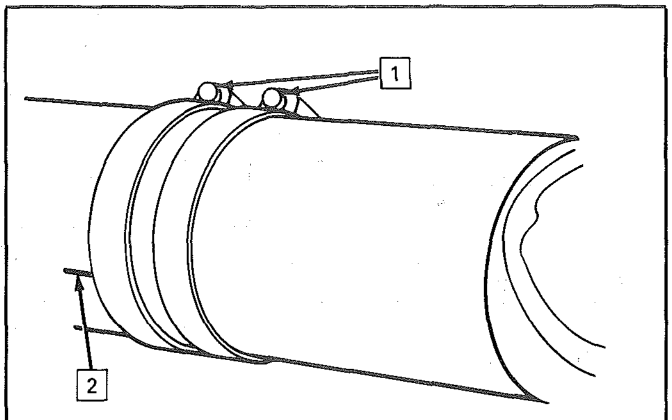
Figure 4A-13 Rotating Balance Hose Clamps

7. Rotate two of the hose clamps equally away from each other toward the top (one on each side of the position) in small increments until the best balance is achieved.
   In some cases it may be necessary to use one clamp or possibly three clamps in order to obtain a good balance.
   Replace the propeller shaft if three hose clamps do not correct problem.
8. Install wheels and road test vehicle for final check of balance.
   Vibration felt in the vehicle on the hoist may not show up during a road test.

PROPELLER SHAFT

Removal

NOTICE: Do not pound on original propeller shaft yoke ears as nylon injected joints may fracture.



1. HOSE CLAMP HEADS 180° FROM CRAYON MARK
2. CRAYON MARK

J10012-4A-F

Figure 4A-12 Balance Hose Clamps in Place

1. Raise vehicle on hoist. Mark relationship of shaft to rear axle pinion companion flange and disconnect the rear universal joint by removing strap bolts. If bearing caps are loose, tape together to prevent dropping and loss of bearing rollers.

2. Withdraw propeller shaft slip yoke from transmission by moving it rearward and passing it under the axle carrier.

NOTICE: Do not allow propeller shaft to drop or allow universal joints to bend to an extreme angle, since this may fracture the nylon injected joint internally. Support propeller shaft during removal.

Installation

NOTICE: The propeller shaft must be supported carefully during handling to avoid jamming or bending any of the parts.

1. Inspect outer diameter of splined yoke to ensure it is not burred since this may cause damage to the transmission extension housing seal and/or bushing. Inspect splines of slip yoke for damage or wear.

2. Apply lubricant to splined propeller shaft yoke and slide yoke/propeller shaft assembly onto transmission output shaft. **Do not drive propeller shaft in place with hammer. Check for burrs on transmission output shaft spline, twisted slip yoke splines, or possibly the wrong slip yoke. Make sure that the splines agree in number and fit. To prevent trunnion seal**

damage, do not place any tool between propeller shaft yoke and the universal joint spider.

When making the rear propeller shaft connection, be sure to align marks made on the pinion flange and propeller shaft prior to removal.

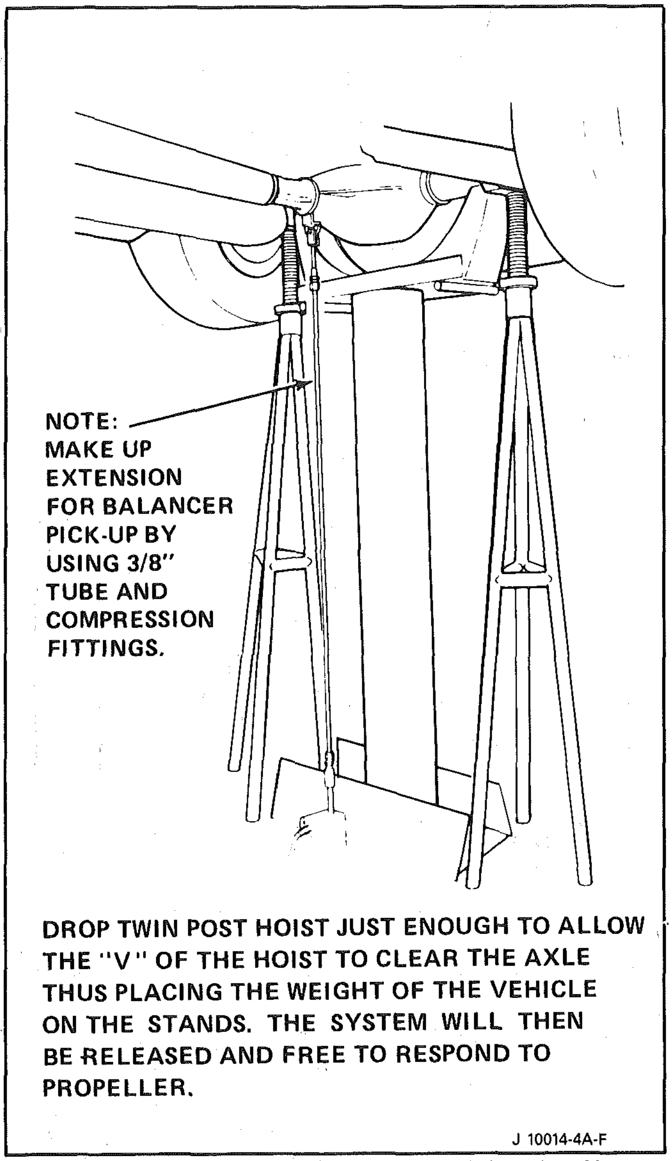


Figure 4A-14 Pick-Up Unit at Differential Pinion Nose

3. Align rear universal joint to rear axle pinion companion flange, making sure bearings are properly seated.

4. Install rear universal joint straps and fasteners and torque to specifications.

UNIT REPAIR

UNIVERSAL JOINTS

NOTICE: Mark slip joint and propeller shaft to ensure correct reassembly.

Nylon Injected Ring Type

Disassembly

Figures 4A-16, 4A-18 and 4A-19

NOTICE: Never clamp propeller shaft tubing in a vise, as the tube may be dented. Always clamp on one of the yokes and support the shaft horizontally. Avoid damaging the slip yoke sealing surface. Nicks may damage the bushing or cut the transmission extension housing seal.

1. Support the propeller shaft in a horizontal position on line with the base plate of a press. Place the universal joint so that the lower ear of the shaft yoke is supported on a 1 1/8" socket. Place Tool J-9522-3 on the open horizontal bearing cap and press the lower bearing cap out of the yoke ear. This will shear the nylon injected retaining ring on the lower bearing cap. If the bearing cap is not completely removed, lift Tool J-9522-3 and insert Spacer J-9522-5 between the seal and bearing cap being removed, as shown. Complete the removal of the bearing cup by pressing it out of the yoke.
2. Rotate the propeller shaft, shear the opposite nylon injected retaining ring and press the bearing cap out of the yoke.
3. Disengage cross from yoke and remove.
4. If the front universal joint is being replaced, remove the pair of bearing caps from the slip yoke in the same manner.

Assembly

Figures 4A-20 thru 4A-22

NOTICE: Production universal joints of this type cannot be reassembled. There are no snap ring bearing retainer grooves in production nylon injected ring retained bearing caps.

When reassembling a propeller shaft, always install a complete universal joint service kit. This kit includes one (1) pregreased cross assembly, four (4) service bearing cap assemblies with seals, needle rollers, washers, grease and four (4) snap rings. Make sure the seals are in place on the service bearing caps to hold the needle rollers in place during handling. Nylon injected types are replaced by external snap ring types, unless specified otherwise in the service parts manual.

1. Remove all of the remains of the nylon injected bearing cap retainers from the grooves in the yokes. The sheared nylon may prevent the bearing caps from being pressed into place, and thus prevent the bearing retainers from being properly seated.
2. Install one (1) bearing cup part way into one side of the yoke, and turn this yoke ear to the bottom.
3. Insert cross into yoke so that the trunnion seats freely into bearing cap.
4. Install opposite bearing cap part way. Make sure that both trunnions are started straight and true into both bearing caps.

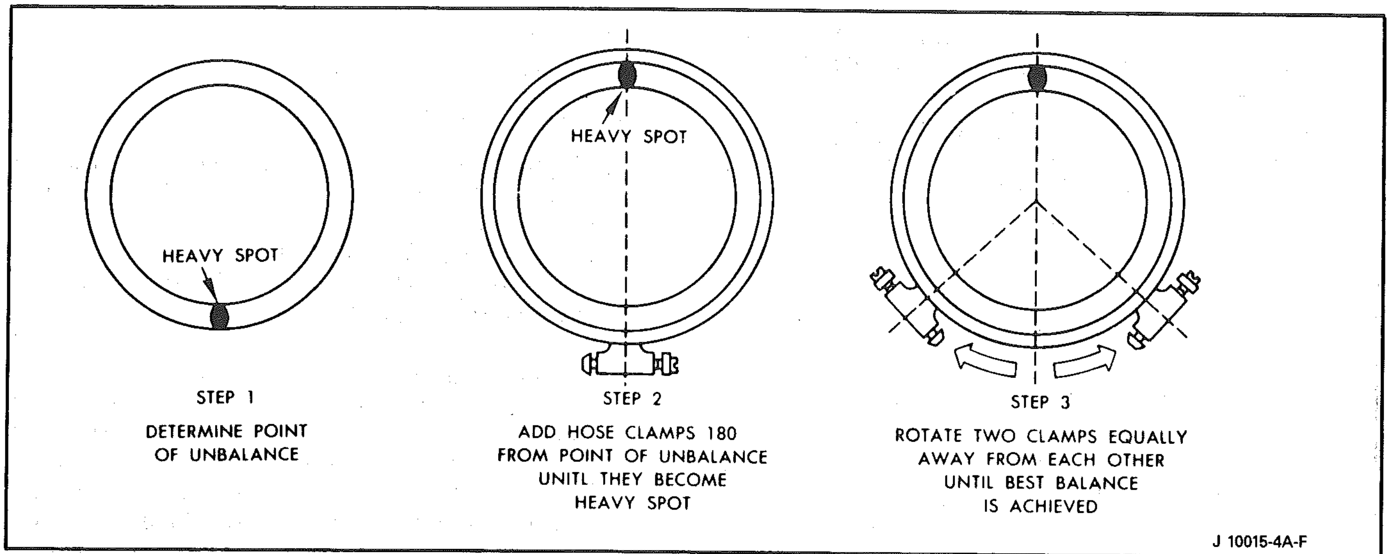


Figure 4A-15 Positioning Hose Clamps to Achieve Best Balance

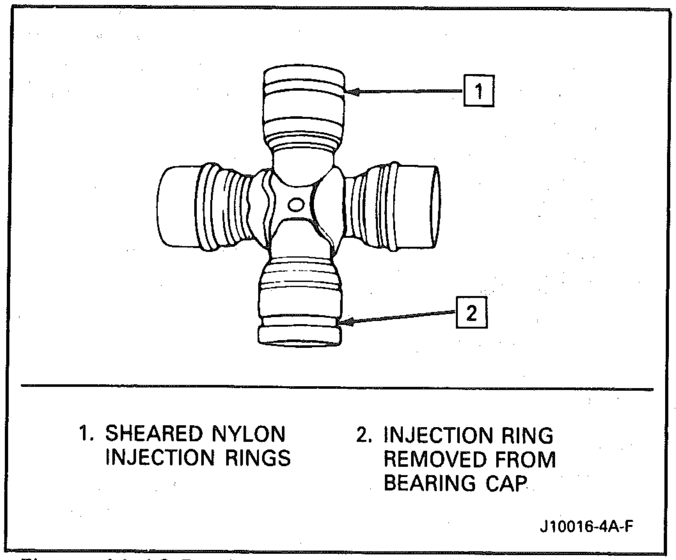


Figure 4A-16 Production U-Joints-Nylon Injected Ring Type

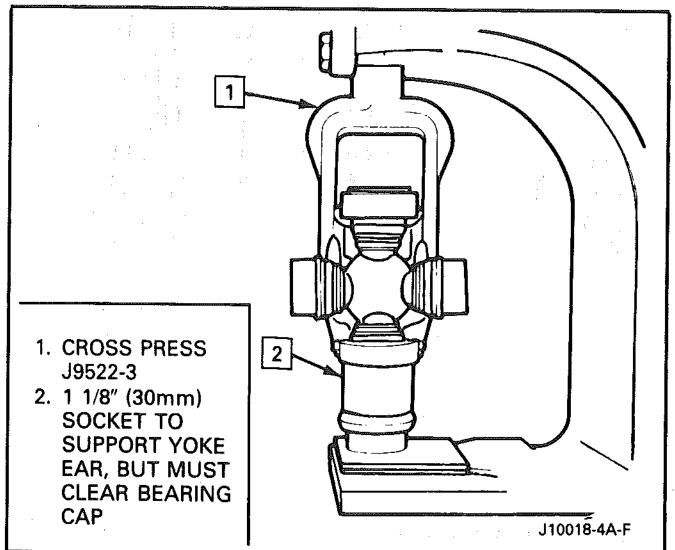


Figure 4A-18 Pressing Out Universal Joint Bearing Cap

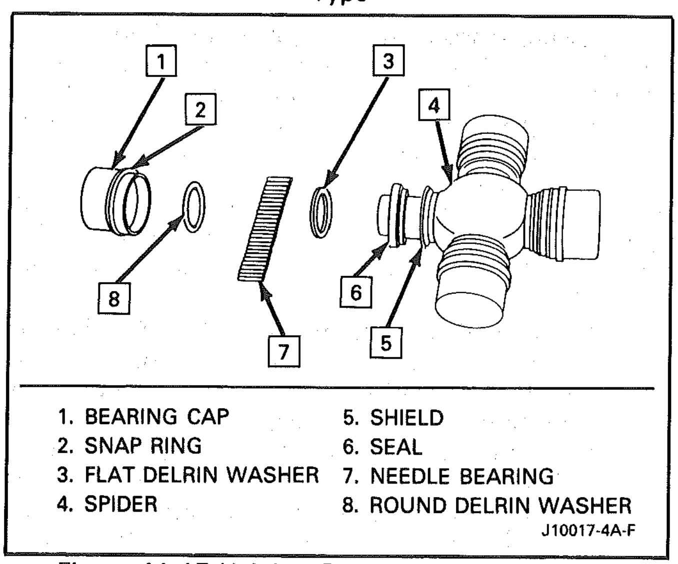


Figure 4A-17 U-Joints-External Snap Ring Type

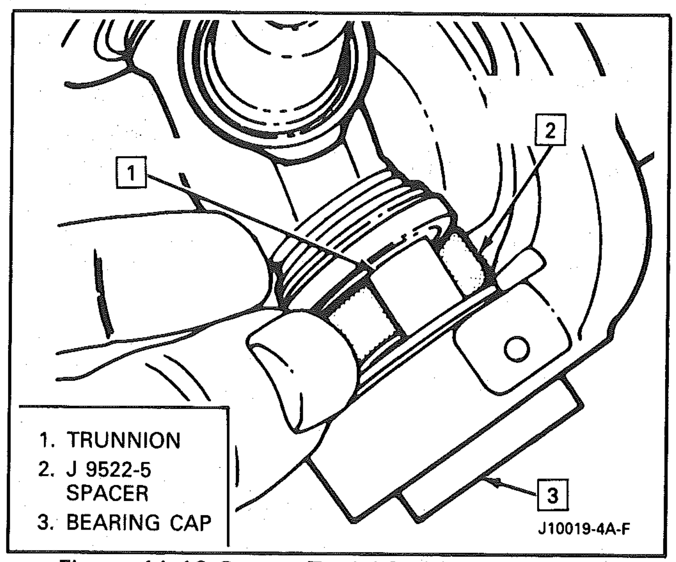
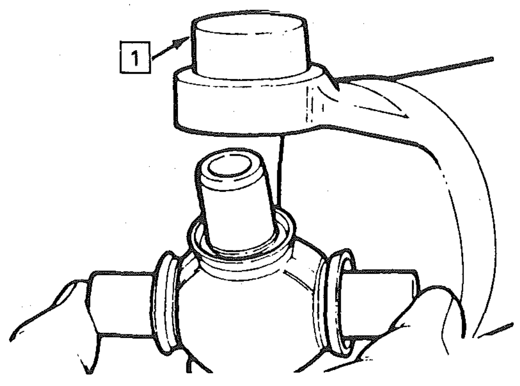


Figure 4A-19 Spacer Tool J-9522-5 Installation

5. Press against opposite bearing caps, working the cross all of the time to check for free movement of the trunnions in the bearing caps. If there seems to be a hang-up, stop pressing and recheck



1. PARTIALLY INSERTED BEARING CAP

J10020-4A-F

Figure 4A-20 Partially Inserted Bearing Cap

needle bearings. One or more of them has probably been tipped under the end of the trunnion.

6. As soon as one bearing cap snap ring retainer groove clears the inside of the yoke, stop pressing and install snap ring into place.
7. Continue to press until the opposite snap ring can be installed in place. If difficulty is encountered, strike the yoke firmly with a hammer to aid in seating snap rings. This springs the yoke ears slightly.
8. Assemble the other half of the universal joint in the same manner.

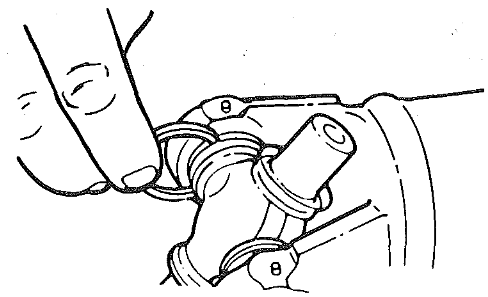
External Snap Ring Type

Disassembly

Figures 4A-17 thru 4A-19

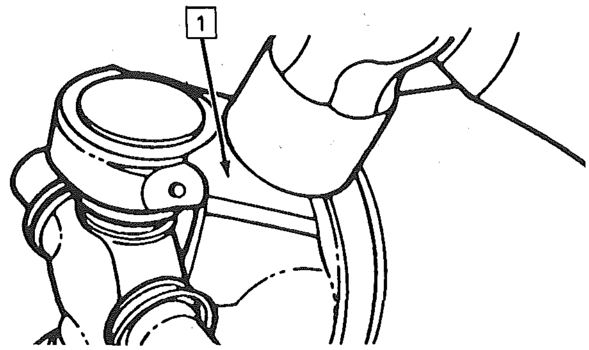
These universal joints are of the extended-life design and do not require periodic inspection or lubrication; however, when these joints are disassembled, repack bearings and lubricate reservoir at end of trunnions with chassis lubricant. Use care not to loosen or damage dust seals. If dust seals are loose or damaged, the entire universal joint must be replaced.

1. Remove snap rings. If snap ring does not readily snap out of the grooves, tap the end of the bearing cap lightly to relieve the pressure against the snap ring.
2. Support the propeller shaft in a horizontal position in line with the base plate of a press. Place the universal joint so the lower ear of the propeller shaft yoke is supported on a 1 1/8″ socket. Place Tool J-9522-3 on the open horizontal bearing cap and press the lower bearing cap out of the yoke ear. If the bearing cap is not completely removed, lift Tool J-9522-3 and insert Spacer J-9522-5 between the seal and bearing cap being removed, as shown. Complete the removal of the bearing cap by pressing it out of the yoke.
3. Rotate the propeller shaft and press the bearing cap out of the yoke.



J10021-4A-F

Figure 4A-21 Installing Retaining Rings - External Type



1. STRIKE TUBE YOKE EAR IN THIS AREA

J10022-4A-F

Figure 4A-22 Seating Universal Joint Snap Rings

4. Disengage cross from yoke and remove.

Assembly

Figures 4A-20 thru 4A-22

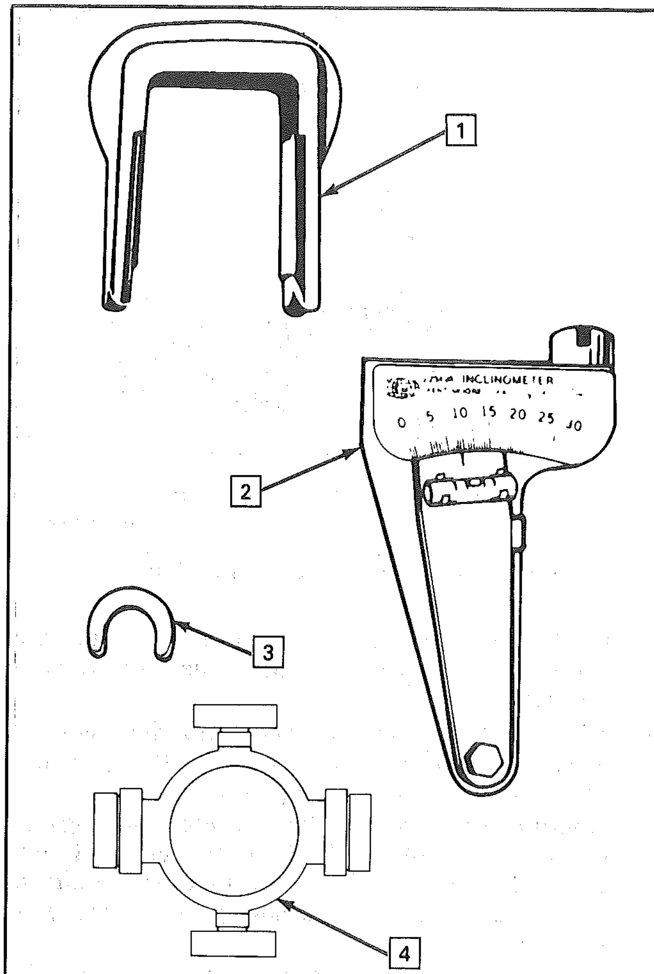
1. Install one (1) bearing cap part way into one side of the yokes and turn this yoke ear to the bottom.
2. Insert cross into yoke so that the trunnion seats freely into bearing cap.
3. Install opposite bearing cap part way, making sure both trunnions are started straight and true into the bearing caps.
4. Press against opposite bearing caps, working the cross all of the time to check for free movement of the trunnions in the bearing caps. If there seems to be a hang-up, stop pressing and recheck needle bearings. One or more of them has probably been tipped under the end of the trunnion.
5. As soon as one bearing cap snap ring retainer groove clears the inside of the yoke, stop pressing and install snap ring into place.

6. Continue to press until the opposite snap ring can be installed into place. If difficulty is encountered, strike the yoke firmly with a hammer to aid in seating the snap rings. This springs the yoke ears slightly.
7. Assemble the other half of the universal joint in the same manner.

Rear Universal Joint Strap Bolt	16-27 N·m	(12-20 ft. lbs.)

J 10023-4A-F

Figure 4A-23 Torque Specifications



1. J 9522-3 CROSS REMOVER
2. J 23498-A DRIVE SHAFT INCLINOMETER
3. J 9522-5 SPACER
4. J 35819

J10024-4A-F

Figure 4A-24 Special Tools

SECTION 4B1

BORG WARNER REAR AXLE

NOTICE: All rear axle attaching fasteners are an important part in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. (There is to be no welding as it may result in extensive damage and weakening of the metal.)

CONTENTS

GENERAL DESCRIPTION

STANDARD REAR AXLE

The rear axle assembly is of the semi-floating type in which the car weight is carried on the axle housing. The rear axle assembly is designed for use with an open drive line and coil springs. The rear axle has a hypoid type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear.

All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a salisbury type axle housing (a carrier casting with tubes pressed and welded into the carrier to form a complete carrier and tube assembly). A removable steel cover bolted to the rear of the carrier permits service of the rear axle without removing the entire assembly from the car.

GENERAL INFORMATION

NOTICE: Most rear axle service repairs can be made with the rear axle assembly in the car, by raising the rear end of the car with the rear axle hanging on the shock absorbers.

A universal joint connects the rear end of the propeller shaft to a companion flange having a splined end which fits over and drives the hypoid pinion gear.

Two pre-loaded tapered roller bearings support the hypoid pinion gear in the carrier. The inner race of the rear bearing is a tight press fit on the pinion stem. The inner race of the front bearing combines a light press fit to a close sliding fit on the pinion flange end of the pinion stem. The outer race of each bearing is pressed against a shoulder recessed in the carrier. Tightening the pinion nut compresses a collapsible spacer which bears against the inner race of the front bearing and a shoulder on the pinion stem. This spacer is used to enable accurate bearing pre-load adjustment and maintain a pre-load on both front and rear pinion bearings. Adjustment of the fore and aft position of the pinion is obtained by placing a shim between the rear pinion bearing cup and axle housing. The differential case is of two-piece construction and is supported in the carrier by two tapered roller side bearings. Pre-load rear axle case by inserting shims between the bearings and the carrier. The rear axle case assembly is positioned for proper ring gear to pinion backlash by varying the shim thickness from side to side. The ring gear is bolted to the case. Two side gears have splined bores for driving the axle shafts. They are positioned to turn in counterbored cavities in the case. The four rear axle pinions have smooth bores and are held in position by a pinion cross shaft, mounted and locked in the rear axle case. All six gears are in mesh with each other and because the pinion gears turn freely on their shaft, they act as idler gears when the rear wheels are turning at different speeds. The pinions and side gears are backed by steel thrust washers.

LIMITED-SLIP REAR AXLE

The operation of the Limited-Slip differential is the same as the standard differential, except that there is additional friction provided by the conical clutches. Under ordinary driving and cornering conditions, the cones slip, allowing the outside wheel to turn faster than the inner. Under poor traction conditions, such as ice, snow, or loose gravel under one driving wheel, the increased friction provided by the cones increases the driving torque available to the wheel with the better traction. The cones are spring loaded to provide the increased driving torque under extremely low traction conditions.

Operation

When the vehicle turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel, turning slower than the outer wheel, slows its differential side gear (as the axle shaft is splined to the side gear) and the differential pinion gears will roll around the slowed differential side gear, driving the other differential side gear and wheel faster.

DIAGNOSIS AND TESTING

Many noises reported as coming from the rear axle assembly actually originate from other sources such as tires, road surfaces, front wheel bearings, axle bearing, engine, transmission, muffler or body drumming. A thorough and careful check should be made to determine the source of the noise before disassembling the rear axle. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the differential. It should also be remembered that rear axle gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

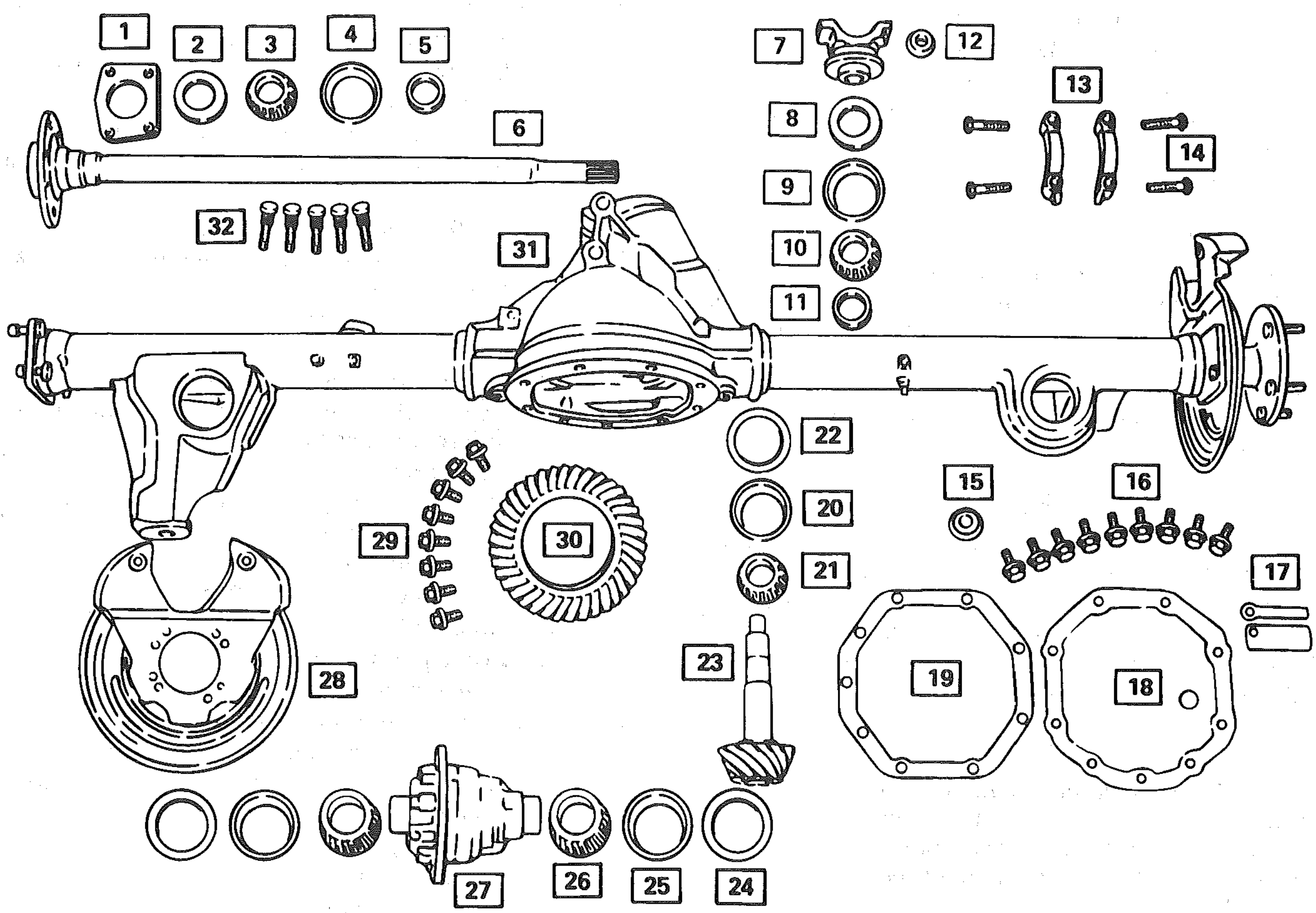
To make a systematic check for axle noise under standard conditions, observe the following:

1. Select a level smooth asphalt road to reduce tire noise and body drumming.
2. Check rear axle lubricant to assure correct level, then drive car far enough to thoroughly warm up rear axle lubricant, approximately 10 miles.
3. Note speed and RPM at which noise occurs. Stop car and put transmission in neutral. Run engine slowly up and down through engine speeds, corresponding to car speed at which noise was most pronounced, to determine if it is caused by exhaust, muffler roar or other engine conditions.
4. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure *for test purposes only* will materially alter noise caused by tires, but will not affect noise caused by rear axle. Rear axle noise usually stops when coasting at speeds under 30 miles per hour; however, tire noise continues, but with lower tone, as car speed is reduced. Rear axle noise usually changes when comparing acceleration and coast, but tire noise remains about the same.

   Distinguish between tire noise and rear axle noise by noting if noise varies with various speeds or sudden acceleration and deceleration; exhaust and axle noise show variations under these conditions while tire noise remains constant and is more pronounced at speeds of 20 to 30 miles per hour. Further check for tire noise by driving car over smooth pavements or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and reappear with changes in road surface.
5. Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing drive and coast. Light application of brakes while holding car speed steady will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, also by shaking wheels to determine if bearings are loose.
6. Rear suspension rubber bushings and spring insulators dampen out rear axle noise when correctly installed. Check to see that no metallic contact exists between the spring and spring seat opening in frame or between upper and lower control arm bushings and frame or axle housing brackets. The track bar and torque arm must be bolted securely. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by bushings.

AXLE NOISES

After the noise has been determined as being in the axle by following the above appraisal procedure, the type of axle noise should be determined to aid in making repairs if necessary.



1—OUTER BRG. RETAINER
2—WHEEL SEAL
3—WHEEL BRG. CONE
4—WHEEL BRG. CUP
5—INNER BRG. RETAINER
6—AXLE SHAFT
7—COMPANION FLANGE
8 —PINION OIL SEAL
9—FRONT PINION BRG. CUP
10—FRONT PINION BRG. CONE
11—COLLAPSIBLE SPACER
12—PINION NUT
13—DIFFERENTIAL BRG. CAPS
14—DIFFERENTIAL CAP BOLTS
15—FILLER PLUG
16—REAR COVER BOLTS
17—LUBRICATION TAG & IDENTIFICATION TAG
18—REAR COVER
19—REAR COVER GASKET
20—REAR PINION BRG. CUP
21—REAR PINION BRG. CONE
22—PINION POSITION SHIM
23—HYPOID PINION
24—DIFF. BRG. SHIM
25—DIFF. BRG. CUP
26—DIFF. BRG. CONE
27—DIFFERENTIAL ASSY
28—BRAKE BACKING PLATE
29—RING GEAR BOLTS
30—HYPOID RING GEAR
31—CARRIER & TUBE ASSY
32—WHEEL BOLTS

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Fig. 1 Standard Rear Axle

Gear Noise

Gear noise (whine) is audible from 20 to 55 mph under four driving conditions:

1. Light Acceleration - Accelerate slowly.
2. Road Load - Car driving load or constant speed.
3. Float - Using enough throttle to keep the car from driving the engine - car slows down gradually but engine still pulls slightly.
4. Coast - Throttle closed and car in gear.

Bearing Noise

Bad bearings generally produce more of a rough growl or grating sound, rather than the whine typical of gear noise. Bearing noise frequently "wow-wows" at bearing rpm, indicating a defective pinion or rear axle case side bearing. This noise could easily be confused with rear wheel bearing noise. Inspect and replace as required.

Rear Wheel Bearing Noise

A rough rear wheel bearing produces a noise which continues with car coasting at low speed and transmission in neutral. Noise may diminish some by gentle braking. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough (noisy) wheel bearing.

Knock At Low Speeds

Low speed knock can be caused by worn universal joints or a side gear hub counterbore in a case that has worn oversize. Inspect and replace universal joint or case and side gear as required.

Backlash Clunk

Excessive clunk with acceleration and deceleration is caused by worn differential pinion gear shaft, excessive clearance between axle shaft and side gear splines, excessive clearance between side gear hub and counterbore in case, worn pinion and side gear teeth, worn thrust washers and excessive drive pinion and ring gear backlash. Remove worn parts and replace as required, selecting close fitting parts when possible. Adjust pinion and ring gear backlash.

DIAGNOSIS

1. Noise is the same in "Light Acceleration" or "Coast".
   a. Road noise.
   b. Tire noise.
   c. Front wheel bearing noise.
   d. Rear axle bearing noise.
2. Noise changes on a different type of road.
   a. Road noise.
   b. Tire noise.
3. Noise tone lowers as car speed is lowered.
   a. Tire noise.
   b. Front wheel bearings and rear axle bearings.
   c. Gear noise.
4. Similar noise is produced with car standing and driving.
   a. Engine noise.
   b. Transmission noise.
   c. Exhaust noise.
5. Vibration.
   a. Rough rear axle bearing.
   b. Unbalanced or damaged propeller shaft.
   c. Tire unbalance.
   d. Worn universal joint in propeller shaft.
   e. Mis-indexed propeller shaft at pinion flange.
   f. Pinion flange runout too great.
6. A knock or click approximately every two revolutions of the rear wheel.
   a. A rear axle bearing.
   b. Worn case.
7. Noise most pronounced on turns.
   a. Rear axle side gear and pinion noise, differential gear noise.
   b. Axle bearings.
8. A continuous low pitch whirring or scraping noise starting at relatively low speed.
   a. All bearing noise.
9. Drive noise, coast noise or float noise.
   a. Ring and pinion gear noise.
   b. Front pinion bearing noise, coast or drive.
   c. Axle bearing noise.
10. Clunk on acceleration or deceleration.
   a. Worn rear axle pinion shaft splines.
   b. Side gear hub counterbore in case worn oversize.
   c. Worn U-joints.
   d. Excessive transmission backlash.
   e. Worn axle shaft splines.
11. Chatter on turns.
   a. Wrong lube in rear axle.
   b. Clutch cone worn or spalled.
12. Clunk or knock on rough road operation.
   a. Worn suspension bushings.

PRE-REPAIR INVESTIGATION AND TROUBLE DIAGNOSIS

A carefull diagnosis of the rear axle prior to disassembly will often reveal valuable information as to the extent and type of repairs or adjustments necessary. Since frequent causes of axle noises are improper backlash, pinion bearing pre-load, or side bearing pre-load, or a combination, a few simple adjustments may be all that are necessary to correct a problem.

Before disassembling the rear axle, the following checks should be made with the results recorded and analyzed: 1) Backlash; 2) Total Assembly Preload; 3) Tooth Contact Pattern Test; 4) Fluid Level; and 5) Fluid Contamination.

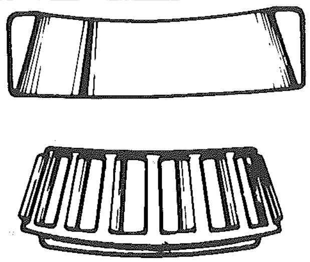
If axle shaft end play is excessive then check bearings, retainer, and bolts securing backing plate. The axle bearings could be worn and need replacement. The four bolts or nuts securing the brake backing plate may be loose, stripped, or missing. If the inner bearing retainer worked loose it must be replaced.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot or sand, away from differential to prevent possibility of subsequent failure.

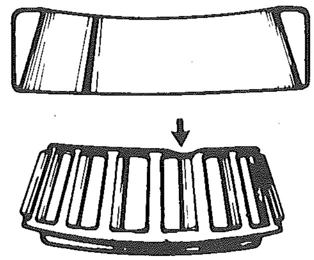
TAPERED ROLLER BEARING DIAGNOSIS

CONSIDER THE FOLLOWING FACTORS WHEN DIAGNOSING BEARING CONDITION:

1. GENERAL CONDITION OF ALL PARTS DURING DISASSEMBLY AND INSPECTION.
2. CLASSIFY THE FAILURE WITH THE AID OF THE ILLUSTRATIONS.
3. DETERMINE THE CAUSE.
4. MAKE ALL REPAIRS FOLLOWING RECOMMENDED PROCEDURES.



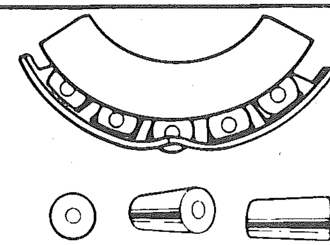
GOOD BEARING



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

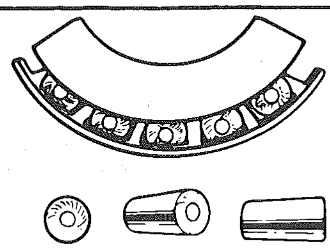
REPLACE BEARING.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

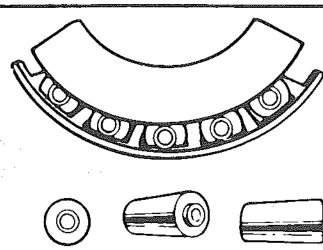
REPLACE BEARING



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD.

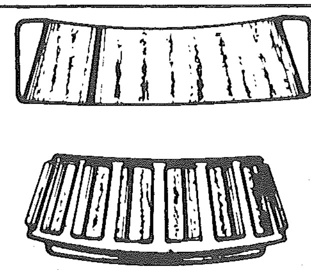
REPLACE BEARING – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

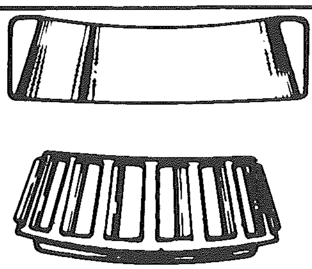
CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.

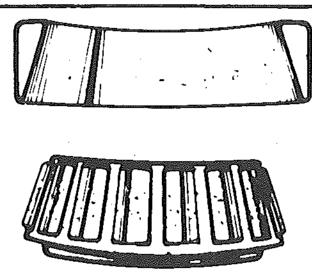
REPLACE BEARINGS – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



MISALIGNMENT

OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.

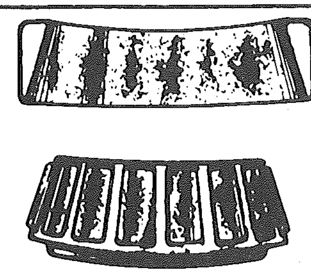
CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.



INDENTATIONS

SURFACE DEPRESSIONS ON RACE AND ROLLERS CAUSED BY HARD PARTICLES OF FOREIGN MATERIAL.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND REPLACE BEARINGS IF ROUGH OR NOISY.



FATIGUE SPALLING

FLAKING OF SURFACE METAL RESULTING FROM FATIGUE.

REPLACE BEARING – CLEAN ALL RELATED PARTS.

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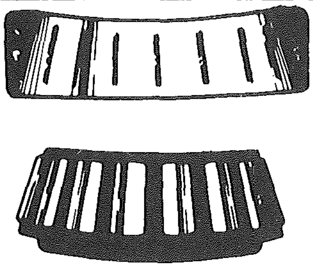
Fig. 2 Rear Axle Bearing Diagnosis

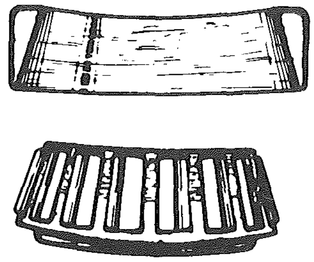
TAPERED ROLLER BEARING DIAGNOSIS - CONT'D



BRINELLING

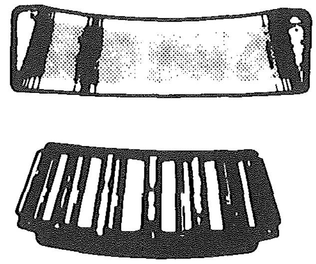
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.



CAGE WEAR

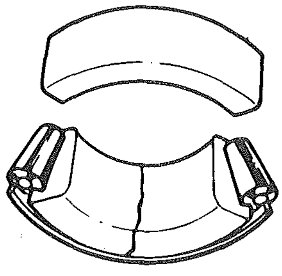
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

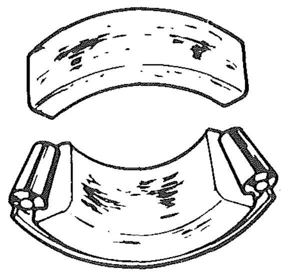
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

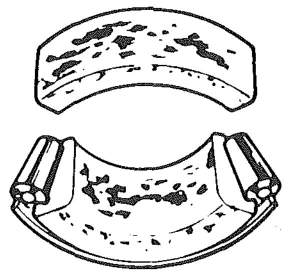


SMEARS

SMEARING OF METAL DUE TO SLIPPAGE, SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FIT AND LUBRICATION.

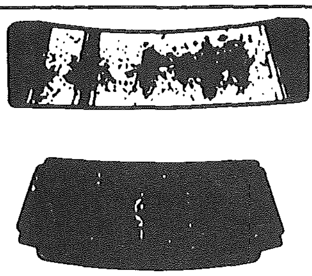
REPLACE SHAFT IF DAMAGED.



FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



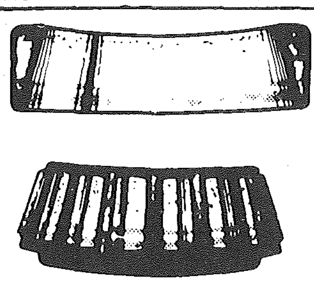
HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.



STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.

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Fig. 3 Rear Axle Bearing Diagnosis

ON-VEHICLE SERVICE

CARRIER COVER AND GASKET

Remove or Disconnect

1. Having a container in place remove drain plug with tool J-35117,remove cover bolts and pry cover loose to drain lubricant.
2. Make sure both gasket sealing surfaces are clean.

Install or Connect

Use cover gasket (do not assemble with sealant alone).

NOTICE: Apply locktite part No. 573, GM Part Nos. 1052080, or 1052279 or equivalent to cover bolts before installing cover. If sealant is not applied bolts may loosen causing fluid leak and damage to rear axle assembly.

1. Torque cover bolts in a crosswise pattern to insure uniform draw on gasket. Torque 26 N·m (20 lb.ft.).
2. Fill with lubricant to bottom of filler plug hole. Refer to specifications for correct lubricant usage and quantity.

AXLE SHAFT

Remove or Disconnect

1. Wheel and brake components as necessary.
2. The four nuts holding the brake anchor plate and outer bearing retainer.
3. Withdraw the axle shaft and wheel bearing assembly using axle shaft remover J 21579 and slide hammer J 2619-01 (Fig. 4).

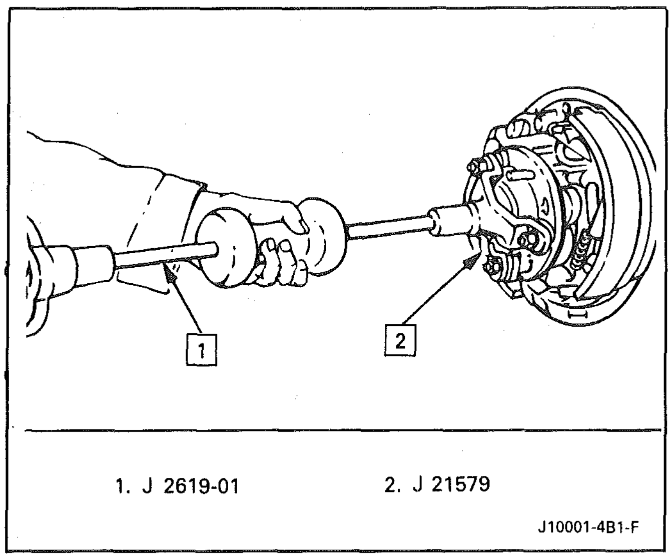


Fig. 4 Axle Shaft Removal

4. Inner bearing retainer and bearing from axle shaft. To do this carefully split the retainer with a chisel and remove from shaft. Press off bearing with tool J-22912-01 from axle. Discard bearing and seal (Fig. 5).

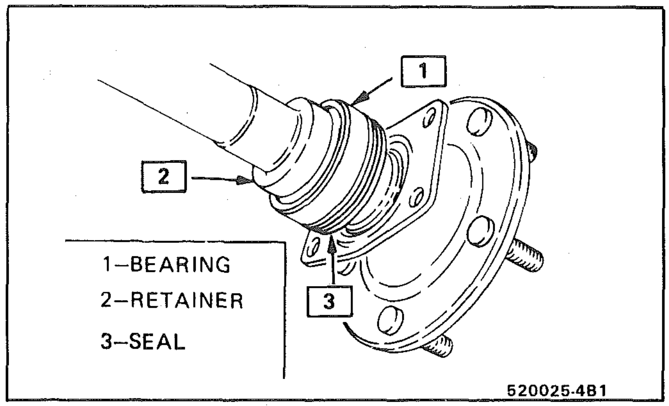


Fig. 5 Bearing and Seal Removal

Examine axle shaft. If axle shaft is in satisfactory condition it may be re-used.

Important

Bearings and inner bearing retainers which have been removed from an axle shaft should not be re-used.

Install or Connect

1. Place the outer bearing retainer on the axle shaft.

Important

Right and left hand axle shaft seals are different in construction. Right hand seal is black banded with right hand ridges. Left hand seal is gold banded with left hand ridges. The part numbers designate left and right sides.

2. Place the oil seal on the axle shaft ensuring that the spring side of the oil seal faces the center of the axle. Lubricate seals lips with a light coat of grease. Note use of excessive amounts of grease may damage seal.
3. Press wheel bearing and inner bearing retainer hard against bearing shoulder on axle shaft with tool J 8853-01, ensuring that the retainer is tight against the bearing and with O.D. chamfer towards bearing.
4. Place the axle shaft through the brake anchor plate and align axle shaft and side gear splines.
5. Once the splines have been engaged in the side gears the wheel bearing and oil seal may be pushed into the housing. A light coat of grease on the seal outside diameter will assist in installation. Tighten four backing plate bolts alternately. Use new locknuts on bolts. (Refer to specifications).

NOTICE: If a limited-slip differential is used ensure that both axle shaft splines are fully engaged before the axle shafts are rotated. This is to mainatain spline alignment, refer to limited-slip instructions.

6. Replace brake components and wheel.
7. Tighten wheel nuts and lower vehicle.

Tooth Contact Pattern Test

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. Toe end of tooth is smaller than heel end.

It is very important that tooth contact be tested before the rear axle carrier assembly is disassembled. Variations in the carrier or pinion rear bearing may cause the pinion to be too far away from, or close to, the ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

Procedure

1. Drain oil out of carrier and carefully clean each tooth of ring gear.
2. Apply parking brake until a torque of 54 to 70 N·m (40-50 lb. ft.) is required to turn the pinion.
3. Tighten bearing cap bolts to 52 N·m (40 lb. ft.).
4. Use gear marking compound part number 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.

   A test made without loading the gears will not give a satisfactory pattern. Turn pinion flange with wrench so that ring gear rotates five full revolutions, then reverse rotation so that ring gear rotates five revolutions in opposite direction.
5. Observe pattern on ring gear teeth and compare with Fig. 6.

Effects of Increasing Load on Teeth Contact Pattern

When "load" on ring and pinion gear is increased, such as when car is accelerated forward from standstill or from normal drive, the tooth contact will tend to spread out and, under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend only about halfway.

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern, backlash and position of drive pinion in carrier. The effects of bearing pre-loads are not readily apparent on (hand-loaded) tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims, which moves the entire case and ring gear assembly closer to, or farther from, the drive pinion (the adjusting shims are also used to set side bearing pre-load). The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the rear pinion cup and axle housing . The shim is used in the rear axle case to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Effects of Pinion Position on Tooth Pattern

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on coast side (Fig. 6). Moving the pinion closer to centerline of the ring gear by increasing shim thickness will cause the high heel contact on drive side to lower and move toward the toe; the high toe contact on coast side will lower and move toward the heel.

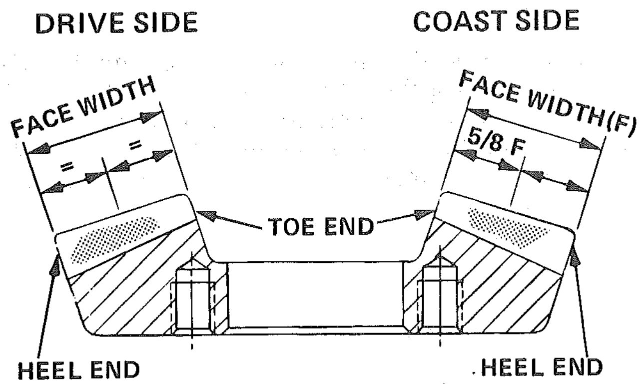
When the pinion is too close to the centerline of the ring gear, the pattern will be a low toe contact on drive side and a low heel contact on the coast side. Moving the pinion farther away from the ring gear by decreasing shim thickness will cause low toe contact on drive side to raise and move toward the heel; the low heel contact on coast side will raise and move toward the toe.

PINION OIL SEAL AND COMPANION FLANGE REPLACEMENT

←→ Remove or Disconnect

1. Mark the propeller shaft and companion flange so they can be reassembled in the same position. Remove four nuts and lock washers from two saddles retaining U-joints to companion flange and remove propeller shaft.
2. Measure and record preload at pinion - this includes pinion bearing, differential bearings, effect of grease and oil seal. (Figure 7).
3. Pinion nut with companion flange remover J-8614-01. (Figure 8).
4. Companion flange with companion flange remover J-8614-01. (Figure 8).
5. Seal and discard.

NOTICE: Before installing a new seal examine the surface of the companion flange on which the seal runs. Should this surface be damaged or the splines excessively worn, a new companion flange should be installed. Also examine the housing bore and remove any nicks or burrs.



ACCEPTABLE HEEL CONTACTS

A central face lengthwise position is shown here representing the limit of acceptability of the contacts position towards the heel.

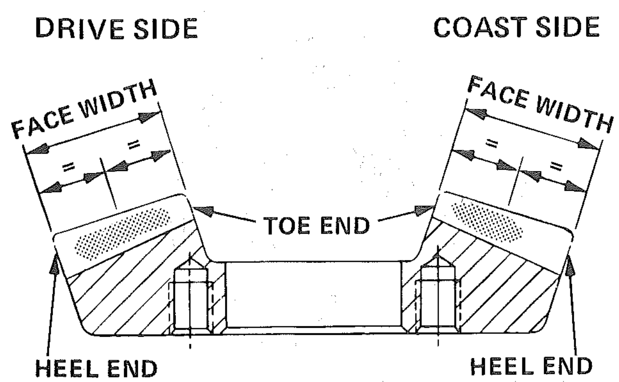
The contact should fade out at least 5mm before the heel end face.

A central profile position is shown and is acceptable although a low contact is preferred.

The center of the contact is located at 5/8 of the face width from the toe and it does not approach the heel end by less than 5mm.

A high contact pattern as shown is preferred for coast side contacts which tend to be towards the heel.

A central profile position is acceptable providing pinion face angle edge lines do not appear low on the gear.



IDEAL CONTACTS

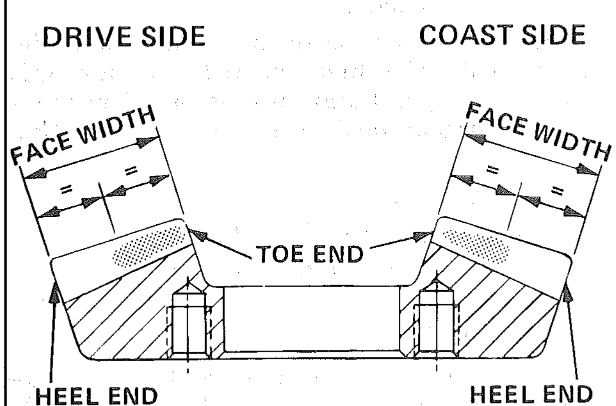
The contact begins almost at the toe end face and extends in length by approx. half the facewidth.

A slightly lower contact pattern as shown is preferrable although a centrally located profile postion will suffice.

The contact begins almost at the toe end face and may appear pointed as shown although a square end is equally acceptable.

The total length of contact is approx. 1/2 of the face width.

A high profile position is desirable although a central profile is acceptable.



ACCEPTABLE TOE CONTACTS

A central toe lengthwise position and a slightly lower contact pattern in the profile position. Total length about 5/8 of gear facewidth.

Note the clearance of about 1mm between the contact and the toe and along the top face angle line.

A centrally located lengthwise position and a slightly higher contact pattern in the profile position. Total length about 5/8 of the gear facewidth.

Note the clearance between the contact and the face angle line of the gear.

H20003-4B1

Fig. 6 Gear Tooth Contact Pattern

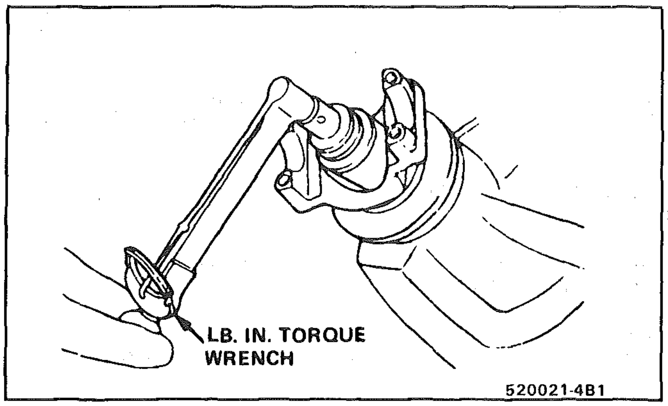


Fig. 7 Bearing Preload Measurement

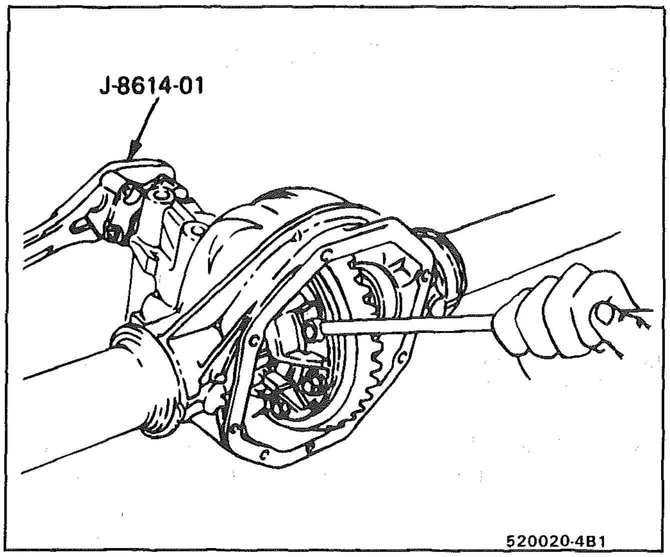


Fig. 8 Companion Flange Removal

Install or Connect

1. Lubricate oil seal lips with a light cover of grease.
2. Install new seal in carrier, flush to 0.25mm (0. 010) below surface with pinion seal installer J-35119. (Fig. 9).

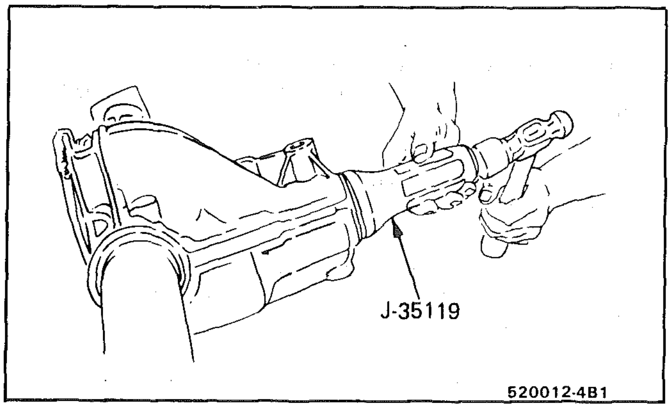


Fig. 9 Pinion Seal Installation

3. Companion flange and tighten nut to achieve the bearing preload as measured in Step 2 above plus 0.5 N·m (5 lb. in.) to allow for the new seal with companion flange installer J-8614-01 (Fig. 8).

NOTICE: If pinion nut is over tightened by more than 0.5 N·m (5 lb. in.) as in step 3 then the unit should be rebuilt with a new collapsible spacer as in step 3.

4. Align propeller shaft on locating marks and connect propeller shaft with 2 U saddles and 4 bolts and lockwashers to companion flange.
5. Fill with lubricant to bottom of filler plug hole. Refer to specifications for correct lubricant usage and quantity.
6. Filler plug.

REAR WHEEL BOLT

Remove or Disconnect

1. Raise vehicle on hoist allowing axle to hang freely.
2. Wheel, tire and caliper and rotor.
3. Using Tool J 6627-A press out stud (Fig. 10).

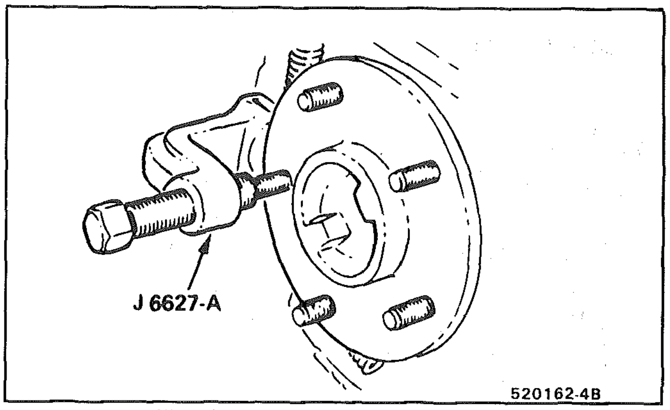


Fig. 10 Removing Wheel Stud

Install or Connect

1. Place new stud in axle flange hole. Slightly start stud serrations in hole by firmly pressing back of stud with your hand.
2. Place a flat washer on the stud and install a lug nut with flat side first (tapered face outboard). Tighten on lug nut drawing stud into flange until stud head is bottomed on back side of flange. (Fig. 11).
3. Remove lug nut.
4. Rotor and caliper, wheel and tire.
5. Lower vehicle and remove from hoist.

REAR AXLE ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed using the following procedure.

Remove or Disconnect

1. Hoist car and support at frame. Hoist must remain under rear axle housing.
2. Wheels and lug nuts.

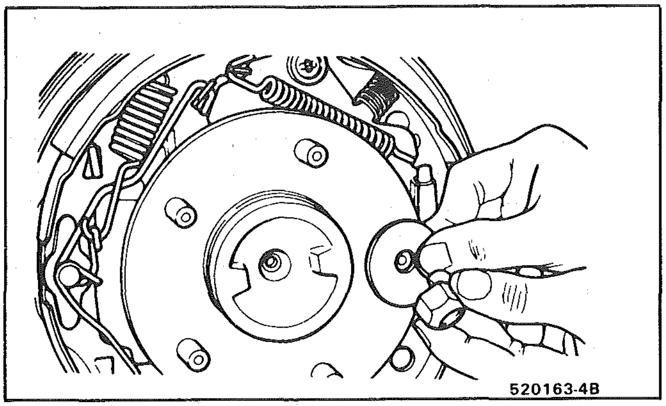


Fig. 11 Installing Wheel Bolt

3. Loosen parking brake cable adjuster nut and remove two parking brake cables from adjuster and body clips.
4. Shock absorbers from axle.
5. Track bar from rear axle and body.
6. Stabilizer bar links from axle and bushings.
7. Mark propeller shaft and companion flange, then disconnect and remove propeller shaft.
8. Brake line junction block bolt at axle housing, then disconnect brake lines at wheel cylinders.
9. Brake lines from clips.
10. Lower rear axle and remove springs.
11. Torque arm from rear axle.
12. Lower control arms from rear axle.
13. Lower hoist and remove rear axle assembly from vehicle.

Install or Connect

1. Raise hoist and rear axle assembly.
2. Lower control arms to rear axle.
3. Torque arm to rear axle.
4. Springs and raise rear axle assembly.
5. Brake lines to clips.
6. Brake line junction block bolt at axle housing, then connect brake lines at wheel cylinders or calipers.
7. Align drive shaft and pinion flange, then install drive shaft and connect.
8. Stabilizer bushings and links to axle.
9. Track bar to body and rear axle.
10. Shock absorbers to axle.
11. Parking brake cables to body clips and cable adjuster, then tighten parking brake cable adjuster nut.
12. Wheels and tighten lug nuts.
13. Frame supports and lower hoist.

NOTICE: Lubricant level is to the bottom of the filler plug hole. Use only the specified lubricant. (Refer to Specifications).

UNIT REPAIR

Before attempting any service procedures the technician must know what type rear axle is to be serviced. Refer to chart (Rear Axle Codes And Identification) to identify codes, ring gear size, and ratios. Remember that all ring gear bolts have L.H. threads.

Most rear axle service repairs can be made by supporting the car by the frame with the axle housing supported and lowered to its lowest travel. On some models it may be necessary to disconnect shock absorbers to obtain additional clearance. When doing this, do not allow the rear brake hose to become kinked or stretched.

Lubricant may be drained by backing out all cover bolts and breaking cover loose at the bottom.

If the rear axle housing is removed for any reason, rear axle service can be performed on the bench.

When a new ring gear and pinion is installed, the owner should be advised not to accelerate rapidly or exceed 50 mph for the first 50 miles of driving.

It is necessary to perform a service diagnosis before disassembly of the rear axle. Check all fasteners with torque wrench for correct torque. Check level and condition of fluid. If fluid is contaminated the rear axle will require disassembly and a complete inspection and cleaning. The bearing preloads should be checked with a torque wrench. A dial indicator reading should be made for run out of ring gear and backlash between ring and pinion gear. Use specifications from chart below to perform suggested diagnostic checks. Roll gears and paint to read out pattern.

DRAIN REAR AXLE ASSEMBLY

1. Loosen cover and pry cover away from carrier.
2. Let axle fluids drain from carrier.
3. Remove cover bolts and cover from carrier.
4. Scrape off gasket and sealer from cover and carrier.

Remove or Disconnect

Differential Assembly

1. Bearing caps and bolts. Identify bearing caps with paint. The bearing caps are not interchangeable.
2. The differential assembly is worked out of the carrier by putting a box wrench on ring gear bolt. The box wrench contacts back of housing when companion flange is rotated with tool J-8614-01. When the differential assembly rotates out of the carrier from pinion rotation the shims will also come out. The shims and bearing caps location, left or right, must be identified for reassembly. (Fig. 12).
3. Differential assembly from carrier.

Remove or Disconnect

Hypoid Pinion and Pinion Bearings

1. Pinion nut and companion flange from pinion with companion flange tool J-8614-01. (Fig. 8).
2. Drive pinion gear through rear of carrier with soft face hammer.

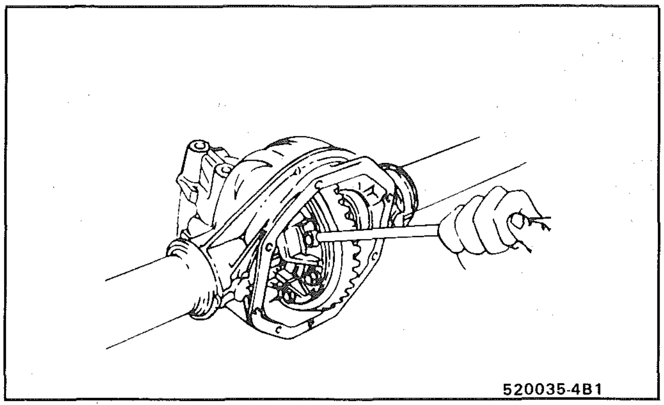


Fig. 12 Differential Assembly Removal

3. Pry front seal out of carrier and remove bearing cone. Discard seal.
4. Rear pinion bearing with tool J 21493-B and press. Clamp tool around pinion shaft holding bearing and press pinion shaft off rear pinion bearing. (Fig. 13).

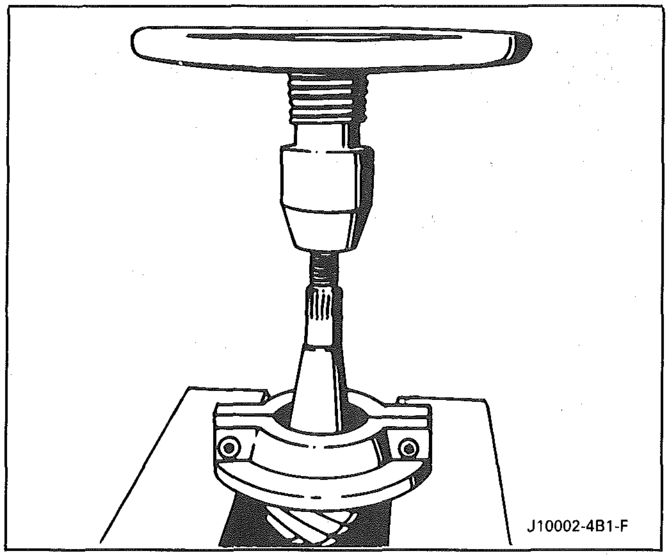


Fig. 13 Rear Pinion Bearing Removal

5. Drive rear bearing cone out of carrier with soft brass drift, and remove selective spacer washer.

Remove or Disconnect

Four Pinion Standard Differential Assembly (Figure 14)

1. Ring gear bolts.

Important

NOTICE: Left hand thread ring gear bolts.

2. Ring gear from differential housing, with soft face hammer.
3. Drive out three differential pinion cross shaft retaining pins.
4. Drive three differential pinion shafts from housing, long shaft first.

NOTICE: Mark differential case halves with alignment mark before disassembly because they could be assembled 180° off from original position.

5. Split differential case by holding one side and tapping against other side with long soft drift.
6. Four differential pinions, side gears and thrust washers from housing.
7. Differential case bearings with tool J-22888-D (Fig. 15).

Inspection

All components should be cleaned and inspected for excessive wear.

Cleaning of bearings should be performed with new solvent and should be followed up by coating the bearing with light engine oil to prevent rusting.

1. Hypoid gear set

Important

a. Examine for scuffed or chipped teeth. A gear set cannot be made to run quiet if teeth are scuffed.
b. Ring gear bore and back face should be clean and free from burrs. The rear bearing preload abutment faces on the hypoid pinion should be clean and free from burrs.
c. Examine the thread and bearing journal of the hypoid pinion.

2. Bearings

Important

a. Cups should have an even wear pattern and be free from flaking or pitting. Ensure that the abutment faces are clean and free from burrs or raised metal.
b. The cone assemblies should feel smooth when turned in the cups.
c. The assembly should be free from loose particles. No cracks should be present in the roller cages and the bores should contain no tears.

3. Differential pinions and side gears.

Important

a. Examine the teeth for cracks and hard contact marks. It is advisable to check the teeth for cracks and excessive wear. The side gear splines should be checked for excessive wear.
b. Check the side gear journals and back thrust for scoring.
c. The differential pinion bores and spherical thrust surfaces should be smooth and free from scores.

4. Thrust washers should be free from cracks, nicks or burrs.
5. Differential pinion cross shafts cannot be bent and the pinion gear mating surfaces must not be scored.

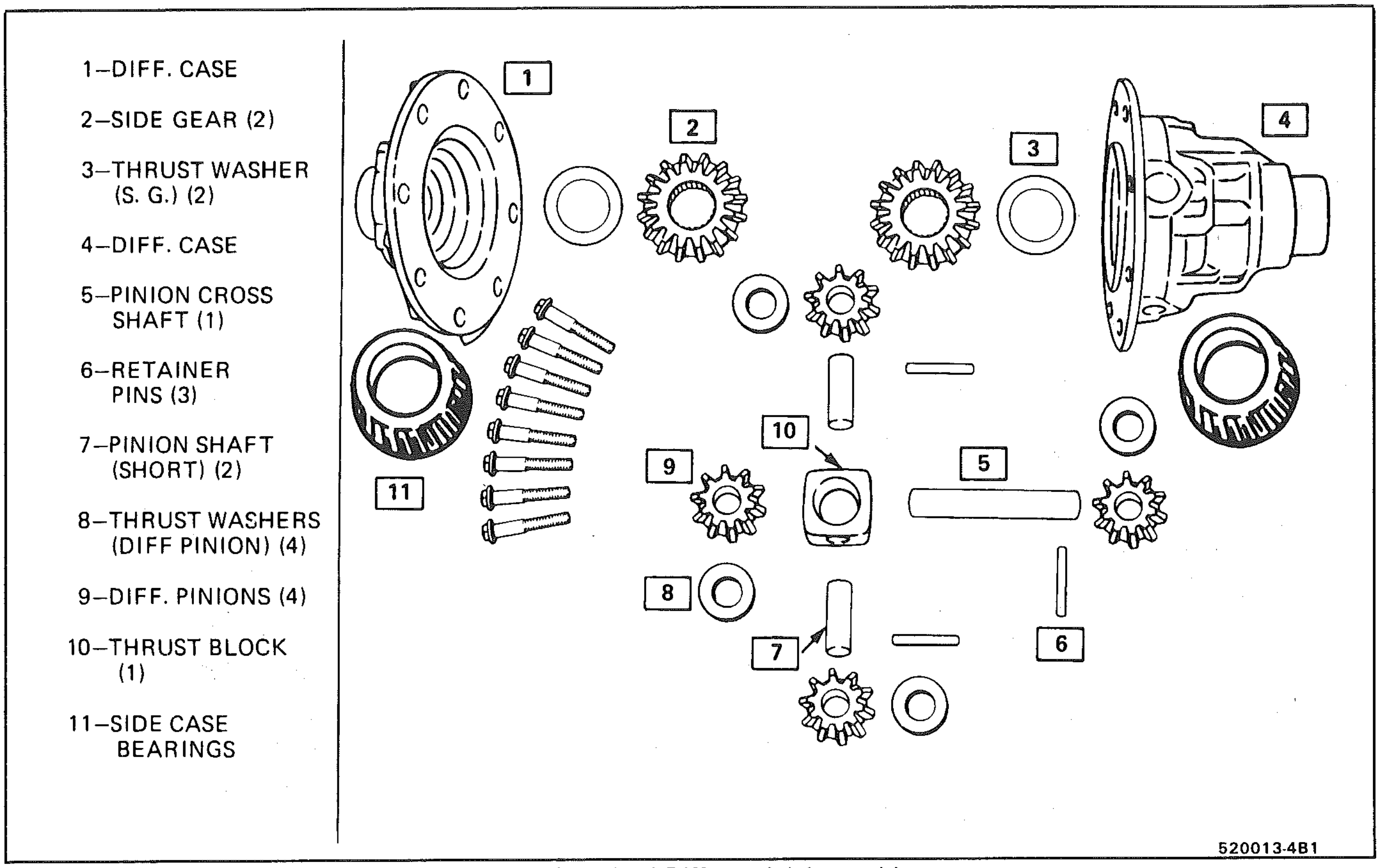


Fig. 14 Standard Differential Assembly

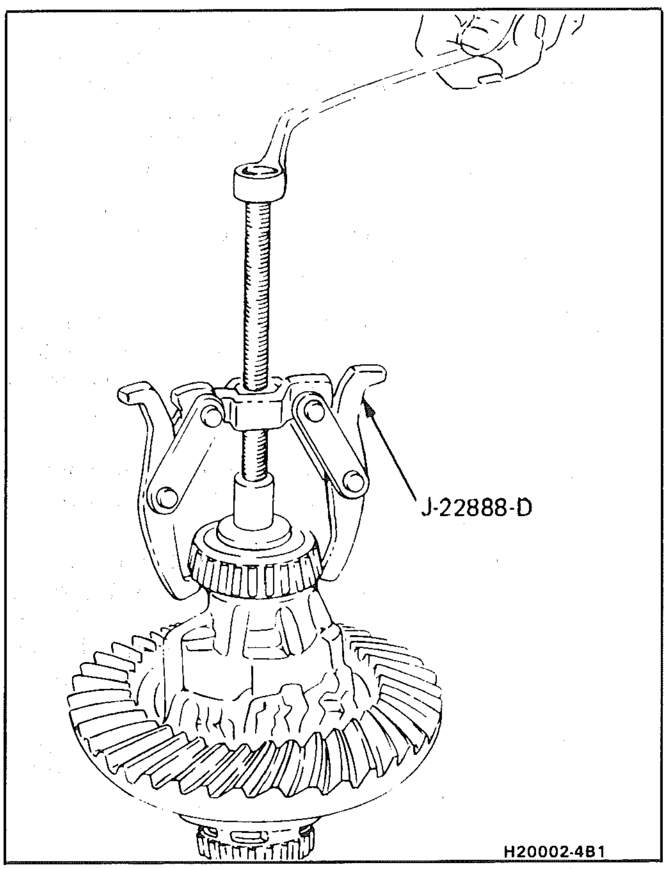


Fig. 15 Differential Case Bearing Removal

6. Differential case.

Important

   a. Check the casting for general soundness.
   b. If the bearings are removed, journals must be free from tears as damaged journals result in premature bearing failures. The bearing abutment faces on the housing must be free from dirt and burrs. The ring gear pilot and mounting face should be clean and free from tears and burrs.
   c. The mating surfaces of the two housing halves should be clean and free from burrs.
   d. The thrust surfaces for the side gears and pinions should be examined for excessive wear.
   e. The side gear journal bores should be clean and free from scores.
   f. The cross shaft bores should not be oval.

7. Carrier

Important

   a. Check the castings all over for general soundness. All bearing bores and abutment faces must be clean and free from burrs.
   b. Examine oil passages and ensure they are free from burrs.
   c. Bore for pinion seal should be free from tears.
   d. Rear cover face and bolt holes should be checked for damage.

8. Shims should be clean and free from burrs.
9. Check rear cover for tears and any damage which may prevent effective sealing.
10. Discard all damaged bolts.

Assemble

Differential Assembly

1. Lubricate all gears and thrust washers with rear axle lubricant.
2. Install side gears thrust washers in differential case. Hold washers in place with grease.
3. Install side gear in differential case large half.
4. Position thrust block in case.
5. Drive long pinion cross shaft through case, thrust washers, pinion, and thrust block bores. Align retainer pin hole with hole in case.Caution should be taken so differential pinion thrust washers are not damaged.
6. Install other two pinions and thrust washers in differential case large half. Drive two short pinion cross shafts through case, pinions and into thrust block bores. Align retainer pin holes with holes in case.
7. Drive three cross shaft retaining pins through case and shafts. Leave the long cross shaft retaining pin protruding 6 mm from case locating other case half.
8. Install remaining side gear and thrust washer in small case half.
9. Install side gear through case bore, and mate the case halves on retaining pin. Rotate side gear to ensure that gears are meshing.
10. Install ring gear on housing and tighten bolts to the specified torque.
    Flanged head durlok bolts can be re-used after cleaning.

    Important

    NOTICE: Left hand thread bolts.

11. Press differential bearings on housing journals with tool J-21784. (Fig. 16).

Assemble

Differential Bearing Preload Spacer Selection

CAUTION: To adjust differential side bearing preload, change the thickness of the right and left shims equally, thus leaving the original backlash undisturbed.

1. Before installation of case assembly, make sure side bearing surfaces are clean and free of burrs. Lubricate side bearings with gear lube. If reusing original bearings, the original outer races must also be used.
2. Place differential case, with bearing outer races in position, in carrier.

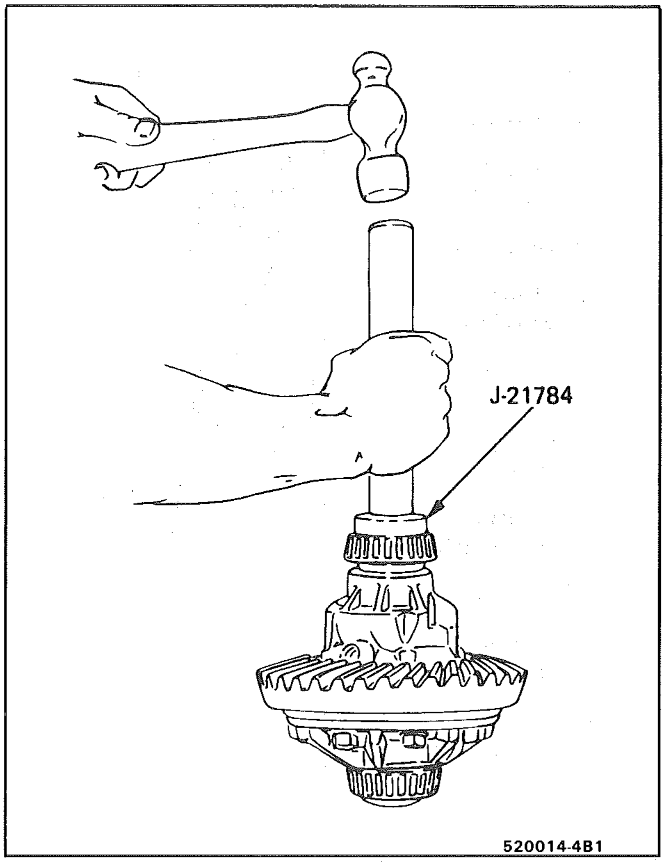


Fig. 16 Differential Bearing Installation

NOTICE: As a safety precaution, install the left bearing cap loosely so that the case may be moved while checking adjustments bolt can be added as an extra safety precaution in the lower right bearing cap hole. This will prevent the case from dropping while making shim adjustments.

3. Achieve a slip fit between the carrier and the side bearings as follows:

NOTICE: A slip fit means zero pre-load, or the point at which bearings have no play and no drag. At this point, in and out movement of the case is possible, but side to side movement is not.

   a. Measure production spacers, and subtract .004″ from each reading. Do not mix the left and the right spacers.
   b. Use a service spacer for each side equal to the thickness of the original shim minus .004″ and install as shown in Fig. 16 (flat edge of spacer against housing). This will duplicate the original setting minus pre-load.
   c. If this does not provide the proper slip fit, shims must be added or removed equally from both sides as necessary.
   d. Check case for zero end play, lateral motion, with dial indicator.

CAUTION: If insertion of shims causes excessive pinion to ring gear contact (noticeable difficulty in rotation of the case), select thinner

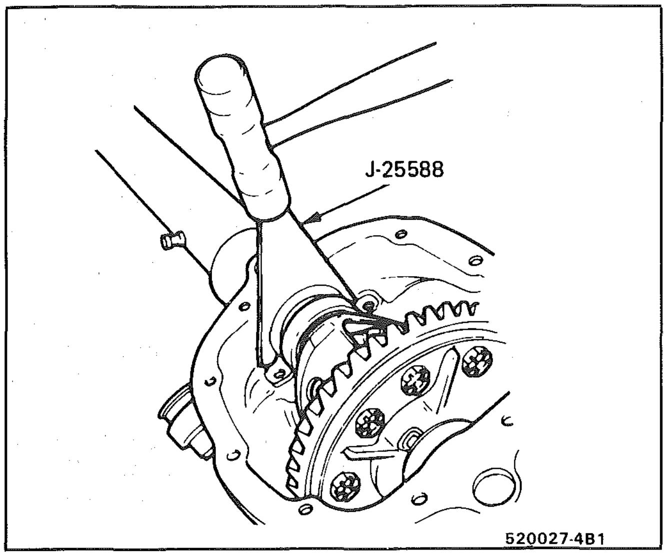


Fig. 17 Installing Service Shims

left shim and add difference to the right side. Keep total shim thickness at a value equal to that obtained in step b.

NOTICE: Original light drag is caused by weight of the case against the carrier while additional drag is caused by side bearing preload.

For convenience in setting backlash and tooth contact, the preload will not be added until the final step.

4. Check backlash and tooth pattern as described in the following section. The bearing caps must be installed and the bolts torqued to specified torque (follow assembly sequence below).
5. When backlash and tooth pattern operations are complete, remove shim packs taking care not to mix them. Select new shims for each side .004″ thicker than those removed and install each shim on its proper side. This additional thickness will provide proper bearing preload. It will be necessary to tap the final shim into place with a soft hammer and tool J-25588 (Fig. 17).

NOTICE: Check total rotational torque. Total torque with differential case preloaded and pinion installed should be 4 to 6 in. lb. over pinion bearing preload specification. If total rotational torque does not meet this specification, reset the differential bearing preload spacers as developed in steps 3 thru 5.

Assemble

Pinion

Hypoid Pinion and Bearing Shim Selection

NOTICE: Select pinion head positioning shim using pattern setting kit J 35118-A. Refer to Fig. 18.

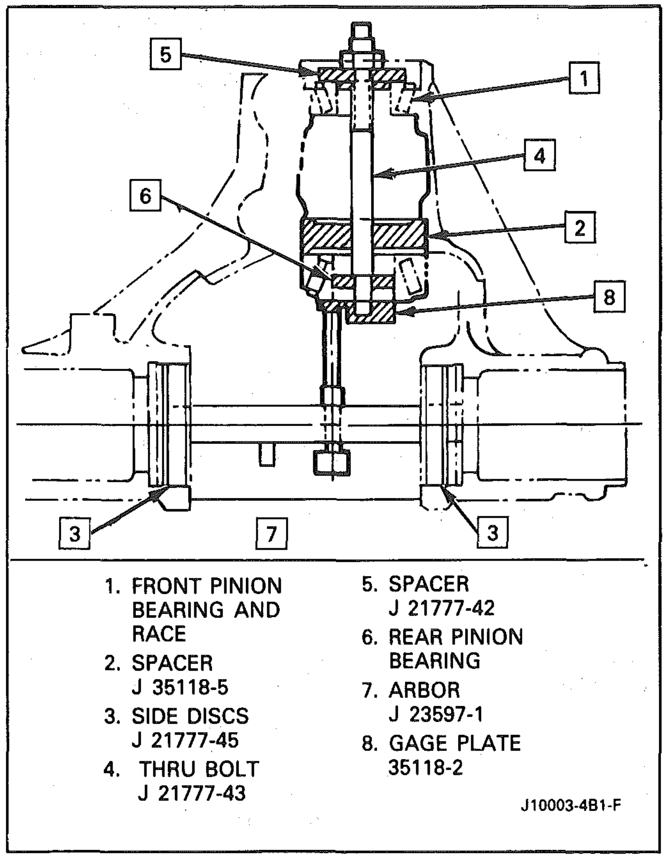


Fig. 18 Hypoid Pinion and Bearing Shim Selection

1. Drive front pinion bearing cup in the carrier (Item a) with tool J-7817. (Fig. 19).

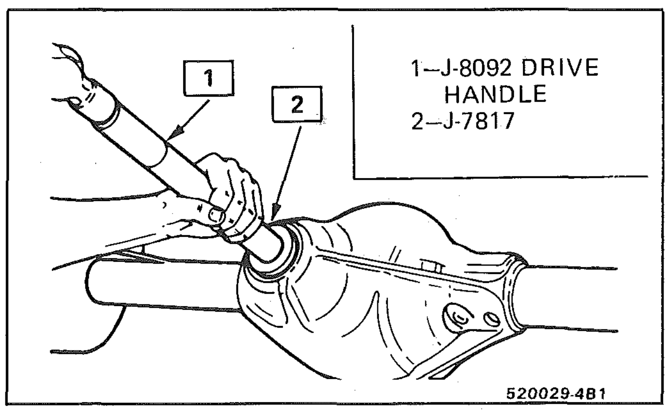


Fig. 19 Front Pinion Bearing Cup Installation

2. Fit spacer (item b) into carrier bore.
3. Slide the rear pinion bearing and cap (item f) onto the thru bolt (item d) and rear bearing into axle housing.
4. Install thru bolt (item d) and rear bearing and cap (item f) into axle housing.
5. Assemble front bearing cone (item a) and spacer (item e) onto thru bolt.
6. Rotate nut and shaft and increase torque on the nut until a rotational torque of 1.7 to 2.8 N·m (15-22 lb. in.) is obtained. Rotate the thru bolt back and forth during tightening to ensure correct seating of bearing.

7. Install discs on thru bolt assembly as shown in Fig. 18 and position in the carrier so that the dial indicator contact rod is directly over the gauging area of the gauge plate. The discs must be fully seated in the side bearing bores.

8. Install bearing caps over gauge shaft discs and torque to specs.

9. Position gauge shaft so that the dial indicator rod contacts the gauging area of J-35118-2. Rock gauge shaft slowly back and forth until the dial indicator records the greatest deflection, (the point where dial indicator needle changes rotational direction) at the point of largest deflection, set dial indicator to zero (Fig. 18). Repeat rocking action of gauge shaft to verify the zero setting.

10. After the zero setting is obtained, rotate gauge shaft until shaft does not contact gauge plate. The dial indicator will read the pinion depth directly.

11. Select correct pinion shim to be used during pinion reassembly on the following basis. Shims are available in increments of (.002").
    a. If reusing production pinion, and pinion is marked "+" (plus), correct shim will have a thickness equal to gauge reading minus the amount specified on pinion.
    b. If production pinion is marked "-" (minus), correct shim will have a thickness equal to gauge reading, plus the amount specified on pinion.
    c. If using production or service pinion which has no marking, the correct shim will have a thickness equal to the gauge reading.

12. The reading obtained from the dial indicator is the shim size to be selected if the figure branded on the hypoid pinion is "0".

Pinion Branding	Shim Thickness Required
-4	Add .004" to shim selected in (12).
-3	Add .003" to shim selected in (12).
-2	Add .002" to shim selected in (12).
-1	Add .001" to shim selected in (12).
+1	Subtract .001" from shim selected in (12).
+2	Subtract .002" from shim selected in (12).
+3	Subtract .003" from selected in (12).
+4	Subtract .004" from shim selected in (12).

13. Install pinion in rear axle.

Important

a. Place the pinion selective shim into the carrier and press the rear pinion bearing cup into carrier with tool J-5590 (Fig. 20).

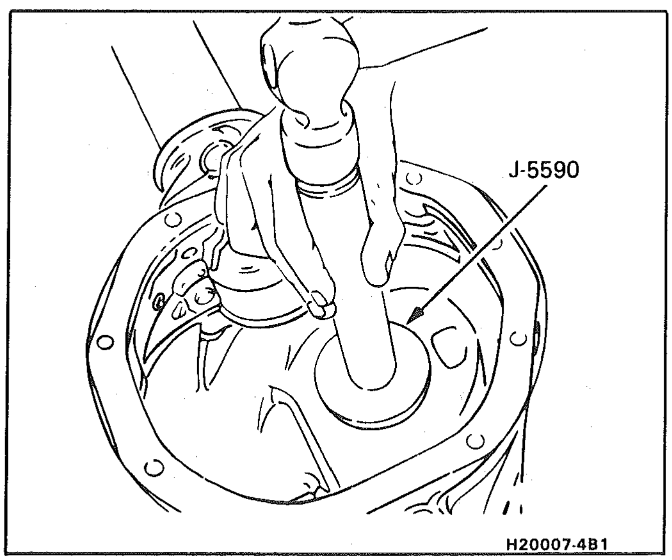


Fig. 20 Rear Pinion Bearing Cup Installation

b. Press rear pinion bearing onto pinion with tool J-6133-01. (Fig. 21).

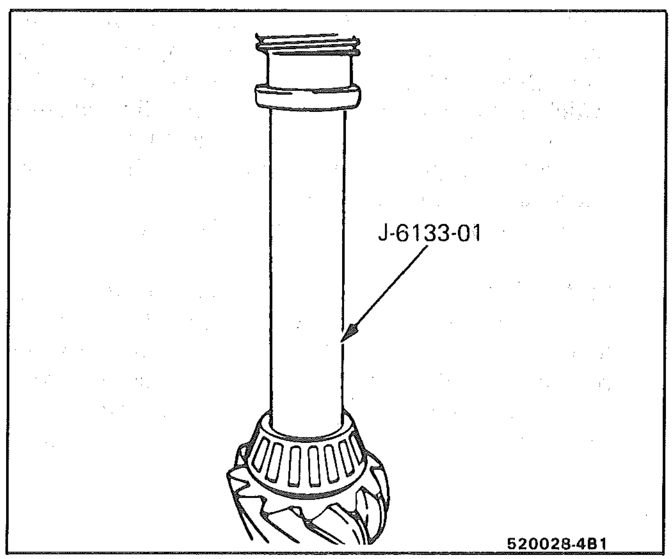


Fig. 21 Pressing Rear Pinion Bearing

c. Place pinion in carrier.

d. Assemble the collapsible spacer and front bearing onto pinion while supporting pinion under head.

e. Assemble **oiled** oil seal, companion flange, and new nut on pinion and tighten nut to specified rotational torque while rotating pinion forwards to seat bearing correctly.

Important

NOTICE: If after tightening pinion nut, the preload is excessive then the collapsible spacer must be replaced and procedure (d) and (e) repeated.

OPERATION OF LIMITED SLIP REAR AXLE (CONE TYPE)

The cone-type limited-slip differential has several definite operating characteristics. An understanding of these characteristics is necessary as an aid to diagnosis.

During regular operation (straight ahead driving) when both wheels rotate at equal speeds, there is an approximately equal driving force delivered to each wheel. When cornering, the inside wheel delivers extra driving force causing slippage in both clutch cones. Consequently, the operational life of the limited slip unit is dependent upon equal rotation of both wheels during straight ahead operation. If wheel rotation for both rear wheels is not equal during straight ahead operation, the limited-slip unit will constantly be functioning as if the vehicle were cornering. This will impose constant slippage on the clutch cones and will eventually lead to abnormal wear on the clutch cones. Therefore, it is important that there be no excessive differences in the rear wheel tire sizes, air pressures, or tire wear patterns. One indication of this condition is "swerving on acceleration." If swerving on acceleration is encountered, check the rear wheels for different tire size, air pressure, or excessively different wear patterns, and tread depths, before proceeding into an overhaul operation.

Checking Limited-Slip Function

1. Place transmisison in Park position.
2. Raise rear of vehicle until one wheel is off the ground, remove one wheel and tire assembly.
3. Attach Adapter J 2619-1 to axle shaft flange and install a 1/2-13 bolt into adapter as shown in Fig. 23.

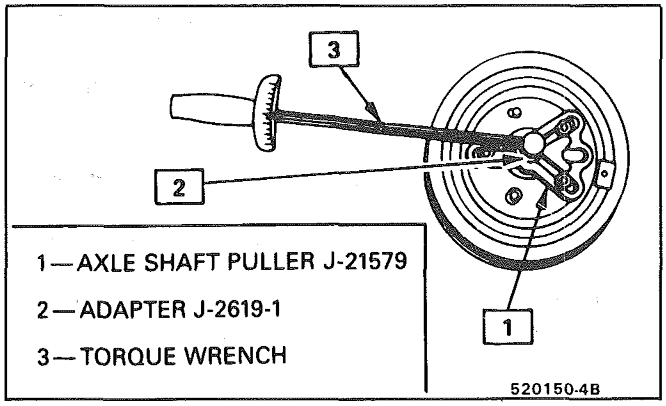


Fig. 23 Measuring Limited-Slip Rotating Torque

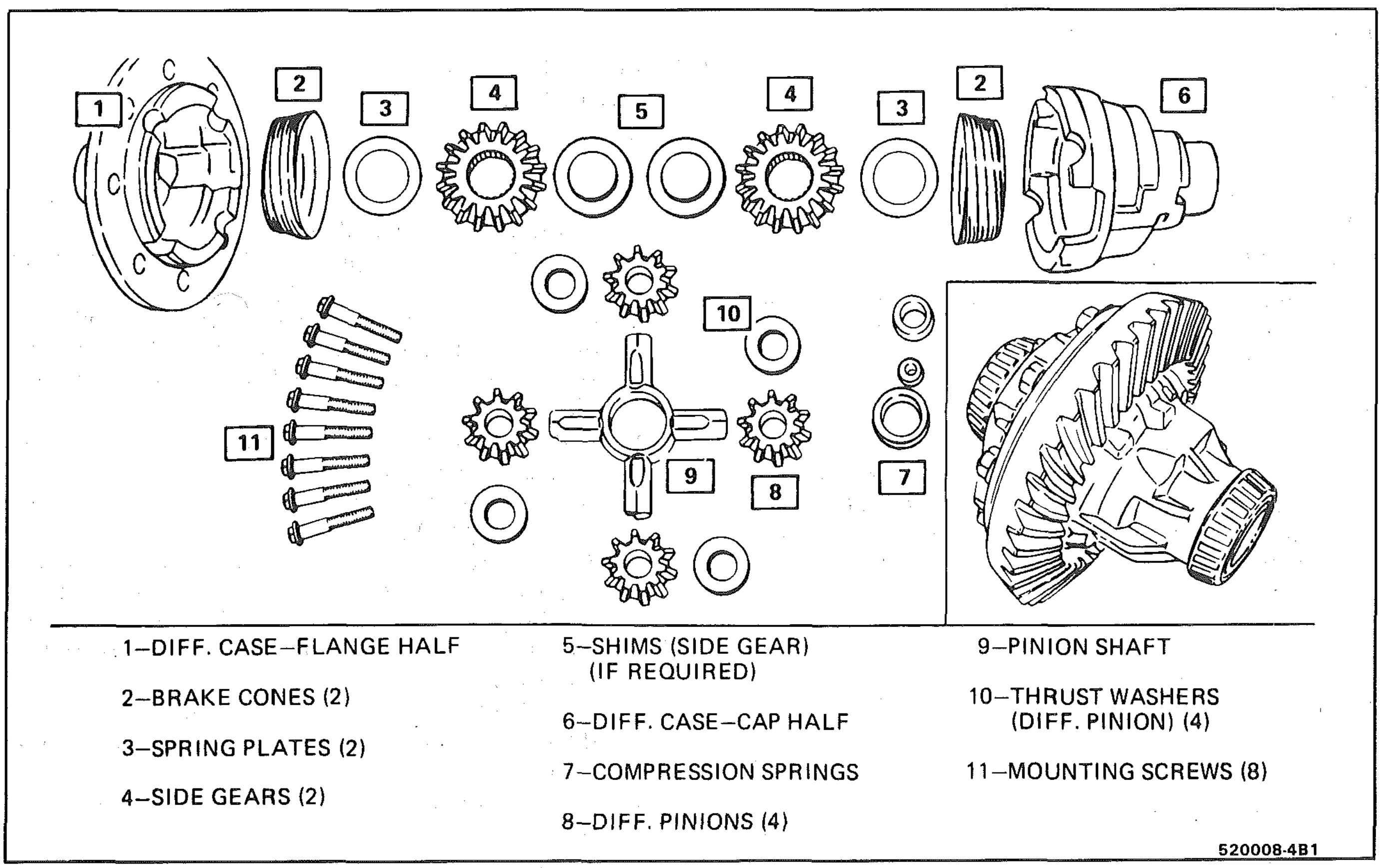


Fig. 22 Limited Slip Differential

4. With transmission in park and both wheels and tires clear of ground, (wheels will rotate in opposite directions), measure torque required to rotate axle shafts with a torque wrench attached to J 2619-1. If the torque reading is less than 48 N·m (35 lb.ft.) the unit should be disassembled and repaired as required.
5. Reinstall wheel and tire assembly.

Disassemble

Limited Slip Differential.

1. Remove ring gear bolts.

NOTICE: Left hand threaded ring gear bolts.

2. Tap ring gear off differential housing with soft face hammer.

NOTICE: Mark differential case halves with alignment mark before disassembly because they could be assembled 180° off from original position.

3. Remove 8 screws holding differential housing halves together and separate halves.
4. Remove pinion shaft, 4 differential pinions, thrust washers side gears, side gear shims (if required), spring plates, and compression springs from housing. Discard compression springs. New springs are required for assembly.
5. Mark each cone during disassembly to ensure that the same brake cone will be assembled with the same case as originally assembled. If shims are used they must be marked so that they will be assembled in original case half.
6. If differential bearings are damaged remove with tool J-22888-D. (Fig. 15).

Inspect

Disassemble

The inspection procedures for the positraction differential are the same as those for the standard rear axle except for the side gear positioning shims. The side gear positioning shims are used to control case size.

1. The shims should be free of cracks, nicks, or burrs.
2. Assemble brake cones in case and measure to determine correct shim size. Measure the distance from case mating surface to flat surface on brake cone when fully seated. Select shim size from chart below.

DISASSEMBLY INSPECTION CHART

Distance Measured mm (ins)	Size Shim Required
29.51/29.34 (1.162/1/155)	no shim required.
29.64/29.54 (1.167/1.163)	0.13 (.005) shim required.
29.77/29.67 (1.172/1.168)	0.25 (.010) shim required.

Assemble

Limited Slip Differential

1. Lubricate both sides of pinion thrust washers, pinion bores and differential pinion shafts with specified rear axle lube before assembling.
2. Install the 4 pinions and spherical thrust washers.
3. Replace original brake cone, shim if required, and side gear in cap half of differential case. For shim selection, if needed, refer to Disassembly Inspection Chart. Apply mixture of molybdenum disulphide and specified axle oil to face of side gear.

NOTICE: Do not replace cone or case independently. They must be replaced as a unit together.

4. Install spring plate on side gear with convex side towards flange half.
5. Assemble differential pinion shaft, pinions, and spherical thrust washers into cap half of differential case with pinions meshing with side gear.
6. Install three new concentric thrust springs through the center of the pinion shaft spider.
7. Assemble second spring plate and springs with convex side towards springs.
8. Coat other side gear face with molybdenum disulphide and axle lubricant and install side gear shim if required. Install brake cone on spring plate.
9. Install flange half of case on top of assembly with oil channels aligned.
10. Install two bolts through cases 180° apart and tighten finger tight.
11. Axle shafts are used to align the side gear and brake cone splines. Put a clamp on one axle shaft so 75 mm (3 inches) extends beyond clamp. Install differential housing onto axle shaft splines, flanged half first.
12. Install other axle shaft through cap side of differential case and align side gear and cone splines.
13. Install remaining bolts and tighten to specified torque.
14. Install ring gear and tighten bolts to specified torque.

15. Press differential bearings on with tool J-21784 (Fig. 16).
16. Install assembled case into carrier following the same procedures as developed for standard differential.
17. Installation of axle bearings and axles is the same as standard axles.

Important

NOTICE: After installing the limited slip differential in the carrier housing, be sure that both axle shafts are assembled before rotating either axle shafts. If rotation of either axle shaft occurs before other is in position, misalignment of the side gear and cone splines will occur, preventing assembly of remaining axle shaft. If this occurred, repeat assembly steps 11 and 12.

Important

CAUTION: Do not run engine with transmission engaged and only one rear wheel of vehicle elevated if rear axle is equipped with limited slip differential. The other rear wheel will drive if in contact with the ground. This action can result in damage to the equipment or injury to the operator.

SPECIFICATIONS

Bolt Torque
- Ring Gear Bolts .... 137 N·m (101 lb. ft.)
- Bearing Cap Bolts .... 52 N·m (40 lb. ft.)
- Rear Cover Bolts .... 26 N·m (20 lb. ft.)
- Breather .... 14 N·m (10 lb. ft.)
- Brake Backing Plate Bolts .... 48 N·m (36 lb. ft.)
- Mounting Screws .... 40 N·m (30 lb. ft.)
- Screw, Brake Line Bracket to Frame .... 11 N·m (8 lb. ft.)
- Case Half Bolt Torque .... 38 N·m (29 lb. ft.)
- Axle Shaft Retainer Nuts .... 46 N·m Disc (35 lb. ft.)

Bearing Loads
- Side Bearings .... 1-3 N·m (New) (10-25 lbs. in.)
  0.5-1 N·m (Used) (6-12 lbs. in.)
- Differential Bearings .... 1.1-2.8 N·m (New) (10-25 lb. in.)
  0.5-1.4 N·m (Used) (5-12 lb. in.)
- Hypoid Pinion .... 1-3 N·m (New) (12-25 lb. in.)
  0.5-1 N·m (Used) (6-12 lb. in.)

End Play
- Axle Shaft (New Bearing) .... 0.04.mm - 0.048mm (0.0016 - 0.0019 in.)
  (Used Bearing) .... 0.076mm (0.003 in.)

Run-Out Specifications
- Differential Case/Ring Gear Mating Surface .... 0.05 mm (0.002") max.
- Ring Gear Runout .... 0.13mm (0.005")
- Ring Gear Backlash .... 0.10mm-0.19mm (0.004 to 0.007")

Lubricant
- GM Part 1050010 .... 1.7 Liters (1.8 Quarts)

RING GEAR SIZE	STD OR OPT	RPO	RATIO	L/S AXLE CODE
7.75	OPT/DISC	GM3	3.45	4EW
	OPT/DISC	GW6	3.27	4EU
	OPT/DISC	GH3	2.77	4ET

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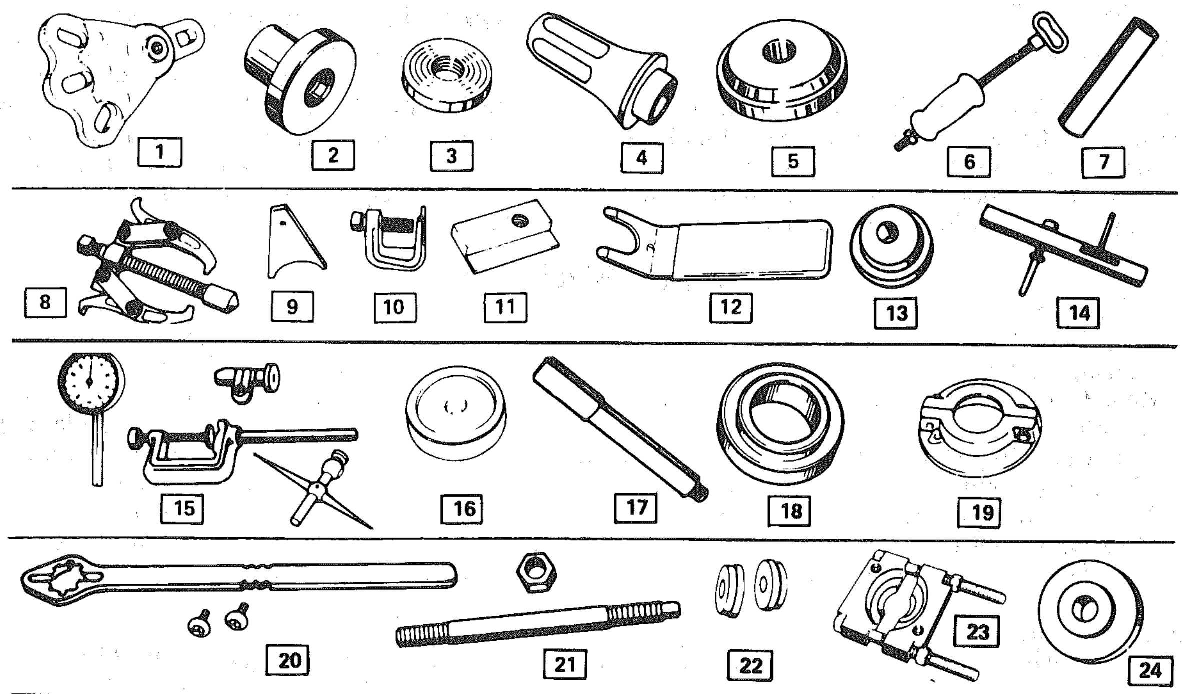
Fig. 24 Identification Chart



1. J 21579 AXLE SHAFT REMOVER
2. J 21784 SIDE BEARING INSTALLER
3. J 23597-12 REAR BEARING
4. J 35119 PINION OIL SEAL INSTALLER
5. J 6197-A REAR BEARING CUP INSTALLER
6. J 2619-01 SLIDE HAMMER ASSEMBLY
7. J 6133-01 REAR PINION BEARING INSTALLER
8. J 22888-D SIDE CASE BEARING PULLER
9. J 25588 SIDE BEARING SHIM INSTALLER
10. J 6627-A WHEEL STUD REMOVER
11. J 35118 -2 GAUGE PLATE
12. J 35117 FILLER PLUG REMOVAL TOOL
13. J 7817 FRONT PINION BEARING RACE INSTALLER
14. J 23597-1 BODY PINION SETTING GAGE
15. J 8001 DIAL INDICATOR ASSEMBLY
16. J 35118-5 SPACER
17. J 8092 DRIVER HANDLE
18. J 8853-01 AXLE BEARING AND RETAINER INSTALLER
19. J 21493-B REAR PINION BEARING REMOVER
20. J 8614-01 PINION FLANGE HOLDER
21. J 21777-43 PINION SETTING GAGE
22. J 21777-45 PINION SETTING GAGE SHAFT DISCS
23. J 22912-01 AXLE BEARING AND RETAINER REMOVER
24. J 21777-42 FRONT PINION BEARING PILOT

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Fig. 25 Special Tools

SECTION 4B

REAR AXLE

NOTICE: All rear axle attaching fasteners are an important part in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of all parts. (There is to be no welding as it may result in extensive damage and weakening of the metal.)

CONTENTS

GENERAL DESCRIPTION

STANDARD REAR AXLE

The rear axle assembly is of the semi-floating type in which the car weight is carried on the axle housing. The rear axle assembly is designed for use with an open drive line and coil springs. The rear axle has a hypoid type ring gear and pinion with the centerline of the pinion gear below the centerline of the ring gear.

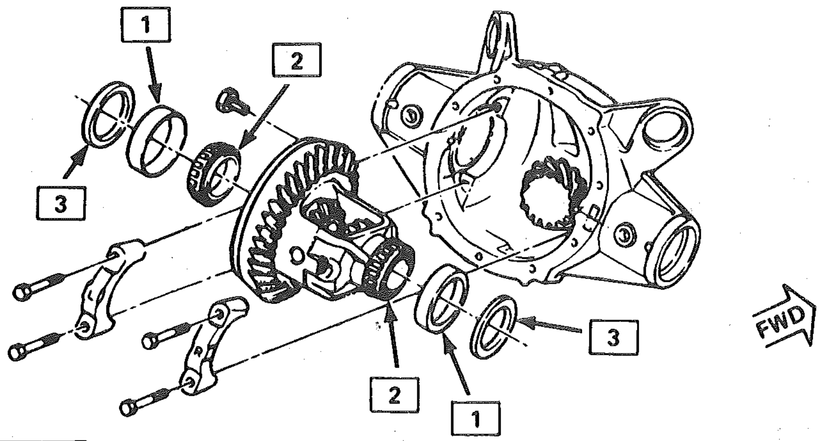
All parts necessary to transmit power from the propeller shaft to the rear wheels are enclosed in a salisbury type axle housing (a carrier casting with tubes pressed and welded into the carrier to form a complete carrier and tube assembly). A removable steel cover bolted to the rear of the carrier permits service of the rear axle without removing the entire assembly from the car.

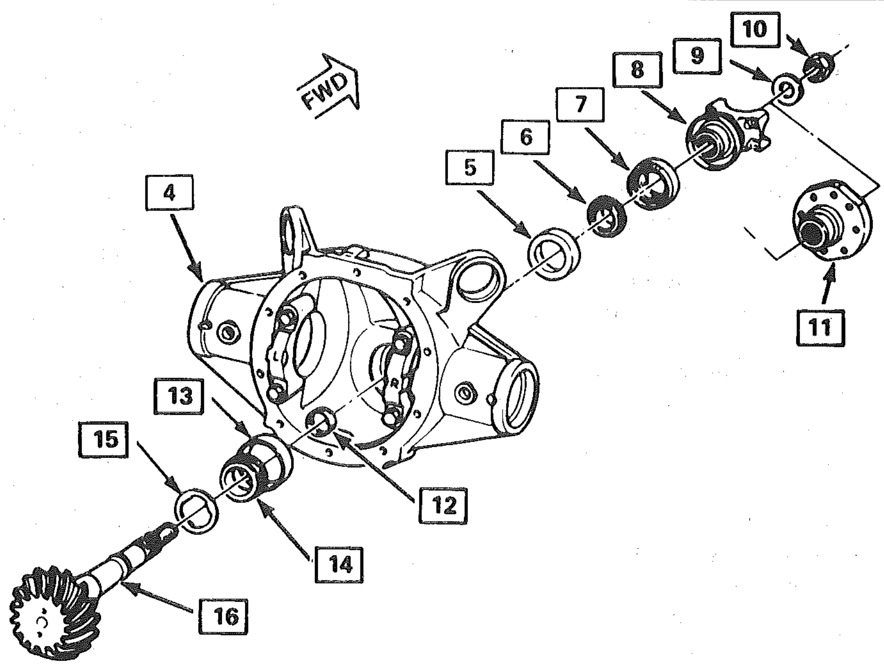
Operation

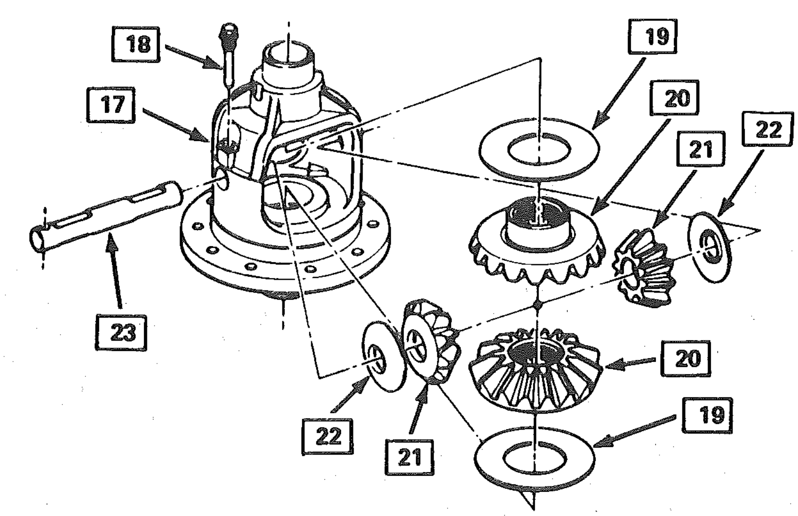
When the vehicle turns a corner, the outer rear wheel must turn faster than the inner wheel. The inner wheel, turning slower than the outer wheel, slows its differential side gear (as the axle shaft is splined to the side gear) and the differential pinion gears will roll around the slowed differential side gear, driving the other differential side gear and wheel faster.

DIAGNOSIS AND TESTING

Many noises reported as coming from the rear axle assembly actually originate from other sources such as tires, road surfaces, wheel bearings, engine, transmission, muffler or body drumming. A thorough and careful check should be made to determine the source of the noise before disassembling the rear axle.







1—RACE

2—ROLLER ASM.

3—SHIM AS REQ.

4—CARRIER & CAP ASM.

5—RACE (PINION FRT)

6—ROLLER ASM. (PINION FRT)

7—SEAL ASM.

8—FLANGE ASM.

9—WASHER

10—NUT

11—FLANGE

12—SPACER

13—RACE (PINION REAR)

14—ROLLER ASM. (PINION REAR)

15—SHIM (AS REQUIRED)

16—DRIVE PINION GEAR

17—CASE

18—SCREW

19—SIDE GEAR THRUST WASHER

20—SIDE GEAR

21—DIFFERENTIAL PINION

22—PINION THRUST WASHER

23—SHAFT

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Fig. 1 Standard Rear Axle

Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the differential. It should also be remembered that rear axle gears, like any other mechanical device, are not absolutely quiet and should be accepted as being commercially quiet unless some abnormal noise is present.

To make a systematic check for axle noise under standard conditions, observe the following:

1. Select a level smooth asphalt road to reduce tire noise and body drumming.
2. Check rear axle lubricant to assure correct level, then drive car far enough to thoroughly warm up rear axle lubricant.
3. Note speed and RPM at which noise occurs. Then stop car and with automatic transmission in neutral, run engine slowly up and down through engine speeds, corresponding to car speed at which noise was most pronounced, to determine if it is caused by exhaust, muffler roar or other engine conditions.
4. Tire noise changes with different road surfaces, but rear axle noise does not. Temporarily inflating all tires to approximately 50 pounds pressure *for test purposes only* will materially alter noise caused by tires, but will not affect noise caused by rear axle. Rear axle noise usually stops when coasting at speeds under 30 miles per hour; however, tire noise continues, but with lower tone, as car speed is reduced. Rear axle noise usually changes when comparing acceleration and coast, but tire noise remains about the same.

   Distinguish between tire noise and rear axle noise by noting if noise varies with various speeds or sudden acceleration and deceleration; exhaust and axle noise show variations under these conditions while tire noise remains constant and is more pronounced at speeds of 20 to 30 miles per hour. Further check for tire noise by driving car over smooth pavements or dirt roads (not gravel) with tires at normal pressure. If noise is caused by tires, it will noticeably change or disappear and reappear with changes in road surface.
5. Loose or rough front wheel bearings will cause noise which may be confused with rear axle noises; however, front wheel bearing noise does not change when comparing drive and coast. Light application of brakes while holding car speed steady will often cause wheel bearing noise to diminish, as this takes some weight off the bearing. Front wheel bearings may be easily checked for noise by jacking up the wheels and spinning them, also by shaking wheels to determine if bearings are loose.
6. Rear suspension rubber bushings and spring insulators dampen out rear axle noise when correctly installed. Check to see that no metallic contact exists between the spring and spring opening in frame or between upper and lower control arm bushings and frame or axle housing brackets. Metal-to-metal contact at those points may result in telegraphing road noise and normal axle noise which would not be objectionable if dampened by bushings.

AXLE NOISES

Gear Noise

After the noise has been determined as being in the axle by following the above appraisal procedure, the type of axle noise should be determined to aid in making repairs if necessary.

Gear noise (whine) is audible from 20 to 55 mph under four driving conditions:

1. Drive - Acceleration or heavy pull.
2. Road Load - Car driving load or constant speed.
3. Float - Using enough throttle to keep the car from driving the engine - car slows down gradually but engine still pulls slightly.
4. Coast - Throttle closed and car in gear. Gear noise most frequently has periods where noise is more prominent, usually 30 to 40 mph and 50 to 55 mph.

Bearing Noise

Bad bearings generally produce more of a rough growl or grating sound, rather than the whine typical of gear noise. Bearing noise frequently "wow-wows" at bearing rpm, indicating a defective pinion or rear axle case side bearing. This noise could easily be confused with rear wheel bearing noise. Inspect and replace as required.

Rear Wheel Bearing Noise

A rough rear wheel bearing produces a noise which continues with car coasting at low speed and transmission in neutral. Noise may diminish some by gentle braking. With rear wheels jacked up, spin rear wheels by hand while listening at hubs for evidence of rough (noisy) wheel bearing.

Knock At Low Speeds

Low speed knock can be caused by worn universal joints or a side gear hub counterbore in a case that has worn oversize. Inspect and replace universal joint or case and side gear as required.

Backlash Clunk

Excessive clunk with acceleration and deceleration is caused by worn differential pinion shaft, excessive clearance between axle shaft and side gear splines, excessive clearance between side gear hub and counterbore in case worn pinion and side gear teeth, worn thrust washers and excessive drive pinion and rear gear backlash. Remove worn parts and replace as required, selecting close fitting parts when possible. Adjust pinion and ring gear backlash.

REAR AXLE STANDARD AND LIMITED-SLIP

1. Noise is the same in "Drive" or "Coast".
   a. Road noise.
   b. Tire noise.
   c. Front wheel bearing noise.

   d. Incorrect driveline angle.
2. Noise changes on a different type of road.
   a. Road noise.
   b. Tire noise.
3. Noise tone lowers as car speed is lowered.
   a. Tire noise.
4. Similar noise is produced with car standing and driving.
   a. Engine noise.
   b. Transmission noise.
5. Vibration.
   a. Rough rear wheel bearing.
   b. Unbalanced or damaged propeller shaft.
   c. Tire unbalance.
   d. Worn universal joint in propeller shaft.
   e. Incorrect driveline angle.
   f. Mis-indexed propeller shaft at pinion flange.
   g. Pinion flange runout too great.
6. A knock or click approximately every two revolutions of the rear wheel.
   a. A rear wheel bearing.
7. Noise most pronounced on turns.
   a. Rear axle side gear and pinion noise.
8. A continuous low pitch whirring or scraping noise starting at relatively low speed.
   a. Pinion bearing noise.
9. Drive noise, coast noise or float noise.
   a. Ring and pinion gear noise.
10. Clunk on acceleration or deceleration.
    a. Worn rear axle pinion shaft in case or side gear hub counterbore in case worn oversize.
    b. Insufficient lubrication on propeller shaft slip yoke.
    c. Worn U-joints on propeller shaft. Front or rear.
11. Groan in "Forward" or "Reverse".
    a. Wrong or contaminated lube in rear axle.
    b. Worn bushings.
12. Chatter on turns.
    a. Wrong or contaminated lube in rear axle.
    b. Clutch cone worn and/or spring(s) worn.
13. Clunk or knock on rough road operation.
    a. Excessive end play of axle shafts to differential cross shaft.
    b. Worn bushings.

PRE-REPAIR INVESTIGATION AND TROUBLE DIAGNOSIS

A carefull diagnosis of the rear axle prior to disassembly will often reveal valuable information as to the extent and type of repairs or adjustments necessary. Since frequent causes of axle noises are improper backlash, pinion bearing pre-load, or side bearing pre-load, or a combination, a few simple adjustments may be all that are necessary to correct a problem.

Therefore, before removing the rear axle from the housing, the following checks should be made with the results recorded and analyzed: 1) Backlash; 2) Total Assembly Preload; 3) Tooth Contact Pattern Test; 4) Fluid Level; and 5) Fluid Contamination.

Use care at all times to keep dirt and other foreign matter, such as grinder dust, soot or sand, away from differential to prevent possibility of subsequent failure.

The pinion and ring gear must be completely assembled, installed and all pre-load and backlash adjustments completed prior to the start of this method of pinion depth setting. The following procedure can be used in place of the gage method of pinion depth setting.

Gear Tooth Nomenclature

The side of the ring gear tooth which curves outward, or is convex, is referred to as the "drive" side. The concave side is the "coast" side. The end of the tooth nearest center of ring gear is referred to as the "toe" end. The end of the tooth farthest away from the center is the "heel" end. Toe end of tooth is smaller than heel end.

It is very important that tooth contact be tested before the rear axle carrier assembly is disassembled. Variations in the carrier or pinion rear bearing may cause the pinion to be too far away from, or close to, the ring gear. Thus, the tooth contact must be tested and corrected, if necessary, or the gears may be noisy.

Tooth Contact Pattern Test

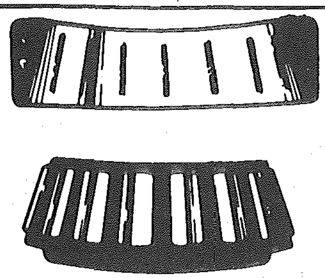
1. Wipe oil out of carrier and carefully clean each tooth of ring gear.
2. Use gear marking compound part number 1052351 or equivalent and apply this mixture sparingly to all ring gear teeth, using a medium stiff brush. When properly used, the area of pinion tooth contact will be visible when hand load is applied.
3. Tighten bearing cap bolts to 75 N·m (55 lb. ft.).
4. Expand brake shoes using parking brake cables until a torque of 54 to 70 N·m (40-50 lb. ft.) is required to turn the pinion.

   A test made without loading the gears will not give a satisfactory pattern. Turn pinion flange with wrench so that ring gear rotates one full revolution, then reverse rotation so that ring gear rotates one revolution in opposite direction.
5. Observe pattern on ring gear teeth and compare with Fig. 3.

Effects of Increasing Load on Teeth Contact Pattern

When "load" on ring and pinion gear is increased, such as when car is accelerated forward from standstill or from normal drive, the tooth contact will tend to spread out and, under very heavy load, will extend from near toe to near heel on the drive side. The entire contact also tends to shift toward heel under increasingly heavier loads and will become somewhat broader with respect to tops and bottoms of teeth. The patterns obtained by this tooth contact pattern test approximate a light load and, for this reason, they will extend only about halfway.

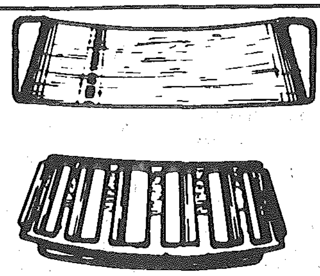
TAPERED ROLLER BEARING DIAGNOSIS



BRINELLING

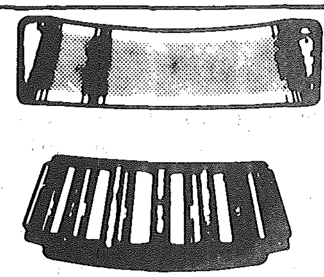
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.



CAGE WEAR

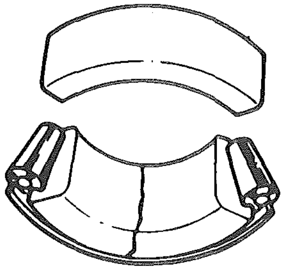
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

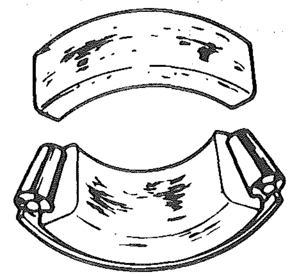
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



CRACKED INNER RACE

RACE CRACKED DUE TO IMPROPER FIT, COCKING, OR POOR BEARING SEATS.

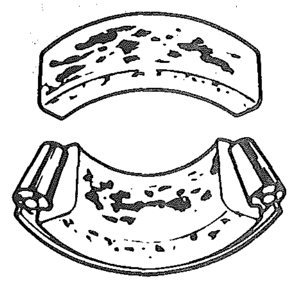


SMEARS

SMEARING OF METAL DUE TO SLIPPAGE, SLIPPAGE CAN BE CAUSED BY POOR FITS, LUBRICATION, OVERHEATING, OVERLOADS OR HANDLING DAMAGE.

REPLACE BEARINGS, CLEAN RELATED PARTS AND CHECK FOR PROPER FIT AND LUBRICATION.

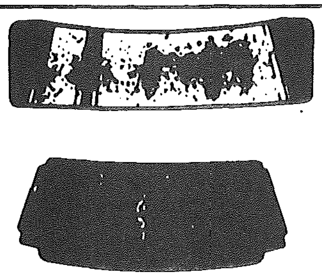
REPLACE SHAFT IF DAMAGED.



FRETTAGE

CORROSION SET UP BY SMALL RELATIVE MOVEMENT OF PARTS WITH NO LUBRICATION.

REPLACE BEARING. CLEAN RELATED PARTS. CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



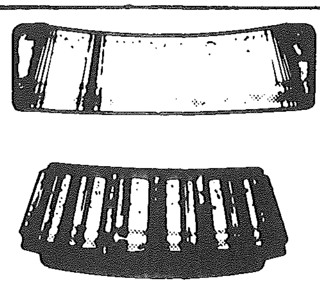
HEAT DISCOLORATION

HEAT DISCOLORATION CAN RANGE FROM FAINT YELLOW TO DARK BLUE RESULTING FROM OVERLOAD OR INCORRECT LUBRICANT.

EXCESSIVE HEAT CAN CAUSE SOFTENING OF RACES OR ROLLERS.

TO CHECK FOR LOSS OF TEMPER ON RACES OR ROLLERS A SIMPLE FILE TEST MAY BE MADE. A FILE DRAWN OVER A TEMPERED PART WILL GRAB AND CUT METAL, WHEREAS, A FILE DRAWN OVER A HARD PART WILL GLIDE READILY WITH NO METAL CUTTING.

REPLACE BEARINGS IF OVER HEATING DAMAGE IS INDICATED. CHECK SEALS AND OTHER PARTS.



STAIN DISCOLORATION

DISCOLORATION CAN RANGE FROM LIGHT BROWN TO BLACK CAUSED BY INCORRECT LUBRICANT OR MOISTURE.

RE-USE BEARINGS IF STAINS CAN BE REMOVED BY LIGHT POLISHING OR IF NO EVIDENCE OF OVERHEATING IS OBSERVED.

CHECK SEALS AND RELATED PARTS FOR DAMAGE.

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Fig. 2 Rear Axle Bearing Diagnosis

The important thing to note is that the contact pattern is centrally located up and down on the face of the ring gear teeth.

Adjustments Affecting Tooth Contact

Two adjustments can be made which will affect tooth contact pattern, backlash and position of drive pinion in carrier. The effects of bearing pre-loads are not readily apparent on (hand-loaded) tooth contact pattern tests; however, these adjustments should be within specifications before proceeding with backlash and drive pinion adjustments.

Backlash is adjusted by means of the side bearing adjusting shims, which moves the entire case and ring gear assembly closer to, or farther from, the drive pinion. Adjusting shims are also used to set side bearing pre-load. The position of the drive pinion is adjusted by increasing or decreasing the shim thickness between the pinion head and inner race of rear bearing. The shim is used in the rear axle case to compensate for manufacturing tolerances. Increasing shim thickness will move the pinion closer to centerline of the ring gear. Decreasing shim thickness will move pinion farther away from centerline of the ring gear.

Effects of Pinion Position on Tooth Pattern

When the drive pinion is too far away from centerline of the ring gear, the pattern will be a high heel contact on the drive side and high toe contact on coast side (Fig. 3). Moving the pinion closer to centerline of the ring gear by increasing shim thickness will cause the high heel contact on drive side to lower and move toward the toe; the high toe contact on coast side will lower and move toward the heel.

When the pinion is too close to the centerline of the ring gear, the pattern will be a low toe contact on drive side and a low heel contact on the coast side. Moving the pinion farther away from the ring gear by decreasing shim thickness will cause low toe contact on drive side to raise and move toward the heel; the low heel contact on coast side will raise and move toward the toe.

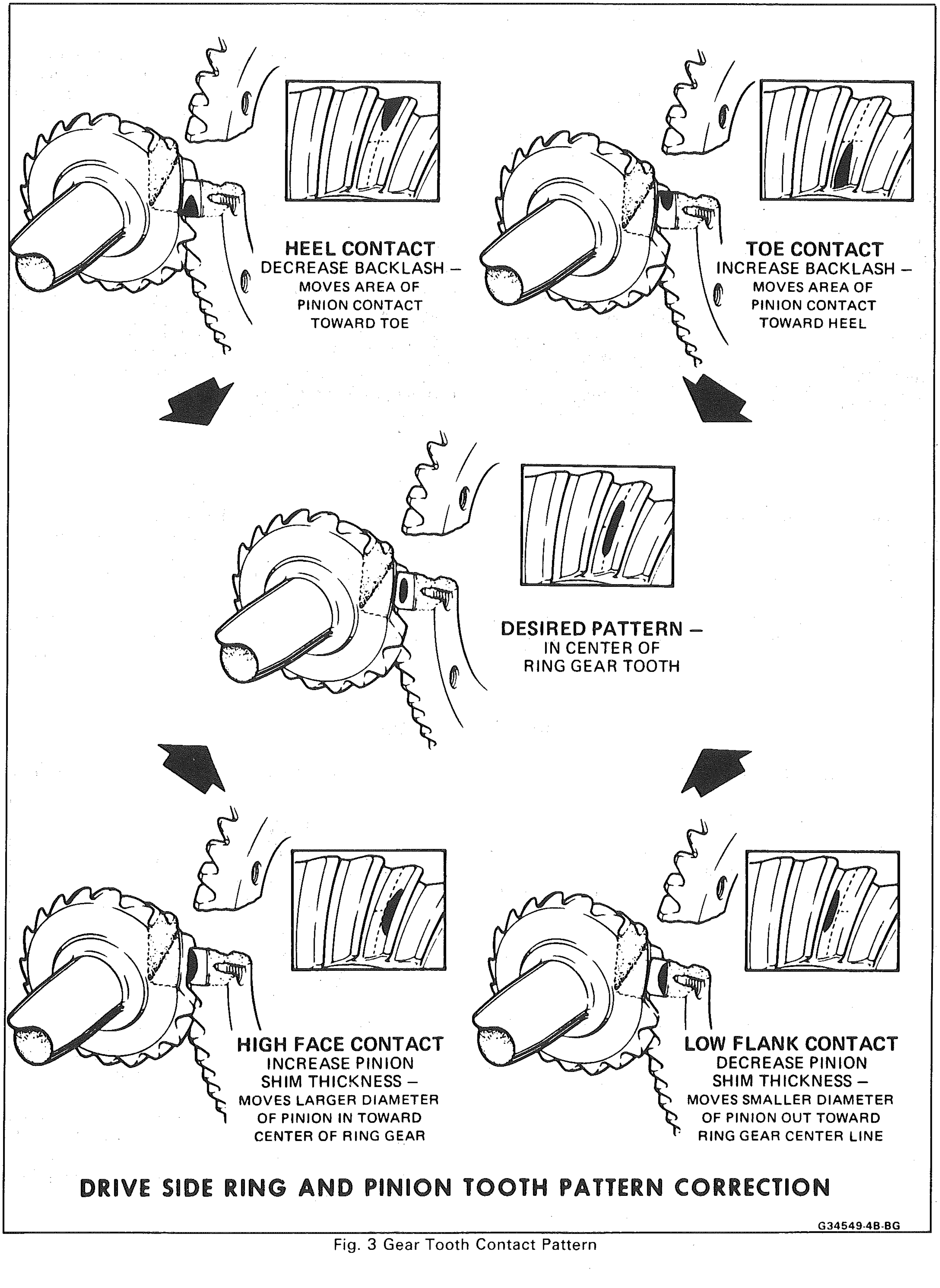


Fig. 3 Gear Tooth Contact Pattern

GENERAL INFORMATION

A universal joint connects the rear end of the propeller shaft to a pinion flange, having a splined end which fits over and drives the hypoid pinion gear. The housing is attached to the underbody through a center bearing support. Inside the housing, an extension shaft is splined to the drive pinion at the rear end, and to the companion flange at the other end. Two pre-loaded tapered roller bearings support the hypoid pinion gear in the carrier. The inner race of the rear bearing is a light press fit on the pinion stem. The inner race of the front bearing combines a light press fit to a close sliding fit on the pinion flange end of the pinion stem. The outer race of each bearing is pressed against a shoulder recessed in the carrier. Tightening the pinion nut compresses a collapsible spacer which bears against the inner race of the front bearing and a shoulder on the pinion stem. This spacer is used to enable accurate bearing pre-load adjustment and maintain a pre-load on both front and rear pinion bearings. Adjustment of the fore and aft position of the pinion is obtained by placing shims between the head of the drive pinion and the rear pinion bearing. The rear axle case is of one-piece construction and is supported in the carrier by two tapered roller side bearings. These are pre-loaded by inserting shims between the bearings and the carrier. The rear axle case assembly is positioned for proper ring gear to pinion backlash by varying the shim thickness from side to side. The ring gear is bolted to the case. Two side gears have splined bores for driving the axle shafts. They are positioned to turn in counterbored cavities in the case. The two rear axle pinions have smooth bores and are held in position by a solid pinion cross shaft, mounted and locked in the rear axle case. All four gears are in mesh with each other and because the pinion gears turn freely on their shaft, they act as idler gears when the rear wheels are turning at different speeds. The pinions and side gears are backed by steel thrust washers.

LIMITED-SLIP REAR AXLE

The operation of the Limited-Slip differential is the same as the standard differential, except that there is additional friction provided by the clutches or cones. Under ordinary driving and cornering conditions, the clutches or cones slip, allowing the outside wheel to turn faster than the inner. Under poor traction conditions, such as ice, snow, or loose gravel under one driving wheel, the increased friction provided by the clutches or cones increases the driving torque available to the wheel with the better traction. The clutches or cones are spring loaded to provide the increased driving torque under extremely low traction conditions.

Most rear axle service repairs can be made with the rear axle assembly in the car, by raising the rear end of the car with the rear axle hanging on the shock absorbers.

ON-VEHICLE SERVICE

CARRIER COVER AND GASKET

Remove or Disconnect

1. Having a container in place, remove cover bolts and pry cover loose to drain lubricant.
2. Make sure both gasket sealing surfaces are clean.

Install or Connect

Use sealant 1052366 or cover gasket only.

1. Torque cover bolts in a crosswise pattern to insure uniform draw on gasket. Torque 27 N·m (20 lb.ft.).
2. Fill with lubricant to a level within 4.5mm (3/16") or filler plug hole. Refer to specifications for correct lubricant usage and quantity.

Axle Shaft

Remove or Disconnect

1. Raise car and remove wheel and brake drum.
2. Clean all dirt from area of carrier.
3. Remove bolts and differential carrier cover and allow lubricant to drain.
4. Remove pinion shaft lock screw and pinion shaft.

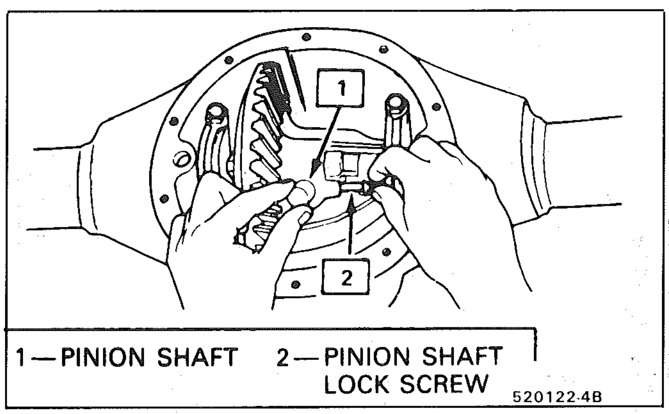


Fig. 401 Pinion Shaft Lock Bolt

5. Push flanged end of axle shaft inward to permit removal of "C" locks, then remove axle shafts being careful not to damage oil seal (Fig. 402).
6. Remove axle shaft from housing, being careful not to damage oil seal.

Install or Connect

1. Slide axle shaft into place taking care that splines on end of shaft do not damage oil seal and that they engage with splines of rear axle side gear.
2. Install axle shaft "C" lock on bottom end of axle shaft and push shaft outward so that shaft lock seats in counterbore of rear axle side gear.
3. Position rear axle pinion shaft through case and pinions, aligning hole in shaft with lock screw hole. Install lock screw and torque to 27 N·m (20 lb.ft.).
4. Using a new gasket, install carrier cover and torque bolts to 27 N·m (20 lb.ft.).
5. Fill axle with lubricant to a level within 9.5mm (3/8") of filler hole. See specifications for proper lubricant.
6. Install brake drum and wheel.
7. Lower car and test operation of axle.

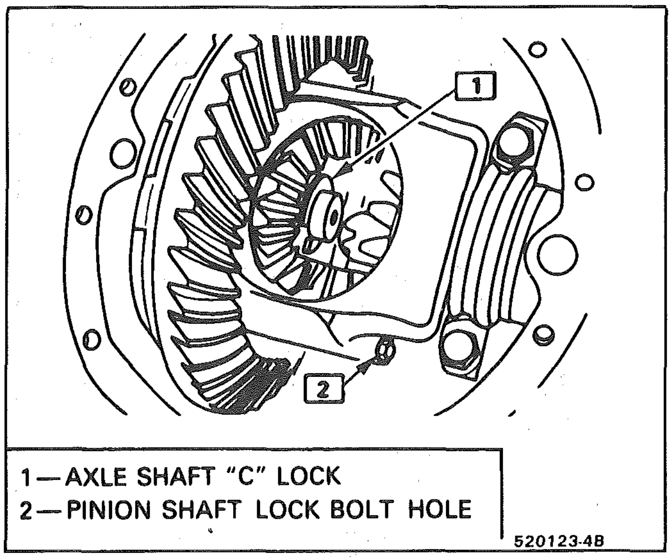


Fig. 402 Axle Shaft "C" Locks

Oil Seal and/or Bearing (With Axle Shaft Removed)

Remove or Disconnect

1. Remove seal from housing with a pry bar behind steel case of seal, being careful not to damage housing.
2. Install axle shaft bearing remover J 22813-01 and remove bearing and seal. See Fig. 403.

Install or Connect

1. Lubricate new bearing with gear lubricant and install bearing so that tool bottoms against shoulder in housing, using tools J-23765 and J-8092. See Fig. 404.
2. Lubricate new seal lips with gear lubricant. Position seal on tool and position seal into housing bore. Tap seal into place so that it is flush with axle tube Fig. 405.

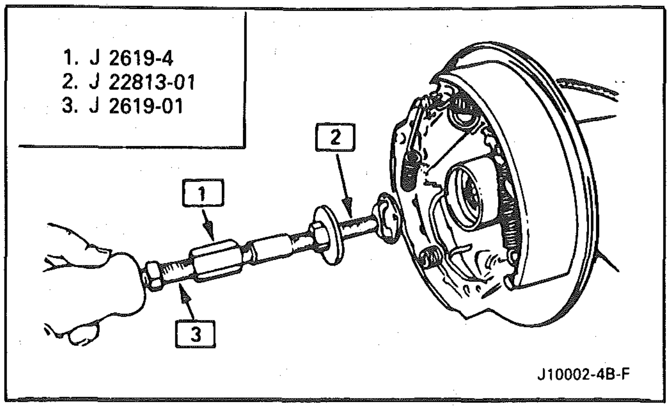


Fig. 403 Axle Shaft Bearing and Seal Remover

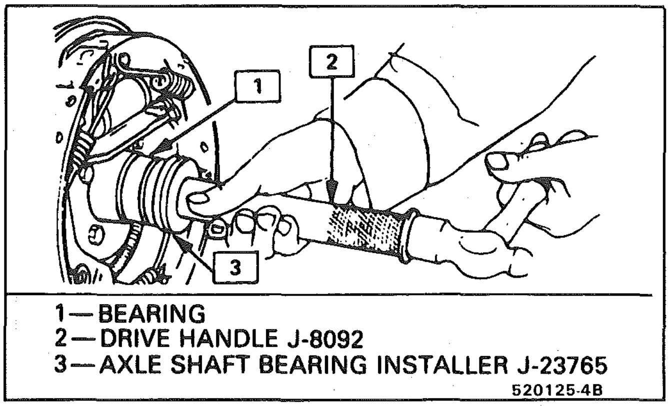


Fig. 404 Axle Shaft Bearing Installer

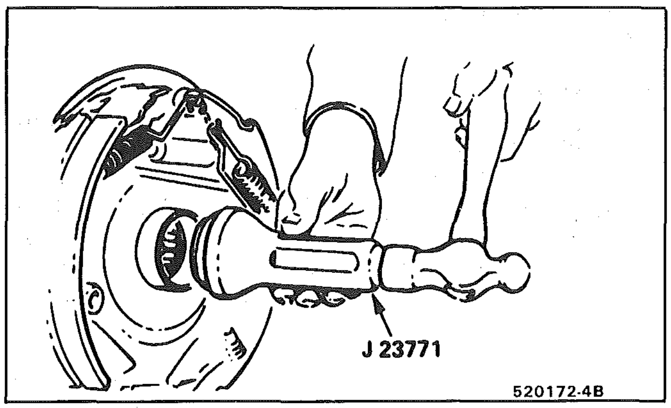


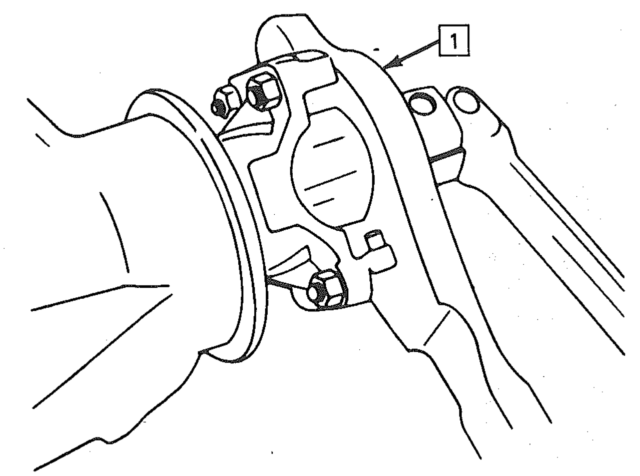
Fig. 405 Installing Axle Shaft Seal

Pinion Oil Seal

Remove or Disconnect

1. Mark the drive shaft and pinion flange so they can be reassembled in the same position.
2. With rear wheels off floor, turn rear wheels and tap brake backing plates with a soft hammer to ensure that brakes are free.
3. Mark the position of the pinion flange, pinion shaft and nut so the proper pinion bearing pre-load can be maintained.
4. Remove pinion flange nut and washer.
5. With suitable container in place to hold fluid, remove pinion flange.

6. Remove oil seal by driving it out of carrier with a blunt chisel. Do not damage carrier. Discard seal.
7. Examine seal surface of pinion flange for tool marks, nicks, or damage. If damaged, replace flange as outlined under Pinion Flange Replacement.
8. Examine carrier bore and remove any burrs that might cause leaks around the O.D. of the seal.

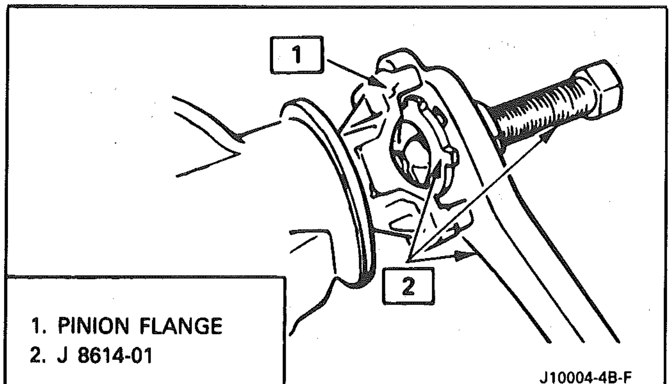


1. J 8614-10 PINION FLANGE REMOVER J10003-4B-F

Fig. 406 Removing Pinion Flange Nut

Install or Connect

1. Install new seal as shown in Fig. 408.
2. Apply special seal lubricant, No. 1050169 or equivalent to the O.D. of the pinion flange and sealing lip of new seal.
3. Install pinion flange and tighten nut to the same position as marked in step 3. While holding pinion flange as shown in Fig. 406. Tighten nut to 1.59mm (1/16") beyond alignment marks.



1. PINION FLANGE
2. J 8614-01

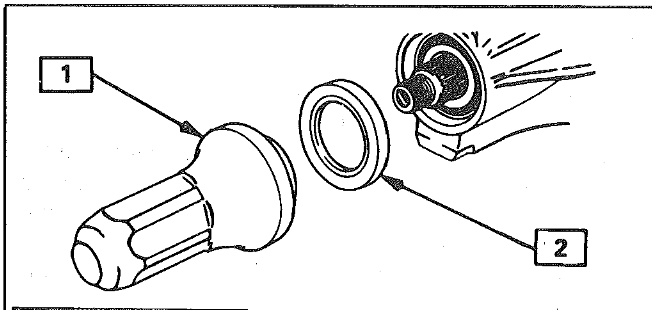
J10004-4B-F

Fig. 407 Removing or Installing Pinion Flange

Pinion Flange

Remove or Disconnect

1. Raise car and remove both rear wheels and drums.

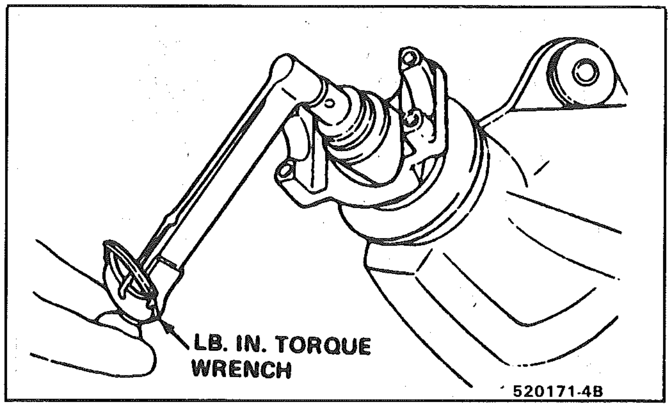


1—J-23911 7½" (190 mm) AXLES
2—PINION SEAL

520144-4B

Fig. 408 Installing Pinion Oil Seal

2. Mark drive shaft and pinion flange, then disconnect rear joint and support drive shaft out of the way. If joint bearings are not retained by a retainer strap, use a piece of tape to hold bearings on their journals.
3. Check pre-load with a torque wrench and record. This will give combined pinion bearing, carrier bearing, axle bearing and seal pre-load.



520171-4B

Fig. 409 Checking Pinion Pre-Load

4. Remove pinion flange nut and washer.
5. With a suitable container in place to hold any fluid that may drain from the rear axle, remove the pinion flange.

Install or Connect

1. Apply special seal lubricant, No. 1050169 or equivalent, to the O.D. of the new pinion flange then install pinion flange, washer and pinion flange nut finger tight.
2. While holding pinion flange, tighten the nut a little at a time and turn drive pinion several revolutions after each tightening to set the rollers. Check the pre-load of bearings each time with a torque wrench until pre-load is 0.3-0.6 N·m (3-5 lb.in.) more than reading obtained in Step 3.
3. Connect drive shaft to rear axle pinion flange. Refer to Torque Specifications.
4. Install drums and wheels.
5. Check and add correct lubricant as necessary. Refer to Specifications for correct lubricant.

Rear Wheel Bolt

Remove or Disconnect

1. Raise vehicle on hoist allowing axle to hang freely.
2. Remove wheel, tire and brake drum.
3. Using Tool J 6627-A press out stud.

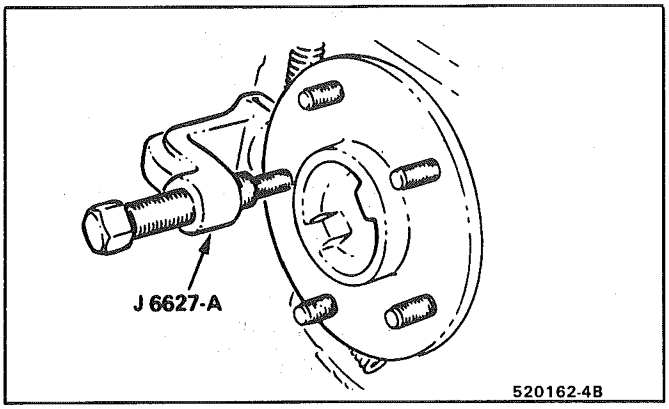


Fig. 410 Removing Wheel Bolt

Install or Connect

1. Place new stud in axle flange hole. Slightly start stud serrations in hole by firmly pressing back of stud with your hand.
2. Place a flat washer on the stud and install a lug nut with flat side first (tapered face outboard). Tighten on lug nut drawing stud into flange until stud head is bottomed on back side of flange.
3. Remove lug nut.
4. Reinstall brake drum (or rotor and caliper), wheel and tire.
5. Lower vehicle and remove from hoist.

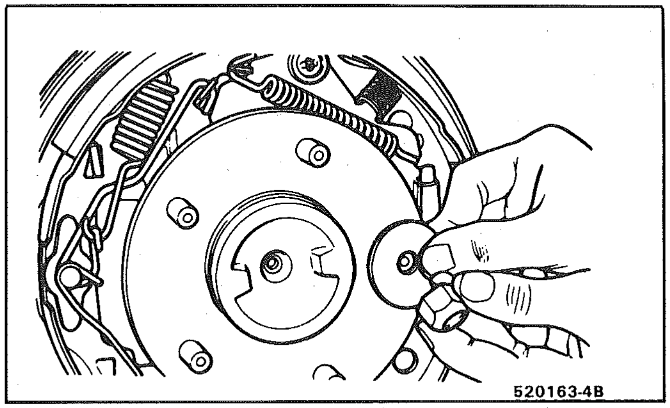


Fig. 411 Installing Wheel Bolt

UNIT REPAIR

REAR AXLE ASSEMBLY

It is not necessary to remove the rear axle assembly for any normal repairs. However, if the housing is damaged, the rear axle assembly may be removed and installed using the following procedure.

Remove or Disconnect

1. Hoist car and support at frame. Hoist must remain under rear axle housing.
2. Disconnect both shock absorbers.
3. Remove bolt securing left side of track bar to axle.
4. Remove brake line junction block bolt at axle housing, then disconnect brake lines at junction block.
5. Lower rear axle assembly on hoist and remove springs.
6. Remove rear wheels and drums.
7. Remove rear axle cover and drain lube.
8. Remove axle shafts.
9. Disconnect brake lines from axle housing clips.
10. Remove brake backing plates.
11. Disconnect lower control arms from axle housing.
12. Disconnect torque arm at axle.
13. Mark propeller shaft and companion flange and disconnect shaft and support out of the way.
14. Remove rear axle housing.

Install or Connect

1. Install rear axle housing.
2. Install propeller shaft aligning marks made at time of removal.
3. Connect torque arm to axle.
4. Connect lower control arms to axle.
5. Install brake backing plates.
6. Connect brake lines to axle housing.
7. Install axle shafts.
8. Install axle housing cover.
9. Install rear wheels and drums.
10. Raise axle and install springs.
11. Install brake line to junction block, then mount junction block on axle housing.
12. Install track bar to axle.
13. Connect shock absorbers.
14. Fill axle and bleed brake system.
15. Remove supports and lower car.

Disassembly of Rear Axle Assembly

Before attempting any service procedures the technician must know what type rear axle is to be serviced. Refer to chart (Rear Axle Codes And Identification) to identify codes, ring gear size, and ratios. Remember that all ring gear bolts have L.H. threads.

Most rear axle service repairs can be made by supporting the car by the frame with the axle housing supported and lowered to its lowest travel. On some models it may be necessary to disconnect shock absorbers to obtain additional clearance. When doing this, do not allow the rear brake hose to become kinked or stretched.

Lubricant may be drained by backing out all cover bolts and breaking cover loose at the bottom.

If the rear axle housing is removed for any reason, rear axle service can be performed on the bench.

When a new ring gear and pinion is installed, the owner should be advised not to accelerate rapidly or exceed 50 mph for the first 50 miles of driving.

Case Assembly

Remove or Disconnect

1. Before removing the rear axle case from the housing, ring gear to drive pinion backlash should be checked. This will indicate gear or bearing wear or an error in backlash or preload setting which will help in determining the cause of axle noise.
2. Remove rear axle bearing cap bolts. Bearing caps should be marked "R" and "L" to make sure they will be reassembled in their original location.
3. Remove rear axle case. Exercise caution in prying on carrier so that gasket sealing surface is not damaged. Place right and left bearing outer races and shims in sets with marked bearing caps so that they can be reinstalled in their original positions.

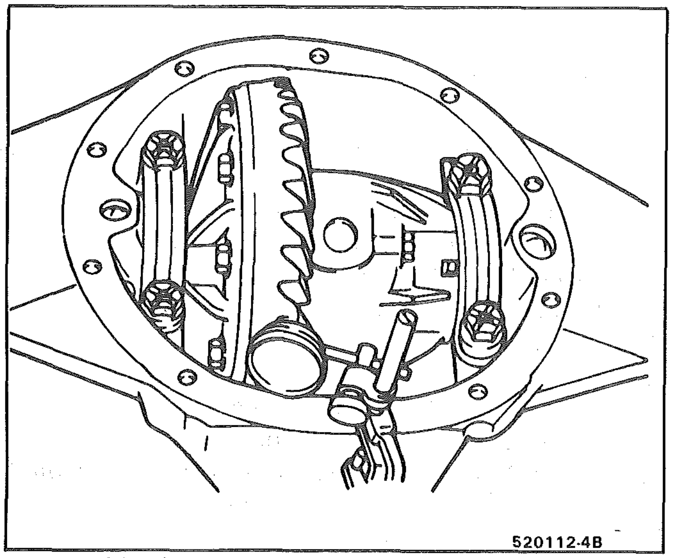


Fig. 601 Checking Ring Gear to Pinion Backlash

Disassemble

1. If rear axle side bearings are to be replaced, they can be removed as shown in Fig. 603.
2. Remove bolt that retains rear axle pinion shaft. Remove rear axle pinions, side gears and thrust washers from case. Mark side gears and case so they can be installed in their original locations.
3. If ring gear is to be replaced and it is tight on case after removing bolts (L.H. Threads), drive it off using a brass drift and hammer. Do not pry between ring gear and case.

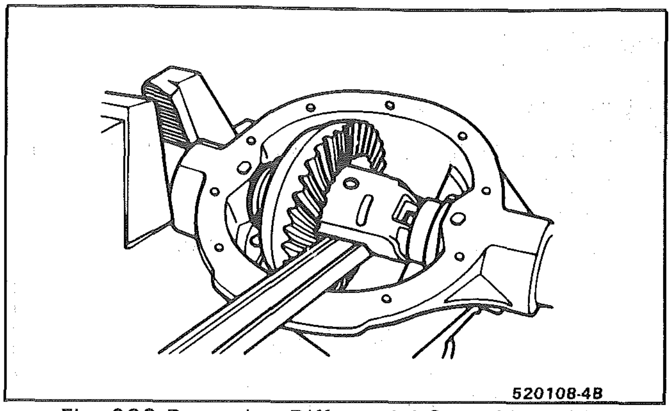


Fig. 602 Removing Differential Case Assembly

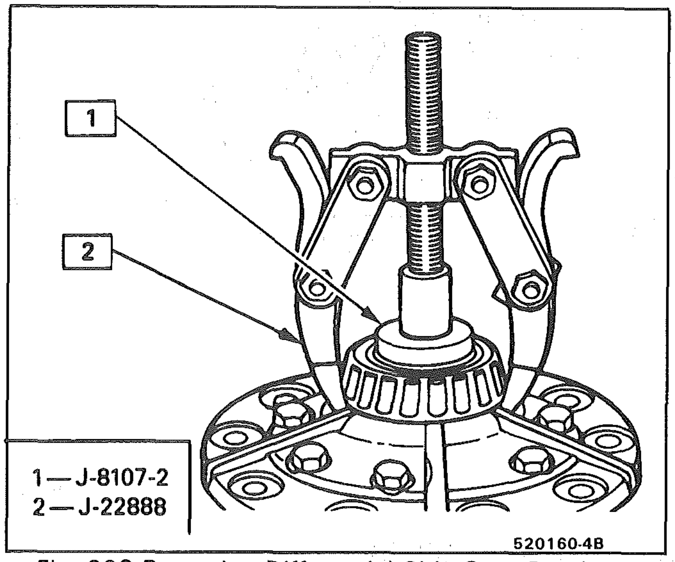


Fig. 603 Removing Differential Side Case Bearings

Drive Pinion, Bearing, and Races

Remove or Disconnect

1. Check pinion bearing pre-load (Fig. 409). If there is no pre-load reading, check for looseness of pinion assembly by shaking. Looseness indicates need for bearing replacement. If assembly is run long with very loose bearings, ring and pinion will also require replacement.
2. Remove pinion flange nut and washer.
3. Remove pinion flange.
4. Install drive pinion remover J 22536 and drive on pinion. Apply heavy hand pressure on pinion remover toward rear axle housing to keep front bearing seated to avoid damage to outer race.

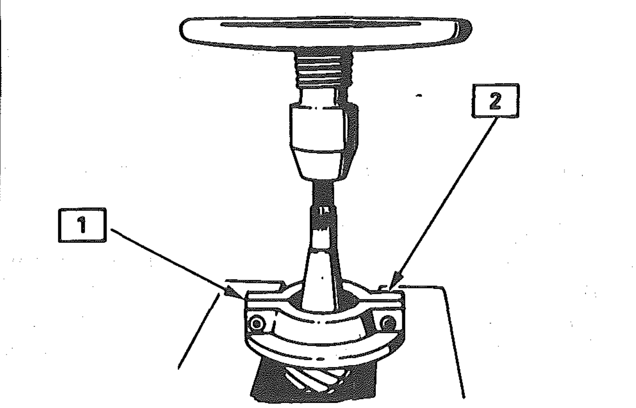
Bearing Replacement

Disassemble

The rear pinion bearing must be removed when it becomes necessary to change the pinion depth adjustment.

1. With drive pinion removed from carrier, press bearing from the pinion gear.

2. Drive pinion oil seal from carrier and remove front pinion bearing. If the bearing is to be replaced, remove outer race from carrier.
3. If rear pinion bearing is to be replaced remove outer race from carrier using a punch in slots provided for this purpose.



1—REMOVER J-22912-01 7½" OR J-33868
2—OPENING IN TOOL MUST BE SUPPORTED
520159-4B

Fig. 604 Removing Rear Pinion Bearing

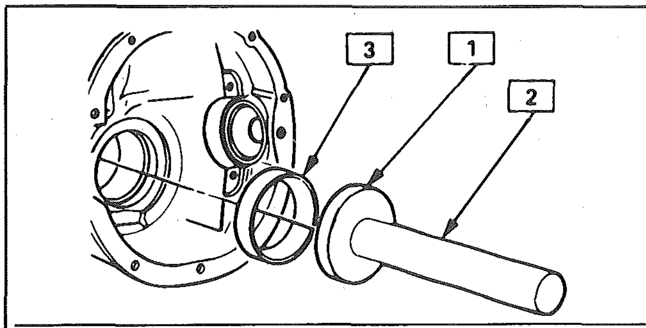
Cleaning and Inspecting

1. Clean all rear axle bearings thoroughly in clean solvent (do not use a brush). Examine bearings visually and by feel. All bearings should feel smooth when oiled and rotated while applying as much hand pressure as possible. Minute scratches and pits that appear on rollers and races at low mileage are due to the initial pre-load, and bearings having these marks should not be rejected.
2. Examine sealing surface of pinion flange for nicks burrs, or rough tool marks which would cause damage to the seal and result in an oil leak. Replace if damaged.
3. Examine carrier bore and remove any burrs that might cause leaks around the O.D. of the pinion seal.
4. Examine the ring gear and drive pinion teeth for excessive wear and scoring. If any of these conditions exist replacement of the gear set will be required.
5. Inspect the pinion gear shaft for unusual wear; also check the pinion and side gears and thrust washers.
6. Check the press fit of the side bearing inner race on the rear axle case hub by prying against the shoulder at the puller recess in the case. Side bearings must be a tight press fit on the hub.
7. Diagnosis of a rear axle failure such as: chipped bearings, loose (lapped-in) bearings, chipped gears, etc., is a warning that some foreign material is present; therefore the axle housing must be cleaned.

Drive Pinion

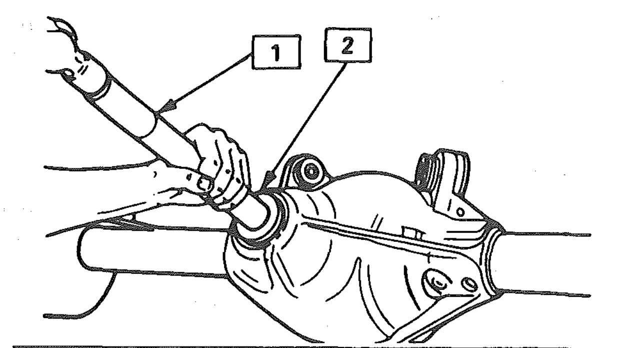
Assemble

1. If a new rear pinion bearing is to be installed, install new outer race.
2. If a new front pinion bearing is to be installed, install new outer race.



1. INSTALLER J 29609
2. DRIVER HANDLE J 8092
3. OUTER RACE
J10005-4B-F

Fig. 605 Installing Rear Pinion Bearing Outer Race



1—J-8092 DRIVE HANDLE 2—J-7817
520158-4B

Fig. 606 Installing Front Pinion Bearing Outer Race

Setting Drive Pinion Depth

Pinion depth is set with pinion setting gage J 21777-B. The pinion setting gage provides in effect a "Nominal" or "Zero" pinion as a gaging reference.

Set up pinion setting gage as follows:

1. Make certain all gage parts are clean.
2. Lubricate front and rear pinion bearings which will be used in final reassembly and position them in their respective races in the carrier. Bearings used with gage set must be those to be installed in vehicle, in order to insure accurate reading.
3. Assemble pinion setting gage assembly into carrier housing as follows:

Step 1

Figure 607

a. Install Pinion Bearing Pre-Load Stud J 21777-43 through Pilot J 23597-12 and into Gage Plate J 23597-11.
b. Install stud and plate assembly into housing and install Front Pinion Bearing Pilot J 21777-42 and hex nut over end of stud, tightening nut until snug and rotate gage

plate to make sure that both pinion bearings are properly seated.

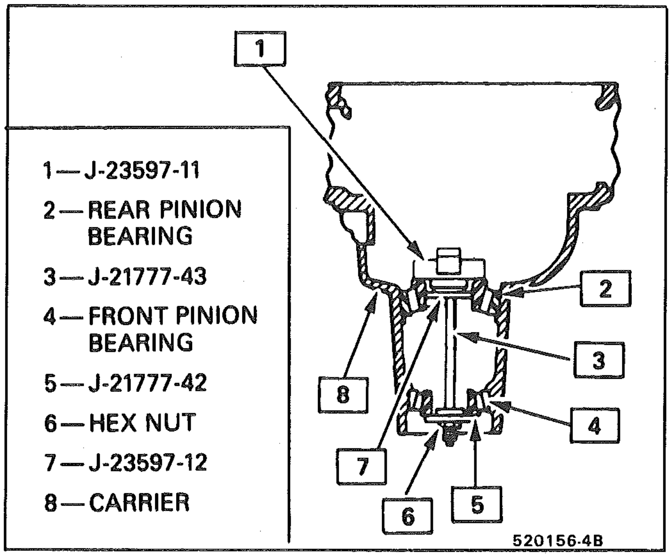


Fig. 607 Pinion Gage Tools - Step 1

c. Hold end of stud with wrench on its flats and tighten hex nut until 27 N·m (20 lb. in.). torque is required to keep gage plate in rotation.

Step 2

Figure 608

a. Install Side Bearing Discs J 21777-45 onto ends of Arbor Plunger Assembly J 23597-1.
b. Make certain that carrier housing side bearing bores are clean, free of burrs and position arbor into housing so that discs are properly seated in bores and dial indicator plunger rod is centered over "gaging area" of gage plate.

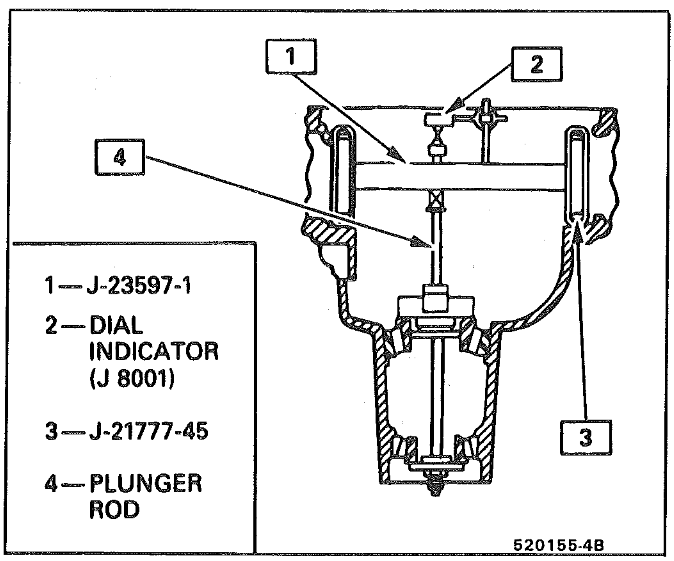


Fig. 608 Pinion Gage Tools - Step 2

c. Install side bearing caps over discs and torque bolts to 96 N·m (70 lb. ft.).

4. Set dial indicator at ZERO. Then, position on mounting post of the gage shaft with the contact button touching the indicator pad. Push dial indicator downward until the needle rotates approximately 3/4 turn clockwise. Tighten the dial indicator in this position and recheck.
5. Rotate arbor slowly back and forth until the dial indicator reads the greatest deflection. At the point of greatest deflection, set the dial indicator to ZERO. Repeat rock action of gage shaft to verify the ZERO setting.
6. After the ZERO setting is obtained, rotate arbor until the plunger rod does not touch the gage block.
7. Record dial reading at pointer position. EXAMPLE: If pointer moved counterclockwise .067" to a dial reading of .033", this indicates a shim thickness of .033".
8. Select correct pinion shim to be used during pinion reassembly on the following basis: *All pinions will be marked in one of three places. See Fig. 609 for areas of pinion depth setting marking.*

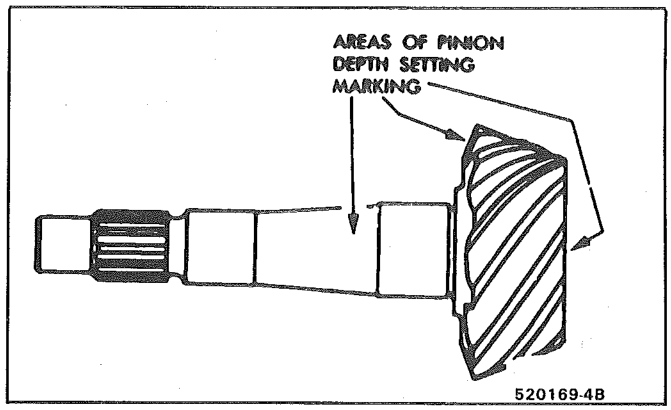


Fig. 609 Pinion Marking

a. If reusing production pinion and pinion is marked "+" (plus), correct shim will have a thickness equal to gage reading, minus the amount specified on pinion.
b. If production pinion is marked "-" (minus), correct shim will have a thickness equal to gage reading, plus the amount specified on pinion.
c. If using production or service pinion which has no marking, the correct shim will have a thickness equal to the gage reading.

9. Remove pinion gage assembly and both pinion bearings from case.
10. Position correct shim on pinion shaft and install rear pinion bearing using Installer J 21022-02.

Rear Axle Case

Assembly (With Axle Shafts Removed)

Before assembling the rear axle case, lubricate all parts with rear axle lubricant.

1. Place side gear thrust washers over side gear hubs and install side gears in case. If same parts are reused, install in original sides.
2. Position one pinion (without washer) between side gears and rotate gears until pinion is directly

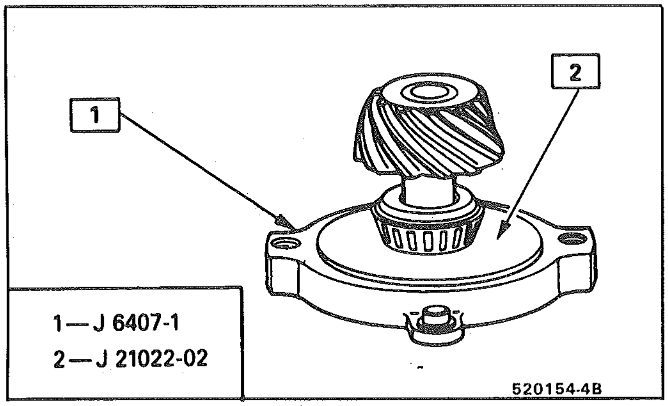


Fig. 610 Installing Rear Pinion Bearing

opposite from loading opening in case. Place other pinion between side gears so that pinion shaft holes are in line; then rotate gears to make sure holes in pinions will line up with holes in case.

3. If holes line up, rotate pinions back toward load opening just enough to permit sliding in pinion thrust washers.
4. Install pinion shaft and pinion shaft retaining bolt. Torque to 27 N·m (20 lb.ft.).
5. After making certain that mating surfaces of case and ring gear are clean and free of burrs, thread two bolts into opposite sides of ring gear; then install ring gear on case. Install NEW ring gear attaching bolts just snug. NEVER REUSE OLD BOLTS. Torque bolts alternately in progressive stages to 120 N·m (90 lb.ft.).
6. If case side bearings were removed, install bearings as shown in Fig. 612.

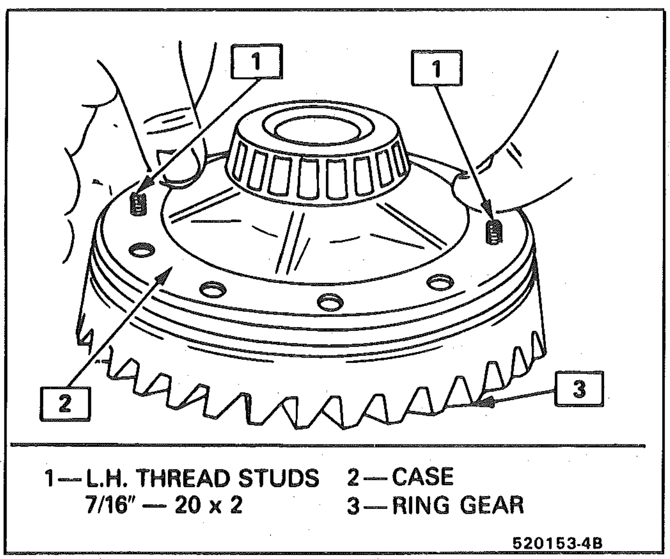


Fig. 611 Installing Ring Gear on Differential Case

Side Bearing Preload Adjustment

The side bearing pre-load adjustment is to be made before installing the pinion. If the pinion is installed, remove ring gear.

Case side bearing pre-load is adjusted by changing the thickness of both the right and left shims by an equal amount. By changing the thickness of both

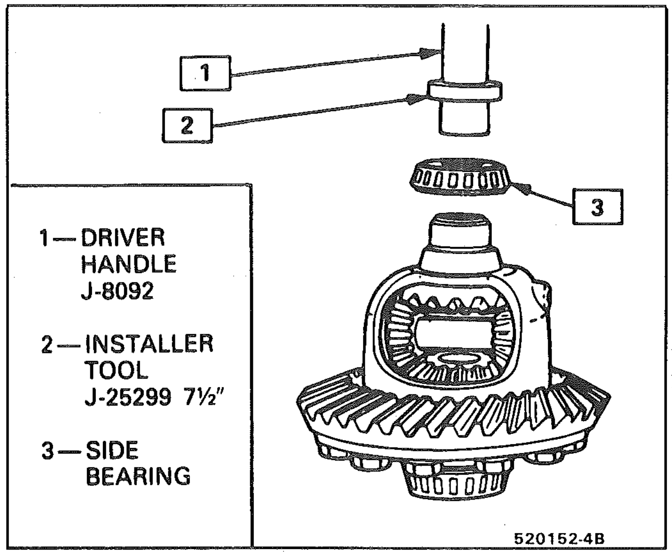


Fig. 612 Installing Side Case Bearings

shims equally, the original backlash will be maintained.

Production shims are cast iron and vary in thickness from 5.33 - 6.91mm (.210" to .272") in increments of .05mm (.002").

Standard Service spacers are 4.32mm (.170") thick and steel service shims are available from 1.02 to 2.08mm (.040" to .082") in increments of .05mm (. 002").

Do not attempt to reinstall the production shims as they may break when tapped into place. If service shims were previously installed, they can be reused, but (whether using new or old bearings) adhere to the following procedures in all cases.

1. Before installation of case assembly, make sure that side bearing surfaces in carrier are clean and free of burrs. Side bearings must be oiled with gear lube and, if the same bearings are being reused, they must have original outer races in place.
2. Determine the approximate thickness of shims needed by measuring each production shim or each service spacer and shim pack.
3. In addition to the service spacer, a service shim will be needed. To select a starting point in service shim thickness use the chart shown in Fig. 613.
4. Place case with bearing outer races in position in carrier. Slip the service spacer between each bearing race and carrier housing with chamfered edge against housing.

   Install the left bearing cap loose so that the case may be moved while checking adjustments. A bearing cap bolt can be added in the lower right bearing cap hole. This will prevent case from dropping while making shim adjustments.

   Select one or two shims and position between the right bearing race and the service spacer. Be sure left bearing race and spacer are against left side of housing.
5. Insert progressively larger feeler gage sizes .25mm, .30mm, .36mm, etc. (.010", .012", .014", etc.) between the right shim and service spacer until there is noticeable increased drag. Push the feeler gage downward until the end of the gage

4.32mm (.170") SERVICE SPACER	
TOTAL THICKNESS OF BOTH PROD. SHIMS REMOVED	TOTAL THICKNESS OF SERVICE SHIMS TO BE USED AS A STARTING POINT
10.57mm .420"	1.52mm .060"
10.92mm .430"	1.78mm .070"
11.18mm .440"	2.03mm .080"
11.43mm .450"	2.29mm .090"
11.68mm .460"	2.54mm .100"
11.94mm .470"	2.79mm .110"
12.19mm .480"	3.05mm .120"
12.45mm .490"	3.30mm .130"
12.70mm .500"	3.56mm .140"
12.95mm .510"	3.81mm .150"
13.21mm .520"	4.06mm .160"
13.46mm .530"	4.32mm .170"
13.97mm .550"	4.83mm .190"

520175-4B

Fig. 613 Shim Thickness

makes contact with the carrier bore so as to obtain a correct reading. The point just before additional drag begins is correct feeler gage thickness. Rotate case while using feeler gage to assure an even reading.

The original light drag is caused by weight of the case against the carrier while additional drag is caused by side bearing pre-load. By starting with a thin feeler gage, a sense of "feel" is obtained so that the beginning of pre-load can be recognized to obtain Zero clearance. It will be necessary to work case in and out and to the left in order to insert the feeler gage.

6. Remove left bearing cap and shim from carrier. The total shim pack needed (with no pre-load on side bearings) is the feeler gage reading found in Step 5 plus thickness of shims installed in Step 4.
7. Select two shims of approximately equal size whose total thickness is equal to the value obtained in Step 5. These shims will be installed between each side bearing race and service spacer when the case is installed in the carrier. The object of Step 7 is to obtain the equivalent of a "slip fit" of the case in the carrier. For convenience in setting backlash, the pre-load will not be added until the final step.
8. If the pinion is in position, install the ring gear, then proceed to Rear Axle Backlash Adjustment.

DRIVE PINION

Install or Connect

1. Install NEW collapsible spacer on pinion and position assembly in carrier. Lubricate pinion bearings with Rear Axle Lubricant before installing pinion.

NOTICE: There are two types of collapsible spacers. The conventional collapsible spacer is used on the 7-1/2" and 8-1/2" axles. The new inverted type is used only on the 7-5/8" axle.

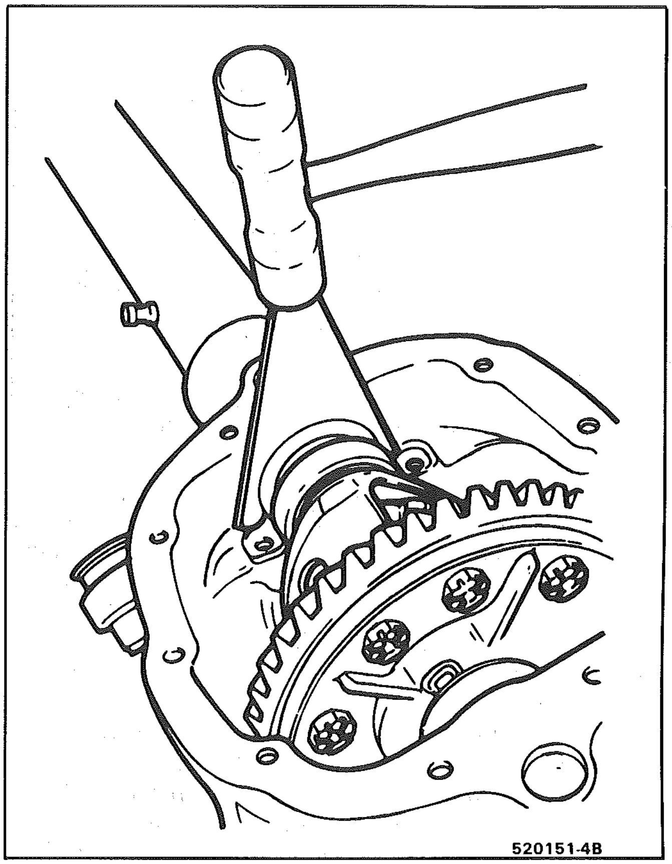


Fig. 614 Installing Differential Adjusting Shims

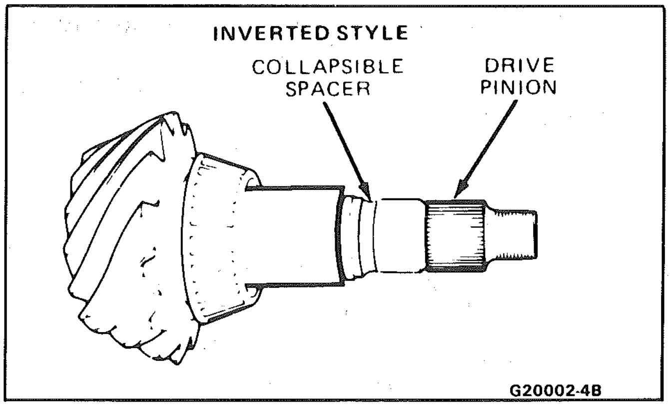


Fig. 615 Collapsible Spacer on Drive Pinion

2. Hold forward on pinion in case assembly.
3. Install front bearing on pinion and drive bearing on pinion shaft until seated in race.
4. Position pinion oil seal in carrier. Install seal.
5. Coat lips of pinion oil seal and seal surface of pinion flange with Lubricant No. 1050169 or equivalent. Install pinion flange on pinion by tapping with a soft hammer until a few pinion threads project through flange.
6. Install pinion washer and nut. Hold pinion flange, while intermittently rotating pinion to seat pinion bearings. Tighten pinion flange nut until end play begins to be taken up.

When no further end play is detectable and when holder will no longer pivot freely as pinion is rotated, pre-load specifications are being approached. No further tightening should be attempted until the pre-load has been checked.

7. Check pre-load by using an inch pound torque wrench.

NOTICE: After pre-load has been checked, final tightening should be done very carefully. For example, if when checking, pre-load was found to be 0.6 N·m (5 lbs. in.), any additional tightening of the pinion nut can add many additional pound inch of torque. Therefore, the pinion nut should be further tightened only a little at a time and the pre-load should be checked after each slight amount of tightening. Exceeding pre-load specifications will compress the collapsible spacer too far and require the installation of a new collapsible spacer.

While observing the preceeding note, carefully set pre-load at 2.7 to 3.6 N·m (24 to 32 lb.in.) on new bearings or 1.0 to 1.4 N·m (8 to 12 lb.in.) on used bearings.

8. Rotate pinion several times to assure that bearings have been seated. Check pre-load again. If pre-load has been reduced by rotating pinion, reset pre-load to specifications.

Rear Axle Backlash Adjustment

1. Install rear axle case into carrier, using shims as determined by the side bearing pre-load adjustment.
2. Rotate rear axle case several times to seat bearings, then mount dial indicator. Use a small button on the indicator stem so that contact can be made near heel end of tooth. Set dial indicator so that stem is in line as nearly as possible with gear rotation perpendicular to tooth angle for accurate backlash reading.
3. Check backlash at three or four points around ring gear. Lash must not vary over .05mm (.002″) around ring gear. Pinion must be held stationary when checking backlash. If variation is over .05mm (.002″) check for burrs, uneven bolting conditions or distorted case flange and make corrections as necessary.
4. Backlash at the point of minimum lash should be between .13 and .23mm (.005″ and .009″) for all new gears.
5. If backlash is not within specifications, correct by increasing thickness of one shim and decreasing thickness of other shim the same amount. This will maintain correct rear axle side bearing pre-load.

   For each .03mm (.001″) change in backlash desired, transfer .05mm (.002″) in shim thickness. To decrease backlash .03mm (.001″), decrease thickness of right shim .05mm (.002″) and increase thickness of left shim .05mm (. 002″). To increase backlash .05mm (.002″) increase thickness of right shim .10mm (.004″) and decrease thickness of left shim .10mm (. 004″).
6. When backlash is correctly adjusted, remove both bearing caps and both shim packs.

   Keep packs in their respective position, right or left side.

   Select a shim .10mm (.004″) thicker than the one removed from the left side, then insert left side shim pack between the spacer and the left bearing race. Loosely install bearing cap.
7. Select a shim .10mm (.004″) thicker than the one removed from right side and insert between the spacer and the right bearing race. It will be necessary to drive the right shim into position (Fig. 614).
8. Torque to 75 N·m (55 lb.ft.).
9. Recheck backlash and correct if necessary.
10. Install axles (See Rear Axle Installation).
11. **Use sealant 1052366 or cover gasket only.** Install cover and torque cover bolts to 27 N·m (20 lb.ft.).
12. Fill rear axle to proper level with the specified lubricant. Refer to specifications.

LIMITED SLIP REAR AXLE (CONE TYPE)

The cone-type limited-slip differential has several definite operating characteristics. An understanding of these characteristics is necessary as an aid to diagnosis.

The clutch energizing force comes from the thrust side of the gears. Consequently, a free spinning wheel may not have enough resistance to drive torque to apply the clutch cones. If this occurs, apply the parking brake a few notches which will provide enough resistance to energize the clutch cones.

Energizing the clutch cones is independent of acceleration; therefore, a very slow application of the throttle on starting is recommended to provide maximum traction by preventing "break away" of either rear wheel.

Improper operation is generally indicated by cone slippage or grabbing. Sometimes this produces a chatter or whirring sound. However, these sounds do not always indicate failure as they could be produced from a lack of proper lubrication. For example, under certain conditions where one wheel is on a very slippery surface and the other on dry pavement, wheel spin can occur if over acceleration is attempted. Continued spinning may cause audible noise, such as a whirring sound, due to the cones lacking sufficient lubricant. This does not necessarily indicate failure of the unit.

During regular operation (straight ahead driving) when both wheels rotate at equal speeds, there is an approximately equal driving force delivered to each wheel. When cornering, the inside wheel delivers extra driving force causing slippage in both clutch cones. Consequently, the operational life of the limited slip unit is dependent upon equal rotation of both wheels during straight ahead operation. If wheel rotation for both rear wheels is not equal during straight ahead operation, the limited-slip unit will constantly be functioning as if the vehicle were cornering. This will impose constant slippage on the clutch cones and will eventually lead to abnormal wear on the clutch cones. Therefore, it is important that there be no excessive differences in the rear wheel tire sizes, air pressures, or tire wear patterns. One indication of this condition is "swerving on acceleration." If swerving on acceleration is encountered, check the rear wheels for different tire size, air pressure, or excessively different wear patterns, and tread depths, before proceeding into an overhaul operation.

Checking Limited-Slip Operation

1. Place transmisison in Park position.
2. Raise rear of vehicle until wheels are off the ground, remove one wheel and tire assembly.
3. Attach Adapter J 2619-1 to axle shaft flange and install a 1/2-13 bolt into adapter as shown in Fig. 617.
4. With opposite wheel and tire assembly still on vehicle and held firmly to prevent turning, measure torque required to rotate opposite axle shaft with a torque wrench attached to J 2619-1. If the torque reading is less than 48 N·m (35 lb. ft.) the unit should be disassembled and repaired as required.
5. The Auburn rear axle check with both tires elevated and transmission in park (differential case not allowed to rotate).

   The torque required to rotate one wheel should be 169 to 305 N·m (125 to 225 lbs.ft.).
6. This is the Auburn rear axle check with only one rear wheel raised and transmission in neutral (differential case free to rotate). The torque required to rotate one wheel is 60 to 136 N·m (45 to 100 lbs. ft.)
7. Reinstall wheel and tire assembly.

AUBURN CONE TYPE

This limited slip rear axle transmits torque from the drive pinion gear to the ring gear and to the case in the same manner as the conventional rear axle. In addition, the limited slip rear axle incorporates the use of cone clutches which tend to lock the axle shafts to the case, or in effect, to each other.

As driving torque is developed at the rear wheels, side gear separating loads are developed which load the rear axle cones. This induced clutch torque capacity resists relative motion between the side gears and the rear axle case. Therefore, if one wheel is on slippery pavement, such as ice or snow, the other wheel must develop considerably more torque before the case assembly will differentiate and allow wheel spin.

The axle shaft torques developed when turning a corner will overcome the clutch capacities and allow differentiation.

All rear axle parts of vehicles equipped with this limited slip rear axle are interchangeable with those equipped with the conventional rear axle, except for the case assembly. It is similar in all respects to the conventional case assembly, with the addition of cone clutches splined to each side gear.

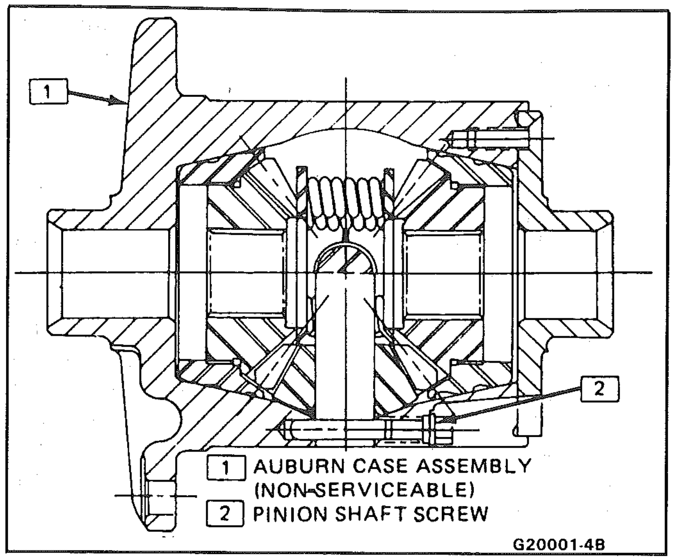


Figure 616 Auburn Cone Type Case

Remove or Disconnect

Figure 616

This limited slip rear axle case is non-serviceable.

1. Follow the procedures under standard case removal in this section.
2. Case side bearings using Tool J-22888.
3. All ring bolts except for two opposite ones.
4. Loosen the two remaining bolts slightly.
5. Tap on the two bolts alternately to loosen ring gear.

Install or Connect

1. Ring gear on new case.

NOTICE: Install new ring gear bolts. Never reuse old bolts.

2. Case side bearings on new case.
3. New case starting with the Side Bearing Preload Adjustment procedures in this section.

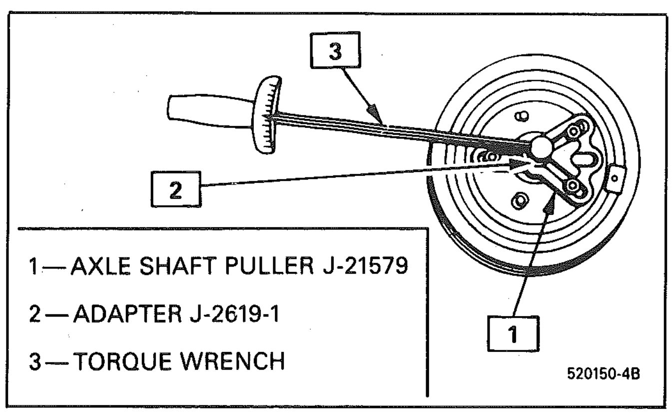


Fig. 617 Measuring Limited Slip Rotating Torque

SPECIFICATIONS

RING GEAR SIZE	RPO	RATIO	BRAKES	NON L/S AXLE CODE	L/S AXLE CODE
7.625	GU2	2.73	ALUMINUM DRUM		6HE
	GU2	2.73	CAST IRON DRUM	6HP	
	GU2	2.73	CAST IRON DRUM		6HT
	GU4	3.08	CAST IRON DRUM		6HF
	GU4	3.08	CAST IRON DRUM	6HK	
	GU4	3.08	ALUMINUM DRUM		6HB
	GU6	3.42	CAST IRON DRUM	6HL	

REAR AXLE SPECIFICATIONS

TIGHTENING SPECIFICATIONS

Bolt - Rear Universal Joint to Pinion Flange
Strap or U-Bolt - All .... 20 N·m (15 LBS. FT.)
Bolt - Rear Axle Housing Cover to Carrier .... 41 N·m (30 LBS. FT.)
Nut - Brake Assembly to Rear Axle Housing .... 48 N·m (35 LBS. FT.)
Bolt - Ring Gear to Differential Tail Case .... 120 N·m (90 LBS. FT.)
Bolt - Bearing Cap to Carrier .... 81 N·m (60 LBS. FT.)
Nut - Rear Wheel to Axle Shaft .... 108 N·m (80 LBS. FT.)
Nut - Filler Plug .... 34 N·m (26 LBS. FT.)

LIMITS FOR FITTINGS AND ADJUSTMENTS

Pinion Bearing Pre-Load (Measured at Pinion Flange Nut)
New Bearings .... 2.26 - 2.82 N·m (20-25 LBS. IN.) Rotating Torque

Reused Bearings - All .... 1.69 N·m (10-15 LBS. IN.) Rotating Torque

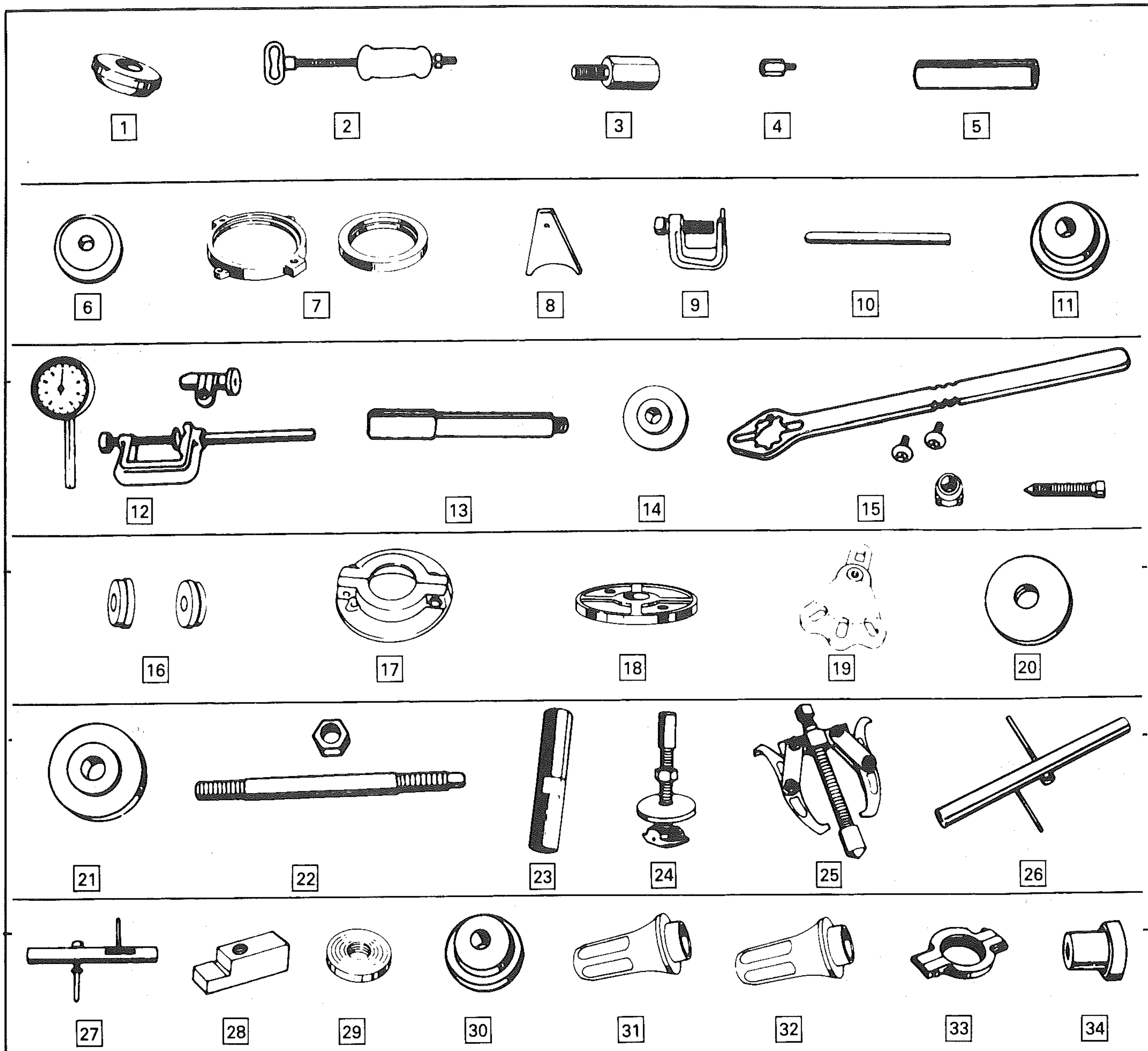
Total Assembly Preload (Measured at Pinion Flange Nut)
New Bearings .... 3.95 - 4.52 N·m (35-40 LBS. IN.) Rotating Torque

Reused Bearings .... 2.26 - 2.82 N·m (20-25 LBS. IN.) Rotating Torque

Ring Gear Position .... .006"-.008" Backlash

J10006-4B-F

Fig. 618 Axle Usage Chart



1. J 29609 REAR PINION BEARING INSTALLER
2. J 2619-01 SLIDE HAMMER ASSEMBLY
3. J 2619-1 ADAPTER
4. J 2619-4 SLIDE HAMMER ADAPTER
5. J 6133-01 FRONT PINION BEARING INSTALLER
6. J 6197-A PINION BEARING RACE INSTALLER
7. J 6407-1 PRESS PLATE HOLDER
8. J 25588 SIDE BEARING SHIM INSTALLER
9. J 6627-A WHEEL STUD REMOVER
10. J 7057 DIAL INDICATOR PLUNGER EXTENSION
11. J 7817 FRONT PINION BEARING RACE INSTALLER
12. J 8001 DIAL INDICATOR ASSEMBLY
13. J 8092 DRIVER HANDLE
14. J 8107-2 SIDE BEARING PULLER ADAPTER
15. J 8614-01 PINION FLANGE REMOVER AND INSTALLER
16. J 21777-45 PINION SETTING GAGE SHAFT DISCS (2 REQUIRED)
17. J 22912-01 REAR PINION BEARING REMOVER
18. J 21022-02 FRONT PINION BEARING REMOVER
19. J 21579-12 AXLE SHAFT PULLER
20. J 21777-40 PINION SETTING GAGE PILOT
21. J 21777-42 FRONT PINION BEARING PILOT
22. J 21777-43 PINION SETTING GAGE
23. J 22536 PINION DRIVER
24. J 22813-01 AXLE SHAFT BEARING AND SEAL REMOVER
25. J 228888 CASE SIDE BEARING PULLER
26. J 23597-1 BODY PINION SETTING GAGE
27. J 23597-1-6 BODY PINION SETTING GAGE
28. J 23597-11 PINION SETTING GAGE
29. J 23597-12 REAR SETTING GAGE
30. J 23765 AXLE SHAFT BEARING INSTALLER
31. J 23771 AXLE SHAFT SEAL INSTALLER
32. J 23911 PINION OIL SEAL INSTALLER
33. J 33868 REAR PINION BEARING REMOVER
34. J 25299 SIDE BEARING INSTALLER

J10007-4B-F

Fig. 619 Special Tools

SECTION 5

BRAKES

NOTICE: All brake attaching fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of parts.

CAUTION: When servicing brake parts, do not create dust by grinding, sanding brake linings, or by cleaning brake parts with a dry brush or with compressed air. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm. A water dampened cloth or water based solution should be used to remove any dust on brake parts. Equipment is commercially available to perform this washing function. These wet methods will prevent asbestos fibers from becoming airborne.

CONTENTS

GENERAL DESCRIPTION

COMPOSITE MASTER CYLINDER

This vehicle uses a composite master cylinder which has an aluminum body and a clear nylon reservoir with fluid level indicators.

The master cylinder uses a "quick take-up" feature in the rear chamber to reduce pedal travel which may result from increased fluid displacement required to move the caliper piston. The quick take-up master cylinder includes a spring loaded ball check valve which holds pressure in the large-diameter rear chamber. When the brake is first applied, the movement of the rear piston causes fluid to be displaced forward, past the primary piston primary seal and into the primary high pressure chamber, which feeds the front brakes. At a predetermined pressure, 480-690 kPa (70-100 psi), the ball unseats and fluid from the large rear bore is displaced past the ball and into the reservoir. The primary and secondary high pressure chambers supply pressure to the front and rear brakes, respectively, in the usual way. When the pedal is released, the large-bore chamber is filled with fluid by drawing fluid from the reservoir around the quick take-up lip seal, and also through a small orifice in the ball seat.

BRAKE FLUID LEVEL INDICATOR (Figure 1)

The nylon master cylinder reservoir has two windows which allow the brake fluid level to be checked without removal of the reservoir cover.

OPERATION OF DISC BRAKE

When the brakes are applied, fluid pressure behind the caliper piston increases. Pressure is exerted equally against the bottom of the piston and also against the bottom of the piston bore. The pressure applied to the piston is transmitted to the inner shoe and lining, forcing the lining against the inner rotor surface. The pressure applied to the bottom of the piston bore forces the caliper to slide on the mounting bolts toward the inner side, or toward the car. Since the caliper is one piece, this movement toward the car causes the outer section of the caliper to apply pressure against the back of the outer shoe and lining assembly, forcing the lining against the outer rotor surface. As line pressure increases, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the car to a stop. When line pressure is released, the seal and seal groove cause the piston to be slightly retracted, resulting in less drag on the rotor by the shoe and lining assembly.

Outward movement of the piston and inward movement of the caliper automatically compensate for lining wear. As the linings wear, the increased area behind the piston is filled with brake fluid from the master cylinder reservoir.

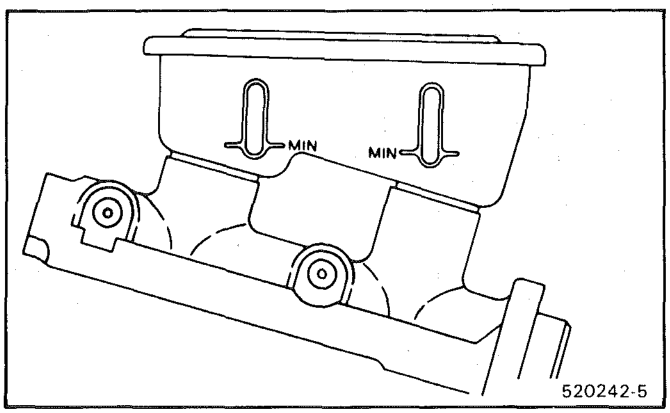


Figure 1 Master Cylinder Reservoir Window (Typical)

OPERATION OF DRUM BRAKE

The drum brake assembly is a duo-servo design. In the duo-servo brake, the force that the wheel cylinder applies to the primary shoe is multipled by the primary lining friction to provide a very high force applied to the secondary shoe. Torque from the brake shoes is transferred through the anchor pin to the axle flange. Adjustment is automatic when the brakes are applied while the car is backing up.

OPERATION OF COMBINATION VALVE

The metering, or hold-off section of the combination valve, limits pressure to the front disc brakes until a predetermined front input pressure is reached, approximating the pressure to overcome the rear shoe and lining retractor springs. There is no restriction at inlet pressures below 20 kPa (3 psi) to allow for pressure equalization during non apply periods.

To prevent early rear wheel lock-up under heavy braking loads, the proportioning section of the combination valve proportions outlet pressure to the rear brakes after a predetermined rear input pressure has been reached.

The valve has a by-pass feature which insures full system pressure to the rear brakes in the event of a front brake system failure. Similarly, full front pressure is retained in the event of a rear brake pressure failure.

BRAKE PRESSURE DIFFERENTIAL WARNING SWITCH

The pressure differential warning switch constantly compares brake pressure in both parts of the system. The switch will activate the "BRAKE" warning lamp on the instrument panel in a failure in either part. The combination valve is designed so the switch will stay in the "warning" position once a failure has occurred. The lamp can only be turned off by repairing the failure and applying a pedal force as required to develop up to 3100 kPa (450 psi) line pressure.

DIAGNOSIS AND INSPECTION

BRAKE SYSTEM TESTING (Figures 2 through 4)

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if the roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be affected if the roadway is crowned which would throw the weight of the car toward the wheels on one side. If the roadway is too rough, the wheels will tend to bounce.

Test brakes at different car speeds with both light and heavy pedal pressure, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency, because heavily braked, but turning wheels will stop the car in less distance than locked brakes. More tire-to-road friction is present with a heavily braked turning tire than with a sliding tire.

The brake system is designed and balanced to avoid locking the wheels, except at very high deceleration levels. The shortest stopping distance and best control is achieved without brake lock-up.

Because of high deceleration capability, a firmer pedal may be felt at higher deceleration levels.

External Conditions That Affect Brake Performance

1. **Tires.** Tires having unequal contact and grip on road will cause unequal braking. Tires must be equally inflated and tread pattern of right and left tires must be approximately equal.
2. **Car Loading.** A heavily loaded car requires more braking effort. When a car has unequal loading, the most heavily loaded wheels require more braking power than others.
3. **Wheel Alignment.** Misalignment of the wheels, particularly excessive camber and caster, will cause the brakes to pull to one side.
4. **Front Wheel Bearings.** A loose front wheel bearing permits the front wheel to tilt and lose contact with the brake shoe linings causing erratic brake operation.

WARNING LAMP OPERATION

The brake system uses a single red "BRAKE" warning lamp located in the instrument panel cluster. When the ignition switch is in the "START" position, the "BRAKE" warning lamp should come on. It should go off when the ignition switch returns to the "RUN" position.

The following conditions will activate the "BRAKE" warning lamp:

1. Parking brake applied. The lamp should be on when the parking brake is applied and the ignition switch is "ON."
2. Pressure differential switch detects a failure. See "Brake Pressure Differential Warning Switch" in this section.

BRAKE FLUID LEAKS

With engine running at idle and the transmission in neutral, depress the brake pedal and hold a constant foot pressure. If the pedal gradually falls away with the constant pressure, the hydraulic system may be leaking. Perform a visual check to confirm any suspected leak.

Check the master cylinder fluid levels. While a slight drop in reservoir level does result from normal lining wear, an abnormally low level in either reservoir indicates a leak in the system. The hydraulic system may be leaking either internally or externally. See "Master Cylinder Check." Also, the system may appear to pass this test but still have slight leakage.

If fluid levels are normal, check the vacuum booster pushrod length. If an incorrect length pushrod is found, adjust or replace the pushrod. Check the service brake pedal travel and the parking brake adjustment.

When checking the fluid levels, the master cylinder reservoir may be as low as 25 mm (1 inch) from the top if the front linings are worn. This is not abnormal.

MASTER CYLINDER CHECK

These checks will help locate some master cylinder malfunctions. Use the Brake Diagnosis Charts to help isolate the problem if it is not found by using these tests.

1. Check for a cracked master cylinder casting or brake fluid around the master cylinder. Leaks are indicated only if there is at least a drop of fluid. A damp condition is not abnormal.
2. Check for a binding pedal linkage.
3. Disassemble the master cylinder and check for swollen or stretched piston seal(s). If swollen seals are found, substandard or contaminated brake fluid should be suspected. If contaminated, all components should be disassembled and cleaned. All rubber components should be replaced and all the pipes should be flushed.

SUBSTANDARD OR CONTAMINATED BRAKE FLUID

Improper brake fluid, mineral oil or water in the fluid may cause the brake fluid to boil or the rubber components to deteriorate.

If piston cups are swollen, the rubber parts have deteriorated. This deterioration may also be seen by swollen wheel cylinder piston cups on the drum brake wheels or a swollen master cylinder cover diaphragm.

If rubber deterioration is evident, disassemble all hydraulic parts and wash with alcohol. Dry these parts with compressed air before assembly to keep alcohol out of the system. Replace all rubber parts in the system, including hoses. Check for fluid on the linings. If excessive fluid is found, replace the linings.

If master cylinder piston seals are satisfactory, check for leakage or excessive heat conditions. If condition is not found, drain fluid, flush with brake fluid, fill and bleed the system.

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow To Respond	Brakes Slow To Release	Brakes Drag	Uneven Braking Action (Side To Side)	Uneven Braking Action (Front To Rear)	Scraping Noise From Brakes	Brakes Squeak During Application*	Brakes Squeak During Stop*	Brakes Chatter (Roughness)	Brakes Groan At End Of Stop*	Brake Warning Lamp Glows During Stop
Leaking Brake Line or Connection	X	XX							X						XX
Leaking Wheel Cylinder or Piston Seal	X	XX		X				X							X
Leaking Master Cylinder	X	XX													X
Air in Brake System	XX								X						XX
Contaminated or Improper Brake Fluid					X	X	X								X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head			X		XX	X									
Damaged Power Head			X	X	X	X	X								
Improperly Assembled Power Head Valving			X	X	X	X	XX								
Worn Out Brake Lining-Replace			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear-Replace and Correct	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material-Replace			X	X				X	X			X		X	
Contaminated Brake Lining-Replace				XX				XX	XX	X	X	X		X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X	X	X		X	
Excessive Brake Lining Dust			X	XX				XX	XX		X	XX		X	
Heat Spotted or Scored Brake Drums or Rotors				X				X	X		X	X	XX	X	
Out-of-Round or Vibrating Brake Drums												X	XX		
Improper Thickness Variation on Brake Rotors													XX		
Excessive Lateral Run-Out													X		
Faulty Automatic Adjusters	X						X	X	X						X
Incorrect Wheel Cylinder Sizes			X	X				X	X						
Weak or Incorrect Brake Shoe Retention Springs				X		X	XX	X	X	XX	X	XX			
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X		X	X	X	
Insufficient Brake Shoe Guide Lubricant						X	X	X	X	XX	XX				
Restricted Brake Fluid Passage or Sticking Wheel Cylinder Piston		X	X		X	X	X	X	X						
Faulty Metering Valve	X		X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X								
Drums Tapered or Threaded										XX					
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments								X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal	X	X	X				X		X					X	
Improperly Adjusted Booster Pushrod	X					X	XX								X
Sticking Wheel Cylinder or Caliper Pistons			X			X	X	X	X						
Faulty Proportioning Valve			X		X	X	X								

XX — Indicates more probable cause(s) X — Indicates other causes *May be a normal condition. J10001-5-F

Figure 2 Brake System Diagnosis

BRAKE DIAGNOSIS CHART — 4 WHEEL DISC SYSTEMS

CAUSE / SYMPTOM	Excessive Brake Pedal Travel	Brake Pedal Travel Gradually Increases	Excessive Brake Pedal Effort	Excessive Braking Action	Brakes Slow To Respond	Brakes Slow To Release	Brakes Drag	Uneven Braking Action (Side To Side)	Uneven Braking Action (Front To Rear)	Scraping Noise From Brakes	Brakes Squeak During Application*	Brakes Squeak During Stop*	Brakes Chatter (Roughness)	Brakes Groan At End Of Stop*	Brake Warning Lamp Glows
Leaking Brake Line or Connection	X	XX	X						X						XX
Leaking Piston Seal	X	XX	X	X				X	X						X
Leaking Master Cylinder	X	XX	X						X						X
Air in Brake System	XX		X						X						XX
Contaminated or Improper Brake Fluid	X				X	X	X	X	X						X
Leaking Vacuum System			XX		X										
Restricted Air Passage in Power Head		X	X		XX	X									
Damaged Power Head		X	X	X	X	XX									
Worn Out Brake Lining			X	X				X	X	X	X	X		X	
Uneven Brake Lining Wear-Replace	X			X				X	X	X	X	XX		X	X
Glazed Brake Lining			XX		X			X	X		X	X			
Incorrect Lining Material-Replace			X	X		X		X	X			X		X	
Contaminated Brake Lining-Replace				XX		X		XX	XX	X	X	X		X	
Linings Damaged by Abusive Use-Replace			X	XX				X	X	X	X	X		X	
Heat Spotted or Scored Discs				X				X	X		X	X	XX	X	
Improper Thickness Variation	X												XX		
Excessive Lateral Run-Out	X												X		
Automatic Adjuster Problem	X						X	X	X						X
Brake Assembly Attachments-Missing or Loose	X						X	X	X	X		X	X	X	
Restricted Brake Fluid Passage		X	X		X	X	X	X	X						X
Improperly Adjusted Stoplamp Switch Or Cruise Control Vacuum Dump							X								
Metering Valve Problem		X	X	X	X	X	X		X						X
Proportioning Valve Problem		X	X	X	X	X	X		X						X
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Improper Length Booster Pushrod	X			X		X	XX		X						
Incorrect Front End Alignment								XX							
Incorrect Tire Pressure								X	X						
Incorrect Wheel Bearing Adjustment	X									X			X		
Loose Front Suspension Attachments							X	X		XX			X	X	
Out-of-Balance Wheel Assemblies													XX		
Operator Riding Brake Pedal			X				X		X					X	
Sticking Caliper or Wheel Cylinder Pistons					X	X	XX	X	X						
Park Brake Switch Circuit Grounded															XX
Park Brake Not Releasing						X		X							XX

XX — Indicates more probable cause(s)
X — Indicates other causes

*May be a normal condition.

208761-R1

Figure 3 4-Wheel Disc Brake Diagnosis

The same types of brake trouble are encountered with power brakes as with standard brakes. Before checking power brake system for source of trouble, refer to the brake system diagnosis charts. After these possible causes have been eliminated, check for cause as outlined below:

HARD PEDAL

CAUSE	CORRECTION
Broken or damaged hydraulic brake pipes.	Inspect and replace as necessary.
Vacuum failure.	Check for: Faulty vacuum check valve or grommet. Replace. Collapsed or damaged vacuum hose. Replace. Plugged or loose vacuum fitting. Repair. Faulty air valve seal or support plate seal. Replace. Damaged floating control valve. Replace. Bad stud welds on front or rear housing or power head. Replace unless easily repaired.
Faulty diaphragm.	Replace.
Restricted air filter element.	Replace.
Worn or distorted reaction plate or levers.	Replace plate or levers.
Cracked or broken power pistons or retainer.	Replace power pistons and piston rod retainer.

GRABBY BRAKES
(Apparent Off-On Condition)

CAUSE	CORRECTION
Broken or damaged hydraulic brake pipes.	Inspect and replace as necessary.
Insufficient fluid in master cylinder.	Fill reservoirs with approved brake fluid. Check for leaks.
Faulty master cylinder seals.	Repair or replace as necessary.
Cracked master cylinder casting.	Replace.
Leaks in pipes or connections at disc brake calipers or wheel cylinders.	Inspect and repair as necessary.
Air in hydraulic system.	Bleed system.

BRAKES FAIL TO RELEASE

CAUSE	CORRECTION
Blocked passage in power piston.	Inspect and repair or replace as necessary.
Air valve sticking shut.	Check for proper lubrication of air valve "O" ring.
Broken piston return spring.	Replace.
Broken air valve spring.	Replace.
Tight pedal linkage.	Repair or replace as necessary.

J10002-5-F

Figure 4 Vacuum Booster Diagnosis

ON-CAR SERVICE

BRAKE PEDAL REPLACEMENT

See Figure 5.

STOPLAMP SWITCH ADJUSTMENT

Adjust (Figure 6)

With brake pedal in fully released position, the stoplamp switch plunger should be fully depressed against the brake pedal shank. Adjust switch by moving in or out as necessary.

1. Make certain that the tubular clip is in brake pedal mounting bracket.
2. With brake pedal depressed, insert switch into tubular clip until switch body seats on clip. Clicks can be heard as the threaded portion of the switch is pushed through the clip toward the brake pedal.
3. Pull brake pedal fully rearward against brake pedal stop until clicking sounds can no longer be heard. Switch will be moved in tubular clip providing adjustment.
4. Release brake pedal and then repeat step 3, to assure that no clicking sounds remain.

FILLING MASTER CYLINDER RESERVOIRS

The master cylinder must be kept properly filled to insure adequate reserve and to prevent air from entering the hydraulic system. However, because of expansion due to heat absorbed from brakes and from engine, master cylinder must not be overfilled.

The brake fluid reservoir is on the master cylinder which is located under the hood on the left side of the vehicle.

Thoroughly clean reservoir cover before removal to avoid getting dirt into reservoir. Remove cover and diaphragm.

NOTICE: Do not use fluid which contains a petroleum base. Do not use a container which has been used for petroleum based fluids or a container which is wet with water. Petroleum based fluids will cause swelling and distortion of rubber parts in the hydraulic brake system and water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent contamination.

Add fluid as required to bring level to approximately 6mm (1/4-inch) from top of reservoir. Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Fluid must be "DOT 3."

BLEEDING BRAKE HYDRAULIC SYSTEM

A bleeding operation is necessary to remove air when it is introduced into the hydraulic system.

It may be necessary to bleed the hydraulic system at all four brakes if air has been introduced through a low fluid level or by disconnecting brake pipes at master cylinder. If a

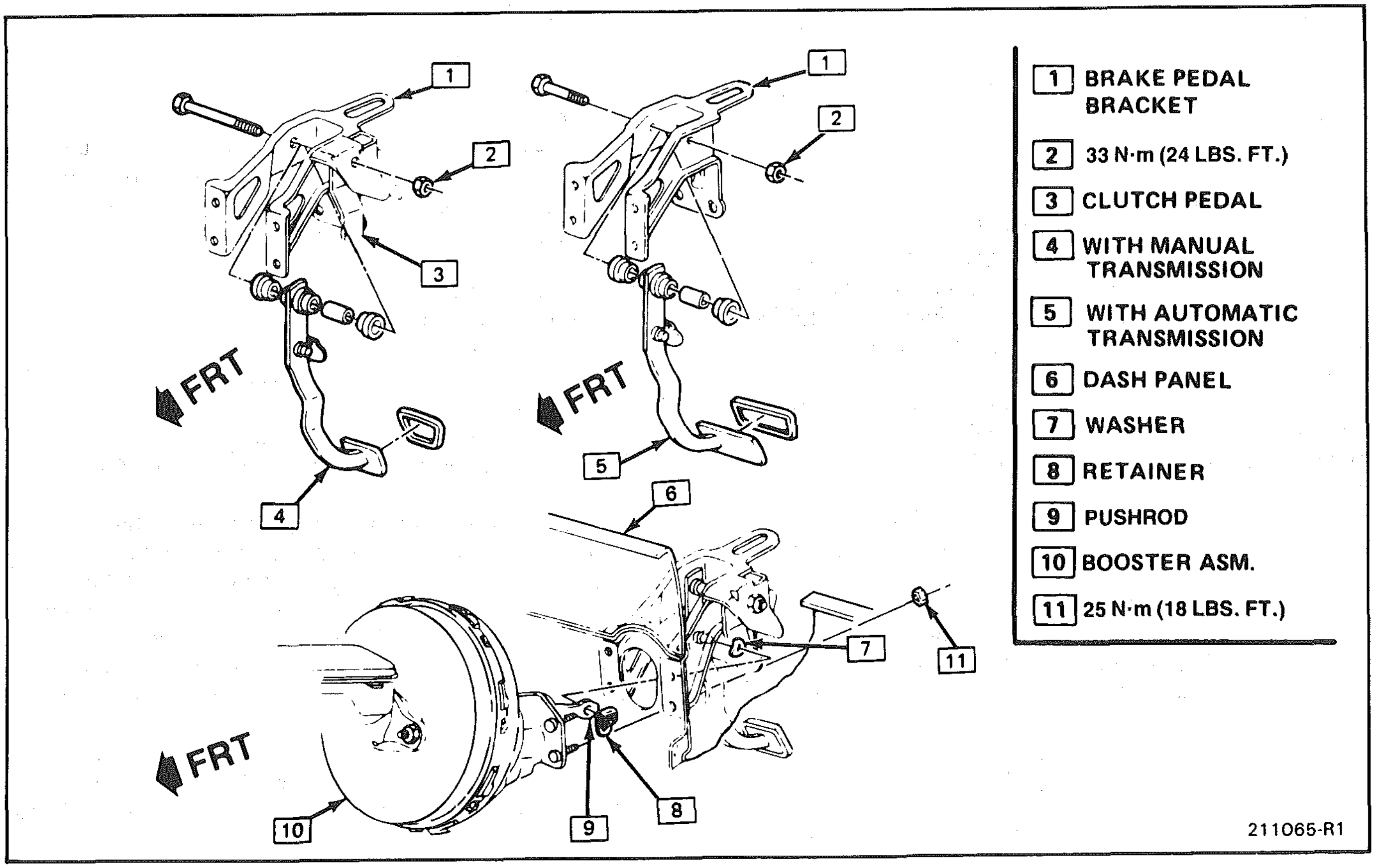


Figure 5 Brake Pedal Mounting

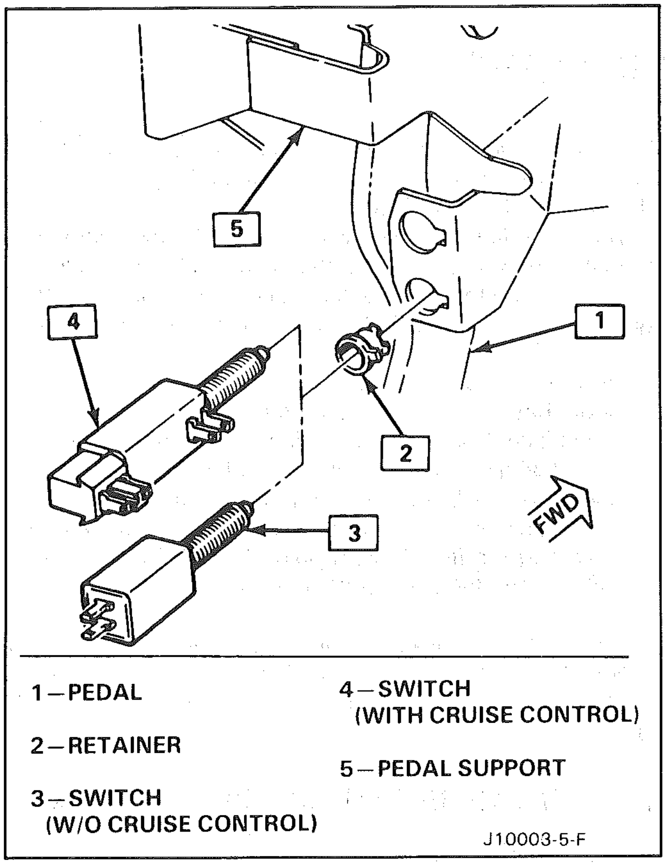


Figure 6 Stoplamp Switch Adjustment

brake pipe is disconnected at one wheel, only that wheel cylinder/caliper needs to be bled. If pipes are disconnected at any fitting located between master cylinder and brakes, then the brake system served by the disconnected pipe must be bled.

Manual Bleeding (Figure 7)

Tools Required:

J 21472 Bleeder Wrench
J 28434 Rear Wheel Cylinder Bleeder Wrench

The time required to bleed the hydraulic system can be reduced if the master cylinder is filled with fluid and as much air as possible is expelled before the cylinder is installed on the vehicle.

Power brakes require removing the vacuum reserve by applying the brakes several times with the engine off. Care must be taken to prevent brake fluid from contacting any painted surface.

1. Fill the master cylinder reservoirs with brake fluid and keep at least half full of fluid during the bleeding operation.
2. If the master cylinder is known or suspected to have air in the bore, then it must be bled before any wheel cylinder or caliper in the following manner:
   a. Disconnect the forward (blind end) brake pipe connection at the master cylinder.
   b. Allow brake fluid to fill the master cylinder bore until it begins to flow from the forward pipe connector port.
   c. Connect the forward brake pipe to the master cylinder and tighten.
   d. Depress the brake pedal **slowly one time and hold.** Loosen the forward brake pipe connection at the master cylinder to purge air from the bore. Tighten the connection and then **release the brake pedal slowly. Wait 15 seconds.** Repeat the sequence, including the 15 second wait, until all air is removed from the bore.
   e. After all air has been removed at the forward connection, repeat step d and bleed the master cylinder at the rear (cowl) connection.
   f. If it is known that the calipers and wheel cylinders do not contain any air, then it will not be necessary to bleed them.
3. Individual wheel cylinders or calipers are bled only after all air is removed from master cylinder.
   a. Place a proper size box end wrench or J 21472 over the bleeder valve. Rear wheel cylinder bleeder screws require tool J 28434. Attach a clear tube over bleeder valve and allow tube to hang submerged in a clear container partially filled with brake fluid. Depress the brake pedal **slowly one time and hold.** Loosen the bleeder valve to purge the air from the cylinder. Tighten bleeder screw and **slowly release pedal. Wait 15 seconds.** Repeat the sequence, including the 15 second wait until all air is removed. It may be necessary to repeat the sequence ten or more times to remove all the air. Rapid pumping of the brake pedal pushes the master cylinder secondary piston down the bore in a way that makes it difficult to bleed the rear side of the system.
4. If it is necessary to bleed all of the calipers or wheel cylinders, the following conventional sequence should be followed:
   a. right rear
   b. left rear
   c. right front
   d. left front
5. Check the brake pedal for "sponginess" and the "BRAKE" warning lamp for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.

Pressure Bleeding (Figures 7 and 8)

Tools Required:

J 21472 Bleeder Wrench
J 28434 Rear Wheel Cylinder Bleeder Wrench
J 29532 Bleeder
J 29567 Bleeder Adapter
J 35856 Proportioning Valve Depressor

NOTICE: Pressure bleeding equipment must be the diaphragm type and must have a rubber diaphragm between the air supply and the brake fluid to prevent air, moisture, oil and other contaminants from entering the hydraulic system. It is very important that the correct master cylinder bleeder adapter be used to avoid possible damage to the master cylinder reservoir.

1. Install J 29567 to the master cylinder reservoir.
2. Make sure the pressure tank is at least 1/2 full of Delco Supreme #11 brake fluid or equivalent. The bleeder must be bled each time fluid is added.

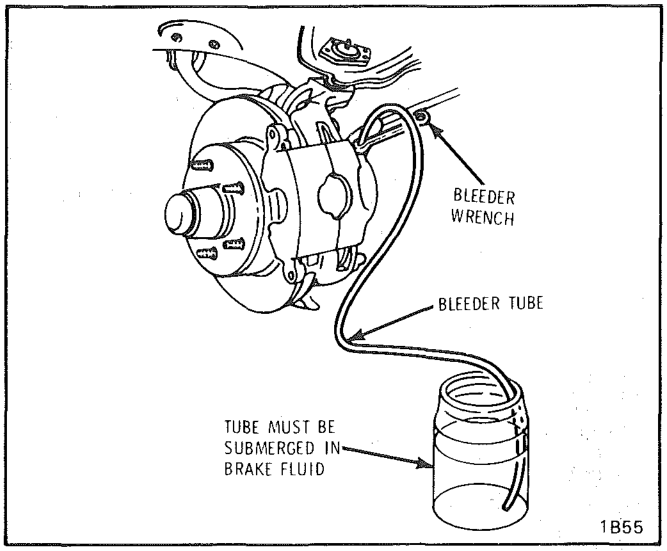


Figure 7 Bleeding Brakes

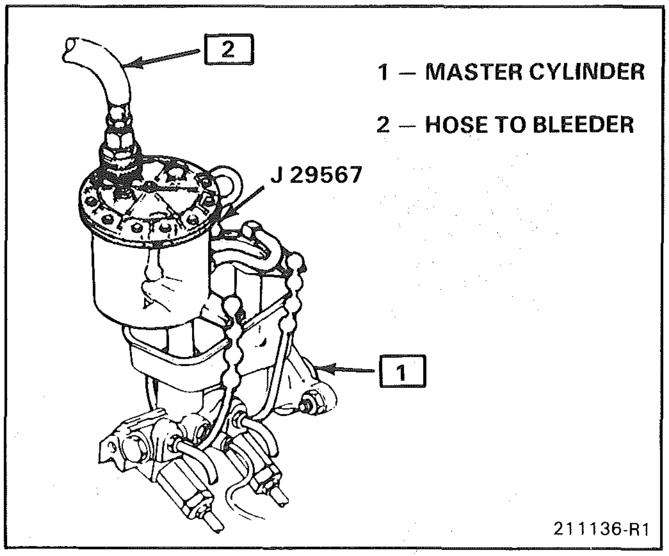


Figure 8 Pressure Bleeding Adapter (Typical)

3. Charge the bleeder to 140-172 kPa (20-25 psi).
4. Connect line to adapter. Open the line valve and depress bleed off valve on top of adapter until a few drops of fluid appear.
5. Rear drum brakes require manual override of the combination valve to permit flow to the front wheels. Use J 35856 to hold the valve stem open when pressure bleeding.
6. Raise car. See Section 0A.
7. Bleed the brakes in the following sequence:
   a. right rear
   b. left rear
   c. right front
   d. left front
8. Place a proper size box end wrench or J 21472 over the bleeder valve. Attach a clear tube over valve and allow tube to hang submerged in a clear container partially filled with brake fluid. When bleeding drum brakes, use J 28434 on the bleeder screw. Attach the bleeder tubing to the tool and submerge the other end in a clean container partially filled with brake fluid.
9. Open the bleeder valves at least 3/4 turn and allow flow to continue until no air is seen in the fluid.
10. Close the bleeder valves or screws.
    - Be sure they seal.
11. Repeat steps 7 through 10 until all calipers and wheel cylinders have been bled.
12. Lower car. See Section 0A.
13. Check the brake pedal for "sponginess" and the "BRAKE" warning lamp for indication of unbalanced pressure.
    - Repeat entire bleeding procedure to correct either of these two conditions.
14. Remove brake bleeding equipment from master cylinder.

FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the complete hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system.

The system must be flushed if there is any doubt about the grade of fluid in the system or if fluid has been used which contains the slightest trace of mineral oil.

All rubber parts that have been used with contaminated fluid must be replaced.

BRAKE PIPE REPLACEMENT (Figures 9 through 11)

Tool Required:
J 29803 I.S.O. Flaring Tool

CAUTION: Never use copper tubing because copper is subject to fatigue cracking and corrosion which could result in brake failure. Use double-walled steel tubing.

I.S.O. Flare

1. Obtain the recommended tubing and steel fitting nuts of the correct size. Outside diameter of tubing is used to specify size.
2. Cut tubing to length. Correct length may be determined by measuring old pipe using a string and adding 3mm (1/8-inch) for each I.S.O. flare.
3. Make sure fittings are installed before starting flare. Flare tubing ends using I.S.O. flaring kit J 29803. Follow instructions included in tool set.
4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of 19mm (3/4-inch) from all moving parts and 13mm (1/2-inch) from all vibrating parts must be maintained.

BRAKE HOSE INSPECTION

Inspect

The flexible hydraulic brake hoses, which transmit hydraulic pressure from the steel brake lines on the body to the rear axle and the calipers, should be inspected at least twice a year when the car is on a lift for lubrication. The

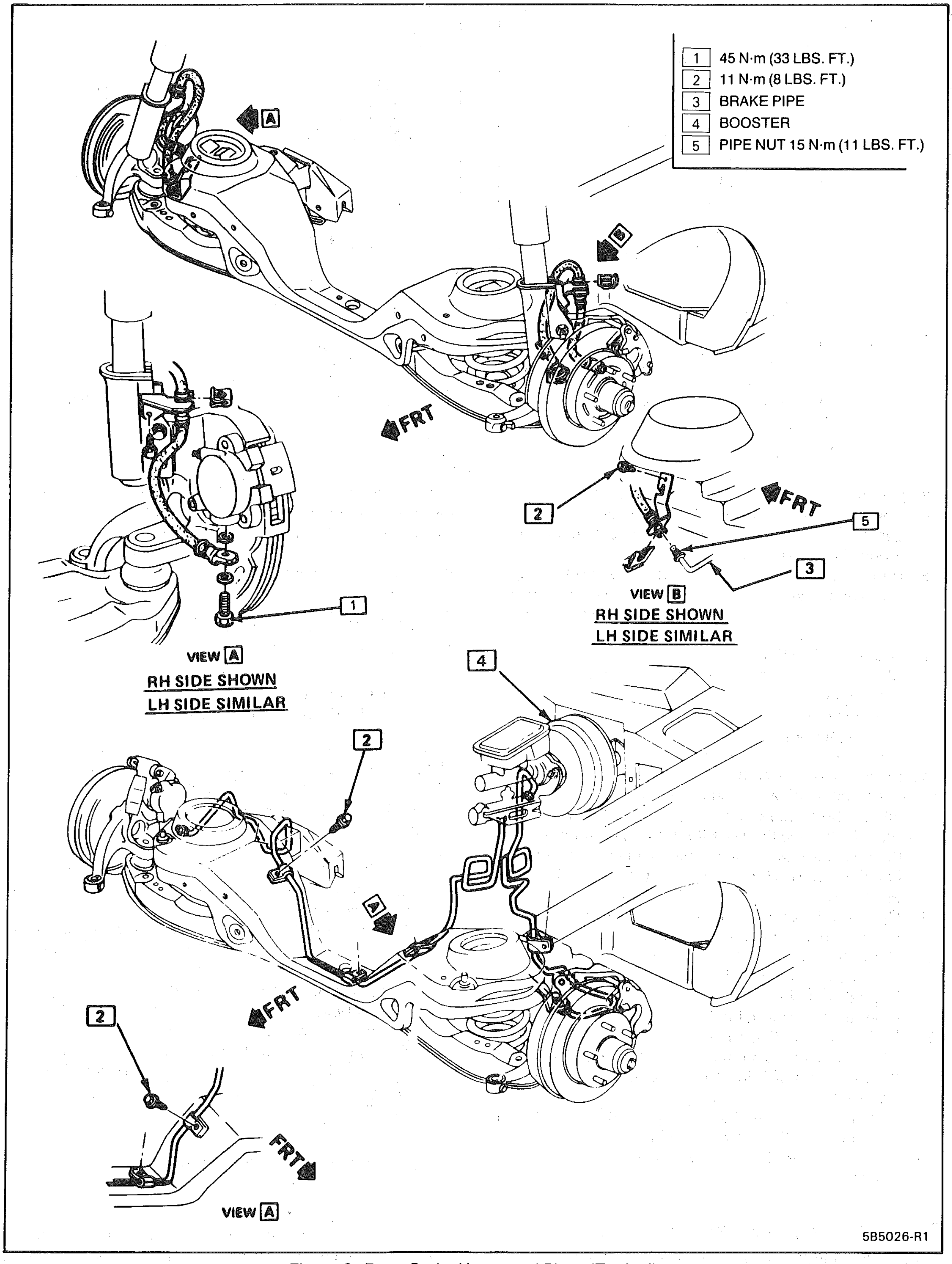


Figure 9 Front Brake Hoses and Pipes (Typical)

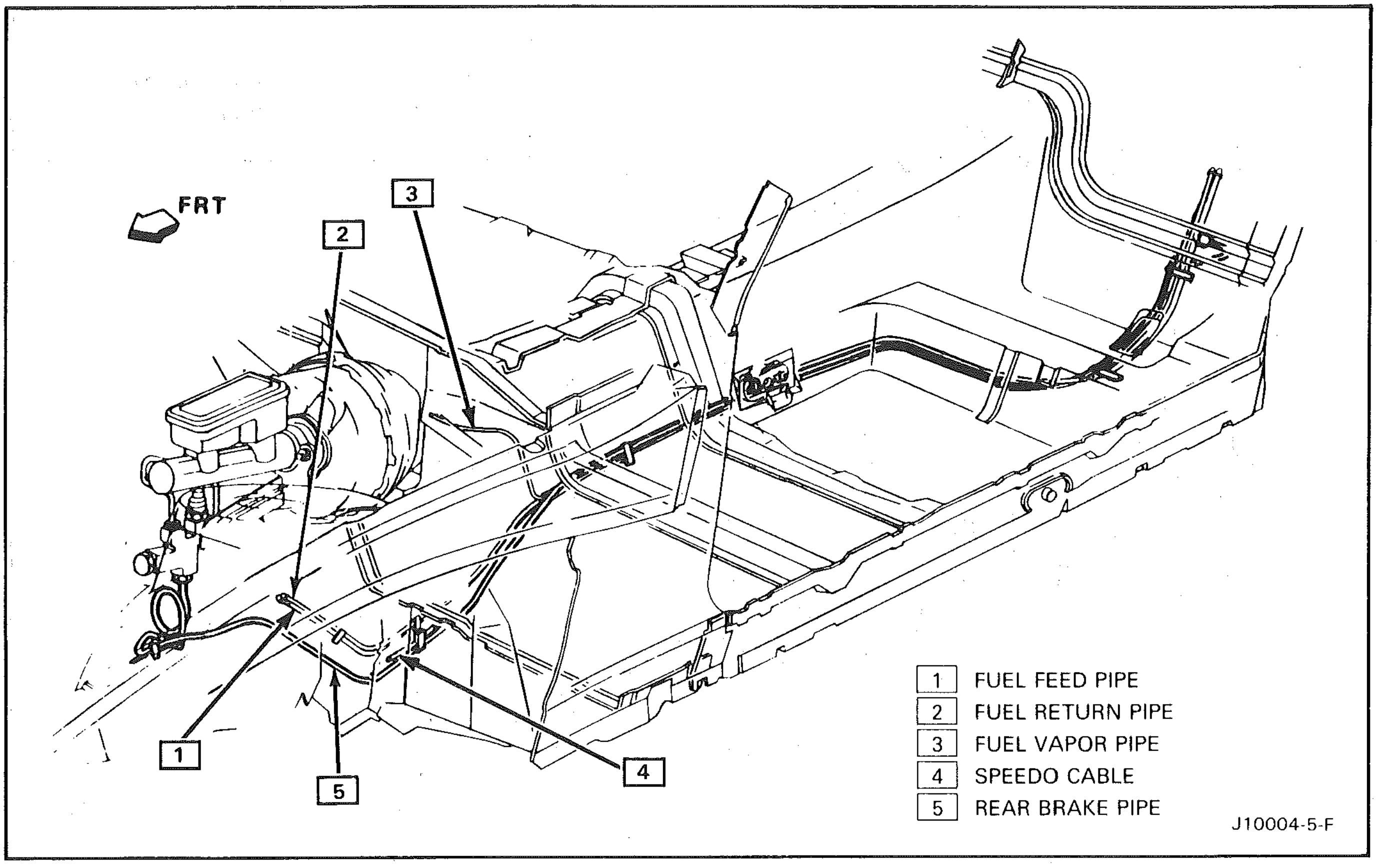


Figure 10 Center Brake Pipes (Typical)

brake hoses should be checked for road hazard damage, for cracks and chafing of the outer cover and for leaks and blisters. A light and mirror may be needed for an adequate inspection. If any of the above conditions are observed on a brake hose it will be necessary to replace it.

Do not allow brake components to hang from the flexible hoses as damage to the hoses may occur. Some brake hoses have protective rings or covers to prevent direct contact of the hose with other chassis parts. Besides causing possible structural damage to the hose, excessive tension could cause the hose rings to move out of their proper locations.

BRAKE HOSE REPLACEMENT

Front Brake Hose (Figure 9)

Remove or Disconnect

1. Wheel and tire. See Section 3E.

Clean

- Dirt and foreign material from hoses and fittings.

2. Brake pipe from hose.
   - Use a backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.
3. Spring clip from female fitting at bracket.
4. Hose from bracket.
5. Bolt, hose, and two copper gaskets from caliper.
   - Discard two copper gaskets.

Install or Connect (Figure 9)

NOTICE: See "Notice" on page 5-1 for steps 1 and 3.

1. Bolt, hose, and two copper gaskets to caliper.
   - Use new copper gaskets.
   - Lubricate bolt threads with brake fluid.
   - Fitting flange must engage caliper orientation ledge.

Tighten

- Bolt to 44 N·m (32 lbs. ft.).

2. Hose into bracket.
   - There should be no kinks in hose.
3. Spring clip at hose mounting bracket.
4. Brake pipe to hose.
   - Use backup wrench on hose fitting.
   - Make sure that hose does not make contact with any part of suspension. Check in extreme right and extreme left turn conditions.

Tighten

- Fittings to 15 N·m (11 lbs. ft.).

5. Bleed brake system. See "Bleeding Brake Hydraulic System" in this section.

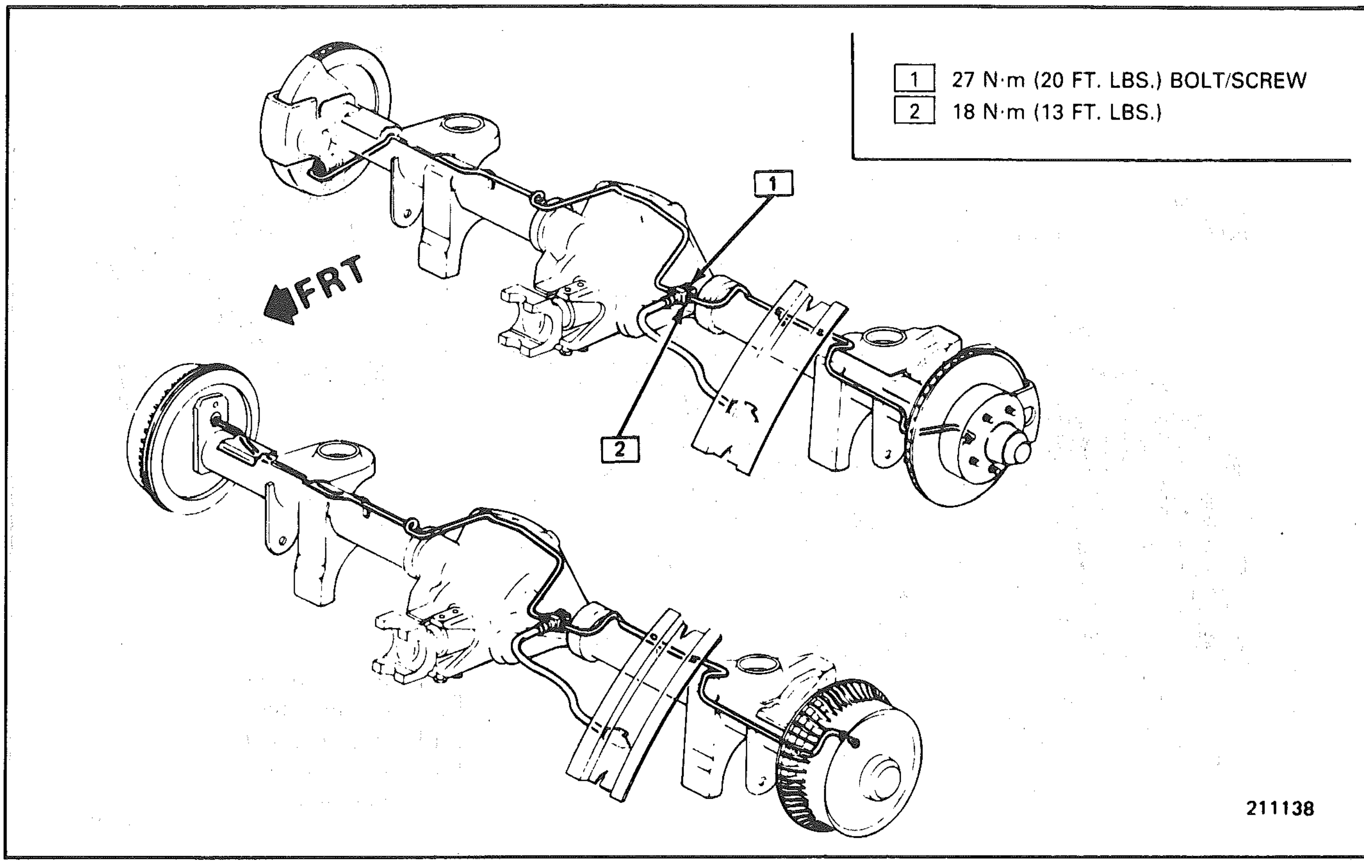


Figure 11 Rear Brake Hose and Pipes

6. Wheel and tire. See Section 3E.

Center Brake Hose (Figures 10 and 11)

Clean

- Dirt and foreign material from hose and fittings.

Remove or Disconnect

1. Front brake pipe from brake hose at hose mounting bracket.
   - Use a backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.
2. Spring clip on hose mounting bracket.
3. Hose from mounting bracket.
4. Two rear brake pipes from junction block.
   - Be careful not to bend pipes.
5. Bolt and junction block from rear axle.
   - Note position of junction block for proper location during installation.

Install or Connect (Figures 10 and 11)

NOTICE: See "Notice" on page 5-1 for steps 1 and 5.

1. Two brake pipes into junction block.
2. Junction block and bolt to rear axle.

Tighten

- Bolt to 27 N·m (20 lbs. ft.).
- Brake pipes to 15 N·m (11 lbs. ft.).

3. Hose in mounting bracket.
   - Hose will only fit in bracket in one position. Be sure hose is seated properly and not twisted.
4. Spring clip on hose mounting bracket.
5. Front brake pipe to hose at hose mounting bracket.

Tighten

- Brake pipe to 15 N·m (11 lbs. ft.).

Rear Disc Brake Hose

Remove or Disconnect (Figure 11)

1. Wheel and tire. See Section 3E.

Clean

- Dirt and foreign material from hoses and fittings.

2. Brake pipe from brake hose at hose mounting bracket.
   - Use a backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.
3. Spring clip at hose mounting bracket.

4. Bolt, hose and two copper gaskets from caliper.
   - Discard two copper gaskets.

Install or Connect (Figure 11)

NOTICE: See "Notice" on page 5-1 for steps 1 and 4.

1. Bolt, hose, and two copper gaskets to caliper.
   - Use new copper gaskets.
   - Lubricate bolt threads with brake fluid.

   Tighten
   - Bolt to 44 N·m (32 lbs. ft.).
2. Hose into bracket.
   - There should be no kinks in hose.
3. Spring clip at hose mounting bracket.
4. Brake pipe to brake hose.
   - Use backup wrench on hose fitting.
   - Be careful not to bend bracket or pipe.

   Tighten
   - Fittings to 15 N·m (11 lbs. ft.).
5. Bleed brake system. See "Bleeding Brake Hydraulic System" in this section.
6. Wheel and tire. See Section 3E.

PARKING BRAKE

This vehicle is equipped with coated parking brake cable assemblies. The wire strand is coated with a plastic material which slides over plastic seals inside the conduit end fittings. This is for corrosion protection and reduced parking brake effort.

NOTICE: Handling of these cables during servicing of the parking brake system requires extra care. Damage to the plastic coating will reduce corrosion protection and if the damaged area passes through the seal, increase parking brake effort could result. Contact of the coating with sharp-edged tools, or with sharp surfaces of the vehicle underbody, shou be avoided.

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake, the following is recommended:
- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

PARKING BRAKE CONTROL ASSEMBLY

Remove or Disconnect (Figure 12)

- Raise vehicle. See Section 0A.
- Loosen adjusting nut at equalizer enough to allow cable to be disconnected from parking brake control assembly.
- Lower vehicle. See Section 0A.

1. Carpet finish molding.

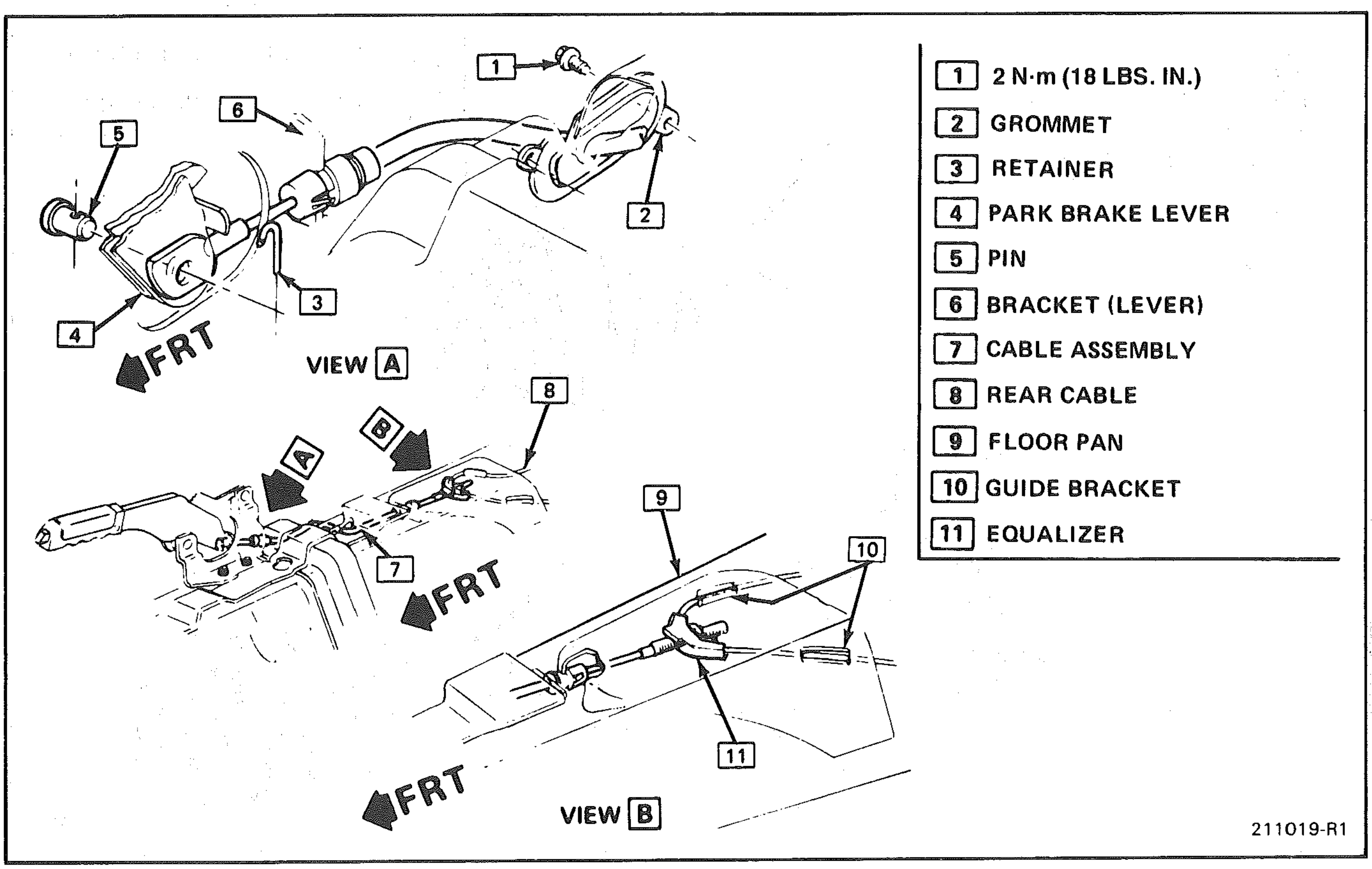


Figure 12 Parking Brake Control Assembly

2. Console. Refer to INSTRUMENT PANEL, GAGES AND CONSOLE (SEC. 8C).
3. Wiring from switch.
4. Cable and casing from control assembly.
   - Use a 1/2-inch box end wrench to free casing from control assembly.
5. Two bolts and control assembly from floor pan.

Install or Connect (Figure 12)

1. Two bolts and control assembly to floor pan.

   Tighten

   - Two bolts to 10 N·m (7 lbs. ft.).
2. Cable and casing to control assembly.
3. Wiring to switch.
4. Console. Refer to INSTRUMENT PANEL, GAGES AND CONSOLE (SEC. 8C).
5. Carpet finish molding.

Adjust

- Parking brake. See Section 5B6 or 5C3.

PARKING BRAKE CABLES

Parking Brake Front Cable

Remove or Disconnect (Figure 12)

- Raise vehicle. See Section 0A.
1. Adjusting nut from equalizer.
2. Spring retainer clip from bracket.
- Lower vehicle. See Section 0A.
3. Upper console cover and lower console rear screws.
- Lift rear of lower console for access to cable retainer at hand lever.
4. Cable retainer pin, cable retainer and cable.

Install or Connect (Figure 12)

1. Cable, cable retainer and cable retainer pin.
2. Lower console rear screws and upper console cover.
- Raise vehicle. See Section 0A.
3. Spring retainer clip to bracket.
4. Adjusting nut to equalizer.
- Lower vehicle. See Section 0A.

Adjust

- Parking brake. See Section 5B6 or 5C3.

Parking Brake Rear Cable (Drum Brakes)

Remove or Disconnect (Figures 12 and 13)

- Raise vehicle. See Section 0A.
1. Rear cable at connector.
   - Loosen adjusting nut at equalizer.
2. Wheel and brake drum.
   - Mark relationship of wheel to axle flange.
3. Cable at brake shoe operating lever.
   - Bend retainer fingers.
- Lower vehicle. See Section 0A.

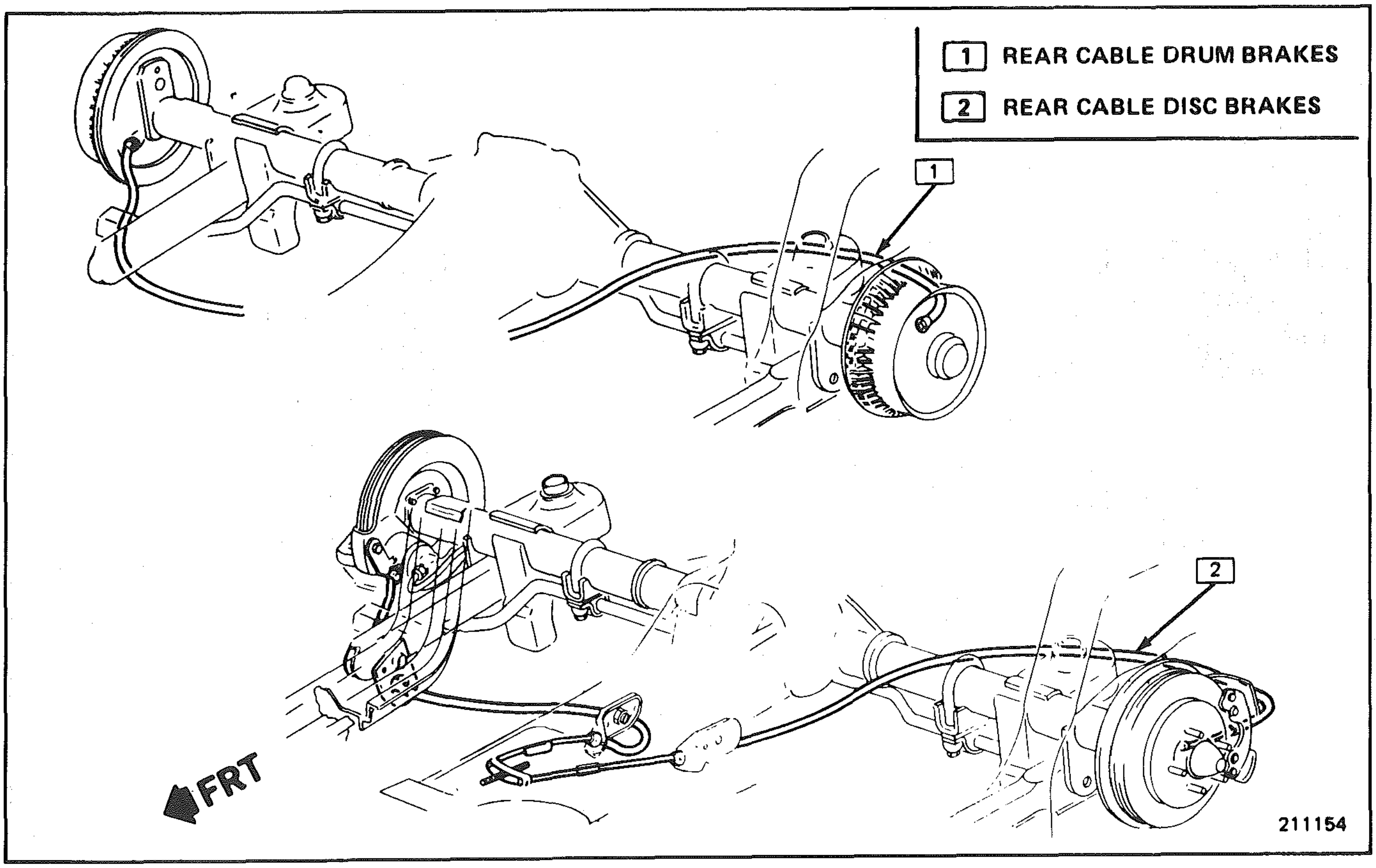


Figure 13 Rear Parking Brake Cables

Install or Connect (Figures 12 and 13)

- Raise vehicle. See Section 0A.

1. Cable at brake shoe operating lever.
   - Bend retainer fingers.
2. Brake drum and wheel.
3. Rear cable at connector.

- Lower vehicle. See Section 0A.

Adjust

- Parking brake. See Section 5C3.

Parking Brake Rear Cable (Disc Brakes)

Remove or Disconnect (Figures 12 and 13)

- Raise vehicle. See Section 0A.

1. Rear cable from connector.
   - Loosen adjusting nut at equalizer.
2. Cable from brake caliper.
   - Push forward on caliper parking brake apply lever.
   - Remove cable from tang in lever.
   - Release lever.

- Lower vehicle. See Section 0A.

Install or Connect (Figures 12 and 13)

- Raise vehicle. See Section 0A.

1. Cable to brake caliper.
   - Push forward on caliper parking brake apply lever.
   - Install cable in lever tang.
   - Release lever.
2. Rear cable to connector.

- Lower vehicle. See Section 0A.

Adjust

- Parking brake. See Section 5B6.

BRAKE LINING INSPECTION (Figure 14)

Inspect the brake linings at least twice a year when the wheels are removed (tire rotation, etc.). Check both ends of the outer shoe by looking in at each end of the caliper. These are the points at which the highest rate of wear normally occurs. Also, check the lining thickness of the inner shoe to make sure that it has not worn prematurely. Look through the hole in the top of the caliper to view the inner shoe. When the thickness of any lining is worn to within 0.76 mm (0.030-inch) of the shoe or rivet, all disc brake shoes and linings should be replaced in axle sets.

All disc brakes have a wear indicator that makes a noise when the linings wear to a degree where replacement is required. The wear indicator is an integral part of the shoe and lining. When the lining is worn, the clip indicator contacts the rotor and produces a warning noise.

Check flatness of brake linings. Place inner shoe lining and outer shoe lining surfaces together and check for gap between surfaces. If more than 0.13 mm (.005-inch) gap is measured midway between attaching lugs, shoe and lining assembly must be replaced.

Inspect rear drum brake shoe and lining assemblies. When the thickness of any lining is worn within 0.76 mm (0.030-inch) of the shoe or rivet, the shoe and lining assemblies must be replaced. Replace shoe and lining assemblies in axle sets.

INSPECTING AND REFINISHING ROTORS

Thickness Variation Check

Thickness variation can be checked by measuring the thickness of the rotor at four or more points around the circumference of the rotor. All measurements must be made at the same distance in from the edge of the rotor. A rotor that varies by more than .013 mm (.0005-inch) can cause pedal pulsation and/or front end vibration during brake applications. A rotor that does not meet these specifications should be refinished to specifications or replaced.

Lateral Runout Check (Figure 15)

1. Tighten wheel bearings until all the play is out of the bearings. See Section 3C.
2. Remove caliper.
3. Fasten a dial indicator to the steering knuckle so that the indicator button contacts the rotor about 25 mm (1 inch) from the rotor edge.
4. Zero the dial indicator.
5. Move the rotor one complete revolution, and observe total indicated runout (T.I.R.).
6. Readjust wheel bearings. See Section 3C.

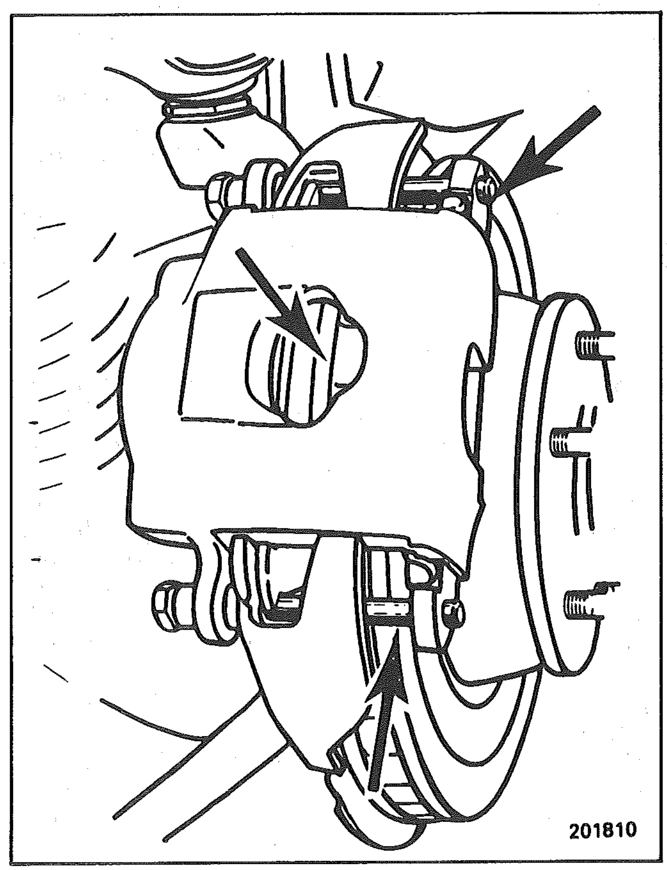


Figure 14 Lining Inspection

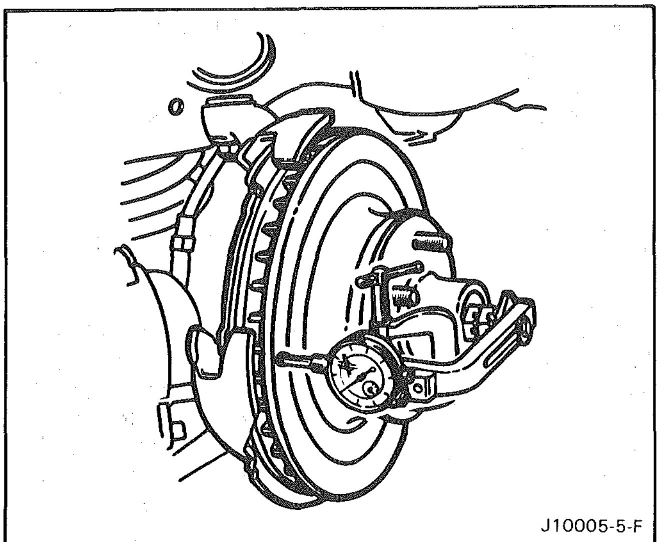


Figure 15 Checking Lateral Runout

Lateral runout of the rotor should not be over 0.13 mm (0.005-inch). A rotor that does not meet the lateral runout specification should be resurfaced or replaced.

Rotor Tolerance and Surface Finish

In manufacturing the brake rotor, tolerances of the braking surfaces for flatness, thickness variation and lateral runout are held very close. The maintenance of close tolerances on the shape of the braking surfaces is necessary to prevent brake roughness.

In addition to these tolerances, the surface finish must be held to a specified range. The control of the braking surface finish is necessary to avoid pulls and erratic performance and to extend lining life.

Light scoring of the rotor surfaces not exceeding 0.38 mm (0.015-inch) in depth, which may result from normal use, will not affect brake operation.

Refinishing Brake Rotors

All brake rotors have a minimum thickness dimension cast into them. This dimension is the minimum wear dimension and not a refinish dimension. Do not use a brake rotor that will not meet specifications. See Section 5F.

Since accurate control of the rotor tolerances is necessary for proper performance of the disc brakes, machining of the rotor should be done only with precision equipment.

When refinishing rotors, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect initial braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

The optimum speed for refinishing braking surfaces is a spindle speed of 200 rpm. Crossfeed for rough cutting should range from 0.254-0.152 mm (0.010-0.006-inch) per revolution. Finish cuts should be made at crossfeeds no greater than 0.051 mm (0.002-inch) per revolution.

INSPECTING AND REFINISHING BRAKE DRUMS

Whenever brake drums are removed, they should be thoroughly cleaned and inspected for cracks, scores, deep grooves, out-of-round and tapered conditions.

Cracked, Scored, or Grooved Drum

A cracked drum is unsafe for further service and must be replaced. Do not attempt to weld a cracked drum.

Smooth any slight scores. Heavy or extensive scoring will cause excessive brake lining wear, and it may be necessary to resurface the brake drum to true up the braking surface.

If the brake linings are slightly worn and the drum is grooved, the drum should be polished with fine emery cloth. The brake drums should not be turned since eliminating all the grooves in the drum and smoothing the ridges on the lining would remove too much metal and lining. If left alone, the grooves and ridges match and satisfactory service can be obtained.

If brake linings are replaced, a grooved drum should be turned. A grooved drum, if used with new lining, will not only wear the lining, but will make it difficult, if not impossible, to obtain efficient brake performance.

Out-Of-Round or Tapered Drum

An out-of-round or tapered brake drum makes accurate brake shoe adjustment impossible and will cause excessive wear of other parts of the brake mechanism. An out-of-round drum can also cause severely irregular tire tread wear as well as a pulsating brake pedal. When the braking surface of a brake drum exceeds the specification limits, the drum should be turned to true up the braking surface. Out-of-round, taper and brake drum wear can be accurately measured with an inside micrometer fitted with proper extension rods.

When measuring a drum for out-of-round, taper and wear, take measurements at the open and closed edges of braking surface and at right angles to the edges.

Refinishing Brake Drums

If a drum is to be refinished, remove only enough metal to obtain a true, smooth braking surface. If a drum does not meet specifications when turned to the maximum rebore diameter shown in the specifications, shown in Section 5F, it must be replaced. Removal of more metal will affect dissipation of heat and may cause distortion of the drum.

All brake drums have a maximum diameter cast into them. This diameter is the maximum wear diameter and not a refinish diameter. Do not refinish a brake drum that will not meet the specifications. Refer to specification chart, Section 5F.

When refinishing drums, always use sharp cutting tools or bits. Dull or worn tools leave a poor surface finish which will affect braking performance. Vibration dampening attachments should always be used when refinishing braking surfaces. These attachments eliminate tool chatter and will result in better surface finish.

Brake Drum Balance

During manufacture, weights are used to balance brake drums. These weights must not be removed.

After drums are refinished or if difficulty is experienced in maintaining proper wheel balance, brake drums should be checked for balance. Brake drums may be checked for balance on most off-the-car balancers.

COMBINATION VALVE

Testing Combination Valve Electrical Circuit

When removing the electrical wire connector from the pressure differential switch, squeeze the eliptical shaped plastic locking ring and pull up. This will move the locking tangs away from the switch. Pliers can be used to help remove the connector.

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "ON." The warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is faulty. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn off ignition switch. Disconnect jumper and connect wire to switch terminal.

Testing Combination Valve Warning Lamp Switch

1. Attach a bleeder hose to a rear brake bleed screw and immerse the other end of the hose in a container partially filled with clean brake fluid. Be sure master cylinder reservoirs are full.
2. Turn ignition switch to "ON." Open bleeder screw while an assistant applies moderate pressure to the brake pedal. Warning lamp should light. Close bleeder screw before assistant releases brake pedal. Apply brake pedal with moderate-to-heavy pressure. Lamp should go out.
3. Attach the bleeder hose to a front brake bleeder screw and repeat steps 1 and 2. Warning lamp action should be the same as in step 2. Turn off ignition switch.
4. If warning lamp does not light during steps 2 and 3, but does light when a jumper is connected to ground, the warning lamp switch portion of the combination valve is faulty. Do not disassemble the combination valve. If any portion of the combination valve is faulty, it must be replaced with a new combination valve.

Combination Valve Replacement

Remove or Disconnect (Figure 16)

- The combination valve is not repairable and must be serviced as a complete assembly.

1. Hydraulic pipes at combination valve.
   - Plug pipes to prevent loss of fluid and entrance of dirt.
2. Wiring harness from valve switch terminal.
3. Nut attaching valve to power booster.
4. Combination valve.

Install or Connect (Figure 16)

NOTICE: See "Notice" on page 5-1.

1. Combination valve.
2. Nut attaching valve to power booster.

Tighten

- Nut to 24 N·m (18 lbs. ft.).

3. Wiring harness to valve switch terminal.
4. Hydraulic pipes at combination valve.

- Bleed brakes. See "Bleeding Brake Hydraulic System" in this section.

CAUTION: Do not move the car until a firm brake pedal is obtained. Air in the brake system can cause loss of brakes.

POWER BRAKE VACUUM HOSE FILTER

See Figure 17.

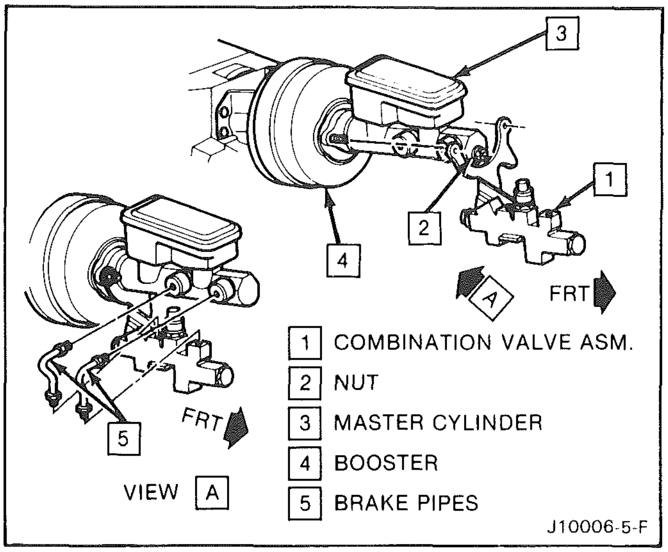


Figure 16 Combination Valve

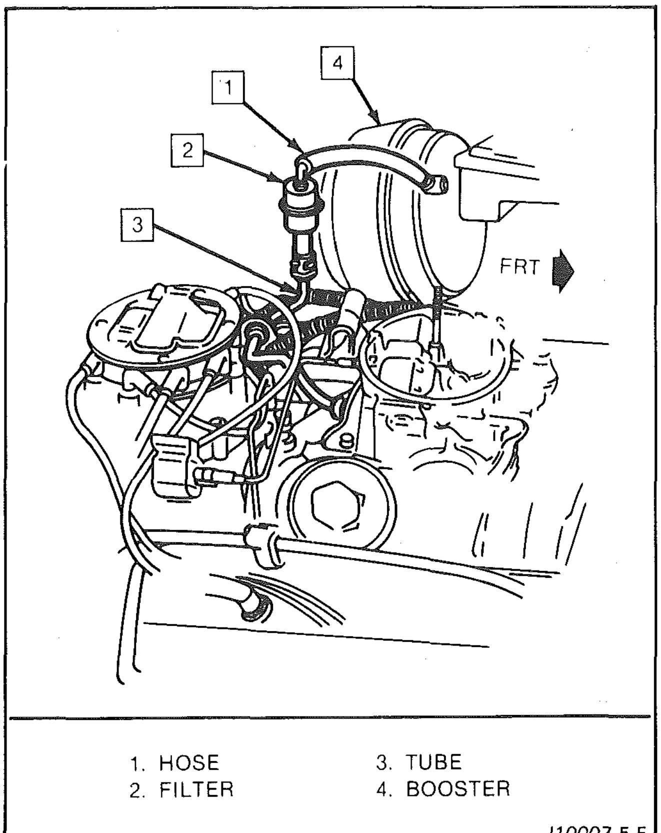


Figure 17 Power Brake Vacuum Hose Filter (Typical)

SECTION 5A3

COMPOSITE MASTER CYLINDER

CONTENTS

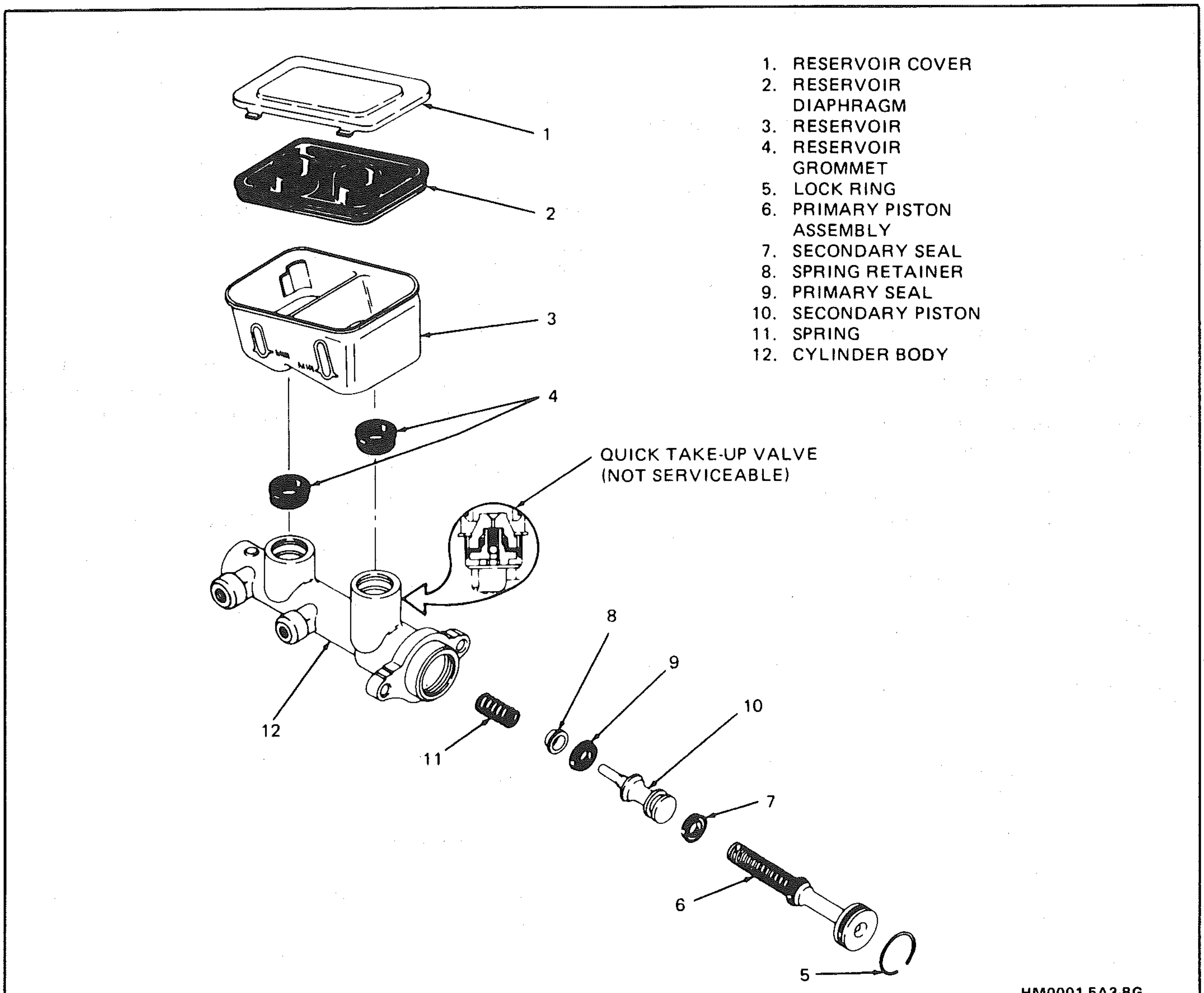


Figure 5A3-1 Composite Master Cylinder

GENERAL DESCRIPTION

This master cylinder is a composite design (plastic reservoir and aluminum bore) incorporating a conventional front to rear brake system split. The primary piston provides the fluid pressure to the front brakes, while the secondary piston provides the fluid pressure to the rear brakes. If pressure is lost from either system, the remaining system will function to stop the vehicle.

A quick take-up feature is incorporated which provides a large volume of fluid to the wheel brakes at low pressure with initial brake apply. The low pressure fluid quickly provides the displacement requirements created by the seal retraction of the pistons into the front calipers.

Important

- Replace all components included in repair kits used to service this master cylinder.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

MASTER CYLINDER ASSEMBLY

Remove or Disconnect (Figure 5A3-2)

1. Tube nuts (14) and hydraulic lines.
   - Plug open lines to prevent fluid loss and contamination.
2. Two attaching nuts (15).
3. Master cylinder (13).

- See NOTICE on page 5-1.

Install or Connect (Figure 5A3-2)

1. Master cylinder (13) with attaching nuts (15) to 27 N·m (20 lb-ft).
2. Hydraulic lines and tube nuts (14) to 23 N·m (17 lb-ft).
3. Fill master cylinder to proper level with clean brake fluid.
   - Bleed hydraulic system.
   - Recheck fluid level.

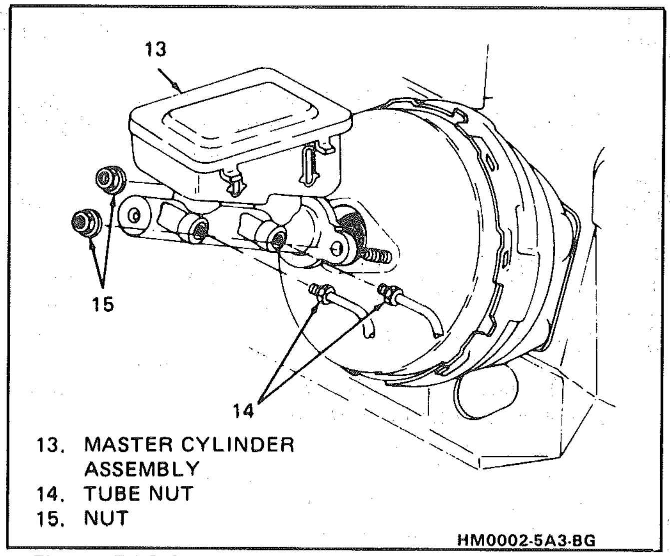


Figure 5A3-2 Removing Master Cylinder Assembly

UNIT REPAIR

MASTER CYLINDER OVERHAUL

Disassemble (Figure 5A3-1)

Important

Reservoir cover and diaphragm can be inspected and/or serviced without removing the master cylinder from the vehicle.

1. Master cylinder (13) completely from vehicle as previously described.
2. Reservoir cover (1) and diaphragm (2).
   - Wipe reservoir cover clean before removing.
   - Empty fluid from reservoir (only if master cylinder is to be completely removed and overhauled).

Inspect

- Reservoir cover (1) and diaphragm (2) for:
  - Cuts
  - Cracks
  - Nicks
  - Deformation
- Replace damaged parts.

3. Retainer (5) while depressing primary piston assembly (6).
   - Take care not to damage the piston, bore, or retainer groove.
4. Apply low pressure dry compressed air into outlet port at blind end of bore (other outlet port plugged) to remove:
   - Primary piston assembly (6).
   - Secondary piston (10).
   - Spring (11).
   - Spring retainer (8).
5. From secondary piston (10):
   - Seals (7 and 9).
   - Spring retainer (8).

Inspect

- Master cylinder bore for scoring or corrosion.
- If noted, replace master cylinder.
- No abrasives should be used in bore.

Clean

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.

Assemble (Figure 5A3-1)

- See NOTICE on page 5-1.

1. Lubricated seals (7 and 9) and spring retainer (8) onto secondary piston (10).
2. Spring (11), and secondary piston assembly (7 thru 10) into cylinder bore.
   - To ease reassembly, lubricate with clean brake fluid.
3. Lubricated primary piston assembly (6) into cylinder bore.
4. Retainer (5) while depressing primary piston assembly (6).
5. Diaphragm (2) into reservoir cover (1) and install on reservoir (3).
6. Master cylinder (13) as previously described.

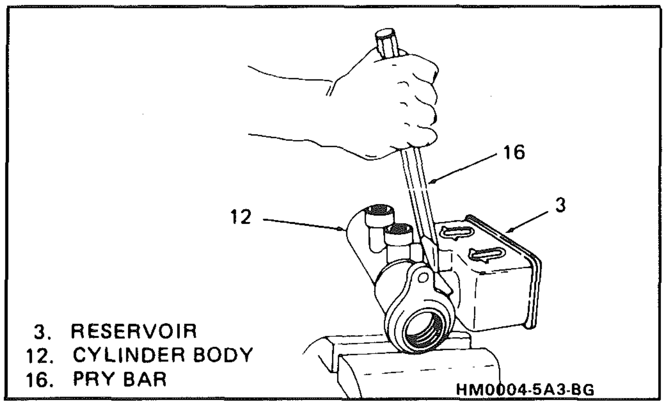


Figure 5A3-3 Removing Reservoir

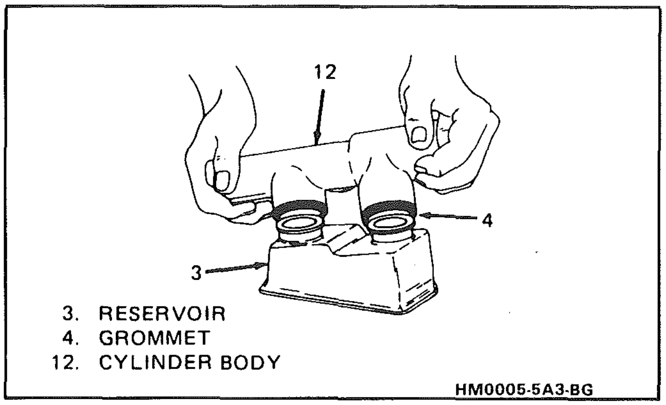


Figure 5A3-4 Installing Reservoir

MASTER CYLINDER RESERVOIR

Disassemble (Figures 5A3-3,5A3-4)

1. Remove and disassemble master cylinder as previously described.
2. Clamp flange of master cylinder body (12) in vise.

Important

- Do not clamp on master cylinder body (12).
- Do not remove quick take-up valve from body.
- Valve is not serviceable separately.

3. Reservoir (3) using a pry bar (16).
4. Reservoir grommets (4).

Inspect

- Reservoir for cracks or deformation.
- Replace if found.

Clean

- Reservoir with clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble (Figure 5A3-4)

- See NOTICE on page 5-1.
  - Lubricate new grommets (4) and reservoir bayonets with clean brake fluid.

1. Grommets (4) into master cylinder body (12).
   - Make sure grommets are properly seated.
2. Reservoir (3) into master cylinder body (12) using rocking motion.
3. Reassemble master cylinder and install as previously described.

SECTION 5B1

DISC BRAKE CALIPER ASSEMBLY 3000/3100 SERIES

CONTENTS

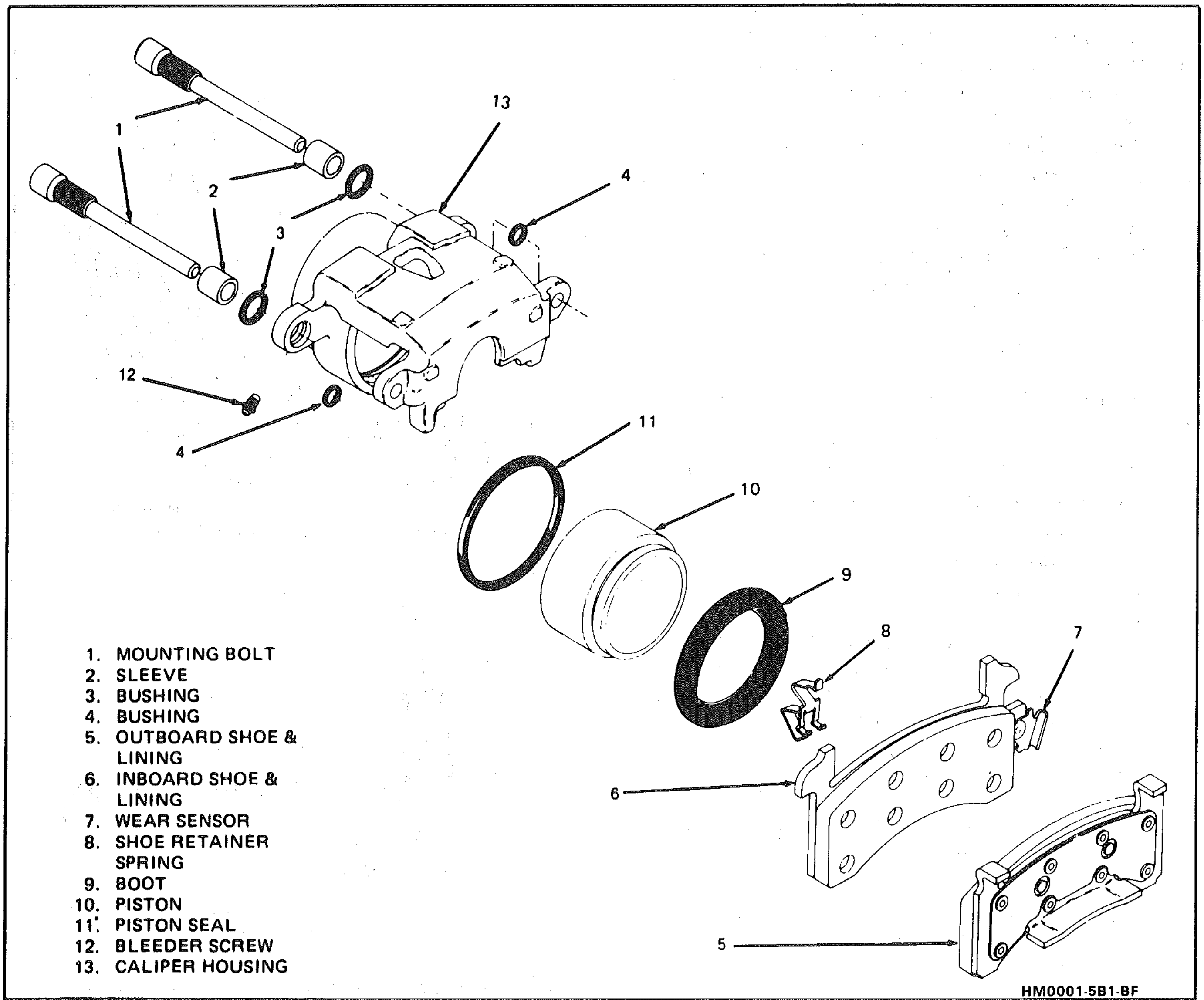


Figure 5B1-1 3000/3100 Front Caliper Assembly

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic pressure, created by applying the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to move (slide) the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor, creating friction to stop the vehicle.

Important

- Replace all components included in repair kits used to service this caliper.
- Lubricate rubber parts with clean brake fluid to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

CALIPER ASSEMBLY

Remove or Disconnect (Figures 5B1-1 through 5B1-6)

1. 2/3 of brake fluid from master cylinder assembly.
2. Raise car and suitably support, see Section 0A.
   - Mark relationship of wheel to axle flange.
3. Wheel and tire.
   - Reinstall two wheel nuts to retain rotor.
4. Bottom piston into caliper bore to provide clearance between linings and rotor.
   - Position C-clamp over inboard brake shoe tab and the inboard caliper housing.
5. Bolt attaching inlet fitting (15) only if caliper is to be removed from vehicle for unit repair (overhaul). If only shoe and linings are being replaced, there is no need to disconnect inlet fitting.
   - Plug openings in caliper and pipe to prevent fluid loss and contamination.
6. Mounting bolts (1) and sleeves (2).
7. Caliper (13) from rotor and mounting bracket (18). If only shoe and linings are being replaced, suspend with a wire hook (17) from strut.

Inspect

- Mounting bolts and sleeves for corrosion.
- If corrosion is found, use new parts, including bushings, when installing caliper.
- Do not attempt to polish away corrosion.
- See NOTICE on page 5-1.

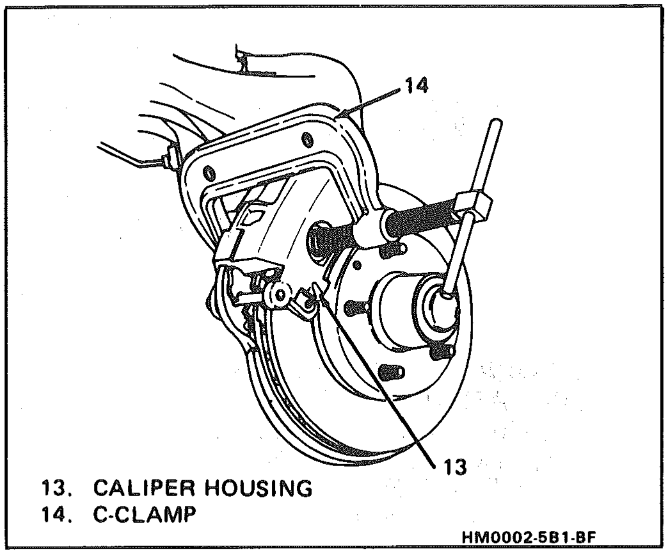


Figure 5B1-2 Compressing Piston

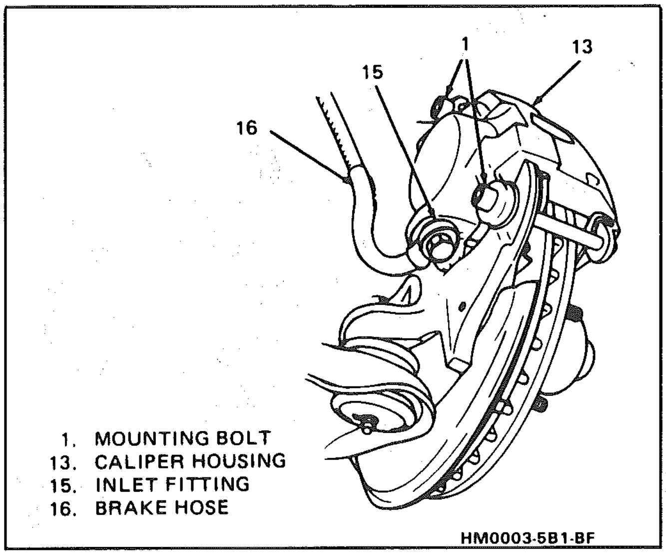


Figure 5B1-3 Caliper Attachment

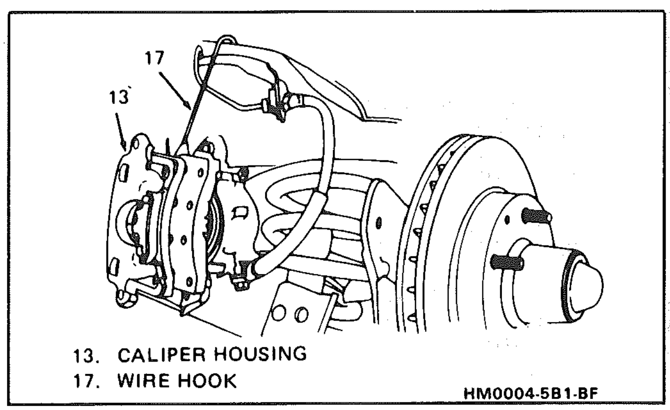


Figure 5B1-4 Suspending Caliper

Install or Connect (Figures 5B1-1 through 5B1-6)

1. Lubricate sleeves (2) and bushings (3 and 4) with silicone grease.
2. Sleeves (2) in caliper ears.
3. Caliper (13) over rotor in mounting bracket (18).
4. Mounting bolts (1) to 51 N·m (38 lb-ft).

Measure

- Clearance between caliper (13) and bracket (18) stops.
- If necessary, remove caliper and file ends of bracket (18) stops to provide proper clearance.

5. Inlet fitting (15), if removed, to 45 N·m (33 lb-ft).
6. Wheels and tires, aligning previous marks.
   - Remove wheel nuts securing rotor to hub.
   - Lower car.
   - Torque wheel nuts. See Section 3E WHEELS AND TIRES.
7. Fill master cylinder to proper level with clean brake fluid.
   - Bleed caliper if inlet fitting was removed.
   - Recheck fluid level.

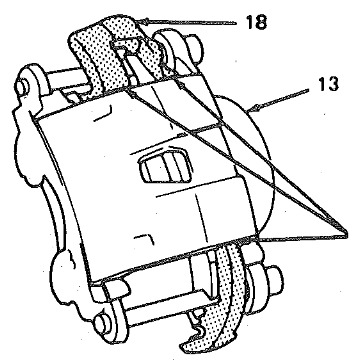


Figure 5B1-5 Caliper to Bracket Clearance

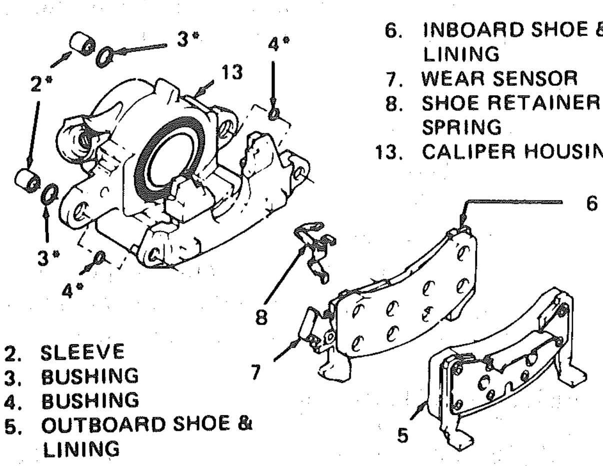


Figure 5B1-6 Shoe & Lining Assembly

SHOE AND LINING ASSEMBLIES

Remove or Disconnect (Figures 5B1-6 through 5B1-10)

1. Caliper as previously described.
2. Outboard shoe and lining (5).
3. Inboard shoe and lining (6).
4. Bushings (3 and 4) from grooves in mounting bolt holes.

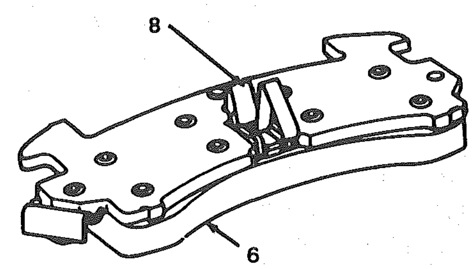


Figure 5B1-7 Inboard Shoe & Retainer

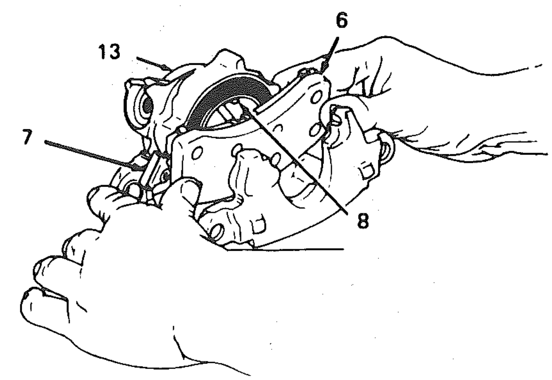


Figure 5B1-8 Installing Inboard Shoe and Lining

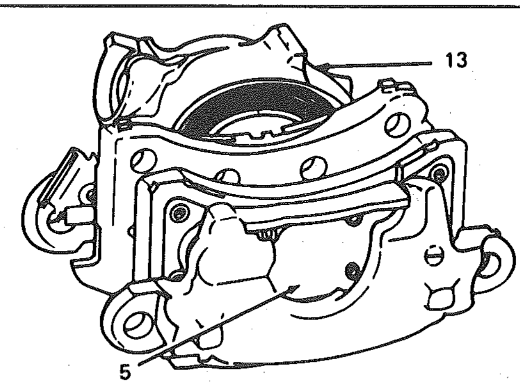


Figure 5B1-9 Installing Outboard Shoe & Lining

Install or Connect (Figures 5B1-6 through 5B1-10)

1. Lubricated new bushings (3 and 4) in grooves in mounting bolt holes.
2. Lubricated sleeves (2) in mounting bolts holes.
3. Retainer spring (8) on inboard shoe (6).

4. Inboard shoe and lining (6) by snapping retainer spring (8) into piston (1) ID. Wear sensor (7) should be at the leading edge of shoe during forward wheel rotation. Shoe must lay flat against piston.
5. Outboard shoe and lining (5). Back of shoe must lay flat against caliper.
6. Caliper as previously described.
7. Apply approximately 778 N (175 lb) force three times to brake pedal to seat linings.
8. Position 12-inch channel lock pliers (19) over brake shoe ears and bottom edge of caliper (13). While holding moderate force (50 lbs) on brake pedal, clinch outboard shoe ears to caliper.

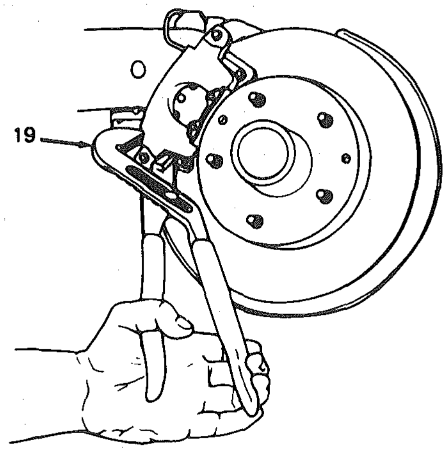


Figure 5B1-10 Clinching Procedure

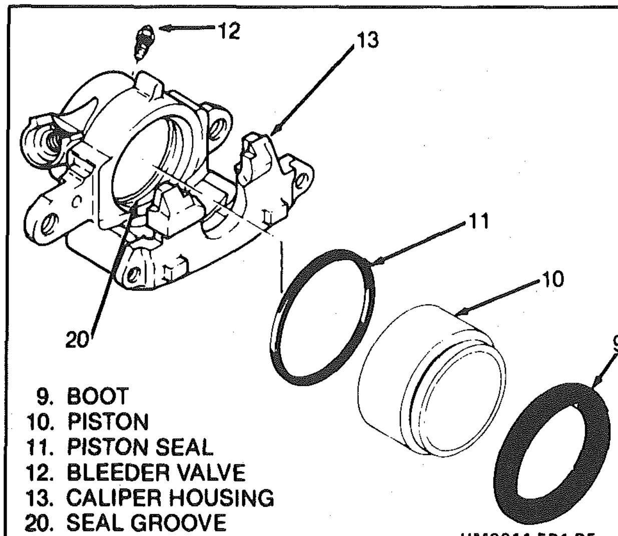


Figure 5B1-11 Caliper Assembly

UNIT REPAIR

CALIPER OVERHAUL

Tool Required:

J 26267 Boot Seal Installer (64 mm)
J 22904 Boot Seal Installer (74 mm)
J 28735 Boot Seal Installer (80 mm)

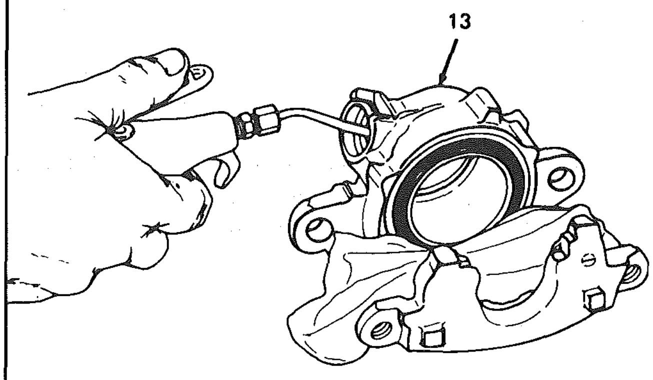


Figure 5B1-12 Removing Piston

Disassemble (Figures 5B1-11 through 5B1-13)

1. Caliper completely from vehicle as previously described.
2. Piston (10) using compressed air into the caliper inlet hole.

CAUTION: Do not place fingers in front of the piston in an attempt to catch or protect it when applying comrpessed air. This could result in serious injury.

Important

- Use clean shop towels to pad the interior of the caliper (13) during removal.

Inspect

- Piston (10) for:
  - Scoring
  - Nicks
  - Corrosion
  - Worn or damaged chrome plating
- Replace piston if any of the above are found.

3. Boot (9), being careful not to scratch housing bore.
4. Piston seal (11) from groove (20) in caliper (13) bore with a small wood or plastic tool. Do not use a metal tool since this may damage caliper bore or seal groove.

Inspect

- Caliper bore and seal groove for:
  - Scoring
  - Nicks
  - Corrosion
  - Wear
- Use crocus cloth to polish out light corrosion.
- Replace caliper housing if corrosion in and around seal groove will not clean up with crocus cloth.

5. Bleeder valve (12) from caliper (13).

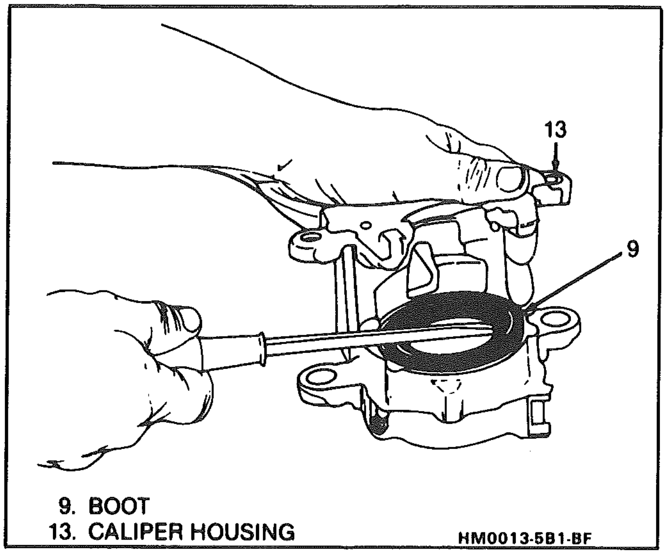


Figure 5B1-13 Removing Boot

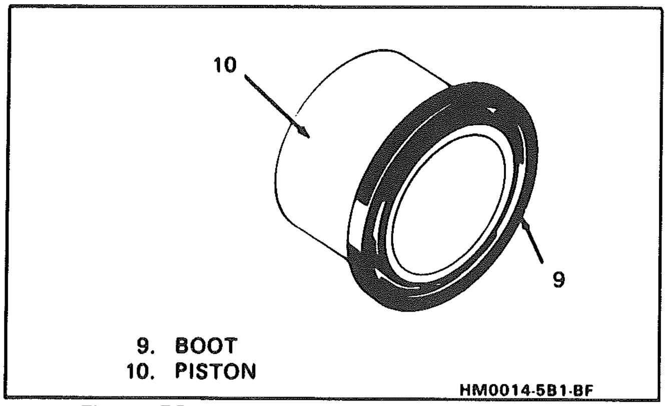


Figure 5B1-14 Installing Boot Onto Piston

Assemble (Figures 5B1-11,5B1-14,5B1-15)

- See NOTICE on page 5-1.

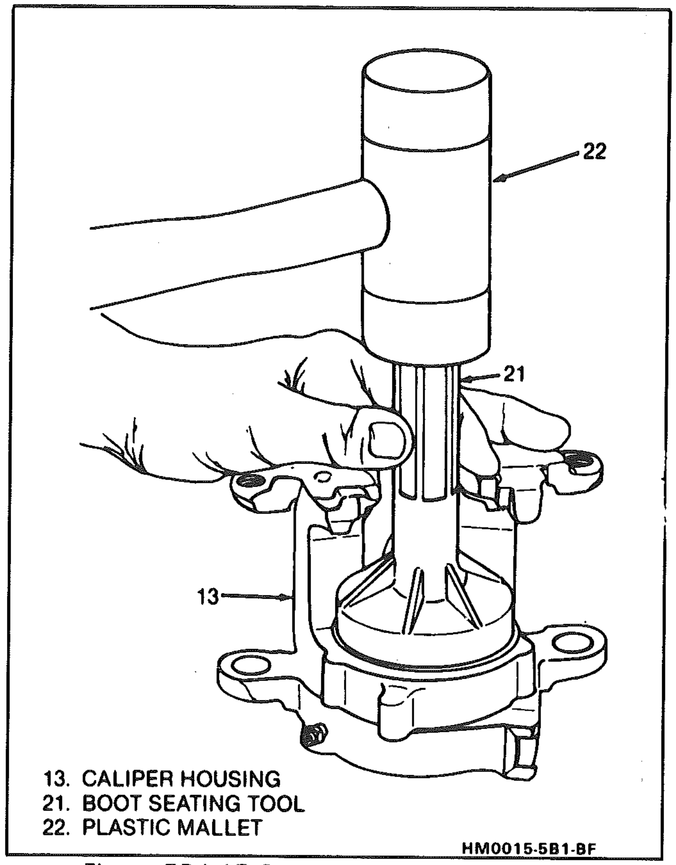


Figure 5B1-15 Seating Boot Into Housing

Clean

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.
- Blow out all passages in housing (13) and bleeder valve (12).

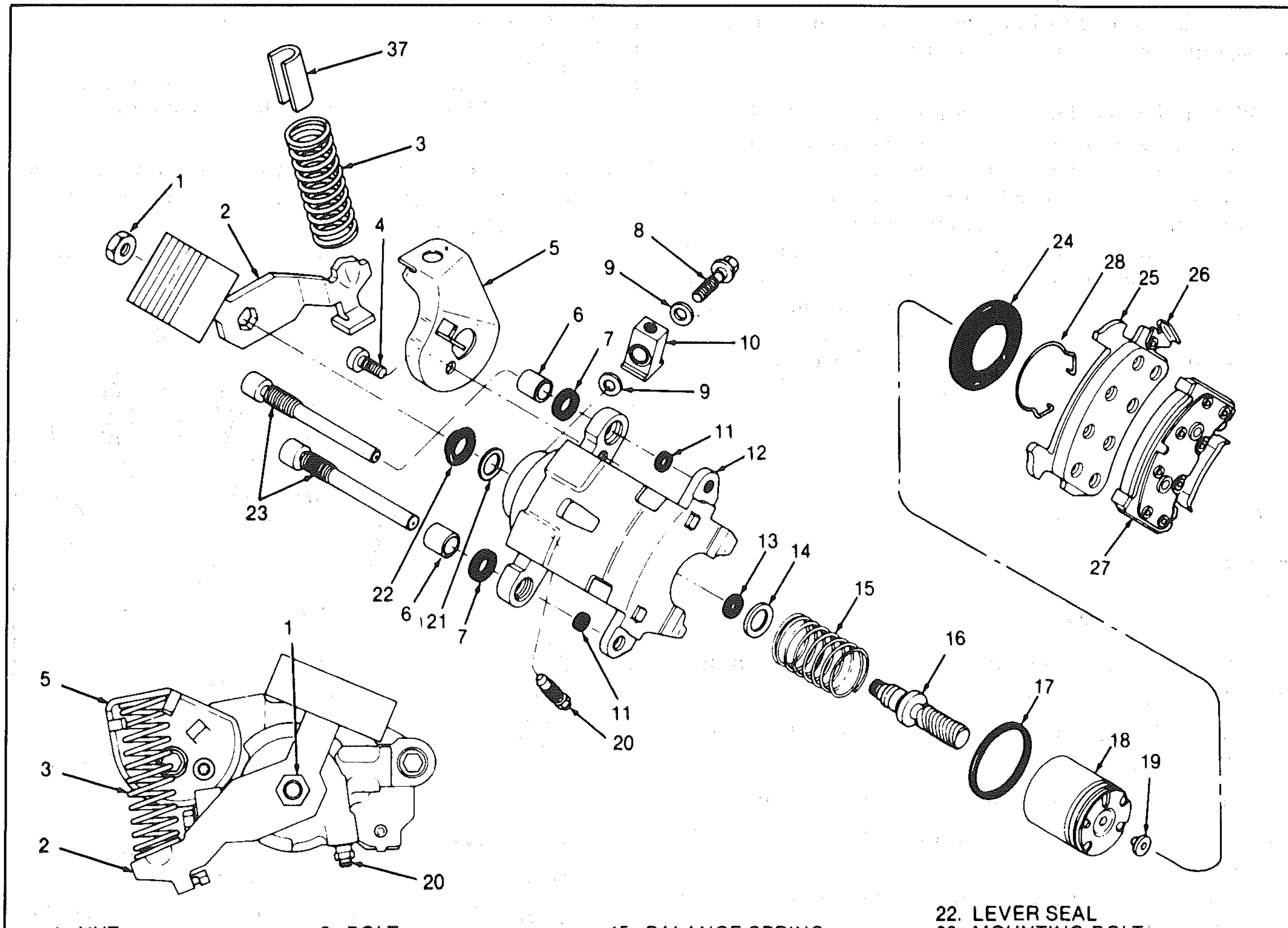
1. Bleeder valve (12) to 13 N·m 110 lb-in).
2. Lubricated new piston seal (11) into caliper bore groove (20).
   - Make sure seal is not twisted.
3. Lubricated boot (9) onto piston (10).
4. Piston (10) and boot (9) into bore of caliper (13) and push to bottom of bore.
5. Seat boot (9) in caliper housing (13) counterbore using appropriate boot seating tool.
6. Caliper as previously described.

SECTION 5B6

DISC BRAKE CALIPER ASSEMBLY

3548 SERIES

CONTENTS



1. NUT
2. LEVER
3. RETURN SPRING
4. BOLT
5. BRACKET
6. SLEEVE
7. BUSHING
8. BOLT
9. COPPER WASHER
10. FITTING
11. BUSHING
12. CALIPER HOUSING
13. SHAFT SEAL
14. THRUST WASHER
15. BALANCE SPRING
16. ACUTATOR SCREW
17. PISTON SEAL
18. PISTON ASSEMBLY
19. TWO WAY CHECK VALVE
20. BLEEDER SCREW
21. ANTI-FRICTION WASHER
22. LEVER SEAL
23. MOUNTING BOLT
24. BOOT
25. INBOARD SHOE & LINING
26. WEAR SENSOR
27. OUTBOARD SHOE & LINING
28. SHOE DAMPENING SPRING
37. DAMPER

HM0001-5B6-F

Fig. 1 Rear Disc Brake Caliper Assembly

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic pressure, created by applying force to the brake pedal, is converted by the caliper to a stopping force. This force acts equally against the piston and the bottom of the caliper bore to move the piston outward and to move (slide) the caliper inward resulting in a clamping action on the rotor. This clamping action forces the linings against the rotor, creating friction to stop the vehicle.

When the parking brake is applied, the lever turns the actuator screw which is threaded into a nut in the piston assembly. This causes the piston to move outward and the caliper to slide inward mechanically, forcing the linings against the rotor. The piston assembly contains a self-adjusting mechanism to keep the parking brake in proper adjustment.

NOTICE: Replace all components included in repair kits used to service this caliper. Lubricate rubber parts with clean brake fluid to ease assembly. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system. Replace shoe and linings in axle sets only. The torque values specified are for dry, unlubricated fasteners. Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

CALIPER ASSEMBLY

Figures 2 thru 4

Remove or Disconnect

1. 2/3 of brake fluid from master cylinder assembly.
2. Raise car and suitably support.
   - Mark relationship of wheel at axle flange.
3. Wheel and tire.
   - Reinstall two lug nuts to retain rotor.
4. Loosen tension on parking brake cable at equalizer.
5. Cable (29), return spring (3) and damper (37) from return spring (3) (Figure 2).
6. Lock nut (1) while holding lever (2) (Figure 1).
7. Lever (2), lever seal (22), and anti-friction washer (21) (Figure 1).

Inspect

- Lever, lever seal, and anti-friction washer for:
  - -- Cuts
  - -- Nicks
  - -- Excessive wear
- Replace part(s) if any of the above are found.

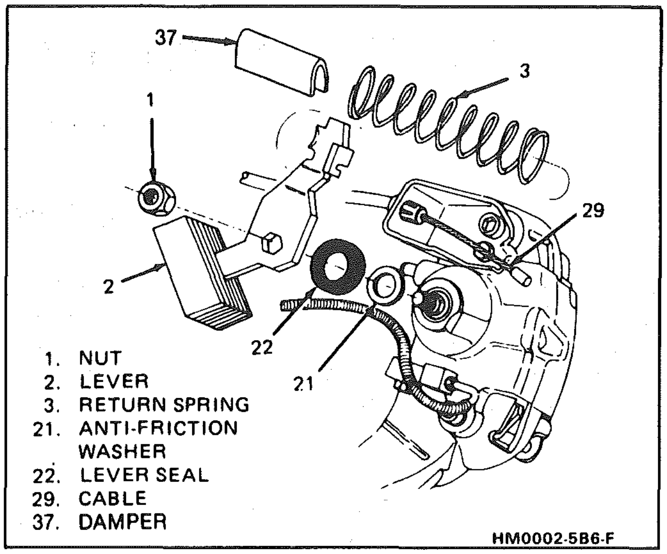


Fig. 2 Parking Brake Cable Attachment

8. Using a C-clamp (30), bottom piston into caliper bore to provide clearance between linings and rotor (Figure 3).

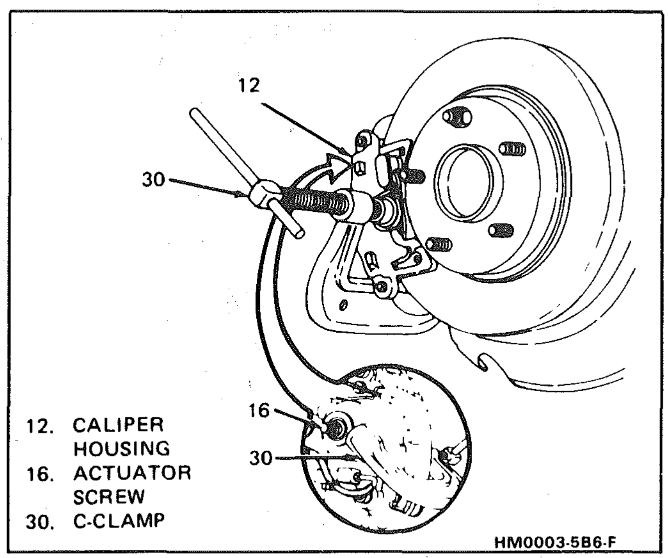


Fig. 3 Compressing Piston

CAUTION: Do not allow C-clamp (30) to contact actuator screw (16).

9. Reinstall anti-friction washer (21), lever seal (22) (sealing bead against housing), lever (2) and nut (1) (Figure 2).
10. Tube nut on brake pipe (31), only if caliper is to be removed from vehicle for unit repair (overhaul). If only shoe and linings are being replaced, there is no need to disconnect brake pipe (Figure 4).
    - Plug openings in caliper and pipe to prevent fluid loss and contamination.
    - If brake pipe is seized, remove brass bolt (8), fitting (10) and copper washers (9) to free brake pipe. Be sure to plug openings (Figures 1 & 8).

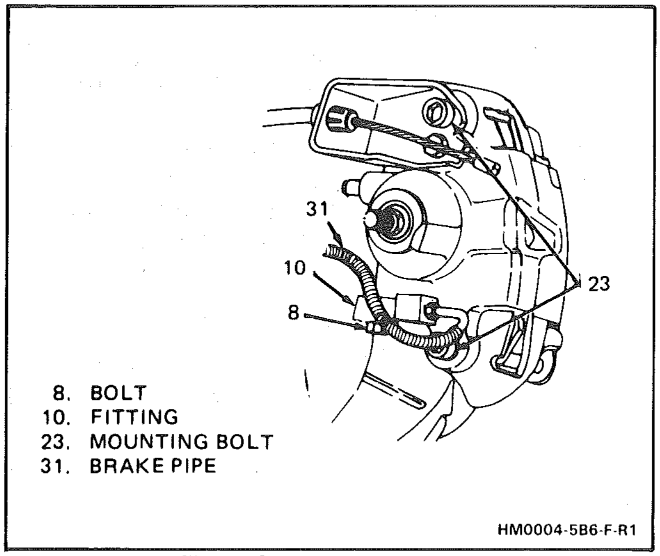


Fig. 4 Caliper Attachment

11. Mounting bolts (23) and sleeves (6), using 3/8 inch allen head socket (Figures 1 & 5).
12. Caliper (12) from rotor. If only shoe and linings are replaced, suspend caliper with a wire hook from strut.

Inspect

- Mounting bolts (23) and sleeves (6) for corrosion (Figures 1 & 5).
- If corrosion is found, use new parts, including bushings, when installing caliper.
- Do not attempt to polish away corrosion.

Install or Connect

Important

- See NOTICE on page 5-1.

1. Lubricate sleeves (6) and bushings (7 and 11) with silicone grease (Figure 5).
2. Sleeves (6) in caliper mounting holes.
3. Caliper (12) over rotor.
4. Mounting bolts (23) to 50 N·m (37 lb.ft.) (Figure 1).
5. Tube nut on brake pipe (31), if removed, to 20 N·m (15 lb.ft.) (Figure 4).
   - If brass bolt (8) and fitting (10) were removed with brake pipe, unplug fitting and install bolt and fitting using two new copper washers (9) to 44 N·m (32 lb. ft.) (Figure 8).
6. Disconnect nut (1), lever (2) lever seal (22), and anti-friction washer (21) and clean (Figure 8).

Clean

- Clean contamination from caliper surface in area of lever seal (22) and around actuator screw (16) (Figure 8).

7. Anti-friction washer (21).
8. Lubricated lever seal (22) with sealing bead against caliper housing (12).
9. Lever (2) on actuator screw hex with lever pointing down.
10. Nut (1), while holding rotated lever (2) toward front of car, to 48 N·m (35 lb.ft.). Rotate lever back against stop on caliper (12).
11. Damper (37) and return spring (3) (Figure 1).
12. Parking brake cable (29). For cable adjustment see PARKING BRAKE ADJUSTMENT.
13. Wheels and tires, aligning previous marks.
    - Remove lug nuts securing rotor to hub.
    - Lower car.
    - Torque lug nuts. See WHEELS AND TIRES.
14. Fill master cylinder to proper lever with clean brake fluid.
    - Bleed caliper if inlet fitting was removed.
    - Recheck fluid level.

PARKING BRAKE ADJUSTMENT

1. Apply service brake pedal three times with a pedal force of approximately 778 N (175 lbs.).
2. Apply and release parking brake three times.
3. Raise car and suitably support.
   - Mark relationship of wheel to axle flange.
4. Check parking brake hand lever for full release.
   - Turn ignition on.
   - "BRAKE" warning lamp should be off. If "BRAKE" warning lamp is still on, and the hand lever is completely released, pull downward on the front parking brake cable to remove slack from lever assembly.
   - Turn ignition off.
5. Remove rear wheels and tires.
   - Reinstall two inverted lug nuts to retain rotor.
6. Pull parking brake hand lever exactly four (4) ratchet clicks.
7. Parking brake levers (2) on both calipers should be against the lever stops on the caliper housings. If levers are not against stops, check for binding in rear cables and/or loosen cables at adjuster until both left and right levers are against their stops.
8. Tighten parking brake cable at adjuster until either the left or right lever begins to move off the stop, then loosen adjustment until lever moves back barely touching stop.
9. Operate parking brake several times to check adjustments. After cable adjustment is performed, parking brake hand lever should travel 14 clicks. Rear wheels should not rotate forward when hand lever is applied 8 to 14 ratchet clicks.
10. Install wheels and tires, aligning previous marks.

- Remove lug nuts securing rotor to hub.
- Lower car.
- Torque lug nuts. See WHEELS AND TIRES.

SHOE AND LINING ASSEMBLIES

Figures 5 thru 8

Remove or Disconnect

1. Caliper as previously described.
2. Outboard shoe and lining (27) (Figure 5).

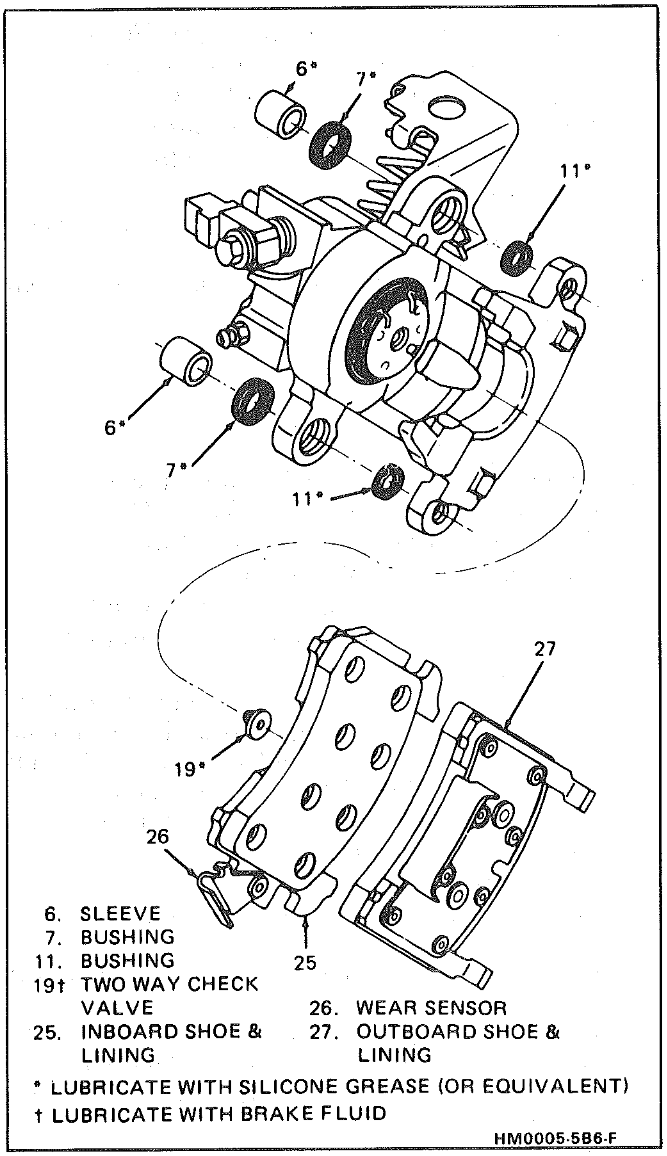


Fig. 5 Shoe & Linings Assemblies

3. Inboard shoe and lining (25) (Figure 6).
4. Bushings (7 and 11) from grooves in mounting bolt holes (Figure 5).
5. Two-way check valve (19) from end of piston (18) using small screwdriver (Figure 8).

NOTICE: If leakage is noted form piston hole after check valve is removed, overhaul caliper as specified.

Install or Connect

1. Lubricated new bushings (7 and 11) (Figure 5).
2. Lubricated new two-way check valve (19) into end of piston (18) (Figure 8).
3. Inboard shoe and lining (25). Slide edge of metal shoe under ends of dampening spring (28) and snap shoe into position against piston. Back of shoe must lay flat against piston (Figure 6).

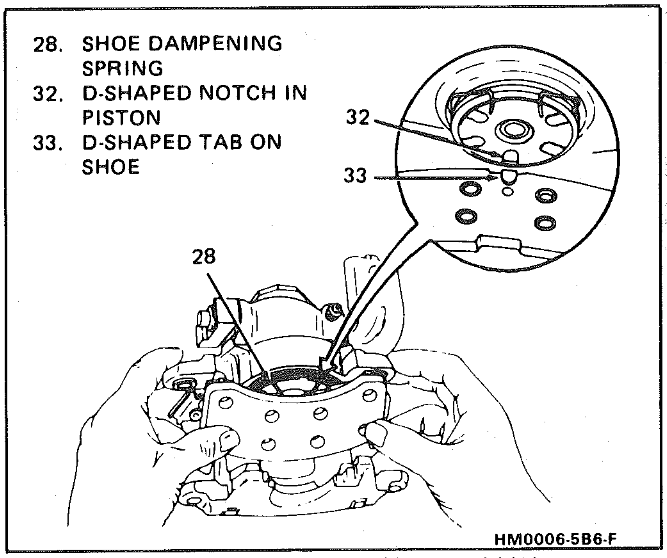


Fig. 6 Installing Inboard Shoe and Lining

- D-shaped tab (33) on shoe must engage D-shaped notch (32) in piston. If tab and hole do not line up, turn piston with spanner wrench J 7624 or equivalent (Figure 6).
- Wear sensor (26) should be at leading edge of shoe during forward wheel rotation (Figure 5).

4. Outboard shoe and lining (27). Back of shoe must lay flat against caliper (Figure 5).
5. Caliper as previously described.
6. Apply approximately 778 N (175 lb.) force three times to brake pedal to seat linings.
7. Position 12-inch channel lock pliers over brake shoe ears and bottom edge of caliper (12). While holding moderate force (50 lb.) on brake pedal, clinch outboard shoe (27) (Figure 7).

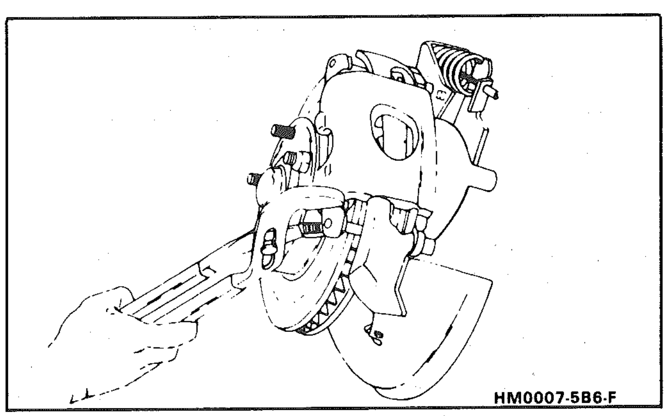


Fig. 7 Clinching Procedure

UNIT REPAIR

CALIPER OVERHAUL

Tools Required:

J 23072 Piston Installer

J 29381 Boot Seal Installer

Figures 8 thru 10

Remove or Disconnect

1. Caliper completely from vehicle as previously described.
2. Shoe dampening spring (28) from end of piston (18) (Figure 8).

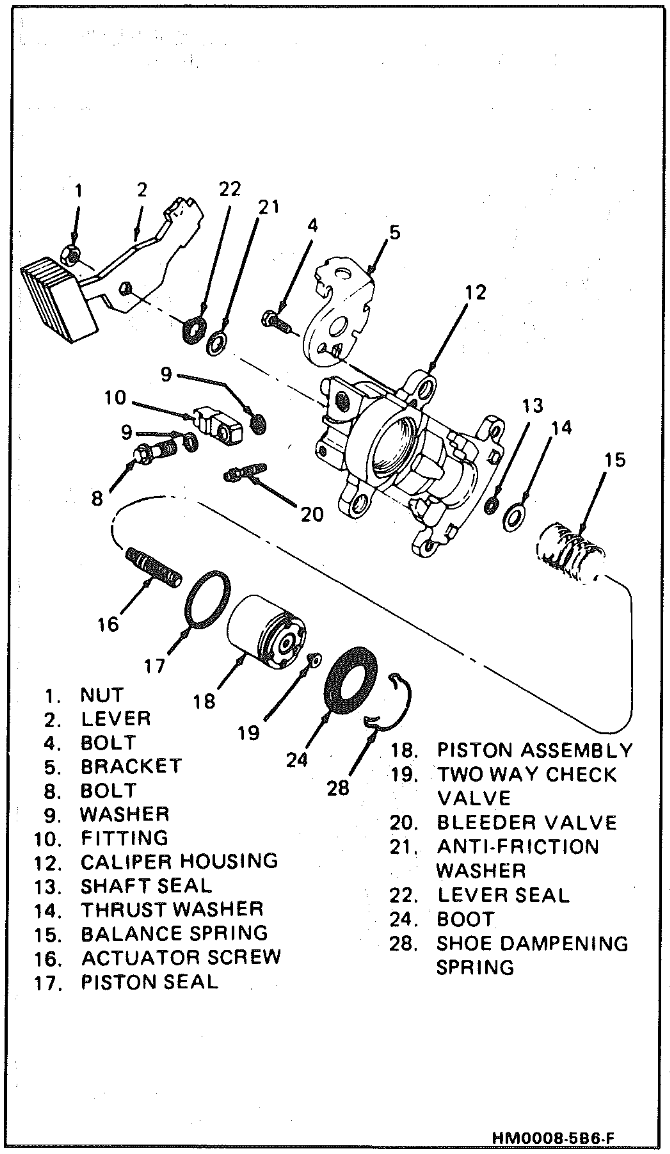


Fig. 8 Caliper Assembly

3. If installed:
   - Nut (1) and lever (2).
   - Lever seal (22) and anti-friction washer (21).
4. Piston (18). Use park brake lever (2) to rotate adjusting screw (16) to work piston out of caliper (12). Rotate in parking brake apply direction (Figures 8 & 9).

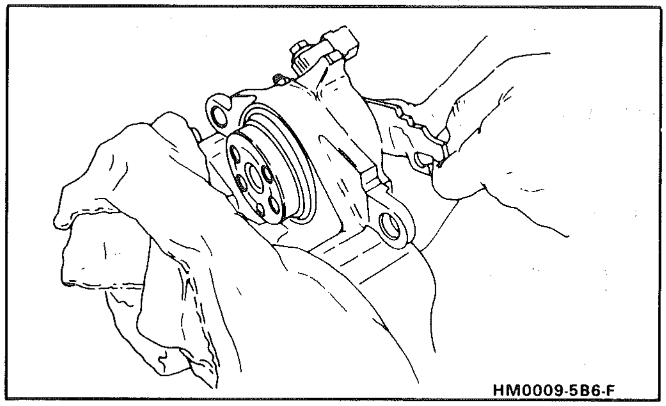


Fig. 9 Removing Piston

Important

- Use clean shop towels to pad the interior of the caliper (12) during removal.
- Piston (18) for:
  -- Scoring
  -- Nicks
  -- Corrosion
  -- Worn or damaged chrome plating
- Replace piston if any of the above are found.

5. Balance spring (15) (Figure 8).
6. Actuator screw (16) by pressing on thread end.
7. Shaft seal (13) and thrust washer (14) form actuator screw (16).
8. Boot (24), being careful not to scratch the housing (12) bore (Figure 10).

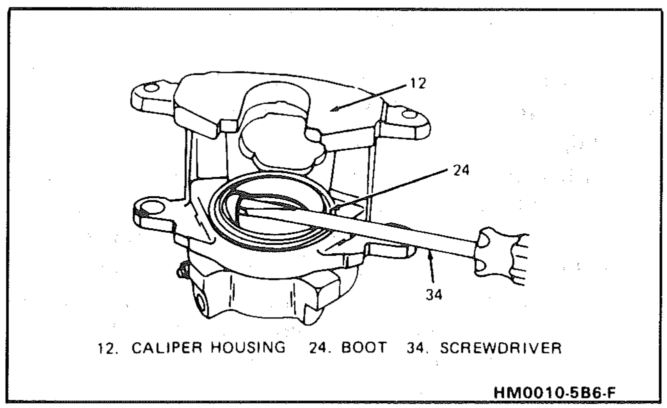


Fig. 10 Removing Boot

9. Piston seal (17) using wooden or plastic tool as as not to damage caliper (12) bore (Figure 8).
10. Bleeder screw (20), bolt (8), fitting (10) and copper washers (9). Remove bracket (5) only if damaged.

Inspect

- Caliper bore and seal groove for:
  -- Scoring
  -- Nicks
  -- Corrosion
  -- Wear

- Use crocus cloth to polish out light corrosion.
- Replace caliper housing if corrosion in and around seal groove will not clean up with crocus cloth.

Install or Connect

Figures 8, 11 thru 13

Important

- See NOTICE on page 5-1.

Clean

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.
- Blow out all passages in housing (12) and bleeder screw (20).

1. Bleeder screw (20) and torque to 13 N·m (116 lb. in.). (Figure 8)
2. Bracket (5), if removed, with bolt (4) to 43 N·m (31 lb.ft.).
3. Fitting (10) and bolt (8) using new copper washers (9) to 33 N·m (24 lb.ft.).
4. Lubricated new piston seal (17) into caliper (12) bore groove.
   - Make sure seal is not twisted.
5. Lubricated boot (24) onto piston (18) with inside lip of boot in piston groove and boot fold toward end of piston that contact inboard brake shoe.
6. Thrust washer (14) on actuator screw (16) with copper side of washer towards the piston assembly and the grayish surface towards caliper housing (12).
7. Lubricated shaft seal (13) on actuator screw (16).
8. Actuator screw (16) in piston (18).
9. Balance spring (15) into piston (18) recess.
10. Lubricated piston (18) with actuator screw assembly, balance spring and boot into lubricated bore of caliper (12). Push piston to bottom of caliper bore using J 23072 (35). (Figure 11)
11. Lubricated anti-friction washer (21) and lever seal (22) over end of actuator screw (16).
    - Sealing bead on lever seal should be against housing (12).
12. Lever (2) on actuator screw (16). Rotate lever away from stop slightly and hold while installing nut (1) to 48 N·m (35 lb.ft.), then rotate lever back to contact stop. (Figure 12)
13. Seat boot (24) in caliper housing (12) counterbore using J 29381.
14. Dampening spring (28) in groove in end of piston (18). (Figure 13)
15. Caliper as previously described.

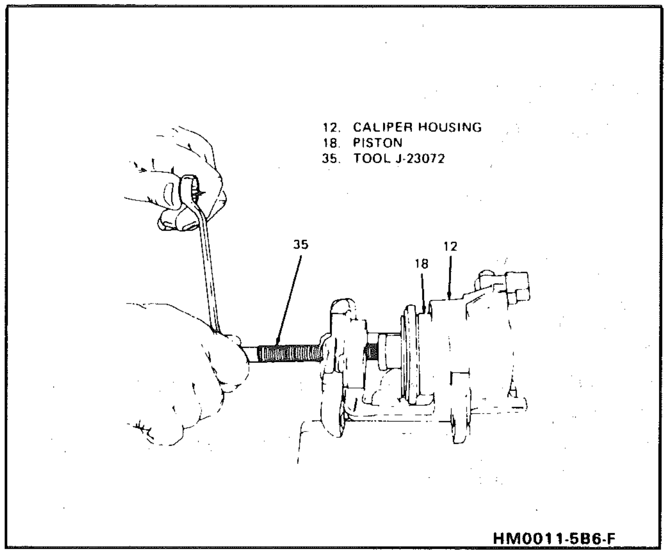


Fig. 11 Installing Piston Into Caliper

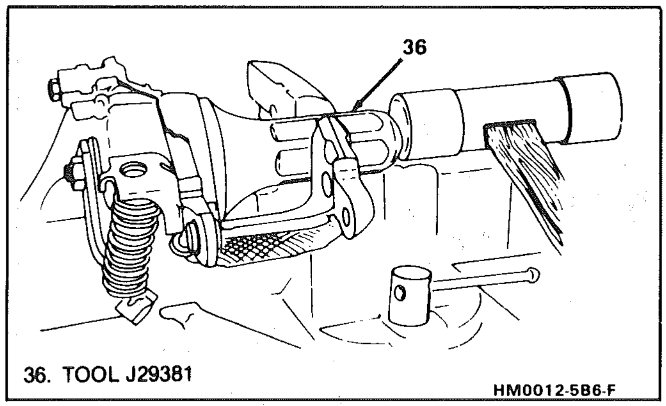


Fig. 12 Seating Boot Into Housing

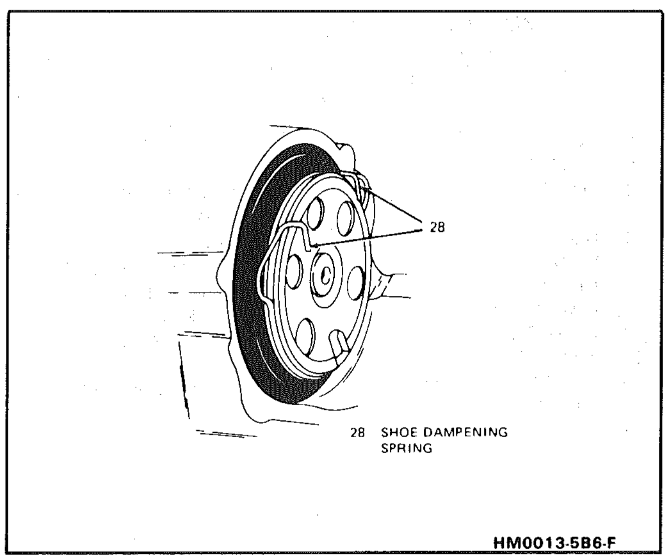
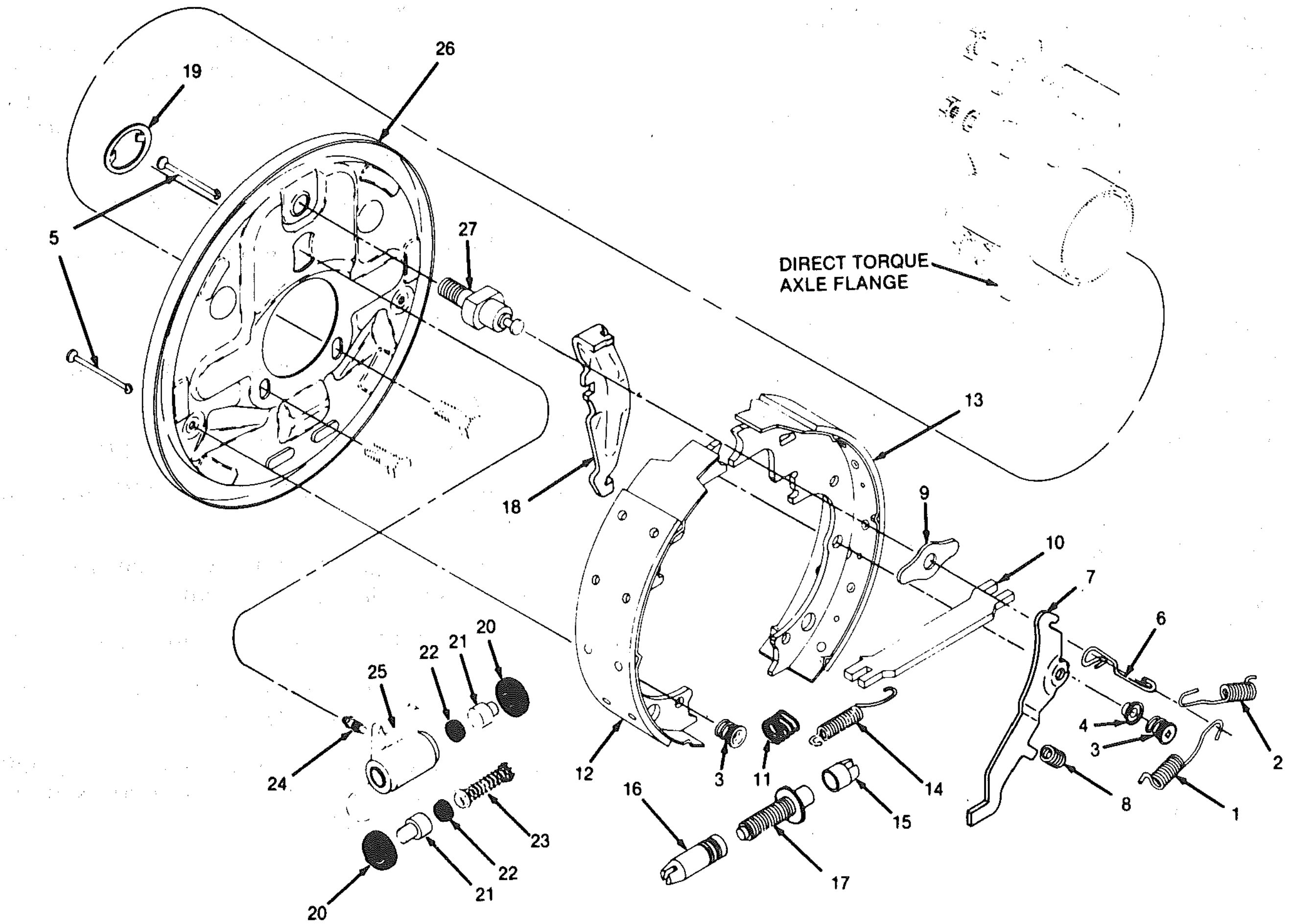


Fig. 13 Shoe Dampening Spring

SECTION 5C3

DIRECT TORQUE DRUM BRAKE ASSEMBLY

CONTENTS



1. RETURN SPRING
2. RETURN SPRING
3. HOLD-DOWN SPRING
4. LEVER PIVOT
5. HOLD-DOWN PIN
6. ACTUATOR LINK
7. ACTUATOR LEVER
8. LEVER RETURN SPRING
9. SHOE GUIDE
10. PARKING BRAKE STRUT
11. STRUT SPRING
12. PRIMARY SHOE
13. SECONDARY SHOE
14. ADJUSTING SCREW SPRING
15. SOCKET
16. PIVOT NUT
17. ADJUSTING SCREW
18. PARKING BRAKE LEVER
19. WHEEL CYLINDER RETAINER
20. BOOT
21. PISTON
22. SEAL
23. SPRING ASSEMBLY
24. BLEEDER VALVE
25. CYLINDER BODY
26. BACKING PLATE
27. ANCHOR PIN

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Figure 1

GENERAL DESCRIPTION

This drum brake asembly is a duo-servo, direct torque design. In the duo-servo brake, the force which the wheel cylinder applies to the primary shoe is multiplied by the primary lining friction to provide a very large force applied to the secondary shoe. With the direct torque design, torque from the brake shoes is transferred directly through the anchor pin to the axle flange. Adjustment for both the primary and secondary shoe and linings is automatic during reverse brake applications.

Important

- Replace all components included in repair kits used to service this drum brake.
- Lubricate parts as specified.
- Do not use lubricated shop air on brake parts as damage to rubber components may result.
- If any hydraulic components is removed or disconnected, it will be necessary to bleed all or part of the brake system.
- Replace shoe and linings in axle sets only.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

CAUTION: When servicing brake parts, do not create dust by grinding or sanding brake linings or by cleaning wheel brake parts with a dry brush or with compressed air. A water dampened cloth should be used. Many brake parts contain asbestos fibers which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibers may cause serious bodily harm.

ON-CAR SERVICE

BRAKE COMPONENTS

Tool Required:

J 8049 Brake Spring Remover and Installer
J 8057 Brake Spring Pliers
J 29839 Brake Cylinder Retainer Remover

See Figures 2, 3 and 4

Remove or Disconnect

1. Raise car and suitably support, see Section 0A.
   - Mark relationship of wheel to axle flange.
2. Wheel and tire.
   - Mark relationship of drum to axle flange.
3. Brake drum.
   - If difficulty is encountered in removing drum the following steps may be of assistance:
     - Make sure parking brake is released.
     - Back off parking brake cable adjustment.
     - Remove adjusting hole cover or knockout plate from backing plate and back off adjusting screw using screw driver and adjusting tool.
     - Use a rubber mallet to tap gently on outer rim of the drum and/or around inner drum diameter by spindle. Take car not to deform by excessive use of force.
4. Return springs (1 and 2) using J 8049 pliers.
5. Hold-down springs (3) and pins (5) using suitable pliers.
6. Lever pivot (4).
7. Actuator link (6) while lifting up on actuator lever (7).
8. Actuator lever (7) and lever return spring (8).
9. Shoe guide (9), parking brake strut (10) and strut spring (11).
10. Shoe and lining assemblies (12 and 13) after disconnecting parking brake cable.
11. Adjusting screw assembly (29) and spring (14).
12. Parking brake lever (18) by unhooking lever tab from secondary shoe (13) slot.

- If any parts are of doubtful strength or quality due to discoloration from heat, over-stress, or are worn, the parts should be replaced.

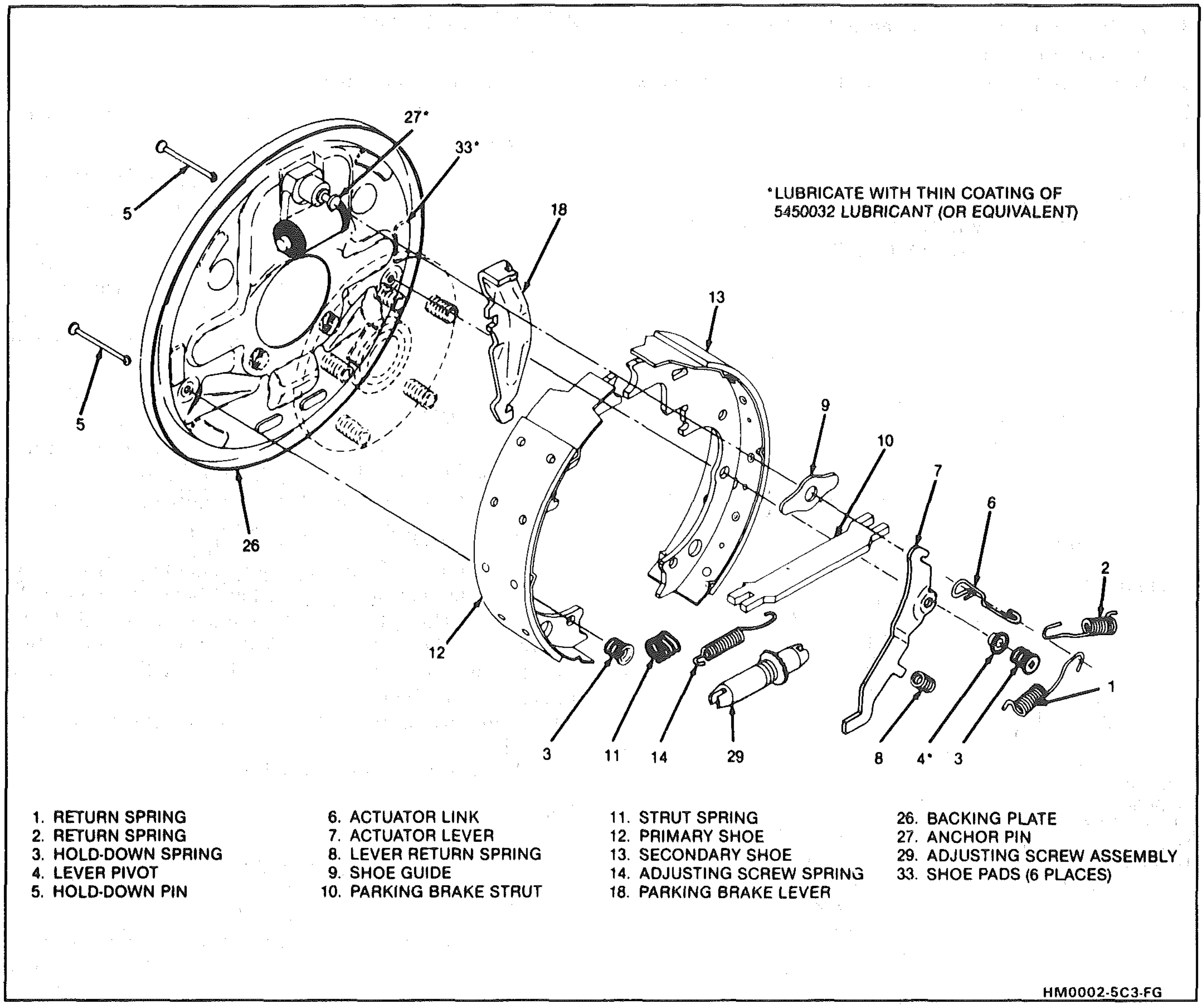


Figure 2 Brake Components

Install or Connect

- See NOTICE on page 5-1.

1. Parking brake lever (18) on secondary shoe (12) by hooking lever tab into secondary shoe (13).

Inspect

- Threads of adjusting screw (17) for smooth rotation over full length.

Clean

- Before reinstalling, adjusting screw assembly (29) must be disassembled and thoroughly cleaned and lubricated.
  - Clean adjuster screw (17) threads with a wire brush.
  - Wash all components in denatured alcohol.
  - Apply brake lubricant P/N 5450032 or equivalent to the adjusting screw (17) threads, inside diameter of socket (15) and socket face.
  - Adequate lubrication is achieved when a continuous bead of lubricant is at open end of pivot nut (16) and socket (15) when threads are fully engaged.

2. Adjusting screw assembly (29) and spring (14).
3. Shoe and lining assemblies (12 and 13) after attaching parking brake cable. For cable adjustment see PARKING BRAKE ADJUSTMENT.
4. Parking brake strut (10) and strut spring (11) by spreading shoes (12 and 13) apart. To be properly positioned.
   - The end without the spring (11) should engage the parking brake lever (18) and shoe lining (12 and 13).
   - The end with the spring should engage the opposite shoe and lining (12 or 13).
5. Shoe guide (9), actuator lever (7) and lever return spring (8).
6. Hold-down pins (5), lever pivot (4) and hold-down springs (3).
7. Actuator link (6) on anchor pin (27).

8. Actuator link (6) into actuator lever (7) while holding up on lever.
9. Shoe return springs (1 and 2) using J 8057 pliers.
10. Brake drum.
11. Wheels and tires.

- Lower car.
- Torque wheel nuts. See Section 3E WHEELS AND TIRES.

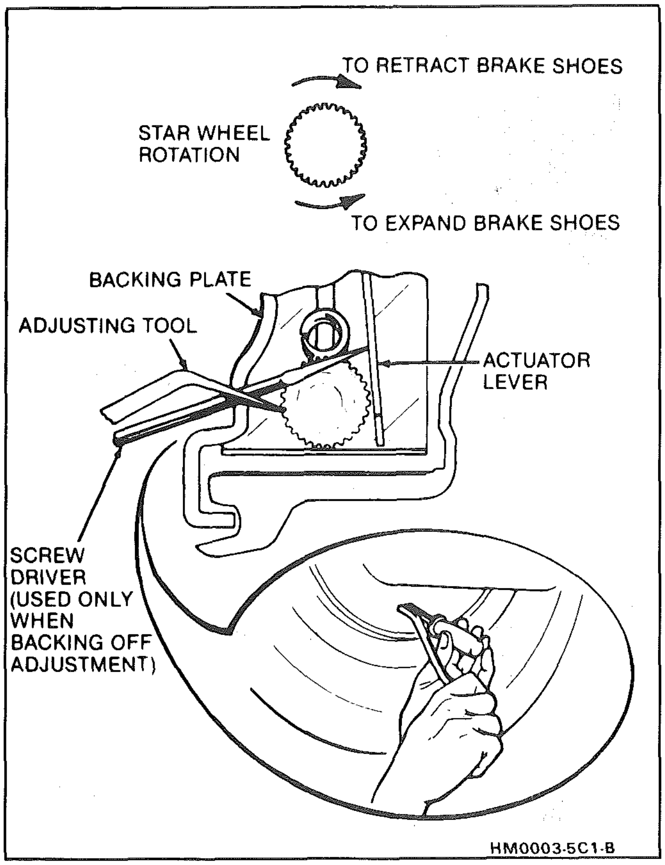


Figure 3 Backing Off Adjusting Screw

BRAKE ADJUSTMENT

See Figure 5

1. Raise car and suitably support.
   - Mark relationship of wheel to axle flange.
2. Wheel and tire.
   - Mark relationship of drum to axle flange.
3. Measure drum inside diameter (ID) using J 21177-A.
4. Turning star wheel, adjust shoe and lining diameter to be 1.27 mm (0.050 in) less than inside drum diameter for each rear wheel.
5. Install drums and wheels, aligning previous marks.
   - Torque wheel nuts. See Section 3E WHEELS AND TIRES.
6. Make several alternate forward and reverse stops applying firm force to the brake pedal. Repeat until ample pedal reserve is built up.

PARKING BRAKE ADJUSTMENT

Adjustment of parking brake cable is necessary whenever the rear brake cables have been disconnected. Need for parking brake adjustment is indicated if the hydraulic brake system operates with good reserve, but the parking brake hand level travel is less than 13 ratchet clicks or more than 17 ratchet clicks.

1. Pull parking brake hand lever exactly two ratchet clicks.
2. Raise and suitably support car.

Important

To prevent damage to the threaded parking brake adjusting rod when servicing the parking brake, the following is recommended.

- Before attempting to turn the adjusting nut, clean the exposed threads on each side of the nut.
- Lubricate the threads of the adjusting rod before turning the nut.

3. Tighten adjusting nut until the left rear wheel can just be turned rearward using two hands but is

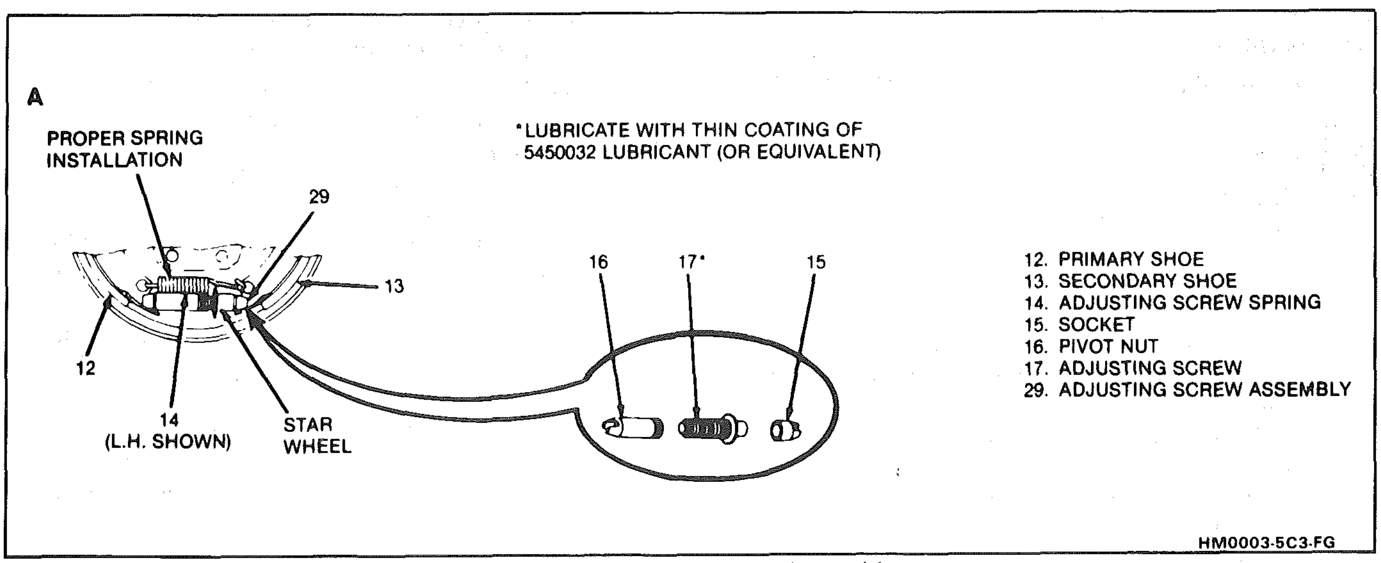


Figure 4 Adjusting Screw Assembly

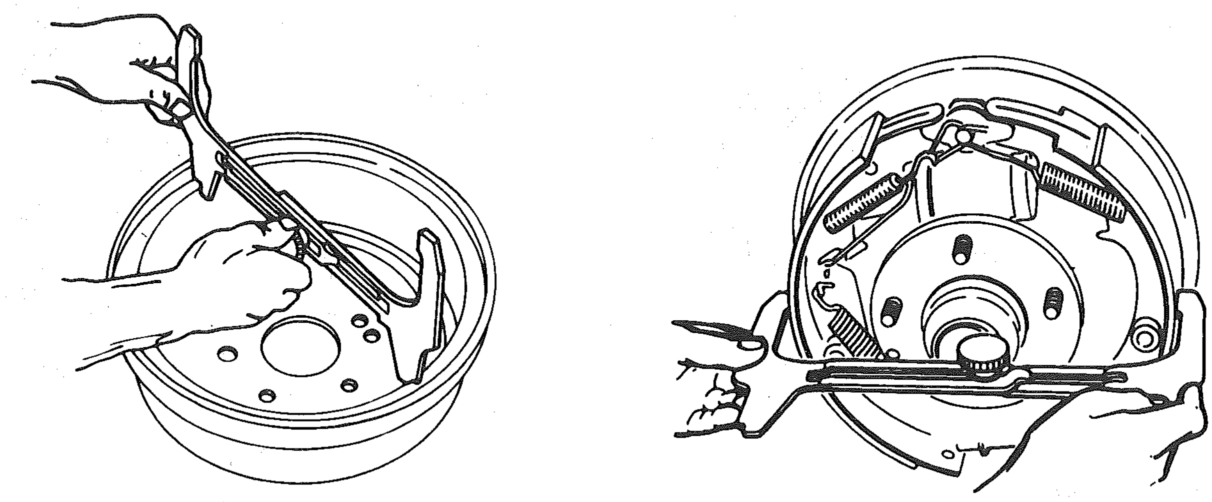


Figure 5 Measuring Drum and Shoe for Adjustment

locked when forward rotation is attempted.

4. With mechanism totally disengaged, rear wheels should turn freely in either direction with no brake drag.
   It is very important that parking brake cables are not adjusted too tightly causing brake drag.
5. Remove support and lower car.

WHEEL CYLINDER

See Figures 6 thru 9

Clean

- Dirt and foreign material around wheel cylinder assembly (28) inlet and pilot.

Remove or Disconnect

1. Inlet tube nut and line.
   - Plug opening in line to prevent fluid loss and contamination.
2. Wheel cylinder retainer (19) using J 29839 Retainer Remover or two awls.
   - Insert awls (30) into access slots between wheel cylinder (28) pilot and retainer (19) locking tabs.
   - Bend both tabs away simultaneously.
3. Wheel cylinder (28).

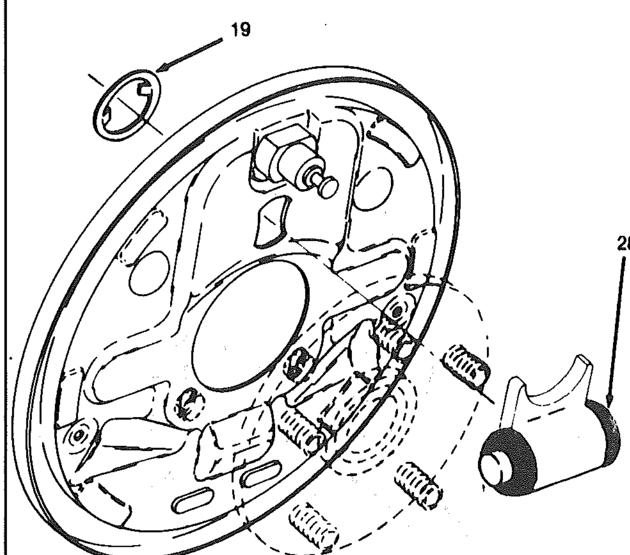
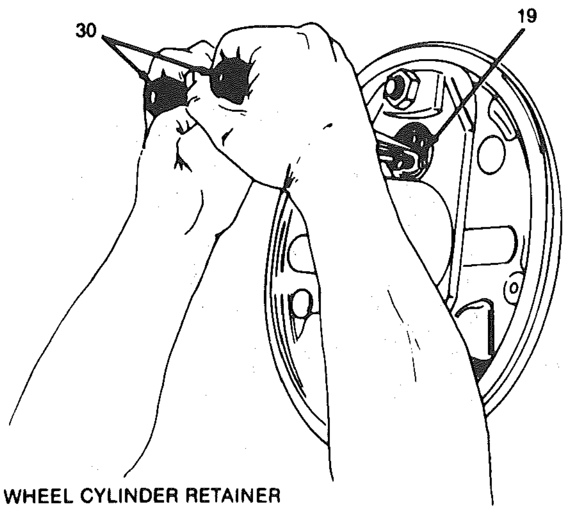


Figure 6 Wheel Cylinder



19. WHEEL CYLINDER RETAINER
30. AWL

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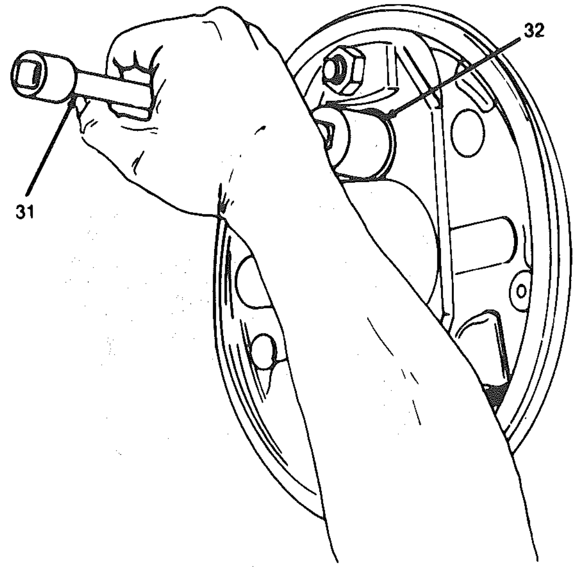
Figure 7 Removing Wheel Cylinder Retainer



31. SOCKET EXTENSION
32. 1-1/8 IN., 12 PT. SOCKET

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Figure 9 Installing Wheel Cylinder Retainer

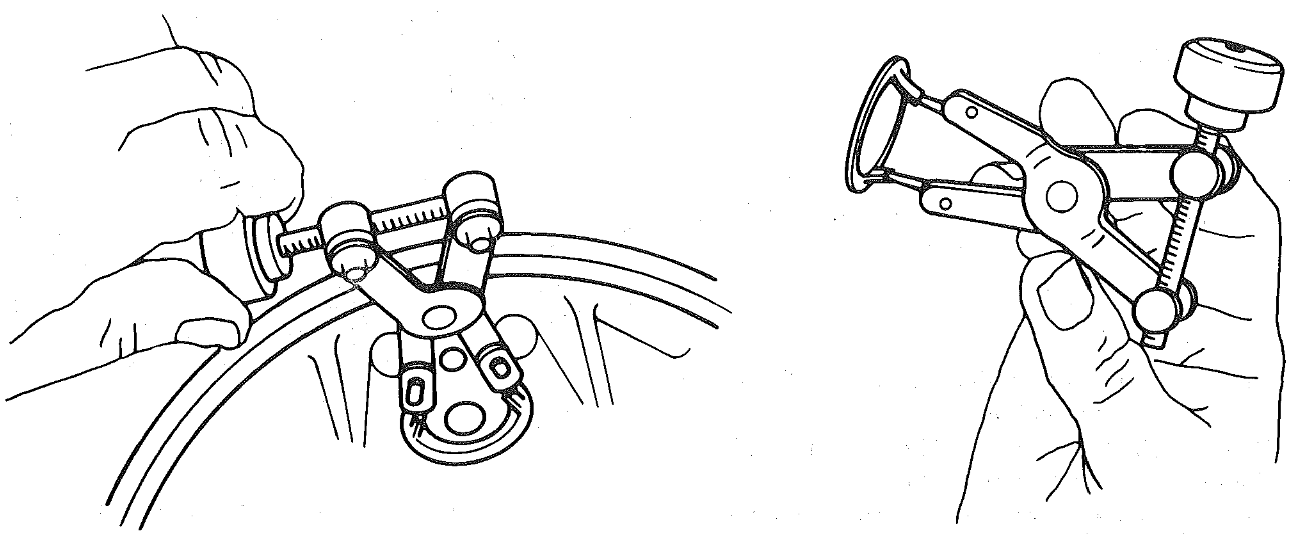

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Figure 8 Removing Wheel Cylinder with J 29839

Install or Connect

- See NOTICE on page 5-1.

1. Position wheel cylinder assembly (28) and hold in place with wooden block between cylinder and axle flange.
2. New retainer (19) over wheel cylinder abutement using a 1-1/8 inch 12-point socket (32) and socket extention (31) as shown in figure 6.
3. Inlet tube nut to 17 N·m (13 lb-ft).
4. Bleed wheel cylinder.

BACKING PLATE

Remove or Disconnect

1. Raise car and suitably support, see Section 0A.
2. Brake components as previously described.
3. Axle shaft, see Section 4B.
4. Parking brake cable from backing plate
5. Brake pipe from wheel cylinder
6. Backing plate bolts and nuts
7. Anchor pin nut and anchor pin

Install or Connect

1. Backing plate to axle flange
2. Backing plate to axle flange nuts and bolts to 58 N·m (45 lbs. ft.)
3. Anchor pin and nut to 140 N·m (103 lbs. ft.)
4. Brake pipe to wheel cylinder to 15 N·m (11 lbs. ft.)
5. Parking brake cable to backing plate
6. Axle shaft, see section 4B
7. Brake components as previously described
8. Lower car.
9. Bleed brake hydraulic system
10. Adjust brake assembly and parking brake

UNIT REPAIR

WHEEL CYLINDER OVERHAUL

See Figure 10

Disassemble

1. Wheel cylinder completely from vehicle as previously described.
2. Boots (20).
3. Pistons (21) and seals (22).
4. Spring assembly (23).
5. Bleeder valve (24).

Inspect

- Cylinder bore for:
  - Scoring
  - Nicks
  - Corrosion
  - Wear
- Use crocus cloth to polish out light corrosion.
- Replace wheel cylinder assembly if bore will not clean up with crocus cloth.
- Pistons for:
  - Scoring
  - Nicks
  - Corrosion
  - Wear

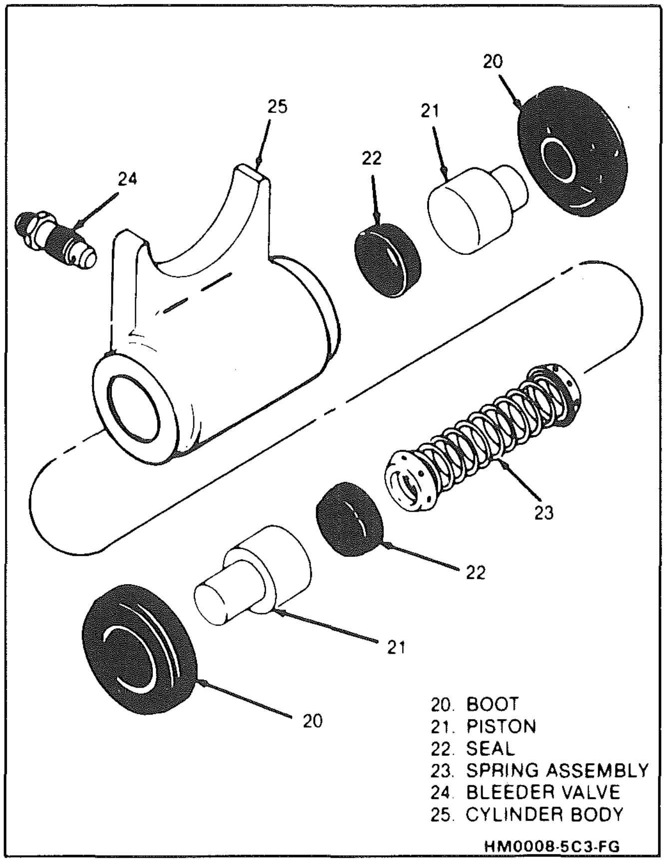


Figure 10 Wheel Cylinder Components

Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.
- Lubricate new seals with clean brake fluid.

Assemble

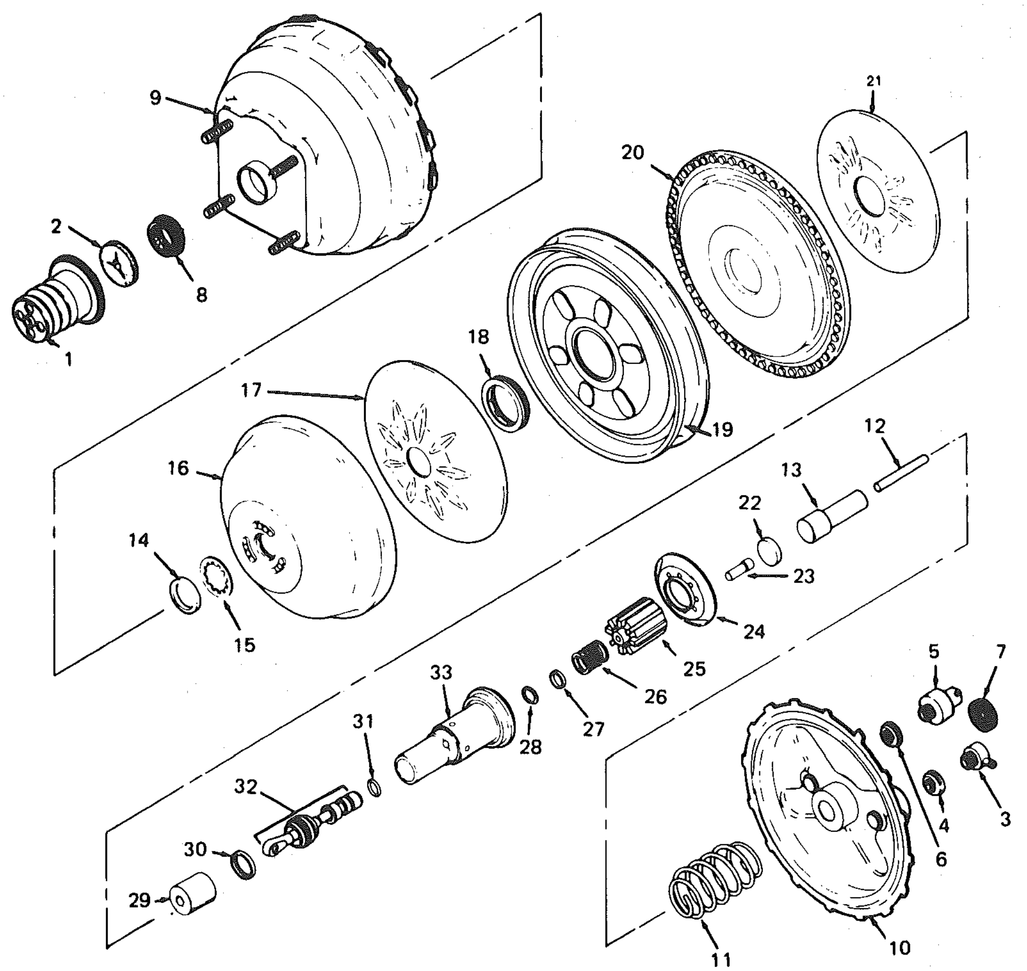
- See NOTICE on page 5-1.

1. Bleeder valve (24) to 6 N·m (50 lb-in).
2. Spring assembly (23).
3. Seal (22), pistons (21) and boots (20).
4. Wheel cylinder as previously described.

SECTION 5D2

POWER HEAD ASSEMBLY - TANDEM DIAPHRAGM

CONTENTS



1. BOOT
2. SILENCER
3. VACUUM CHECK VALVE
4. GROMMET
5. VACUUM SWITCH (SOME MODELS)
6. GROMMET
7. FRONT HOUSING SEAL
8. PRIMARY PISTON BEARING
9. REAR HOUSING
10. FRONT HOUSING
11. RETURN SPRING
12. PISTON ROD (GAGED)
13. REACTION RETAINER
14. POWER HEAD SILENCER
15. DIAPHRAGM RETAINER
16. PRIMARY DIAPHRAGM
17. PRIMARY SUPPORT PLATE
18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
22. REACTION DISC
23. REACTION PISTON
24. REACTION BODY RETAINER
25. REACTION BODY
26. AIR VALVE SPRING
27. REACTION BUMPER
28. RETAINING RING
29. FILTER
30. RETAINER
31. O-RING
32. AIR VALVE PUSH ROD ASSEMBLY
33. POWER PISTON

HM0001-5D2-AB

Figure 1 Booster Assembly

GENERAL DESCRIPTION

This booster is a tandem vacuum suspended unit. In a normal operating mode, with the service brakes in the released position, the tandem vacuum suspended booster operates with vacuum on both sides of its diaphragms. When the brakes are applied, air at atmospheric pressure is admitted to one side of each diaphragm to provide the power assist. When the service brake is released, the atmospheric air is shut off from the one side of each diaphragm. The air is then drawn from the booster through the vacuum check valve to the vacuum source.

Important

- Replace all components included in repair kits used to service this booster.
- Lubricate rubber parts with silicone grease, provided in kits, to ease assembly.
- Do not use lubricated shop air on brake parts as damage to rubber parts may result.
- If any hydraulic component is removed or disconnected, it may be necessary to bleed all or part of the brake system.
- The torque values specified are for dry, unlubricated fasteners.
- Perform service operations on a clean bench free from all mineral oil materials.

ON-CAR SERVICE

BOOSTER ASSEMBLY

(Figure 2)

Remove or Disconnect

1. Master cylinder attaching nuts (37).
2. Master cylinder (34) from booster (35).
3. Booster pushrod (32) from brake pedal.
4. Booster attaching nuts (36) and booster (35).

See NOTICE on page 5-1.

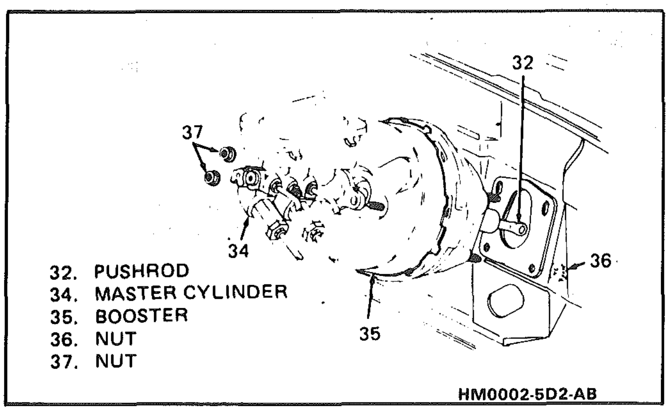


Figure 2 Removing Booster Assembly

Install or Connect

1. Booster (35) and attaching nuts (36) to 21 N·m (15 lb-ft).
2. Booster pushrod (32) to brake pedal.
3. Master cylinder (34) to booster (35) and attaching nuts (37) to 27 N·m (20 lb-ft).

EXTERIOR COMPONENTS

(Figure 3)

Important

The vacuum check valve, grommet and front housing seal can be inspected and/or serviced without removing the booster from the vehicle.

Remove or Disconnect

1. Booster (35) as previously described.
2. Boot (1) and silencer (2).
3. Vacuum check valve (3) and grommet (4).
4. Front housing seal (7).

Inspect

- Boot, front housing seal, and grommets for:
  - Cuts
  - Nicks
  - Excessive wear
- Replace part(s) if any of the above are found.

Clean

- Above parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

See NOTICE on page 5-1.

Install or Connect

- Lubricate inside and outside diameters of grommet (4) and front housing seal (7) with a thin layer of silicone grease.

1. Grommet (4) and vacuum check valve (3).
2. Front housing seal (7).
3. Silencer (2) and boot (1).
4. Booster (35) as previously described.

UNIT REPAIR

BOOSTER

Tool Required:
J 23456 Power Brake Booster Disassembly and Reassembly Tool

(Figures 4 thru 6)

Disassemble

1. Booster (35) as previously described.
2. Scribe a mark on front and rear housings (10 and 9) to aid reassembly.
3. Using Tool J 23456 (39), apply force in a counter-clockwise direction to unlock housings (9 and 10).
4. Return spring (11) and power piston group (38).

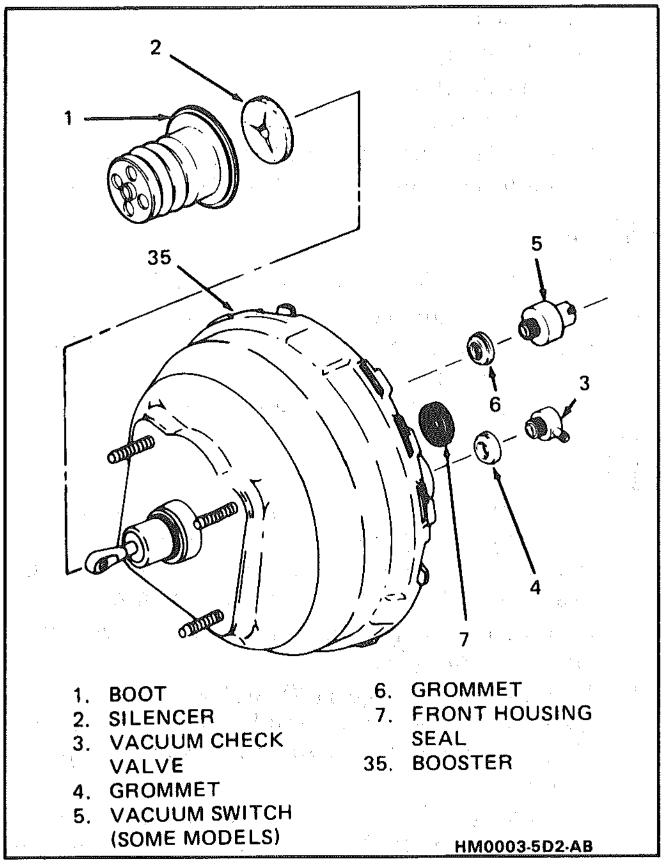


Figure 3 Exterior Components

5. Primary piston bearing (8) from rear housing (9).

Inspect

- Front and rear housings:
  - Corrosion
  - Cracks
  - Distortion
  - Excessive wear
- Use crocus cloth to polish away minor corrosion.
- Power piston bearing for:
  - Cuts
  - Nicks
- Replace if damaged.

Clean

- Above parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate inside and outside diameters of primary piston bearing (8) with silicone grease, P/N 1052863 or equivalent.
2. Primary piston bearing (8) into rear housing (9).
3. Power piston group (38) into rear housing (9).
4. Return spring (11).
5. Align scribe marks on housings (9 and 10).
6. Using tool J 23456 (39), apply force in a clockwise direction to lock front and rear housings (10 and 9).

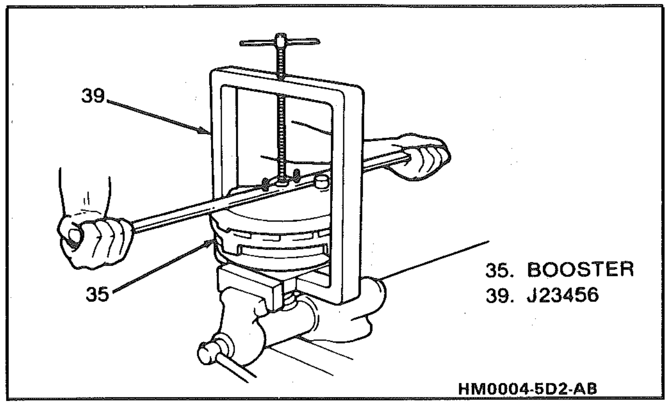


Figure 4 Unlocking and Locking Booster

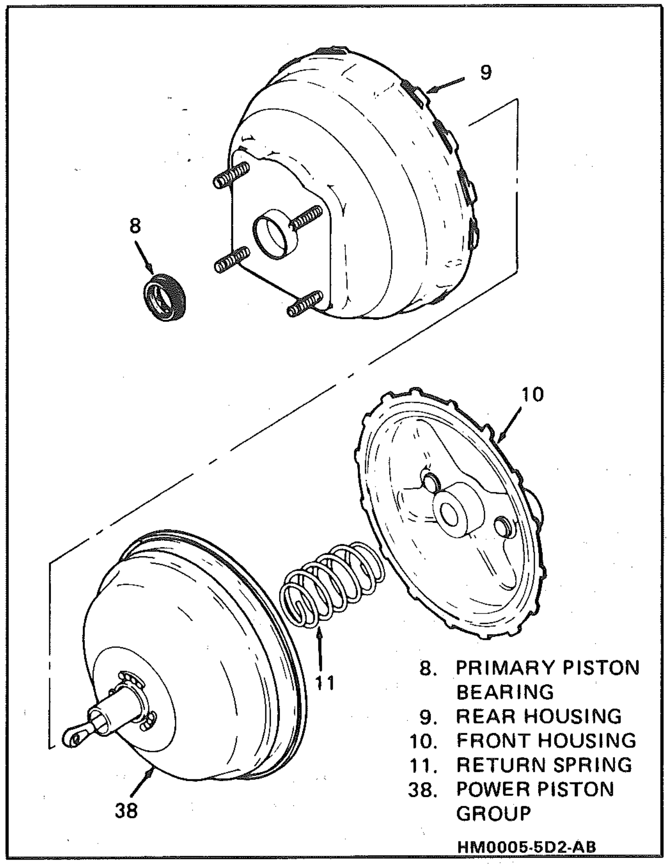


Figure 5 Booster Inner Components

- Stake housing after locking. Stake two tabs 180 degrees apart.
- Do not stake a tab that has been previously staked.
- Assembly can be aided by connecting a vacuum source to the booster.

7. Booster as previously described.

POWER PISTON GROUP

Tool Required:

J 28458 Retainer Installer (Power Piston Seal Protector)

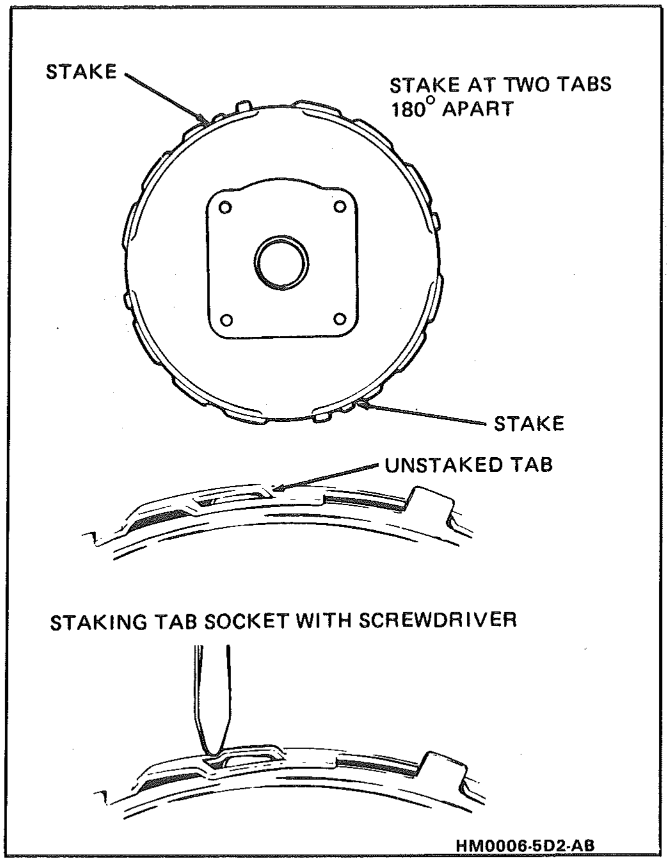


Figure 6 Staking Procedure

(Figures 7 thru 11)

Disassemble

1. Remove booster (35) and disconnect housings (9 and 10) as previously described.
2. Piston rod (12), reaction retainer (13) and power head silencer (14).
3. Power piston assembly (41) along with pushrod (32).
   - Grasp assemby at outside edge of housing divider (19) and diaphragms (16 and 20).
   - Hold with pushrod (32) down against a hard surface.
   - Use a slight force or impact to dislodge diaphragm retainer (15).
4. Primary diaphragm (16) and primary support plate (17) from housing divider (19).
5. Primary diaphragm (16) from primary support plate (17).
6. Secondary diaphragm (20) and secondary support plate (21) from housing divider (19).
7. Secondary piston bearing (18) from housing divider (19).
8. Secondary diaphragm (20) from secondary support plate (21).

Inspect

- Parts for:
  - Corrosion
  - Nicks
  - Cracks
  - Cuts
  - Scoring
  - Distortion
  - Excessive wear
- Use crocus cloth to polish away minor corrosion to diaphragm supports, or housing divider.

Clean

- All parts in clean denatured alcohol.
- Do not immerse power piston and pushrod assembly in alcohol, rather wipe clean with an alcohol dampened cloth.
- Dry with unlubricated compressed air.

Assemble

1. Lubricate inside diameter of secondary diaphragm (20) lip, inside diameter of primary diaphragm (16) lip and secondary piston bearing (18) with a thin layer of silicone grease.
2. Secondary diaphragm (20) into secondary support plate (21).
3. Secondary diaphragm (20) and support plate (21) over power piston assembly (41) and pushrod (32). Use J 28458 as a guide to protect the power piston.
4. Secondary piston bearing (18) into housing divider (19) with flat surface of bearing on same side as six raised lugs on divider.
5. Secondary piston bearing (18) and housing divider (19) over power piston assembly (41) and pushrod (32). Use J 28458 as a guide.
6. Primary diaphragm (16) into primary support plate (17).
7. Fold primary diaphragm (16) up, away from primary support plate (17).
8. Primary diaphragm (16) and support plate (17) over power piston assembly (41) and pushrod (32).
9. Fold primary diaphragm (16) back into position and pull diaphragm OD over formed flange of housing divider (19).
   - Check that beads on secondary diaphragm (20) are seated evenly around complete circumference.
10. New diaphragm retainer (15) and seat using J 28458 Retainer Installer.
11. Silencer (14), reaction retainer (13) and piston rod (12).
12. Reassemble booster as previously described.

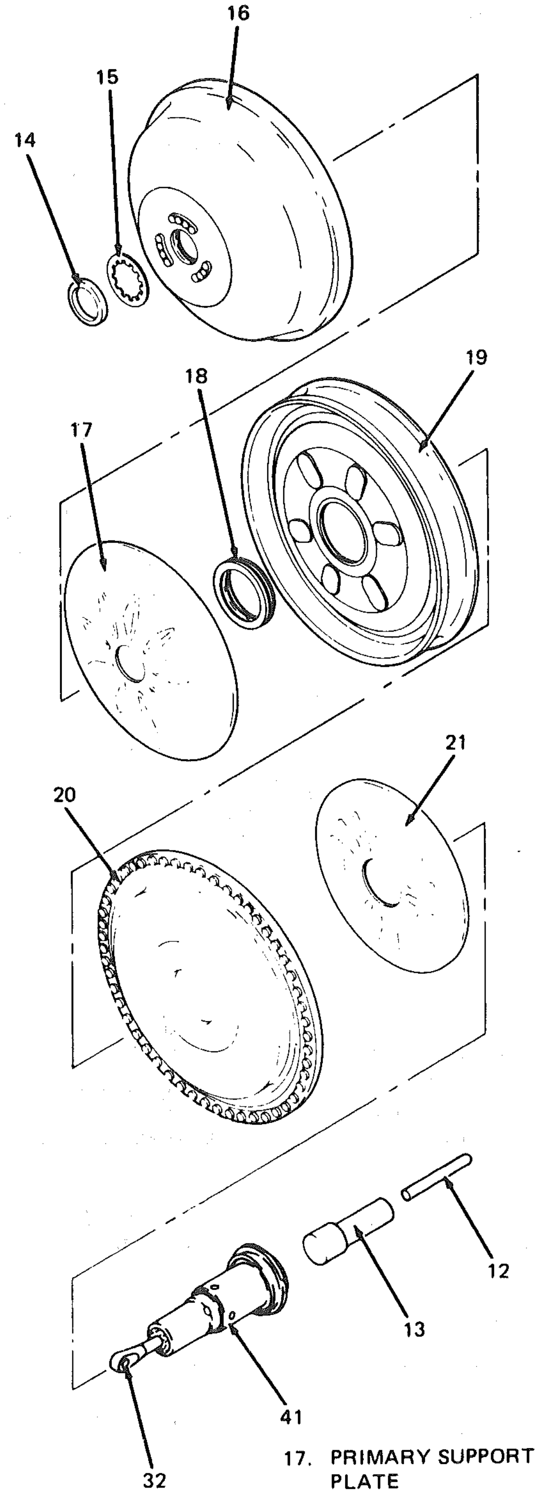
POWER PISTON OVERHAUL

Tools Required:
J 29282 Air Valve Push Rod Retainer Installer

(Figures 12 thru 14)

Disassemble

1. Reaction body retainer (24).
2. Reaction body (25).



17. PRIMARY SUPPORT PLATE
18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
32. PUSHROD
41. POWER PISTON ASSEMBLY

12. PISTON ROD (GAGED)
13. REACTION RETAINER
14. POWER HEAD SILENCER
15. DIAPHRAGM RETAINER
16. PRIMARY DIAPHRAGM

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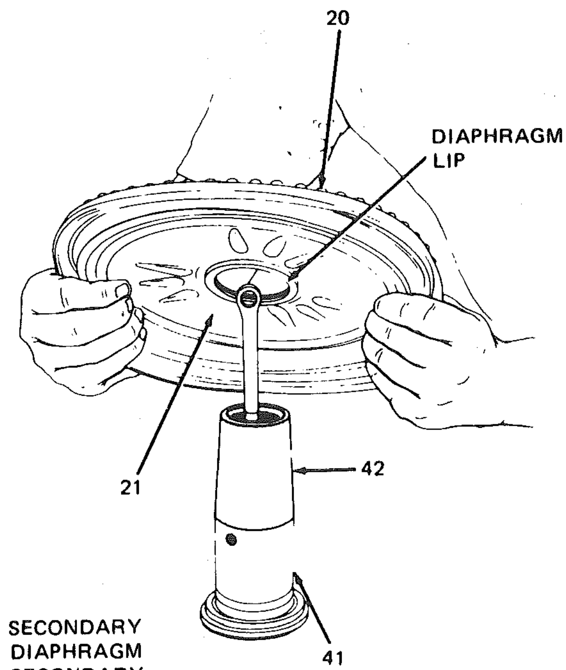
Figure 7 Power Piston Group



20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
41. POWER PISTON ASSEMBLY
42. TOOL J28458

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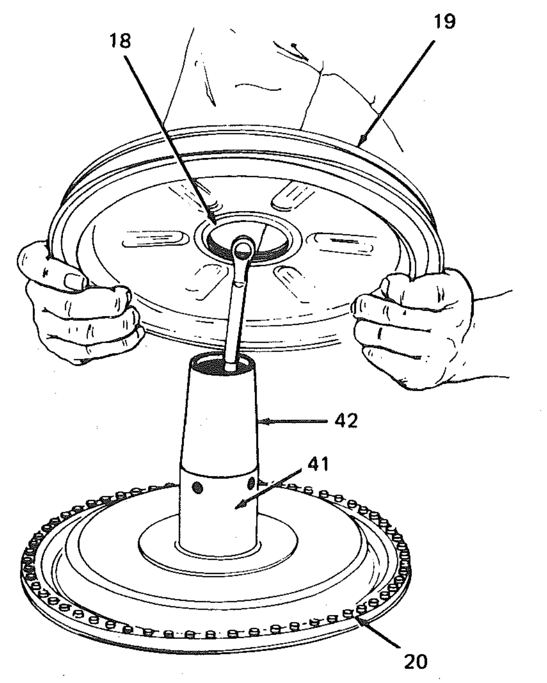
Figure 8 Assembling Secondary Diaphram & Support



18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
41. POWER PISTON ASSEMBLY
42. TOOL J28458

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Figure 9 Assembling Housing Divider

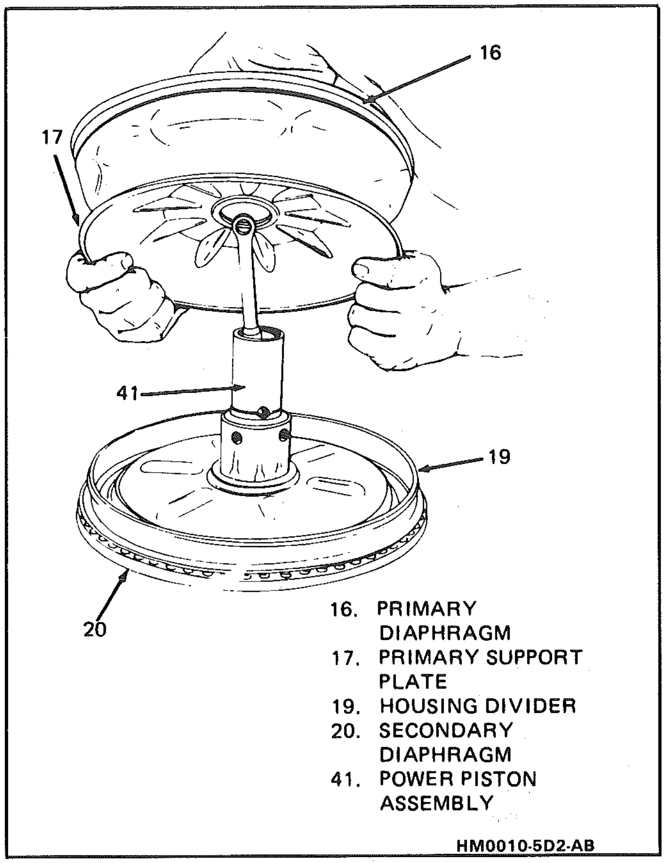


Figure 10 Assembling Primary Diaphram and Support

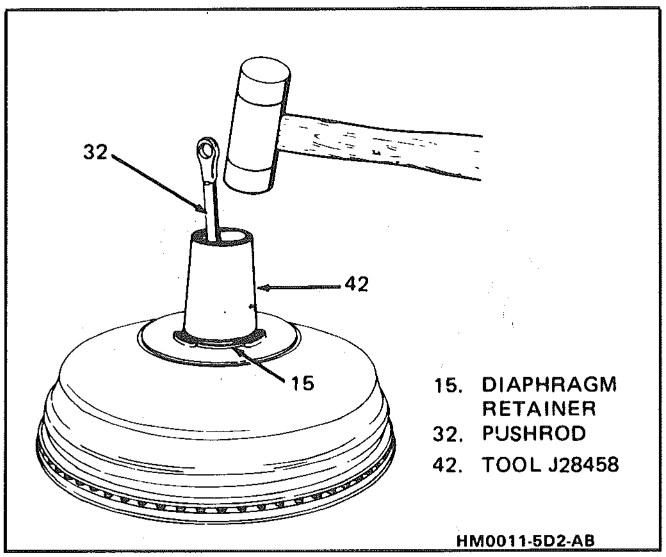


Figure 11 Sealing Diaphragm Retainer

3. Reaction disc (22) and reaction piston (23) from reaction body (25).
4. Air valve spring (26) and reaction bumper (27) from end of air valve pushrod (32).
5. Retaining ring (28) from air valve pushrod assembly (32) using No. 2 Truarc pliers or equivalent.
6. Air valve pushrod assembly (32) by inserting screwdriver through pushrod eyelet and pulling straight out.
   - Considerable force will be required.
7. Filter (29), retainer (30) and O-ring (31) from air valve pushrod assembly (32).

Inspect

- Power piston for cracks.
- Rubber parts for cuts or nicks.
- Air valve pushrod assembly for corrosion.
- Replace part(s) if any of the preceding are found.

Clean

- All parts in clean denatured alcohol.
- Dry with unlubricated compressed air.

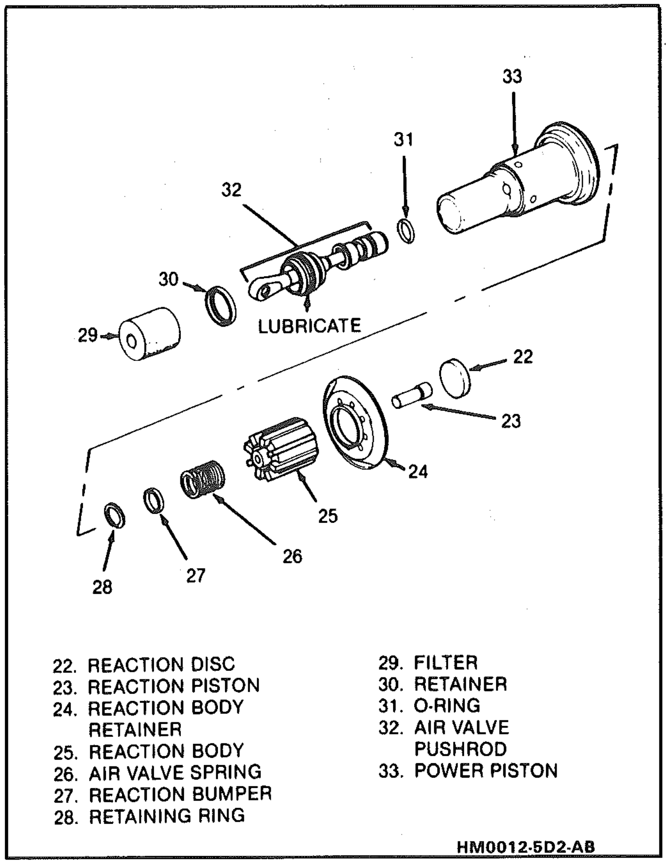


Figure 12 Power Piston Assembly

Assemble

1. Lubricated O-ring (31) onto air valve pushrod assembly (32).
2. Air valve pushrod assembly (32) into power piston (41).
3. Retainer (30) and seat using appropriate Retainer Installer (44).
4. Filter (29) over pushrod eyelet into power piston (41).
5. Retaining ring (28) onto air valve pushrod assembly (32) using No. 2 Truarc pliers or equivalent.
6. Reaction bumper (27), air valve spring (26).
7. Reaction piston (23) and reaction disc (22) into reaction body (25).
8. Reaction body (25).
9. Reaction body retainer (24).

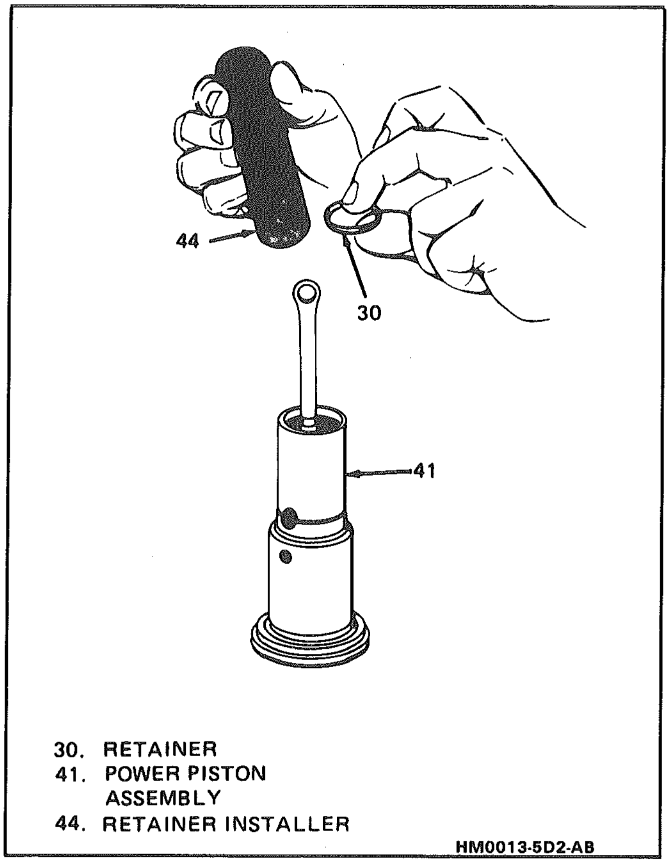


Figure 13 Retainer Assembly

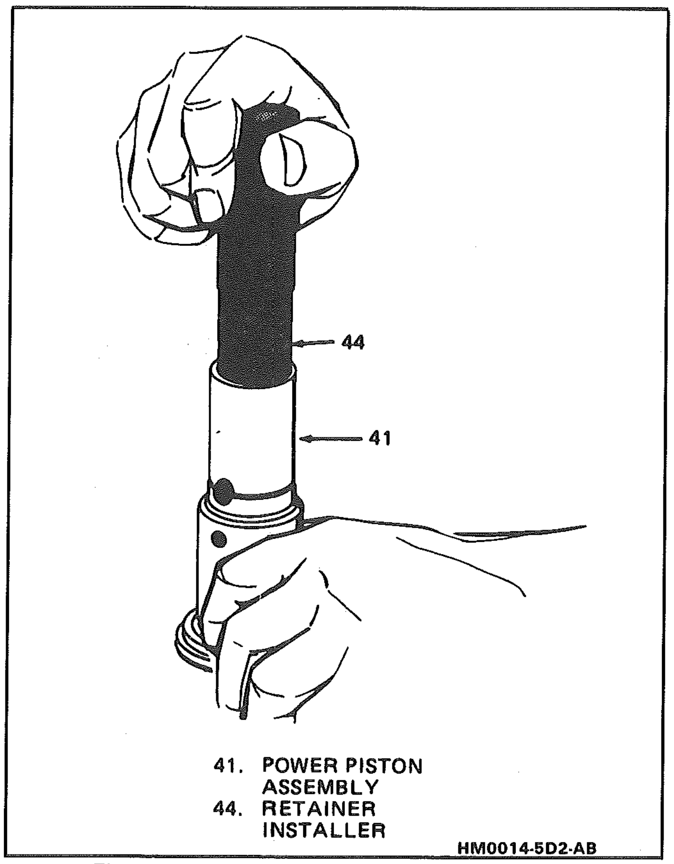


Figure 14 Installing Retainer Into Piston

GAGING PROCEDURE

Tool Required:

J 22647 Push Rod Height Gage

(Figure 15)

Measure

- After assembly of booster, position J 22647 Gage (43) over piston rod (12).
- If piston rod (12) height is not within GO-NO GO limits of gage (43), use a service-adjustable piston rod to obtain correct height.

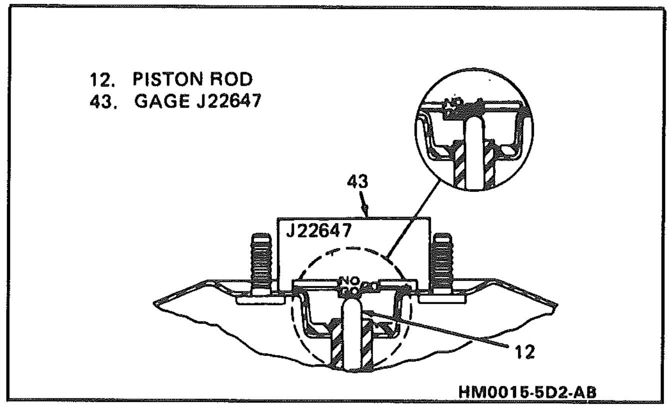


Figure 15 Gaging Piston Rod

SECTION 5F

SPECIFICATIONS AND SPECIAL TOOLS

GENERAL SPECIFICATIONS

Item	mm	In.
Front Disc Brake Rotor		
Rotor Diameter	267.00	10.5
Lateral Runout	0.13	0.005
Thickness Variation	0.013	0.0005
Rotor Thickness (Maximum)	26.5	1.043
Minimum Thickness After Refinish	24.84	0.980
*Discard Thickness	24.5	0.965
Rear Disc Brake Rotor		
Rotor Diameter	267.00	10.5
Lateral Runout	0.13	0.005
Thickness Variation	0.013	0.0005
Rotor Thickness (Maximum)	26.47	1.042
Minimum Thickness After Refinish	25.04	0.986
*Discard Thickness	24.3	0.956
Drums		
Inside Diameter	241.00	9.5
Maximum Rebore Diameter	242.81	9.56
*Discard Diameter	243.59	9.59
Runout	0.15	0.006

*All brake drums and rotors have a discard dimension cast into them. This is a wear dimension and not a refinish dimension. Any drum or rotor which does not meet the specification should be replaced.

TORQUE SPECIFICATIONS

Item	N·m	Lbs. Ft.	Lbs. In.
Brake Pedal to Bracket Nut	34	25	—
Booster to Pedal Bracket Nut	21	15	—
Master Cylinder to Booster Nut	27	20	—
Parking Brake Control Assembly to Floor Pan Bolt	10	7	—
Brake Hose to Caliper Bolt	45	33	—
Brake Pipe	15	11	—
Caliper Mounting Bolt	50	37	—
Wheel Cylinder Bleeder Valve	6	—	53
Backing Plate to Axle Housing Nut	58	45	—
Caliper Bleeder Valve	13	—	110
Junction Block to Rear Axle Bolt	27	20	—
Inlet Tube Nut	17	13	—
Anchor Pin Nut	140	103	—
Master Cylinder to Combination Valve Pipe	23	17	—
Parking Brake Caliper Lever Nut	48	35	—

SPECIAL TOOLS

Number	Name
J 7624	Spanner Wrench
J 8049	Brake Spring Remover and Installer
J 8057	Brake Spring Pliers
J 21177A	Drum to Brake Shoe Clearance Gage
J 21472	Bleeder Wrench
J 22647	Pushrod Height Gage
J 23072	Piston Installer
J 23456	Power Brake Booster Disassembly and Reassembly Tool
J 26267	Boot Seal Installer (64 mm)
J 28434	Wheel Cylinder Bleeder Wrench
J 28458	Retainer Installer
J 29282	Air Valve Pushrod Retainer Installer
J 29381	Dust Boot Seal Installer
J 29532	Power Brake Bleeder
J 29567	Brake Bleeder Adapter
J 29803	I.S.O. Flaring Kit
J 29839	Brake Cylinder Retainer Remover
J 35856	Proportioning Valve Depressor

SECTION 6

ENGINE GENERAL INFORMATION

CONTENTS

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

DESCRIPTION OF SECTION 6

SECTION 6A - ENGINE MECHANICAL

This section general contains information on the mechanical parts of the engine, such as block, crankshaft, pistons, valve train, and camshaft, that are common to most engines. Overhaul procedures, removal and replacement procedures, and specifications are also covered. Subsections furnish detailed information on each specific engine. Service information is also given that relates to that engine's use in each Carline. Specific subsections are:

6A2 - 2.8L V-6 Engine
6A3 - 5.0L V-8 Engine

SECTION 6B - ENGINE COOLING

Engine cooling system components such as radiator, water pump, thermostat, and cooling fan, are covered in this section. Accessory drive belts are also covered, along with cooling system capacities.

SECTION 6C - FUEL SYSTEM

This section contains information on all the parts of the fuel system **except** the carburetor, or Throttle Body Injection unit (TBI) itself. Items covered are fuel tank, fuel pump, and fuel lines. Specific subsections are used for each carburetor. TBI units are described in Section 6E.

SECTION 6D - ENGINE ELECTRICAL

Items covered in this section are battery, generator, starter, primary and secondary ignition, engine wire harness, spark plugs and wires, and ignition switch.

SECTION 6E - DRIVEABILITY AND EMISSIONS

This section covers emission control systems general information, and diagnostic procedures which will lead to repairing performance and driveability related problems for gasoline engine equipped vehicles. All emission components are covered, as well as all removal and replacement procedures. Instructions on use of special tools are also given. Specific sections are:

6E - Driveability and Emissions

6E2 - Fuel Injection (TBI)

6E3 - Fuel Injection (Ported)

SECTION 6F - EXHAUST SYSTEM

This section has information on all exhaust system parts, such as tailpipes, mufflers, and the catalytic converter.

GENERAL INFORMATION

CLEANLINESS AND CARE

An automobile engine is a combination of many machined, honed, polished and lapped surfaces with tolerances that are measured in the ten-thousandths of an inch. When any internal engine parts are serviced, care and cleanliness are important. A liberal coating of engine oil should be applied to friction areas during assembly, to protect and lubricate the surfaces on initial operation. Throughout this section, it should be understood that proper cleaning and protection of machined surfaces and friction areas is part of the repair procedure. This is considered standard shop practice, even if not specifically stated.

Whenever valve train components are removed for service, they should be kept in order. They should be installed in the same locations, and with the same mating surfaces, as when removed

Battery cables should be disconnected before any major work is performed on the engine. Failure to disconnect cables may result in damage to wire harness or other electrical parts.

ENGINE SERVICE

THE FOLLOWING INFORMATION ON ENGINE SERVICE SHOULD BE NOTED CAREFULLY, AS IT IS IMPORTANT IN PREVENTING DAMAGE AND IN CONTRIBUTING TO RELIABLE ENGINE PERFORMANCE.

When raising or supporting the engine for any reason, do not use a jack under the oil pan. Due to the small clearance between the oil pan and the oil pump screen, jacking against the oil pan may cause it to be bent against the pump screen resulting in a damaged oil pick-up unit.

When working on the engine, remember that the 12-volt electrical system is capable of causing short circuits. When performing any work where electrical terminals could possibly be grounded, the ground cable of the battery should be disconnected at the battery.

Any time the carburetor or air cleaner is removed, the intake opening should be covered. This will protect against accidental entrance of foreign material, which could follow the intake passage into the cylinder and cause extensive damage when the engine is started.

IN THE MECHANICAL PROCEDURES DESCRIBED IN THIS SECTION, GENERALLY NO REFERENCES WILL BE MADE TO THE REMOVAL OF OPTIONAL EQUIPMENT SUCH AS POWER STEERING PUMP, AIR CONDITIONING COMPRESSOR, ETC.

SHOULD IT BECOME NECESSARY TO REMOVE ANY SUCH ITEM TO PERFORM OTHER SERVICE, REFER TO THE APPROPRIATE SECTION OF THIS SERVICE MANUAL FOR SPECIFIC INFORMATION.

ENGINE PERFORMANCE DIAGNOSIS

INTRODUCTION

Engine Performance Diagnosis procedures are guides that will lead to the most probable causes of engine performance complaints. They cover the components of the fuel, ignition, and mechanical systems that could cause a particular complaint, and then outline repairs in a logical sequence.

It is important to determine if the **"Service Engine Soon"** light is **"ON,"** or has come **"ON"** for a short interval while driving. If the **"Service Engine Soon"** light has come **"ON,"** the Computer Command Control System or DECS should be checked for stored **"Trouble Codes"** (See Diagnostic Circuit Check, Section 6E, for the engine you are working on) which may indicate the cause for the performance complaint.Each Symptom is defined, and it is important that the correct one be selected, based on the complaints reported or found. The definition of each symptom is included with the symptom.

The words used may not be what you are used to in all cases, but because these terms have been used interchangeably for so long, it was necessary to decide on the most common usage and then define them. If the definition is not understood, and the exact Symptom is not used, the Diagnostic procedure will not work.

It is important to keep two facts in mind:

1. The procedures are written to diagnose problems on cars that have **"run well at one time"** and that time and wear have created the condition.
2. All possible causes cannot be covered, particularly with regard to emission controls. If doing the work prescribed does not correct the complaint, then either the wrong Symptom was used, or a more detailed analysis will have to be made.

All of the Symptoms can be caused by worn out or defective parts such as Spark Plugs, Ignition Wiring, etc. If time and/or mileage indicate that parts should be replaced, it is recommended that it be done.

Refer to:

- Section 6E - Driveability and Emissions

- Section 6E2 - Fuel Injection (TBI)
- Section 6E3 - Fuel Injection (Ported)

ENGINE MECHANICAL DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made, the problem should be corrected by adjustment, repair or part replacement as required. Refer to the appropriate section of the manual for these procedures.

EXCESSIVE OIL LOSS

- External oil leaks. Tighten bolts and/or replace gaskets and seals as necessary.
- Improper reading of dipstick. Check oil with car on a level surface and allow adequate drain-down time.
- Improper oil viscosity. Use recommended S.A.E. viscosity for prevailing temperatures. See Owner's Manual for proper specifications.
- Continuous high speed driving, and/or severe usage such as trailer hauling, will normally cause decreased oil mileage.
- PCV system malfunctioning.
- Valve guides and/or valve stem seals worn, or seals omitted. Ream guides and install oversize service valves and/or new valve stem seals.
- Piston rings broken, worn, or not seated. Allow adequate time for rings to seat. Replace broken or worn rings, as necessary.
- Piston improperly installed or misfitted.

LOW OIL PRESSURE

- Slow idle speed. Set idle speed to correct specification, if not ECM controlled.
- Incorrect, or malfunctioning, oil pressure switch.
- Incorrect, or malfunctioning, oil pressure gage. Replace with proper gage.
- Improper oil viscosity, or diluted oil. Install oil of proper viscosity for expected temperature, or install new oil if diluted with moisture or unburned fuel mixtures.
- Oil pump worn or dirty.
- Plugged oil filter.
- Oil pickup screen loose or plugged.
- Hole in oil pickup tube.
- Excessive bearing clearance. Replace if necessary.
- Cracked, porous or plugged oil galleys. Repair or replace block.
- Galley plugs missing or misinstalled. Install plugs, or repair as necessary.

VALVE TRAIN NOISE

- Low oil pressure. Repair as necessary. (See preceding diagnosis for low oil pressure.)
- Loose rocker arm attachments. Inspect and repair as necessary.
- Worn rocker arm and/or pushrod.
- Broken valve spring.
- Sticking valves.
- Lifters worn, dirty, or defective. Clean, inspect, test and replace as necessary.
- Camshaft worn, or poor machining. Replace camshaft.
- Worn valve guides.

ENGINE KNOCK DIAGNOSIS

KNOCKS COLD AND CONTINUES FOR TWO TO THREE MINUTES

INCREASES WITH TORQUE

- Vacuum operated EFE engines may have valve knock. Replace EFE valve.
- Flywheel contacting splash shield. Reposition splash shield.
- Loose or broken balancer or drive pulleys. Tighten, or replace as necessary.
- Excessive piston to bore clearance. Replace piston.

  Cold engine piston knock usually disappears when the cylinder is grounded out. Cold engine piston knock which disappears in 1.5 minutes should be considered acceptable.

- Bent connecting rod.

HEAVY KNOCK HOT WITH TORQUE APPLIED

- Broken balancer, or pulley hub. Replace parts as necessary.
- Loose torque converter bolts.
- Accessory belts too tight or nicked. Replace and/or tension to specs as necessary.
- Exhaust system grounded. Reposition as necessary.
- Flywheel cracked.
- Excessive main bearing clearance. Replace as necessary.
- Excessive rod bearing clearance. Replace as necessary.

LIGHT KNOCK HOT

- Detonation or spark knock. Check operation of EST or ESC (See Section 6D or 6E). Check engine timing and fuel quality.
- Loose torque converter bolts.
- Exhaust leak at manifold. Tighten bolts and/or replace gasket.
- Excessive rod bearing clearance. Replace bearings as necessary.

KNOCKS ON INITIAL START-UP BUT ONLY LASTS A FEW SECONDS

- Noisy mechanical fuel pump. Replace pump.
- Improper oil viscosity. Install proper oil viscosity for expected temperatures. See Owner's Manual.
- Hydraulic lifter bleed down. Clean, test and replace as necessary.

  When the engine is stopped, some valves will be open. Spring pressure against lifters will tend to bleed lifter down. Attempts to repair should be made only if the problem is consistent.
- Excessive crankshaft end clearance. Replace crankshaft thrust bearing.
- Excessive front main bearing clearance. Replace worn parts.

KNOCKS AT IDLE HOT

- Loose or worn drive belts. Tension and/or replace as necessary.
- A/C Compressor or generator bearing. Replace as necessary.
- Noisy mechanical fuel pump. Replace pump.
- Valve train. Replace parts as necessary.
- Improper oil viscosity. Install proper viscosity oil for expected temperature. See Owner's Manual.
- Excessive piston pin clearance. Ream and install oversize pins. (VIN R and 2) or replace piston and pin.
- Connecting rod alignment. Check and replace rods as necessary.
- Insufficient piston to bore clearance. Hone bore and fit new piston.
- Loose crankshaft balancer. Torque and/or replace worn parts.
- Piston pin offset to wrong side. Install correct piston.

ENGINE OVERHEATS

1. Coolant system leak, oil cooler system leak, or coolant recovery system not operating. Check for leaks and correct as required. Check coolant recovery tank, hose and radiator cap.
2. Belt slipping or damaged. Replace tensioner, or belt, as required.
3. Thermostat stuck closed. Check and replace if required.
4. Electrical cooling fan operation. See the ELECTRICAL TROUBLESHOOTING MANUAL.
5. Head gasket leaking. Check and repair as required.

INSTRUMENT PANEL OIL WARNING LAMP "ON" AT IDLE

1. Oil cooler, or oil or cooler line restricted. Remove restrictions in cooler or cooler line.
2. Oil pump pressure low. See oil pump repair procedures in Section 6A.

ENGINE COMPRESSION TEST

COMPRESSION TEST

Important

- Disconnect the **"BAT."** terminal from the HEI distributor or ignition module.

To determine if the valves or pistons are at fault, a test should be made to determine the cylinder compression pressure. When checking cylinder compression, the throttle and choke should be open, all spark plugs removed, and the battery at or near full charge. The lowest reading cylinder should not be less than 70% of the highest and no cylinder reading should be less than 689 kPa (100 PSI).

This should be done with four **"puffs"** per cylinder.

Normal – Compression builds up quickly and evenly to specified compression on each cylinder.

Piston Rings – Compression low on first stroke, tends to build up on following strokes, but does not reach normal. Improves considerably with addition of oil.

Valves – Low on first stroke, does not tend to build up on following strokes. Does not improve much with addition of oil.

Use approximately three squirts from a plunger type oiler.

SECTION 6A2

2.8 LITER V-6 VIN CODE S RPO (LB8)

CONTENTS

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of alloy cast iron and has 6 cylinders arranged in a "V" shape with 3 cylinders in each bank. The cylinder banks are set at a 60° angle from each other.

The right bank cylinders are 1, 3, 5. Cylinders 2, 4, 6 are on the left bank.

Four main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearances.

CYLINDER HEAD

The cast alloy iron cylinder heads have individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual threaded studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron with deep rolled fillets on all six crankpins and two center main journals. Four steel backed aluminum bearings are used, with #3 bearing being the end-thrust bearing.

CAMSHAFT AND DRIVE

The camshaft is cast alloy iron with tapered 13. 2mm wide lobes, offset from the lifters and tapered to provide positive valve lifter rotation. The camshaft is supported by four journals and includes a distributor/oil pump drive gear, and fuel pump eccentric.

A 3/8" pitch chain drives the camshaft through a hardened sintered iron sprocket. The crankshaft sprocket is also hardened sintered iron, and is pressed onto the nose of the crankshaft. A rubber snubber is used to dampen chain motion.

PISTONS AND CONNECTING RODS

The pistons are cast aluminum with steel struts using two compression rings and one coil control ring. The piston pin is offset 1.5mm towards the major thrust side. This allows a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are chromium steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker arm ball locates on a stud, threaded into the head, and is retained by a nut. The push rod is located by a guide plate held under the rocker arm stud, assuring that the rocker arm operates in the plane of the valve.

INTAKE MANIFOLD

The intake manifold is a three piece cast aluminum unit. It centrally supports a fuel rail with 6 fuel injectors.

EXHAUST MANIFOLDS

The exhaust manifolds are cast nodular iron.

ENGINE LUBRICATION (FIGURES 6A2-1 THRU 6A2-4)

Full pressure lubrication, through a full flow oil filter is furnished by a gear type oil pump. Oil is drawn up through the pick up screen and tube and passed through the pump to the oil filter.

The oil filter is a full flow paper element unit. An oil filter by-pass is used to ensure adequate oil supply should the filter develope excessive pressure drop. The by-pass is designed to open at 69-83 kPa.

From the filter, oil is routed to the main oil gallery, rifle drilled above the camshaft to the left of the camshaft centerline. This gallery supplies the left bank hydraulic lifters with oil.

From the left gallery oil is directed, by means of interesting passages to the camshaft bearings and right oil gallery.

The hydraulic lifters pump oil up through the push rods to the rocker arms. Oil draining back from the rocker arms is directed, by cast dams which are part of the crankcase casting, to supply the camshaft lobes.

The passages supplying oil to the camshaft bearings also supply the crankshaft main bearings through intersecting vertical drilled holes. Oil from the crankshaft main bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft.

Oil also drains past specific hydraulic lifter flats to oil camshaft lobes directly.

The front cam bearing has a .25mm deep slot on its outside diameter to supply oil to the cam sprocket thrust face.

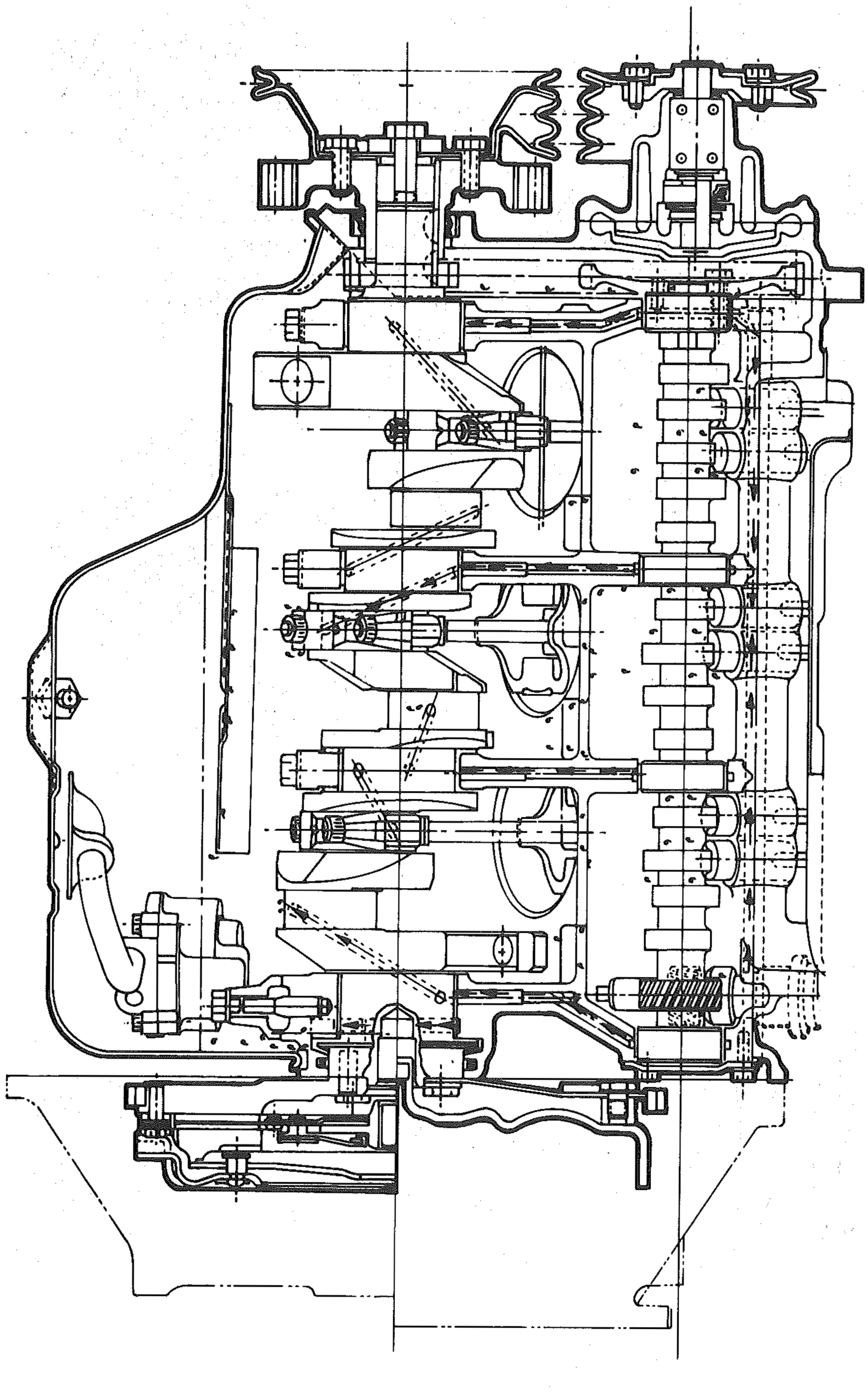


Figure 6A2-1 Engine Lubrication (1 of 4)

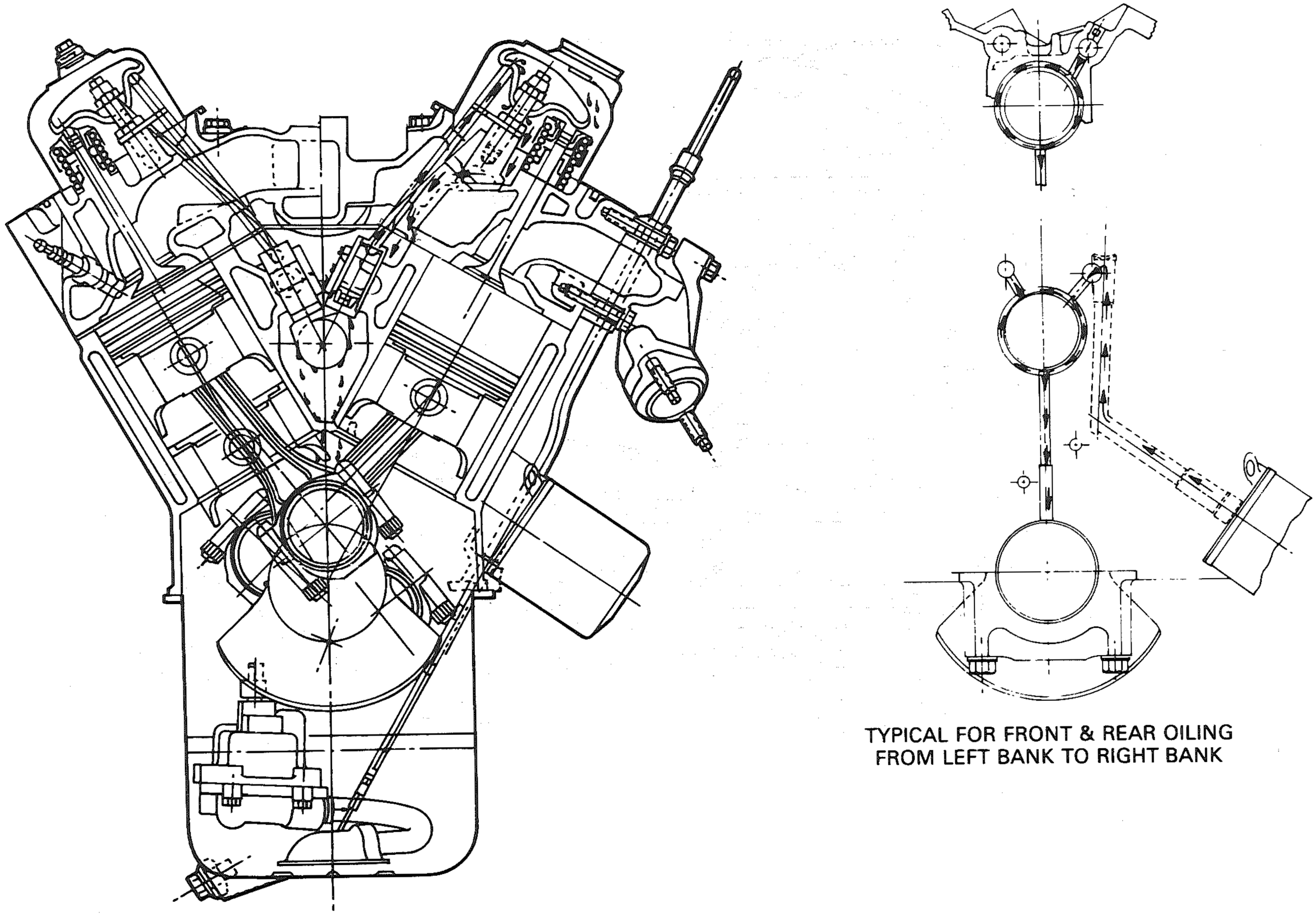


Figure 6A2-2 Engine Lubrication (2 of 4)

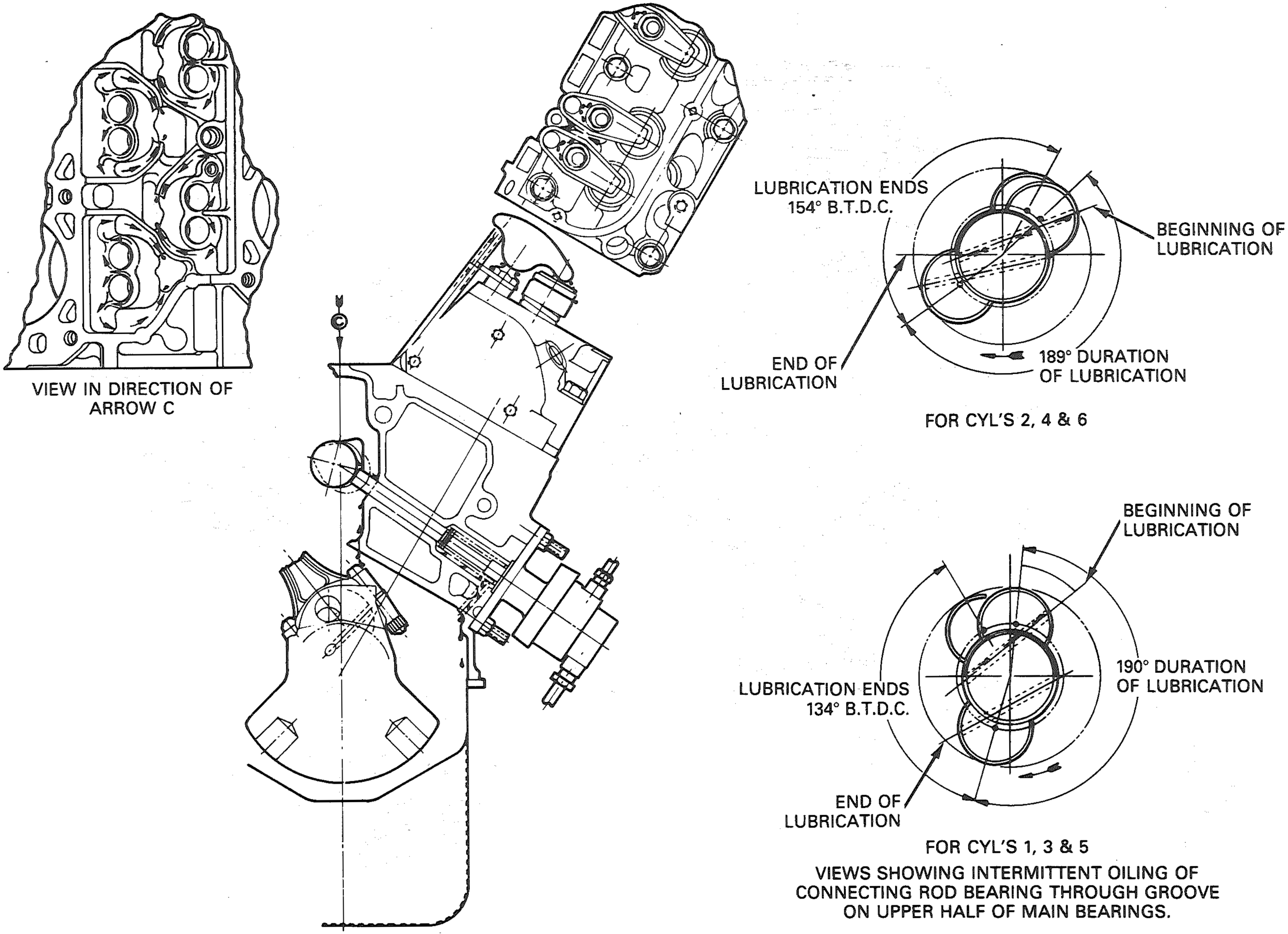


Figure 6A2-3 Engine Lubrication (3 of 4)

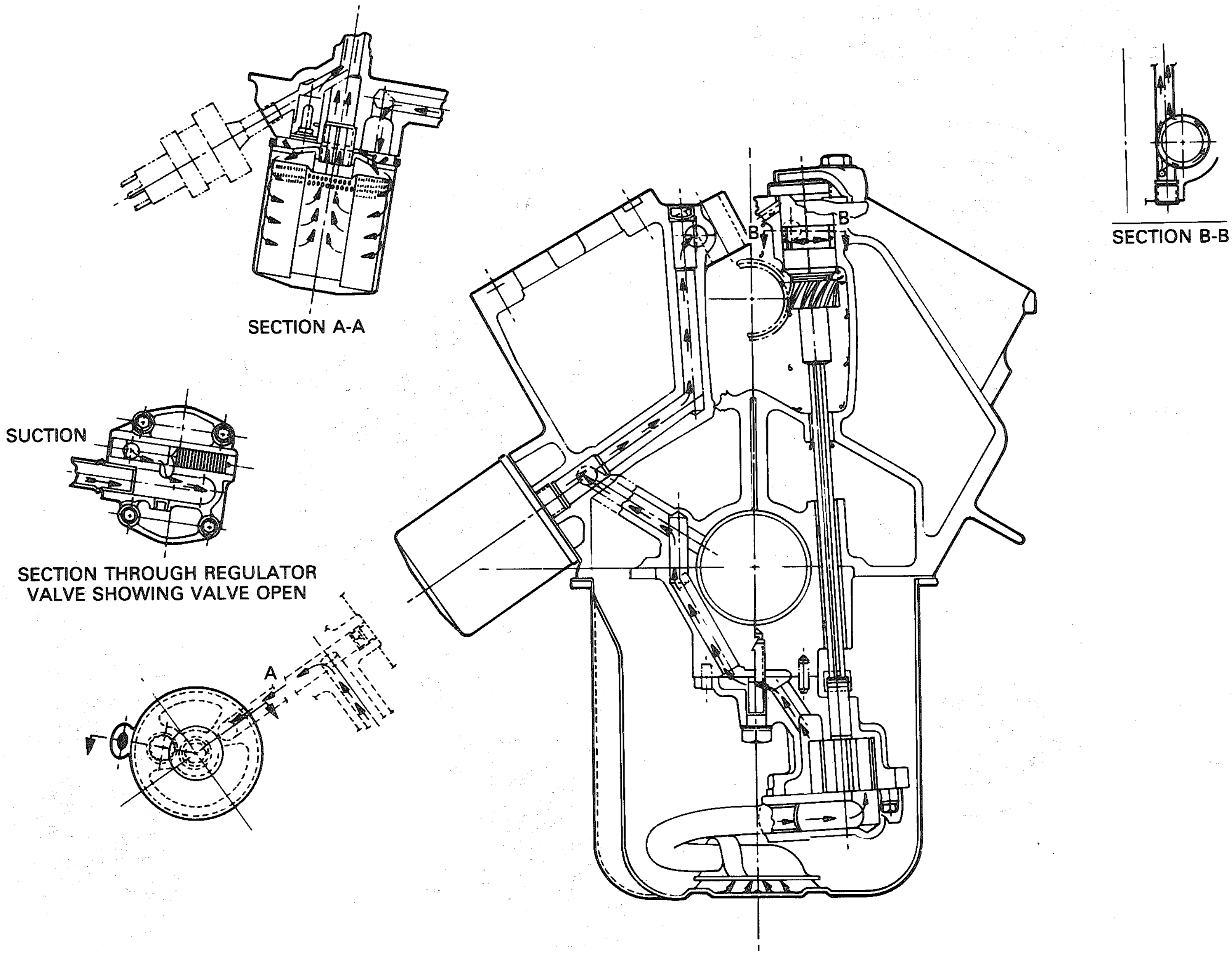


Figure 6A2-4 Engine Lubrication (4 of 4)

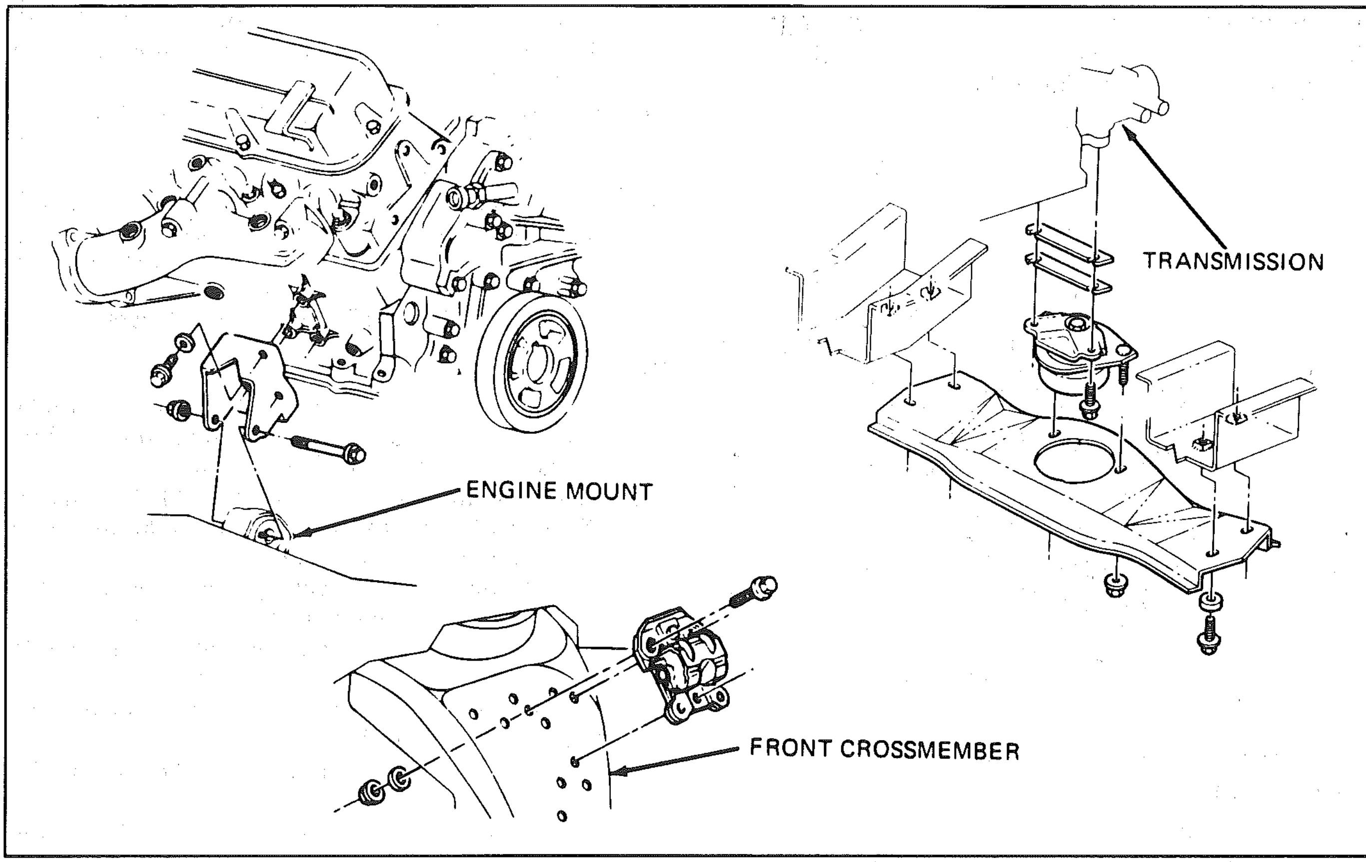


Figure 6A2-5 Engine Mounting

ON-VEHICLE SERVICE

POWERTRAIN MOUNTS

Engine mounts (Figure 6A2-5) are the nonadjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;
b. Rubber separated from a metal plate of the mount;
c. Rubber split through center, replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out), replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Disconnect battery.
2. Remove top half of fan shroud.
3. Raise vehicle.
4. Remove mount through bolt.
5. Raise front of engine and remove mount-to-engine bolts and remove mount.

NOTICE: Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel which could cause distributor damage.

6. Replace mount to engine and lower engine into place.
7. Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

1. Disconnect battery.
2. Raise vehicle.
3. Remove mount and support nuts.
4. Raise transmission.
5. Remove mount.

6. Install new mount.
7. Lower transmission.
8. Torque nuts to specifications.

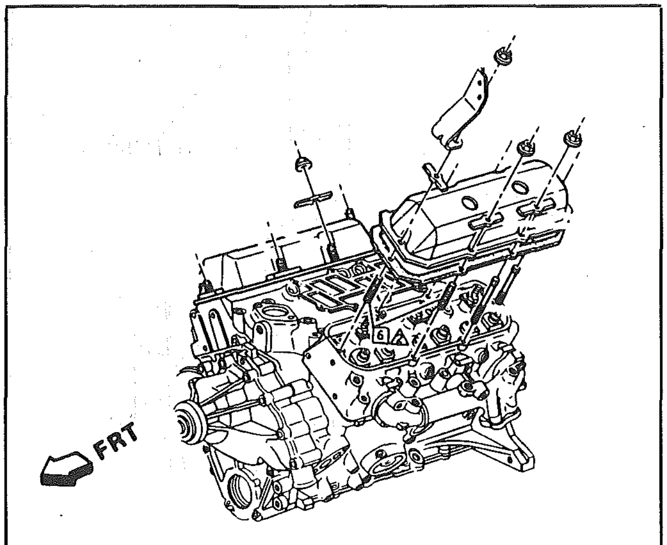


Figure 6A2-6 Rocker Arm Cover

ROCKER ARM COVER

Removal (Left)

1. Disconnect battery.
2. Disconnect air management hose (manual transmission only).
3. Remove plenum and runners and disconnect throttle body per Section 6E3.
4. Remove A/C bracket.
5. Remove rocker cover reinforcements and nuts.
6. Remove cover. If cover adheres to cylinder head, shear off by bumping end of rocker arm cover with palm of hand or rubber mallet. If cover still will not come loose, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE. It may be necessary to remove the two spark plug wire harness studs in order to get the rocker cover past the windshield wiper motor.

Installation (Left)

1. Clean sealing surface on cylinder head, intake manifold and rocker cover. Make sure sealing flange or rocker cover is not bent.
2. Place a 3mm diameter (1/8") dot of RTV sealant, #1052917 or equivalent, at the intake manifold and cylinder head splitline.
3. Install rocker cover gasket over studs in the manifold and cylinder head.
4. Install the reinforcements and nuts and torque to 8-20 N·m (6-14 ft. lbs.).
5. Install the plenum and runners and connect the throttle body as per Section 6E3.
6. Connect air management hose (manual transmission only).
7. Install A/C bracket.
8. Connect battery.

Removal (Right)

1. Disconnect battery.
2. Remove EGR valve transfer tube from plenum.
3. Remove coil and coil mounting bracket from cylinder head.
4. Remove plenum and runners and disconnect throttle body per Section 6E3.
5. Remove rocker cover retainers and nuts.
6. Remove cover. If cover adheres to cylinder head, shear off by bumping end of rocker cover with palm of hand or rubber mallet. If cover still does not come loose, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Installation (Right)

1. Clean sealing surface on cylinder head, intake manifold, and rocker cover. Make sure sealing flange or rocker cover is not bent.
2. Place a 3mm diameter (1/8") dot of RTV sealant, #1052917 or equivalent, at the intake manifold and cylinder head splitline.
3. Install rocker cover gasket over studs in the manifold and cylinder head.
4. Install the load spreaders and nuts and torque to 90 in. lbs.
5. Install plenum and runners and connect throttle body per Section 6E3.
6. Install coil and coil mounting bracket at cylinder head.
7. Install EGR valve and transfer tube at plenum.
8. Connect battery.

NOTE APPLY A SMOOTH CONTINUOUS BEAD APPROX 2.0-3.0 WIDE AND 3.0-5.0 THICK ON BOTH SURFACES. BEAD CONFIGURATION MUST INSURE COMPLETE SEALING OF WATER AND OIL. SURFACE MUST BE FREE OF OIL AND DIRT TO INSURE ADEQUATE SEAL.

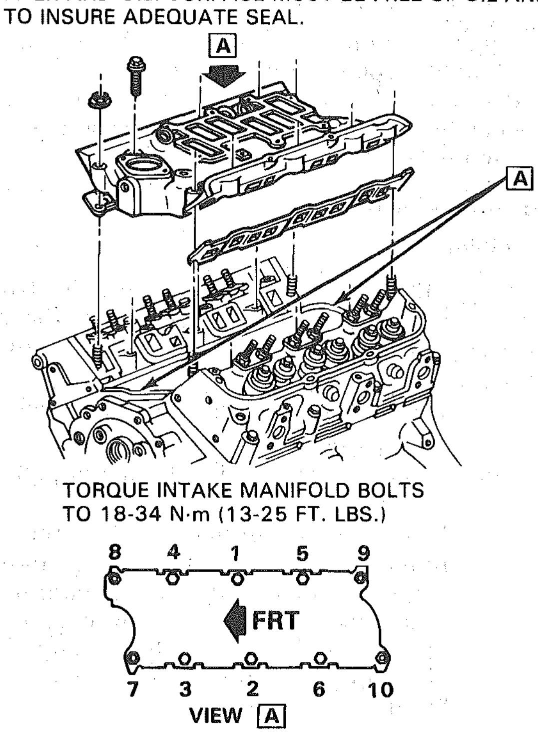


Figure 6A2-7 Intake Manifold

INTAKE MANIFOLD (FIGURE 6A2-7)

Removal

1. Disconnect battery.
2. Remove air cleaner.
3. Drain coolant.
4. Refer to Section 6E3 for removal of the following PFI sub-assemblies.
   - Plenum
   - Fuel Rail
   - Runner
5. Disconnect spark plug wires at spark plugs.
6. Disconnect wires at coil.
7. Remove distributor cap and spark plug wires.
8. Mark distributor position and remove hold down bracket.
9. Remove distributor.
10. Remove air management hose, manual transmission only.
11. Disconnect emission canister hoses. Remove pipe bracket (front left valve cover).
12. Remove left valve cover.
13. Remove air management bracket, manual transmission only.
14. Remove right valve cover.
15. Remove upper radiator hose.
16. Disconnect heater hose.
17. Disconnect coolant switches.
18. Remove manifold bolts.
19. Remove manifold. Discard manifold gaskets and remove loose RTV from front and rear ridges of cylinder case.

Installation

When installing intake gaskets, notice that the gaskets are marked Right Side and Left Side (carbureted only). Use them only as indicated to maintain designed efficiency of this engine.

1. Make sure that no oil or water is present on surface when new RTV is applied. Place a 5mm diameter (3/16") bead of RTV, #1052917 or equivalent, on each ridge.
2. Install new intake gaskets on cylinder heads. Hold in place by extending ridge RTV bead up 6mm onto the gasket ends. The new intake gaskets will have to be cut, where indicated, to install behind push rods. Cut only those areas that are necessary.
3. Install intake manifold on engine. Make sure areas between case ridges and intake are completely sealed.
4. Install manifold retaining bolts and nuts and torque in the sequence shown in Figure 6A2-7.
5. Install heater and radiator hose to manifold.
6. Install rocker covers as previously outlined.
7. Connect coolant switches.
8. Install air management bracket.
9. Install pipe bracket (front left rocker cover).
10. Install distributor, distributor cap and retaining nut. Do not tighten.
11. Refer to Section 6E3 for installation of PFI sub-assemblies removed.
12. Connect necessary wires and hoses.
13. Fill cooling system with the proper mixture of ethylene glycol anti-freeze and water. Do not install radiator cap.
14. Start engine, set intitial timing. After set, torque distibutor hold down clamp bolt to 34 N·m (25 lb. ft.). Recheck timing after torquing bolt.
15. Let engine run until radiator upper hose becomes hot (thermostat open).
16. With engine idling, add coolant to radiator, if necessary, until level reaches bottom of filler neck.
17. Install radiator cap, making sure arrows on cap line up with overflow tube.

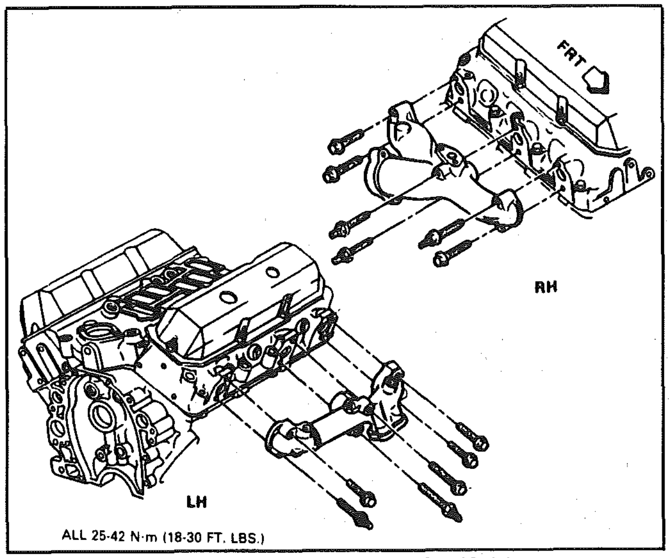


Figure 6A2-8 Exhaust Manifold

EXHAUST MANIFOLD (FIGURE 6A2-8)

Removal (Left)

1. Disconnect battery.
2. Raise vehicle.
3. Disconnect exhaust pipe.
4. Remove (4) rear manifold bolts and (1) nut.
5. Lower vehicle.
6. Disconnect air management, hoses and wires.
7. Remove power steering and fuel line bracket.
8. Remove manifold.

Installation (Left)

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts.
2. Torque manifold bolts to 34 N·m (25 ft. lbs.).
3. Install power steering bracket.
4. Raise vehicle.
5. Install exhaust pipe.
6. Lower vehicle.
7. Connect battery.

Removal (Right)

1. Disconnect battery.
2. Raise vehicle.
3. Disconnect exhaust pipe.
4. Lower vehicle.

5. Remove air management valve from A.I.R. pump.
6. Remove alternator bracket.
7. Remove exhaust manifold bolts.
8. Disconnect air management hose.
9. Remove manifold.

Installation (Right)

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts.
2. Torque manifold bolts to 34 N·m (25 ft. lbs.).
3. Attach air management hose.
4. Raise vehicle.
5. Install exhaust pipes.
6. Lower vehicle.
7. Install alternator bracket.
8. Install air management valve.
7. Connect battery.

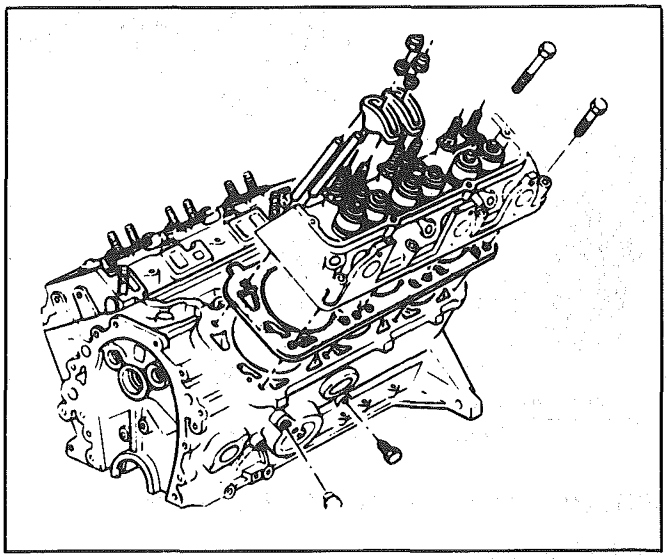


Figure 6A2-9 Rocker Arm and Push Rods

ROCKER ARM AND PUSH ROD (FIGURE 6A2-9)

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place components in a rack so they can be reinstalled in the same location.

Installation and Adjustment

Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker balls with a thin even coating of "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Crank engine until mark on torsional damper lines up with "O" mark on the timing tab. The engine should also be in the #1 firing position. This may be determined by placing fingers on the #1 rocker arms as the mark on the damper comes near the "O" mark. If the valves are not moving, the engine is in the #1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in the #4 firing position and should be rotated one revolution to reach the #1 position.
   b. With the engine in the #1 firing position, the following valves may be adjusted.
      Exhaust 1, 2, 3
      Intake 1, 5, 6
   c. Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed (Figure 6A2-10). (This can be determined by rotating push rod while turning adjusting nut). When lash has been removed, turn adjusting nut in 1-1/2 additional turns (to center lifter plunger).
   d. Crank the engine one revolution until the timing tab "O" mark and torsional damper mark are again in alignment. This is the #4 firing position. With the engine in this position, the following valves may be adjusted:
      Exhaust 4, 5, 6
      Intake 2, 3, 4
4. Install rocker arm covers as previously outlined.
5. Start engine and check timing and idle speed.

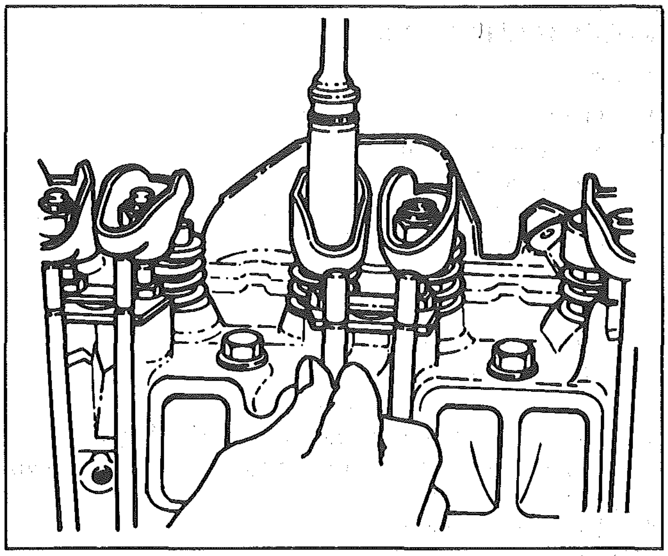


Figure 6A2-10 Adjusting Valve Lash

VALVE MECHANISM

Valve Stem Oil Seal and/or Valve Spring (Figure 6A2-12)

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.

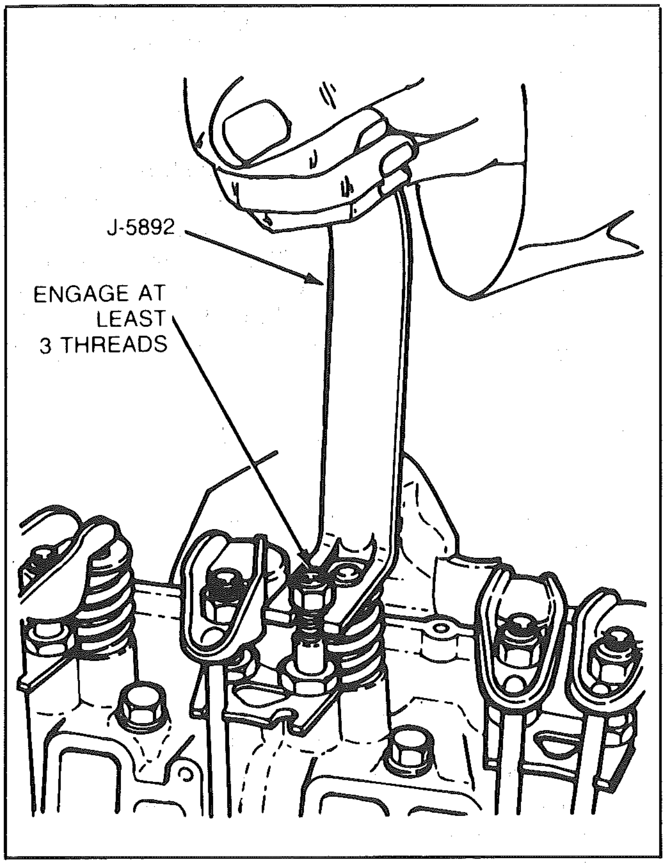


Figure 6A2-11 Depressing Valve Spring

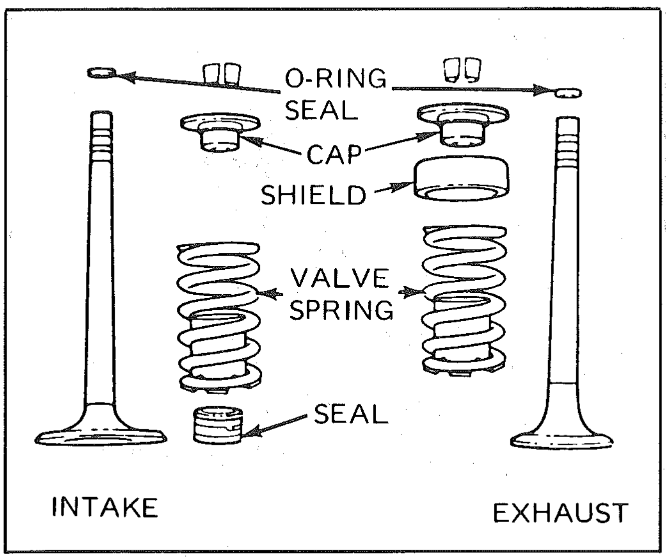


Figure 6A2-12 Valve Stem Seal

4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap, oil shedder (exhaust only) and valve spring and damper (Figure 6A2-11).
5. Remove the valve stem oil seal.

Installation

1. Set the valve spring and damper around the valve guide boss.
2. Install a valve stem seal over the valve stem and valve guide base inlet only.
3. Drop an oil shedder and valve rotator over the exhaust and a valve spring cap over the valve spring.
4. Using Tool J-5892, compress the valve spring.
5. Install the square cut "O" ring around the valve stem in the lower groove, making sure it is not twisted.
6. Insert valve stem key locks and release tool.

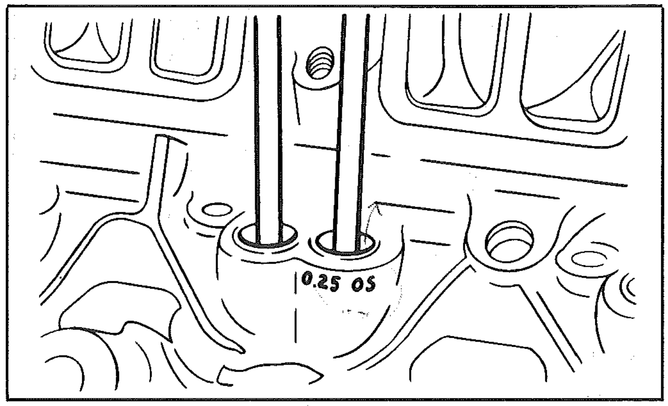


Figure 6A2-13 Oversize Lifter Marking

Valve Lifters (6A2-14)

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts. Valve lifters should be kept in order so they may be reinstalled in their original position. Some engines will have both standard and .010" oversize valve lifters.

The cylinder case will be marked, where the O.S. lifters are used, with a dab of white paint and 0.25 (mm) O.S. stamped on the lifter boss (Figure 6A2-13).

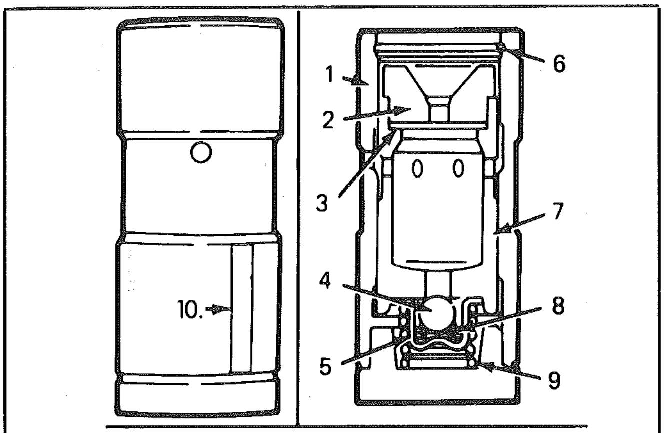
If for any reason, the lifters are removed, it is important that all lifters be reinstalled in their original location. If replacement is necessary, lifters with a narrow flat along the lower 3/4 of the length should be used. This provides additional area to the cam lobe and lifter surfaces.

Removal

1. Remove rocker arm covers and intake manifold as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place components in a rack so they can be reinstalled in the same location.
3. Remove lifters.

Installation

1. Install valve lifters. Whenever new valve lifters are being installed, coat foot of valve lifters with "Molykote" or its equivalent. Make sure lifter foot is convex.
   Lifter foot is very slightly convex. It can be detected by holding a good straight edge to the surface and looking into a light source.
2. Install intake manifold as previously outlined.
3. Install and adjust valve mechanism as previously outlined.



1 Lifter Body
2 Push Rod Seat
3 Metering Valve
4 Check Ball
5 Check Ball Retainer
6 Push Rod Seat Retainer
7 Plunger
8 Check Ball Spring
9 Plunger Spring
10 Oiling Flat

Figure 6A2-14 Valve Lifter

Disassembly

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve.
3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver.

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced. If the lifter body wall is scuffed or worn, inspect the cylinder block lifter bore. If the bottom of the lifter is scuffed or worn, inspect the camshaft lobe. If the push rod seat is scuffed or worn, inspect the push rod. An additive containing EP lube, such as EOS, should always be added to crankcase oil for run-in when any new camshaft or lifters are installed. All damaged or worn lifters should be replaced. For proper lifter rotation during engine operation, lifter foot must be convex.

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver.
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" drift pin into the plunger and press down solid. Do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned.
5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension.
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat.
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation. Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD (FIGURE 6A2-15)

Removal (Left)

1. Remove intake manifold as previously outlined.
2. Raise vehicle.
3. Drain engine block.
4. Disconnect exhaust pipe.
5. Remove dipstick tube attachment.
6. Lower vehicle.
7. Remove serpentine belt.
8. Remove A/C compressor and lay aside.
9. Remove P/S pump and lay aside.
10. Loosen rocker arm until able to remove push rod.
11. Remove head bolts.
12. Remove head.

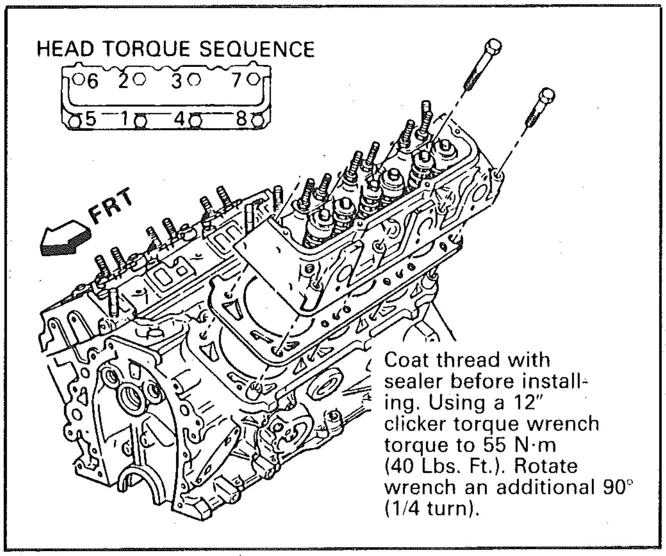


Figure 6A2-15 Cylinder Head Installation

Installation (Left)

The gasket surfaces on both head and cylinder case deck must be clean of any foreign matter and free of nicks of heavy scratches. Cylinder bolt threads in the case and threads on the cylinder head bolts must be clean. Dirt will affect bolt torque.

1. Place the gasket in position, over the dowel pins, with the note "This Side Up" showing.
2. Install cylinder head.
3. Coat cylinder head bolt threads with sealer, #1052080 or equivalent, and install bolts.

Torque bolts as shown in Figure 6A2-15.

4. Install push rods and loosely retain with rocker arms. Make sure lower ends of pushrods are in lifter seats.
5. Install intake manifold.
6. Raise vehicle.
7. Install dipstick tube bracket.
8. Connect exhaust pipe to exhaust manifold flange.
9. Lower vehicle.
10. Adjust valve lash as previously outlined.
11. Continue following intake manifold installation for build up.

Removal (Right)

1. Remove intake manifold as previously outlined.
2. Raise vehicle.
3. Disconnect exhaust pipe.
4. Drain engine block.
5. Lower vehicle.
6. Loosen rocker arms until able to remove push rod.
7. Remove serpentine belt.
8. Remove tensioner.
9. Remove A.I.R. bracket.
10. Remove generator bracket.
11. Remove head bolts.
12. Remove head.

Installation (Right)

The gasket surfaces on both the head and cylinder case deck must be clean of any foreign matter and free of nicks of heavy scratches. Cylinder bolt threads in the case and threads on the cylinder head bolts must be clean. Dirt will affect bolt torque.

1. Place the gasket in position, over the dowel pins, with the note "This Side Up" showing.
2. Install cylinder head.
3. Coat cylinder head bolt threads with sealer, #1052080 or equivalent, and install bolts. Torque bolts as shown in (Figure 6A2-15).
4. Install push rods and loosely retain with rocker arms. Make sure lower ends of push rods are in lifter seats.
5. Install intake manifold.
6. Raise vehicle.
7. Install exhaust pipe to exhaust manifold flange.
8. Lower vehicle.
9. Adjust valve lash as previously outlined.
10. Install AIR bracket.
11. Install tensioner.
12. Install generator bracket.
13. Continue following intake manifold installation for build up.

Disassembly

1. With cylinder head removed, remove rocker arm nuts, balls and rocker arms (if not previously done).
2. Using tool J-8062, compress the valve springs and remove valve keys. Release the compressor tool and remove spring caps, oil shedders, springs and damper assemblies, then remove oil seals.
3. Remove valves from cylinder head and place them in a rack so they can be installed in their original positions.

Cleaning and Inspection

1. Clean all carbon from combustion chambers and valve ports using 'tool J-8089.
2. Thoroughly clean valve guides using J-8101.
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.
6. Inspect cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water jacket.
7. Inspect the valves for burned heads, cracked faces or damaged stems.

NOTICE: Excessive valve stem to bore clearance will cause high oil consumption and may cause valve breakage. Insufficient clearance will result in noise and sticky functioning of the valve and disturb engine smoothness.

8. Measure valve stem clearance as follows:
   a. Clamp a dial indicator on one side of the cylinder head. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the guide.
   b. Drop the valve head 1.5mm off the valve seat.
   c. Move the stem of the valve from side to side, using light pressure, to obtain a clearance reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves. Service valves are available in std., 089, .394 and .775mm O.S. sizes.
9. Check valve spring tension with tool J-8056, spring tester. Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 44 N (10 lbs.) of the specified load (without dampers).
10. Inspect rocker arm studs for wear or damage.

ROCKER ARM STUDS

Cylinder heads use threaded rocker arm studs. Rocker arm studs that have damaged threads should be replaced with new studs. If, for some reason, the threads in the head are damaged or stripped, the head can be retapped, and a helical type insert added. If such an insert is not available, the head should be replaced.

VALVE GUIDES

Valves with oversize stems are available in .089, .394 and .775mm over sizes. To ream the valve guide bores for oversize valves use tool J-5330-1, 2 or 3, respectively.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the engine to deliver the power and performance designed into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valve seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

VALVES

Valves that are pitted can be refaced, to the proper angle, insuring correct relation between the head and stem, on a valve refacing machine. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface the valve. Knife edges lead to breakage, burning or preignition due to heat localizing on this knife edge. If the edge of the valve head is less than .8mm thick after grinding, replace the valve.

Several different types of equipment are available for refacing valves. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain the proper results.

Assembly

1. Insert a valve in the proper port.
2. Install a valve stem seal over the valve stem and valve guide base inlet only.
3. Drop an oil shedder and valve rotator over the exhaust and a valve spring cap over the valve spring.
4. Using tool J-8062 compress the valve spring.
5. Install the square cut "O" ring around the valve stem in the lower groove, making sure it is not twisted.
6. Insert valve, stem key locks and release tool.
7. Install the valve locks and release the compressor tool making sure that the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
8. Install the remaining valves.
9. Check each valve stem oil seal by placing valve stem leak detector, tool J-23994, over the end of the valve stem and against the cap. Operate the vacuum pump and make sure no air leaks pass the seal.
10. Check the installed height of the valve springs, using a narrow thin scale. Measure from the top of the spring damper "feet" to the bottom inside of the oil shedder exhaust and from the top of the spring damper "feet" to the bottom of the valve cap for intake. If this is found to exceed the specified height, install valve spring seat shim approximately .75mm thick. At no time should the spring be shimmed to give an installed height under the minumum specified of 40mm.

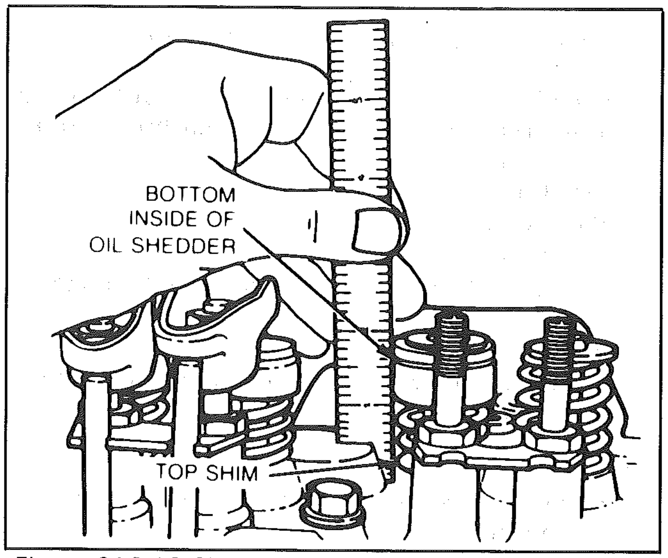


Figure 6A2-16 Checking Valve Spring Installed Height

TORSIONAL DAMPER

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber sleeve. The removal and installation procedures (with proper tools) must be followed or movement of the inertia weight section the hub will destroy the tuning of the torsional damper and the engine timing reference.

Removal

1. Disconnect battery negative cable at battery.
2. Remove serpentine drive belt.
3. Raise vehicle.
4. Remove drive pulley and remove damper retaining bolt.
5. Install Tool J-23523 on damper and then turning puller screw, remove damper.

Installation

1. Coat front cover seal contact area (on damper) with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:
   a. Install Tool J-29113 into crankshaft so that at least 6mm of thread engagement is obtained.
   b. Pull damper into position and remove tool from damper.
4. Install drive pulley and damper retaining bolts. Torque to specifications.
5. Lower vehicle.
6. Install serpentine belt.
7. Connect battery negative cable.

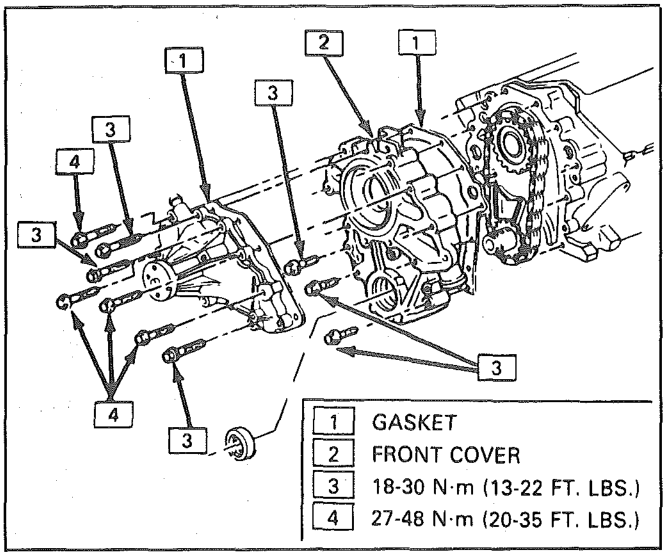


Figure 6A2-17 Water Pump/Front Cover Orientation

CRANKCASE FRONT COVER

Removal

1. Raise engine.
2. Remove oil pan.
3. Lower vehicle.
4. Remove water pump as outlined in Section 6B.
5. If A/C equipped, remove compressor from mounting bracket and lay aside. Then remove compressor mounting bracket.
6. Remove torsional damper as previously outlined.
7. Disconnect lower radiator hose at front cover and heater hose at water pump.
8. Remove remaining front cover bolts and remove cover.

Installation

1. Install new gasket. When installing new gasket, be sure sealing surfaces are clean. Care should be taken not to damage sealing surfaces.
2. Place front cover on the engine, install stud bolt and bolts, install water pump as outlined in Section 6B, install retaining bolts and nut and torque to specifications.
3. Connect lower radiator hose to front cover. Torque clamps to 3.5 N·m (30 lb. in.).
4. Install torsional damper as previously outlined.
5. Install water pump as outlined in Section 6B.
6. If A/C equipped, install compressor mounting bracket and install compressor.
7. Raise vehicle.
8. Inspect oil pan gasket replace if necessary.
9. Install oil pan.
10. Lower vehicle.
11. Install serpentine belt.
12. Fill cooling system. Leave radiator cap off.
13. Connect battery negative cable and start engine.
14. Run engine until upper radiator hose becomes hot (thermostat open).
15. Check coolant level and add as necessary.
16. Install radiator cap, making sure arrows on cap line up with overflow tube.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screw driver.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042. Support cover at seal area. Pre-lube seal with engine oil prior to installation of torsional damper.

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screw driver, being careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042.

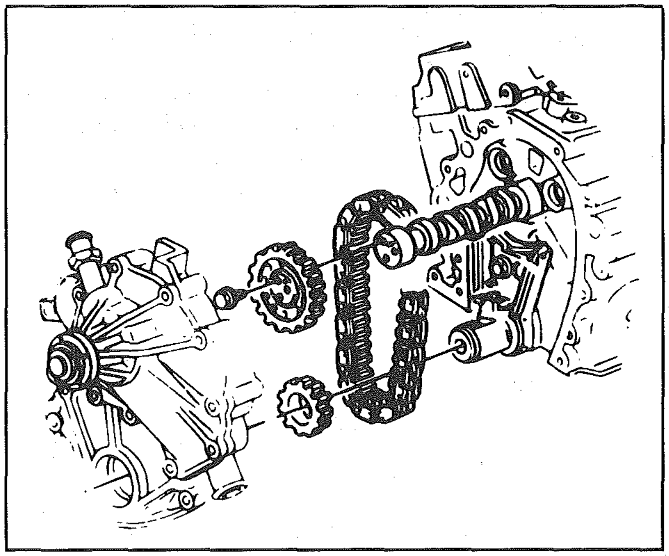


Figure 6A2-18 Timing Chain and Sprockets

TIMING CHAIN AND SPROCKET

Removal

1. Remove crankcase front cover as previously outlined.
2. Place #1 piston at top dead center with the marks on the camshaft and crankshaft sprockets aligned (#4 firing).
3. Remove camshaft sprocket bolts and remove camshaft sprocket and chain (Figure 6A2-18). Sprocket is a light fit on camshaft. If sprocket does not come off easily, a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.

Installation

1. Install timing chain on camshaft sprocket, lube thrust surface with Molykote or its equivalent. Hold the sprocket vertically with the chain hanging down and align the marks on the camshaft and crankshaft sprockets. (Refer to Figure 6A2-19).

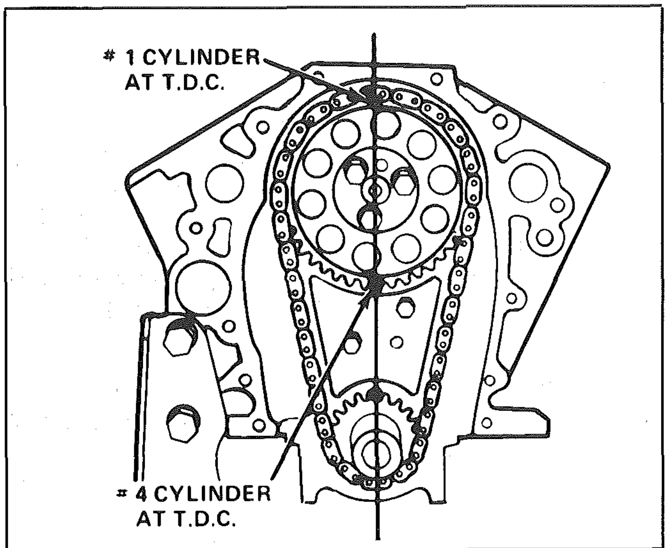


Figure 6A2-19 Camshaft Timing

2. Align dowel in camshaft with dowel hole in camshaft sprocket, then install sprocket on camshaft.
3. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
4. Lubricate timing chain with engine oil.
5. Install crankcase front cover as previously outlined.

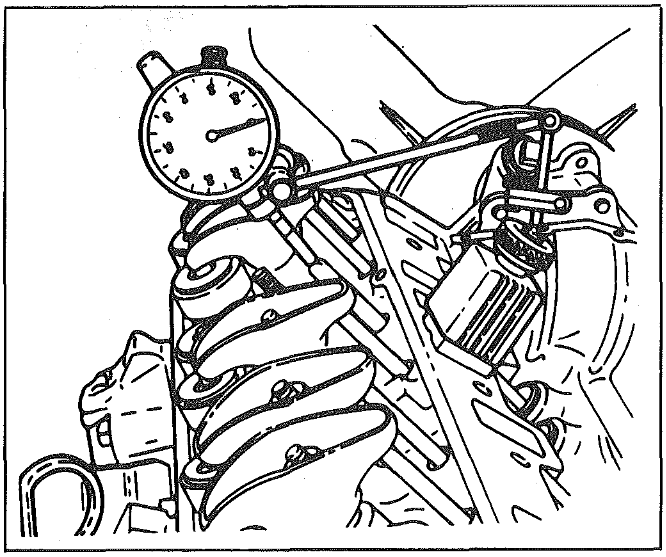


Figure 6A2-20 Measuring Camshaft Lobe Lift

CAMSHAFT

Measuring Lobe Lift Procedure is similar to that used for checking valve timing. If improper valve operation is indicated, measure the lift of each push rod in consecutive order and record the readings.

1. Remove the valve mechanism, as previously outlined.
2. Position indicator with ball socket adapater (Tool J-8520) on push rod. Make sure push rod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod is in its lowest position.
4. Set the dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is in the fully raised position (Figure 6A2-20).

   CAUTION: Whenever the engine is cranked remotely at the starter, with a special jumper cable or other means, the distributor primary lead must be disconnected from the coil to prevent electrical shock.
5. Compare the total lift recorded from the dial indicator with the specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism, as previously outlined.

Removal

1. Remove valve lifters as previously outlined.
2. Remove crankcase front cover as previously outlined.
3. Remove fuel pump and push rod.
4. Remove timing chain and sprocket as previously outlined.
5. Remove camshaft.

NOTICE: All camshaft journals are the same diameter and care must be exercised in removing camshaft to avoid damage to bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .025mm out-of-round, the camshaft should be replaced.

Installation

Whenever a new camshaft is installed, coat camshaft lobes with GM E.O.S. or equivalent.

Whenever a new camshaft is installed, install new oil, new filter and replacement of all valve lifters is recommended to insure durability of the camshaft lobes and lifter feet.

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain, as previously outlined.
3. Install fuel pump push rod and fuel pump.
4. Install crankcase cover, as previously outlined.
5. Install lifters, as previously outlined.
6. Complete build up of engine.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced while engine is disassembled for overhaul or without complete disassembly of the engine. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of

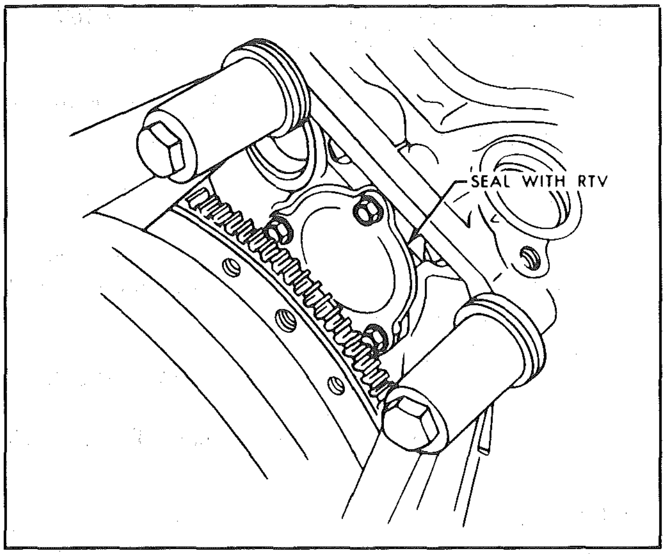


Figure 6A2-21 Camshaft Rear Cover

connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, remove camshaft rear cover from cylinder block (Figure 6A2-21).
2. Using Tool J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from bore, remove remover and installer tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block.

Installation

1. Assemble remover and installer tool on driver handle and install camshaft bearings.
2. Using Tool Set J-6098, with nut then thrust washer installed to end of threads, index pilot in camshaft bearing and install puller screw through pilot.
3. Index camshaft bearing in bore with oil hole aligned at 2:30 o'clock on rear and intermediate bearing. Front bearing has oil holes at 1:00 o'clock and 2:30.
4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner.
6. Install the camshaft rear cover after applying a fresh 3mm diameter (1/8") bead of RTV, #1052917 or equivalent. Apply RTV or equivalent on engine block in machined groove. Sealant must be wet to touch when bolts are torqued.

NOTICE: Prior to rear cover installation check that the sealing surfaces on the cover and block are clean or free of oil. Be sure that all loose RTV is removed. Make sure that old RTV is removed from block groove and blind attaching holes.

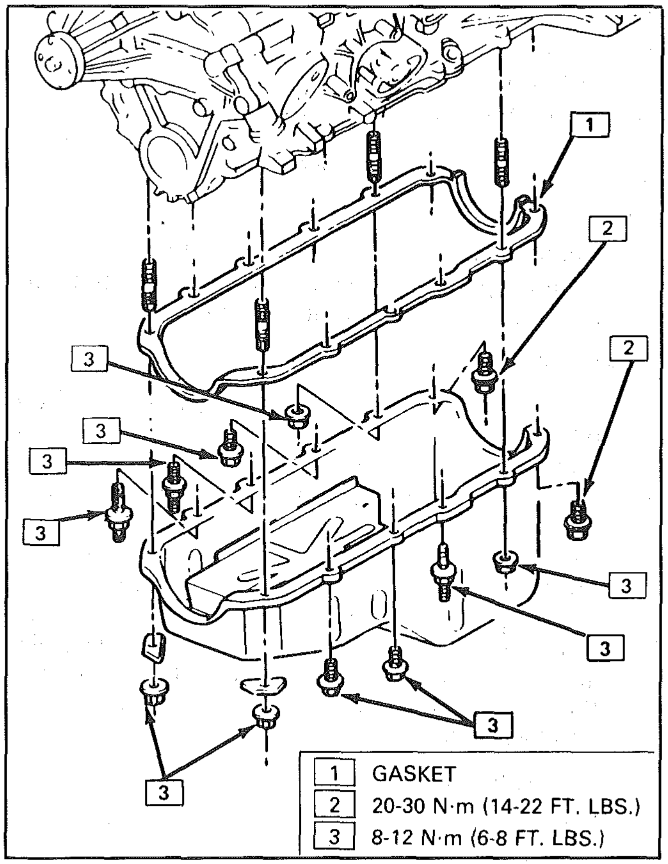


Figure 6A2-22 Oil Pan

OIL PAN (FIGURE 6A2-22)

Removal

1. Disconnect battery negative cable.
2. Remove air cleaner.
3. Remove distributor cap and lay aside.
4. Remove upper half of fan shroud.
5. Raise vehicle.
6. Drain engine oil.
7. Remove converter dust cover.
8. Remove exhaust pipe at manifolds.
9. Remove starter bolts and lay starter aside.
10. Remove motor mount through bolts.
11. Remove oil pan bolts.
12. Install jack and raise engine.
13. Remove oil pan.

Installation

1. Clean sealing surfaces on cylinder case and oil pan.
2. Install gasket and attach retaining bolts.
3. Remove jack and lower engine.
4. Install motor mount through bolts.
5. Install starter.
6. Install exhaust pipes.
7. Install converter dust cover.
8. Lower vehicle.
9. Install fan shroud.
10. Install distributor cap.
11. Refill crankcase.
12. Install air cleaner.
13. Connect battery.
14. Start engine, check for leaks.

OIL PUMP (FIGURE 6A2-22)

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly

1. Remove the pump cover attaching bolts and the pump cover. Mark gear teeth so they may be reassembled with the same teeth indexing.
2. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin pressure regulator spring and valve.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump cover. Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear. The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen or pipe.
7. Check the pressure regulator valve for fit.

Assembly

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to outside diameter of swaged end of pipe, and using Tool J-8369 tap the pipe in place with a plastic hammer.

NOTICE: Be careful of twisting, shearing or collapsing pipe while installing in pump.

2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body in the original orientation.
5. Install cover gasket.
6. Install the pump cover and torque attaching screws to specifications.
7. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft with retainer to rear main bearing cap, aligning top end of hexagon extension shaft with hexagon socket lower end of distributor drive gear.
2. Install pump to rear bearing cap bolt and torque to specifications.
3. Install oil pan as previously outlined.

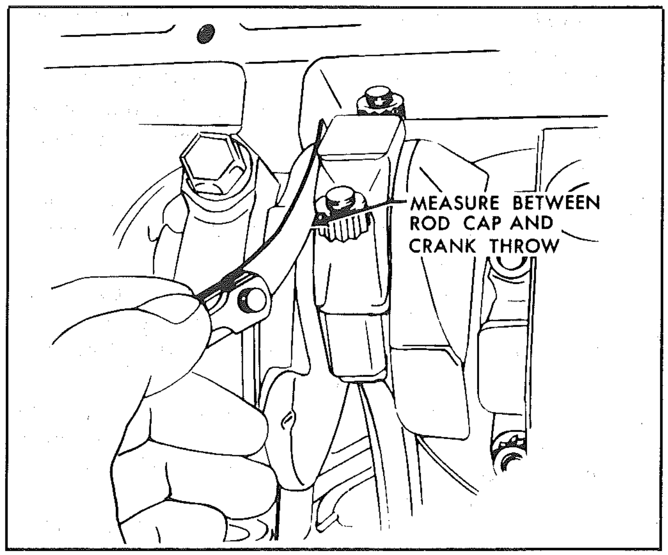


Figure 6A2-23 Measuring Connecting Rod Side Clearance

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive, a new bearing will be required. Service bearings are available in standard size and .013mm and .026mm undersize for use with new and used standard size crankshafts.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be reinstalled.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications, replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin, to determine new bearing size required.
5. If within specifications, measure new or used bearing clearance with Plastigage or its equivalent.

NOTICE: If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .025mm interference between the bearing and crankpin will result in a rapid bearing failure.

   a. Place a piece of gaging plastic the full width of the crankpin as contacted by the bearing (parallel to the crankshaft).
   b. Install the bearing in the connecting rod and cap.
   c. Install the rod cap and evenly torque nuts to specifications. Do not turn the crankshaft with gaging plastic installed.
   d. Remove the rod cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point.

6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

   If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.

7. Coat the bearing surface with oil, install the rod cap and torque nuts to 50 N·m (37 lb. ft.).
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between the rod cap and crankshaft throw (Figure 6A2-23).

MAIN BEARINGS (FIGURE 6A2-24)

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half of a standard insert with one half of a .016mm undersize insert which will decrease the clearance .008mm from using a full standard bearing.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection, the lower half is suitable for use, it can be assumed that the upper half

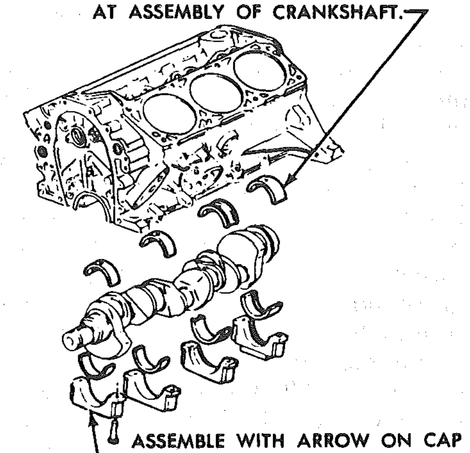


Figure 6A2-24 Main Bearings

is also satisfactory. Of the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent), a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft should be supported both front and rear to remove the clearance from the upper bearing. The toal clearance can then be measured between the lower bearing and journal. When checking #1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.

NOTICE: To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, prior to checking the bearing fit, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal. Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.
3. Install the bearing cap and evenly torque the retaining bolts to 95 N·m (70 lb. ft.). Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.

4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.
5. On the edge of gaging plastic envelope, there is a graduated scale which is correlated in thousandths of a millimetre. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope. Normally, main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round (.025mm max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .025mm, interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .025mm difference.
6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.
7. A standard, .016mm and .032mm undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing. After selecting new bearing, recheck clearance.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the #3 main bearing with a feeler gage (Figure 6A2-25).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

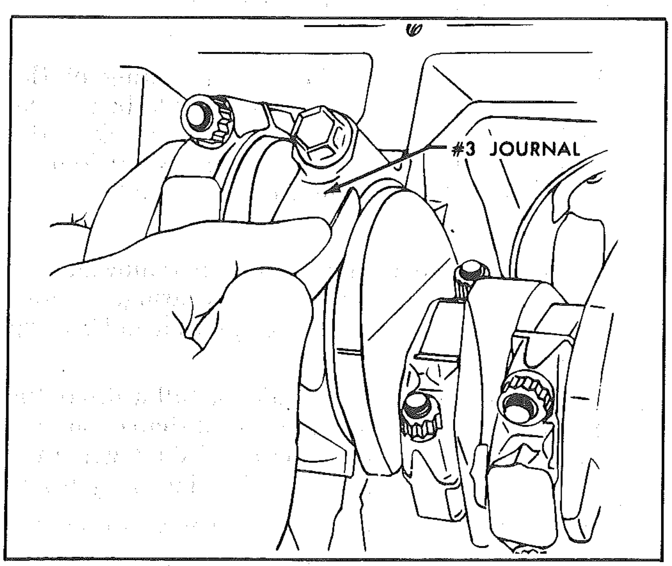


Figure 6A2-25 Measuring Crankshaft End Play

Replacement

Main bearings may be replaced with or without removing the crankshaft.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block. Rotate the bearing into place and remove tool from oil hole in crankshaft journal. Inspect for burrs at oil hole, remove if required.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE #3 MAIN CAP, to 95 N·m (70 lb. ft.). Torque #3 main bearing cap to 15 N·m (11 lb. ft.) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to 95 N·m (70 lb. ft.).

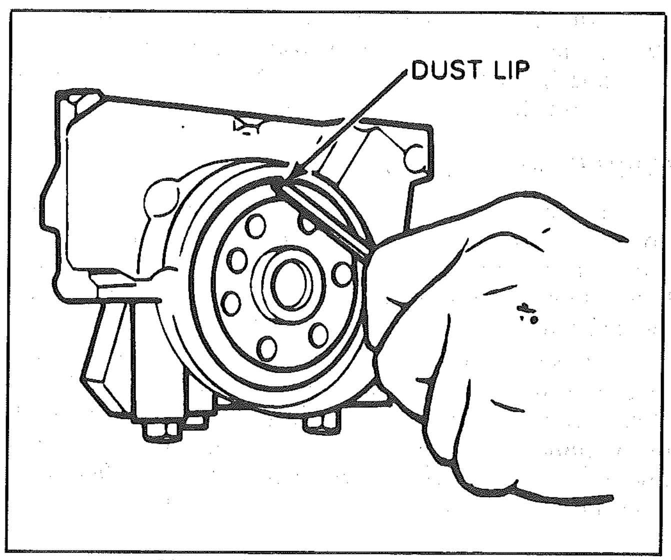


Figure 6A2-26 Removing Seal

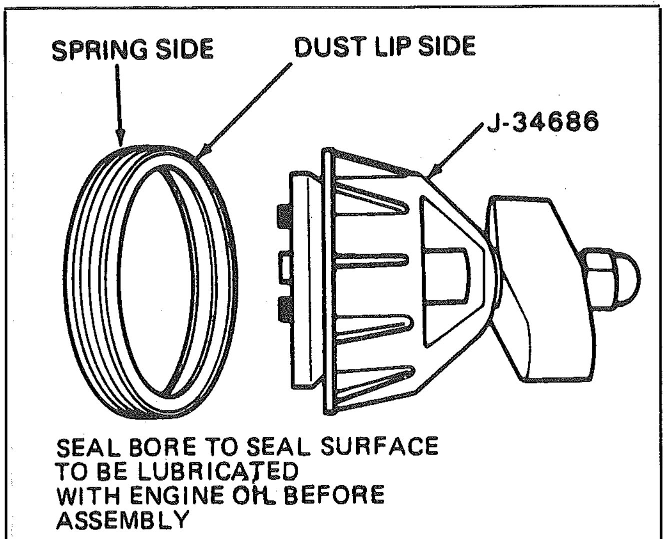


Figure 6A2-27 Seal and Tool J-34686

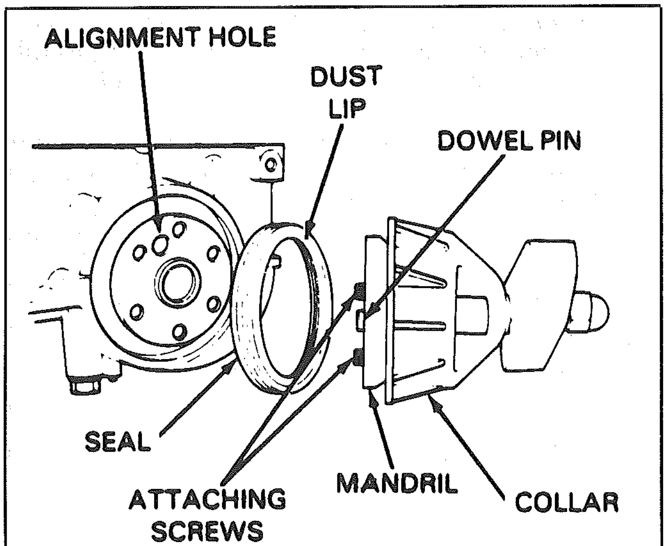


Figure 6A2-28 Installing Seal

OIL SEAL - REAR MAIN

Repair

1. Remove transmission.
2. Remove flexplate.
3. Old seal, insert a screwdriver or similar tool through the dust lip at an angle as shown in Figure 6A2-26. Pry seal out by moving handle of tool towards the end of the crankshaft. Repeat as required around the seal until seal is removed. **CARE MUST BE TAKEN NOT TO DAMAGE THE CRANKSHAFT O.D. SURFACE WITH THE PRY TOOL.**
4. Check the I.D. of bore for knicks or burrs and correct as required. Inspect crankshaft for burrs or knicks on surface which contacts seal. Repair or replace crankshaft as required.
5. Install new seal using Tool J-34686, Figure 6A2-27.
6. Apply a light coat of oil to I.D. of new seal and install over mandril, slide the seal on the mandril until the dust lip (back of seal) bottoms squarely against collar of tool, Figure 6A2-28.
7. Align dowel pin of tool with dowel pin hole in crankshaft and attach tool to crankshaft by hand or torque attaching screw to 2-5 ft. lbs.
8. Turn "T" handle of tool so that collar pushes seal into the bore, turn handle until the collar is tight against the case. This will insure that the seal is seated properly.
9. Loosen the "T" handle of the tool until it comes to a stop. This will insure that the collar will be in the proper position for installing a new seal. Remove attaching screws.
10. Check seal, making sure seal is seated squarely in the bore.
11. Install flywheel.
12. Install transmission.
13. Start engine, check for leaks.

PISTONS, RINGS AND CONNECTING RODS

Removal

1. Remove cylinder heads.
2. Examine the cylinder bores above the ring tavel. If bores are worn so that a shoulder or ridge exists at the top of the cylinder, remove the ridges with a ridge reamer to avoid damaging rings or cracking ring lands in pistons during removal.
3. Use a silver pencil or quick drying paint to mark the cylinder number on all pistons, connecting rods and caps. Starting at the front end of the crankcase the cylinders in the right bank are numbered 1-3-5 and those in the left bank are number 2-4-6.
4. Remove rod bearing cap and bearing.
5. Install guide hose over threads of rod bolts. This is to prevent damage to bearing journal and rod bolt threads.
6. Remove rod and piston assembly through the top of the cylinder bore.

Disassembly

1. Remove compression rings and oil ring.
2. Install piston and connecting rod assembly on fixture and support J-24086-20 and place in an arbor press. Press pin out of connecting rod.

Inspection

1. Inspect cylinder walls for scoring, roughtness, or ridges which indicate excessive wear. Check cylinder bores for taper and out-of-round with an accurate cylinder gage at top, middle and bottom of bore, both parallel at right angles to the cylinder bores at any point may be measured with an inside micrometer or setting the cylinder gage dial at "O" and measuring across the gage contact points with outside micrometer while the gage is at same "O" setting.
2. If a cylinder bore is moderately rough or slightly scored but is not out-of-round or tapered, it is usually possible to remedy the situation by honing the bore to fit a standard service piston since standard service pistons are high limit production pistons. If cylinder bore is very rough or deeply scored, however, it may be necessary to

rebore the cylinder to fit an oversize piston in order to insure satisfactory results.

3. If cylinder bore is tapered 0.1mm or more or is out-of-round 0.1mm or more, it is advisable to rebore for the smallest possible oversize piston and rings. Below these limits, the cylinder bore can be trued up with honing.
4. Clean carbon from piston surfaces and under side of piston heads. Clean carbon from ring grooves with suitable tool and remove any gum or varnish from piston skirts with suitable solvent.
5. Carefully examine pistons for rough or scored surfaces; cracks in skirt or head; cracked or broken ring lands; chipped or uneven wearing pistons would cause rings to seat improperly or have excessive clearance in ring grooves. Damaged or faulty pistons should be replaced. The pistons are cam ground, which means that the diameter at a right angle to the wrist pin is greater than the diameter parallel to the wrist pin. When a piston is checked for size, it must be done at points 90° to the piston pin. The piston should be checked (for fitting purposes) in a plane through the piston pin centerline.
6. Inspect surfaces of wrist pins and check for wear by measuring worn or unworn surfaces with micrometers. Occasionally pins will be found tight due to gum or varnish deposits. This may be corrected by removing the deposit with a suitable solvent. If piston bosses are worn out-of-round or oversize, the piston and pin assembly must be replaced. Oversize pins are not practical due to the pin being a press fit in the connecting rod. Piston pins must fit the piston with an easy finger push at 70°F (21°C) (.0065 to .0091mm clearance).
7. Examine all piston rings for scores, chips or cracks. Check compression rings for tension by comparing with new rings. Check gap of compression rings by placing rings in bore at bottom of ring travel. Measure gap with feeler gage. Gap should be between 0.25mm and 0. 50mm. If gaps are excessive (over 0.50mm) it indicates the rings have worn considerably and should be replaced. Bore wear should be checked before rings are replaced, .125mm bore wear will result in .39mm increase in ring gap.

Assembly

There is a machined hole or a cast notch in the top of all pistons to facilitate proper installation. The piston assemblies should always be installed with the hole toward the front of the engine (Figure 6A2-29).

1. Lubricate piston pin holes in piston and connecting rod light with engine oil.
2. Position conncecting rod in its respective piston. Hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly J-24086-20.
3. Press the piston pin into the piston and connecting rod.

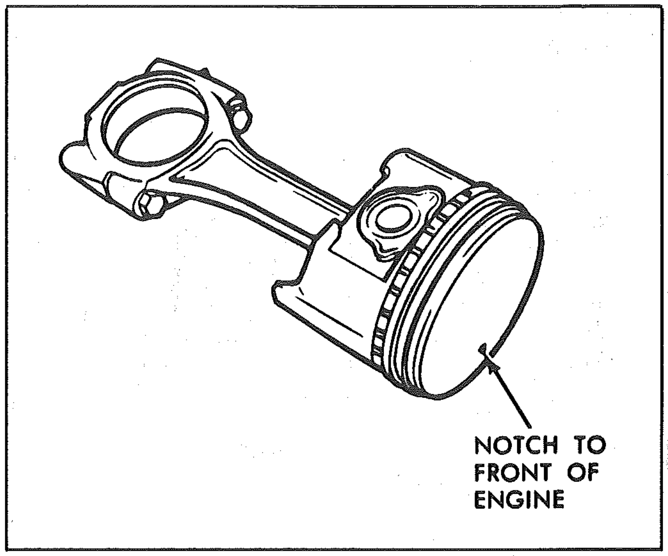


Figure 6A2-29 Piston

NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston pin for freedom of movement on piston.

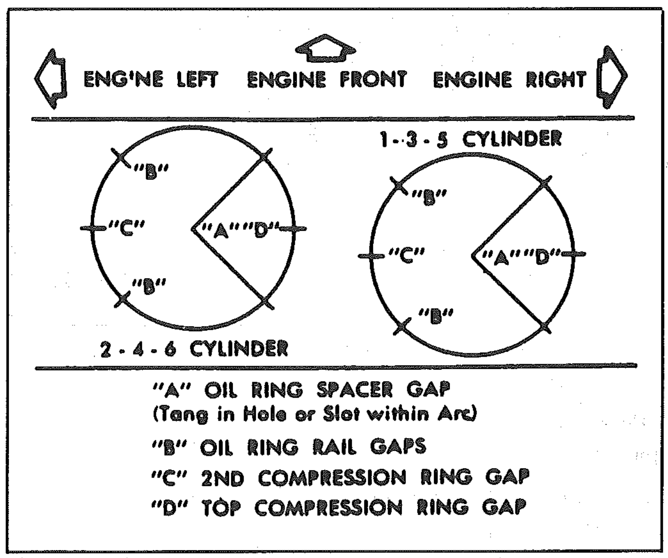


Figure 6A2-30 Ring Gap Locations

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.
2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install guide hose over connecting rod bolts. These guide hoses protect the crankpin journal from damage during installation of connecting rod and piston assembly.

4. Make sure the gap in the oil ring rails are in "up" position toward center of engine and the gaps of the compression rings are positioned as shown in Figure 6A2-30.
5. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 or J-8910 to compress the rings. Guide the connecting rod into place on the crankshaft journal.
   Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
6. Install the bearing caps and torque nuts to specifications. If bearing replacement is required refer to "Connecting Rod Bearings".
   Be sure to install new pistons in the same cylinders for which they were fitted, and used pistons in the same cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine.
   On V-6 engines, 1,3 and 5 are in the right bank and 2, 4 and 6 are in the left bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

2.8 LITER V-6
SERVICE PISTONS

TYPE	CODE	SIZE
STD.	S4	89.001-89.014
	S5	89.014-89.027
HI LIMIT	S6	89.027-89.040
	S7	89.040-89.053
.50 O. S.	1	89.501-89.514
	2	89.514-89.527
	3	89.527-89.540
	4	89.540-89.553
1.0 O. S.	1	90.001-90.014
	2	90.014-90.027
	3	90.027-90.040
	4	90.040-90.053

NOTE: All dimensions are in millimetres.

Figure 6A2-31 Service Pistons

HONING OR REBORING CYLINDERS (FIGURE 6A2-32)

If one or more cylinder bores are rough, scored or worn beyond limits, it will be necessary to smooth or true up such bores to fit new pistons.

If relatively few bores require correction, it will not be necessary to rebore all cylinders to the same oversize in order to maintain engine balance. All oversize service pistons (Figure 6A2-31) are held to the same weights as standard size pistons.

HONED SURFACE

1. Cross Hatch Angle 20° - 32°
2. Uniformly Cut in Both Directions
3. Clean Cut Not Sharp Free of Torn and Folded Metal
4. Micro Ave. 10-20 Micro In. (0.25-0.30 micrometers) Range 10-15 micro in. (0.25-0.38 micrometers)
5. Cross Hatch Ave. .0004"-.0006" Wide Range .0002"-.0009"
6. Cross Hatch Ave. .00015"-.00025" Deep Range .0001"-.0003"
7. Plateau to be 1/2 to 2/3 of Surface
8. Free of Burnish or Glaze
9. Free of Imbedded Particles

Figure 6A2-32 Honing Specifications

No attempt should be made to cut down oversize pistons to fit cylinder bores as this will destroy the surface treatment and affect the weight. The smallest possible oversize service pistons should be used and the cylinder bores should be honed to size for proper clearances.

Before the honing or reboring operation is started, measure all new pistons with micrometer contacting at points exactly 90 degrees from piston pin centerline then select the smallest piston for the first fitting. The slight variation usually found beween pistons in a set may provide for correction in case the first piston is fitted too free.

If wear at top of cylinder does not exceed 0.10 mm on the diameter or exceed 0.10mm out-of-round, honing is recommended for truing the bore. If wear or out-of-round exceeds these limits, the bore should be trued up with a boring bar of the fly cutter type, then finish honed.

When reboring cylinders, all crankshaft bearing caps must be in place and tightened to proper torque to avoid distortion of bores in final assembly. Always be sure the crankshaft is out of the way of the boring cutter when boring each cylinder. When taking the final cut with boring bar, leave .025mm on the diameter for finish honing to give the required clearance specified.

When honing cylinders, use clean sharps tones of proper grade for the amount of metal to be removed, in accordance with instructions of the hone manufacturer. Dull or dirty stones cut unevenly and generate excessive heat. When using coarse or medium grade stones use care to leave sufficient metal so that all stone marks may be removed with the fine stones used for finishing to provide proper clearance.

It is of the greatest importance that refinished cylinder bores are trued up to have not over .02mm out-of-round or taper. Each bore must be final honed to remove all stone or cutter marks and provide a smooth surface. During final honing, each piston must be fitted individually to the bore in which it will be installed and should be marked to insure correct installation.

After final honing and before the piston is checked for fit, each cylinder bore must be thoroughly washed to remove all traces of abrasives and then dried thoroughly. The dry bore should then be brushed clean with a power-driven fibre brush. If all traces of the abrasives are not removed, rapid wear of new pistons and rings will result.

FITTING PISTONS

1. Remove all rings from pistons which will be fitted. It is not necessary to separate rods from pistons. If an excess amount of varnish or carbon appears as a ridge at the top of the cylinder, remove by scraping or sanding.
2. Wipe bores and pistons clean, removing oil or other foreign material. Select a piston-rod assembly for the bore to be fitted (or piston and pin if a new piston is being fitted) and position down into the bore with the top of piston down. The piston should fall free by its own weight through the bore when when the bottom of the piston skirt is 12 to 25mm from top of block.

   Caution must be used to insure piston is not damaged when it "falls" through the cylinder. If it does not, the piston fit is too tight and another piston should be selected until the piston will slide freely through the bore without any force being applied. Mark piston and bore for proper assembly.
3. After a piston has been slected, which will slide freely through a bore, it must be determined if piston fit will be too loose. This is done by placing a .060 mm feeler gage for used pistons and a .050 mm feeler gage for new pistons at least 150mm long and not over 12mm wide, down into the same bore with selected piston while holding feeler to top of the bore.

   Position selected piston and feeler down into the bore until the bottom of the skirt is again 12 to 25 mm from top of block, being sure that the feeler gage is 90° from the pin. If the piston hangs on the feeler gage and does not fall free, it indicates that the piston is correctly fitted to that respective bore. Mark both piston and bore before going to the next bore. If the piston fell free during this check with the .060mm feeler gage (. 050mm feeler gage for new pistons) then that particular piston is too small for the bore and a larger diameter piston will be required.

   When checking more than one bore, it is very possible that what may be a piston too small for one bore will be a correct fit in another.

PISTON RINGS

When new piston rings are installed without reboring cylinders, the glazed cylinder walls should be slightly dulled, but without increasing the bore diameter, by means of the finest grade of stones in a cylinder hone.

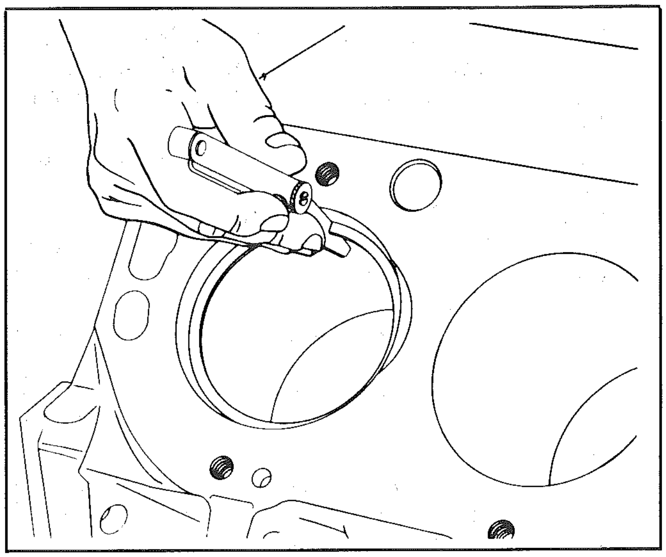


Figure 6A2-33 Measuring Ring Gap

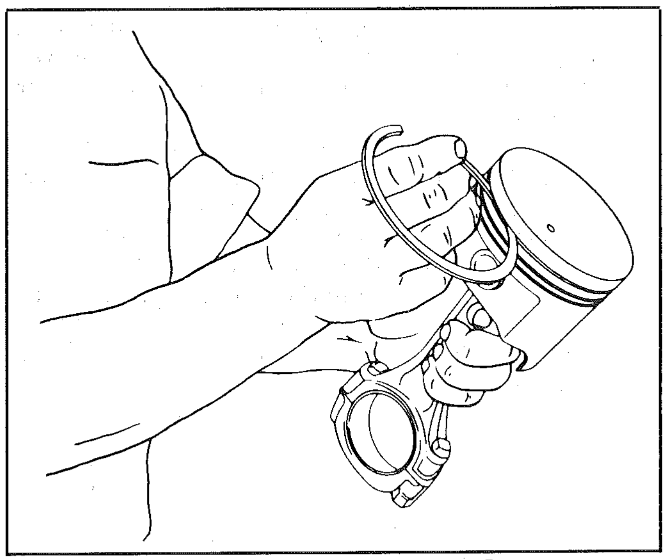


Figure 6A2-34 Checking Ring In Groove

New piston rings must be checked for clearance in piston grooves and for gap in cylinder bores. The cylinder bores and piston grooves must be clean, dry and free of carbon and burrs.

With rings installed, check clearance in grooves by inserting feeler gages between each ring and its lower land because any wear that occurs forms a step at inner portion of the lower land.

If the piston grooves have worn to the extent that relatively high steps exist on the lower lands, the piston should be replaced because the steps will interfere with the operation of new rings and the ring clearances will be excessive. Piston rings are not furnished in oversize widths to compensate for ring groove wear.

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the marked side is toward the top of the piston. The top ring is treated with molybdenum for maximum life.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

Fitting

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 6mm above ring travel. Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (Figure 6A2-33).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.
7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Figure 6A2-34). If binding occurs at any point, the cause should be determined. If there is a ring groove, remove by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.

Installation

1. Install oil ring spacer in groove being sure ends are butted and not overlapped.
2. Hold spacer ends butted and install lower steel oil ring rail.
3. Install upper steel oil ring rail with gap staggered.
4. Flex the oil ring assembly to make sure ring is free. If binding occurs, the cause should be detemined. If caused by ring groove, remove by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
5. Install second compression ring. Stagger gap from other rings.
6. Install top compression ring with gap properly located.

ENGINE ASSEMBLY

Removal

1. Disconnect battery.
2. Remove air cleaner.
3. Remove hood.
4. Drain radiator.
5. Remove lower radiator hose.
6. Remove upper fan shroud.
7. Remove upper radiator hose and coolant recovery hose.
8. Remove transmission cooler lines.
9. Remove radiator.
10. Remove fan assembly.
11. Remove heater hoses.
12. Disconnect carburetor linkage, includes cruise control detent cable.
13. Remove vacuum brake booster line.
14. Remove distributor cap and lay wiring aside.
15. Disconnect necessary wires and hoses.
16. Remove power steering pump and lay aside.
17. Raise vehicle.
18. Remove exhaust pipes at exhaust manifold.
19. Remove dust cover.
20. Remove converter bolts.
21. Disconnect starter wires.
22. Remove bell housing bolts.
23. Remove motor mount through bolts.
24. Disconnect fuel lines at fuel pump.
25. Lower vehicle.
26. Support transmission.
27. Remove A.I.R./Converter pipes bracket.
28. Remove engine, include removing wire from bracket at rear left of engine.

Installation

1. Position engine assembly in vehicle.
2. Attach motor mount to engine brackets and lower engine in place.
3. Remove engine lifting device.
4. Remove transmission floor jack.
5. Raise vehicle on hoist.
6. Install mount "through" bolts. Torque to specifications.
7. Install bell housing bolts. Torque to specifications.
8. On vehicles with automatic transmission, install converter to flywheel attaching bolts. Torque to specifications.
9. Install flywheel splash shield of conveter housing cover as applicable. Torque attaching bolts to specifications.
10. Install starter wires.
11. Connect fuel lines.
12. Connect exhaust pipe at manifold.
13. Lower vehicle on hoist.
14. Reinstall power steering pump, if so equipped.
15. Connect necessary wires and hoses.
16. Install radiator and fan shroud and reconnect radiator and heater hoses.
17. Fill cooling system.
18. Fill crankcase with oil. See owner's manual for specifications.
19. Install air cleaner.
20. Install hood.
21. Connect battery cables.

NOTICE: To avoid possible arcing of battery, connect positive battery cable first.

22. Start engine, check for leaks and check timing.

CRANKSHAFT

The crankshaft can be removed while the engine is dissassembled for overhaul, as previously outlined or without complete disassembly.

Removal

1. With the engine removed from the vehicle, remove the clutch assembly (if equipped) and flywheel. Mount engine in stand and clamp securely.

2. Remove the spark plugs.
3. Remove crankshaft pulley and torsional damper.
4. Remove oil pan and oil pump.
5. Remove water pump, crankcase front cover, camshaft sprocket and timing chain.
6. Check the connecting rod caps for cylinder number identification. If necessary mark them.
7. Remove the connecting rod caps and push the pistons to top of bores.
8. Remove main bearing caps and lift crankshaft out of cylinder block.
9. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize (See Specifications).
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator (See Specifications).
4. Replace or recondition the crankshaft if out of specifications.

Installation

1. Install rear main bearing oil seal in cylinder block and rear bearing cap grooves.
2. Lubricate seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Recheck bearing clearances using plastigage.
6. Apply a thin coat of anaerobic sealant #1052357 or equivalent to rear of the block mating surface or corresponding surface or rear main cap only. Do not allow sealer on crankshaft or seal.
7. Install main bearing caps with arrow pointing toward front of engine.
8. Torque all except #3 main bearing cap bolts to specifications. Torque #3 main bearing cap bolts to 14-16 N·m (10-12 lbs. ft.) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
9. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the #3 main bearing and crankshaft thrust surface.
10. Install flywheel and torque to specifications.

SPROCKET OR GEAR REPLACEMENT

Remove crankshaft sprocket using Tool J-5825, install using Tool J-5590.

GENERAL DATA

TYPE	60° V-6
DISPLACEMENT	2.8 Liter
RPO	LB8
BORE	89
STROKE	76
COMPRESSION RATIO	8.9:1
FIRING ORDER	1-2-3-4-5-6

Cylinder Bore

DIAMETER	88.992-88.070
OUT OF ROUND	.02 Max.
TAPER-THRUST SIDE	.02 Max.

Piston

CLEARANCE	.017-.043

Piston Ring

COMPRESSION	
Groove Clearance	
Top	.030-.070
Second	.040-.095
Gap	
Top	.25-.50
Second	.25-.50
OIL	
Groove Clearance	.0199 Max.
Gap	0.51-1.40

Piston Pin

DIAMETER	22.9937-23.0015
CLEARANCE	.0065-.0091
FIT IN ROD	.0187-.0515 Press

Camshaft

LIFT	
Intake	6.67
Exhaust	6.94
JOURNAL DIAMETER	47.44-47.49
JOURNAL CLEARANCE	.026-.101

Crankshaft

MAIN JOURNAL	
	Diameter All 67.241-67.265mm
Taper	.005 Max.
Out of Round	.005 Max.
MAIN BEARING CLEARANCE	.041-.081
MAIN THRUST BEARING CLEARANCE	.054-.084
CRANKSHAFT END PLAY	.06-.21mm
CRANK PIN	
Diameter	50.784-50.758
Taper	.005 Max.
Out of Round	.005 Max.
ROD BEARING CLEARANCE	.035-.095
ROD SIDE CLEARANCE	.16-.44

Valve System

LIFTER	Hydraulic
ROCKER ARM RATIO	1.5:1
VALVE LASH	1-1/2 Turns From Zero Lash
FACE ANGLE	45°
SEAT ANGLE	46°
SEAT RUNOUT	.05°
SEAT WIDTH	
Intake	1.25-1.50
Exhaust	1.60-1.90
STEM CLEARANCE	.026-.068
VALVE SPRING	
Free Length	48.5
Pressure N·m	
Closed	391 @ 40
Open	867 @ 30
Installed Height	40
DAMPER	
Free Length	47.2

Approx. # of Coils 4

SPECIFICATIONS

Camshaft Sprocket	20-35 N·m, 15-25 ft. lbs.
Camshaft Rear Cover	8-12 N·m, 6-9 ft. lbs.
Connecting Rod Caps	46-60 N·m, 34-45 ft. lbs.
Torsional Damper	90-115 N·m, 67-85 ft. lbs.
Dist. Hold Down Bolt	27-41 N·m, 20-31 ft. lbs.
Exhaust Manifold	25-42 N·m, 19-31 ft. lbs.
Water Pump	
M8x1.25x70.0	18-30 N·m, 13-22 ft. lbs.
M10x1.5x75.0	27-48 N·m, 20-35 ft. lbs.
Thermostat Housing	18-24 N·m, 13-18 ft. lbs.
Inlet Manifold Lower	18-34 N·m, 13-25 ft. lbs.
Inlet Manifold Center	20-30 N·m (15-22 ft. lbs.)
Timing Chain Damper	18-24 N·m, 14-19 ft. lbs.
Rocker Arm Nut	6-14 N·m, 5-11 ft. lbs.
Rocker Arm Covers	8-20 N·m, 7-15 ft. lbs.
Spark Plugs	9.5-20.3 N·m, 7-15 ft. lbs.
Oil Pan	
M8x1.25x14.0	20-30 N·m, 15-22 ft. lbs.
M6x1x16.0	8-12 N·m, 6-9 ft. lbs.
Main Bearing Caps	85-112 N·m, 63-83 ft. lbs.
Oil Pump	35-47 N·m, 25-35 ft. lbs.

SECTION 6A3

5.0 LITER V8 VIN CODE E (L03)
5.0 LITER V8 VIN CODE F (LB9)
5.7 LITER V8 VIN CODE 8 (L98)

CONTENTS

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has 8 cylinders arranged in a "V" shape with 4 cylinders in each bank. 5 main bearings support the crankshaft which is retained by bearing caps that are machined with the block for proper alignment and clearances. Cylinders are completely encircled by coolant jackets.

CYLINDER HEAD

The cast iron cylinder heads feature individual intake and exhaust ports for each cylinder. Valve guides are integral, and rocker arms are retained on individual pressed studs.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings #5 is the end thrust bearing.

Main bearings are lubricated from oil holes which intersect the camshaft bearings. The camshaft bearings are fed oil by the main oil gallery which is rifle drilled down the center of the block, above the camshaft. Two additional oil galleries are on either side of the main oil gallery to provide an oil supply for the hydraulic lifters.

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by 5 bearings and is chain driven. A steel crankshaft sprocket drives the timing chain which in turn drives the camshaft through a cast iron sprocket.

Cam lobes are ground, hardened and tapered with the high side toward the rear. This, coupled with a spherical face on the lifter, causes the valve lifters to rotate.

Camshaft bearings are lubricated through oil holes which intersect the main oil gallery. The main oil gallery is rifle drilled down the center of the block, above the camshaft.

PISTONS AND CONNECTING RODS

The pistons are made of cast aluminum alloy using two compression rings and one oil control ring. Piston pins are offset 1/16" (1.6mm) toward the thrust side (right hand side) to provide a gradual change in thrust pressure against the cylinder wall as the piston travels its path. Pins are Chromium steel and have a floating fit in the pistons They are retained in the connecting rods by a press fit. Connecting rods are made of forged steel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal.

VALVE TRAIN

A very simple ball pivot-type train is used. Motion is transmitted from the camshaft through the hydraulic lifter and push rod to the rocker arm. The rocker arm pivots on its ball and transmits the camshaft motion to the valve. The rocker-arm ball is retained by a nut.

HYDRAULIC VALVE LIFTERS

Hydraulic Valve Lifters are used to keep all parts of the valve train in constant contact.

The hydraulic lifter assembly consists of: a roller, the lifter body, which rides in the cylinder block boss, a plunger, a push rod seat, a metering valve, a plunger spring, a check ball and spring, a check ball retainer and a push rod seat retainer.

When the lifter is riding on the low point of the cam, the plunger spring keeps the plunger and push rod seat in contact with the push rod.

When the lifter body begins to ride up the cam lobe, the check ball cuts off the transfer of oil from the reservoir below the plunger. The plunger and lifter body then rise as a unit, pushing up the push rod and opening the valve.

As the lifter body rides down the other side of the cam, the plunger follows with it until the valve closes. The lifter body continues to follow the cam to its low point, but the plunger spring keeps the plunger in contact with the push rod. The ball check valve will then move off its seat and the lifter reservoir will remain full.

INTAKE MANIFOLD

The intake manifold for those engines with carburetors are made of cast iron or aluminum double level design for efficient fuel distribution. An Exhaust Gas Recirculation (EGR) port is also cast into the manifold for the mixture of exhaust gases with the fuel air mixture.

The intake manifold for those vehicles equipped with PFI is a cast aluminum unit. It centrally supports a fuel rail with 8 fuel injectors.

EXHAUST MANIFOLDS

Two cast iron exhaust manifolds are used to direct exhaust gases from the combustion chambers to the exhaust system. The left hand side manifold receives a heat shield that is used to route heated air to the air cleaner. for better fuel vaporization during warm-up.

COMBUSTION CHAMBERS

Combustion Chambers are cast to insure uniform shape for all cylinders. Spark plugs are located between the intake and exhaust valves. The contoured wedge shape of the combustion chamber minimizes the possibility of detonation, facilitates breathing and provides swirling turbulence for smooth, complete combustion.

ENGINE LUBRICATION

Full pressure lubrication through a full flow oil filter, is furnished by a gear-type oil pump. The distributor, driven by a helical gear on the camshaft, drives the oil pump. The main oil gallery feeds oil, through drilled passages, to the camshaft and crankshaft to lubricate the bearings. The valve lifter oil gallery feeds the valve lifters which, through hollow push rods, feed the individually mounted rocker arms.

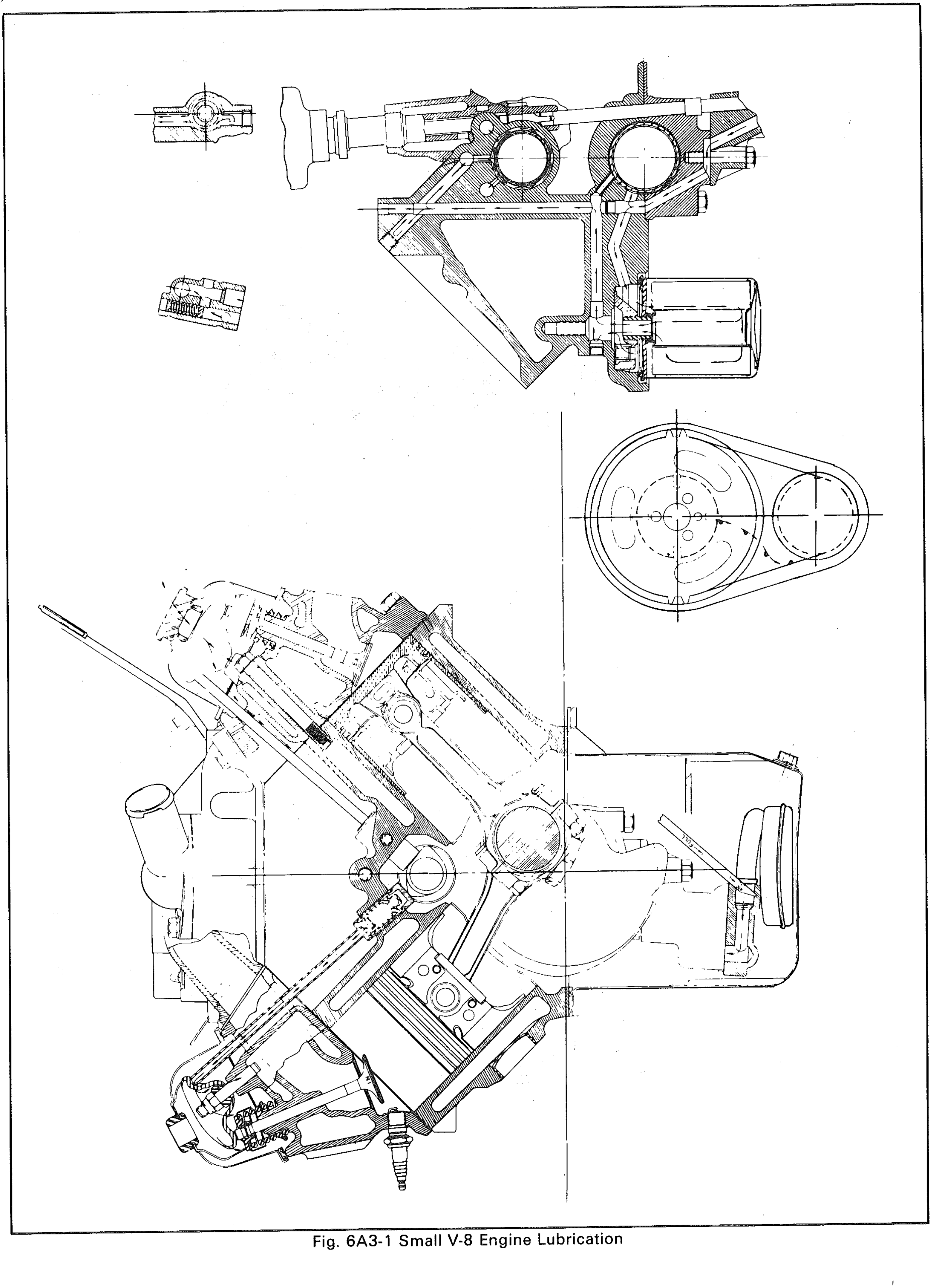


Fig. 6A3-1 Small V-8 Engine Lubrication

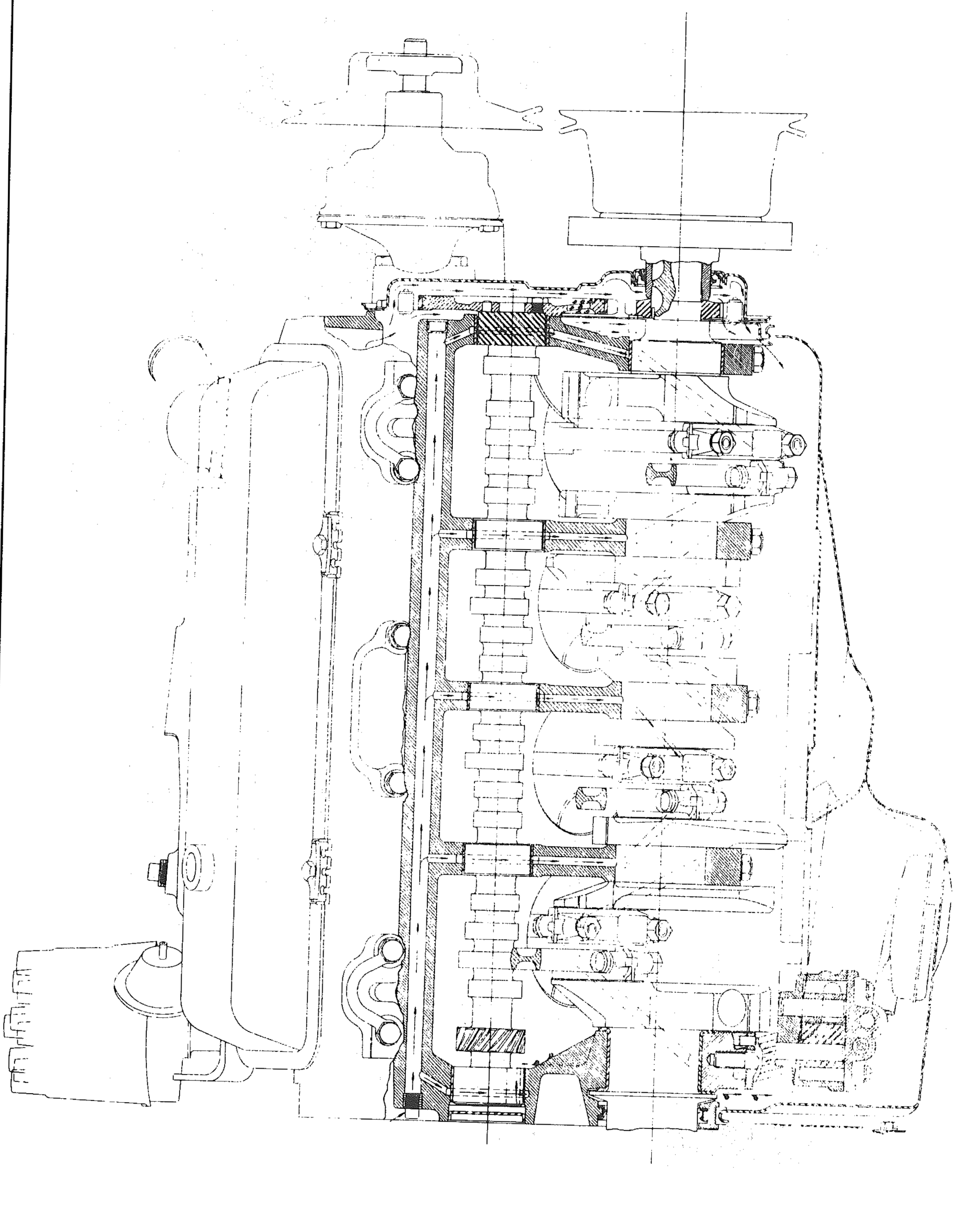


Fig. 6A3-2 Small V-8 Engine Lubrication

ON-VEHICLE SERVICE

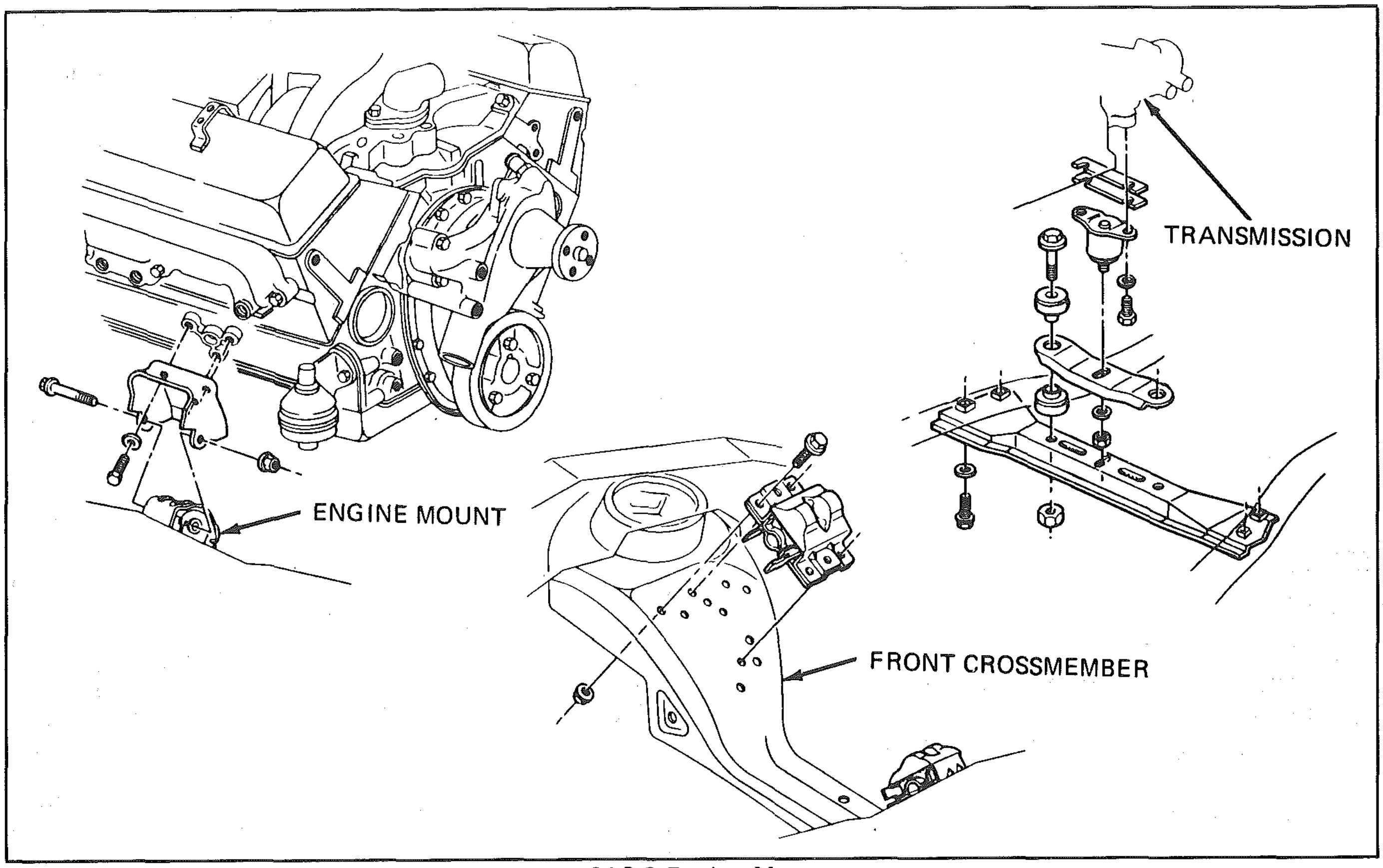


Fig. 6A3-3 Engine Mounts

POWERTRAIN MOUNTS

Engine mounts (fig. 6A3-3) are the non-adjustable type and seldom require service. Broken or deteriorated mounts should be replaced immediately, because of the added strain placed on other mounts and drive line components.

Checking Engine Mounts

Front Mount

Raise the engine to remove weight from the mounts and to place a slight tension in the rubber. Observe both mounts while raising engine. If an engine mount exhibits:

a. Hard rubber surface covered with heat check cracks;
b. Rubber separated from a metal plate of the mount;
c. Rubber split through center

replace the mount. If there is relative movement between a metal plate of the mount and its attaching points, lower the engine on the mounts and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

Rear Mount

Raise the vehicle on a hoist. Push up and pull down on the transmission tailshaft while observing the transmission mount. If the rubber separates from the metal plate of the mount or if the tailshaft moves up but not down (mount bottomed out) replace the mount. If there is relative movement between a metal plate of the mount and its attaching point, tighten the screws or nuts attaching the mount to the transmission or crossmember.

Front Mount Replacement

1. Remove mount retaining bolt from below frame mounting bracket.
2. Raise front of engine and remove mount-to-engine bolts and remove mount. Raise engine only enough for sufficient clearance. Check for interference between rear of engine and cowl panel.
3. Replace mount to engine and lower engine into place.
4. Install retaining bolt and torque all bolts to specifications.

Rear Mount Replacement

1. Support transmission weight to relieve rear mounts.
2. Remove crossmember-to-mount nuts.
3. Remove mount-to-transmission bolts, raise transmission, then remove mount.
4. Install new mount on transmission.
5. While lowering transmission, align mount to crossmember.
6. Torque bolts to specifications.

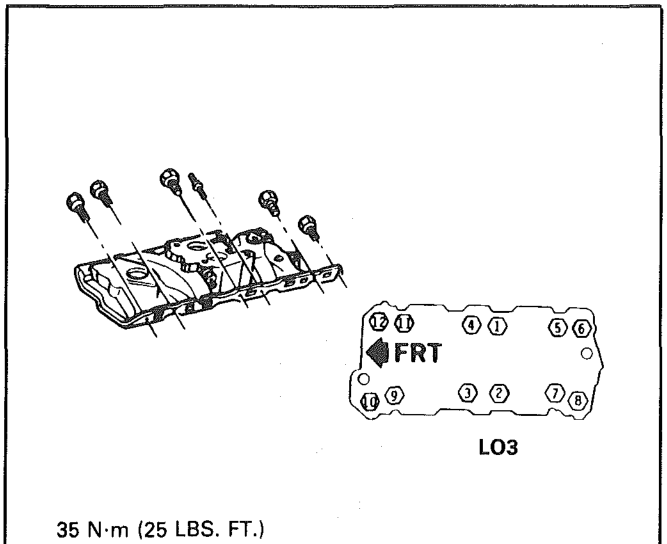


Fig. 6A3-4 Intake Manifold Installation (LO3)

INTAKE MANIFOLD

Removal (TBI)

1. Disconnect battery negative cable.
2. Drain radiator and remove air cleaner.
3. Disconnect:
   - Radiator upper hose and heater hose at manifold.
   - TBI linkage.
   - Fuel lines
   - Spark plug wires (right side).
   - Necessary wires and hoses.
4. Remove distributor cap and mark rotor position with chalk, then remove distributor.
5. Remove (as required) air compressor and brackets and cruise control servo and bracket.
6. Remove generator upper mounting bracket.
7. Remove EGR solenoids and bracket.
8. Remove vacuum brake line.
9. Remove manifold attaching bolts, then remove manifold, discard gaskets.
10. If manifold is to be replaced, transfer:
    - TBI attaching bolts, where applicable.
    - Thermostat with housing (use new gasket or RTV, as applicable).
    - EGR Valve (use new gasket), where applicable.
    - Necessary switches and fittings.

Installation

1. Clean gasket and seal surfaces on manifold, block, and cylinder heads with degreaser. Remove all RTV that is loose or will cause installation interference.
2. Install gaskets on cylinder heads and place a 3/16" (5mm) bead of RTV, #1052917 or equivalent, on the front and rear ridges of the cylinder case. Extend the bead 1/2" (13mm) up each cylinder head to seal and retain the manifold side gaskets. Use sealer at water passages.
3. Install manifold and torque bolts to specifications in the sequence outlined in fig. 4.
4. Install (if removed) air compressor and bracket, and cruise control servo and bracket.
5. Install distributor, positioning rotor at chalk mark, then install distributor cap.
6. Install generator upper mounting bracket.
7. Install vacuum brake line.
8. Install EGR solenoid and bracket.
9. Connect:
   - Fuel lines
   - Accelerator linkage at carburetor.
   - Disconnected wires and hoses.
   - Battery negative cable at battery.
10. Install air cleaner.
11. Fill with coolant, start engine, adjust ignition timing
    and check for leaks.

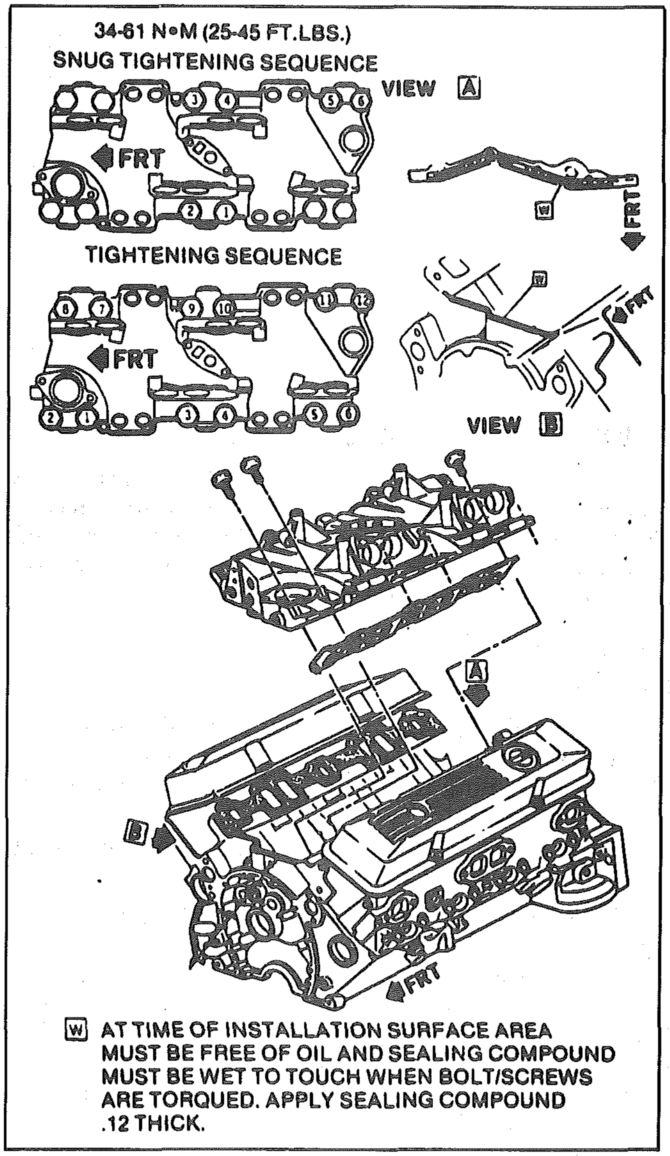


Figure 6A3-4a Intake Manifold Installation (PFI)

Removal (PFI)

1. Disconnect the negative battery cable.
2. Drain the cooling system.

3. Disconnect accelerator T.V. and cruise cables.
4. Remove air intake duct.
5. Disconnect coolant hoses at throttle body.
6. Disconnect wires at throttle body.
7. Disconnect vacuum and breather hoses at throttle body.
8. Remove throttle body from plenum.
9. Remove distributor shield.
10. Disconnect brake vacuum hoses at plenum.
11. Disconnect vacuum hoses at plenum.
12. Refer to Section 6E3 for removal of:
    - Plenum
    - Fuel Rail
    - Cold Start Injector
    - Runners
13. Remove distributor.
14. Disconnect EGR solenoid.
15. Disconnect all electrical wires that would interfere.
16. Remove intake manifold bolts.
17. Remove intake manifold.

Installation

1. Clean all seal surfaces.
2. Install gaskets and place a 3/16 inch 5 (mm) bead of RTV, No. 1052917 or equivalent,on the front and rear ridges of the cylinder case. Extend the bead 1/2 inch (13mm) up each cylinder head to seal and retain the manifold side gaskets and install intake manifold.
3. Torque manifold bolts to specified torque.
4. Reconnect electrical and vacuum wires.
5. Install distributor.
6. Refer to Section 6E3 for installation of:
    - Plenum
    - Fuel Rail
    - Cold Start Injectors
    - Runners
7. Vacuum hoses at plenum.
8. Install distributor shield.
9. Install throttle body and related parts.
10. Fill cooling system.
11. Reconnect battery cable.
12. Start engine and look for leaks.

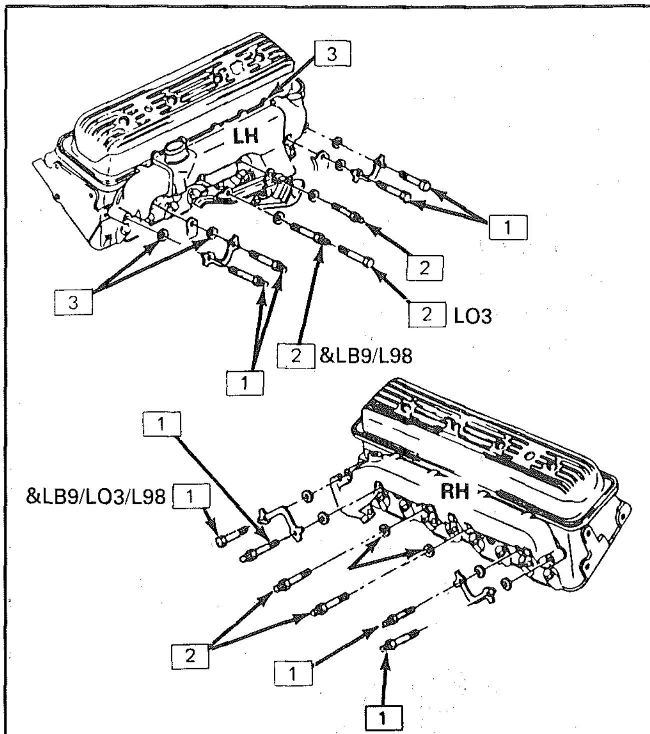
DIPSTICK TUBE

Removal

1. Disconnect battery negative cable to prevent possible contact of the dipstick tube with the battery terminal on starter during removal.
2. Remove bolt attaching bracket to engine and remove tube (loose fit).

Installation

1. Clean tube and apply sealant #1052080 or equivalent, around tube 1/2" below bead.
2. Insert tube in block and rotate into position.
3. Install bolt (with starter brace on top of tube bracket) and connect battery cable.



1 19-35 N·m (14-26 FT. LBS.)
2 27-43 N·m (20-32 FT. LBS.)
3 HEAT STOVE (LO3)

Fig. 6A3-5 Exhaust Manifold Installation

EXHAUST MANIFOLD

Removal (Right Side)

1. Disconnect battery negative cable.
2. Disconnect spark plug wires.
3. Disconnect A.I.R. hoses.
4. Remove air management valve.
5. Raise vehicle.
6. Remove exhaust pipe nuts.
7. Lower vehicle.
8. Remove manifold bolts.
9. Remove exhaust manifold.

Installation

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts finger tight.
2. Torque bolts to specifications.
3. Reverse removal procedures.

Removal (Left Side)

1. Disconnect battery negative cable.
2. Disconnect spark plug wires.
3. Disconnect A.I.R. hoses.
4. If equipped with A/C, remove compressor and lay aside.
5. Remove power steering pump and lay aside.
6. Loosen brackets.
7. Remove rear A/C and power steering adjusting bracket.
8. Remove lower power steering adjusting bracket.
9. Raise vehicle.

10. Remove exhaust pipe nuts.
11. Lower vehicle.
12. Remove manifold bolts.
13. Remove manifold.

Installation

1. Clean mating surfaces on manifold and head, then install manifold in position and install bolts finger tight.
2. Torque bolts to specifications.
3. Reverse removal procedures.
4. Adjust necessary drive belts.

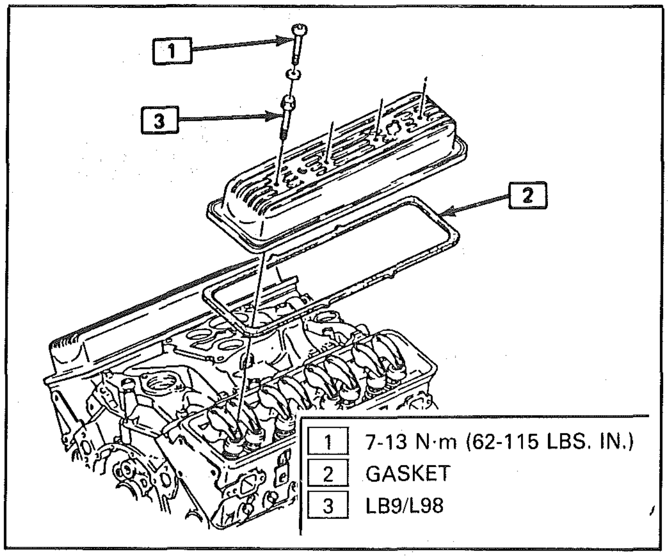


Fig. 6A3-6 Rocker Arm Cover

ROCKER ARM COVER (FIG. 6A3-6)

Removal (Right Side)

1. Disconnect battery negative cable.
2. Remove air cleaner if equipped.
3. Disconnect air management hoses.
4. Disconnect wires and hoses.
   - EGR solenoid.
   - Alternator
5. Remove EGR solenoid.
6. Remove air management valve bracket and move aside.
7. Remove air management tubes.
8. Remove cover bolts.
9. Remove cover.

NOTICE: If cover adheres to cylinder head, shear off by bumping end of rocker arm cover with a block of wood and a rubber mallet. If cover still will not come loose, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Removal (Left Side)

1. Disconnect battery negative cable.
2. Remove air cleaner if equipped.
3. Remove power brake booster line.
4. Disconnect A.I.R. hoses.
5. Disconnect PCV and move wire harness.
6. Remove cover bolts.
7. Remove cover.

NOTICE: If cover adheres to cylinder head, shear off by bumping end of rocker arm cover with a block of wood and a rubber mallet. If cover still will not come loose, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Installation

1. Clean gasket surface on cylinder head and rocker arm cover.
2. Inspect rocker arm cover for damage or distortion and replace cover if necessary.
3. Install a new gasket.
4. Reverse removal procedures.
5. Start engine and check for leaks.

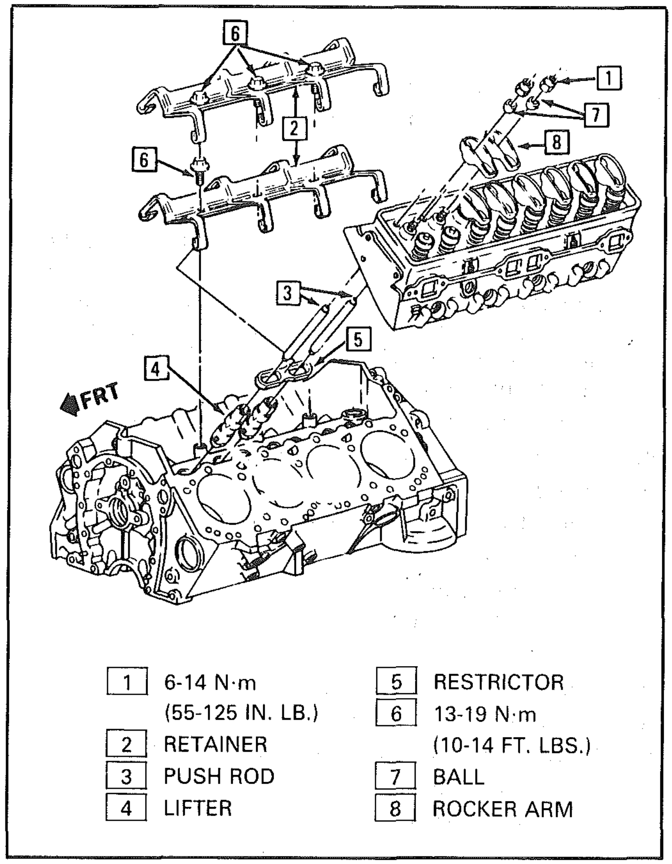


Fig. 6A3-7 Rocker Arm and Pushrods

ROCKER ARM AND PUSHRODS

Removal

1. Remove rocker arm covers as previously outlined.
2. Remove rocker arm nuts, rocker arm balls, rocker arms and push rods. Place rocker arms, rocker arm balls and push rods in a rack to they may be reinstalled in the same locations.

Installation and Adjustment

- Whenever new rocker arms and/or rocker arm balls are being installed, coat bearing surfaces of rocker arms and rocker arm balls with "Molykote" or its equivalent.

1. Install push rods. Be sure push rods seat in lifter socket.
2. Install rocker arms, rocker arm balls and rocker arm nuts. Tighten rocker arm nuts until all lash is eliminated.
3. Adjust valves when lifter is on base circle of camshaft lobe as follows:
   a. Crank engine until mark on torsional damper lines up with center or "O" mark on the timing tab fastened to the crankcase front cover and the engine is in the #1 firing position. This may be determined by placing fingers on the #1 valve as the mark on the damper comes near the "O" mark on the crankcase front cover. If the valves are not moving, the engine is in the #1 firing position. If the valves move as the mark comes up to the timing tab, the engine is in #6 firing position and should be turned over one more time to reach the #1 position.
   b. With the engine in the #1 firing position as just determined, the following valves may be adjusted:
   - Exhaust--1, 3, 4, 8
   - Intake--1, 2, 5, 7

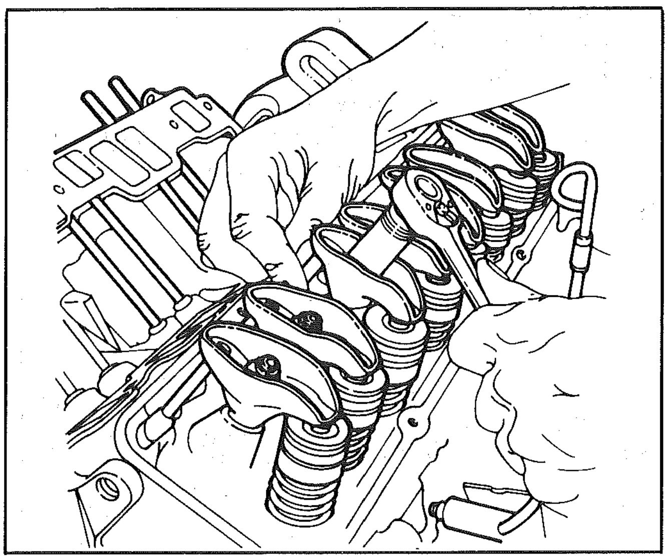


Fig. 6A3-8 Valve Adjustment - Typical

   c. Back out adjusting nut until lash is felt at the push rod then turn in adjusting nut until all lash is removed. This can be determined by rotating push rod while turning adjusting nut (fig. 6A3-8). When play has been removed, turn adjusting nut 1+1/4 in additional turn (to center lifter plunger).
   d. Crank the engine one revolution until the pointer "0" mark and torsional damper mark are again in alignment. This is #6 firing position. With the engine in this position the following valves may be adjusted.
   - Exhaust--2, 5, 6, 7
   - ntake--3, 4, 6, 8
4. Install rocker arm covers as previously outlined.
5. Start engine and adjust carburetor idle speed, if needed.

VALVE STEM OIL SEAL AND/OR VALVE SPRING (6A3-9)

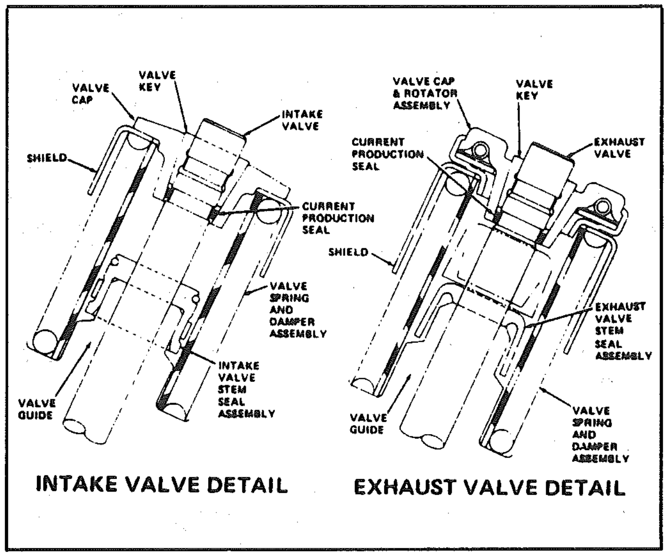


Fig. 6A3-9 Valve Seals

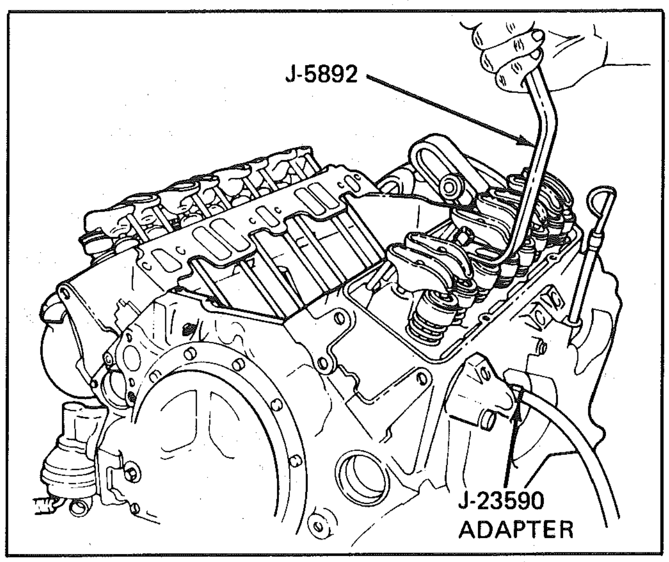


Fig. 6A3-10 Compressing Valve Spring

Removal

1. Remove rocker arm cover as previously outlined.
2. Remove spark plug, rocker arm and push rod on the cylinder(s) to be serviced.
3. Install air line adapter Tool J-23590 to spark plug port and apply compressed air to hold the valves in place.
4. Using Tool J-5892 to compress the valve spring, remove the valve locks, valve cap and valve spring and damper (fig. 6A3-10).
5. Remove the valve stem or head oil seal.

Installation

1. Install valve stem seal over valve stem and seat against head.
2. Set the valve spring and damper, oil shedder and valve cap in place. Compress the spring with Tool J-5892 and install oil seal in the lower groove of the stem, making sure the seal is flat and not twisted. A light coat of oil on the seal will help prevent twisting.
3. Install the valve locks and release the compressor tool making sure the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tool.
4. Using tool J-23994, apply vacuum to the valve cap to make sure no air leaks past the seal.
5. Install spark plug and torque to 22 lb. ft. (30N·m).
6. Install and adjust valve mechanism as previously outlined.

VALVE LIFTERS

Hydraulic valve lifters very seldom require attention. The lifters are extremely simple in design, readjustments are not necessary, and servicing of the lifters requires only that care and cleanliness be exercised in the handling of parts.

Valve Lifter Diagnosis

1. Momentarily Noisy When Car is Started:
   This condition is normal. Oil drains from the lifters which are holding the valves open when the engine is not running. It will take a few seconds for the lifter to fill after the engine is started.
2. Intermittently Noisy On Idle Only. Disappearing When Engine Speed is Increased:
   Intermittent clicking may be an indication of a pitted check valve ball, or it may be caused by dirt.
   Correction: Clean the lifter and inspect. If check valve ball is defective, replace lifter.
3. Noisy At Slow Idle Or With Hot Oil, Quiet With Cold Oil Or As Engine Speed Is Increased:
   High leak down rate. Replace suspect lifter.
4. Noisy At High Car Speeds And Quiet At Low Speeds:
   a. High oil level - Oil level above the "Full" mark allows crankshaft counterweights to churn the oil into foam. When foam is pumped into the lifters, they will become noisy since a solid column of oil is required for proper operation. Correction: Drain oil intil proper level is obtained.
   b. Low oil level - Oil level below the "Add" mark allows the pump to pump air at high speeds which results in noisy lifters. Correction: Fill until proper oil level is obtained.
   c. Oil pan bent on bottom or pump screen cocked or loose, replace or repair as necessary.
5. Noisy At Idle Becoming Louder As Engine Speed Is Increased To 1500 rpm:
   This noise is not connected with lifter malfunction. It becomes most noticeable in the car at 10 to 15 mph "1" (Low) range, or 30 to 35 mph "D" (Drive) range and is best described as a hashy sound. At slow idle, it may be entirely gone or appear as a light ticking noise in one or more valves. It is caused by one or more of the following:
   a. Badly worn or scuffed valve tip and rocker arm pad.
   b. Excessive valve stem to guide clearance.
   c. Excessive valve seat runout.
   d. Off square valve spring.
   e. Excessive valve face runout.
   f. Valve spring damper clicking on rotator.

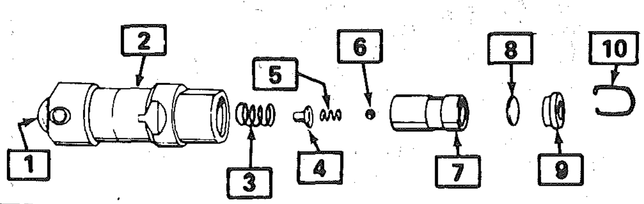
Removal

1. Remove intake manifold as previously outlined.
2. Remove valve mechanism as previously outlined.
3. Remove valve lifter retainer.
4. Remvoe valve lifter restrictor.
5. Remove valve lifters (Fig. 6A3-7). Place valve lifters in a rack so that they may be reinstalled in the same location.

Installation

1. Coat roller of valve lifters with "Molykote" or its equivalent and install valve lifters.
2. Install valve lifter restrictor.
3. Install valve lifter retainer.
4. Install intake manifold as previously outlined.
5. Install and adjust valve mechanism as outlined.

Disassembly



1 ROLLER
2 LIFTER BODY
3 PLUNGER SPRING
4 BALL CHECK RETAINER
5 BALL CHECK SPRING
6 BALL CHECK
7 PLUNGER
8 OIL METERING VALVE
9 PUSH ROD SEAT
10 RETAINER RING

Fig. 6A3-11 Hydraulic Valve Lifter

1. Hold the plunger down with a push rod, and using the blade of a small screw driver, remove the push rod seat retainer.
2. Remove the push rod seat and metering valve (fig. 6A3-11).

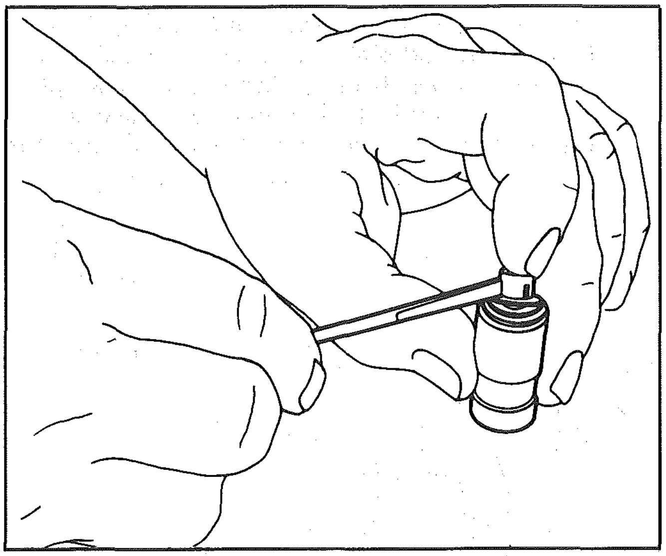


Fig. 6A3-12 Removing Ball Check Valve Typical

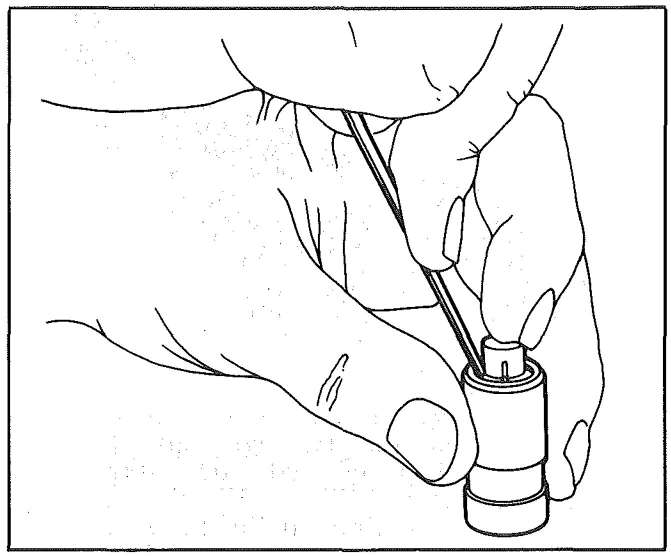


Fig. 6A3-13 Installing Ball Check Valve Typical

3. Remove the plunger, ball check valve assembly and the plunger spring.
4. Remove the ball check valve and spring by prying the ball retainer loose from the plunger with the blade of a small screw driver (fig. 6A3-12).

Cleaning and Inspection

Thoroughly clean all parts in cleaning solvent, and inspect them carefully. If any parts are damaged or worn, the entire lifter assembly should be replaced.

1. Lifter body for:
   - Wear
   - Scuffing. Also inspect the bore in the cylinder block.
   - Flat spot on the bottom. If the bottom is worn flat or grooved, replace the lifter. Also inspect the camshaft lobe.
2. Roller for:
   - Freedom of movement. Replace the lifter if it binds or roughness can be felt.
   - Excessive looseness in the roller bearings. Replace lifter if necessary.
   - Flat spots. Replace the lifter, if worn.
   - Pitting, replace the lifter if pitted.
3. Pushrod seat. If worn, inspect the pushrod. Replace the pushrod, if worn.

Assembly

1. Place the check ball on small hole in bottom of the plunger.
2. Insert check ball spring on seat in ball retainer and place retainer over ball so that spring rests on the ball. Carefully press the retainer into position in plunger with the blade of a small screw driver (fig. 6A3-13).
3. Place the plunger spring over the ball retainer and slide the lifter body over the spring and plunger, being careful to line up the oil feed holes in the lifter body and plunger.
4. Fill the assembly with SAE 10 oil, then insert the end of a 1/8" (3mm) drift pin into the plunger and press down solid. Do not attempt to force or pump the plunger. At this point, oil holes in the lifter body and plunger assembly will be aligned (fig. 15).

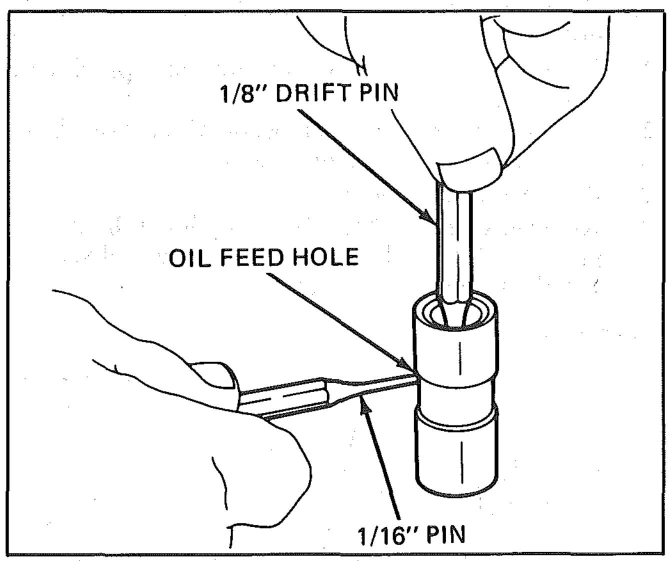


Fig. 6A3-14 Assembling Hydraulic Lifter Typical

5. Insert a 1/16" drift pin through both oil holes to hold the plunger down against the lifter spring tension (fig. 6A3-14).
6. Remove the 1/8" drift pin, refill assembly with SAE 10 oil.
7. Install the metering valve and push rod seat (fig. 6A3-11).
8. Install the push rod seat retainer, press down on the push rod seat and remove the 1/16" drift pin from the oil holes. The lifter is now completely assembled, filled with oil and ready for installation. Before installing lifters, coat the bottom of the lifter with "Molykote" or its equivalent.

CYLINDER HEAD ASSEMBLY (FIG. 6A3-15)

Removal

1. Remove intake manifold as previously outlined.

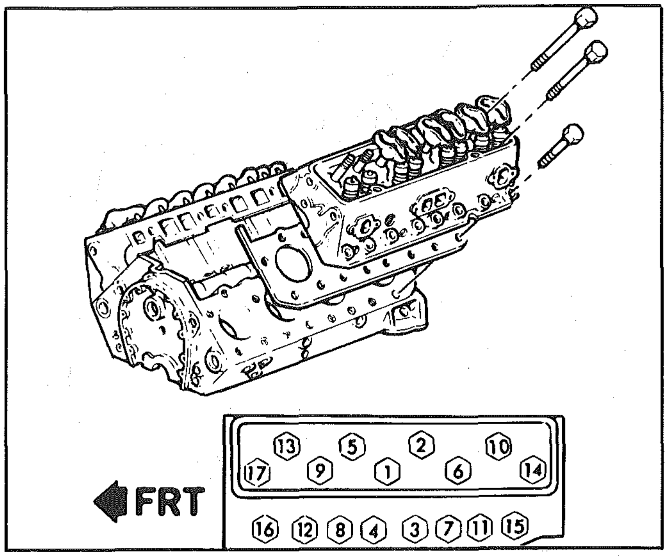


Fig. 6A3-15 Cylinder Head

2. Remove generator lower mounting bolt and lay unit aside.
3. Remove exhaust manifolds as previously outlined.
4. Remove rocker arm covers as previously outlined.
5. Remove valve mechanism as previously outlined.
6. Drain cylinder block of coolant.
7. Remove diverter valve.
8. Remove cylinder head bolts, cylinder head and gasket. Place cylinder head on two blocks of wood to prevent damage.

Disassembly

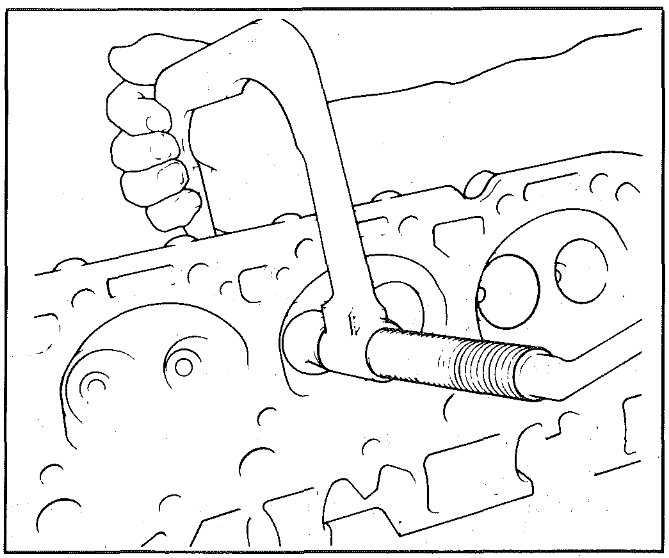


Fig. 6A3-16 Compressing Valve Spring-Typical

1. With cylinder head removed, remove valve rocker arm nuts, balls and rocker arms (if not previously done).
2. Using Tool J-8062, compress the valve springs (fig. 6A3-16) and remove valve keys. Release the compressor tool and remove rotators or spring caps, oil shedders, springs and spring damper, then remove oil seals and valve spring shims.
3. Remove valves from cylinder head and place them in a rack in their proper sequence so that they can be assembled in their original positions.

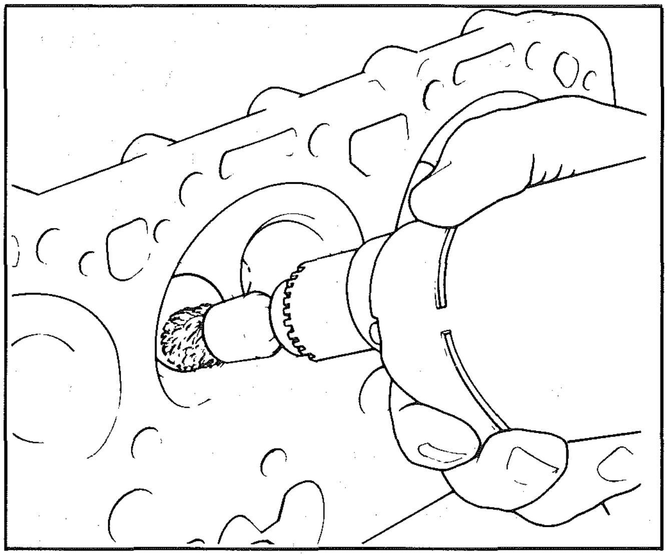


Fig. 6A3-17 Cleaning Combustion Chambers-Typical

Cleaning

1. Clean all carbon from combustion chambers and valve ports using Tool J-8089 (fig. 6A3-17).
2. Thoroughly clean the valve guides using Tool J-8101.
3. Clean all carbon and sludge from push rods, rocker arms and push rod guides.
4. Clean valve stems and heads on a buffing wheel.
5. Clean carbon deposits from head gasket mating surface.

Inspection

1. Inspect the cylinder head for cracks in the exhaust ports, combustion chambers, or external cracks to the water chamber.
2. Inspect the valves for burned heads, cracked faces or damaged stems.
   - Excessive valve stem to bore clearance will cause excessive oil consumption and may cause valve breakage. Insufficient clearance will result in noisy and sticky functioning of the valve and disturb engine smoothness.
3. Measure valve stem clearance (Fig. 6A3-19) as follows:
   a. Clamp a dial indicator on one side of the cylinder head rocker arm cover gasket rail.
   b. Locate the indicator so that movement of the valve stem from side to side (crosswise to the head) will cause a direct movement of the indicator stem. The indicator stem must contact the side of the valve stem just above the valve guide.
   c. Drop the valve head about 1/16" (1.6mm) off the valve seat.
   d. Move the stem of the valve from side to side using light pressure to obtain a clearance

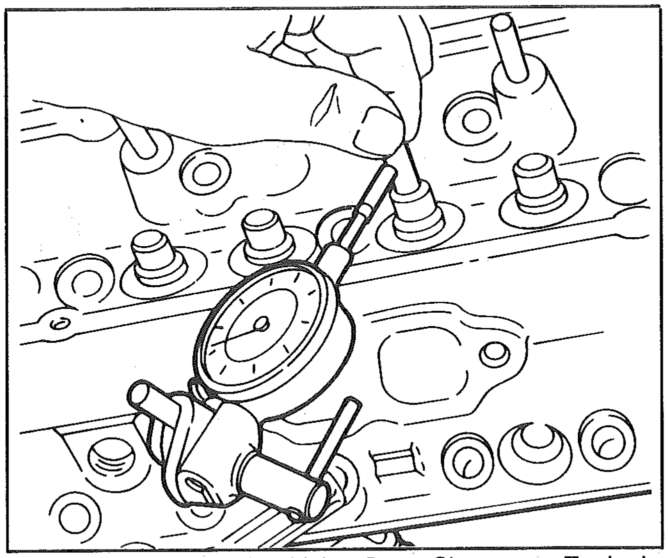


Fig. 6A3-18 Measuring Valve Stem Clearances-Typical

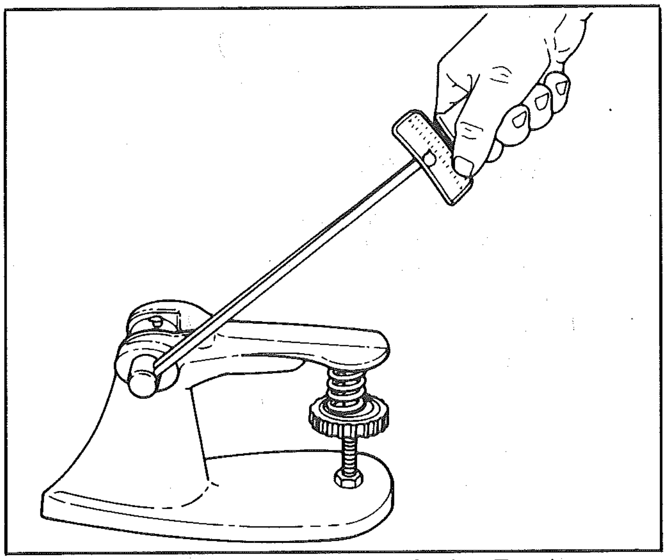


Fig. 6A3-19 Checking Valve Spring Tension

reading. If clearance exceeds specifications, it will be necessary to ream valve guides for oversize valves.

- Service valves are available in standard, .003", .015" and .030" oversize.

4. Check valve spring tension with Tool J-8056 spring tester (fig. 6A3-19). Springs should be compressed to the specified height and checked against the specifications chart. Springs should be replaced if not within 10 lbs. (44 N) of the specified load (without dampers).
5. Inspect rocker arm studs for wear of damage.

Assembly

1. Insert a valve in the proper port.
2. Assemble the valve spring and related parts as follows:
   a. Set the valve spring shim, valve spring (with damper), oil shedder and valve cap or rotator in place.
   b. Compress the spring with Tool J-8062.
   c. Install oil seal in the lower groove of the stem, making sure that the seal is flat and not twisted.
   d. Install the valve locks and release the compressor tool making sure that the locks seat properly in the upper groove of the valve stem. Grease may be used to hold the locks in place while releasing the compressor tools.

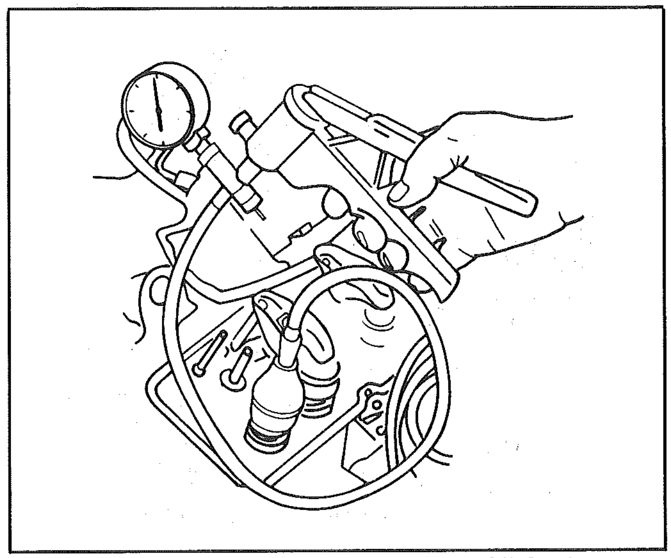


Fig. 6A3-20 Checking Valve Stem Oil Seals

3. Install the remaining valves.
4. Check each valve stem oil seal by placing Valve Seal Leak Detector (Toool J-23994) over the end of the valve stem and against the cap. Operate the vacuum pump and make sure no air leaks past the seal (fig. 6A3-20).

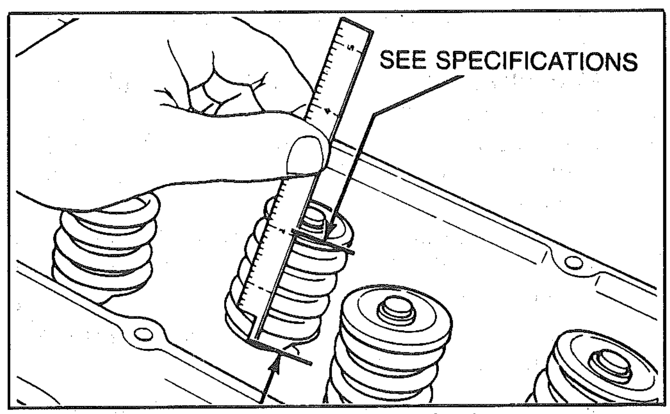


Fig. 6A3-21 Cutaway Scale

5. Check the installed height of the valve springs, using a narrow thin scale. A cutaway scale will help (fig. 6A3-21). Measure from the top of the shim or the spring seat to the top of the oil shedder. If this is found to exceed the specified height, install a valve spring seat shim approximately 1/16" (1.6mm) thick. At no time should the spring be shimmed to give an installed height under the minimum specified.

Installation

- The gasket surfaces on both the head and the block must be clean of any foreign matter and free of nicks or heavy scratches. Cylinder bolt threads in the block and threads on the cylinder head bolts must be clean as dirt will affect bolt torque.

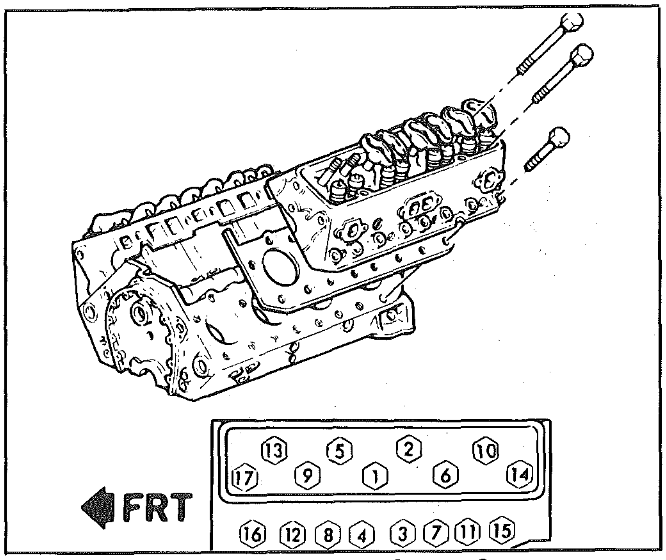


Fig. 6A3-22 Cylinder Head Torque Sequence

1. On engines using a STEEL gasket, coat both sides of a new gasket with a good sealer. Spread the sealer thin and even. One method of applying the sealer that will assure the proper coat is with the use of a paint roller. Too much sealer may hold the gasket away from the head or block.
   - Use no sealer on engines using a composition STEEL ASBESTOS gasket.
2. Place the gasket in position over the dowel pins with the bead up.
3. Carefully guide the cylinder head into place over the dowel pins and gasket.
4. Coat threads of cylinder head bolts with sealing compound, #1052080 or equivalent, and install bolts finger tight.
5. Tighten each cylinder head bolt a little at a time until the specified torque is reached (fig. 6A3-22).
6. Install exhaust manifolds as previously outlined.
7. Install rocker arm covers as previously outlined.
8. Install diverter valve.
9. Install intake manifold as previously outlined.
10. Install and adjust valve mechanism as previously outlined.

ROCKER ARM STUDS

Replacement

Rocker arm studs that have damaged threads or are loose in cylinder heads should be replaced with new studs available in .003" and .013" oversize. Studs may be installed after reaming the holes as follows:

1. Remove old stud by placing Tool J-5802-1 over the stud, installing nut and flat washer and removing stud by turning nut (fig. 6A3-23).

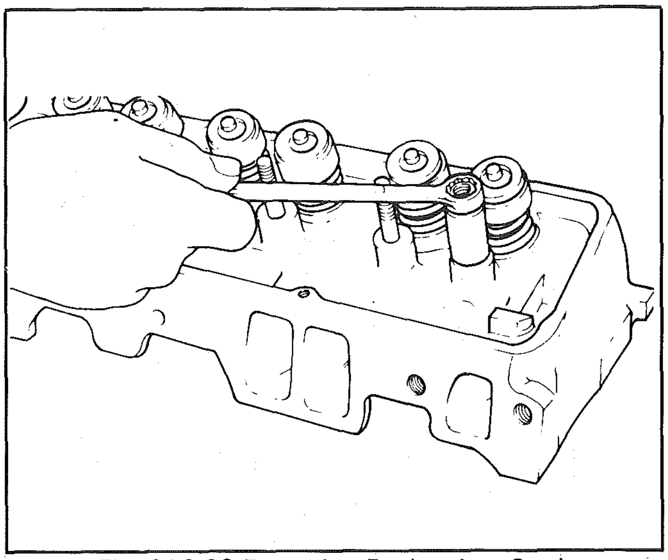


Fig. 6A3-23 Removing Rocker Arm Stud

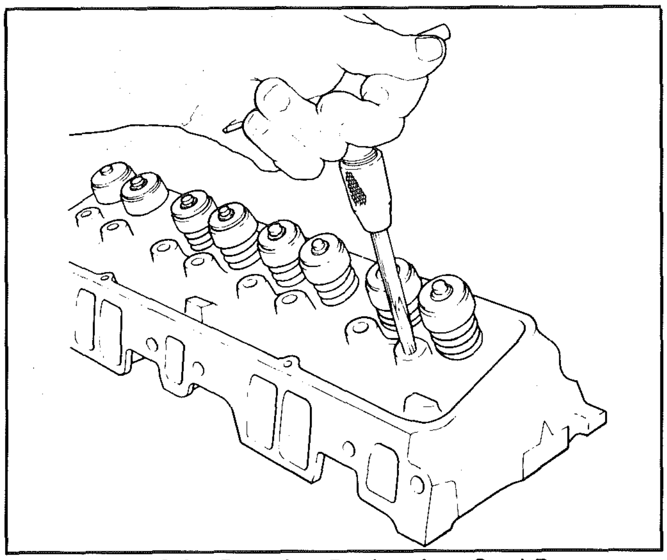


Fig. 6A3-24 Reaming Rocker Arm Stud Bore

2. Ream hole for oversize stud using Tool J-5715 for .003" oversize or Tool J-6036 for .013" oversize (fig. 6A3-24).

NOTICE: Do not attempt to install an oversize stud without reaming stud hole as this could damage the head casting.

3. Coat press-fit area of stud with hypoid axle lubricant. Install new stud, using Tool J-6880 as a guide. Gage should bottom on head (fig. 6A3-25).

VALVE GUIDE BORES

Valves with oversize stems are available (see specifications). To ream the valve guide bores for oversize valves use Tool Set J-5830.

VALVE SEATS

Reconditioning the valve seats is very important, because the seating of the valves must be perfect for the

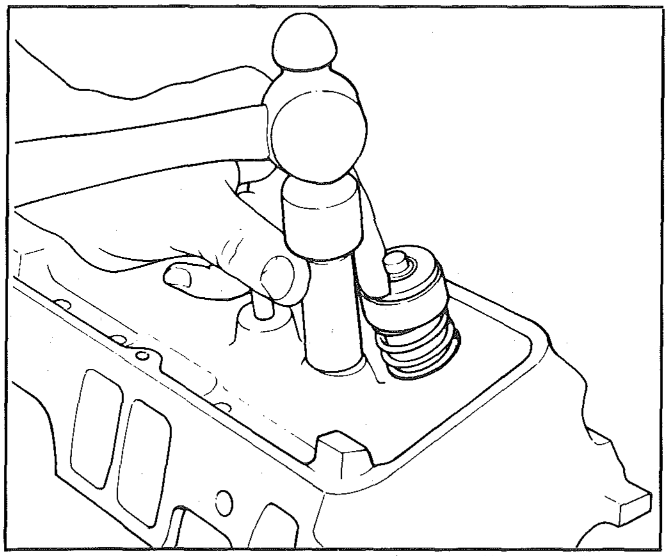


Fig. 6A3-25 Installing Rocker Arm Stud

engine to deliver the power and performance built into it.

Another important factor is the cooling of the valve heads. Good contact between each valve and its seat in the head is imperative to insure that the heat in the valve head will be properly carried away.

Several different types of equipment are available for reseating valves seats. The recommendations of the manufacturer of the equipment being used should be carefully followed to attain proper results.

Regardless of what type of equipment is used, however, it is essential that valve guide bores be free from carbon or dirt to ensure proper centering of pilot in the guide. Valve seats should be concentric to within .002" total indicator reading.

VALVES

Valves that are pitted can be refaced to the proper angle, insuring correct relation between the head and stem on a valve refacing mechanism. Valve stems which show excessive wear, or valves that are warped excessively should be replaced. When a valve head which is warped excessively is refaced, a knife edge will be ground on part or all of the valve head due to the amount of metal that must be removed to completely reface. Knife edges lead to breakage, burning or pre-ignition due to heat localizing on this knife edge. If the edge of the valve head is less than 1/32" (.08mm) thick after grinding, replace the valve. Several different types of equipment are available for refacing valves. The recommendation of the manufacturer of the equipment being used should be carefully followed to attain proper results.

TORSIONAL DAMPER

Removal

1. Remove drive belts and pulley.
2. Raise vehicle.
3. Remove crankshaft pulley, then remove damper retaining bolt.
4. Install Tool J-23523 on damper then, turning puller screw, remove damper.

Installation

NOTICE: The inertial weight section of the torsional damper is assembled to the hub with a rubber type material. The installation procedures (with proper tool) must be followed or movement of the inertia weight section on the hub will destroy the tuning of the torsional damper.

1. Inspect the cover seal contact area surface (on damper) for damage or grooving and coat front cover seal with engine oil.
2. Place damper in position over key on crankshaft.
3. Pull damper onto crankshaft as follows:
   a. Install appropriate threaded end of Tool J-23523 into crankshaft. Install tool in crankshaft so that at least 1/2" (13mm) of thread engagement is obtained.

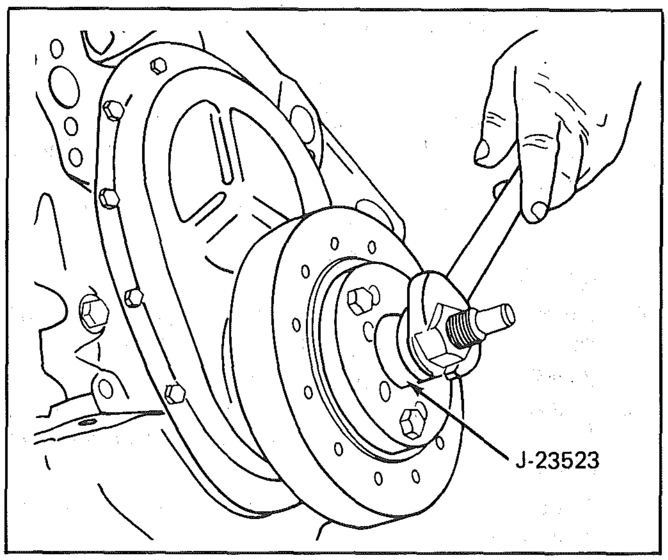


Fig. 6A3-26 Installing Torsional Damper

   b. Install plate, thrust bearing and nut to complete tool installation.
   c. Pull damper into position as shown in Figure 6A3-26.
   d. Remove tool from crankshaft then install damper retaining bolt and torque to specifications.
4. Install crankshaft pulley.
5. Lower vehicle.
6. Install drive belts and adjust to specifications.

CRANKCASE FRONT COVER (FIG. 6A3-27)

Removal

1. Remove torsional damper as previously outlined.
2. Remove oil pan.
3. Remove water pump as outlined in Section 6B.
4. Remove crankcase front cover attaching screws and remove front cover and gasket, then discard gasket.

Installation

1. Clean gasket surface on block and crankcase front cover.

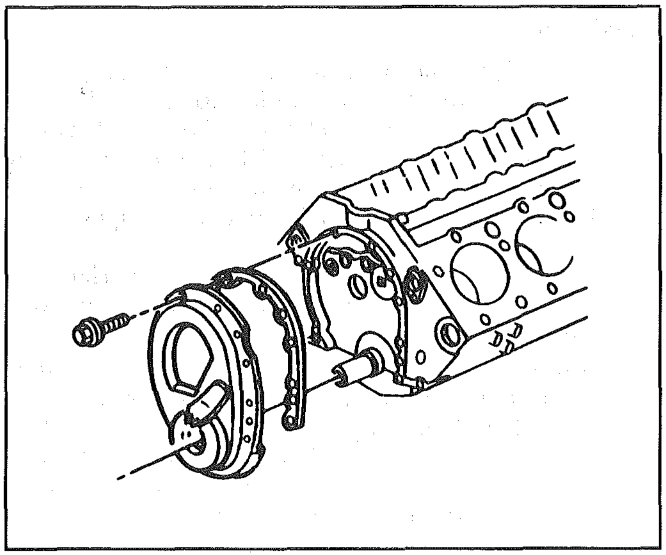


Fig. 6A3-27 Crankcase Front Cover

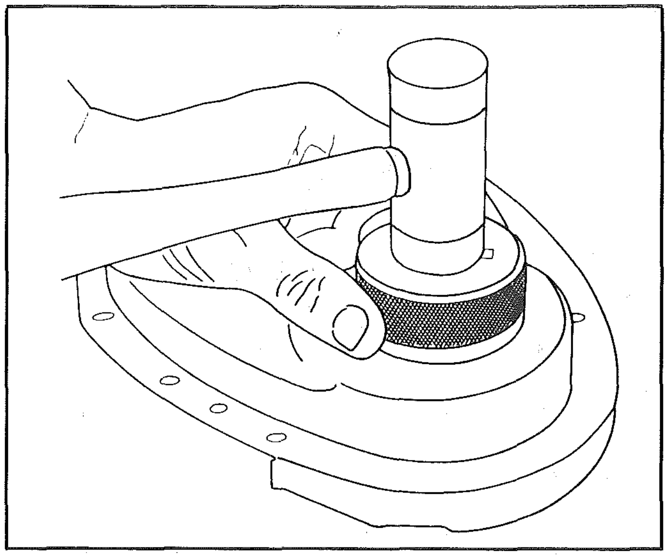


Fig. 6A3-28 Installing Oil Seal-Cover Removed

2. Use a sharp knife or other suitable cutting tool to remove any excess oil pan gasket material that may be protruding at the oil to engine block junction.
3. Apply a 1/8" (3mm) bead of RTV, #1052917 or equivalent, to the joint formed at the oil pan and cylinder block.
4. Inspect the cover for damage or distortion and replace if necessary. Coat the cover gasket with gasket sealant and place in position on cover.
5. Install cover-to-oil pan seal, lightly coat bottom of seal with engine oil, and position cover over crankshaft end.
6. Loosely install the cover-to-block upper attaching screws.
7. Tighten screws alternately and evenly while pressing downward on cover so that dowels in block are aligned with corresponding holes in cover. Position cover so that dowels enter holes in cover without binding. Do not force cover over dowels so that cover flange or holes are distorted.
8. Install remaining cover screws and torque to specifications.
9. Install torsional damper and water pump as previously outlined.
10. Install oil pan.

OIL SEAL (FRONT COVER)

Replacement

With Cover Removed

1. With cover removed, pry oil seal out of cover from the front with a large screwdriver. Be careful not to damage the cover while removing seal.
2. Install new seal so that open end of the seal is toward the inside of cover and drive it into position with Tool J-23042 (Fig. 6A3-28). Support rear of cover at seal area.

With Cover Installed

1. With torsional damper removed, pry seal out of cover from the front with a large screw driver. Be careful not to damage the surface on the crankshaft.
2. Install new seal so that open end of seal is toward the inside of cover and drive it into position with Tool J-23042. Care should be taken to avoid damaging the cover.

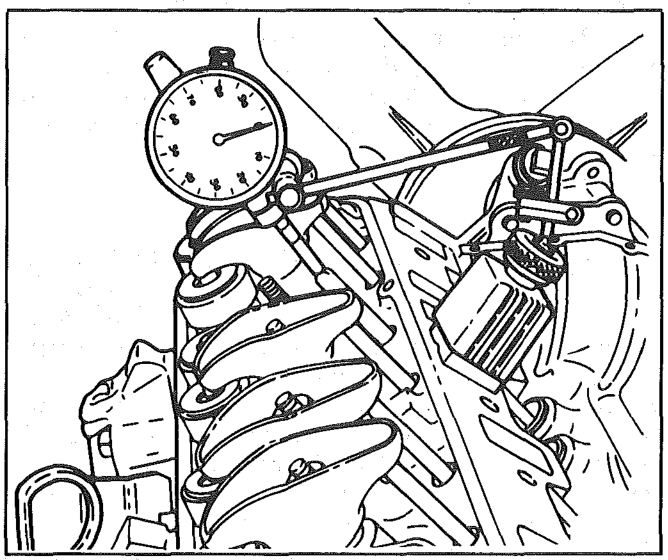


Fig. 6A3-29 Measuring Camshaft Lobe Lift

CAMSHAFT

Measuring Lobe Lift

1. Remove the valve mechanism as previously outlined.
2. Position indicator with ball socket adapter (Tool J-8520) on push rod (Fig. 6A3-29). Make sure push rod is in the lifter socket.
3. Rotate the crankshaft slowly in the direction of rotation until the lifter is on the heel of the cam lobe. At this point, the push rod will be in its lowest position.

4. Set dial indicator on zero, then rotate the crankshaft slowly, or attach an auxiliary starter switch and "bump" the engine over, until the push rod is fully raised position.
   - Whenever the engine is cranked remotely at the started, with a special jumper cable or other means, the distributor primary lead should be disconnected from the distributor (coil).
5. Compare the total lift recorded from the dial indicator with specifications.
6. If camshaft readings for all lobes are within specifications, remove dial indicator assembly.
7. Install and adjust valve mechanism as outlined.

Removal

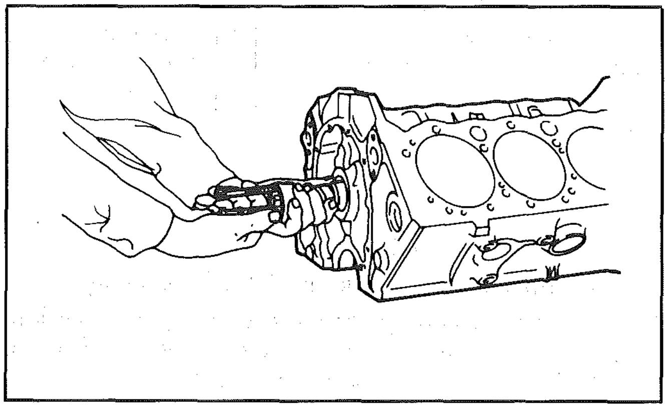


Fig. 6A3-30 Removing Camshaft

1. Remove valve lifters as previously outlined.
2. Remove crankcase front cover as previously outlined.
3. Remove grille.
4. Remove fuel pump push rod as outlined in Section 6C.
5. Complete camshaft removal as follows:
   - Sprocket is a light fit on camshaft. If sprocket does not come off easily a light blow on the lower edge of the sprocket (with a plastic mallet) should dislodge the sprocket.
6. Install two 5/16" - 18 x 4" bolts in camshaft bolt holes then remove camshaft (fig. 6A3-30).

NOTICE: All camshaft journals are the same diameter and care must be used in removing camshaft to avoid damage to bearings.

Inspection

The camshaft bearing journals should be measured with a micrometer for an out-of-round condition. If the journals exceed .001" out-of-round, the camshaft should be replaced.

Installation

When a new camshaft is installed coat camshaft lobes with "Molykote" or its equivalent. When a new camshaft is installed, replacement of all valve lifters is recommended to insure durability of the camshaft lobes and lifter feet.

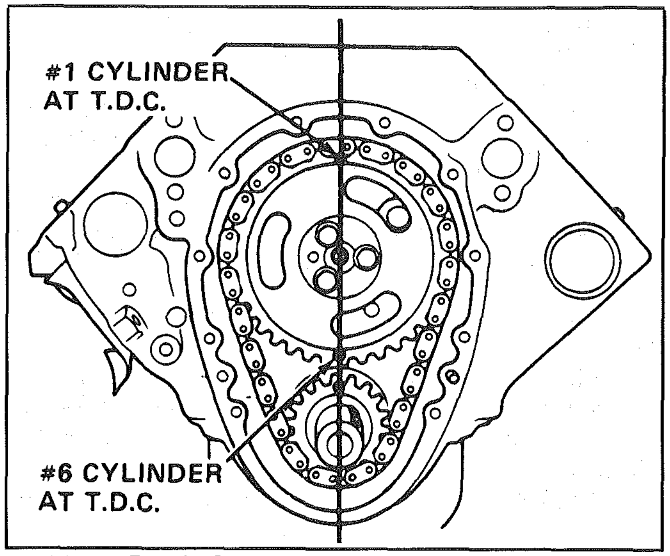


Fig. 6A3-31 Aligning Timing Marks

1. Lubricate camshaft journals with engine oil and install camshaft.
2. Install timing chain on camshaft sprocket. Hold the sprocket vertically with the chain hanging down and align marks on camshaft and crankshaft sprockets. (Refer to fig. 6A3-31).
3. Align dowel in camshaft with dowel hole in camshaft sprocket then install sprocket on camshaft.
4. Draw the camshaft sprocket onto camshaft using the mounting bolts. Torque to specifications.
5. Lubricate timing chain with engine oil.
6. Install fuel pump push rod as outlined in Section 6C.
7. Install grille.
8. Install crankcase front cover as previously outlined.
9. Install valve lifters as previously outlined.

CAMSHAFT BEARINGS

Removal

Camshaft bearings can be replaced with engine completely or partially disassembled. To replace bearings without complete disassembly remove the camshaft and crankshaft leaving cylinder heads attached and pistons in place. Before removing crankshaft, tape threads of connecting rod bolts to prevent damage to crankshaft. Fasten connecting rods against sides of engine so they will not be in the way while replacing camshaft bearings.

1. With camshaft and crankshaft removed, drive camshaft rear plug from cylinder block.
2. Using Tool J-6098, with nut and thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Install remover and installer tool with shoulder toward bearing, making sure a sufficient amount of threads are engaged.
4. Using two wrenches, hold puller screw while turning nut. When bearing has been pulled from

bore, remove remover and installer tool and bearing from puller screw.
5. Remove remaining bearings (except front and rear) in the same manner. It will be necessary to index pilot in camshaft rear bearing to remove the rear intermediate bearing.
6. Assemble remover and installer tool on driver handle and remove camshaft front and rear bearings by driving towards center of cylinder block.

Installation

The camshaft front and rear bearings should be installed first. These bearings will act as guides for the pilot and center the remaining bearings being pulled into place.

1. Assemble remover and installer tool on driver handle and install camshaft front and rear bearings by driving towards center of cylinder block.
2. Using Tool Set J-6098, with nut then thrust washer installed to end of threads, index pilot in camshaft front bearing and install puller screw through pilot.
3. Index camshaft bearing in bore (with oil hole aligned as outlined below), then install remover and installer tool on puller screw with shoulder toward bearing.
   - Number one cam bearing oil hole must be positioned so that oil holes are equidistant from 6 o'clock position.
   - Number two through number four bearing oil holes must be positioned at 5 o'clock position (toward left side of engine and at a position even with bottom of cylinder bore).
   - Number five bearing oil hole must be in 12 o'clock position.
4. Using two wrenches, hold puller screw while turning nut. After bearing has been pulled into bore, remove the remover and installer tool from puller screw and check alignment of oil hole in camshaft bearing.
5. Install remaining bearings in the same manner. It will be necessary to index pilot in the camshaft rear bearing to install the rear intermediate bearing.
6. Coat new camshaft rear plug O.D. with #1052080 sealant, or equivalent, and install flush to 1/32" (.80mm) deep.

OIL PAN

Removal

1. Disconnect battery negative cable.
2. Remove fan shroud.
3. Remove air cleaner and lay aside if equipped.
4. Remove distributor cap and lay aside.
5. Raise vehicle.
6. Drain crankcase.
7. Disconnect exhaust pipe at manifold.
8. Disconnect AIR pipe clamp.
9. Disconnect converter hanger bolts and allow exhaust to hang down.

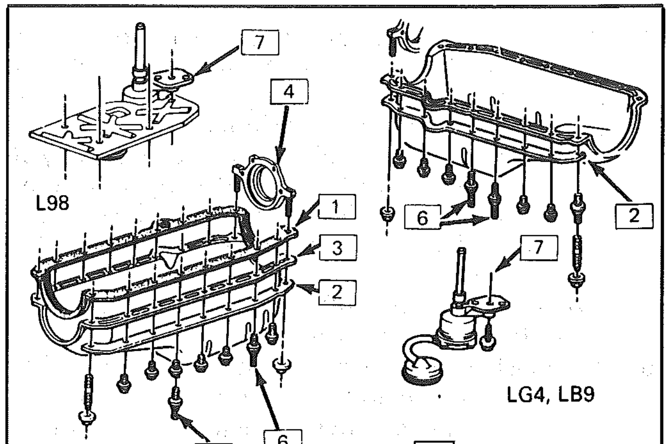


Fig. 6A3-32 Oil Pan

10. Remove front starter brace.
11. Remove starter bolts and let starter hang.
12. On vehicles equipped with manual transmission, it may be necessary to remove the oil filter in order to remove the inspection cover.
13. Remove inspection cover.
14. Remove engine mount through bolts.
15. Remove oil pan bolts.
16. Raise engine.
17. Rotate crankshaft to position throws so as not to block pan removal.
18. Remove oil pan.

Installation

1. Clean sealing surfaces on cylinder case and oil pan.
2. Check oil pan gasket for damage and replace if necessary.
3. Apply a small amount of 1052751, or equivalent, to front and rear corners of oil pan.

   NOTICE: Only a small amount of sealant is required. Excessive amounts of sealant may cause a problem with proper sealing of oil pan.

4. Reverse removal procedures.

OIL PUMP

Removal

1. Remove oil pan as previously outlined.
2. Remove pump to rear main bearing cap bolt and remove pump and extension shaft.

Disassembly (Figure 6A3-33)

1. Remove the pump cover attaching screws and the pump cover.

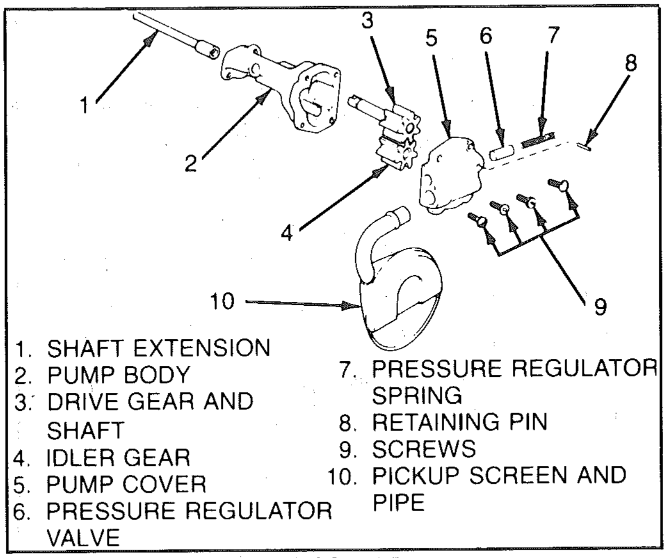


Fig. 6A3-33 Oil Pump

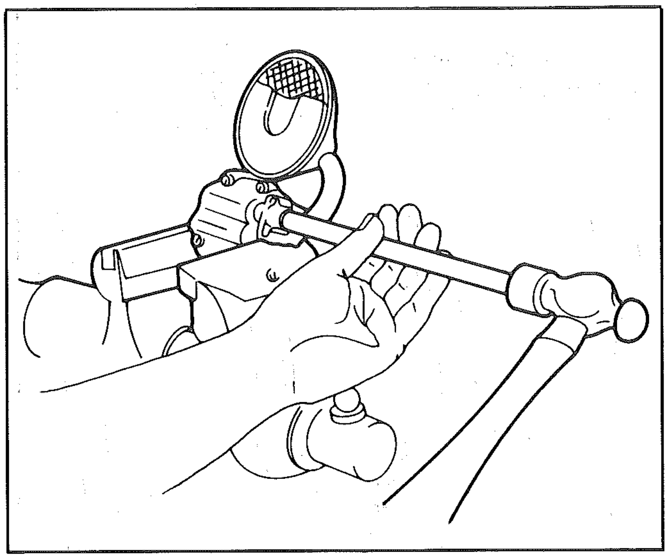


Fig. 6A3-34 Installing Screen

2. Mark gear teeth so they may be reassembled with the same teeth indexing. Remove the idler gear and the drive gear and shaft from the pump body.
3. Remove the pressure regulator valve retaining pin, pressure regulator valve and related parts.
4. If the pickup screen and pipe assembly need replacing, mount the pump in a soft-jawed vise and extract pipe from pump. Do not disturb the pickup screen on the pipe. This is serviced as an assembly.

Cleaning and Inspection

1. Wash all parts in cleaning solvent and dry with compressed air.
2. Inspect the pump body and cover for cracks or excessive wear.
3. Inspect pump gears for damage or excessive wear.
   - The pump gears and body are not serviced separately. If the pump gears or body are damaged or worn, replacement of the entire oil pump assembly is necessary.
4. Check the drive gear shaft for looseness in the pump body.
5. Inspect inside of pump cover for wear that would permit oil to leak past the ends of the gears.
6. Inspect the pickup screen and pipe assembly for damage to screen, pipe or relief grommet.
7. Check the pressure regulator valve for fit.

Assembly (Figure 6A3-33)

1. If the pickup screen and pipe assembly was removed, it should be replaced with a new part. Loss of press fit condition could result in an air leak and loss of oil pressure. Mount the pump in a soft-jawed vise, apply sealer to end of pipe, and using Tool J-8369 (fig. 6A3-34) tap the pipe in place with a plastic hammer.

NOTICE: Be careful of twisting, shearing or collapsing pipe while installing in pump.

2. Install the pressure regulator valve and related parts.
3. Install the drive gear and shaft in the pump body.
4. Install the idler gear in the pump body with the smooth side of gear towards pump cover opening.
5. Install the pump cover and torque attaching screws to specifications.
6. Turn drive shaft by hand to check for smooth operation.

Installation

1. Assemble pump and extension shaft to rear main bearing cap, aligning slot on top end of extension shaft with drive tang on lower end of distributor drive shaft.
2. Install pump to rear bearing cap bolt and torque to specifications.
3. Install oil pan previously outlined.

CONNECTING ROD BEARINGS

Connecting rod bearings are of the precision insert type and do not utilize shims for adjustment. DO NOT FILE RODS OR ROD CAPS. If clearances are found to be excessive a new bearing will be required. Service bearings are available in standard size and .001" and .002" undersize for use with new and used standard size crankshafts, and in .010" and .020" undersize for use with reconditioned crankshafts.

On removing a connecting rod cap, it is possible to find a .010" undersize bearing. These are used in manufacturing for selective fitting.

Inspection and Replacement

1. With oil pan and oil pump removed, remove the connecting rod cap and bearing.

   Before removal of connecting rod cap, mark the side of the rod and cap with the cylinder number to assure matched reassembly of rod and cap.
2. Inspect the bearing for evidence of wear or damage. (Bearings showing the above should not be installed.)
3. Wipe both upper and lower bearing shells and crankpin clean of oil.

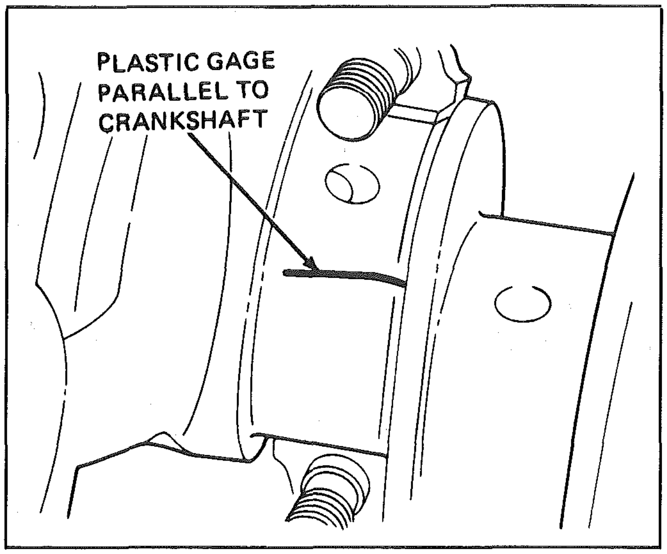


Fig. 6A3-35 Gaging Plastic On Crankpin-Typical

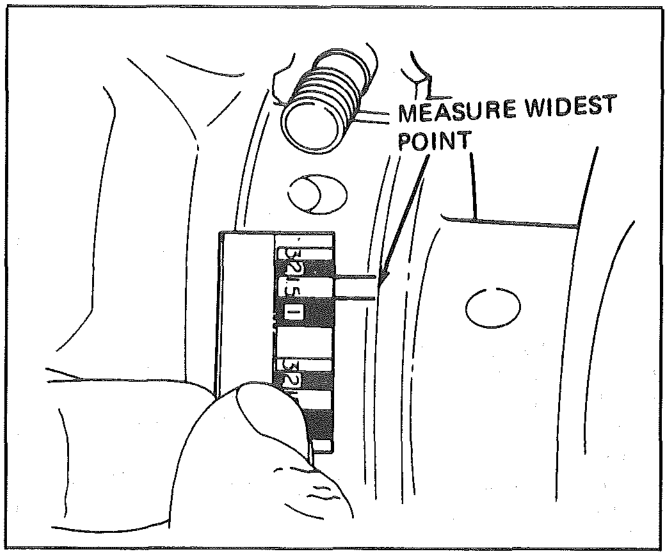


Fig. 6A3-36 Measuring Gaging Plastic-Typical

4. Measure the crankpin for out-of-round or taper with a micrometer. If not within specifications replace or recondition the crankshaft. If within specifications and a new bearing is to be installed, measure the maximum diameter of the crankpin to determine new bearing size required.
5. If within specifications measure new or used bearing clearances with Plastigage or its equivalent.

   If a bearing is being fitted to an out-of-round crankpin, be sure to fit to the maximum diameter of the crankpin. If the bearing is fitted to the minimum diameter and the crankpin is out-of-round .001" interference between the bearing and crankpin will result in rapid bearing failure.

   a. Place a piece of gaging plastic, the length of the bearing (parallel to the crankshaft), on the crankpin or bearing surface (fig. 6A3-35). Plastic gage should be positioned in the middle of the bearing shell. (Bearings are eccentric and false readings could occur if placed elsewhere).
   b. Install the bearing in the connecting rod and cap.
   c. Install the bearing cap and evenly torque nuts to specifications.

NOTICE: Do not turn the crankshaft with the gaging plastic installed.

   d. Remove the bearing cap and using the scale on the gaging plastic envelope, measure the gaging plastic width at the widest point (fig. 6A3-36).
6. If the clearance exceeds specifications, select a new, correct size, bearing and remeasure the clearance.

   Be sure to check what size bearing is being removed in order to determine proper replacement size bearing. If clearance cannot be brought to within specifications, the crankpin will have to be ground undersize. If the crankpin is already at maximum undersize, replace crankshaft.
7. Coat the bearing surface with oil, install the rod cap and torque nuts to specifications.
8. When all connecting rod bearings have been installed tap each rod lightly (parallel to the crankpin) to make sure they have clearance.
9. Measure all connecting rod side clearances (see specifications) between connecting rod caps (fig. 6A3-37).

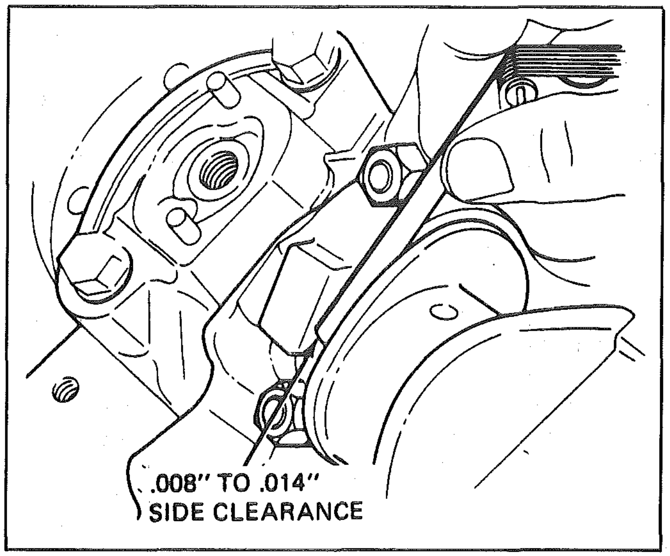


Fig. 6A3-37 Measuring Connecting Rod Side Clearance-Typical

MAIN BEARINGS (FIG. 6A3-38)

Main bearings are of the precision insert type and do not utilize shims for adjustment. If clearances are found to be excessive, a new bearing, both upper and lower halves, will be required. Service bearings are available in standard size and .001", .002", .009", .010" and .020" undersize.

Selective fitting of both rod and main bearing inserts is necessary in production in order to obtain close tolerances. For this reason you may find one half

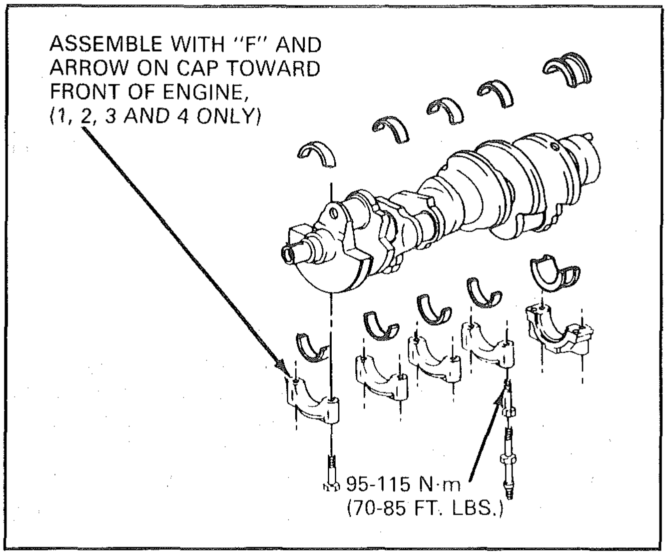


Fig. 6A3-38 Main Bearings

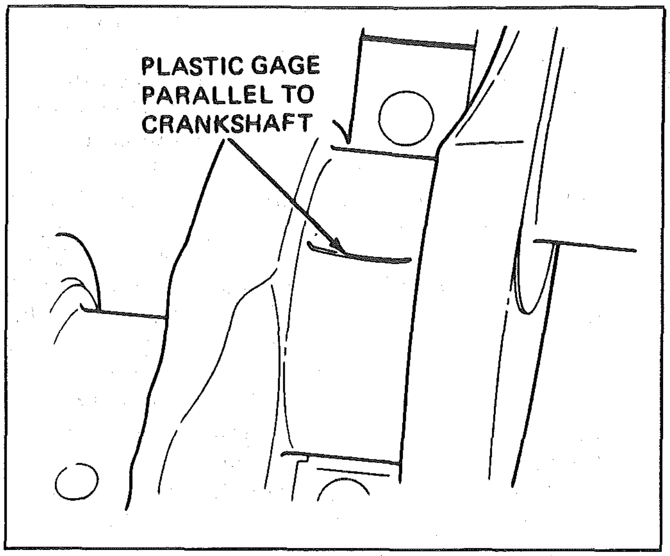


Fig. 6A3-39 Gaging Plastic on Journal-Typical

of a standard insert with one half of a .001" undersize insert which will decrease the clearance .0005" from using a full standard bearing.

When a production crankshaft cannot be precision fitted by this method, it is then ground .009" undersize **ON ONLY THOSE MAIN JOURNALS THAT CANNOT BE PROPERLY FITTED. ALL JOURNALS WILL NOT NECESSARILY BE GROUND.** A .009" undersize bearing and .010" undersize bearing may be used for precision fitting in the same manner as previously described.

If, for any reason, main bearing caps are replaced, shimming may be necessary. Laminated shims for each cap are available for service. Shim requirement will be determined by bearing clearance.

Inspection

In general, the lower half of the bearing (except #1 bearing) shows a greater wear and the most distress from fatigue. If upon inspection the lower half is suitable for use, it can be assumed that the upper half is also satisfactory. If the lower half shows evidence of wear or damage, both upper and lower halves should be replaced. Never replace one half without replacing the other half.

Checking Clearance

To obtain the most accurate results with "Plastigage", (or its equivalent) a wax-like plastic material which will compress evenly between the bearing and journal surfaces without damaging either surface, certain precautions should be observed.

If the engine is out of the vehicle and upside down, the crankshaft will rest on the upper bearings and the total clearance can be measured between the lower bearing and journal. If the engine is to remain in the vehicle, the crankshaft must be supported upward to remove any clearance from the upper bearing. The total clearance can then be measured between the lower bearing and journal.

To assure the proper seating of the crankshaft, all bearing cap bolts should be at their specified torque. In addition, preparatory to checking fit of bearings, the surface of the crankshaft journal and bearing should be wiped clean of oil.

1. With the oil pan and oil pump removed, and starting with the rear main bearing, remove bearing cap and wipe oil from journal and bearing cap.
2. Place a piece of gaging plastic the full width of the bearing (parallel to the crankshaft) on the journal (fig. 6A3-39).

NOTICE: Do not rotate the crankshaft while the gaging plastic is between the bearing and journal.

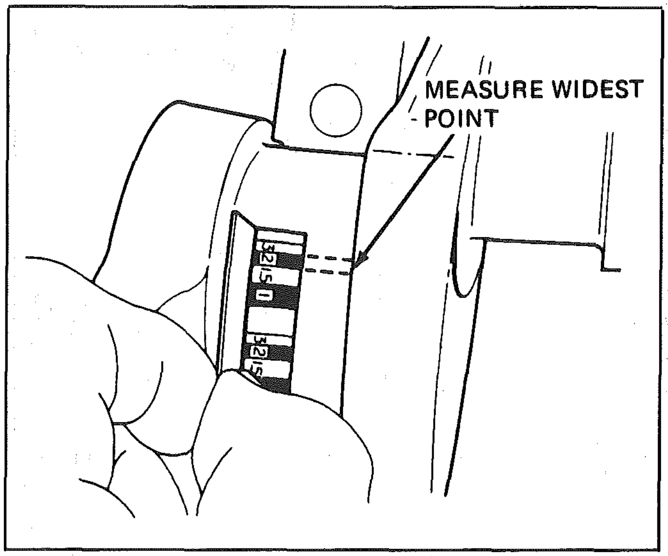


Fig. 6A3-40 Measuring Gaging Plastic-Typical

3. Install the bearing cap and evenly torque the retaining bolts to specifications. Bearing cap MUST be torqued to specification in order to assure proper reading. Variations in torque affect the compression of the plastic gage.
4. Remove bearing cap. The flattened gaging plastic will be found adhering to either the bearing shell or journal.

5. On the edge of gaging plastic envelope there is a graduated scale which is correlated in thousandths of an inch. Without removing the gaging plastic, measure its compressed width (at the widest point) with the graduations on the gaging plastic envelope (fig. 6A3-40).
   Normally main bearing journals wear evenly and are not out-of-round. However, if a bearing is being fitted to an out-of-round journal (.001" max.), be sure to fit to the maximum diameter of the journal: If the bearing is fitted to the minimum diameter and the journal is out-of-round .001", interference between the bearing and journal will result in rapid bearing failure. If the flattened gaging plastic tapers toward the middle or ends, there is a difference in clearance indicating taper, low spot or other irregularity of the bearing or journal. Be sure to measure the journal with a micrometer if the flattened gaging plastic indicates more than .001" difference.
6. If the bearing clearance is within specifications, the bearing insert is satisfactory. If the clearance is not within specifications, replace the insert. Always replace both upper and lower inserts as a unit.
   If a new bearing cap is being installed and clearance is less than .001", inspect for burrs or nicks; if none are found then install shims as required.

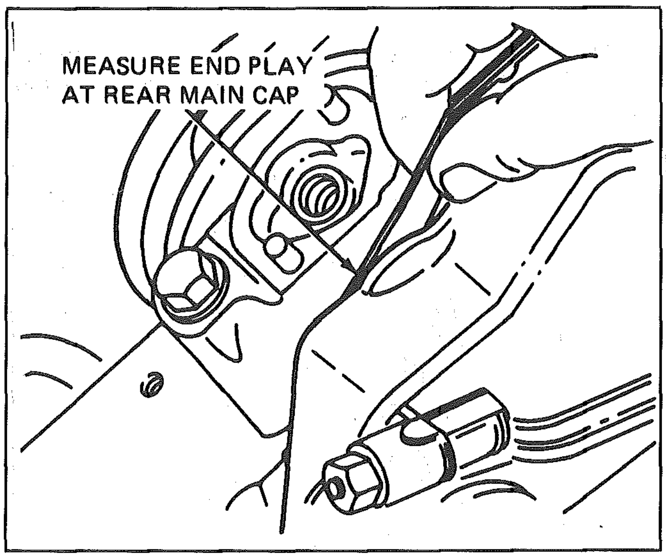


Fig. 6A3-41 Measuring Crankshaft End Play - Typical

7. A standard, .001" or .002" undersize bearing may produce the proper clearance. If not, it will be necessary to regrind the crankshaft journal for use with the next undersize bearing.
   After selecting new bearing, recheck clearance.
8. Proceed to the next bearing. After all bearings have been checked rotate the crankshaft to see that there is no excessive drag.
   When checking # 1 main bearing, loosen accessory drive belts so as to prevent tapered reading with plastic gage.
9. Measure crankshaft end play (see specifications) by forcing the crankshaft to the extreme front position. Measure at the front end of the rear main bearing with a feeler gage (fig. 6A3-41).
10. Install a new rear main bearing oil seal in the cylinder block and main bearing cap.

Replacement

Main bearings may be replaced with or without removing the crankshaft.

NOTICE: Some production engines may come with rear main bearings with the distance between thrust faces .008" wider than the standard size. The crankshaft will be identified by .008" stamped on the rear counterweight. If the rear main bearings are replaced, they must have the proper distance between thrust faces to ensure correct crankshaft end play.

With Crankshaft Removal

1. Remove and inspect the crankshaft.
2. Remove the main bearings from the cylinder block and main bearing caps.
3. Coat bearing surfaces of new, correct size, main bearings with oil and install in the cylinder block and main bearing caps.
4. Install the crankshaft.

Without Crankshaft Removal

1. With oil pan, oil pump and spark plugs removed, remove cap on main bearing requiring replacement and remove bearing from cap.
2. Install a main bearing removing and installing tool in oil hole in crankshaft journal. If such a tool is not available, a cotter pin may be bent as required to do the job.
3. Rotate the crankshaft clockwise as viewed from the front of engine. This will roll upper bearing out of block.
4. Oil new selected size upper bearing and insert plain (unnotched) end between crankshaft and indented or notched side of block.
   Rotate the bearing into place and remove tool from oil hole in crankshaft journal.
5. Oil new lower bearing and install in bearing cap.
6. Install main bearing cap with arrows pointing toward front of engine.
7. Torque all main bearing caps, EXCEPT THE REAR MAIN CAP, to specifications. Torque rear main bearing cap to 10-12 lb. ft. (14-16N·m) then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing caps to specifications.

REAR MAIN SEAL

Removal

1. Remove transmission as outlined in Section 7.
2. Using notches provided in retainer, pry out seal with a screwdriver (Figure 6A4-43).

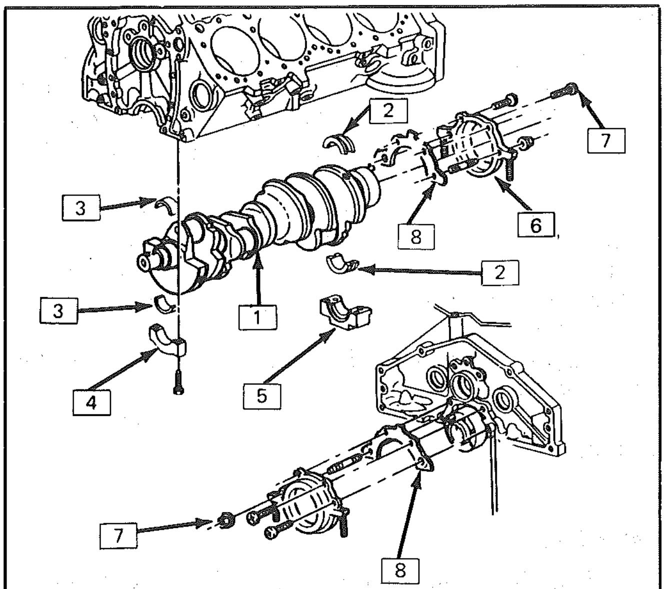


Figure 6A3-42 Crankshaft Oil Seal-Rear Main

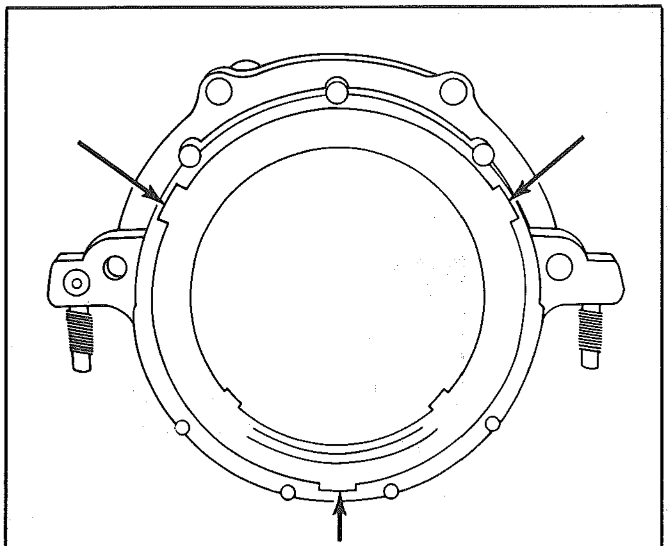


Figure 6A3-43 Seal Removal

NOTICE: Care should be taken when removing the seal so as not to nick crankshaft sealing surface.

Installation

1. Lubricate the I.D. and O.D. of new seal with engine oil.
2. Install seal on tool J-35621 (Figure 6A4-44).
3. Thread screws into rear of crankshaft. Tighten screws with a screwdriver snugly, this is to insure that the seal will be installed squarely over the crankshaft.

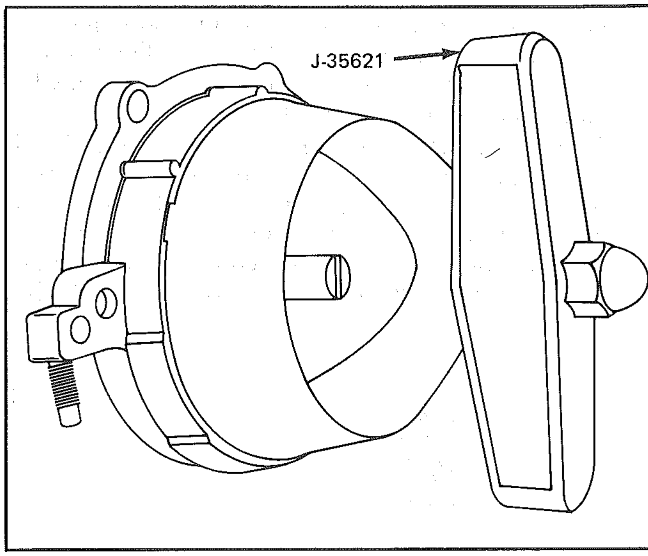


Figure 6A3-44 Seal Installation

4. Tighten the wing nut until it bottoms.
5. Remove tool from crankshaft.
6. Install transmission.

REAR MAIN SEAL RETAINER/GASKET

Removal

1. Remove oil pan bolts and lower oil pan.
2. Remove transmission as outlined in Section 7.
3. Remove retainer and seal assembly.
4. Remove gasket.

Installation

Whenever the retainer is removed, a new retainer gasket and rear main seal must be installed.

1. Clean mating surfaces of case and retainer assembly.
2. (Install new gasket on studs in engine case. It is not necessary to use any type of sealant to retain gasket in place.
3. (Install retainer to case bolts, torque bolts to 10-13 N·m (90-120 in. lbs.).
4. Install transmission.
5. Inspect oil pan gasket for damage. Replace gasket if necessary.
6. Apply a small amount of 1052751 or equivalent to front and rear corners of oil pan.

NOTICE: Only a small amount of sealant is required. Excessive amounts of sealant may cause a problem with proper sealing of oil pan.

7. Install oil pan bolts (Figure 6A4-32).
8. Install rear main seal using tool J-35621 as previously outlined.

CONNECTING ROD AND PISTON ASSEMBLIES

Removal

1. Remove oil pan, oil pump and cylinder head as previously outlined.
2. For the cylinder being serviced, turn crankshaft until piston is at the bottom of the stroke. Place a cloth on top of the piston.

3. Use a ridge reamer to remove any ridge and/or deposits from the upper end of the cylinder bore.
4. Turn crankshaft until piston is at top of stroke and remove cloth and cuttings.
5. Remove connecting rod cap and install Tool J-5239 (3/8") on studs. Push connecting rod and piston assembly out of top of cylinder block. It will be necessary to turn the crankshaft slightly to disconnectt some of the connecting rod and piston assemblies and push them out of the cylinder.

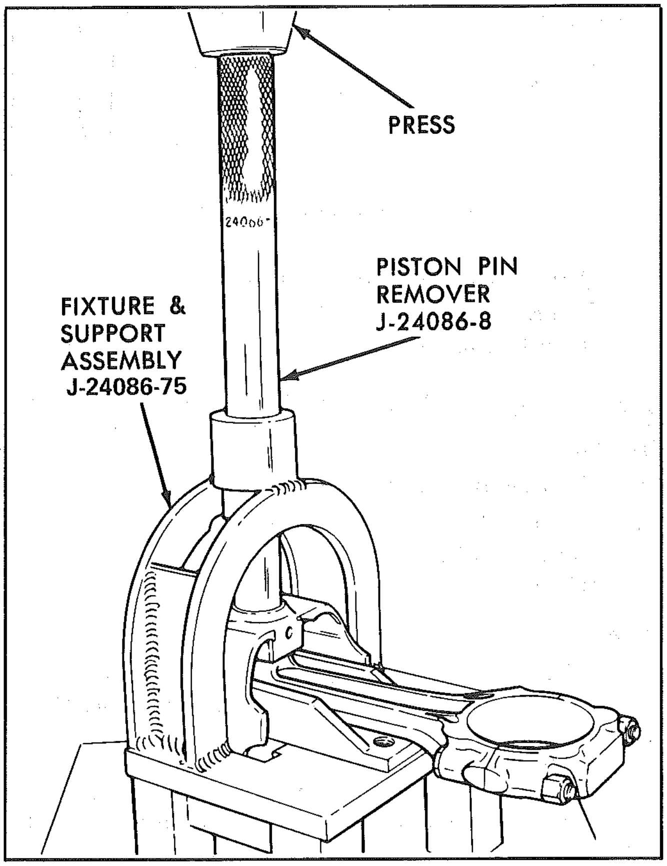


Fig. 6A3-45 Removing Piston Pin

Disassembly

1. Remove connecting rod bearings from connecting rods and caps. If bearings are being reused, place them in a rack so they may be reinstalled in their original rod and cap.
2. Remove piston rings by expanding and sliding them off the pistons.
3. Place connecting rod and piston assembly on Tool J-24086-20. Using an arbor press and piston pin remover, J-24086-8, press the piston pin out of connecting rod and piston (Fig. 6A3-45).

Cleaning and Inspection

Connecting Rods

Wash connecting rods in cleaning solvent and dry with compressed air. Check for twisted or bent rods and inspect for nicks or cracks. Replace connecting rods that are damaged.

Pistons

Clean varnish from piston skirts and pins with a cleaning solvent. DO NOT WIRE BRUSH ANY PART OF THE PISTON. Clean the ring grooves with a groove cleaner and make sure oil ring holes and slots are clean.

Inspect the piston for cracked ring lands, skirts or pin bosses, wavy or worn ring lands, scuffed or damaged skirts, eroded areas at top of the piston. Replace pistons that are damaged or show signs of excessive wear.

Inspect the grooves for nicks or burrs that might cause the rings to hang up.

Measure piston skirt (across center line of piston pin) and check clearance.

Piston Pins

The piston pin clearance is designed to maintain adequate clearance under all engine operating conditions. Because of this, the piston and piston pin are a matched set and not serviced separately.

Inspect piston pin bores and piston pins for wear. Piston pin bores and piston pins must be free of varnish or scuffing when being measured. The piston pin should be measured with a micrometer and the piston pin bore should be measured with a dial bore gage or an inside micrometer. If clearance is in excess of the .001" wear limit, the piston and piston pin assembly should be replaced.

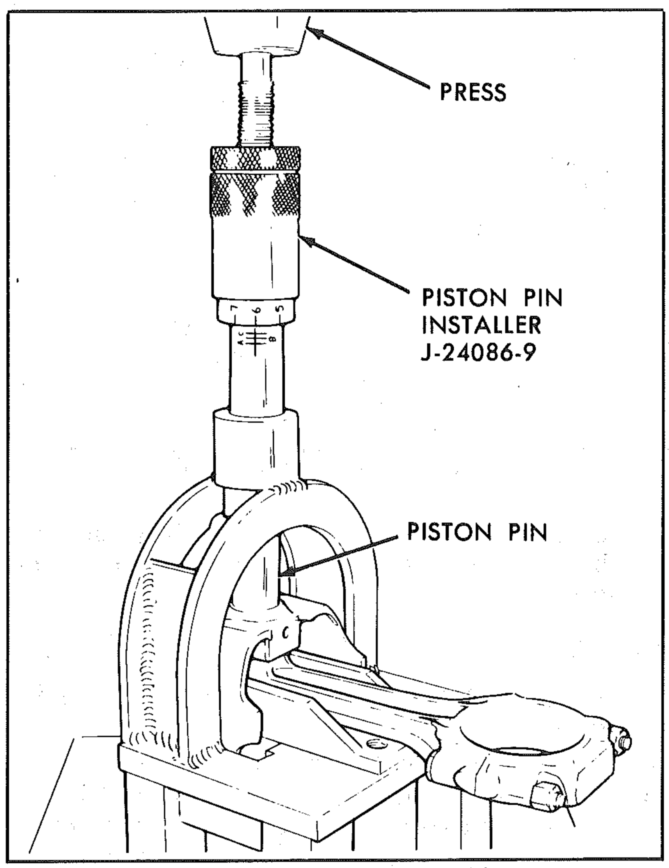


Fig. 6A3-46 Installing Piston Pin

Assembly

1. Lubricate piston pin holes in piston and connecting rod to facilitate installation of pin.
2. Place connecting rod in piston and hold in place with piston pin guide and piston pin. Place assembly on fixture and support assembly.
3. Using piston pin installer, J-24086-9, press the piston pin into the piston and connecting rod (Fig. 6A3-46).

   NOTICE: After installer hub bottoms on support assembly, do not exceed 5000 psi pressure, as this could cause structural damage to the tool.

4. Remove piston and connecting rod assembly from tool and check piston for freedom of movement on piston pin.

Piston Rings

All compression rings are marked on the upper side of the ring. When installing compression rings, make sure the MARKED SIDE IS TOWARD THE TOP OF THE PISTON. The top ring is chrome faced, or treated with molybdenum for maximum life. The second compression ring is a tapered face acting as both a compression and oil control ring.

The oil control rings are of three piece type, consisting of two segments (rails) and a spacer.

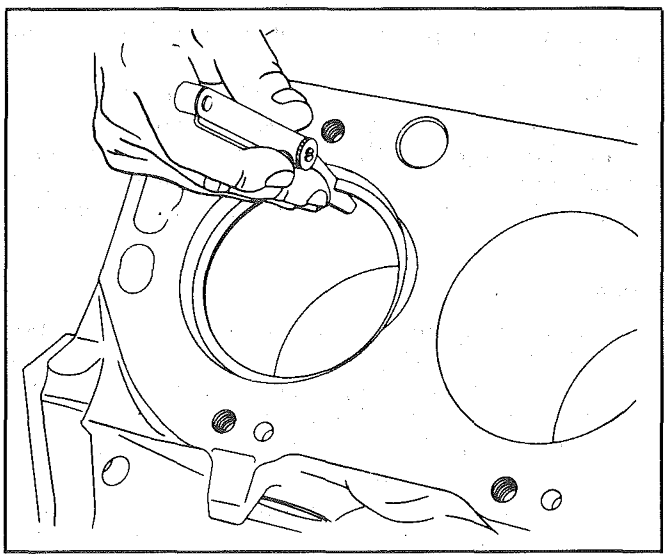


Fig. 6A3-47 Measuring Ring Gap

1. Select rings comparable in size to the piston being used.
2. Slip the compression ring in the cylinder bore; then press the ring down into the cylinder bore about 1/4" (6.5mm) (above ring travel). Be sure ring is square with cylinder wall.
3. Measure the space or gap between the ends of the ring with a feeler gage (Fig. 6A3-47).
4. If the gap between the ends of the ring is below specifications, remove the ring and try another for fit.
5. Fit each compression ring to the cylinder in which it is going to be used.
6. If the pistons have not been cleaned and inspected as previously outlined, do so.

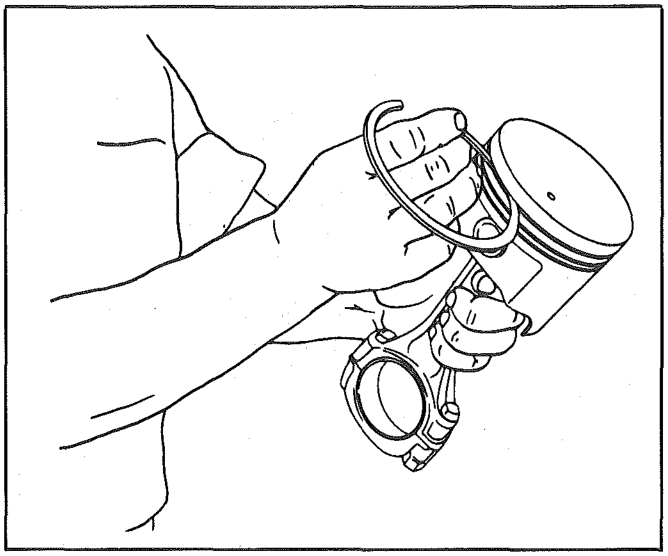


Fig. 6A3-48 Checking Ring in Groove

7. Slip the outer surface of the top and second compression ring into the respective piston ring groove and roll the ring entirely around the groove (Fig. 6A3-48) to make sure that the ring is free. If binding occurs at any point, the cause should be determined. If binding is caused by ring groove, correct by dressing with a fine cut file. If the binding is caused by a distorted ring, check a new ring.
8. Install piston rings as follows:
   a. Install oil ring spacer in groove and insert anti-rotation tang (where applicable) in drilled hole.
   b. Hold spacer ends butted and install lower steel oil ring rail with gap properly located.
   c. Install upper steel oil ring rail with gap properly located.
   d. Flex the oil ring assembly to make sure ring is free. If binding occurs at any point the cause should be determined. If binding is caused by ring groove, correct by dressing groove with a fine cut file. If binding is caused by a distorted ring, check a new ring.
   e. Install second compression ring (manufacturer mark up) with gaps properly located.
   f. Install top compression ring (manufacturer mark up) with gap properly located.
9. Proper clearance of the piston ring in its piston ring groove is very important to provide proper ring action and reduce wear. Therefore, when fitting new rings, the clearances between the surfaces of the ring and groove should be measured (Fig. 6A3-49). (See Specifications).

Installation

Cylinder bores must be clean before piston installation. This may be accomplished with a hot water and detergent wash or with a light honing as necessary. After cleaning, the bores should be swabbed several times with light engine oil and a clean dry cloth.

1. Lubricate connecting rod bearings and install in rods and rod caps.

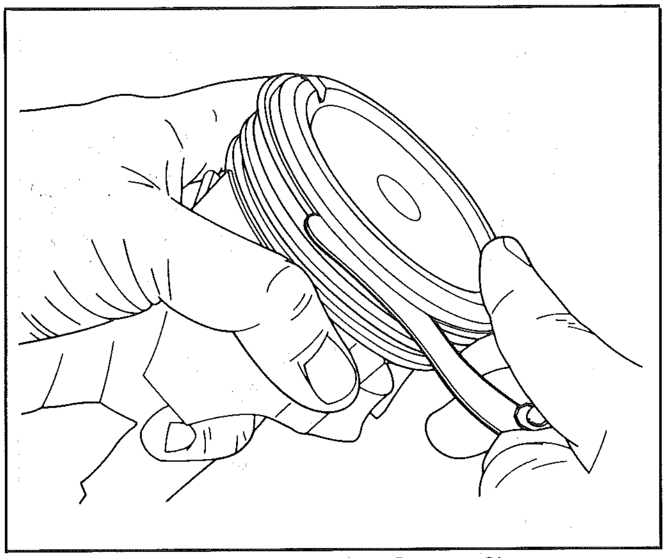


Fig. 6A3-49 Measuring Ring Groove Clearance

2. Lightly coat pistons, rings and cylinder walls with light engine oil.
3. With bearing caps removed, install Tool J-5239 (3/8") on connecting rod bolts.
4. Install each connecting rod and piston assembly in its respective bore. Install with connecting rod bearing tang slots on side opposite camshaft. Use Tool J-8037 to compress the rings. Guide the connecting rod into place on the crankshaft journal with Tool J-5239 (3/8"). Use a hammer handle and light blows to install the piston into the bore. Hold the ring compressor firmly against the cylinder block until all piston rings have entered the cylinder bore.
5. Remove Tool J-5239.
6. Install the bearing caps and torque nuts to specifications.

Be sure to install new pistons in the cylinders for which they were fitted, and used pistons in the cylinder from which they were removed. Each connecting rod and bearing cap should be marked, beginning at the front of the engine. 1,3,5 and 7 in the left bank and, 2 4, 6 and 8 in the right bank. The numbers on the connecting rod and bearing cap must be on the same side when installed in the cylinder bore. If a connecting rod is ever transposed from one block or cylinder to another, new bearings should be fitted and the connecting rod should be numbered to correspond with the new cylinder number.

CYLINDER BLOCK

Cleaning and Inspection

1. Wash cylinder block thoroughly in cleaning solvent and clean all gasket surfaces.
2. Remove oil gallery plugs and clean all oil passages.
3. Clean and inspect coolant passages in the cylinder block.
4. Inspect the cylinder block for cracks in the cylinder walls, coolant jacket, valve lifter bores and main bearing webs.
5. Measure the cylinder walls for taper, out-of-round or excessive ridge at top of ring travel. This should be done with a dial indicator. Set the gage so that the thrust pin must be forced in about 1/4" (6.5mm) to enter gage in cylinder bore. Center gage in cylinder and turn dial to "0". Carefully work gage up and down cylinder to determine taper and turn it to different points around cylinder wall to determine the out-of-round condition. If cylinders were found to exceed specifications, honing or boring will be necessary.

Conditioning

The performance of the following operation is contingent upon engine condition at time of repair.

If the cylinder block inspection indicated that the block was suitable for continued use except for out-of-round or tapered cylinders, they can be conditioned by honing or boring.

If the cylinders were found to have less than .005" (.13mm) taper or wear, they can be conditioned with a hone and fitted with the high limit standard size piston. A cylinder bore of less then .005" (.13mm) wear or taper may not entirely clean up when fitted to a high limit piston. If it is desired to entirely clean up the bore in these cases, it will be necessary to rebore for an oversize piston. If more than .005" (.13mm) taper or wear, they should be bored and honed to the smallest oversize that will permit complete resurfacing of all cylinders.

When pistons are being fitted and honing is not necessary, cylinder bores may be cleaned with a hot water and detergent wash. After cleaning, the cylinder bores should be swabbed several times with light engine oil and a clean cloth and then wiped with a clean dry cloth.

Boring

1. Before using any type boring bar, the top of the cylinder block should be filed to remove any dirt or burrs. This is very important. If not checked, the boring bar may be tilted which would result in the rebored cylinder wall not being at right angles to the crankshaft.
2. The piston to be fitted should be measured with a micrometer, measuring at the center of the piston skirt and at right angles to the piston pin. The cylinder should be bored to the same diameter as the piston and honed to give the specified clearance.
3. The instructions furnished by the manufacturer of the equipment being used should be carefully followed.

Honing

1. When cylinders are to be honed, follow the hone manufacturer's recommendations for the use of the hone and cleaning and lubrication during honing.
2. Occasionally during the honing operation, the cylinder bore should be thoroughly cleaned and the piston selected for the individual cylinder checked for correct fit.

3. When finish honing a cylinder bore to fit a piston, the hone should be moved up and down at a sufficient speed to obtain very fine uniform surface finish marks in a cross-hatch pattern of approximately 45° to 65° included angle. The finish marks should be clean but not sharp, free from imbedded particles and torn or folded metal.
4. Permanently mark the piston for the cylinder to which it has been fitted and proceed to hone cylinders and fit the remaining pistons.

NOTICE: Handle the pistons with care and do not attempt to force them through the cylinder until the cylinder has been honed to correct size as this type piston can be distorted through careless handling.

5. Thoroughly clean the bores with hot water and detergent. Scrub well with a stiff bristle brush and rinse thoroughly with hot water. It is extremely essential that a good cleaning operation be performed. If any of the abrasive material is allowed to remain in the cylinder bores, it will rapidly wear the new rings and cylinder bores in addition to the bearings lubricated by the contaminated oil, the bores should be swabbed and then wiped with a clean dry cloth. Cylinder should not be cleaned with kerosene or gasoline. Clean the remainder of the cylinder block to remove the excess material spread during the honing operation.

Piston Selection

1. Check USED piston to cylinder bore clearance as follows:
   a. Measure the "Cylinder Bore Diameter" with a telescope gage "2-1/2″ (64mm) from top of cylinder bore").
   b. Measure the "Piston Diameter" (at skirt across center line of piston pin).
   c. Subtract piston diameter from cylinder bore diameter to determine "Piston to Bore Clearance".
   d. Determine if piston to bore clearance is in the acceptable range.
2. If used piston is not acceptable, check Piston Size Chart and determine if a new piston can be selected to fit cylinder bore within the acceptable range.
3. If cylinder bore must be reconditioned, measure new piston diameter (across center line of piston pin) then hone cylinder bore to correct clearance (preferable range).
4. Mark the piston to identify the cylinder for which it was fitted.

OIL FILTER BYPASS VALVE

Inspection and Replacement

With the oil filter removed, check the spring and fibre valve for operation. Inspect for a cracked or broken valve. If replacement is necessary, the oil filter adapter and bypass valve assembly must be replaced as an assembly. Clean valve chamber in cylinder block thoroughly. Torque retaining screws to specifications.

ENGINE ASSEMBLY

Removal

1. Disconnect battery.
2. Remove air cleaner.
3. Remove hood.
4. Drain radiator.
5. Remove lower radiator hose.
6. Remove upper fan shroud.
7. Remove upper radiator hose and coolant recovery hose.
8. Remove transmission cooler lines.
9. Remove radiator.
10. Remove fan assembly.
11. Remove heater hoses.
12. Disconnect carburetor linkage, includes cruise control detent cable.
13. Remove vacuum brake booster line.
14. Remove distributor cap and lay wiring aside.
15. Disconnect necessary wires and hoses.
16. Remove power steering pump and lay aside.
17. Raise vehicle.
18. Remove exhaust pipes at exhaust manifold.
19. Remove dust cover.
20. Remove converter bolts.
21. Disconnect starter wires.
22. Remove bell housing bolts.
23. Remove motor mount through bolts.
24. Disconnect fuel lines at fuel pump.
25. Lower vehicle.
26. Support transmission.
27. Remove A.I.R./Converter pipe bracket.
28. Remove engine, include removing wire from bracket at rear left of engine.

Installation

1. Position engine assembly in vehicle.
2. Attach motor mount to engine brackets and lower engine in place.
3. Remove engine lifting device.
4. Remove transmission floor jack.
5. Raise vehicle on hoist.
6. Install mount "through" bolts. Torque to specifications.
7. Install bell housing bolts. Torque to specifications.
8. On vehicles with automatic transmissions, install converter to flywheel attaching bolts. Torque to specifications.
9. Install flywheel splash shield of converter housing cover as applicable. Torque attaching bolts to specifications.
10. Install starter wires.
11. Connect fuel lines.
12. Connect exhaust pipe at manifold.
13. Lower vehicle on hoist.
14. Reinstall power steering pump, if so equipped.
15. Connect necessary wires and hoses.

16. Install radiator and fan shroud and reconnect radiator and heater hoses.
17. Fill cooling system.
18. Fill crankcase with oil. See owner's manual for specifications.
19. Install air cleaner.
20. Install hood.
21. Connect battery cables.

NOTICE: To avoid possible arcing of battery, connect positive battery cable first.

22. Start engine, check for leaks and check timing.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, as previously outlined, or without complete disassembly.

Removal

1. With the engine removed from the vehicle and the transmission and/or clutch housing removed from the engine, mount engine in stand and clamp securely.
2. Remove the oil dip stick and oil dip stick tube, (if applicable).
3. Remove the starting motor, clutch assembly (if equipped) and flywheel.
4. Remove the spark plugs.
5. Remove crankshaft pulley and torsional damper.
6. Remove oil pan and oil pump.
7. Remove crankcase front cover, and if so equipped, remove timing chain and camshaft sprocket.
8. Check the connecting rod caps for cylinder number identification. If necessary, mark them.
9. Remove the connecting rod caps and push the pistons to top of bores.
10. Remove main bearing caps and lift crankshaft out of cylinder block.
11. Remove rear main bearing oil seal and main bearings from cylinder block and main bearing caps.

Cleaning and Inspection

1. Wash crankshaft in solvent and dry with compressed air.
2. Measure dimensions of main bearing journals and crankpins with a micrometer for out-of-round, taper or undersize. (See Specifications.)
3. Check crankshaft for run-out by supporting at the front and rear main bearings journals in "V" blocks and check at the front and rear intermediate journals with a dial indicator. (See Specifications.)
4. Replace or recondition the crankshaft if out of specifications.

SPROCKET OR GEAR REPLACEMENT

- Remove crankshaft sprocket using Tool J-5825, install using Tool J-5590.

Installation

1. Install rear main bearing oil seal in cylinder block and rear main bearing cap grooves. Install with lip of seal toward front of engine. Where seal has two lips install lip with helix towards front of engine.
2. Lubricate lips of seal with engine oil. Keep oil off parting line surface.
3. Install main bearings in cylinder block and main bearing caps then lubricate bearing surface with engine oil.
4. Install crankshaft, being careful not to damage bearing surfaces.
5. Recheck bearing clearances using plastigage.
6. Apply a thin coat of brush-on type oil sealing compound to block mating surface and corresponding surface of cap only. Do not allow sealant on crankshaft or seal.
7. Install main bearing caps with arrows pointing toward front of engine.
8. Torque all except rear main bearing cap bolts to specifications. Torque rear main bearing cap bolts to 10-12 lbs. ft. (14-16 N·m)then tap end of crankshaft, first rearward then forward with a lead hammer. This will line up rear main bearing and crankshaft thrust surfaces. Retorque all main bearing cap bolts to specifications.
9. Measure crankshaft end play with a feeler gage. Force crankshaft forward and measure clearance between the front of the rear main bearing and the crankshaft thrust surface.
10. Install flywheel and torque to specifications. A wood block placed between the crankshaft and cylinder block will prevent crankshaft from rotating.
    - Align dowel hole in flywheel with dowel hole in crankshaft. On vehicles equipped with automatic transmissions, install flywheel with the converter attaching pads towards transmission.

GENERAL DATA

TYPE	90° V-8
DISPLACEMENT	305 Cu. In., 350 Cu. In.
LITER (VIN)	**5.0, (E), (F), 5.7 (8)**
RPO	**L03, LB9, L98**
BORE	3.736, 4.000
STROKE	3.480, 3.480
COMPRESSION RATIO	**9.3:1, 9.3:1, 9.5:1**
FIRING ORDER	1-8-4-3-6-5-7-2

Cylinder Bore

DIAMETER 3.7350-4.7385, (L98) 3.9995-4.0025
OUT-OF-ROUND
Production .... .0010 Max.
Service .... .0020 Max.
TAPER
Production Thrust Side .... .0005 Max.
Production Relief Side .... .0010 Max.
Service .... .0010 Max.

Piston

CLEARANCE
Production .... .0007-.0017
Service .... .0027 Max.

Piston Ring

COMPRESSION
Groove Clearance
Production 1st .... .0012-.0032
Production 2nd .... .0012-.0032
Service .... Hi Limit Production + .001
Gap
Production 1st .... .010-.020
Production 2nd .... .010-.025
Service .... Hi Limit Production + .010
OIL
Groove Clearance
Production .... .002-.007
Service .... Hi Limit Production + .001
Gap
Production .... .015-.055
Service .... Hi Limit Production + .010

Piston Pin

DIAMETER .... .9270-.9273
CLEARANCE
Production .... .00025-.00035
Service .... .001 Max.
FIT IN ROD .... .0008-.0016 Interference

Crankshaft

MAIN JOURNAL
Diameter
Front 2.4484-2.4493
Intermediate 2.4481-2.4490
Rear 2.4479-2.4488
Taper
Production .... .0002 Max.
Service .... .0010 Max.
Out-Of-Round
Production .... .0002 Max.
Service .... .0010 Max.
MAIN BEARING CLEARANCE
Production
Front .... .0008-.0020
Intermediate .... .0011-.0032

Rear	.0017-.0032
Service	
Front	.001-.0015
Intermediate	.001-.0020
Rear	.0025-.0030
CRANKSHAFT END PLAY	.002-.006
CRANKPIN	
Diameter	2.0986-2.0998
Taper	
Production	.0005 Max., (L98) .0003 Max.
Service	.001 Max.
Out-Of-Round	
Production	.0002
Service	.001 Max.
ROD BEARING CLEARANCE	
Production	.0018-.0039, (L98), 0013-.0035
Service	.002-.0030, (L98) .0035 Max.
ROD SIDE CLEARANCE	.008-.014, (L98) .006-.014

Camshaft

LOBE LIFT ± .002	
Intake	.234, .269, (L98) .273
Exhaust	.257, .276, (L98) .282
JOURNAL DIAMETER	1.8682-1.8692
CAMSHAFT END PLAY	.004-.012

VALVE SYSTEM

LIFTER	Hydraulic
ROCKER ARM RATIO	1.50:1
VALVE LASH	
Intake	One Turn Down
Exhaust	From Zero Lash
FACE ANGLE	45°
SEAT ANGLE	46°
SEAT RUNOUT	.002 Max.
SEAT WIDTH	
Intake	1/32-1/16
Exhaust	1/16-3/32
STEM CLEARANCE	
Production	
Intake	.0010-.0027
Exhaust	.0010-.0027
Service	Hi Limit Production + .001 Intake + .002 Exhaust
VALVE SPRING	
Free Length	2.03
Pressure Lbs. @ In.	
Closed	76-84 @ 1.70 INT., 1.61 EXH.
Open	194-206 @ 1.25 INT., 1.16 EXH.
Installed Height	1-23/32 INT., 1-19/32 EXH.
DAMPER	
Free Length	1.86
Approx. # of Coils	4

TORQUE SPECIFICATIONS

Main Bearing Caps	85-115 N·m, 63-85 ft. lbs.
Cylinder Head Bolts	81-102 N·m, 60-75 ft. lbs.
Flywheel Bolts	85-115 N·m, 63-85 ft. lbs.
Connecting Rod Caps	57-64 N·m, 42-47 ft. lbs.
Oil Pan	
Stud 5/16-18x1.44	10 in. lbs. minimum
Stud Nut	17-28 N·m, 150-250 in. lbs.
1/4-20x.56	8-14 N·m, 72-130 in. lbs.
Stud 1/4-20x.50x.56	8-14 N·m, 72-130 in. lbs.
Oil Pump to Case	81-95 N·m, 60-70 ft. lbs.
Front Cover	8-14 N·m, 69-130 in. lbs.
Water Pump	34-47 N·m, 25-35 ft. lbs.
Thermostat Housing	
T.P.I.	27-40 N·m, 20-30 ft. lbs.
Intake Manifold	
Carbureted	34-61 N·m, 25-45 ft. lbs.
T.P.I.	34-61 N·m, 25-45 ft. lbs.
Exhaust Manifold	
Outer 4 bolts	19-35 N·m, 14-26 ft. lbs.
Inner 2 bolts	27-43 N·m, 20-32 ft. lbs.
Camshaft Sprocket	17-31 N·m, 13-23 ft. lbs.
Rocker Arm Nuts	6-14 N·m, 55-125 in. lbs.
Rocker Arm Covers	7-12 N·m, 62-115 in. lbs.
Distributor Hold Down Bolt	27-47 N·m, 20-35 ft. lbs.

SECTION 6B

ENGINE COOLING

GENERAL DESCRIPTION

The cooling system maintains engine temperature at an efficient level during all engine operating conditions. When the engine is cold the system cools slowly, or not at all, to allow the engine to warm up quickly.

The cooling system includes a radiator and recovery sub-system, cooling fan, thermostat and housing, water pump, and drive belts.

Operation of the cooling system requires proper functioning of all components. Coolant is drawn from the radiator by the water pump and circulated through water jackets in the engine block, intake manifold, and cylinder head(s), and then directed back to the radiator where it's cooled.

This system directs some coolant through hoses to the heater core, to provide for heating and defrosting. A recovery bottle is connected to the radiator to recover coolant displaced by expansion from high temperatures and maintain correct coolant level. As the coolant cools and contracts it is drawn back into the radiator by vacuum.

RADIATOR

A cross-flow radiator is used on all models. Tanks in this type radiator are located to the right and left of the core, instead of above and below.

Radiators used with automatic transmissions have oil coolers with inlet and outlet fittings for transmission fluid circulation. Cars with manual transmissions use radiators without oil coolers. Vehicles equipped with air conditioning use a radiator with extra cooling capability.

An aluminum-plastic radiator, used on some models, can be identified by a note on the outlet tank 5″ below the filler neck which reads, "Important - for repair see Harrison Service Manual". Service procedures for the aluminum plastic radiator are described in that manual and in this section.

Radiator Cap

A pressure-vent cap is used on the cross-flow radiator to allow a buildup of 103 kPa (15 psi) in the cooling system. This pressure raises the boiling point of coolant to approximately 125°C (262°F) at sea level. **Do not remove radiator cap to check engine coolant level; check coolant visually at the see-through coolant reservoir. Coolant should be added only to the reservoir.**

CAUTION: As long as there is pressure in the cooling system, the temperature can be considerably higher than the boiling temperature of the solution in the radiator without causing the solution to boil. Removal of the radiator cap while engine is hot and pressure is high will cause the solution to boil instantaneously and possibly with explosive force, spewing the solution over engine, fenders and person removing cap. If the solution contains flammable antifreeze, such as alcohol (not recommended for use at any time), there is also the possibility of causing a serious fire.

The pressure-type radiator filler cap contains a blow off or pressure valve and a vacuum or atmospheric valve (Figure 1). The pressure valve is held against its seat by a spring of pre-determined strength, which protects the radiator by relieving pressure if it exceeds design limits. The vacuum valve is held against its seat by a light spring, which permits opening of the valve to relieve vacuum created in the system when it cools off and which otherwise might cause the radiator to collapse.

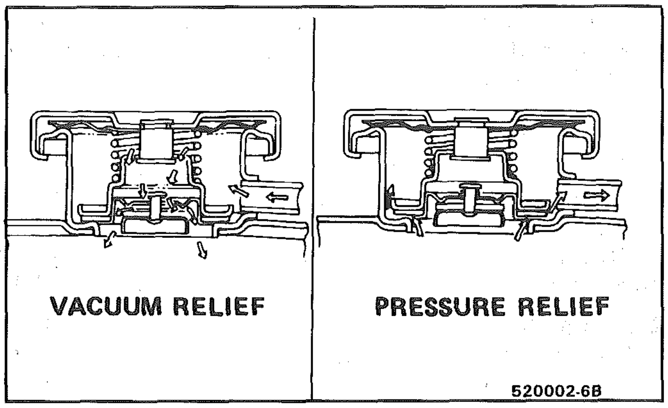


Fig. 1 Pressure-Type Radiator Cap

The radiator cap is designed to discourage inadvertent removal. The finger grips have been removed so the cap is round in shape. It also must be pushed downward before it can be removed. A rubber asbestos gasket is added to the diaphragm spring at the top of the cap. Embossed on the cap is a caution against its being opened and arrows indicating the proper closed position.

Every vehicle has a radiator cap. Also, J, N and P Series vehicles with 2.5L engines have a thermostat housing cap. For these engines, add coolant through the thermostat housing (with the thermostat and cap removed).

Recovery Bottle

A "see-through" plastic reservoir, similar to the familiar windshield washer jar, is connected to the radiator by a hose. As the car is driven, the coolant is heated and expands. The portion of the fluid displaced by this expansion flows from the radiator into the recovery bottle. When the engine is stopped and the coolant cools and contracts, the displaced coolant is drawn back into the radiator by vacuum. Thus, the radiator is kept filled with coolant to the desired level at all times, resulting in increased cooling efficiency. Coolant level should be between "ADD" and "FULL" marks on recovery bottle. These marks are approximately two quarts apart so that a 50/50 mixture can be added (one quart of ethylene glycol anti-freeze and one quart of water).

FAN

Electric Fan

Fans range in sizes from 290mm (11.6 in) to 422mm (16.9 in) with 4 to 7 blades to aid air flow through the radiator/condenser. The fan is driven by an electric motor which is attached to the radiator support.

The fan motor is activated by a coolant temperature switch. If the vehicle is equipped with

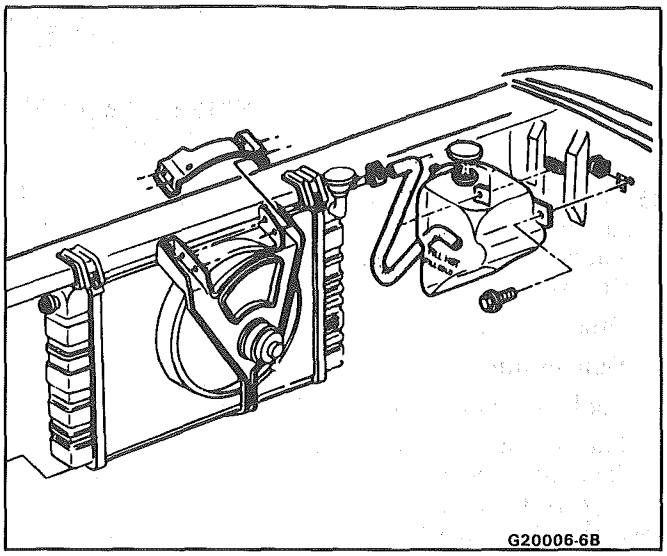


Fig. 2 Coolant Recovery Bottle

A/C, a second switch can activate the circuit, depending upon A/C compressor head pressure to the condenser.

CAUTION: If a fan blade is bent or damaged in any way, no attempt should be made to repair and reuse the damaged part. A bent or damaged fan assembly should always be replaced with a new fan assembly. It is essential that fan assemblies remain in proper balance and proper balance cannot be assured once a fan assembly has been bent or damaged. A fan assembly that is not in proper balance could fail and fly apart during subsequent use, creating an extremely dangerous condition.

The majority of non-A/C cars use a fan with four blades which are unevenly spaced and have curled tips to provide minimum noise. A fan shroud is used to prevent recirculation of air around the fan on most cars.

Thermostatically Controlled Fluid Clutch Fan

A thermostatically controlled fluid clutch fan is used on some air conditioned vehicles. It operates only when additional air flow is required to reduce radiator coolant temperatures. This clutch is of a simple, functional design. It is made of lightweight metal filled with silicone oil and is hermetically sealed. The finned (rear) housing contains a hub assembly (secured to the housing bearing) which attaches to the engine water pump. Four bosses with tapped holes in the rear face provide for attachment of the engine fan. The front surface of the housing has six deep circular grooves which index with six matching bosses on the rear face of a floating clutch. A separator plate and front cover, with thermostatic coil control, complete the clutch assembly.

During periods of operation when radiator discharge air temperature is low, below approximately 66°C (150°F), the clutch limits the fan speed to 800-1400 rpm. In this position, the clutch is disengaged since a small oil pump driven by the separator plate forces the silicone oil into a reservoir between the separator plate and the front cover assembly. In this position, the passage from this cavity to the clutch area is closed by a slide valve. As operating conditions produce a high radiator air temperature discharge, above approximately 66°C (150°F), the temperature sensitive bi-metal coil tightens to move the slide valve (attached to the coil) which opens a port in the separator plate. This allows a flow of silicone oil into the clutch chamber to engage the clutch, providing a maximum fan speed of approximately 2200 rpm. The clutch coil is calibrated so that, with a road load at an ambient temperature of approximately 32°C (90°F), the clutch is just at a point of shift between high and low fan speed. No attempt should be made to disturb the calibration of the engine clutch fan assembly as each assembly is individually calibrated at the time of manufacture. Under certain temperature conditions there is a lateral movement at the fan tip which should not be considered as a hub or bearing failure. This condition is a design feature of the clutch assembly which allows up to approximately 1/4" lateral movement measured at the fan tip.

Testing a clutch fan by holding the small hub with one hand and rotating the aluminum housing in a clockwise/counter-clockwise motion will cause the clutch to freewheel, which is a normal condition when operated in this manner. This should not be considered a test by which replacement is determined.

Temperature Switch

This switch activates a warning lamp in the instrument cluster if the engine overheats. With optional instrumentation, a temperature gage replaces the warning lamp and the temperature switch is replaced with a transducer. See Section 8A for Temperature Switch location and diagnosis.

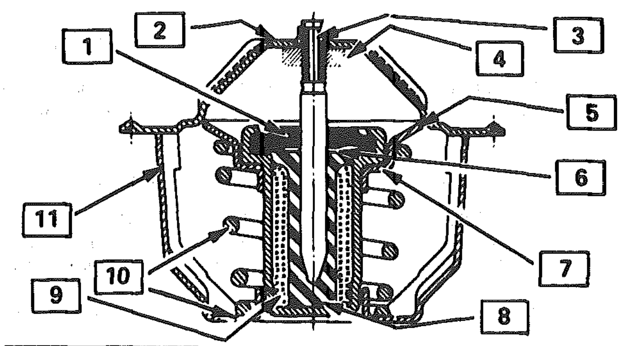
Coolant Temperature Fan Switch

This switch regulates voltage to the coolant fan relay, which operates the fan whenever the engine coolant temperature exceeds 230° F (110° C). For location and diagnosis see Section 8A for Coolant Temperature Fan Switch.

Thermostat

A pellet-type thermostat is used in the coolant outlet passage to control the flow of engine coolant, to provide fast engine warm-up and to regulate coolant temperatures. A wax pellet element in the thermostat expands when heated and contracts when cooled. The pellet element is connected through a piston to a valve. When the pellet element is heated, pressure is exerted against a rubber diaphragm which forces the valve to open. As the pellet element is cooled, the contraction allows a spring to close the valve. Thus, the valve remains closed while the coolant is cold, preventing circulation of coolant through the radiator. At this point, coolant is allowed to circulate only throughout the engine to warm it quickly and evenly.

As the engine warms, the pellet element expands and the thermostat valve opens, permitting coolant to flow through the radiator, where heat is dissipated through the radiator walls. This opening and closing of the thermostat permits enough coolant to enter the radiator to keep the engine within operating limits.



1–FLANGE SEAL
2–FLANGE
3–PISTON
4–NUT
5–VALVE SEAT
6–TEFLON SEAL
7–VALVE
8–RUBBER DIAPHRAGM
9–WAX PELLET
10–COIL SPRING
11–FRAME

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Fig. 3 Pellet Type Thermostat

Coolant Recovery System

A recovery-type cooling system is standard on all cars and is designed to maintain the engine at proper operating temperatures. The recovery tank collects coolant that expands with rising temperature and would otherwise overflow from the system. When the system temperature drops, the coolant is drawn from the recovery tank back into the radiator by the suction created by coolant contraction. The cooling system has been filled at the factory with a high-quality, inhibited, year-around coolant that meets the standards of General Motors Specification 1825-M. This coolant solution provides freezing protection to at least -37°C (-34°F). It has been formulated to be used for two full calendar years or 30,00 miles, whichever first occurs, of normal operation without replacement, provided the proper concentration of coolant is maintained.

DIAGNOSIS

The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made the problem should be corrected by part replacement, adjustment, or repair as required. Refer to the appropriate section of the service manual for these procedures.

SERVICE PROCEDURES

Cooling System Care

The radiator cap should not be removed to check coolant level. Check the coolant level visually in the "see-through" coolant recovery tank every time hood is up. Level should be near "ADD" mark when the system is cold. At normal operating temperature the coolant level should increase to the "FULL" mark on the recovery tank. Coolant should be added only to the reservoir to raise level to the "FULL" mark. Use a 50/50 mixture of high-quality ethylene glycol antifreeze and water for coolant additions.

ENGINE COOLING SYSTEM COMPLAINT

TO AVOID NEEDLESS TIME AND COST IN DIAGNOSING COOLING SYSTEM COMPLAINTS, THE CUSTOMER SHOULD BE QUESTIONED ABOUT DRIVING CONDITIONS THAT PLACE ABNORMAL LOADS ON THE COOLING SYSTEM.

1. DOES OVERHEATING OCCUR WHILE PULLING A TRAILER?

   IF ANSWER IS "YES" — HOW HEAVY IS TRAILER? IF TRAILER WEIGHT IS GREATER THAN 1,000 LBS. & CAR IS EQUIPPED WITH NORMAL DUTY COOLING SYSTEM, A HEAVY DUTY COOLING PACKAGE IS REQUIRED (PER MFR'S TRAILER HAULING SPECS.). FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

2. IS CAR EQUIPPED WITH ADD—ON OR AFTER MARKET AIR CONDITIONING SYSTEM?

   IF ANSWER IS "YES" — WAS HEAVY DUTY RADIATOR INSTALLED WITH THE SYSTEM? IF NOT, INSTALL HEAVY DUTY AIR CONDITIONING RADIATOR FOR THE CAR MODEL INVOLVED (PER MANUFACTURER'S SPECS.). FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

3. IS OVERHEATING OCCURRING AFTER PROLONGED IDLE, IN GEAR, A/C SYSTEM OPERATING?

   IF ANSWER IS "YES" — INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING SUCH AS:
   a. IDLE IN NEUTRAL AS MUCH AS POSSIBLE — INCREASE ENGINE R.P.M. TO GET HIGHER AIR FLOW & WATER FLOW THROUGH RADIATOR.
   b. TURN A/C SYSTEM OFF DURING EXTENDED IDLES IF OVERHEATING IS INDICATED BY HOT LIGHT OR TEMP. GAGE.

   FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

4. IS OVERHEATING OCCURRING AFTER PROLONGED DRIVING IN SLOW CITY TRAFFIC, TRAFFIC JAMS, GARAGES, ETC.?

   IF ANSWER IS "YES" — INSTRUCT OWNER ON DRIVING TECHNIQUES THAT WOULD AVOID OVERHEATING — SAME AS FOR PROLONGED IDLES — NO. 3 FURTHER DIAGNOSTIC CHECKS SHOULD NOT BE REQUIRED.

IF NONE OF THE ABOVE APPLY, GO TO DIAGNOSTIC CHART

TO EFFECTIVELY USE THIS CHART, QUESTION THE OWNER TO DETERMINE WHICH OF THE FOLLOWING (3) CATEGORIES APPLIES TO THE COMPLAINT:

1. HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE
2. BOILING
3. COOLANT LOSS

1. IF COMPLAINT IS HOT LIGHT OR HOT INDICATION ON TEMPERATURE GAGE —

   WAS HOT LIGHT ACCOMPANIED BY BOILING? IF ANSWER IS "YES", GO TO BOILING ON CHART
   IF ANSWER IS "NO", GO TO HOT LIGHT ON CHART

2. IF COMPLAINT IS BOILING — GO TO BOILING ON CHART
   IF PROBLEM REMAINS, GO TO COOLING FAN DIAGNOSIS SECTION 8 (IF SO EQUIPPED).

3. IF COMPLAINT IS COOLANT LOSS —

DETERMINE IF CUSTOMER IS OVERFILLING THE SYSTEM, THIS WOULD NORMALLY RESULT IN SMALL AMOUNTS OF COOLANT LOSS THROUGH THE OVERFLOW TUBE. IF THIS IS THE CASE, INSTRUCT THE CUSTOMER ON PROPER FILL LEVEL & NO FURTHER DIAGNOSTIC CHECKS SHOULD BE REQUIRED.

IF OVERFILLING IS NOT THE PROBLEM, GO TO COOLANT LOSS ON CHART.

NOTICE: ANYTIME COOLING SYSTEM IS OBVIOUSLY CONTAMINATED, THE SYSTEM SHOULD BE DRAINED AND FLUSHED.

CAUTION — THE COOLING SYSTEM IS DESIGNED TO OPERATE AT 15 P.S.I. PRESSURE & TEMPERATURES EXCEEDING 200°F. CAUTION SHOULD BE EXERCISED WHEN REMOVING PRESSURE CAP OR SERVICING THE SYSTEM.

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Fig. 4 Cooling System Diagnosis Chart (1 of 3)

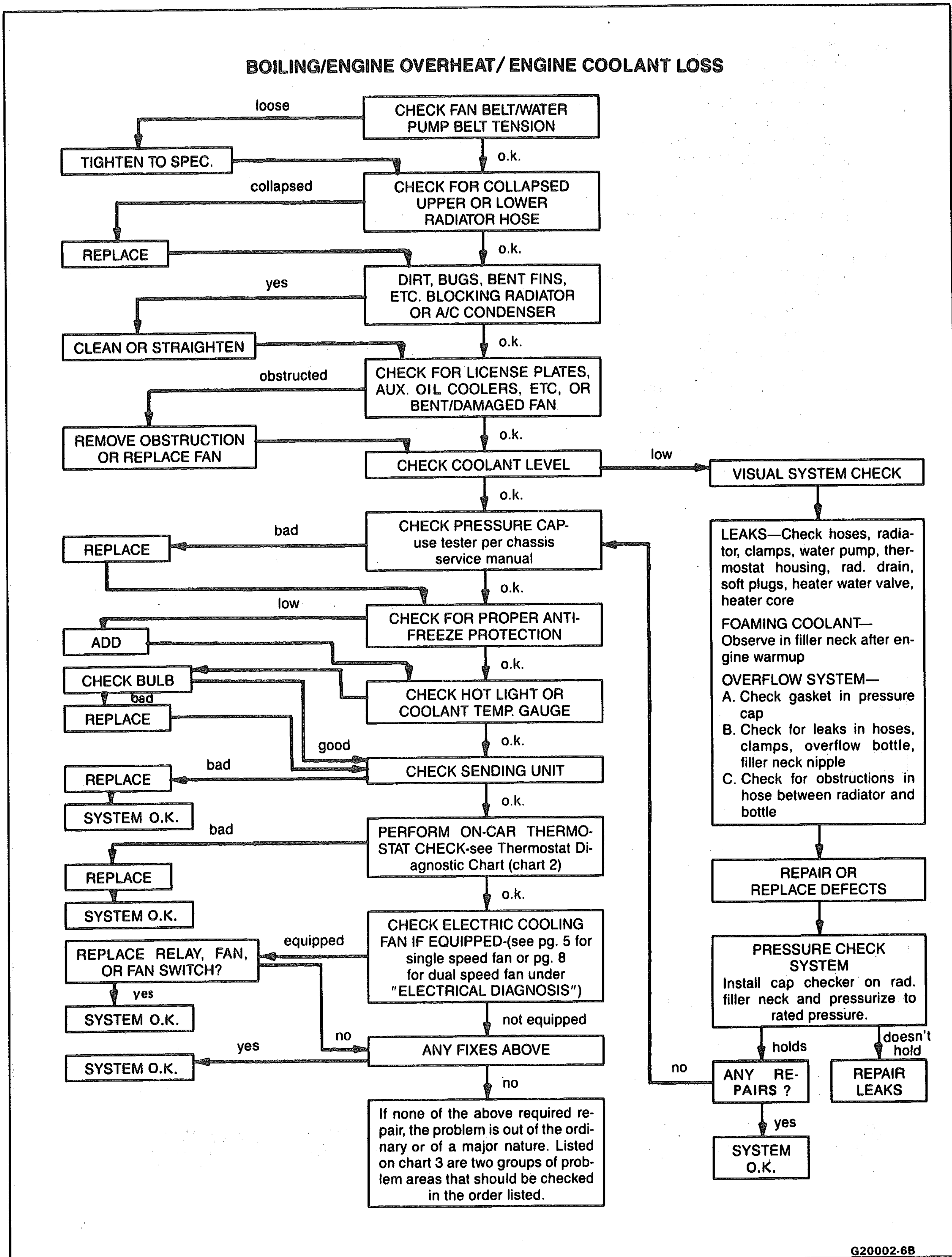

Fig. 5 Cooling System Diagnosis Chart (2 of 3)

A. PROBLEMS NOT REQUIRING DISASSEMBLY OF COOLING SYSTEM –

1. LARGE OBSTRUCTIONS BLOCKING RADIATOR OR CONDENSER
   a. AUXILIARY OIL COOLERS ⎤
   b. LICENSE PLATES ⎬ RELOCATE
   c. SPARE TIRES ⎦
   d. ICE, MUD OR SNOW OBSTRUCTING GRILLE – REMOVE
2. ENGINE OIL OVERFILL – CHECK ENGINE OIL DIPSTICK
3. WRONG RADIATOR FOR APPLICATION – CHECK PART NO. AGAINST PARTS LIST
4. LOOSE, DAMAGED OR MISSING AIR SEALS – SEE BODY SERVICE MANUAL
5. MISSING OR DAMAGED LOWER AIR BAFFLE – SEE BODY SERVICE MANUAL
6. WRONG IGNITION TIMING – SEE CHASSIS SERVICE MANUAL

B. PROBLEMS REQUIRING DISASSEMBLY OF COOLING SYSTEM –

1. INCORRECT OR DAMAGED FAN – CHECK PART NO. AGAINST PARTS LIST
2. FAULTY EMISSION SYSTEM COMPONENTS (COULD CAUSE OVERHEATING AT IDLE)
   a. PCV VALVE ⎤
   b. TVS OR TCS ⎦ – SEE CHASSIS SERVICE MANUAL
3. PRESSURE CHECK COOLING SYSTEM WITH PRESSURE CAP INSTALLED – WILL SHOW IF PRESSURE CAP LEAKS BECAUSE OF RADIATOR FILLER NECK DAMAGE
4. DEFECTIVE WATER PUMP
   a. ERODED OR BROKEN IMPELLER VANES
   b. FAILED BEARING OR SEAL – CHECK FOR SHAFT OR BEARING PLAY
5. PLUGGED RADIATOR TUBES – SEND TO RADIATOR REPAIR SHOP FOR FLOW CHECK
6. INTERNAL SYSTEM LEAKS
   a. HEAD GASKET – SEE CHASSIS SERVICE MANUAL
   b. CRACKED BLOCK
   c. TIMING CHAIN COVER
   d. INTAKE MANIFOLD GASKET
7. PLUGGED COOLANT PASSAGES IN CYLINDER HEADS – REMOVE HEADS AND CHECK VISUALLY

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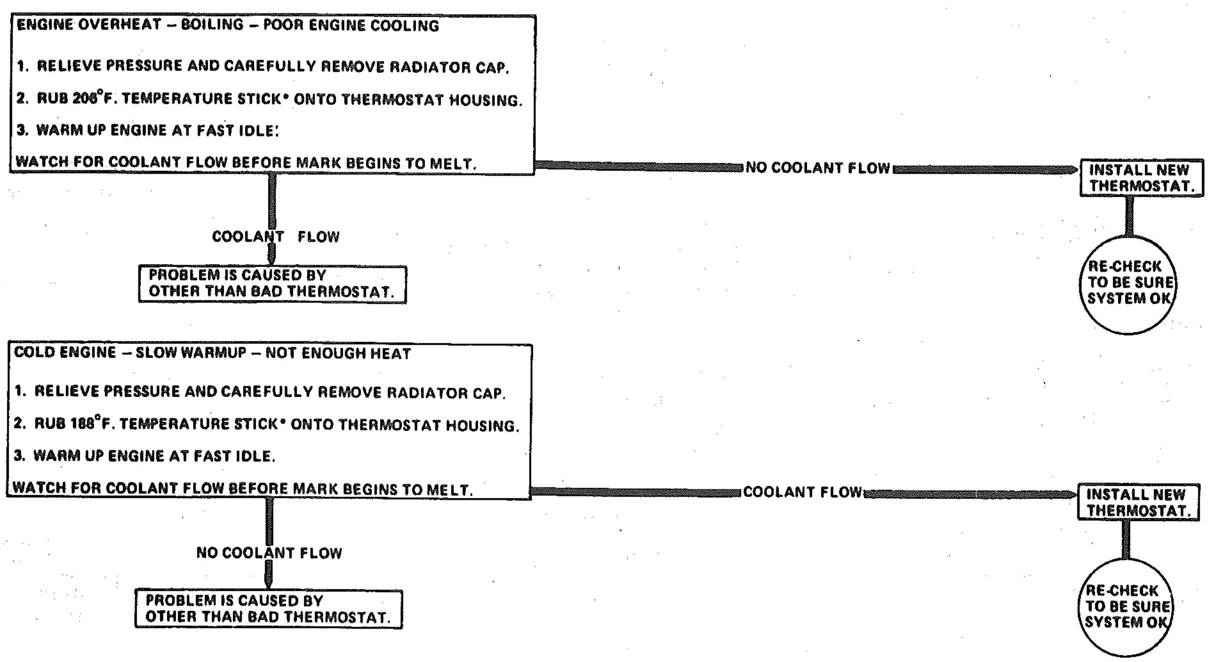
Fig. 6 Cooling System Diagnosis Chart (3 of 3)



*NOTE: THE TEMPERATURE STICK IS A PENCIL LIKE DEVICE WHICH HAS A WAX MATERIAL CONTAINING CERTAIN CHEMICALS WHICH MELT AT A GIVEN TEMPERATURE. THEMPERATURE STICKS CAN BE USED TO DETERMINE A THERMOSTAT'S OPERATING TEMPERATURE BY RUBBING 188°F. AND 206°F. STICKS ON THE THERMOSTAT HOUSING. THE MARKS MADE BY THE STICKS SHOULD MELT WHEN COOLANT TEMPERATURES OF 188°F. AND 206°F. ARE REACHED, RESPECTIVELY. THESE TEMPERATURES ARE THE NORMAL OPERATING RANGE OF THE THERMOSTAT, THEREFORE, IF THE COOLANT FLOWS AS INDICATED ON THE DIAGNOSIS CHART, THE THERMOSTAT MAY BE DEFECTIVE.

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Fig. 7 Thermostat Diagnosis Chart

NOTICE: If recommended quality antifreeze is used, supplemental inhibitors or additives claiming to provide increased cooling capability are not necessary. They may be detrimental to the efficient operation of the system, and represent an unnecessary operating expense.

Every 12 months or 15,000 miles, the cooling system should be serviced as follows:

1. Wash radiator cap and filler neck with clean water.
2. Check coolant for proper level and freeze protection.
3. Pressure test system and radiator cap for proper pressure holding capacity, 103 kPa (15 psi). If replacement of cap is required, use the proper cap specified for car model.
4. Tighten hose clamps and inspect all hoses. Replace hoses whenever cracked, swollen or otherwise deteriorated.
5. Clean frontal area of radiator core and air conditioning condenser.

DRAINING AND REFILLING THE COOLING SYSTEM

Replace hoses every 24 months or 30,000 miles or earlier if cracked, swollen or otherwise deteriorated. Every two years or 30,000 miles, whichever first occurs, the cooling system should be flushed and refilled using the following recommended procedure:

1. Remove radiator cap, or thermostat housing cap (VIN 0, J, R and U), when engine is cool by:
   a. Slowly rotating cap counterclockwise to detent. (Do not press down while rotating.)
   b. Wait until any residual pressure (indicated by a hissing sound) is relieved.
   c. After all hissing ceases, press down on cap while continuing to rotate counterclockwise.

   CAUTION: To avoid the danger of being burned, do not remove radiator cap while engine and radiator are still hot. Scalding fluid and steam may be blown out under pressure.
2. Remove the thermostat by using the wire handle to lift it out of the housing (VIN 0, J, R and U).
3. With the thermostat removed, reinstall the thermostat housing cap (VIN 0, J, R and U).
4. Open radiator drain valve and block drain plugs to drain coolant. On VIN R and 9 (P series) engines, open coolant pipe plugs.
5. Close valve. Reinstall drain plugs, and add sufficient water to fill system.
6. Run engine, drain and refill the system, as described in steps 4 and 5 a sufficient number of times, until the drained liquid is nearly colorless.

   Important

   - BLOCK DRIVE WHEELS, place transmission in PARK (automatic transmission) or NEUTRAL (manual transmission) and set the parking brake.
7. Allow system to drain completely. Then close radiator drain valve tightly, and reinstall block drain plugs.
8. Remove recovery cap leaving hoses in place. Remove coolant recovery tank and empty of fluid. Flush tank with clean water, drain and reinstall.
9. Add sufficient ethylene glycol coolant, meeting GM specification 1825-M, to provide the required freezing and corrosion protection - at least 50 percent solution -37°C (-34°F). Fill radiator to the base of the radiator fill neck and add sufficient coolant to the recovery tank to raise level to the "FULL" mark. Reinstall recovery tank cap.
10. Run engine, with radiator cap or thermostat housing cap removed, until normal operating temperature is reached. (Radiator upper hose becomes hot.)
11. With engine idling, add coolant until level reaches bottom of filler neck and reinstall cap, making certain arrows line up with overflow tube.

   CAUTION: Under some conditions, the ethylene glycol in engine coolant is flammable. To help avoid being burned when adding coolant, DO NOT spill it on the exhaust system or hot engine parts.

   It is the owner's responsibility to keep the freeze protection at a level appropriate to the temperatures which may occur in the area of vehicle operation.
   a. Maintain cooling system freeze protection at -37°C (-34°F), to ensure protection against corrosion and loss of coolant from boiling, even though freezing temperatures are not expected.
   b. Add ethylene glycol base coolant that meets GM Specification 1825-M, when coolant additions are required because of coolant loss, or to provide additional protection against freezing at temperatures lower than -37°C (-34°F).

NOTICE: Alcohol or methanol base coolants, or plain water, are not recommended at any time.

DRIVE BELT

NOTICE: Routine inspection of the belt may reveal cracks in the belt ribs. These cracks will not impair belt performance and therefore should not be considered a problem requiring belt replacement. However, the belt should be replaced if belt slip occurs or if sections of the belt ribs are missing.

A single (serpentine) belt is used to drive all engine accessories formerly driven by multiple drive belts. All belt driven accessories are ridgedly mounted with belt tension maintained by a spring loaded tensioner.

The drive belt tensioner has the ability to control belt tension over a fairly broad range of belt lengths.

However, there are limits to the tensioner's ability to compensate for varying lengths of belts. With the tensioner outside of its operating range, poor tension control and/or damage to the tensioner may result.

The tensioner has provisions for a visual check to verify that it is in the "operating range" (see Figures 608 and 609).

ALUMINUM RADIATOR REPAIR

This radiator utilizes an aluminum core with plastic side tanks. The core and side tanks can be replaced separately and core repair is easily made with the hot melt adhesive method. A transaxle oil cooler is located in one of the side tanks. The oil cooler can be replaced. The drain cock is located on the lower part of one of the tanks. The drain cock is also serviceable.

Core

The core is made of aluminum and is of the crossflow design. It utilizes large tubes that resist plugging, and repairs to the tubes and core are easily made using the hot melt adhesive method.

The core is attached to the tanks by clinched tabs on the core that can be bent back if tank or core replacement is required.

If the damage to a tube is too severe, a tube can be blocked or plugged as explained in "Tube Blocking. " No more than two tubes should ever be blocked on a core. Also replace the core if more than three tabs are broken on one side, or if two adjacent tabs are broken.

Tanks

The tanks are attached to the core by the use of clinched tabs. The clinched tabs can be bent back if the tanks need to be removed from the core. Bend the tabs back only enough to remove the tank. Overbending will weaken the tabs.

A high temperature rubber gasket is used to seal the mating surface between the core and the tank. (See Fig. 8). The gasket must be replaced any time a tank is removed from the core.

Transaxle Oil Cooler

The transaxle oil cooler is located in one of the radiator side tanks. The oil cooler can be replaced by removing the tank from the core.

A leaking oil cooler gasket can be replaced without removing the tank from the core.

Drain Cock

The aluminum/plastic radiator utilizes a two piece plastic drain cock and a rubber seal. The drain cock is serviceable (See Fig. 9).

ALUMINUM RADIATOR SERVICE

The aluminum-plastic radiator can be repaired at the dealership. The following components are easily replaced:

- Core
- Tanks and gaskets
- Oil coolers and gaskets
- Drain cock and gasket

The **tanks cannot be repaired** if broken or cracked. The radiator core can be replaced and the new core used with the original tanks and oil cooler.

Precautions

As with all cooling system service, take measures to prevent personal injury and damage to the system.

CAUTION: To help avoid the danger of being burned, do not remove the radiator cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if the cap is taken off too soon.

NOTICE: DO NOT USE "BOIL OUT" TANKS OR VATS. Common service methods may actually destroy an aluminum radiator. Caustic or lye cleaning solutions must NOT be used for aluminum radiators.

- Do not open the hood if you can see, or hear, steam or coolant escaping from the engine compartment.
- Do not remove radiator cap if radiator feels warm.
- Do not remove the radiator cap or coolant recovery tank cap if the coolant in the recovery tank looks like it is boiling.
- Wear eye protection.
- Wear gloves to protect your hands against excessive heat, or the effects of chemicals on your skin.
- Prevent dirt and water from entering the transmission oil cooler.
- Do not use boil-out tanks, or vats, or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank containing clean water is strongly recommended for servicing aluminum-plastic radiators.

NOTICE: Never use shop air that is not regulated at 20 psi (138 kPa) to pressure test radiator. Pressures over 20 psi (138 kPa) will damage the radiator.

DIAGNOSIS

Leak Testing

Some core leaks can be detected by merely adding water to the radiator. It is helpful to clean the core so that the damaged area can be more easily found.

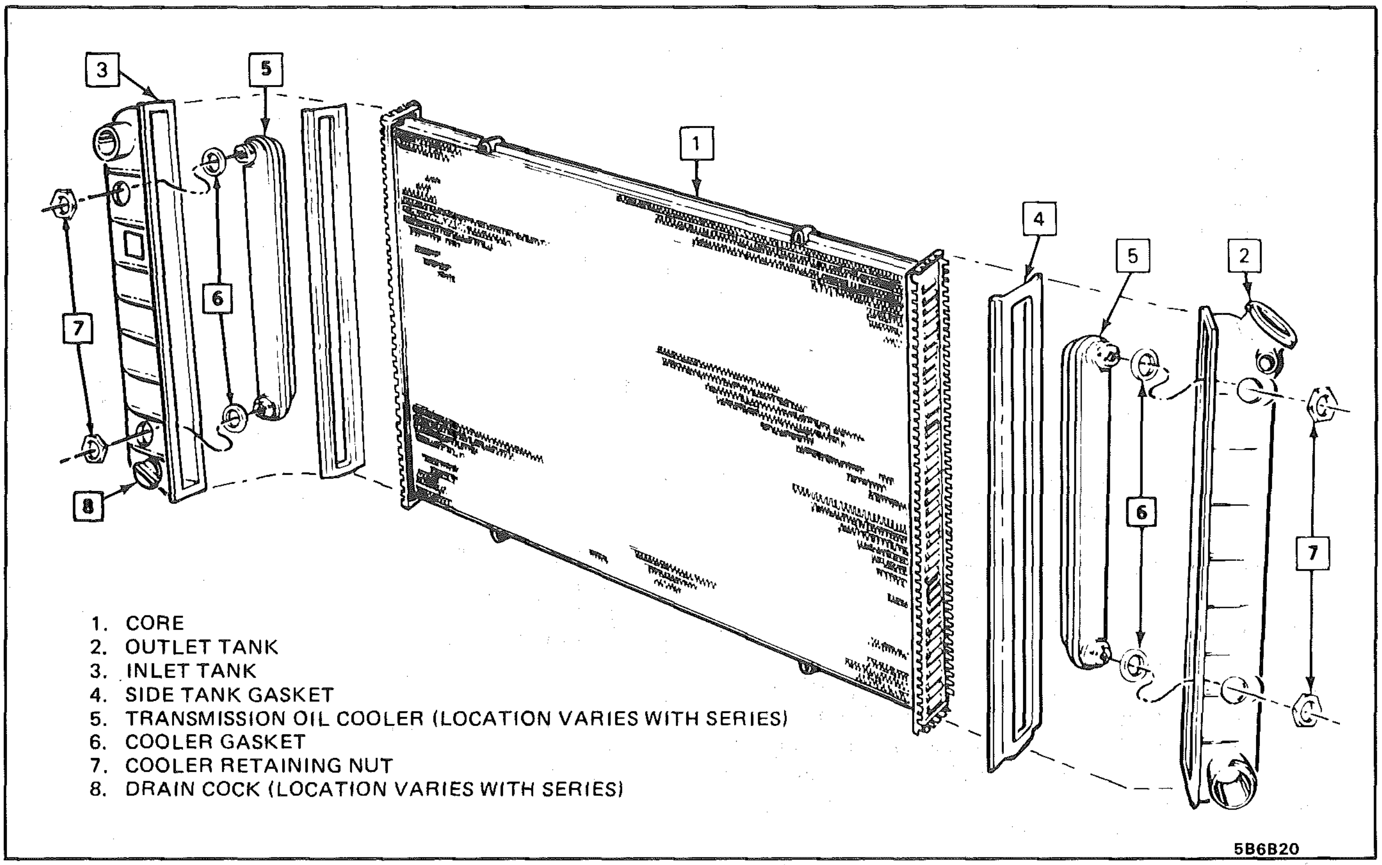


Fig. 8 Aluminum Radiator

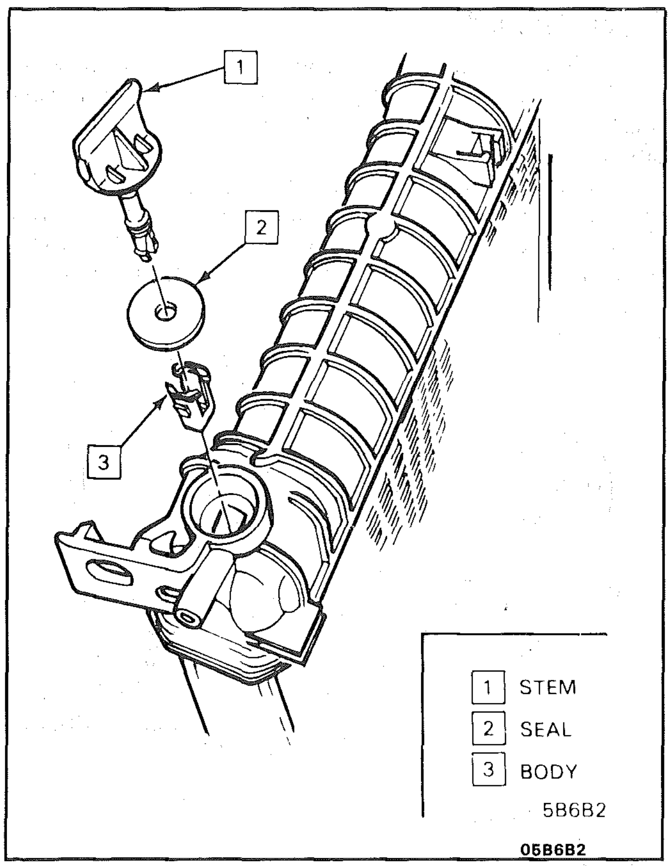


Fig. 9 Aluminum Radiator Drain Cock

1. Remove dirt and insects from the fins with a common water hose without a nozzle. Excessive water pressure could damage the fins.
2. Scrub the core with a soft-bristle brush using clean, hot water, or hot water with a mild detergent solution.

On-Vehicle Pressure Testing

You can pressure-test the aluminum-plastic radiator with a common pump and gage, such as BT-7002-3 or J-24460-01 with J-23699 (Figure 10). With the system at a cool temperature, remove the radiator cap, connect the gage, and apply normal system operating pressure. Do not exceed 20 psi (138 kPa). Watch the gage needle for an indication of a leak, and examine the radiator and other cooling system parts for signs of escaping coolant.

Repair all hose and hose connections as required. Also check radiator cap to ensure that it will maintain the correct pressure.

If the radiator is found to be leaking during the pressure test, mark the leak area so that it is easily found once the radiator has been removed from the vehicle.

Off-Vehicle Leak Testing

NOTICE: Do not use boil-out tanks, or vats, or other tanks that have been used for copper and brass radiators. The flux, acid, and caustic cleaners remaining in these tanks will attack the aluminum and cause radiator failure. A separate test tank

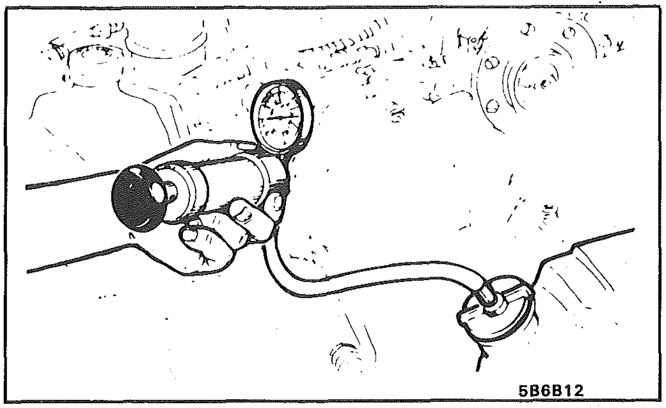


Fig. 10 Pressure Testing Radiator

containing clean water is strongly recommended for servicing aluminum-plastic radiator.

1. Install test fittings or rubber test caps in the inlet and outlet necks and seal the oil cooler fittings with metal plugs to protect the cooler and keep the fluid from running out (Fig. 11).
2. Attach pressure tester and gradually apply air pressure until 20 psi (138 kPa) is attained. Do not exceed 20 psi (138 kPa). Check pressure gage to see if there is a pressure loss. To ensure that there are no small leaks, run water over the repair area and look for bubbles. (A mild detergent is very helpful).

   If a large water tank is available, the radiator can be submerged, and a check for air bubbles can be made.

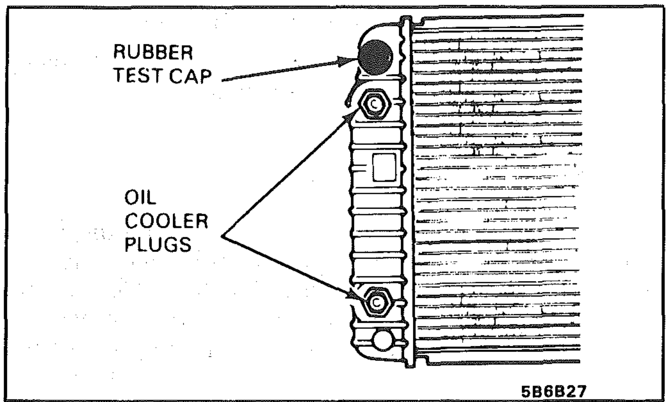


Fig. 11 Aluminum Radiator and Oil Cooler Plugs

Repairable Leaks

There are two types of leaks that can be repaired on the aluminum-plastic radiator: core leaks and gasket leaks. Leaks in the plastic tanks cannot be repaired.

Core leaks can occur in a tube, or in the joints between the tubes and headers. Gasket leaks can occur in the joints between the plastic tanks and the headers, or in the joints between the oil cooler fittings and the tank. Some leaks can be repaired while the radiator is on the car; however, it is usually best to remove the radiator.

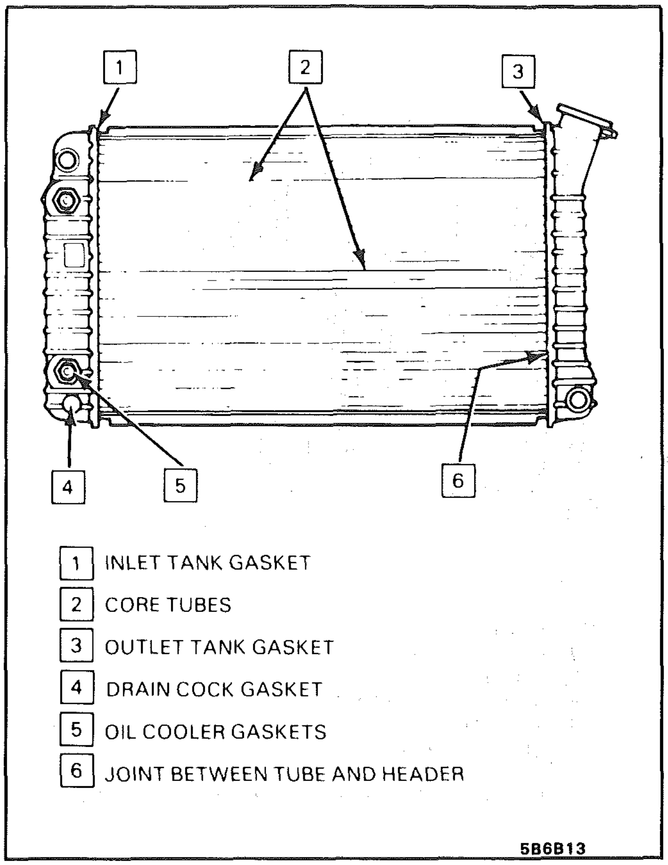


Fig. 12 Possible Leak Areas

Repair Methods

There are several methods that can be used to repair the radiator core, but the hot melt adhesive method has been found to be the most simple and effective.

The kit contains adhesive sticks, cotton swabs, wire brush and primer. The adhesive stick is reusable, has an indefinite shelf life, and is waste-free. The sticks must be stored in a sealed container to keep them dry (Fig. 13).

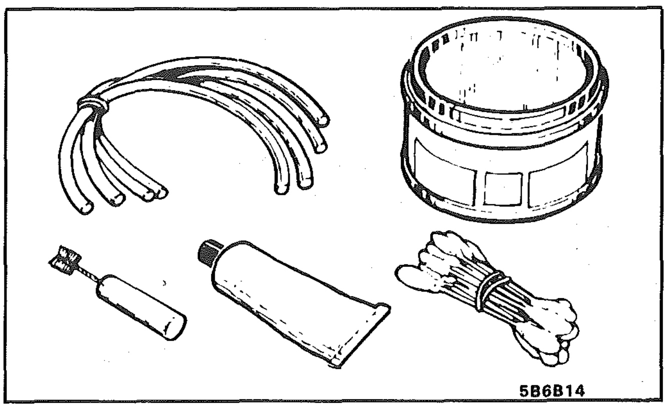


Fig. 13 Hot Melt Adhesive Repair Kit

Special Preparation

Cooling Fin Removal

For damaged areas that are between the cooling fins, it may be necessary to remove some of the fins. Do not remove more fins than necessary. Usually 6mm

(1/4") beyond the leak or damage area is enough to make an effective repair. (Fig. 14).

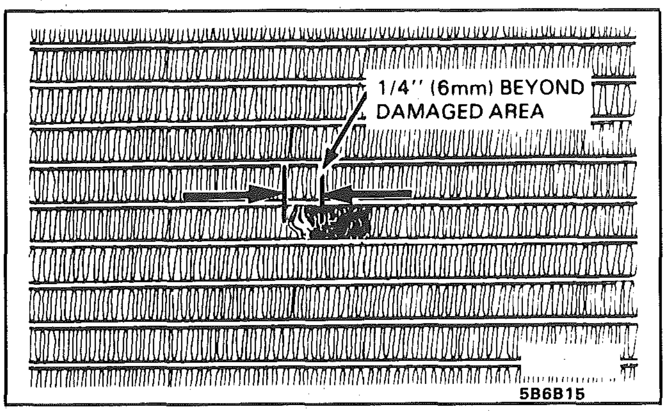


Fig. 14 Fins Removed from Damaged Area

Tube Blocking

If a tube is severely damaged, it can be blocked off. (Fig. 15).

NOTICE: DO NOT BLOCK OFF MORE THAN TWO TUBES IN A RADIATOR. BLOCKING OFF MORE THAN TWO TUBES WILL REDUCE THE COOLING CAPABILITY OF THE SYSTEM.

The tube should be cut off 6mm (1/4") from the header and pinched shut before it is cleaned and sealed. (See General Core Sealing).

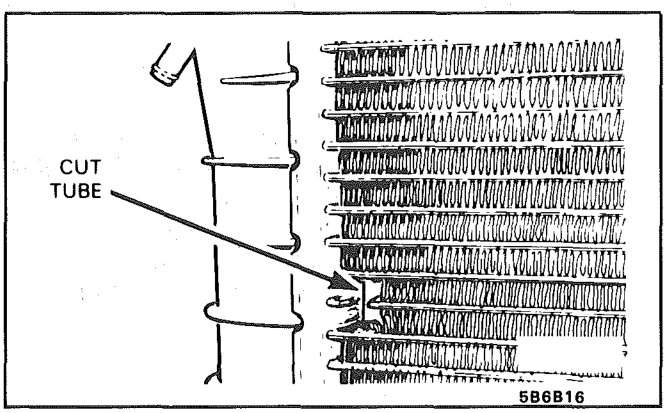


Fig. 15 Tube Blocking

Header Repair

If the header or a tube near the header requires a repair, the side tank does not have to be removed. A damp cloth can be placed against the side tank where the repair has to be made (Fig. 16). The side tank can also be submerged in a tank of water up to the header (Fig. 17).

NOTICE: One of these procedures has to be used when repairs are made on or near the header, to prevent damage to the tank or gasket.

General Core Repair

Preparation of the surface in the repair area cannot be overemphasized. If the leak area surface is not clean, none of the repair materials will stick to the surface.

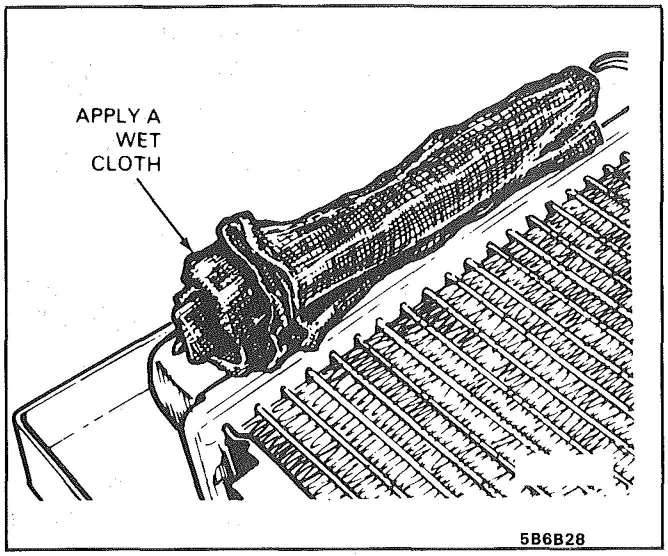


Fig. 16 Using Wet Cloth on Side Tank

1. Position the core so the repair area is accessible.
2. Apply a wet cloth if you are working near the plastic tanks or the joints between the core tubes and header (Fig. 16); or submerge the tank in water (Fig. 17).

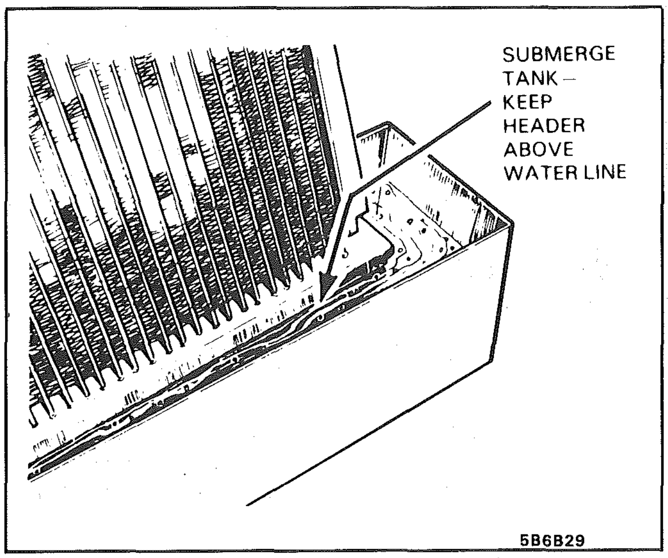


Fig. 17 Submerging Side Tank

3. Heat the repair area slightly with a small torch or heat gun to be sure it is dry. **Do not use a blow torch.**
4. Brush the area to be repaired with the small steel brush that is supplied in the kit and blow dust away from repair area. (See Fig. 18).
5. Open the tube of primer, using the spurred cap or a pin, and apply primer to the repair area only. Use of the primer produces a stronger repair. **Do not heat the primer.**

CAUTION: The primer contains trichlorethane.

- **It could be harmful, or fatal, if swallowed. If swallowed, get medical attention.**

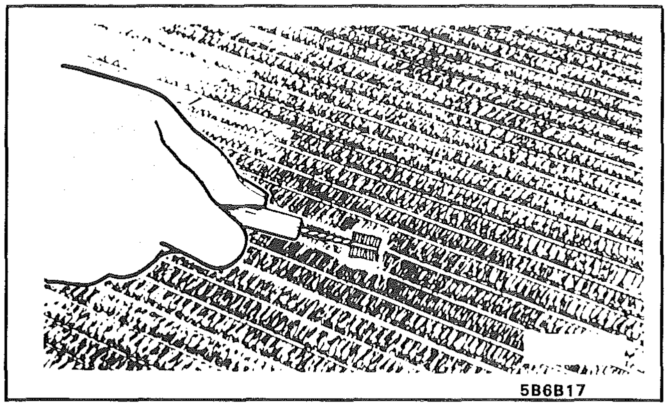


Fig. 18 Cleaning Area With Steel Brush

- **Use with adequate ventilation.**
- **In case of eye contact, flush with plenty of water and get medical attention.**
- **In case of body contact, wash thoroughly with soap and water.**
- **Do not mix the primer with water.**

6. Scrub the repair area with a cotton swab until a fresh swab stays clean. The clear, yellow-brown coating does not have to be removed (Fig. 19).

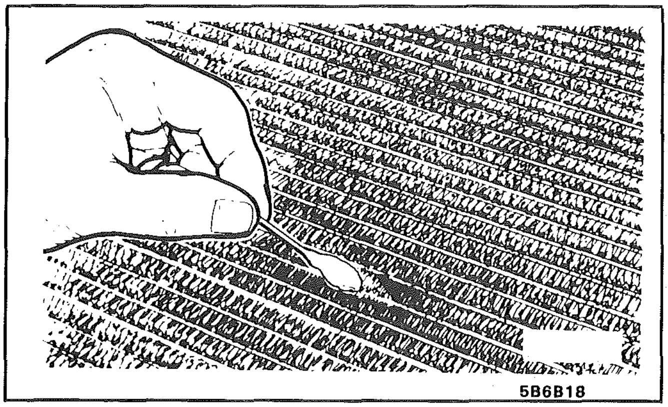


Fig. 19 Scrubbing Area with Primer

7. Heat the repair area with the heat gun or by moving the torch in a circular pattern (Fig. 20). Use a soft, small blue flame (like a gas stove flame).

8. Withdraw the torch and rub the adhesive stick on the repair area (Fig. 21). The adhesive will flow at a temperature of approximately 500°F (260°C). If the stick doesn't start to melt, remove it and reapply the heat. **Do not heat the stick directly with a flame. High heat will burn and char the adhesive.**

9. Continue heating until the adhesive flows and wets the entire repair area and fills the joint. If a hole is in the center of a tube, heat the tube and let the hot surface melt and pull in the adhesive. The force of the flame or heat gun will also tend to guide the adhesive toward the hole. For leaks between a tube and header, flow the adhesive completely around the tube and header joint with the tank installed.

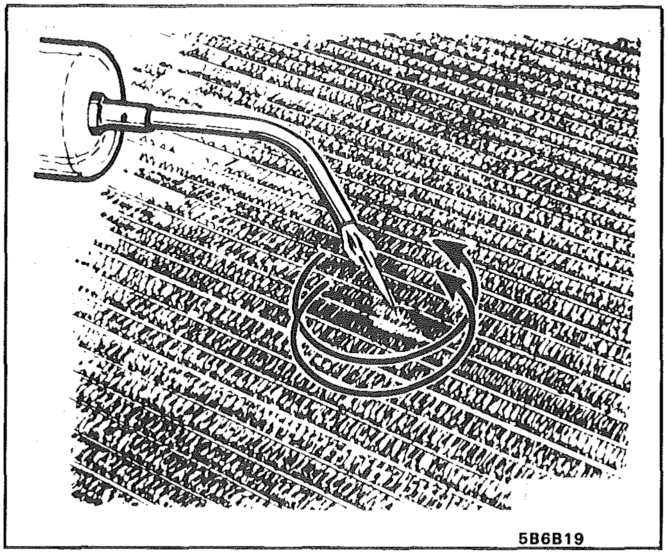


Fig. 20 Heating the Repair Area

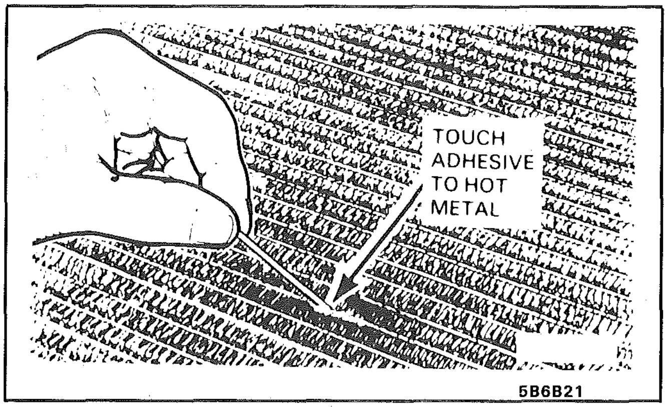


Fig. 21 Applying Hot Melt Adhesive

10. Heat the repair area until the adhesive is bubble-free and smooth, with a light yellow color. Curing is not required.
11. Test the radiator for leaks, when cool. If the repair area still leaks, reheat it gently to dry it. Heat and reflow the adhesive, or apply more as necessary, to repair the leak.

Tank Gasket Leak Repair

Tank gasket leaks can easily be mistaken for tank or header leaks. If a plastic tank leaks from the header joint gasket, tighten the clinch tabs with locking-type pliers (Fig. 22). If this method doesn't seal the leak, remove the tank for further inspection.

1. Pry open the clinch tabs, except those under inlet, outlet, and filler necks, using J33419-A or a screwdriver (Fig. 23). Lift tabs only enough to allow removal.

NOTICE: Care should be taken not to overbend tabs. Overbending could result in breakage. If there are more than 3 tabs broken on one side of the header, or more than 2 adjacent tabs together, the core must be replaced.

2. Lift the tank and slide it out from under the remaining clinched tab. You may have to tap the

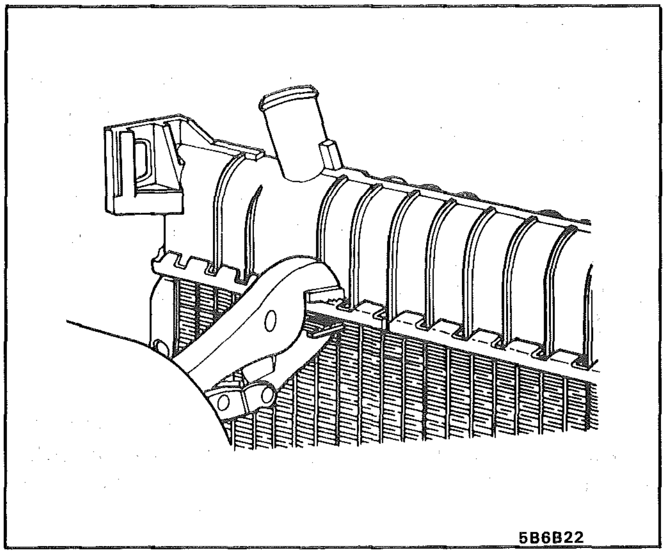


Fig. 22 Tightening Clinch Tabs

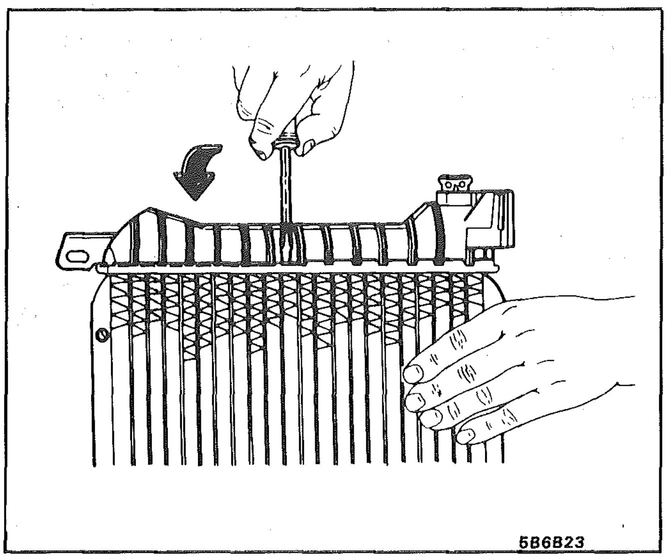


Fig. 23 Opening Clinch Tabs

tank with your hand to dislodge the gasket. Lift the remaining tab(s) with pliers.

3. Remove and discard the gasket.
4. Clean the header and gasket groove of all dirt and old rubber.
5. Clean the sealing edge of the plastic tank.
6. Examine the header gasket surface and tank flange for evidence of leakage, and clean or repair the surface to remove dirt, burrs, and bumps.
7. Remove the oil cooler, if equipped, and install it in the new tank.
8. Dip or coat the new tank gasket in engine coolant and position it on the header surface. The coolant helps hold the gasket in place.
9. Position the tank and gasket to the header, clamp it in place and secure it by bending four clinch tabs as shown in Fig. 24.
10. Clamp remaining clinch tabs around the header using the clinching tool or pliers (Fig. 25).

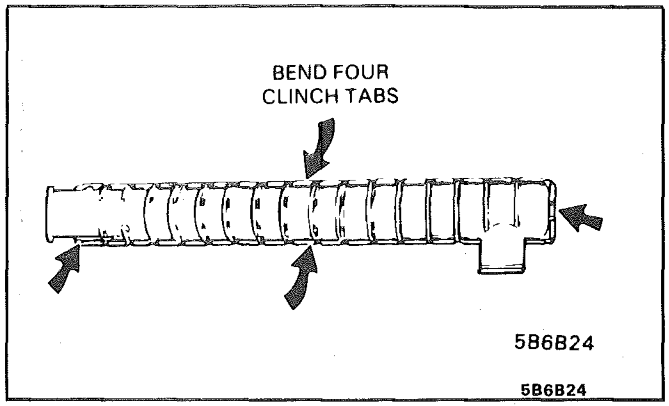


Fig. 24 Seating Tank to Core

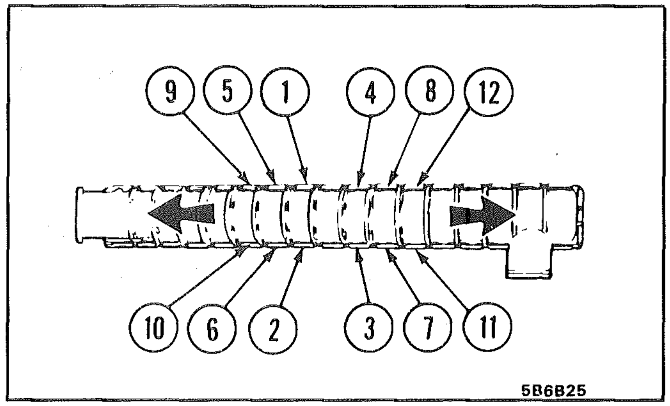


Fig. 25 Clinching Sequence

NOTICE: Tighten the clinch tabs as you would cylinder head bolts, starting at the center and working out to the ends.

11. Replace the core if there are more than three tabs broken on one side or two adjacent tabs broken.
12. Install the drain cock, if removed.
13. Test the radiator for leaks.

Oil Cooler Gasket Replacement

The outlet tank must be removed to replace the oil cooler, but the oil cooler gaskets can be replaced without removing the tank.

1. Remove the radiator and lay it on a flat surface.
2. Remove the bottom oil cooler nut and loosen the top nut.
3. Press the oil cooler into the hole and remove the gasket using a small hook (Fig. 26).
4. Blow-dry all surfaces on the tank and oil cooler.
5. Install a new gasket **without lubrication.** Be sure it is seated properly inside the lip of the fitting.
6. Reach into the inlet or outlet opening and push the oil cooler into position against the tank.
7. Assemble the oil cooler nut loosely.
8. Replace the other gasket by following the same procedure.
9. Install the oil cooler nuts and torque to 20 N·m (15 lb. ft.). Do not overtighten, as damage to the gasket could result.
10. Leak-test the radiator.

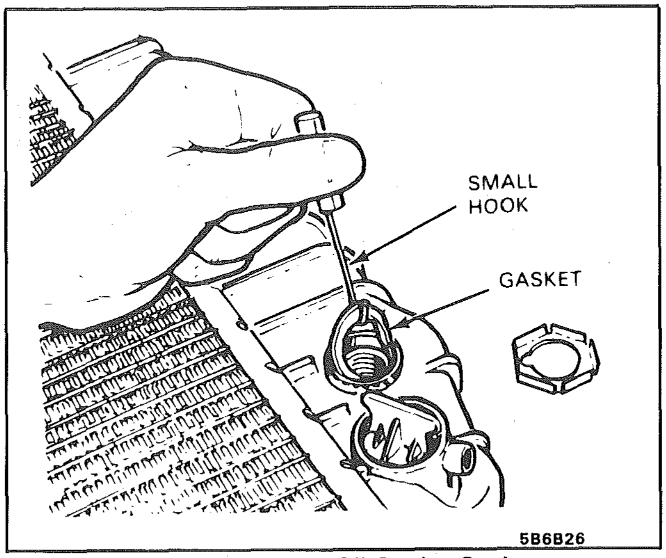


Fig. 26 Removing Oil Cooler Gasket

Oil Cooler Replacement

1. Remove the outlet tank as previously outlined.
2. Remove nuts from the oil cooler fittings.
3. Remove oil cooler and gaskets from tank.
4. Remove old rubber gaskets, throw away, clean and dry seal areas.
5. Place rubber gaskets on a new oil cooler and place onto outlet tank fitting holes, being careful not to loosen or misalign gaskets. Gaskets must be installed dry and free of dirt and oil.
6. Install and tighten nuts snugly onto fittings.
7. Torque nuts to 20 N·m (15 lb. ft.). Overtorquing could cut the rubber gaskets.
8. Replace tank as previously described.
9. Test radiator.

Recore

If the radiator core is damaged beyond repair and the other parts are serviceable, install the original inlet and outlet tanks, oil cooler, radiator cap, and drain valve, onto a new core and install new gaskets.

Drain Cock

If the drain cock does not seal when tightened snugly, remove the drain cock, clean drain and replace. If the body of the draincock is broken, remove the body from the tank by squeezing the sides together with needle nose pliers (Fig. 9).

Special Tools

Special tools are available through normal channels for servicing the aluminum-plastic radiator. The universal Cooling System and Cap Pressure Tester, BT-7518 or J-24460-01, can also be used with the aluminum-plastic radiator.

ON-VEHICLE SERVICE

THERMOSTAT

Remove or Disconnect

1. Battery negative cable at battery.
2. Air cleaner.
3. Drain cooling system.
4. Thermostat housing attaching bolts and remove housing. Remove thermostat from manifold.

Clean

- Clean housing and manifold sealing surfaces.

Install or Connect

1. New gasket.
2. Thermostat in intake manifold.
3. Refer to Section 6E3 for plenum and throttle body installation.
4. Battery negative cable.
5. Fill cooling system.
6. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
7. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
8. Cap making sure arrows line up with overflow tube.

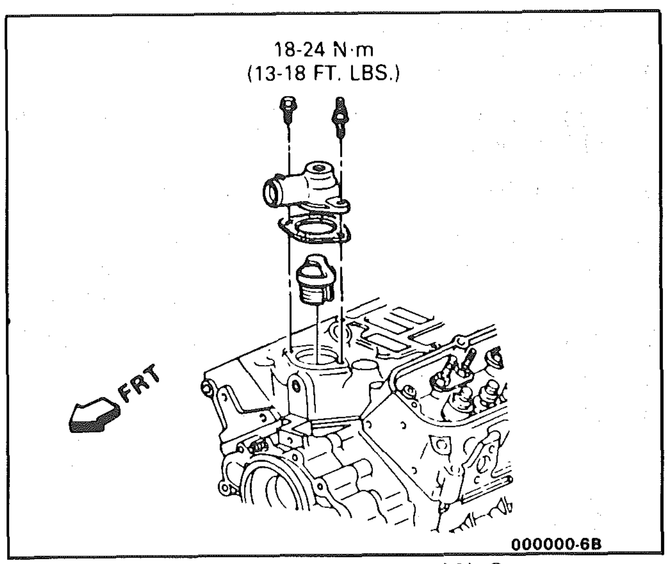


Fig. 601 Thermostat — V.I.N. S

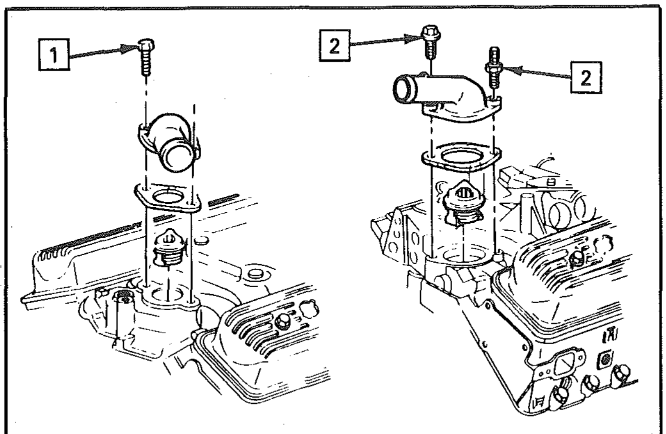


Fig. 602 Thermostat — V.I.N. E, F and 8

ELECTRIC COOLING FAN

CAUTION: Keep hands, tools, and clothing away from engine cooling fan to help prevent personal injury. This fan is electric and can come on whether or not the engine is running. The fan can start automatically in response to a heat sensor with the ignition in the "On" position.

Remove or Disconnect

1. Negative battery cable.
2. Harness from fan motor and fan frame.
3. Fan frame to radiator support attaching bolts.
4. Fan and frame assembly.

Install or Connect

1. Fan and frame assembly.
2. Fan frame to radiator support attaching bolts and torque to specification.
3. Harness to fan frame and fan motor.
4. Negative battery cable.

Inspect

- For proper completion of repairs.
- For operation of fan motor.

WATER PUMP

Remove or Disconnect

1. Battery negative cable at battery.
2. Cooling system.
3. If equipped with M.F.I., remove air intake tube and mass air flow sensor.
4. Fan and radiator upper support, as applicable.
5. Serpentine belt.
6. Generator upper and lower brackets, A/C brace and bracket and, if equipped, power steering pump lower bracket from water pump and swing aside.
7. Radiator lower hose and heater hose from water pump.
8. Water pump to block attaching bolts and remove water pump.

Install or Connect

- If installing a new water pump, transfer heater hose fitting from old unit.

1. With clean sealing surfaces on both block and water pump, install water pump to block with new gaskets and retain with attaching bolts. Torque to specifications. (V6 small bolt 10 N·m, 7 lb. ft., large bolt and nut 20 N·m, 15 lb. ft.) (V8-40 N·m, 30 lb. ft.)
2. Radiator lower hose and heater hose to water pump and torque clamps to 2 N·m (20 lb. in.).
3. Generator upper and lower brackets and, if equipped, the power steering pump lower bracket to the water pump. Torque bolts to 41 N·m (30 lb. in.).
4. Serpentine belt.
5. If equipped with M.F.I., install air intake tube and mass air flow sensor.
6. Fan and radiator upper support, as applicable.
7. Battery negative cable.
8. Fill cooling system with an ethylene glycol antifreeze and water mixture of 50/50.
9. Start engine and run, with radiator cap removed, until radiator upper hose becomes hot (thermostat open).
10. With engine idling, add coolant to radiator until level reaches bottom of filler neck.
11. Cap, making sure arrows line up with overflow tube.

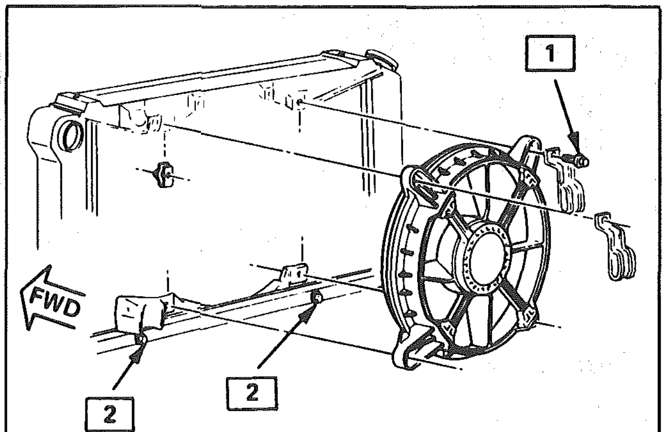


Fig. 603 Fan Mounting V.I.N. E, S (All) F, 8 (w/o A/C)

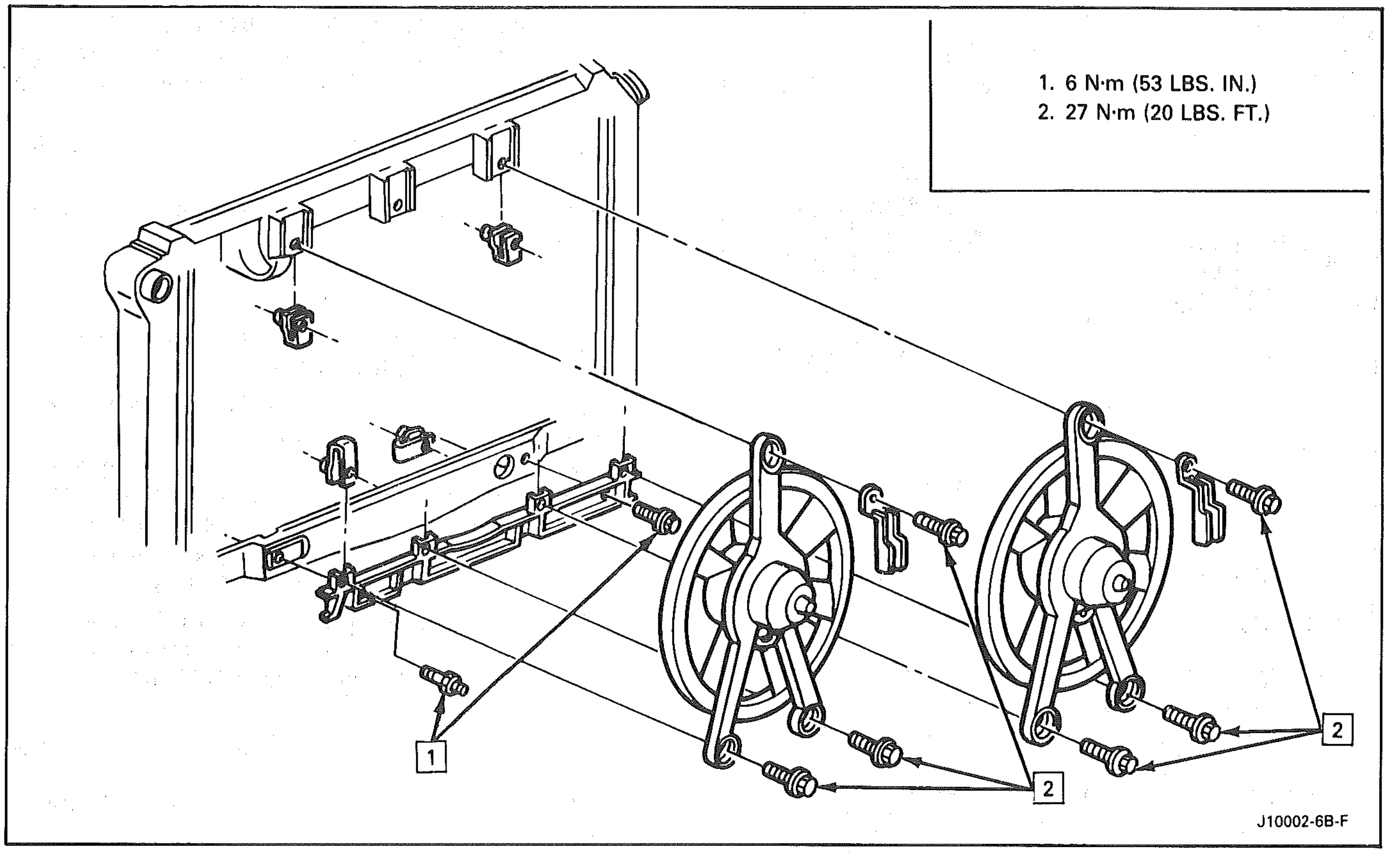
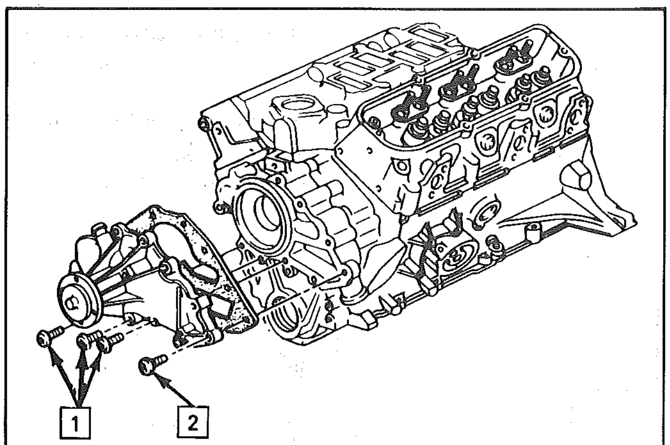


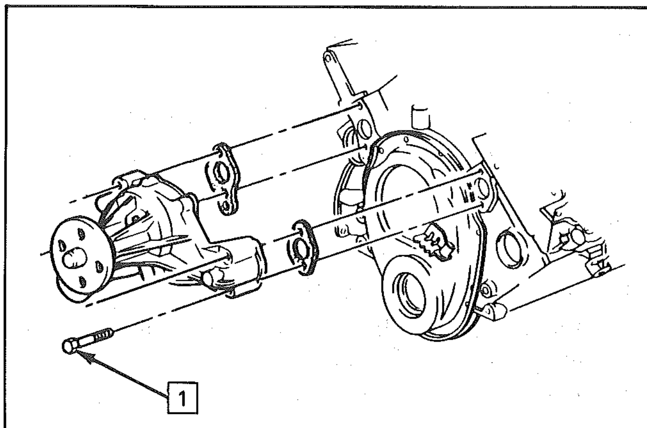
Fig. 604 Fan Mounting — V.I.N. F and 8 (with A/C)



1. 14 N·m (10 LBS. FT.)
2. 29 N·m (21 LBS. FT.)

J10003-6B-F

Fig. 605 Water Pump Mounting — V.I.N. S



1. 41 N·m (30 LBS. FT.)

J10004-6B-F

Fig. 606 Water Pump Mounting — V.I.N. E, F and 8

COOLANT RECOVERY BOTTLE

Remove or Disconnect

1. Hose from recovery bottle.
2. Attaching screws and remove bottle.

Clean

- Recovery bottle with suitable solution.

Install or Connect

1. Place bottle in vehicle and torque attaching screws to 3 N·m (27 lb.in.).
2. Coolant hose to bottle.
3. Fill bottle to appropriate mark.

RADIATOR

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant.
3. Fan blade. On fan clutch equipped cars, store clutch in upright position to prevent seal leakage.
4. Upper and lower radiator hoses.
5. On vehicles equipped with automatic transmission, plug transmission cooler lines.
6. Fan shield assembly, if applicable.
7. Radiator and shroud assembly, lift straight up. The radiator assembly is held at the bottom by two cradles secured to the radiator support.

Install or Connect

1. If new radiator, transfer fittings from old radiator to new radiator.
2. Radiator in car, locating bottom of radiator in lower mounting pads.
3. Transmission/Engine oil cooler lines at radiator.
4. Coolant recovery bottle hose at radiator.
5. Coolant hoses at radiator.
6. Upper radiator support bracket.
7. Engine coolant.
8. Negative battery cable.

Inspect

- For proper completion of repair.
- For fluid leaks.

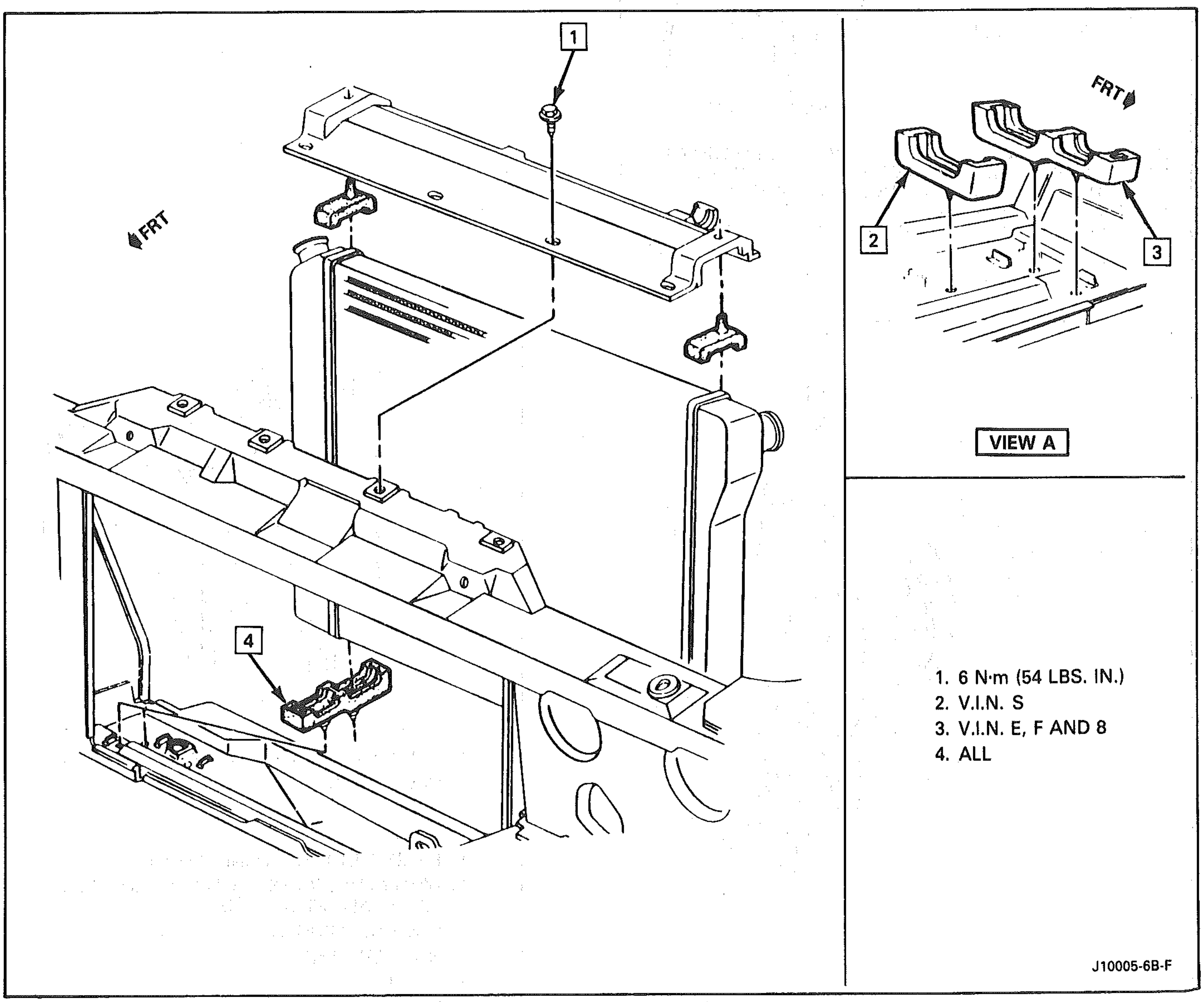


Fig. 607 Radiator Mounting

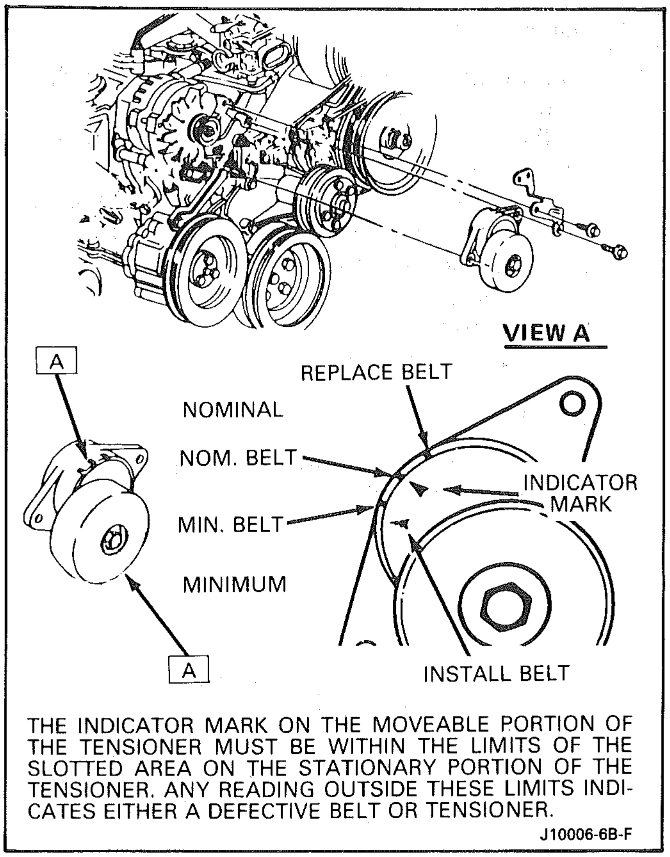
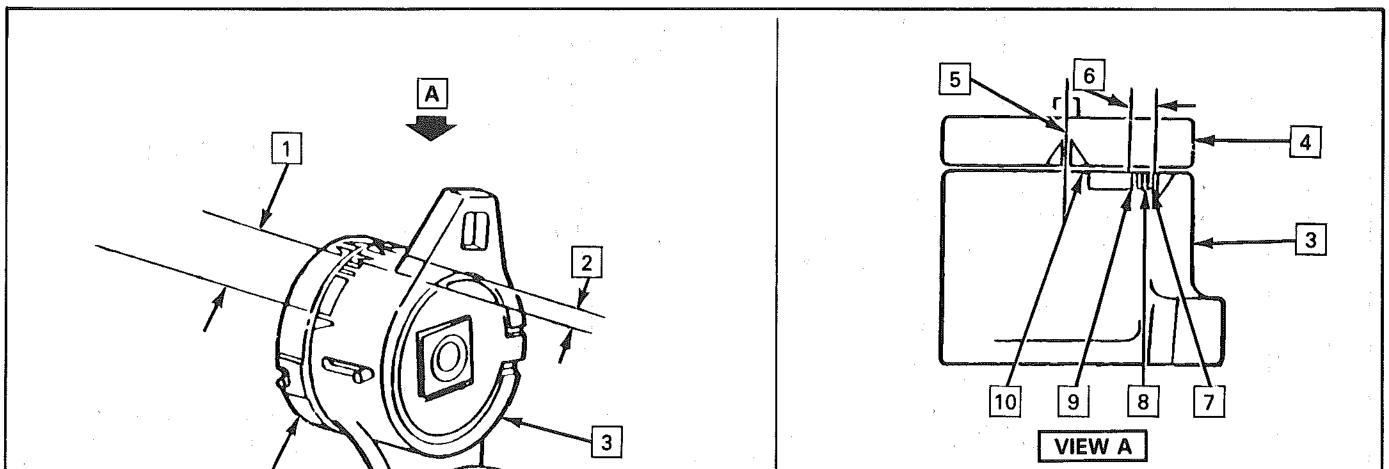


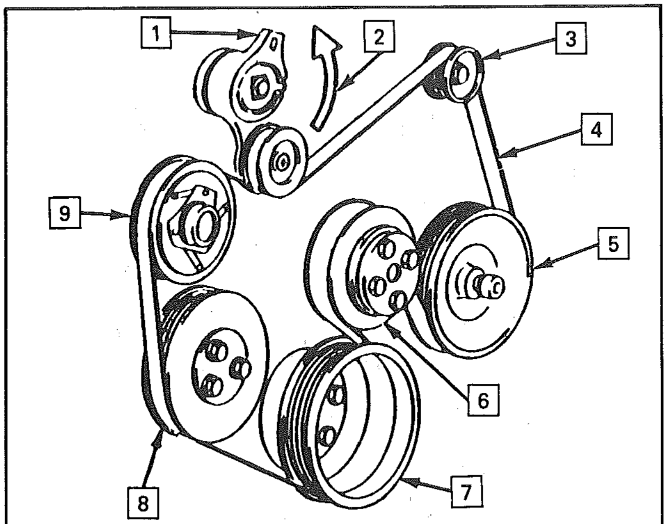
Fig. 608 Belt Tensioner — V.I.N. S



1. USED BELT ACCEPTABLE WEAR RANGE
2. NEW BELT RANGE
3. ARM
4. SPINDLE
5. FIXED BELT LENGTH INDICATOR
6. WITH NEW BELT INSTALLED, FIXED POINTER MUST FALL WITHIN THIS RANGE
7. MINIMUM LENGTH – NEW BELT
8. NOMINAL LENGTH – NEW BELT
9. MAXIMUM LENGTH – NEW BELT
10. REPLACE BELT POSITION

J10007-6B-F

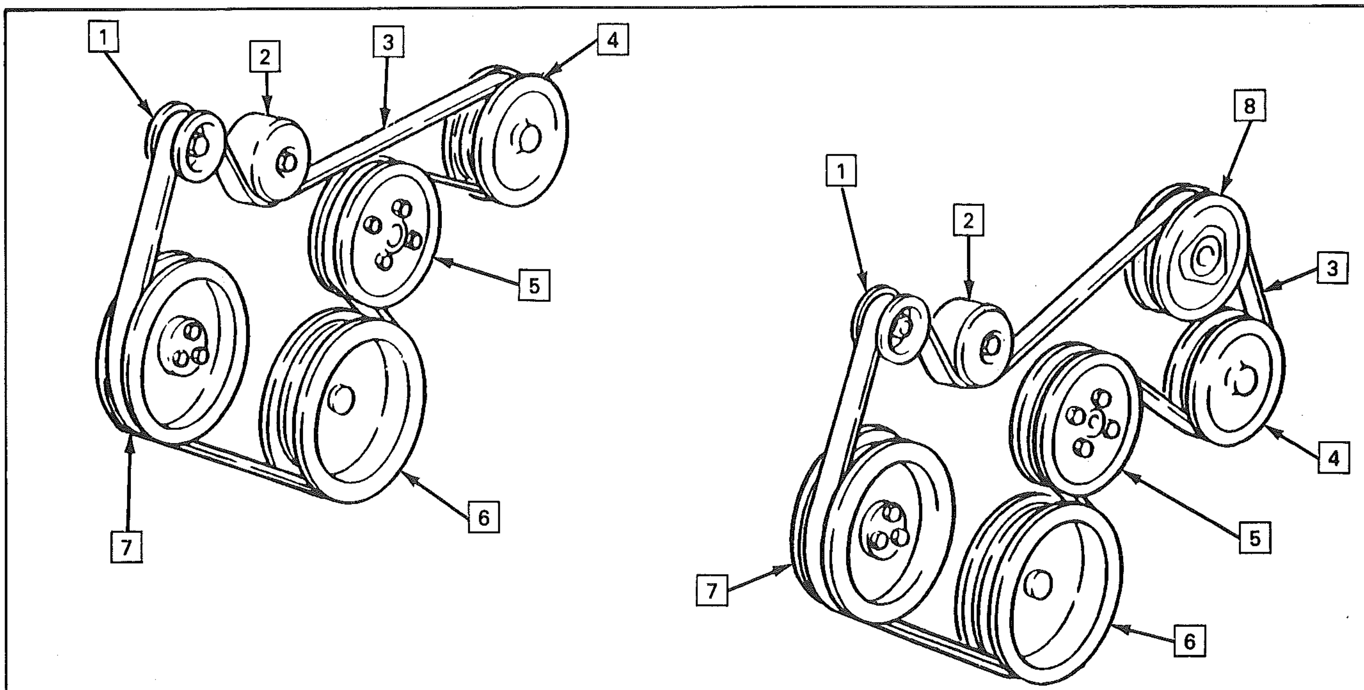
Fig. 609 Belt Tensioner — V.I.N. E, F and 8



1. TENSIONER ASSEMBLY
2. ROTATE TENSIONER IN DIRECTION SHOWN TO INSTALL OR REMOVE BELT
3. GENERATOR ASSEMBLY
4. ACCESSORY DRIVE BELT
5. P/S PUMP
6. WATER PUMP
7. CRANKSHAFT
8. A.I.R. PUMP
9. A/C COMPRESSOR OR BELT IDLER

J10008-6B-F

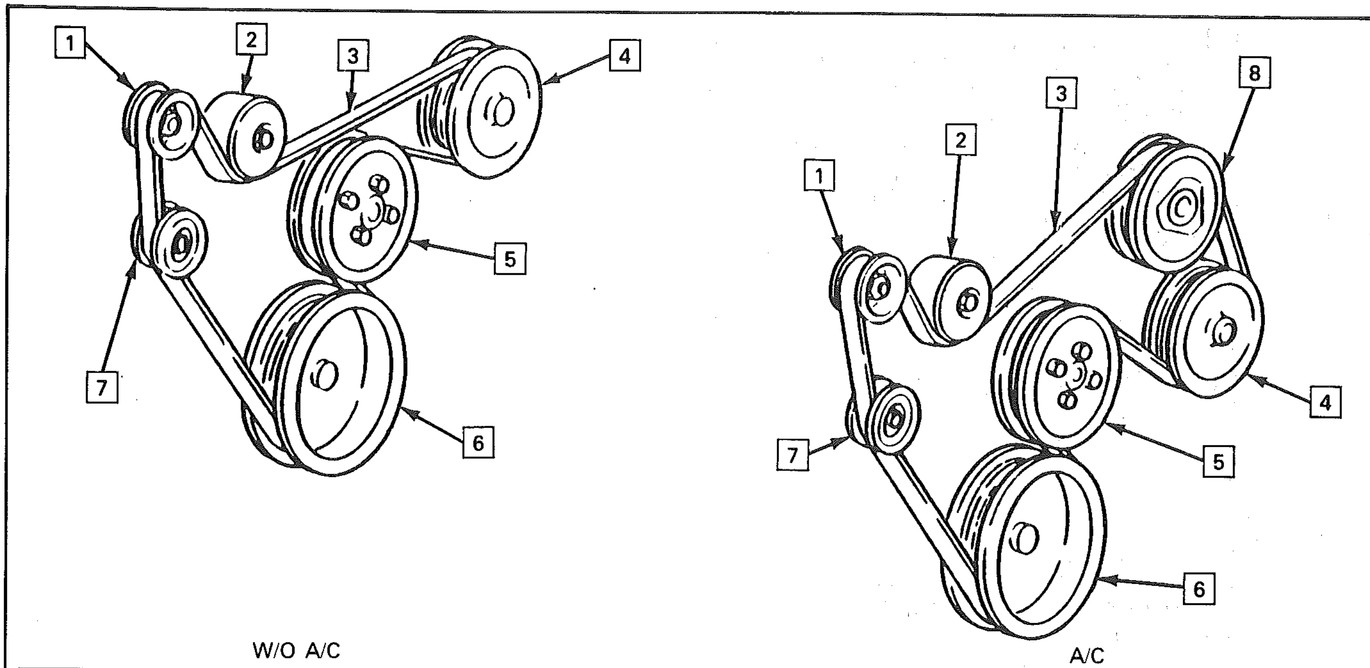
Fig. 610 Belt Diagram — V.I.N. E, F and 8



1. GENERATOR
2. TENSIONER
3. BELT
4. P/S PUMP
5. WATER PUMP
6. CRANKSHAFT
7. A.I.R. PUMP
8. A/C COMPRESSOR

J10009-6B-F

Fig. 611 Belt Diagram — V.I.N. S (Manual Transmission)



1. GENERATOR
2. TENSIONER
3. BELT
4. P/S PUMP
5. WATER PUMP
6. CRANKSHAFT
7. BELT IDLER
8. A/C COMPRESSOR

J10010-6B-F

Fig. 612 Belt Diagram — V.I.N. S (Automatic Transmission)

SECTION 6C

ENGINE FUEL

CONTENTS

All new General Motors vehicles are certified by the United States Environmental Protection Agency as conforming to the requirements of the regulations for the control of air pollution from new motor vehicles. This certification is contingent on certain adjustments being set to factory standards. In most cases, these adjustment points either have been permanently sealed and/or made inaccessible to prevent indiscriminate or routine adjustment in the field. For this reason, the factory procedure for temporarily removing plugs, caps, etc., for purposes of servicing the product must be strictly followed and, wherever practicable, returned to the original intent of the design.

GENERAL DESCRIPTION

All gasoline engines are designed to use only unleaded gasoline. Unleaded gasoline must be used for proper emission control system operation. Its use will also minimize spark plug fouling and extend engine oil life. Using leaded gasoline can damage the emission control system and could result in loss of emission warranty coverage.

All cars are equipped with an Evaporative Emission System. The purpose of the system is to minimize the escape of fuel vapors to the atmosphere. Information on this system will be found in Section 6E2, or 6E3.

When working on the fuel system, there are several things to keep in mind.

- **Any time fuel system is being worked on, disconnect the negative battery cable except for those tests where battery voltage is required.**
- On MPFI, TPI, SFI and TBI systems, always relieve the line pressure before servicing any fuel system components.
- Do not repair the fuel system until you have read the copy and checked the illustrations relating to that repair.
- Adhere to all Notices and Cautions.
- Always keep a dry chemical (Class B) fire extinguisher near the work area.
- Always use a backup wrench when loosening or tightening a screw couple fitting.
- The torque on a screw fitting is 30 N·m (22 lb. ft.).
- Pipe is used on all MPFI, TPI, SFI, and TBI applications. Fittings require the use of an "O" Ring. Replace all pipe with the same type of pipe and fittings that were removed.
- All fuel pipes must meet GM Specification 124-M, or its equivalent.
- All fuel hoses must meet GM Specification 6163-M, or its equivalent.
- Do not replace fuel pipe with fuel hose.

Alcohol-In-Fuel

Certain driveability complaints such as hesitation, lack of power, stall, no start, etc., may be caused by an excessive amount of alcohol-in-fuel. The complaints may be due to fuel system corrosion and subsequent fuel filter plugging, deterioration of rubber components such as the accelerator pumps and/or air-fuel mixture leaning effects.

Various types and concentrations of alcohols are used in commercial gasoline. Some alcohols are more detrimental to fuel system components than others. If an excessive amount of alcohol in the fuel is suspected as the cause of a driveability condition, the following procedure may be used to detect the presence of alcohol in the fuel. In this procedure, water is used to extract the alcohol from the fuel. However, the specific type of alcohol is not determined.

The fuel sample should be drawn from the bottom part of the tank so that any water, if already present, can be detected. The sample should be bright and clear. If the sample appears cloudy or contaminated with water as indicated by a water layer in the bottom part of the sample, this procedure should not be used. The fuel system should then be cleaned (See Fuel System Cleaning).

Testing Procedure

1. Using a 100 ml cylinder with 1 ml graduation marks, fill with fuel to the 90 ml mark.
2. Add 10 ml of water to bring the total fluid volume to 100 ml and install a stopper.
3. Shake vigorously for 10 to 15 seconds.
4. Carefully loosen stopper to release pressure.
5. Close the stopper and shake vigorously again for 10 to 15 seconds.
6. Carefully loosen stopper to release pressure.
7. Put the graduated cylinder on a level surface for approximately 5 minutes to allow adequate liquid separation.

If alcohol is present in the fuel, the volume of the lower layer, which would now contain alcohol and water will be greater than 10 ml. For example, if the volume of the lower layer is increased to 15 ml, it would indicate at least 5 percent alcohol in fuel. The actual amount of alcohol may be somewhat greater because this procedure does not extract all of the alcohol from the fuel.

FUEL METERING

Throttle Body Injection (TBI)

With Throttle Body Injection (TBI), an injection unit is placed on the intake manifold where the carburetor is normally mounted. The TBI unit is computer controlled and supplies the correct amount of fuel during all engine operating conditions. See Section 6E2 for information relative to operation and diagnosis of TBI units.

Port Fuel Injection

The ECM is in complete control of this fuel delivery system during all driving conditions.

The intake manifold is used only to let air into the engine. Fuel is injected by separate injectors that are mounted over the intake valve.

With the Port Injection System, there is no need for a Thermac, EFE, Map Sensor, Baro Sensor, A.I.R. System, or Dual Bed Converter.

This system provides better cold driveability, lower exhaust emissions and better throttle response.

In Sequential Fuel Injection systems (SFI), injectors turn on at every crankshaft revolution. The ECM controls the injector "on" time so that the correct amount of fuel is metered, depending on driving conditions.

Two interchangeable "O" rings are used on the injector that must be inspected when the injectors are removed. Check "O" rings for cuts or other type of damage and replace as necessary.

The air cleaner is remotely mounted near the radiator. It is connected to the intake manifold by air intake ducting.

Also, mounted between the air cleaner and intake, are the mass air flow sensor and throttle body.

Cold driveability characteristics are greatly improved with the aid of an engine coolant supply to the throttle body for rapid warm up.

The throttle body design uses an integral Idle Air Control to govern idle speed and a Throttle Position Sensor (TPS). The IAC and TPS are both controlled by the ECM.

A large diameter fuel rail is attached to the intake manifold and supplies fuel to all the injectors.

A fuel pressure tap is located on the rail for quick pressure checks.

Fuel is recirculated through the rail continually while the engine is running. This removes air and vapors from the fuel as well as keeping the fuel cool during hot weather operation.

A fuel pressure regulator is mounted on the fuel rail. It maintains a constant 36 psi pressure across the injectors under all operating conditions. It is accomplished by controlling the amount of fuel that is recirculated back to the fuel tank, based on engine demand.

The pressure regulator also uses an "O" ring for attachment. The "O" ring used is the same one that is used for the injectors.

Some engines also have an accumulator that is located in the fuel feed line near the cowl area. It is used to dampen the vibration that is caused by the pressurized fuel and the pulsing of the injector.

See Section 6E3 for more information and diagnosis.

Fuel Feed and Return Pipe

When replacing fuel feed and return pipes, always replace them with welded steel tubing meeting GM Specification 124M, or its equivalent. The replacement pipe must use the same type of fittings as the original pipes to ensure the integrity of the connection.

NOTICE: Do not replace fuel pipe with fuel hose or any other type of tubing such as copper or aluminum. Only tubing meeting the 124M specification is capable of meeting all the pressure and vibration characteristics necessary to ensure the durability standard required.

- Always check and replace any "O" rings or washers that appear damaged.

- Fuel feed and return pipes are secured to the underbody with clamps and screw assemblies. The pipes should be inspected occasionally for leaks, kinks or dents.
- Follow the same routing as the original pipe.
- Pipes must be properly secured to the frame to prevent chafing. A minimum of 6 mm (1/4") clearance must be maintained around a pipe to prevent contact and chafing.

MPFI Fuel Pipes

Due to the fact that fuel pipes are under high pressure, these systems require special consideration for service.

Many feed and return pipes use screw couplings with "O" Rings. Any time these fittings are loosened to service or replace components, ensure that:

- A backup wrench is used while loosening and tightening the fitting.
- Check all "O" rings at fitting locations (if applicable) for cuts or any damage and replace any that appear worn or damaged.
- Use correct torque when tightening fittings.
- If pipes are replaced always use original equipment parts, or parts that meet GM specifications.

Fuel and Vapor Hoses

NOTICE: Fuel and vapor hoses are specially manufactured. If replacement becomes necessary, it is important to use only replacement hoses meeting GM Specification 6163-M. These hoses are identified with the words "Fluoroelastomer" on them. Hoses not so marked could cause early failure, or fail to meet emission standards.

- Do not use rubber hose within 4" of any part of the exhaust system, or within 10" of the catalytic converter.

FUEL PUMP

The electric fuel pump is in the fuel tank. The tank has an outlet for a vapor return system. Any vapor which forms is returned to the fuel tank along with hot fuel through a separate line. This greatly reduces any possibility of vapor lock by keeping cool fuel from the tank constantly circulating through the fuel pump.

FUEL PUMP RELAY

To control fuel pump operation, a fuel pump relay is used.

When the ignition switch is turned to "RUN" position, the fuel pump relay activates the electric fuel pump for 1.5 to 2.0 seconds to prime the injector(s). If the ECM does not receive reference pulses from the distributor after this time, the ECM signals the relay to turn off the fuel pump. The relay will once again activate the fuel pump when the ECM receives distributor reference pulses.

Fuel Filter

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components. (See Fuel System Pressure Relief.)

The inline filters can be found on the rear crossmember of the vehicle. Always use a backup wrench any time that the fuel filter is removed or installed. Also make sure that a good "O" Ring is used at all screw couple locations. Torque on fittings is 30 N·m (22 lb. ft.).

FUEL TANK

The fuel tank is usually located under the rear of the vehicle and a number of shapes and sizes are used depending on the application.

The tank is held in place by two metal straps, hinged (with a bolt through the hinge) and secured at the opposite end with a nut and bolt assembly.

Anti-squeak pieces are used on top of the tank to reduce rattles and other annoying noises.

The fuel tank, cap and lines should be inspected for road damage, whch could cause leakage. Inspect fuel cap for correct sealing and indications of physical damage. Replace any damaged or malfunctioning parts.

Before attempting service of any type on the fuel tank, always (1) remove negative battery cable from battery, (2) place "no smoking" signs near work areas, (3) be sure to have CO2 fire extinguisher handy, (4) wear safety glasses and (5) siphon or pump fuel into an explosion proof container.

Fuel Filler Cap

The fuel tank filler neck is equipped with a screw-type cap. The threaded part of the cap requires several turns counterclockwise to remove. The long threaded area is designed to allow any remaining fuel tank pressure to escape while the cap is being removed. A built-in torque-limiting device prevents overtightening. To install, turn the cap clockwise until a clicking noise is heard. This signals that the correct torque has been reached and the cap is fully seated.

NOTICE: If a fuel filler cap requires replacement, use only a cap with the same features. Failure to use the correct cap can result in a serious malfunction of the system.

Available on some models is an electric locking fuel filler cap. Information on this option will be found in Section 9E.

FUEL TANK FILLER NECK

To help prevent refueling with leaded gasoline, the fuel filler neck on gasoline engine cars has a built-in restrictor and deflector. The opening in the restrictor will only admit the smaller unleaded gas nozzle spout, which must be fully inserted to bypass the deflector. Attempted refueling with a leaded gas nozzle or failure to fully insert the unleaded gas nozzle will result in gasoline splashing back out of the filler neck.

Fuel Gage Sending Unit

The fuel gage sending unit is attached to the top of the fuel tank. It is held in place with a cam lock ring and a gasket is used between the tank and sending unit.

Sending units have three hoses attached. One line is for the fuel feed. The second line is connected to the vapor canister, to keep fuel vapor from getting into the air (see Section 6E). The third line is used as a fuel return line to the tank.

On some sending units a wire is attached to the unit. On others the connectors attach directly to the sender.

When a fuel gage sending unit is removed always make sure to install the gasket and any power or ground leads that were removed.

DIAGNOSIS

Fuel system diagnostic procedures are located in Section(s) 6E1 thru 6E3.

SERVICE PROCEDURES

If the fuel system is suspected of delivering an improper amount of fuel, it should be inspected and tested in the vehicle, as follows:

1. Make certain that there is fuel in the tank.
2. With the engine running, inspect for leaks at all fuel feed pipe and hose connections from fuel tank to injection pump. Tighten any loose connections. Inspect all hoses for flattening or kinks which would restrict the flow of fuel. Air leaks or restrictions on suction side of fuel pump will seriously affect pump output.

FUEL SYSTEM PRESSURE RELIEF

CAUTION: To reduce risk of fire and personal injury, it is necessary to relieve fuel system pressure before servicing fuel system components. To do this:

- **Remove "fuel pump" fuse from fuse block in passenger compartment.**
- **Crank engine - engine will start and run until fuel supply remaining in fuel lines is consumed. Engage starter for 3.0 seconds to assure relief of any remaining pressure.**
- **With ignition "OFF", replace fuel pump fuse.**

Unless this procedure is followed before servicing fuel lines or connections, fuel spray could occur.

When repair to the fuel system has been completed, start engine and check all connections that were loosened for possible leaks.

Refer to Section 6E for additional diagnosis of engine fuel system.

Fuel Pump Flow Test

1. Test fuel pump by connecting hose from EFI fuel feed line to a suitable unbreakable container. Apply battery voltage to the fuel pump test terminal (terminal "G" of ALCL).
2. Fuel pump should supply 1/2 pint or more in 15 seconds.
3. If flow is below minimum, check for fuel restriction. If there is no restriction, check pump pressure.

Fuel System Pressure Test

This test must be performed when diagnosing the fuel system.

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve fuel system pressure before servicing fuel system components on the TBI system. To do this:

- Remove "Fuel Pump" fuse from fuse block in passenger compartment.
- Crank engine. Engine will start and run until fuel remaining in fuel lines is consumed. Crank the starter for three seconds to assure that any remaining pressure is relieved.
- With the ignition off, replace the "Fuel Pump" fuse.

1. Obtain two sections of 3/8" steel tubing. Each should be about 254 mm (10 inches) long. Double-flare one end of each section.
2. Install a flare nut on each section. Connect each of the above sections of tubing into the "flare nut to flare nut adapters" that are included in J-29658 Gage Adapters.
3. Attach the pipe and adapter assemblies to the J-29658 gage.
4. Hoist the car.
5. Disconnect front fuel feed hose from the fuel pipe on the body.
6. Install a 254 mm (10 inch) length of 3/8" fuel hose onto the fuel feed pipe on the body. Attach the other end of the hose onto one of the sections of pipe mentioned in Step 1. Secure the hose connections with clamps.
7. Attach the front fuel feed hose onto the other section of tubing mentioned in Step 1. Secure the hose connection with a clamp.
8. Start the engine and check for leaks.
9. Observe the fuel pressure reading. It should be 62 to 90 kPa (9 to 13 psi). If not, refer to the appropriate Emissions Section.
10. Depressurize the fuel system and remove the gage with adapters. Reconnect the fuel feed hose to the pipe and torque the clamp to 1.7 N·m (15 lb. in.).
11. Lower the car. Start the engine and check for fuel leaks.

Fuel System Pressure Test- MPFI

Fuel system diagnosis is in Section 6E3, Chart A-7.

FUEL TANK

Draining Fuel Tank

1. Disconnect the negative battery cable. Also have a dry chemical (Class B) fire extinguisher near the work area.
2. Use a hand operated pump device when possible to drain as much fuel through the filler tube as possible.
3. If a hand operated pump device cannot be used to complete the draining process, use a siphon at the main (not return) fuel pipe at the fuel pump or the fuel tank gage unit.

   CAUTION: Never drain or store gasoline in an open container due to the possibility of fire or explosion.
4. Reinstall any removed hoses, lines and cap.

Removing Fuel Tank

1. Remove all fuel, see "Draining Fuel Tank".
2. Support fuel tank and disconnect the two fuel tank retaining straps.
3. Lower tank enough to disconnect sending unit wire, hoses, and ground strap, if so equipped.
4. Remove tank from vehicle.
5. Remove sending unit.

Installing Fuel Tank

1. Reverse removal procedure.
2. Always replace "O" ring when tank unit has been removed.
3. When reinstalling fuel tank, be sure to reinstall anti-squeak pieces on top of the tank to reduce rattles and other annoying noises.
4. Tighten fuel tank retaining strap bolts or screws.

Fuel System Cleaning

CAUTION: This procedure will NOT remove all fuel vapor. Do not attempt any repair on tank or filler neck where heat or flame is required, as an explosion resulting in personal injury could occur.

If trouble is due to contaminated fuel or foreign material that is in the tank, it can usually be cleaned. If tank is rusted internally, it should be replaced.

1. Disconnect negative battery cable.
2. Disconnect ignition engine harness connector. Have dry chemical (Class B) fire extinguisher near the work area.
3. Relieve fuel system pressure.
4. Drain fuel tank (see "Draining Fuel Tank").
5. Remove fuel tank (see "Fuel Tank Removal").
6. Remove external fuel filter and inspect for contamination. If filter is plugged, replace.
7. Locate tank away from heat, flame, or other source of ignition. Remove fuel gage sending unit and fuel pump assembly, if so equipped, and inspect condition of strainer. If strainer is contaminated, a new strainer should be installed.
8. Complete draining of tank by rocking it and allowing fuel to run out of fuel sending unit opening.
9. Flush fuel tank with running hot water for at least five minutes. Pour water out of fuel sending unit opening. (Rock tank to be sure that removal of water is complete.)
10. Disconnect fuel feed pipe and use air pressure to clean fuel line. Apply air pressure in the opposite direction fuel normally flows through the line. On vehicles equipped with a fuel return line, clean line in similar manner. Disconnect pipe at throttle body unit and apply air pressure to clean return line. Reconnect and torque all pipes to 30 N·m (22 lb. ft.).
11. Use low air pressure to clean pipes on fuel gage sending unit.
12. Install new strainer on fuel gage sending unit, if required. Install fuel gage sending unit and fuel pump, with new gasket, into tank and install fuel tank. Connect fuel gage wire harness to body harness. Connect all fuel lines except feed line to external fuel filter.
13. Disconnect fuel feed hose to chassis pipe at front. Connect a hose to front end of chassis fuel feed pipe and insert other end of hose into a one gallon fuel can.
14. Connect battery cable.
15. Put six gallons of clean fuel into fuel tank and apply 12 volts to Terminal "G" of ALCL to operate fuel pump. Pump two quarts of fuel into fuel can. This will purge fuel pump.
16. Remove hose and connect fuel hose to chassis pipe.
17. Check all connections for leaks; tighten all hose clamps.

Fuel Tank Purging Procedure

The following procedure is used prior to repairing of fuel tank.

1. Remove fuel sending unit and fuel pump and drain all remaining fuel from tank.
2. Visually inspect interior cavity of tank. If any fuel is evident, drain again.
3. Move tank to flushing area (wash rack).
4. Fill tank completely with tap water, agitate vigorously and drain.
5. Add gasoline emulsifying agent to the tank, refill with water, agitate mixture for 10 minutes, and drain tank completely.

   For correct gasoline emulsifying agent-to-water mixture, refer to the manufacturer's specifications. Use an available emulsifying agent, such as "Product-Sol No. 913", or equivalent.
6. When empty, refill the tank to overflowing with water. Completely flush out remaining mixture and empty tank.
7. If available, an explosion meter should be used to check for negative reading.
8. Perform required service work.

Fuel Tank Leak Test Procedure

Plug all outlets. Before removing a fuel tank for a suspected fuel leak, make sure that it is not one of the fuel hoses that is leaking onto the tank.

On-Car Test

If fuel is leaking from tank, replace tank.

Off-Car Test

Apply a small amount of air pressure to tank through vent tube (approximately 7 to 10 kPa or 1 to 1-1/2 lbs. of pressure).

NOTICE: More than 1-1/2 pounds of pressure will damage tank permanently.

Test repaired area for leaks with soap solution, or by submersion. If leak is noted, replace tank.

ACCELERATOR CONTROLS

The accelerator control system is cable type. There are no linkage adjustments.

As there are no adjustments, the specific cable for each application must be used. Only the specific replacement part will work.

When work has been performed on accelerator controls, always check to ensure that all components are installed as removed and that all linkage and cables are not rubbing or binding in any manner.

Accelerator Control Cable

Refer to On-Car Service for removal and installation of accelerator control cable.

When performing service on the accelerator control cable, observe the following:

- Retainer must be installed with tangs secured over head of stud.
- Conduit fitting at both ends of cable must have locking tangs expanded and locked in attaching holes.
- The braided portion of the accelerator cable assembly must not come in contact with the front of dash sealer during assembly, repair or replacement of the assembly.
- Flexible components (hoses, wires, conduits, etc.) must be routed within 50.0mm (2.0 in.) of moving parts of accelerator linkage, outboard of support, unless routing is positively controlled.

Whenever disconnecting or replacing parts, lube pivot points with Accelerator Linkage Lubricant 1052541, or equivalent.

Accelerator Pedal

When performing service on the accelerator pedal, observe the following:

- The mounting surface between support and dash panel must be free of insulation. The carpet and padding in pedal and tunnel area must be positioned to lay flat and be free of wrinkles and bunches.
- Slip accelerator control cable through slot in rod and then install retainer in rod, being sure it is seated. Care must be utilized in pressing the retainer into hole in rod, to assure the cable is not kinked or damaged in any way.
- After securing all components of the accelerator linkage, linkage must operate freely, without binding, between full closed throttle and full wide open throttle.
- Wire, hoses, cables or other obstructions must not be placed within 13mm (33/64 in.) of cable or rod at any point in their travel.

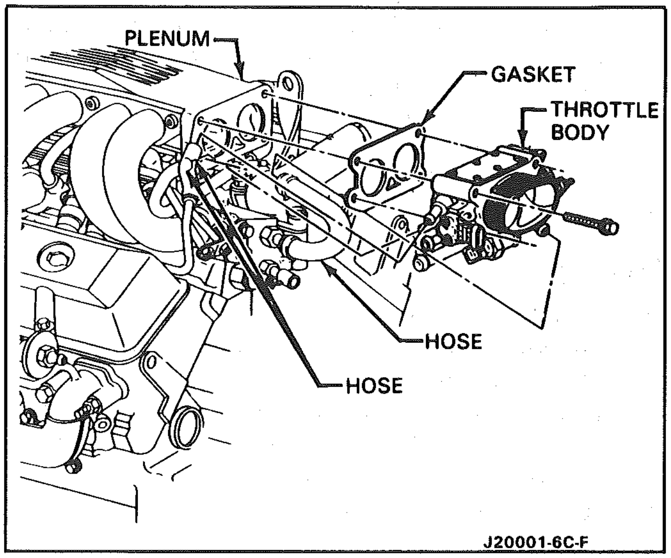


Fig. 1 Throttle Body - LB9 Shown

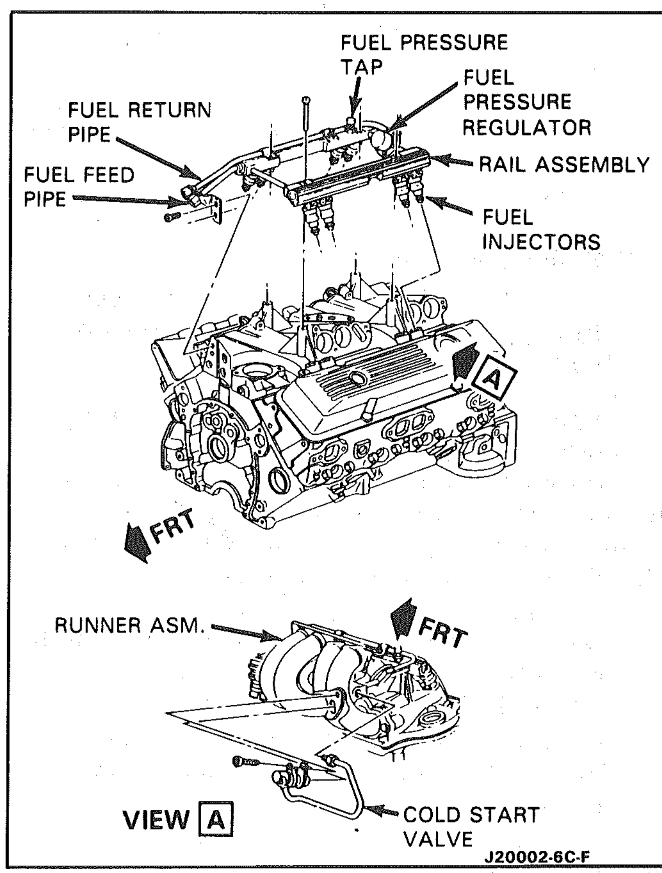


Fig. 2 Fuel Rail Components - LB9 Shown

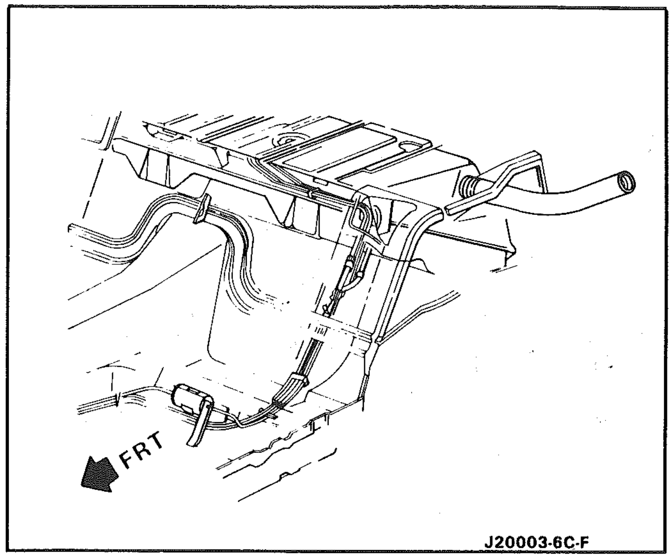


Fig. 3 Fuel Filter Location

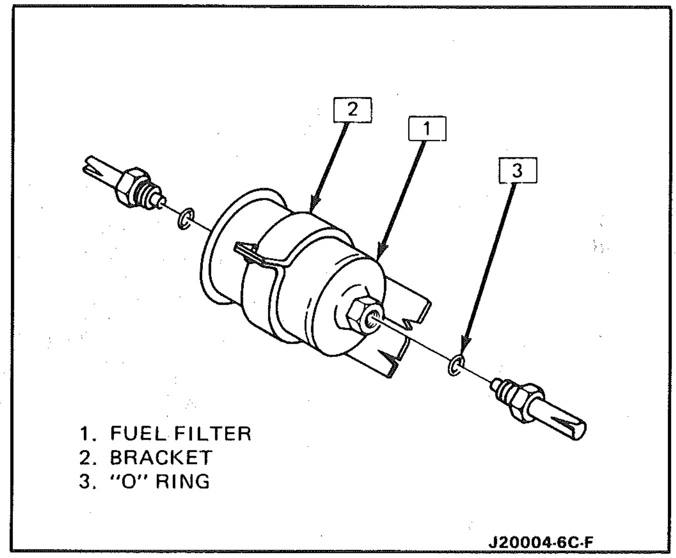


Fig. 4 Fuel Filter

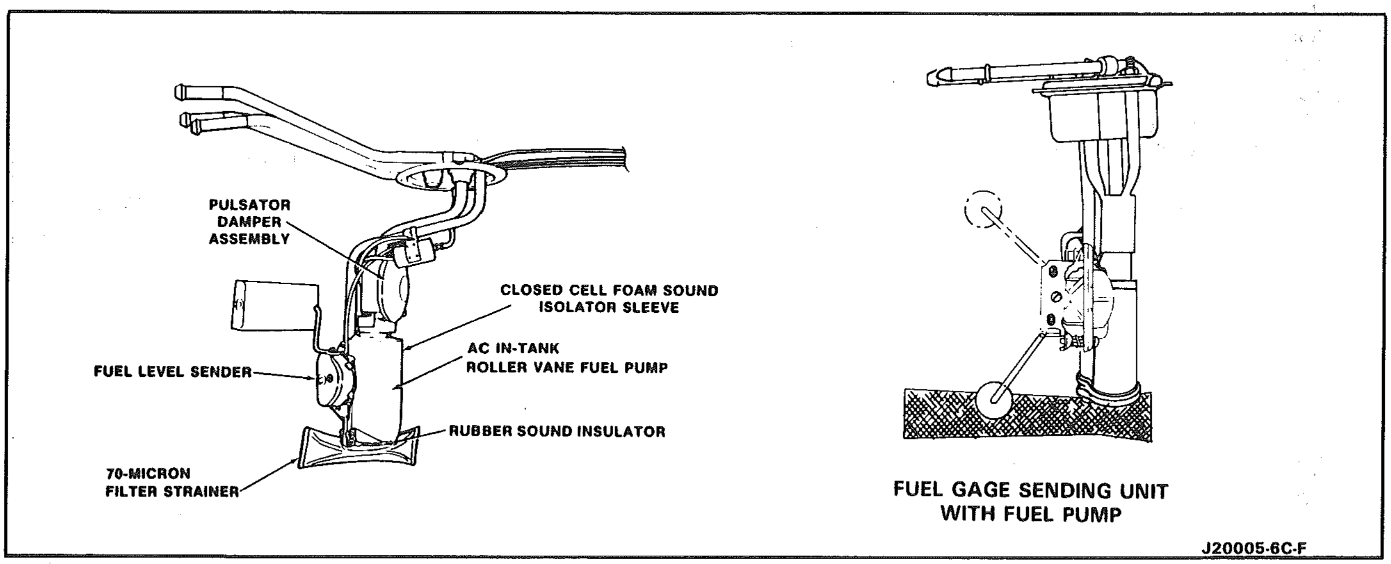


Fig. 5 Fuel Pump

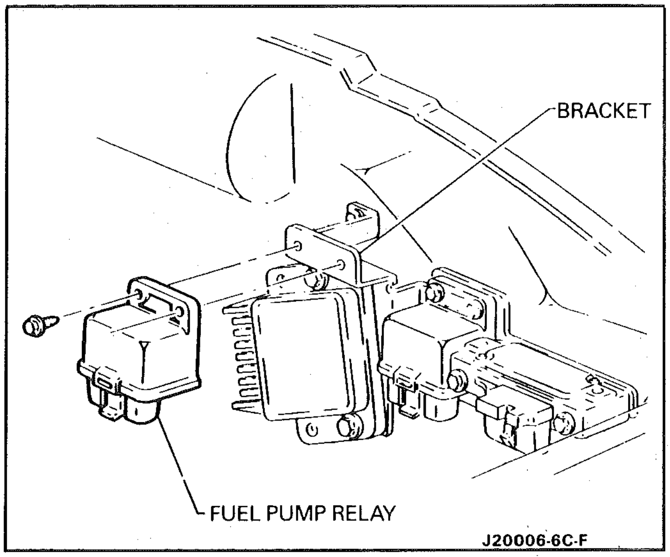


Fig. 6 Fuel Pump Relay - LB8/LO3

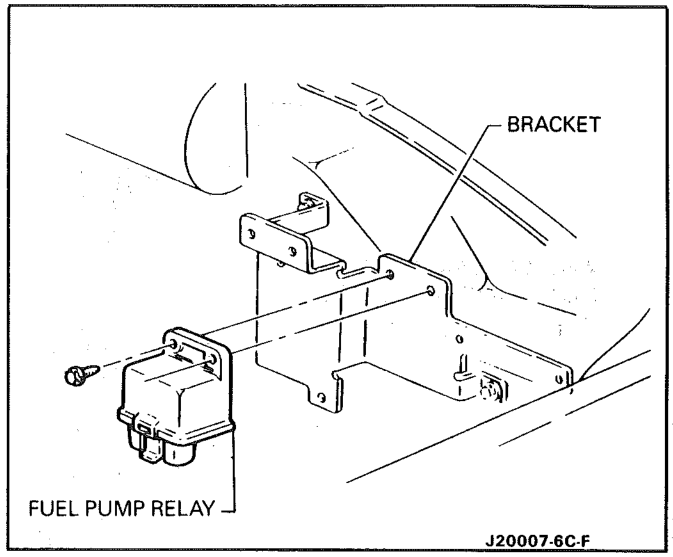


Fig. 7 Fuel Pump Relay - LB9/L98

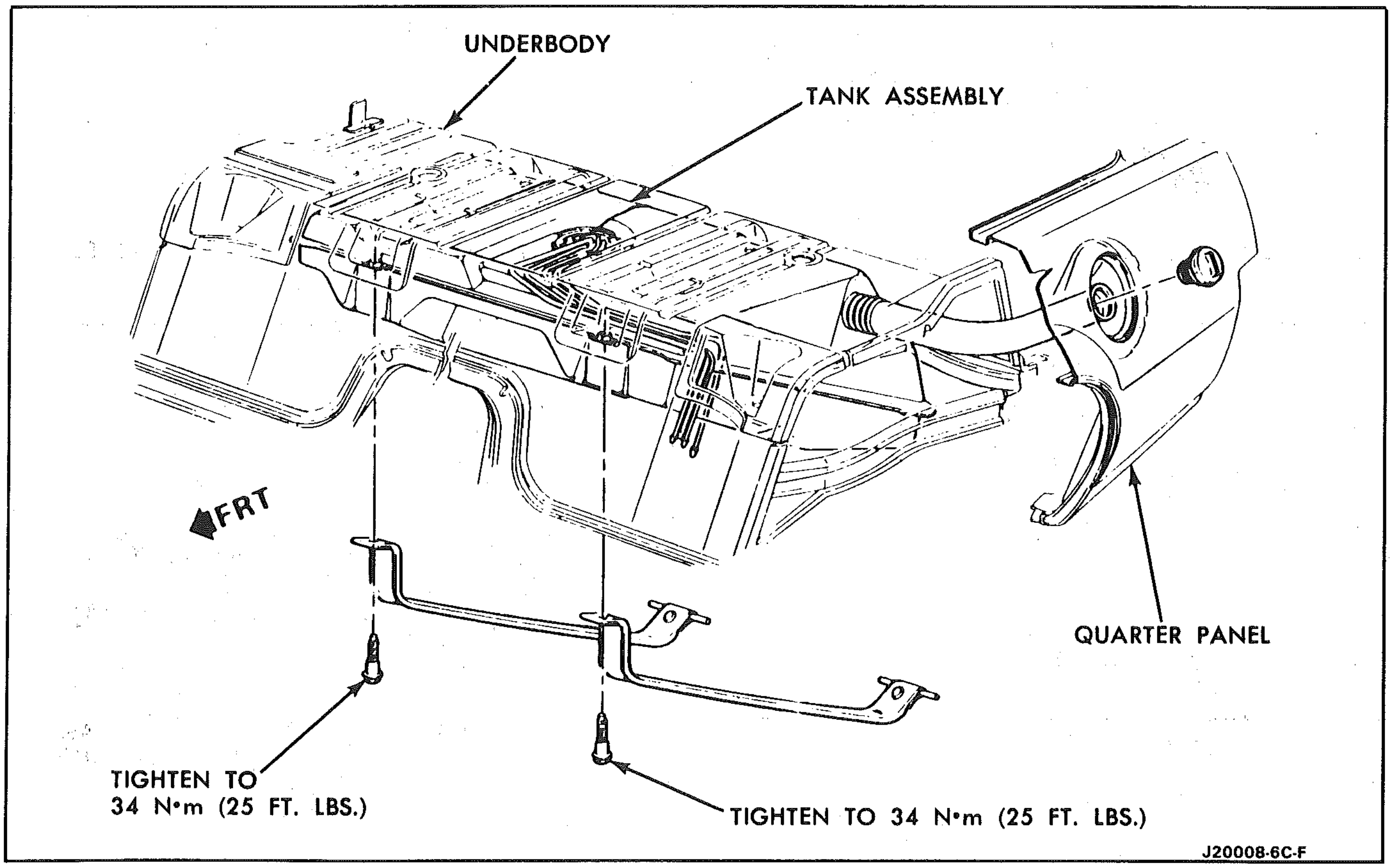


Fig. 8 Strap Attachment

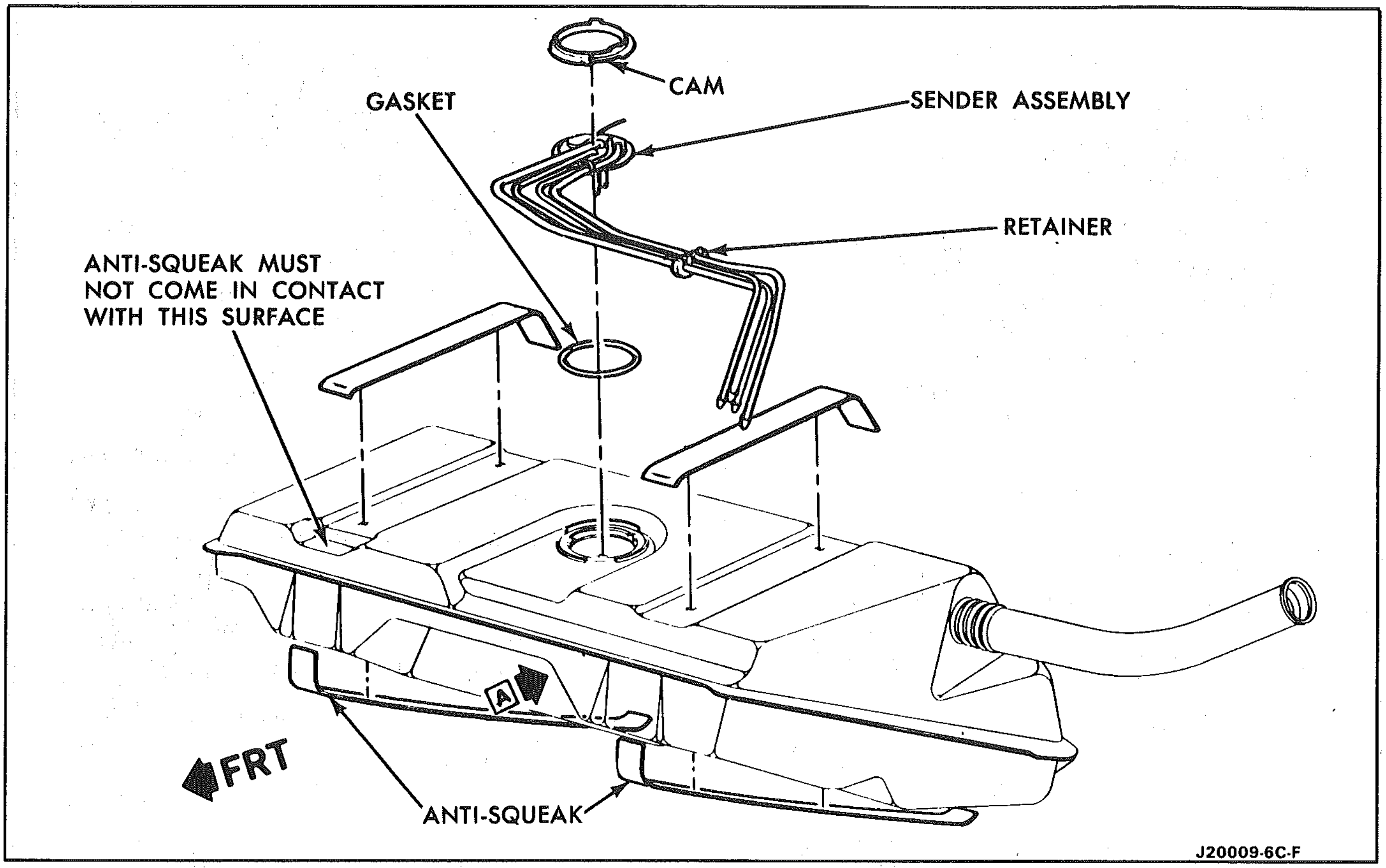


Fig. 9 Fuel Tank Insulator

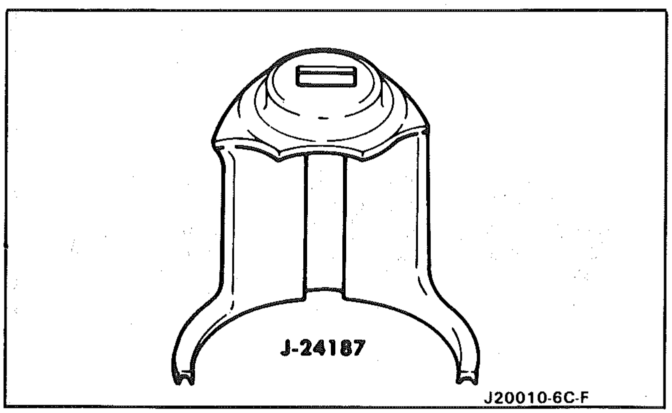


Fig. 10 Locking Cam Tool

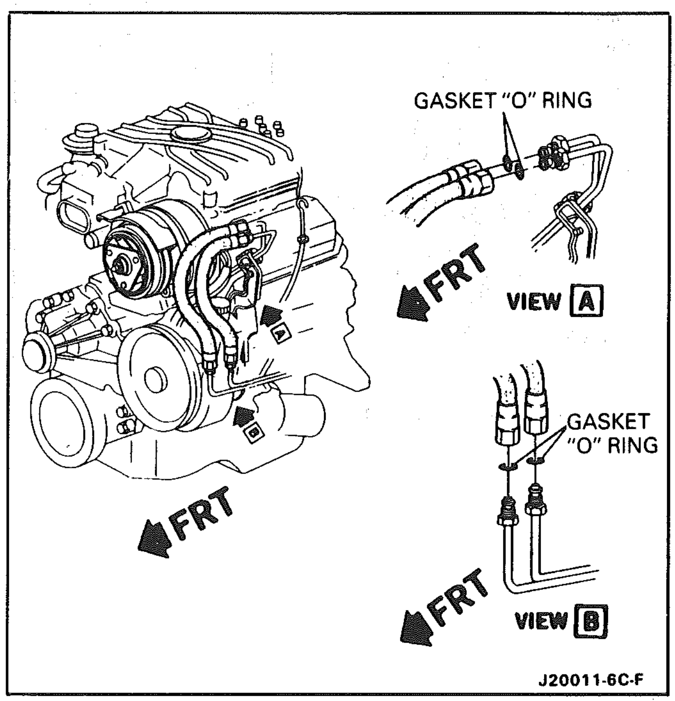


Fig. 11 Fuel Pipes and Hoses - LB8

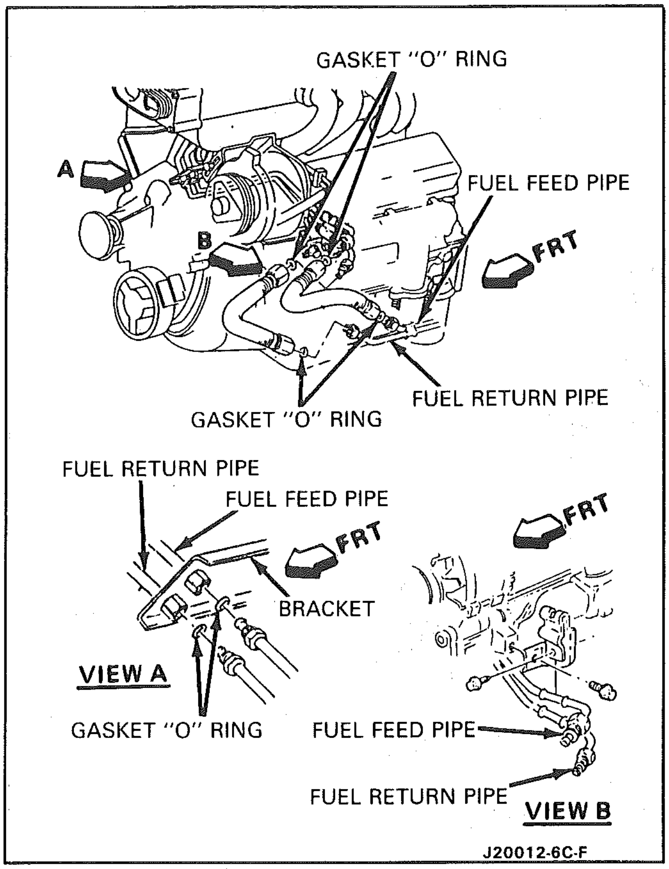


Fig. 12 Fuel Pipes and Hoses - LB9/L98

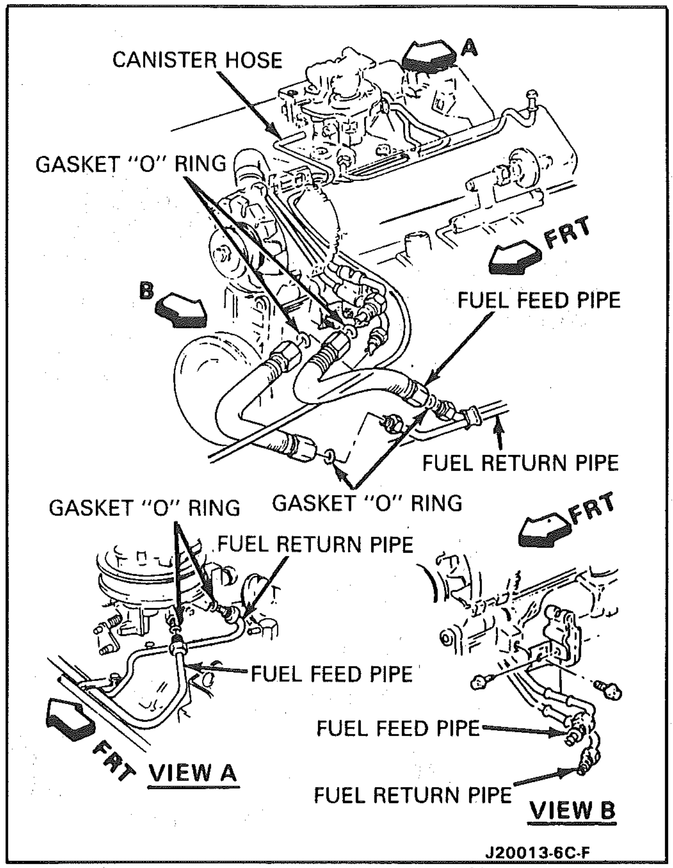


Fig. 13 Fuel Pipes and Hoses - LO3

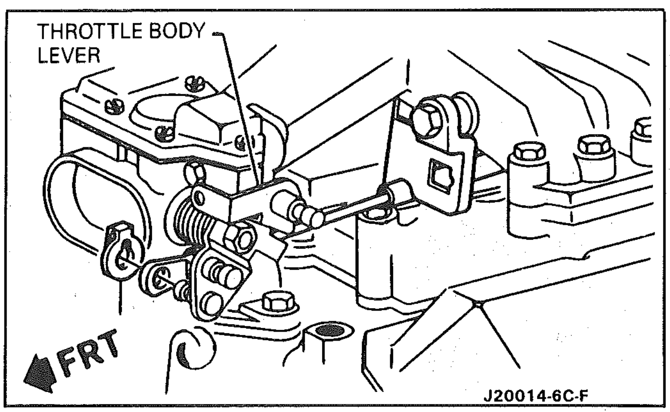


Fig. 14 Control Cable Attachment - LB8

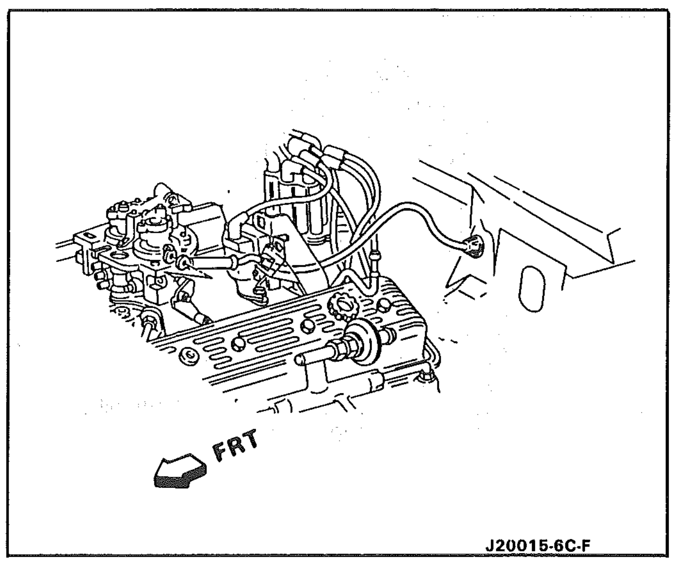


Fig. 15 Control Cable Attachment - LO3

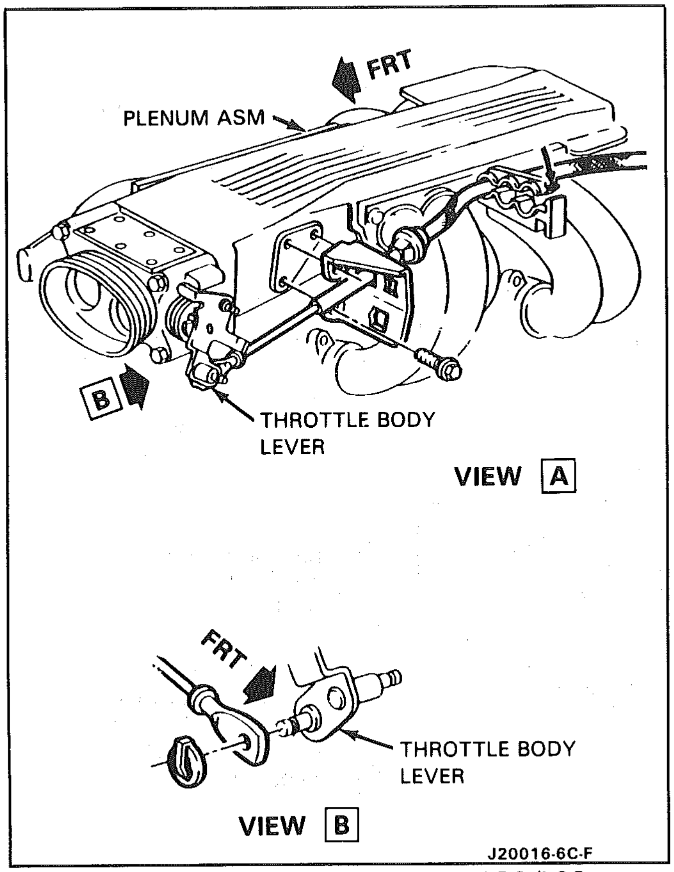


Fig. 16 Control Cable Attachment - LB9/L98

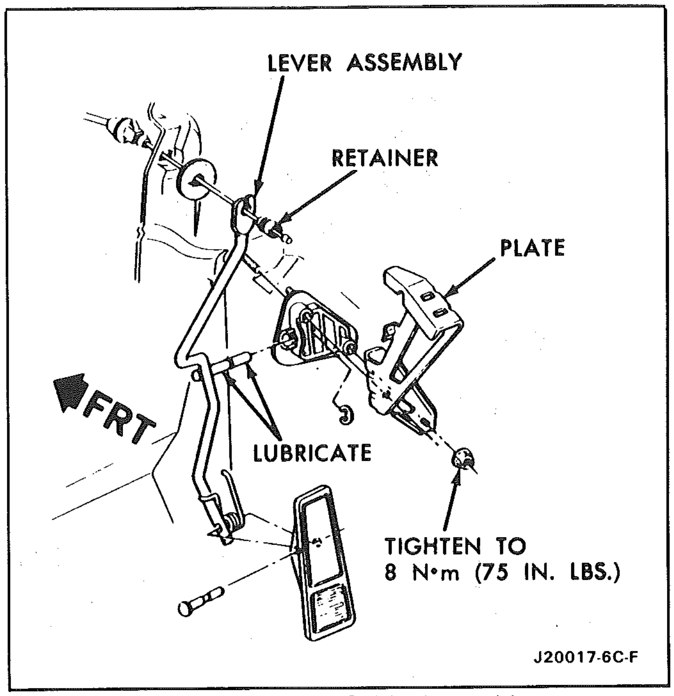


Fig. 17 Accelerator Cable Assembly

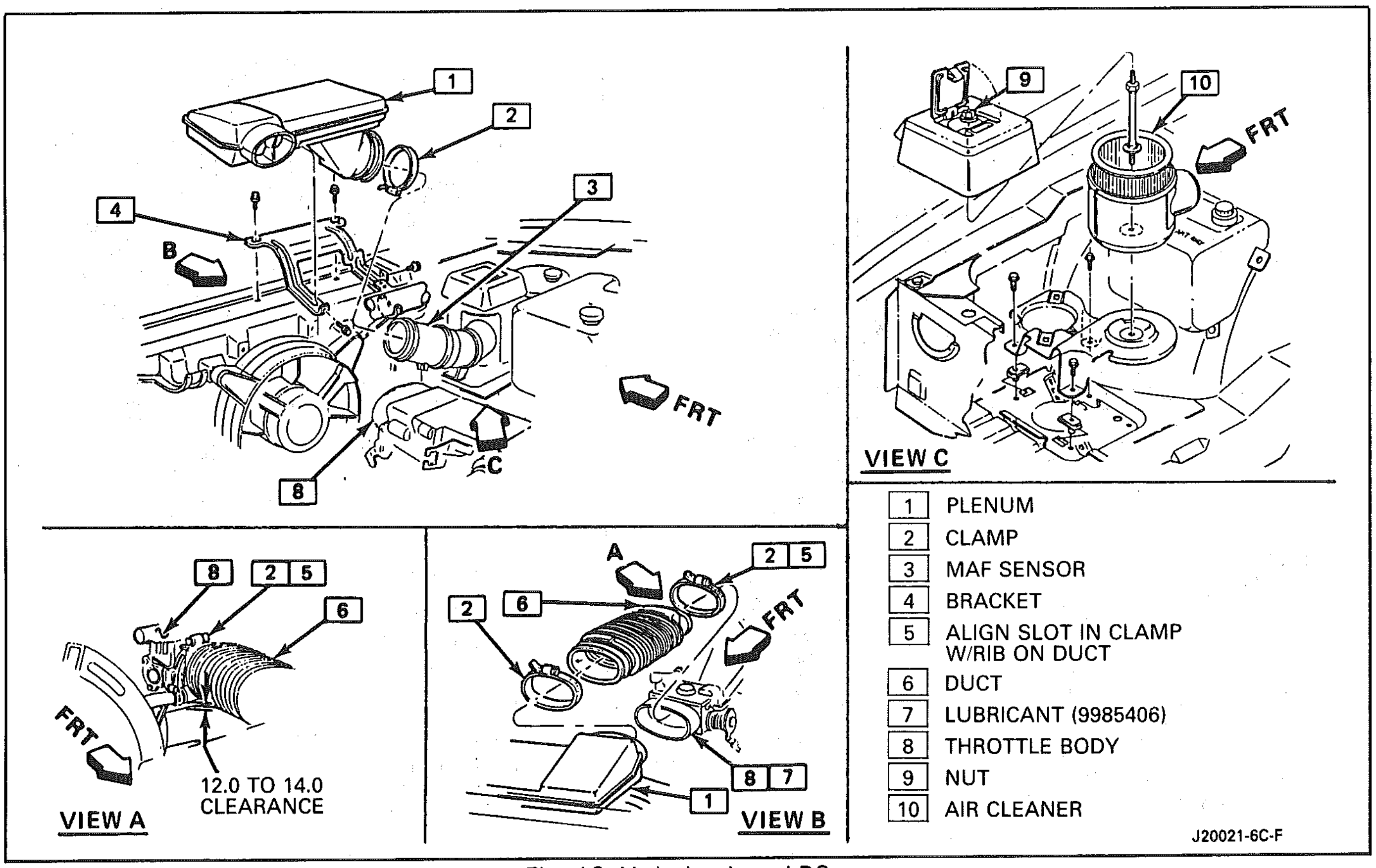


Fig. 18 Air Induction - LB8

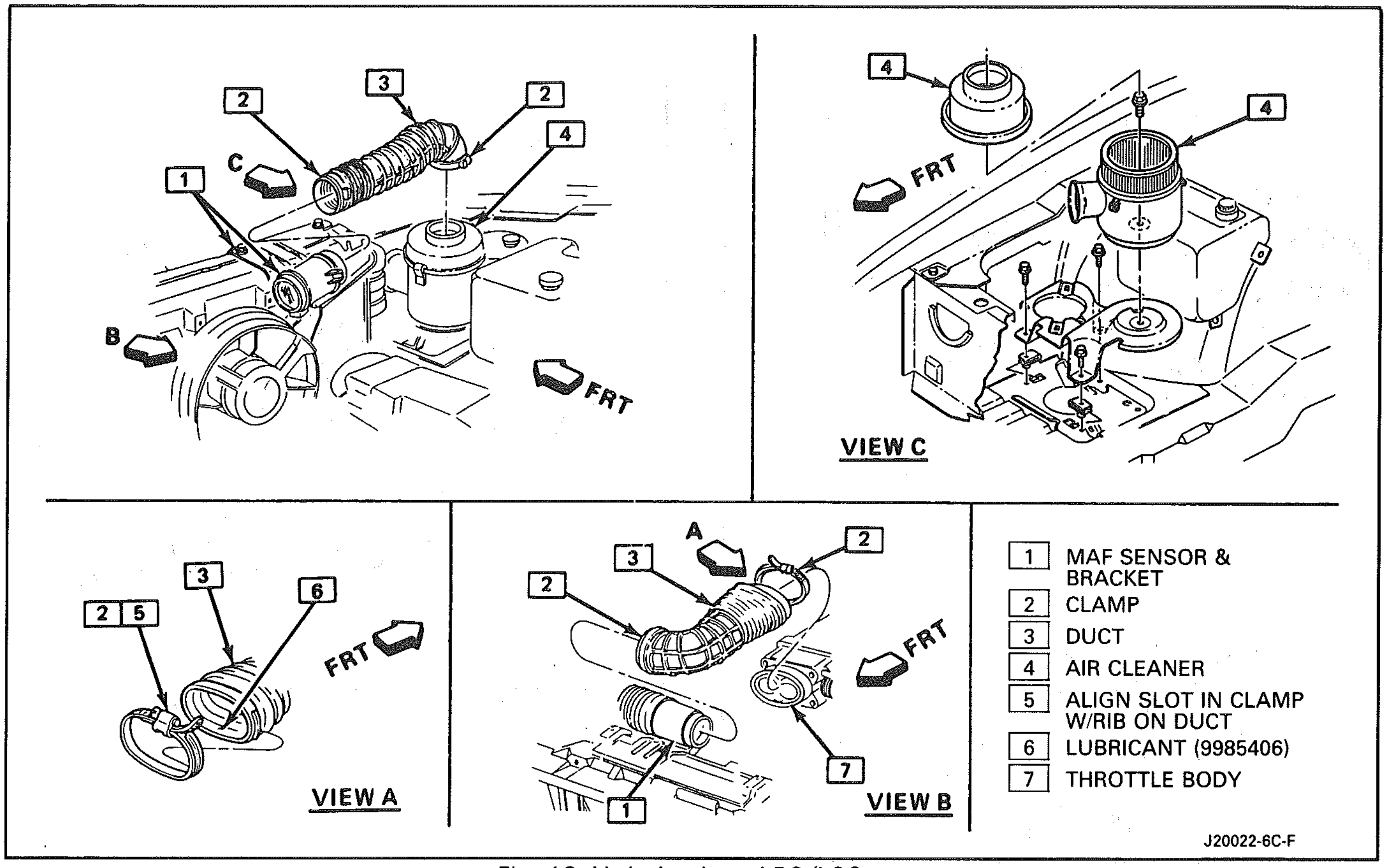


Fig. 19 Air Induction - LB9/L98

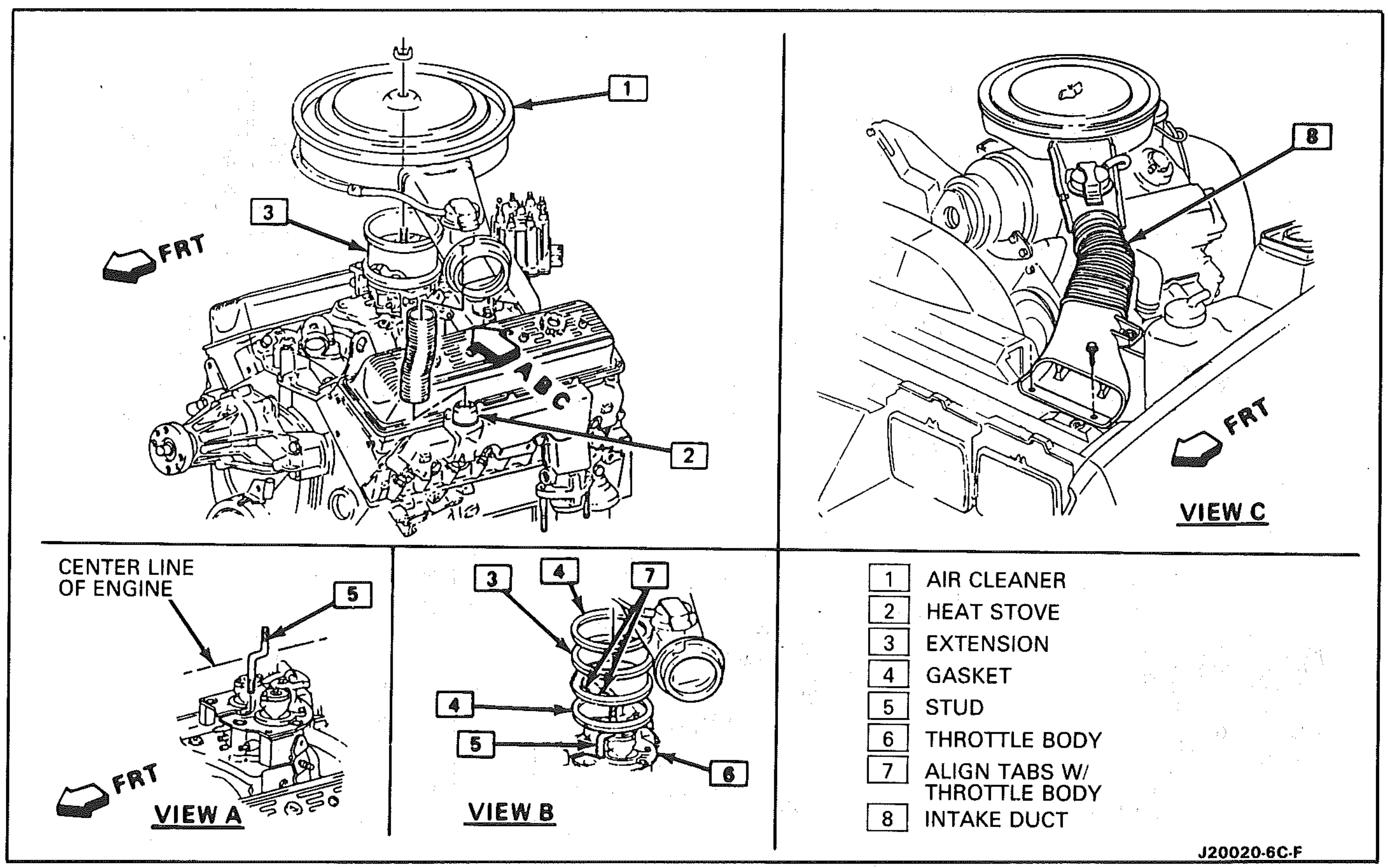


Fig. 20 Air Induction - LO3

SECTION 6D1

BATTERY

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

BATTERY

The sealed battery (see Fig. 1) is standard on all cars. (See Specifications for specific applications.) There are no vent plugs in the cover. The battery is completely sealed, except for two small vent holes in the sides. These vent holes allow the small amount of gas produced in the battery to escape. The battery has the following advantages over conventional batteries:

1. No water addition for the life of the battery.
2. Overcharge protection. If too much voltage is applied to the battery, it will not accept as much current as a conventional battery. In a conventional battery, the excess voltage will still try to charge the battery, leading to gassing which causes liquid loss.
3. Not as liable to self-discharge as compared to a conventional battery. This is particularly important when a battery is left standing for long periods of time.
4. More power available in a lighter and smaller case.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

Ratings

A battery has two ratings: (1) a reserve capacity rating at 27°C (80°F) which is the time a fully charged battery will provide 25 amperes current flow at or above 10.5 volts; and (2) a cold rating at -18°C (0°F) which indicates the cranking load capacity (see Diagnosis Section for specific battery ratings).

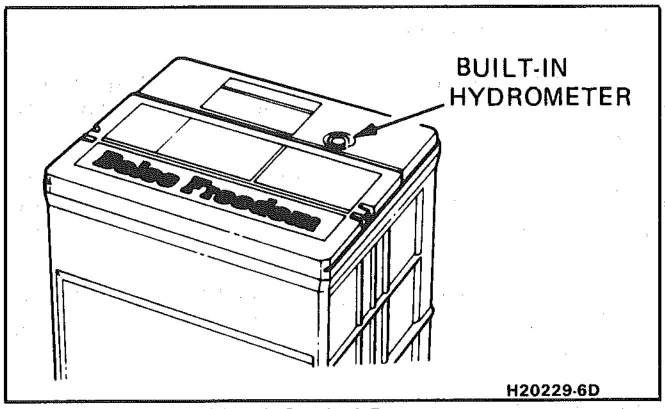


Fig. 1 Sealed Battery

Reserve Capacity

The "Reserve Capacity" is the maximum length of time it is possible to travel at night with minimum electrical load and no generator output.

Expressed in minutes it is the time required for a fully charged battery, at a temperature of 80°F being discharged at a constant current of 25-amperes, to reach a terminal voltage of 10.5 volts.

Cold Cranking Amperage

The "Cold Cranking Amperage" test is expressed at a battery temperature of 0°F. The current rating is the minimum amperage, which must be maintained by the battery for 30 seconds at the specified temperature, while meeting a minimum voltage requirement of 7.2 volts. This rating is a measure of cold cranking capacity.

The battery is not designed to last indefinitely; however, with proper care, it will provide many years of service.

If the battery tests good, but fails to perform satisfactorily in service for no apparent reason, the following are some of the more important factors that may point to the cause of trouble:

1. Vehicle accessories left on overnight.
2. Slow average driving speeds for short periods.

3. The vehicle's electrical load is more than the generator output, particularly with the addition of aftermarket equipment.
4. Defects in the charging system such as electrical shorts, slipping fan belt, faulty generator, or faulty voltage regulator.
5. Battery abuse, including failure to keep the battery cable terminals clean and tight, or loose battery hold-down. See "Service Procedures" for torque specifications.
6. Mechanical problems in the electrical system, such as shorted or pinched wires.

Electrolyte Freezing

The freezing point of electrolyte depends on its specific gravity. Since freezing may ruin a battery, it should be protected against freezing by keeping it in a charged condition.

Carrier and Hold-Down

The battery carrier and hold-down clamp should be clean and free from corrosion before installing battery.

The carrier should be in sound condition, to hold the battery securely and keep it level. Make certain there are no parts in the carrier before installing battery.

To prevent the battery from shaking in its carrier, the hold-down bolts should be tight, but not overtightened.

Built-In Hydrometer

The sealed battery has a built-in, temperature compensated hydrometer in the top of the battery. This hydrometer is to be used with the following diagnostic procedure.

When observing the hydrometer, make sure that the battery has a clean top. A light may be required, if the lighting is poor.

Under normal operation, two indications can be observed (see Fig. 4).

1. GREEN DOT VISIBLE
   Any green appearance is interpreted as a "green dot" and the battery is ready for testing.
2. DARK; GREEN DOT NOT VISIBLE
   If there is a cranking complaint, the battery should be tested as described in the "Diagnosis" section. The charging and electrical system should also be checked at this time.

   Occasionally, a third condition may appear:
3. CLEAR OR LIGHT YELLOW
   This means the fluid level is below the bottom of the hydrometer. This may have been caused by excessive or prolonged charging, a broken case, excessive tipping, or normal battery wearout. Finding a battery in this condition may indicate high charging voltages caused by a faulty charging system. Therefore, the charging and electrical systems may need to be checked. If a cranking complaint exists and is caused by the battery, it should be replaced.

DIAGNOSIS

BATTERY

1. VISUAL INSPECTION
   Check for obvious damage, such as cracked or broken case or cover, that could permit loss of electrolyte. If obvious damage is noted, replace the battery. Determine cause of damage and correct as needed. If not, proceed to step 2.
2. HYDROMETER CHECK
   a. GREEN DOT VISIBLE - Go To Step 3
   b. DARK; GREEN DOT NOT VISIBLE - Charge the battery as outlined under "Charging Procedure" section and proceed to Step 3.
3. LOAD TEST
   Load testing may require use of battery side terminal adapters to insure good connections (see Fig. 2).
   a. Connect a voltmeter and a battery load tester across the battery terminals.

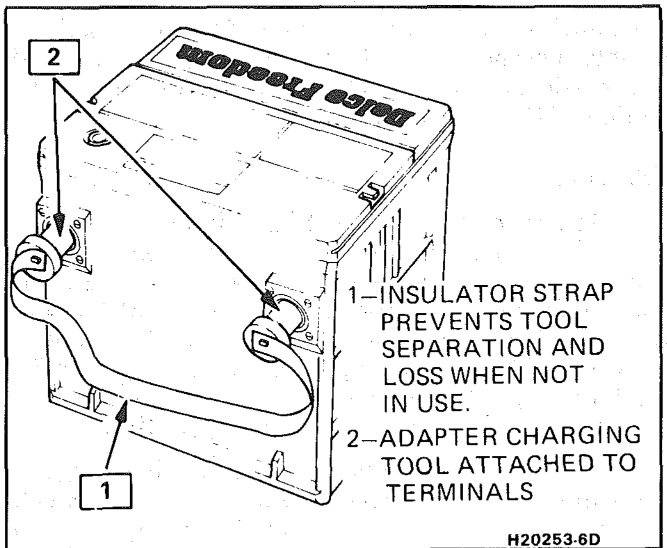


Fig. 2 Side Terminal Battery Adapters

   b. Apply 300 ampere load for 15 seconds to remove surface charge from the battery. Remove load.
   c. Wait 15 seconds to let battery recover and apply specified load from specifications. Read voltage after 15 seconds, then remove load.
   d. If voltage does not drop below the minimum listed in Fig. 3, the battery is good and should be returned to service. If voltage is less than minimum listed, replace battery. (The battery temperature must be estimated by feel and by the temperature the battery has been exposed to for the preceding few hours.)

SERVICE PROCEDURES

BATTERY CHARGING

When it is necessary to charge the battery, the following basic rules must be followed:

ESTIMATED TEMPERATURE	MINIMUM VOLTAGE
70° F. (21° C.)	9.6
50° F. (10° C.)	9.4
30° F. (0° C.)	9.1
15° F. (−10° C.)	8.8
0° F. (−18° C.)	8.5
0° F. (BELOW: −18° C.)	8.0

520011-6D

Fig. 3 Minimum Voltage

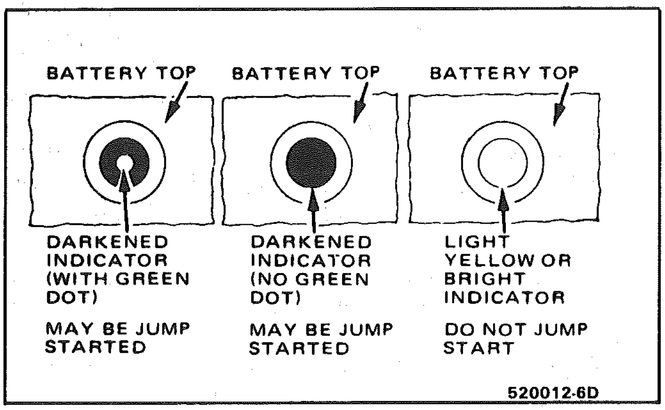


Fig. 4 Built-In Hydrometer

1. Do not charge battery if hydrometer is clear or light yellow. Replace battery.
2. If the battery feels hot 52°C (125°F), or if violent gassing or spewing of electrolyte through the vent holes occurs, discontinue charging or reduce charging rate.

Charging Procedure

1. Batteries with green dot showing do not require charging unless they have just been discharged (such as in cranking vehicle).
2. When charging sealed-terminal batteries out of vehicle, install adapter kit (AC Delco part number ST-1201 or GM part number 1846855, or equivalent). (Refer to Fig. 2.) Post-type batteries need no adapters.
3. Make sure all charger connections are clean and tight.
4. For best results, batteries should be charged while electrolyte and plates are at room temperature. A battery that is extremely cold may not accept current for several hours after starting charger.
5. Charge battery until green dot appears (see "Charging Time Required"). Battery should be checked every half-hour while charging. Tipping or shaking battery may be necessary to make green dot appear.
6. After charging, battery should be load tested as outlined in BATTERY DIAGNOSIS.

Charging Time Required:

The time required to charge a battery will vary depending upon the following factors:

- **Size of Battery** - A completely discharged large heavy-duty battery requires more than twice the recharging as a completely discharged small passenger car battery.
- **Temperature** - A longer time will be needed to charge any battery at 0°F than at 80°F. When a fast charger is connected to a cold battery, the current accepted by the battery will be very low at first. Then, in time, the battery will accept a higher rate as the battery warms.
- **Charger Capacity** - A charger which can supply only five amperes will require a much longer period of charging than a charger that can supply 30 amperes or more.
- **State-Of-Charge** - A completely discharged battery requires more than twice as much charge as a one-half charged battery. Because the electrolyte is nearly pure water and a poor conductor in a completely discharged battery, the current accepted by the battery is very low at first. Later, as the charging current causes the electrolyte acid content to increase, the charging current will likewise increase.

CHARGING A COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

The following procedure should be used to recharge a completely discharged battery:

Unless the procedure is properly followed, a perfectly good battery may be needlessly replaced.

1. Measure voltage at battery terminals with an accurate voltmeter. If below 10 volts, the charge current will be very low and it could take some time before it accepts current in excess of a few milliamperes.

   Such low current may not be detectable on ammeters available in the field.
2. Set battery charger on high setting.
3. Some chargers feature polarity protection circuitry, which prevents charging unless the charger leads are connected to the battery terminals correctly. A completely discharged battery may not have enough voltage to activate this circuitry, even though leads are connected properly, making it appear that the battery will not accept charging current. Therefore, follow the specific charger manufacturer's instruction telling how to bypass or override the circuitry so that the charger will turn on and charge a low-voltage battery.
4. Battery chargers vary in the amount of voltage and current they provide. The time required for the battery to accept measurable charger current at various voltages may be as follows:

VOLTAGE	HOURS
A. 16.0 or more	Up to 4 Hours
B. 14.0 - 15.9	Up to 8 Hours
C. 13.9 or less	Up to 16 Hours

If the charge current is still not measurable at the end of the above charging times, the battery should be replaced.

If the charge current is measurable during the charging time, the battery is considered to be good and charging should be completed in the normal manner.

5. It is important to remember that a completely discharged battery must be recharged for a sufficient number of ampere hours (AH) to restore it to a usable state. As a general rule of thumb, using the reserve capacity rating (RC) of the battery as the number of ampere hours of charge will usually bring the green dot into view.

   For example, if battery is rated at 75 RC minutes, it would be completely recharged as follows:

   10 ampere charge x 7-1/2 hours = 75 AH

   or

   25 ampere charge x 3 hours = 75 AH, etc.

6. It is recommended that any battery recharged by this procedure be **LOAD TESTED** to establish serviceability.

JUMP STARTING IN CASE OF EMERGENCY WITH AUXILIARY (BOOSTER) BATTERY

NOTICE: Do not push or tow the vehicle to start. Damage to the emission system, or to other parts of the vehicle may result.

Both booster and discharged battery should be treated carefully when using jumper cables. Follow the procedure outlined below, being careful not to cause sparks:

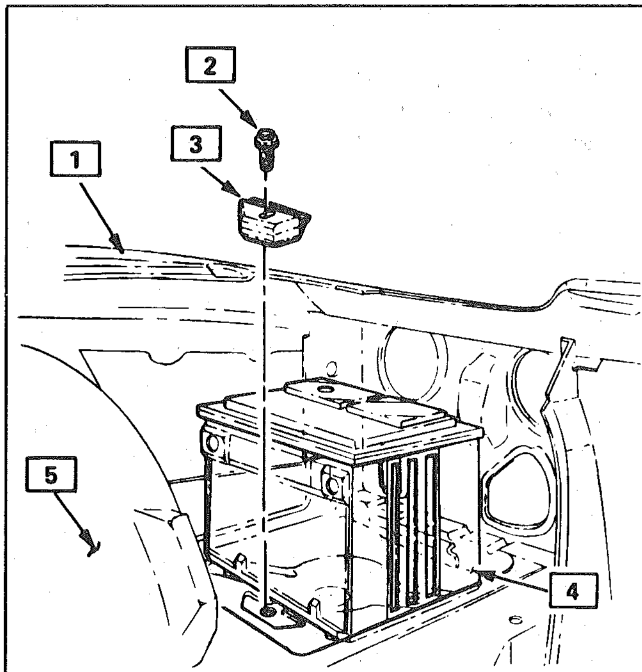
CAUTION: Departure from these conditions or the procedure below could result in: (1) Serious personal injury (particularly to eyes) or property damage from such causes as battery explosion, battery acid, or electrical burns; and/or (2) damage to electronic components of either vehicle.

Never expose battery to open flame or electric spark - batteries generate a gas which is flammable and explosive.

Remove rings, watches, and other jewelry. Wear approved eye protection.

Do not allow battery fluid to contact eyes, skin, fabrics, or painted surfaces - fluid is a corrosive acid. Flush any contacted area with water immediately and thoroughly. Be careful that metal tools or jumper cables do not contact the positive battery terminal (or metal in contact with it) and any other metal on the car, because a short circuit could occur. Batteries should always be kept out of the reach of children.

1. Set parking brake and place automatic transmission in "PARK" (NEUTRAL for manual transmission.) **Turn off the ignition, turn off lights, and all other electrical loads.**
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.
3. Attach the end of one jumper cable to the positive terminal of the booster battery and the other end of the same cable to the positive terminal of the discharged battery. Do not permit vehicles to touch each other as this could cause a ground connection and counteract the benefits of this procedure. (Use 12-volt battery only to jump start the engine).
4. Attach one end of the remaining negative cable to the negative terminal of the booster battery, and the other end to a solid engine ground (such as A/C compresser bracket or generator mounting bracket) at least 18 inches from the battery of the vehicle being started (DO NOT CONNECT DIRECTLY TO THE NEGATIVE TERMINAL OF THE DEAD BATTERY).
5. Start the engine of the vehicle that is providing the jump start and turn off electrical accessories. Then start the engine in the car with the discharged battery.
6. Reverse these directions exactly when removing the jumper cables. The negative cable must be disconnected from the engine that was jump started first.



1—FENDER
2—BOLT/SCREW
3—RETAINER
4—BATTERY (REF.)
5—FENDER SKIRT

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Fig. 5 Battery Hold-Down (Typical)

ON-CAR SERVICE

BATTERY

Remove or Disconnect

1. Negative cable.
2. Positive cable.
3. Retainer screw and retainer.
4. Battery.

Install or Connect

1. Battery.
2. Retainer and retainer screw - 17 N·m (13 lb.ft.).
3. Positive cable - 17 N·m (13 lb.ft.).
4. Negative cable - 17 N·m (13 lb.ft.).

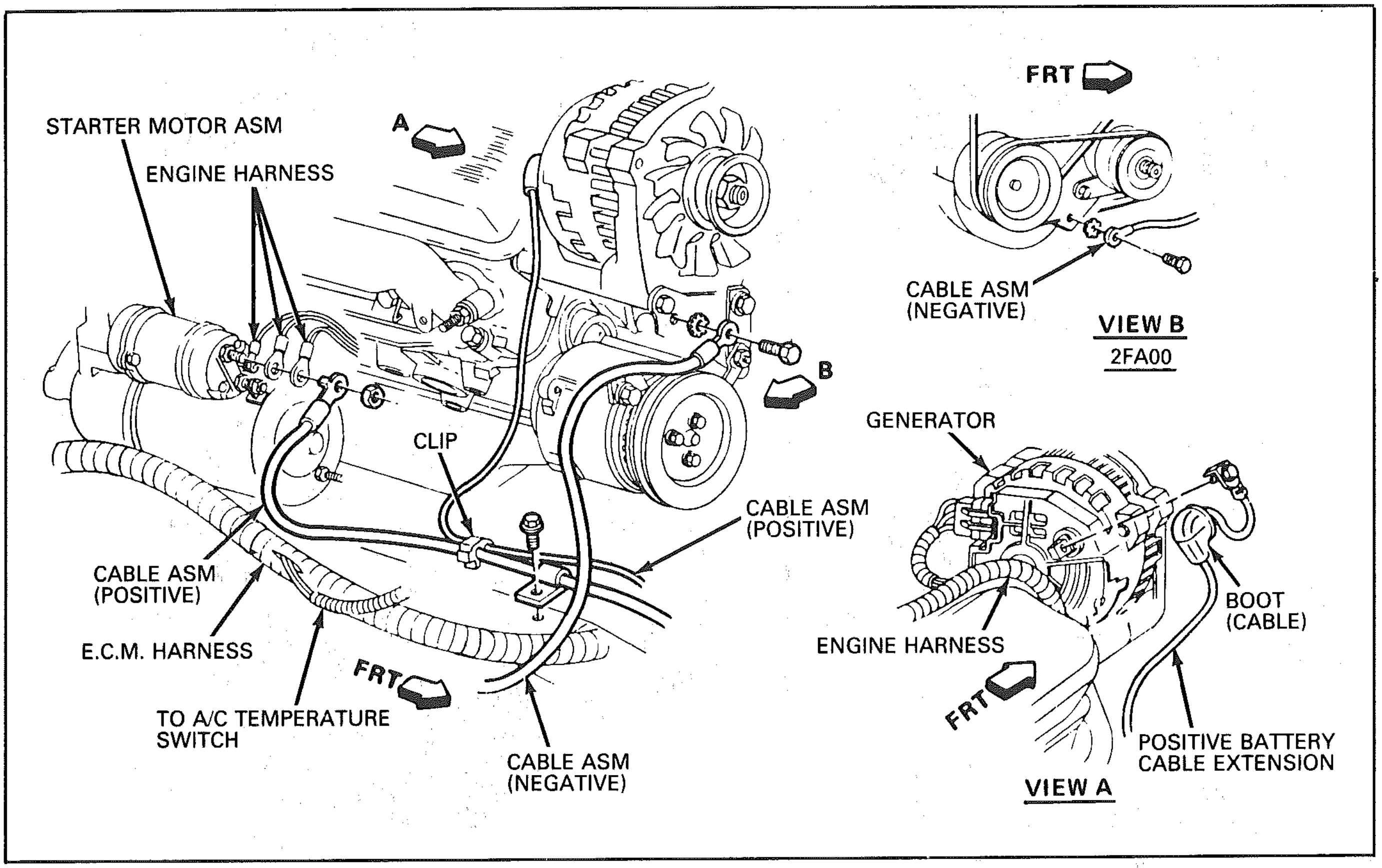
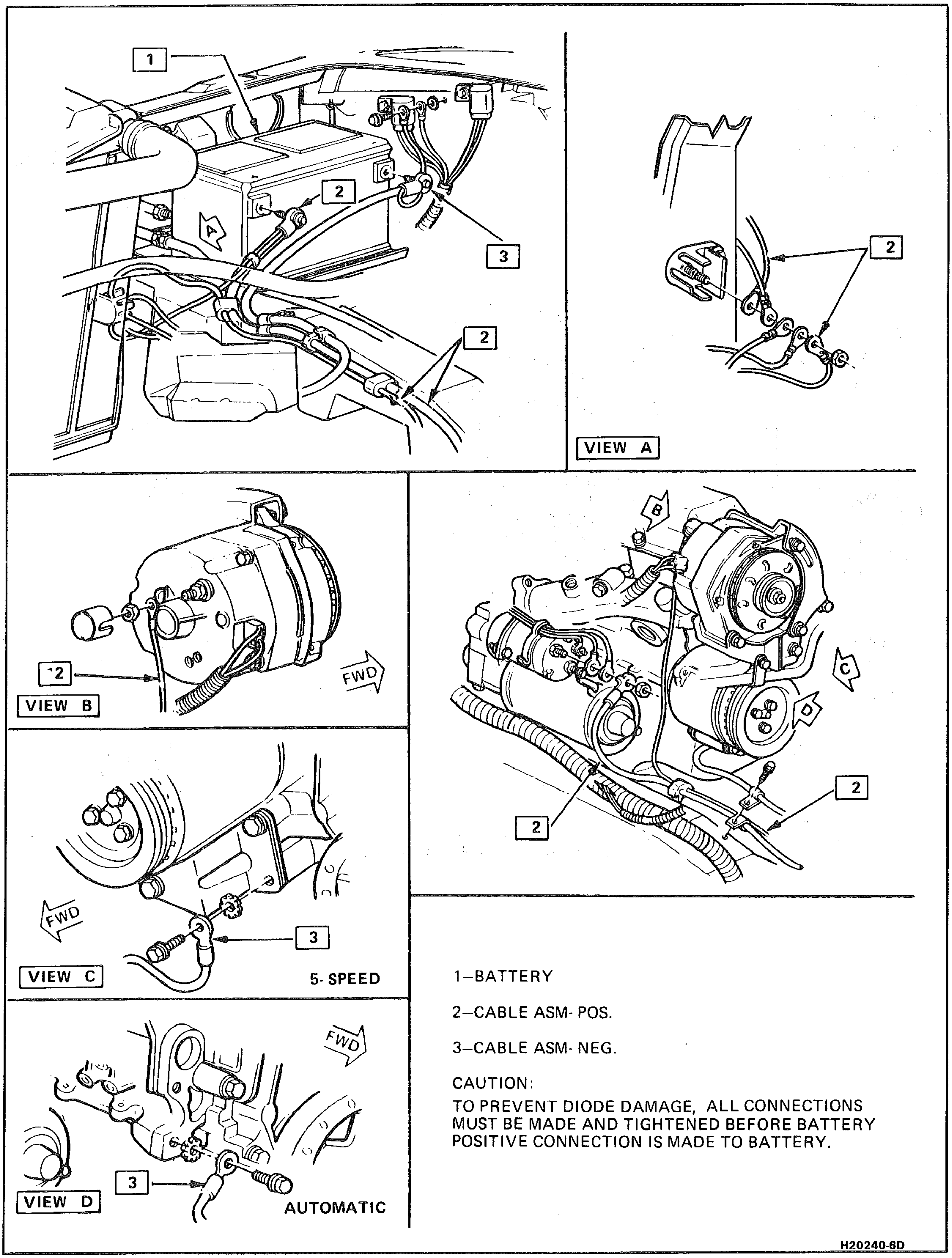


Figure 600 Battery Cable Routing LB9/L98



1–BATTERY

2–CABLE ASM- POS.

3–CABLE ASM- NEG.

CAUTION:

TO PREVENT DIODE DAMAGE, ALL CONNECTIONS MUST BE MADE AND TIGHTENED BEFORE BATTERY POSITIVE CONNECTION IS MADE TO BATTERY.

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Fig. 601 Battery Cables (LB8)

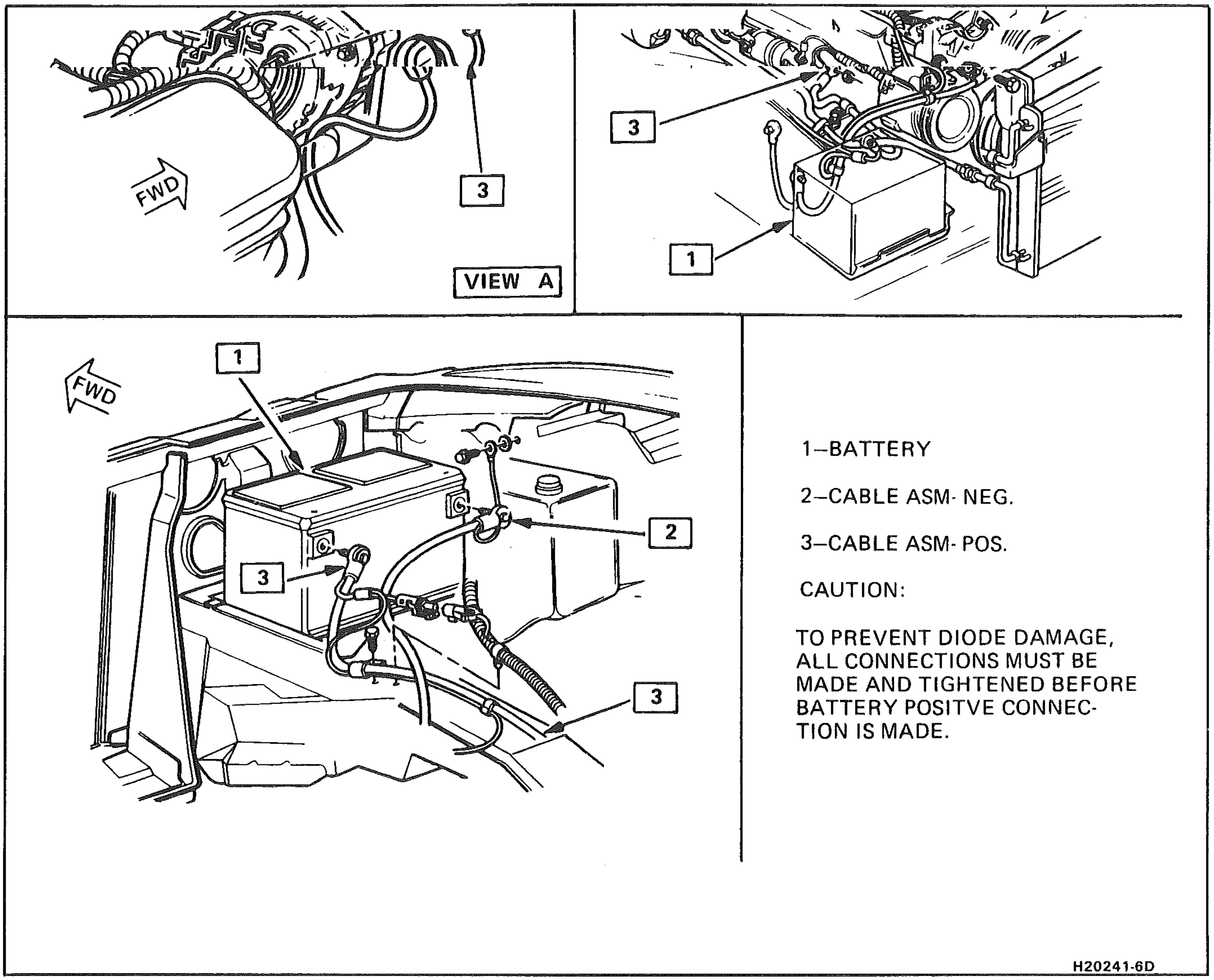

Fig. 602 Battery Cables (LB9/LG4)

SPECIFICATIONS

ENGINE	BATTERY/FUNCTION	REPLACEMENT
LB8/LO3	1981730-STD CCA 525 RC(MIN)90 Load Test 260 Amps	730
	1981731-HD CCA 570 RC(MIN)90 Load Test 280 AMPS	731
LB9	**1981600-STD CCA 525 RC(MIN)75 Load Test 260 Amps**	**600**
	1981731-HD CCA 570 RC(MIN)90 Load Test 280 AMPS	**731**
L98	1981601 CCA 630 RC(MIN)90 Load Test 310 AMPS	601

SECTION 6D2

CRANKING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring. These components are connected electrically as shown in Fig. 1.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

In the basic circuit shown in Fig. 1, solenoid windings are energized when the switch is closed. The resulting plunger and shift lever movement causes the pinion to engage the engine flywheel ring gear and the solenoid main contacts to close, and cranking takes place. When the engine starts, pinion overrun protects the armature from excessive speed until the switch is opened, at which time the return spring causes the pinion to disengage. To prevent excessive overrun, the switch should open immediately when the engine starts.

DIAGNOSIS

CRANKING SYSTEM

Before removing any unit in a cranking circuit for repair, the following checks should be made:

Electrical System General Diagnosis: Follow the procedures shown in Section 6D to isolate problem.

Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery section (6D1).

Wiring: Inspect the wiring for damage. Inspect all connections to the cranking motor, solenoid, ignition switch and battery, including all ground connections. Clean and tighten all connections, as required.

Solenoid and Ignition Switch: Inspect all switches to determine their condition.

Starter Motor Noise: To correct starter motor noise during starting, use the following procedure:

1. Refer to Fig. 2 to determine the problem.
2. If the complaint is noise, correction can be achieved by proper "shimming" as follows:
   a. Check flywheel for damage - bent flywheel, unusual wear, etc.
   b. Start engine and carefully touch outside diameter of rotating flywheel ring gear with chalk or crayon to show high point of tooth runout. Turn engine off and rotate flywheel so that the marked teeth are in the area of the starter pinion gear.
   c. Disconnect negative battery cable to prevent cranking of engine.
   d. Check pinion to flywheel clearance, as shown in Fig. 3, by using a wire gage of .5mm (.020") minimum thickness (or diameter). Center a pinion tooth between two flywheel teeth and gage, as shown in Fig. 3. Do not gage in the corners, where a misleading larger dimension may be observed. If the clearance is under this minimum, shimming the starter away from the flywheel is required.
   e. If the clearance is grossly over .5mm (.020") in the vicinity of 1.5mm (.060") or more, shimming the starter toward the flywheel is required. (This is generally the problem causing broken flywheel teeth or starter housings.) Shimming the starter toward the flywheel can be accomplished by shimming only the outboard starter mounting pad. A shim of .4mm (.015") thickness, at this

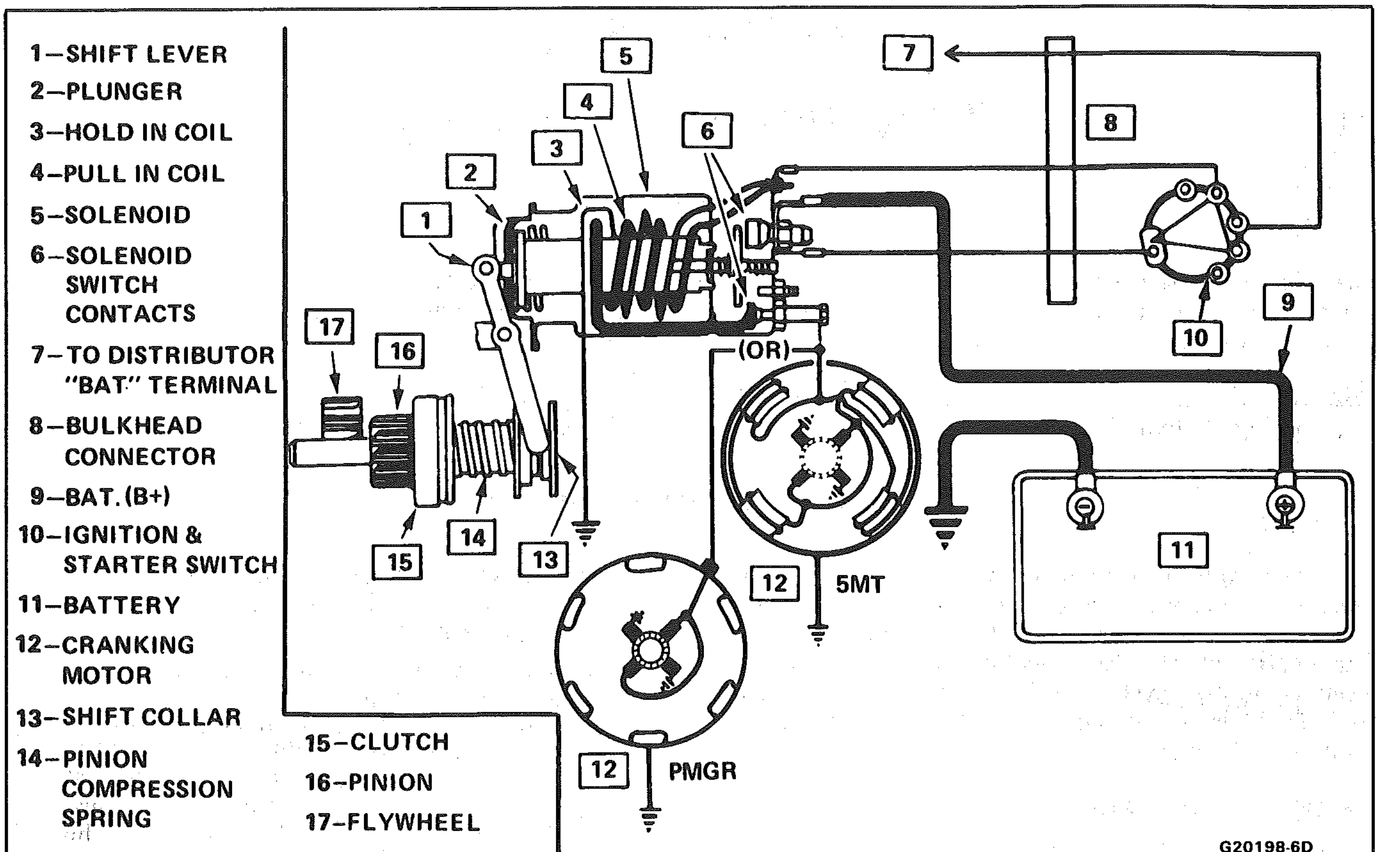

Fig. 1 Cranking Circuit - 5MT or PMGR

	PROBLEM	CAUSE
1.	HIGH PITCHED WHINE DURING CRANKING (BEFORE ENGINE FIRES) BUT ENGINE CRANKS AND FIRES OKAY.	DISTANCE TOO GREAT BETWEEN STARTER PINION AND FLYWHEEL.
2.	HIGH PITCHED "WHINE" AFTER ENGINE FIRES, AS KEY IS BEING RELEASED. ENGINE CRANKS AND FIRES OKAY. THIS INTERMITTENT COMPLAINT IS OFTEN DIAGNOSED AS "STARTER HANG-IN" OR "SOLENOID WEAK."	DISTANCE TOO SMALL BETWEEN STARTER PINION AND FLYWHEEL. FLYWHEEL RUNOUT CONTRIBUTES TO THE INTERMITTENT NATURE.
3.	A LOUD "WHOOP" AFTER THE ENGINE FIRES BUT WHILE THE STARTER IS STILL HELD ENGAGED. SOUNDS LIKE A SIREN IF THE ENGINE IS REVVED WHILE STARTER IS ENGAGED.	MOST PROBABLE CAUSE IS A DEFECTIVE CLUTCH. A NEW CLUTCH WILL OFTEN CORRECT THIS PROBLEM.
4.	A "RUMBLE", "GROWL" OR (IN SEVERE CASES) A "KNOCK" AS THE STARTER IS COASTING DOWN TO A STOP AFTER STARTING THE ENGINE.	MOST PROBABLE CAUSE IS A BENT OR UNBALANCED STARTER ARMATURE. A NEW ARMATURE WILL OFTEN CORRECT THIS PROBLEM.

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Fig. 2 Starter Motor Noise Diagnosis

location will decrease the clearance by approximately .3mm (.010").

If normal starter shims are not available, they can be improvised from plain washers or other suitable material.

Starter Motor: If the battery, wiring and switches are in satisfactory condition, and the engine is known to be functioning properly, remove the motor and follow the procedures shown in Starter Motor Disassembly, Test and Reassembly (Unit Repair).

Never operate the cranking motor more than 30 seconds at a time without pausing to allow it to cool for at least two minutes. Overheating, caused by excessive cranking, will seriously damage the cranking motor.

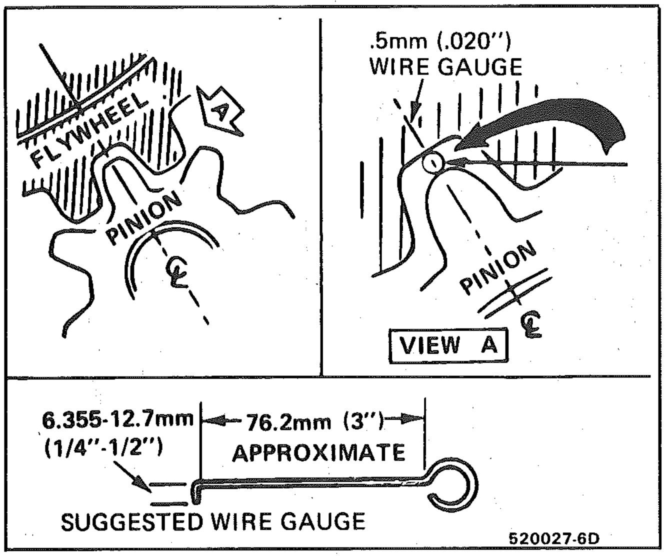


Fig. 3 Flywheel to Pinion Clearance

SERVICE PROCEDURES

CRANKING SYSTEM

Starting motors do not require lubrication except during overhaul.

When the motor is disassembled for any reason, lubricate as follows:

5MT and 10 MT Starters

1. The roll type overrunning clutch requires no lubrication; however, the drive assembly should be wiped clean. **Do Not** clean in any degreasing tank, or with grease dissolving solvents; this will dissolve the lubricant in the clutch mechanism. Use silicon grease General Electric CG321, Dow Corning 33 Medium, or equivalent, on the shaft underneath the overrunning clutch assembly.
2. Avoid excessive lubrication.

1–CONTACT DISC
2–PLUNGER
3–SOLENOID
4–RETURN SPRING
5–SHIFT LEVER
6–BUSHING
7–PINION STOP
8–CLUTCH
9–FIELD COIL
10–ARMATURE
11–BRUSH
12–TERMINALS

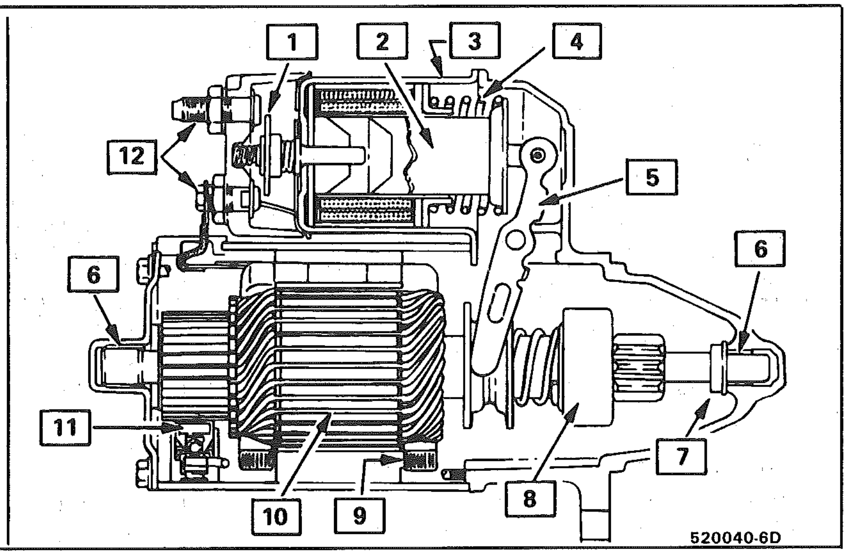
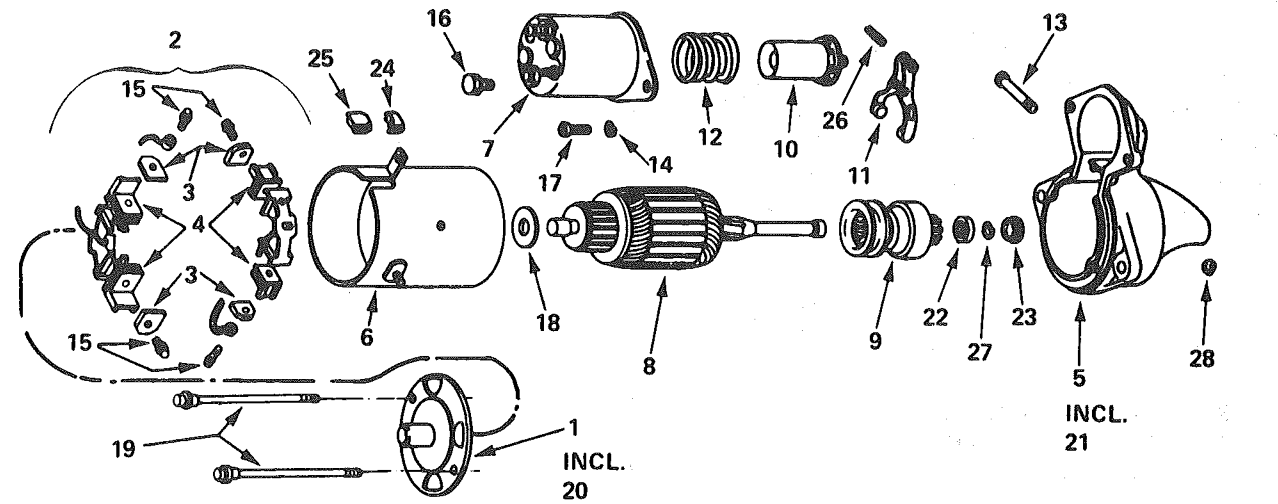


Fig. 4 Cross Section of 5MT Starting Motor



1-FRAME–COMMUTATOR END
2-BRUSH AND HOLDER PKG.
3-BRUSH
4-BRUSH HOLDER
5-HOUSING–DRIVE END
6-FRAME AND FIELD ASM.
7-SOLENOID SWITCH
8-ARMATURE
9-DRIVE ASM.
10-PLUNGER
11-SHIFT LEVER
12-PLUNGER RETURN SPRINGER
13-SHIFT LEVER SHAFT
14-LOCK WASHER
15-SCREW–BRUSH ATTACHING
16-SCREW–FIELD LEAD TO SWITCH
17-SCREW–SWITCH ATTACHING
18-WASHER–BRAKE
19—THRU BOLT
20—BUSHING–COMMUTATOR END
21—BUSHING–DRIVE END
22—PINION STOP COLLAR
23—THRUST COLLAR
24—GROMMET
25—GROMMET
26—PLUNGER PIN
27—PINION STOP RETAINER RING
28—LEVER SHAFT RETAINING RING

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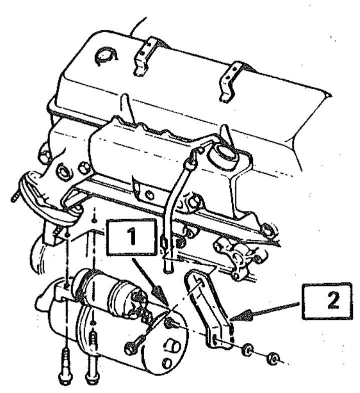
Fig. 4A 5MT Starting Motor - Disassembled View

ON-CAR SERVICE



1–STARTER

2–BRACE (4.3L & 5.0L)

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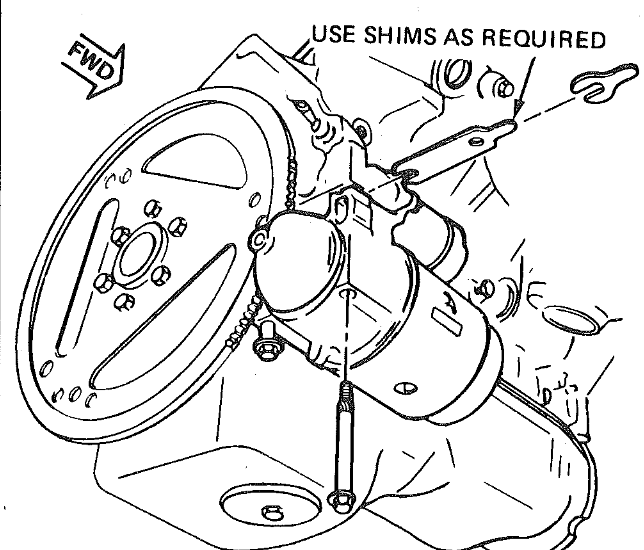
Fig. 601 Starter Motor Mounting VIN F, H, 8



STARTER NOISE DIAGNOSTIC PROCEDURE

1. STARTER NOISE DURING CRANKING: REMOVE 1 – .015" DOUBLE SHIM OR ADD SINGLE .015" SHIM TO OUTER BOLT ONLY.
2. HIGH PITCHED WHINE AFTER ENGINE FIRES: ADD .015" DOUBLE SHIMS UNTIL NOISE DISAPPEARS.

SEE TEXT FOR COMPLETE PROCEDURE.

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Fig. 602 Starter Motor Shims

Starting motors do not require lubrication except during overhaul. When the motor is disassembled for any reason, lubricate as follows:

1. The roll-type overrunning clutch requires no lubrication. However, the drive assembly should be wiped clean. DO NOT clean in any degreasing tank or with grease dissolving solvents; this will dissolve the lubricant in the clutch mechanism. Use silicone grease General Electric CG321, Dow

Corning 33 Medium or equivalent, on the shaft underneath the overrunning clutch assembly.

2. Avoid excessive lubrication.

STARTER

Use the following procedure to remove the starter:

1. Disconnect negative battery lead at battery.
2. Raise car.
3. Remove starter braces, shields, etc., that may be in the way.
4. Remove two starter motor to engine bolts, and allow starter to drop down.
5. Remove solenoid wires and battery cable and remove starter.
6. To replace, reverse the above procedure. Ensure that any shims removed are replaced.

SOLENOID

Use the following procedure to remove the solenoid from the starter:

1. Disconnect field strap.
2. Remove solenoid to drive housing attaching screws, motor terminal bolt, and remove solenoid by twisting.
3. Replace by reversing above procedures.

OVERRUNNING CLUTCH

1. Test overrunning clutch action. The pinion should turn freely in the overrunning direction. Check pinion teeth to see that they have not been chipped, cracked or excessively worn. Replace assembly if necessary. Badly chipped pinion teeth may indicate chipped teeth on the ring gear. This should be checked under such conditions and replaced if necessary.
2. Check the overrunning clutch for slipping by leaving the clutch attached to the armature. Wrap the armature with a shop towel and clamp the armature in a vise. Using a 12-point deep socket and torque wrench, put the socket on the clutch and turn counterclockwise. The clutch should not slip up to 68 N·m (50 ft. lb.) of torque. If it does, replace the clutch.

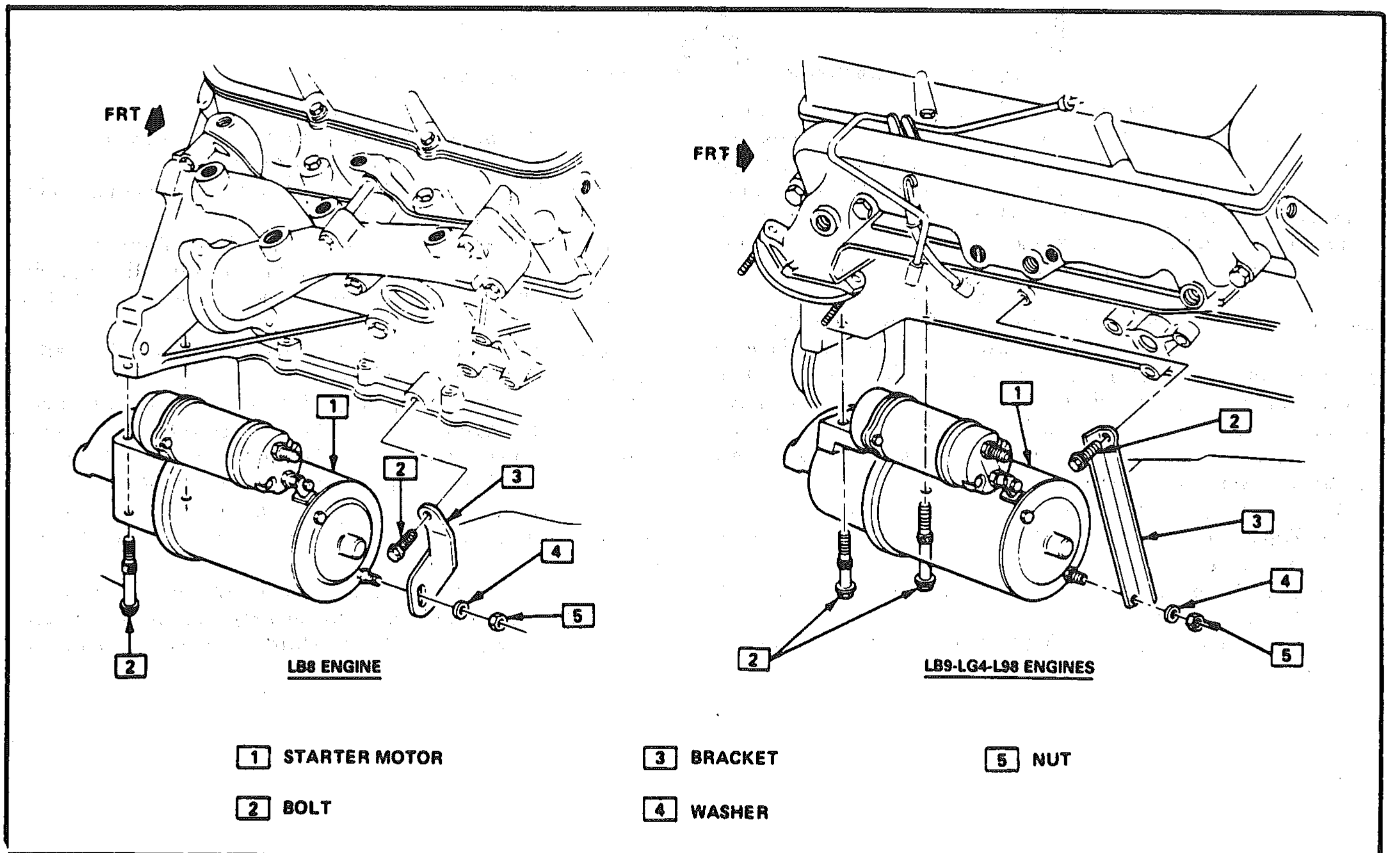
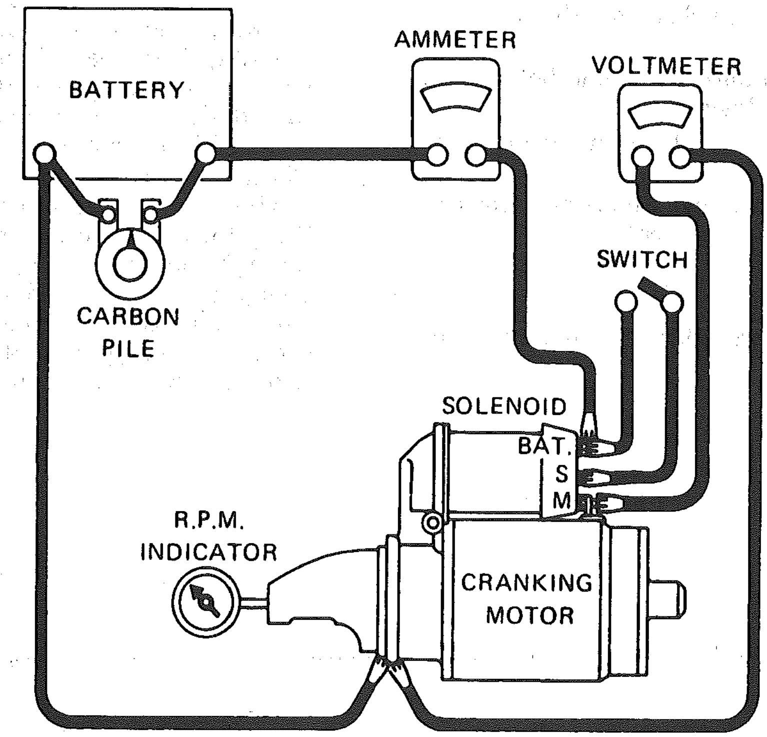


Fig. 602A--Starter Motor Mounting

5MT AND 10MT STARTER MOTORS DISASSEMBLY, TEST AND REASSEMBLY (STARTER REMOVED FROM ENGINE)

NO-LOAD TEST



With the starter motor removed from the engine, the pinion should be checked for freedom of operation by turning it on the screw shaft. The armature should be checked for freedom of rotation by prying the pinion with a screwdriver. If the armature does not turn freely, the motor should be disassembled immediately. However, if the armature does rotate freely, the motor should be given a no-load test before disassembly.

Make connections as shown. Close the switch and compare the RPM, current, and voltage readings with the specifications If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with the switch open. Use the test results as follows:

1. **Rated current draw and no-load speed indicates normal condition of the starter motor.**
2. **Low free speed and high current draw indicates:**
   - Too much friction — tight, dirty, or worn bearings, bent armature shaft allowing armature to drag.
   - Shorted armature. This can be further checked on a growler after disassembly.
   - Grounded armature or fields. Check further after disassembly.
3. **Failure to operate with high current draw indicates:**
   - A direct ground in the terminal or fields.
   - "Frozen" bearings (this should have been determined by turning the armature by hand).
4. **Failure to operate with no current draw indicates:**
   - Open field circuit. This can be checked after disassembly by inspecting internal connections and tracing circuit with a test lamp.
   - Open armature coils. Inspect the commutator for badly burned bars after disassembly.
   - Broken brush springs, worn brushes, high insulation between the commutator bars or other causes which would prevent good contact between the brushes and commutator.
5. **Low no-load speed and low current draw indicates:**
   - High internal resistance due to poor connections, defective leads, dirty commutator and causes listed under Number 4.
6. **High free speed and high current draw usually indicate** shorted fields. If shorted fields are suspected, replace the field coil assembly. Also check for shorted armature, using a growler.

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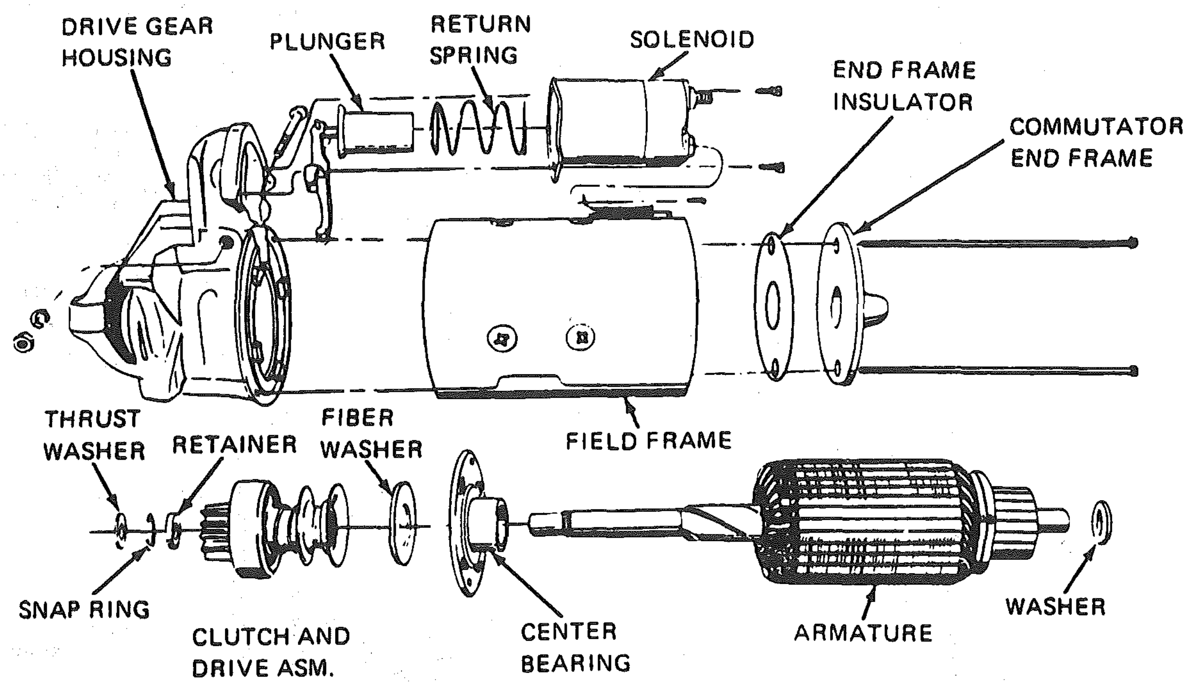
Fig. 603 Starter Motor Disassembly, Test and Reassembly 1 of 6

STARTER DISASSEMBLY

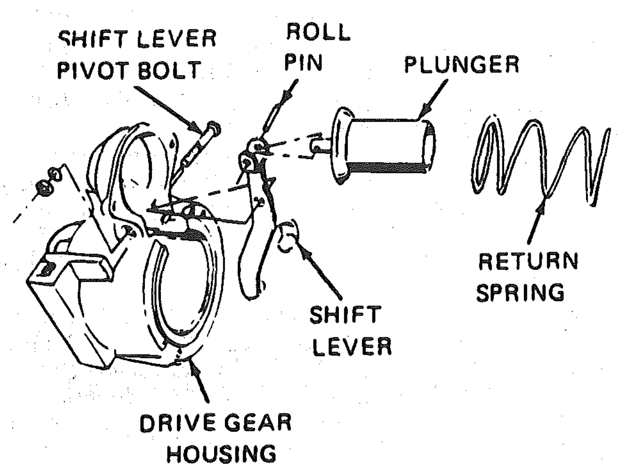


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

8. Remove 2 through bolt, then remove commutator end frame (diesel only, remove insulator) and washer.

9. Remove field frame assembly from drive gear housing. (On diesel starter, armature remains in drive end frame.)

SHIFT LEVER AND PLUNGER REMOVAL

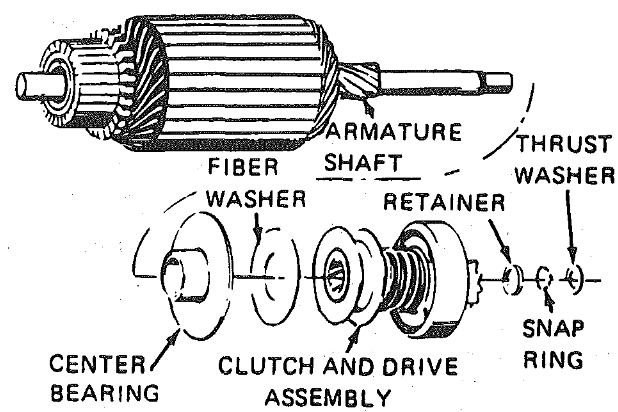


Steps 10 and 11 are required only on diesel starters.

10. Remove shift lever pivot bolt.

11. Remove drive gear housing from armature shaft. Shift lever and plunger assembly will now fall away from starter clutch.

REMOVE DRIVE ASSEMBLY FROM SHAFT



12. If necessary to remove overrunning clutch from armature shaft, proceed as follows:

a. Remove thrust washer or collar from armature shaft.

b. Slide a 5/8" deep socket or piece of pipe of suitable size over shaft against retainer as a driving tool. Tap tool to move retainer off snap ring.

c. Remove snap ring from groove in shaft. If snap ring is distorted, it will be necessary to use a new one on reassembly.

d. Remove retainer, clutch assembly (also fiber washer and center bearing on diesel) from armature shaft.

13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

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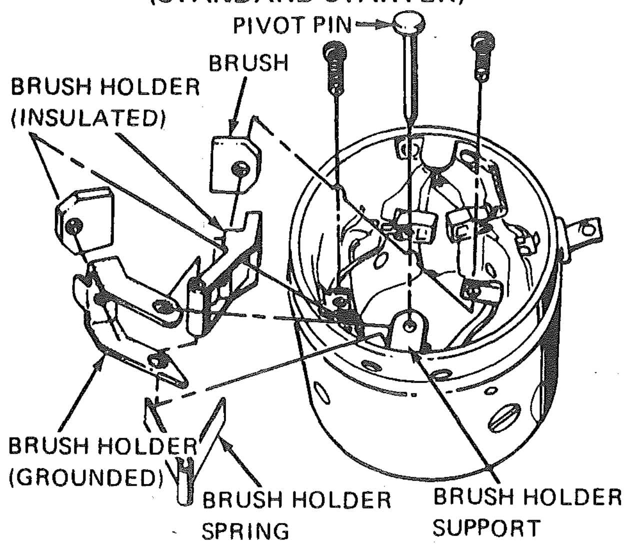
Fig. 604 Starter Motor Disassembly, Test and Reassembly 2 of 6

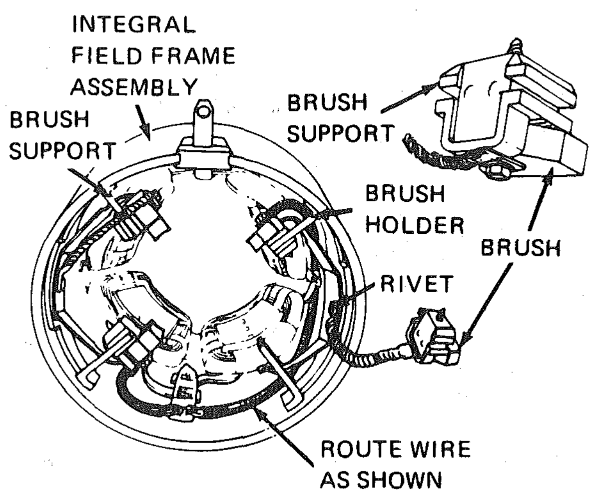
REPLACE BRUSH HOLDER

(STANDARD STARTER)



14. If necessary to replace brush holder parts, proceed as follows:
   a. Remove brush holder pivot pin which positions one insulated and one grounded brush.
   b. Remove brush spring.
   c. Replace brushes as necessary.

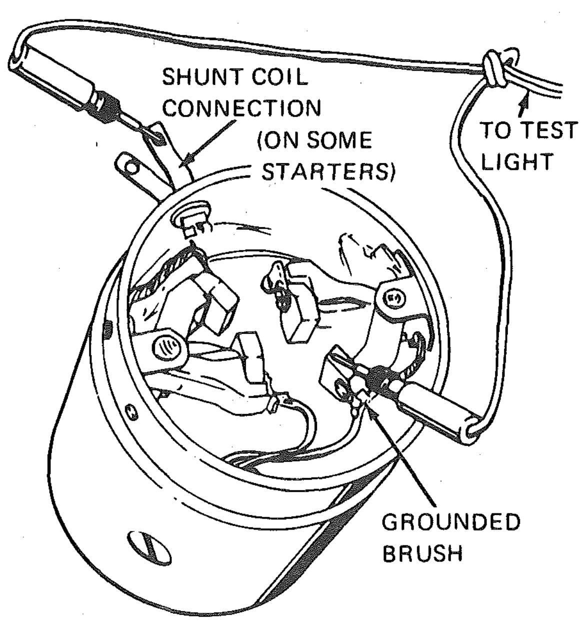
(SMALL 5MT STARTER)



a. Remove brush holder from brush support.
b. Remove screw from brush holder and separate brush and holder.
c. Inspect brush holder for wear or damage.
d. Replace brushes and/or holders as necessary.

CLEANING INSPECTION AND TESTS

TESTING SHUNT COIL FOR OPEN



15. Clean all starting motor parts, but DO NOT USE GREASE DISSOLVING SOLVENTS FOR CLEANING THE OVERRUNNING CLUTCH, ARMATURE, AND FIELD COILS, solvent would dissolve the grease packed in the clutch and would damage armature and field coil insulation.
16. Inspect armature commutator, shaft and bushings, overrunning clutch pinion, brushes and springs for discoloration, damage or wear. Replace as required.
17. Check fit of armature shaft in bushing in drive housing. Shaft should fit snugly in the bushing. If the bushing is worn, it should be replaced.
18. Inspect armature commutator. If commutator is rough, it should be turned down. Do not undercut or turn to less than 1.650" O.D. Do not turn out-of-round commutators. Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator bar is usually evidence of a poor connection.
19. If test equipment is available:
   a. Check the armature for short circuits by placing on growler and holding hack saw blade over armature core while armature is rotated. If saw blade vibrates, armature is shorted. Recheck after cleaning between the commutator bars. If saw blade still vibrates, replace the armature.
   b. Using a test lamp, place one lead on the shunt coil terminal and connect the other lead to a ground brush. This test should be made from both ground brushes to insure continuity through both brushes and leads. If the lamp fails to light, the field coil is open and will require replacement.

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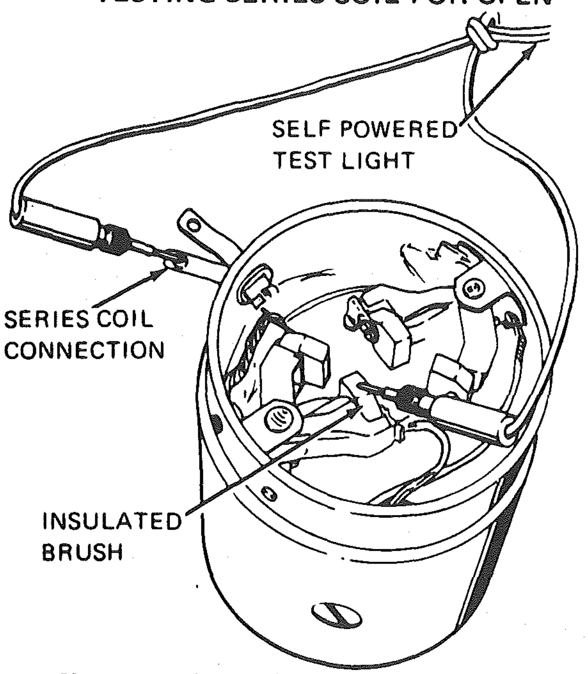
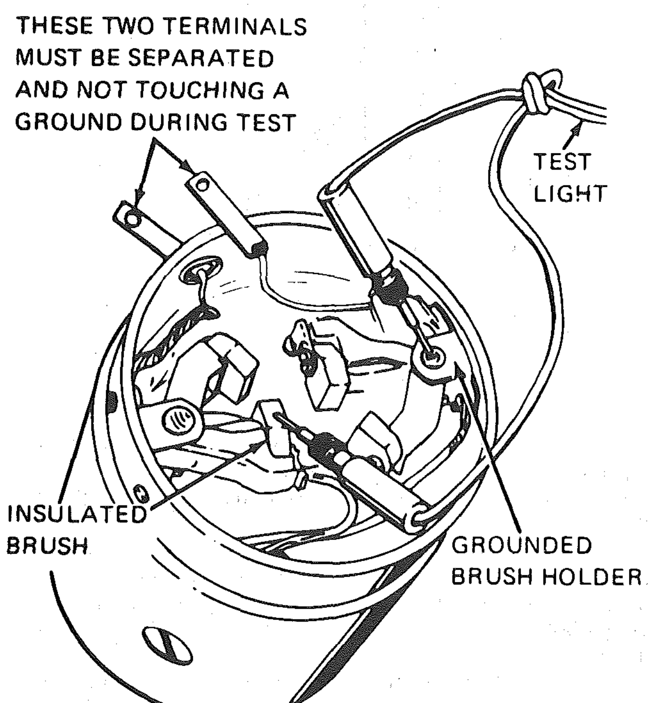
Fig. 605 Starter Motor Disassembly, Test and Reassembly 3 of 6

TESTING SERIES COIL FOR OPEN



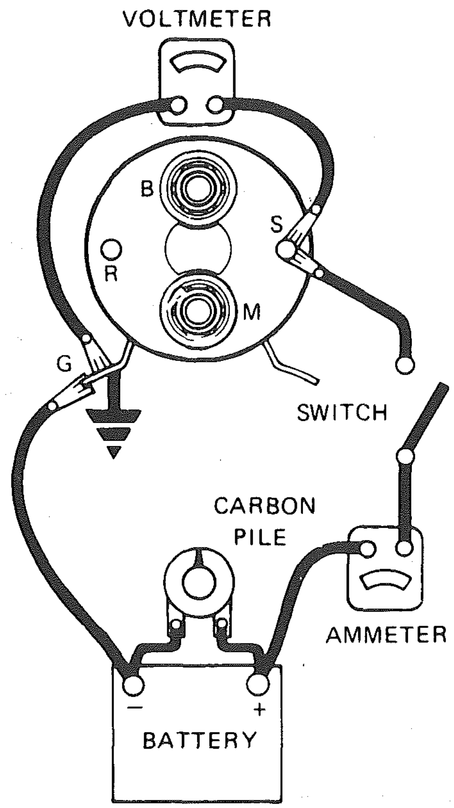
c. Using a test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. If the lamp fails to light, the series coil is open and will require repair or replacement. This test should be made from each insulated brush to check brush and lead continuity.

TESTING SERIES COIL FOR GROUND



d. On starters with shunt coil, separtate series and shunt coil strap terminals during this test. Do not let strap terminals touch case or other ground. Using a test lamp place one lead on the grounded brush holder and the other lead on either insulated brush. If the lamp lights, a grounded series coil is indicated and must be repaired or replaced.

TESTING SOLENOID WINDINGS



e. Check the current draw of the solenoid winding as follows:

If solenoid is not removed from starting motor, the connector strap terminals must be removed from the terminal on the solenoid before making these tests. Complete tests in a minimum of time to prevent overheating of the solenoid.

To check hold-in winding, connect an ammeter in series with 12-volt battery and the "switch" terminal on the solenoid. Connect a voltmeter to the "switch" terminal and to ground. Connect carbon pile across battery. Adjust the voltage to 10 volts and note the ammeter reading. It should be 13 to 19 amperes for all starting motors.

To check both windings, connect as for previous test. Ground the solenoid motor terminal. Adjust the voltage to 10 volts and note the ammeter reading. It should be 59 to 79 amperes for all starting motors.

NOTE: *Current will decrease as windings heat up.*

Current draw readings that are over specifications indicate shorted turns or a ground in the windings of the solenoid and the solenoid should be replaced. Current draw readings that are under specifications indicate excessive resistance. No reading indicates an open circuit. Check connections then replace solenoid if necessary.

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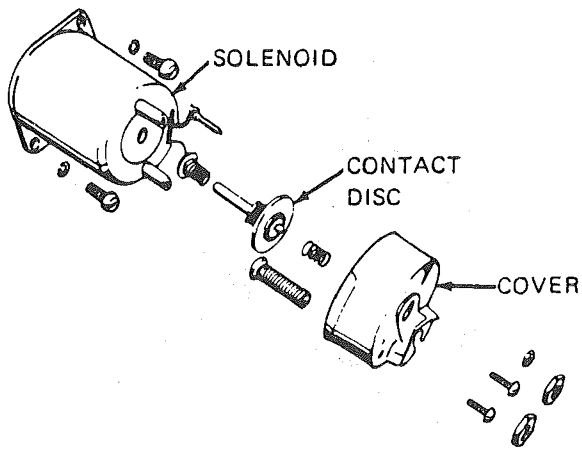
Fig. 606 Starter Motor Disassembly, Test and Reassembly 4 of 6

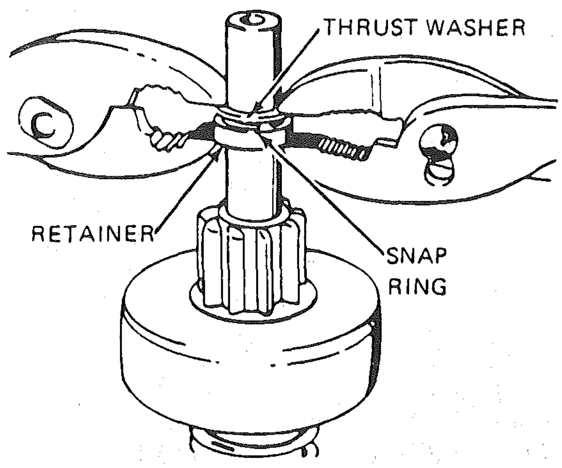
SOLENOID SWITCH DISASSEMBLY



f. The starter solenoid switch is serviced as an assembly. The cover can be removed to inspect the contacts and contact disc if necessary.

STARTER ASSEMBLY

INSTALLING RETAINER, WASHER AND RING



20. Assemble the armature and clutch as follows:
 a. Lubricate drive end of armature shaft with lubricant 1960954 or equivalent.
 b. Install center bearing (diesel starters) with bearing toward the armature winding. Then install the fiber washer on the armature shaft.
 c. Slide clutch assembly onto armature shaft with pinion away from armature.
 d. Slide retainer onto shaft with cupped side facing the end of shaft.
 e. Install snap ring into groove on armature shaft.
 f. Install thrust washer on shaft.
 g. Position retainer and thrust washer with snap ring in between. Using two pliers, grip retainer and thrust washer or collar and squeeze until snap ring is forced into retainer and is held securely in groove in armature shaft.
21. Lubricate drive gear housing bushing with lubricant 1960954 or equivalent.
22. Engage shift lever yoke with clutch and slide complete assembly into drive gear housing.

On non-diesel starters the shift lever may be installed in drive gear housing first.

23. Install the shift lever pivot bolt. Tighten securely.
24. Install solenoid assembly.
25. Apply sealer, No. 1050026 or equivalent to solenoid flange where field frame contacts it.
26. Position field frame against drive gear housing on alignment pin using care to prevent damage to brushes.
27. Lubricate commutator end-frame bushing with lubricant 1960954 or equivalent.
28. Install washer on armature shaft and slide end frame onto shaft, then install and tighten through-bolts. On diesel starter, install insulator and then end frame onto shaft. Then install through bolts, making sure they pass through bolt holes in insulator.
29. Connect the field coil connector to the solenoid terminal.
30. Check pinion clearance as outlined under PINION CLEARANCE.

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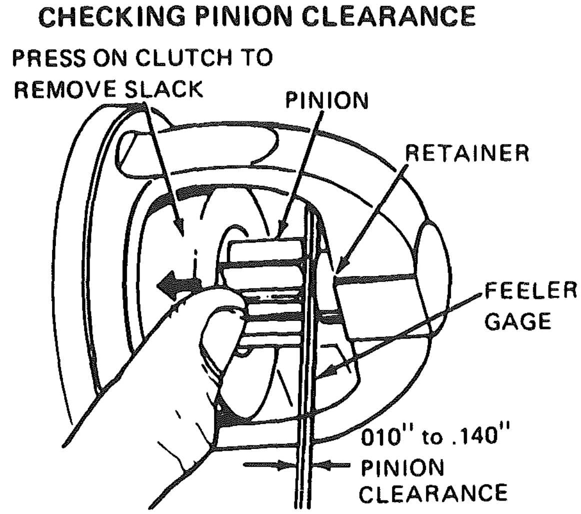
Fig. 607 Starter Motor Disassembly, Test and Reassembly 5 of 6



When the starter motor has been disassembled or the solenoid has been replaced, it is necessary to check the pinion clearance. Pinion clearance must be correct to prevent the buttons on the shift lever yoke from rubbing on the clutch collar during cranking.

31. Disconnect the motor field coil connector from the solenoid motor terminal and insulate it carefully.

32. Connect one 12 volt battery lead to the solenoid switch terminal and the other to the starter frame.

33. Flash a jumper lead momentarily from the solenoid motor terminal to the starter frame. This will shift the pinion into cranking position and it will remain so until the battery is disconnected.

34. Push the pinion back as far as possible to take up any movement, and check the clearance with a feeler gage. The clearance should be .010" to .140".

Means for adjusting pinion clearance is not provided on the starter motor. If the clearance does not fall within limits, check for improper installation and replace all worn parts.

520047-6D

Fig. 608 Starter Motor Disassembly, Test and Reassembly 6 of 6

SPECIFICATIONS

Engine (RPO/VIN)	2.8L-V6-LB8-S	5.0L-V8-LB9-F	5.0L-V8-LB9-F
Starter	5MT-1998524	10MT-1998580 (Auto Trans)	5MT-1998527 (Manual Trans)
——No Load Test @10V	Min. 50A Max. 75A 6000 rpm - 11,900 rpm	Min. 70A Max. 110A 6500 rpm - 10,700 rpm	Min. 52A Max. 76A 6000 rpm - 12,000 rpm
Solenoid			
——Hold-in Windings @10V	13-19A	13-19A	13-19A
——Pull-in Windings @5V	23-30A	23-30A	23-30A
Engine (RPO/VIN)	5.0L-V8-LO3-E	5.0L-V8-LO3-E	5.7L-V8-B2L-8
Starter	10MT-1998580 (Auto Trans)	5MT-1998527 (Manual Trans)	10MT-1998591
——No Load Test @10V	Min. 70A Max. 110A 6500 rpm - 10,700 rpm	Min. 52A Max. 76A 6000 rpm - 12,000 rpm	Min. 70A Max. 110A 6500 rpm - 10,700 rpm
Solenoid			
——Hold-in Windings @10V	13-19A	13-19A	13-19A
——Pull-in Windings @5V	23-30A	23-30A	23-30A

SECTION 6D3

CHARGING SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

Unlike three-wire generators, the CS-130 and CS-144 may be used with only two connections - battery positive and an "L" terminal to the charge indicator bulb. Use of "P", "F", and "S" terminals is optional. The "P" terminal is connected to the stator, and may be connected externally to a tachometer or other device. The "F" terminal is connected internally to field positive, and may be used as a fault indicator. The "S" terminal may be connected externally to a voltage, such as battery voltage, to sense voltage to be controlled.

As on other charging systems, the charge indicator lights when the switch is closed, and goes out when the engine is running. If the charge indicator is on with the engine running, a charging system defect is indicated. For all kinds of defects, the indicator will glow at full brilliance, not "half lit". Also, the charge indicator will be on with the engine running if system voltage is too high or too low. The regulator voltage setting varies with temperature, and limits system voltage by controlling rotor field current.

This regulator switches rotor field current on and off at a fixed frequency of about 400 cycles per second. By varying the on-off time, correct average field current for proper system voltage control is obtained. At high speeds, the on-time may be 10% and the off-time 90%. At low speeds, with high electrical loads, on-off time may be 90% and 10%, respectively.

No periodic maintenance on the generator is required.

DIAGNOSIS

SERVICE PROCEDURES

CHARGING SYSTEM

The generator does not require periodic lubrication. The rotor shaft is mounted on ball bearings at the drive end and roller bearings at the slip ring end. Each contains a permanent grease supply. At periodic intervals, check mounting bolts for tightness and adjust belt tension (see Section 6B), if applicable.

- When adjusting belt tension, apply pressure at center of generator, never against either end frame.

GENERATOR BENCH CHECK-CS

To check generator in a test stand, remove as specified in On-Car Service and proceed as follows:

1. Make connections as shown in Figure 1H, except leave the carbon pile disconnected. The ground polarity of generator and battery must be the same. The battery must be fully charged. Use a 30-500 OHM resistor between battery and "L" terminal.

2. Slowly increase generator speed and observe voltage.

3. If the voltage is uncontrolled and increases above 16.0 volts, the rotor field is shorted, the regulator is defective, or both. A shorted rotor field coil can cause the regulator to become defective. NOTE: The battery must be fully charged when making this test.

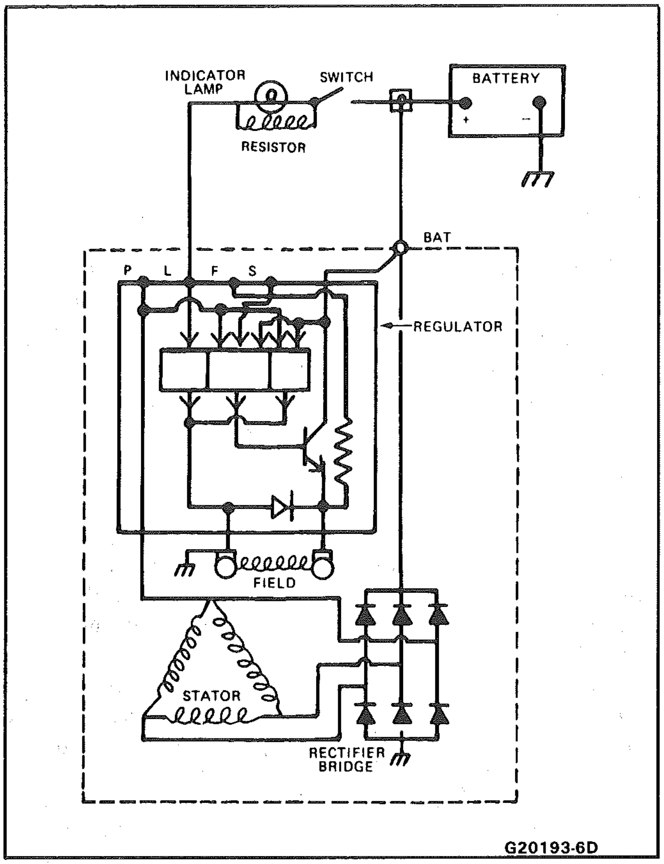


Fig. 1F CS Charging System Wiring Diagram

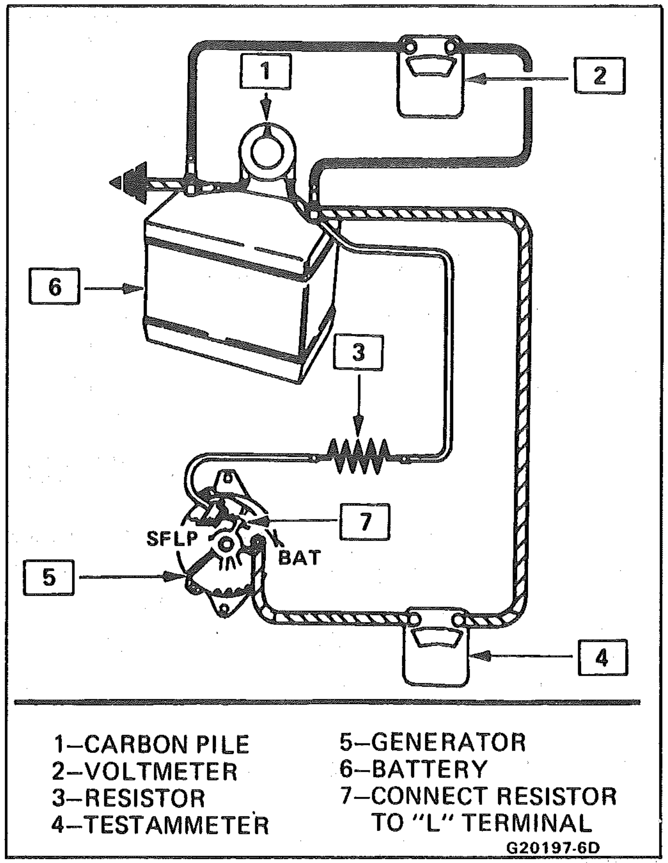


Fig. 1H Generator Bench Check - CS

4. If voltage is below 16.0 volts, increase speed and adjust carbon pile to obtain maximum amperage output. Maintain voltage above 13.0 volts.
5. If output is within 15 amperes of rated output, generator is good.
6. If output is not within 15 amperes of rated output, generator is defective and requires repair.

ON-CAR SERVICE

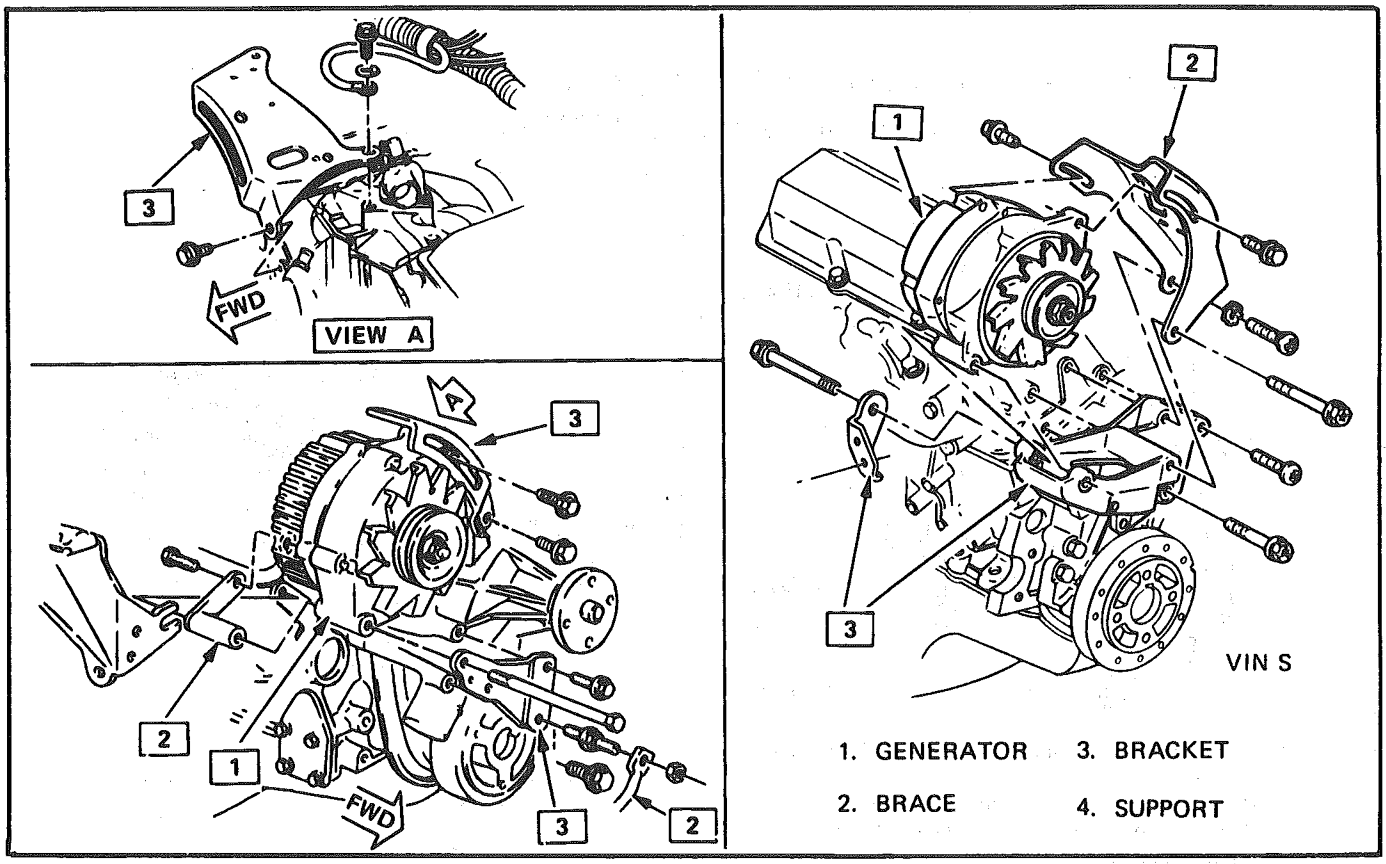


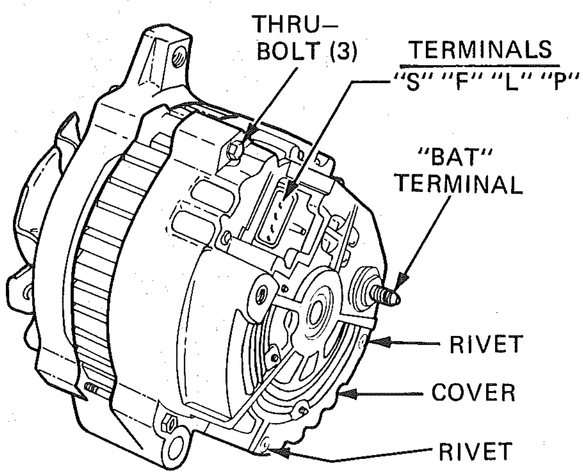
Fig. 601 Generator Mountings

SPECIFICATIONS

ENGINE	EQUIPMENT	GEN/MOD	AMP
LB8	H-H/HBL	1101139/CS130	85A
	A-A/HBL	1101140/CS130	100A
LB9/L98	H-H/HBL-A-A/HBL	1101255/CS130	105A
LO3	H-H/HBL	1101253/CS130	85A
	A-A/HBL	1101254/CS130	100A

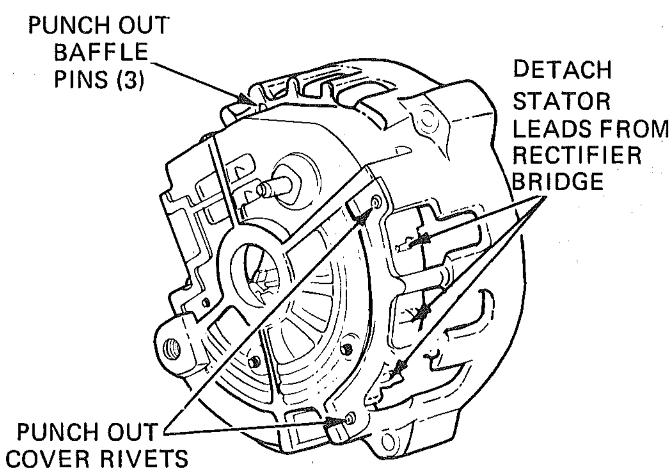
CS130 GENERATOR DISASSEMBLY, TEST AND REASSEMBLY (GENERATOR REMOVED FROM ENGINE)

THRU–BOLT LOCATION



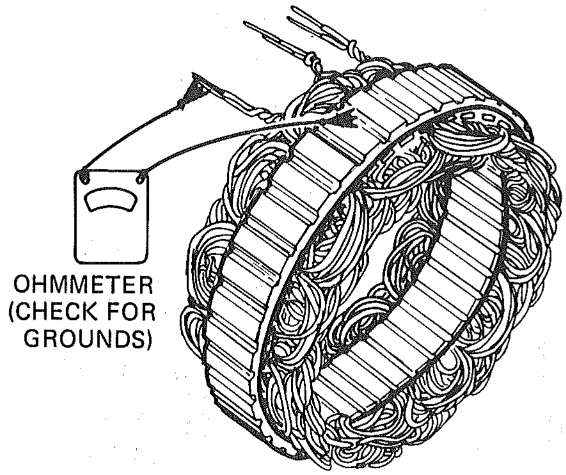
1. Make scribe marks on end frames to facilitate reassembly.
2. Remove thru-bolts and separate end frames.
3. Punch out cover rivets, or pins, and remove cover on slip ring end frame.

END FRAME VIEW



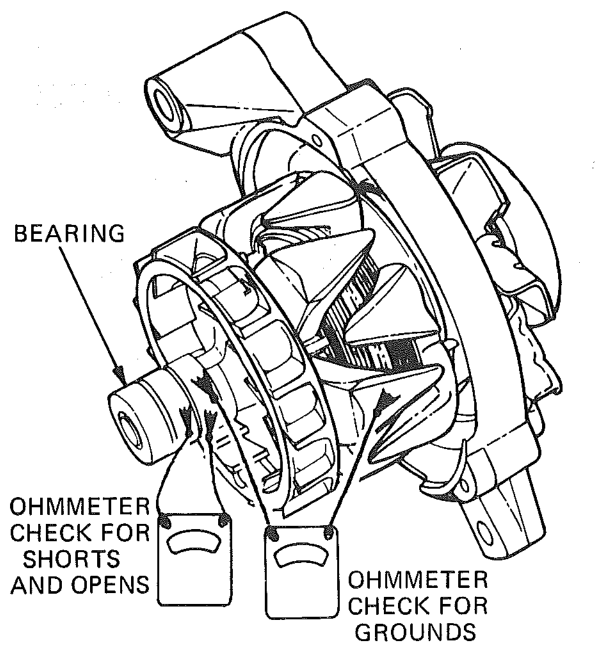
4. Unsolder stator leads at three terminals on rectifier bridge. Avoid excessive heat, which could damage diodes in rectifier bridge. NOTICE: If stator leads are welded, in place of soldered, cut stator leads about half way back on rectifier bridge terminals.
5. Remove stator.
6. Drive out three baffle pins and remove baffle from inside of slip ring end frame.

TESTING STATOR



7. Check stator for grounds with ohmmeter. If reading is low, replace stator.

TESTING ROTOR



8. Check rotor for grounds with ohmmeter. Check can be made with drive end frame assembled. Reading should be very high. If not, replace rotor. Hold rotor with hex wrench in shaft when removing shaft nut.
9. Check rotor for opens and shorts. Should read 1.7-2.3 ohms. If not, replace rotor.

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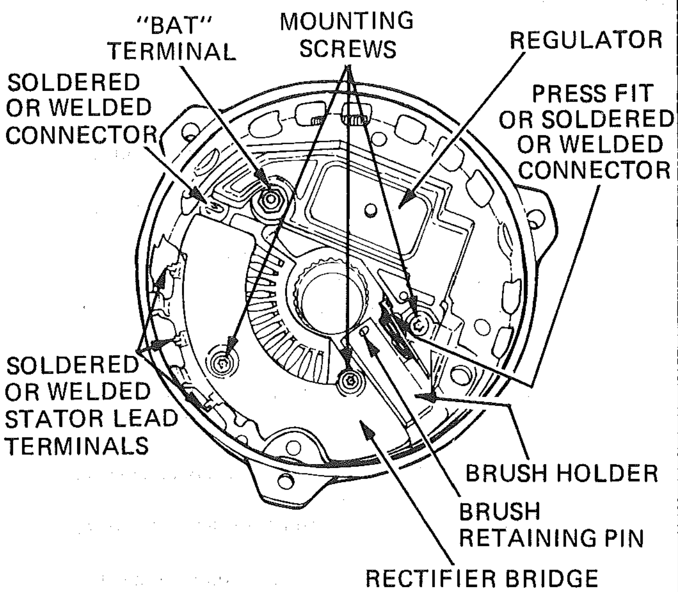
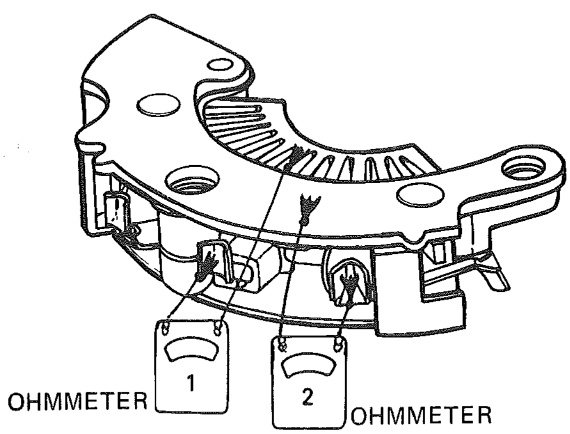
Fig. 602 CS130 Generator Disassembly, Test and Reassembly 1 of 3

REMOVE BRUSH HOLDER, REGULATOR AND RECTIFIER



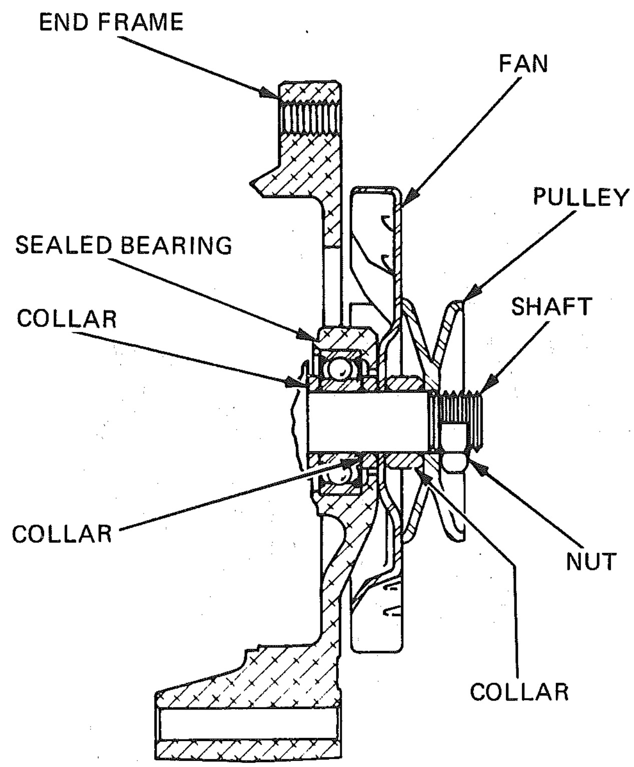
10. Remove brush holder screw, disconnect terminal and remove brush holder assembly. If brushes are to be reused, clean with a soft dry cloth and use retaining pin to hold brushes in holder.
11. Unsolder and pry open terminal between regulator and rectifier bridge. Remove terminal and attaching screws to remove regulator and rectifier bridge from end frame.

TESTING RECTIFIER BRIDGE



12. To check rectifier bridge, connect ohmmeter using low scale to one terminal and heat sink (step 1). Reverse leads. If both readings are the same, replace rectifier bridge. Check other two diodes in same manner as step 1. NOTICE: Some digital ohmmeters cannot be used to check diodes in bridge. Consult ohmmeter manufacturer to determine tester capabilities.
13. Check remaining three diodes in same manner by connecting ohmmeter from each terminal to base plate (step 2). If both readings are the same on any diode, replace rectifier bridge.

DRIVE END BEARING



CROSS SECTION
DE FRAME CS–130

14. Note stack up of parts for drive end bearing assembly. Hold rotor with hex wrench to remove, or tighten shaft nut. Torque to 54-108 N•m (40-80 lb.-ft.).

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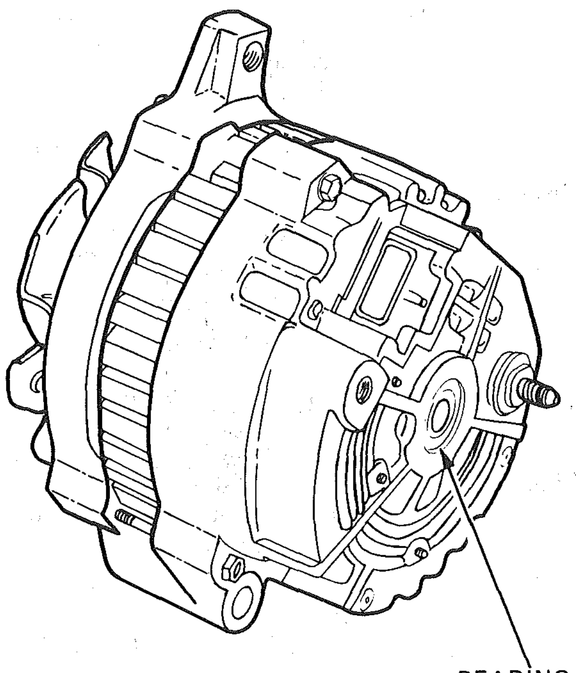
Fig. 603 CS130 Generator Disassembly, Test and Reassembly 2 of 3

SLIP RING END FRAME BEARING



15. Install new tolerance ring inside of slip ring end frame.
16. Press outer race of new bearing against bottom of end frame casting.
17. Assemble brush holder using insulated screw to end frame; position holder so brushes will ride squarely on commutator. Use retainer pin to hold brushes in holder.
18. Assemble rectifier bridge to end frame using silicone grease (to dissipate heat) between bridge and end frame. Securely crimp the electrical connection between bridge and brush holder.
19. Install regulator, crimp and solder connection between regulator and bridge.
20. Install new baffle. Use punch to drive pins down flush with baffle.
21. Install stator, solder and crimp to three connectors on bridge. Avoid excessive heat which could damage diodes in rectifier bridge.
22. Install outside cover using punch to drive pins down flush with cover.
23. To assemble drive end frame and rotor assembly into end frame, push on both inner and outer race to push slip ring end assembly over shaft. Then push on both inner and outer race until outer race is recessed 1.9-2.2 mm inside end frame casting.
24. Assemble three bolts and remove brush retaining pin.

G20214-6D

Fig. 604 CS130 Generator Disassembly, Test and Reassembly 3 of 3

SECTION 6D4

IGNITION SYSTEM

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery portion of this section for battery information.

HEI Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor.

The distributor has an internal magnetic pick-up assembly which contains a permanent magnet, a pole piece with internal teeth and a pick-up coil. When the teeth of the timer core, rotating inside the pole piece, line up with the teeth of the pole piece, an induced voltage in the pick-up coil signals the electronic module to trigger the coil primary circuit. The primary current decreases and a high voltage is induced in the ignition coil secondary winding. This voltage is directed through the rotor and secondary leads to fire the spark plugs. The capacitor in the distributor is for radio noise suppression.

All spark timing changes in the HEI (EST) distributor are done electronically by an Electronic Control Module (ECM), which monitors information from various engine sensors, computes the desired spark timing and signals the distributor to change the timing accordingly. A back-up spark advance system is incorporated to signal the ignition module in case of (ECM) failure. No vacuum or mechanical advance is used. Further (EST) information is found in sections 6E Emissions Control, and 8A Electrical Troubleshooting.

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type pick-up. **Do not pierce the plug lead.** Once the insulation of the spark plug cable has been broken, voltage will jump to the nearest ground, and the spark plug will not fire properly. **Always follow the tune-up label procedures when adjusting timing.**

Some engines will incorporate a magnetic timing probe hole for use with special electronic timing equipment. Fig. 1A shows a typical magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. Silicone spark plug boots form a tight seal on the plug. **The boot should be twisted 1/2 turn before removing.** Care should also be exercised when connecting a timing light or other pick-up equipment. Do not force anything between the boot and wiring, or through the silicone jacket. Connections should be made in parallel using an adapter. DO NOT pull on the wire to remove. Pull on the boot, or use a tool designed for this purpose.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines (except aluminum heads). No gasket is used on these tapered seat plugs. See Figs. 1B and 1C for an explanation of coding on spark plugs.

Normal service is assumed to be a mixture of idling, slow speed, and high speed driving. Occasional or intermittent high-speed driving is needed for good

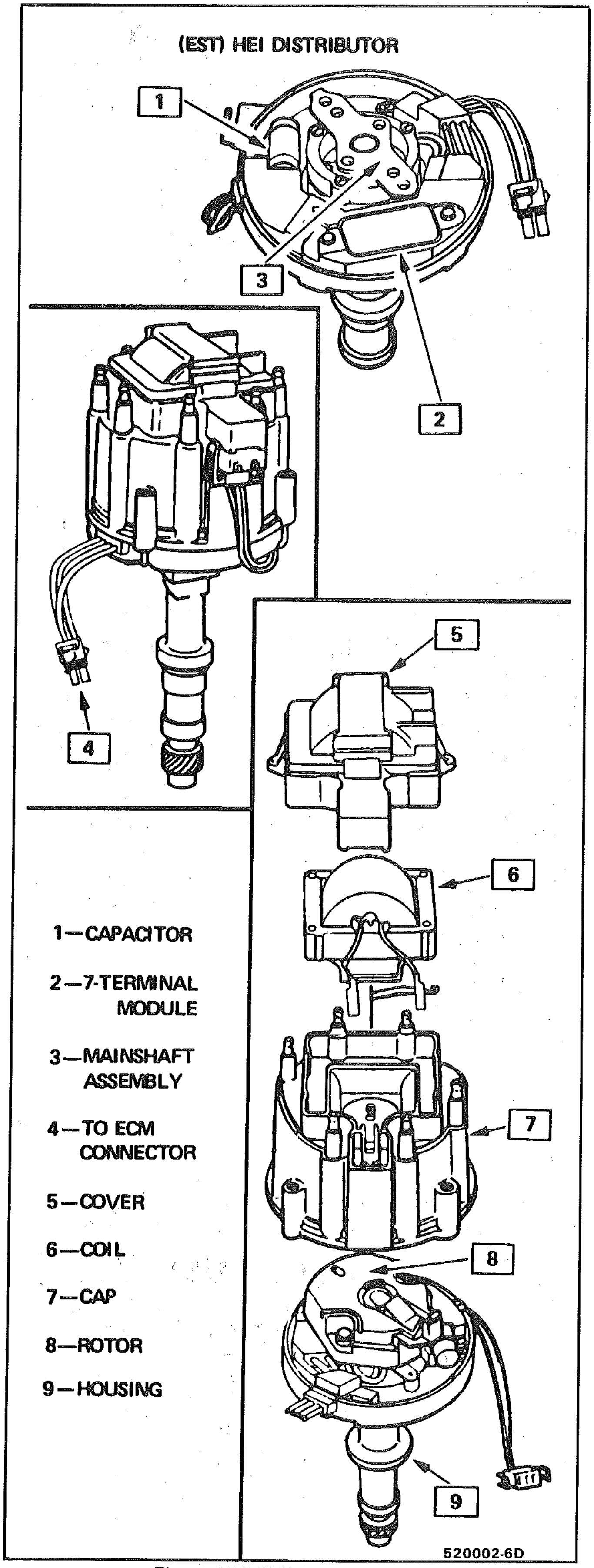


Fig. 1 HEI (EST) Distributor

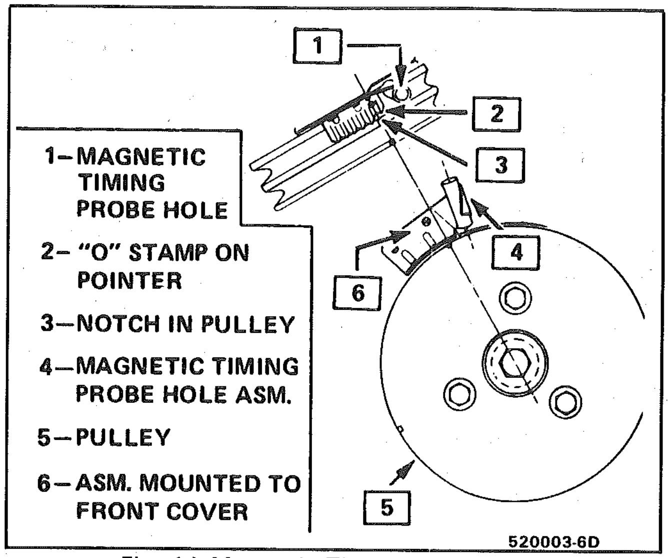


Fig. 1A Magnetic Timing Probe Hole

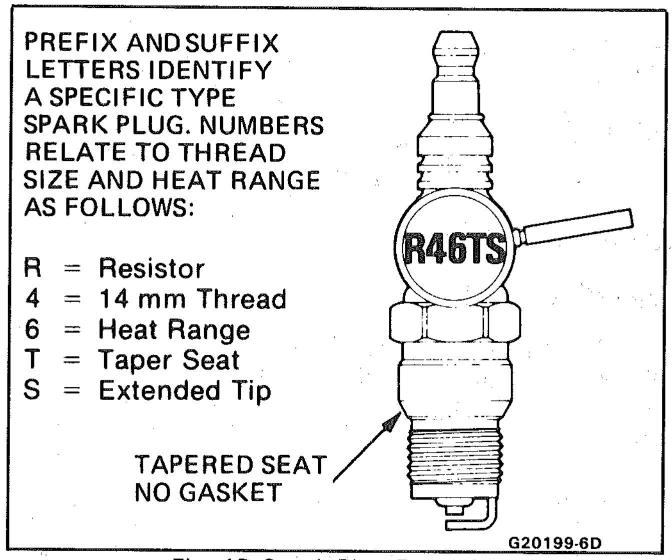


Fig. 1B Spark Plug Example

1st number denotes THREAD SIZE

4 = 14 mm	2 = ½-inch taper
8 = 18 mm	5 = ½-inch
10 = 10 mm	6 = ¾-inch
12 = 12 mm	7 = ⅞-inch

2nd number denotes HEAT RANGE

0-1-2-3-4-5-6-7-8-9

COLD ——— HOT

G20200-6D

Fig. 1C Spark Plug Coding

spark plug performance. It gives increased combustion heat, burning away carbon or oxides that have built up from frequent idling, or continual stop-and-go driving. Spark plugs are protected by an insulating nipple made of special heat-resistant material, which covers the spark plug terminal and extends downward over a portion of the plug insulator. These nipples prevent flash-over, which causes engine misfiring. Do not mistake corona discharge for flash-over, or a shorted insulator. Corona is a steady blue light appearing around the insulator, just above the shell crimp. It is the visible evidence of a high-tension field and has no effect on ignition performance. Usually it can be detected only in darkness. This discharge may repel dust particles, leaving a clear ring on the insulator just above the shell. This ring is sometimes mistakenly regarded as evidence that combustion gases have blown out between shell and insulator.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel. The electrical switching portion of the assembly is separate from the key and lock cylinder. However, both are synchronized and work in conjunction with each other through the action of the actuator rod assembly.

For a complete explanation of the key and lock cylinder, and the actuator rod assembly, see STEERING, Section 3B. See Section 8 for electrical switching.

DIAGNOSIS

IGNITION SYSTEM

Spark Plugs

Worn or dirty plugs may give satisfactory operation at idling speed, but at higher RPM they frequently fail. Faulty plugs are indicated in a number of ways: poor fuel economy, power loss, loss of speed, hard starting and generally poor engine performance.

Spark plugs may also fail due to carbon fouling, excessive gap, or a broken insulator.

Fouled plugs may be indicated by black carbon deposits. The black deposits are usually the result of slow-speed driving and short runs, where sufficient engine operating temperature is seldom reached. Worn pistons, rings, faulty ignition, over-rich carburetion and spark plugs which are too cold will also result in carbon deposits.

Excessive gap wear, on plugs of low mileage, usually indicates the engine is operating at high speeds, or loads that are consistently greater than normal, or that a plug which is too hot is being used. Electrode wear may also be the result of plug overheating, caused by combustion gases leaking past the threads due to insufficient torquing of the spark plug. Excessively lean carburetion will also result in accelerated electrode wear.

Broken insulators are usually the result of improper installation, or carelessness when regapping the plug. Broken upper insulators usually result from a poor fitting wrench, or an outside blow. The cracked insulator may not show up right away, but will as soon as oil or moisture penetrates the crack. The crack is usually just below the crimped part of shell and may not be visible.

Broken lower insulators usually result from carelessness when regapping and generally are visible. This type of break may result from the plug operating too "hot", which may happen in periods of high-speed operation or under heavy loads. When regapping a spark plug, always make the gap adjustment by bending the ground (side) electrode. Spark plugs with broken insulators should always be replaced.

HEI Distributor

See Unit Repair for distributor disassembly, test and reassembly of individual distributor components, when the distributor is removed from the vehicle. See On-Car Service for distributor removal and installation and for component removal with distributor in car. See Section 6E for HEI and EST diagnosis.

SERVICE PROCEDURES

IGNITION SYSTEM

Distributor Ignition

NOTICE: This procedure is generally true for most carlines. Where procedure is different, or where additional information is required, see "ON-CAR SERVICE" for specific carline.

HEI DISTRIBUTOR

Service Precautions

1. When making compression checks, disconnect the ignition switch feed wire at the distributor. When disconnecting this connector, **do not** use a screwdriver or tool to release the locking tab, as it may break.
2. No periodic lubrication is required. Engine oil lubricates the lower bushing and an oil-filled reservoir provides lubrication for the upper bushing.
3. The tachometer (TACH) terminal is next to the ignition switch (BAT) connector on the distributor cap.

NOTICE: The tachometer terminal must NEVER be allowed to touch ground, as damage to the module and/or ignition coil can result.

Some tachometers currently in use may NOT be compatible with the High Energy Ignition System. Consult the manufacturer of the tachometer if questions arise.

4. Dwell adjustment is controlled by the module, and cannot be adjusted.
5. The material used to construct the spark plug cables is very soft. This cable will withstand more heat and carry a higher voltage, but scuffing and cutting become easier. The spark plug cables must be routed correctly to prevent chaffing or cutting. See Spark Plug Section. When removing

a spark plug wire from a spark plug, twist the boot on the spark plug and pull **on the boot** to remove the wire, or use a special tool designed to remove spark plug boots.

Remove or Disconnect

1. Ignition switch battery feed wire and tachometer lead (if equipped) from distributor cap. Also release the coil connectors from the cap. (DO NOT use a screwdriver or tool to release the locking tabs.)
2. Distributor cap by turning four screws counterclockwise. Move cap out of the way.
3. Four-terminal ECM harness from distributor.
4. If necessary, remove secondary wires from cap, release wiring harness latches and remove wiring harness retainer. The spark plug wire numbers are indicated on the retainer.
5. Distributor clamp screw and hold-down clamp.
6. Note position of rotor, then pull distributor up until rotor just stops turning counterclockwise and again note position of rotor.
   - To insure correct timing of the distributor, the distributor must be INSTALLED with the rotor correctly positioned as noted.

If the engine was accidentally cranked after the distributor was removed, the following procedure can be used for installing:

1. Remove No. 1 spark plug.
2. Place finger over No. 1 spark plug hole and crank engine slowly until compression is felt.
3. Align timing mark on pulley to "0" on engine timing indicator.
4. Turn rotor to point between No. 1 and No. 8 spark plug towers on distributor cap on V8 engines, between No. 1 and No. 6 on V6 engines, and No. 1 and No. 4 on 4 cylinder engines.
5. Install distributor and connect ignition feed wire.
6. Install distributor cap and spark plug wires.
7. Check engine timing (see Set Ignition Timing).

Install or Connect

1. Insert distributor, positioning rotor as removed.
2. Distributor hold-down clamp and screw.
3. Wiring harness retainer and secondary wires, if removed.
4. ECM harness connector.
5. Distributor cap.
6. Coil connectors.
7. Battery wire and tachometer lead, if equipped.

Module

It is not necessary to remove the distributor from car.

Remove or Disconnect

1. Distributor cap and rotor.
2. Two module attaching screws, and lift module up.
3. Leads from module. (Observe color code on leads as these cannot be interchanged.)
4. Do not wipe grease from module, or distributor base, if same module is to be replaced.

Install or Connect

NOTICE: If a new module is to be installed, a package of silicone grease will be included with it. Spread the grease on the metal face of the module and on the distributor base where the module seats. This grease is necessary for module cooling.

1. Module.
2. Module leads (observe color code).
3. Attaching screws to module.
4. Rotor.
5. Cap.

Pick-Up Coil

1. Remove distributor from car and follow instructions in Unit Repair, as applicable.

Rotor

Fig. 1

1. Remove distributor cap.
2. The rotor is retained by two screws and is provided with a slot which fits over a square lug, so that the rotor can be installed in only one position.

Integral Ignition Coil

Fig. 1

Remove or Disconnect

1. Distributor cap.
2. Three coil cover attaching screws, and lift off cover.
3. Coil attaching screws and lift ignition coil and leads from cap.

Install or Connect

1. Coil and attaching screws.
2. Coil leads.
3. Coil cover and attaching screws.

Capacitor

Fig. 1

The capacitor is part of the coil wire harness assembly. Since the capacitor is used only for radio noise suppression, it will seldom need replacement.

Remove or Disconnect

1. Distributor cap and rotor.
2. Capacitor attaching screw and unplug connector from module. It may help to loosen the module.

Install or Connect

1. Plug into module.
2. Capacitor and hold-down screw (be sure ground lead is under screw).

3. Rotor and cap.

Set Ignition Timing

1. Refer to the tune-up label located in the engine compartment. Follow all instructions on the label.

2. With ignition off, connect the pick-up lead of timing light to the number one spark plug. Use a jumper lead between the wire and plug, or an inductive type pick-up. **DO NOT** pierce the wire, or attempt to insert a wire between the boot and the wire. Connect the timing light power leads according to manufacturer's instructions.

3. Start the engine and aim the timing light at the timing mark. The line on the balancer or pulley will line up at the timing mark. If a change is necessary, loosen the distributor hold-down clamp bolt at the base of the distributor. While observing the mark with the timing light, slighty rotate the distributor until the line indicates the correct timing. Tighten the hold-down bolt and re-check the timing.

4. Turn off the engine and remove the timing light. Reconnect the number one spark plug wire, if removed.

Spark Plug Wires

Use care when removing spark plug wire boots from spark plugs. Twist the boot 1/2 turn before removing and pull on the **boot only** to remove the wire.

When replacing plug wires, route the wires correctly and through the proper retainers. Failure to route the wires properly can lead to radio ignition noise and crossfiring of the plugs, or shorting of the leads to ground.

Special care should be exercised when reinstalling spark plug boots, to assure that the metal terminal within the boot is fully seated on the spark plug terminal and that the boot has not moved on the wire. If boot to wire movement has occurred, the boot will give a false visual impression of being fully seated. A good check to assure that boots have been properly assembled is to push sideways on the installed boots. If they have been correctly installed, a stiff boot, with only slight looseness, will be noted. If the terminal has not been properly seated on the spark plug, only the resistance of the rubber boot will be felt when pushing sideways.

ON-CAR SERVICE

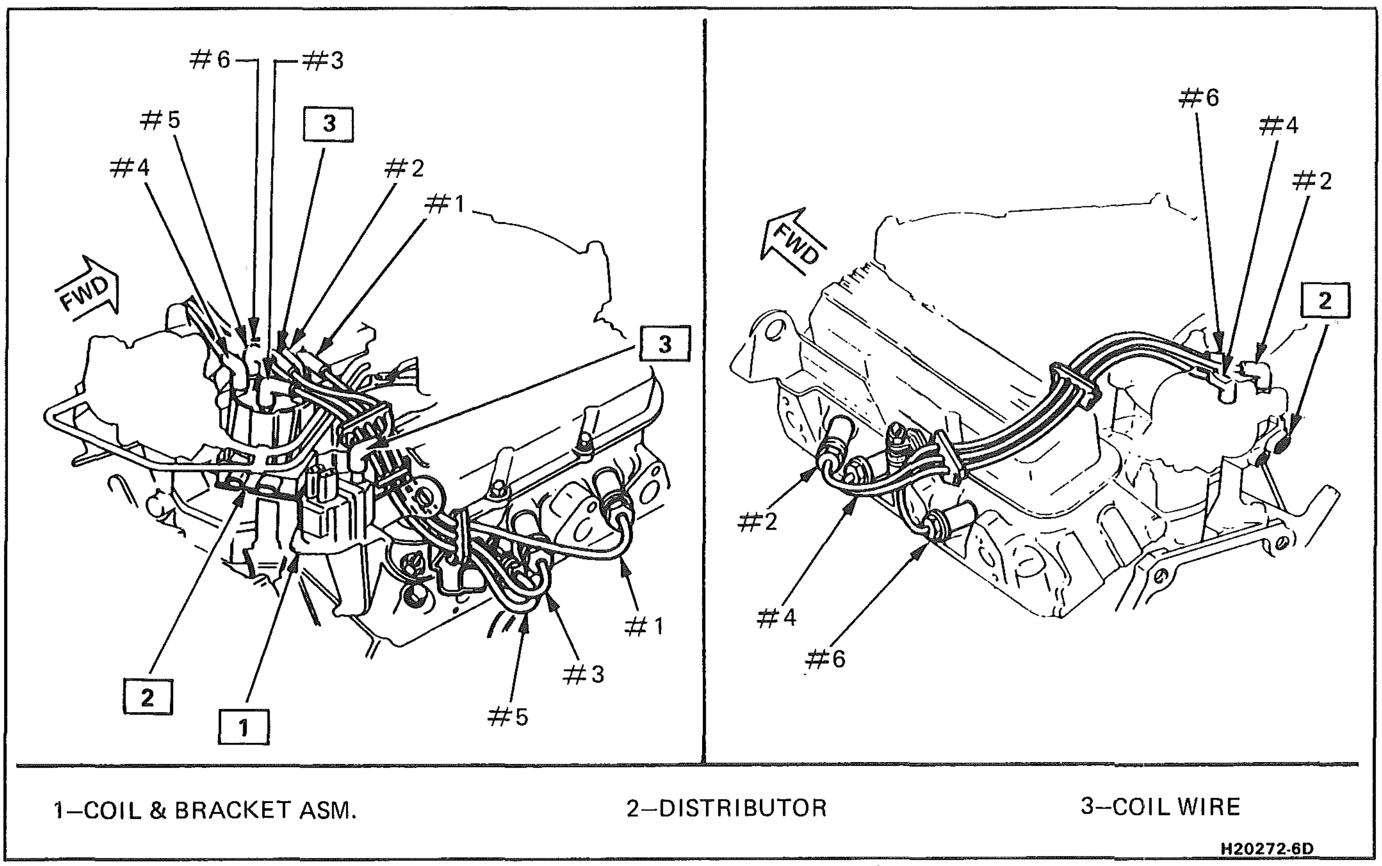


Fig. 601 Distributor and Coil - LB8

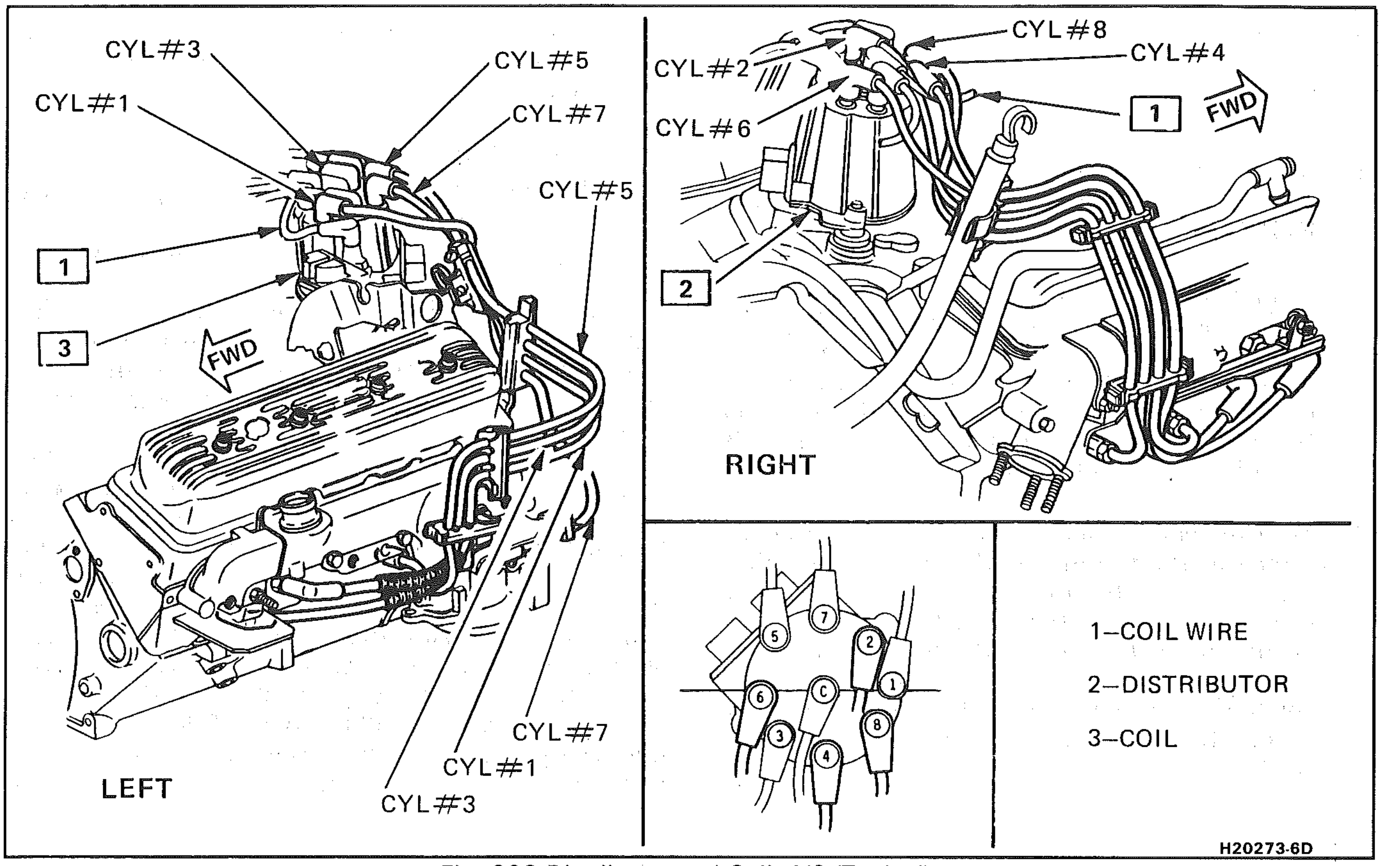
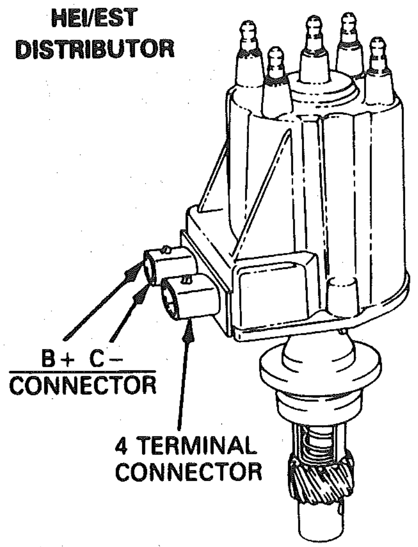


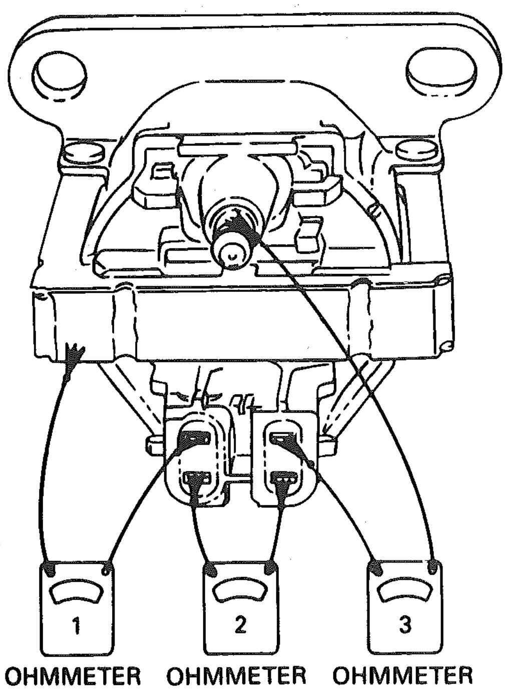
Fig. 602 Distributor and Coil - V8 (Typical)

DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (SEPARATELY MOUNTED COIL)



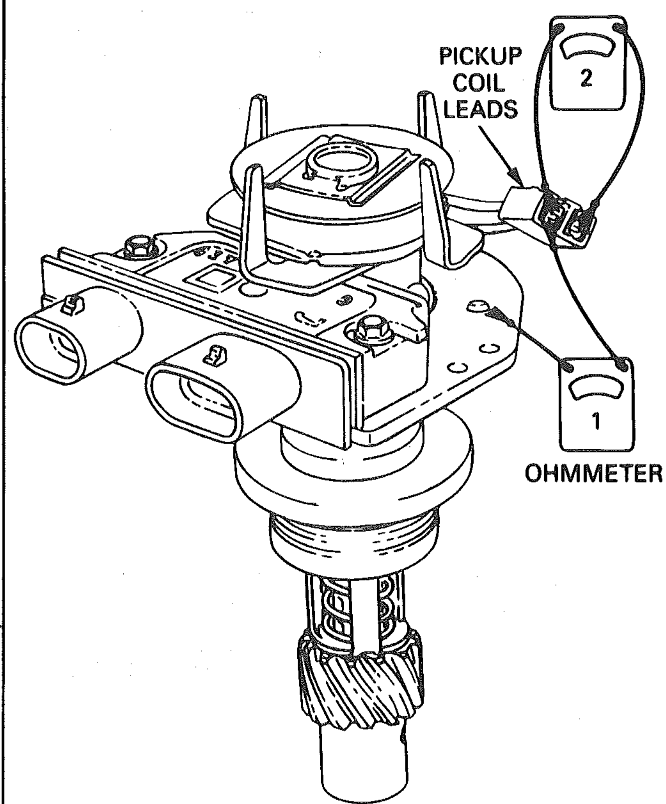
1. A TYPICAL DISTRIBUTOR USED WITH A SEPARATELY MOUNTED COIL IS SHOWN.

TESTING IGNITION COIL



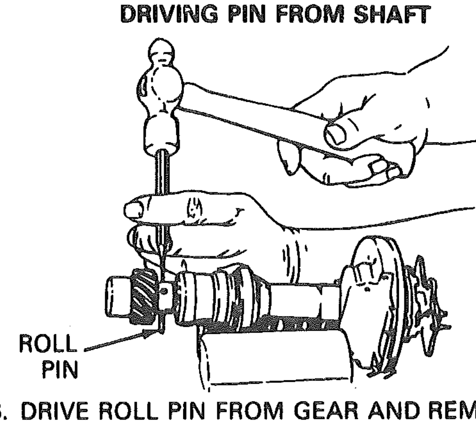
2. CHECK IGNITION COIL WITH OHMMETER FOR OPENS AND GROUNDS:
   STEP 1. — USE HIGH SCALE. SHOULD READ VERY HIGH (INFINITE). IF NOT, REPLACE COIL.
   STEP 2. — USE LOW SCALE. SHOULD READ VERY LOW OR ZERO. IF NOT, REPLACE COIL.
   STEP 3. — USE HIGH SCALE. SHOULD NOT READ INFINITE. IF IT DOES, REPLACE COIL.

TESTING PICKUP COIL



3. REMOVE ROTOR AND PICKUP COIL LEADS FROM MODULE.
4. CONNECT OHMMETER PART 1 AND PART 2.
5. OBSERVE OHMMETER. FLEX LEADS BY HAND TO CHECK FOR INTERMITTENT OPENS.
   STEP 1 — SHOULD READ INFINITE AT ALL TIMES. IF NOT, PICKUP COIL IS DEFECTIVE.
   STEP 2 — SHOULD READ ONE STEADY VALUE BETWEEN 500-1500 OHMS AS LEADS ARE FLEXED BY HAND. IF NOT, PICKUP COIL IS DEFECTIVE.

DRIVING PIN FROM SHAFT



6. DRIVE ROLL PIN FROM GEAR AND REMOVE SHAFT ASSEMBLY. MARK GEAR AND SHAFT FOR CORRECT REASSEMBLY.

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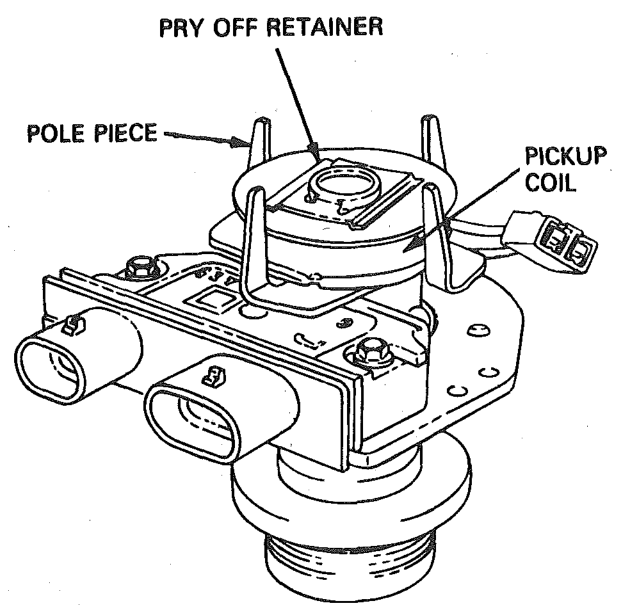
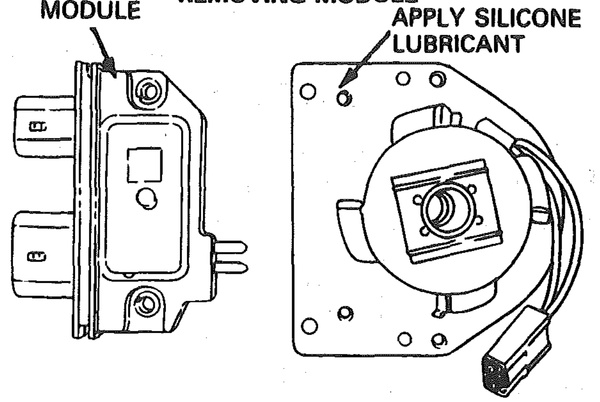
Fig. 603 Distributor Disassembly, Test and Reassembly (Separate Coil) 1 of 2

REMOVE PICKUP COIL



7. TO REMOVE PICKUP COIL, REMOVE RETAINER.
8. LIFT PICKUP COIL ASSEMBLY STRAIGHT UP TO REMOVE FROM DISTRIBUTOR.

REMOVING MODULE



9. DISCONNECT WIRING CONNECTORS FROM MODULE. REMOVE TWO SCREWS TO REMOVE MODULE TEST MODULE WITH AN APPROVED MODULE TESTER.

REASSEMBLY

10. WIPE DISTRIBUTOR BASE AND MODULE CLEAN, APPLY SILICONE LUBRICANT BETWEEN MODULE AND BASE FOR HEAT DISSIPATION.
11. ATTACH MODULE TO BASE. ATTACH PICKUP CONNECTOR TO MODULE.
12. ASSEMBLE PICKUP POLE PIECE AND RETAINER.
13. ASSEMBLE SHAFT, GEAR PARTS AND ROLL PIN.
14. SPIN SHAFT TO INSURE THAT TEETH DO NOT TOUCH.
15. INSTALL ROTOR AND CAP.

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Fig. 604 Distributor Disassembly, Test and Reassembly (Separate Coil) 2 of 2

SECTION 6D5

ENGINE WIRING

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). Diagnostic charts (see Section 6D) will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

ON-CAR SERVICE

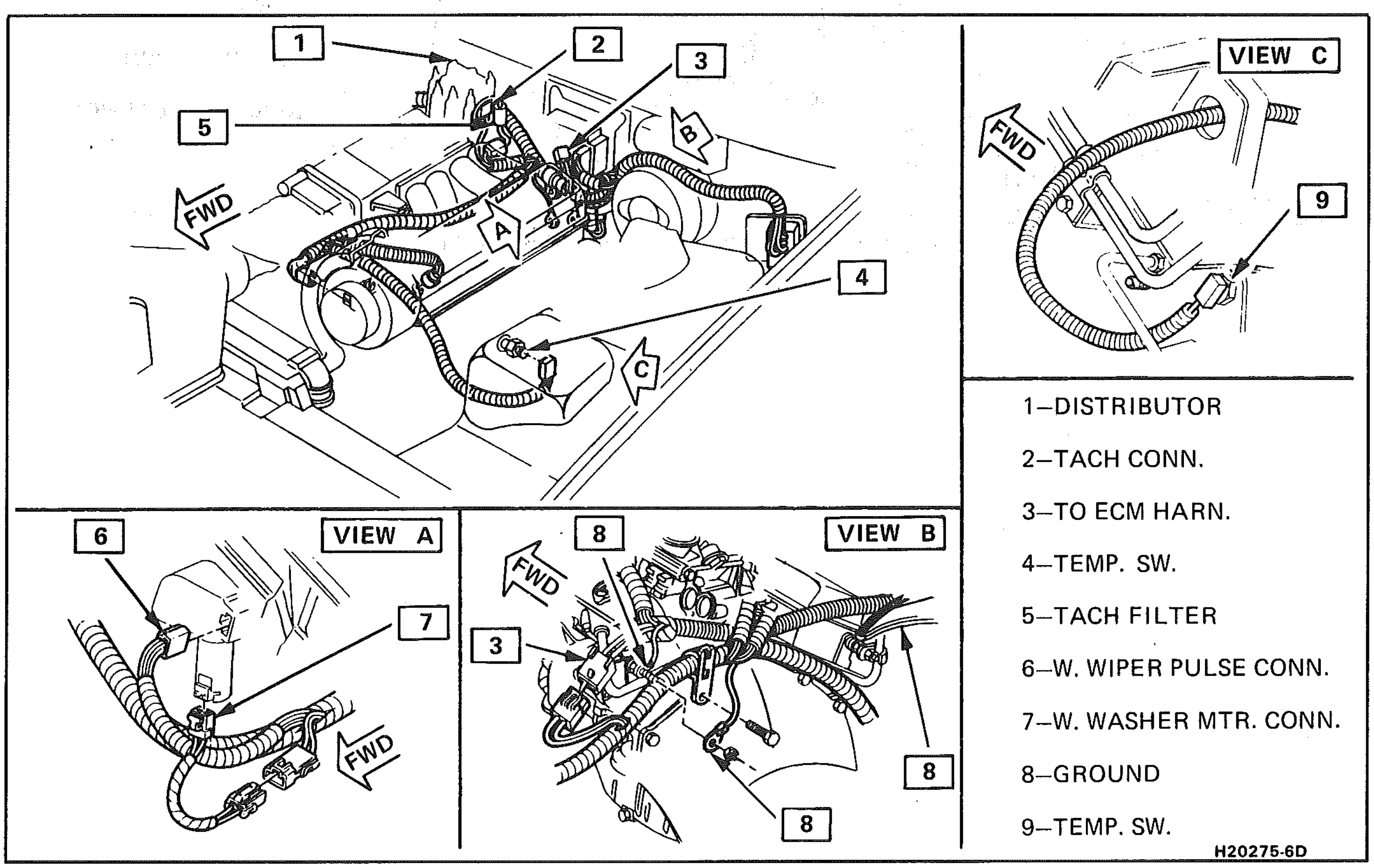


Fig. 601 Engine Harness - Left (LB9/B2L)

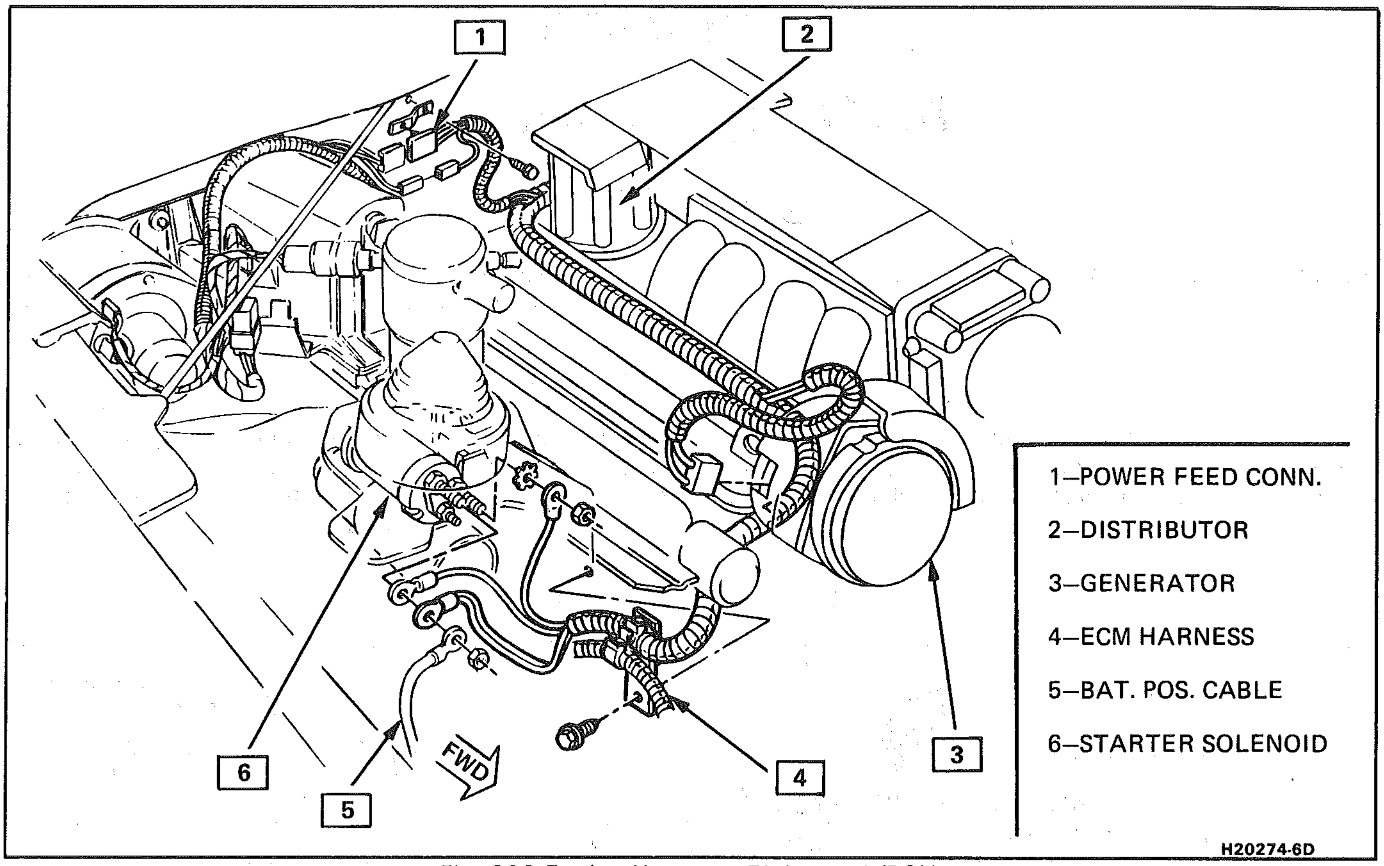


Fig. 602 Engine Harness - Right (LB9/B2L)

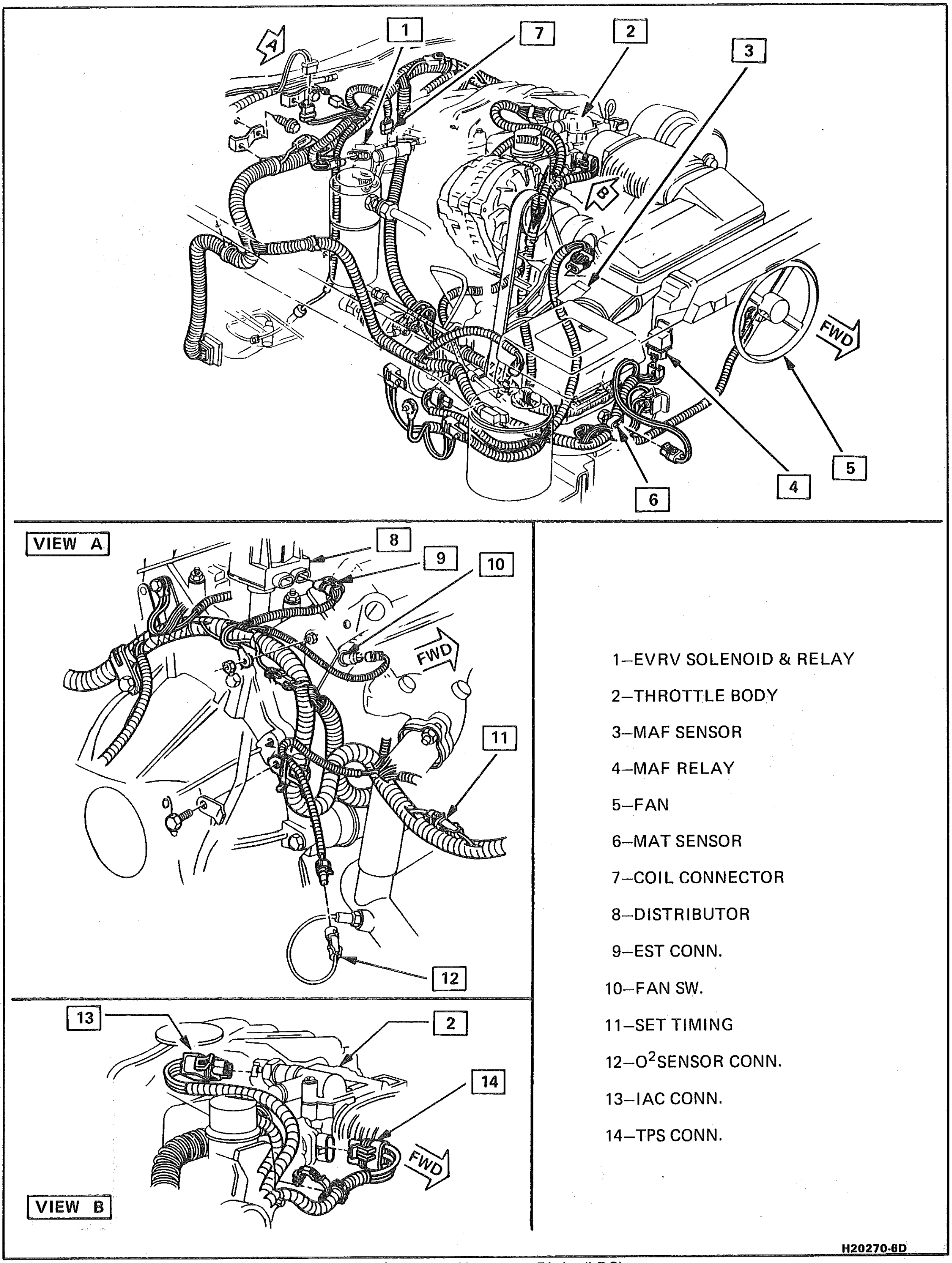


Fig. 603 Engine Harness - Right (LB8)

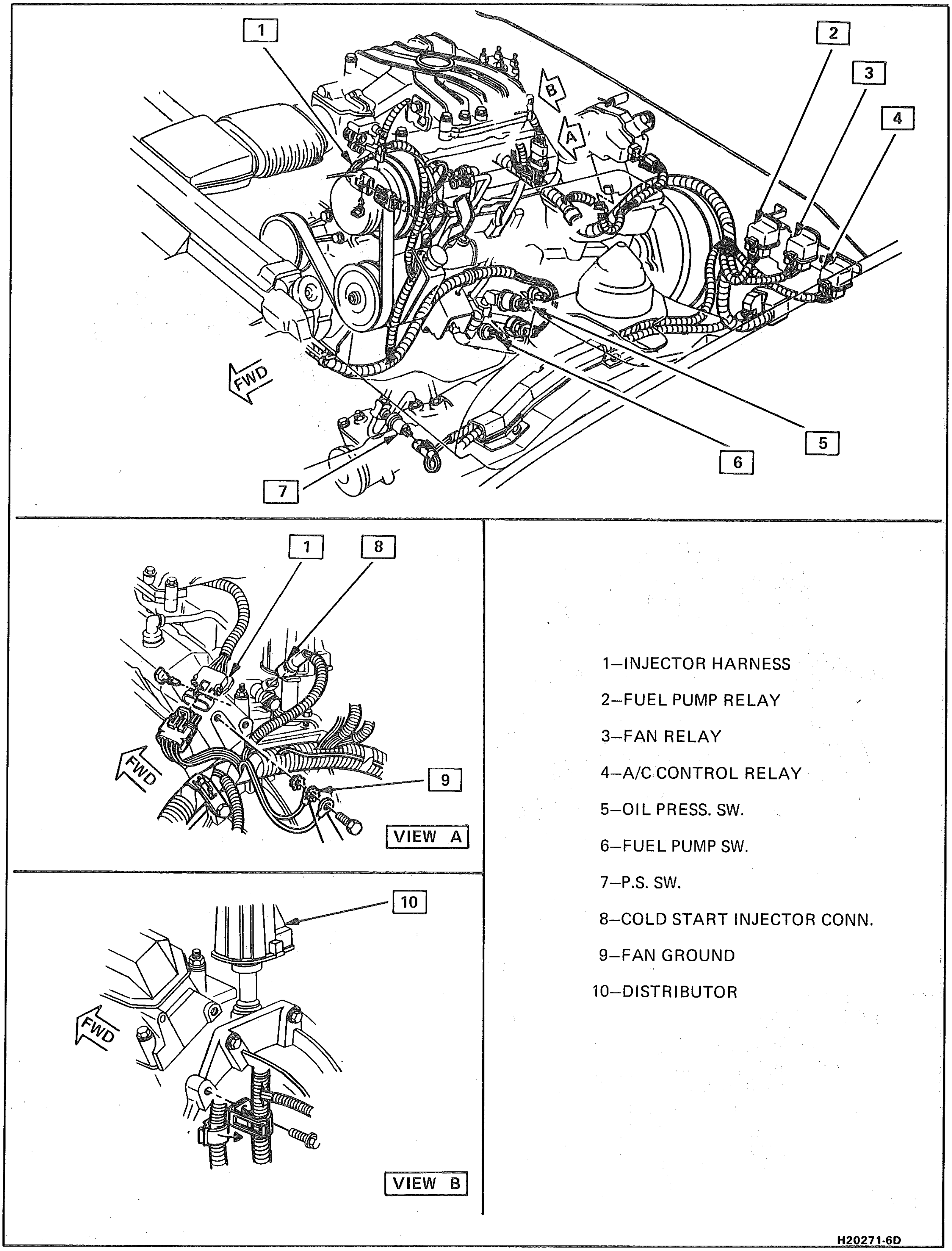


Fig. 604 Engine Harness - Left (LB8)

SECTION 6D

ENGINE ELECTRICAL

CONTENTS

GENERAL DESCRIPTION

The engine electrical system includes the battery, ignition (primary and secondary), starter (and related wiring) and the generator (and related wiring). The accompanying diagnosis charts will aid in trouble-shooting system faults. When a fault is traced to a particular component, refer to that components' section of the service manual.

BATTERY

The sealed battery is standard on all cars.

The battery has three major functions in the electrical system: First, it provides a source of energy for cranking the engine; Second, it acts as a voltage stabilizer for the electrical system; And third, it can, for a limited time, provide energy when the electrical load used exceeds the output of the generator.

CHARGING SYSTEM-CS

The CS Charging System has several sizes available, including the CS-130 and CS-144. The number (130 or 144) denotes the OD in mm of the stator laminations.

CS generators use a new type regulator and a diode trio is not used. A delta stator, rectifier bridge, and rotor with slip rings and brushes are electrically similar to earlier generators. A conventional pulley and fan is used and, on the CS-130, an internal fan cools the slip ring end frame, rectifier bridge and regulator.

IGNITION SYSTEM

Distributor Ignition

The ignition circuit consists of the battery, distributor, ignition switch, spark plugs and primary and secondary wiring. Refer to the Battery Section (6D1) for battery information.

Distributor

The High Energy Ignition (HEI) distributor with Electronic Spark Timing (EST), used on most engines, combines all ignition components in one unit. The ignition coil is in the distributor cap and connects through a resistance brush to the rotor. Another type of HEI/EST ignition system, used on some engines, has a separately mounted coil.

Ignition Timing

Timing specifications for each engine are listed in Section 6E. When using a timing light, connect an adapter between the No. 1 spark plug and the No. 1 spark plug wire, or use an inductive type

Secondary Wiring

The spark plug wiring used with ignition systems is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the system.

Spark Plugs

Resistor type, tapered seat spark plugs are used on all engines, except those with aluminum heads.

Ignition Switch

The mechanical switch is located in the steering column on the right hand side just below the steering wheel.

CRANKING SYSTEM

The cranking circuit consists of the battery, starting motor, ignition switch, and related electrical wiring.

Starter Motor

Wound field starter motors have pole pieces, arranged around the armature, that are energized by wound field coils.

Solenoid

Enclosed shift lever cranking motors have the shift lever mechanism and the solenoid plunger enclosed in the drive housing, protecting them from exposure to dirt, icing conditions and splash.

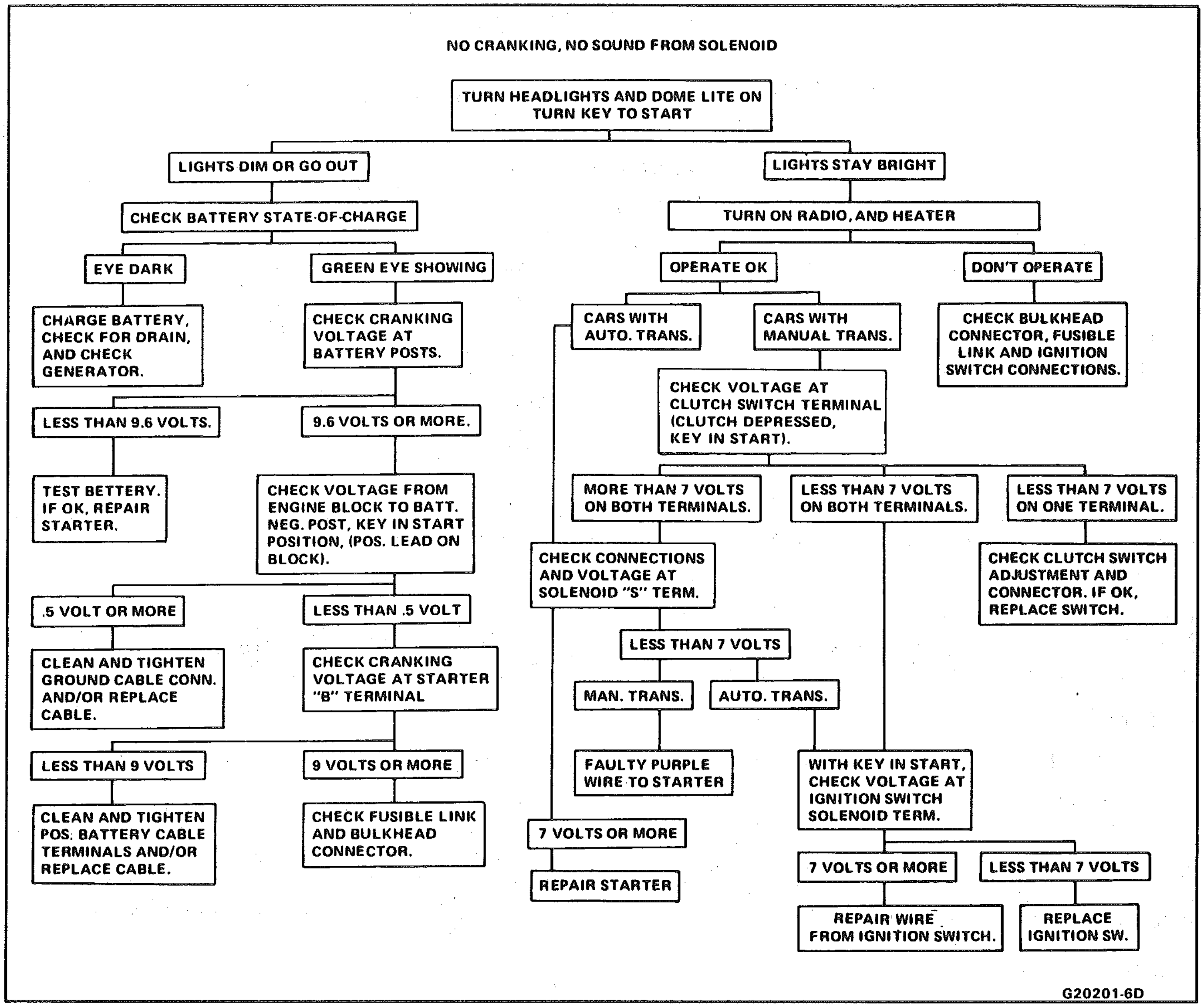


Fig. 1 Electrical System General Diagnosis - 1 of 2

GENERAL ELECTRICAL SYSTEM DIAGNOSIS

Diagnosis and repair procedures for engine electrical subsystems are located in the following subsections:

6D1 - Battery

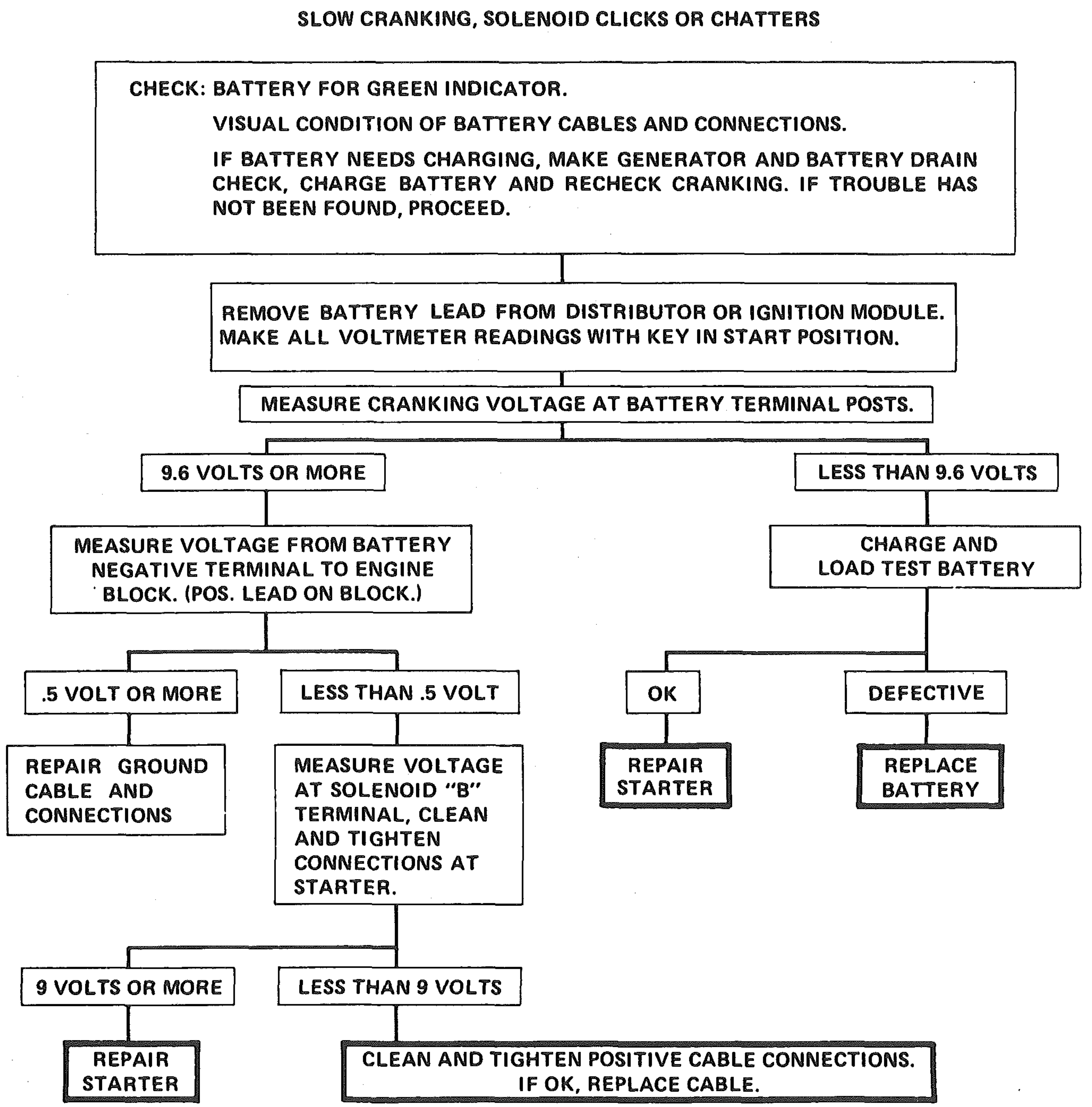
6D2 - Cranking System

6D3 - Charging System

6D4 - Ignition System

6D5 - Engine Wiring

Where a "driveability" complaint exists, or an ECM code is set, go to Section 6E. Wiring diagrams, component locations and system checks are located in Section 8A.



THIS PROCEDURE IS DESIGNED FOR USE ON ENGINES AND BATTERIES AT ROOM OR NORMAL OPERATING TEMPERATURES. IT ALSO ASSUMES THERE ARE NO ENGINE DEFECTS WHICH WOULD CAUSE CRANKING PROBLEMS. TO USE IT UNDER OTHER CONDITIONS MIGHT RESULT IN MISDIAGNOSIS.

G20202-6D

Fig. 2 Electrical System General Diagnosis - 2 of 2

SECTION 6E2
DRIVEABILITY AND EMISSIONS FUEL INJECTION (TBI)

THIS SECTION APPLIES TO:
5.0L (VIN E) "F" SERIES

CONTENTS

INTRODUCTION

SECTION A - DIAGNOSTIC CHARTS

SECTION B - SYMPTOMS

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS

SECTION C - COMPONENT SYSTEMS

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This section applies to engines which have a fuel injector mounted above a throttle body assembly. The entire assembly is mounted to the intake manifold and is referred to as "Throttle Body Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An engine control module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section "C", Component Systems.

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming "ON" should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section "6E". If the proper diagnosis procedures are not followed, as described in Section "6E", it may result in unnecessary replacement of good parts.

Trouble tree charts incorporate diagnosis procedures using an ALDL "Scan" tool, where possible. The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "Scan" tool's limitations. See Section 6E for more information.**

BLANK

SECTION A
5.0L ENGINE

DIAGNOSTIC CIRCUIT CHECK

The "Diagnostic Circuit Check" verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked while checking the system.

Cold Oxygen Sensor

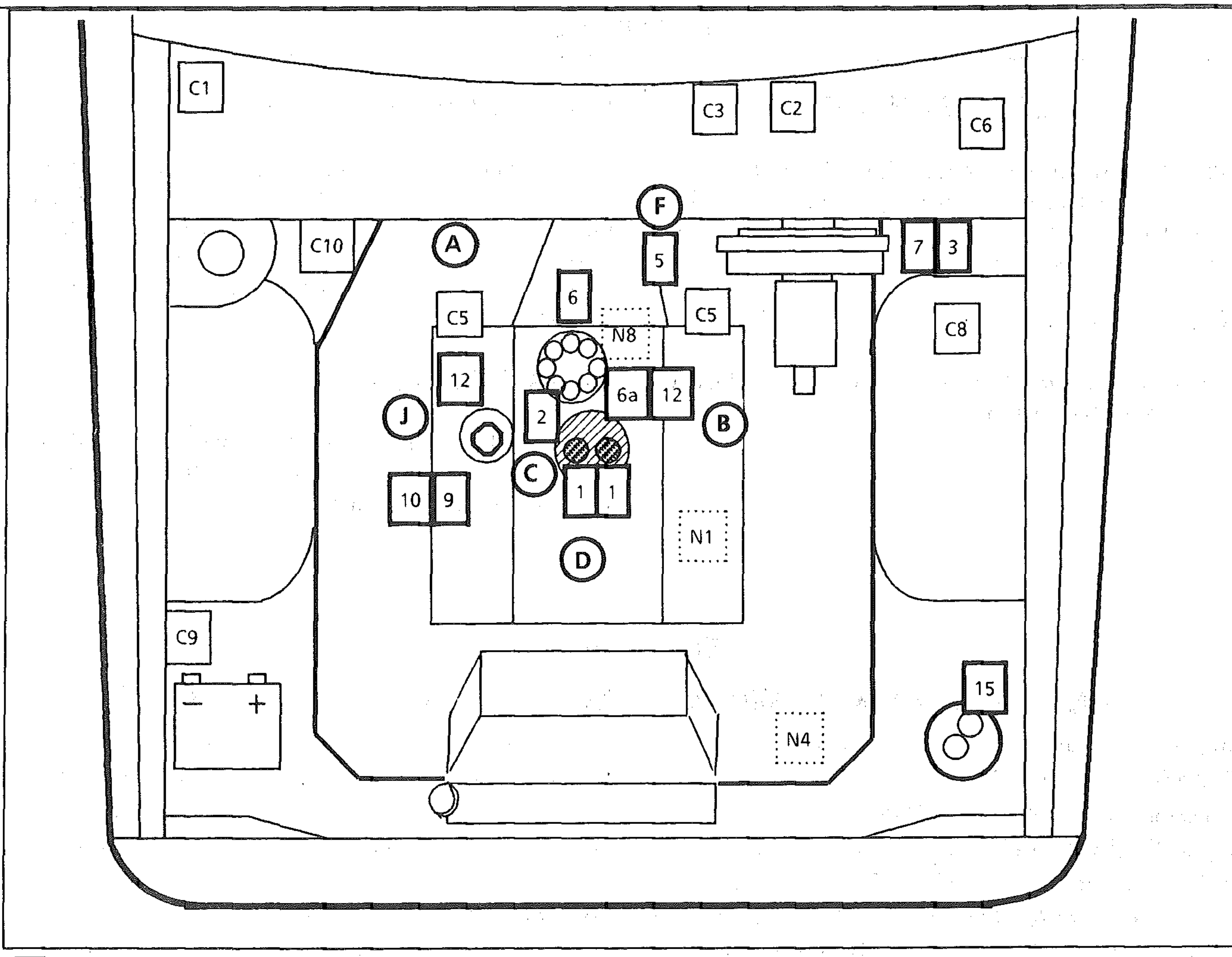
On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

BASIC PROCEDURE

If you have not reviewed the basic information on how to use the diagnostic procedures, go to the introduction of this section.

SECTION A
ENGINE COMPONENTS / WIRING DIAGRAMS / DIAGNOSTIC CHARTS

'F' SERIES RPO: LO3 VIN CODE: E 5.0L V8 TBI



COMPUTER HARNESS
C1 Electronic Control Module
C2 ALDL diagnostic connector
C3 "SERVICE ENGINE SOON" light
C5 ECM harness grounds
C6 Fuse panel
C8 Fuel pump test connector
C9 Fuel pump fuse & ECM power
C10 Set timing connector

NOT ECM CONNECTED
N1 Crankcase vent valve (PCV)
N4 P/S Switch
N8 Oil pressure switch

CONTROLLED DEVICES
1 Fuel injectors
2 Idle air control motor
3 Fuel pump relay
5 Trans. Conv. Clutch connector
6 EST distributor
6a Remote ignition coil
7 Electronic Spark Control module
9 Air injection port solenoid
10 Air injection converter solenoid
12 Exh. Gas Recirc. vacuum solenoid
15 Fuel vapor canister solenoid
Exhaust Gas Recirculation valve

INFORMATION SENSORS
A Manifold Absolute Pressure
B Exhaust oxygen
C Throttle position
D Coolant temperature
F Vehicle speed
J ESC knock
MAT (on air cleaner)

6-10-87
*8S 4419-6E

Figure A-1 - Component Locations 5.0L (VIN E)

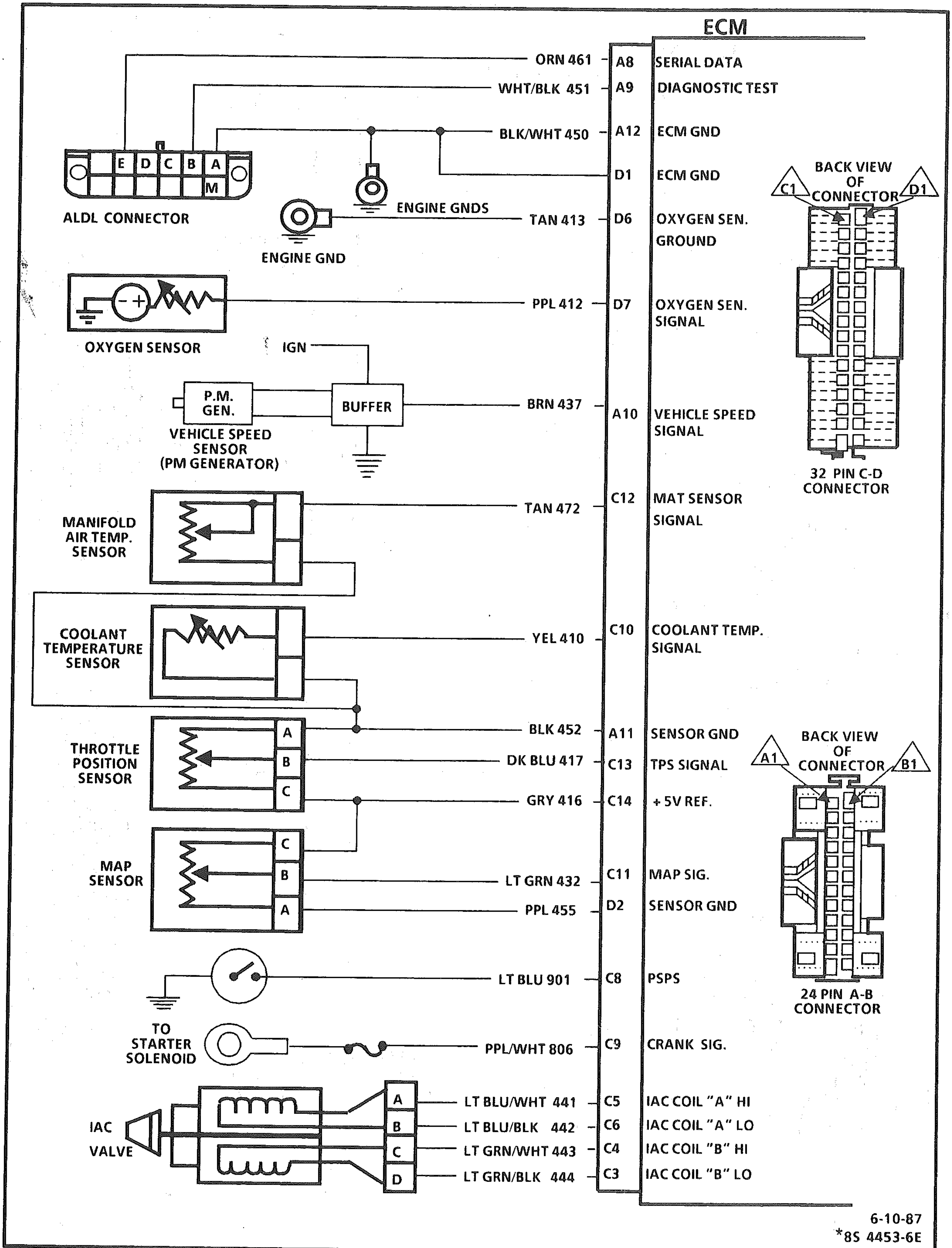


Figure A-2 - ECM Wiring Diagram 5.0L (VIN E) (1 of 3)

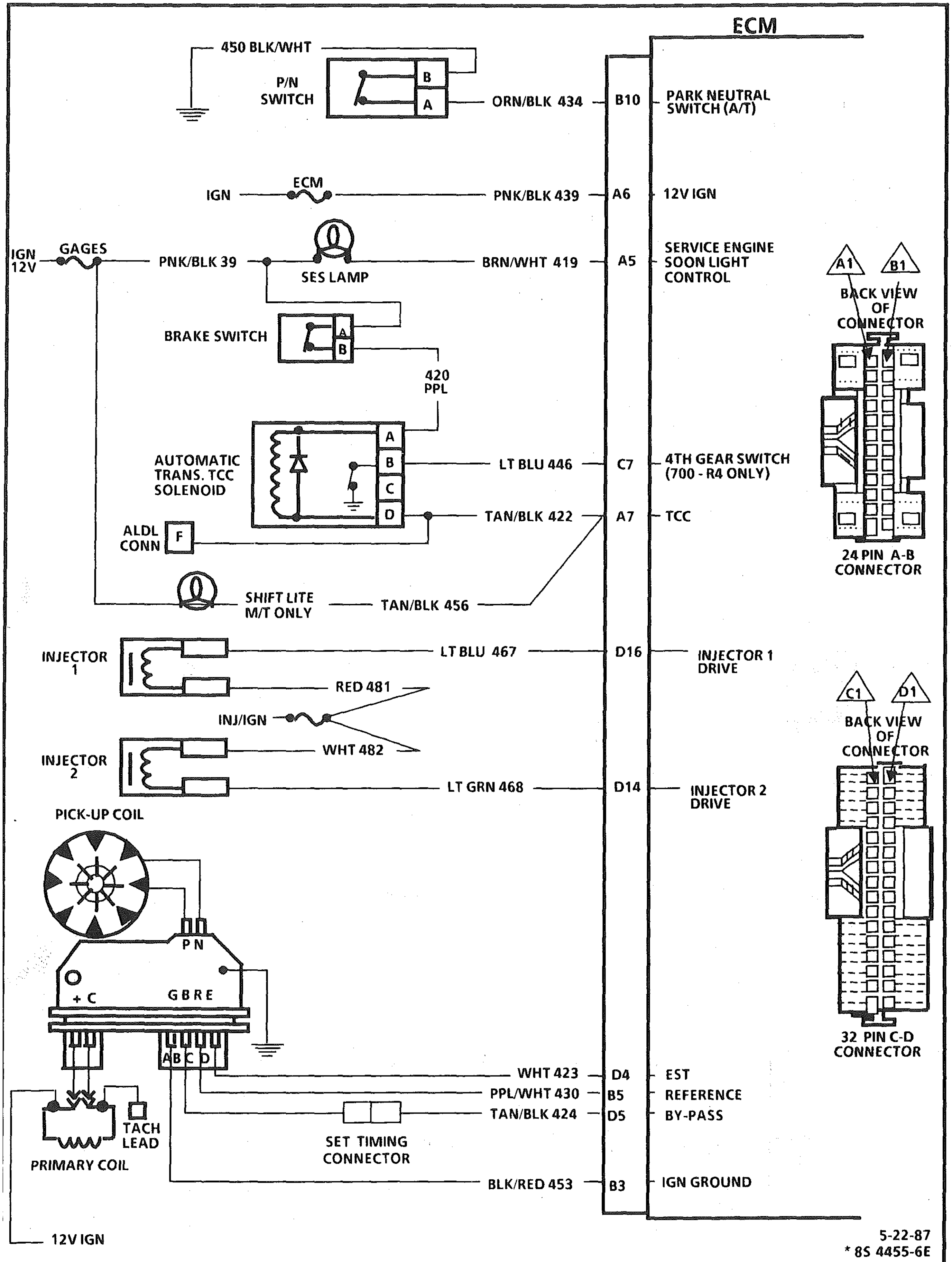


Figure A-3 - ECM Wiring Diagram 5.0L (VIN E) (2 of 3)

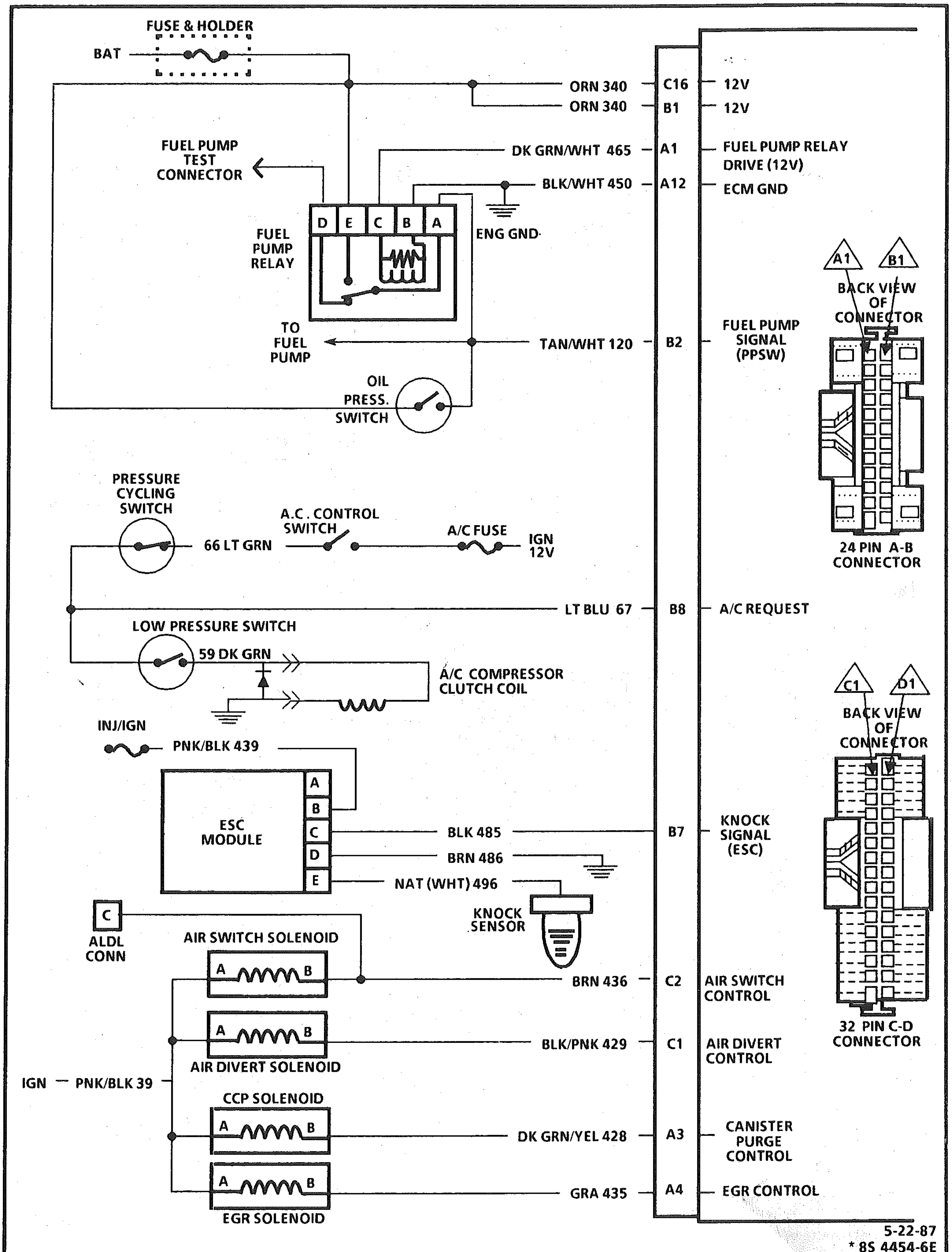


Figure A-4 - ECM Wiring Diagram 5.0L (VIN E) (3 of 3)

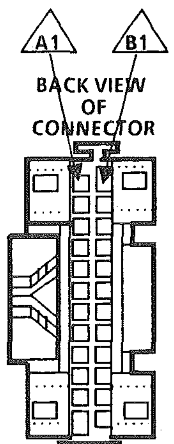
FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALDL tool not installed

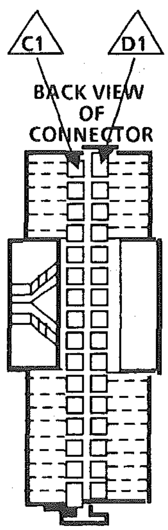
Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
2	0	B+	FUEL PUMP RELAY CONTROL	A1	DK GRN/ WHT
			NOT USED	A2	
	0	B+	CANISTER PURGE CONTROL	A3	DK GRN/ YEL
	B+	B+	EGR CONTROL SOL.	A4	GRY
	0	B+	"SERVICE ENGINE SOON" CONTROL	A5	BRN/ WHT
	B+	B+	IGN (ECM)	A6	PNK/ BLK
	B+	B+	A/T SHIFT LIGHT TCC CONTROL	A7	TAN/ BLK
	2-5 VARYING	2-5	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/ BLK
1	0 OR 12	0 OR 12	SPEED SENSOR SIGNAL	A10	BRN
	0	0	COOLANT AND MAT TPS GROUND	A11	BLK
	0	0	SYSTEM GROUND	A12	BLK/ WHT



24 PIN A-B CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
ORN	B1	BATT.12.VOLTS	B+	B+	
TAN/WHT	B2	FUEL PUMP SIGNAL	0	B+	4
BLK/ RED	B3	IGNITION GROUND	0	0	
	B4	NOT USED			
PPL/ WHT	B5	DISTRIBUTOR REFERENCE HIGH	0	1.3	
PPL	B6	VATS	5	5	
BLK	B7	ESC SIGNAL	9.2	9.3	
LT BLU	B8	A/C SIGNAL OFF / ON	0 / B+	0 / B+	
	B9	NOT USED			
ORN/ BLK	B10	PARK/NEUTRAL SW.SIGNAL (A/T)	0	0	6
	B11	NOT USED			
	B12	NOT USED			

Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
	B+	B+	A.I.R. DIVERT SOLENOID	C1	BLK/ PNK
	B+	B+	A.I.R. SWITCH SOLENOID	C2	BRN
	NOT USEABLE		IAC "B" LO	C3	LT GRN/ BLK
	NOT USEABLE		IAC "B" HI	C4	LT GRN/ WHT
	NOT USEABLE		IAC "A" HI	C5	LT BLU/ WHT
	NOT USEABLE		IAC "A" LO	C6	LT BLU BLK
	0	0	4 TH GEAR	C7	LT BLU
	B+	B+	PSPS	C8	LT BLU
7	0	0	CRANK DISCRETE	C9	PPL/ WHT
5	1.6	1.6	COOLANT TEMP. SIGNAL	C10	YEL
3	4.75	1.1	MAP SIGNAL	C11	LT GRN
	2.5	2.5	MAT	C12	TAN
	.7	.7	TPS SIGNAL	C13	DK BLU
	5	5	TPS 5 VOLT REFERENCE	C14	GRY
			NOT USED	C15	
	B+	B+	BATTERY	C16	ORN



32 PIN C-D CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
BLK/ WHT	D1	SYSTEM GROUND	0	0	
PPL	D2	MAP GROUND	0	0	
	D3	NOT USED			
WHT	D4	EST CONTROL	0	1.3	
TAN/ BLK	D5	BYPASS	0	4.75	
TAN	D6	GRN'D. (0_2)	0	0	
PPL	D7	02 SENSOR SIGNAL	3.5	1.9	3
	D8	NOT USED			
	D9	NOT USED			
	D10	NOT USED			
	D11	NOT USED			
	D12	NOT USED			
	D13	NOT USED			
LT GRN	D14	INJECTOR B	B+	B+	
	D15	NOT USED			
LT BLU	D16	INJECTOR A	B+	B+	

1 Varies from .60 to battery voltage, depending on position of drive wheels.
2 12 V for first two seconds.
3 Varies.
4 12V when fuel pump is running.
5 Varies with temperature.
6 Reads battery voltage in gear.
7 12 volts, when engine is cranking.

ENGINE 5.0 L

6-10-87
8S 4588-6E

Figure A-5 - ECM Connector Terminal End View 5.0L (VIN E)

BLANK

DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the service technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the diagnostic circuit check and finding the on-board diagnostics functioning properly and no trouble codes displayed. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

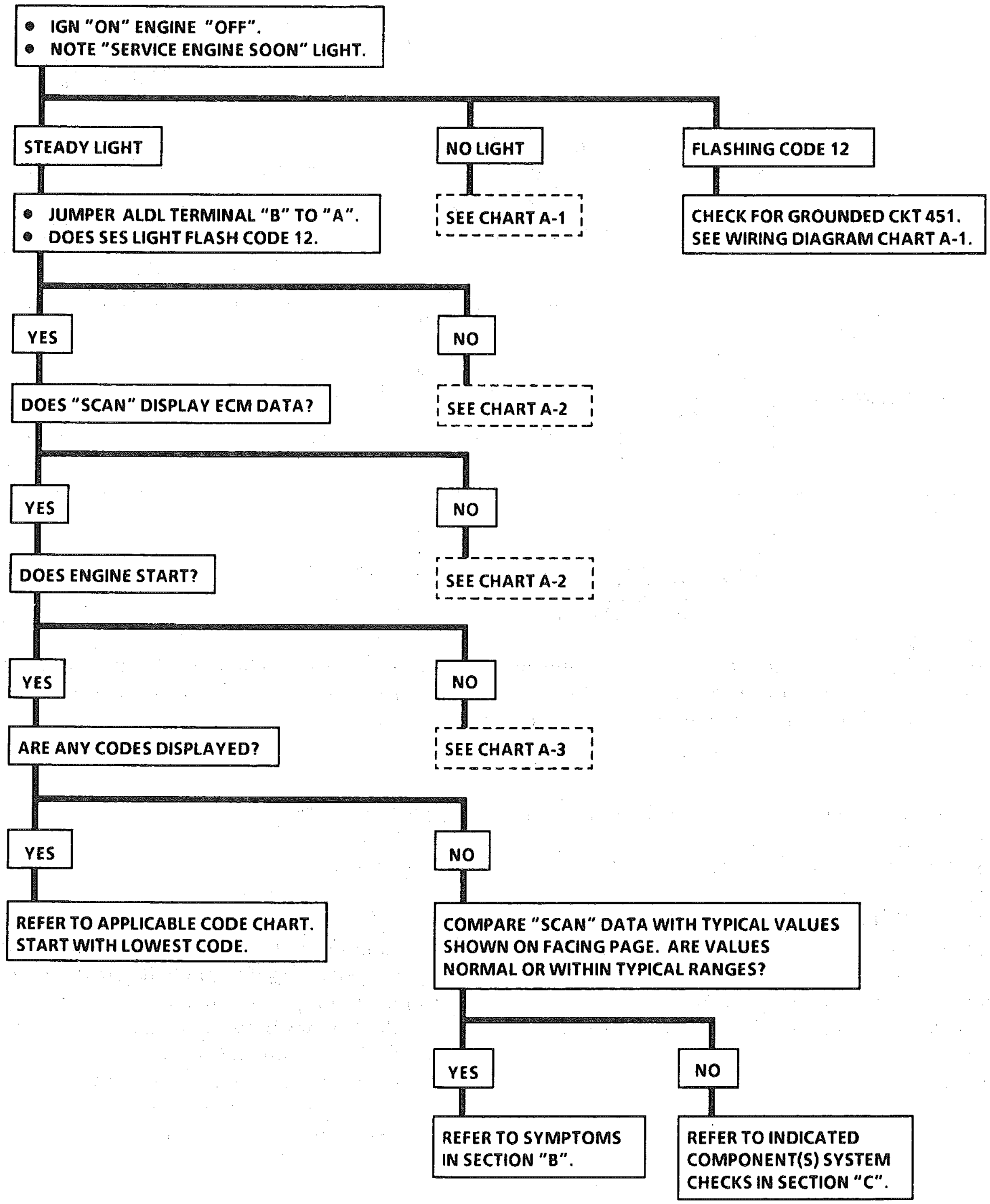
Only the parameters listed below are used in this manual for diagnosis. If a "Scan" tool reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section "C". If all values are within the range illustrated, refer to "Symptoms" in Section "B".

"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Coolant Temp.	C°	85° - 105°
TPS	Volts	.4 - 1.25
MAP	Volts	1 - 2 (depends on Vac. & Baro pressure)
INT (Integrator)	Counts	Varies
BLM (Block Learn)	Counts	118 - 138
IAC	Counts (steps)	1 - 50
RPM	RPM	1000 ± 75 RPM (depends on temperature)
O_2	Volts	.001 - 999 and varies
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
A/C Request	Yes/No	No (yes, with A/C requested)
P/N Switch	P/N and RDL	Park/Neutral (P/N)
TCC	On/Off	Off/ (on, with TCC commanded)
VSS	MPH	0
Battery	Volts	13.5 - 14.5
Air Switch	Normal/Divert	Normal
Air Divert	Converter/Port	Converter
Knock Signal	Yes/No	No
4th Gear	Yes/No	No (Yes, if in 4th Gear)
MAT Temp.	C°	10° - 90° (Depends on Under Hood Temp.).
Power Steering Pressure Switch	Normal/Hi Pressure	Normal

DIAGNOSTIC CIRCUIT CHECK
5.0L (VIN E) "F" SERIES (TBI)



4-22-87
• 7S 3227-6E

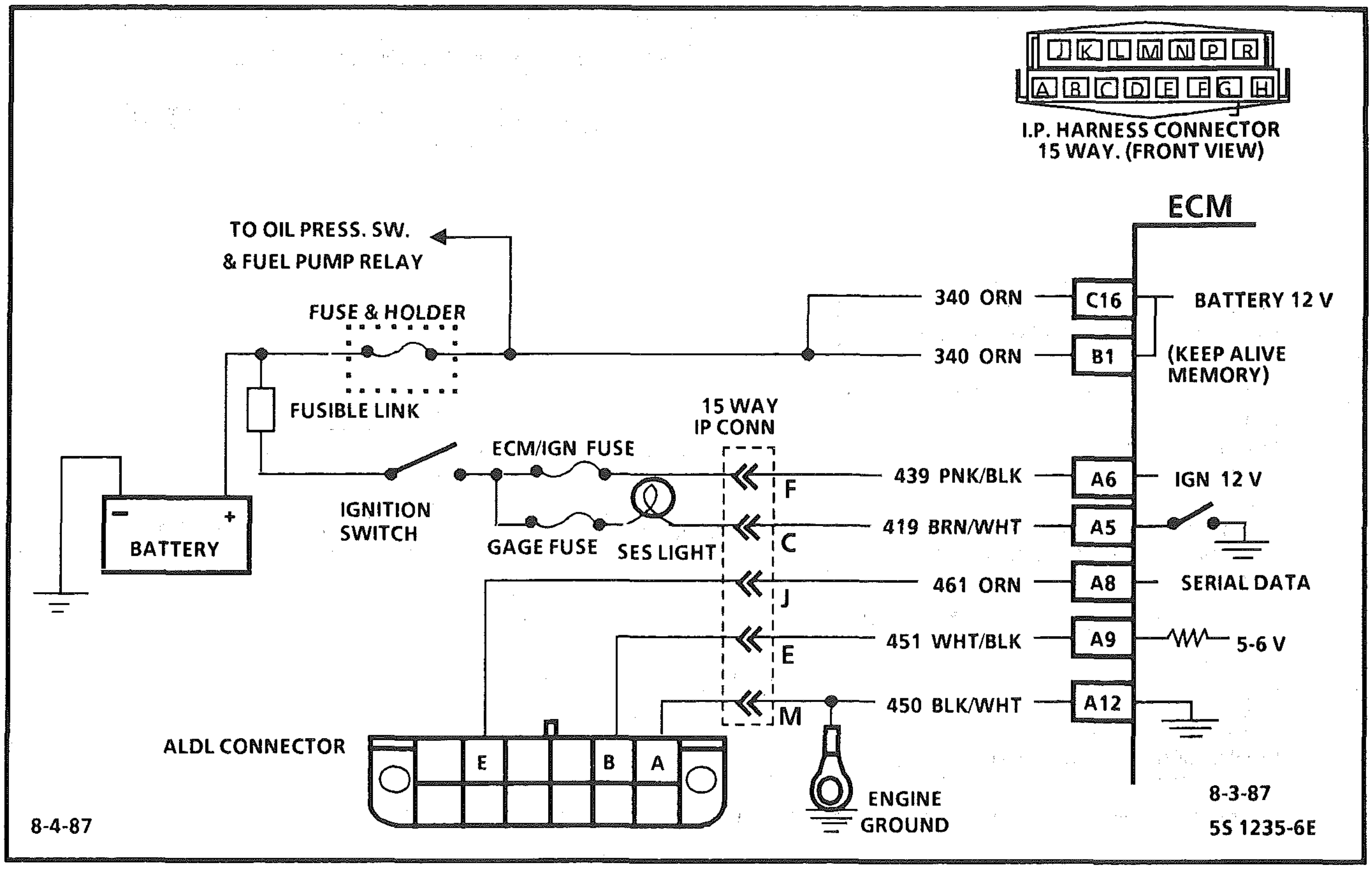


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Battery feed CKT 340 is protected by a 20amp in-line fuse. If this fuse was blown, refer to wiring diagram on the facing page of Code 54.
2. Using a test light connected to 12 volts, probe each of the system ground circuits to be sure a good ground is present. See ECM terminal end view in front of this section for ECM pin locations of ground circuits.

Diagnostic Aids:

Engine runs ok, check:

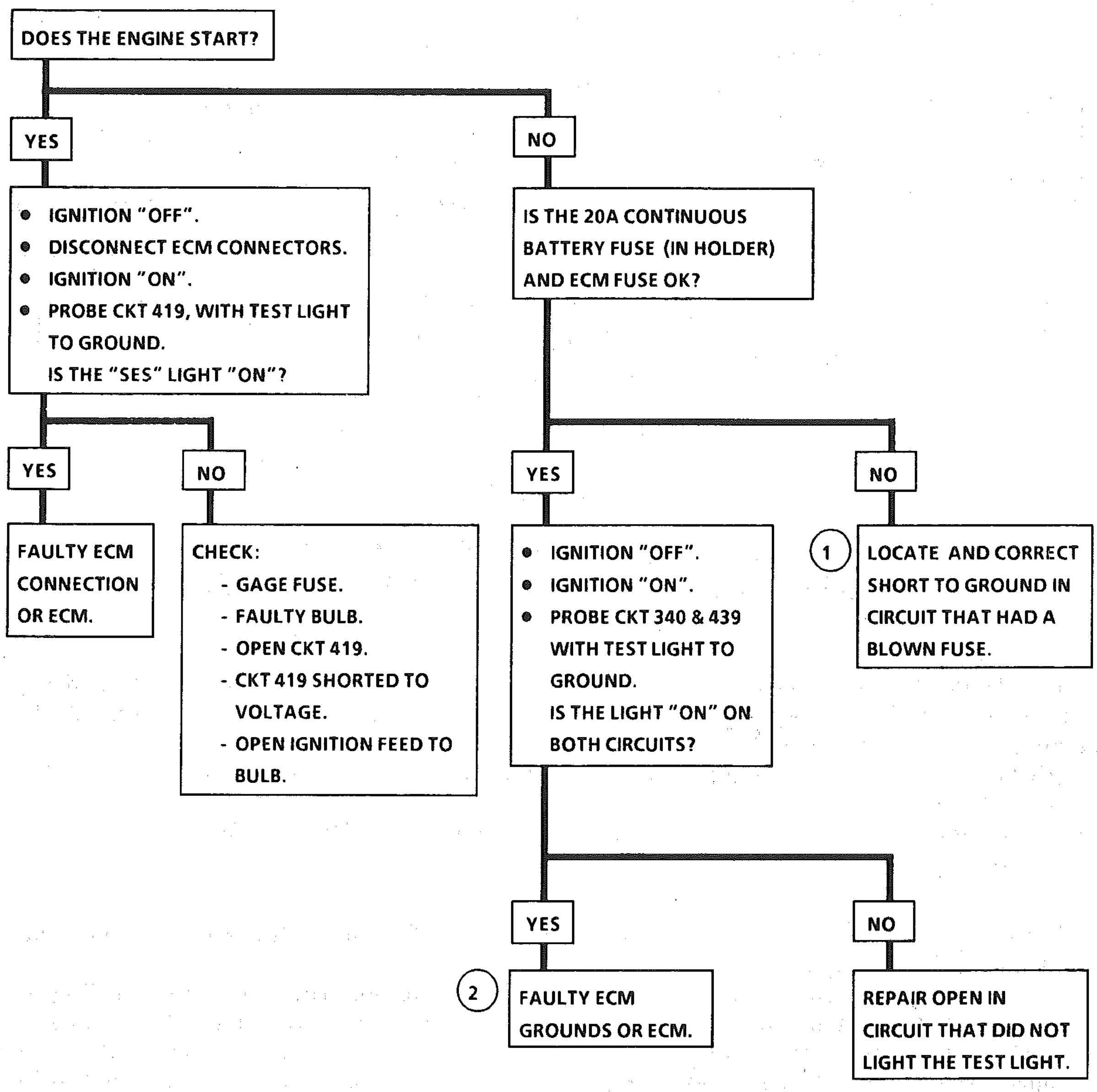
- Faulty light bulb
- CKT 419 open
- Gage fuse blown. This will result in no oil, or generator lights, seat belt reminder, etc.

Engine cranks, but will not run.

- Continuous battery - fuse or fusible link open.
- ECM ignition fuse open.
- Battery CKT 340 to ECM open.
- Ignition CKT 439 to ECM open.
- Poor connection to ECM.

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-21-87
7S 3185-6E

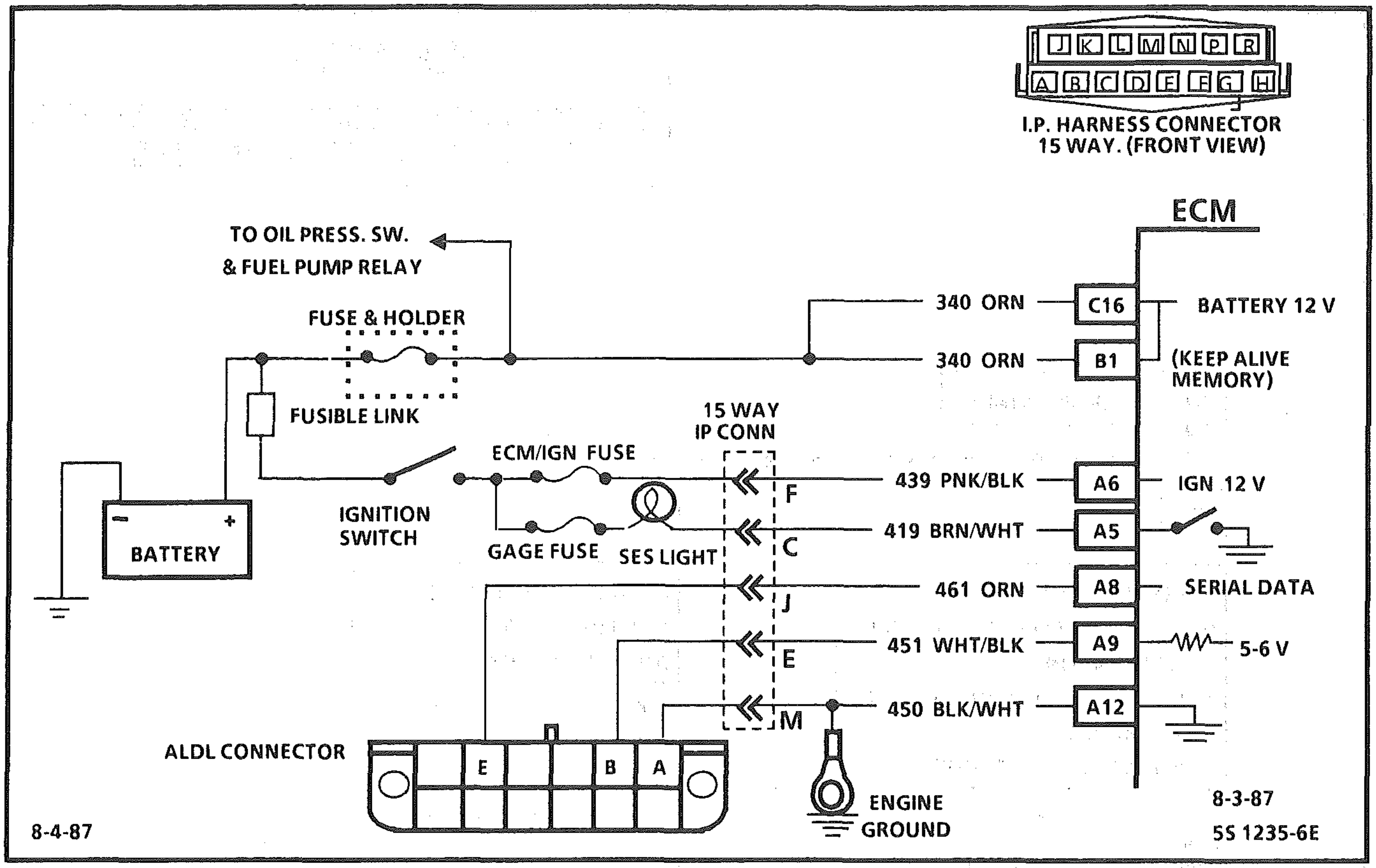


CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT "ON" STEADY 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

There should always be a steady "Service Engine Soon" light, when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

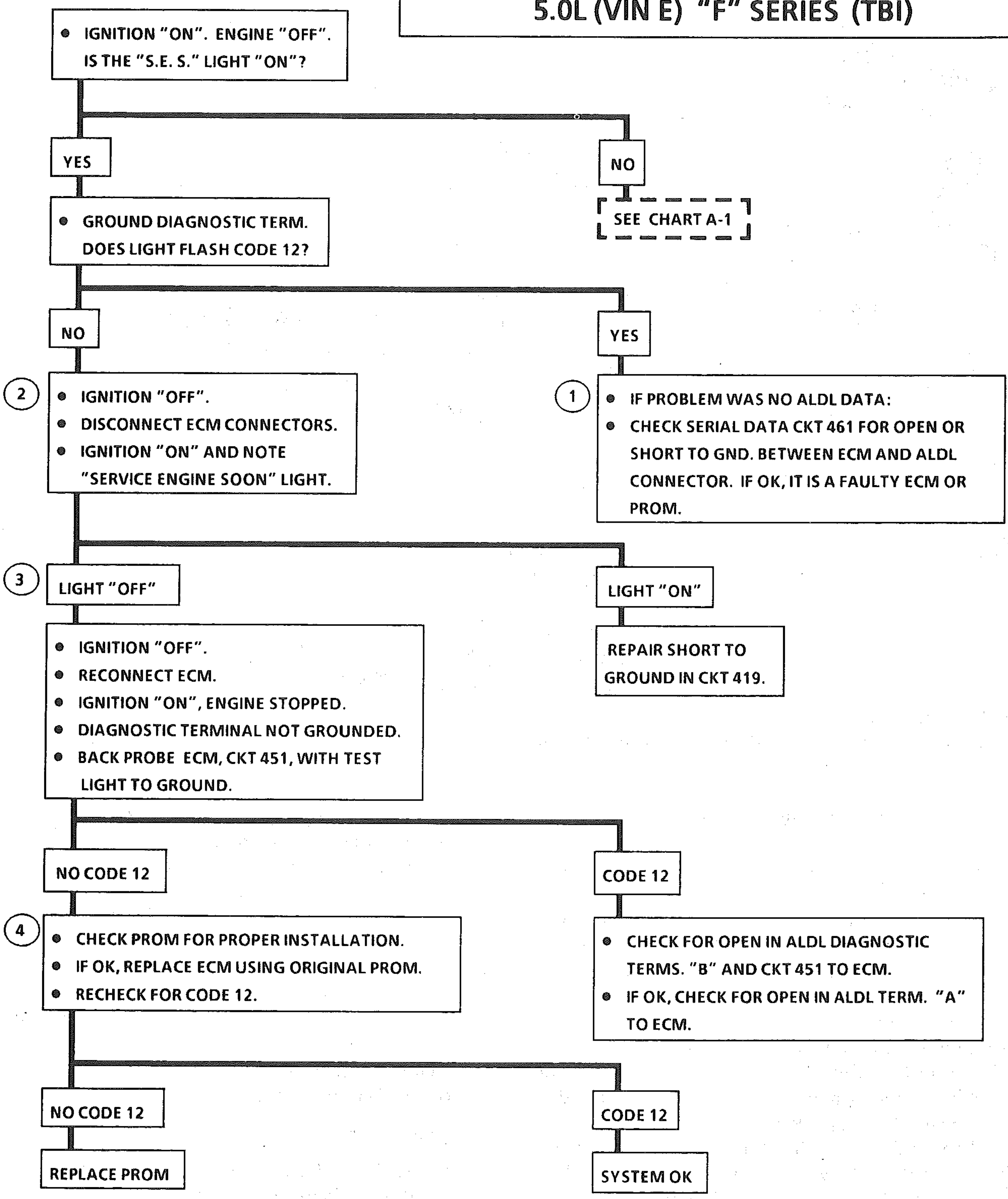
A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read serial data, then the ECM should not flash a Code 12. If Code 12 does flash, be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK, the PROM or ECM may be at fault for the NO ALDL symptom.
2. If the light goes "OFF" when the ECM connector is disconnected, then CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point, the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or PROM. If Code 12 does not flash, the ECM should be replaced using the original PROM. Replace the PROM only after trying an ECM, as a defective PROM is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT "ON" STEADY 5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-16-87
7S 3341-6E

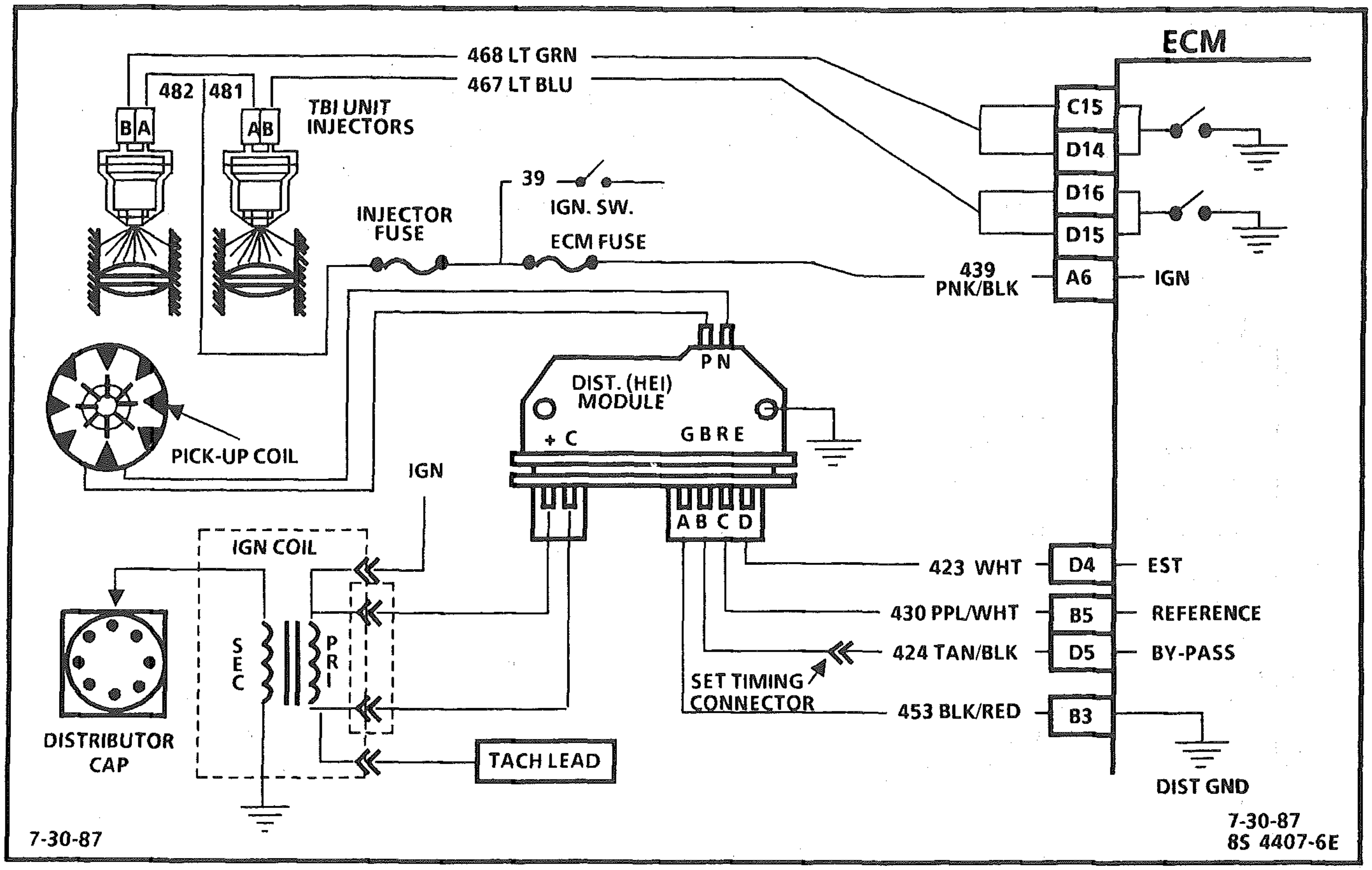


CHART A-3

(Page 1 of 2)

ENGINE CRANKS BUT WILL NOT RUN 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts, the engine may be in the clear flood mode, which will cause starting problems.
2. No spark may be caused by one of several components related to the ignition system. CHART C-4 will address all problems related to the causes of a no spark condition.
3. Fuel spray from the injector(s) indicates that fuel is available. However, the engine could be severely flooded due to too much fuel.
4. While cranking engine, there should be no fuel spray with injector disconnected. Replace an injector if it sprays fuel or drips like a leaking water faucet.
5. The fuel pressure will drop after the fuel pump stops running due to a controlled bleed in the fuel system. Use of the fuel pressure gage will determine if fuel system pressure is enough for the engine to start and run. The key may have to be cycled 2 or more times for accurate reading.
6. No fuel spray from injector indicates a faulty fuel system or no ECM control of injector.
7. This test will determine if the ignition module is not generating the reference pulse if the wiring or ECM is at fault. By touching and removing a test light to 12 volts on CKT 430, a reference pulse should be generated. If injector test light blinks, the ECM and wiring are OK.

Diagnost Aids:

- Water or foreign material can cause a no start during freezing weather.
- An EGR sticking open can cause a low air/fuel ratio during cranking.
- Fuel pressure: Low fuel pressure can result in a very lean air/fuel ratio. See CHART A-7.
- A grounded CKT 423 (EST) may cause a "No-Start" or a "Start then Stall" condition.

CHART A-3

(Page 1 of 2)

ENGINE CRANKS BUT WILL NOT RUN
5.0L (VIN E) "F" SERIES (TBI)

1
- FUEL QUANTITY OK.
- IGN. "ON" - IF S.E.S. LIGHT IS "OFF", SEE CHART A-1.
- INSTALL "SCAN" TOOL - IF "NO ALDL", SEE CHART A-2.
- CHECK THE FOLLOWING:
- TPS - IF OVER 2.5V AT CLOSED THROTTLE, SEE CODE 21.
- IF CODE 54 IS SET, SEE CODE 54 CHART.

2
- CONNECT ST-125 (SPARK CHECKER) J-26792, OR EQUIVALENT.
- CHECK FOR SPARK WHILE CRANKING.
- CHECK AT LEAST TWO WIRES.

SPARK

3
- RECONNECT SPARK PLUG WIRES TO PLUGS.
- OBSERVE INJECTOR FUEL SPRAY WHILE CRANKING.

NO SPARK

CHECK FOR BATTERY VOLTAGE TO IGNITION SYSTEM. IF OK THERE IS A BASIC HEI PROGRAM. REFER TO APPROPRIATE CHART C-4.

FUEL SPRAY BOTH INJECTORS

4
- DISCONNECT BOTH INJECTORS
- OBSERVE INJECTOR FUEL SPRAY WHILE CRANKING.

NO SPRAY

5
- INSTALL FUEL PRESSURE GAGE AND NOTE PRESSURE AFTER IGNITION "ON" AND FUEL PUMP STOPS RUNNING SHOULD BE 9 TO 13 psi (62-89 kPa).

OK

- REVIEW "DIAGNOSTIC AIDS" ON FACING PAGE FOR ADDITIONAL ITEMS TO CHECK.

IF ALL CHECK OK. THERE IS NO TROUBLE FOUND. REVIEW SYMPTOMS SECTION "B", "HARD START".

NOT OK

USE FUEL SYSTEM CHART A-7

SPRAY OR LEAKAGE

FAULTY INJECTOR SEAL OR INJECTOR.

6 NO SPRAY BOTH INJECTORS

- DISCONNECT BOTH INJECTOR CONNECTORS.
- PROBE TERMINAL "A" AT EACH INJ. CONNECTOR WITH A TEST LIGHT TO GND.

LIGHT

- CONNECT INJ. TEST LIGHT (BT 8320 OR EQUIV.) ON EITHER INJ. HARNESS CONNECTOR.
- NOTE INJ. TEST LIGHT WHILE CRANKING.

NO BLINKING LIGHT

7
- DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
- MOMENTARILY TOUCH HARNESS CONNECTOR TERMINAL CKT 430 WITH TEST LIGHT TO 12 VOLTS. NOTE INJECTOR TEST LIGHT SHOULD "BLINK" EACH TIME THE TEST LIGHT IS REMOVED FROM CKT 430.

INJECTOR LIGHT "BLINKS"

- FAULTY IGNITION MODULE OR CONNECTION.

NO BLINKING INJ. LIGHT

- OPEN OR GROUNDED CKT 430.
- OPEN INJECTOR DRIVE CIRCUITS.
- FAULTY CONNECTION AT "B5" OR FAULTY ECM.

BLINKING LIGHT

USE FUEL SYSTEM CHART A-7

NO LIGHT

OPEN IGNITION CIRCUIT OR FAULTY FUSE. OPEN INJECTOR OR 12 VOLT FEED CIRCUIT.

NO SPRAY ONE INJECTOR

USE CHART A-3 (2 of 2)

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-29-87
* 5S 1559-6E

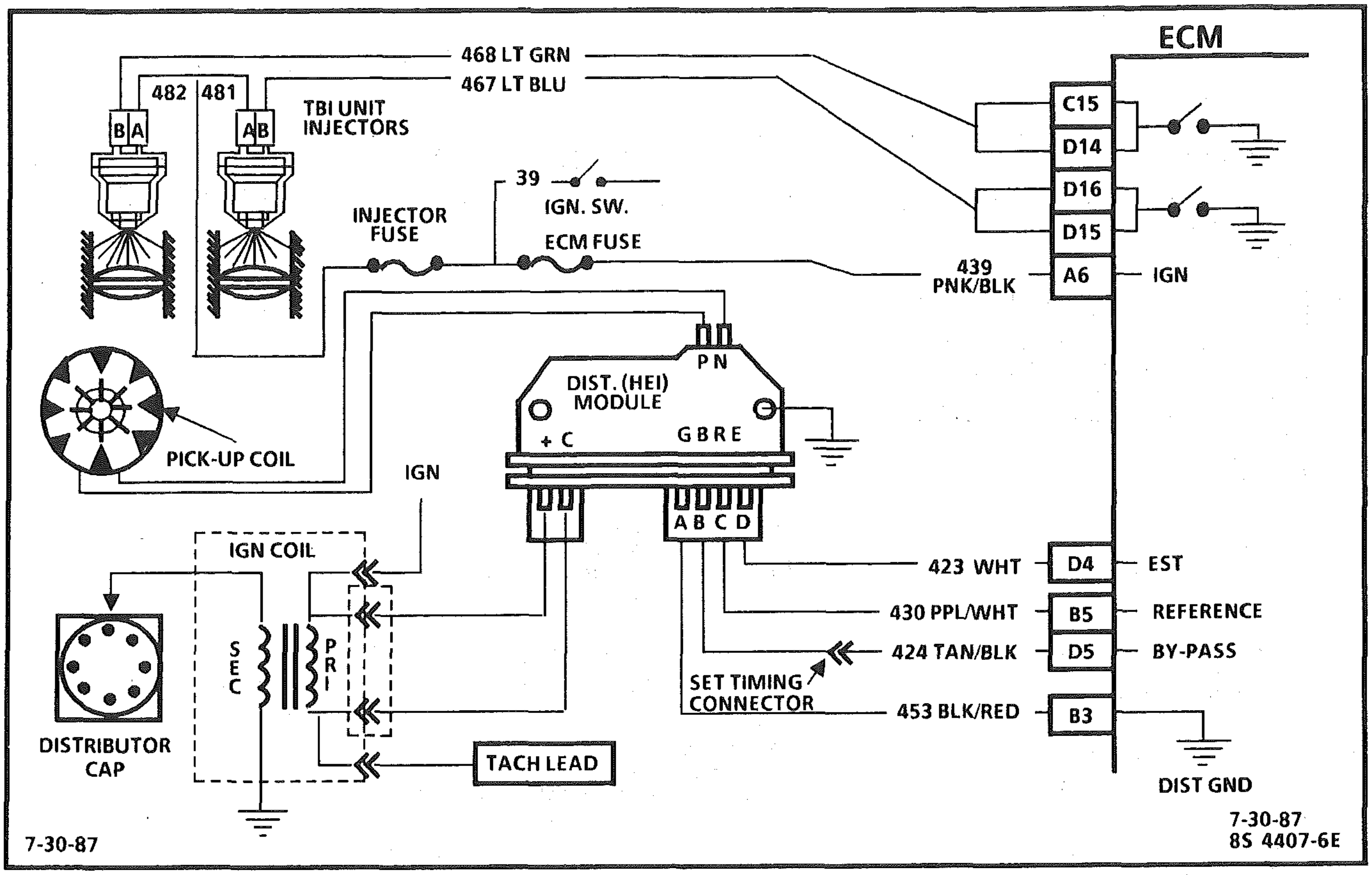


CHART A-3

(Page 2 of 2)
ENGINE CRANKS BUT WILL NOT RUN
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank.

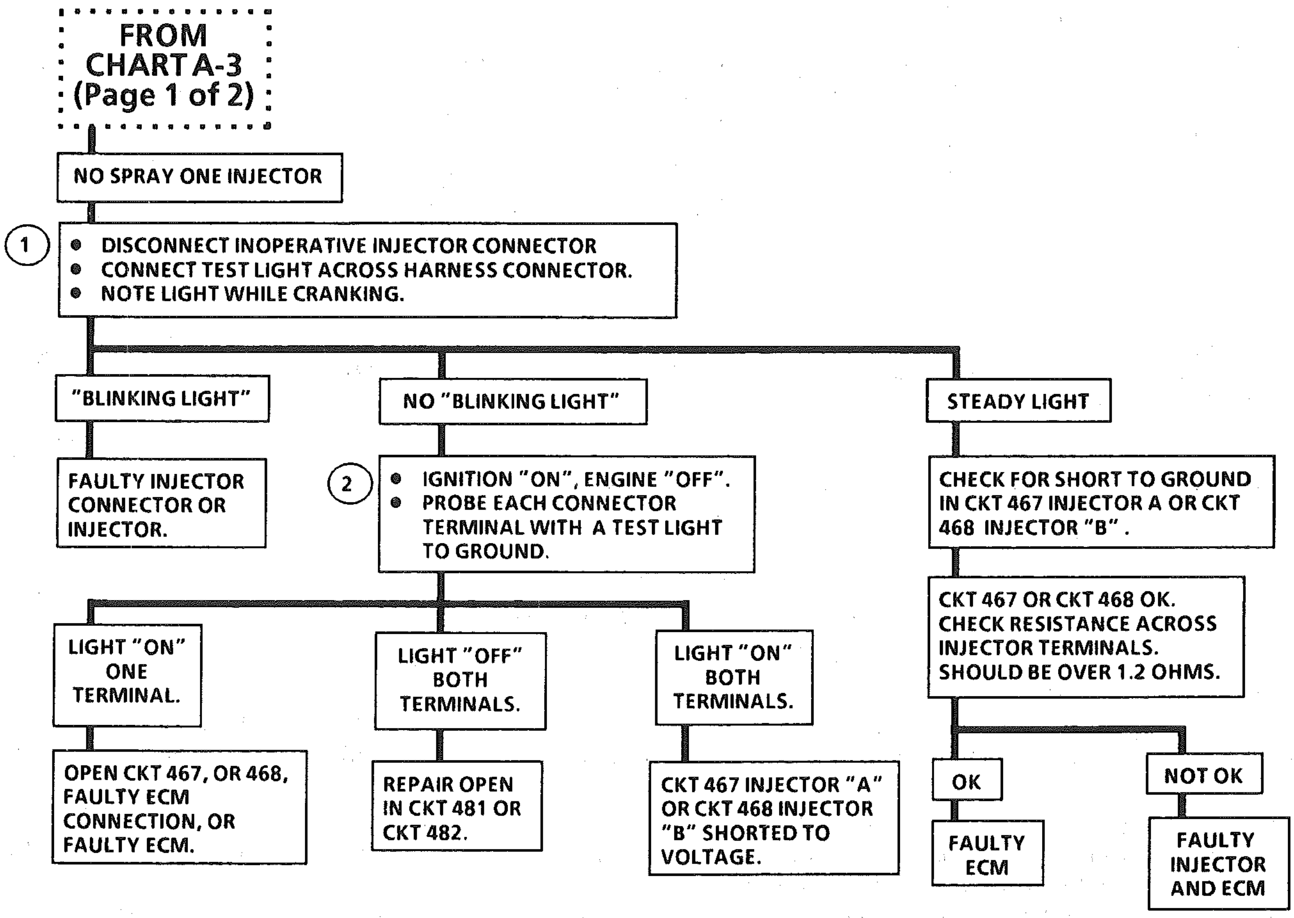
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. No fuel spray from one injector indicates a faulty fuel injector or no ECM control of injector. If the test light "blinks" while cranking, then ECM control should be considered OK. Be sure test light makes good contact between connector terminals during test. The light may be a little dim when "blinking". This is due to current draw of the test light. How bright it "blinks" is not important. However, the test light should be a BT 8320 or equivalent.
2. CKTs 481 and 482 supply ignition voltage to the injectors. Probe each connector terminal with a test light to ground. There should be a light on at one terminal. If the test light confirms ignition voltage at the connector, the ECM injector control CKT 467 or 468 may be open. Reconnect the injector, and using a test light connected to ground, check for a light at the applicable ECM connector terminal ("D14" or "D16"). A light at this point indicates that the injector drive circuit involved is OK.
   If an ECM repeat failure has occurred, the injector is shorted. Replace the injector and ECM.

CHART A-3

(Page 2 of 2)

ENGINE CRANKS BUT WILL NOT RUN
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-29-87
* 5S 1561-6E

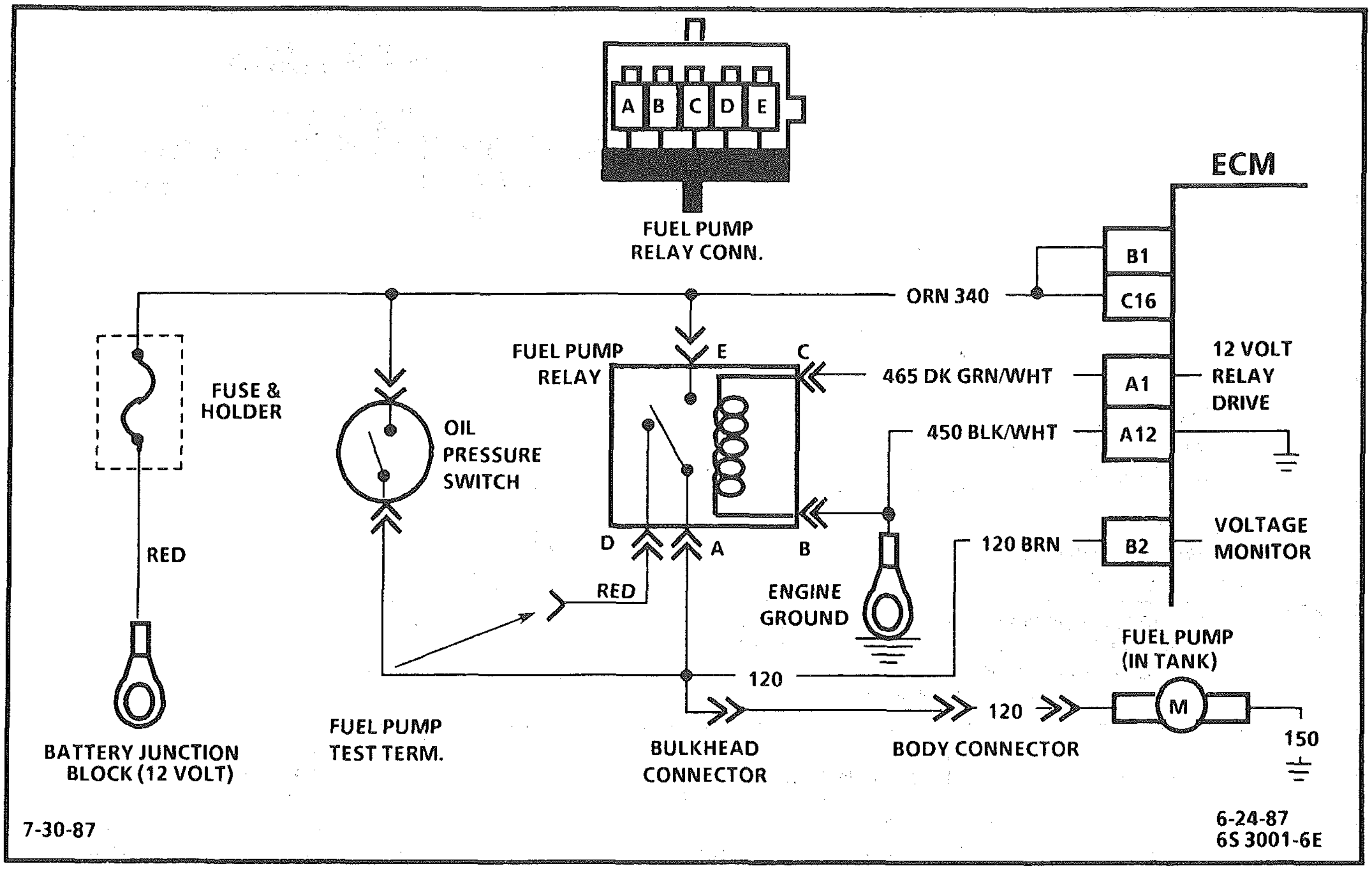


CHART A-7

(Page 1 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses.

If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after key "ON".

The pump will deliver fuel to the TBI unit, where the system pressure is controlled to 62 to 90 kPa (9 to 13 psi). Excess fuel is then returned to the fuel tank.

The fuel pump test terminal is located in the left side of the engine compartment. When the engine is stopped, the pump can be turned "ON" by applying battery voltage to the test terminal.

Test Description: Numbers below refer to circled numbers on the diagnostic chart

1. Fuel pressure should be noted while fuel pump is running. Fuel pressure will drop immediately after fuel pump stops running due to a controlled bleed in the fuel system.

Diagnostic Aids:

Improper fuel system pressure can result in one of the following symptoms:

- Cranks, but won't run.
- Code 44.
- Code 45.
- Cuts out, may feel like ignition problem.
- Poor fuel economy, loss of power.
- Hesitation.

CHART A-7

(Page 1 of 2)

FUEL SYSTEM DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)

(1)
- THIS CHART ASSUMES THERE IS NO CODE 54.
- IGNITION "OFF".
- FUEL TANK QUANTITY OK.
- INSTALL PRESSURE GAGE.
- APPLY BATTERY VOLTAGE TO FUEL PUMP TEST CONNECTOR.
- NOTE FUEL PRESSURE.
- SHOULD BE 62-90 kPa (9-13 psi).

NO PRESSURE

- LISTEN FOR PUMP RUNNING AT FUEL TANK

PUMP RUNS

- CHECK FOR:
- PLUGGED IN-LINE FILTER.
- PLUGGED PUMP INLET FILTER.
- RESTRICTED FUEL LINE.
- LEAKING PUMP RUBBER COUPLING.

IF OK, REPLACE IN-TANK FUEL PUMP.

PUMP NOT RUNNING

- DISCONNECT FUEL PUMP RELAY.
- USING A FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS. DOES PUMP RUN?

YES

FAULTY CONNECTION AT RELAY OR FAULTY FUEL PUMP RELAY.

NO

OPEN CKT 120, FAULTY IN-TANK PUMP, OR FAULTY PUMP GROUND.

PRESSURE LESS THAN 62 kPa (9psi) OR MORE THAN 90 kPa (13 psi)

USE CHART A-7 (2 OF 2)

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-27-87
6S 2628-6E

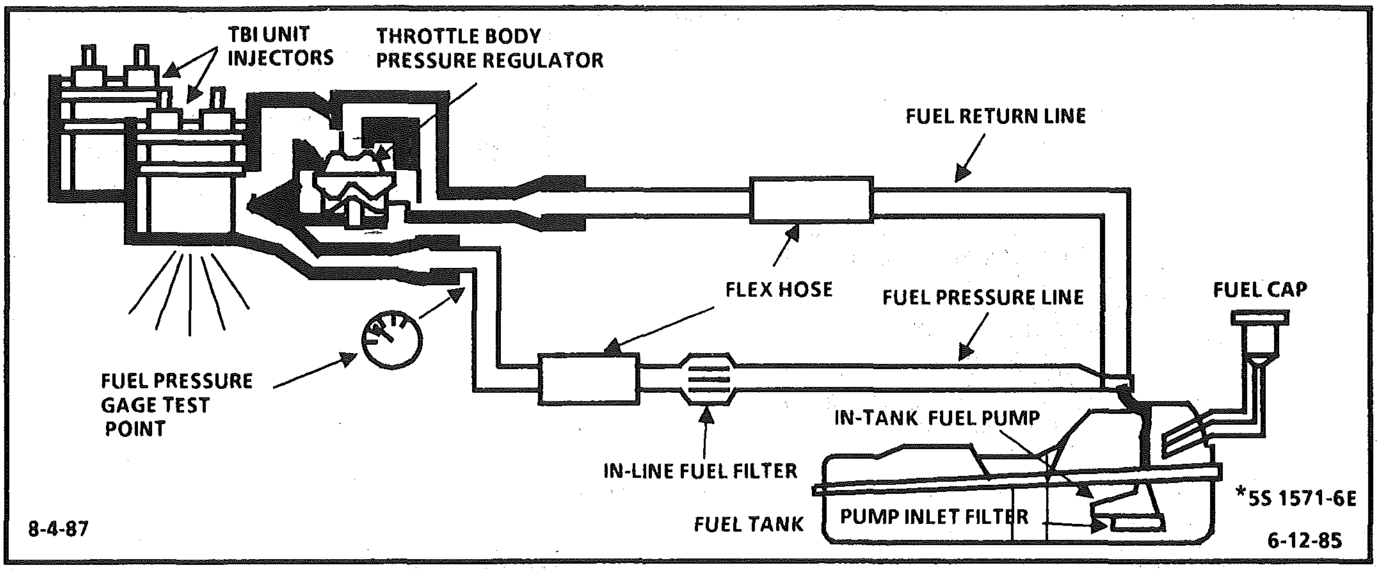


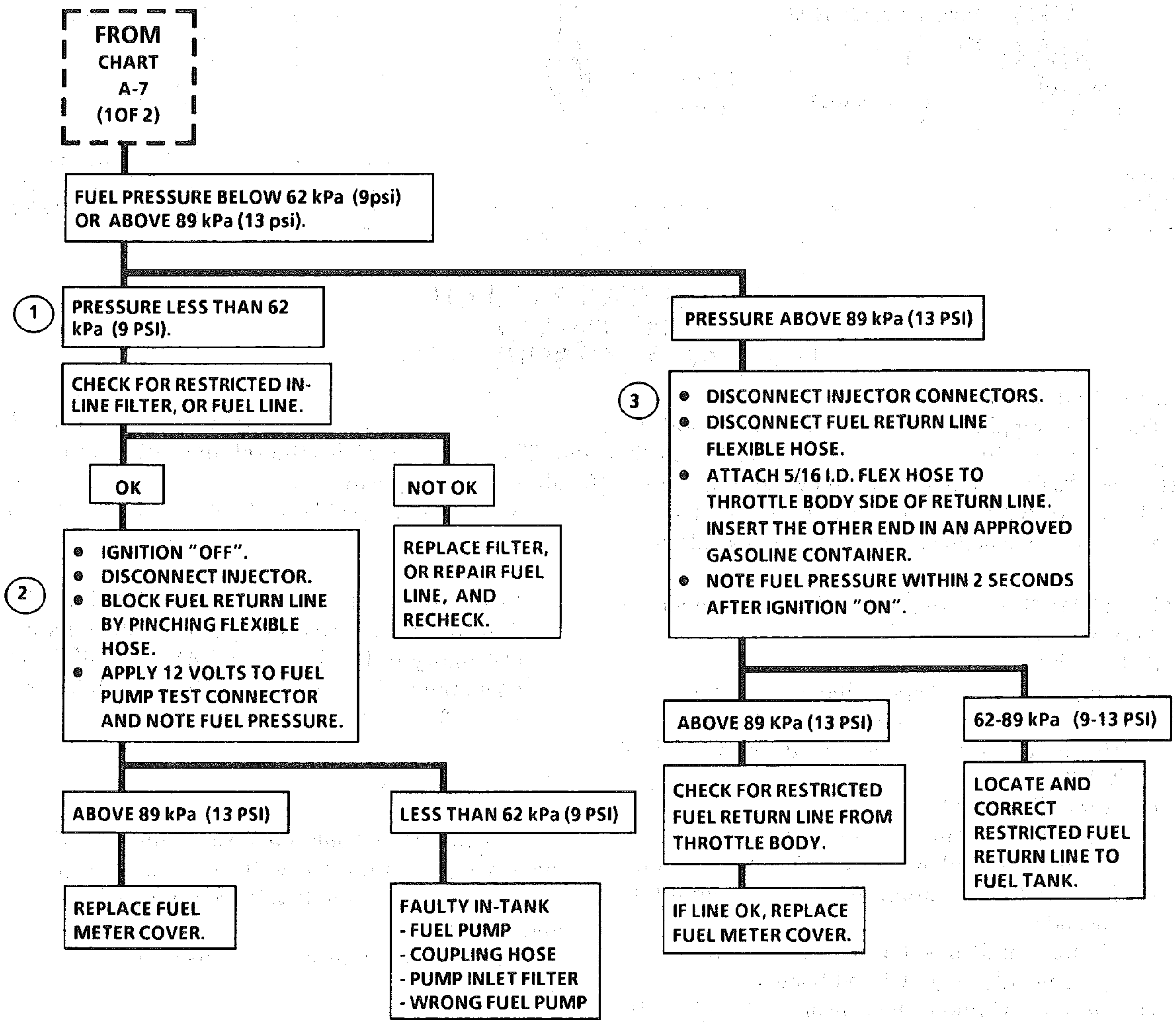
CHART A-7

(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

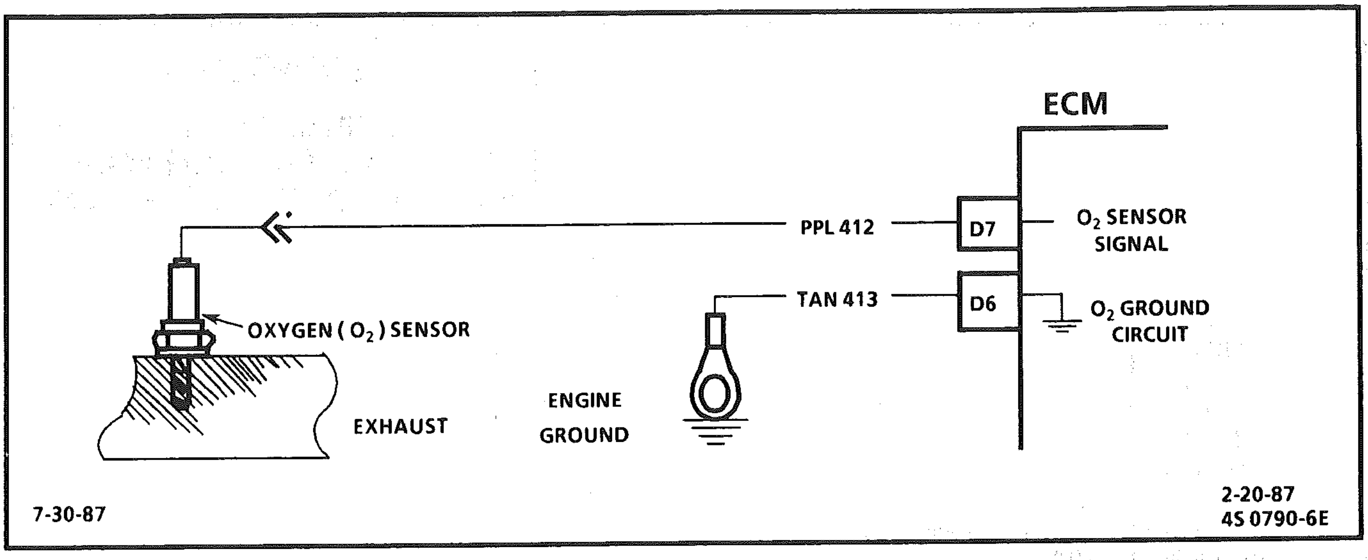
1. Pressure, but less than 62 kPa (9 psi) falls into two areas:
   - Pressure less than 62 kPa (9 psi). Amount of fuel to injectors OK but, pressure is too low. System will be lean and may set Code 44. Also, hard starting cold and poor overall performance.
   - Restricted flow causing pressure drop. Normally, a vehicle with a fuel pressure of less than 62 kPa (9 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will surge then stop as pressure begins to drop.
2. Restricting the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be from 90 to 124 kPa (13 to 18 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a throttle body pressure regulator problem.

CHART A-7
(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-27-87
5S 1572-6E



CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "D6". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts). The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 will set:
   - Engine at normal operating temperature.
   - At least 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Rpm above 1600.
   - Throttle position sensor signal above 5% (about .3 volts above closed throttle voltage).
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist, the system will not go "Closed Loop".
2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.
3. In doing this test, use only a high impedence digital volt ohmmeter. This test checks the continuity of CKTs 412 and 413. If CKT 413 is open, the ECM voltage on CKT 412 will be over .6 volts (600 mV).

Diagnostic Aids:

Normal "Scan" voltage varies between 100 mV to 999 mV (.1 and 1.0 volt), while in "Closed Loop". Code 13 sets in one minute, if voltage remains between .35 and .55 volts.

Refer to "Intermittents" in Section "B".

CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
5.0L (VIN E) "F" SERIES (TBI)

1. ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
   - RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.

   DOES "SCAN" INDICATE "CLOSED LOOP"?

   - **YES:** CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.
   - **NO:** go to 2.

2.
   - DISCONNECT O_2 SENSOR.
   - JUMPER HARNESS CKT 412 TO GROUND.
   - "SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 mV) WITH ENGINE RUNNING.

   DOES IT?

   - **YES:** FAULTY O_2 SENSOR CONNECTION OR SENSOR.
   - **NO:** go to 3.

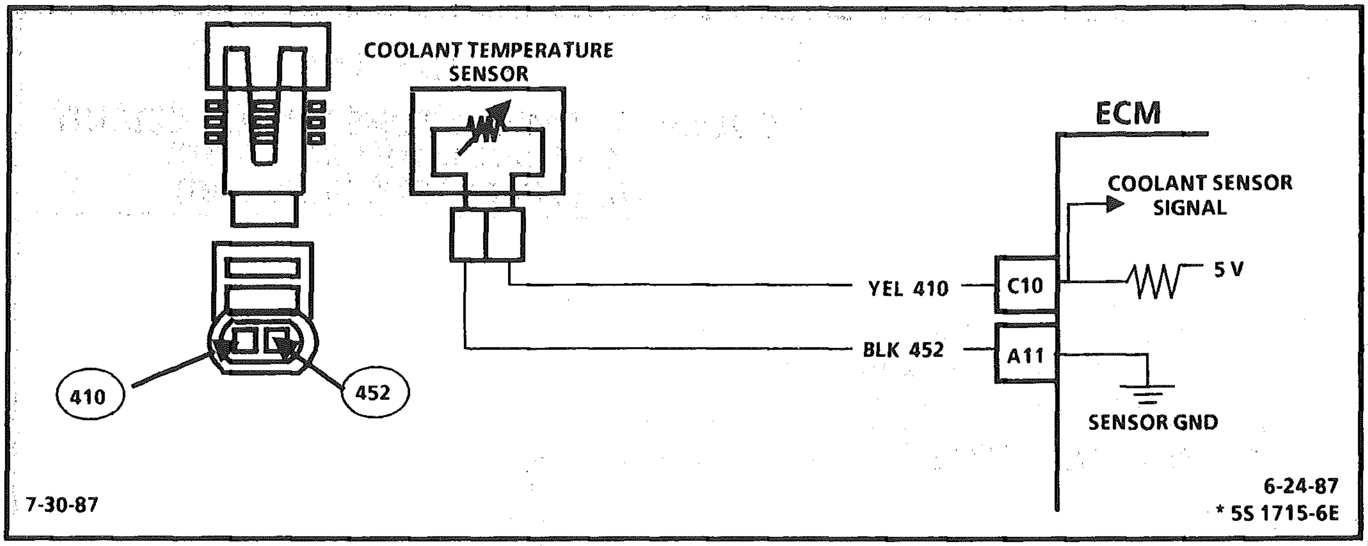
3.
   - IGNITION "ON", ENGINE "OFF".
   - CHECK VOLTAGE OF CKT 412 (ECM SIDE) AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.

   IT SHOULD BE .3-.6 VOLTS (300 - 600 mV).

   - **.3-.6 VOLTS (300 - 600 mV):** FAULTY ECM
   - **OVER .6 VOLT (600 mV):** OPEN CKT 413, FAULTY CONNECTION OR FAULTY ECM.
   - **LESS THAN .3 VOLT (300 mV):** OPEN CKT 412, FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-23-87
● 7S 3054-6E



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for 2 seconds.
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410.

"Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

Refer to "Intermittents" in Section "B".

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

1 DOES "SCAN" DISPLAY 130°C OR HOTTER?

YES

2 • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMP. BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 410 SHORTED TO GROUND.
OR
CKT 410 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

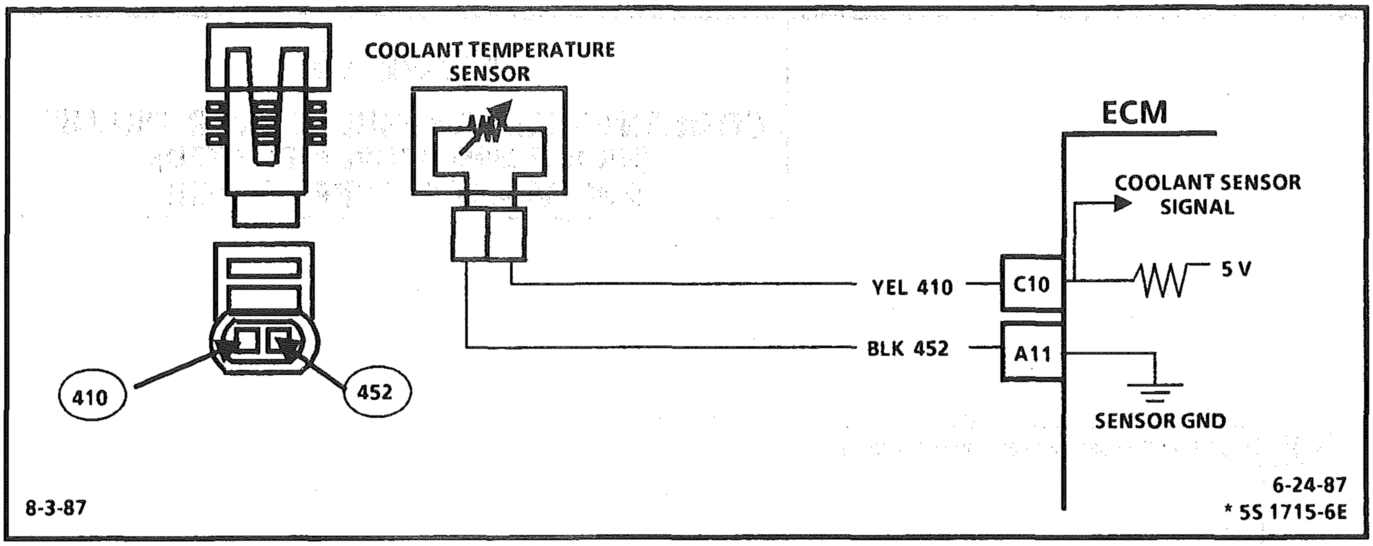
CODE 14 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-28-87
• 7S 3055-6E



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 15 will set if:
   - Engine running longer than 30 seconds.
   - Coolant temperature less than -30°C (-22°F), for 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temperature) and the "Scan" reads 130°C or above, the ECM and wiring are OK.
3. This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector if measured with a DVM.

Diagnostic Aids:

A "Scan" tool reads engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

If Code 21 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact.

Refer to "Intermittents" in Section "B".

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

1 DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

YES

2
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

3
- JUMPER CKT 410 TO GROUND. "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

NO

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

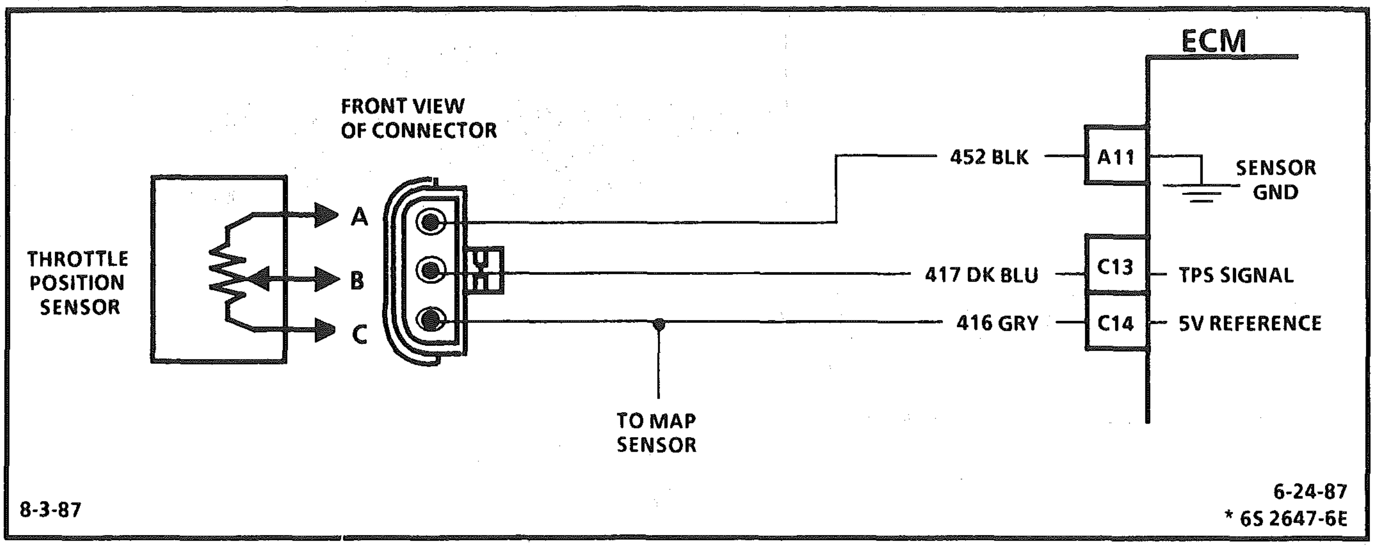
DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-11-87

• 7S 3261-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throtttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 21 will set if:
   - TPS signal voltage is greater than 2.5 volts.
   - All conditions met for 8 seconds.
   - MAP less than 52 kPa.
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring are OK.
3. Probing CKT 452 with a test light checks the 5 volt return circuit, because a faulty 5 volt return will cause a Code 21.

Diagnostic Aids:

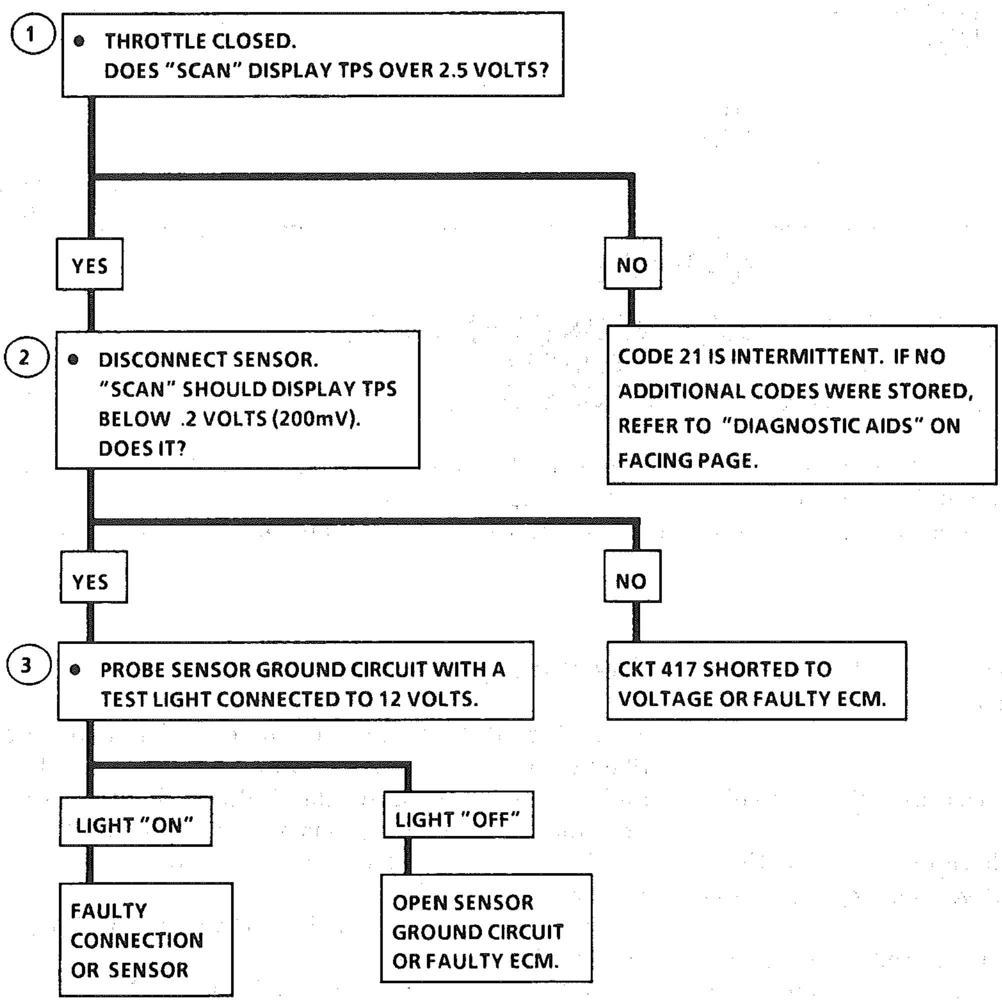
A "Scan" tool reads throttle position in volts. Should read less than 1.25 volts with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open in CKT 452 will result in a Code 21.

Refer to "Intermittents" in Section "B".

CODE 21

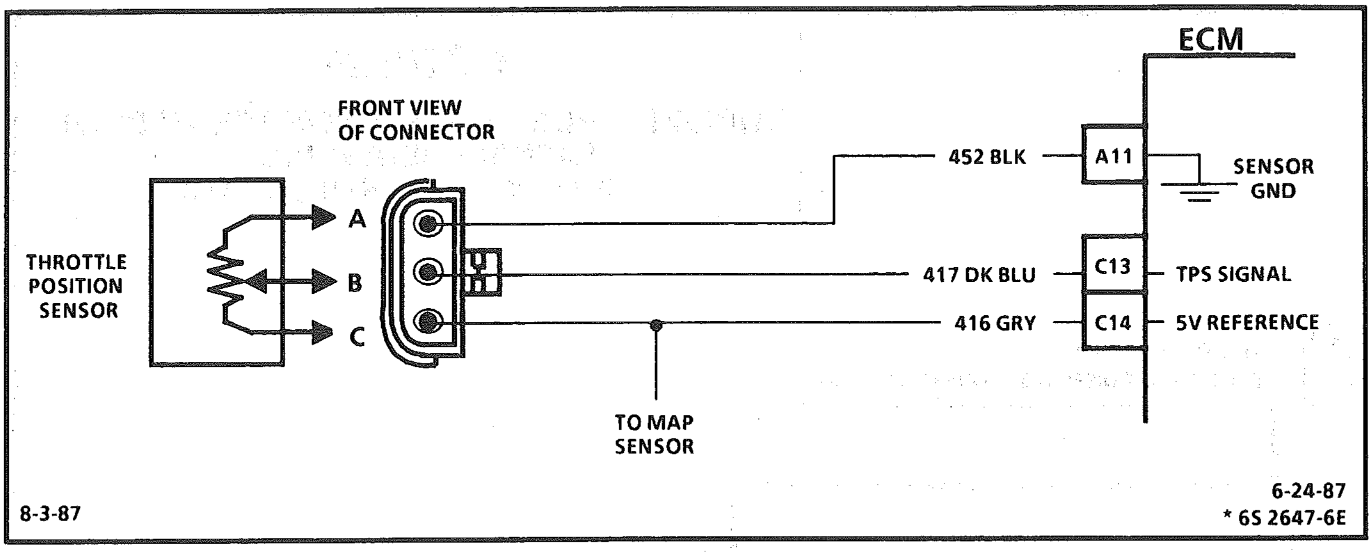
THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-24-87

• 7S 3057-6E



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throtttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 22 will set if:
   - Engine is running
   - TPS signal voltage is less than about .2 volts for 2 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage the ECM and wiring are OK.
3. This simulates a high signal voltage to check for an open in CKT 417. The "Scan" tool will not read up to 12 volts, but what's important is that the ECM recognizes the signal on CKT 417.
4. There should be 5 volts at terminal "C" if measured with a DVM when ignition is "ON".

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read less than 1.25 volts with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open or short to ground in CKTs 416 or 417 will result in a Code 22.

If a Code 22 is also set check CKT 416 carefully for open or short to ground.

Refer to "Intermittents" in Section "B".

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
5.0L (VIN E) "F" SERIES (TBI)

1
- THROTTLE CLOSED
- DOES "SCAN" DISPLAY TPS .2V (200 mV) OR BELOW?

YES

2
- DISCONNECT SENSOR.
- JUMPER CKTS 416 & 417 TOGETHER.
- "SCAN" SHOULD DISPLAY TPS OVER 4.0 V. DOES IT?

NO

CODE 22 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

3
- PROBE CKT 417 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
- "SCAN" TOOL SHOULD DISPLAY TPS OVER 4.0 V. DOES IT?

YES

REPLACE SENSOR.

YES

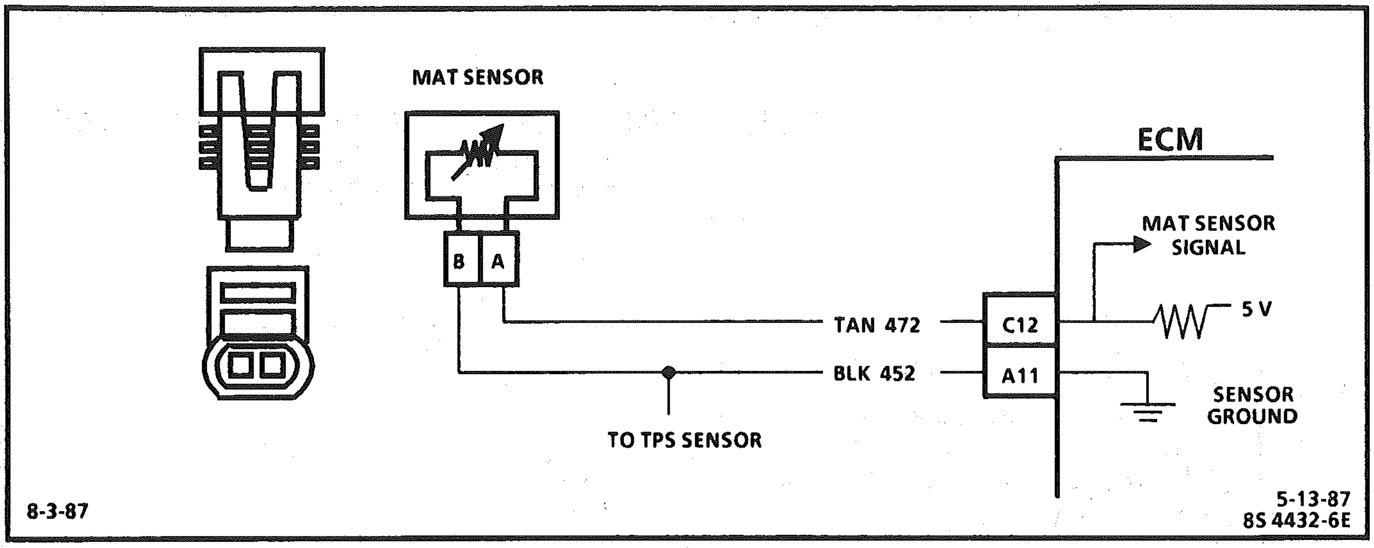
4
CKT 416 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

NO

CKT 417 OPEN, SHORTED TO GROUND, FAULTY CONNECTION OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-18-87
*7S 3260-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The MAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 volts) on CKT 472 to the sensor. When the air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the air is warm, the sensor resistance is low, therefore, the ECM will see a low voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 23 will set if:
   - A signal voltage indicates amanifold air termperature below -30°C (-22°F) for 12 seconds.
   - Time since engine start is 1 minute or longer.
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK.
3. This will determine if the signal CKT 472 or the sensor ground is open.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Carefully check harness and connections for possible open CKT 472 or 452.

Refer to "Intermittents" in Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

1 • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

- YES:
  - 2 • DISCONNECT SENSOR.
    • JUMPER HARNESS TERMINALS TOGETHER.
    "SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C.
    DOES IT?
    - YES: FAULTY CONNECTION OR SENSOR.
    - NO:
      - 3 • JUMPER CKT 472 TO GROUND.
        "SCAN" SHOULD DISPLAY TEMP. OVER 130°C.
        DOES IT?
        - YES: OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.
        - NO: OPEN CKT 472, FAULTY CONNECTION OR FAULTY ECM.
- NO: CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

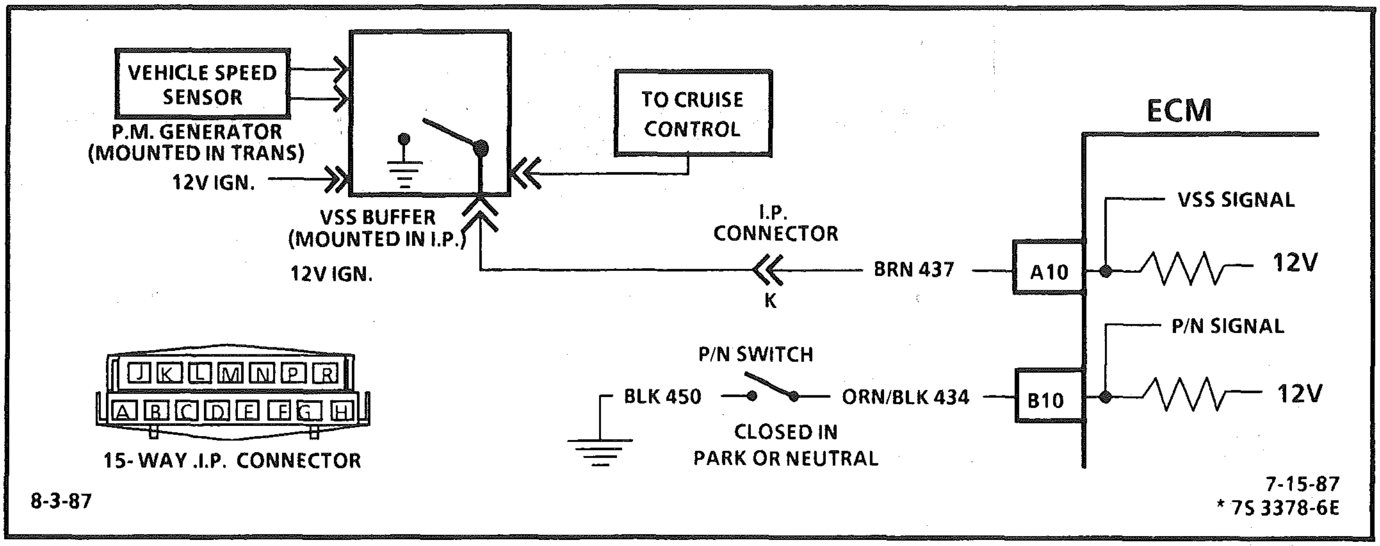
DIAGNOSTIC AID

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-25-87
• 7S 3285



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

A "Scan" reading should closely match with speedometer reading with drive wheels turning.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 24 will set if:
   - CKT 437 voltage is constant.
   - Engine speed is between 1400 and 3600 rpm.
   - Less than 2% throttle opening.
   - Low load condition.
   - Not in park or neutral.
   - All conditions must be met for 4 seconds.

   These conditions are met during a road load deceleration.
2. A voltage of less than 1 volt, at the 15-way connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the vehicle speed sensor buffer. If voltage remains less than 10 volts, then CKT 437 wire is grounded or open. If 437 is not grounded or open, check for a faulty ECM connector or ECM.

Diagnostic Aids:

If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with auto trans. If switch is OK, check for intermittent connections. An open or short to ground in CKT 437 will result in a a Code 24. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
5.0L (VIN E) "F" SERIES (TBI)

NOTE: TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION "8A" OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 IF SET WHEN DRIVE WHEELS ARE NOT TURNING.

1

- ASSUMES SPEEDOMETER IS WORKING OK.
- RAISE DRIVE WHEELS.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

NO

- ENGINE STILL IDLING IN GEAR.
- BACKPROBE 15 WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- IS VOLTAGE VARYING BETWEEN 1 AND 12 VOLTS ?

YES

CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO " DIAGNOSTIC AIDS " ON FACING PAGE .

NO

2

- IGNITION "OFF".
- DISCONNECT VSS BUFFER
- IGNITION "ON."
- BACK PROBE 15-WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.
  DOES IT?

YES

FAULTY ECM

YES

CKT 437 OPEN BETWEEN I.P. 15-WAY CONNECTOR AND VSS BUFFER CONNECTOR OR FAULTY BUFFER.

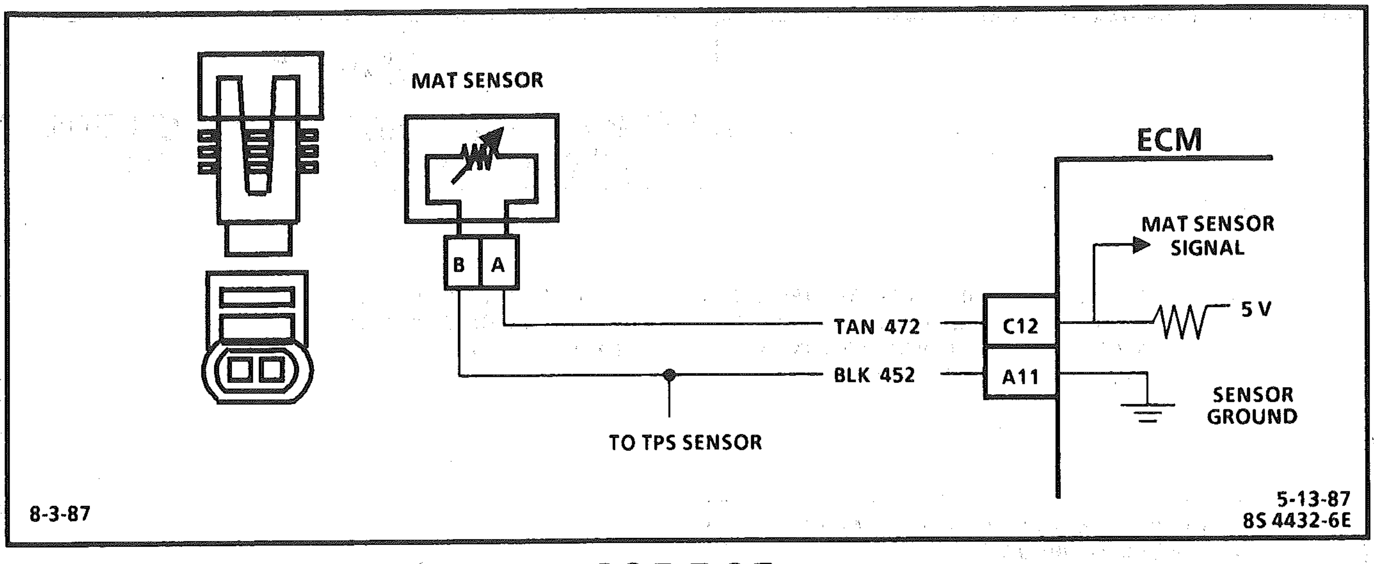
NO

CKT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. 15-WAY CONNECTOR, OR FAULTY ECM.

*8S 4684-6E

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-30-87



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The manifold air temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less, and the voltage drops.

Test Description:
Numbers below refer to circled numbers on the diagnostic chart.

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature greater than 150°C (302°F) for 2 seconds.
   - Time since engine start is 1 minute or longer.

Diagnostic Aids:

A "Scan" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases.

Check harness routing for possible short to ground in CKT 472.

Refer to "Intermittents" in Section "B".

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

1 • DOES "SCAN" TOOL DISPLAY MAT 145°C OR HOTTER?

YES

• DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMPERATURE BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 472 SHORTED TO GROUND.
OR
CKT 472 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

CODE 25 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

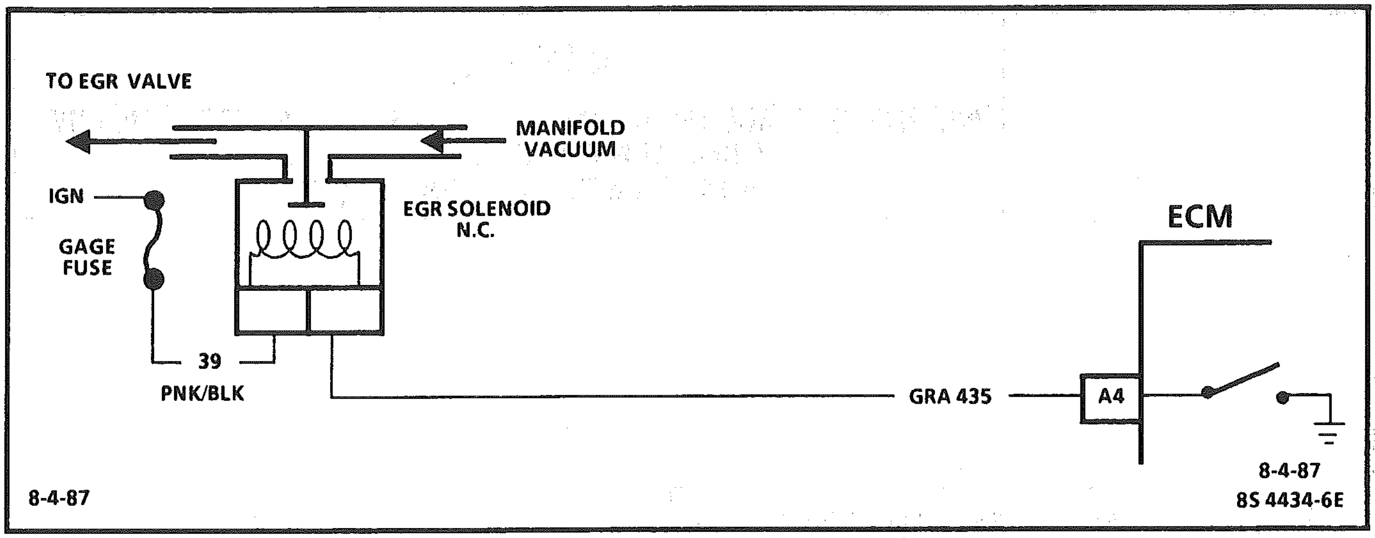
DIAGNOSTIC AID

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-17-87
• 7S 3190-6E



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM operates a solenoid to control the exhaust gas recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve.

The ECM monitors EGR effectiveness by de-energizing the EGR control solenoid thereby shutting off vacuum to the EGR valve diaphragm. With the EGR valve closed, manifold vacuum will be greater than it was during normal EGR operation and this change will be relayed to the ECM by the MAP sensor. If the change is not within the calibrated window, a Code 32 will be set.

The ECM will check EGR operation when:

- Vehicle speed is above 50 mph.
- Engine vacuum is between 40 and 51 kPa.
- No change in throttle position while test is being run.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for solenoid stuck open.
2. Checks for solenoid always being energized.
3. Grounding test terminal should energize solenoid and vacuum should drop.
4. Negative backpressure valve should hold vacuum with engine "OFF".
5. When engine is started, exhaust backpressure should cause vacuum to bleed off and valve to fully close.
6. 5.0L engines have a manifold vacuum source which should have at least 7" Hg at idle.

Diagnostic Aids:

Vacuum lines should be thoroughly checked for internal restrictions. The ECM uses the MAP sensor for checking EGR operation. If there is a question of MAP sensor accuracy use CHART C-1D MAP output check in Section "C".

If no problems are found refer to "Intermittents" in Section "B".

CODE 32

EXHAUST GAS RECRICULATION (EGR) CIRCUIT 5.0L (VIN E) "F" SERIES (TBI)

BEFORE USING THIS CHART, CHECK FOR MANIFOLD VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST (7") HG VACUUM AT 2000 RPM.

1
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE,
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL.
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
- APPLY VACUUM AND OBSERVE EGR VALVE DIAPHRAGM.
- VALVE SHOULD MOVE.

DOES IT?

YES

2
- UNGROUND DIAGNOSTIC TERMINAL.
- VACUUM SHOULD BLEED OFF AND VALVE SHOULD CLOSE.

DOES IT?

YES

4
- IGNITION "OFF"
- CONNECT A VACUUM PUMP TO EGR VALVE.
- USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM.
- DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.

DOES IT?

YES

5
- APPLY 10" Hg VACUUM TO EGR VALVE.
- START ENGINE AND IMMEDIATELY OBSERVE VACUUM GAGE ON VACUUM PUMP.
- VALVE IS GOOD IF DIAPHRAGM HAS MOVED TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.

VACUUM DROPPED

BE SURE VACUUM HOSE BETWEEN SOLENOID AND EGR VALVE IS OK. (NO LEAKS OR RESTRICTIONS) IF NO PROBLEM IS FOUND, THE EGR CIRCUIT IS OK.

NO VACUUM DROP

- REMOVE EGR VALVE.
- CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED, REPLACE VALVE,

NO (from 4)

REPLACE EGR VALVE.

NO (from 2)

- DISCONNECT SOLENOID ELECTRICAL CONNECTOR. DOES VACUUM BLEED OFF?

YES

CKT 435 SHORTED TO GROUND OR FAULTY ECM.

NO

REPLACE SOLENOID

NO (from 1)

- CONNECT VACUUM PUMP TO EGR VALVE SIDE OF HARNESS.
- APPLY VACUUM AND OBSERVE VALVE.
- VALVE SHOULD MOVE.

DOES IT?

NO

- FAULTY VACUUM HOSE TO EGR VALVE OR FAULTY VALVE.

YES

3
- DISCONNECT EGR ELECTRICAL CONNECTOR.
- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.
- IGNITION "ON", ENGINE "OFF".
- TEST LIGHT SHOULD LIGHT.

DOES IT?

YES

FAULTY SOLENOID CONNECTION OR FAULTY SOLENOID.

NO

CONNECT TEST LIGHT BETWEEN HARNESS TERMINAL "A" AND GROUND.

NO LIGHT

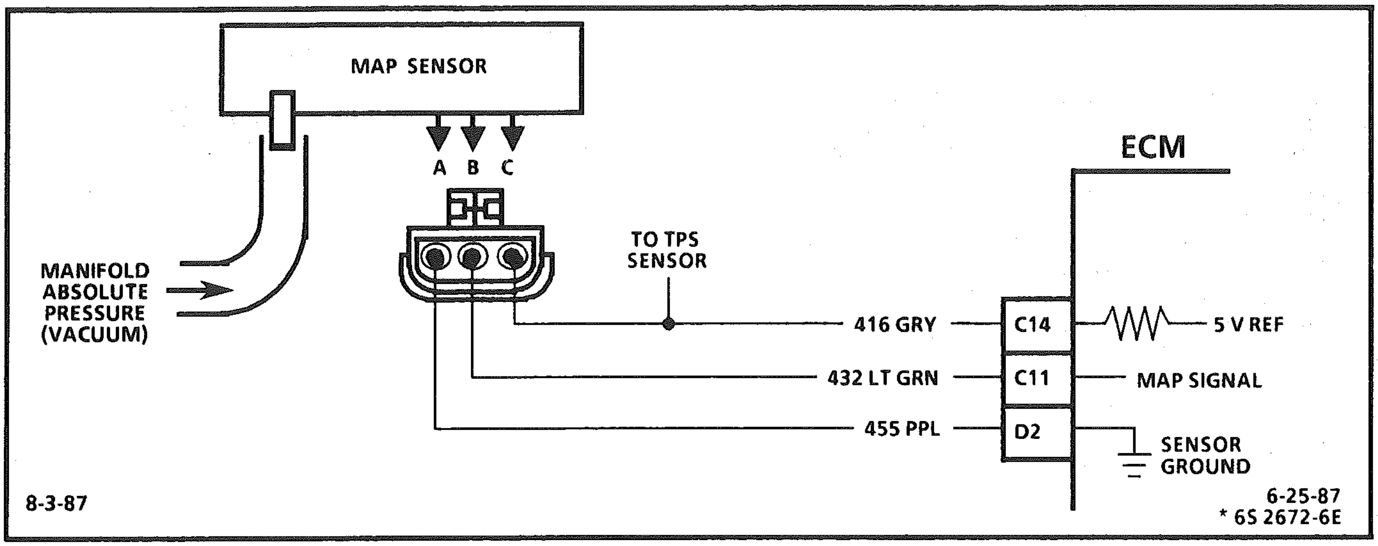
REPAIR OPEN CKT 39.

LIGHT

REPAIR OPEN CKT 435. IF NOT OPEN, IT IS A FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-27-87
* 7S 3554-6E



CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE HIGH - LOW VACUUM)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

A "Scan" displays manifold pressure in volts. Low pressure (high vacuum) reads a low voltage while a high pressure (low vacuum) reads a high voltage.

If the MAP sensor fails the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 33 will set when:
   - Signal is too high, (kPa greater than 68 kPa), for a time greater than 5 seconds.
   - TPS less than 4%.

   Engine misfire or a low unstable idle may set Code 33. Disconnect MAP sensor and system will go into backup mode. If the misfire or idle condition remains, see "Symptoms" in Section "B".
2. If the ECM recognizes the low MAP signal, the ECM and wiring are OK.

Diagnostic Aids:

If idle is rough or unstable refer to "Symptoms" in Section "B" for items which can cause an unstable idle.

An open in CKT 455 will result in a Code 33.

With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Reading should be the same, ± .4 volt.

Also CHART C-1D can be used to test the MAP sensor.

Refer to "Intermittnets" in Section "B".

CODE 33

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE HIGH - LOW VACUUM)
5.0L (VIN E) "F" SERIES (TBI)

1
- IF ENGINE IDLE IS ROUGH, UNSTABLE OR INCORRECT, CORRECT BEFORE USING CHART. SEE "SYMPTOMS" IN SECTION "B".
- ENGINE IDLING.
- DOES "SCAN" DISPLAY A MAP OF 4.0 VOLTS OR OVER?

YES

2
- IGNITION "OFF".
- DISCONNECT MAP SENSOR ELECTRICAL CONNECTOR .
- IGNITION "ON".
- "SCAN" SHOULD READ A VOLTAGE OF 1 VOLT OR LESS. DOES IT?

NO

CODE 33 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

- PROBE CKT 455 WITH A TEST LIGHT TO 12 VOLTS.
- TEST LIGHT SHOULD LIGHT. DOES IT?

NO

CKT 432 SHORTED TO VOLTAGE, SHORTED TO CKT 416, OR FAULTY ECM.

YES

PLUGGED OR LEAKING SENSOR VACUUM HOSE OR FAULTY MAP SENSOR .

NO

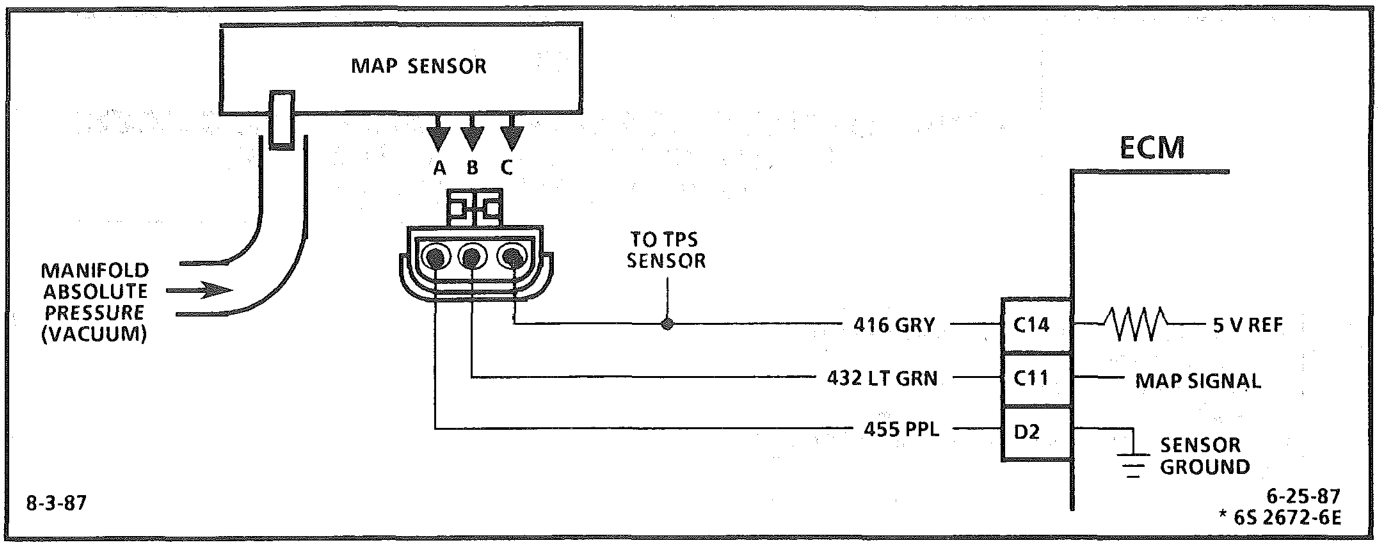
OPEN CKT 455.

IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

8-3-87
7S 3796-6E



CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE LOW - HIGH VACUUM)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) responds to changes in manifold pressure (vacuum). The ECM receives this information as a signal voltage that will vary from about 1-1.5 volts at idle to 4-4.5 volts at wide open throttle.

If the MAP sensor fails the ECM will substitute a fixed MAP value and use the throttle position sensor (TPS) to control fuel delivery.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 34 will set when:
   - Signal is too low (kPa less than 14) and engine running less than 1200 rpm.

     OR
   - Engine running greater than 1200 rpm.
   - Throttle position greater than 21% (over 1.5 volts).
2. If the ECM recognizes the high MAP signal, the ECM and wiring are OK.
3. The "Scan" tool may not display 12 volts. The important thing is that the ECM recognizes the voltage as more than 4 volts, indicating that the ECM and CKT 432 are OK.

Diagnostic Aids:

An intermittent open in CKTs 432 or 416 will result in a Code 34.

With the ignition "ON" and engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Reading should be the same, ± .4 volts.

Refer to "Intermittnets" in Section "B".

CODE 34

MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR CIRCUIT
(SIGNAL VOLTAGE LOW - HIGH VACUUM)
5.0L (VIN E) "F" SERIES (TBI)

1
- ENGINE IDLING.
  DOES "SCAN" DISPLAY MAP BELOW .25 VOLTS?

YES

2
- IGNITION "OFF".
- DISCONNECT SENSOR ELECTRICAL CONNECTOR.
- JUMPER HARNESS TERMINALS "B" TO "C".
- IGNITION "ON".
- MAP VOLTAGE SHOULD READ OVER 4 VOLTS.
  DOES IT?

NO

CODE 34 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

3
- IGNITION "OFF".
- REMOVE JUMPER WIRE.
- PROBE TERMINAL "B" (CKT 432) WITH A TEST LIGHT TO 12 VOLTS.
- IGNITION "ON".
- "SCAN" SHOULD READ OVER 4 VOLTS.
  DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

YES

CKT 416 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

NO

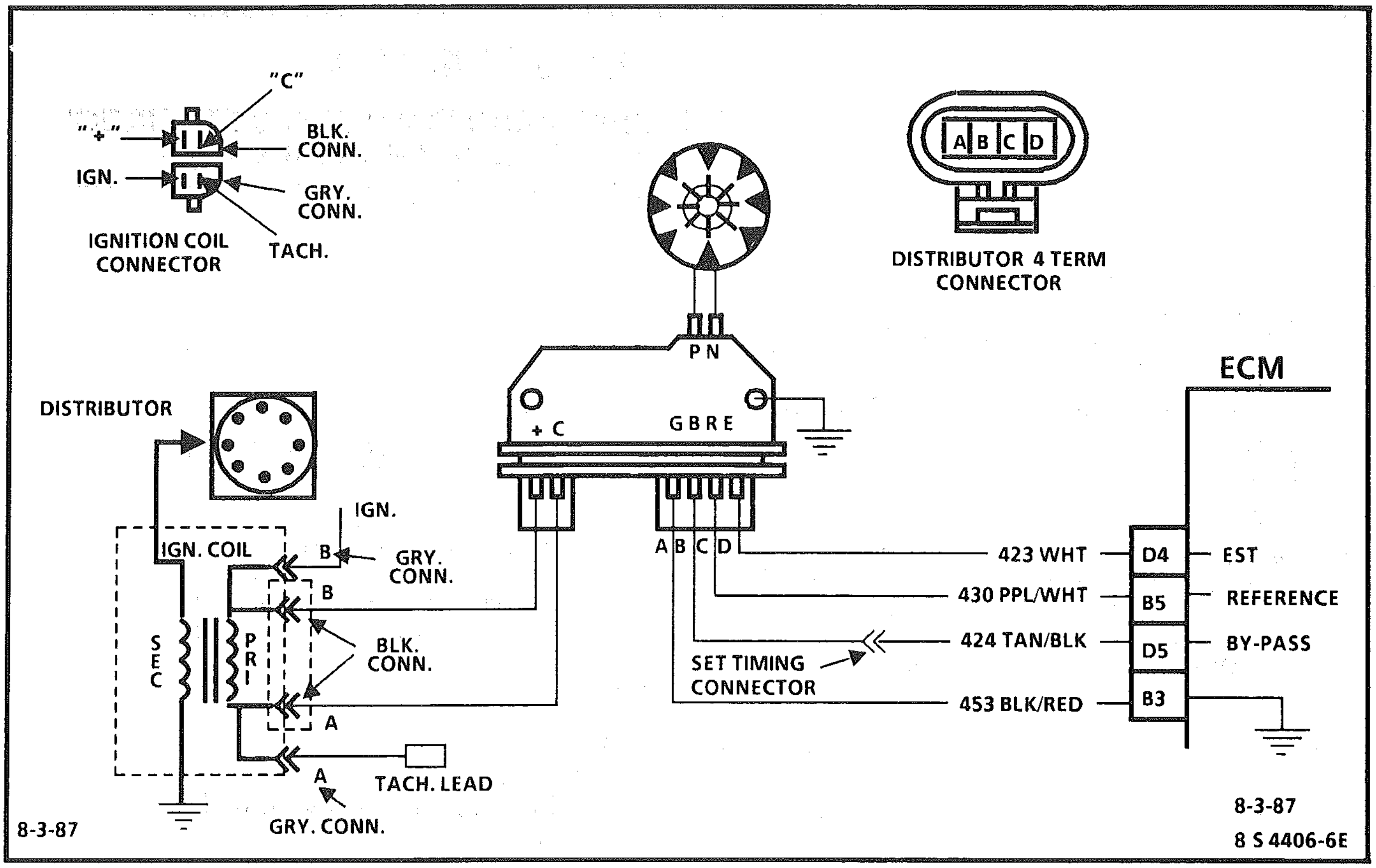
CKT 432 OPEN OR SHORTED TO GROUND OR FAULTY ECM.

IGNITION "ON" ENGINE STOPPED VOLTAGES

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

6-17-87
7S 3211-6E



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

When the system is running on the ignition module, that is, no voltage on the by-pass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), and by-pass voltage applied, the EST should no longer be grounded in the ignition module so the EST voltage should be varying.

If the by-pass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or by-pass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched"
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

If a Code 42 was stored and the customer complains of a "Hard Start", the problem is most likely a grounded EST line (CKT 423).

The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A PROM not fully seated in the ECM can result in a Code 42.

Refer to "Intermittents" in Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT
5.0L (VIN E) "F" SERIES (TBI)

1
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE 42 SET?

YES

2
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON".
- OHMMETER SELECTOR SWITCH IN THE 1000 TO 2000 OHMS RANGE.
- PROBE ECM HARNESS CONNECTOR CKT 423 WITH AN OHMMETER TO GROUND.
  IT SHOULD READ LESS THAN 500 OHMS.
  DOES IT?

NO

CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

NO

OPEN CKT 423, FAULTY CONNECTION OR FAULTY IGNITION MODULE.

LIGHT "OFF"

3
- WITH OHMMETER STILL CONNECTED TO ECM HARNESS CKT 423 AND GROUND. AGAIN PROBE ECM HARNESS CKT 424 WITH THE TEST LIGHT CONNECTED TO 12 VOLTS. (AS TEST LIGHT CONTACTS CKT 424, RESISTANCE SHOULD SWITCH FROM UNDER 500 TO OVER 5,000 OHMS,)
  DOES IT?

LIGHT "ON"

- DISCONNECT IGNITION MODULE 4-WAY CONNECTOR.

LIGHT "ON"

CKT 424 SHORTED TO GROUND.

LIGHT "OFF"

FAULTY IGNITION MODULE.

NO

4
- DISCONNECT DIST. 4-WAY CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD HAVE GONE HIGH (OPEN CIRCUIT) .
  DOES IT?

YES

5
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE SET?

YES

CKT 424 OPEN, FAULTY CONNECTIONS OR FAULTY IGNITION MODULE.

NO

CKT 423 SHORTED TO GROUND.

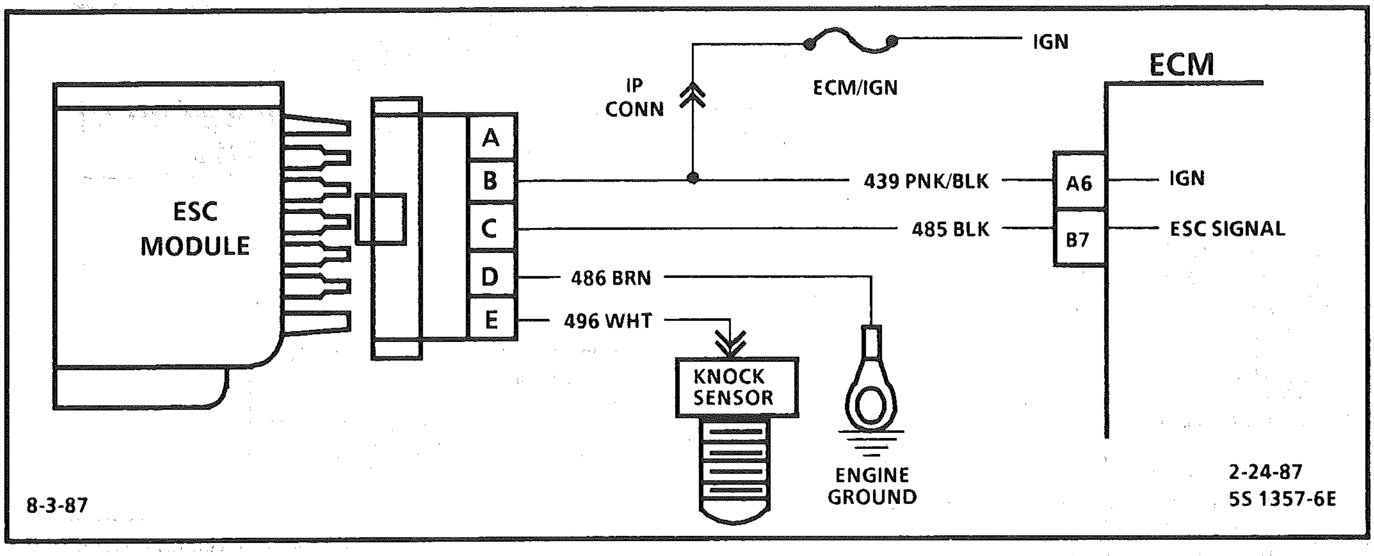
YES

FAULTY ECM

NO

CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM drops, and this signals the ECM to retard timing. The ECM will retard the timing when knock is detected and rpm is above about 900 rpm.

Code 43 means the ECM has been low voltage at CKT 485 terminal "B7" for longer than 5 seconds with the engine running or the system has failed the functional check.

This system performs a functional check once per start up to check the ESC system. To perform this test the ECM will advance the spark when coolant is above 95°C and at a high load condition (near W.O.T.). The ECM then checks the signal at "B7" to see if a knock is detected. The functional check is performed once per start up and if knock is detected when coolant is below 95°C (194°F) the test has passed and the functional check will not be run. If the functional check fails, the "Service Engine Soon" light will remain "ON" until ignition is turned "OFF" or until a knock signal is detected.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the conditions for a Code 43 are present the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem exists.
2. This test will determine if the system is functioning at this time. Usually a knock signal can be generated by tapping on the block close to the area of the sensor.
3. Because Code 43 sets when the signal voltage on CKT 485 remains low this test should cause the signal on CKT 485 to go high. The 12 volts signal should be seen by the ECM as "no knock" if the ECM and wiring are OK.
4. This test will determine if the knock signal is being detected on CKT 496 or if the ESC module is at fault.
5. If CKT 496 is routed to close to secondary ignition wires the ESC module may see the interference as a knock signal.
6. This checks the ground circuit to the module. An open ground will cause the voltage on CKT 485 to be about 12 volts which would cause the Code 43 functional test to fail.
7. Contacting CKT 496 with a test light to 12 volts should generate a knock signal. This will determine if the ESC module is operating correctly.

Diagnostic Aids:

Code 43 can be caused by a faulty connection at the knock sensor at the ESC module or at the ECM. Also check CKT 485 for possible open or short to ground.

Refer to "Intermittents" in Section "B".

CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.0L (VIN E) "F" SERIES (TBI)

1
- ENGINE IDLING.
- "SCAN" SET ON KNOCK SIGNAL.

IS THERE A KNOCK SIGNAL INDICATED?

YES

3
- DISCONNECT ESC MODULE.
- ENGINE IDLING.
- PROBE HARNESS TERMINAL "C" (CKT 485) WITH A TEST LIGHT CONNECTED TO 12 VOLTS.

AFTER 5 SECONDS, DOES "SCAN" DISPLAY A KNOCK SIGNAL?

NO

- IGNITION "ON".
- PROBE TERMINAL "B" (CKT 439) WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

4
- REMOVE CKT 496 FROM CONNECTOR.
- RECONNECT ESC MODULE.
- ENGINE IDLING.

IS THERE A KNOCK SIGNAL INDICATED?

YES

FAULTY CONNECTION OR ESC MODULE.

NO

5
- IF AN AUDIBLE KNOCK CAN BE HEARD, REPAIR INTERNAL ENGINE PROBLEM. IF OK, CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE KNOCK SENSOR.

LIGHT "OFF"

OPEN CKT 439

YES

CKT 485 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

NO

2
- ENGINE IDLING.
- TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
- IS A KNOCK SIGNAL INDICATED WHILE TAPPING ON ENGINE?

NO

6
- DISCONNECT ESC MODULE.
- PROBE HARNESS TERMINAL "D" (CKT 486) WITH A TEST LIGHT TO 12 V.

LIGHT "ON"

7
- RECONNECT ESC MODULE.
- DISCONNECT KNOCK SENSOR.
- ENGINE IDLING.
- MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
- EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
- IS A KNOCK SIGNAL INDICATED WITH "SCAN"?

YES

FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.

NO

CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.

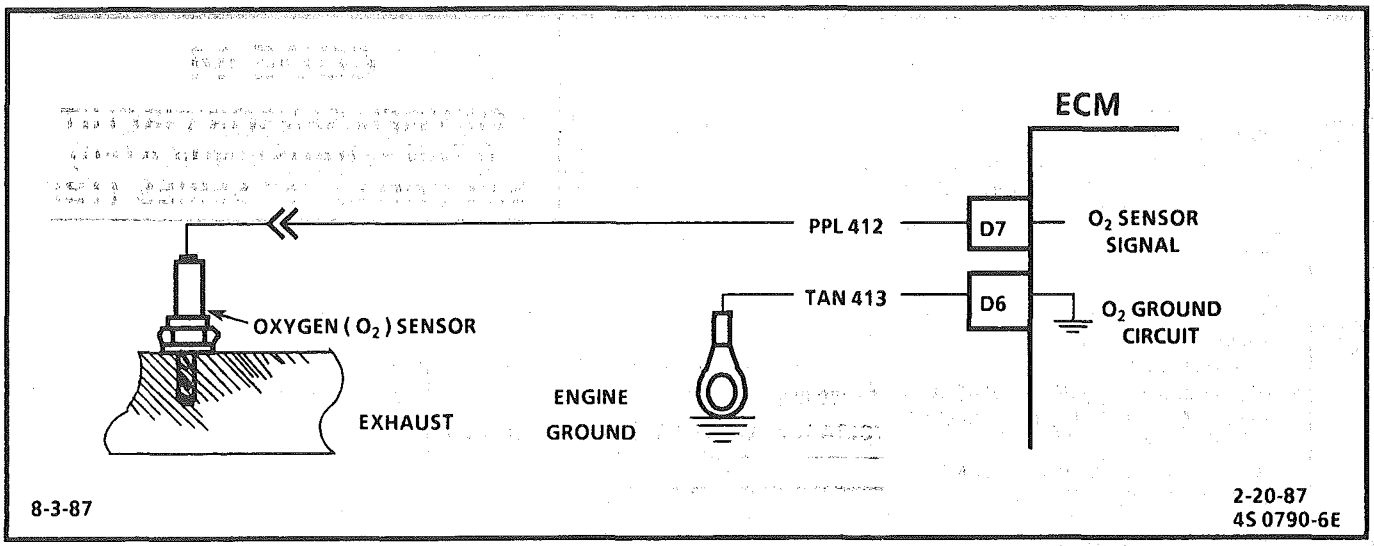
LIGHT "OFF"

REPAIR OPEN GROUND CKT 486.

YES

CODE 43 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2-12-87
* 7S 3292-6E



CODE 44

OXYGEN SENSOR CIRCUIT (LEAN EXHAUST INDICATED) 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412.
   - Remains below .2 volt for 50 seconds,
   - And the system is operating in "Closed Loop".

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions to determine when the Code 44 may have been set. If the conditions for Code 44 exists the block learn values will be around 150.

- O_2 Sensor Wire Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAP Sensor A (MAP) sensor output that causes the ECM to sense a higher than normal vacuum will cause the system to go lean. Disconnect the MAP sensor and if the lean condition is gone, replace the sensor.
- Lean Injector(s)
- Fuel Contamination Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See "Fuel System Diagnosis", CHART A-7.
- Exhaust Leaks If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- If the above are OK, it is a faulty oxygen sensor.

CODE 44
OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 SENSOR VOLTAGE FIXED BELOW .35 VOLTS (350 mV)?

YES

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY O_2 SENSOR BETWEEN .35 VOLTS AND .55 VOLTS (350 mV AND 550 mV).
  DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO

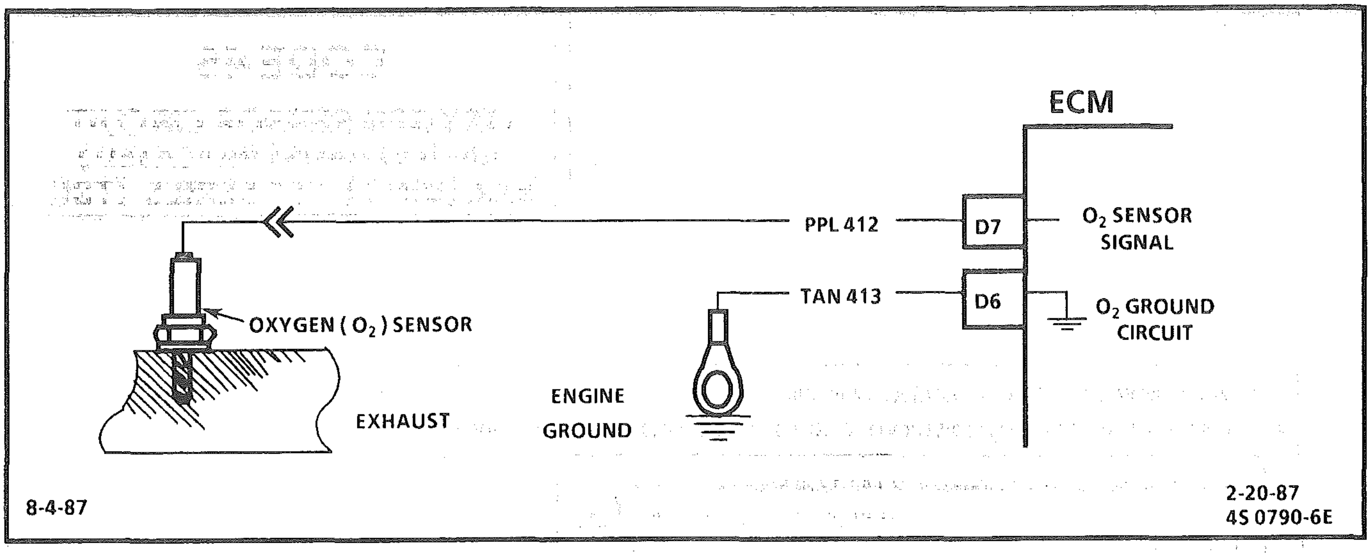
CKT 412 SHORTED TO GROUND OR FAULTY ECM.

NO

CODE 44 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-30-87
*7S 3191-6E



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 45 is set when the O_2 sensor signal voltage or CKT 412.
   - Remains above .7 volts for 50 seconds; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle angle greater than 2% (about .2 volts above idle voltage) but less than 25%.

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm conditions to determine when the Code 45 may have been set. If the conditions for Code 45 exists, The block learn values will be around 115.

- Fuel Pressure System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set. See "Fuel System Diagnosis", CHART A-7.
- Leaking injector See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding An open ground CKT 453 (ignition system ref. low) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister Purge Check for fuel saturation. If full of fuel, check canister control and hoses. See "Canister Purge", Section "C3".
- MAP Sensor An output that causes the ECM to sense a lower than normal vacuum can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAP sensor if the the rich condition is gone while the sensor is disconnected.
- TPS An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.0L (VIN E) "F" SERIES (TBI)

1
- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" TOOL DISPLAY O_2 SENSOR FIXED ABOVE .75 VOLTS (750 mV)?

YES

- DISCONNECT O_2 SENSOR AND JUMPER HARNESS CKT 412 TO GROUND.
- "SCAN" SHOULD DISPLAY O_2 BELOW .35 VOLTS (350 mV).

DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

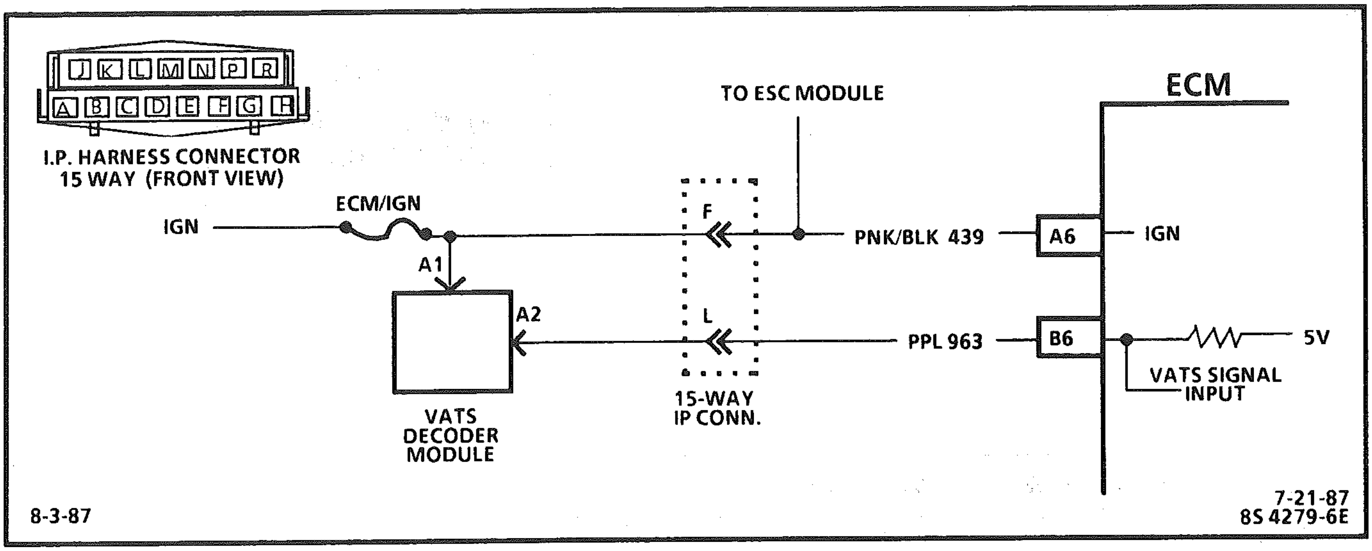
FAULTY ECM.

NO

CODE 45 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-27-87
*7S 3192-6E



CODE 53

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The VATS system is designed to disable vehicle operation if the incorrect key or starting procedure is used. The VATS decoder module sends a signal to the ECM if the correct key is being used. If the proper signal does not reach the ECM on CKT 963, the ECM will not pulse the injectors "ON" and thus not allow the vehicle to be started.

Code 53 will set, if the proper signal is not being received at ECM terminal "B6" when the ignition is turned "ON". Code 53 does not store in the ECM memory but is only present when the conditions stated above are met.

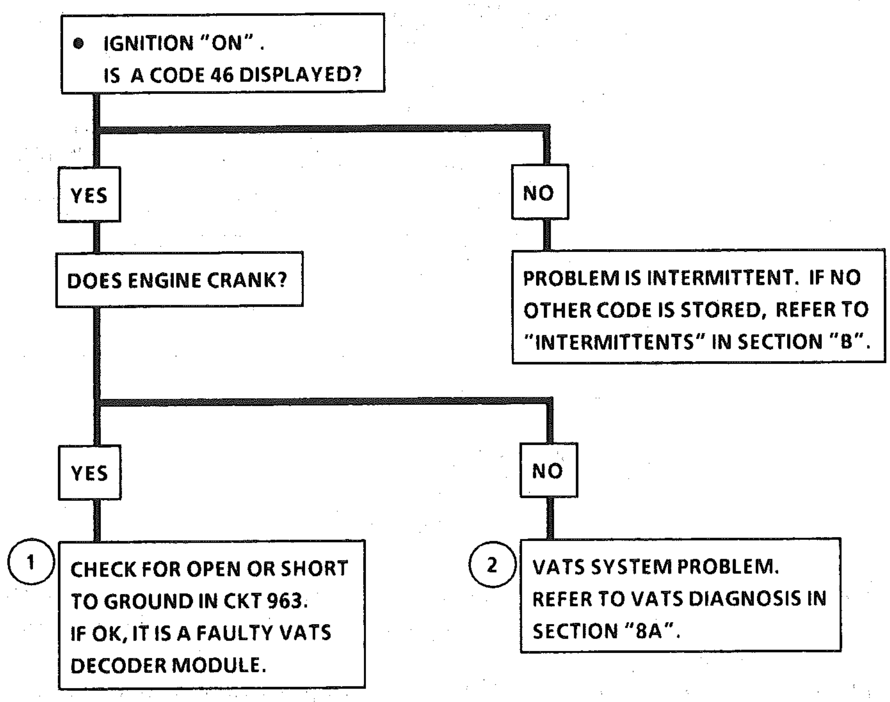
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

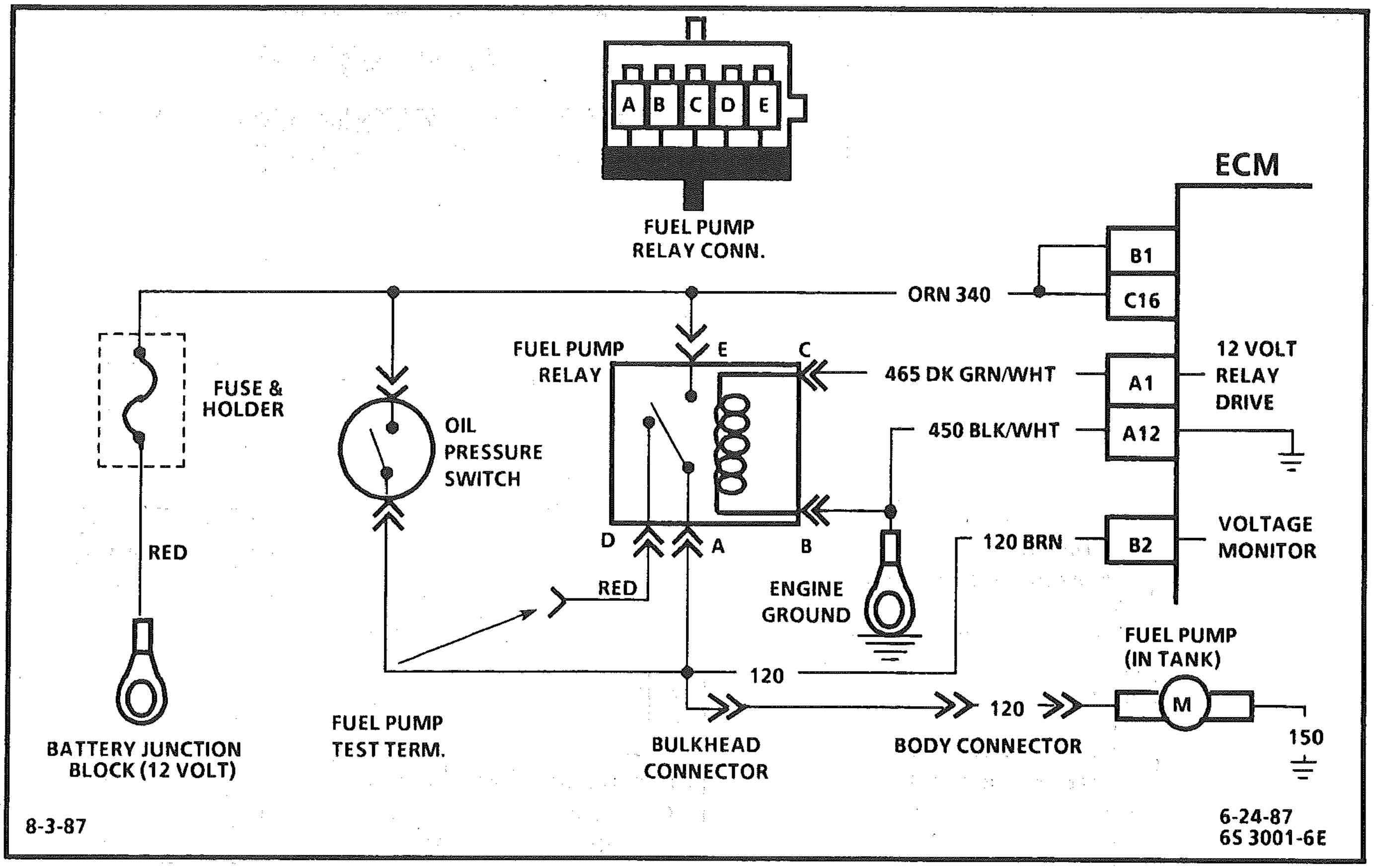
1. If the engine cranks, and a Code 53 is stored, it indicates that the portion of the module which generates the signal to the ECM is not operating or CKT 963 is open or shorted to ground.

   If the decoder module is found to be OK, as determined from Section "8A", the ECM may be at fault, but this is not a likely condition.
2. If Code 53 is stored, and the engine will not crank, it indicates that there is a VATS problem or an incorrect key or starting procedure is being used.

CODE 53

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT 5.0L (VIN E) "F" SERIES (TBI)





CODE 54

FUEL PUMP CIRCUIT
(LOW VOLTAGE)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will activate the fuel pump relay and run the in-tank fuel pump. The fuel pump will operate as long as the engine is cranking or running, and the ECM is receiving ignition reference pulses.

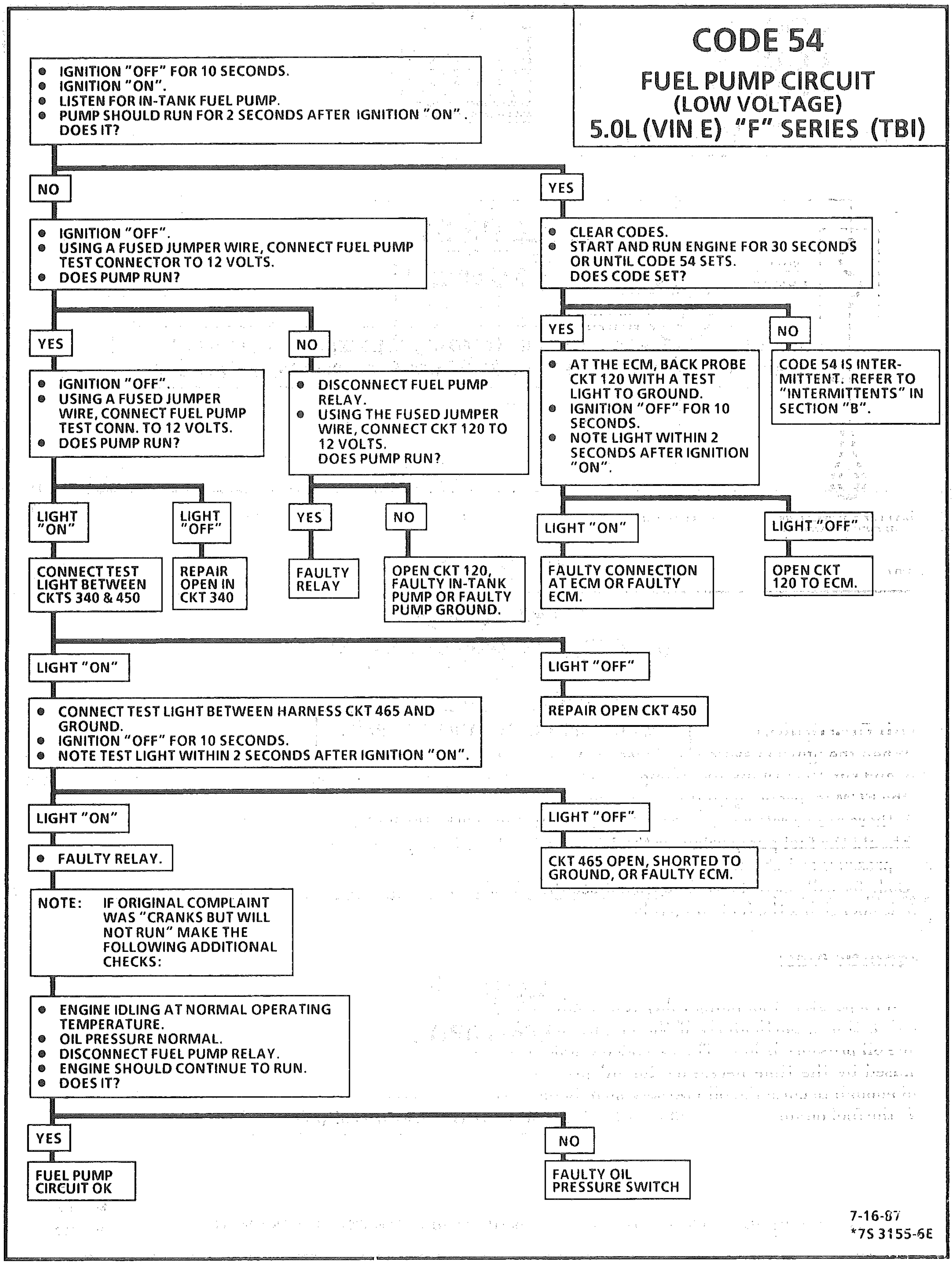
If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after key "ON".

Should the fuel pump relay, or the 12 volt relay drive from the ECM fail, the fuel pump will be run through an oil pressure switch back-up circuit.

Code 54 will set if the ECM does not see the 12 volts signal at terminal "B2" during the 2 seconds that the ECM is energizing the fuel pump relay.

Diagnostic Aids:

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold or engine oil pressure is low. The extended crank period is caused by the time necessary for oil pressure to build enough to close the oil pressure switch and turn "ON" the fuel pump.


CODE 54
FUEL PUMP CIRCUIT
(LOW VOLTAGE)
5.0L (VIN E) "F" SERIES (TBI)
● IGNITION "OFF" FOR 10 SECONDS.
● IGNITION "ON".
● LISTEN FOR IN-TANK FUEL PUMP.
● PUMP SHOULD RUN FOR 2 SECONDS AFTER IGNITION "ON". DOES IT?
NO
● IGNITION "OFF".
● USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONNECTOR TO 12 VOLTS.
● DOES PUMP RUN?
YES
● IGNITION "OFF".
● USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONN. TO 12 VOLTS.
● DOES PUMP RUN?
LIGHT "ON"
CONNECT TEST LIGHT BETWEEN CKTS 340 & 450
LIGHT "OFF"
REPAIR OPEN IN CKT 340
NO
● DISCONNECT FUEL PUMP RELAY.
● USING THE FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS. DOES PUMP RUN?
YES
FAULTY RELAY
NO
OPEN CKT 120, FAULTY IN-TANK PUMP OR FAULTY PUMP GROUND.
YES
● CLEAR CODES.
● START AND RUN ENGINE FOR 30 SECONDS OR UNTIL CODE 54 SETS. DOES CODE SET?
YES
● AT THE ECM, BACK PROBE CKT 120 WITH A TEST LIGHT TO GROUND.
● IGNITION "OFF" FOR 10 SECONDS.
● NOTE LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
LIGHT "ON"
FAULTY CONNECTION AT ECM OR FAULTY ECM.
LIGHT "OFF"
OPEN CKT 120 TO ECM.
NO
CODE 54 IS INTERMITTENT. REFER TO "INTERMITTENTS" IN SECTION "B".
LIGHT "ON"
● CONNECT TEST LIGHT BETWEEN HARNESS CKT 465 AND GROUND.
● IGNITION "OFF" FOR 10 SECONDS.
● NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
LIGHT "OFF"
REPAIR OPEN CKT 450
LIGHT "ON"
● FAULTY RELAY.
NOTE: IF ORIGINAL COMPLAINT WAS "CRANKS BUT WILL NOT RUN" MAKE THE FOLLOWING ADDITIONAL CHECKS:
● ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
● OIL PRESSURE NORMAL.
● DISCONNECT FUEL PUMP RELAY.
● ENGINE SHOULD CONTINUE TO RUN.
● DOES IT?
YES
FUEL PUMP CIRCUIT OK
NO
FAULTY OIL PRESSURE SWITCH
LIGHT "OFF"
CKT 465 OPEN, SHORTED TO GROUND, OR FAULTY ECM.
7-16-87
*7S 3155-6E

CODE 51
CODE 52
CODE 55

5.0L (VIN E) "F" SERIES (TBI)

CODE 51

PROM ERROR

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CODE 52

CALPAK ERROR
(FAULTY OR INCORRECT CALPAK)

INSTALL MISSING OR FAULTY CALPAK.

CODE 55

ECM ERROR

REPLACE ELECTRONIC CONTROL MODULE (ECM).

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-26-87
4S 1212-6E

SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK.

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the following symptom procedures call for a careful visual (physical) check.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

This check should include:

- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The following symptoms cover several engines. To determine if a particular system or component is used, refer to the ECM wiring diagrams for application.

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the trouble code charts in Section "A" for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of trouble code charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check of suspect circuits for:
  - Poor mating of the connector halves, or terminals, not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check as outlined in the Introduction to Section "6E".
- If a visual (physical) check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit or a "Scan" tool may be used. An abnormal voltage reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK, and a trouble code was stored for a circuit having a sensor, except for Codes 44 and 45, substitute a known good sensor and recheck.
- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes "ON". Code 22 should be stored, and kept in memory, when ignition is turned "OFF" for at least 10 seconds. If not, the ECM is faulty.
- An intermittent "SES" light, and no trouble codes, may be caused by:
  - Electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
  - Improper installation of electrical options, such as lights, 2-way radios, etc.
  - EST wires should be routed away from spark plug wires, ignition system components, and generator. Wire for CKT 453 from ECM to ignition system should be a good ground.
  - Ignition secondary shorted to ground.
  - CKTs 419 ("SES" light) or 451 (Diagnostic Test) intermittently shorted to ground.
  - ECM power grounds.

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- **CHECK:**
  - For water contaminated fuel.
  - Fuel system pressure CHART A-7.
  - TPS for sticking or binding should read less than 1.25 volts on a "Scan" tool.
  - No crank signal; see CHART C-1B.
  - EGR operation; CHART C-7.
  - Fuel System - CHART A-7.
  - For a faulty in-tank fuel pump check valve, which would allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
    1. Ignition "OFF".
    2. Disconnect fuel line at the filter.
    3. Remove the tank filler cap.
    4. Connect a radiator test pump to the line and apply 103 kPa (15 psi) pressure. If the pressure will hold for 60 seconds, the check valve is OK.
- Check ignition system for:
  - Proper output with ST-125.
  - Worn shaft.
  - Bare and shorted wires.
  - Pickup coil resistance and connections.
  - Loose ignition coil connections.
  - Moisture in distributor cap.
  - Spark plugs, wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits.
- If engine starts but then, immediately stalls, open distributor bypass line. If engine then starts, and runs OK, replace distributor pickup coil.
- Check CKT 423 (EST) for short to ground.

SURGES AND/OR CHUGGLE

Definition: Engine power variation, under steady throttle or cruise. Feels like the car speeds up and slows down, with no change in the accelerator pedal.

- Use a "Scan" tool to make sure reading of VSS matches vehicle speedometer. See "Special Information", Section "6E".
- **CHECK:**
  - For intermittent EGR at idle. See appropriate CHART C-7.
  - Ignition timing. See Emission Control Information label.
  - Inline fuel filter for dirt or restriction.
  - Fuel pressure. See CHART A-7.
  - Generator output voltage. Repair if less than 9, or more than 16 volts.
  - TCC Operation. CHART C-8A.
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also, check condition of the rest of the ignition system.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed, when accelerator pedal is pushed down part way.

- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- If there is spray from only one injector, then, there is a malfunction in the injector assembly, or in the signal to the injector assembly. The malfunction can be isolated, by switching the injector connectors. If the problem remains with the original injector, after switching the connector, then the injector is defective. Replace the injector. If the problem moves with the injector connector, then the problem is an improper signal in the injector circuits, see CHART A-3.
- **CHECK:**
  - Ignition timing. See Emission Control Information label.
  - For restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM Grounds.
  - EGR operation for being open, or partly open, all the time - CHART C-7.
  - Generator output voltage. Repair if less than 9, or more than 16 volts.
  - Engine valve timing and compression.
  - Engine, for proper or worn camshaft. See Section "6A".
  - Transmission torque converter operation. See Section "7A".
  - Secondary ignition voltage.
  - Proper operation or ESC. See Section "C5".
- Check exhaust system for restriction. See CHART B-1.

DETONATION / SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening.

- CHECK for obvious overheating problems.
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Faulty or incorrect thermostat.
  - Coolant sensor, which has shifted in value.
  - Correct coolant solution - should be a 50/50 mix of GM #1052753 anti-freeze coolant (or equiv.) and water.
- CHECK:
  - For poor fuel quality, proper octane rating.
  - For correct PROM.
  - Spark plugs for correct heat range.
  - ESC system opeation. See CHART C-5.
  - Ignition timing. See Vehicle Emission Control Information label.
  - Fuel system for low pressure. See CHART A-7.
  - Check EGR system. - CHART C-7.
  - For proper transmission shift points. See Section "7".
  - TCC operation. See CHART C-8.
  - For incorrect basic engine parts such as cam, heads, pistons, etc.
  - Excessive oil entering combustion chamber.
- Remove carbon with top engine cleaner. Follow instructions on can.
- If there is spray from only one injector, then there is a malfunction in the injector assembly, or in the signal to the injector assembly. The malfunction can be isolated by switching the injector connectors. If the problem remains with the original injector, after switching the connector, then the injector is defective. Replace the injector. If the problem moves with the injector connector, then the problem is an improper signal in the injector circuits. See CHART A-3.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual (physical) check, as described at start of Section "B".
- CHECK:
  - Fuel pressure. See CHART A-7.
  - Water contaminated fuel.
  - TPS for binding or sticking.
  - Ignition timing. See "Emission Control Information" label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - For open ignition system ground, CKT 453.
  - Canister purge system for proper operation. See Section "C3".
  - EGR valve operation, CHART C-7.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual (physical) check, as described at start of Section "B".
- If ignition system is suspected of causing a miss at idle or cutting, out under load:
- Check for missing cylinder by:
  1. Disconnect IAC motor. Start engine. Remove one spark plug wire at a time, using insulated pliers.
  2. If there is an rpm drop on all cylinders, (equal to within 50 rpm), go to "Rough, Unstable, Or Incorrect Idle, Or Stalling" symptom. Reconnect IAC motor.
  3. If there is no rpm drop on one or more cylinders, or excessive variation in drop, check for spark, on the suspected cylinder(s) with J 26792 (ST-125) spark tester or equivalent. If no spark, see Section "6D" for "Intermittent Operation or Miss". If there is spark, remove spark plug(s) in these cylinders and check for:
     - Cracks
     - Wear
     - Improper gap
     - Burned electrodes
     - Heavy deposits
     - Perform compression check on questionable cylinder.
- Check wire resistance (should not exceed 30,000 ohms), also, check rotor and distributor cap.

- If the previous checks did not find the problem:
  - Visually inspect ignition system for moisture, dust, cracks, burns, etc. Spray plug wires with fine water mist to check for shorts.
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Perform compression check.
  - Valve timing.
  - Remove rocker covers. Check for bent pushrods, worn rocker arms, broken or weak valve springs, worn camshaft lobes. Repair as necessary. See Section "6A".
- If there is spray from only one injector, then, there is a malfunction in the injector assembly, or in the signal to the injector assembly. The malfunction can be isolated by switching the injector connectors. If the problem remains with the original injector, after switching the connector, then the injector is defective. Replace the injector. If the problem moves with the injector connector, then, the problem is an improper signal in the injector circuits. See CHART A-3.

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- **CHECK:**
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Fuel Pressure. See CHART A-7.
- Check owner's driving habits.
  - Is A/C "ON" full time (Defroster mode "ON")?
  - Are tires at correct pressure?
  - Are excessively heavy loads being carried?
  - Is acceleration too much, too often?
  - Suggest driver read "Important Facts on Fuel Economy" in owner's manual.
- Perform "Diagnostic Circuit Check".
- Check air cleaner element (filter) for dirt or being plugged.
- Check for proper calibration of speedometer.
- Visually (physically) check:
  - Vacuum hoses for splits, kinks, and proper connections, as shown on Vehicle Emission Control Information label.
  - Ignition wires for cracking, hardness, and proper connections.
- Check ignition timing. See Emission Control Information label.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes or heavy deposits. Repair or replace, as necessary.
- Check compression. See Section "6A".
- Check TCC for proper operation. See CHART C-8. Use "Scan" tool if available.
- Check for dragging brakes.
- Suggest owner fill fuel tank and recheck fuel economy.
- Check for exhaust system restriction. See CHART B-1.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in rpm (called "hunting"). Either condition may be severe enough to cause stalling. Engine idles at incorrect speed.

- **CHECK:**
  - Ignition timing. See Emission Control Information label.
  - P/N switch circuit. See CHART C-1A.
  - For injector(s) leaking. Check fuel pressure, CHART A-7.
  - IAC - See CHART C-2C.
  - If a sticking throttle shaft or binding linkage causes a high TPS voltage (open throttle indication), the ECM will not control idle. Monitor TPS voltage. "Scan" and/or voltmeter should read less than 1.2 volts with throttle closed.
  - Vacuum leaks can cause higher than normal idle.
  - EGR "ON", while idling, will cause roughness, stalling, and hard starting. CHART C-7.
  - Battery cables and ground straps should be clean and secure. Erratic voltage will cause IAC to change its position, resulting in poor idle quality.
  - IAC valve will not move, if system voltage is below 9, or greater than 17.8 volts.
  - Use "Scan" tool to determine if ECM is receiving A/C request signal.

- MAP Sensor - Ignition "ON", engine stopped. Compare MAP voltage with known good vehicle. Voltage should be the same ± 400 mV (.4 volts).

  OR

  Start and idle engine. Disconnect sensor electrical connector. If idle improves, substitute a known good sensor and recheck.
- A/C refrigerant pressure too high. Check for overcharge or faulty pressure switch.
- PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
- Run a cylinder compression check See Section "6".
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check".
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors)
  - Check items that will cause engine to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See Vehicle Emission Control Information label.
  - Canister for fuel loading. See CHART C-3.
  - PCV valve for being plugged, stuck or blocked PCV hose or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
    - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NO_X:
  - Check items which cause car to run LEAN, or to run too hot.
  - EGR valve for not opening. See CHART C-7.
  - Vacuum leaks.
  - Coolant system and coolant fan for proper operation. See CHART C-12.
  - Remove carbon with top engine cleaner. Follow instructions on can.
  - Check ignition timing for excessive base advance. See Emission Control Information label.
- If the system is running lean, (block learn greater than 138) refer to "Diagnostic Aids" on facing page of Code 44.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injector for leaking. Apply 12 volts to fuel pump test terminal to turn "ON" fuel pump and pressurize fuel system. Visually check injector and TBI assembly for fuel leakage.

BACKFIRE

Definition: Fuel ignites in intake manifold, making a loud popping noise.

- **CHECK:**
  - EGR operation for being open all the time. See CHART C-7.
  - Output voltage of ignition coil.
  - For crossfire between spark plugs (distributor cap, spark plug wires, and proper routing of plug wires).
  - Engine timing - See Emission Control Information label.
  - For faulty spark plugs and/or plug wires or boots.
  - Faulty A.I.R. check valve.
- Perform a compression check - look for sticking or leaking valves.
  - For proper valve timing.
  - Broken or worn valve train parts.

CHART B-1
RESTRICTED EXHAUST SYSTEM CHECK
ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

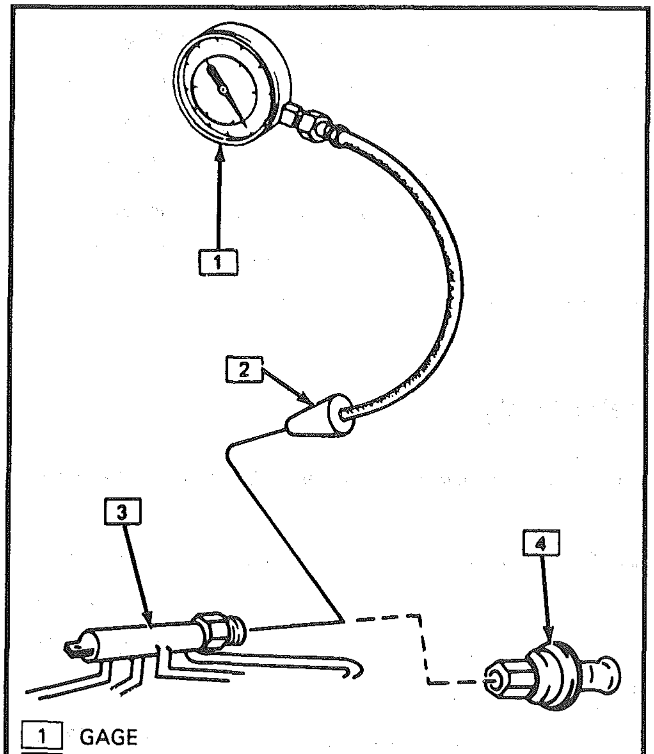
CHECK AT A. I. R. PIPE:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

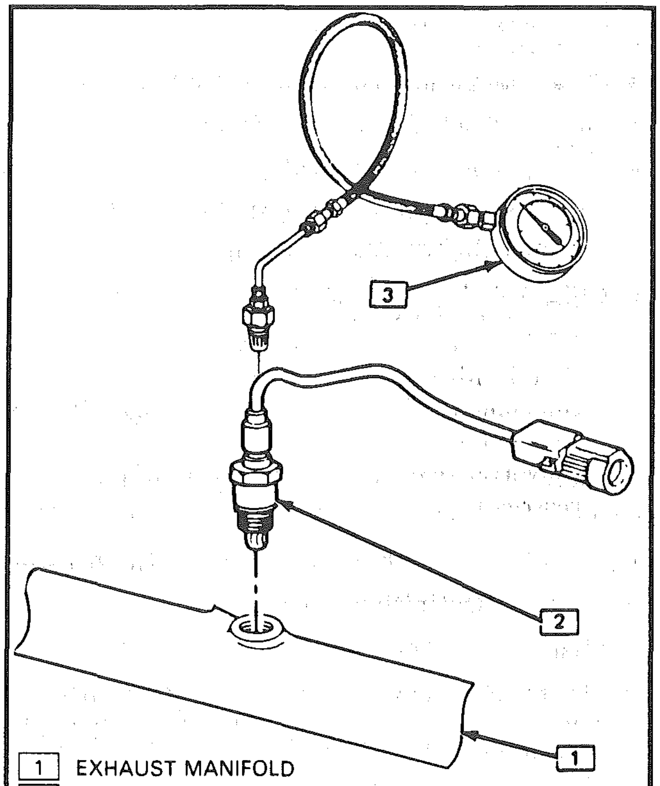
CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.



1 GAGE
2 HOSE AND NIPPLE ADAPTER
3 A.I.R. PIPE (EXHAUST PORT)
4 CHECK VALVE

7S 3363 6E



1 EXHAUST MANIFOLD
2 OXYGEN (O_2) SENSOR
3 BACK PRESSURE GAGE

7S 3338 6E

DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 $\frac{1}{4}$ psi (8.6 kPa).
2. Accelerate engine to 2000 RPM and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either RPM, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the A Section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1) is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM. For service, the ECM has three parts: a Controller (the ECM without the PROM), a separate calibrator (PROM), and a CALPAK.

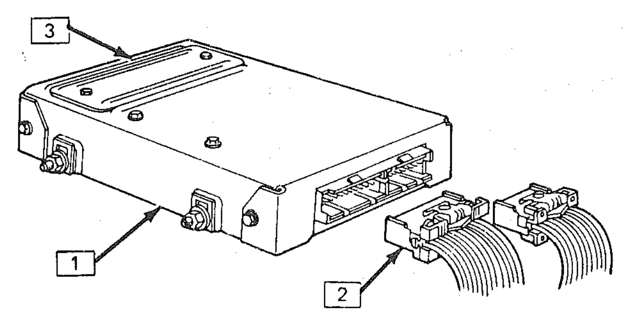


Figure C1-1 Electronic Control Module (ECM) (5.0L)

PROM

To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-2). The PROM is located inside the ECM, and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many car lines, a PROM is very specific and must be used for the right car. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

An ECM used for service (called a controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (see On-Car Service).

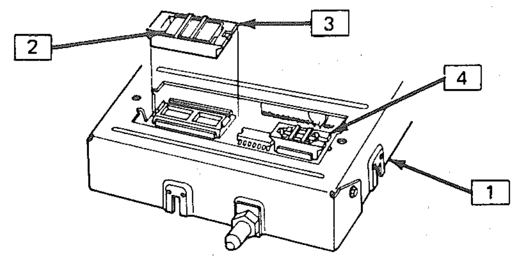


Figure C1-2 - PROM (Calibrator) and CALPAK (5.0L)

CALPAK

A device called a CALPAK is used to allow fuel delivery if other parts of the ECM are damaged. It has an access door in the ECM, and removal and replacement procedures are the same as with a PROM.

If the CALPAK is missing, it will result in a no start and run condition. The CALPAK must be transferred to a replacement ECM.

ECM FUNCTION

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 Meg Ohm input impedance digital voltlmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor

The coolant sensor (Figure C1-3) is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F)

The ECM supplies a 5-volt signal to the coolant sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

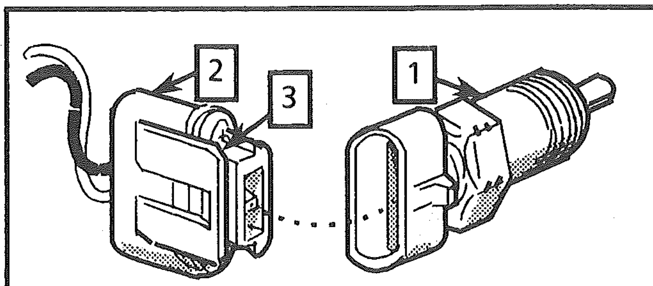


Figure C1-3 - Engine Coolant Temperature Sensor

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

MAP Sensor

The manifold absolute pressure (MAP) sensor (Figure C1-4) measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.

A closed throttle on engine coastdown would produce a relatively low MAP output, while a wide-open throttle would produce a high output. This high output is produced because the pressure inside the manifold is the same as outside the manifold, so you measure 100% of outside air pressure. Manifold absolute pressure (MAP) is the OPPOSITE of what you would measure on a vacuum gage.

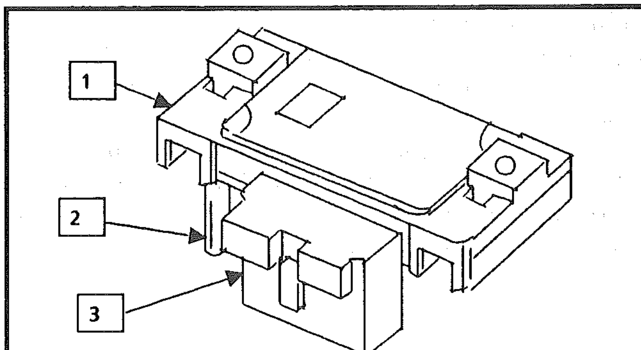


Figure C1-4 - MAP Sensor

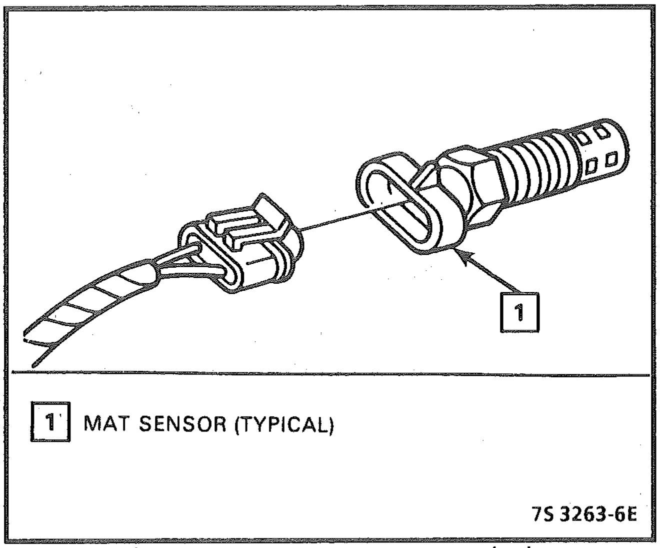


Figure C1-5 - MAT Sensor - Typical

When manifold pressure is high, vacuum is low. The MAP sensor is also used to measure barometric pressure under certain conditions, which allows the ECM to automatically adjust for different altitudes.

The ECM sends a 5-volt reference signal to the MAP sensor. As the manifold pressure changes, the electrical resistance of the sensor also changes. By monitoring the sensor output voltage, the ECM knows the manifold pressure. A higher pressure, low vacuum (high voltage) requires more fuel, while a lower pressure, higher vacuum (low voltage) requires less fuel.

The ECM uses the MAP sensor to control fuel delivery and ignition timing.

A failure in the MAP sensor circuit should set a Code 33 or Code 34.

Manifold Air Temperature (MAT) Sensor

The manifold air temperature sensor (MAT) is a thermistor, a resistor which changes value based on the temperature of air entering the enigne. Low temperature produces a high resistance (100,000 ohms at - 40°C /- 40°F), while high temperature causes low resistance (70 ohms at 130°C / 226°F). The ECM supplies a 5 volt signal to the sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the intake air is cold and low when the air is hot. By measuring the voltage, the ECM knows the manifold air temperature.

The MAT sensor is also used to control spark timing and to delay EGR when intake air is cold.

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Oxygen (O_2) Sensor

The exhaust oxygen sensor is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream.

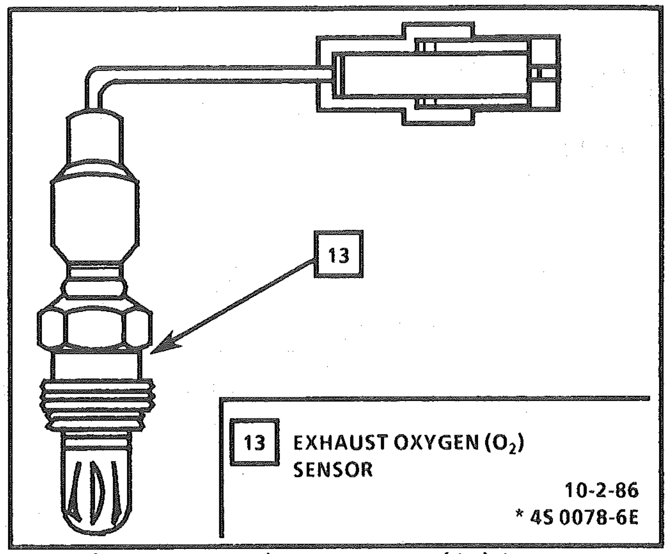


Figure C1-6 - Exhaust Oxygen (O_2) Sensor

The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately .1 volts (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture).

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the injector (lean mixture - low voltage - rich command, rich mixture - high voltage - lean command). This voltage can be measured with a digital voltmeter having at least 10 Meg Ohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

The O_2 sensor, if open, should set a Code 13. A shorted sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45. When any of these codes are set, the car should run in the "Open Loop" mode.

Throttle Position Sensor (TPS)

The throttle position sensor (TPS) is connected to the throttle shaft on the TBI unit (see Figure C1-7). It is a potentiometer with one end connected to 5 volts from the ECM and the other to ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the output of the TPS also changes. At a closed throttle position, the output of the TPS is low (approximately .5 volts). As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand).If the sensor CKT is open, the ECM will set a Trouble Code 22. If the circuit is shorted, the ECM will think the vehicle is at WOT, and a Trouble Code 21 will be set.

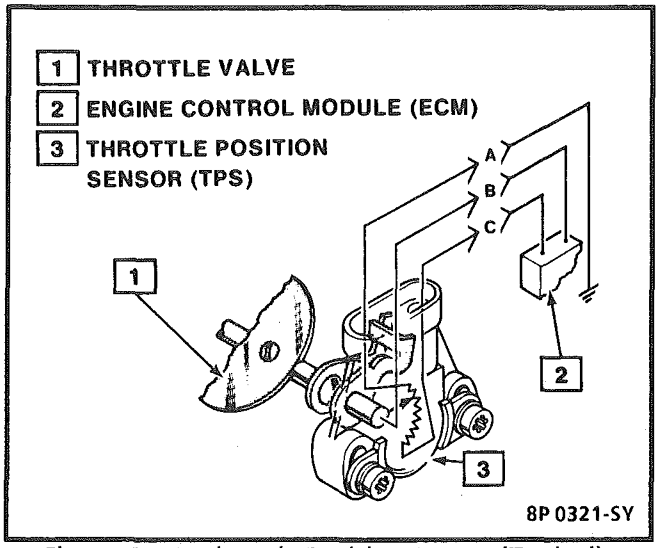


Figure C1-7 - Throttle Position Sensor (Typical)

A broken or loose TPS can cause intermittent bursts of fuel from the injector, and an unstable idle, because the ECM thinks the throttle is moving. Once a trouble code is set, the ECM will use an artificial value for TPS, and some vehicle performance will return.

On all engines, the TPS is not adjustable. The ECM uses the reading at idle for the zero reading, so no adjustment is necessary.

Knock Sensor

The knock sensor is mounted in the engine block. When abnormal engine vibrations (spark knock) are present, the sensor produces a voltage signal, which is sent to the ESC module.

See Section "C5" for further information on the electornic spark control (ESC) system.

Park/Neutral Switch (Auto Only)

The park/neutral (P/N) switch indicates to the ECM when the transmission is in park or neutral. This information is used for the TCC , and the IAC valve operation.

Important

Vehicle should not be driven with park/neutral switch disconnected as idle quality will be affected and a possible false Code 24 VSS.

See Section "8A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly.

Crank Signal

The ECM looks at the starter solenoid to tell when the engine is cranking. It uses this to tell when the car is in the Starting Mode.

If this signal is not available, car may be hard to start in extremely cold weather.

A/C Request Signal

This signal tells the ECM that the A/C selector switch is turned "ON", and that the pressure cycling switch is closed. The ECM uses this to adjust the idle speed when the air conditioning is working.

Vehicle Speed Sensor (VSS)

The vehicle speed sensor (VSS) sends a pulsing voltage signal to the ECM, which the ECM converts to miles per hour. This sensor mainly controls the operation of the TCC system. See "TCC System" for more information.

Distributor Reference Signal

The distributor sends a signal to the ECM to tell it both engine rpm and crankshaft position. See "EST System" for further information.

Power Steering Pressure Switch (PSPS)

This switch tells the ECM that the vehicle is in a parking maneuver. The ECM uses this information to compensate for the additional engine load by moving the IAC valve. The ECM will, also, turn "OFF" the A/C clutch when high pressure is detected.

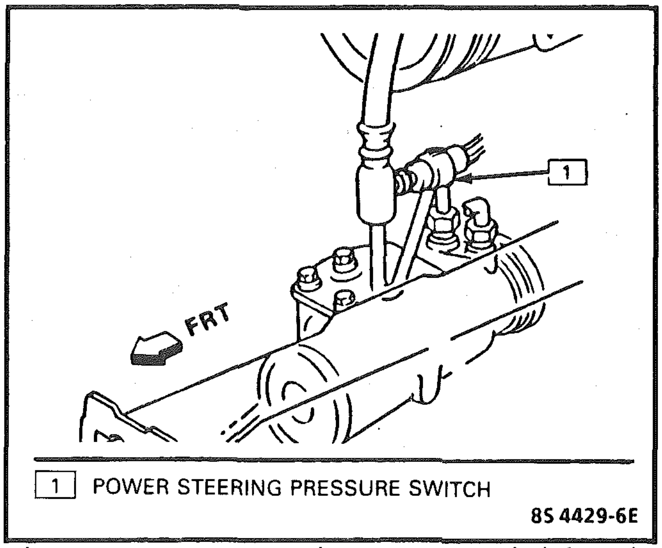


Figure C1-8 - Power Steering Pressure Switch (PSPS)

DIAGNOSIS

Since the ECM can have a failure which may effect only one circuit, following the diagnostic procedures in this section can reliably tell when a failure has occurred in the ECM. Also, a Code 55 in dicates a failure of the ECM.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem,and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections. - The diagnostic chart will say "ECM Connections or ECM". The terminals may have to be removed from the connector in order to check them properly.
- The ECM or PROM is not correct for the application. - The incorrect ECM or PROM may cause a malfunction and may or may not set a code.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness. - Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches called "Drivers".

A shorted solenoid, relay coil, or harness in a GMP4 computer will not damage the ECM, but will cause the circuit and controlled component to be inoperative. When the circuit fault is not present or has been repaired, the "Quad-Driver" will again operate in a normal manner due to it's fault protected design. If a fault has been repaired in a circuit controlled by a "Quad-Driver", the original ECM should be reinstalled and the circuit checked for proper operation. ECM replacement will not be necessary if the repaired circuit or component now operates correctly.

J34636 or BT8405 testers or equivalent provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.

- The PROM may be faulty. - Although the PROM rarely fails,it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good PROM.
- The replacement ECM may be faulty. - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the ECM is the problem, substitute a known good ECM. Although this is a rare condition, it could happen.

The components or circuits and the codes or charts, related to them are:

- Code 55 indicates a failure of the ECM.
- PROM - Code 51.
- Coolant Temperature Sensor - CHARTS 14 - 15.
- MAP sensor - CHART 33 or 34. To check the sensor with no code set, use CHART C-1D.
- TPS - CHARTS 21 or 22.
- P/N switch - CHART C-1A
- Crank Signal - CHART C-1B
- O_2 Sensor - CHARTS 13, 44, 45.
- VSS - CHART 24 and in TCC System.
- Distributor - CHART 42 and in EST system.
- Distributor - Chart and in the EST system.

ECM

A faulty ECM will be determined in the diagnostic charts, or by a Code 55.

PROM

An incorrect or faulty PROM, which is part of the ECM, may set a Code 51.

ECM INPUTS

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches can be diagnosed by the use of "a Scan" tool. The "Scan" tool can also by used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temperature Sensor

A "Scan" tool displays engine temp. in degrees centigrade. After the engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAT Sensor

A "Scan" tool displays temperature of the air entering the engine and should read close ambient air temperature, when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight), the MAT sensor temperature and coolant temperature should read close to each other.

A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAP Sensor

A "Scan" tool reads manifold pressure and will display either volts or kPa of pressure.

Key "ON", engine stopped, (no vacuum), MAP will read high voltage or pressure, while at idle (highvacuum), MAP will read low voltage or pressure. Likewise, on accel., MAP will read high and on decel., will read low.

A failure in the MAP sensor, or circuit, should result in a Code 33 or 34.

Oxygen (O_2) Sensor

The "Scan" tool has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" tool position information in the Introduction of Section "6E".

A problem in the O_2 sensor circuit should set a Code 13 (open circuit), Code 44 (lean O_2 indication), Code 45 (rich O_2 indication). Refer to the applicable chart, if any of these codes were stored in memory.

Throttle Position Sensor (TPS)

A "Scan" tool displays throttle position in volts. The 5.0L should read under 1.25 volts, with throttle closed and ignition on, or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

The ECM has the ability to Auto-Zero the TPS voltage, if it is below about 1.25 volts. This means that any voltage less than 1.25 volts volts will be determined by the ECM to be 0% throttle. Some "Scan" tools have the ability to read the percentage of throttle angle and should read 0%, when the throttle is closed. A failure in the TPS circuit or TPS, should set a Code 21 or 22.

Vehicle Speed Sensor (VSS)

A "Scan" tool reading should closely match with speedometer reading, with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read "ON", when in park or neutral and "OFF", when in drive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

Power Steering Pressure Switch (PSPS)

A Scan" tool should read "OFF" normally, and "ON" with high pressure. This reading may vary with different makes of tools. Refer to CHART C-1E for PSPS diagnosis.

A/C Request Signal

If the low pressure switch is closed and A/C is "ON", the "Scan" tool should indicate A/C "ON".

Distributor Reference Signal

A "Scan" tool will read this signal and is displayed in rpm. See Section "C4", for more information on the Ignition System .

Knock Signal

A "Scan" tool will indicate when the ESC module signals the ECM that knock is present. See Section "C5" for further information on the ESC System.

ON-CAR SERVICE

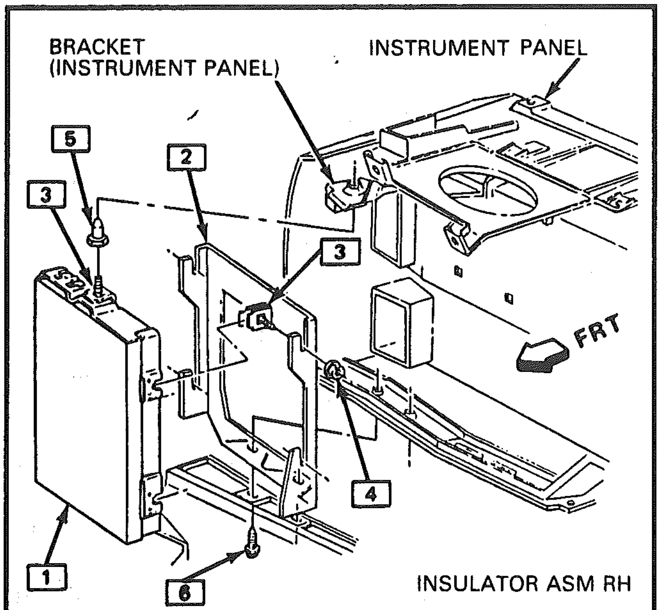
ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should normally consist of either replacement of the ECM or a PROM change.

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (PROM) and ECM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A PROM. Trouble Code "51" indicates the PROM is installed improperly or has malfunctioned. When Code "51" is obtained, check the PROM installation for bent pins or pins not fully seated in the socket. If the PROM is installed correctly and Code "51" still shows, replace the PROM.

Important

When replacing the production ECM with a service ECM (controller), it is important to transfer the Broadcast code and production ECM number to the service ECM label. Please do not record on ECM cover. This will allow positive identification of ECM parts throughout the service life of the vehicle.



1 MODULE ASM ECM (TBI)
2 BRACKET
3 BOLT/SCREW (5)
4 NUT (4) 4.7-7.0 N·m (3.3-5.1 LBS. FT.)
5 NUT
6 BOLT/SCREW (2) 2.2-3.4 N·m (1.6-2.5 LBS. FT.)

8S 4427-6E

Figure C1-9 - ECM Mounting

NOTICE: To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example, battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

Remove or Disconnect

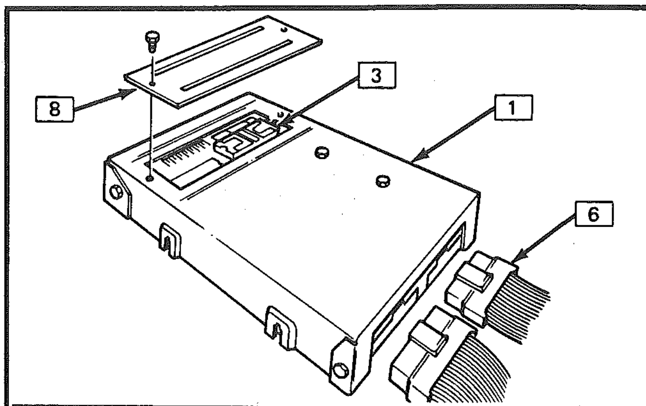
1. Negative battery cable.
2. Right hand hush panel.
3. Connectors to ECM.
4. ECM.
5. PROM from ECM.

Install or Connect

1. Old PROM in new ECM.
2. ECM into car.
3. Connectors.
4. Hush panel.
5. Negative battery cable.

PROM

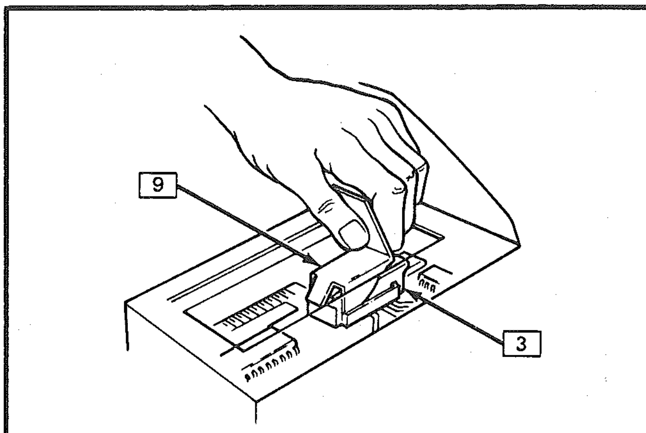
Code 51 indicates a faulty PROM, bent pins, or incorrect installation.



1 ECM
3 PROM CARRIER
6 ECM HARNESS CONNECTORS TO ECM
8 PROM ACCESS COVER

4S 0463-6E

Figure C1-10 PROM Access Cover



3 PROM CARRIER
9 PROM REMOVAL TOOL

4S 0464-6E

Figure C1-11 PROM Removal Tool

Important

It is possible to install a PROM backward. If the PROM is installed backward and the ignition key turned to "ON," the PROM circuitry will be destroyed, requiring PROM replacement.

Important

The ignition should always be off when installing or removing the ECM connectors.

Remove or Disconnect

1. Connectors from ECM.
2. ECM mounting hardware.
3. ECM from passenger compartment.
4. Prom access cover (see Figure C1-10).
5. Remove PROM assembly

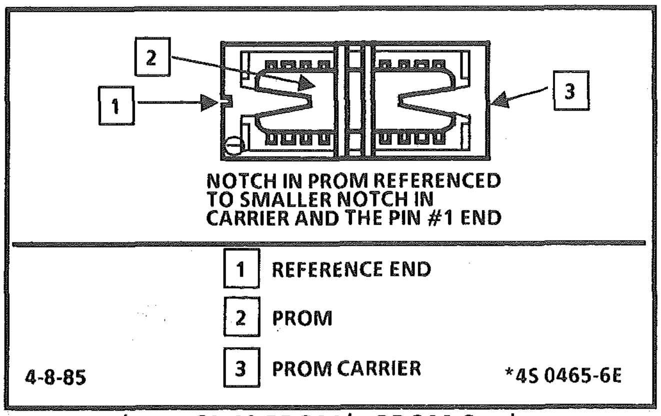


Figure C1-12 PROM in PROM Carrier

Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool (see Figure C1-11). Press on the vertical bar end of the tool and rock the engaged end of the PROM carrier up as far as possible. Engage the opposite end of the PROM carrier in the same manner and rock this end up as far as possible. Repeat this process until the PROM carrier and PROM are free of the PROM socket. The PROM carrier with PROM in it should lift off of the PROM socket easily. PROM carrier should only be removed by using the pictured PROM removal tool. Other methods could cause damage to the PROM or PROM socket.

Remove or Disconnect

1. New PROM carrier in PROM socket.

Inspect

1. New PROM for same part number as old or updated number per service bulletin.

Important

Do not remove PROM from carrier to check PROM number.

2. For correct reference of PROM in carrier, see Figure C1-12.

Important

Small notch of carrier should be aligned with small notch in socket. Press on PROM carrier until it is firmly seated in the socket. Do not press on PROM; only the carrier.

2. Access cover on ECM.
3. ECM in passenger compartment.
4. Connectors to ECM.

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics (see Diagnostic Circuit Check for procedure).
   A. Allow Code 12 to flash four times to verify that no other codes are present. This indicates the PROM is installed properly.
   B. If trouble Code 51 occurs or if the "Service Engine Soon" light is "ON" constantly with no codes, the PROM is not fully seated, installed backwards, has bent pins, or is defective.
      - If not fully seated, press firmly on PROM carrier.
      - If it is necessary to remove the PROM, follow instructions in steps "A" and "B".
      - If installed backwards, REPLACE THE PROM.
   - If pins bend, remove PROM, straighten pins, and reinstall. If bent pins break or crack during straightening, discard PROM and replace it.

NOTICE: Any time the PROM is installed backward and the ignition switch turned "ON", the PROM is destroyed.

CALPAK

Remove or Disconnect

1. Remove ECM access cover.
2. Remove CALPAK (Figure C1-13) using removal tool shown. Grasp the CALPAK carrier at the narrow end only. Gently rock the carrier from end to end while applying a firm upward force.

Inspect

3. Inspect reference end of the CALPAK carrier and carefully set aside. Do not remove CALPAK from the carrier to confirm CALPAK correctness. Notch in CALPAK referenced to smaller notch in carrier and the (1).

Install or Connect

4. Install CALPAK. If a service CALPAK is being installed, make sure it has the same part number as the removed CALPAK. Do not press on the CALPAK - only the carrier.
   Small notch of the carrier must be aligned with small notch in socket. Press on CALPAK carrier until it is firmly seated in the socket.
5. Install ECM access cover.
6. Install ECM in passenger compartment and perform a "Diagnostic Circuit Check" to confirm proper installation.

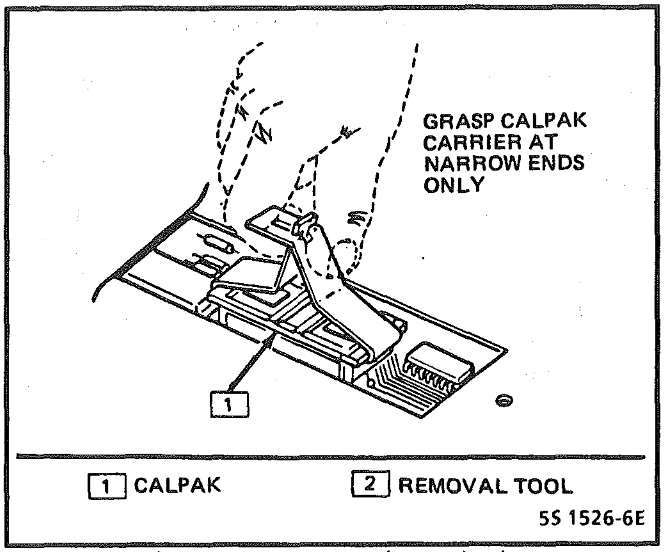


Figure C1-13 Removing Calpak

COOLANT SENSOR

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Injection system.

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Negative battery cable.

MAT Sensor

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out sensor.

Install or Connect

1. Coat threads only with sealant, P/N 1052080 or equivalent.
2. Sensor in engine.
3. Electrical connector.
4. negative battery cable.

MAP SENSOR

Other than checking for loose hoses and electrical connections the only service possible is unit replacement if diagnosis shows sensor to be faulty.

OXYGEN SENSOR

NOTICE: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.

Important

Take care when handling the oxygen sensor (Figure C1-14). The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out oxygen sensor.

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F). Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out Oxygen Sensor.

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will tend to burn away, but the glass beads will remain, making the sensor easier to remove.

New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 3613695 or equivalent if necessary.
2. Sensor, and torque to 41 N·M (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

THROTTLE POSITION SENSOR (TPS)

Remove or Disconnect

1 Air cleaner.
2 Electrical connector.
3 Two TPS attaching screws, lockwashers and retainers.
4. Sensor.

Install or Connect

1. With throttle valve in the normal closed idle position, install throttle position sensor on throttle body assembly, making sure TPS pickup lever is located ABOVE tang on throttle actuator lever.
2. Retainers and two TPS screws and lockwashers using a thread locking compound on the screws. Use loctite 262, GM part No. 1052624, or equivalent. Tighten screws.
3. Connector.
4. Air cleaner.

PARK/NEUTRAL SWITCH

See Section 8A for location of park/neutral switch. On-Car Service and Adjustment Procedures are also listed there.

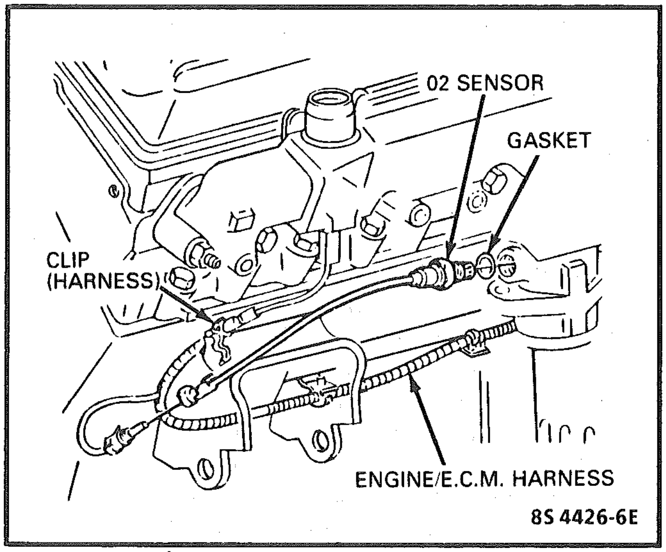


Figure C1-14 Oxygen Sensor

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, Coolant Temp.	3.682
MAT Sensor	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, MAP	3.682
Sensor Kit, Throttle Position	3.764
Switch, Neu Saf and Backing LP	2.698

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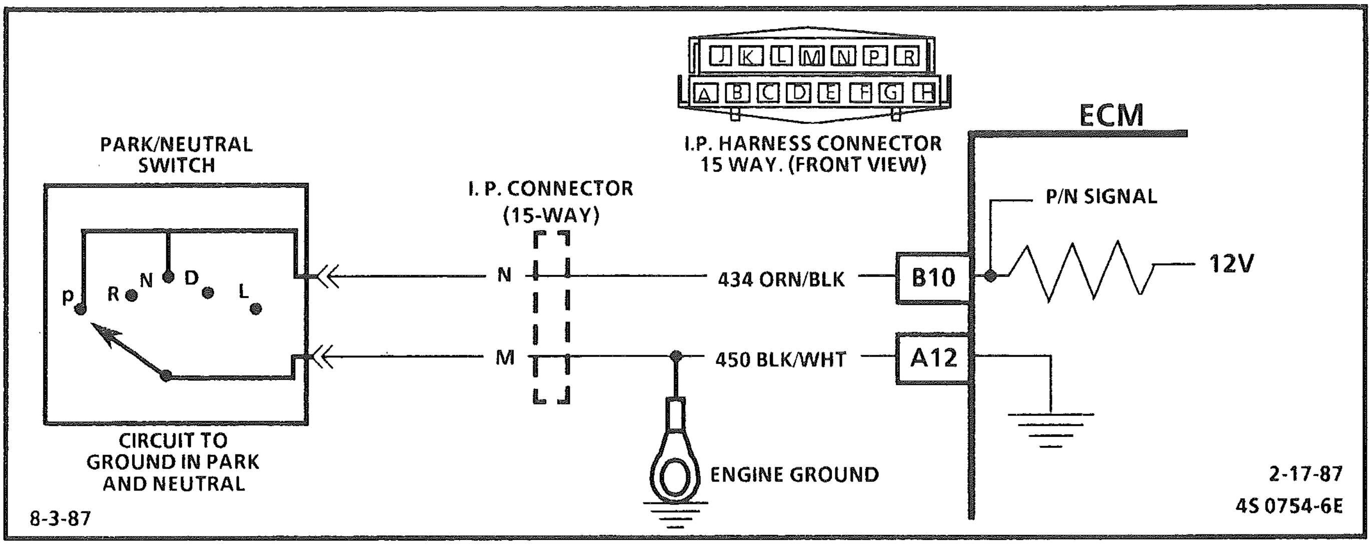


CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSMISSION ONLY)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The park/neutral switch contacts are a part of the neutral start switch, and are closed to ground in park or neutral and open in drive ranges.

The ECM supplies ignition voltage through a current limiting resistor to CKT 434 and senses a closed switch when the voltage on CKT 434 drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

Idle air control
VSS diagnostics
EGR

If CKT 434 indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

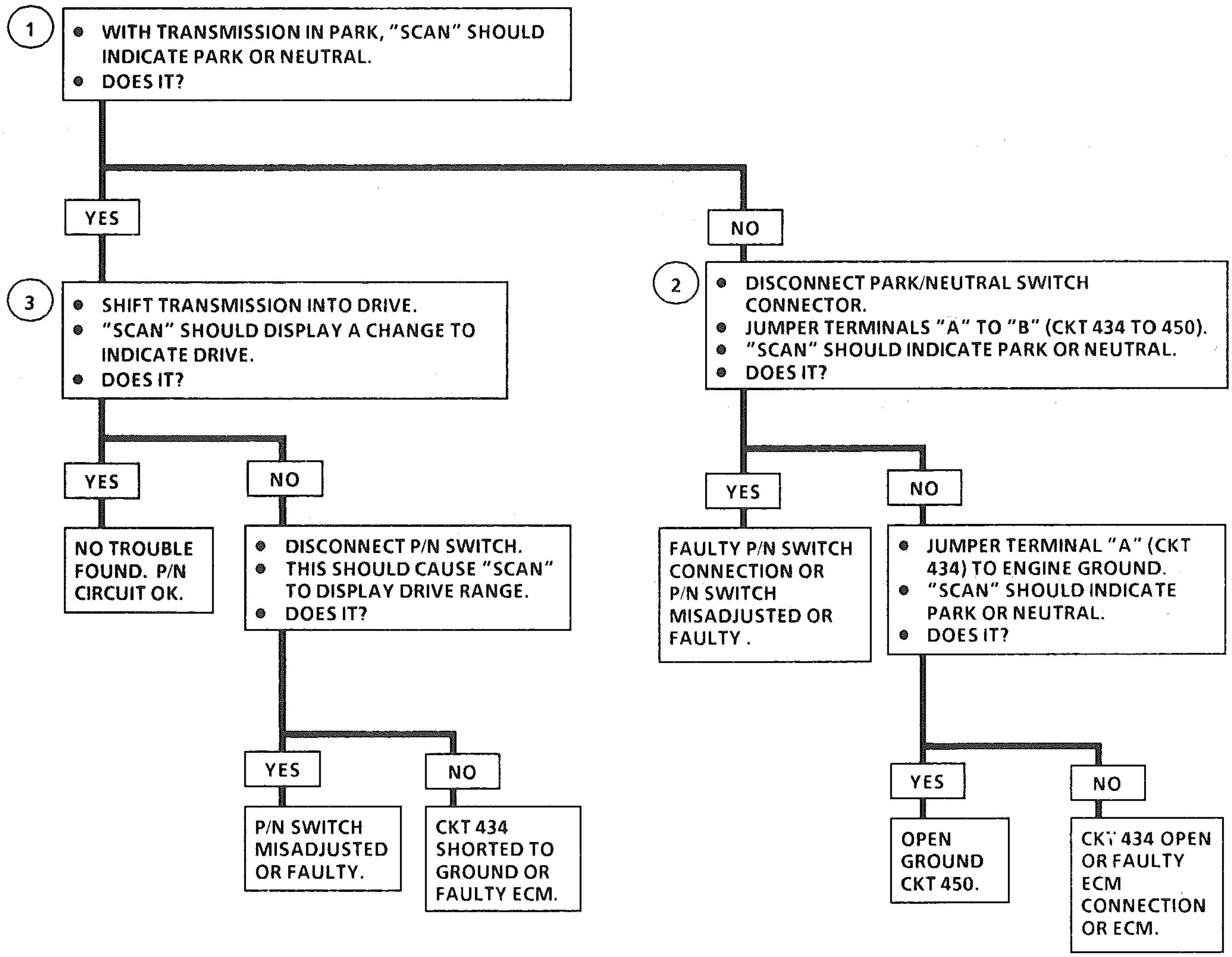
If CKT 434 always indicates drive (open), a drop in the idle may exist when the gear selector is moved into drive range.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to "Operators Manual" for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" tool indicates drive, even while wiggling shifter to test for an intermittent or misadjusted switch in drive range.

CHART C-1A

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSMISSION ONLY)
5.0L (VIN E) "F" SERIES (TBI)



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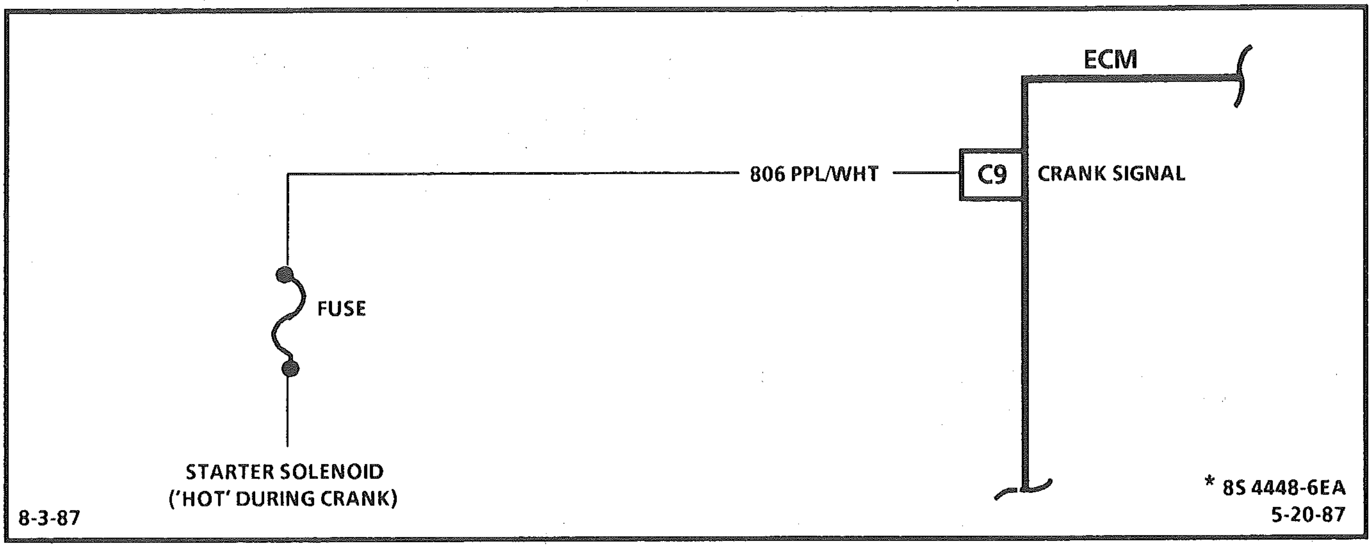


CHART C-1B

CRANK SIGNAL
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

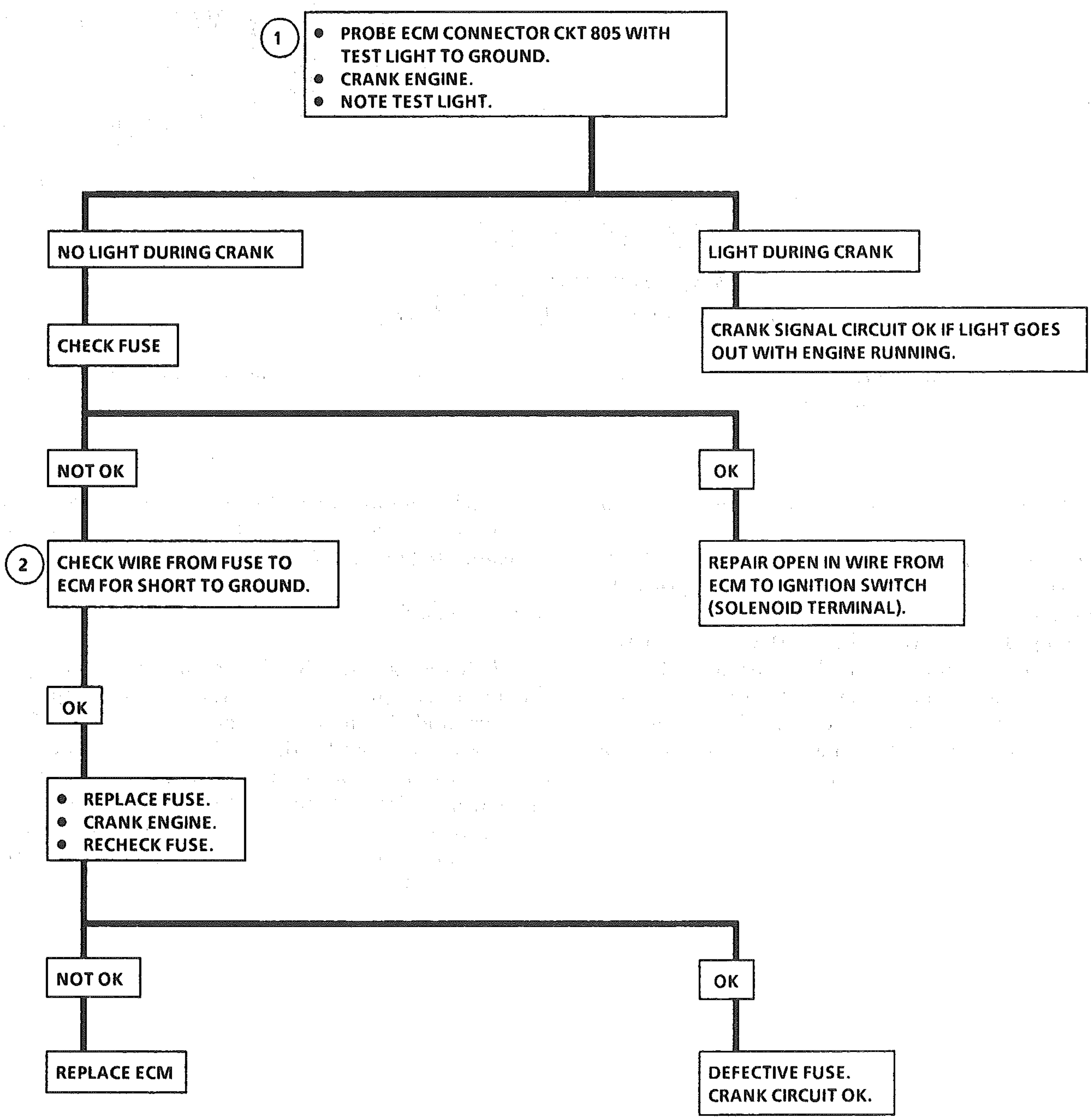
Crank signal is a 12 volts signal to the ECM during cranking to allow enrichment and cancel diagnostics until engine is running and 12 volts is no longer on circuit.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for normal (cranking) voltage to terminal "C9" of ECM. Test light should be "ON" during cranking.
2. Checks to determine if source of blown fuse was a faulty ECM.

CHART C-1B

CRANK SIGNAL
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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4S 0820-6E

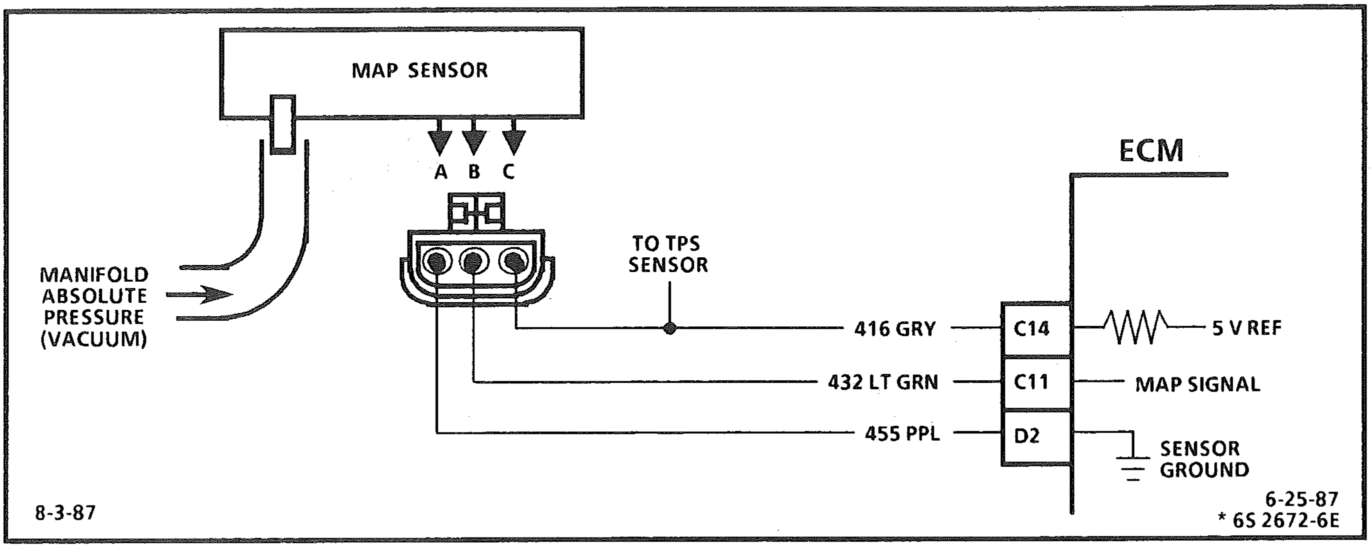

CHART C-1D

MAP OUTPUT CHECK
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The manifold absolute pressure sensor (MAP) measures manifold pressure (vacuum) and sends that signal to the ECM. The ECM uses this information for fuel and spark control.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks MAP sensor output voltage to the ECM. This voltage, without engine running, represents a barometer reading to the ECM.
2. Applying 34 kPa (10 inches Hg) vacuum to the MAP sensor should cause the voltage to be 1.2 volts less than the voltage at Step 1. Upon applying vacuum to the sensor, the change in voltage should be instantaneous. A slow voltage change indicates a faulty sensor.
3. Check vacuum hose to sensor for leaking or restriction. Be sure no other vacuum devices are connected to the MAP hose.

Diagnostic Aids:

With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor. Reading should be the same, ± .4 volt.

CHART C-1D

MAP OUTPUT CHECK
5.0L (VIN E) "F" SERIES (TBI)

(1)
- IGNITION "ON", ENGINE STOPPED.
  "SCAN" TOOL SHOULD INDICATE A VOLTAGE WITHIN THE VALUES SHOWN IN THE CHART BELOW.

OK

(2)
- DISCONNECT VACUUM HOSE AT MAP SENSOR AND PLUG HOSE
- CONNECT A HAND VACUUM PUMP TO MAP SENSOR
- START ENGINE
- APPLY 34 kPa (10") OF VACUUM AND NOTE VOLTAGE CHANGE. (VOLTAGE SHOULD BE 1.2 - 2.3 VOLTS LESS THAN STEP 1.)

OK

(3) NO TROUBLE FOUND. CHECK MAP HOSE FOR LEAKAGE OR RESTRICTION. BE SURE THIS HOSE SUPPLIES VACUUM TO MAP SENSOR ONLY.

NOT OK

CHECK SENSOR CONNECTION, IF OK, REPLACE SENSOR.

NOT OK (step 1)

REPLACE SENSOR

ALTITUDE Meters	ALTITUDE Feet	VOLTAGE RANGE
Below 305	Below 1,000	3.8---5.5V
305--- 610	1,000--2,000	3.6---5.3V
610--- 914	2,000--3,000	3.5---5.1V
914--1219	3,000--4,000	3.3---5.0V
1219--1524	4,000--5,000	3.2---4.8V
1524--1829	5,000--6,000	3.0---4.6V
1829--2133	6,000--7,000	2.9---4.5V
2133--2438	7,000--8,000	2.8---4.3V
2438--2743	8,000--9,000	2.6---4.2V
2743--3048	9,000--10,000	2.5---4.0V

LOW ALTITUDE = HIGH PRESSURE = HIGH VOLTAGE

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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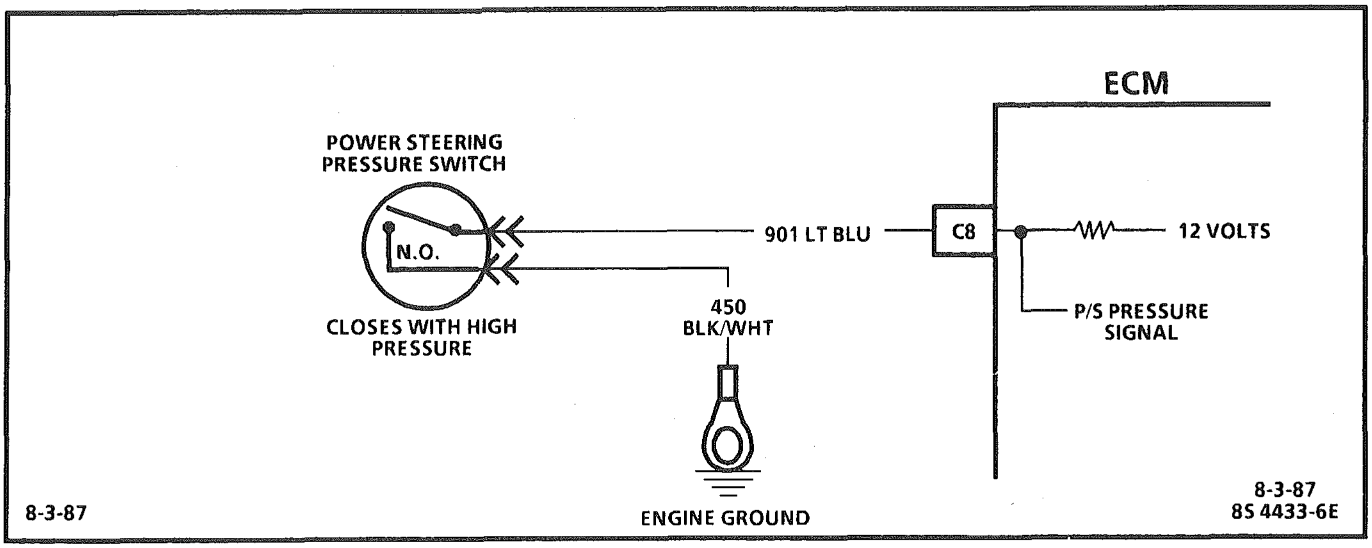


CHART C-1E

POWER STEERING PRESSURE SWITCH (PSPS) DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The power steering pressure switch is normally open to ground, and CKT 901 will be near the battery voltage.

Turning the steering wheel increases power steering oil pressure and its load on an idling engine. The pressure switch will close before the load can cause an idle problem.

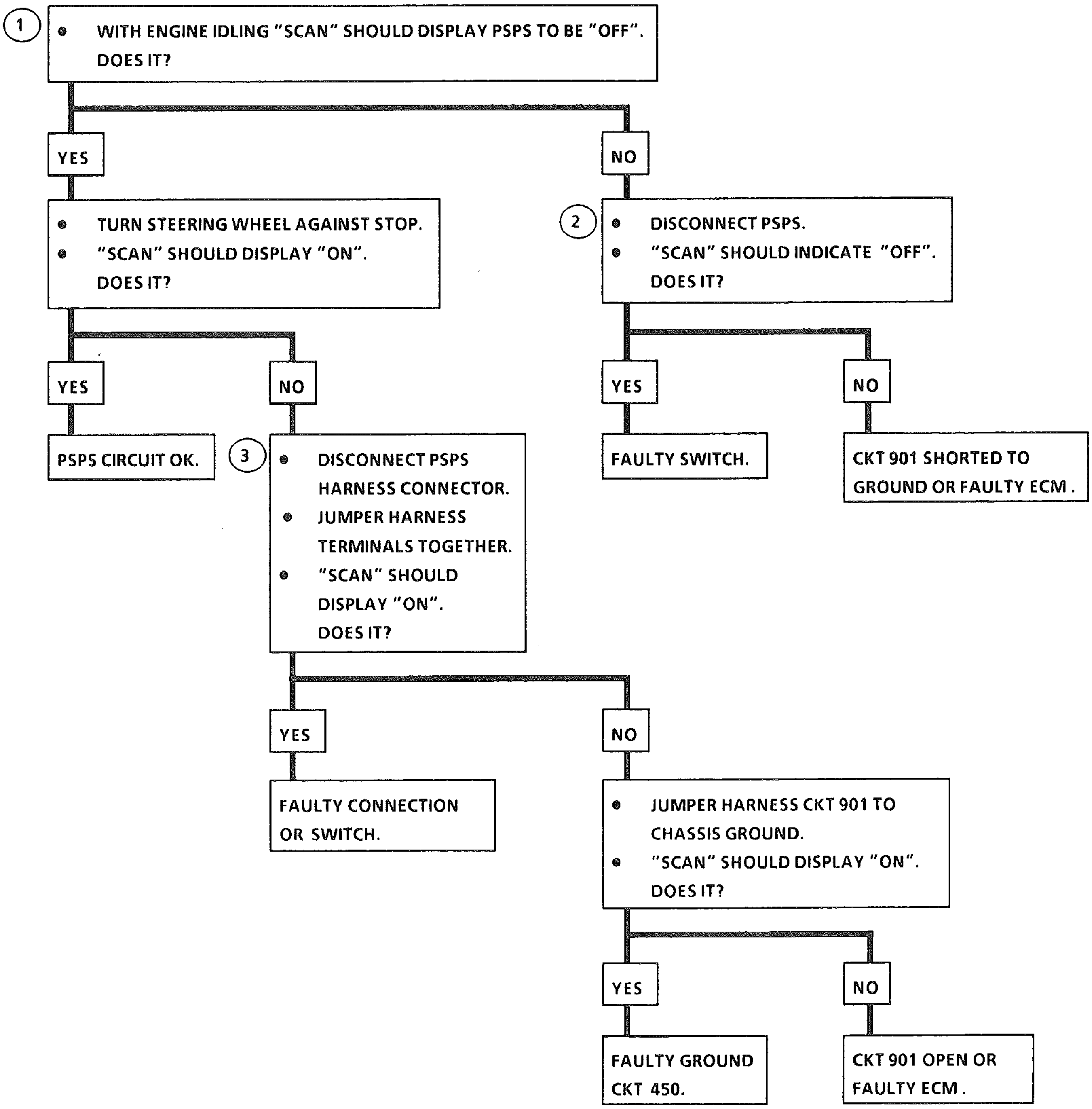
Closing the switch causes CKT 901 to read less than 1 volt and the ECM will increase the idle air rate and de-energize the A/C relay.

- A pressure switch that will not close, or an open CKT 901 or 450, may cause the engine to stop when power steering loads are high.
- A switch that will not open, or a CKT 901 shorted to ground, may affect idle quality, and will cause the A/C relay to be de-energized.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Different makes of "Scan" tools may display the state of this switch in different ways. Refer to "Scan" tool upgrading to determine how this input is indicated.
2. Checks to determine if CKT 901 is shorted to ground.
3. This should simulate a closed switch.

CHART C-1E
POWER STEERING PRESSURE SWITCH (PSPS) DIAGNOSIS
5.0L (VIN E) "F" SERIES (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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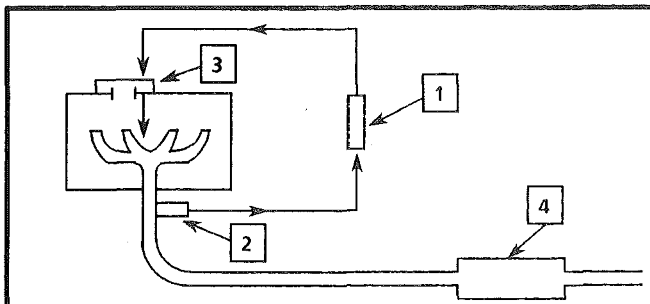
SECTION C2
FUEL CONTROL SYSTEM
TBI MODEL 220

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine. Fuel is delivered to the engine by a throttle body injection (TBI) unit.



1 ENGINE CONTROL MODULE (ECM)
2 EXHAUST OXYGEN (O_2) SENSOR
3 THROTTLE BODY INJECTION UNIT (TBI)
4 CATALYTIC CONVERTER

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4 3 87

Figure C2-1 - Closed Loop System

The main control sensor is the oxygen (O_2) sensor, which is located in the exhaust manifold. The O_2 sensor tells the engine control module ECM the amount of oxygen in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injector. A 14.7:1 air/fuel ratio is required for efficient catalytic converter operation. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "Closed Loop" System (Figure C2 -1).

MODES OF OPERATION

The ECM monitors voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called "modes." All the modes are controlled by the ECM.

Starting Mode

When the key is first turned "ON", the ECM turns on the fuel pump relay for two seconds, and the fuel pump builds up pressure to the TBI unit. The ECM checks the coolant temperature sensor, throttle position sensor (TPS), manifold absolute pressure (MAP) sensor, and crank signal, then determines the proper air/fuel ratio for starting. This ranges from

1.5:1 at -36°C (-33°F) to 14.7:1, at 94°C (201°F) running temperature.

The ECM controls the amount of fuel delivered in the starting mode by changing how long the injector is turned "ON" and "OFF". This is done by "pulsing" the injector for very short times.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injector at a 20:1 air/fuel ratio, and holds this injector rate as long as the throttle stays wide open, and the engine is below 600 rpm. If the throttle position becomes less than 80%, the ECM returns to the starting mode.

Run Mode

The run mode has two conditions called "Open Loop" and "Closed Loop."

Open Loop

When the engine is first started, and it is above 400 rpm, the system goes into "Open Loop" operation. In "Open Loop," the ECM ignores the signal from the (O_2) sensor, and calculates the air/fuel ratio based on inputs from the coolant temperature and MAP sensors.

The system stays in "Open Loop" until the following conditions are met:

1. The O_2 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The coolant temperature sensor is above a specified temperature.
3. A specific amount of time has elapsed after starting the engine.

Closed Loop

The specific values for the above conditions vary with different engines, and are stored in the programmable read only memory (PROM). When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop," the ECM calculates the air/fuel ratio (injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

The ECM looks at rapid changes in throttle position and manifold pressure, and provides extra fuel.

Deceleration Mode

When deceleration occurs, the fuel remaining in the intake manifold can cause excessive emissions and backfiring. Again, the ECM looks at changes in throttle position and manifold pressure and reduces the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for a weak spark delivered by the distributor by:

- Increasing injector on time of fuel delivered;
- Increasing the idle rpm.

Fuel Cutoff Mode

No fuel is delivered by the injectors when the ignition is "OFF". This prevents dieseling. Also, fuel is not delivered if no reference pulses are seen from the distributor, which means the engine is not running. **Fuel cutoff also occurs at high engine rpm, to protect internal engine components from damage.**

FUEL CONTROL SYSTEM COMPONENTS

The fuel control system consists of the following:

- Throttle body injection (TBI) unit
- Fuel pump
- Fuel pump relay.

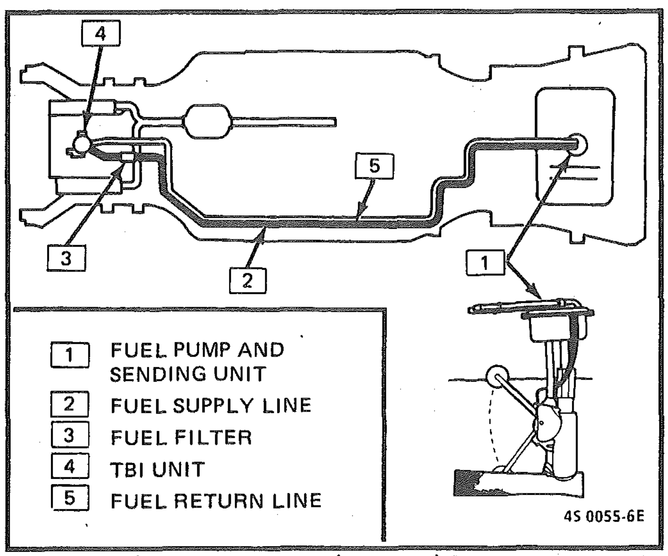


Figure C2-2 - Fuel Control System

BASIC SYSTEM OPERATION

The fuel control system (Figure C2-2) has an electric fuel pump, located in the fuel tank with the gage sending unit, which pumps fuel to the TBI through the fuel supply line, then through an in-line fuel filter. The pump is designed to provide pressurized fuel at about 125 kPa (18 psi). A pressure regulator in the TBI keeps fuel available to the injectors at a constant pressure between 62 and 90 kPa (9 and 13 psi). Fuel in excess of injector need is returned to the fuel tank by a separate line.

The ECM controls the injectors that are located in the fuel meter body assembly of the TBI. The injectors deliver fuel in one of several modes, described above.

In order to properly control the fuel supply, the fuel pump is operated by the ECM through the fuel pump relay and oil pressure switch (see "Fuel Pump Electrical Circuit").

THROTTLE BODY INJECTION (TBI) UNIT

The Model 220 unit (Figure C2-3) consists of three major casting assemblies:

1. A fuel meter cover with:
   - A pressure regulator
2. A fuel meter body with:
   - Two fuel injectors
3. A throttle body with:
   - Two throttle valves
   - An idle air control (IAC) valve
   - A throttle position sensor (TPS).

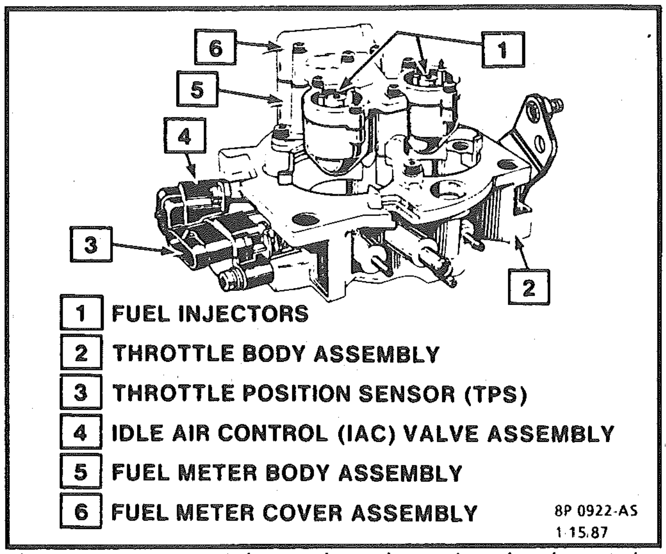


Figure C2-3 - Model 220 Throttle Body Injection Unit

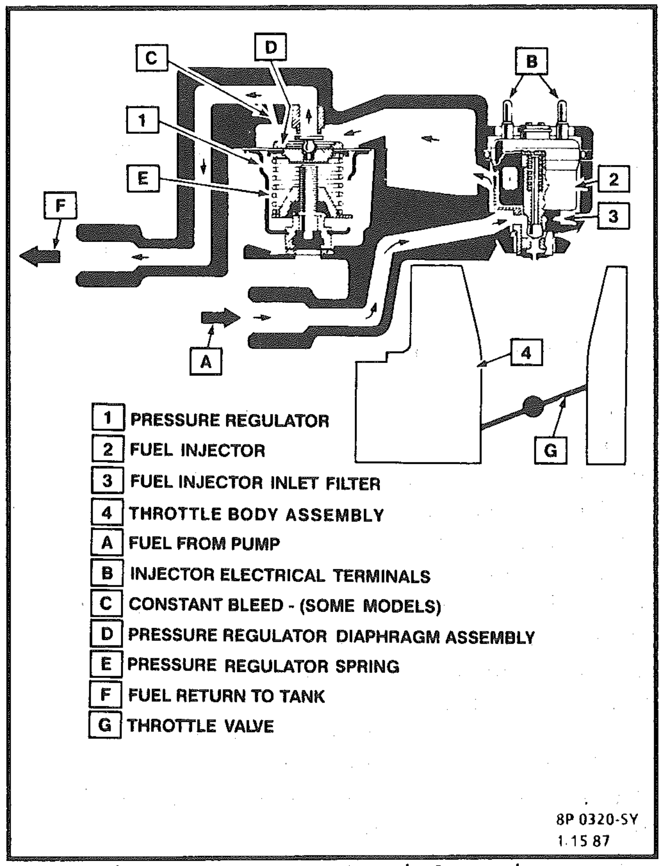


Figure C2-4 - TBI 220 Unit Operation

Fuel Injectors

Fuel injectors (Figure C2-4) are solenoid-operated devices controlled by the ECM. The ECM turns on the solenoid, which lifts a normally closed ball valve off a seat. Fuel, under pressure, is injected in a conical spray pattern at the walls of the throttle body bore above the throttle valve. The fuel which is not used by the injectors passes through the pressure regulator before being returned to the fuel tank.

A fuel injector which does not open may cause a no-start condition. An injector which is stuck partly open will cause a loss of pressure after setting, so long crank times would be noticed. Also, dieseling could occur because some fuel would be delivered to the engine after the key is turned "OFF."

Pressure Regulator

The pressure regulator (see Figure C2-4) is a diaphragm-operated relief valve with injector pressure on one side and air cleaner pressure on the other. The function of the regulator is to maintain a constant pressure at the injectors at all times, by controlling the flow in the return line (by means of a calibrated bypass).

The pressure regulator is serviced as part of the fuel meter cover and should not be disasembled.

If the pressure regulator in the TBI supplies pressure which is too low (below 62 kPa or 9 psi), poor performance could result. If the pressure is too high, excess emissions and unpleasant exhaust odor may result.

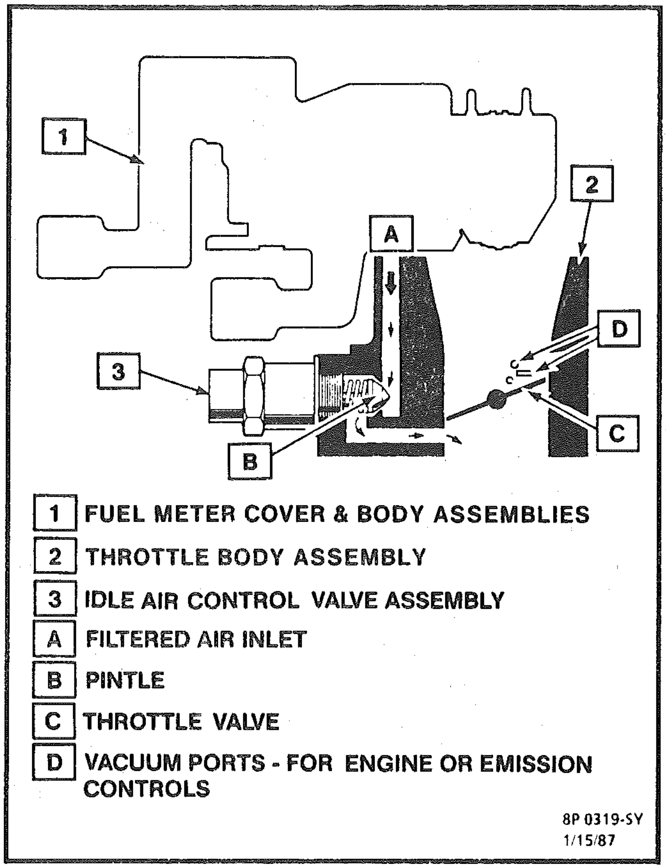


Figure C2-5 - Idle Air Contol System

Idle Air Control (IAC) Valve

The purpose of the idle air control (IAC) valve , is to control engine idle speed, and prevent stalls due to changes in engine load (see Figure C2-5) .

The IAC valve, mounted on the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle valve. If rpm is too low, more air is bypassed around the throttle valve to increase rpm. If rpm is too high, less air is bypassed around the throttle valve to decrease rpm.

The IAC valve moves in small steps called "Counts," and can be monitored by a "Scan" tool which plugs into the assembly line data link (ALDL) connector

During idle, the proper position of the IAC valve is calculated by the ECM based on battery voltage, coolant temperature, engine load, and engine rpm. If the rpm drops below a specified rpm, and the throttle valve is closed, the ECM senses a near stall condition. The ECM will then calculate a new IAC valve position to prevent stalls .

If the IAC valve is disconnected or connected with the engine running, the idle rpm may be wrong. In this case, the IAC valve may be reset by turning the ignition switch "ON" and "OFF" one time.

The IAC valve affects only the idle characteristics of the engine. If it is open fully, too much air will be

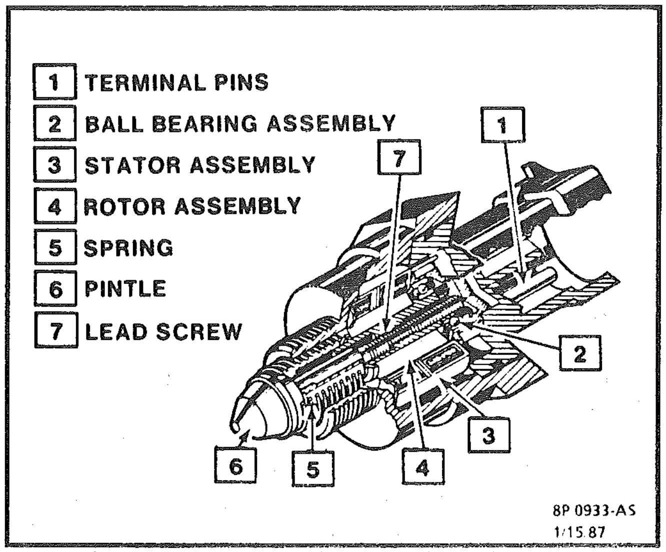


Figure C2-6 - Idle Air Control (IAC) Valve

allowed to the manifold and idle speed will be high. If it is stuck closed, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

On 4.3L (VIN Z) V6, LB4 engines, for "B" and "G" cars, the valve is thread mounted, with a dual taper,10 mm diameter pintle (Figure C2-6). If replacement is necessary, use only an IAC valve with the correct part number and appropriate pintle shape and diameter.

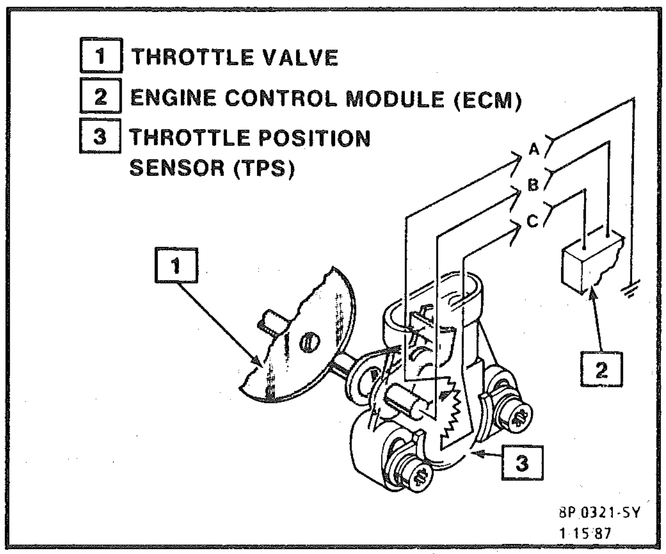


Figure C2-7 - Throttle Position Sensor

Throttle Position Sensor (TPS)

The throttle position sensor (TPS), is mounted on the side of the throttle body opposite the throttle lever assembly. Its function is to sense the current throttle valve position and relay that information to the ECM (Figure C2-7). Knowledge of throttle position allows the ECM to generate the required injector control signals (base pulse). If the TPS senses a wide open throttle, a voltage signal indicating this condition is sent to the ECM. The ECM then increases the injector base pulse width, permitting increased fuel flow.

As the throttle valve rotates in response to movement of the accelerator pedal, the throttle shaft transfers this rotational movement to the TPS. A potentiometer (variable resistor) within the TPS assembly changes its resistance (and voltage drop) in proportion to throttle movement.

By applying a reference voltage (5.0 volts) to the TPS input, a varying voltage (reflecting throttle position) is available at the TPS output. For example, approximately 2.5 volts results from a 50% throttle valve opening (depending on TPS calibration). The voltage output from the TPS assembly is routed to the ECM for use in determining throttle position.

FUEL PUMP

The fuel pump is a turbine type, low pressure electric pump, mounted in the fuel tank. Fuel is pumped at a positive pressure (above 62 kPa or 9 psi) from the fuel pump through the in-line filter to the pressure regulator in the TBI assembly. Excess fuel is returned to the fuel tank through the fuel return line.

The fuel pump is attached to the fuel gage sender assembly. A fuel strainer is attached to the fuel pump inlet line and prevents dirt particles from entering the fuel line and tends to separate water from the fuel.

Vapor lock problems are reduced when using an electric pump because the fuel is pushed from the tank under pressure rather than being pulled under vacuum, a condition that produces vapor.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance. (See "Fuel System Pressure Test" procedure).

FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON" without the engine running, the ECM turns the fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump "OFF" and waits until the engine starts. As soon as the engine is cranked, the ECM turns the relay "ON" and runs the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned on by the oil pressure switch. The oil pressure sender has two circuits internally. One operates the oil pressure indicator or gage in the instrument cluster, and the other is anormally open switch which closes when oil pressure reaches about 28 kPa (4 psi). If the fuel pump relay fails, the oil pressure switch will run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold. The oil pressure switch will turn on the fuel pump as soon as oil pressure reaches about 28 kPa (4 psi).

DIAGNOSIS

FUEL CONTROL

Always start with the "Diagnostic Circuit Check" in Section "6E2-A". This will reduce diagnosis time and prevents unnecessary replacement of parts. The information in this check will direct diagnosis concerning "Engine Cranks But Won't Run" and the "Fuel Control System," Section "6E2-C2", including diagnosis of an injector, pressure regulator, fuel pump, fuel pump relay, and oil pressure switch.

Idle Air Control (IAC) Valve

A "Scan" tool reads IAC position in steps, called "Counts." "0" steps indicates the ECM is commanding the IAC to be driven in, to a fully seated position (minimum idle air). The higher the number steps, the more idle air being allowed to pass by the IAC valve.

Refer to CHART C-2C for information to diagnose the function of the IAC valve.

Drivability

Refer to Section "B" for driveability symptoms related to the fuel control.

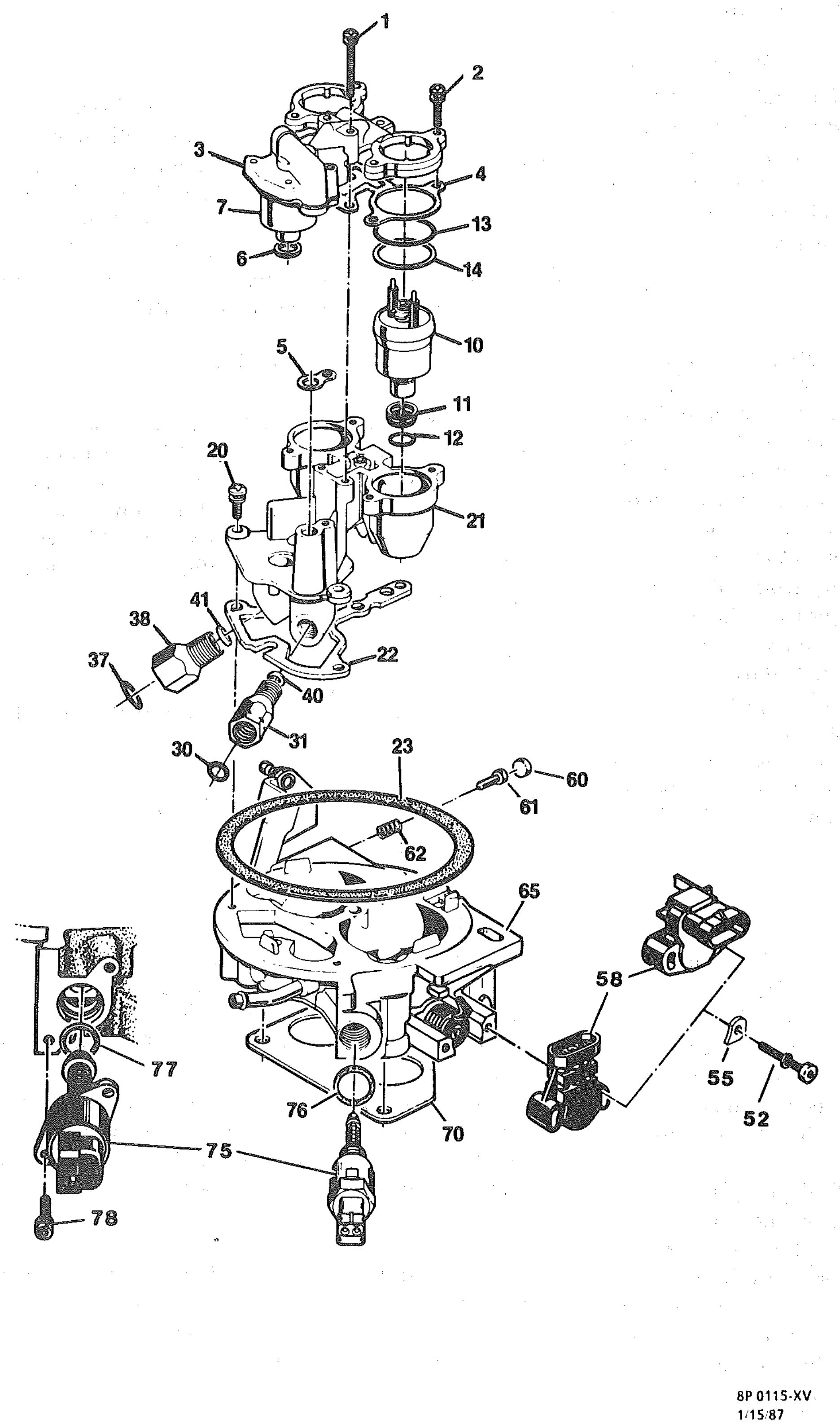
ON-VEHICLE SERVICE

GENERAL SERVICE INFORMATION

CAUTION:

- **To prevent personal injury or damage to the vehicle as the result of an accidental start, disconnect and reconnect the negative battery cable before and after service is performed.**
- **Also, catch any fuel that leaks out when disconnecting the fuel lines, by covering the fittings with a shop cloth. Place the cloth in an approved container when work is complete.**

The TBI unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine.



PARTS IDENTIFICATION Model 220 TBI

1	Screw Assembly - Fuel Meter Cover Attaching - Long
2	Screw Assembly - Fuel Meter Cover Attaching - Short
3	Fuel Meter Cover Assembly
4	Gasket - Fuel Meter Cover
5	Gasket - Fuel Meter Outlet
6	Seal - Pressure Regulator
7	Pressure Regulator
10	Injector - Fuel
11	Filter - Fuel Injector Inlet
12	O-ring - Fuel Injector - Lower
13	O-ring - Fuel Injector - Upper
14	Washer - Fuel Injector
20	Screw Assembly - Fuel Meter Body - Throttle Body Attaching
21	Fuel Meter Body Assembly
22	Gasket - Throttle Body to Fuel Meter Body
23	Gasket - Air Cleaner
30	O-ring - Fuel Return Line
31	Nut - Fuel Outlet
37	O-ring - Fuel Inlet Line
38	Nut - Fuel Inlet
40	Gasket - Fuel Outlet Nut
41	Gasket - Fuel Inlet Nut
52	Screw Assembly - TPS Attaching
55	Retainer - TPS Attaching Screw
58	Sensor - Throttle Position
60	Plug - Idle Stop Screw
61	Screw Assembly - Idle Stop
62	Spring - Idle Stop Screw
65	Throttle Body Assembly
70	Gasket - Flange
75	Valve Assembly - Idle Air Control
76	Gasket - Idle Air Control Valve Assembly
77	O-Ring - IACV
78	Screw Assembly - IACV Attaching

Figure C2-8 - Model 220 TBI Parts Identification

Refer to the disassembled view (Figure C2-8) for identification of parts during repair procedures. Service repair of individual components is performed without removing the TBI unit from the engine. If removed, it is essential that care is taken to prevent damage to the throttle valve or sealing surface while performing any service.

Whenever service is performed on the TBI or any of its components, first remove the air cleaner, adapter and air cleaner gaskets. Discard the gaskets and replace them with new ones before replacing the air cleaner after service is complete.

When disconnecting the fuel lines, be sure to use a backup wrench (J-29698-A, or BT8251-A, or equivalent) to keep the TBI nuts from turning.

Fuel Pressure Relief

The TBI Model 220 on this engine contains a constant bleed feature in the pressure regulator that relieves pressure. Therefore, no special pressure relief procedure is required.

Fuel System Pressure Test

A fuel system pressure test is part of several of the diagnostic charts and symptom checks. To perform this test, follow this procedure:

1. Turn engine "OFF" to relieve fuel pressure.
2. Remove air cleaner and plug THERMAC vacuum port on TBI.
3. Uncouple fuel supply flexible hose in engine compartment. Install fuel pressure gage J-29658A/BT8205 and adapter 29658A-85 between steel line and flexible hose.
4. Tighten gage in line to ensure no leaks occur during testing.
5. Start car and observe fuel pressure reading. It should be 62-90 kPa (9-13 psi); if not, refer to CHART A-7.
6. Relieve fuel pressure.
7. Remove fuel pressure gage.
8. Reinstall fuel line.
9. Start car and check for fuel leaks.
10. Remove plug from vacuum port and install air cleaner with new gasket.

Cleaning and Inspection

All TBI component parts, with the exception of those noted below, should be cleaned in a cold immersion cleaner such as Carbon X (X-55) or equivalent.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, pressure regulator diaphragm assembly, fuel injectors or other components containing rubber,should NOT be placed in a solvent or cleaner bath. A chemical reaction will cause these parts to swell, harden or distort. Do not soak the throttle body with the above parts attached. If the throttle body assembly requires cleaning, soaking time in the cleaner should be kept to a minimum. Some models have hidden throttle shaft dust seals that could lose their effectiveness by extended soaking.

1. Clean all metal parts thoroughly and blow dry with shop air. Be sure that all fuel and air passages are free of dirt or burrs.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

Thread Locking Compound

Service repair kits are supplied with a small vial of thread locking compound with directions for use. If material is not available, use Loctite 262, or GM part number 10522624, or equivalent.

NOTICE: Do not use a higher strength locking compound than recommended, since to do so could make removing the screw extremely difficult, or result in damaging the screw head.

FUEL METER COVER ASSEMBLY Replacement (Figure C2-9)

The fuel meter cover assembly contains the fuel pressure regulator assembly. The regulator has been adjusted at the factory and should only be serviced as a complete preset assembly.

CAUTION: **DO NOT remove the four screws securing the pressure regulator to the fuel meter cover. The fuel pressure regulator includes a large spring under heavy compression which, if accidentally released, could cause personal injury. Disassembly might also result in a fuel leak between the diaphragm and the regulator container.**

Remove or Disconnect

1. Electrical connectors to fuel injectors. (Squeeze plastic tabs and pull straight up.)
2. Long and short fuel meter cover screw assemblies.
3. Fuel meter cover assembly.

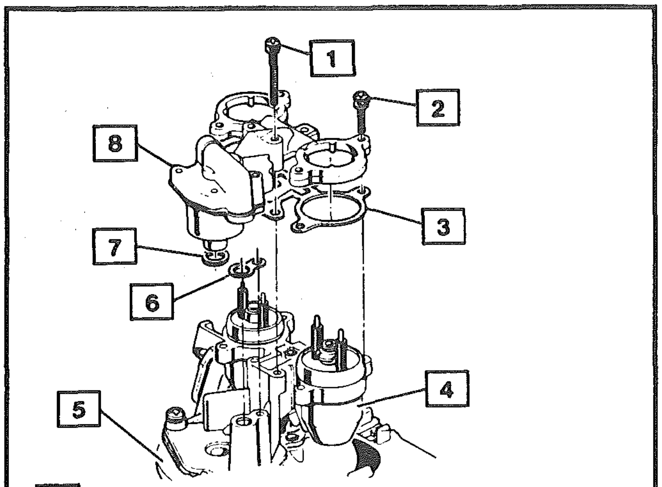


Figure C2-9 - Replacing Model 220 Fuel Meter Cover

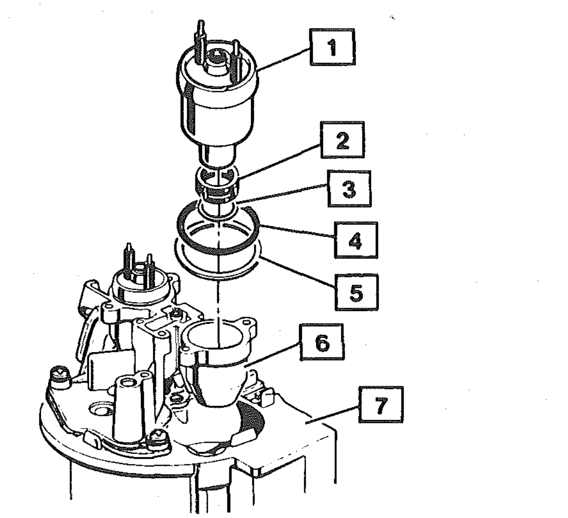


Figure C2-10 - Model TBI 220 Fuel Injector Parts

NOTICE: DO NOT immerse the fuel meter cover (with pressure regulator) in cleaner, as damage to the regulator diaphragm and gasket could occur.

4. Fuel meter outlet gasket, cover gasket and pressure regulator seal. Discard gaskets and seal.

Inspect

- For dirt, foreign material and casting warpage.

Install or Connect

1. New pressure regulator seal, fuel meter outlet passage gasket, and cover gasket.
2. Fuel meter cover assembly.
3. Attaching screw assemblies, coated with appropriate locking compound to threads. (Short screws are next to injectors.)

Tighten

- Screw assemblies to 3.0 N·m (28.0 lb. in.).

4. Electrical connectors to fuel injectors.
5. With engine "OFF", and ignition "ON", check for leaks around gasket and fuel line couplings.

FUEL INJECTOR ASSEMBLIES Replacement (Figure C2-10 to C2-13)

Each fuel injector is serviced as a complete assembly only.

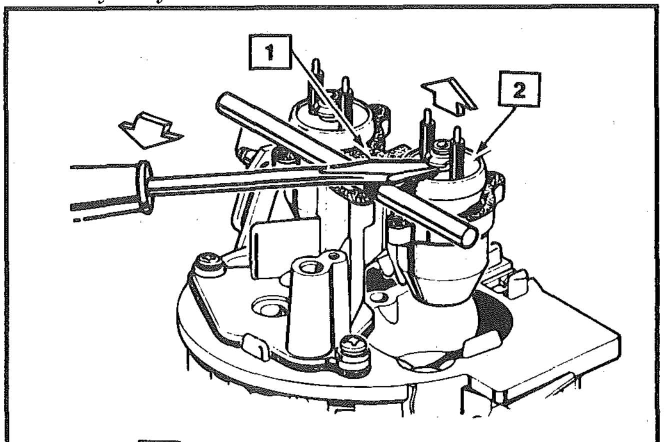


Figure C2 - 11 - Removing TBI 220 Fuel Injector

NOTICE: Use care in removing the fuel injectors to prevent damage to the electrical connector terminals, the injector filter, and the fuel nozzle. Also, since the injectors are electrical components, they should not be immersed in any type of liquid solvent or cleaner as damage may occur.

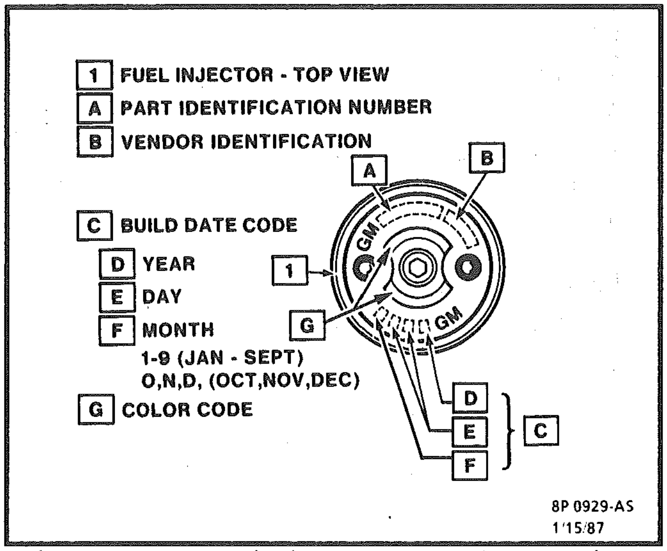


Figure C2-12 - Fuel Injector Part Number Location

Remove or Disconnect

1. Electrical connectors to fuel injectors. (Squeeze plastic tabs and pull straight up.)
2. Fuel meter cover assembly following above procedure.
3. With fuel meter cover gasket in place to prevent damage to casting, use a screwdriver and fulcrum to carefully lift out each injector (Figure C2-11).
4. Lower (small) o-rings from nozzle of injectors and discard.
5. Fuel meter cover gasket and discard.
6. Upper (large o-rings and steel backup washers from top of each fuel injector cavity and discard.

Inspect

- Fuel injector filter for evidence of dirt and contamination. If present, check for presence of dirt in fuel lines and fuel tank.

Important

Be sure to replace the injector with an identical part. Injectors from other models can fit in Model 220 TBI, but are calibrated for different flow rates. (See Figure C2-12 for part number location.)

Install or Connect

1. Lubricate new lower (small) o-ring with automatic transmission fluid and push on nozzle end of injector until it presses against injector fuel filter.
2. Steel injector backup washer in counterbore of fuel meter body.
3. Lubricate new upper (large) o-ring with automatic transmission fluid and install directly over the backup washer. Be sure o-ring is seated properly and is flush with top of fuel meter body surface.

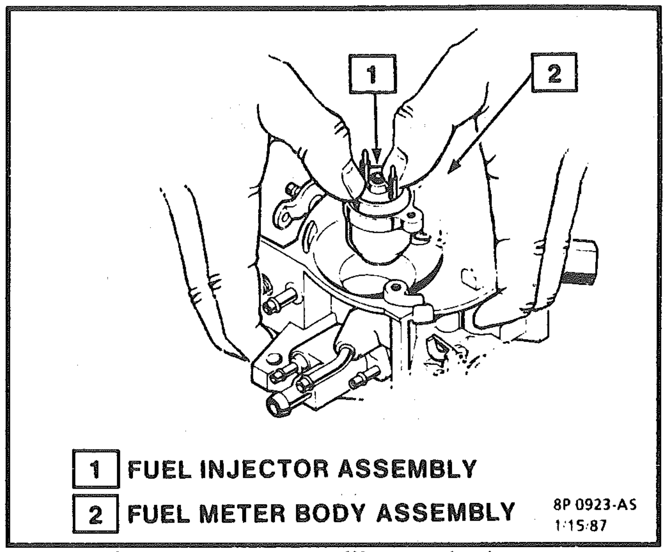


Figure C2-13 - Installing Fuel Injector

NOTICE: Backup washers and o-rings must be installed before injectors, or improper seating of large o-ring could cause fuel to leak.

4. Injector, aligning raised lug on each injector base with notch in fuel meter body cavity. Push down on injector until it is fully seated in fuel meter body (Figure C2-13). (Electrical terminals of injector should be parallel with throttle shaft.)
5. Fuel meter cover gasket.
6. Fuel meter cover (see above procedure).
7. Fuel meter cover attaching screws, coated with appropriate thread locking compound.
8. Electrical connectors to fuel injectors.
9. With engine "OFF" and ignition "ON", check for fuel leaks.

FUEL METER BODY ASSEMBLY Replacement (Figure C2-14)

Remove or Disconnect

1. Electrical connections to fuel injectors. (Squeeze plastic tabs and pull straight up.)
2. Fuel meter cover assembly, (see previous procedure).
3. Fuel meter cover assembly, following above procedure.
4. Fuel injectors, following above procedure.
5. Fuel inlet and return lines. Discard o-rings.
6. Fuel inlet and outlet nuts and gaskets from the fuel meter body assembly. Discard gaskets.

Important

Note locations of nuts, for proper reassembly later. Inlet nut has a larger passage than outlet nut.

7. Fuel meter body to throttle body attaching screw assemblies.

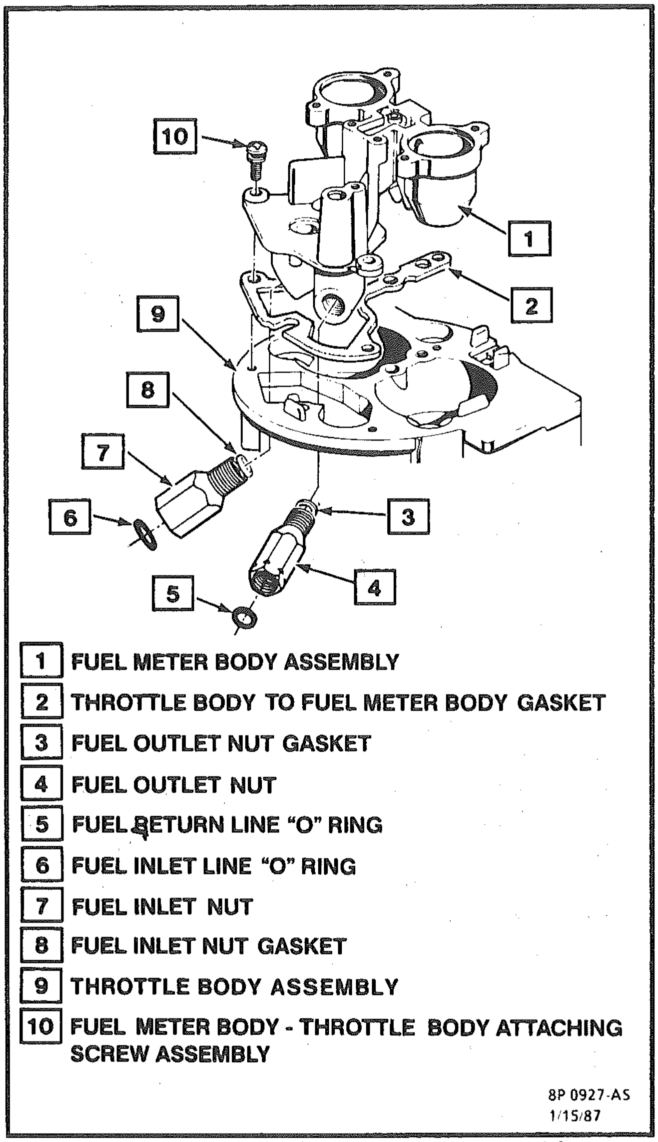


Figure C2-14 - Fuel Meter Body Assembly

8. Fuel meter body assembly from throttle body assembly.
9. Throttle body to fuel meter body gasket and discard.

Install or Connect

1. New throttle body to fuel meter body gasket. Match cut-out portions in gasket with openings in throttle body.
2. Fuel meter body assembly on throttle body assembly.
3. Fuel meter body-to-throttle body attaching screw assemblies, coated with approriate locking compound.

Tighten

- Screw assemblies to 4.0 N·m (35.0 lb. in.).

4. Fuel inlet and outlet nuts with new gaskets to fuel meter body assembly.

Tighten

- Inlet nut to 40.0 N·m (30.0 lb. ft.).
- Outlet nut to 29.0 N·m (21.0 lb. ft.).

5. Fuel inlet and return lines and new o-rings. (Use back-up wrench J-29698-A or BT-8251-A to keep TBI nuts from turning.)

Tighten

- Fuel lines to 23 N·m (17 lb. ft.).

6. Injectors, with new upper and lower o-rings in fuel meter body assembly.
7. Fuel meter cover gasket, fuel meter outlet gasket, and pressure regulator seal.
8. Fuel meter cover assembly.
9. Long and short fuel meter cover attaching screw assemblies, coated with appropriate thread locking compound.

Tighten

- Screw assemblies to 3.0 N·m (27.0 lb.in.).

10. Electrical connectors to fuel injectors.
11. With engine "OFF," and ignition "ON," check for leaks around fuel meter body, gasket and around fuel line nuts.

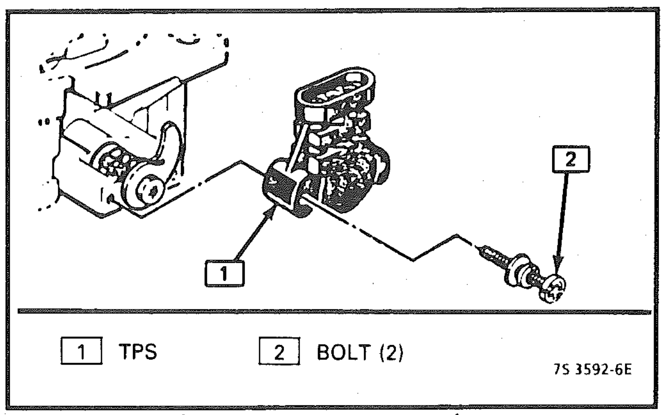


Figure C2-15 - TPS Service

THROTTLE POSITION SENSOR (TPS) Replacement (Figure C2-15)

Remove or Disconnect

1. Electrical connector.
2. Two TPS attaching screw assemblies and retainers, (if applicable).
3. TPS from throttle body assembly .

NOTICE: The TPS is an electrical component and must not be soaked in any liquid cleaner or solvent, as damage may result.

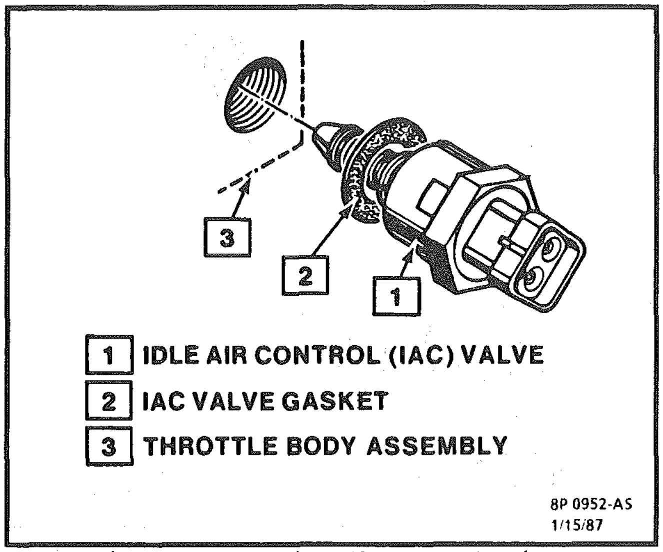


Figure C2-16 - Thread-Type IAC Valve

Install or Connect

1. TPS on throttle body assembly, while lining up TPS lever with TPS drive lever on throttle body.
2. Two TPS attaching screw assemblies.

Tighten

- Screw assemblies to 2.0 N·m (18.0 in.lbs.).

3. Electrical connector.
4. Check for TPS output as follows:
   - Use an ALDL scanner to read TPS output voltage.
   - With ignition "ON" and engine stopped, TPS voltage should be less than 1.25 volts. If more than 1.25 volts, replace TPS.

IDLE AIR CONTROL (IAC) VALVE Replacement (Figure C2-16)

NOTICE: The IAC valve is an electrical component and must not be soaked in any liquid cleaner or solvent. Otherwise damage could result.

Important

All thread-mounted IAC valves on Model 220 TBI units have a dual taper, 10 mm diameter, pintle. Any replacement of an IAC valve must have the correct part number with the appropriate pintle taper and diameter for proper seating of the valve in the throttle body.

Remove or Disconnect

1. Electrical connector.
2. IAC valve, using 32 mm (1-1/4") wrench.
3. IAC valve gasket and discard.

Clean

- Old gasket material from surface of throttle body assembly to insure proper seal of new gasket.

NOTICE: If the IAC valve has been removed during service, its operation may be tested electrically with the IAC/ISC Motor Tester (Available Tool # J-37027, or BT-8256K). However, if the valve pintle is extended electrically, it must also be retracted electrically. Under no circumstances should the valve pintle be tampered with by hand, screwed, or pushed in, or pulled out, as damage could occur.

Important

No physical adjustment of the IAC valve assembly is required after installation. The IAC valve is reset by the ECM. When the vehicle is operated at normal engine temperature at approximately 40 mph (64 km/hr.), the ECM causes the valve pintle to seat in the throttle body. The ECM then resets the pintle to the correct position. Proper idle regulation should result.

Install or Connect

1. IAC valve with new gasket into throttle body.

NOTICE: New IAC valves that have been preset at the factory should be installed in the throttle body in an "as is" condition, without any adjustment.

Tighten

- IAC valve assembly to 18.0 N·m (13.0 lb. ft.) with 32 mm (1-1/4") wrench.

2. Electrical connector to IAC valve.
3. Start engine and allow engine to reach operating temperature.

Important

When the engine is turned "OFF," the IAC valve will be reset by the ECM.

THROTTLE BODY ASSEMBLY Replacement (Figure C2-8)

NOTICE: Procedures related to replacement of the individual components below have been described previously and should be followed, or damage could occur.

Remove or Disconnect

1. Throttle body injection unit, described below.
2. Fuel meter body-to-throttle body attaching screw assemblies.

3. Fuel meter body assembly.
4. Throttle body-to-fuel meter body gasket. Discard gasket.

Disassemble

- TPS from old throttle body, according to previous instructions, for reuse on new throttle body. (New IAC valve comes with new throttle body.)

Assemble

- TPS onto replacement throttle body assembly, according to previous instructions.

Install or Connect

1. New throttle body-to-fuel meter body gasket.
2. Fuel meter body assembly on throttle body assembly.
3. Fuel meter body-throttle body attaching screw assemblies that have been coated with locking compound.

Tighten

- Attaching screw assemblies to 4.0 N·m (35.0 lb. in.).

4. TBI unit onto engine, as described below.

MINIMUM IDLE SPEED CHECK

The idle stop screw, used in mechanically setting minimum engine idle speed has been set at the factory and should not require further adjustment. However, to check that the setting is correct, proceed as follows:

1. Plug any vacuum ports, as required.
2. If present, remove idle stop screw plug by piercing it with an awl, then applying leverage (Figure C2-17).
3. Connect tachometer to engine.
4. With IAC valve connected, ground the diagnostic terminal (ALDL connector).
5. Turn "ON" ignition, do not start engine. Wait at least 45 seconds (this allows IAC valve pintle to extend and seat in throttle body).
6. With ignition "ON," engine stopped, test terminal still grounded, disconnect IAC valve electrical connector.
7. Remove ground from diagnostic terminal and "start" engine. With transmission in neutral, allow engine rpm to stabilize.
8. The tachometer should read 400 - 450 rpm. If not, adjust the idle stop speed screw accordingly.
9. Turn ignition "OFF" and reconnect IAC valve electrical connector.
10. Use silicon sealant or equivalent to cover minimum idle adjustment screw hole.
11. Unplug any plugged vacuum ports.

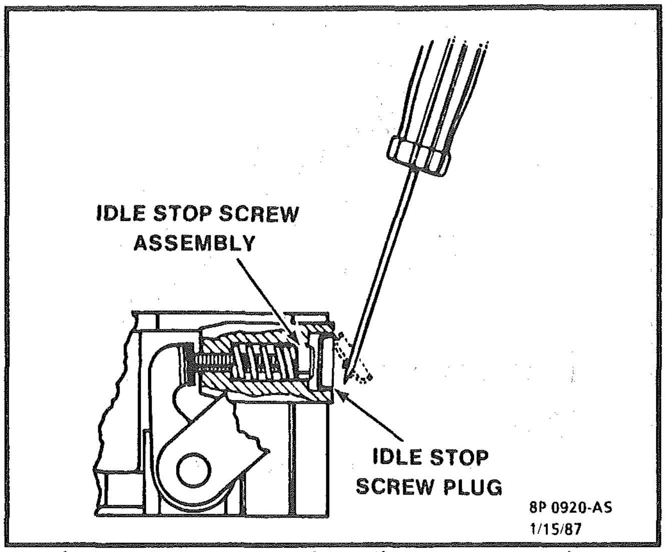
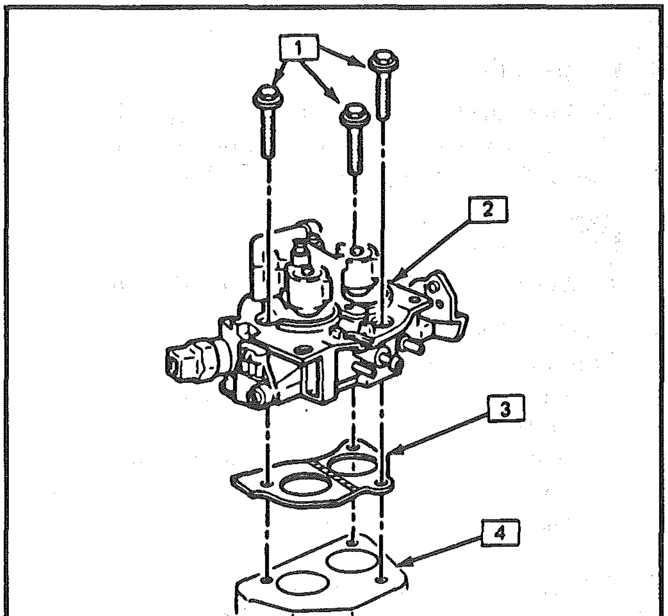


Figure C2-17 - Removing Idle Stop Screw Plug



1 BOLT - TIGHTEN TO 16 N·m (12 FT. LBS.)
2 TBI UNIT
3 GASKET (MUST BE INSTALLED WITH STRIPE FACING UP)
4 ENGINE INTAKE MANIFOLD

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Figure C2-18 - Replacing TBI 220 Unit

THROTTLE BODY INJECTION (TBI) UNIT Replacement (Figure C2-18)

Remove or Disconnect

1. THERMAC hose from engine fitting.
2. Electrical connectors to IAC valve, TPS and fuel injectors.
3. Grommet with wires from throttle body.
4. Throttle linkage, return spring(s) transmission control cable and cruise control (wherever applicable).
5. Vacuum hoses (noting position of hoses) and bracket.
6. Fuel inlet and return lines (use back-up wrench J-29698-A or BT-8251-A). Discard o- rings from nuts.
7. TBI mounting hardware.
8. TBI flange (manifold mounting) gasket and discard.

NOTICE: Stuff manifold opening with a rag to prevent material from entering engine, and remove old gasket material from surface of intake manifold.

Inspect

- Intake manifold bore for loose parts and foreign material, etc.
- Intake manifold sealing surface for cleanliness.

Install or Connect

1. New TBI flange (manifold mounting) gasket.
2. TBI with mounting hardware.

Tighten

- Hardware to, 16.5 N·m (12 lb. ft.).

3. New o-rings on fuel line nuts.
4. Fuel inlet and outlet lines.

Tighten

- To 23 N·m (17 lb. ft.). (Use back-up wrench J-29698-A or BT-8251-A to keep TBI nuts from turning.)

5. Vacuum hoses and bracket.
6. Throttle linkage, return spring(s) transmission control cable and cruise control (wherever applicable).
7. Grommet with wire harness to throttle body.
8. Electrical connectors, making sure connectors are fully seated and latched.
9. Check to see if accelerator pedal is free by depressing pedal to the floor and releasing while engine is "OFF".
10. With engine "OFF," and ignition "ON," check for leaks around fuel line nuts.
11. Start engine and check for fuel leaks.

FUEL HOSE/PIPE ASSEMBLIES

Materials

Fuel Lines. These are welded steel tubes, meeting GM Specification 124-M, or its equivalent. The fuel feed line is 3/8" diameter, and the fuel return line is 5/16" diameter. Do not use copper or aluminum tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibration.

Clamps. These are stainless steel, screw band type clamps, #249472, or equivalent.

Coupled Hose. These are not to be repaired and are replaced only as an assembly.

Uncoupled Hose. Use only reinforced fuel resistant hose, made of "fluroelastomer" material. Do not use a hose within 4 inches (100 mm) of any part of the exhaust system, or within 10 inches (254 mm) of the catalytic converter. The hose's inside diameter must match the outside diameter of the steel tubing.

Fuel Line Repair

1. Cut a piece of fuel hose 4 inches (100 mm) longer than the section of line to be removed. If more than 6 inches (152 mm) is to be removed, use a combination of steel pipe and hose. The hose length should not be more than 10 inches total.
2. Cut a section of pipe to be replaced, with a tube cutter. Use the first step of a double flaring tool to form a bead on the ends of the pipe and also, on the new section of pipe, if used.
3. Slide the hose clamps onto the pipe and push the hose 2 inches (51 mm) onto each portion of the fuel pipe. Tighten a clamp on each side of the repair.
4. Secure fuel line to the frame.

FUEL PUMP RELAY (Figure C2-19)

The fuel pump relay is mounted in the engine compartment. Other than checking for loose connectors, the only service possible is replacement.

OIL PRESSURE SWITCH (Figure C2-20)

The oil pressure switch is mounted on the engine. This switch is a parallel power supply, with the fuel pump relay, and will provide battery voltage to the fuel pump, after approximately 28 kPa (4 psi) oil pressure is reached.

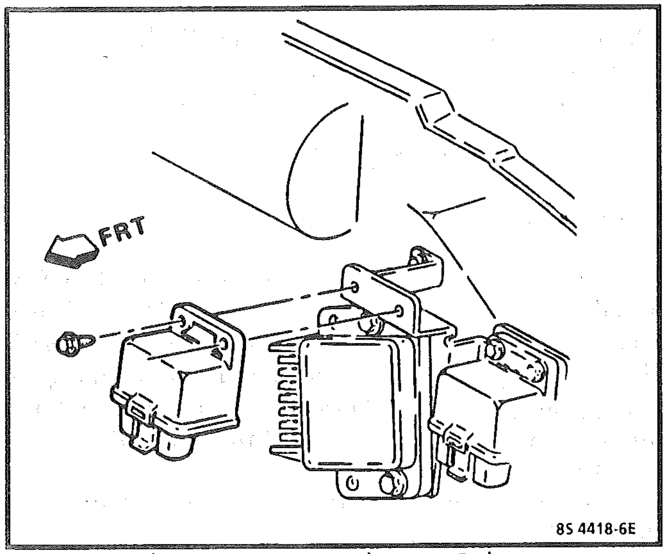

Figure C2-19 - Fuel Pump Relay

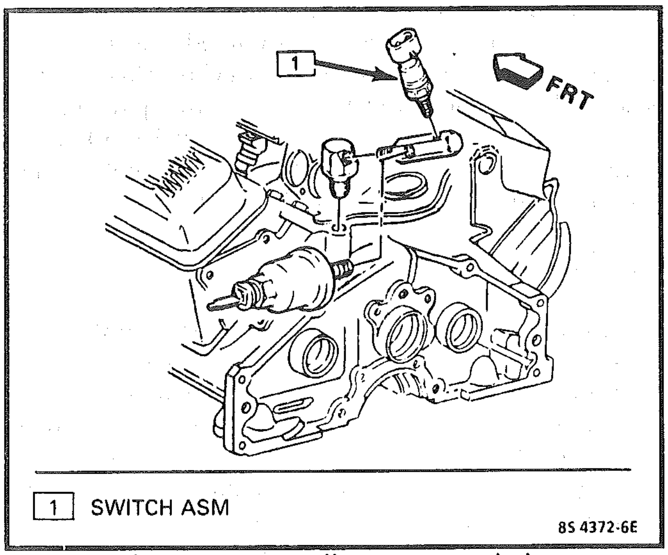

Figure C2-20 - Oil Pressure Switch

PARTS INFORMATION

PART NAME	GROUP
Meter Kit, Fuel	3.734
Injector Kit, Fuel	3.774
Pump, Fuel (In Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Press	1.800
Throttle Body Injection Unit	3.725
Control Kit, Idle Air Valve	3.820

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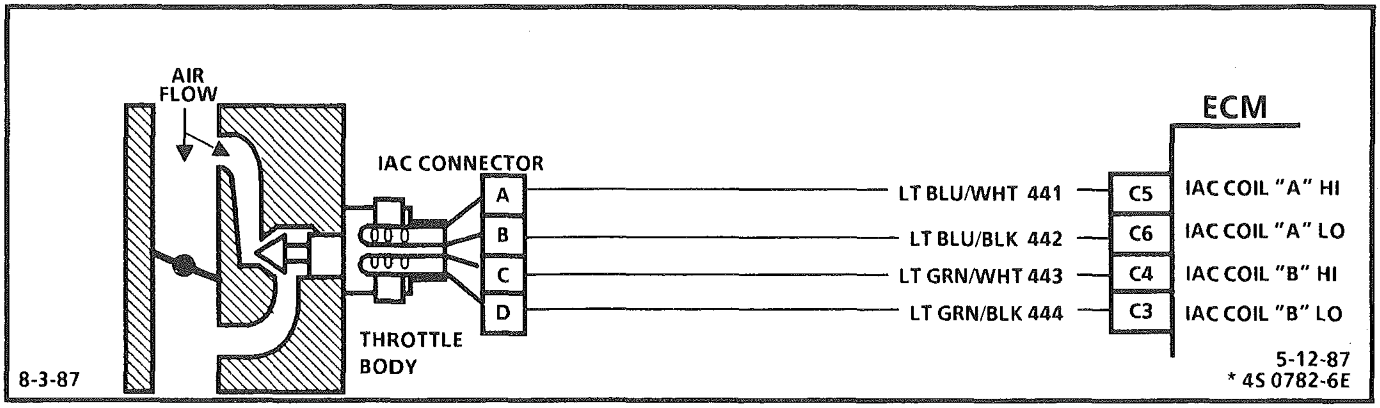

CHART C-2C

IDLE AIR CONTROL (IAC) VALVE CHECK 5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM controls idle rpm with the IAC valve. To increase idle rpm, the ECM moves the IAC valve out, allowing more air to pass by the throttle plate. To decrease rpm, it moves the IAC valve in, reducing air flow by the throttle plate. A "Scan" tool will read the ECM commands to the IAC valve in counts. The higher the counts, the more air allowed (higher idle). The lower the counts, the less air allowed (lower idle).

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Continue with test, even if engine will not idle. If idle is to low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "0" counts. Occasionally, an erratic or unstable idle may occur. Engine speed may vary 200 rpm, or more, up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 100 or more counts. When performing this test, immediately note rpm on start up, because, on a warm engine, the rpm will decrease rapidly.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage, which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. "Scan" counts will be above 60 counts, if too low, and "0" counts, if engine speed is too high.

If idle is too high, stop engine. Ignition "ON". Ground diagnostic terminal. Wait 30 seconds for IAC to seat, then, disconnect IAC. Unground diagnostic terminal and start engine. If idle speed is above 450 rpm in drive, locate and correct vacuum leak. If rpm is less than 450 rpm, adjust minimum idle speed, or correct other conditions, which may affect idle. refer to Rough Unstable or Incorrect Idle, in Symptoms, Section "B".

- System too lean (High Air/Fuel Ratio)
  Idle speed may be too high or too low. Engine speed may vary up and down, disconnecting IAC does not help. May set Code 44.
  "Scan" and/or Voltmeter will read an oxygen sensor output less than 300 mv (.3 volts). Check for low regulated fuel pressure or water in fuel. A lean exhaust, with an oxygen sensor output fixed above 800 mv (.8 volts), will be a contaminated sensor, usually silicone. This may also set a Code 45.
- System too rich (Low Air/Fuel Ratio)
  Idle speed too low. "Scan" counts usually above 80. System obviously rich and may exhibit black smoke exhaust.
  "Scan" tool and/or Voltmeter will read an oxygen sensor signal fixed above 800 mv (.8 volts).
  Check:
  - High fuel pressure
  - Injector leaking or sticking
- Throttle Body. Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.
- If above are all OK, refer to "Rough, Unstable, Incorrect Idle or Stalling", in Symptoms, Section "B".

CHART C-2C

IDLE AIR CONTROL (IAC) VALVE CHECK
5.0L (VIN E) "F" SERIES (TBI)

(1)
- ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
- NOTE RPM IN PARK OR NEUTRAL.

(2)
- IGNITION "OFF" FOR 10 SEC.
- START ENGINE AND IMMEDIATELY NOTE RPM.

IDLE RPM, NO INCREASE

IDLE RPM, INCREASE

- IDLE ENGINE FOR 1 MINUTE AND NOTE RPM.

WILL NOT RETURN TO IDLE RPM RECORDED ABOVE.

RETURNS TO IDLE RPM RECORDED ABOVE.

IDLE AIR CONTROL CIRCUIT OK.
SEE FACING PAGE "DIAGNOSTIC AIDS".

(3)
- IGNITION "OFF".
- DISCONNECT IAC VALVE HARNESS.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TEST TERMINAL.
- CONNECT A TEST LIGHT BETWEEN EACH IAC HARNESS CONNECTOR TERMINAL AND GROUND.

NO LIGHTS, ONE OR MORE CIRCUITS.

(4) LIGHT STEADY OR FLASHING ALL CIRCUITS.

FAULTY IAC CONNECTION OR IAC VALVE.

CHECK FOR OPEN OR SHORT TO GROUND IN CIRCUIT WITH NO LIGHT.

ARE ALL CIRCUITS OK?

YES

NO

REPAIR WIRING AND RECHECK.

CHECK RESISTANCE ACROSS IAC COILS. SHOULD BE MORE THAN 20 OHMS BETWEEN IAC TERMINALS OPPOSITE HARNESS CONNECTOR TERMS. "A" TO "B" AND "C" TO "D".

OK

NOT OK

FAULTY ECM CONN. OR ECM.

REPLACE IAC VALVE AND RETEST.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C3

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic evaporative emission control system (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

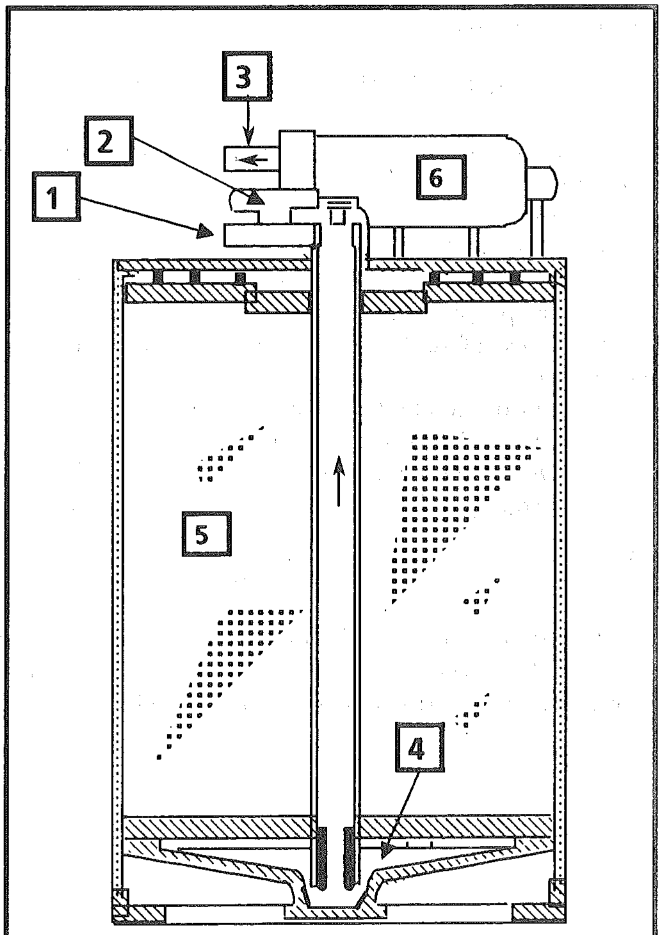
VAPOR CANISTER

Gasoline vapors from the fuel tank flow into the tube labeled tank. Any liquid fuel goes into a reservoir in the bottom of the canister to protect the integrity of the carbon bed above (Figure C3-1). These vapors are absorbed into the carbon. The canister is purged when the engine is running above idle speed. Ambient air is allowed into the canister through the air tube in the top. The air mixes with the vapor and the mixture is drawn into the intake manifold.

EVAPORATIVE EMISSION SYSTEM

The canister is equipped with a normally closed (N/C) solenoid to control canister purge. The ECM operates the solenoid which controls vacuum to the purge valve in the charcoal canister. Under cold engine or idle conditions, the solenoid is turned "OFF" by the ECM, which closes the solenoid and blocks vacuum to the canister purge valve.
The ECM turns "ON" the solenoid valve and allows purge when:

- Engine is warm.
- After the engine has been running a specified time.
- Above a specified road speed.
- Above a specified throttle opening.



1	TANK TUBE	4	LQUID FUEL AREA
2	INLET AIR	5	VAPOR STORAGE AREA
3	PURGE TUBE	6	PURGE SOLENOID

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Figure C3-1 - Inverted Function Vapor Canister - With Encapsulated Purge Solenoid

This is an ECM feedback system that increases purge until the ECM senses a rich condition from the oxygen sensor. The purge is then regulated until the ECM no longer receives a rich signal from the O_2 sensor. This system uses an in-tank pressure control valve to control the flow of vapors from the fuel tank to the canister.

IN-TANK PRESSURE CONTROL VALVE

The in-tank pressure control valve, a combination roll-over, integral pressure and vacuum relief valve, is located with the fuel sending unit in the fuel tank. When vapor pressure in the tank exceeds 1" Hg (5 kPa) the valve opens and allows vapors to vent to the canister and then be purged. When the tank pressure drops below the opening point of the valve it will close, keeping vapors in the fuel tank. The valve provides vacuum relief to protect against vacuum build up in the fuel tank and roll- over protection to prevent liquid fuel from entering the canister during normal driving maneuvers.

RESULTS OF INCORRECT OPERATION

Poor idle, stalling and poor driveability can be caused by:

- Inoperative purge solenoid.
- Damaged canister.
- Hoses split, cracked and, or not connected to the proper tubes.

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines.
- Cracked or damaged canister.
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

DIAGNOSIS

The canister purge solenoid operation is covered in CHART C-3 at the end of this section. A failure in the solenoid or connections may result in a Code 26.

VISUAL CHECK OF CANISTER

Cracked or damaged , replace canister.

ON-CAR SERVICE

FUEL VAPOR CANISTER

←→ Remove or Disconnect

1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

→← Install or Connect

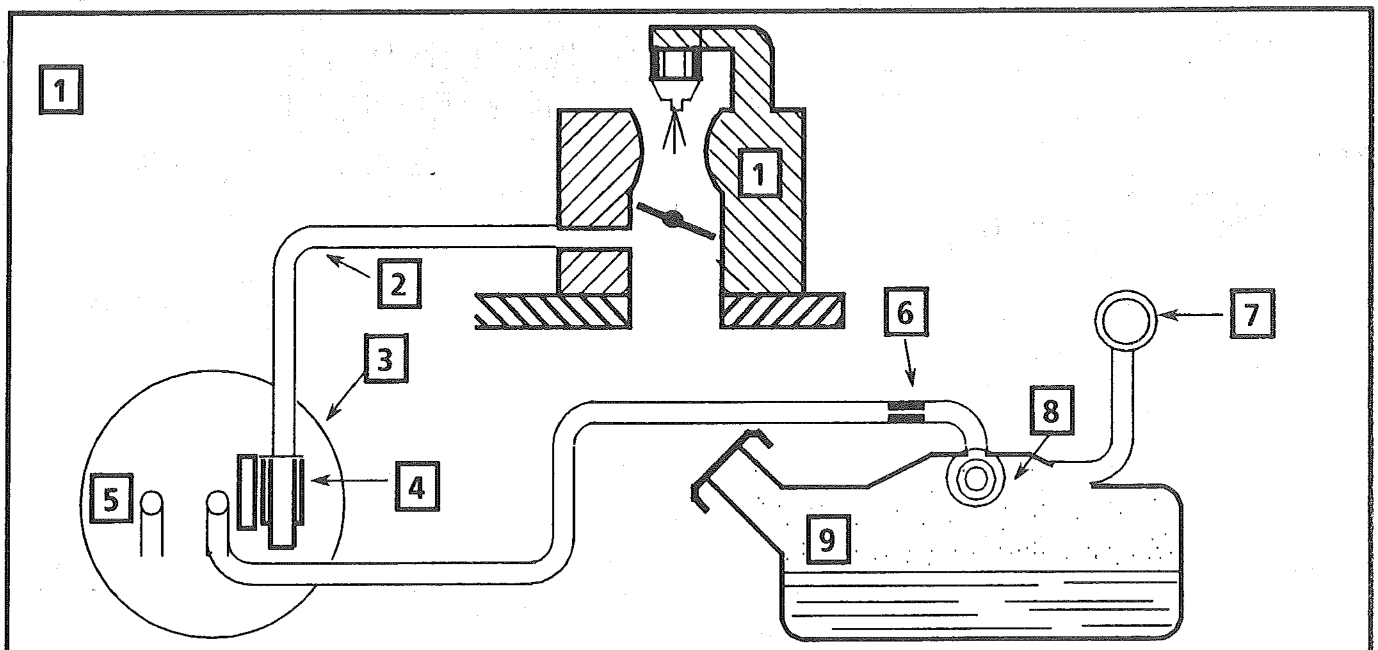
1. Canister as removed.
2. Hoses. Make sure connections are correct.

CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130



1	TBI UNIT	4	PURGE SOLENOID ASSEMBLY	7	REMOTE PRESSURE / VACUUM RELIEF VALVE
2	PURGE LINE	5	AIR INLET	8	IN-TANK PRESSURE CONTROL VALVE
3	VAPOR CANISTER	6	VAPOR RESTRICTION	9	FUEL TANK

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Figure C3-2 - Evaporative Emissions Control System Schematic 5.0L VIN E

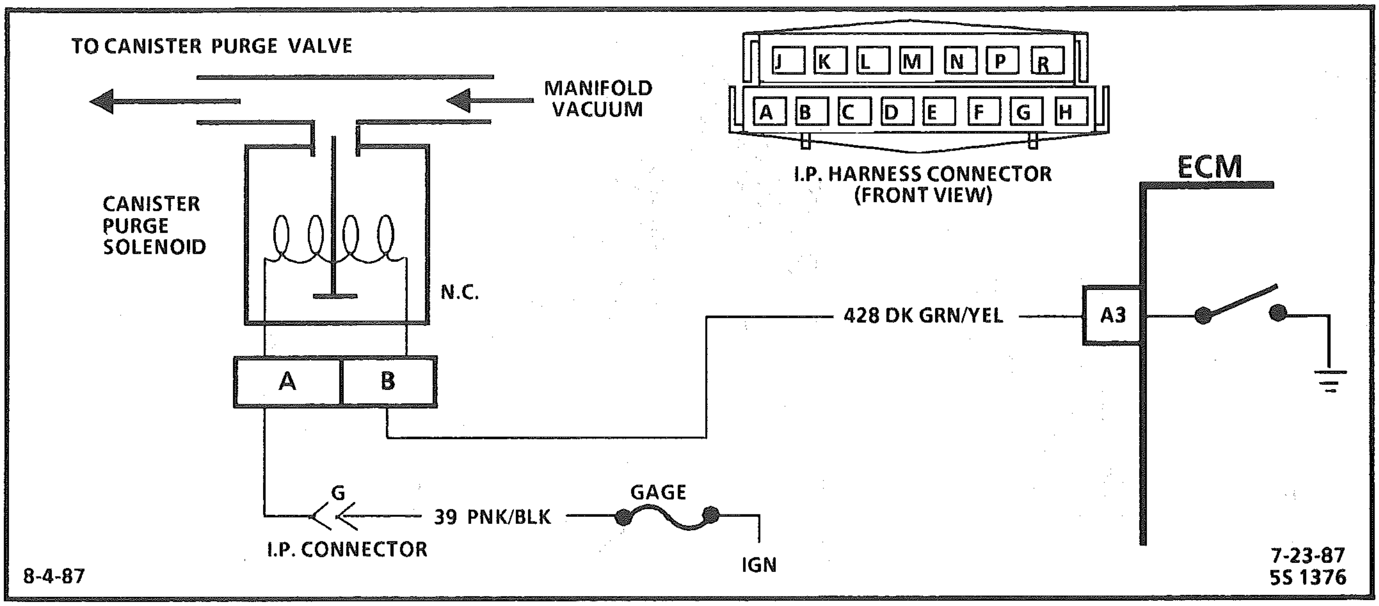


CHART C-3

CANISTER PURGE VALVE CHECK
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when energized. The ECM supplies a ground to energize the solenoid (purge "ON").

If the following conditions are met with the engine running, the purge solenoid is energized (purge "ON").

- Engine run time after start more than 1 min.
- Coolant temperature above 80°C.
- Vehicle speed above 5 mph.
- Throttle off idle. TPS signal about .75 volt.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks to see if the solenoid is opened or closed. The solenoid is energized in this step so it should be open.
2. Completes functional check, by grounding test terminal. This should, normally, de-energize the solenoid and allow the vacuum to drop (purge "ON").
3. Checks for a complete circuit. Normally, there is battery voltage on CKT 39, and the ECM provides a ground on CKT 428. A shorted solenoid could cause an open circuit in the ECM.

Diagnostic Aids:

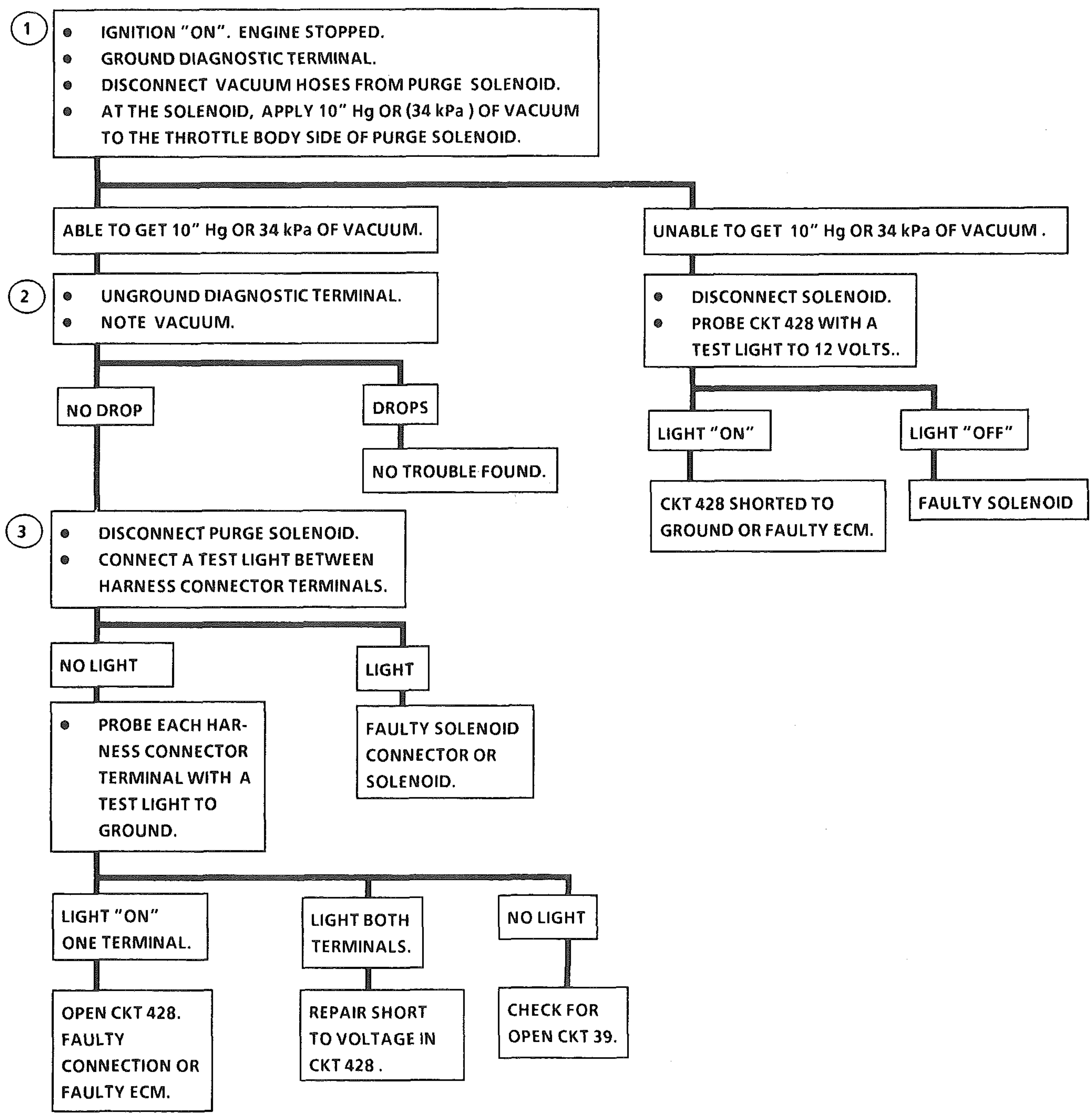
Normal operation of the canister purge solenoid is described as follows:

With ignition "ON", engine stopped, diagnostic terminal ungrounded, the purge solenoid will be energized.

With ignition "ON", engine "OFF", diagnostic terminal grounded, the purge solenoid will be de-energized.

CHART C-3

CANISTER PURGE VALVE CHECK 5.0L (VIN E) "F" SERIES (TBI)



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CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

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SECTION C4

IGNITION SYSTEM / (EST)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the Electronic Spark Timing (EST) system will be described here. Additional information on the HEI system is found in Section 6D.

OPERATION

The standard high energy ignition (HEI) system (described in Section 6D) has a modified distributor module, which is used in connection with EST. The module has eight terminals. (See Figure C4-1).

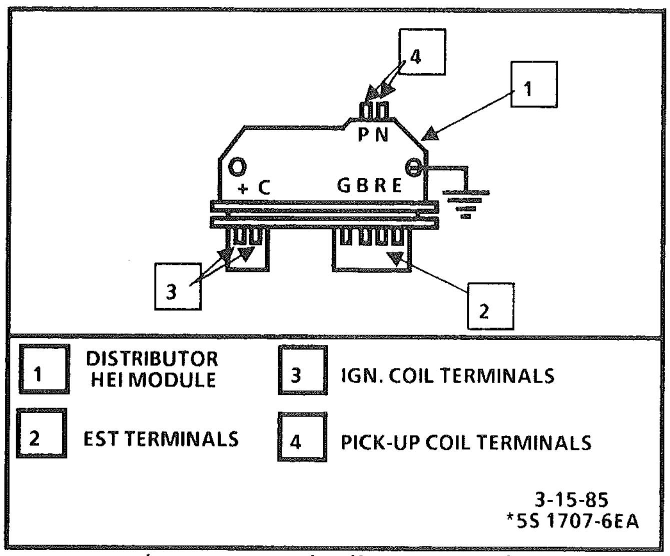

Figure C4-1 - Distributor Module

To properly control ignition/combustion timing, the ECM needs to know:

- crankshaft position
- engine speed (rpm)
- engine load (manifold pressure or vacuum)
- atmospheric (barometric) pressure
- engine temperature

The EST system consists of the distributor module, ECM, and connecting wires. The distributor has four wires, from the HEI module, connected to the ECM.

These circuits perform the following functions:

- Distributor reference. Terminal "C"
  This provides the ECM with rpm and crankshaft position information.
- Reference ground. Terminal "A"
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.
- Bypass. Terminal "B"
  At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.
- EST. Terminal "D"
  After bypass voltage is applied, the ECM uses this circuit to trigger the HEI module. The ECM uses the distributor reference signal to base its calculation of the amount of spark advance needed, under present engine conditions. If the base timing of the engine is incorrect, the entire spark curve will be incorrect.

DIAGNOSIS

RESULTS OF INCORRECT EST OPERATION

An open, or ground, in the EST circuit, will set a Code 42 and cause the engine to run on the HEI module timing. This will cause poor performance and poor fuel economy.

The ECM uses information from the MAP and coolant sensors, in addition to rpm, to calculate spark advance as follows.

Low MAP output voltage = More spark advance
Cold Engine = More spark advance
High MAP Output Voltage, = Less spark advance
Hot Engine = Less spark advance

Therefore, detonation could be caused by low MAP output or high resistance in the coolant sensor circuit.

Poor performance could be caused by high MAP output or low resistance in the coolant sensor circuit.

HOW CODE 42 IS DETERMINED

When the system is running on the HEI module, that is, no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module, so, the EST voltage should be varying.

If the bypass line is open, the HEI module will not switch to EST mode, so, the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the HEI module will switch to EST but, because the line is grounded, there will be no EST signal and the engine will not run. A Code 42 may, or may not, be set.

The description, operation, and diagnosis of the HEI system are found in Section 6D of this manual. This section will address diagnosis of that portion of the Ignition System pertaining to the EST operation.

CODE 12

Code 12 is used during the Diagnostic Circuit Check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON" and the engine not running.

The "Reference" signal, also, triggers the fuel injection system. Without the "Reference" signal, the engine cannot run.

ON-CAR SERVICE

SETTING TIMING

Set timing according to instructions on Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Module, Distr	2.383
Coil, Distr	2.170

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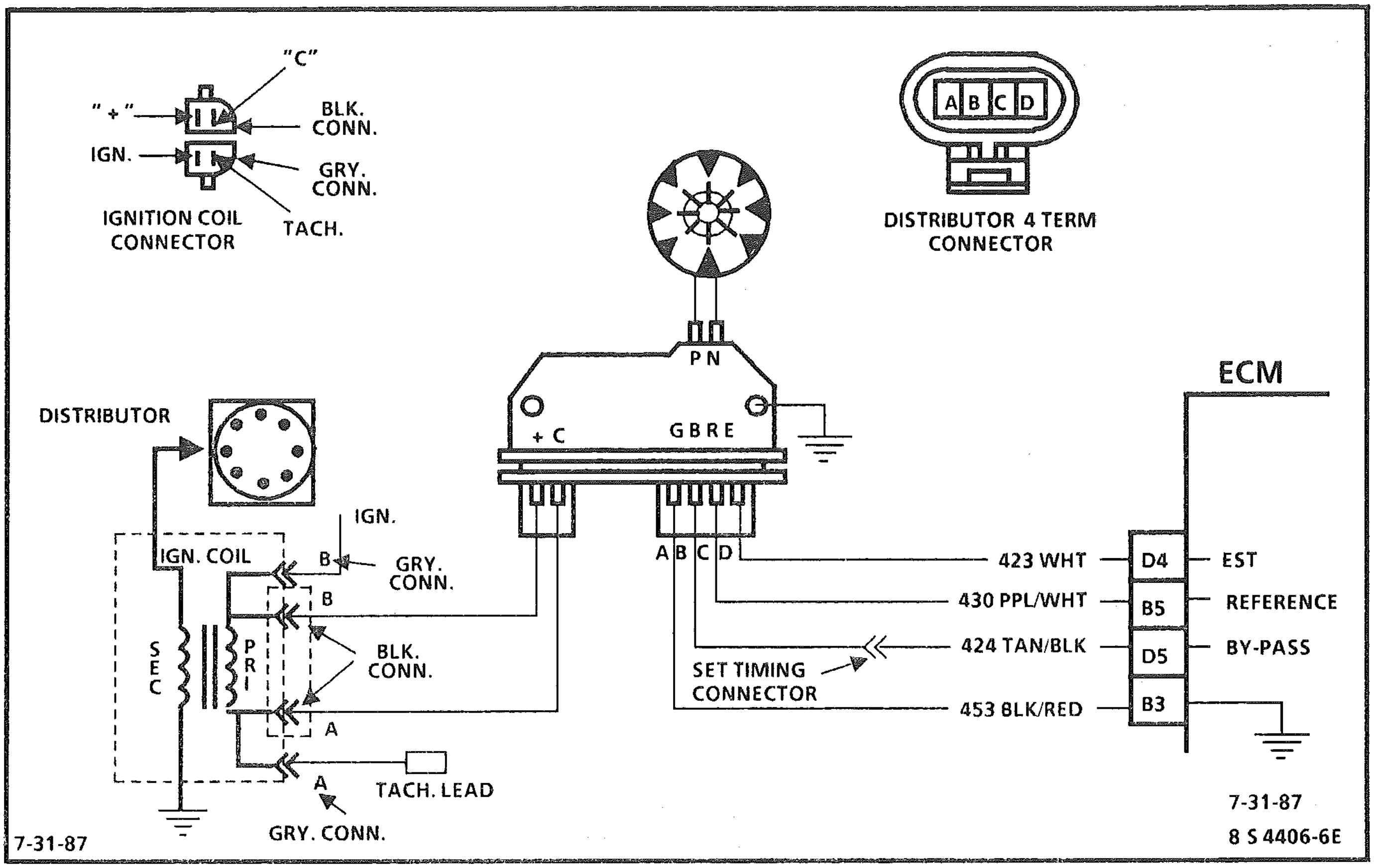

CHART C-4

IGNITION SYSTEM CHECK
(REMOTE COIL/SEALED MODULE CONNECTOR DISTRIBUTOR)
5.0L (VIN E) "F" SERIES (TBI)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with EST connector disconnected, pick-up coil output is too low for EST operation.

2. A spark indicates the problem must be the distributor cap or rotor.

3. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" term. voltage was low, but "+" term. voltage is 10 volts or more, circuit from "C" term. to Ign. coil or ignition coil primary winding is open.

4. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF", so normal voltage should be about 12 volts.
   If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat.
   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.

5. Applying a voltage (1.5 to 8 volts) to module terminal "P" should turn the module "ON" and the tach. term. voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON". This test can be performed by using a DC battery with a rating of 1.5 to 8 volts. The use of the test light is mainly to allow the "P" terminal to be probed more easily. Some digital multi-meters can also be used to trigger the module by selecting ohms, usually the diode position. In this position the meter may have a voltage across it's terminals which can be used to trigger the module. The voltage in the ohm's position can be checked by using a second meter or by checking the manufacture's specification of the tool being used.

6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4
IGNITION SYSTEM CHECK (REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR) 5.0L (VIN E) "F" SERIES (TBI)

(1)
- Perform Diagnostic Circuit Check before proceeding with this test. (If a tachometer is connected to the Tach term., disconnect it before proceeding with the test).
- Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire) A few sparks and then nothing is considered no spark.

No Spark → (1A)

Spark → Check fuel,spark plugs, etc. See section "B" symptoms.

(1A)
- Disconnect 4 term. distributor connector and check for spark.

No spark → (2)

Spark → Replace pick-up coil

(2)
- Check for spark at coil wire with tester while cranking. (Leave spark tester connected to coil wire for Steps 3-6).

No Spark → (3)

Spark → Inspect cap for water, cracks, etc. If OK, replace rotor.

(3)
- Disconnect distributor 2 term. "C / +" connector.
- Ignition switch "on", Engine stopped.
- Check volts at "+" and "C" term's. of dist. harn. conn.

Both term's. 10 volts or more → (4)

Both term's. under 10 volts → Repair wire from module "+" term. to "B" term. of black Ign. coil connector or primary ckt. to ign. sw.

Under 10 volts "C" term. only → Check for open or gnd. in ckt. from "C" term. to ign. coil. If Ckt. is OK, fault is. ign. coil or conn..

(4)
- Reconnect dist. 2 term. conn.
- With ign. "ON", check voltage from tach. term. to gnd. (term. may be taped back in harness).

Over10 volts →
- Connect test light from tach. term. to ground.
- Crank engine and observe light.

Light on steady → (5)

Light blinks → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..

Under 1 volt → Repair open tach. lead or conn and repeat test #4.

1 to 10 volts → Replace module and check for spark from coil as in Step 6.
- Spark → System OK
- No Spark → Replace ign. coil, it too is faulty

(5)
- Disconnect distributor 4 term. connector.
- Remove dist. cap.
- Disconnect pick-up coil connector from module.
- Connect voltmeter from tach. term. to ground.
- Ignition on.
- Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).

Voltage drops → (6)

No drop in voltage → Check module ground. If OK, replace module.

(6)
- Check for spark from coil wire with spark tester as test light is removed from module term.

No Spark →
- If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
  - No Spark → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
  - Spark → System OK
- If module tester (J24642) is available: test module
  - OK → Check coil wire from cap to coil. If OK, replace coil.
  - Not OK → Replace module

Spark →
- Is rotating pole piece still magnetized?
  - Yes → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
  - No → Replace pole piece and shaft assy.

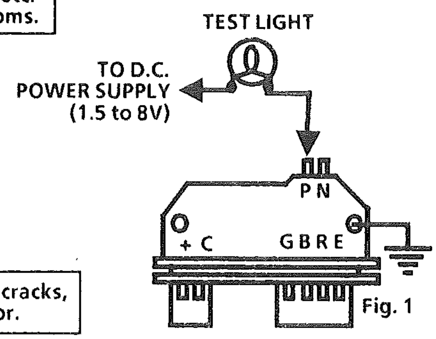

Fig. 1

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SECTION C5
ELECTRONIC SPARK CONTROL (ESC) SYSTEM
CONTENTS

GENERAL DESCRIPTION

PURPOSE

To control spark knock, an electronic spark control (ESC) system has been added. This system is designed to retard spark timing up to 20°, to reduce spark knock in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

Varying octane levels in today's gasoline can cause detonation in high performance engines. Detonation is called spark knock.

OPERATION

The ESC system has two major components:

- ESC Module
- ESC Knock Sensor

The sensor is mounted in the engine block near the cylinders, or in the intake manifold at the rear of the engine. When the ESC knock sensor detects abnormal vibration (spark knocking) in the engine, it produced a voltage that is received by the ESC module. As long as the ESC module sees no voltage from the knock sensor (knock not present), it sends a signal voltage (8 to 10 volts) to the ECM and the ECM provides normal spark advance.

When the module detects voltage from the knock sensor (knock present), it turns "OFF" the signal to the ECM and the voltage at terminal B7 goes to 0 volts. The ECM then retards EST to reduce spark knock.

DIAGNOSIS

RESULTS OF INCORRECT ESC OPERATION

Loss of the ESC knock sensor signal or loss of ground at ESC module would cause the signal to the ECM to remain high. This condition would cause the ECM to control EST, as if no spark knocking were happening. No retard would occur, and spark knocking could become severe under heavy engine load conditions.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This could result in sluggish performance and cause a Code 43 to set.

A "Scan" tool will read knock signal in A/D counts. When detonation is detected, knock signal counts will increment, as long as knock is present. "Scan" tools will indicate knock being present either by showing A/D counts, or displaying Yes (knock present), or No (knock not present). If Code 43 is present, use that chart to diagnose system. If no code is present and ESC system is suspected, use CHART C-5.

ON-CAR SERVICE

ESC KNOCK SENSOR

See Figure C5-1.

←→ Remove or Disconnect

1. Negative battery cable.
2. ESC wiring harness connector from ESC sensor.
3. ESC sensor from engine block.

→← Install or Connect

1. ESC sensor into engine block. Apply thread sealer, such as soft tape, to the ESC sensor threads.
2. ESC wiring harness connector to the ESC sensor.
3. Negative battery cable.

ESC MODULE

Refer to Figure C5-1.

←→ Remove or Disconnect

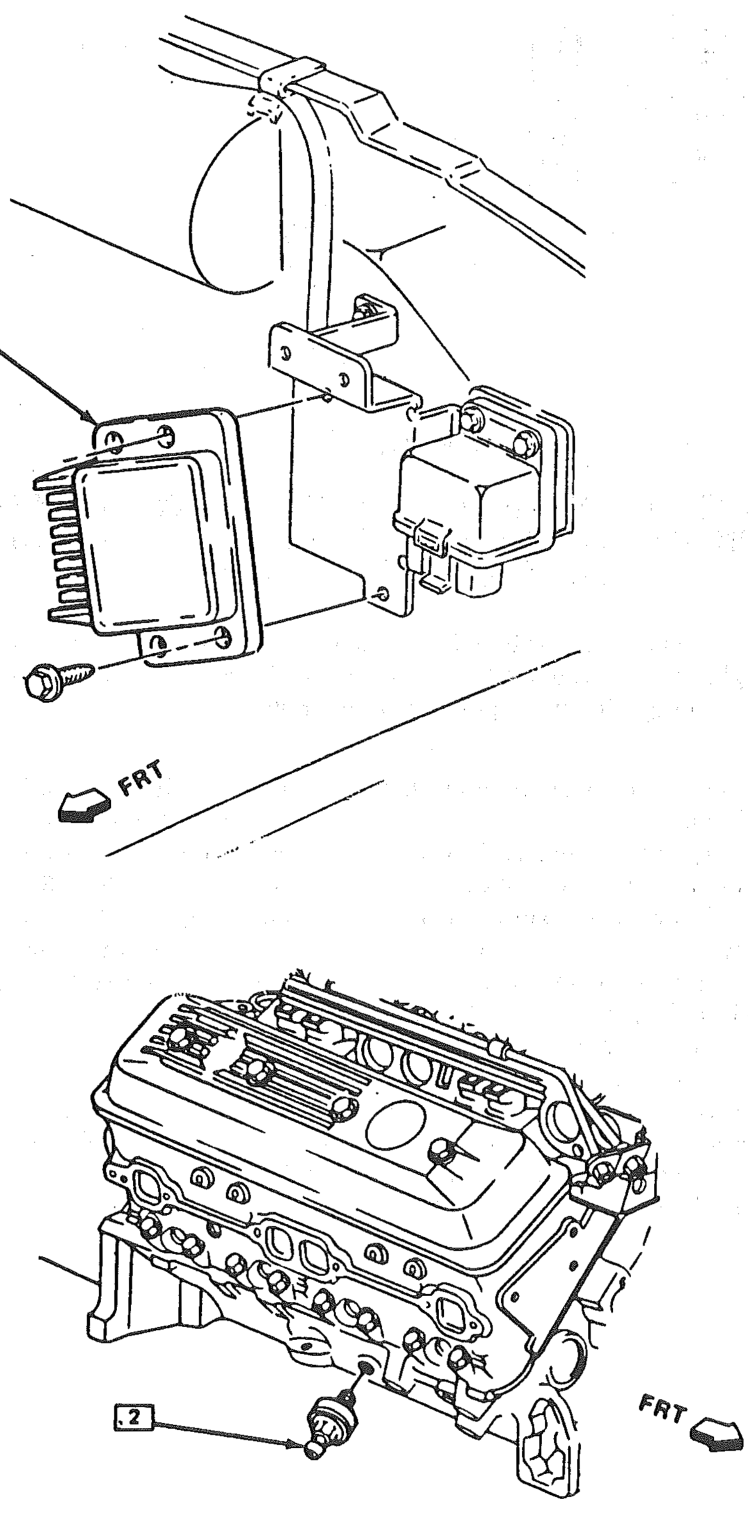
1. ESC module connector.
2. Attaching screws.
3. ESC module.

Install or Connect

1, ESC module.
2. Attaching screws.
3. ESC module connector.

PARTS INFORMATION

PART NAME	GROUP
Sensor, ESC Knock	2.383
Module, Elek Spark Cont	2.383



1	ESC MODULE
2	ESC KNOCK SENSOR

Figure C5-1 - ESC Module and ESC Knock Sensor

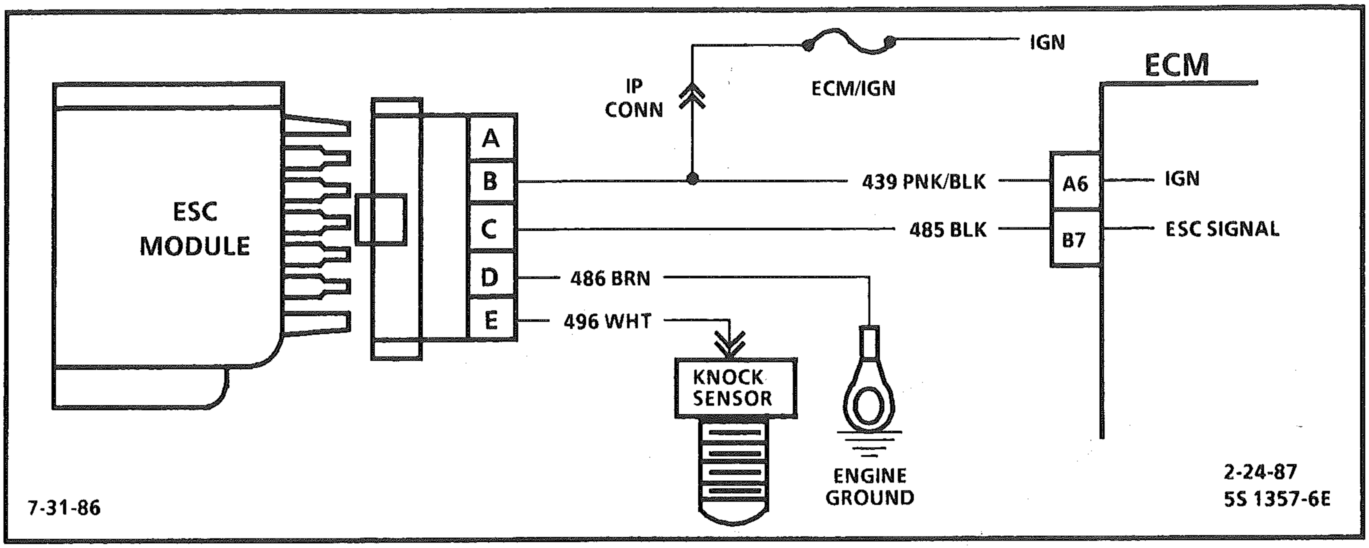


CHART C-5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM CHECK
(ENGINE KNOCK, POOR PERFORMANCE, OR POOR ECONOMY)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM is shut "OFF" and this signals the ECM to retard timing, if engine rpm is over about 900.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If a Code 43 is not set, but a knock signal is indicated while running at 1500 rpm, listen for an internal engine noise. Under a no load condition, there should not be any detonation, and if knock is indicated, an internal engine problem may exist.
2. Usually a knock signal can be generated by tapping on the right exhaust manifold. This test can also be performed at idle. Test number 1 was run at 1500 rpm, to determine if a constant knock signal was present, which would affect engine performance.
3. This tests whether the knock signal is due to the sensor, a basic engine problem, or the ESC module.
4. If the module ground circuit is faulty, the ESC module will not function correctly. The test light should light indicating the ground circuit is OK.
5. Contacting CKT 496, with a test light to 12 volts, should generate a knock signal to determine whether the knock sensor is faulty, or the ESC module can't recognize a knock signal.

Diagnostic Aids:

If the ESC system checks OK, but detonation is the complaint, refer to Detonation/Spark knock in Section "B".

CHART C-5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM CHECK
(ENGINE KNOCK, POOR PERFORMANCE, OR POOR ECONOMY)
5.0L (VIN E) "F" SERIES (TBI)

THIS CHART SHOULD BE USED AFTER ALL OTHER CAUSES OF SPARK KNOCK HAVE BEEN CHECKED. I.E., TIMING, EGR, ENGINE TEMPERATURE OR EXCESSIVE ENGINE NOISE,ETC. IF CODE 43 IS SET, USE THAT CHART FIRST.

1
- IF A CODE 43 WAS SET USE THAT CHART FIRST. THIS CHART ASSUMES CODE 43 IS NOT PRESENT.
- "SCAN" TOOL SET ON KNOCK SIGNAL.
- ENGINE RUNNING AT ABOUT 1500 RPM.
- IS THERE A KNOCK SIGNAL INDICATED?

NO

2
- ENGINE RUNNING AT 1500 RPM.
- TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
- DOES "SCAN" INDICATE A KNOCK SIGNAL WHILE TAPPING ON ENGINE?

YES

3
- DISCONNECT KNOCK SENSOR.
- REPEAT TEST.
- IS THERE A KNOCK SIGNAL INDICATED?

YES

CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE ESC MODULE.

NO

INTERNAL ENGINE KNOCK OR FAULTY SENSOR.

NO

4
- DISCONNECT ESC MODULE.
- PROBE HARNESS TERMINAL "D" (CKT 486) WITH A TEST LIGHT TO 12 V.

YES

ESC SYSTEM OK. REVIEW "DIAGNOSTIC AIDS" ON FACING PAGE.

LIGHT "ON"

5
- RECONNECT ESC MODULE.
- DISCONNECT KNOCK SENSOR.
- ENGINE IDLING.
- MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
- EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
- IS A KNOCK SIGNAL INDICATED WITH "SCAN"?

LIGHT "OFF"

REPAIR OPEN GROUND CKT 486.

YES

FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.

NO

CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.

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SECTION C6

AIR INJECTION REACTION (A.I.R.) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The A.I.R. system helps reduce hydrocarbon (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) exhaust emissions. It also heats up the catalytic converter quickly on engine start-up so conversion of exhaust gases can occur sooner.

A Dual bed converter is used. It consists of a three way catalyst (which controls all three emissions) in series with a two way catalyst (which controls only HC and CO) both are in one housing. A pipe between the two converters allows air to be injected into the second (two way) converter to increase its efficiency to further control HC and CO (Figure C6-1).

As shown in Figure C6-1, air can be directed to:

- A divert silencer.
- Exhaust ports; or
- Catalytic converter.

OPERATION

The system (Figure C6-1) includes:

- An Air Pump
  The air pump is driven by a belt on the front of the engine and supplies the air to the system. Intake air passes through a centrifugal filter fan at the front of the pump; where foreign materials are separated from the air by centrifugal force.
- A Control Valve
  Air flows from the pump through an ECM controlled valve (called a control valve) through check valves to either the exhaust ports or the converter.
- Check Valves
  The check valves prevent back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.
- Necessary Plumbing

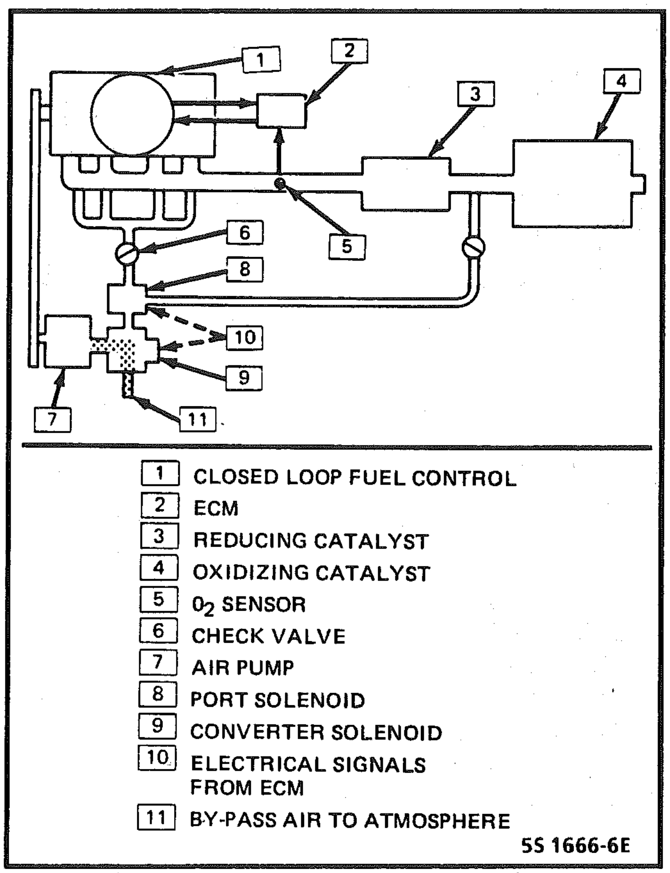

Figure C6-1 - A.I.R. System Operation

AIR CONTROL PEDES VALVE

Pressure Operated Electric Divert / Electric Air Switching (PEDES) valve is used on this engine. The diverting and switching functions are electronically controlled by the ECM,which grounds to complete the circuit and energize the solenoid. Self-generated pressure from the A.I.R. pump is used to operate the valve, which is completely independent of manifold vacuum.

Air enters the body of the valve from the pump. Air pressure builds against the control valve and for:

- Cold Mode - The port solenoid is energized which in turn opens the port valve and allows flow to the exhaust ports.
- Warm Mode - The port solenoid is de-energized and the converter solenoid energized which closes the port valve and keeps the converter valve seated, thus forcing flow past the converter valve and to the converter.
- Divert Mode - Both solenoids are de-energized which opens the converter valve, allowing air to take the path of least resistance, i.e., out the divert / relief tube to atmosphere.

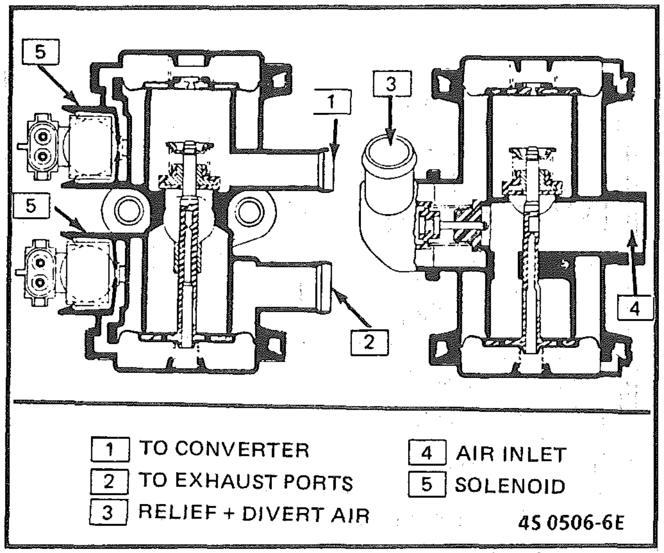

Figure C6-2 - A.I.R. System Control Valve

Air is diverted to the atmosphere under the following conditions:

- Rich operation.
- When the ECM recognizes a problem and sets the "Service Engine Soon" light.
- During deceleration.
- During high RPM operation when air pressure is greater than the setting for the internal relief valve.

RESULTS OF INCORRECT OPERATION

If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels will be too high.

Air flowing to the exhaust ports at all times could increase temperature of the converter.

Air flowing at all times to the catalytic converter may cause converter overheating during rich operation.

Electrical failure (open circuit) of the control valve will divert air flow overboard at all times. Air will flow to the converter at all times if an open circuit occurs to the switching valve (converter solenoid).

Mechanical failures in the valves could cause the air to flow incorrectly to the exhaust ports or the converter.

DIAGNOSIS

The diagnosis of the AIR system is covered in CHART C-6 at the end of this section.

OPERATIONAL CHECKS

Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 rpm's and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump (see Fig. C6B-3).

NOTICE: The AIR System is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases.

Inspect

3. For a seized Air Injection Pump.
4. Hoses, tubes and all connections for leaks and proper routing.
5. For air flow from control/switching valve.
6. AIR injection pump for proper mounting and bolt torque.
7. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

CAUTION: **Do Not Oil A.I.R. Pump**

Hoses and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected form a check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction(toward the exhaust manifold). Replace valve which does not operate properly.

ON-CAR SERVICE

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for wear, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of all belt driven components.

AIR INJECTION PUMP

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Drive belt and pulley.
3. Hoses, vacuum, and electrical connections from Air Injection Control valve.
4. Air pump mounting bolts, and pump assembly (See Figure C6-3).

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Spacer and pump pulley against centrifugal filter fan.
3. Pump pulley bolts and tighten equally to 13 N m (10 lb. ft).
4. Check air injection system for proper operation (see Chart C-6).

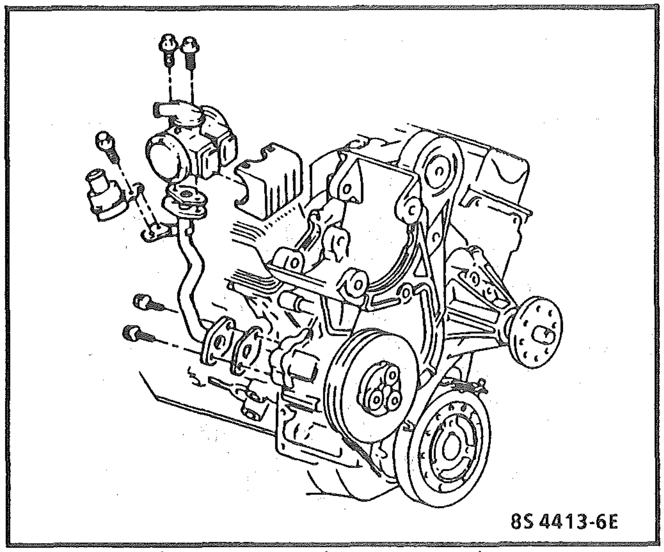

Figure C6-3 - Air Pump Service

AIR INJECTION CONTROL (PEDES) VALVE

Remove or Disconnect

1. Battery ground cable.
2. Adapter bolts (See Figure C6-4).
3. Air outlet hoses from valve.
4. Splash guard / cover
5. Electrical connectors and vacuum hoses from valve.
6. Control valve.

Install or Connect

1. Control valve.
2. Electrical connectors.
3. Splash guard / cover
4. Air hoses to valve.
5. Battery ground cable.
6. Check system operation (see CHART C-6).

AIR INJECTION CHECK VALVE

↔ Remove or Disconnect

1. Release clamp and disconnect air hoses from check valve.
2. Unscrew check valve from air injection pipe.

→← Install or Connect

1. Screw check valve onto air injection pipe. 23 N · m (17 lb. ft.).
2. Position air hoses on check valve and secure with clamp.

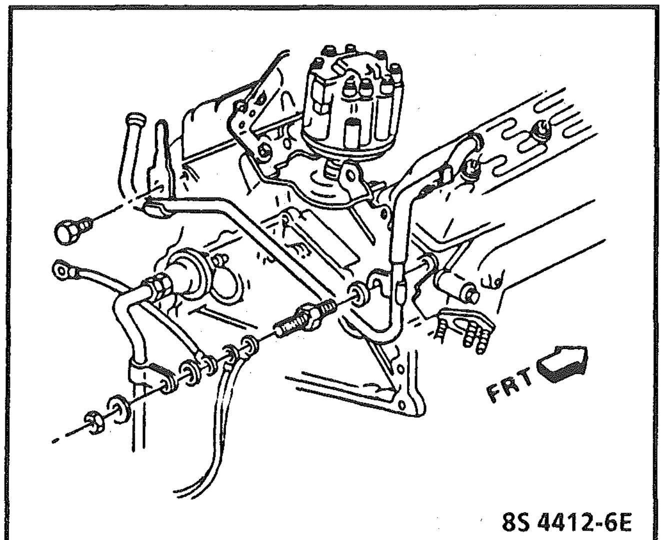

Figure C6-4 - PEDES Valve Service

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv	3.671
Brace, AIR Inj Pump	3.655
Bracket, AIR Inj Pump	3.655
Gasket, AIR Inj Dvtr Vlv El	3.671
Harness, AIR Inj Cont Vlv Vac	3.675
Hose, AIR Inj Cont Vlv	3.675
Hose, AIR Inj Cont Vlv Dvtr	3.675
Hose, Ctltc Conv AIR Inj Chk Vlv	3.675
Pipe, AIR Inj Ctltc Conv Chk Vlv	3.690
Pipe, Ctltc Conv AIR Inj	3.675
Pulley, AIR Inj Pump	3.650
Pump, AIR Inj	3.660
Silencer AIR Inj Cont Vlv	3.660
Support, AIR Inj Pump	3.660
Valve, AIR Inj Cont	3.670
Valve, AIR Inj Eng Chk	3.670
Valve, Ctltc Conv AIR Inj Chk	3.670

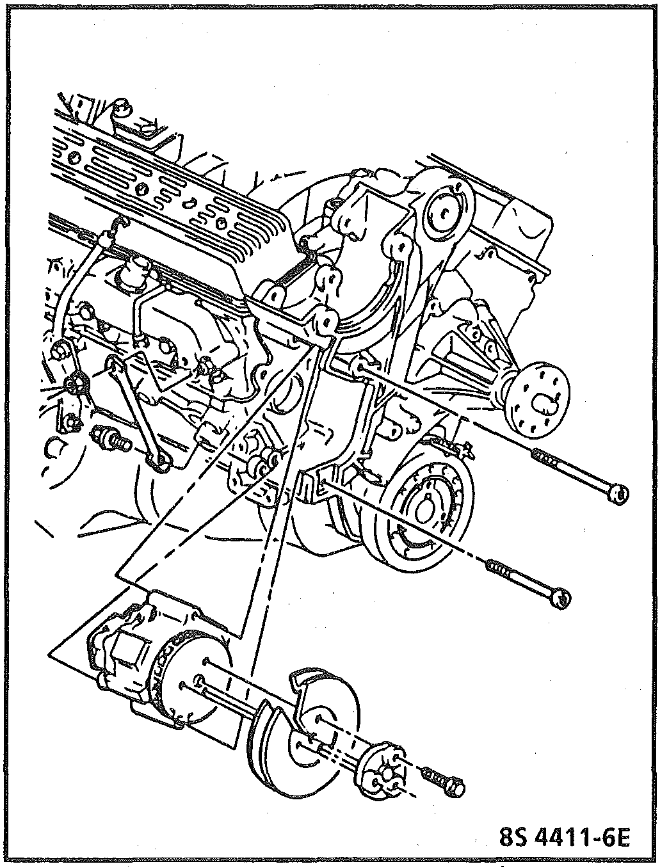

Figure C6-5 - A.I.R. Pump mounting

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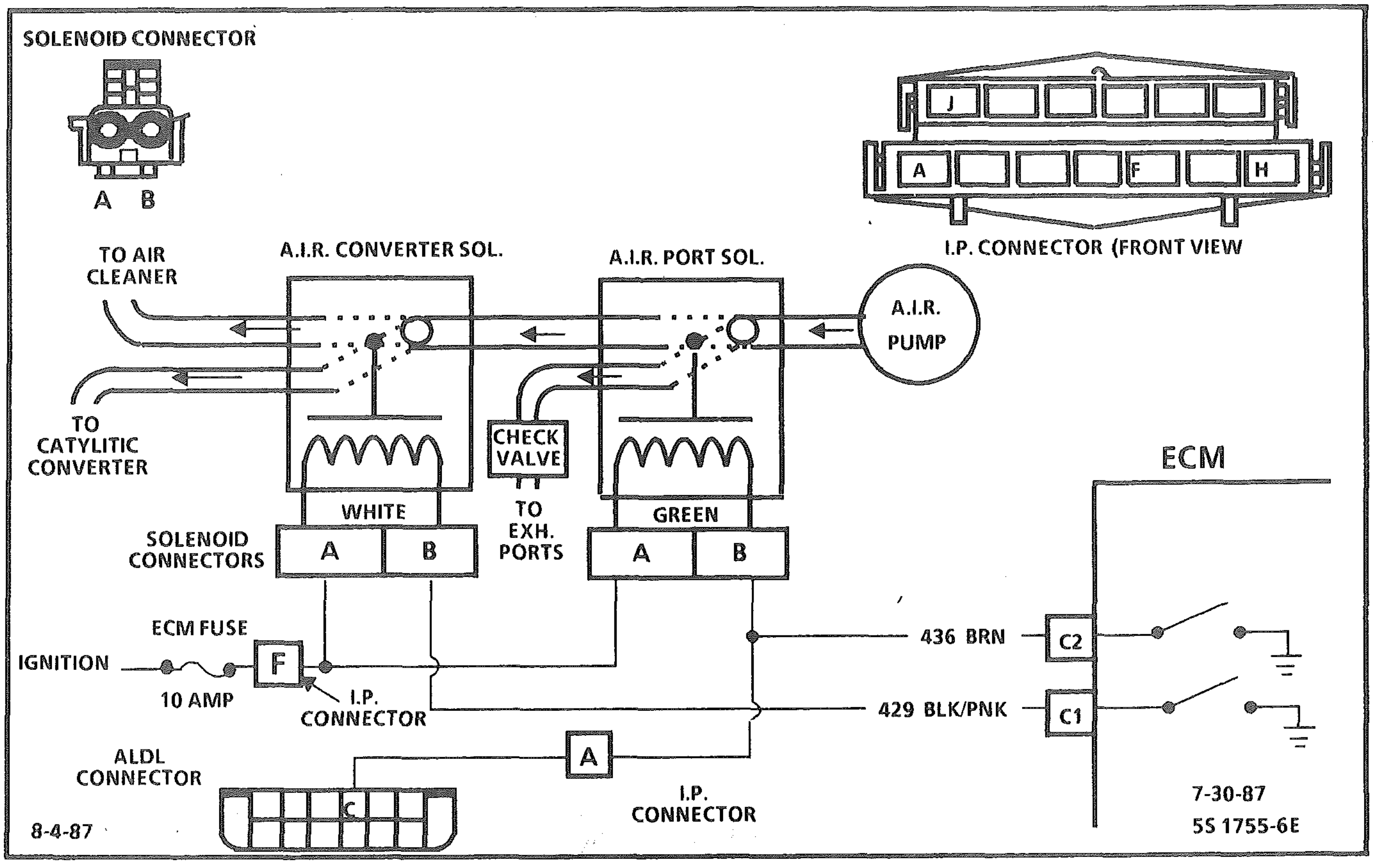


CHART C-6

AIR MANAGEMENT CHECK - PEDES VALVE
(PRESSURE OPERATED ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

Air management is controlled by a port valve and a converter valve, each with an ECM controlled vacuum solenoid. When the solenoid is grounded by the ECM, AIR pressure will activate the valve and allow pump air to be directed as follows:

Neither solenoid grounded by the ECM - Air pump air diverted to atmosphere. Converter solenoid grounded by the ECM - Air pump air to converter.

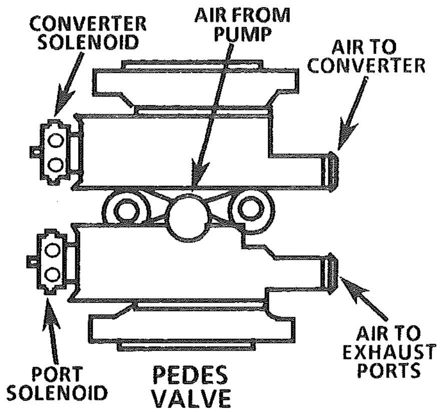
Port solenoid grounded by the ECM - Air pump air to exhaust ports.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This is a system functional check. Air is directed to ports during "Open Loop" and all engine start in "Open Loop" even on a warm engine. Since the air to the ports time is very short on some engines, prepare to observe port air prior to engine start up. On some engines, this can be done by squeezing a hose. On others, steel pipes have to be disconnected.
2. This should normally set a Code 22. When any code is set, the ECM opens the ground to the air control valve and allows air to divert. This checks for ECM response to a fault. A ground in the control valve circuit to the ECM would prevent divert action.
3. This checks for a grounded circuit to the ECM. Test light "OFF" is normal and would indicate the circuit is not grounded.
4. Checks for an open in the solenoid control circuits. Grounding the test terminal should ground both solenoid circuits. Normally, the test light should be "ON" which indicates the problem is not in the ECM or wiring but at the solenoid connections or valve itself.
5. Checks for a grounded switching valve circuit. Test light "OFF" would indicate the circuit is normal and fault is in the valve.

CHART C-6

AIR MANAGEMENT CHECK - PEDES VALVE
(PRESSURE OPERATED ELECTRIC DIVERT/ELECTRIC SWITCHING)
5.0L (VIN E) "F" SERIES (TBI)



(1)
- "DIAGNOSTIC" TERMINAL UNGROUNDED.
- START ENGINE, RUNNING AT PART THROTTLE, BELOW 2000 RPM, AIR SHOULD BE FELT AT OUTLET TO EXHAUST PORTS DURING "OPEN LOOP" OPERATION (FROM 6 SECONDS TO 3 MINUTES ON WARM ENGINE DEPENDING ON APPLICATION) AND SWITCH TO CONVERTER WHEN SYSTEM GOES "CLOSED LOOP".

OK

(2)
- DISCONNECT TPS CONNECTOR AT IDLE AND AIR SHOULD DIVERT TO ATMOSPHERE AFTER A FEW SECONDS.

NO DIVERT

(3)
- IGNITION "ON", ENGINE STOPPED.
- DISCONNECT CONVERTER SOLENOID ELECT. CONNECTOR AND CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS
- NOTE LIGHT.

LIGHT "ON"

CHECK CKT 429 FOR SHORT TO GROUND. IF NOT GROUNDED, IT IS A FAULTY ECM.

LIGHT "OFF"

REPLACE PEDES VALVE.

OK

NO TROUBLE FOUND. CLEAR MEMORY AND REVIEW SYMPTOMS SECTION "B".

PORT THEN DIVERT ONLY

(4)
- IGNITION "ON", ENGINE STOPPED
- GROUND "DIAGNOSTIC" TERMINAL
- DISCONNECT CONVERTER VALVE SOLENOID
- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS AND NOTE LIGHT.

LIGHT "OFF"

- CONNECT TEST LIGHT BETWEEN CKT 39 AND GROUND.

LIGHT "OFF"

OPEN CKT 39

LIGHT "ON"

OPEN IN CKT 429. FAULTY ECM CONNECTION OR ECM.

LIGHT "ON"

FAULT IS CONVERTER VALVE SOLENOID, CONNECTION, OR VALVE.

CONSTANT PORT OR CONVERTER AIR

(5)
- IGNITION "ON", ENGINE STOPPED.
- "DIAGNOSTIC" TERMINAL NOT GROUNDED.
- DISCONNECT PORT VALVE SOLENOID
- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS AND NOTE LIGHT.

LIGHT "OFF"

- GROUND "DIAGNOSTIC" TERMINAL.
- NOTE TEST LIGHT.

LIGHT "OFF"

- CONNECT TEST LIGHT BETWEEN CKT 39 AND GROUND.

LIGHT "OFF"

REPAIR OPEN CKT 39

LIGHT "ON"

OPEN CKT 436. FAULTY CONNECTION OR ECM.

LIGHT "ON"

FAULTY CONNECTION AT PORT SOLENOID OR FAULTY PEDES VALVE.

LIGHT "ON"

GROUNDED CKT 436 OR FAULTY ECM.

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NO_X (oxides of nitrogen) emission levels caused by high combustion temperatures. It does this by decreasing combustion temperature.

The main element of the system is an EGR valve operated by vacuum, and mounted on the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

OPERATION

The EGR valve is opened by manifold vacuum regulated by an ECM controlled solenoid to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open during warm engine operation and when the vehicle is above idle speed.

EGR CONTROL

The EGR vacuum control has a vacuum solenoid that uses "pulse width modulation". This means the ECM turns the solenoid "ON" and "OFF" many times a second and varies the amount of "ON" time ("pulse width") to vary the amount of EGR.

The ECM uses information from the following sensors to regulate the EGR solenoid:

- Coolant Temperature
- Throttle Position (TPS)
- P / N Switch

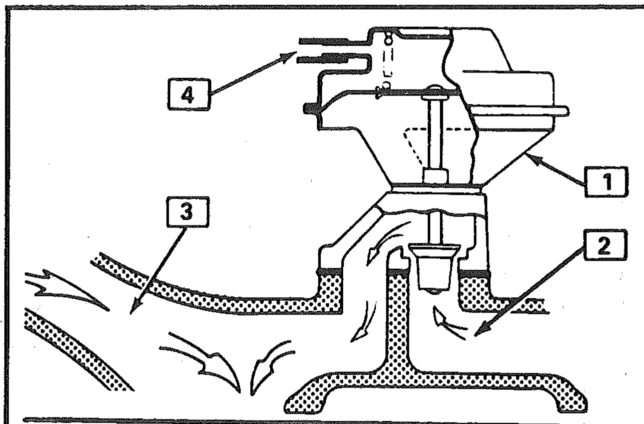

Figure C7-1 - Exhaust Gas Recirculation

During cold operation and at idle, the solenoid circuit is not grounded by the ECM. This blocks vacuum to the EGR valve.

A system malfunction should trigger a "Service Engine Soon" light, and set a Code 32. For more information see Code CHART 32.

NEGATIVE BACKPRESSURE VALVE

The valve used on this engine is a negative backpressure valve. It varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust backpressure.

The diaphragm on this valve (shown in Figure C7-2) has an internal vacuum bleed hole which is held closed by a small spring when there is no exhaust backpressure. The amount of vacuum to the valve is controlled by the ECM controlling a solenoid.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes

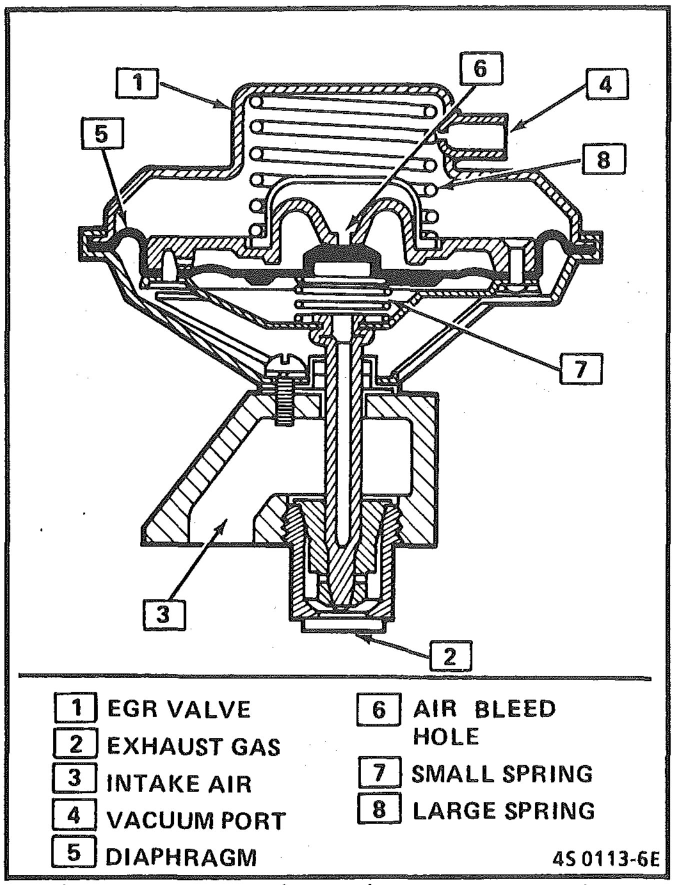

Figure C7-2 - Negative Backpressure EGR Valve

EGR VALVE IDENTIFICATION

- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number (Figure C7-3).
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.
- Port EGR valves have no identification stamped after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

RESULTS OF INCORRECT OPERATION

Too much EGR flow (at idle, cruise, or cold operation) and may result in any of the following conditions:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could causes:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

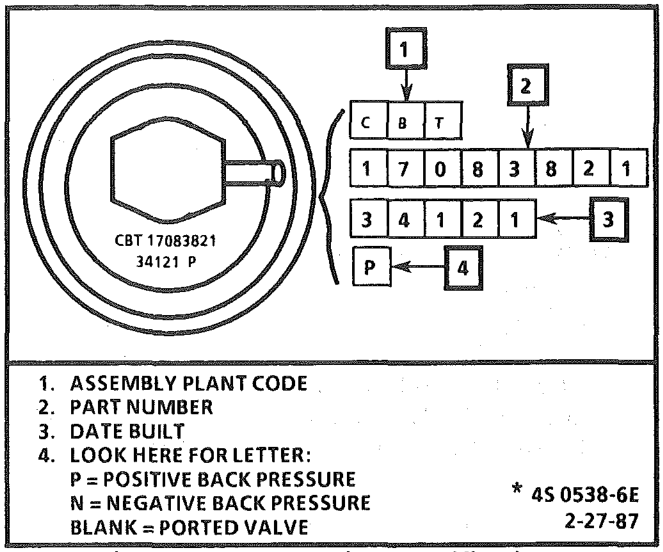

Figure C7-3 - EGR Valve Identification

DIAGNOSIS

Diagnosis of the ECM controlled EGR system on the 5.0L is covered in CHART C-7 at the end of this section. If the vehicle has a stored Code 32 see that chart first.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Air cleaner.
2. EGR valve vacuum hose at valve.
3. Bolts.
4. EGR valve from manifold.

EGR Manifold Passage

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

Install or Connect

1, EGR valve on intake manifold using new gasket.
2. Bolts and tighten to 22 N · m (16 lb. ft.).
3. Vacuum hose to valve.
4. Air cleaner.

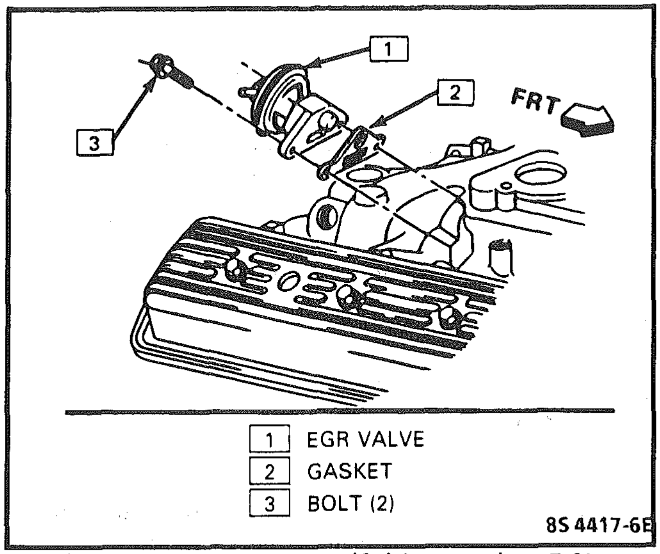

Figure C7-4 - EGR to Manifold Mounting 5.0L

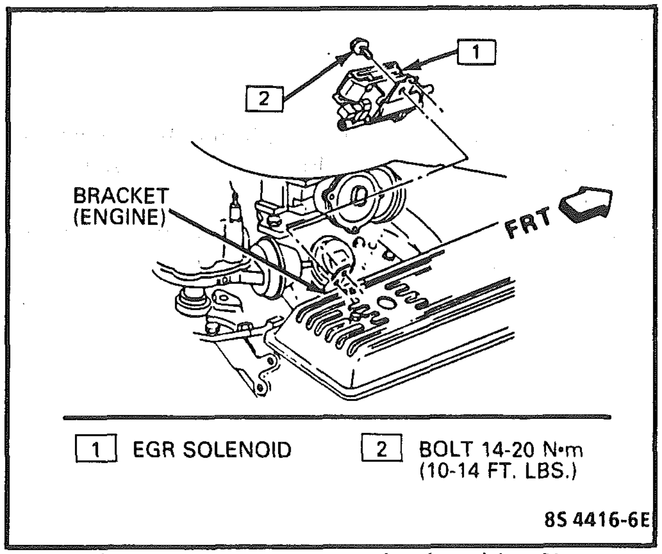

Figure C7-5 - EGR Control Solenoid 5.0L

EGR CONTROL SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. Electrical connector at solenoid, (Figure C7-4)
4. Vacuum hoses.
5. Nut and solenoid.

Install or Connect

1. Solenoid and bracket. Tighten nut to 24 N · m (17 lb. ft.).
2. Vacuum hoses.
3. Electrical connector.
4. Air cleaner.
5. Negative battery cable.

PARTS INFORMATION

PART NAME	GROUP
Valve, EGR	3.670
Solenoid, EGR Cont Vlv Rly	3.670
Gasket, EGR Valve	3.680

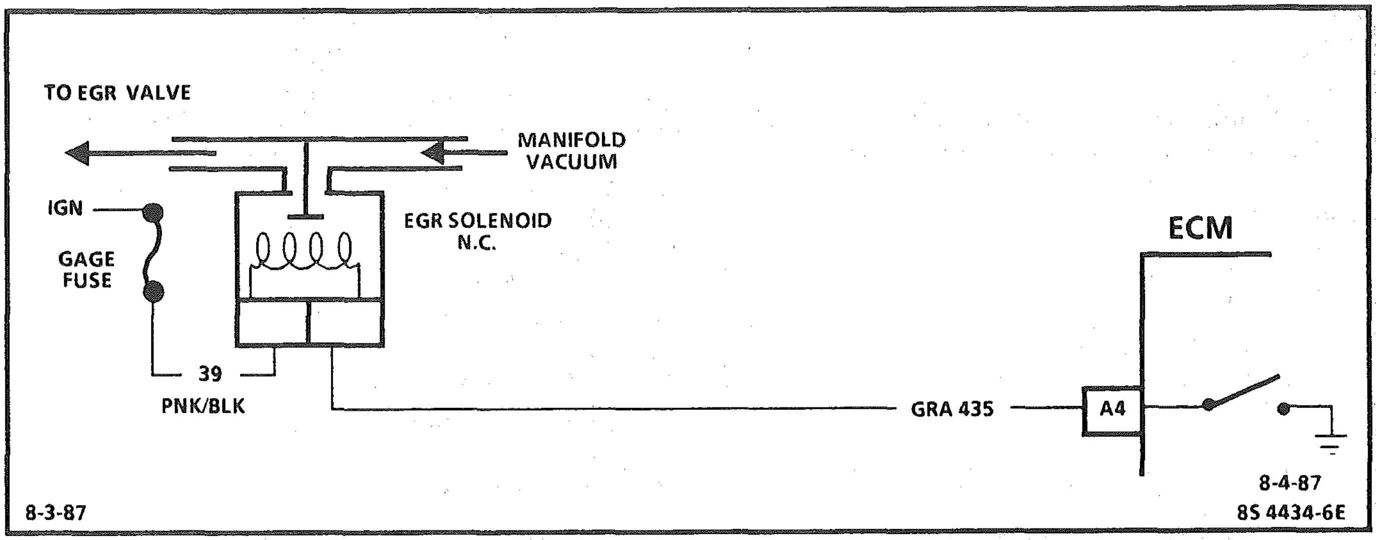

CHART C-7

EXHAUST GAS RECIRULATION (EGR) CHECK
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The ECM operates a solenoid to control the exhaust gas recirculation (EGR) valve. This solenoid is normally closed. By providing a ground path, the ECM energizes the solenoid which then allows vacuum to pass to the EGR valve. The ECM control of the EGR is based on the following inputs:

- Engine coolant temperature - above 25°C.
- TPS - off idle
- MAP

If Code 24 is stored, use that chart first.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for solenoid stuck open.
2. Checks for solenoid always being energized.
3. Grounding test terminal will energize the solenoid and vacuum will drop.
4. Negative backpressure valve should hold vacuum with engine "OFF".
5. When engine is started, exhaust backpressure should cause vacuum to bleed off and valve to fully close.
6. 5.0L engines have a manifold vacuum source which should have at least 7 hg at idle.

CHART C-7

EXHAUST GAS RECIRCULATION (EGR) CHECK
5.0L (VIN E) "F" SERIES (TBI)

BEFORE USING THIS CHART, CHECK FOR MANIFOLD VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST (7") HG VACUUM AT 2000 RPM.

1
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE,
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL.
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
- APPLY VACUUM AND OBSERVE EGR VALVE DIAPHRAGM.
- VALVE SHOULD MOVE.

DOES IT?

YES →

2
- UNGROUND DIAGNOSTIC TERMINAL.
- VACUUM SHOULD BLEED OFF AND VALVE SHOULD CLOSE.

DOES IT?

- **YES →**

  4
  - IGNITION "OFF"
  - CONNECT A VACUUM PUMP TO EGR VALVE.
  - USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM.
  - DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS.

  DOES IT?

  - **YES →**

    5
    - APPLY 10" Hg VACUUM TO EGR VALVE.
    - START ENGINE AND IMMEDIATELY OBSERVE VACUUM GAGE ON VACUUM PUMP.
    - VALVE IS GOOD IF DIAPHRAGM HAS MOVED TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.

    - **VACUUM DROPPED →**

      6 BE SURE VACUUM HOSE BETWEEN SOLENOID AND EGR VALVE IS OK. (NO LEAKS OR RESTRICTIONS) IF NO PROBLEM IS FOUND, THE EGR CIRCUIT IS OK.

    - **NO VACUUM DROP →**
      - REMOVE EGR VALVE.
      - CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED, REPLACE VALVE,

  - **NO →** REPLACE EGR VALVE.

- **NO →**
  - DISCONNECT SOLENOID ELECTRICAL CONNECTOR. DOES VACUUM BLEED OFF?

  - **YES →** CKT 435 SHORTED TO GROUND OR FAULTY ECM.
  - **NO →** REPLACE SOLENOID

NO →
- CONNECT VACUUM PUMP TO EGR VALVE SIDE OF HARNESS.
- APPLY VACUUM AND OBSERVE VALVE.
- VALVE SHOULD MOVE.

DOES IT?

- **YES →**

  3
  - DISCONNECT EGR ELECTRICAL CONNECTOR.
  - CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.
  - IGNITION "ON", ENGINE "OFF".
  - TEST LIGHT SHOULD LIGHT.

  DOES IT?

  - **YES →** FAULTY SOLENOID CONNECTION OR FAULTY SOLENOID.
  - **NO →** CONNECT TEST LIGHT BETWEEN HARNESS TERMINAL "A" AND GROUND.
    - **NO LIGHT →** REPAIR OPEN CKT 39.
    - **LIGHT →** REPAIR OPEN CKT 435. IF NOT OPEN, IT IS A FAULTY ECM.

- **NO →**
  - FAULTY VACUUM HOSE TO EGR VALVE OR FAULTY VALVE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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7S 3554-6E

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SECTION C8

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The transmission converter clutch (TCC) system is designed to eliminate power loss by the converter (slippage) thus increasing fuel economy. By locking the converter clutch, a more effective coupling to the flywheel is achieved. The converter clutch is operated by an ECM controlled solenoid.

OPERATION

Engagement of the TCC is accomplished by a solenoid operated valve within the transmission. The solenoid is activated when an internal switch in the ECM is grounded. Although the ECM may command the TCC "ON", the converter clutch will not apply until internal transmission fluid pressure requirements are met. See Section "7A".

Before the ECM activates the TCC apply solenoid, several inputs must be monitored:

- Vehicle Speed. Must be above a certain value before the TCC can be applied.
- Coolant Temperature. The engine coolant temperature must be above a certain value before the TCC can be applied.
- Throttle Position Sensor. After the TCC is applied, during low engine load condition, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.

CIRCUIT DESCRIPTION

The 12 volt power supply for the solenoid in the transmission is provided through a normally closed switch located on the brake pedal linkage. When the brake pedal is depressed (switch open), the power supply to the TCC solenoid is interrupted and the TCC is disengaged regardless of any other conditions.

When the brake pedal is not depressed (switch closed), battery voltage will be fed to the TCC solenoid. If the ECM has determined that conditions are correct, the circuit from the TCC solenoid will be completed to ground through the ECM and the TCC solenoid will be activated.

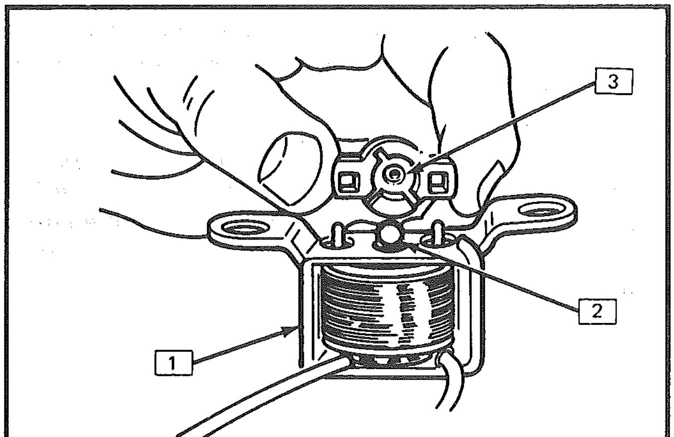

Figure C8-1 - TCC Solenoid

Some transmission use other internal switches in addition to the TCC solenoid.

- 700-R4. transmissions normally use a 4th gear switch to send a signal to the ECM telling it when the transmission is in 4th gear. The ECM uses this information to vary the conditions under which the clutch applies or releases. However, the transmission does not have to be in 4th gear in order for the ECM to turn the clutch "ON"

RESULTS OF INCORRECT TCC OPERATION

An engine stall will result if the converter clutch remains applied at all times.

If the converter clutch does not apply, fuel economy may be lower than expected.

The transmission converter clutch (TCC) system has different operating characteristics than an automatic transmission without TCC. If the driver complains of a "chuggle" or "surge" condition, the car should be road tested and compared to a similar car to see if a real problem exists. Another TCC complaint may be a downshift felt when going up a grade, especially with cruise control. This may not be a downshift, but a clutch disengagement due to the change in TPS to maintain cruising speed. The Owner's Manual section on TCC operation should be reviewed with the driver.

DIAGNOSIS

The diagnosis of the TCC system is covered in CHART C-8. If the ECM detects a problem in the VSS system, a Code 24 should set. In this case see Code 24 Chart.

If the ECM doesn't switch the TCC "ON" when driving, but will turn it "ON" when the "test" terminal is grounded with ignition "ON" and engine stopped, the sensors such as coolant, speed, and throttle position should be checked.

ON-CAR SERVICE

- See Section "7" for TCC Solenoid.
- See Section "8B" for VSS (IP mounted) and brake system.

PARTS INFORMATION

PART NAME	GROUP
Sensor, VSS	9.761
Solenoid, TCC	4.122

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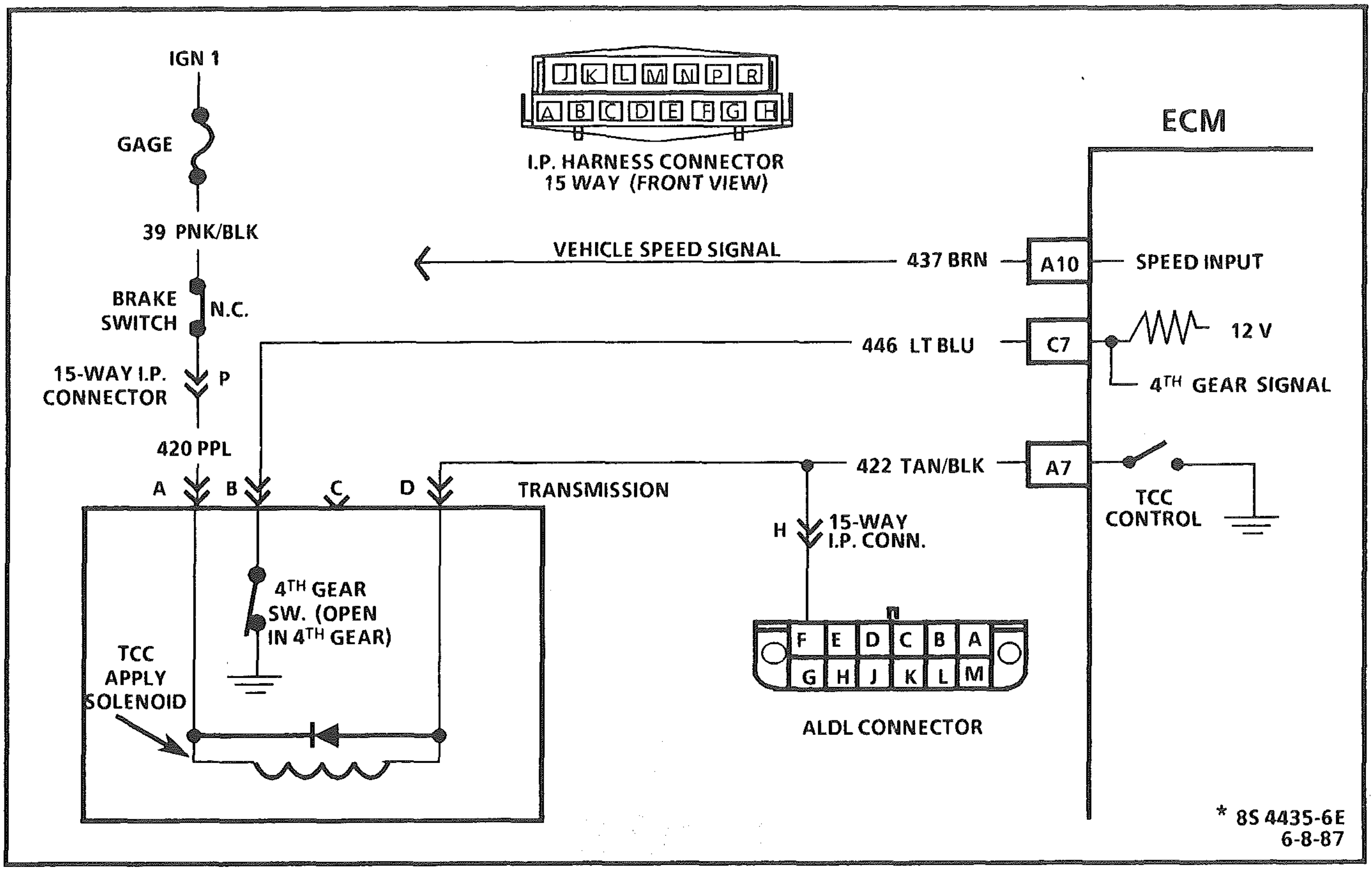

CHART C-8A

TRANSMISSION CONVERTER CLUTCH (TCC)
ELECTRICAL DIAGNOSIS
(Page 1 of 2)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The purpose of the automatic transmission torque converter clutch is to eliminate the power loss of the torque converter, when the vehicle is in a cruise condition. This allows the convenience of the automatic transmission and the fuel economy of a manual transmission.

Fused battery ignition is supplied to the TCC solenoid through the brake switch. the ECM will engage TCC by grounding CKT 422 to energize the solenoid.

TCC will engage when:
- Vehicle speed above 24 mph
- Engine at normal operating temperature (above 70°C, 156°F)
- Throttle position sensor output not changing, indicating a steady road speed
- Brake switch closed

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Confirms 12 volt supply as well as continuity of TCC circuit.
2. Grounding the diagnostic terminal with engine "OFF", should energize the capability of the ECM to control the solenoid.
3. Solenoid coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "Driver". Using an ohmmeter, check the solenoid coil resistance of all ECM controlled solenoids and relays before installing a replacement ECM. Replace any solenoid or relay that measures less than 20 ohms.

Diagnostic Aids:

An engine coolant thermostat that is stuck open or opens at too low a temperature, may result in an inoperative TCC.

CHART C-8A

TRANSMISSION CONVERTER CLUTCH (TCC)
ELECTRICAL DIAGNOSIS
(Page 1 of 2)
5.0L (VIN E) "F" SERIES (TBI)

- USING A "SCAN" TOOL CHECK THE FOLLOWING AND CORRECT IF NECESSARY.
- COOLANT TEMPERATURE SHOULD BE ABOVE 65°C.
- TPS - BE SURE TPS SIGNAL IS NOT ERRATIC.
- VSS - BE SURE "SCAN" DISPLAYS VSS WITH DRIVE WHEELS TURNING. IF CODE 24 IS PRESENT, SEE CODE CHART 24.

(1)
- MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
- IGNITION "ON".
- CONNECT TEST LIGHT TO ALDL CONNECTOR TERMINAL "F" AND GROUND.
- BULB SHOULD "LIGHT."

DOES IT?

YES
- DEPRESS BRAKE PEDAL.
- LIGHT SHOULD GO OUT.

DOES IT?

- **YES** → (2)
  - IGNITION "ON", ENGINE "OFF."
  - RELEASE BRAKE PEDAL.
  - GROUND DIAGNOSTIC TERMINAL.
  - LIGHT SHOULD GO OUT.

  DOES IT?
  - **YES** → TCC CIRCUIT OK. BE SURE VEHICLE IS EQUIPPED WITH THE CORRECT PROM. TO CHECK 4TH GEAR SWITCH (700-R4 ONLY), SEE CHART C-8 (2 OF 2).
  - **NO** → (3)
    - DISCONNECT ECM CONNECTOR.
    - JUMPER CKT 422 TO GROUND.
    - NOTE LIGHT.
    - **"ON"** → REPAIR OPEN CKT 422.
    - **"OFF"** → REPLACE ECM.
- **NO** → BRAKE SWITCH OUT OF ADJUSTMENT OR FAULTY, OR CKT 422 SHORTED TO VOLTAGE.

NO
- DISCONNECT TCC ELECTRICAL CONNECTOR.
- CONNECT TEST LIGHT BETWEEN TERMINAL "A & D".
- BULB SHOULD NOT "LIGHT."

DOES IT?

- **NO**
  - CONNECT TEST LIGHT FROM TERMINAL "A" TO GROUND.
  - BULB SHOULD "LIGHT."

  DOES IT?
  - **YES**
    - GROUND ALDL TERMINAL "F".
    - WITH TEST LIGHT CONNECTED BETWEEN TRANS. CONNECTOR TERMINALS "A & D".
    - THE BULB SHOULD "LIGHT"

    DOES IT?
    - **YES** → FAULTY TCC CONNECTION OR TCC SOLENOID.
    - **NO** → REPAIR OPEN CIRCUIT BETWEEN TRANS. & ALDL TERMINAL "F"
  - **NO** → OPEN IN CKT 39, TCC BRAKE SWITCH CIRCUIT, OR ADJUST SWITCH.
- **YES**
  - DISCONNECT ECM CONNECTOR.
  - NOTE LIGHT.
  - **"ON"** → REPAIR SHORTED TO GROUND CKT 422.
  - **"OFF"** → REPLACE ECM

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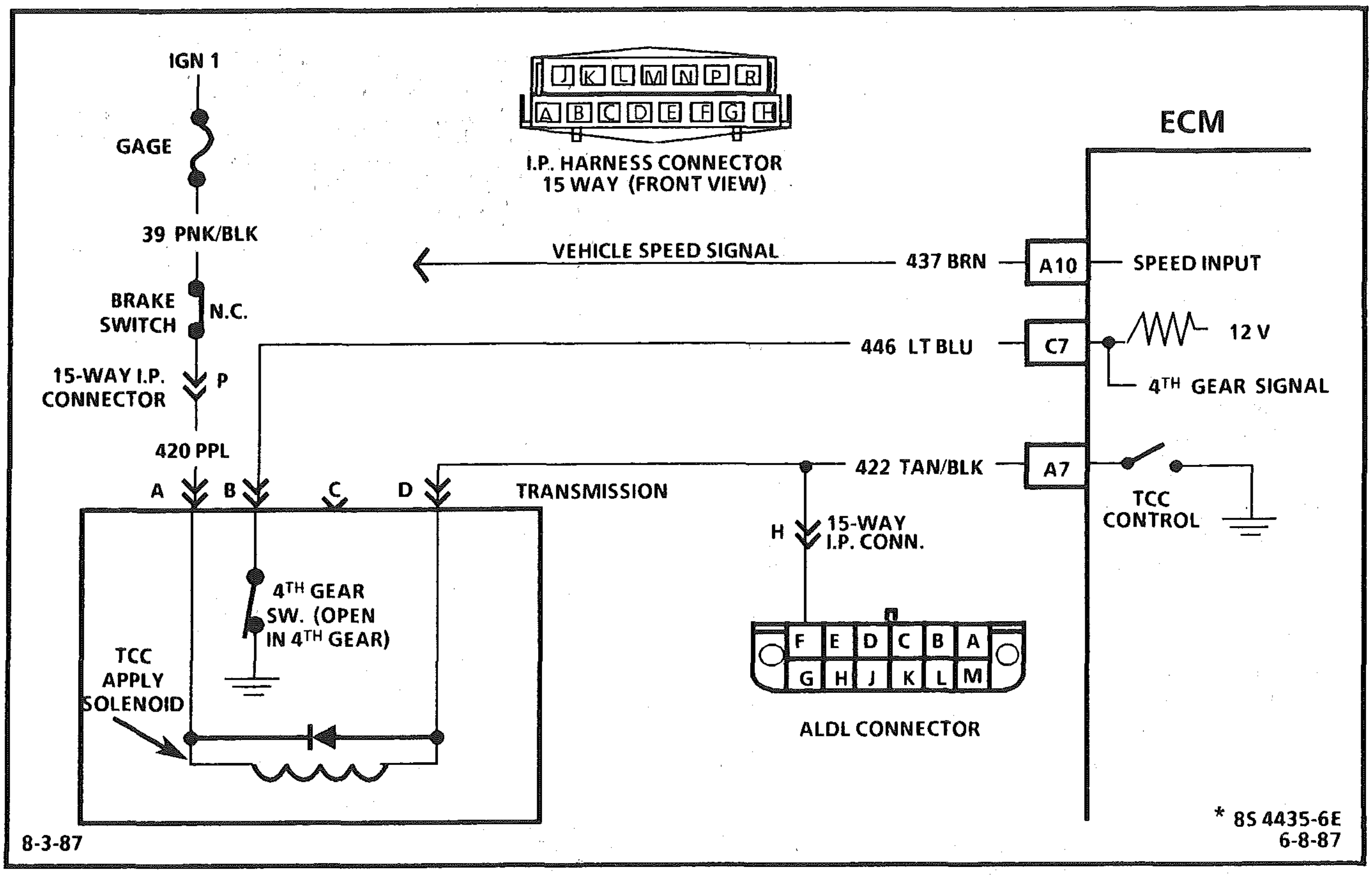

CHART C-8A

700-4R TRANSMISSION
ELECTRICAL DIAGNOSIS
(Page 2 of 2)
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

A 4th gear switch (mounted in the trans.) opens when the trans. shifts into 4th gear, and this switch is used by the ECM to modify TCC lock and unlock points, when in a 4-3 downshift maneuver.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Unless the switch or CKT 446 is open the "Scan" should display "NO", indicating the trans. is not in 4th gear. The 4th gear switch should only be open while in 4th gear.
2. This step determines if the ECM and wiring are OK. Grounding CKT 446 should cause the "Scan" to display "NO", indicating the trans. is not in 4th gear.
3. Checks the operation of the 4th gear switch. When the trans. shifts into 4th gear the switch should open and the "Scan" should display "YES".
4. Disconnecting the TCC connector simulates an open switch to determine if CKT 446 is shorted to ground or the problem is in the transmission.

Diagnostic Aids:

A road test may be necessary to verify the customer complaint. If the "Scan" indicates TCC is turning "ON" and "OFF" erratically, check the state of the 4th gear switch to be sure it is not changing states under a steady throttle position. If the switch is changing states, check connections and wire routing carefully. Also if the 4th gear switch is always open the TCC may engage as soon as sufficient oil pressure is reached.

CHART C-8A

700-4R TRANSMISSION
ELECTRICAL DIAGNOSIS
(Page 2 of 2)
5.0L (VIN E) "F" SERIES (TBI)

CHECKS MADE ON THIS PAGE WILL NOT PREVENT THE TCC FROM WORKING, BUT WILL AFFECT ENGAGEMENT OR DISENGAGEMENT POINTS.

1
- IGNITION "ON", ENGINE "OFF".
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

NO

3
- RAISE DRIVE WHEELS
- SHIFT VEHICLE INTO OVERDRIVE
- INCREASE SPEED SLOWLY UNTIL TRANS. SHIFTS INTO 4TH GEAR.
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

YES

4TH GEAR SWITCH OK. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

4
- IGNITION "ON" ENGINE "OFF"
- DISCONNECT TRANS. ELECTRICAL CONNECTOR
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

YES

WIRE GROUNDED INTERNALLY IN TRANS. OR FAULTY 4TH GEAR SWITCH.

NO

CKT 446 SHORTED TO GROUND OR FAULTY ECM.

YES

2
- DISCONNECT TCC ELECTRICAL CONNECTOR.
- JUMPER HARNESS TERMINAL "B" (CKT 446) TO GROUND.
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

NO

FAULTY CONNECTION OR 4TH GEAR SWITCH.

YES

OPEN CKT 446, FAULTY CONNECTION OR FAULTY ECM.

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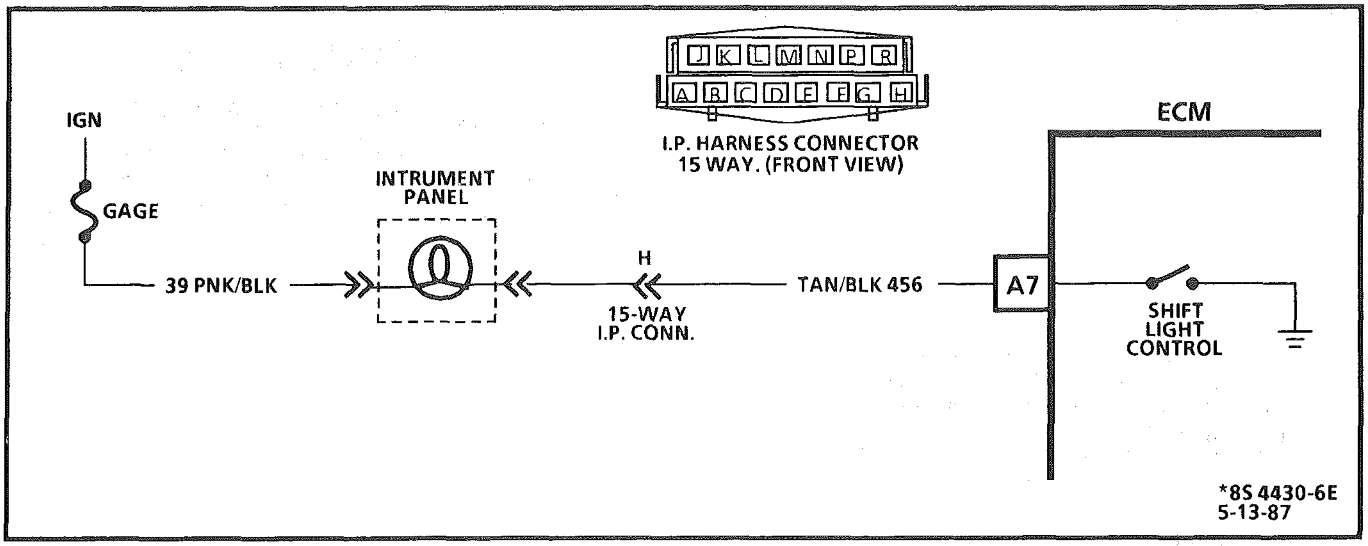


CHART C-8B

MANUAL TRANSMISSION (M/T)
SHIFT LIGHT CHECK
5.0L (VIN E) "F" SERIES (TBI)

Circuit Description:

The shift indicates the best transmission shift point for maximum fuel economy. The light is controlled by the ECM and is turned "ON" by grounding CKT 456.

The ECM uses information from the following inputs to control the shift light:

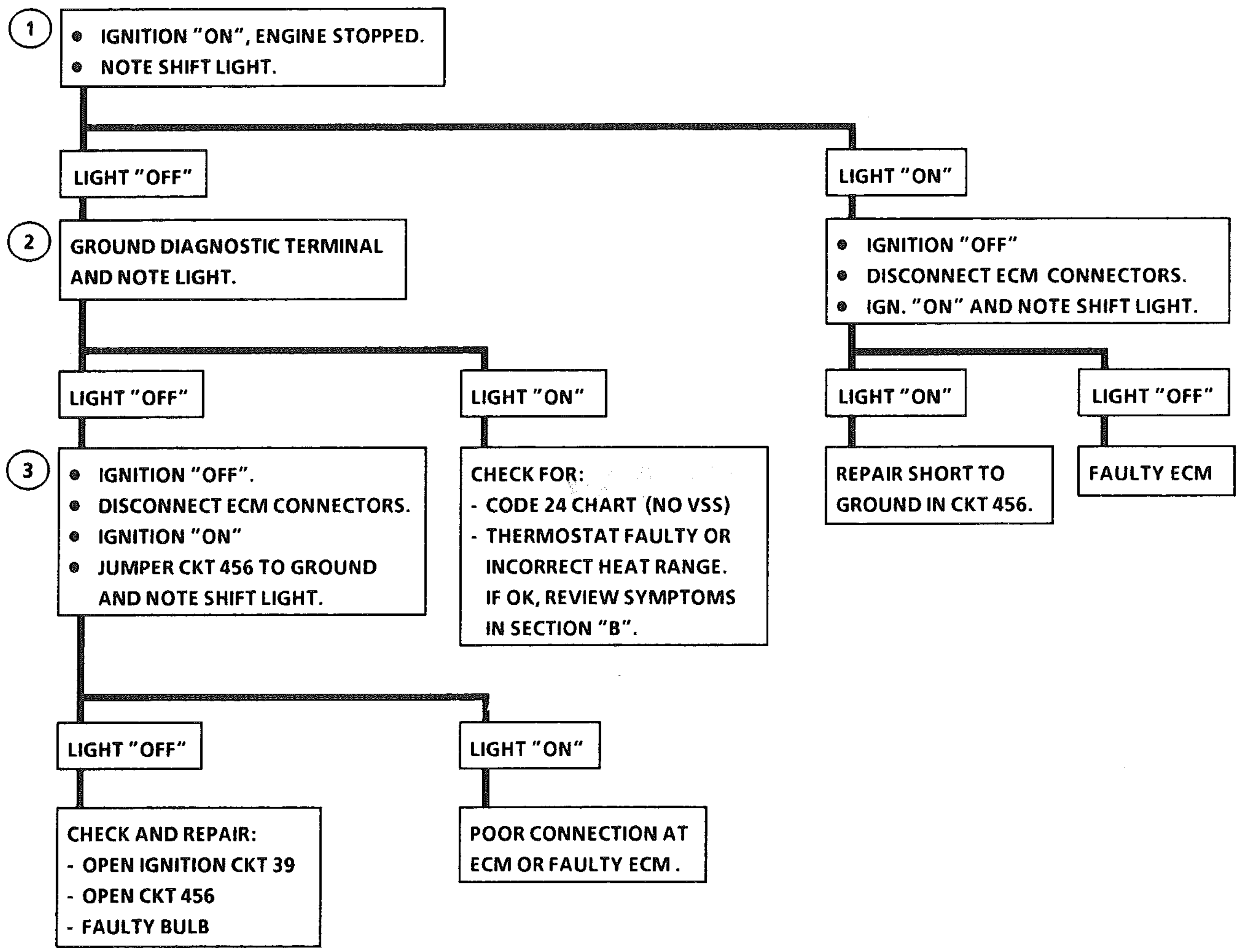
- Coolant temperature
- TPS
- VSS
- RPM

The ECM uses the measured rpm and the vehicle speed to calculate what gear the vehicle is in. It is this calculation that determines when the shift light should be turned on.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This should not turn "ON" the shift light. If the light is "ON", there is a short to ground in CKT 456 wiring, or a fault in the ECM.
2. When the diagnostic terminal is grounded, the ECM should ground CKT 456, and the shift light should come on.
3. This checks the shift light circuit up to the ECM connector. If the shift light illuminates, then the ECM connector is faulty, or the ECM does not have the ability to ground the circuit.

CHART C-8B
MANUAL TRANSMISSION (M/T) SHIFT LIGHT CHECK 5.0L (VIN E) "F" SERIES (TBI)



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SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION

A positive crankcase ventilation (PCV) system is used to consume crankcase vapors in the combustion process instead of venting to atmosphere. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-2).

The primary control is through the PCV valve which meters the flow at a rate depending on manifold vacuum.

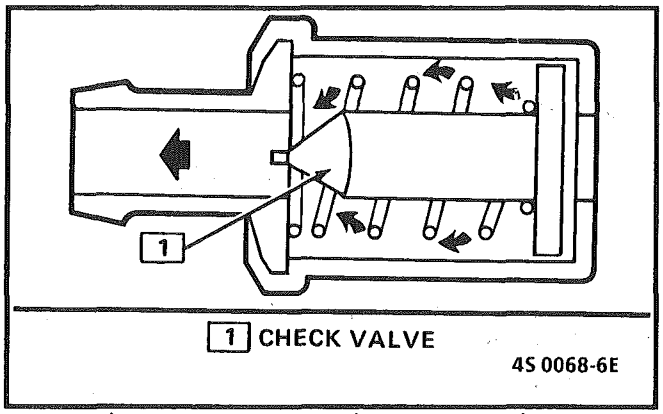


Figure C13-1 - PCV Valve Cross Section

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the air cleaner to be consumed by normal combustion.

- A leaking valve or hose would cause:
  - Rough idle.
  - Stalling.
  - High idle speed.

DIAGNOSIS

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.

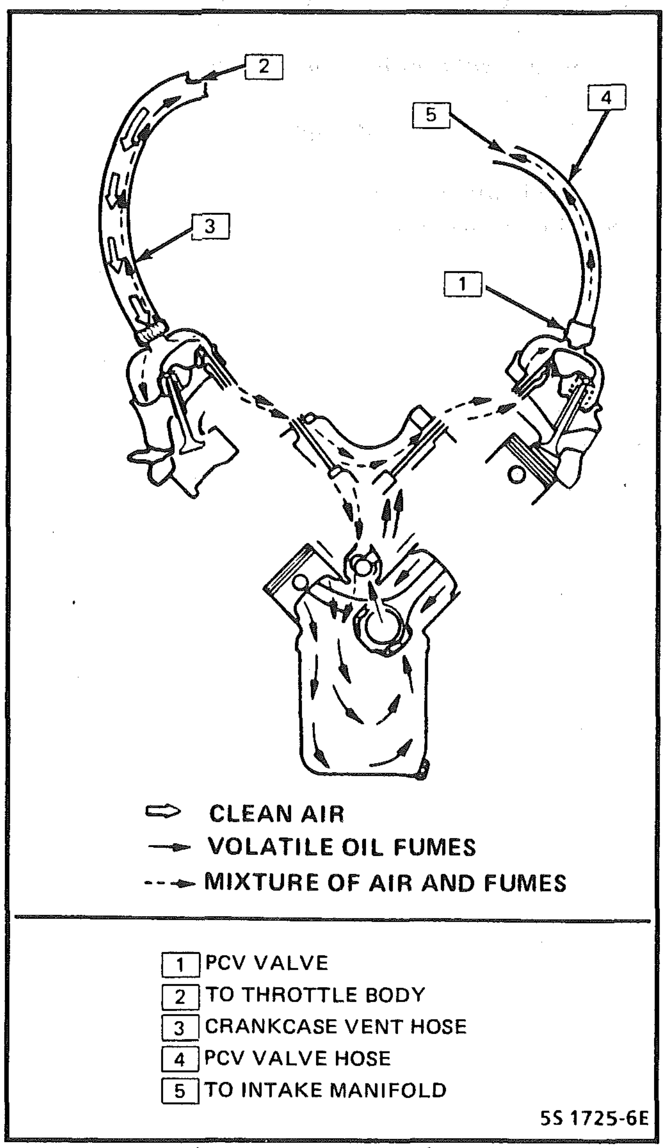


Figure C13-2 - PCV-Flow

3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn "OFF" the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

Proper operation of the PCV System is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

Results of Incorrect PCV Operation

- A plugged valve or hose may cause:
  - Rough idle.
  - Stalling or slow idle speed.
  - Oil leaks.
  - Oil in air cleaner.
  - Sludge in engine.

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve and air cleaner breather at intervals shown in Section "0B".

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, C/Case Vent	1.745

SECTION C14

THERMOSTATIC AIR CLEANER (THERMAC)

CONTENTS

GENERAL DESCRIPTION

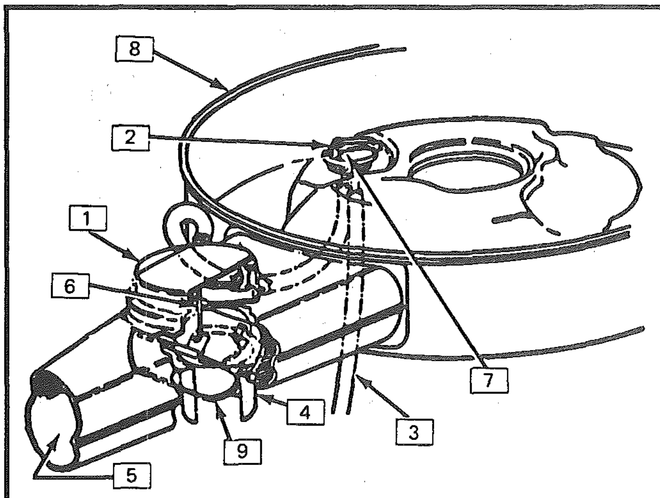
PURPOSE

A heated intake air system is used to give good driveability under varying climatic conditions. By having a uniform inlet air temperature, the fuel system can be calibrated to reduce exhaust emissions and to eliminate throttle valve icing.

OPERATION

The THERMAC air cleaner operates by heated air and manifold vacuum (Figure C14-1). Air can enter the air cleaner from outside the engine compartment or from a heat stove built around the exhaust manifold. A vacuum diaphram motor, built into the air cleaner snorkel, moves a damper door, to admit hot air from the exhaust manifold, outside air, or a combination of both. Inside the air cleaner is a temperature sensor that reacts to air intake temperature and controls the amount of vacuum going to the motor.

- Hot Air Delivery Mode. When the temperature is below 86°F (30°C), the sensor allows vacuum to the motor and the damper door will be up, shuting off outside air and allowing only heated air from the exhaust manifold to enter the air cleaner.
- Outside Air Delivery Mode. When the temperature is above 55°C (131°F), the damper door drops down and only outside air enters the air cleaner.
- Regulating Mode. Between 30°C (86°F) and 55°C (131°F) the damper door allows both heated and outside air to enter the air cleaner.



1 VACUUM DIAPHRAGM MOTOR
2 TEMPERATURE SENSOR
3 VACUUM HOSE (TO MANIFOLD VACUUM)
4 HEAT STOVE DUCT
5 SNORKEL
6 LINKAGE
7 AIR BLEED VALVE
8 AIR CLEANER ASM.
9 DAMPER DOOR

4S 0648-6E

Figure C14-1 - THERMAC Air Cleaner - Typical

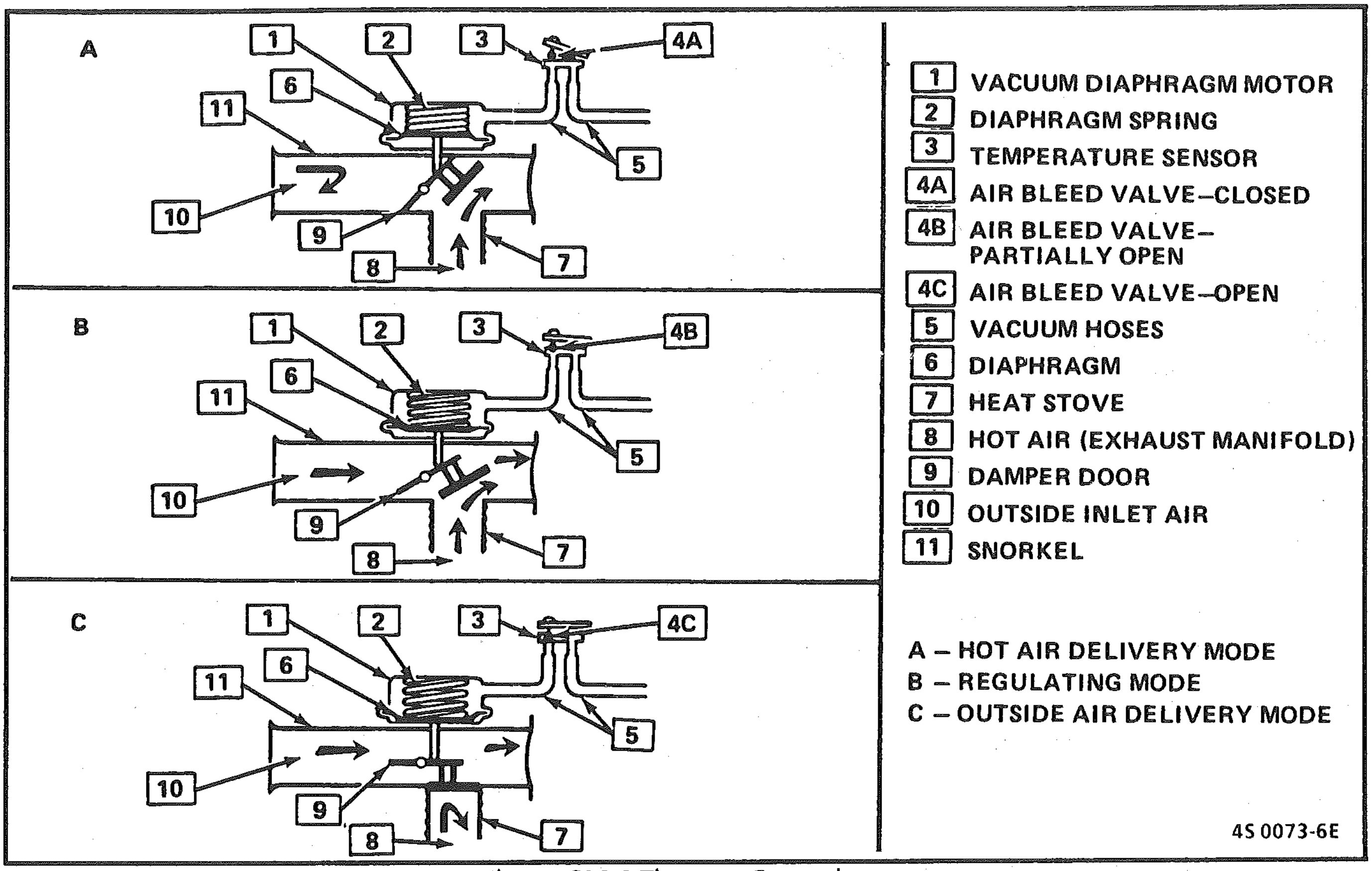


Figure C14-2 Thermac Operation

DIAGNOSIS

RESULTS OF INCORRECT THERMAC OPERAITON

Hesitation during warm-up can be caused by:

- Heat stove tube disconnected.
- Vacuum diaphram motor inoperative (open to snorkel).
- No manifold vacuum.
- Damper door does not move.
- Missing air cleaner to carburetor seal.
- Missing air cleaner cover seal or loose cover.
- Loose air cleaner.

Spark Knock, Lack of power, sluggish, or spongy, on a hot engine can be caused by:

- Damper door does not open to outside air.
- Temperature sensor doesn't bleed off vacuum.

THERMAC AIR CLEANER CHECK

1. Inspect system to be sure all hoses and heat stove tube are connected. Check for kinked, plugged or deteriorated hoses.
2. Check for presence and condition of air cleaner to carburetor gasket seal.
3. With air cleaner assembly installed, damper door should be open to outside air.
4. Start engine. Watch damper door in air cleaner snorkel. When engine is first started, damper door should move and close off outside air.
   As air cleaner warms up, damper door should open slowly to outside air.
5. If the air cleaner fails to operate as described above, perform vacuum motor check. If it operates, the door may not be moving at the right temperature. If the driveability problem is during warm-up, make the temperature sensor check below.

VACUUM MOTOR CHECK

1. With engine "OFF", disconnect vacuum hose at vacuum diaphragm motor.
2. Apply at least 23 kPa (7in.Hg.) of vacuum to the vacuum diaphragm motor. Damper door should completely block off to outside air when vacuum is applied. If not, check to see if linkage is hooked up correctly.
3. With vacuum still applied, trap vacuum in vacuum diaphragm motor by bending hose.
   Damper door should remain closed. If not, replace vacuum diaphragm motor assembly. (Failure of the vacuum diaphragm motor assembly is more

likely to be caused from binding linkage or a corroded snorkel than from a failed diaphragm. This should be checked first, before replacing the diaphragm.)

4. If vacuum motor checks OK, check vacuum hoses and connections. If OK, replace the temperature sensor.

TEMPERATURE SENSOR CHECK

1. Start test with air cleaner temperature below 30°C (86°F). If engine has been run recently, remove air cleaner cover and place thermometer as close as possible to the sensor. Let air cleaner cool until thermometer reads below 30°C (86°F) about 5 to 10 minutes. Reinstall air cleaner on engine and continue to Step 2.
2. Start and idle engine. Damper door should move to close off outside air immediately if engine is cool enough. When damper door starts to open the snorkel passage (in a few minutes), remove air cleaner cover and read thermometer. It must read about 55°C (131°F).
3. If the damper door is not open to outside air at temperature indicated, temperature sensor is malfunctioning and must be replaced.

ON-CAR SERVICE

AIR CLEANER ELEMENT

Remove or Disconnect

1. Air cleaner cover.
2. Old element.

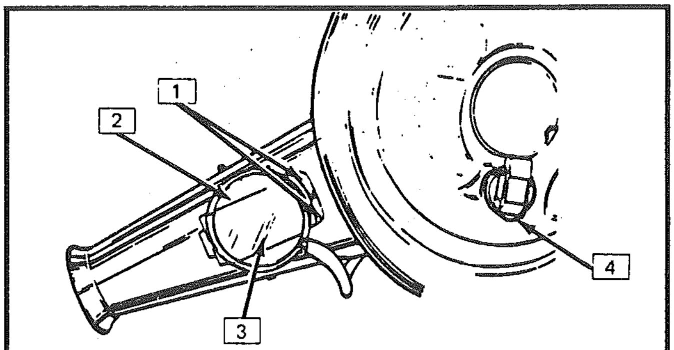
Install or Connect

1. New element.
2. Air cleaner cover. Do not over-torque nuts (install finger- tight).

VACUUM DIAPHRAGM MOTOR

Remove or Disconnect

1. Air cleaner.
2. Vacuum hose from motor.
3. Drill out the two spot welds initially with a 1. 6mm (1/16") drill, then enlarge as required to remove the retaining strap. Do not damage the snorkel tube.
4. Motor retaining strap.
5. Lift up motor, cocking it to one side to unhook the motor linkage at the control damper assembly.



[1] SPOT WELDS
[2] MOTOR ASM.
[3] RETAINING STRAP
[4] INSTALL REPLACEMENT SENSOR ASM. IN SAME POSITION AS ORIGINAL ASM.

4S 0649-6E

Figure C14-3 - Replacing THERMAC Vacuum Motor

Install or Connect

1. Drill a 2.8mm (7/64") hole in snorkel tube at center of vacuum motor retaining strap.
2. Vacuum motor linkage into control damper assembly.
3. Use the motor retaining strap and sheet metal screw provided in the motor service package to secure motor to the snorkel tube. Make sure the screw does not interfere with the operation of the damper assembly. Shorten screw if required.
4. Vacuum hose to motor and install air cleaner.

SENSOR

Remove or Disconnect

1. Air cleaner.
2. Hoses at sensor.
3. Pry up tabs on sensor retaining clip. Remove clip and sensor from air cleaner. Note position of sensor for installation.

Install or Connect

1. Sensor and gasket assembly in original position.
2. Retainer clip on hose connectors.
3. Vacuum hoses and air cleaner on engine.

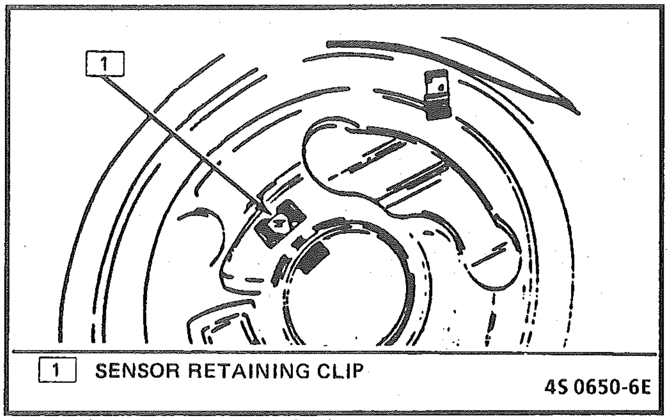


Figure C14-4 - Replacing THERMAC Sensor

PARTS INFORMATION

PART NAME	GROUP
Sensor, A/C	3.415
Motor, A/CVac Diaph	3.415

SECTION 6E3
DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:
2.8L LB8 (VIN S) "F" SERIES
5.0L LB9 (VIN F) "F" SERIES
5.7L L98 (VIN 8) "F" SERIES

CONTENTS

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS
2.8L (VIN S)

SECTION C - COMPONENT SYSTEMS
2.8L (VIN S)

SECTION A - DIAGNOSTIC CHARTS
5.0L (VIN F) & 5.7L (VIN 8)

SECTION B - SYMPTOMS
5.0L (VIN F) & 5.7L (VIN 8)

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS
5.0L (VIN F) & 5.7L (VIN 8)

SECTION C - COMPONENT SYSTEMS
5.0L (VIN F) & 5.7L (VIN 8)

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

INTRODUCTION

GENERAL DESCRIPTION

This section applies to engines which have a fuel injector in the intake manifold near the intake valve for each cylinder. It is commonly referred to as "Port Fuel Injection".

These engines have controls to reduce exhaust emissions, while maintaining good driveability and fuel economy.

An engine control module (ECM) is the heart of this control system and has sensors used to provide information about engine operation and the various systems it controls. Details of basic operation, diagnosis, functional checks, and on-vehicle service are covered in Section "C", "Component Systems".

The ECM has the ability to do some diagnosis of itself, and of other parts of the system. When it finds a problem, it lights a "Service Engine Soon" light on the instrument panel and a trouble code will be stored in the ECM memory. This does not mean that the engine should be stopped right away, but that the cause of the light coming "ON" should be checked as soon as reasonably possible.

DIAGNOSIS PROCEDURE

The following sections(s) are written for specific engine applications and are clearly indentified. Be sure to use only the section which applies to the engine family being diagnosed.

Before using this section of the manual, you should be familiar with the information and the proper diagnosing procedures as described in Section "6E". If the proper diagnosis procedures are not followed, as described in Section "6E", it may result in unnecessary replacement of good parts.

Trouble tree charts incorporate diagnosis procedures using an ALDL "SCAN" tool where possible. The "SCAN" tool has the ability to save time in diagnosis and prevent the replacement of good parts. **The key to using the "SCAN" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose, as well as an understanding of the "SCAN" tool's limitations. See Section "6E" for more information.**

SECTION A
2.8L ENGINE

DIAGNOSTIC CIRCUIT CHECK

The "Diagnostic Circuit Check" verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

The vehicle drive wheels should always be blocked while checking the system.

Cold Oxygen Sensor

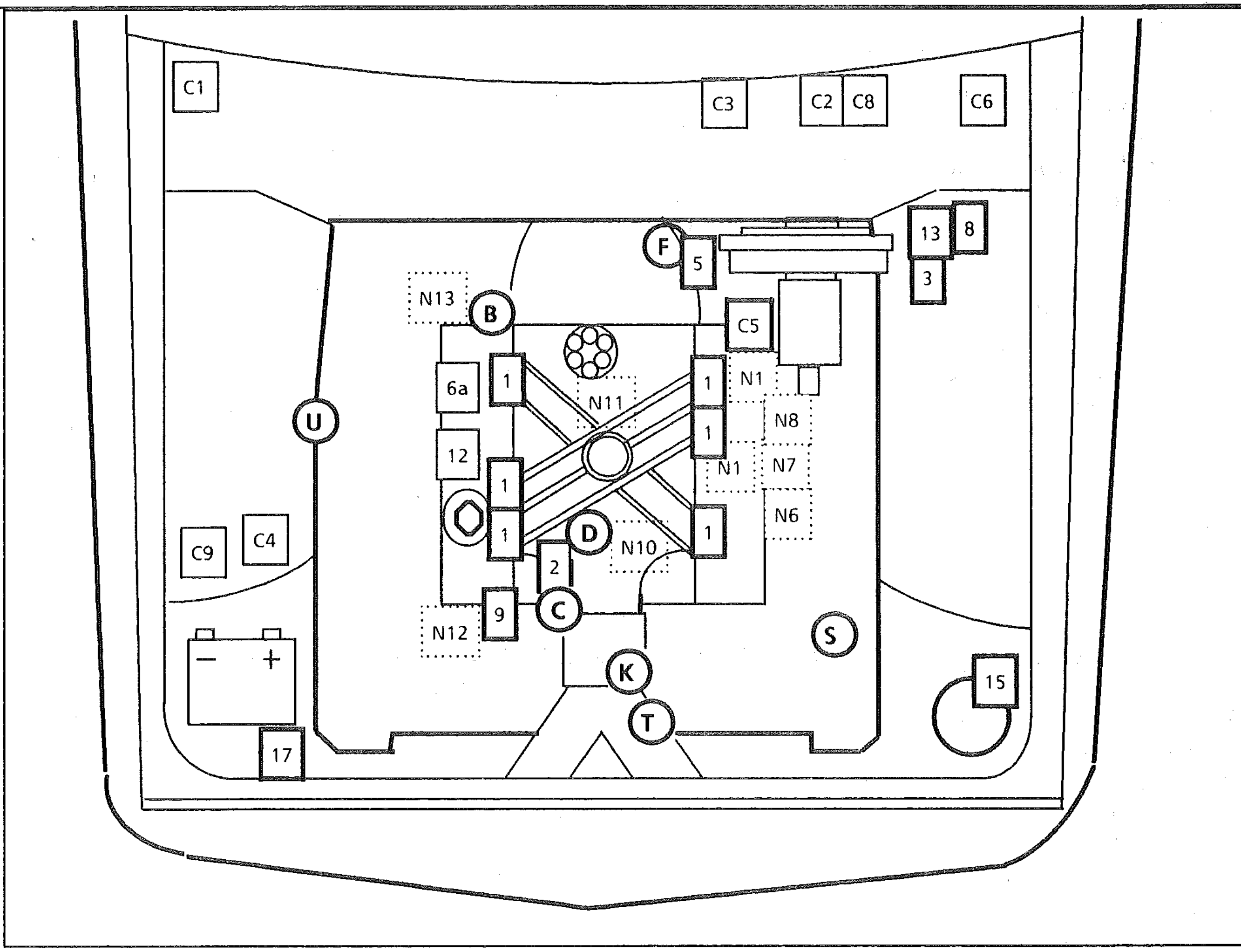
On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

Basic Procedure

If you have not reviewed the basic information on how to use the diagnostic procedures, go to the introduction of this section.

SECTION A
ENGINE COMPONENTS / WIRING DIAGRAMS / DIAGNOSTIC CHARTS

'F' SERIES RPO:LB8 VIN CODE:S 2.8L V6 PFI



COMPUTER HARNESS

- C1 Electronic Control Module (ECM)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C4 ECM power/fuel pump fuse
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector (ALDL"G")
- C9 MAF fuse

NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N4 Engine temp. switch (telltale)
- N5 Engine temp. sensor (gage)
- N6 Oil press. switch (telltale)
- N7 Oil press. sensor (gage)
- N8 Oil press. swich (fuel pump)
- N10 Cold start fuel injection switch
- N11 Cold start valve
- N12 Deceleration Valve (M/T only)
- N13 Fan Override Switch

CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control motor
- 3 Fuel pump relay
- 5 Trans. Conv. Clutch connector
- 6a Remote ignition coil
- 8 Engine coolant fan relay
- 9 Air control solenoid (M.T. only)
- 12 Exhaust Gas Recirculation solenoid
- 13 A/C compressor relay
- 15 Fuel vapor canister solenoid
- 17 Mass air flow sensor relay
- Exhaust Gas Recirculation valve

INFORMATION SENSORS

- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed
- K Mass Air Flow
- S Power steering pressure switch
- T Manifold Air Temperature
- U A/C pressure fan switch

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Figure A1-1 - Component Locations 2.8L "F" Series

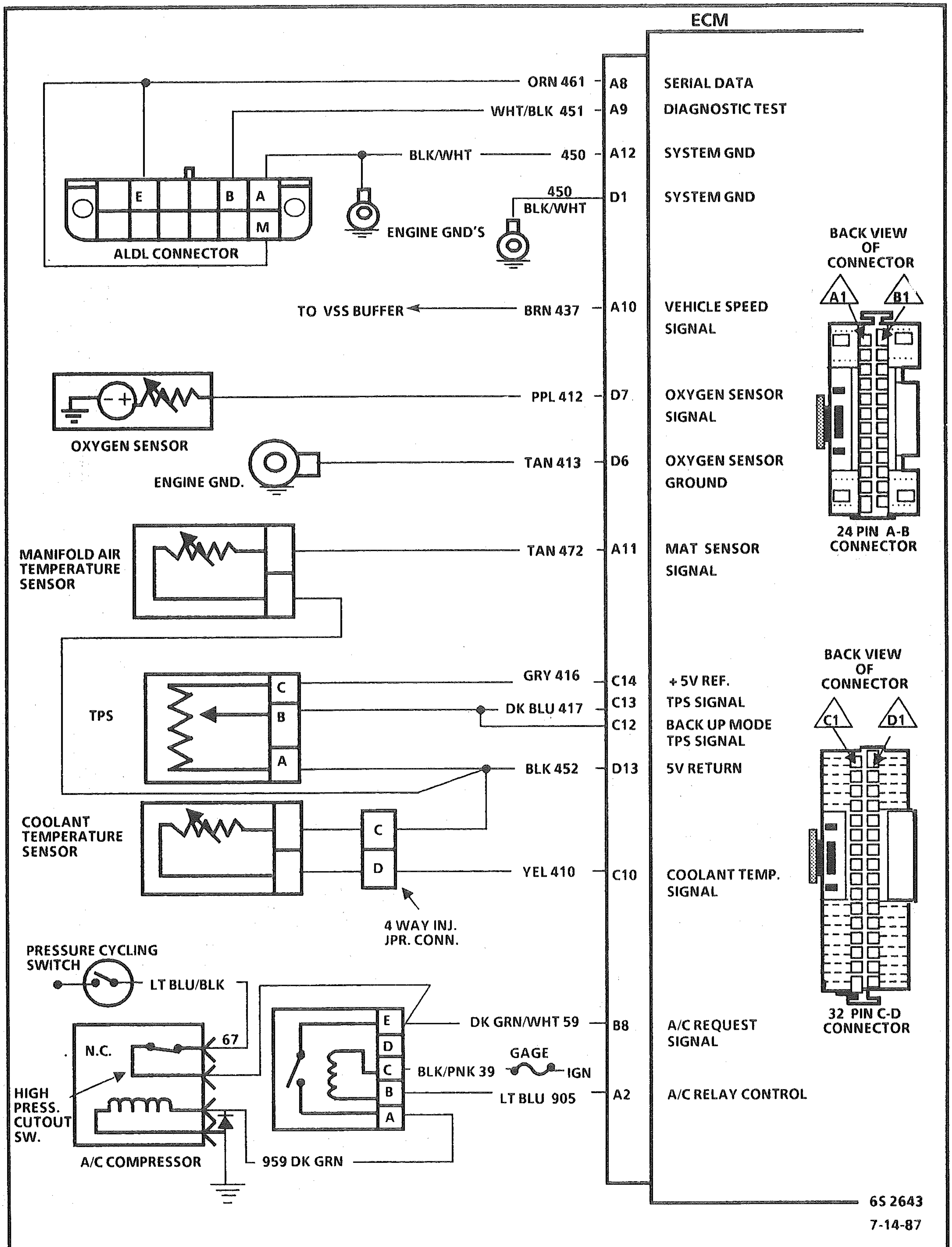


Figure A1-2 - Wiring Diagram 2.8L "F" Series (1 of 3)

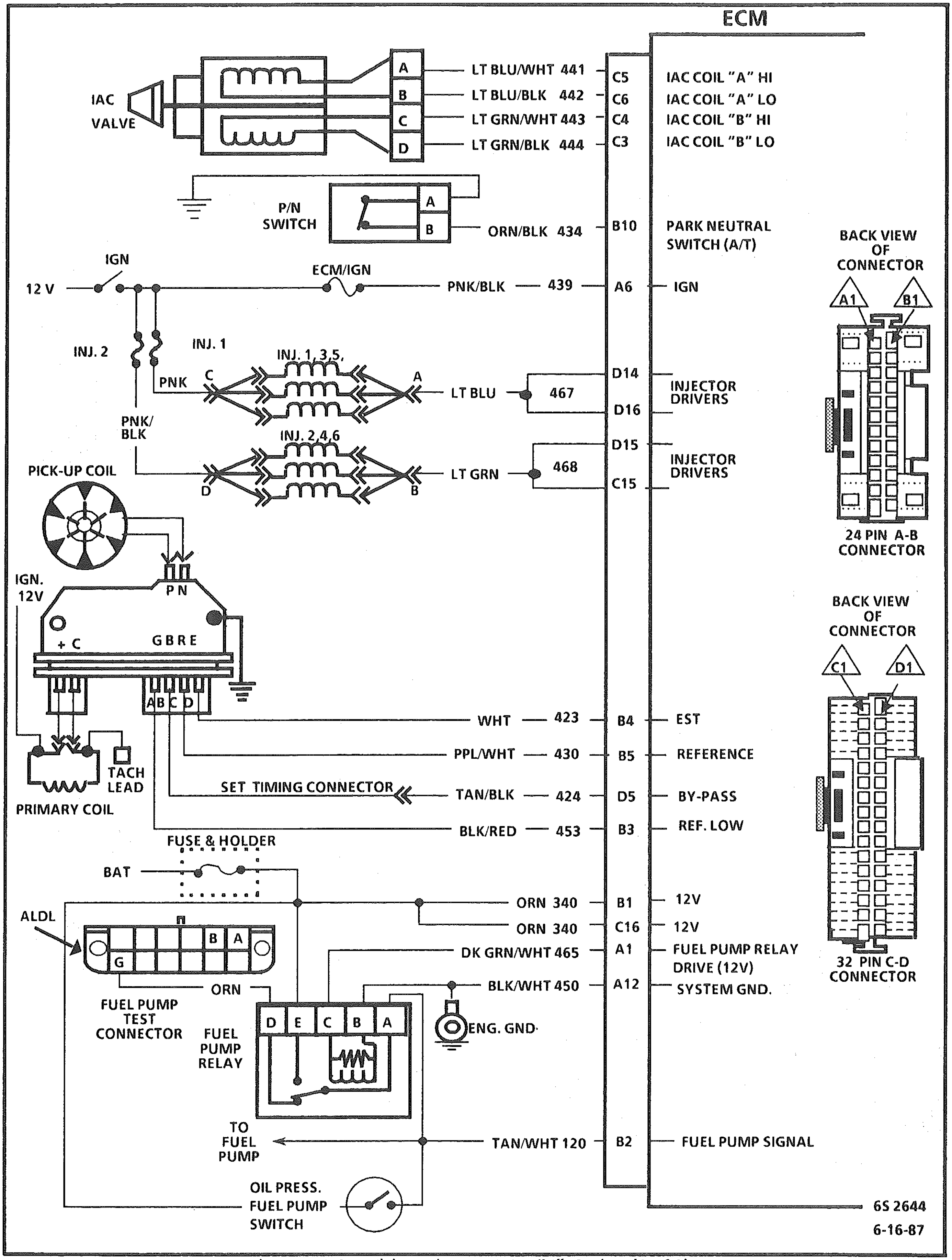


Figure A1-3 - Wiring Diagrm 2.8L "F" Series (2 of 3)

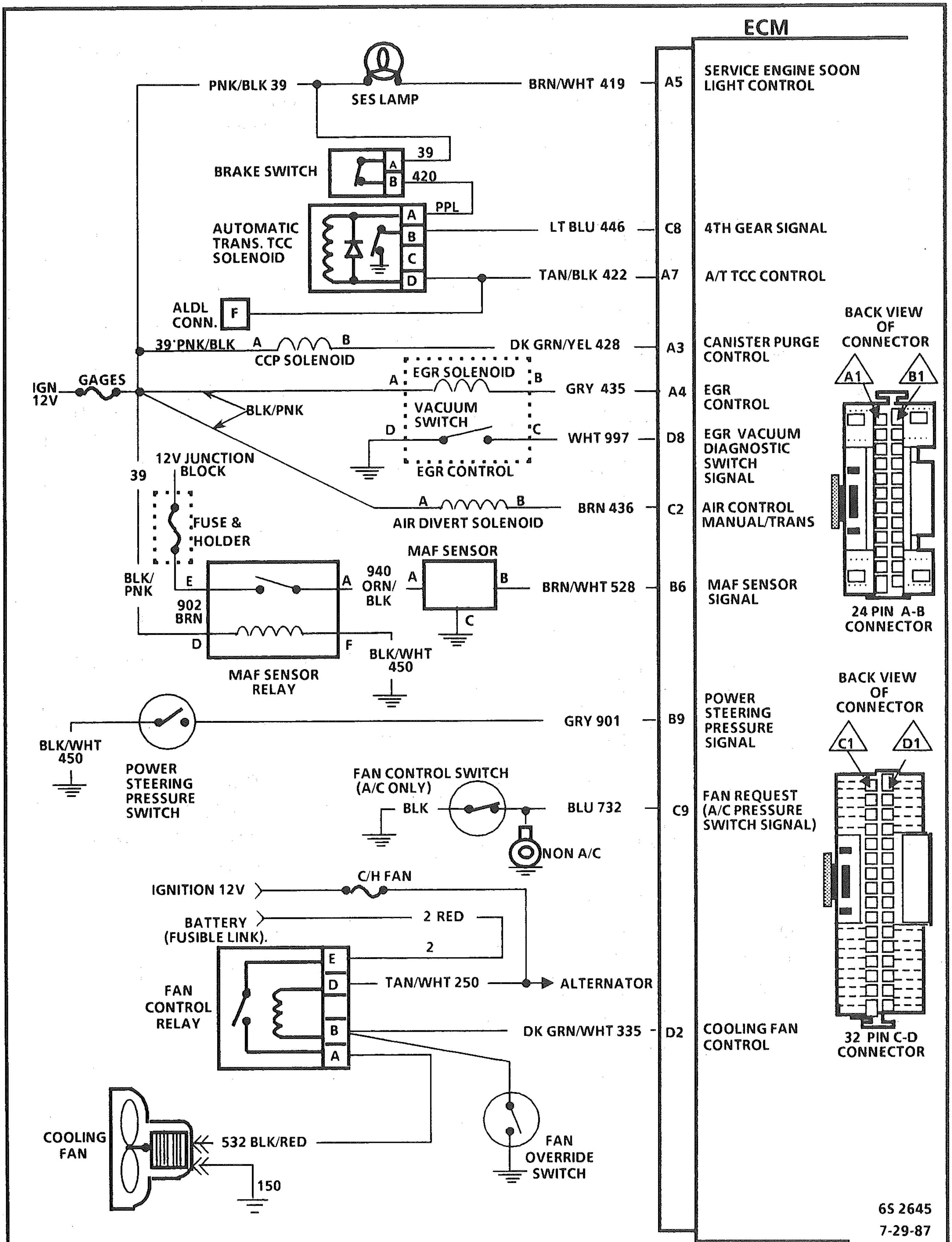


Figure A1-4 - Wiring Diagram 2.8L "F" Series (3 of 3)

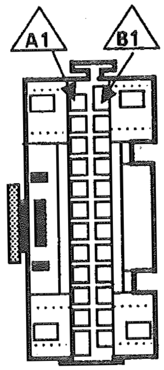
PORT FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALDL tool not installed

Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
4	0	14	FUEL PUMP RELAY	A1	DK GRN/WHT
	12	14	A/C CLUTCH CONTROL	A2	LT BLU
	12	14	CANISTER PURGE CONTROL	A3	DK GRN/YEL
	12	14	EGR CONTROL	A4	GRY
	0	14	"SERVICE ENGINE SOON" CONTROL	A5	BRN/WHT
	12	14	IGN - ECM FUSE	A6	PNK/BLK
	0	0	TCC CONTROL	A7	TAN/BLK
	2-5	2.5	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/BLK
1			SPEED SENSOR SIGNAL	A10	BRN
2			MAT SIGNAL	A11	TAN
	0	0	SYSTEM GROUND	A12	BLK/WHT

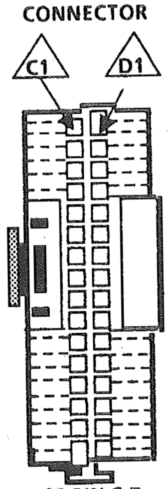


BACK VIEW OF CONNECTOR

24 PIN A-B CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
ORN	B1	BATT.12.VOLTS	12	14	
TAN/WHT	B2	FUEL PUMP SIGNAL	0	14	4
BLK/RED	B3	EST REF LOW	0	0	
WHT	B4	EST CONTROL	0	1.3	
PPL/WHT	B5	REFERENCE	0	1.6	
BRN/WHT	B6	MASS AIR FLOW SENSOR SIGNAL	2.5	2.5	
	B7	NOT USED			
DK GRN/WHT	B8	A/C SIGNAL	0	0	
GRY	B9	P.S.P.S.	12	12	
ORN/BLK	B10	PARK/NEUTRAL SW.SIGNAL	0	0	
	B11	NOT USED			
	B12	NOT USED			

Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
			NOT USED	C1	
	12	14	AIR DIVERT SOL.	C2	BRN
	NOT USEABLE		IAC "B" LO	C3	LT GRN/BLK
	NOT USEABLE		IAC "B" HI	C4	LT GRN/WHT
	NOT USEABLE		IAC "A" HI	C5	LT BLU WHT
	NOT USEABLE		IAC "A" LO	C6	LT BLU BLK
			NOT USED	C7	
	0	0	4TH GEAR SIGNAL	C8	LT BLU
	0	0	A/C FAN REQUEST	C9	BLU
2	1.9	1.7	COOLANT TEMP. SIGNAL	C10	YEL
			NOT USED	C11	
5	0.35	± 0.67	TPS BACK-UP	C12	DK BLU
5	0.35	± 0.67	TPS SIGNAL	C13	DK BLU
	5	5	TPS 5 VOLT REFERENCE	C14	GRY
	12	14	INJ. 2,4,6	C15	LT GRN
	12	14	BATTERY 12 VOLTS	C16	ORN



BACK VIEW OF CONNECTOR

32 PIN C-D CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
BLK/WHT	D1	SYSTEM GROUND			
DK GRN/WHT	D2	COOLING FAN CONTROL	12	14	
	D3	NOT USED			
	D4	NOT USED			
TAN/BLK	D5	EST BYPASS	0	4.75	
TAN	D6	GRN'D. (O_2)	0	0	
PPL	D7	O^2 SENSOR SIGNAL			3
WHT	D8	EGR DIAG. SWITCH	12	14	
	D9	NOT USED			
	D10	NOT USED			
	D11	NOT USED			
	D12	NOT USED			
BLK	D13	COOLANT,TPS,MAT, SENSOR GRD.	0	0	
LT BLU	D14	INJ. 1,3,5	12	14	
LT GRN	D15	INJ 2,4,6	12	14	
LT BLU	D16	INJ.1,3,5	12	14	

1 Varies from .60 to battery voltage depending on position of drive wheels.
2 Varies with temperature.
3 Varies.
4 12V First two seconds.
5 Measured between terminals C13 and D13.

ENGINE 2.8L LB8

CARLINE "F"

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Figure A1-5 - ECM Connector Terminal End View 2.8L "F" Series

BLANK

DIAGNOSTIC CIRCUIT CHECK

The diagnostic circuit check is an organized approach to identifying a problem created by an electronic engine control system malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the service technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the diagnostic circuit check and finding the on-board diagnostics functioning properly and no trouble codes displayed. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

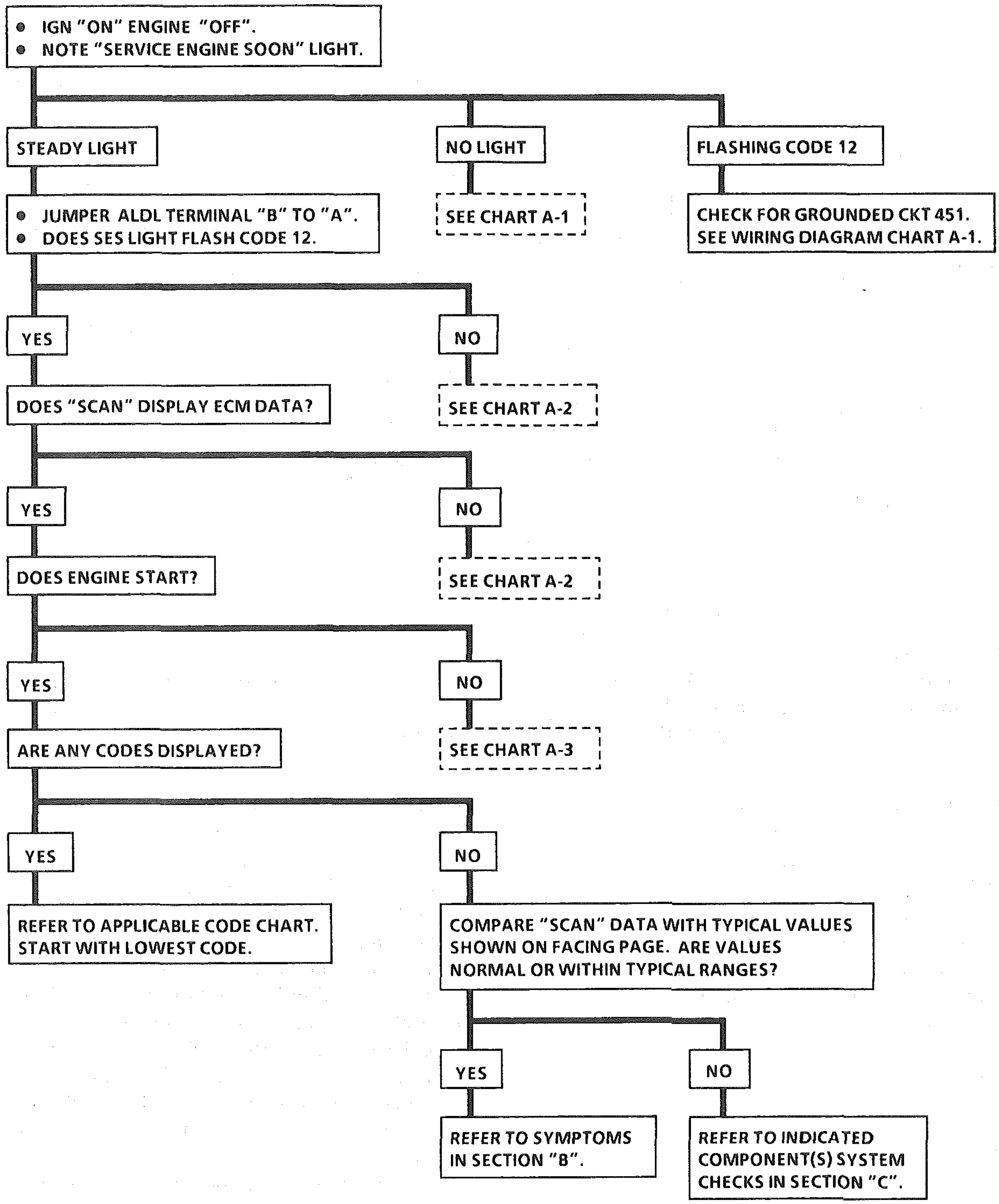
Only the parameters listed below are used in this manual for diagnosis. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosis. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section "C". If all values are within the range illustrated, refer to symptoms in Section "B".

"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Coolant Temp.	C°	85° - 105°
MAT Temp.	C°	10° - 60° (depends on underhood temp.)
TPS	volts	0.35 - 0.67
MAF	gm/sec	4 - 7
INT (Integrator)	Counts	Varies
BLM (Block Learn)	Counts	118 - 138
IAC	Counts (steps)	5 - 50
rpm	rpm	1000 ± 50 rpm (depends on temperature)
O_2	volts	.1 - 1 and varies
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
Spark Advance	# of Degrees	Varies
BPW (base pulse width)	M/Sec	.7 - 2.0
EGR Duty Cycle	0-100%	0% (at idle)
A/C Request	Yes/No	No (yes, with A/C requested)
4th gear	Yes/No	No (yes, when in 4th gear)
A/C Clutch	ON/OFF	OFF (ON, with A/C commanded ON)
P/N Switch	P/N and RDL	Park/Neutral (P/N)
Power Steering Pressure Switch	Normal/HI pressure	Normal
TCC	ON/OFF	OFF/ (ON, with TCC commanded)
VSS	mph	0

DIAGNOSTIC CIRCUIT CHECK
2.8L (VIN S) "F" SERIES (PORT)



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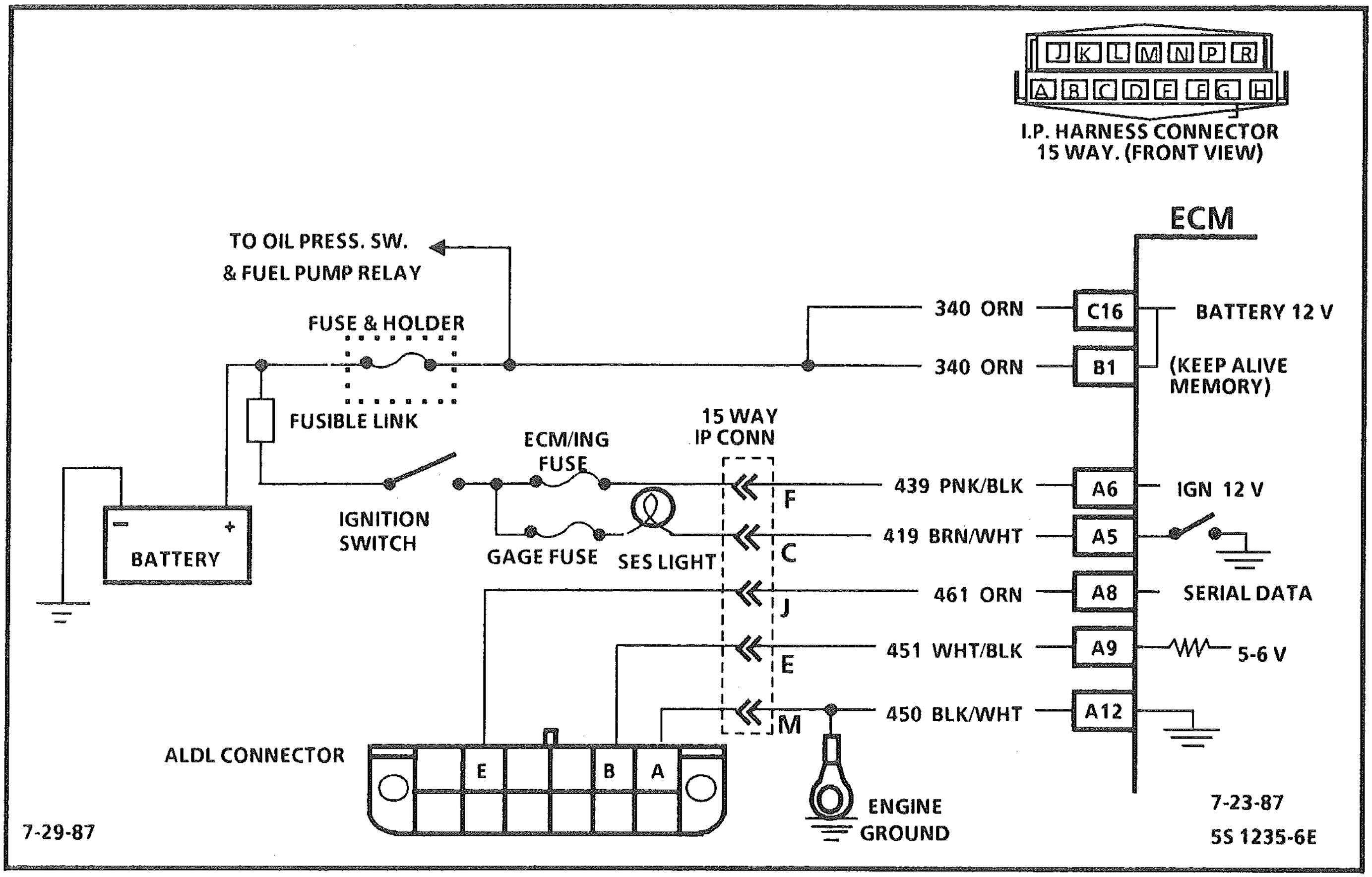


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT 2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Battery is supplied directly to the light bulb. The electronic control module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. If the fuse in holder is blown refer to facing page of Code 54 for complete circuit.
2. Using a test light connected to 12 volts probe each of the system ground circuits to be sure a good ground is present. See ECM terminal end view in front of this section for ECM pin locations of ground circuits.

Diagnostic Aids:

Engine runs OK, check:

- Faulty light bulb.
- CKT 419 open.
- Gage fuse blown. This will result in no oil or generator lights, seat belt reminder, etc.

Engine cranks but will not run.

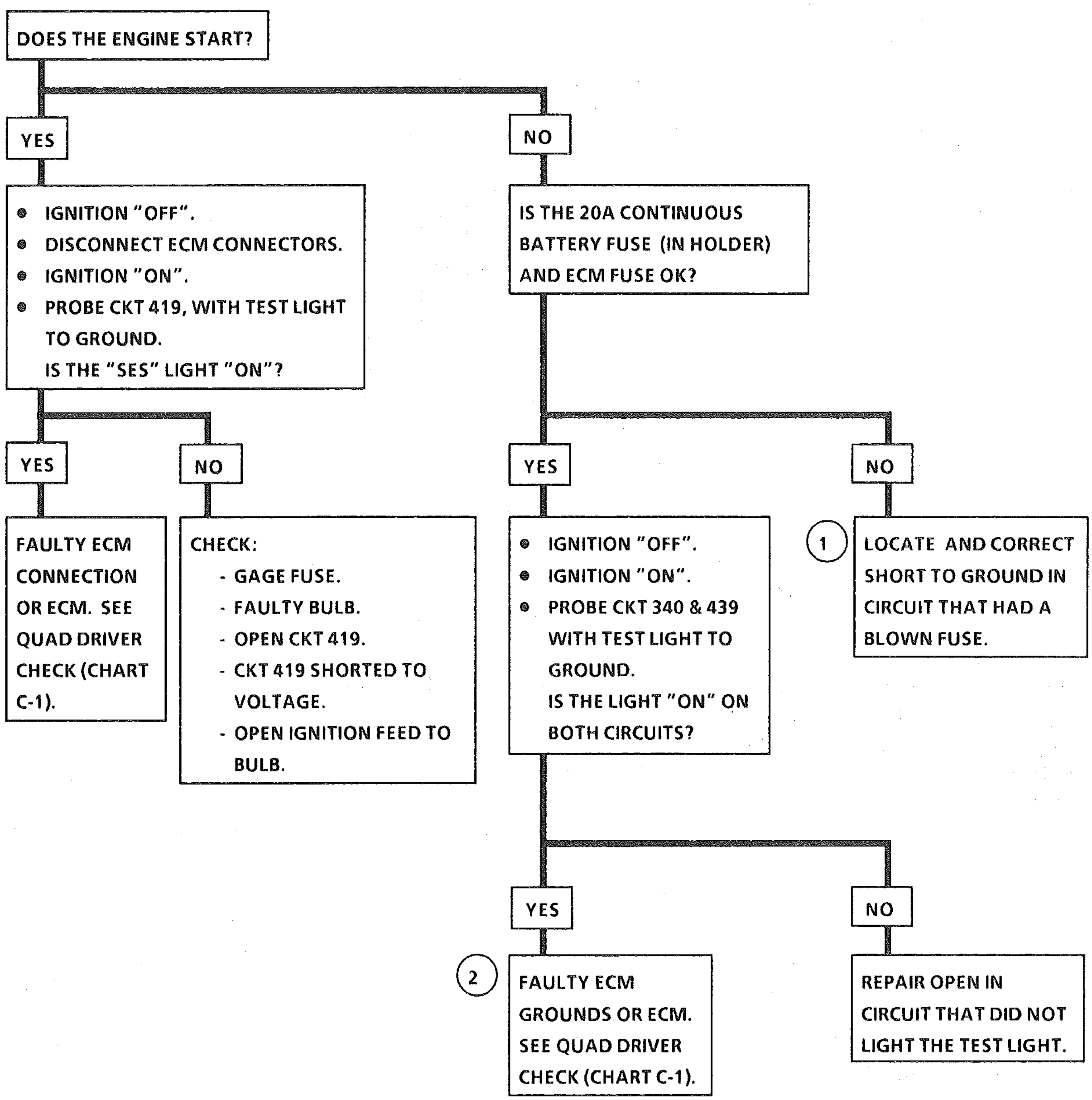
- Continuous battery - fuse or fusible link open.
- ECM ignition fuse open.
- Battery CKT 340 to ECM open.
- Ignition CKT 439 to ECM open.
- Poor connection to ECM.

Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches called "drivers". Each driver is part of a group of four called "Quad-Drivers". Failure of one driver can damage any other driver in the set. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "driver".

Before replacing ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoid(s) and relay(s) and the coil terminal identification.

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT 2.8L (VIN S) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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8S 4694-6E

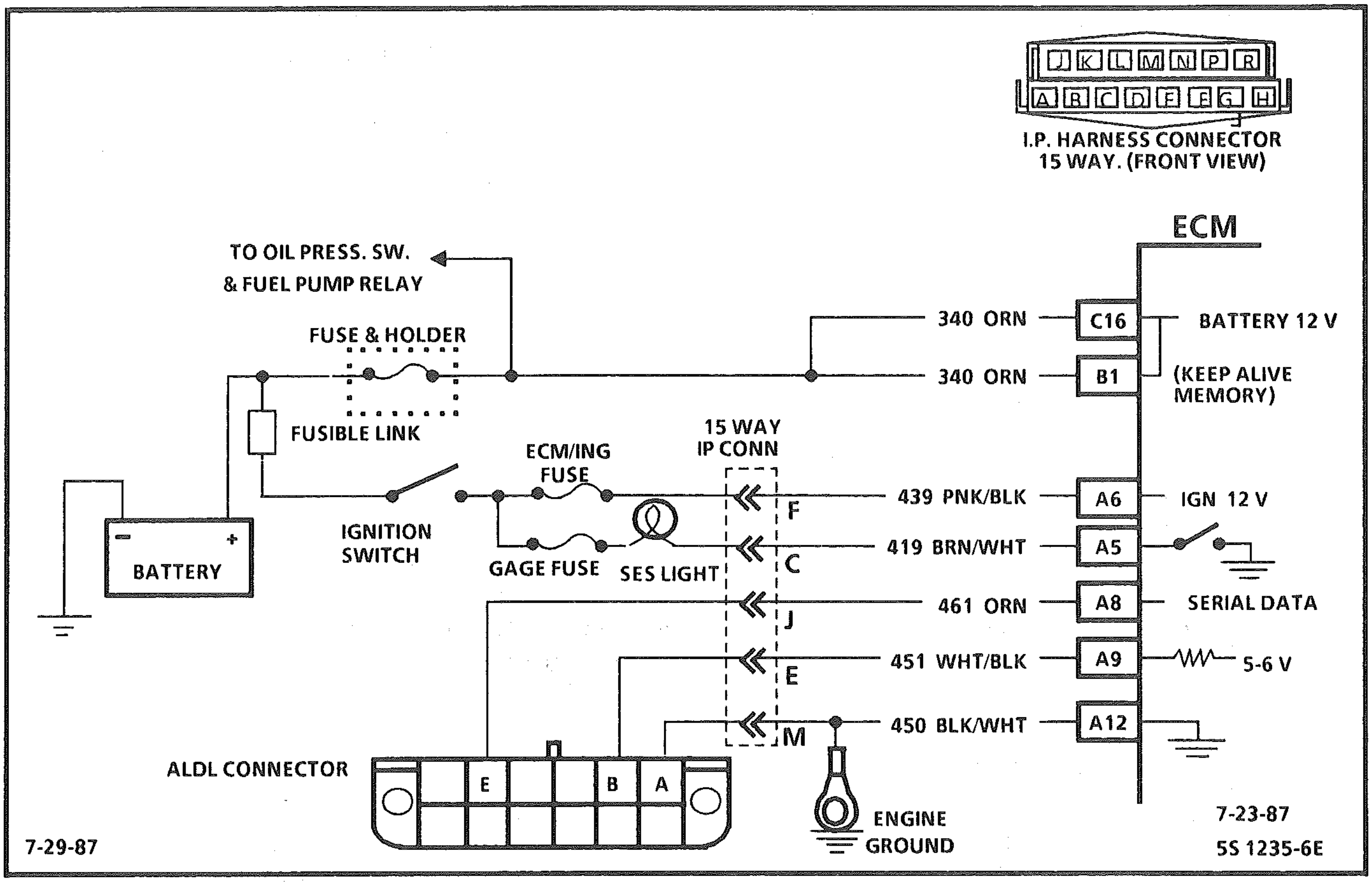


CHART A-2

NO ALDL OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT "ON" STEADY 2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Battery ignition voltage is supplied to the light bulb. The electronic control module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read serial data, the ECM should not flash a Code 12. If Code 12 is flashing check for CKT 451 short to ground. If Code 12 does flash be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK the PROM or ECM may be at fault for the NO ALDL symptom.
2. If the light goes "OFF" when the ECM connector is disconnected, CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or PROM. If Code 12 does not flash, the ECM should be replaced using the original PROM. Replace the PROM only after trying an ECM, as a defective PROM is an unlikely cause of the problem.

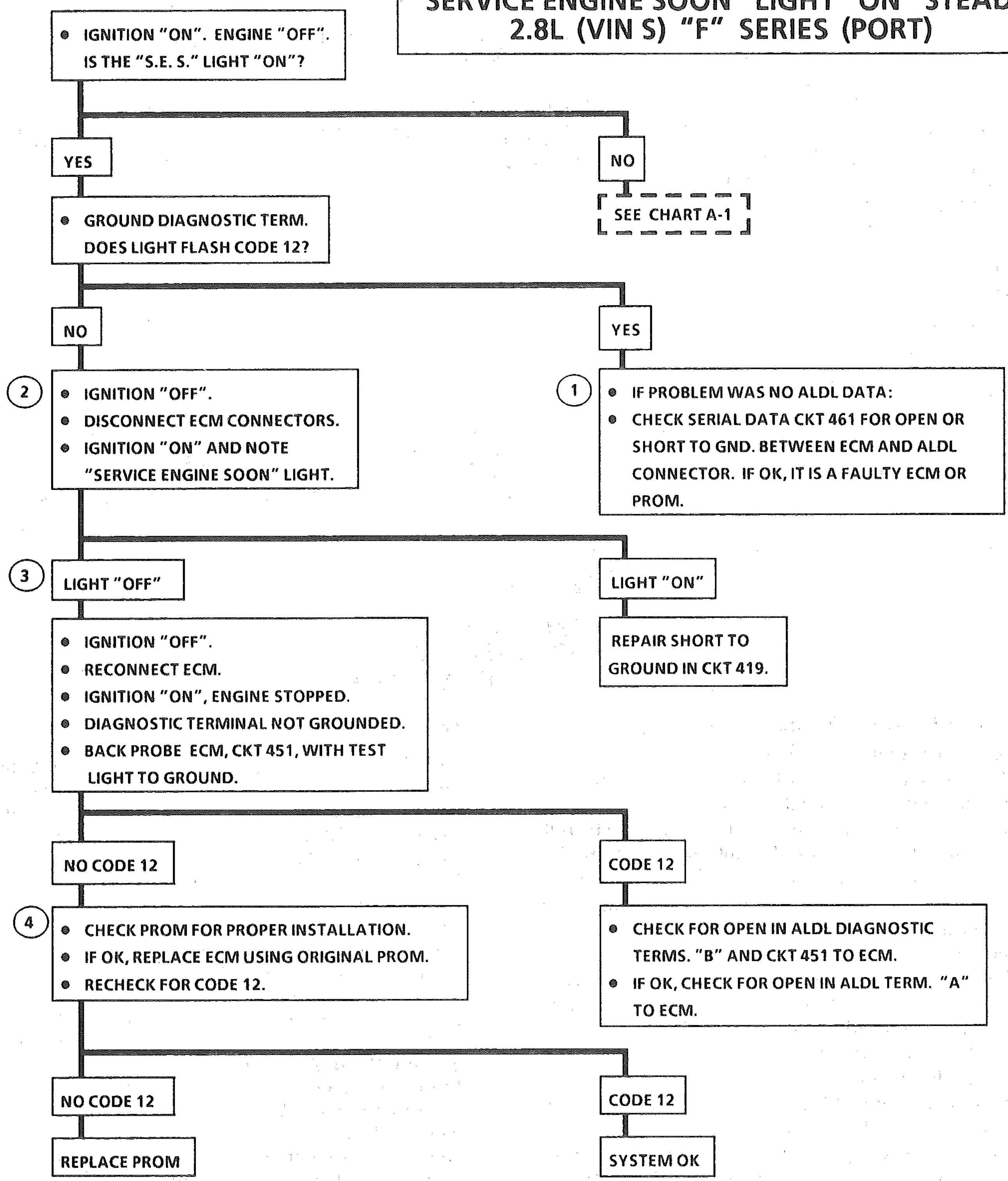
Diagnostic Aids:

Solenoids and relays are turned "ON" or "OFF" by the ECM using internal electronic switches called "drivers". Each driver is part of a group of four called "Quad-Drivers". Failure of one driver can damage any other driver in the set.

Before replacing ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoid(s) and relay(s) and the coil terminal identification.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12 "SERVICE ENGINE SOON" LIGHT "ON" STEADY 2.8L (VIN S) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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7S 3341-6E

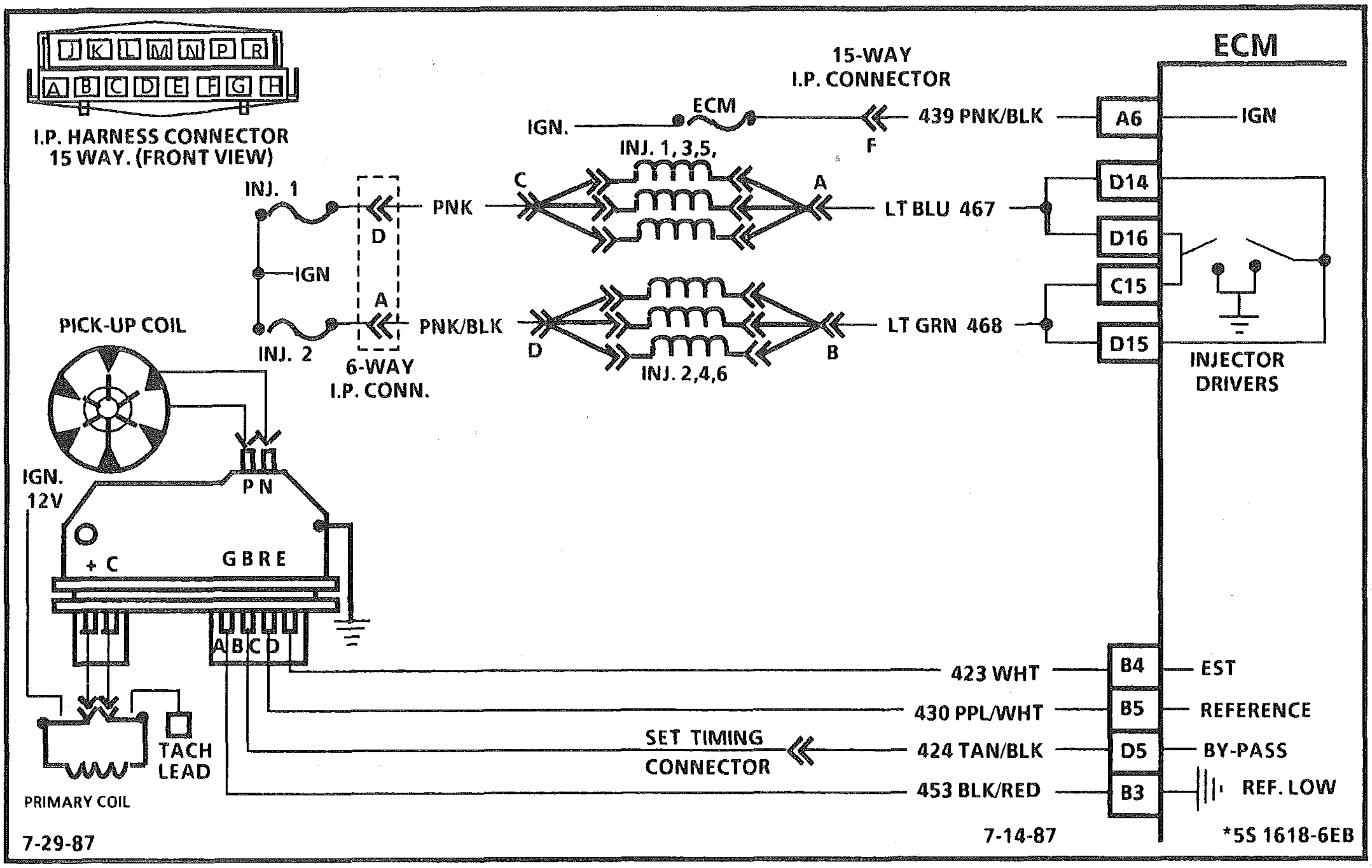


CHART A-3

(Page 1 of 2)
ENGINE CRANKS BUT WON'T RUN
2.8L (VIN S) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank. If engine starts but immediately stalls, see "Symptoms", Section "B" (Hard Start). A "Service Engine Soon" light "ON" is a basic check for ignition and battery supply to the electronic control module (ECM).
2. No spark indicates a basic HEI problem.
3. This test will determine if the ECM is receiving the reference signal and controlling the injectors. This test could also be performed at the 4-way injector connector by using a test light between terminals "A" and "D".
   If the test light "blinks" while cranking, then ECM control should be considered OK. How bright the test light "blinks" is not important. However, the test light should be a J-34730-2 or equivalent.
4. Use pressure gage J-34730-1. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.

Diagnostic Aids:

- An EGR valve sticking open can cause a low air/fuel ratio during cranking. Unless engine enters "Clear Flood" at the first indication of a flooding condition, it can result in a no start.
- Check for fouled plugs:
- If the TPS is sticking or binding in the wide open throttle position, the ECM will be in the "Clear Flood" mode.
- A defective cold start circuit or water in fuel line can cause a no start in cold weather. To check cold start circuit: See CHART A-9.
- A defective MAF sensor may cause a no start or a stall after start. To determine if the sensor is causing the problem, disconnect it. The ECM will then use a default value for the sensor, and if the condition is corrected and the connections are OK, replace the sensor.
- Also check that injectors on both sides of engine will cause a test light to "blink". Checking of two injectors on each bank in this manner will locate a shorted injector.
  If above are all OK, refer to "Symptoms" in Section "B" "Hard Start".
- Also check that injectors are not open or shorted. Injector resistance should be greater than ohms.

NOTICE: *FUEL SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

CHART A-3

(Page 1 of 2)
ENGINE CRANKS BUT WON'T RUN
2.8L (VIN S) "F" SERIES (PORT)

1
- FUEL QUANTITY OK.
- IGN. "ON" - IF "SES" LIGHT IS "OFF", SEE CHART A-1.
- INSTALL "SCAN" TOOL - IF "NO ALDL", SEE CHART A-2.
- CHECK THE FOLLOWING:
- TPS - IF OVER 2.5V AT CLOSED THROTTLE, SEE CODE 21.
- IF CODE 54 IS SET SEE CODE 54 CHART

2
- CONNECT ST-125 (SPARK CHECKER) J-26792 OR EQUIVALENT
- CHECK FOR SPARK WHILE CRANKING .
- CHECK AT LEAST TWO WIRES .

SPARK

3
- CHECK EACH BANK OF INJECTORS AS FOLLOWS:
- DISCONNECT ONE INJECTOR.
- CONNECT TEST LIGHT J-34730-2 OR EQUIVALENT TO INJECTOR HARNESS CONNECTOR TERMINALS.
- CHECK FOR BLINKING LIGHT WHILE CRANKING.
- RECONNECT INJECTOR.
- REPEAT TEST ON ANOTHER INJECTOR ON THE SAME BANK.
- LIGHT SHOULD BLINK ON BOTH.

NOTICE : *DO NOT ALLOW INJECTOR,TERMINALS TO SHORT OR TOUCH TOGETHER WHILE CRANKING OR ECM MAY BE DAMAGED .*

BLINKING LIGHT

4
- INSTALL FUEL PRESSURE GAGE AND NOTE PRESSURE AFTER IGNITION "ON" AND FUEL PUMP STOPS RUNNING SHOULD BE 34 TO 47 psi (234-325 kPa)

OK

- SEE "DIAGNOSTIC AIDS" ON FACING PAGE FOR ADDITIONAL ITEMS TO CHECK .

IF ALL CHECK OK . THERE IS NO TROUBLE FOUND . REVIEW SYMPTOMS, SECTION "B ", "HARD START".

NOT OK

- SEE FUEL SYSTEM DIAGNOSTIC CHART A-7

STEADY LIGHT

- CHECK INJECTOR DRIVER CKT WITH STEADY LIGHT FOR SHORT TO GROUND.
- IF CIRCUIT IS NOT SHORTED, CHECK RESISTANCE ACROSS EACH INJECTOR IN THE CIRCUIT.
- RESISTANCE SHOULD BE GREATER THAN 8 OHMS .

OK

FAULTY ECM

NOT OK

REPLACE ECM AND ANY INJECTOR THAT MEASURES UNDER 8 OHMS.

NO LIGHT

SEE CHART A-3 PAGE 2 OF 2

NO SPARK

CHECK FOR BATTERY VOLTAGE TO IGNITION SYSTEM . IF OK THERE IS A BASIC HEI PROBLEM . REFER TO APPROPRIATE CHART C-4.

* CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON " LIGHT.

7-29-87
8S 4692-6E

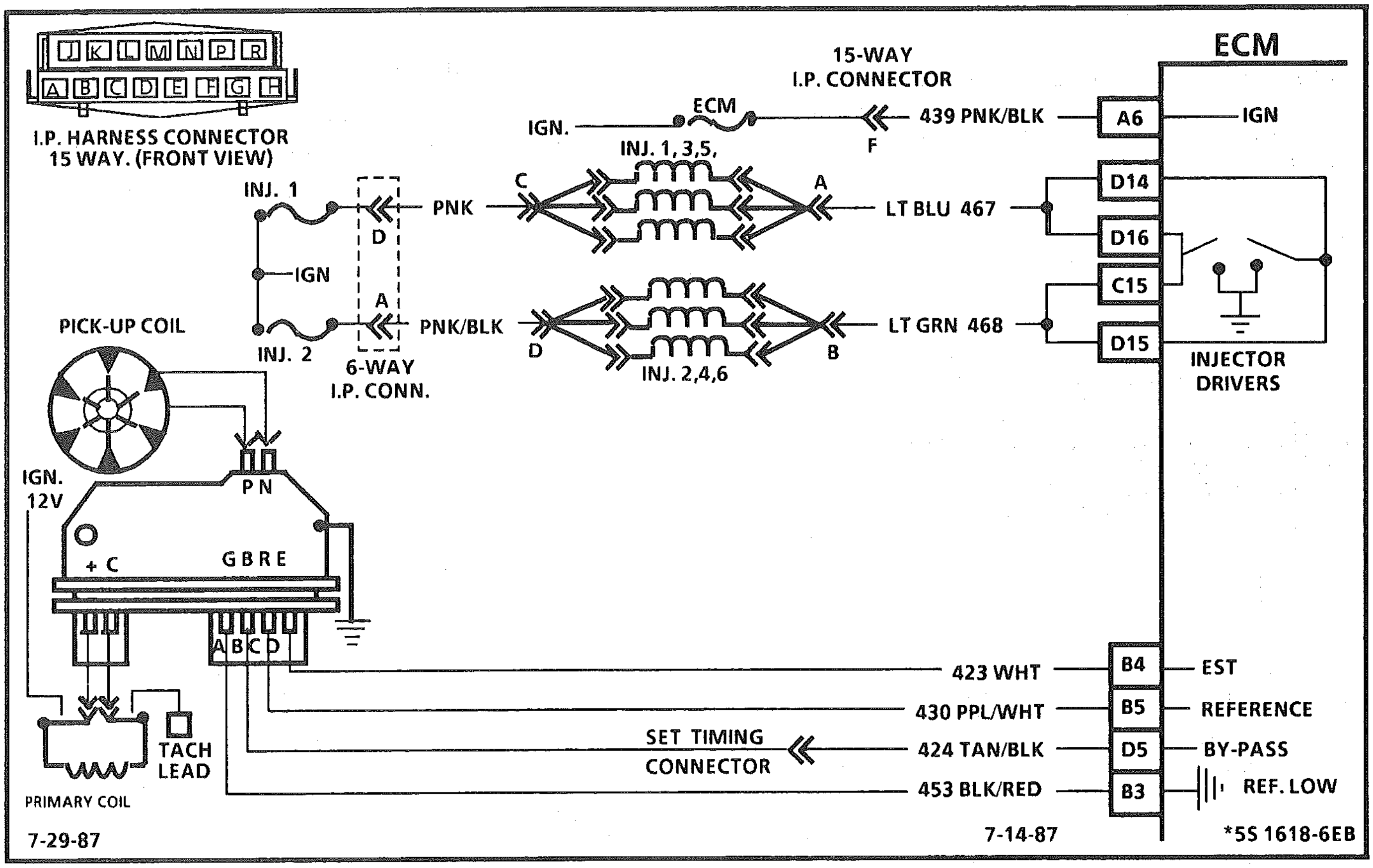


CHART A-3

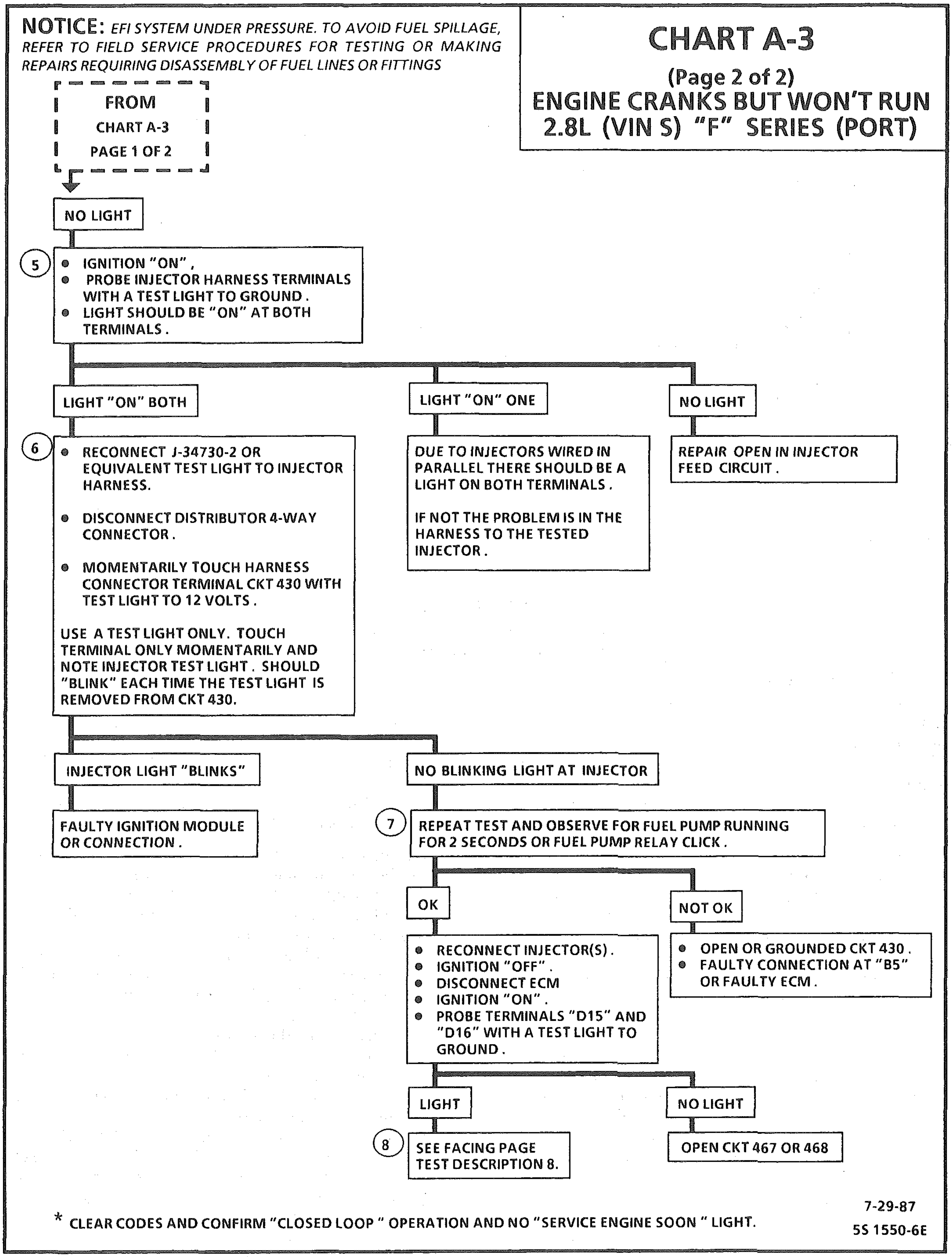
(Page 2 of 2)
ENGINE CRANKS BUT WON'T RUN
2.8L (VIN S) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

5. Checks for 12 volt supply to injectors.
6. This test will determine if the distributor module is not generating the reference pulse or if the wiring or ECM are at fault. By touching CKT 430 with a test light a reference signal is being generated. If the test light (J-34730-2) blinks at the injector, then the ECM and wiring is OK.
7. Each time the test light touches CKT 430, the ECM should turn "ON" the fuel pump for 2 seconds.
8. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 or 468 being shorted to a voltage source either in the engine harness or in the injector harness.

To test for this condition:

- Disconnect the injector 4-way connector.
- Ignition "ON"
- Probe CKTs 467 and 468 on the ECM side of harness with a test light connected to ground. There should be no light.
- If OK, check the resistance of the injector harness between terminals "A & C", "A & D", "B & D", and "B & C".
- Should be more than 4 ohms
- If less than 4 ohms check harness for wires shorted together and check each injector resistance.
- Resistance should be more than 10 ohms.
- If all OK, replace ECM.


NOTICE: EFI SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS
CHART A-3
(Page 2 of 2)
ENGINE CRANKS BUT WON'T RUN
2.8L (VIN S) "F" SERIES (PORT)
FROM CHART A-3 PAGE 1 OF 2
NO LIGHT
5
• IGNITION "ON",
• PROBE INJECTOR HARNESS TERMINALS WITH A TEST LIGHT TO GROUND.
• LIGHT SHOULD BE "ON" AT BOTH TERMINALS.
LIGHT "ON" BOTH
LIGHT "ON" ONE
NO LIGHT
6
• RECONNECT J-34730-2 OR EQUIVALENT TEST LIGHT TO INJECTOR HARNESS.
• DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
• MOMENTARILY TOUCH HARNESS CONNECTOR TERMINAL CKT 430 WITH TEST LIGHT TO 12 VOLTS.
USE A TEST LIGHT ONLY. TOUCH TERMINAL ONLY MOMENTARILY AND NOTE INJECTOR TEST LIGHT. SHOULD "BLINK" EACH TIME THE TEST LIGHT IS REMOVED FROM CKT 430.
DUE TO INJECTORS WIRED IN PARALLEL THERE SHOULD BE A LIGHT ON BOTH TERMINALS.
IF NOT THE PROBLEM IS IN THE HARNESS TO THE TESTED INJECTOR.
REPAIR OPEN IN INJECTOR FEED CIRCUIT.
INJECTOR LIGHT "BLINKS"
NO BLINKING LIGHT AT INJECTOR
FAULTY IGNITION MODULE OR CONNECTION.
7
REPEAT TEST AND OBSERVE FOR FUEL PUMP RUNNING FOR 2 SECONDS OR FUEL PUMP RELAY CLICK.
OK
NOT OK
• RECONNECT INJECTOR(S).
• IGNITION "OFF".
• DISCONNECT ECM
• IGNITION "ON".
• PROBE TERMINALS "D15" AND "D16" WITH A TEST LIGHT TO GROUND.
• OPEN OR GROUNDED CKT 430.
• FAULTY CONNECTION AT "B5" OR FAULTY ECM.
LIGHT
NO LIGHT
8
SEE FACING PAGE TEST DESCRIPTION 8.
OPEN CKT 467 OR 468
* CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.
7-29-87
5S 1550-6E

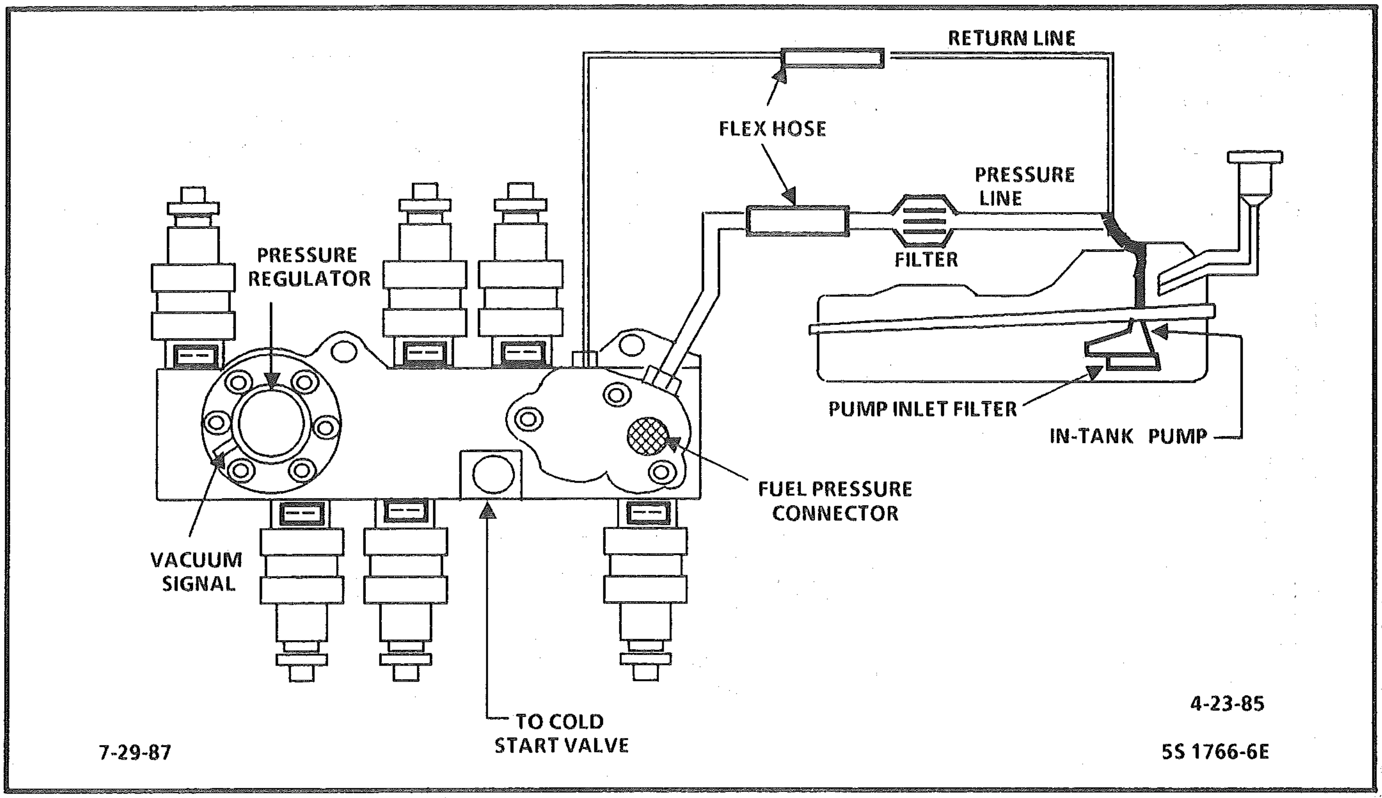


CHART A-7

(Page 1 of 2)
FUEL SYSTEM DIAGNOSIS
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving HEI distributor reference pulses.

If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after key "ON" or engine stopped.

The pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled to about 234 to 317 kPa (34 to 46 psi). Excess fuel is then returned to the fuel tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Use pressure gage J-34730-1. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.
   Ignition "ON", pump pressure should be 280-325 kPa (40.5-47 psi). This pressure is controlled by spring pressure within the regulator assembly.
2. When the engine is idling, the manifold pressure is low (high vacuum) and is applied to the fuel regulator diaphragm. This will offset the spring and result in a lower fuel pressure. This idle pressure will vary somewhat depending on barometric pressure, however, the pressure idling was less indicating pressure regulator control.
3. Pressure that continues to fall is caused by one of the following:
   - In-tank fuel pump check valve not holding.
   - Pump coupling hose or pulsator leaking.
   - Fuel pressure regulator valve leaking.
   - Injector sticking open.
4. An injector sticking open can best be determined by checking for a fouled or saturated spark plug(s). If a leaking injector can not be determined by a fouled or saturated spark plug the following procedure should be used.
   - Remove Plenum, cold start valve and remove fuel rail bolts. Follow the procedures in the fuel control section of this manual, but leave fuel lines connected.
   - Reconnect cold start valve.
   - Connect a hose to valve nozzle and insert into a gasoline container.
   - Lift fuel rail out just enough to leave injector nozzles in the ports.

   CAUTION: ***BE SURE INJECTOR(S) ARE NOT ALLOWED TO SPRAY ON ENGINE AND THAT INJECTOR RETAINING CLIPS ARE INTACT. THIS SHOULD BE CAREFULLY FOLLOWED TO PREVENT FUEL SPRAY ON ENGINE WHICH WOULD CAUSE A FIRE HAZARD.***

   - Pressurize the fuel system.
   - Lift each side of rail up and observe for injector(s) leaking.

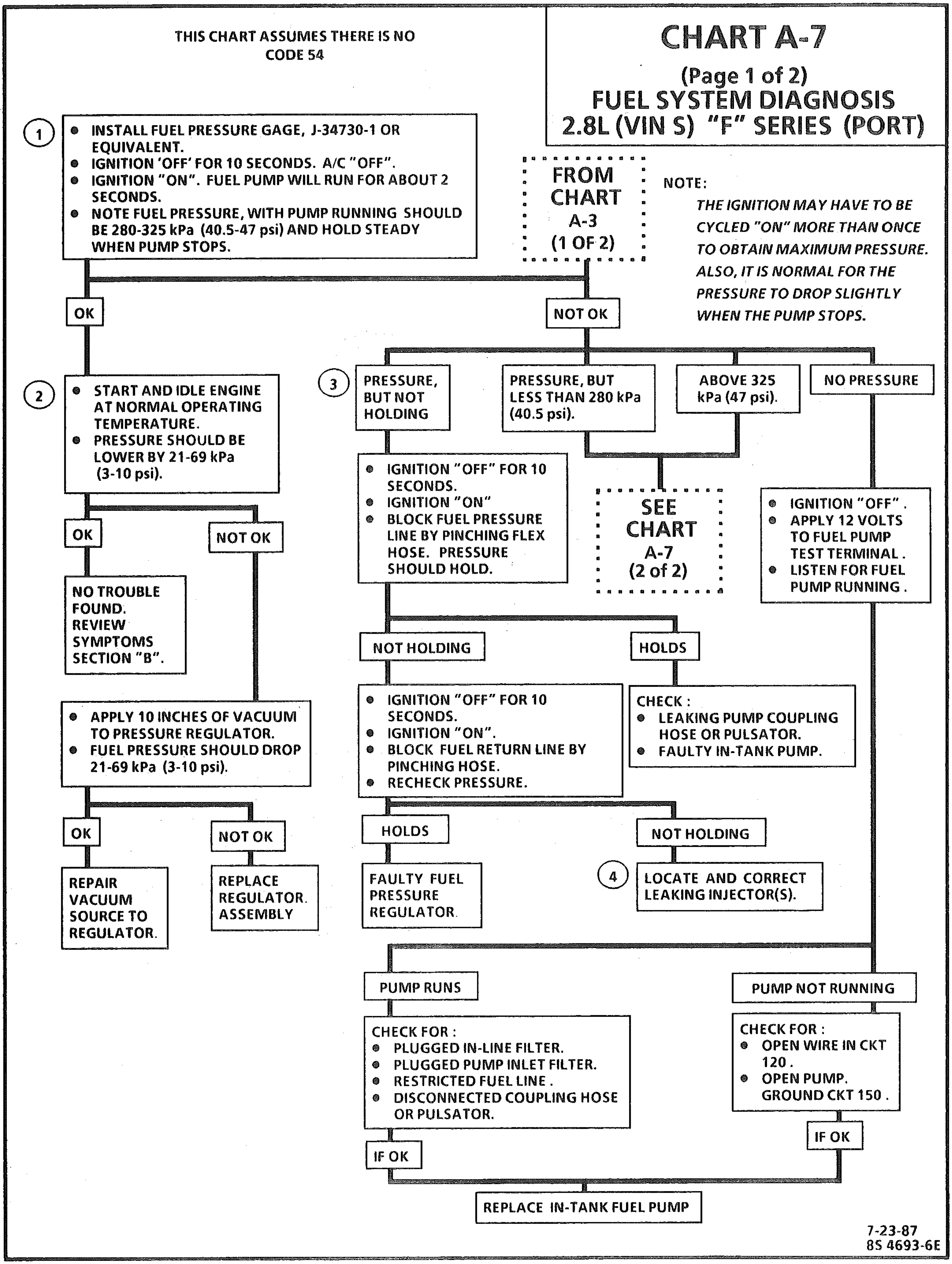


CHART A-7
(Page 1 of 2)
FUEL SYSTEM DIAGNOSIS
2.8L (VIN S) "F" SERIES (PORT)
THIS CHART ASSUMES THERE IS NO CODE 54
1
• INSTALL FUEL PRESSURE GAGE, J-34730-1 OR EQUIVALENT.
• IGNITION 'OFF' FOR 10 SECONDS. A/C "OFF".
• IGNITION "ON". FUEL PUMP WILL RUN FOR ABOUT 2 SECONDS.
• NOTE FUEL PRESSURE, WITH PUMP RUNNING SHOULD BE 280-325 kPa (40.5-47 psi) AND HOLD STEADY WHEN PUMP STOPS.
FROM CHART A-3 (1 OF 2)
NOTE:
THE IGNITION MAY HAVE TO BE CYCLED "ON" MORE THAN ONCE TO OBTAIN MAXIMUM PRESSURE. ALSO, IT IS NORMAL FOR THE PRESSURE TO DROP SLIGHTLY WHEN THE PUMP STOPS.
OK
NOT OK
2
• START AND IDLE ENGINE AT NORMAL OPERATING TEMPERATURE.
• PRESSURE SHOULD BE LOWER BY 21-69 kPa (3-10 psi).
OK
NOT OK
NO TROUBLE FOUND. REVIEW SYMPTOMS SECTION "B".
• APPLY 10 INCHES OF VACUUM TO PRESSURE REGULATOR.
• FUEL PRESSURE SHOULD DROP 21-69 kPa (3-10 psi).
OK
NOT OK
REPAIR VACUUM SOURCE TO REGULATOR.
REPLACE REGULATOR. ASSEMBLY
3
PRESSURE, BUT NOT HOLDING
PRESSURE, BUT LESS THAN 280 kPa (40.5 psi).
ABOVE 325 kPa (47 psi).
NO PRESSURE
• IGNITION "OFF" FOR 10 SECONDS.
• IGNITION "ON"
• BLOCK FUEL PRESSURE LINE BY PINCHING FLEX HOSE. PRESSURE SHOULD HOLD.
SEE CHART A-7 (2 of 2)
• IGNITION "OFF".
• APPLY 12 VOLTS TO FUEL PUMP TEST TERMINAL.
• LISTEN FOR FUEL PUMP RUNNING.
NOT HOLDING
HOLDS
• IGNITION "OFF" FOR 10 SECONDS.
• IGNITION "ON".
• BLOCK FUEL RETURN LINE BY PINCHING HOSE.
• RECHECK PRESSURE.
CHECK:
• LEAKING PUMP COUPLING HOSE OR PULSATOR.
• FAULTY IN-TANK PUMP.
HOLDS
NOT HOLDING
FAULTY FUEL PRESSURE REGULATOR.
4
LOCATE AND CORRECT LEAKING INJECTOR(S).
PUMP RUNS
PUMP NOT RUNNING
CHECK FOR:
• PLUGGED IN-LINE FILTER.
• PLUGGED PUMP INLET FILTER.
• RESTRICTED FUEL LINE.
• DISCONNECTED COUPLING HOSE OR PULSATOR.
CHECK FOR:
• OPEN WIRE IN CKT 120.
• OPEN PUMP. GROUND CKT 150.
IF OK
IF OK
REPLACE IN-TANK FUEL PUMP
7-23-87
8S 4693-6E

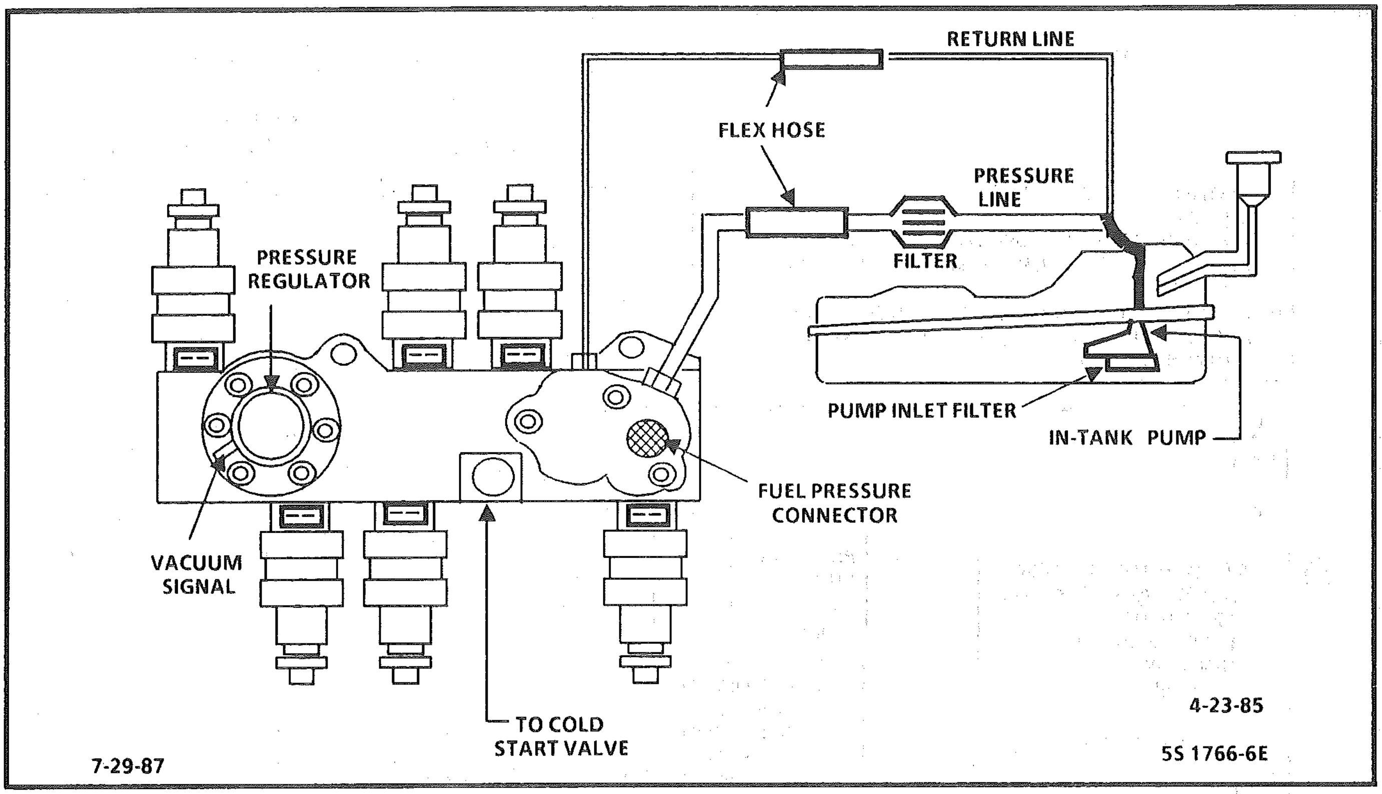


CHART A-7

(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS
2.8L (VIN S) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Pressure but less than 280 kPa (40.5 psi) falls into two areas:
   - Regulated pressure, but less than 280 kPa (40.5 psi). Amount of fuel to injectors OK but pressure is too low. System will be lean running and may set Code 44. Also, hard starting cold and overall poor performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 165 kPa (24 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop as pressure begins to drop rapidly.
2. Restricting the the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be above 414 kPa (60 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a pressure regulator problem.

CHART A-7
(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS 2.8L (VIN S) "F" SERIES (PORT)

NOTICE: *FUEL SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

FROM CHART A-7 (1 of 2)

1 HAS PRESSURE BUT LESS THAN 280 kPa (40.5 psi).

CHECK FOR RESTRICTED FUEL LINES OR IN-LINE FILTER.

- OK
- NOT OK → REPLACE FILTER OR REPAIR FUEL LINE AND RECHECK.

2 (OK)
- IGNITION "OFF".
- BLOCK FUEL RETURN LINE .
- APPLY 12 VOLTS TO FUEL PUMP RELAY HARNESS TERMINAL "A" OR FUEL PUMP TEST CONNECTOR AND NOTE PRESSURE .

- ABOVE 325 kPa (47 psi). → FAULTY PRESSURE REGULATOR.
- PRESSURE BUT LESS THAN 280 kPa (40.5 psi). → FAULTY IN-TANK
  - FUEL PUMP
  - COUPLING HOSE OR PULSATOR
  - INLET FILTER
  - WRONG FUEL PUMP

ABOVE 325 kPa (47 psi).

3
- DISCONNECT FUEL RETURN LINE FLEXIBLE HOSE.
- ATTACH $^{5}/_{16}$ I.D. FLEX HOSE TO PRESSURE REGULATOR SIDE OF RETURN LINE. INSERT THE OTHER END IN AN APPROVED GASOLINE CONTAINER.
  NOTE FUEL PRESSURE WITHIN 2 SECONDS AFTER IGNITION "ON".

- ABOVE 325 kPa (47 psi) → CHECK FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR TO POINT WHERE FUEL LINE WAS DISCONNECTED. → IF LINE OK REPLACE FUEL PRESSURE REGULATOR.
- 280-325 kPa (40.5-47 psi) → LOCATE AND CORRECT RESTRICTED FUEL RETURN LINE TO FUEL TANK.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

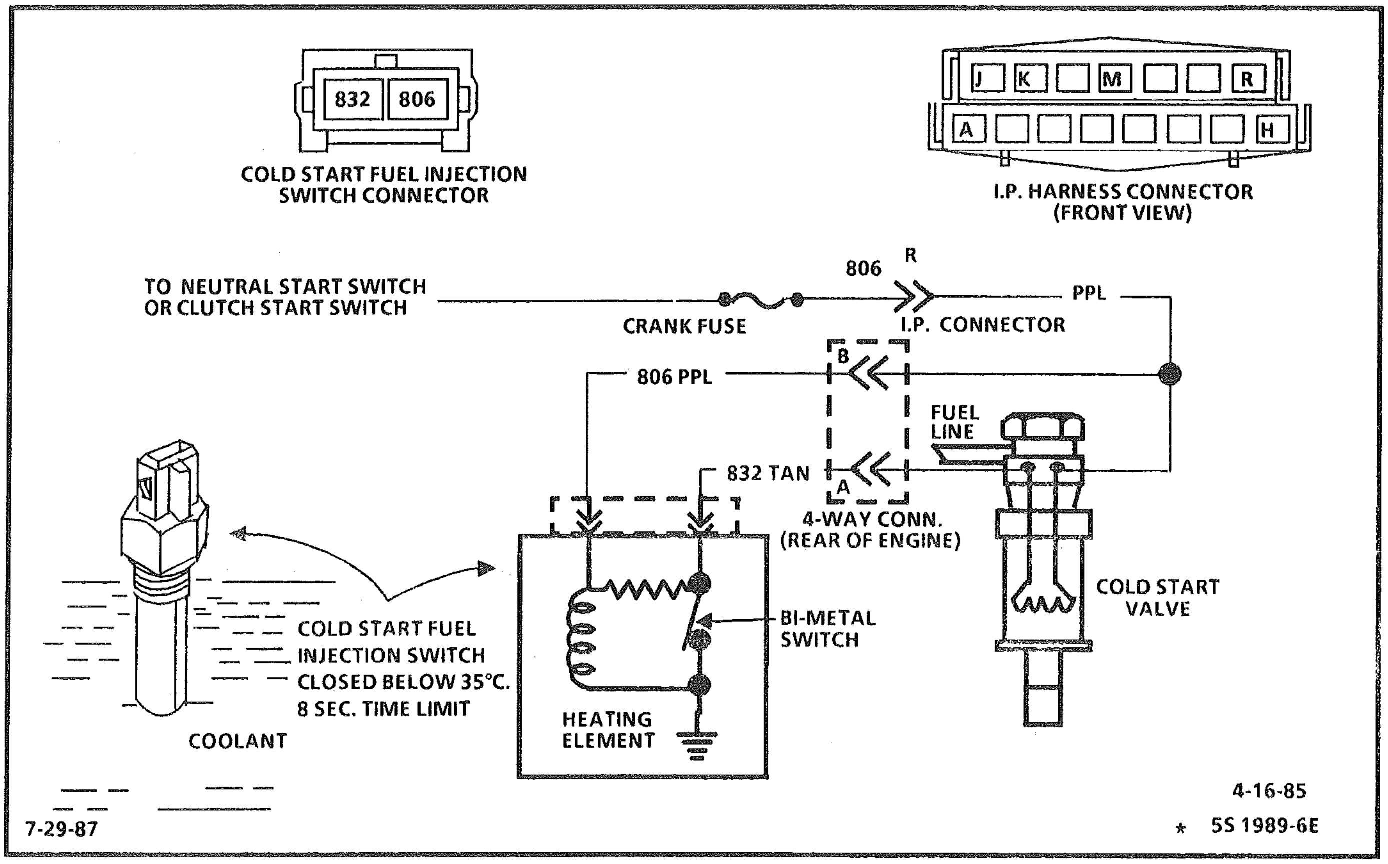


CHART A-9

COLD START VALVE
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The cold start valve is used to provide additional fuel during the crank mode to improve cold start-ups. This circuit is important when engine coolant temperature is low because the other injectors are not pulsed "ON" long enough to provide the needed amount of fuel to start.

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by a fuse. The system is controlled by a cold start fuel injection switch which provides a ground path for the valve during cranking when engine coolant is below 95°F (35°C).

The cold start fuel injection switch consists of a bimetal material which opens at a specified coolant temperature. This bimetal is also heated by the winding in the switch which allows the valve to stay "ON" for 8 seconds at -20°C (-5°F) coolant. The time the switch will stay closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up, the cold start valve "ON" time goes down.

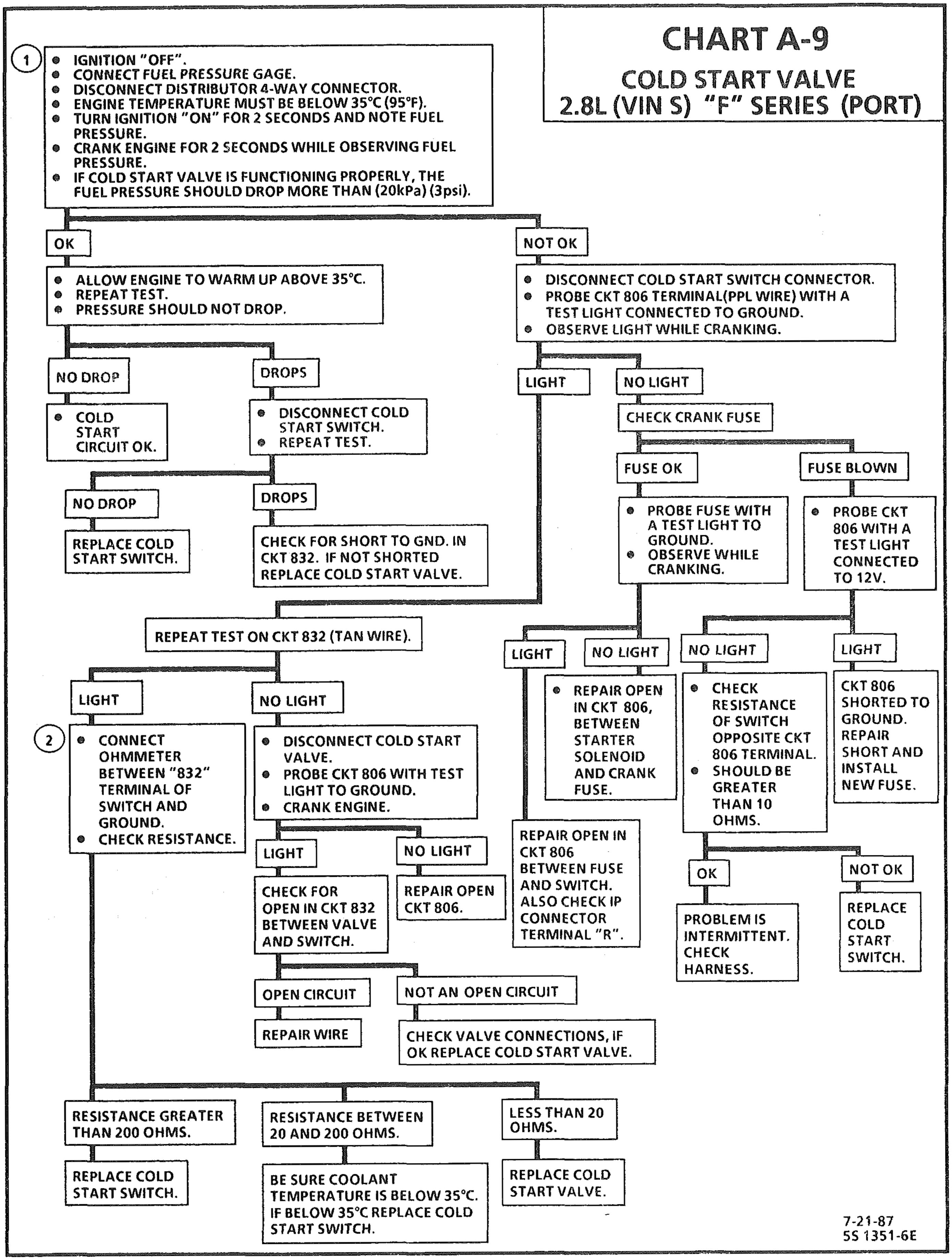
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

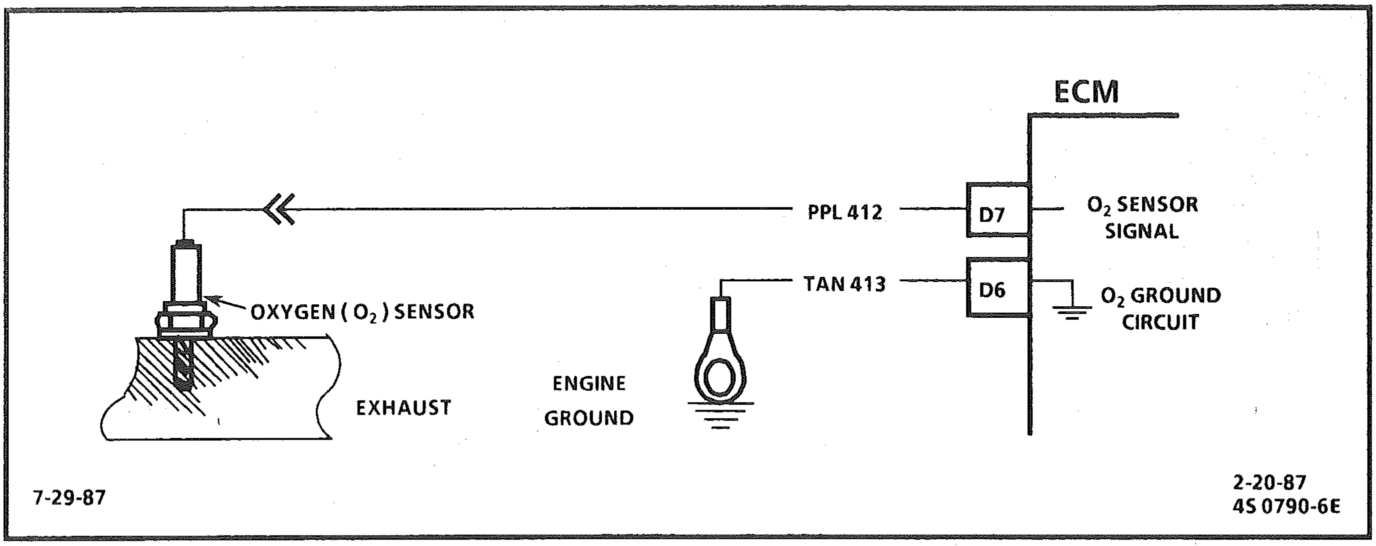
1. Disconnecting the distributor 4-way connector will disable the other injectors.

   The amount of pressure drop depends on the temperature of the engine.
2. This test will determine the continuity through the switch to ground.

CHART A-9

COLD START VALVE
2.8L (VIN S) "F" SERIES (PORT)





CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 315° C (600° F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 will set:
   - Engine at normal operating temperature.
   - At least 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle position sensor signal above 4%.
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist the system will not go "Closed Loop".
2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.
3. In doing this test use only a high impedence digital volt ohmmeter. This test checks the continuity of CKTs 412 and 413 because if CKT 413 is open the ECM voltage on CKT 412 will be over .6 volts (600 mV).

Diagnostic Aids:

Normal "Scan" voltage varies between 100mV to 999mV (.1 and 1.0 volt) while in "Closed Loop". Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds. Refer to "Intermittents" in Section "B".

CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
2.8L (VIN S) "F" SERIES (PORT)

1. ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
   - RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.

   DOES "SCAN" INDICATE "CLOSED LOOP"?

YES → CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO →

2. - DISCONNECT O_2 SENSOR.
   - JUMPER HARNESS CKT 412 TO GROUND.
   - "SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 mV) WITH ENGINE RUNNING.

   DOES IT?

YES → FAULTY O_2 SENSOR CONNECTION OR SENSOR.

NO →

3. - IGNITION "ON", ENGINE "OFF".
   - CHECK VOLTAGE OF CKT 412 (ECM SIDE) AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.

   IT SHOULD BE .3-.6 VOLTS (300 - 600 mV).

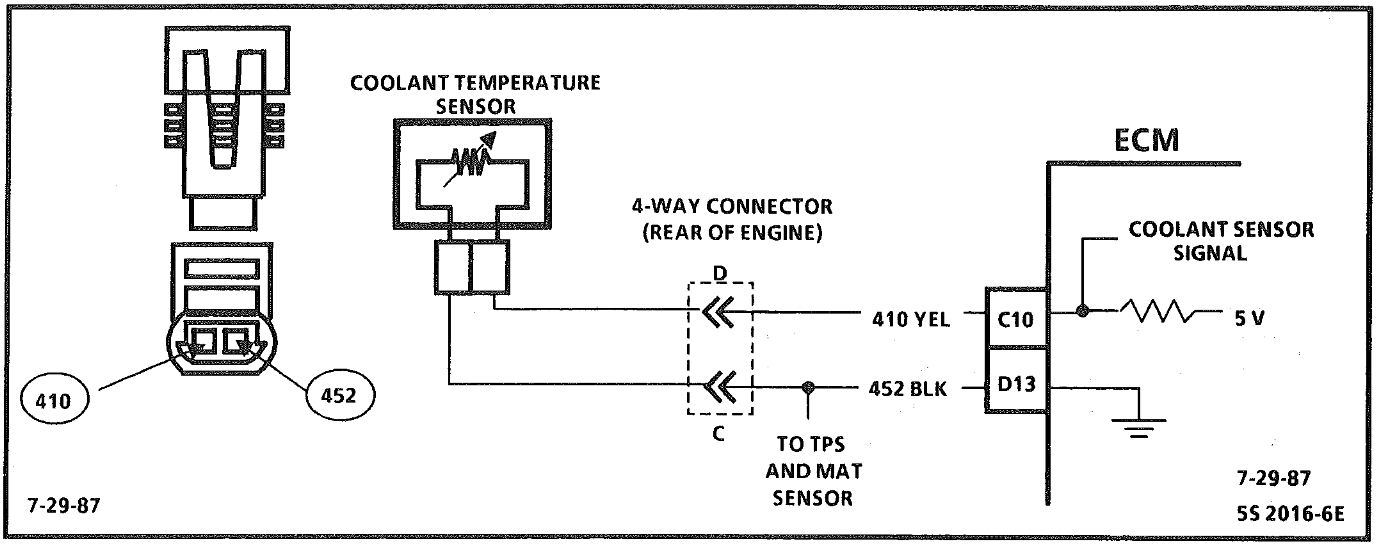
.3-.6 VOLTS (300 - 600 mV) → FAULTY ECM

OVER .6 VOLT (600 mV) → OPEN CKT 413, FAULTY CONNECTION OR FAULTY ECM.

LESS THAN .3 VOLT (300 mV) → OPEN CKT 412, FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-23-87
● 7S 3054-6E



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 14 will set if:
   - Signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds.
2. This test will determine if CKT 410 is shorted to ground, which will cause the conditions for Code 14.

Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410. "SCAN" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. Refer to "Intermittents" in Section "B".

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

1 DOES "SCAN" DISPLAY 130°C OR HOTTER?

YES

2 • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMP. BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 410 SHORTED TO GROUND.
OR
CKT 410 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

CODE 14 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

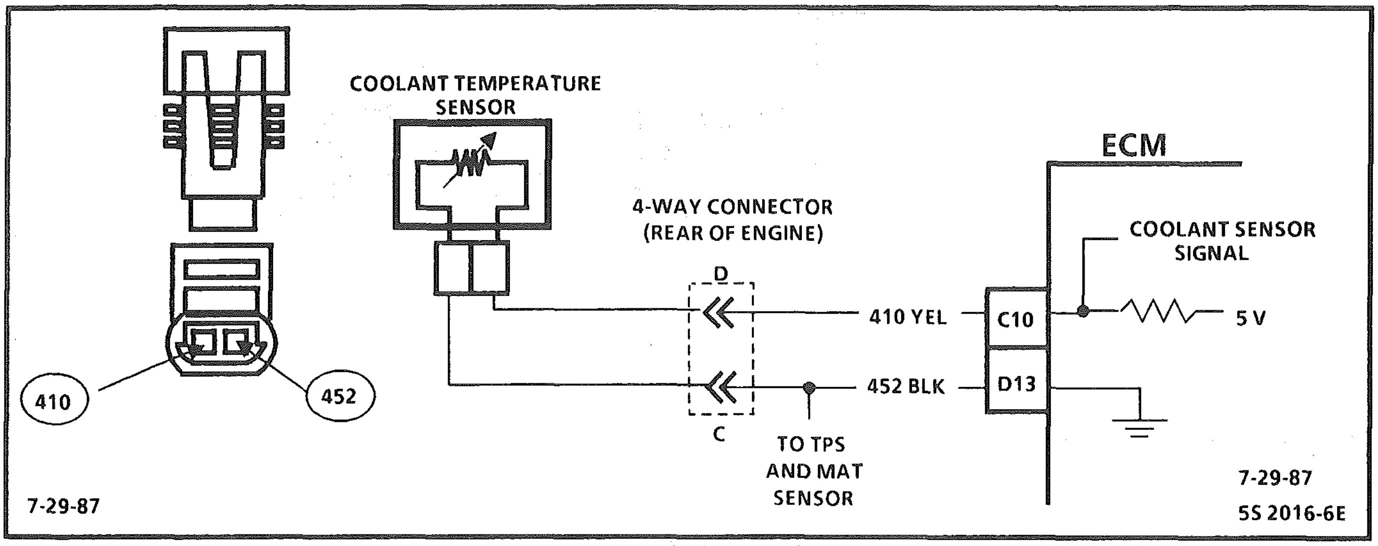
DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-28-87

• 7S 3055-6E



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold the sensor (thermistor) resistance is high, therefore the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C) the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 15 will set if:
   - Signal voltage indicates a coolant temperature less than -44° C (-47° F) for 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temperature) and the "Scan" reads 130°C, the ECM and wiring are OK.
3. This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector if measured with a DVM.

Diagnostic Aids:

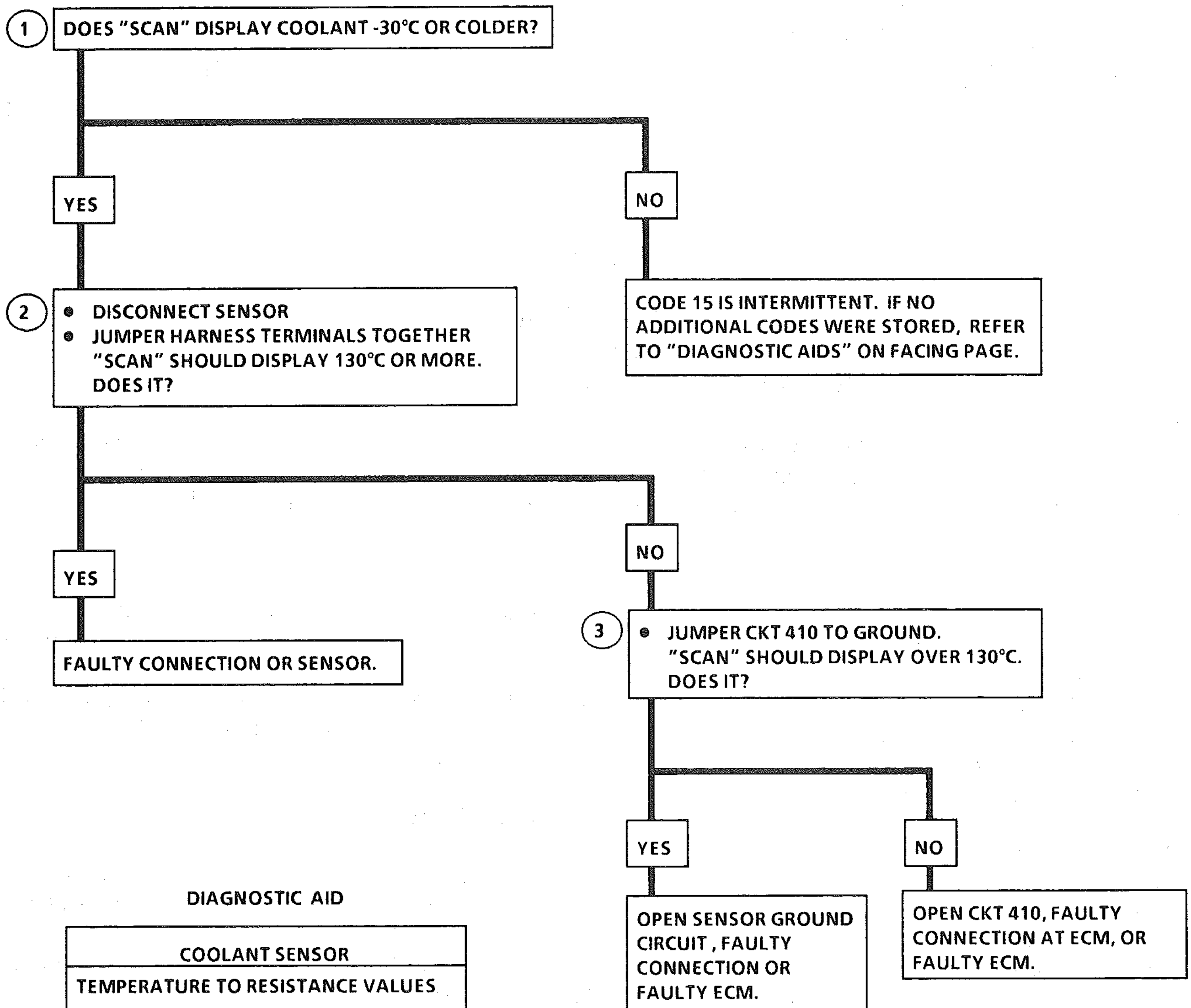
A "SCAN" tool reads engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

A faulty connection, or an open in CKT 410 or 452 will result in a Code 15.

If Code 23 or 63 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact. Refer to "Intermittents" in Section "B".

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)



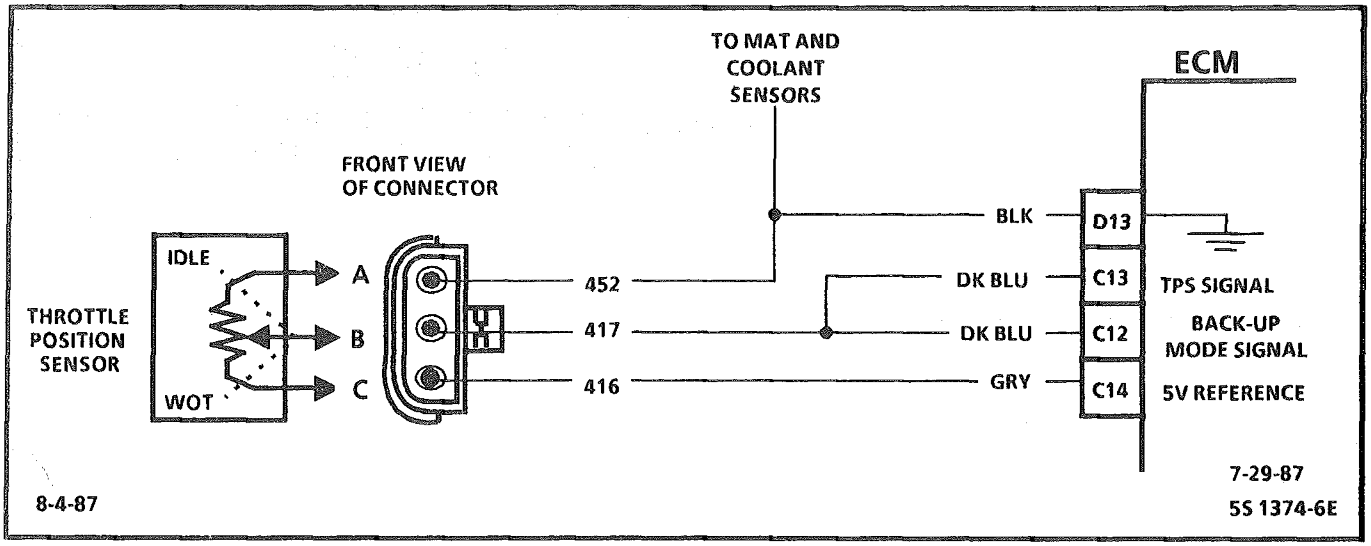
DIAGNOSTIC AID

COOLANT SENSOR		
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)		
°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-11-87

● 7S 3261-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 21 will set if:
   - Engine is running
   - TPS signal voltage is greater than 2.5 volts
   - Air flow is less than 12 gm/sec.
   - All conditions met for 5 seconds.

   OR

- TPS signal voltage over 4.5 volts with ignition "ON".

The TPS has an auto zeroing feature. If the voltage reading is within the range of 0.35 to 0.7 volts, the ECM will use that value as closed throttle. If the voltage reading is out of the auto zero range at closed throttle, refer to "TPS Adjustment" in Section "6E3-C1".

2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring is OK.
3. Probing CKT 452 with a test light checks the 5volt return circuit, because a faulty 5volt return will cause a Code 21.

Diagnostic Aids:

A "SCAN" tool reads throttle position in volts. Voltage should increase at a steady rate as throttle is moved toward WOT.

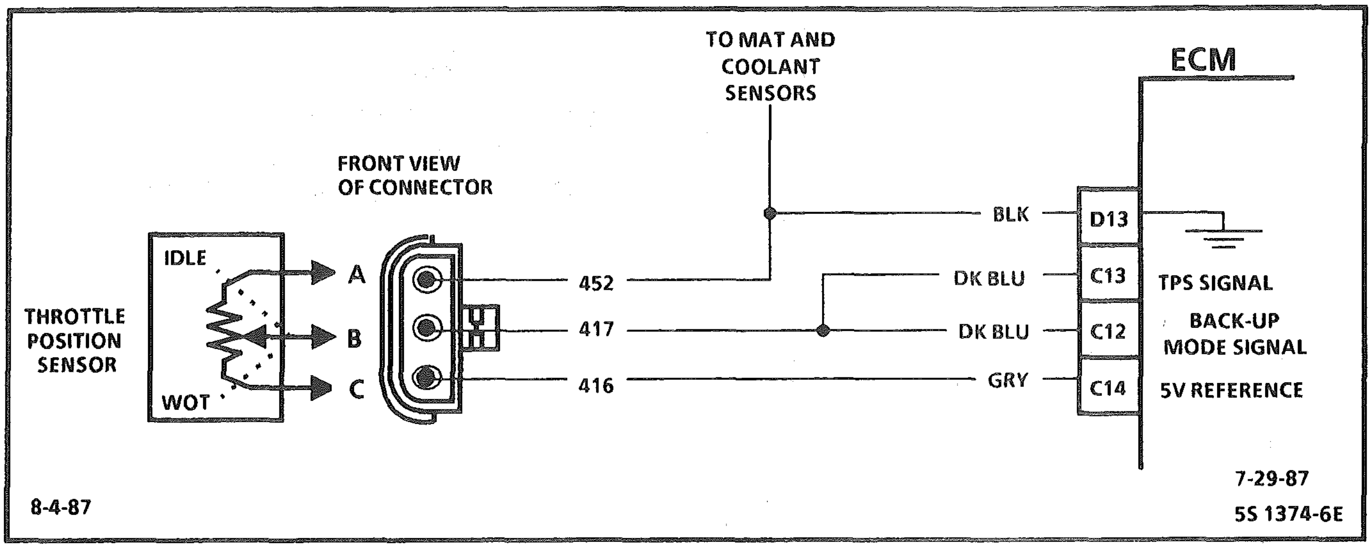
An open in CKT 452 will result in a Code 21. Refer to "Intermittents" in Section "B".

CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L (VIN S) "F" SERIES (PORT)

1. • THROTTLE CLOSED.
   DOES "SCAN" DISPLAY TPS OVER 2.5 VOLTS?
   - **YES**
     2. • DISCONNECT SENSOR.
        "SCAN" SHOULD DISPLAY TPS BELOW .2 VOLTS (200mV).
        DOES IT?
        - **YES**
          3. • PROBE SENSOR GROUND CIRCUIT WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
             - **LIGHT "ON"**: FAULTY CONNECTION OR SENSOR
             - **LIGHT "OFF"**: OPEN SENSOR GROUND CIRCUIT OR FAULTY ECM.
        - **NO**: CKT 417 SHORTED TO VOLTAGE OR FAULTY ECM.
   - **NO**: CODE 21 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 22 will set if:
   - Engine running
   - TPS signal voltage is less than about .2 volt for 3 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage the ECM and wiring are OK.
3. The TPS has an auto zeroing feature. If the voltage reading is within the range of 0.35 to 0.7 volts, the ECM will use that value as closed throttle. If the voltage reading is out of the auto zero range at closed throttle, refer to "TPS Adjustment" in Section "6E3-C1".
4. This simulates a high signal voltage to check for an open in CKT 417.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open or short to ground in CKTs 416 or 417 will result in a Code 22.

Refer to "Intermittents" in Section "B".

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
2.8L (VIN S) "F" SERIES (PORT)

1 • THROTTLE CLOSED
DOES "SCAN" DISPLAY TPS .2V (200 mV) OR BELOW?

YES

2 • DISCONNECT TPS SENSOR.
• JUMPER CKTS 416 & 417 TOGETHER.
"SCAN" SHOULD DISPLAY TPS OVER 4.0 V (4000 mV).
DOES IT?

NO

• CODE 22 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

4 • PROBE CKT 417 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
"SCAN" TOOL SHOULD DISPLAY TPS OVER 4.0V (4000 mV)
DOES IT?

YES

3 • REFER TO FACING PAGE FOR SPECIFIC INSTRUCTIONS.

YES

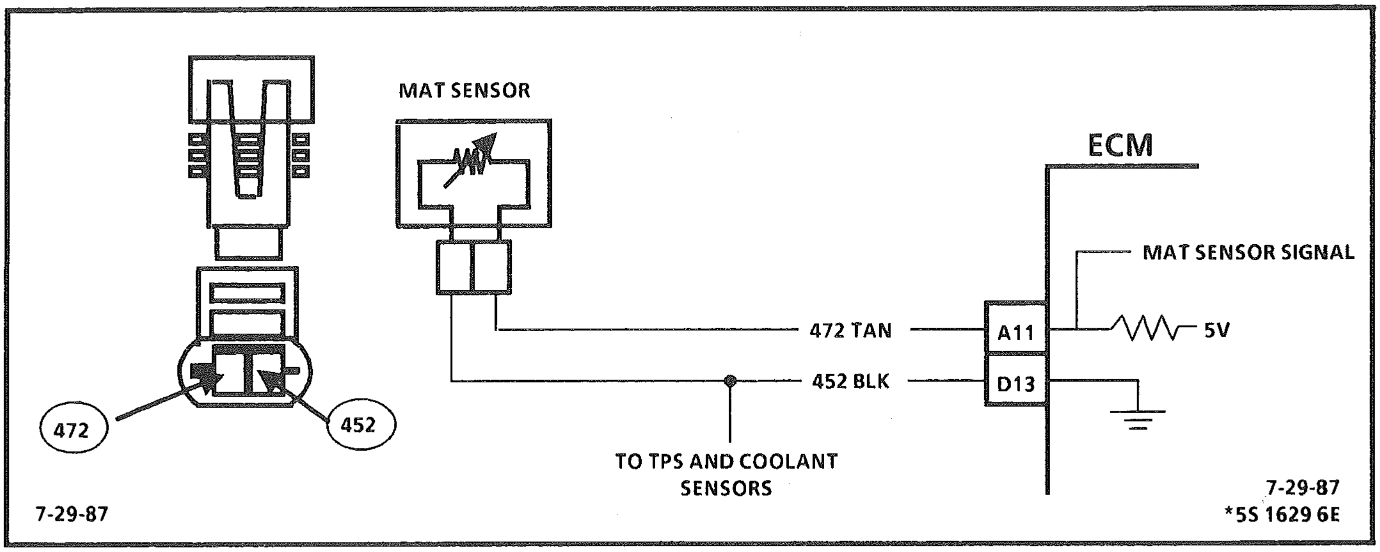
CKT 416 OPEN.
OR
SHORTED TO GROUND.
OR
FAULTY CONNECTION.
OR
FAULTY ECM.

NO

CKT 417 OPEN.
OR
SHORTED TO GROUND.
OR
SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM CONNECTION.
OR
FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-25-87
• 7S 3365-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The MAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When the air is cold the sensor (thermistor) resistance is high, therefore the ECM will see a high signal voltage. If the air is warm the sensor resistance is low, therefore, the ECM will see a low voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 23 will set if:
   - A signal voltage indicates a manifold air temperature below −35°C (-31°F) for 3 seconds.
   - Time since engine start is 8 minutes or longer.
   - No VSS.
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK.
3. This will determine if the signal CKT 472 or the 5V return CKT 452 is open.

Diagnostic Aids:

A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

A faulty connection, or an open in CKT 472 or 452 will result in a Code 23.

Refer to "Intermittents" in Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

1 • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

- YES
  - 2 • DISCONNECT SENSOR.
    • JUMPER HARNESS TERMINALS TOGETHER.
    "SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C.
    DOES IT?
    - YES
      - FAULTY CONNECTION OR SENSOR.
    - NO
      - 3 • JUMPER CKT 472 TO GROUND.
        "SCAN" SHOULD DISPLAY TEMP. OVER 130°C.
        DOES IT?
        - YES
          - OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.
        - NO
          - OPEN CKT 472, FAULTY CONNECTION OR FAULTY ECM.
- NO
  - CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

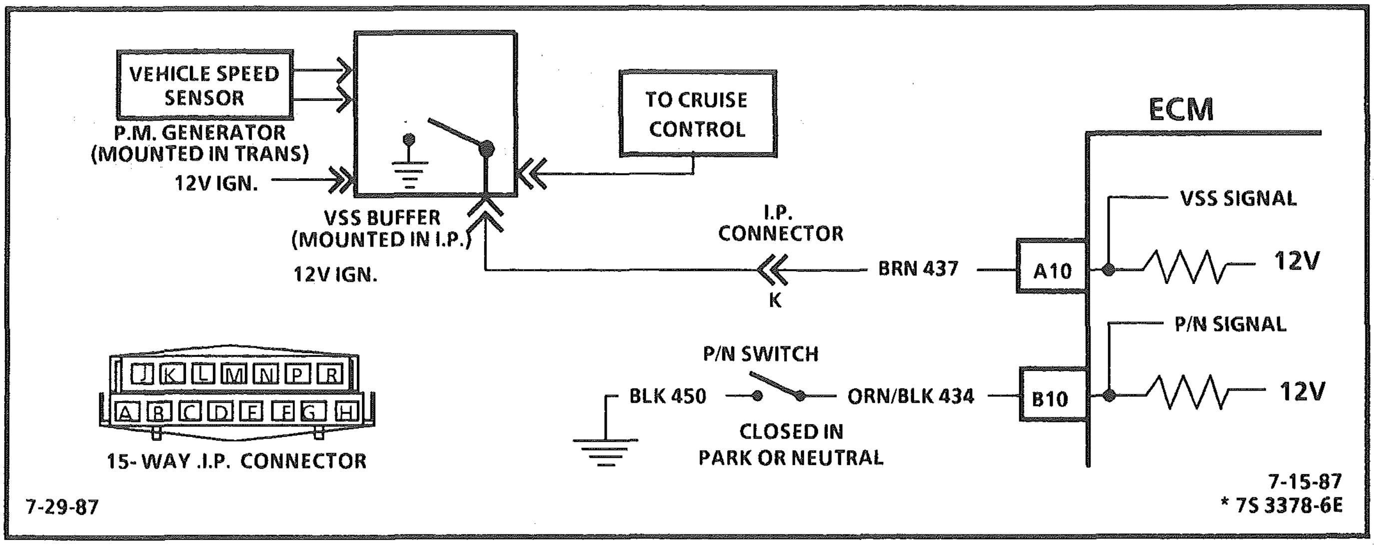
MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

2-25-87

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

• 7S 3285



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor buffer which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

A "SCAN" tool reading should closely match with speedometer reading with drive wheels turning.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 24 will set if:
   - CKT 437 voltage is constant.
   - Engine speed between 1400 and 3600 rpm.
   - Less than 2% throttle opening.
   - Low load condition (low air flow).
   - Not in park or neutral.
   - All conditions must be met for 3 seconds.

   These conditions are met during a road load deceleration.
2. A voltage of less than 1 volt at the 15-way connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the VSS buffer. If voltage now reads above 10 volts, the VSS buffer is faulty.

   If voltage remains less than 10 volt, then CKT 437 wire is grounded or open. If 437 is not grounded or open, check for a faulty ECM connector or ECM.

Diagnostic Aids:

If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with auto trans. If switch is OK, check for intermittent connections. An open or short to ground in CKT 437 will result in a Code 24. If the customer also complained about a loss of mph on the I.P., check the P.M. generator circuit. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT 2.8L (VIN S) "F" SERIES (PORT)

NOTE: TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION "8A" OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 IF SET WHEN DRIVE WHEELS ARE NOT TURNING.

1

- ASSUMES SPEEDOMETER IS WORKING OK.
- RAISE DRIVE WHEELS.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

NO

- ENGINE STILL IDLING IN GEAR.
- BACKPROBE 15 WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- IS VOLTAGE VARYING BETWEEN 1 AND 12 VOLTS ?

YES

CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO " DIAGNOSTIC AIDS " ON FACING PAGE .

NO

2

- IGNITION "OFF".
- DISCONNECT VSS BUFFER
- IGNITION "ON."
- BACK PROBE 15-WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.
  DOES IT?

YES

FAULTY ECM

YES

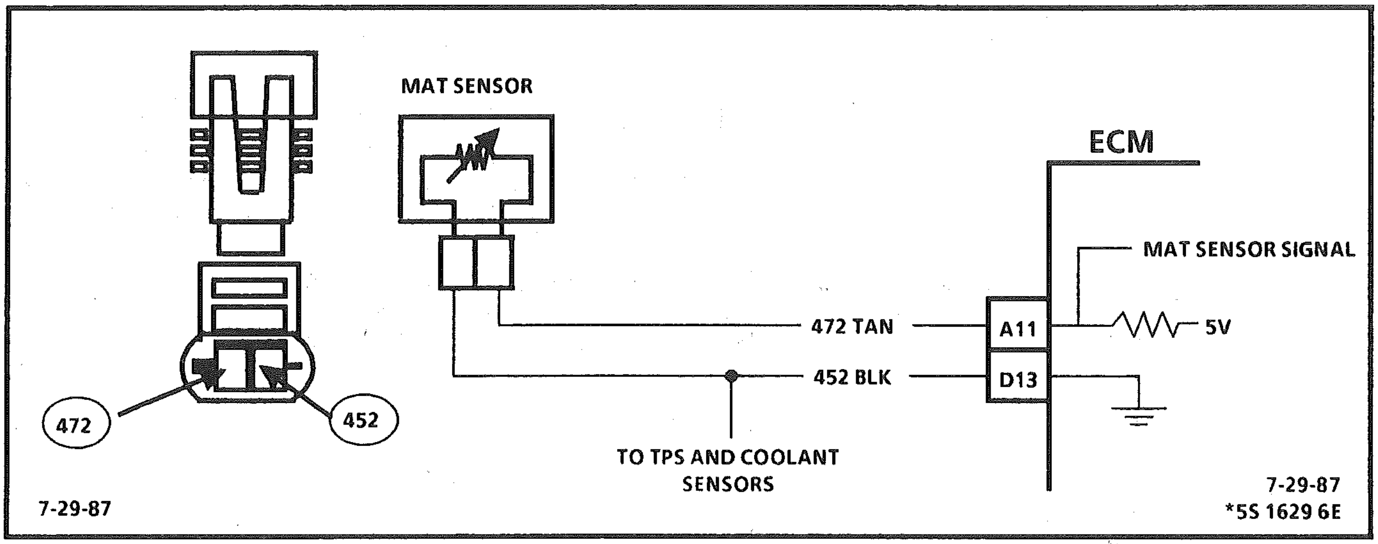
CKT 437 OPEN BETWEEN I.P. 15-WAY CONNECTOR AND VSS BUFFER CONNECTOR OR FAULTY BUFFER.

NO

CKT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. 15-WAY CONNECTOR, OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*8S 4684-6E
7-30-87



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The manifold air temperature sensor uses a thermistor to control the signal-voltage to the ECM. The ECM applies a voltage (about 5 volts) on CKT 472 to the sensor. When manifold air is cold, the sensor (thermistor) resistance is high, therefore the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less, and the voltage drops.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature greater than 145°C (293° F) for 3 seconds.
   - Time since engine start is 8 minutes or longer.
   - A vehicle speed is present.

Diagnostic Aids:

A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature, when engine is cold, and rises as underhood temperature increases.

A short to ground in CKT 472 will result in a Code 25.

Refer to "Intermittents" in Section "B".

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

1 • DOES "SCAN" TOOL DISPLAY MAT 145°C OR HOTTER?

YES

• DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMPERATURE BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 472 SHORTED TO GROUND.
OR
CKT 472 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

CODE 25 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

MAT SENSOR

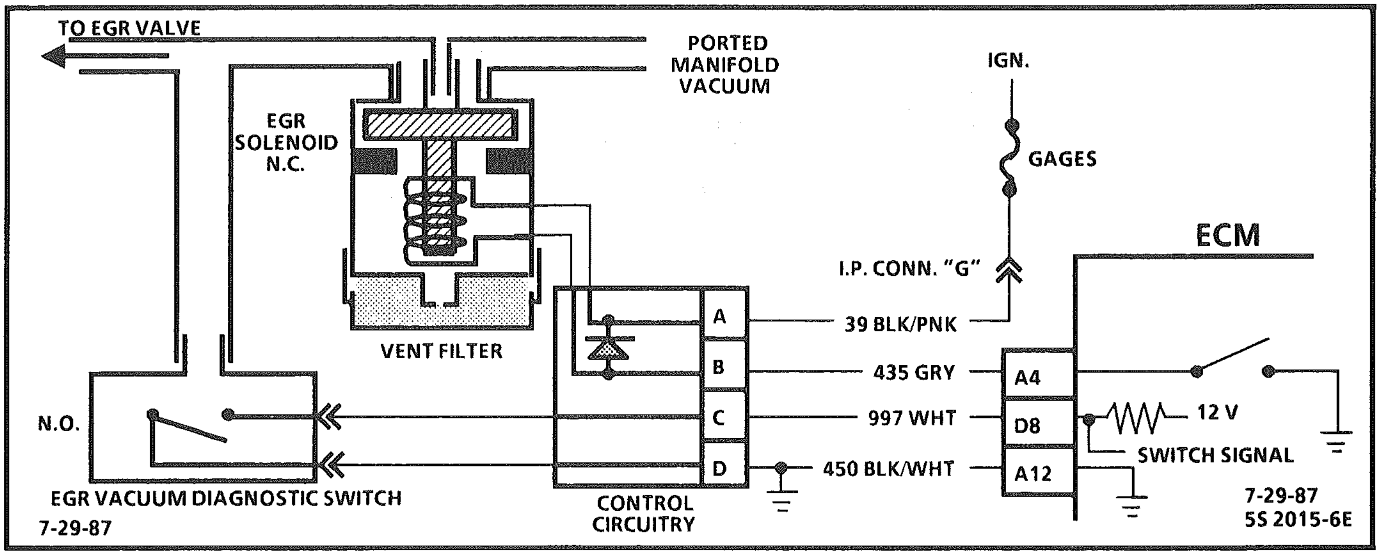
TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-17-87

• 7S 3190-6E



CODE 32

EGR SYSTEM FAILURE
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The EGR vacuum control uses an ECM controlled solenoid. The solenoid is normally closed and the vacuum source is a ported signal. The ECM will turn the EGR "ON" and "OFF" (Duty Cycle) by grounding CKT 435. The duty cycle is calculated by the ECM based on information from the coolant and mass airflow sensor and engine rpm. The duty cycle should be 0% (no EGR) when in park or neutral, TPS input below a specified value, or TPS indicating WOT.

With the ignition "ON", engine stopped, the EGR solenoid is de-energized unless the diagnostic terminal is grounded.

Code 32 means that the EGR vacuum diagnostic switch was closed during start-up, or that the switch was not detected closed under the following conditions.

- Coolant temperature greater than 80° C (176°F).
- EGR duty cycle commanded by the ECM is greater than 55%.
- TPS less than half throttle, but not at idle.
- All conditions above must be met for 5 seconds.

If the switch is detected closed during start-up, or , if the switch is detected open when the above conditions are met, the "Service Engine Soon" light will remain "ON" unless the switch changes state.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the first step caused Code 32 to set, then the ECM has recognized a closed vacuum switch on start-up. This test will determine whether the EGR vacuum diagnostic switch is the cause or if the wiring or the ECM is the cause.
2. With the ignition "ON", the solenoid should not be energized and vacuum should not pass to the EGR valve.
3. To this point the EGR solenoid and valve are OK and the following check will check the diagnostic vacuum switch portion of the system.
4. The diagnostic switch should close at about 2" of vacuum. With vacuum applied, the switch should close and resistance go to near zero ohms and the vacuum should hold.

CODE 32

EGR SYSTEM FAILURE
2.8L (VIN S) "F" SERIES (PORT)

BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 23.64 kPa (7") HG VACUUM AT 2000 RPM.

- IGNITION "OFF", CLEAR CODES.
- START ENGINE. AND IDLE FOR 30 SECONDS OR UNTIL CODE 32 SETS.

NO CODE 32

(2)
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE.
- IGNITION "ON", ENGINE STOPPED.
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE TO MANIFOLD SIDE OF EGR SOLENOID.
- APPLY VACUUM AND OBSERVE EGR VALVE.
- VALVE SHOULD NOT MOVE.

VALVE DOES NOT MOVE

- GROUND DIAGNOSTIC TERMINAL.
- REPEAT TEST.

VALVE MOVES

(3)
- DISCONNECT EGR 4-WAY CONNECTOR.
- CONNECT VOLTMETER BETWEEN "C" & "D".
- IGNITION "ON".

OVER 10 VOLTS

(4)
- CONNECT OHMMETER ACROSS TERMINALS "C" & "D" OF SOLENOID.
- APPLY 23.64 kPa (7") VACUUM TO VACUUM DIAGNOSTIC SWITCH.
- NOTE RESISTANCE.

LOW RESISTANCE (SWITCH CLOSED)

PROBLEM IS INTERMITTENT, CHECK ALL CONNECTIONS AND TERMINALS.

HIGH RESISTANCE (SWITCH OPEN)

FAULTY SWITCH, WIRING OR CONNECTIONS.

UNDER 10 VOLTS

CONNECT VOLTMETER BETWEEN TERMINAL "C" AND CHASSIS GROUND.

OVER 10 VOLTS

REPAIR OPEN GROUND CKT 450.

UNDER 10 VOLTS

CHECK CKT 997 FOR OPEN. IF NOT OPEN, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

VALVE DOES NOT MOVE

- DISCONNECT EGR 4-WAY CONNECTOR
- CONNECT TEST LIGHT BETWEEN HARNESS TERMINALS "A" & "B".

LIGHT "ON"

- CONNECT VACUUM PUMP TO EGR VALVE.
- APPLY VACUUM AND OBSERVE VALVE.

VALVE MOVES

FAULTY HOSE OR CONNECTION BETWEEN EGR SOLENOID AND EGR VALVE OR FAULTY EGR SOLENOID.

VALVE DOES NOT MOVE

REPLACE EGR VALVE

LIGHT "OFF"

CONNECT TEST LIGHT BETWEEN "A" AND GROUND.

NO LIGHT

REPAIR OPEN CKT 39.

LIGHT

REPAIR OPEN CKT 435. IF NOT OPEN, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

VALVE MOVES

- DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR.
- REPEAT TEST.

VALVE MOVES

FAULTY EGR SOLENOID

VALVE DOES NOT MOVE

CHECK CKT 435 FOR SHORT TO GROUND. IF OK, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

CODE 32

(1)
- CLEAR CODES.
- DISCONNECT EGR SOLENOID 4-WAY CONNECTOR.
- REPEAT TEST.

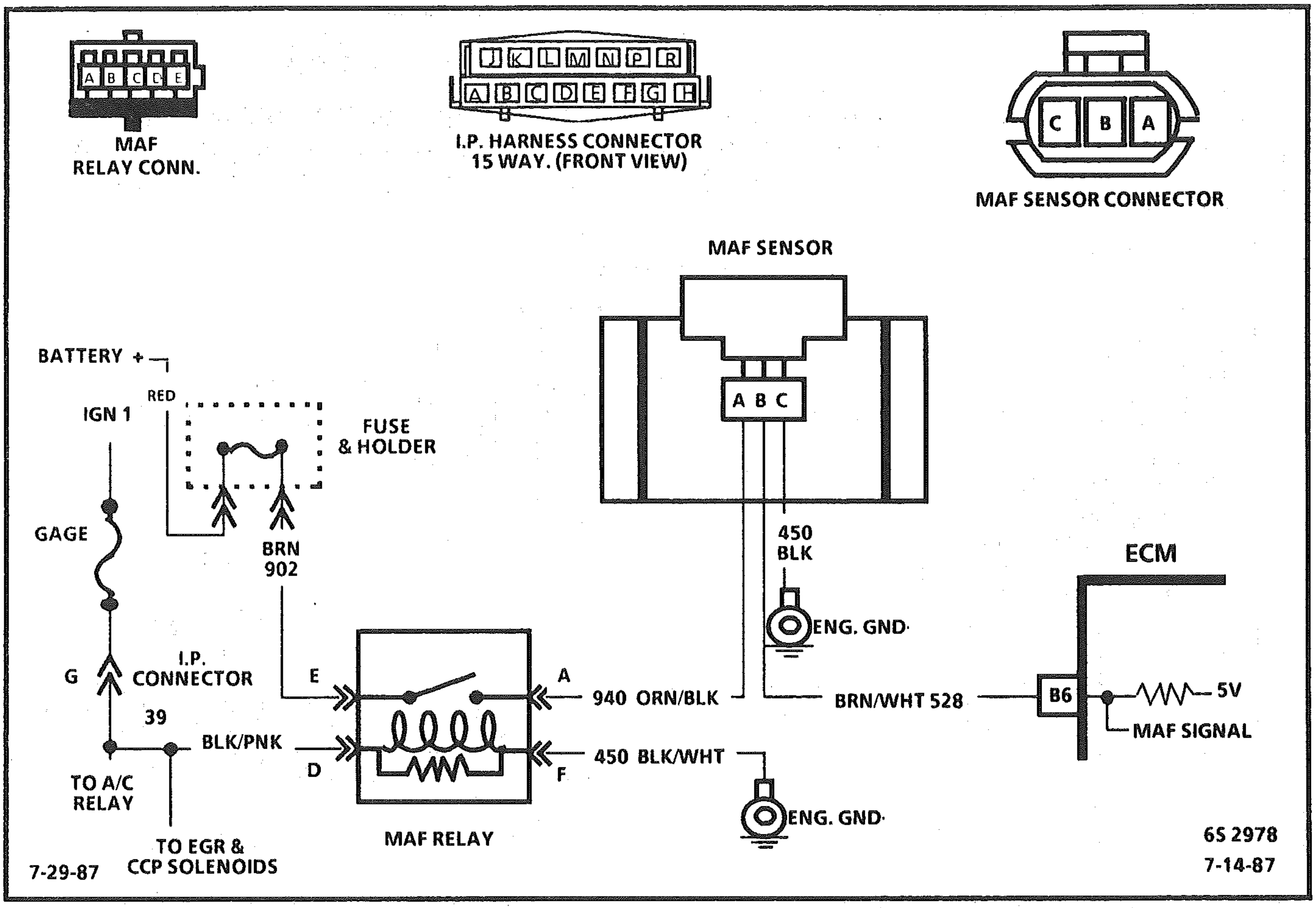
NO CODE 32

CHECK FOR A STUCK CLOSED SWITCH. IF NOT CLOSED, IT IS FAULTY WIRING OR CONNECTIONS.

CODE 32

CHECK CKT 997 FOR SHORT TO GROUND. IF NOT SHORTED IT IS A FAULTY ECM.

7-29-87
5S 1602-6E



CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC HIGH)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The MAF sensor measures the flow of air entering the engine. The sensor produces a frequency output between 32 and 150 hertz (3gm/sec to 150gm/sec). A large quantity (high frequency) indicates acceleration, and a small quantity (low frequency) indicates deceleration or idle. This information is used by the ECM for fuel control and is converted by a "Scan" tool to read out the air flow in grams per second. A normal reading is about 4-7 grams per second at idle and increases with rpm.

The MAF sensor is powered up by the MAF sensor relay and the sensor should have power supplied to it anytime the ignition is "ON".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 33 will set if:
   - Ign. "ON" and air flow exceeds 20gm/sec.

     OR
   - Engine is running less than 1300 rpm.
   - TPS is 8% or less.
   - Air flow greater than 20 grams per second (high frequency).
   - All of the above are met for 2 seconds.

Diagnostic Aids:

The "Scan" tool is not of much use in diagnosing this code because when the code sets gm/sec will be displaying the default value. However, the "Scan" may be useful in comparing the signal of a problem vehicle with that of a known good running one.

Refer to "Intermittents" in Section "B".

CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC HIGH)
2.8L (VIN S) "F" SERIES (PORT)

1
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 33 SETS.

DOES CODE 33 SET?

YES

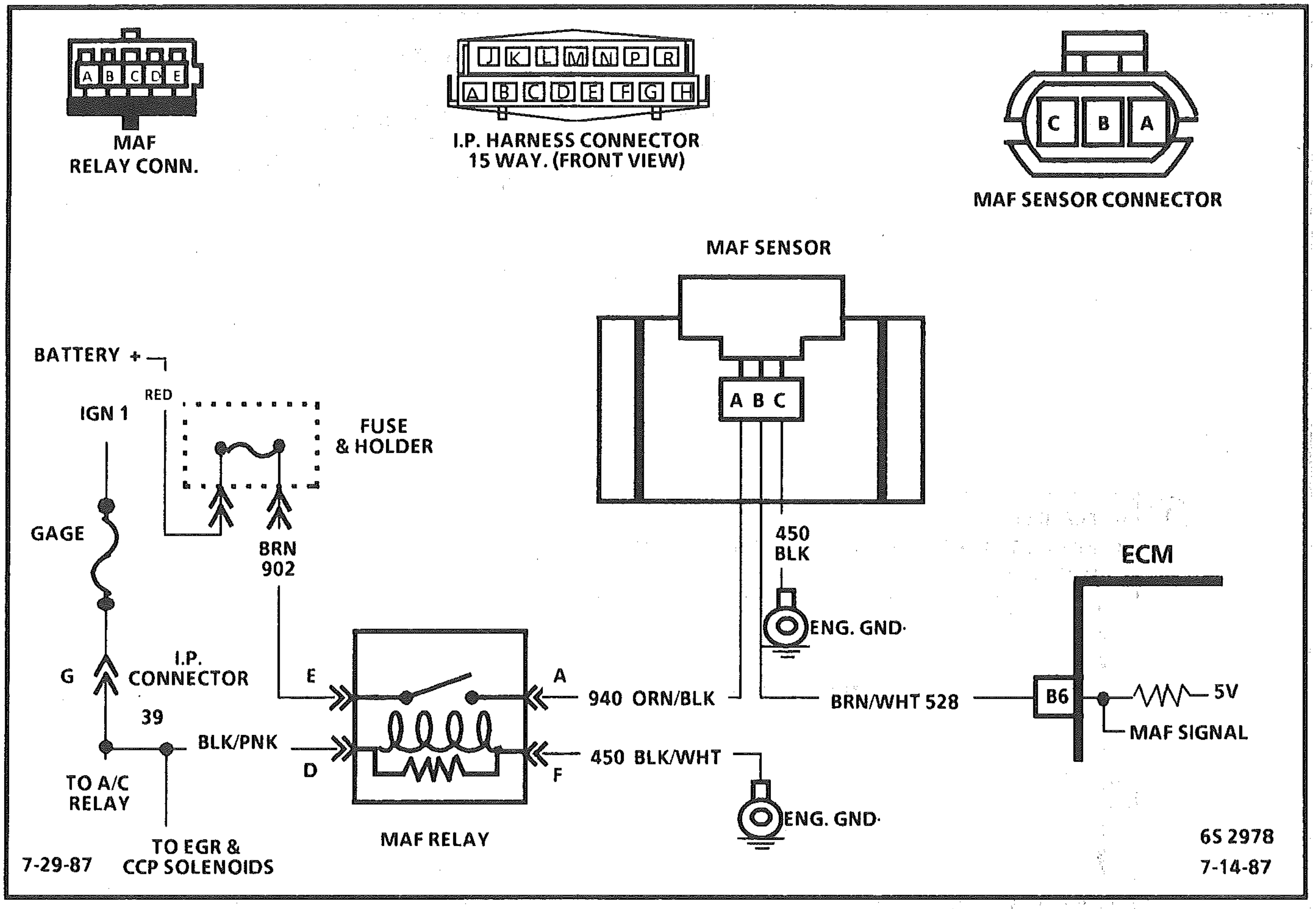
REPLACE MAF SENSOR

NO

CODE 33 IS INTERMITTENT.
REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-2-87
* 7S 3149-6E



CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC LOW)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The MAF sensor measures the flow of air entering the engine. The sensor produces a frequency output between 32 and 150 hertz (3gm/sec to 150gm/sec). A large quantity (high frequency) indicates acceleration, and a small quantity (low frequency) indicates deceleration or idle. This information is used by the ECM for fuel control and is converted by a "SCAN" tool to read out the air flow in grams per second. A normal reading is about 4-7 grams per second at idle and increase with rpm.

The MAF sensor is powered up by the MAF sensor relay and the sensor should have power supplied to it anytime the ignition is "ON".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 34 will set if:
   - Engine running
   - MAF sensor disconnected, faulty relay, or MAF signal circuit shorted to ground.

     OR
   - Air flow less than 2 grams per second (low frequency).

   A loose or damaged air duct can set Code 34.
   This test checks to see if ECM recognizes a problem. A light "OFF" at this point indicates an intermittent problem.
2. Checks to see if 5 volt reference signal from ECM is at MAF sensor harness connector.
3. Checks for 12 volt supply to MAF sensor.
4. Checks for open in 12 volt supply to relay.

Diagnostic Aids:

The "Scan" tool is not of much use in diagnosing this code because when the code sets gm/sec will be displaying the default value. However, the "Scan" may be useful in comparing the signal of a problem vehicle with that of a known good running one.

Check for loose or damaged air duct.

Inspect sensor and relay connections as an open will result in a Code 34.

Refer to "Intermittents" in Section "B".

CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC LOW) 2.8L (VIN S) "F" SERIES (PORT)

1
- CHECK FOR LOOSE OR DAMAGED AIR DUCT BETWEEN MAF SENSOR AND THROTTLE BODY.
- CLEAR CODES.
- START AND IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 34 SETS.
  DOES CODE SET?

YES

2
- IGNITION "OFF".
- DISCONNECT MAF SENSOR ELECTRICAL CONNECTOR.
- IGNITION "ON", ENGINE STOPPED.
- CONNECT VOLTMETER BETWEEN HARNESS CONNECTOR TERMINAL "B" (CKT 528) AND GROUND.
- SHOULD READ 4-6 VOLTS.
  DOES IT?

NO

CODE 34 IS INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS "A" AND "C".

NO

LESS THAN 4 VOLTS

CKT 528 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

OVER 6 VOLTS

CKT 528 SHORTED TO VOLTAGE OR FAULTY ECM.

LIGHT "OFF"

3
CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINAL "A" AND CHASSIS GROUND.

LIGHT "ON"

FAULTY MAF SENSOR CONNECTION OR SENSOR.

LIGHT "OFF"

4
- DISCONNECT MAF RELAY, IGNITION "ON".
- CONNECT A TEST LIGHT BETWEEN TERMINAL "A" AND GND AND TERMINAL "C" AND GND.

LIGHT "ON"

OPEN CKT 450

NO LIGHT ON ONE OR BOTH

REPAIR OPEN IN CIRCUIT THAT DID NOT LIGHT.

LIGHT ON BOTH

CONNECT TEST LIGHT BETWEEN TERMINALS "A" AND "B" (GND).

LIGHT "OFF"

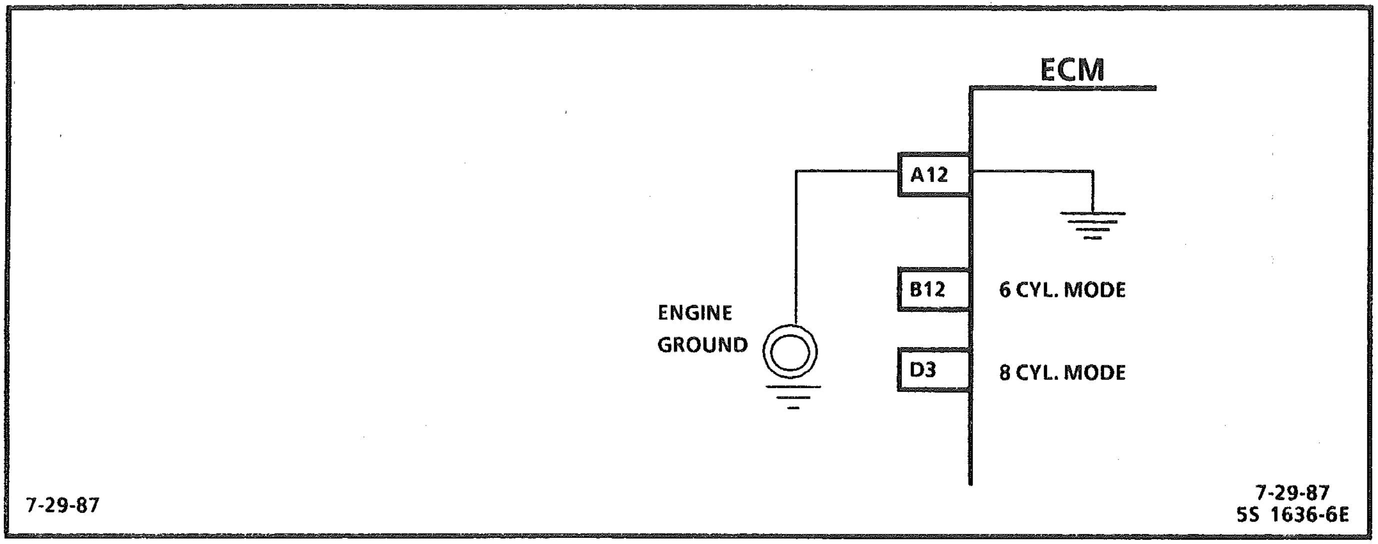
REPAIR OPEN GROUND WIRE 450.

LIGHT "ON"

CKT 940 OPEN SHORTED TO GROUNDD., OR THE MAF RELAY IS FAULTY.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-29-87
5S 1635-6E



CODE 41

CYLINDER SELECT ERROR
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

Due to the ECM being used for different engines, it is necessary for the engine application to be selected. This is done by leaving "B12" and "D3" open for a six cylinder engine.

A Code 41 will set if the reference pulses are not equal to a value selected within the PROM when engine rpm's are below 2000. This code may set if the incorrect PROM is installed into the ECM.

CODE 41

CYLINDER SELECT ERROR
2.8L (VIN S) "F" SERIES (PORT)

- IGNITION "OFF", CLEAR CODES.
- START ENGINE AND IDLE FOR I MINUTE OR UNTIL CODE 41 SETS.
- DOES CODE 41 SET?

YES

- THERE SHOULD BE NO WIRES CONNECTED TO ECM TERMINALS "B12" OR "D3".

OK

- CHECK FOR CORRECT PROM.
- IF FOUND TO BE THE CORRECT PROM, THE ECM IS FAULTY.

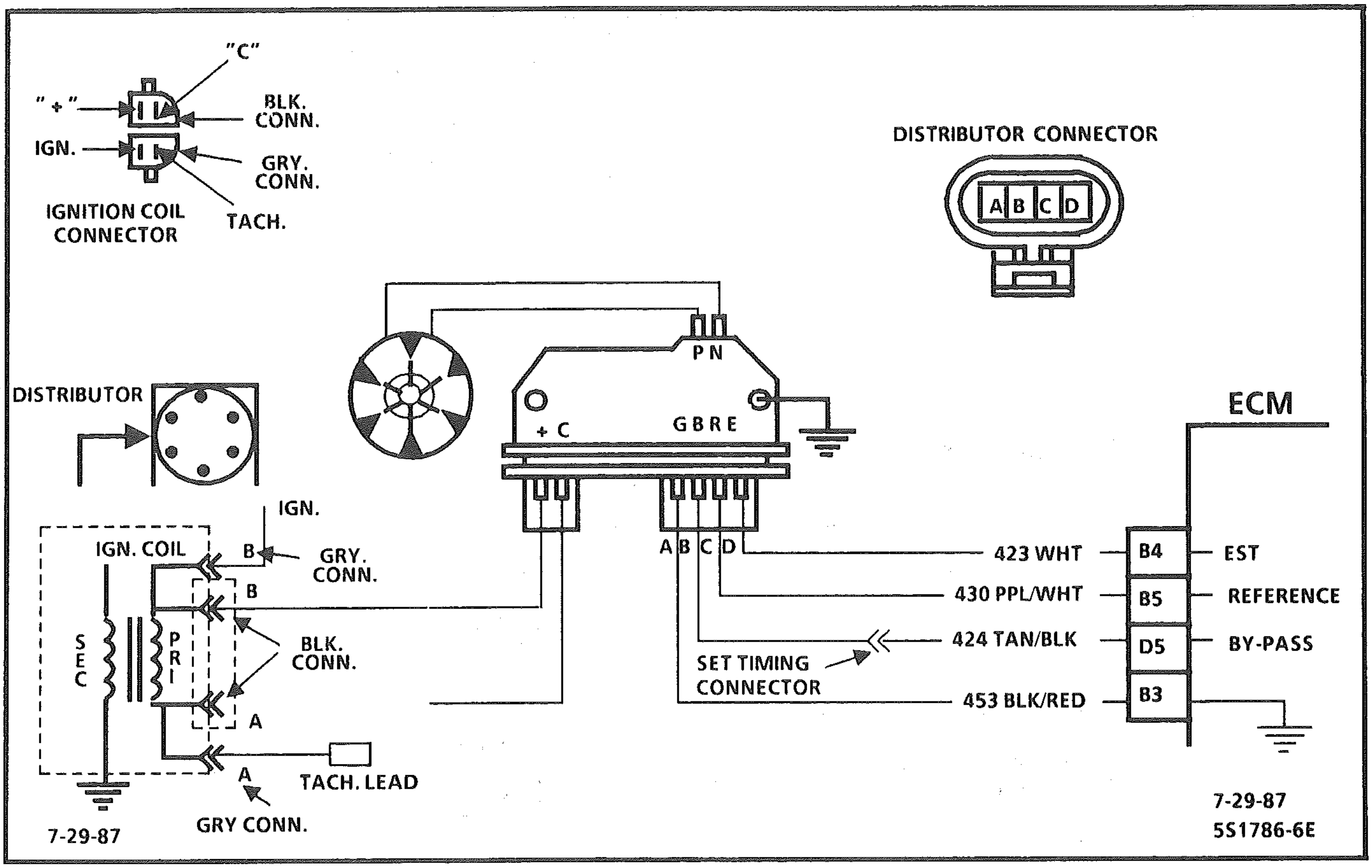
NOT OK

DISCONNECT WIRES FROM CONNECTOR.

NO

CODE 41 IS INTERMITTENT. IF NO OTHER CODES WERE STORED, REFER TO "INTERMITTENTS" IN SECTION "B".

7-29-87
5S 1637-6E



CODE 42

ELECTRONIC SPARK TIMING (EST) FAULT
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

When the system is running on the ignition module, that is, no voltage on the bypass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST Line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), and bypass voltage applied, the EST should on longer be grounded in the ignition module so the EST voltage should be varying.

If the bypass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST, but because the line is grounded there will be no EST signal. A Code 42 will be set.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
3. As the test light voltage touches CKT 424, the module should switch causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A PROM not fully seated in the ECM can result in a Code 42.

Refer to "Intermittents" in Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) FAULT 2.8L (VIN S) "F" SERIES (PORT)

1
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE 42 SET?

YES

2
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON".
- OHMMETER SELECTOR SWITCH IN THE 1000 TO 2000 OHMS RANGE.
- PROBE ECM HARNESS CONNECTOR CKT 423 WITH AN OHMMETER TO GROUND.
  IT SHOULD READ LESS THAN 500 OHMS.
  DOES IT?

NO

CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES

- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

NO

OPEN CKT 423, FAULTY CONNECTION OR FAULTY IGNITION MODULE.

LIGHT "OFF"

3
- WITH OHMMETER STILL CONNECTED TO ECM HARNESS CKT 423 AND GROUND. AGAIN PROBE ECM HARNESS CKT 424 WITH THE TEST LIGHT CONNECTED TO 12 VOLTS. (AS TEST LIGHT CONTACTS CKT 424, RESISTANCE SHOULD SWITCH FROM UNDER 500 TO OVER 5,000 OHMS,)
  DOES IT?

LIGHT "ON"

- DISCONNECT IGNITION MODULE 4-WAY CONNECTOR.

LIGHT "ON"

CKT 424 SHORTED TO GROUND.

LIGHT "OFF"

FAULTY IGNITION MODULE.

NO

4
- DISCONNECT DIST. 4-WAY CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD HAVE GONE HIGH (OPEN CIRCUIT) .
  DOES IT?

YES

CKT 424 OPEN, FAULTY CONNECTIONS OR FAULTY IGNITION MODULE.

NO

CKT 423 SHORTED TO GROUND.

YES

5
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE SET?

YES

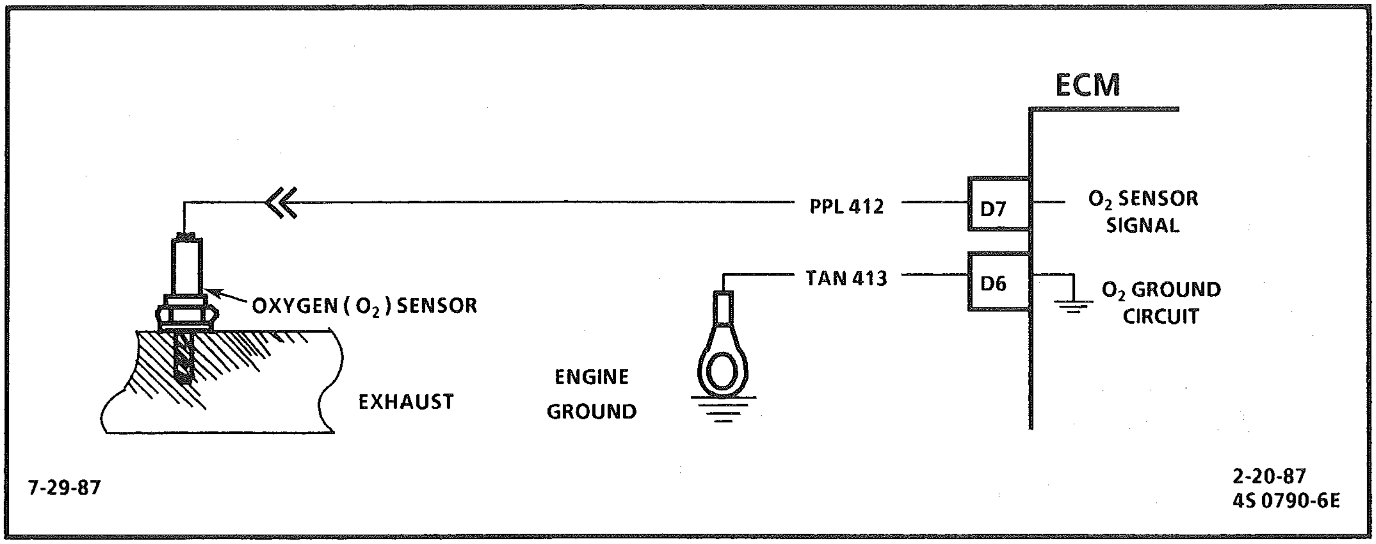
FAULTY ECM

NO

CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-12-87
* 7S 3291-6E



CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F) An open sensor circuit or cold sensor causes open loop operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412.
   - Remains below .2 volt for 60 seconds or more:
   - And the system is operating in "Closed Loop".

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. If the conditions for Code 44 exists the block learn values will be around 150.

- O_2 Sensor Wire Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAF Sensor A mass air flow (MAF) sensor output that causes the ECM to sense a lower than normal air flow will cause the system to go lean. Disconnect the MAF sensor and if the lean condition is gone, check for a Code 34.
- Lean Injector(s) Perform injector balance test, CHART C-2A.
- Fuel Contamination Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See "Fuel System Diagnosis", CHART A-7.
- Exhaust Leaks If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- Air System (manual trans only)
  Be sure air is not being directed to the exhaust ports while in "Closed Loop". If the block learn value goes down while squeezing air hose to exhaust ports , refer to CHART C-6.
- If the above are OK, it is a faulty oxygen sensor.

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 SENSOR VOLTAGE FIXED BELOW .35 VOLTS (350 mV)?

YES

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY O_2 SENSOR BETWEEN .35 VOLTS AND .55 VOLTS (350 mV AND 550 mV).

DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO

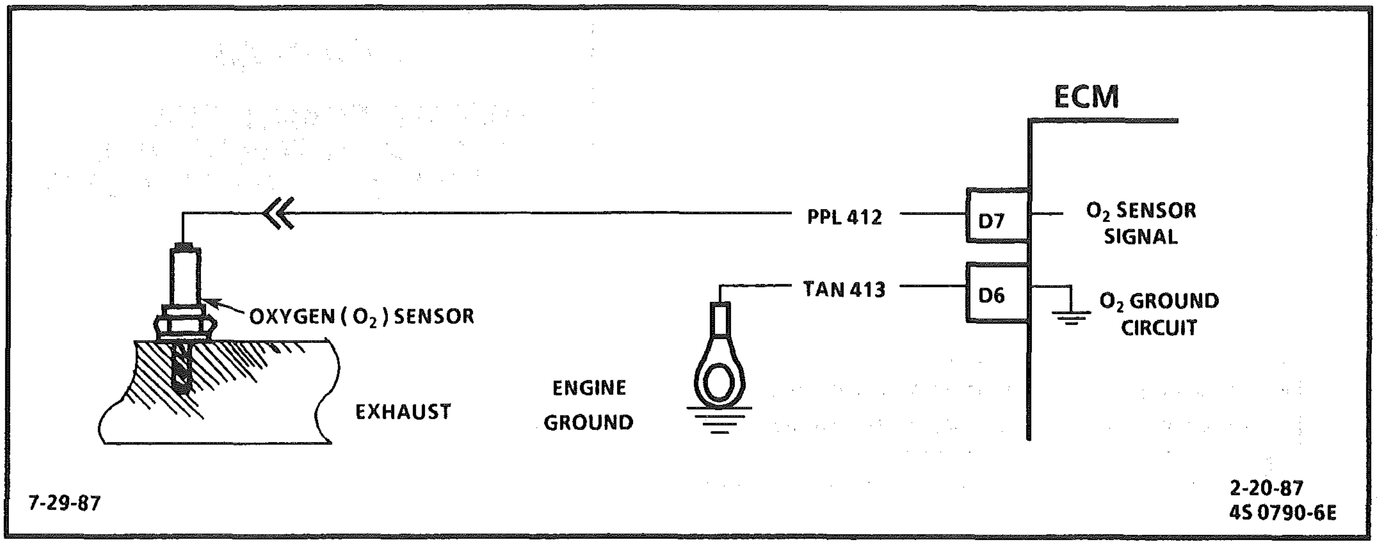
CKT 412 SHORTED TO GROUND OR FAULTY ECM.

NO

CODE 44 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-30-87
*7S 3191-6E



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 315°C (600°F). An open sensor circuit or cold sensor causes open loop operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 45 is set when the O_2 sensor signal voltage or CKT 412.
   - Remains above .7 volt for 30 seconds; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle less than 1/2 open but not at idle.

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. If the conditions for Code 45 exists, the block learn values will be around 115.

- Fuel Pressure System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set. See "Fuel System Diagnosis", CHART A-7.
- Rich Injector Perform injector balance test CHART C-2A.
- Leaking Injector See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding An open ground CKT 453 (ignition system reflow) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister Purge Check for fuel saturation. If full of fuel, check canister control and hoses. See "Canister Purge", Section "C3".
- MAF Sensor An output that causes the ECM to sense a higher than normal airflow can cause the system to go rich. Disconnecting the MAF sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAF sensor if the the rich condition is gone while the sensor is disconnected. Check for a Code 34.
- Check for leaking fuel pressure regulator diaphragm by checking vacuum line to regulator for fuel.
- TPS An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.
- EGR An EGR staying open (especially at idle) will cause the O_2 sensor to indicate a rich exhaust.

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
2.8L (VIN S) "F" SERIES (PORT)

1

- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" TOOL DISPLAY O_2 SENSOR FIXED ABOVE .75 VOLTS (750 mV)?

YES

- DISCONNECT O_2 SENSOR AND JUMPER HARNESS CKT 412 TO GROUND.
- "SCAN" SHOULD DISPLAY O_2 BELOW .35 VOLTS (350 mV).

DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

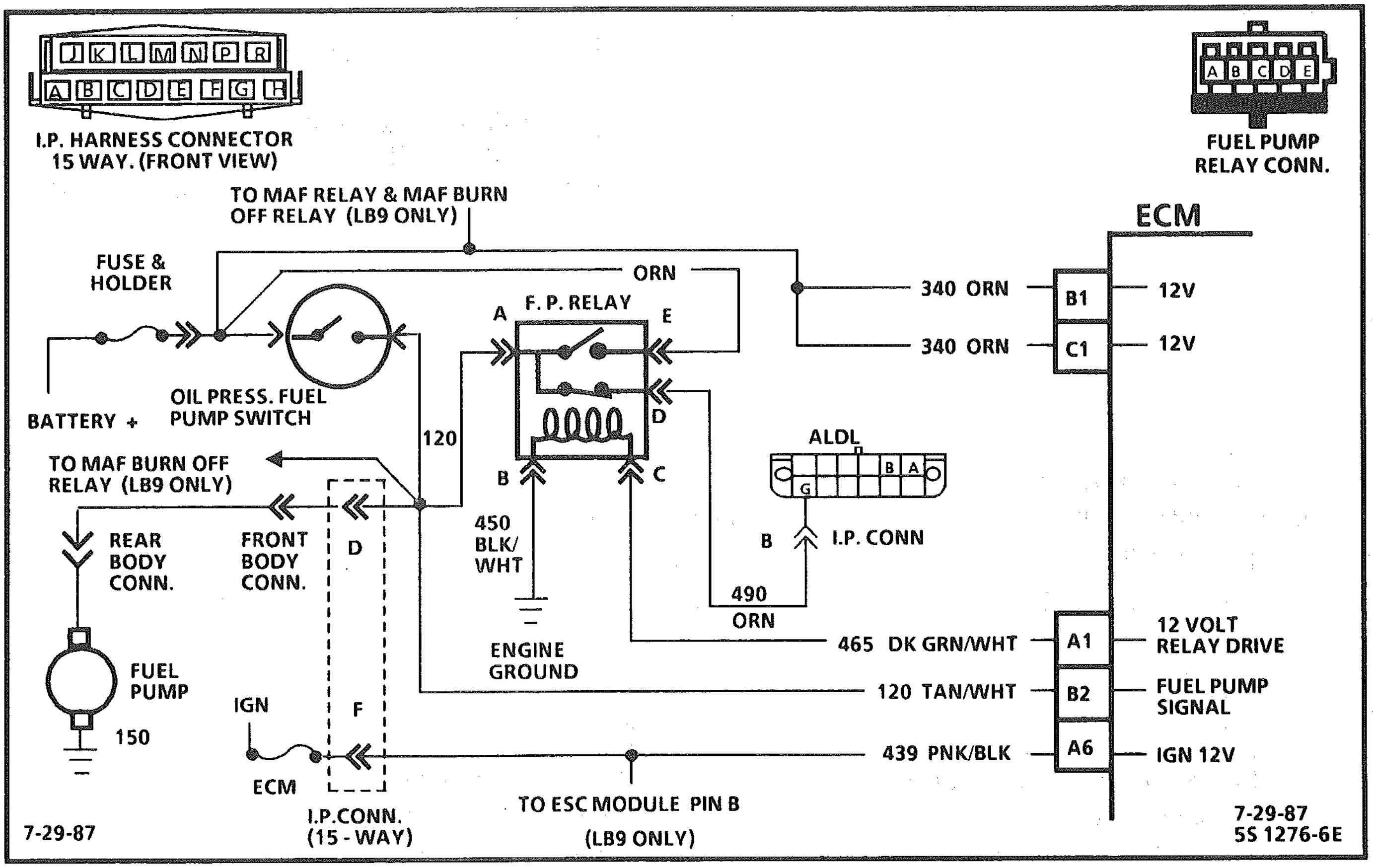
FAULTY ECM.

NO

CODE 45 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-27-87
*7S 3192-6E



CODE 54

FUEL PUMP CIRCUIT
(LOW VOLTAGE)
2.8L (VIN S) "F" SERIES (PORT)

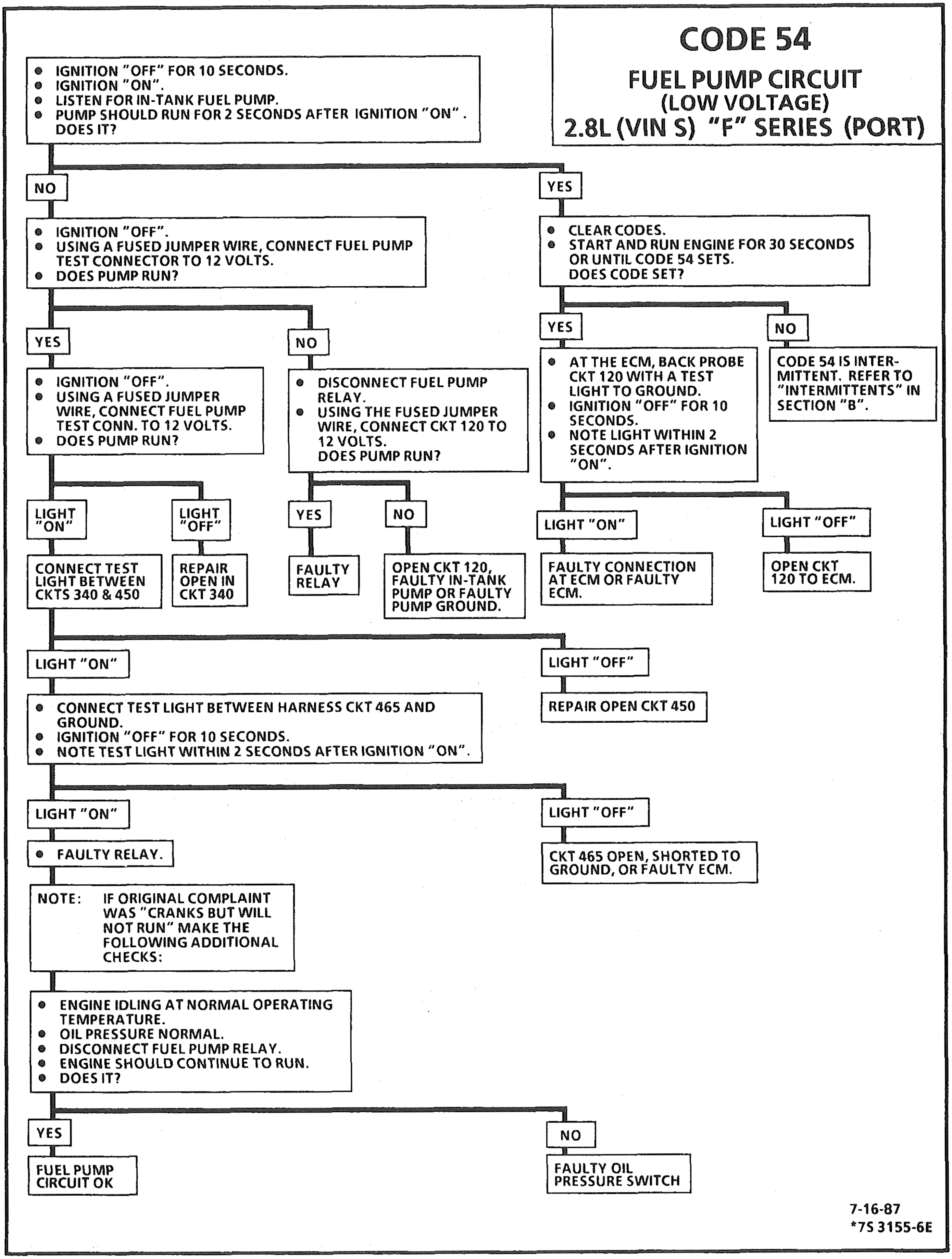
Circuit Description:

The status of the fuel pump CKT 120 is monitored by the ECM at terminal "B2", and is used to compensate fuel delivery based on system voltage. This signal is also used to store a trouble code if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on CKT 120 for 2 seconds after the ignition is turned or any time references pulses are being received by the ECM.

Diagnostic Aids:

Code 54 will set if the voltage at terminal "B2" is less than 2 volts for 1.5 seconds since the last reference pulse was received. This will help in detecting a faulty relay, causing extended crank time and the code will help the diagnosis of an engine that "CRANKS BUT WILL NOT RUN".

If a fault is detected during start-up the "Service Engine Soon" light will stay "ON" until the ignition is cycled off. However, if the voltage is detected below 2 volts with the engine running the light will only remain on while the condition exists.


CODE 54
FUEL PUMP CIRCUIT
(LOW VOLTAGE)
2.8L (VIN S) "F" SERIES (PORT)
• IGNITION "OFF" FOR 10 SECONDS.
• IGNITION "ON".
• LISTEN FOR IN-TANK FUEL PUMP.
• PUMP SHOULD RUN FOR 2 SECONDS AFTER IGNITION "ON". DOES IT?
NO
• IGNITION "OFF".
• USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONNECTOR TO 12 VOLTS.
• DOES PUMP RUN?
YES
• IGNITION "OFF".
• USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONN. TO 12 VOLTS.
• DOES PUMP RUN?
LIGHT "ON"
CONNECT TEST LIGHT BETWEEN CKTS 340 & 450
LIGHT "OFF"
REPAIR OPEN IN CKT 340
NO
• DISCONNECT FUEL PUMP RELAY.
• USING THE FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS. DOES PUMP RUN?
YES
FAULTY RELAY
NO
OPEN CKT 120, FAULTY IN-TANK PUMP OR FAULTY PUMP GROUND.
YES
• CLEAR CODES.
• START AND RUN ENGINE FOR 30 SECONDS OR UNTIL CODE 54 SETS. DOES CODE SET?
YES
• AT THE ECM, BACK PROBE CKT 120 WITH A TEST LIGHT TO GROUND.
• IGNITION "OFF" FOR 10 SECONDS.
• NOTE LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
LIGHT "ON"
FAULTY CONNECTION AT ECM OR FAULTY ECM.
LIGHT "OFF"
OPEN CKT 120 TO ECM.
NO
CODE 54 IS INTERMITTENT. REFER TO "INTERMITTENTS" IN SECTION "B".
LIGHT "ON"
• CONNECT TEST LIGHT BETWEEN HARNESS CKT 465 AND GROUND.
• IGNITION "OFF" FOR 10 SECONDS.
• NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
LIGHT "OFF"
REPAIR OPEN CKT 450
LIGHT "ON"
• FAULTY RELAY.
NOTE: IF ORIGINAL COMPLAINT WAS "CRANKS BUT WILL NOT RUN" MAKE THE FOLLOWING ADDITIONAL CHECKS:
• ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
• OIL PRESSURE NORMAL.
• DISCONNECT FUEL PUMP RELAY.
• ENGINE SHOULD CONTINUE TO RUN.
• DOES IT?
YES
FUEL PUMP CIRCUIT OK
NO
FAULTY OIL PRESSURE SWITCH
LIGHT "OFF"
CKT 465 OPEN, SHORTED TO GROUND, OR FAULTY ECM.
7-16-87
*7S 3155-6E

CODE 51
CODE 52
CODE 53
CODE 55
2.8L (VIN S) "F" SERIES (PORT)

CODE 51
PROM ERROR
(FAULTY OR INCORRECT PROM)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE PROM, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 52
CALPAK ERROR
(FAULTY OR INCORRECT CALPAK)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET. IF OK, REPLACE CALPAK, CLEAR MEMORY, AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 53
SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET IF VOLTAGE AT ECM TERMINAL "B2" IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. SEE SECTION "6D".

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 55
ECM ERROR

BE SURE ECM GROUNDS ARE OK. IF OK REPLACE ELECTRONIC CONTROL MODULE (ECM)

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-30-87
5S 1516-6E

SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "Service Engine Soon" light are operating.
2. There are no trouble codes stored, or there is a trouble code but no "Service Engine Soon" light.

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the symptom procedures below call for a careful visual check. This check should include:

- ECM grounds for being clean and tight.
- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Air leaks between MAF sensor and throttle body.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

<u>The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.</u>

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the trouble code charts in Section "A" for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of trouble code charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check as described at start of Section "B". Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed to increase contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check. See "Introduction" to Section "6E".
- If a visual check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. A "Scan" tool can also be used for monitoring input signals to the ECM to help detect intermittent conditions. An abnormal voltage, or "Scan" reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK and a trouble code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

An intermittent "Service Engine Soon" light with no stored code may be caused by:

- Ignition coil shorted to ground and arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic "Test" terminal wire to ECM, shorted to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.

- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes "ON". Code 22 should be stored, and kept in memory when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM to distributor (CKT 453) should be a good connection.
- Check for open diode across A/C compressor clutch, and for other open diodes (see wiring diagrams).

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- Perform careful check as described at start of Section "B".
- Make sure driver is using correct starting procedure.
- **CHECK:**
  - TPS for sticking or binding or a high TPS voltage with the throttle closed (should read less than .700 volts).
  - High resistance in coolant sensor circuit or sensor itself. See Code 15 chart or with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Both injector fuses (visually inspect).
  - Ignition system - Check distributor for:
    - Proper output with ST-125.
    - Worn shaft.
    - Bare and shorted wires.
  - Pickup coil resistance and connections.
    - Loose ignition coil ground.
    - Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .

- A faulty in-tank fuel pump check valve will allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
  Perform Fuel System Diagnosis, CHART A-7.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- If engine starts but then immediately stalls, open distributor by-pass line. If engine then starts and runs OK, replace pickup coil.
- If engine starts and stalls, disconnect MAF sensor. If engine then runs and sensor connections are OK, replace the sensor.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Fuel pressure. See CHART A-7. Also check for water contaminated fuel.
  - Air leaks at air duct between MAF sensor and throttle body.
  - Spark plugs for being fouled or faulty wiring.
  - PROM (2.8L) or MEM-CAL (5.0L & 5.7L) number. Also check service bulletins for latest MEM-CAL or PROM.
  - TPS for binding or sticking. Voltage should increase at a steady rate as throttle is moved toward WOT.
  - Ignition timing. See Emission Control Information label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - HEI ground, CKT 453.
  - Canister purge system for proper operation. See CHART C-3.
  - EGR - See CHART C-7.
- Perform injector balance test CHART C-2A.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.

- Be sure driver understands transmission converter clutch and A/C compressor operation in Owner's Manual.
- Perform careful visual inspection as described at start of Section "B".
- **CHECK:**
  - TCC and 4th gear switch operation - See CHART C-8A.
  - Loose or leaking air duct between MAF sensor and throttle body.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - EGR - There should be no EGR at idle. See CHART C-7. Also check for plugged EGR solenoid filter.
  - Vacuum lines for kinks or leaks.
  - Ignition timing. See Emission Control Information label.
  - In-line fuel filter. Replace if dirty or plugged.
  - Fuel pressure while condition exists. See CHART A-7.
- Inspect oxygen sensor for silicone contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also check condition of distributor cap, rotor, and spark plug wires.
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.

- Perform careful visual check as described at start of Section "B".
- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- **CHECK:**
  - For loose or leaking air duct between MAF Sensor and throttle body.
  - Ignition timing. See Emission Control Information label.
  - Restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM ground circuits - See ECM wiring diagrams.
  - EGR operation for being open or partly open all the time - CHART C-7.
  - Exhaust system for possible restriction: See CHART B-1.
    - Inspect exhaust system for damaged or collapsed pipes.
    - Inspect muffler for heat distress or possible internal failure.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft. See Section "6A".
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.

DETONATION /SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like popcorn popping.

- Check for obvious overheating problems:
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit. See CHART C-12.
- **CHECK:**
  - Ignition timing. See Vehicle Emission Control Information label.
  - EGR system for not opening - CHART C-7.
  - TCC operation - CHART C-8.
  - Fuel system pressure. See CHART A-7.
  - PROM or MEM-CAL - Be sure it's the correct one. (See Service Bulletins)
  - Valve oil seals for leaking.
- Check for incorrect basic engine parts such as cam, heads, pistons, etc.
- Check for poor fuel quality.
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check ESC system (5.0L & 5.7L) See CHART C-5
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual check as described at start of Section "B".
- Check for missing cylinder by:
  1. Disconnect IAC valve. Start engine. Remove one spark plug wire at a time using insulated pliers.
  2. If there is an rpm drop on all cylinders (equal to within 50 rpm), go to "ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING" symptom. Reconnect IAC valve.
  3. If there is no rpm drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with J 26792 (ST-125) Spark Gap Tool or equivalent. If no spark, see Section "6D" for intermittent operation or miss. If there is spark, remove spark plug(s) in these cylinders and check for:
     - Cracks
     - Wear
     - Improper gap
     - Burned electrodes
     - Heavy deposits
- Perform compression check on questionable cylinder(s) found above. If compression is low, repair as necessary. See Section "6".
- Disconnect all injector harness connectors. Connect J-34730-2 injector test light or equivalent 6 volt test light between the harness terms, of each injector connector and note light while cranking. If test light fails to blink at any connector, it is a faulty injector drive circuit harness, connector, or terminal.
- Perform the injector balance test. See CHART C-2A.
- **CHECK:**
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Valve timing.
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.
- Visually inspect distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
- A miss condition can be caused by EMI (Electromagnetic Interference) on the reference circuit. EMI can usually be detected by monitoring engine rpm with a "Scan" tool. A sudden increase in rpm with little change in actual engine rpm change, indicates EMI is present.

  If the problem exists, check routing of secondary wires, check all distributor ground circuits.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section "6A".

BACKFIRE

Definition: Fuel ignites in intake manifold, or in exhaust system, making a loud popping noise.

- **CHECK:**
- Loose wiring connector or air duct at MAF sensor.
- Compression - Look for sticking or leaking valves.
- EGR operation for being open all the time. See CHART C-7.
- EGR gasket for faulty or loose fit.
- Valve timing.
- Output voltage of ignition coil using a shop ocilliscope or spark tester J-26792 (ST-125) or equivalent.
- Spark plugs for crossfire also inspect (distributor cap, spark plug wires, and proper routing of plug wires).
- Ignition system for intermittent condition. (See Section "6D").
- Engine timing - see Emission Control Information label.
- Perform fuel system diagnosis check, CHART A-7A.
- Perform injector balance test, CHART C-2A.
- Deceleration valve (2.8L manual/trans) - See Section "C6".
- A.I.R. system check valves - See Section "C-6".

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Compression
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. A "Scan" should indicate an rpm drop when the TCC is commanded "ON". See CHART C-8.
  - Induction system and crankcase for air leaks.
- Check for exhaust restriction. See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned "OFF", but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in rpm (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Throttle linkage for sticking or binding. Also check TPS adjustment. Refer to Section "C2".
  - Ignition timing. See Emission Control Information label.
  - ECM ground circuits.
  - IAC system. See CHART C-2C.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "SCAN" tool.
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Evaporative Emission Control System. CHART C-3.
  - A/C signal to ECM terminal "B8" (5.0L & 5.7L). "Scan" tool should indicate A/C is being requested when ever A/C is selected and the pressure cycling switch is closed.
  - A/C system operation (2.8L) - See CHART C-10.
  - Minimum idle speed. See Section "C2".
  - Loose or damaged MAF sensor duct between sensor and throttle body.
  - Power Steering Pressure Switch (2.8L - See CHART C-1E.
  - Check AIR system. There should be no AIR to ports while in "Closed Loop". See CHART C-6.
  - EGR valve: There should be no EGR at idle.
- Run a cylinder compression check. See Section "6".
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check for fuel in pressure regulator hose. If present replace regulator assembly.
- Check ignition system; wires, plugs, rotor, etc.
- Check for loose or damaged air duct between MAF sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected replace sensor.
- Clean injectors.
- Monitoring block learn will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See emission control information label.
- If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

CHART B-1

RESTRICTED EXHAUST SYSTEM CHECK

ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

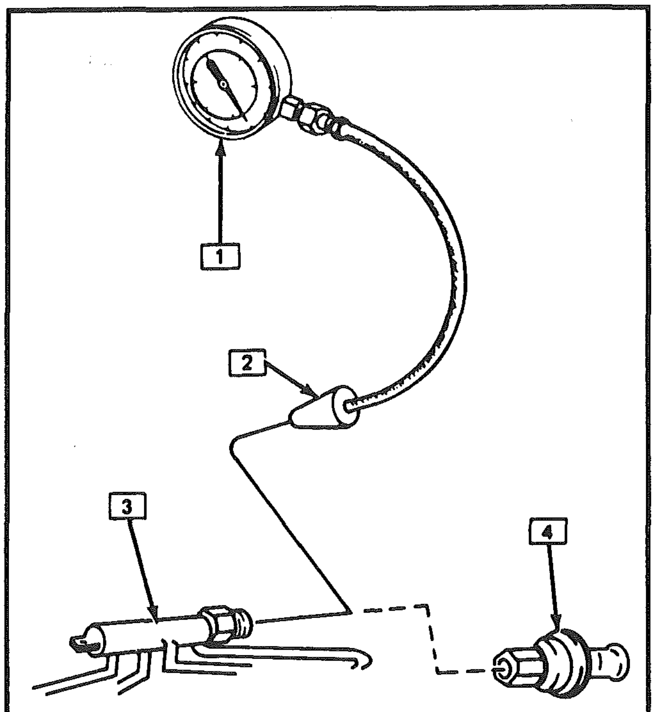
CHECK AT A. I. R. PIPE:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

OR

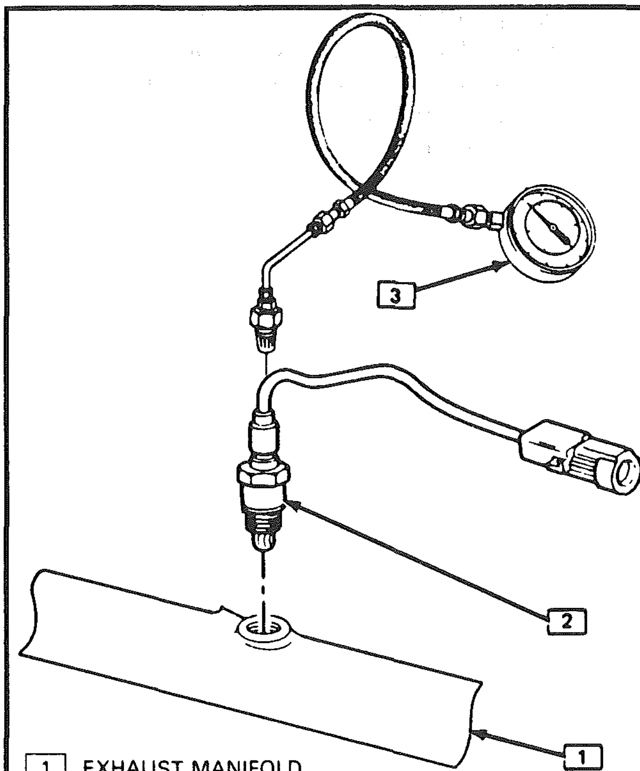
CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.



1 GAGE
2 HOSE AND NIPPLE ADAPTER
3 A.I.R. PIPE (EXHAUST PORT)
4 CHECK VALVE

7S 3363-6E



1 EXHAUST MANIFOLD
2 OXYGEN (O_2) SENSOR
3 BACK PRESSURE GAGE

7S 3338-6E

DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 $\frac{1}{4}$ psi (8.6 kPa).
2. Accelerate engine to 2000 RPM and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either RPM, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

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7S 3340-6E

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SECTION C
COMPONENT SYSTEMS

Section C provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams and ECM Terminal End View refer to the front of the A Sections of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See "Introduction" for more information on using the diagnostic function of the ECM.

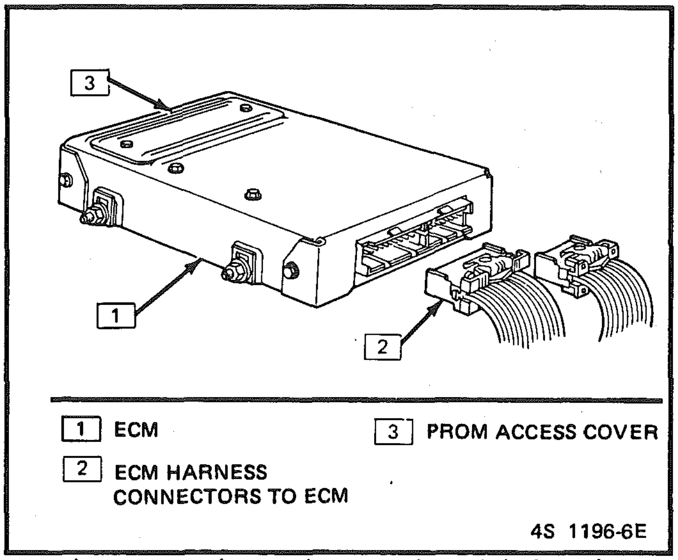

Figure C1-1 Electronic Control Module (ECM)

ECM TYPES

There are two types of ECM'S used for "F" series vehicles equipped with port fuel engines:

Vehicles equipped with a 2.8L engine will use an ECM referred to as GMCM. For service, the ECM consists of three parts: a Controller (the ECM without a PROM), a separate Calibrator (PROM), and a CALPAK.

PROM

To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-2). The PROM is located inside the ECM, and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one ECM part number can be used by many car lines, a PROM is very specific and must be used for the right car. For this reason, it is very important to check the latest parts book and Service Bulletin information for the correct part number when replacing a PROM.

An ECM used for service (called a controller) comes without a PROM. The PROM from the old ECM must be carefully removed and installed in the new ECM (see On-Car Service).

CALPAK (Fig. C1-2)

A device called a CALPAK is used to allow fuel delivery if other parts of the ECM are damaged.

It has an access door in the ECM, and removal and replacement procedures are similar to the PROM removal procedures.

The CALPAK must be transferred to a replacement ECM.

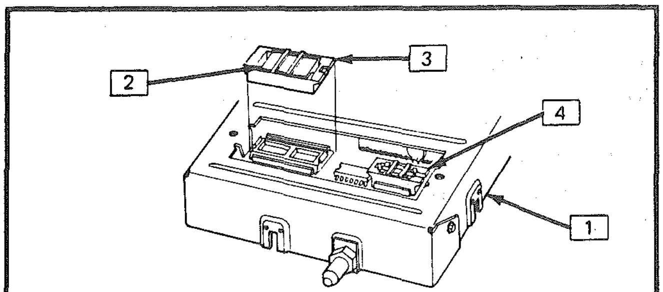

Figure C1-2 PROM (Calibrator) and CALPAK

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 Meg Ohm input impedance digital voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injector, IAC, Cooling Fan Relay, etc. by controlling the ground circuit through transistors in the ECM.

INFORMATION SENSORS

Engine Coolant Temperature Sensor (Fig.C1-3)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

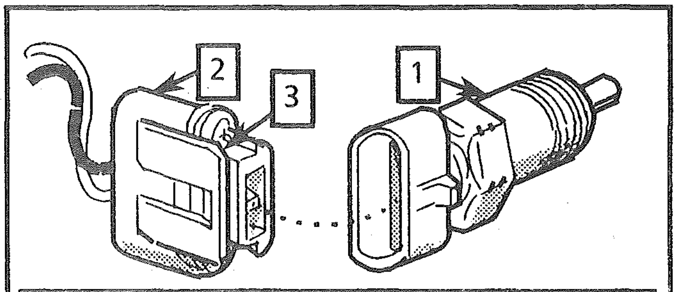

Figure C1-3 Engine Coolant Temperature Sensor

The ECM supplies a 5-volt signal to the coolant sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.

Mass Air Flow (MAF) Sensor Figure C1-4

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

A/C MAF Sensor

The MAF sensor produces a frequency output which is proportional to the air entering the engine. The output will vary from about 32 hertz at idle to 150 hertz at WOT. If the sensor fails at a low frequency, a Code 34 should set. If the sensor fails at a high frequency, a Code 33 should set. A Code 44 or 45 may also be caused by a faulty MAF sensor.

The code charts will explain how to determine if the sensor is causing the rich or lean condition.

Manifold Air Temperature (MAT) Sensor

The manifold air temperature (MAT) sensor is a thermistor (a resistor which changes value based on temperature mounted in the air cleaner assembly. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the sensor thru a resistor in the ECM and measures the voltage. The voltage will be high when the manifold air is cold, and low when the air is hot. By measuring the voltage, the ECM knows the manifold air temperature.

The 2.8L uses the signal to slightly retard the timing during high ambient air temperatures and to help compensate the MAF sensor based on air temperature.

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Oxygen (O_2) Sensor (Fig. C1-4)

The exhaust oxygen sensor (O_2) is mounted in the exhaust system where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the sensor to produce a voltage output. This voltage ranges from approximately .1 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 megohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the Injector (lean mixture-low O_2 voltage = rich command, rich mixture-high O_2 voltage = lean command).

The O_2 sensor, if open, should set a Code 13. A low voltage in the sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45. Codes 44 and 45 could also be set as a result of fuel system problems. See code charts.

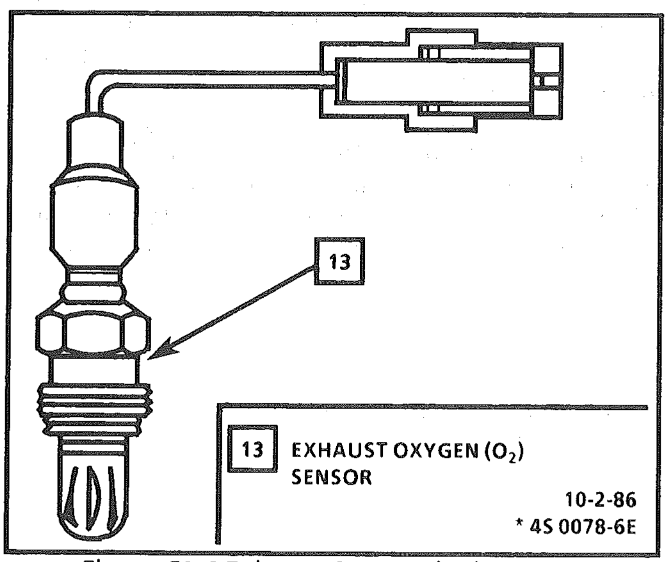

Figure C1-4 Exhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS) (Fig. C1-5)

The throttle position sensor (TPS) is connected to the throttle shaft on the throttle body. It is a potentiometer with one end connected to 5 volts from the ECM and the other to ECM ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the output of the TPS also changes. At a closed throttle position, the output of the TPS is low (approximately .5 volts). As the throttle valve opens, the output increases so that, at wide open throttle, the output voltage should be approximately 5 volts.

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector, and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits will set either a Code 21 or 22. Once a trouble code is set, the ECM will use an artificial default value for TPS, and some vehicle performance will return.

See "On-Car Service" for replacement or adjustment of TPS.

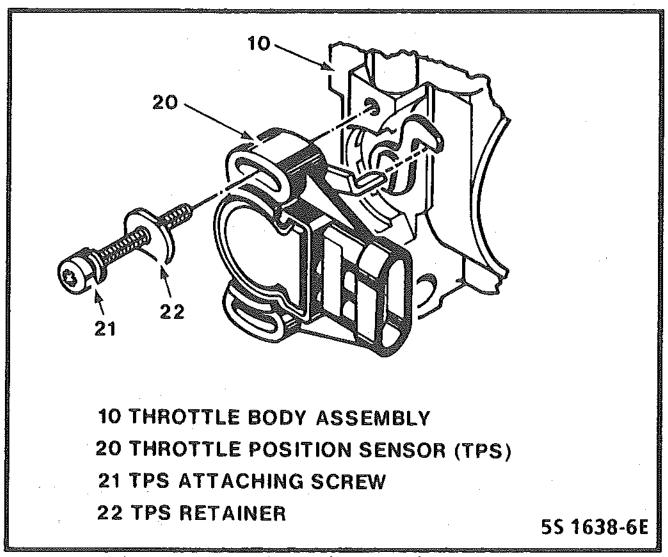

Figure C1-5 Throttle Position Sensor

Vehicle Speed Sensor

The vehicle speed sensor (VSS) sends a pulsing voltage signal to the ECM, which the ECM converts to miles per hour. This sensor mainly controls the operation of the TCC system. See "TCC System" for more information.

Park/Neutral Switch (Auto Only)

The Park/Neutral (P/N) switch indicates to the ECM when the transmission is in Park or Neutral. This information is used for the TCC and the IAC valve operation.

Important

Vehicle should not be driven with Park/Neutral switch disconnected as idle quality will be affected and a possible false Code 24 (VSS).

See Section "8A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly.

A/C "On" Signal

This signal tells the ECM that the A/C selector Switch is turned on, and that the pressure cycling switch is closed. The ECM uses this to adjust the idle Speed when the air conditioning is working.

If this signal is not available to the ECM, idle may be rough, especially when the A/C compressor cycles. The voltage at ECM terminal "B8" should equal battery voltage when A/C is requested and the pressure cycling switch is closed.

The signal at B8 will cause the ECM to turn on the A/C clutch by energizing the A/C relay.

Distributor Reference Signal

The distributor sends a signal to the ECM to tell it both engine RPM and crankshaft position. See EST System for further information.

DIAGNOSIS

To read the codes, use a "Scan" tool or ground the diagnostic terminal with the engine not running and the ignition on. The "Service Engine Soon" light will flash Code 12 three times and then flash each code stored in memory three times. All codes stored in memory would have been read when Code 12 was flashed again. No new codes can be stored when in the Diagnostics Mode (diagnostics lead grounded). This eliminates confusion while the system is being worked on.

To clear the codes from memory:

- Ignition off
- Remove fuse located in a weather proof holder located near the battery for 30 seconds.

Since the ECM can have a failure which may effect only one circuit, following the Diagnostic Procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections. - The diagnostic chart will say "ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- The ECM or PROM is not correct for the application. - The incorrect components may cause a malfunction and may or may not set a code.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness. - Solenoids and relays are turned "ON" and "OFF" by the ECM,using internal electronic switches called "Drivers". Each driver is part of a group of four called "Quad-drivers". Failure of one driver can damage any other driver in the set. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early failure of the ECM "driver". A shorted solenoid, relay coil, or harness, with a GMP4 computer, will not damage the ECM, but will cause the component to be inoperative.

Before replacing an ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoid(s) and relay(s) and the coil terminal identification.

J34636 or BT 8405 testers or equivalent provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.

- The PROM may be faulty. - Although these rarely fail, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good PROM.
- The replacement ECM may be faulty. - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the ECM is the problem, substitute a known good ECM. Although this is a rare condition, it could happen.

ECM

A faulty ECM will be determined in the diagnostic charts or by a Code 55.

PROM

A faulty PROM may result in a Code 51.

ECM Inputs

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches can be diagnosed by the use of "Scan". The "Scan" can also be used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temperature Sensor

A "Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. If the engine has not been run for several hours (overnight) the coolant temperature and MAT temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAF Sensor

A "Scan" tool reads the MAF value and displays it in grams per second. Should read between 4-7 on a fully warmed up idling engine. Values should change rather quickly on acceleration, but values should remain fairly stable at any given RPM. Most "Scan" tools will have 2 positions for reading MAF sensor values. (MAF & Air Flow). Both values should read the same if no Code 33 or 34 is set, but if a code is set, the MAF values will be the default value and the Air Flow parameter will lock in on the value to which the ECM recognized the fault. A failure in the MAF sensor or circuit should set a Code 33 or 34.

MAT Sensor

A "Scan" tool displays temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the MAT sensor temperature and coolant temperature should read close to each other. A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

O_2 Sensor

The "Scan" has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" position information in "Introduction," Section "6E".

A problem in the O_2 sensor circuit, or fuel system, should set a Code 13 (open circuit), Code 44 (lean indication), Code 45 (rich indication). Refer to applicable chart if any of these codes were stored in memory.

TPS

A "Scan" tool displays throttle position in volts. You should read .55V ± .08V, with throttle closed and ignition on, or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

The ECM has the ability to Auto-Zero the TPS voltage if it is below about .7V (700 mV). This means that any voltage less than .7 volts will be determined by the ECM to be 0% throttle. A failure in the TPS or circuit should set a Code 21 or 22.

VSS

A "Scan" tools reading should closely match with speedometer reading with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read P/N when in Park, or Neutral, and R-D, L, when in Drive or Overdrive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

A/C Request Signal

"Scan" tool should indicate A/C request "ON," when A/C is requested and the pressure cycling switch is closed.

Power Steering Pressure Switch

A "Scan" tool should read "OFF" normally and "ON" with high pressure. This reading may vary with different make of tools. Refer to CHART C-1E for PSPS diagnosis.

Reference Signal

A "Scan" tool will read this signal and is displayed in rpm.

ON-CAR SERVICE

ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should normally consist of either replacement of the ECM or a PROM change.

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (PROM) and ECM should be checked first to see if they are the correct parts. If they are, remove the PROM from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A PROM or CALPAK. Trouble Code 51 indicates the PROM is installed improperly or has malfunctioned. When Code 51 is obtained, check the PROM installation for bent pins or pins not fully seated in the socket. If it is installed correctly and Code 51 still shows, replace the PROM.

Important

When replacing the production ECM with a service ECM (controller), it is important to transfer the Broadcast code and production ECM number to the service ECM label. Please do not record on ECM cover. This will allow positive identification of ECM parts throughout the service life of the vehicle.

Important

To prevent internal ECM damage, the ignition must be "OFF" when disconnecting or reconnecting power to ECM (for example, battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

ECM AND COMPONENTS REPLACEMENT PROM OR ECM

Code 51 indicates a faulty PROM, possibly caused by bent pins, or incorrect installation.

Important

It is possible to install a PROM backwards. If the PROM is installed backwards and the ignition key turned to "ON," the PROM circuitry will be destroyed, requiring PROM replacement.

NOTICE: The ignition should always be off when installing or removing the ECM connectors or internal components.

Remove or Disconnect

1. Negative battery cable.
2. Right hand hush panel.
3. Connectors from ECM.
4. ECM mounting hardware.
5. ECM from passenger compartment.
6. ECM access cover (see Figure C1-6).
7. Remove PROM assembly.

Important

Using the rocker-type PROM removal tool, engage one end of the PROM carrier with the hook end of the tool (see Figure C1-8). Press on the vertical bar end of the tool and rock the engaged end of the PROM carrier up as far as possible. Engage the opposite end of the PROM carrier in the same manner and rock this end up as far as possible. Repeat this process until the PROM carrier and PROM are free of the PROM socket. The PROM carrier with PROM in it Should lift off of the PROM socket easily. PROM carrier should only be removed by using the pictured PROM removal tool. Other methods could cause damage to the PROM or PROM socket.

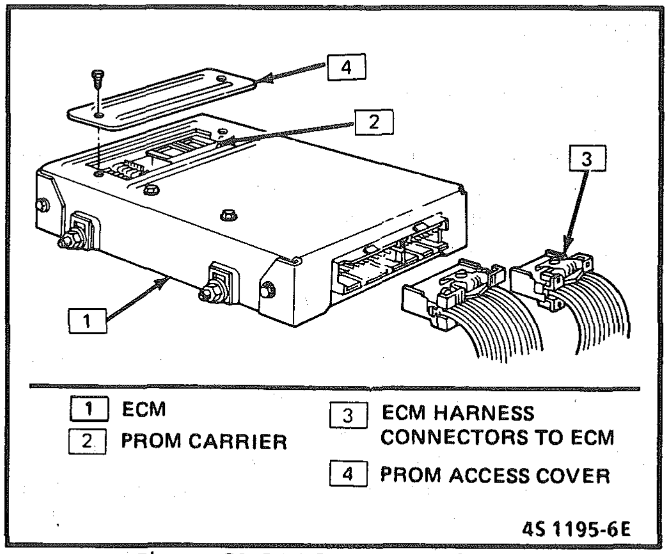

Figure C1-6 PROM Access Cover

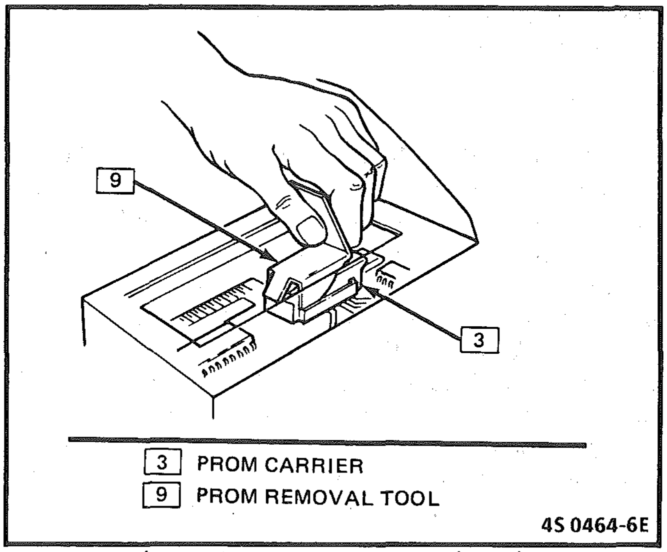

Figure C1-7 PROM Removal Tool

Inspect

1. New PROM for same part number as old.

Important

Do not remove PROM from carrier to check PROM number

2. For correct reference of PROM in carrier, Figure C1-8.
3. CALPAK Assembly

Using the removal tool, pictured in Figure C1-9, grasp the carrier at the narrow ends. Gently rock the carrier from end to end while applying a firm upward force and remove the CALPAK and carrier. Use of unapproved CALPAK removal tools or methods will cause damage to the CALPAK or CALPAK socket.

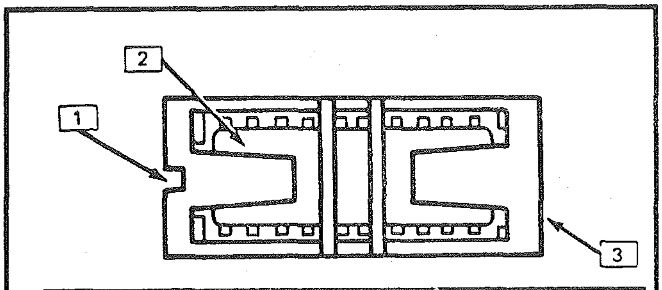

Figure C1-8 PROM in PROM Carrier

Install or Connect

1. New PROM carrier in PROM socket.
2. CALPAK in CALPAK socket.

Important

Small notch of carrier should be aligned with small notch in socket. Press on PROM carrier until it is firmly seated in the socket. Do not press on PROM; only the carrier.

3. Access cover on ECM.
4. ECM in passenger compartment.
5. Connectors to ECM.

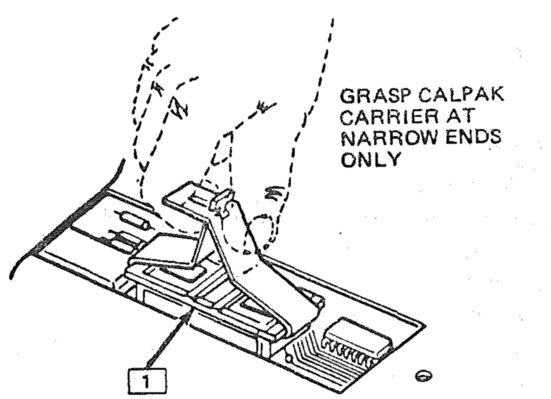

Figure C1-9 Removing CALPAK

Functional Check

1. Turn ignition on.
2. Enter diagnostics (see Diagnostic Circuit Check for procedure).
   A. Code 12 should flash at least four times. (No other codes present). This indicates the PROM and CALPAK is installed properly.
   B. If Trouble Code 51 occurs or if the "Service Engine Soon" light is on constantly with no codes, the PROM is not fully seated, installed backwards, has bent pins, or is defective. If Code 52 occurs, the CALPAK is not fully seated, installed backwards, has bent pins, or is defective.
      - If not fully seated, press firmly on PROM or CALPAK carrier.
      - If it is necessary to remove the PROM or CALPAK, follow instructions in steps "A" and "B".
      - If installed backwards, REPLACE THE PROM. The CALPAK may be removed and reinstalled correctly.
      - If pins bend, remove PROM or CALPAK, straighten pins, and reinstall. If bent pins break or crack during straightening, discard PROM or CALPAK and replace it.

Important

Any time the PROM in installed backwards and the ignition switch turned "ON," the PROM is destroyed.

CALPAK see figure C1-9 or refer to step 3 of PROM and ECM replacement.

COOLANT SENSOR

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the Fuel Injection system.

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Negative battery cable.

MAF SENSOR

Replacement of the MAF sensor is shown in Figure C1-10. When replacing the MAF sensor, replace clamps with special screw type clamps (Service Part).

MAF SENSOR POWER & BURN-OFF RELAY

Refer to Figure C1-11 for relay location. The MAF power relay is to the right of the radiator.

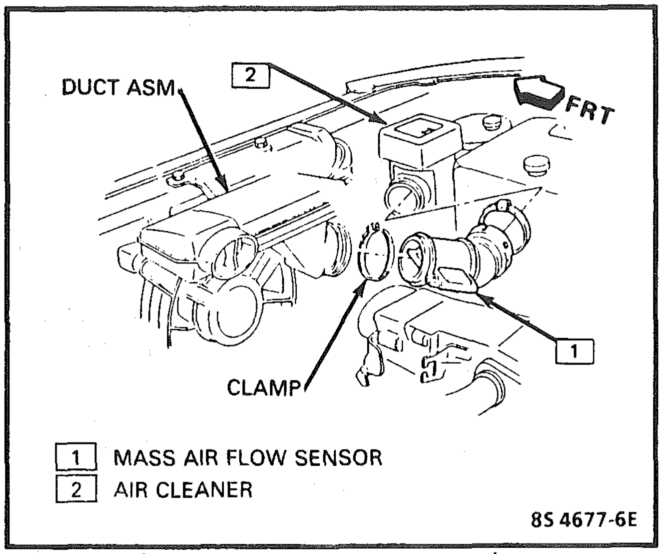

Figure C1-10 MAF Sensor Service

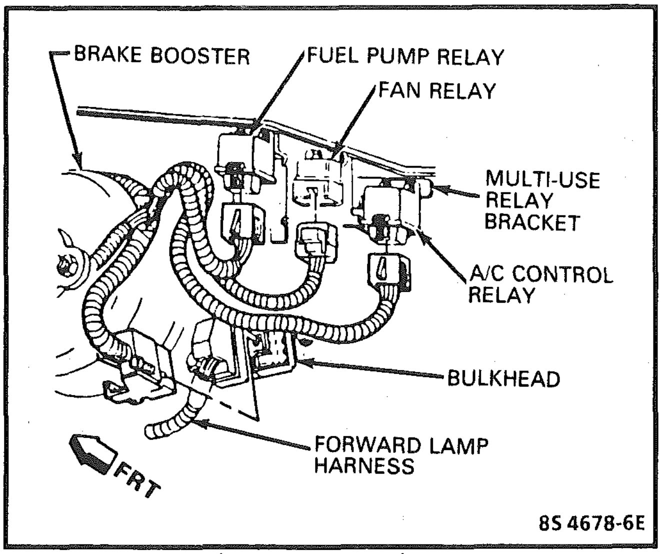

Figure C1-11 Relays

OXYGEN SENSOR

NOTICE: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.

Important

Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

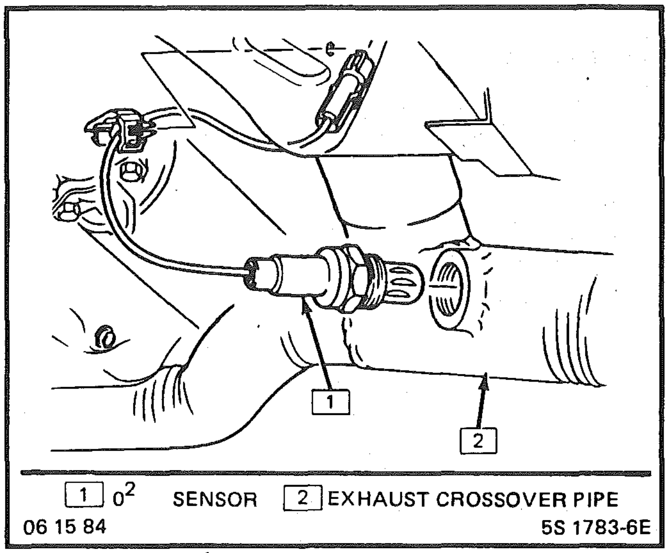

Figure C1-12 O_2 Sensor

Remove or Disconnect

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F).

Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Electrical connector.
   The vehicle should be raised on hoist because the O_2 sensor is mounted behind the exhaust Y-pipe.
3. Carefully back out Oxygen Sensor.

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove.

New or service sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 5613695 or equivalent if necessary.
2. Sensor, and torque to 41 N-m (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

Throttle Position Sensor (TPS)

Remove or Disconnect

1 Electrical connector.
2. Two TPS attaching screws and retainers.
3. Sensor.

Install or Connect

1. With throttle valve in the normal closed idle position, install throttle position sensor on throttle body assembly, making sure TPS pickup lever lines up with tang on throttle actuator lever. (See Figure C1-13)
2. Retainers and two TPS screws.

DO NOT tighten screws until TPS is adjusted.

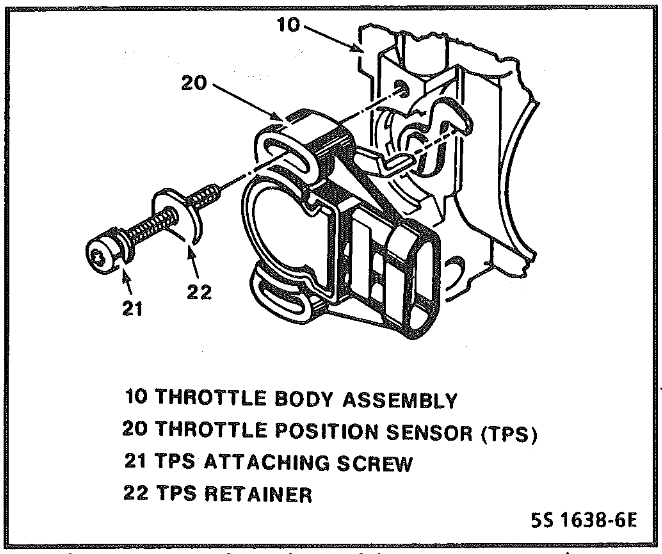

Figure C1-13 Throttle Position Sensor Service

Adjust

1. Install "Scan" tool and select TPS.
2. With ignition "ON," adjust TPS to obtain;
   - .55 volts ± 0.1 volts
3. Tighten screws, then recheck reading to insure that adjustment has not changed.

PARK/NEUTRAL SWITCH

See Section "8A" for location of Park/Neutral Switch. On-Car Service and Adjustment Procedures are also listed there.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM (Mem-Cal)	3.670
Sensor, Coolant Temp	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manifold Air Temp (MAT)	3.682
Sensor, Mass Air Flow (MAF)	3.682
Relay - MAF Burn-off	3.682
Relay - MAF Power	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

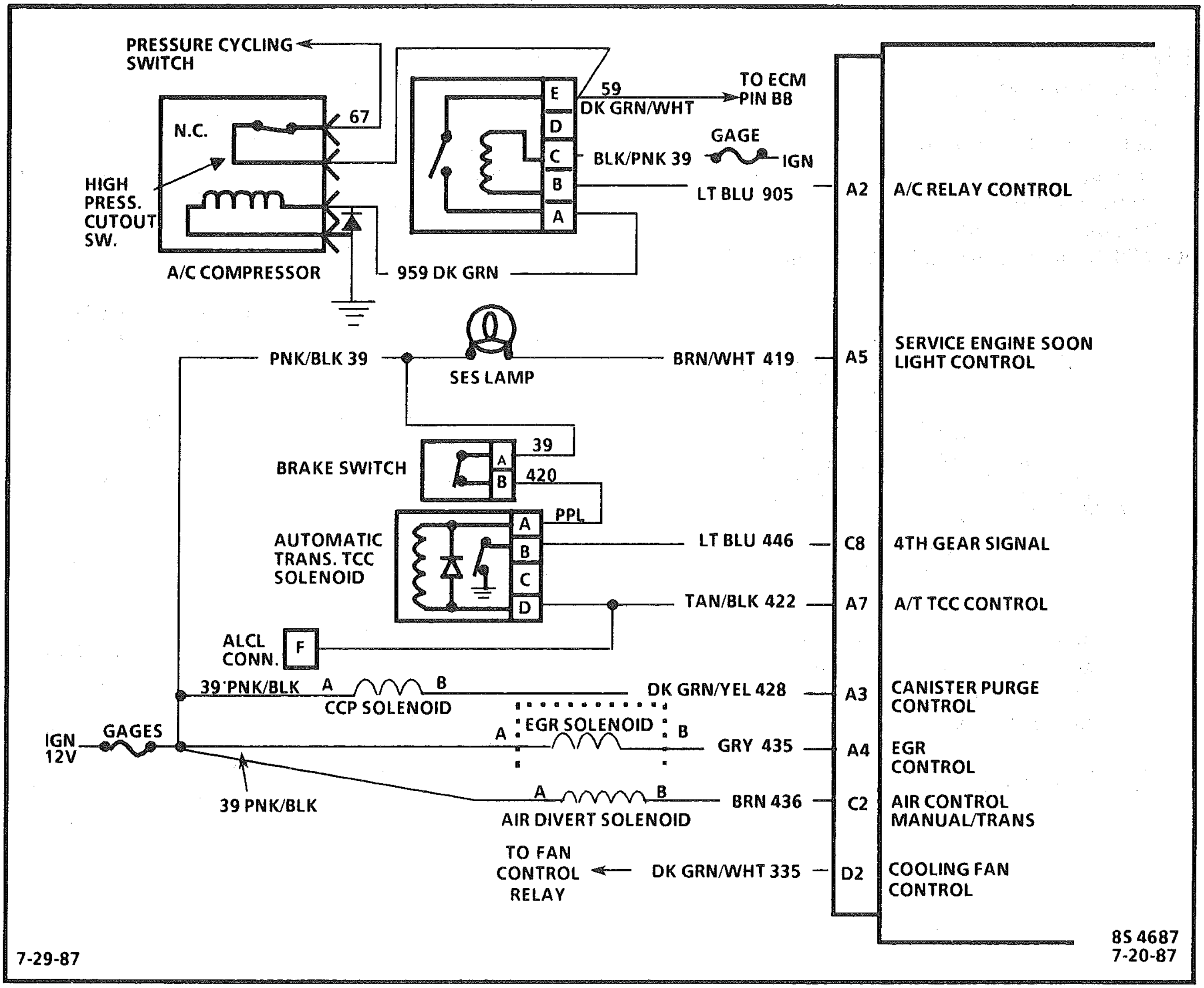

CHART C-1

ECM QDR CHECK
2.8L (VIN S) "F" SERIES (PORT)

ECM Quad Driver (QDR) Check

The ECM uses an integrated circuit (IC) called a quad driver (QDR) in place of separate transistors to turn "ON" or "OFF" different circuits controlled by the ECM. Each QDR has four separate outputs that can independently turn "ON" or "OFF" four different circuits.

ECM service part number 1227302, used with this engine, does not have fault protection, therefor, a single faulty circuit many time causes all four QDR outputs to be inoperative or "ON" all the time. A failed QDR usually results in either a shorted or open ECM output. Because of the increased current flow, two QDR outputs are used to drive the TCC solenoid.

Refer to the ECM QDR check procedure on the facing page. This check will not test all ECM functions, but it will determine if a specific circuit has caused a specific QDR to fail in the ECM.

A faulty circuit is the largest cause of a failed QDR, therefore, the check procedure should be used whenever ECM replacement is indicated, especially if the removed ECM exhibits characteristics of a damaged QDR such as:

- SES light with no code stored.
- Engine will not start and/or ECM will not flash Code 12.
- Flickering, intermittent, or dim SES light.
- Output, such as TCC circuit, is inoperative or "ON" at all times.
- Engine misfires, surges or stalls.
- "Scan" tool is erratic or inoperative.

CHART C-1

ECM QDR CHECK
2.8L (VIN S) "F" SERIES (PORT)

USE THIS CHECK PROCEDURE ONLY AFTER OTHER DIAGNOSTIC CHARTS, IN THIS SERVICE MANUAL HAVE DETERMINED THAT THERE WAS AN ECM FAILURE.

- REMOVE THE ECM FROM THE VEHICLE.

- REFER TO LIST BELOW OF THE ECM TERMINALS WHICH ARE QDR OUTPUTS.
- USING THE 100/200 K OHM SCALE ON DVM*, MEASURE RESISTANCE BETWEEN THE ECM CASE AND EACH ECM TERMINAL LISTED, BLACK (NEG.) LEAD TO CASE AND RED (POS.) LEAD TO ECM TERMINAL.
- ALL TERMINALS LISTED SHOULD HAVE RESISTANCE OF 50K OHMS OR MORE.
- DO THEY?

NO

THE PRIOR TEST HAS DETERMINED THAT A QDR IN THE ECM HAS BEEN DAMAGED. IT IS MOST IMPORTANT TO LOCATE AND REPAIR THE CIRCUIT OR COMPONENT THAT CAUSED THE DAMAGE. FAILURE TO DO SO WILL RESULT IN ANOTHER FAILURE OF THE NEWLY REPLACED ECM. ANY TERMINAL WITH LESS THAN 50K OHMS RESISTANCE IS CONNECTED TO A DEFECTIVE QDR. THE ECM TERMINAL WITH THE LOWEST RESISTANCE WAS CONNECTED TO THE VEHICLE CIRCUIT MOST LIKELY TO HAVE CAUSED THE QDR FAILURE.

- DISCONNECT THE COMPONENT IN THAT VEHICLE CIRCUIT AND CHECK FOR A SHORT TO VOLTAGE. IF THE CIRCUIT IS NOT SHORTED TO VOLTAGE, REPLACE THE COMPONENT IN THAT CIRCUIT AND THE ECM.

YES

- KEY "ON", ENGINE NOT RUNNING.
- USE A FUSED AMMETER CAPABLE OF MEASURING AT LEAST 2 AMPS (J-34029-A OR EQUIVALENT).
- CONNECT ONE LEAD OF THE AMMETER TO CHASSIS GROUND.
- CONNECT THE REMAINING LEAD TO EACH VEHICLE CIRCUIT WHICH WAS LISTED ABOVE.
- MEASURE SUSTAINED CURRENT FLOW THROUGH EACH CIRCUIT FOR 2 MINUTES EACH (IN MOST CASES, THE TCC SOLENOID CANNOT BE EASILY TESTED FOR CURRENT DRAW).
- NOTE AMPERAGE.

IF A CIRCUIT(S) HAS MORE THAN 0.75 AMPS CURRENT DRAW.

- CHECK FOR A SHORT TO VOLTAGE IN EXCESSIVE CURRENT DRAW CIRCUIT.
- IF NO SHORT TO VOLTAGE, REPLACE RELATED SOLENOID OR RELAY.

IF NO CIRCUIT HAS MORE THAN 0.75 AMPS CURRENT DRAW.

- REPLACE ECM

ECM# 1227302

QDR NUMBER	ECM OUTPUT TERMINAL	CIRCUIT
1	A2	A/C RELAY CONTROL
	A4	EGR CONTROL
	A5	SES LIGHT
2	A3	CANNISTER PURGE SOL.
	D2	COOLANT FAN RELAY
3	A7	SHIFT LIGHT M/T TCC CONTROL A/T
	C2	AIR DIVERT SOLENOID

* USE DVM J-34029-A OR EQUIVALENT

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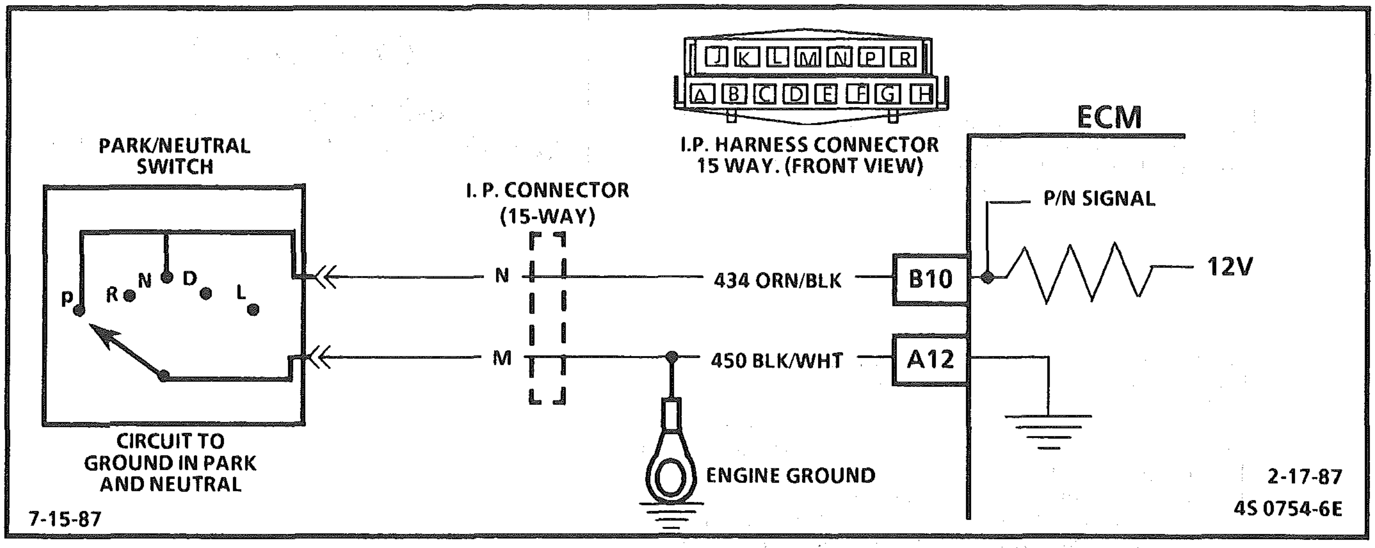


CHART C-1A

PARK/NEUTRAL SWITCH
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The Park/Neutral Switch contacts are a part of the Neutral Start switch, and are closed to ground in park or neutral and open in drive ranges.

The ECM supplies ignition voltage, through a current limiting resistor, to CKT 434 and senses a closed switch, when the voltage on CKT 434 drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

Idle Air Control
VSS Diagnostics
EGR

If CKT 434 indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

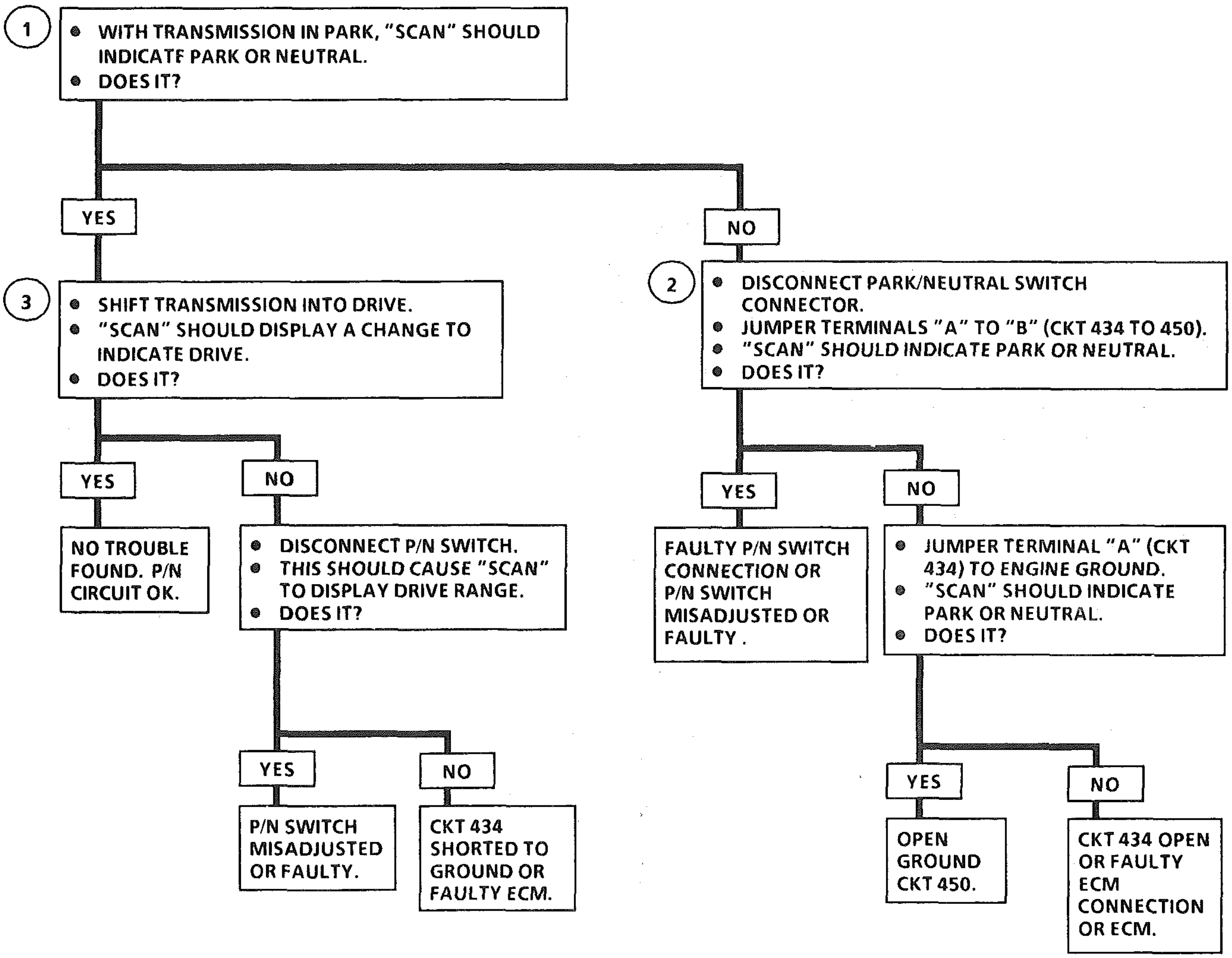
If CKT 434 always indicates drive (open), a drop in the idle may exist when the gear selector is moved into drive range.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to operator's manual for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive, even while wiggling shifter to test for an intermittent or misadjusted switch in drive range.

CHART C-1A

PARK/NEUTRAL SWITCH
2.8L (VIN S) "F" SERIES (PORT)



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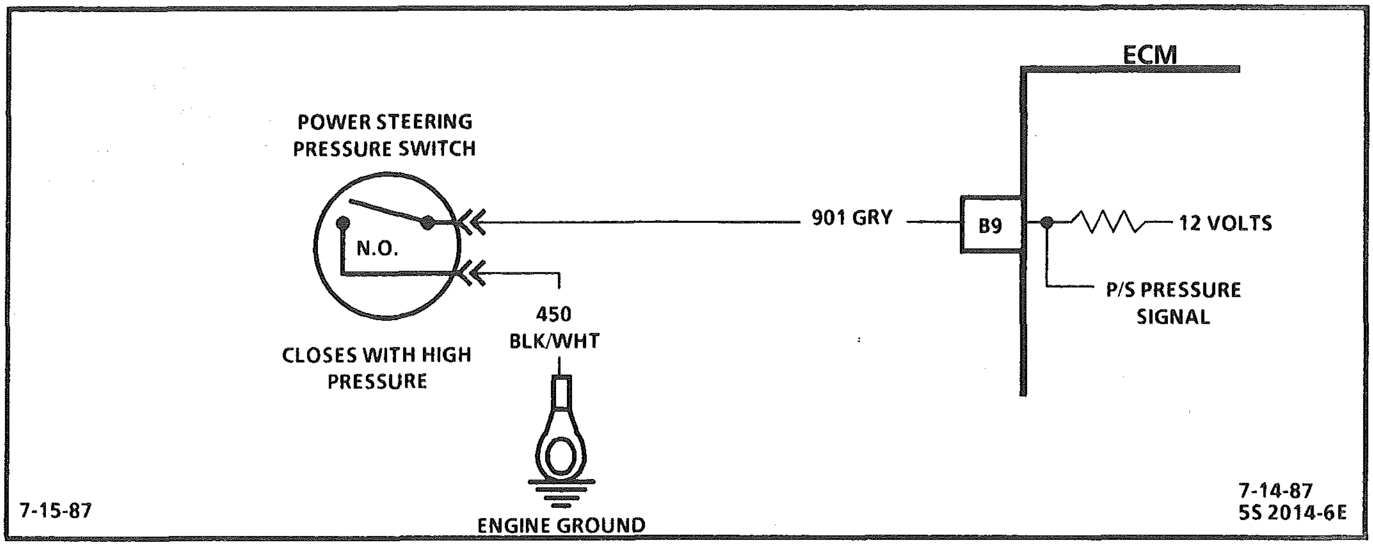


CHART C-1E

POWER STEERING PRESSURE SWITCH
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The power steering pressure switch is normally open to ground, and CKT 901 will be near the battery voltage.

Turning the steering wheel increases power steering oil pressure and its load on an idling engine. The pressure switch will close before the load can cause an idle problem.

Closing the switch causes CKT 901 to read less than 1 volt. The ECM will increase the idle air rate and disengage the A/C relay.

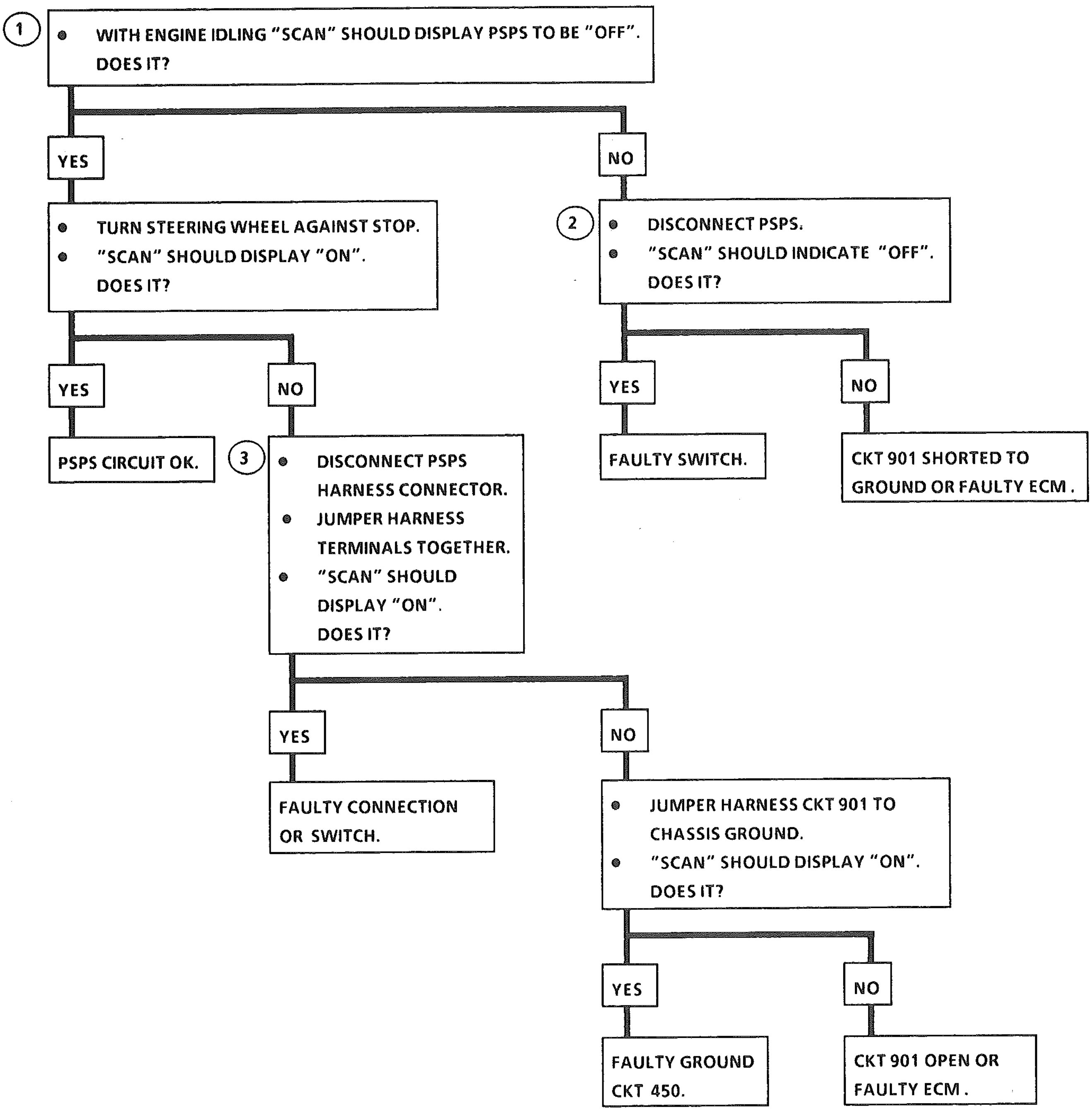
- A pressure switch that will not close, or an open CKT 901 or 450, may cause the engine to stop when power steering loads are high.
- A switch that will not open, or a CKT 901 shorted to ground, may affect idle quality and will cause the A/C relay to be de-energized.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Different makes of "Scan" tools may display the state of this switch in different ways. Refer to "Scan" tool operator's manual to determine how this input is indicated.
2. Checks to determine if CKT 901 is shorted to ground.
3. This should simulate a closed switch.

CHART C-1E

POWER STEERING PRESSURE SWITCH 2.8L (VIN S) "F" SERIES (PORT)



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CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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BLANK

SECTION C2

FUEL CONTROL SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

The main control sensor is the oxygen (O_2) sensor, which is located in the exhaust manifold. The O_2 sensor tells the ECM how much oxygen is in the exhaust gas, and the ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best mixture to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate the most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "Closed Loop" system (shown in Figure C2-1).

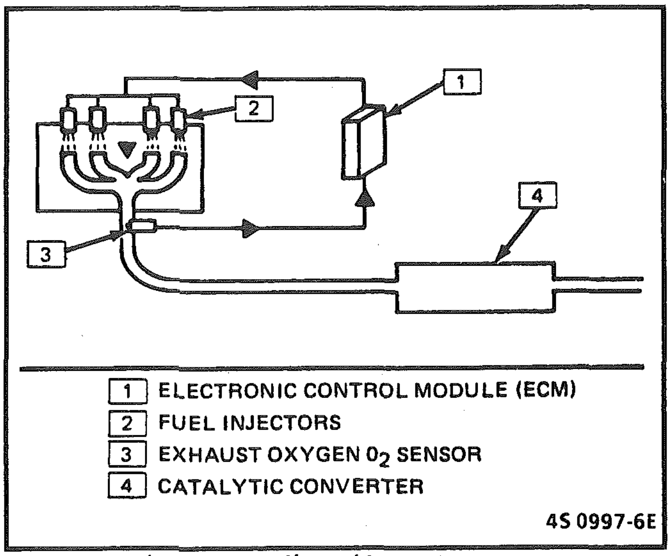


Figure C2-1 Closed Loop System

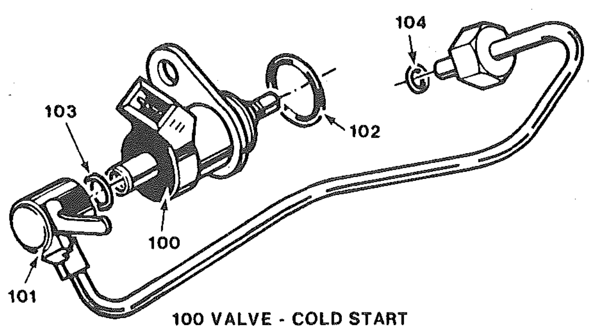
MODES OF OPERATION

The ECM looks at voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called "modes". All the modes are controlled by the ECM, and are described below.

Starting Mode

When the ignition is first turned "ON," the ECM will turn "ON" the fuel pump relay for two seconds, and the fuel pump will build up pressure. The ECM then checks the coolant temperature sensor, throttle position sensor, and determines the proper air/fuel ratio for starting. This ranges from 1.5 : 1 at -36°C (-33°F) to 14.7 : 1 at 94°C (201°F). The ECM controls the amount of fuel delivered in the STARTING mode by changing how long the injectors are pulsed "ON".

The cold start valve (Figure C2-2) not controlled by the ECM is used to provide additional fuel during the starting mode to improve cold start-ups. This circuit is important when the engine coolant temperature is very low because the other injectors would not be pulsed "ON" long enough to provide the needed amount of fuel to start. The cold start valve is somewhat different from the other injectors in that it causes the fuel to be vaporized for a better combustible mixture.



100 VALVE - COLD START
101 TUBE AND BODY ASSEMBLY
102 O-RING SEAL - VALVE
103 O-RING SEAL - BODY
104 O-RING SEAL - TUBE

5S 1446-6E

Figure C2-2 Cold Start Valve

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by the crank fuse. The system is controlled by a cold start fuel injection switch which provides a ground path for the valve during cranking whenever engine coolant is below 35° C (95°F).

The cold start fuel injection switch contains a bimetal switch which opens the circuit at specified coolant temperature. This bimetal is also heated by the winding in the switch which would allow the valve to stay "ON" 8 seconds at -20°C or below. The time the switch stays closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then will turn "OFF" the fuel to the injectors. The ECM holds this injector rate as long as the throttle stays wide open, and the engine rpm is below 600. If the throttle position becomes less than 80%, the ECM returns to the STARTING mode.

Run Mode

The RUN mode has two conditions called "Open Loop" and "Closed Loop".

When the engine is first started, and rpm is above 400 rpm, the system goes into "Open Loop" operation. In "Open Loop," the ECM will ignore the signal from the oxygen (O_2) sensor, and calculate the air/fuel ratio based on inputs from the coolant and MAF sensors.

The system will stay in "Open Loop" until the following conditions are met:

1. The O_2 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The coolant sensor is above a specified temperature about 25°C (77°F).
3. A specific amount of time has elapsed after starting the engine.

The specific values for the above conditions vary with different engines, and are stored in the PROM or Mem-Cal. When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop", the ECM will calculate the air/fuel ratio (injector on-time) based on the signal from the O_2 sensor. This allows the air/fuel ratio to stay very close to 14.7:1.

Acceleration Mode

The ECM looks at rapid changes in throttle position and air flow, and provides extra fuel.

Deceleration Mode

The ECM looks at changes in throttle position and air flow to reduce the amount of fuel. When deceleration is very fast, the ECM can cut off fuel completely for short periods.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for the weak spark delivered by the distributor by:

- Increasing the amount of fuel delivered;
- Increasing the idle rpm; and
- Increasing ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is "OFF". This prevents dieseling. Also, fuel is not delivered if no reference pulses are seen from the distributor, which means the engine is not running. This prevents flooding.

Fuel Control System Components

The fuel control system is made up of the following parts:

- Fuel Injectors
- Throttle Body
- Fuel pump relay
- Fuel Pressure Regulator
- Fuel Rail

Basic System Operation

The fuel system (Figure C2-3) starts with the fuel in the fuel tank. An electric fuel pump, located in the fuel tank with the gage sending unit, pumps fuel to the fuel rail through an in-line fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A pressure regulator in the fuel rail keeps fuel available to the injectors at a constant pressure. Unused fuel is returned to the fuel tank by a separate line. For further information on the fuel tank, in-line filter , and fuel lines , see Section "6C".

The injectors, are controlled by the ECM. They deliver fuel in one of several modes, as described above.

In order to properly control the fuel supply, the fuel pump is operated by the ECM thru the fuel pump relay and oil pressure switch (see "Fuel Pump Electrical Circuit", Code 54).

THROTTLE BODY UNIT

The throttle body has a throttle valve to control the amount of air delivered to the engine. The TPS and IAC valve are also mounted on the throttle body.

The throttle body contains vacuum ports located at, above, or below the throttle valve. These ports generate the vacuum signals needed by various components.

FUEL RAIL

The fuel rail is mounted to the top of the engine. It distributes fuel to the individual injectors. Fuel is delivered to the input end of the rail by the fuel lines, goes thru the rail, then to the pressure regulator. Remaining fuel is then returned to the fuel tank.

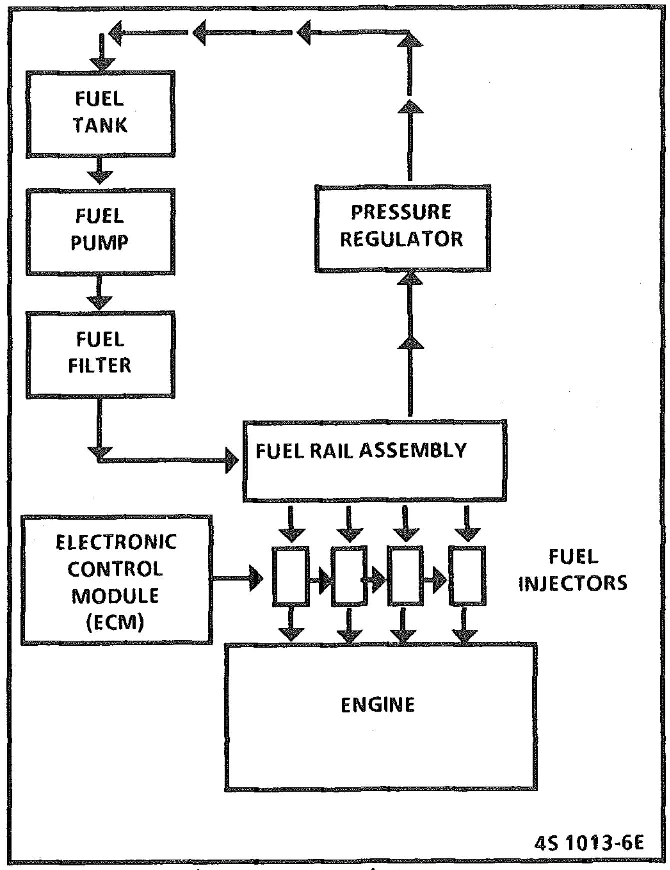


Figure C2-3 Fuel System

FUEL INJECTOR

The fuel injector is a solenoid operated device controlled by the ECM (See Figure C2-4). The ECM turns "ON" the solenoid, which opens a valve to allow fuel delivery. The fuel, under pressure, is injected in a conical spray pattern at the opening of the intake valve. The fuel which is not used by the injectors passes through the pressure regulator before being returned to the fuel tank.

An injector which is stuck partly open will cause loss of pressure after engine shut down, so long crank times would be noticed on some engines. Also, dieseling could occur because some fuel could be delivered to the engine after the ignition is turned "OFF".

PRESSURE REGULATOR

The pressure regulator is a diaphragm-operated relief valve with injector pressure on one side and manifold pressure on the other. The function of the regulator is to maintain a constant pressure at the injector at all times. The pressure regulator compensates for engine load, by increasing fuel pressure when it sees low engine vacuum.

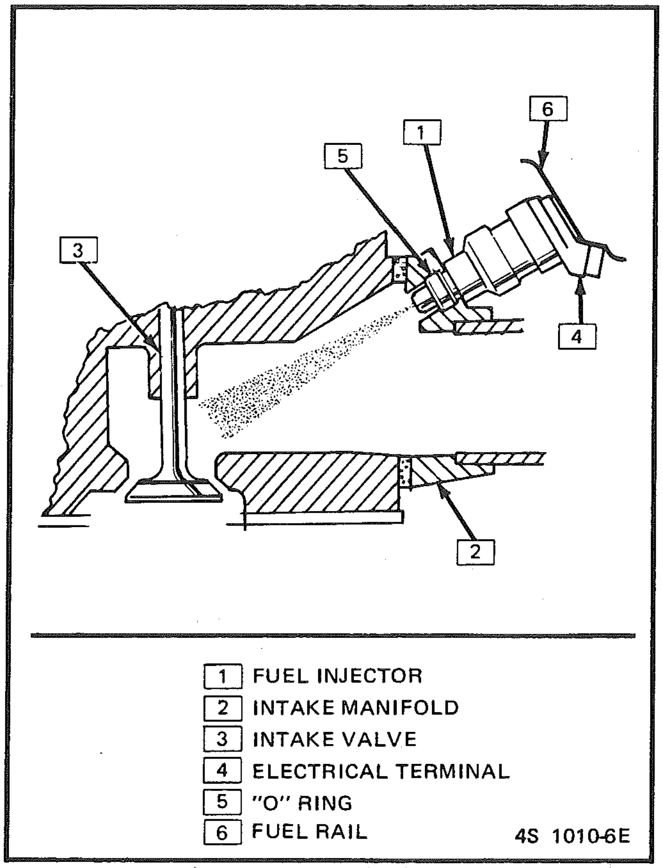


Figure C2-4 Fuel Injector

The pressure regulator is mounted on the fuel rail, and is replaced as an assembly.

If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Code 45 may result. CHART A-7 has information on diagnosing fuel pressure conditions.

IDLE AIR CONTROL (IAC) VALVE

The purpose of the idle air control (IAC) valve (shown in Figure C2-5), is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted in the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle plate. If rpm is too low, more air is bypassed around the throttle valve to increase rpm. If rpm is too high, less air is bypassed around the throttle valve to decrease rpm.

The IAC valve moves in small steps called "counts," which can be measured by some test equipment which plugs into the ALDL.

During idle, the proper position of the IAC valve is calculated by the ECM based on battery voltage, coolant temperature, engine load, and engine rpm. If the rpm drops below a specified rpm, and the throttle plate is closed, the ECM senses a near stall condition.

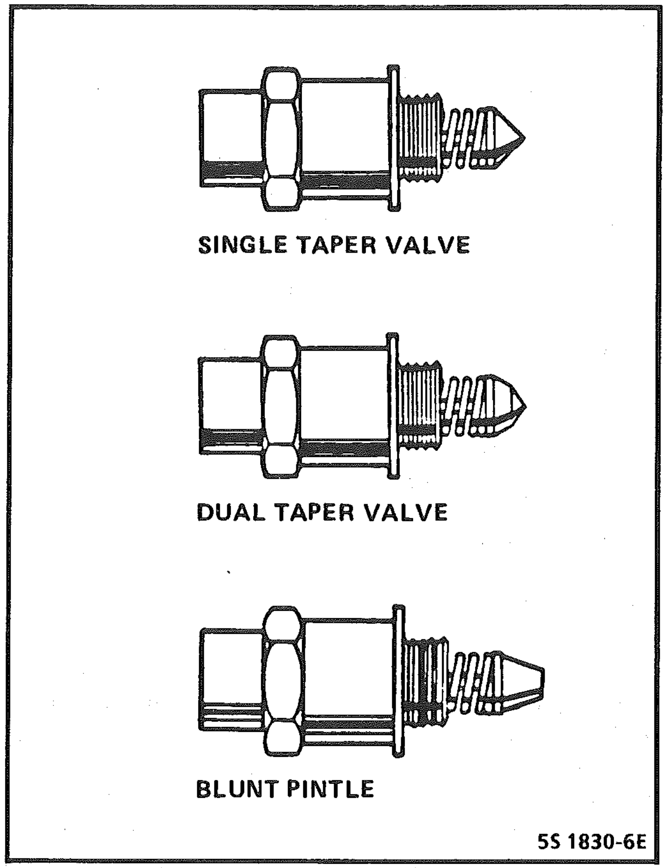


Figure C2-5 IAC Valve Designs

The ECM will then calculate a new valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle rpm may be wrong. In this case, the IAC can be reset by starting the engine momentarily and then turning the ignition "OFF".

Different designs are used for the IAC valve. Be sure to use the correct design when replacement is required.

The IAC valve affects only the idle characteristics of the vehicle. If it is open fully, too much air will be allowed into the manifold and idle speed will be high. If it is stuck closed, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

FUEL PUMP ELECTRICAL CIRCUIT

When the ignition is first turned "ON" without the engine running, the ECM will turn the fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM will shut the fuel pump "OFF" and wait until the engine starts. As soon as the engine is cranked, the ECM will turn the relay "ON" and run the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned "ON" by the oil pressure switch. The oil pressure switch is a normally open switch which closes when oil pressure reaches about 28 kPa (4 psi). If the fuel pump relay fails, the oil pressure switch will close and run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance.

DIAGNOSIS

FUEL CONTROL SYSTEM

Some failures of this system will result in an "Engine Cranks But Won't Run". If this condition exists, see CHART A-3. This chart will determine if the problem is caused by the ignition system, ECM or fuel pump circuit. If it's determined to be a fuel problem, CHART A-7 will be used. This includes the injectors, pressure regulator, fuel pump and fuel pump relay. The fuel system wiring schematic is covered on the facing page of Code CHART 54.

If a malfunction occurs in the fuel control system it usually results in either a rich or a lean exhaust condition. This condition is sensed by the oxygen sensor and the ECM will change the fuel calculation (injector pulse width) based on the O_2 sensor reading. The change made to the fuel calculation will be indicated by a change in the block learn values which can be monitored by a "Scan" tool. The normal block learn values are around 128 and if the O_2 sensor is sensing a lean condition, the ECM will add fuel and this will result in a block learn value above 128. If the O_2 sensor is sensing a rich exhaust the ECM will reduce fuel to the engine and this will result in block learn values below 128. Some variations in block learn values are normal because all engines are not exactly the same. However, if the block learn values are $\pm$ 10 counts from 128, a system problem exists. If the block learn values are greater than 138, see Code 44 for items which can cause a lean system.

If the block learn values are less than 118, see Code 45 for items which can cause the system to run rich. If a driveability symptom exists, refer to the particular symptom in Section "B" for additional items to check.

IDLE AIR CONTROL VALVE

A "Scan" tool will read IAC position in steps (counts). "0" steps indicates the ECM is commanding the IAC to be driven all the way in, to a fully seated position, and this is usually caused by a vacuum leak. The higher the number of counts the more air being allowed to pass the IAC valve. CHART C-2C can be used to diagnosis the IAC valve. Also refer to "Rough, Unstable, or Incorrect Idle, Stalling" in "Symptoms," Section "B" for other possibilities for the cause of idle problems.

ON-CAR SERVICE

PORT FUEL INJECTION COMPONENTS

CAUTION: Before servicing an injector, fuel rail, or pressure regulator, it is necessary to relieve the pressure in the fuel system, to minimize the risk of fire and personal injury. (See "Fuel Pressure Relief Procedure" below). To reduce the chance of personal injury, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container.

FUEL PRESSURE RELIEF PROCEDURE

1. Connect fuel gage J 34730-1 or equivalent to fuel pressure valve. Wrap a shop towel around fitting while connecting gage to avoid spillage.
2. Install bleed hose into an approved container and open valve to bleed system pressure.

Plenum

←→ Remove or Disconnect

1. Negative battery cable.
2. Air inlet duct at throttle body.
3. Throttle body retaining bolts (2).
4. EGR pipe bolts (2).
5. Throttle cable bracket.
6. Plenum bolts (8).

→← Install or Connect

1. Plenum and gaskets.
2. Plenum bolts. See Figure C2-6.
3. Throttle cable bracket.
4. EGR pipe bolts.
5. Throttle body and bolts.
6. Air inlet duct
7. Negative battery cable.

Fuel Rail and Pressure Regulator Assembly

? Important

When servicing the fuel rail assembly, precautions must be taken to prevent dirt and other contaminants from entering the fuel passages. It is recommended that fittings be capped and holes be plugged during servicing.

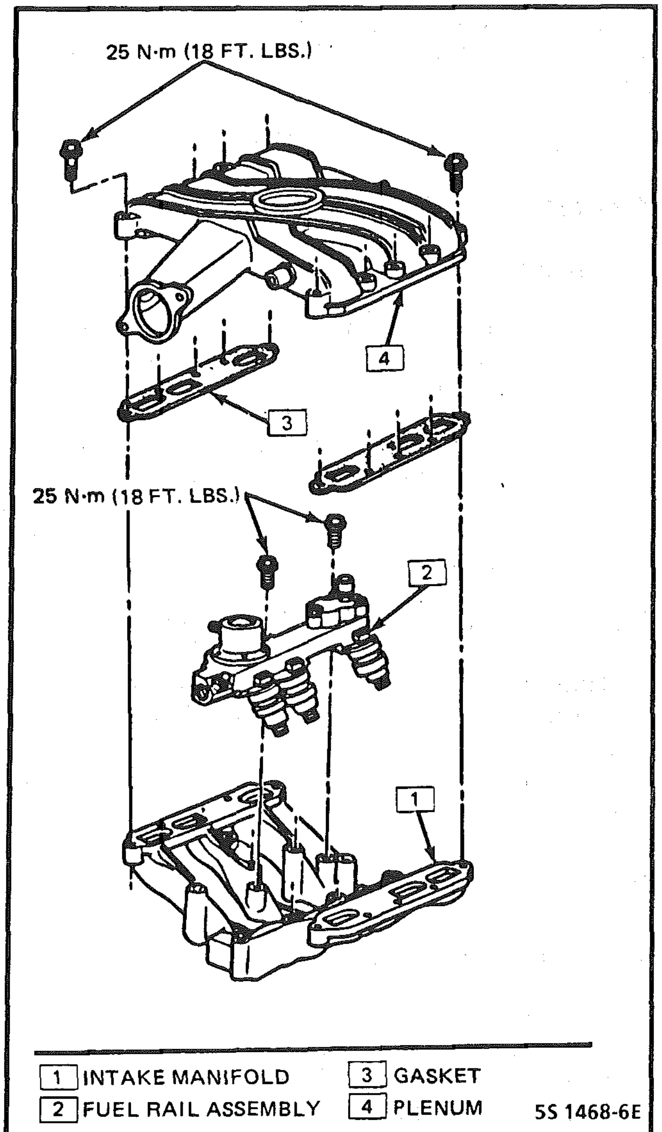


Figure C2-6 Plenum and Fuel Rail Removal

Important

At any time the fuel system is opened for service, the O-ring seals used with the related component(s) should be replaced.

Remove or Disconnect

1. Negative battery cable.
2. Plenum.
3. Fuel lines.
4. Cold start valve.
5. Vacuum line at pressure regulator.
6. Fuel rail retaining bolts
7. Injector harness connectors.
8. Rail and injectors.

Install or Connect

1. Coat injector "O"-rings with engine oil.
2. Rail and injectors.
3. Injector harness.
4. Fuel rail retaining bolt.
5. Vacuum line at pressure regulator.
6. Cold start valve.
7. Fuel lines.
8. Plenum.
9. Negative cable
10. Cycle the ignition on and off several times and inspect fuel system for leaks.

FUEL RAIL SERVICE

Names of component parts will be found on the numbered list that accompanies the exploded view (Figure C2-9). Numbers used to identify parts on the exploded view will identify the same parts in other illustrations of this section.

An eight digit identification number is stamped on the side of the fuel rail assembly, as shown in Figure C2-7. Refer to this number if servicing or part replacement is required.

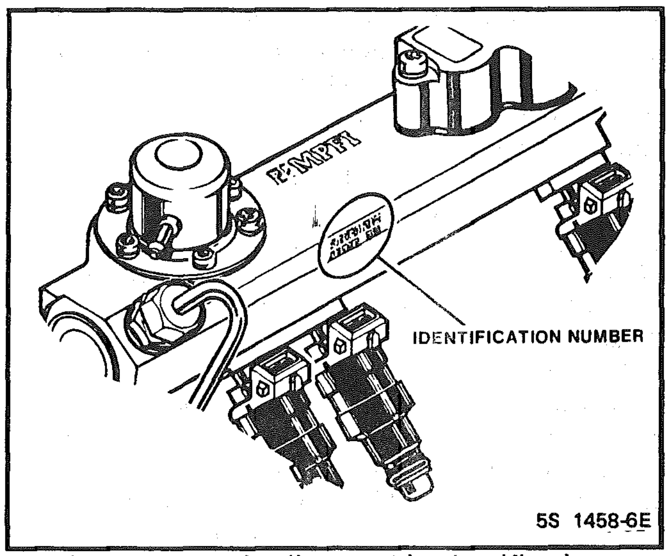


Figure C2-7 Fuel Rail Assembly Identification

UNIT SERVICE PROCEDURES

Important

When servicing the fuel rail assembly, precautions must be taken to prevent dirt and other contaminants from entering the fuel passages. It is recommended that fittings be capped, and holes be plugged, during servicing.

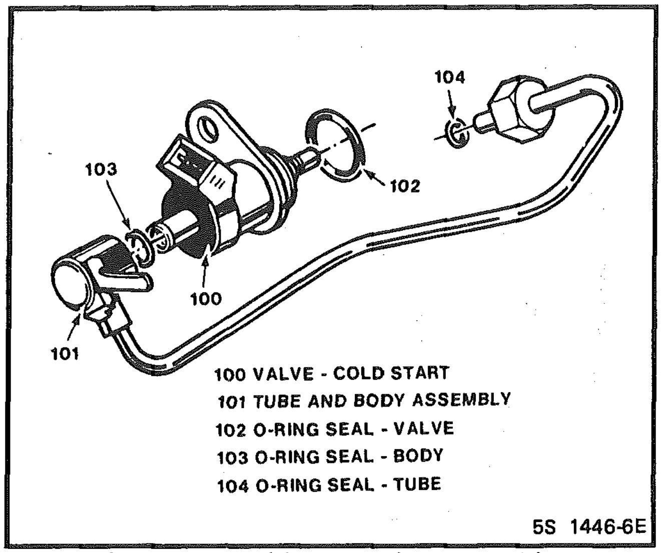


Figure C2-8 Cold Start Valve Assembly

Important

At any time the fuel system is opened for service, the O-ring seals used with related component(s) should be replaced.

Cleaning and Inspection

Before disassembly, the fuel rail assembly may be cleaned with a spray type engine cleaner, such as AC Delco X-30A or equivalent, following package instructions. The fuel rail should not be immersed in liquid solvent.

COLD START TUBE AND VALVE ASSEMBLY (Figure C2-8)

Remove or Disconnect

1. Negative battery cable.
2. Plenum.
3. Distributor cap.
4. Cold start valve retaining bolts.
5. Tube from rail.

Clean

- Areas around valve and connection with AC Delco X-30A or equivalent.
- Valve from tube and body assembly (101).
- Bend tab back to permit unscrewing of valve.

Adjust

1. Turn valve completely into body.
2. Turn valve back one full turn, until electrical connector is at top position.
3. Bend tang of body forward to limit rotation of valve to less than a full turn.

Install or Connect

1. New valve O-ring seal (102) and body O-ring seal (103), on cold start valve (100).
2. Tube O-ring seal (104) on tube and body assembly (101).
3. Cold start valve in body assembly.
4. Distributor cap.
5. Plenum.
6. Negative battery cable.

FUEL PRESSURE CONNECTION ASSEMBLY (Figure C2-10)

Remove or Disconnect

1. Negative battery terminal.

Clean

- Area around valve and connection with AC Delco X-30A or equivalent.

2. Fuel pressure connection assembly (26) and seal (27). Discard seal.

Install or Connect

1. New seal (27) on fuel pressure connection assembly (26).
2. Fuel pressure connection assembly in fuel rail.

Tighten

- Fuel pressure connection assembly to 10.0 N·m (88.0 in lbs.)

3. Negative battery terminal.

Inspect

- Energize fuel pump and check for leaks.

Part #	Part Name
1	O-ring—Fuel Inlet Line
2	O-ring—Fuel Return Line
11	Fuel Rail and Pressure Regulator Assembly
26	Fuel Pressure Connection Assembly
27	Seal—Fuel Pressure Connection Assembly
28	Cap—Fuel Pressure Connection
55	Fuel Block
56	Seal—Fuel Block
57	Screw Assembly—Fuel Block Attaching
85	Injector—Port
86	Seal—O-ring—Injector
87	Clip—Injector Retainer
100	Valve—Cold Start
101	Tube and Body Assembly
102	O-Ring Seal—Valve
103	O-Ring Seal—Body
104	O-Ring Seal—Tube
105	Fitting—Cold Start

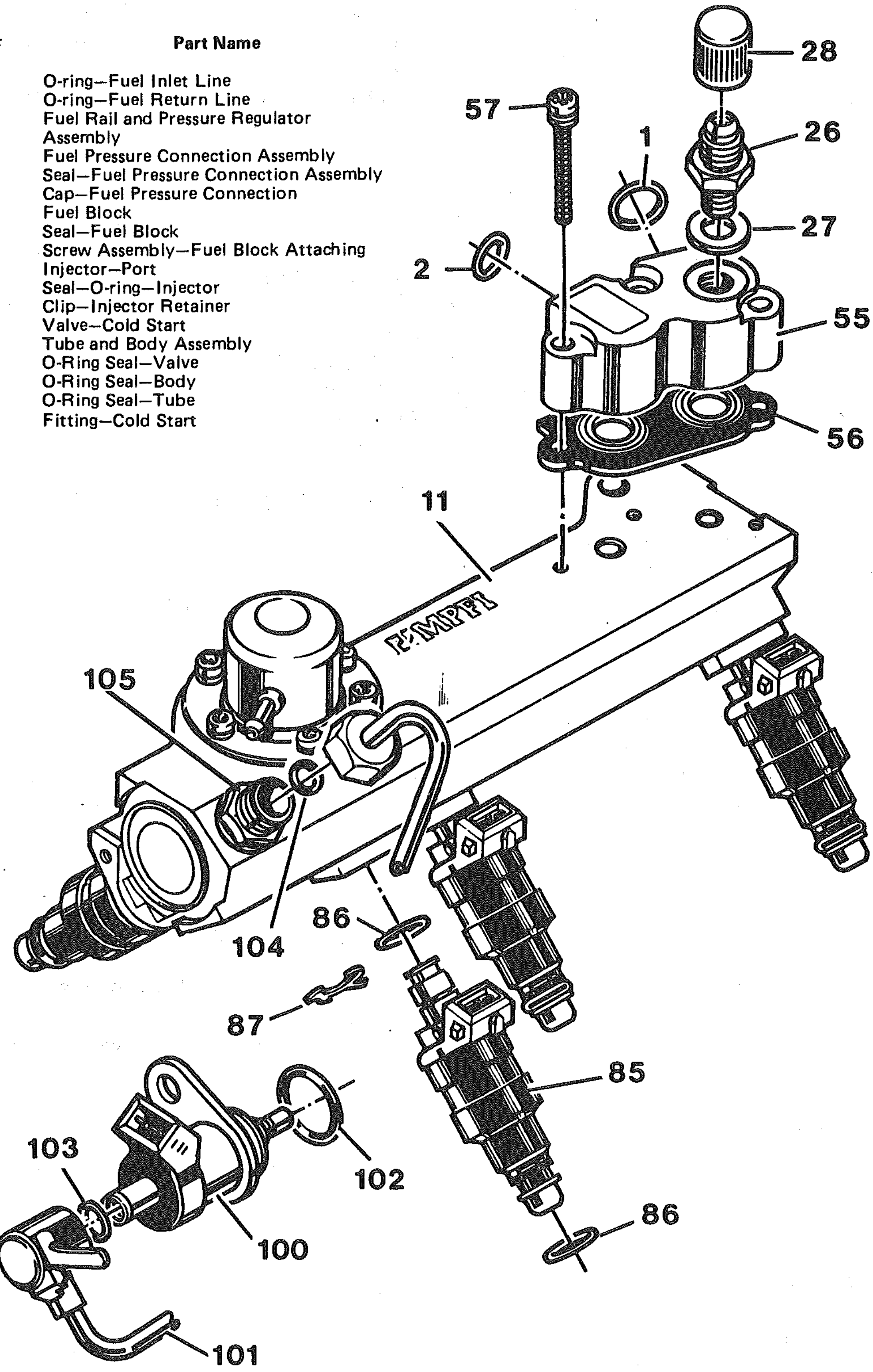


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Figure C2-9 Fuel Rail Assembly

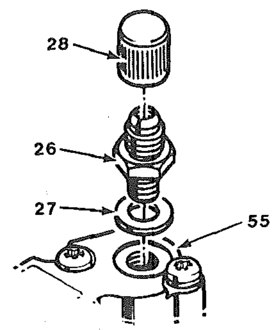


Figure C2-10 Fuel Pressure Connection Assembly

FUEL BLOCK AND SEAL
Figure C2-11

Remove or Disconnect

1. Negative battery terminal.
2. Engine components above fuel block.

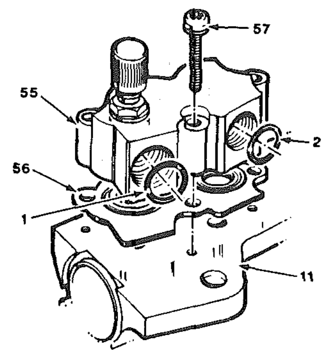


Figure C2-11 Fuel Block Assembly

Clean

- Fuel block (55) and adjacent fuel line connections with AC Delco X-30A or equivalent.

3. Fuel inlet and return lines, and O-ring seals (1) and (2).
   - Discard O-ring seals.
4. Fuel block attaching screw assemblies (57).
5. Fuel block (55) and seal (56). Discard seal.

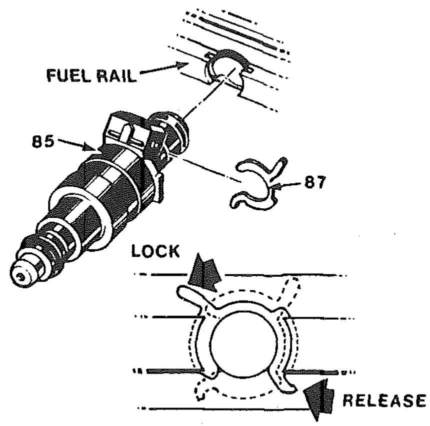


Figure C2-12 Injector Removal

Clean

- Sealing surfaces of fuel block and fuel rail assembly to ensure a good seal.

Install or Connect

1. New fuel block seal (56) on fuel rail assembly (11).
2. Fuel block (55) on seal.
3. Fuel block attaching screw assemblies (57).

Tighten

- Attaching screw assemblies to 5.0 Nm (44.0 in. lbs.)

4. New O-ring seals (1) and (2) on fuel inlet and return lines.
5. Fuel inlet and return lines.
6. Battery negative terminal.

Inspect

- Energize fuel pump and check for fuel leaks.

FUEL INJECTORS

Each port injector is located and held in position by a retainer clip that must be rotated to release and/or lock the injector in place, as shown in Figure C2-12.

Port Injectors with Injector Retaining Clips

Remove or Disconnect

1. Rotate injector retaining clip(s) (87) to unlocked position.
2. Port injectors (85).

Inspect

- All injector O-ring seals (86).
  - Replace if damaged.

Assemble

- New O-ring seals (86) as required, on port injectors (85).

Install or Connect

1. Lubricate all injector O-ring seals with engine oil.
2. Port injectors to fuel rail and pressure regulator assembly (11).
3. Rotate injector retainer clips (87) to locking position (Figure C2-12).

Fuel Pressure Regulator

Important

The pressure regulator is factory adjusted and is not serviceable. Do not attempt to remove the regulator from the fuel rail.

PORT INJECTORS

Each port injector is located and held in position by a retainer clip that must be rotated to release and/or lock the injector in place, as shown in Figure C2-13.

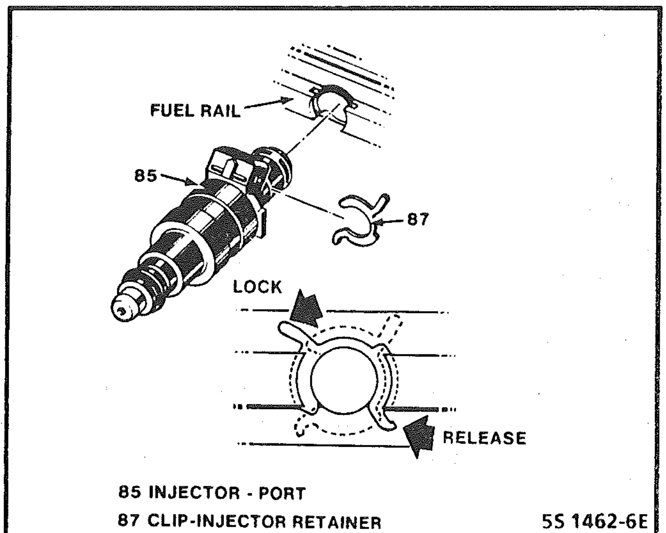


Figure C2-13 Port Injector with Injector Retainer Clip

Remove or Disconnect

1. Rotate injector retaining clip(s) (87) to unlocked position.
2. Injectors (85).

Inspect

- All injector O-ring seals (86).
  - Replace if damaged.

Assemble

- New O-ring seals (86) as required, on injectors (85).

Install or Connect

1. Lubricate all injector O-ring seals with engine oil.
2. Injectors to fuel rail and pressure regulator assembly (11).
3. Rotate injector retainer clips (87) to locking position (Figure C2-13).

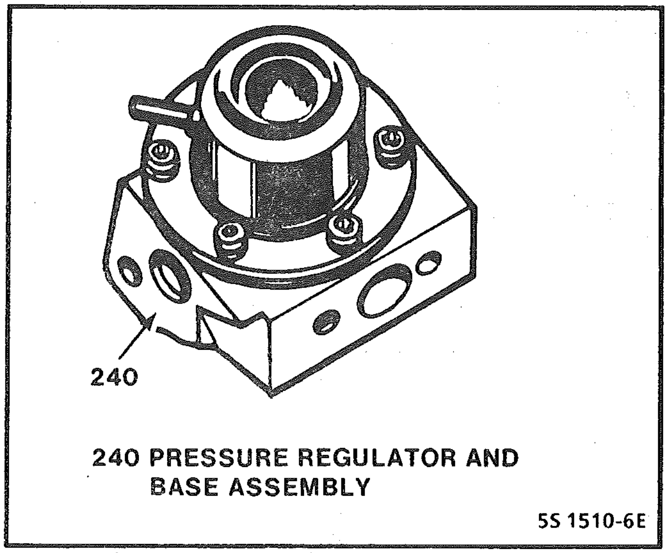


Figure C2-14 Fuel Pressure Regulator

PRESSURE REGULATOR
Figure C2-14

Important

The pressure regulator is factory adjusted and is not serviceable. Do not attempt to remove regulator cover.

Remove or Disconnect

1. Front crossover tube retainer attaching screw assembly (235) and crossover tube retainer (234).
2. Retainer to base screw assembly (273) and rear crossover tube retainer (270)
3. Separate the left hand fuel rail and plug assembly (200) from the right hand fuel rail and tube assembly (220).
4. Bracket to rail attaching screw assembly (256), bracket to base attaching screw assembly (258) and the pressure regulator and base assembly bracket (255).
5. Rear bracket attaching study assembly (222).
6. Base to right hand rail screw assembly (275).

7. Pressure regulator and base assembly (240) from right hand rail assembly (220).
8. Rotate the regulator and base assembly to remove from the fuel outlet tube.
9. Base to rail connector (250).

Important

When removing O-Ring seals, note locations and sizes, to assure correct replacement and re-assembly.

10. O-Ring seals:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).

Install or Connect

1. Lubricate with engine oil, and install O-Ring seals:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).
2. Base to rail connector (250) in pressure regulator and base assembly (240).
3. Regulator and base assembly on fuel outlet tube.
4. Rotate the regulator and base assembly to install base to rail connector (250) into right hand rail assembly.
5. Base to right hand rail screw assembly (275).
6. Pressure regulator and base assembly bracket (255), bracket to base attaching screw assembly (258) and bracket to rail attaching screw assembly (256).
7. Rear bracket attaching study assembly (222).
8. Left hand rail and plug assembly (200), with front and rear crossover tubes (230) and 265), to right hand rail and tube assembly (220).
9. Rear crossover tube retainer (270) and retainer to base screw assembly (273).
10. Front crossover tube retainer (234) and retainer attaching screw assembly (235).

COLD START FUEL INJECTION SWITCH

Remove or Disconnect

1. Connector.
2. Switch.

Install or Connect

1. Switch.
2. Connector.

THROTTLE BODY (Figure C2-15)

Remove or Disconnect

1. Air inlet duct.
2. IAC and TPS connectors.
3. Vacuum lines.
4. Coolant hoses (2).
5. Throttle, TV and cruise control cables.
6. Throttle body retaining bolts.

Install or Connect

1. Reverse procedure to reinstall.
2. Refill radiator with lost coolant.

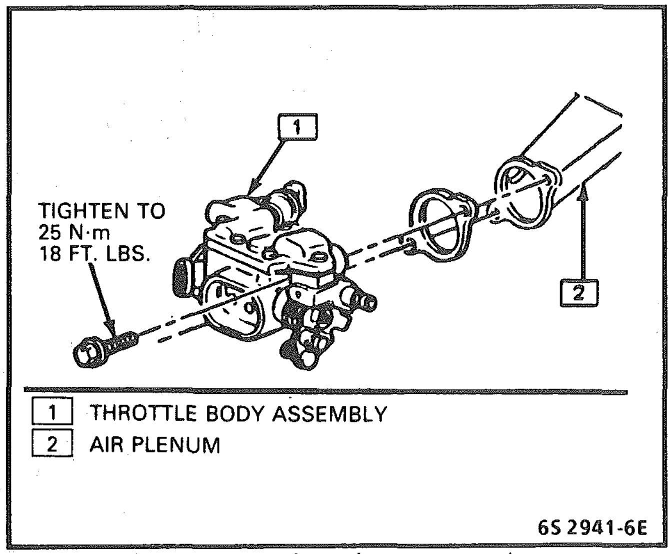


Figure C2-15 Throttle Body Service

THROTTLE BODY SERVICE IDENTIFICATION

An eight digit identification number is stamped on the throttle body casting next to the coolant cover, as shown in Figure C2-16. Refer to this model identification number if servicing or part replacement is required.

Names of component parts will be found on the numbered list that accompanies the exploded view (Figure C2-17). Numbers used to identify parts in the exploded views also are used to identify the same parts in other illustrations of this manual.

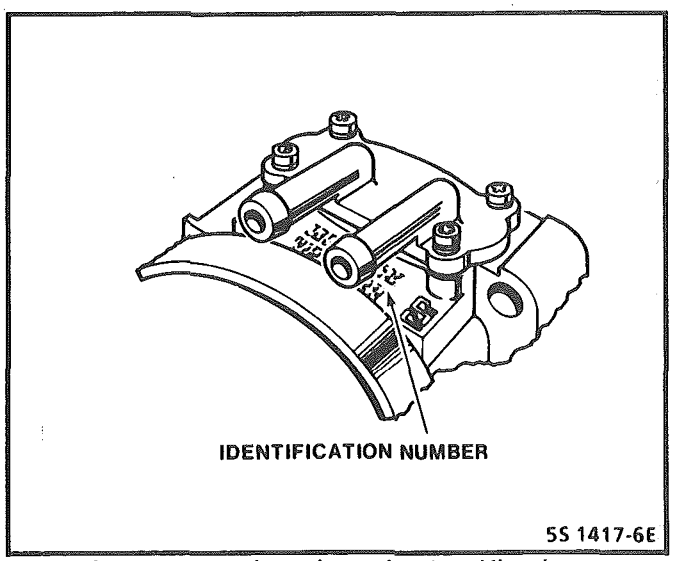


Figure C2-16 Throttle Body Identification

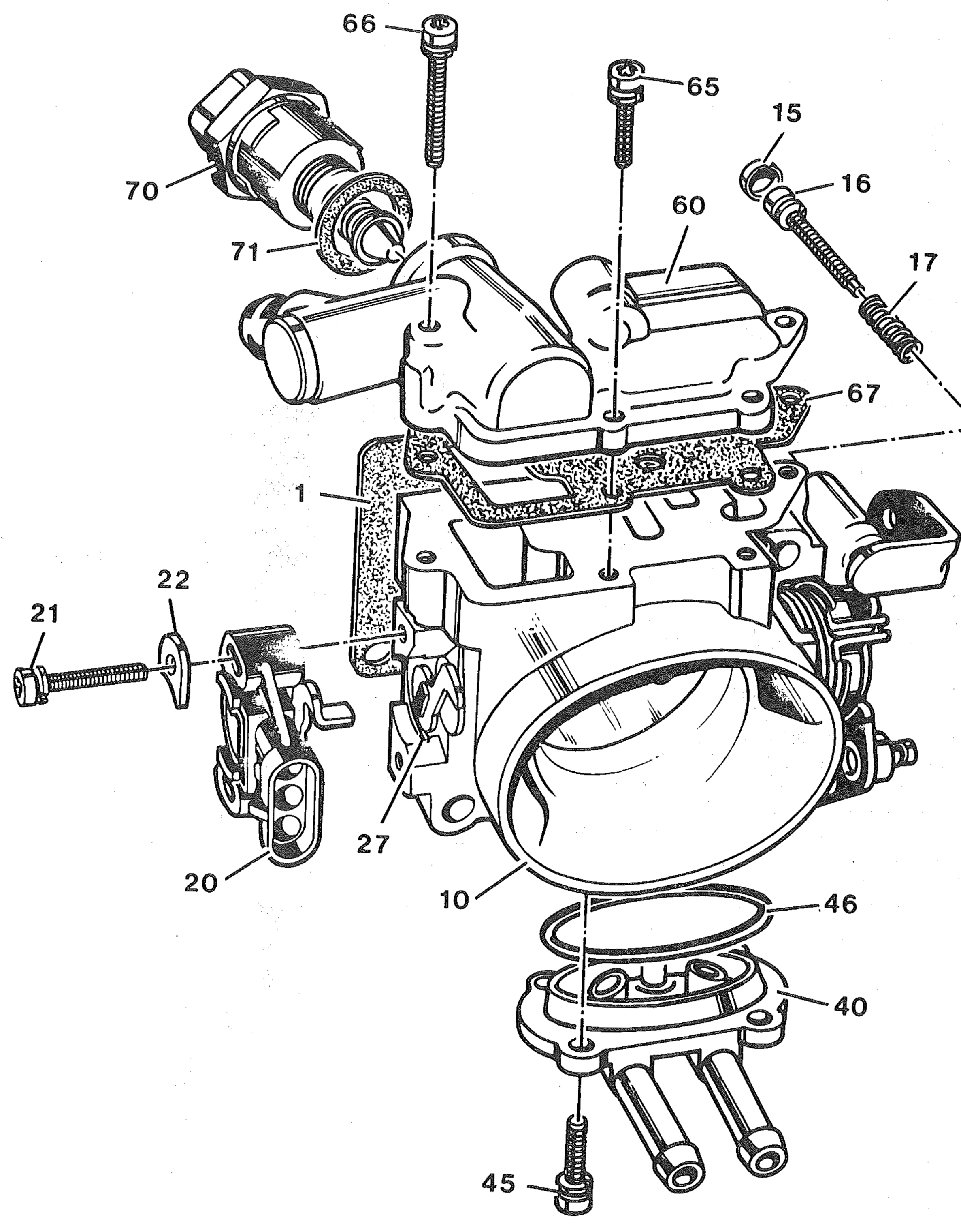


Figure C2-17 Throttle Body

PARTS INFORMATION

PART NAME	PART #
Throttle Body Assembly	10
Plug - Idle Stop Screw	15
Screw Assembly - Idle Stop	16
Spring - Idle Stop Screw	17
Sensor - Throttle Position (TPS)	20
Screw Assembly - TPS Attaching	21
Retainer - TPS Attaching Screw	22
Cover - Coolant Cavity	40
Screw Assembly - Coolant Cover Attaching	45
O-Ring - Coolant Cover to Throttle Body	46
Idle Air/Vacuum Signal Housing Assembly	60
Screw Assembly - Idle Air/Vacuum Signal Assembly	65
Screw Assembly - Idle Air/Vacuum Signal Assembly	66
Gasket - Idle Air/Vacuum Signal Assembly	67
Valve Assembly - Idle Air Control (IAC)	70
Gasket - IAC Valve Assembly	71

MINIMUM IDLE SPEED ADJUSTMENT

The idle stop screw (16), used to regulate minimum idle speed of the engine, is adjusted at the factory, then is covered with a plug (15) to discourage unnecessary readjustment. However, if it is necessary to gain access to the idle stop screw assembly, proceed as shown in Figure C2-18.

Adjust

1. Pierce the idle stop screw plug (15) with an awl, and apply leverage to remove it.
2. Adjust idle stop screw assembly (16) as required.
3. With IAC motor connected, ground diagnostic lead.
4. Turn "ON" ignition, do not start engine. Wait at least 30 seconds.
5. With ignition "ON," disconnect IAC electrical connector.
6. Start engine and allow to go "Closed Loop".
7. Remove ground from diagnostic terminal.
8. Adjust idle stop screw to 550 rpm in drive, 650 rpm in neutral on manual transmission vehicles.
9. Turn ignition "OFF" and reconnect connector at IAC motor.
10. Do not adjust TPS unless setting is outside of 0.35-0.67 limits. If adjustment is required, see procedure in Section "6E3-C1".
11. Start engine and inspect for proper idle operation.

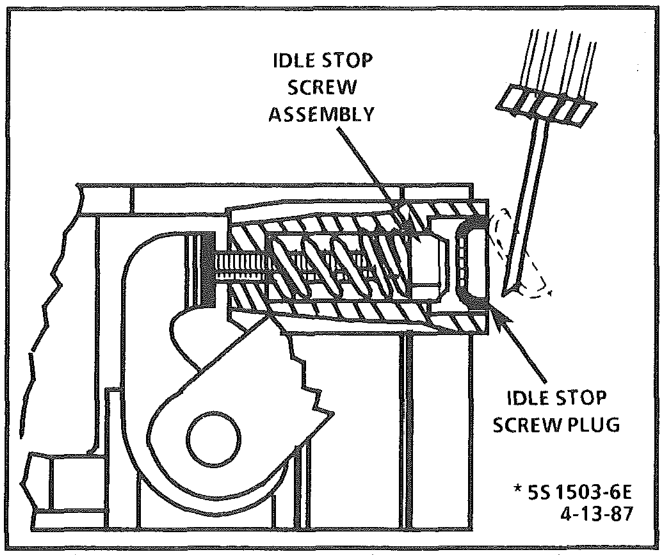


Figure C2-18 Removing Idle Stop Screw Plug

UNIT REPAIR PROCEDURES

The unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine. If removed, it may be placed on a holding fixture, such as J-9789-118, BT-3553, or equivalent, to prevent damage to the throttle valve.

Cleaning and Inspection

Throttle body parts, except as noted below, may be cleaned in a cold immersion-type cleaner such as AC Delco X-55 or equivalent.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, throttle body with cover and seals or gaskets in place, should NOT be soaked in liquid solvent or cleaner, as they may be damaged. If TPS or IAC valve is still mounted in the throttle body, do not immerse throttle body.

1. Clean all metal parts throughly and blow dry with shop air. Be sure all air passages are free of burrs and dirt.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

IDLE AIR CONTROL VALVE ASSEMBLY AND GASKET (Figure C2-19)

Remove or Disconnect

1. Electrical connector at idle air control valve assembly (70).
2. IAC valve assembly from idle air/vacuum signal housing assembly (60).
3. IAC valve assembly gasket (71) and discard.

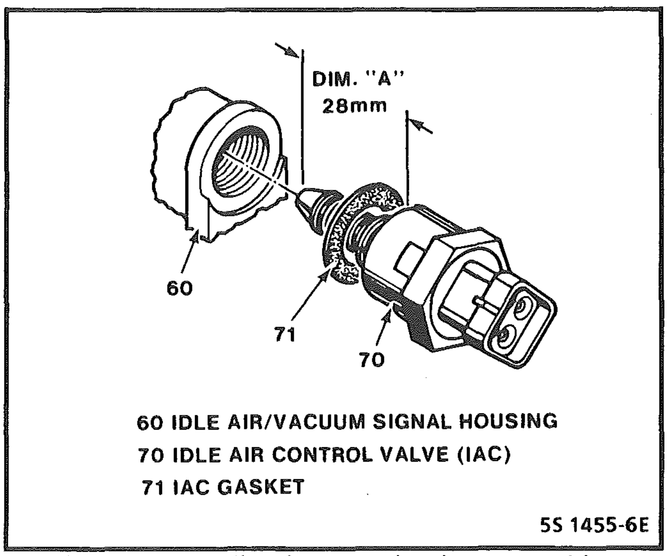


Figure C2-19 Idle Air Control Valve Assembly

NOTICE: Before installing new idle air control valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur.

Measure

- Distance from gasket mounting surface of IAC valve assembly (70) to tip of pintle, Dimension "A" in Figure C2-19.

Adjust

If distance is greater that 28 mm (1 1/8 in.), reduce it as follows:

a. If IAC valve assembly has a "collar" around electrical connector end, use firm hand pressure on pintle to retract it. (A slight side-to-side motion may help.)

b. If IAC valve assembly has "no collar", compress pintle-retaining spring toward body of the IAC and try to turn pintle clockwise.
   - If pintle will turn, continue turning until 28mm (1 1/8 in.) is reached. Return spring to original position, with straight part of spring end lined up with flat surface under the pintle head.
   - If pintle will not turn, use firm hand pressure to retract it.

Install or Connect

1. New IAC valve assembly gasket (71) on IAC valve assembly (70).
2. IAC valve assembly in idle air/vacuum signal housing assembly (60).

Tighten

- IAC valve assembly to 18N·m (13 ft. lbs.), with wrench on hex surface only.

3. Electrical connector at IAC valve assembly (70).

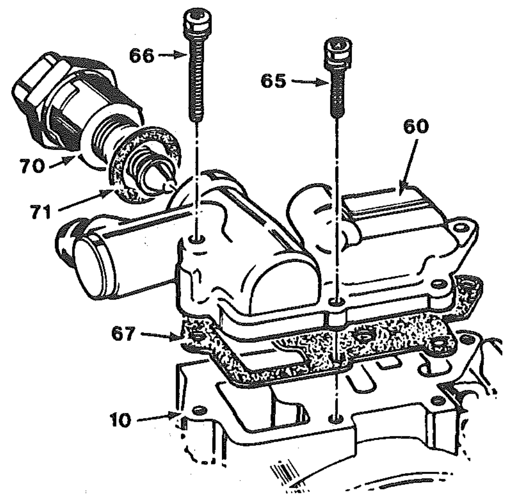
Important

No physical adjustment is made to the IAC assembly after installation. IAC resetting occurs after reinstallation on the vehicle, and is reset after the engine is started and then the ignition turned off.

IDLE AIR / VACUUM SIGNAL HOUSING ASSEMBLY (With IAC Removed) (Figure C2-20)

Remove or Disconnect

1. Idle air/vacuum signal assembly attaching screw assemblies (65) and (66).
2. Idle air/vacuum signal housing assembly (60).
3. Idle air/vacuum signal assembly gasket (67).



10 THROTTLE BODY ASSEMBLY
60 IDLE AIR/VACUUM SIGNAL HOUSING ASSY
65 SCREW ASSY - IDLE AIR/VACUUM SIGNAL HOUSING ASSY.
66 SCREW ASSY - IDLE AIR/VACUUM SIGNAL HOUSING ASSY
67 GASKET - IDLE AIR VACUUM SIGNAL ASSY
70 VALVE ASSY - IDLE AIR CONTROL (IAC)
71 GASKET - IAC VALVE ASSY

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Figure C2-20 Idle Air/Vacuum Signal Housing Assembly

Tighten

- Attaching screw assemblies (starting in center and moving outward) to 3.0 N·m (27.0 in. lbs.).

COOLANT CAVITY COVER AND O-RING (Figure C2-21)

Remove or Disconnect

1. Coolant cover attaching screw assemblies (45).
2. Coolant cavity cover (40).
3. Coolant cover to throttle body O-ring (46).

Clean

- O-ring surface of coolant cavity cover.

Inspect

- Gasket and O-ring surfaces, for damage and corrosion which might effect sealing.

Install and Connect

1. Lubricate coolant cover to throttle body O-ring (46) with ethylene glycol antifreeze.
2. O-ring in throttle body assembly (10).
3. Coolant cavity cover.
4. Coolant cover attaching screw assemblies (45), applying pressure against throttle body (10).

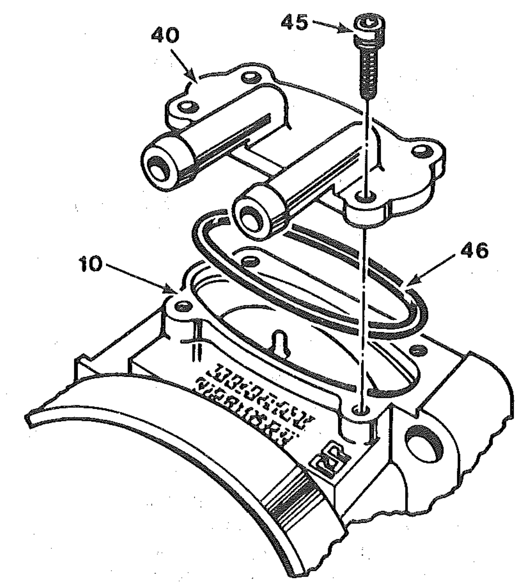


Figure C2-21 Coolant Cavity Cover Assembly

Tighten

- Screw assemblies to 3.0 Nm (27.0 in. lbs.).

IDLE AIR CONTROL/COOLANT COVER ASSEMBLY

With Throttle Body Removed From Engine (Figure C2-22)

Remove or Disconnect

1. Idle air control (IAC) valve assembly (70) from IACV/coolant cover assembly. (See "Idle Air Control valve and Gasket" section.)
2. IACV cover assembly to throttle body screw assemblies (62).
3. Cover assembly (61).
4. Cover assembly to throttle body gasket (63).

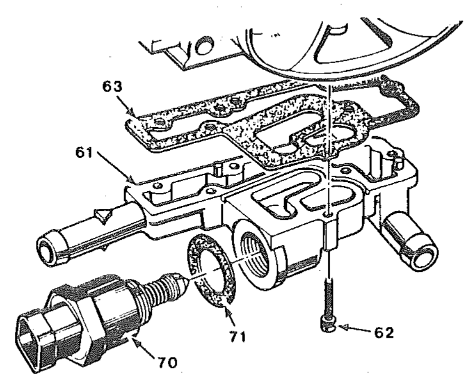


Figure C2-22 Idle Air control/Coolant Cover Assembly

REINSTALLATION

Clean

- Throttle body gasket mounting surface to ensure a good seal.
- Sealing surface for damage that could prevent sealing properly or cause coolant leak.

Install and Connect

1. New IACV/coolant cover assembly to throttle body gasket (63).
2. IACV/coolant cover assembly (61).
3. IACV cover assembly to throttle body screw assemblies (62).

Tighten

- Screw assemblies to 3.0 N·m (27.0 in. lbs.).

4. IAC valve assembly (70). (See "Idle Air Control Valve and Gasket" section.)

NOTICE: Before installing the IAC valve assembly the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur. (See "Idle Air Control Valve and Gasket" section.)

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (see Figure C2-23). Other than checking for loose connectors, the only service possible is replacement.

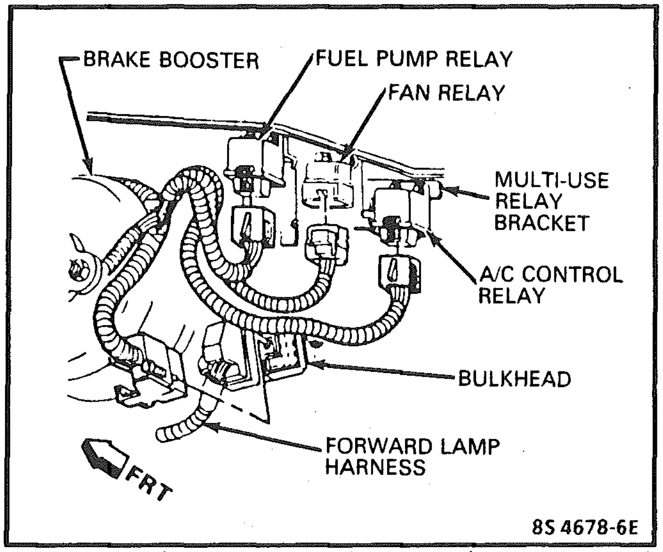


Figure C2-23 Fuel Pump Relay

OIL PRESSURE SWITCH

The oil pressure switch is mounted as shown in Figure C2-24.

Remove or Disconnect

1. Electrical Connector.
2. Oil Pressure Switch.

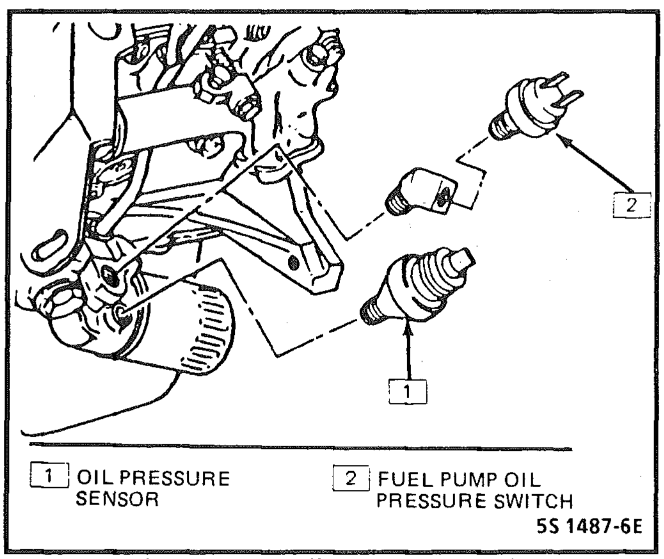


Figure C2-24 Oil Pressure Switch

Install or Connect

1. Make sure fittings (41) are properly aligned to allow switch installation.
2. Oil Pressure Switch.
3. Electrical Connector.

PARTS INFORMATION

PART NAME	GROUP
Injector, fuel	3.300
Pump, Fuel (In-Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Pressure	1.800
Valve Asm, Idle Air Control : Part Of Control Kit, Idle Air Valve	3.820
Regulator, Fuel Pressure	3.164
Rail, Fuel Feed	3.330

CHART C-2A

INJECTOR BALANCE TEST

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop (± 10 kpa). Any injector with a pressure drop that is 10 kpa (or more) greater or less than the average drop of the other injectors should be considered faulty and replaced.

STEP 1

Engine "cool down" period (10 minutes) is necessary to avoid irregular readings due to "Hot Soak" fuel boiling. With ignition "OFF" connect fuel gauge J347301 or equivalent to fuel pressure tap. Wrap a shop towel around fitting while connecting gage to avoid fuel spillage.

Disconnect harness connectors at all injectors, and connect injector tester J-34730-3, or equivalent, to one injector. On Turbo equipped engines, use adaptor harness furnished with injector tester to energize injectors that are not accessible. Follow manufacturers instructions for use of adaptor harness. Ignition must be "OFF" at least 10 seconds to complete ECM shutdown cycle. Fuel pump should run about 2 seconds after ignition is turned "ON". At this point, insert clear tubing attached to vent valve into a suitable container and bleed air from gauge and hose to insure accurate gauge operation. Repeat this step until all air is bled from gauge.

STEP 2

Turn ignition "OFF" for 10 seconds and then "ON" again to get fuel pressure to its maximum. Record this initial pressure reading. Energize tester one time and note pressure drop at its lowest point (Disregard any slight pressure increase after drop hits low point.). By subtracting this second pressure reading from the initial pressure, we have the actual amount of injector pressure drop.

STEP 3

Repeat step 2 on each injector and compare the amount of drop. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10kPa, either more or less than the average of the other injectors on the engine. Replace any injector that also fails the retest. If the pressure drop of all injectors is within 10kPa of this average, the injectors appear to be flowing properly. Reconnect them and review "Symptoms," Section "B".

NOTE: ***The entire test should <u>not</u> be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors).***

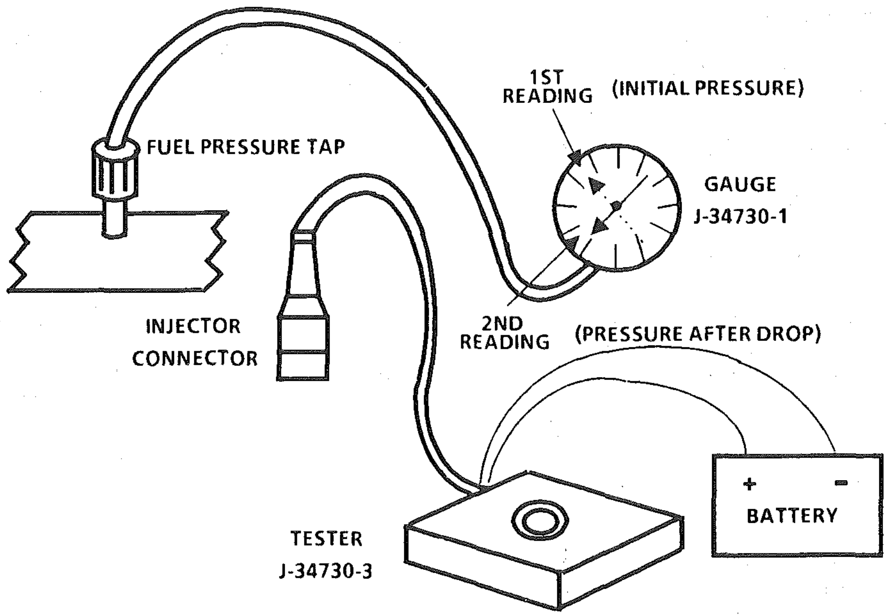
CHART C-2A
INJECTOR BALANCE TEST 2.8L (VIN S) "F" SERIES (PORT)

NOTE: If injectors are suspected of being dirty, they should be cleaned using an approved tool and procedure prior to performing this test. The fuel pressure test in Section A, Chart A-7, should be completed prior to this test.

Step 1. If engine is at operating temperature, allow a 10 minute "cool down" period then connect fuel pressure gauge and injector tester.
1. Ignition "OFF".
2. Connect fuel pressure gauge and injector tester.
3. Ignition "ON".
4. Bleed off air in gauge. Repeat until all air is bled from gauge.

Step 2. Run test:
1. Ignition "OFF" for 10 seconds.
2. Ignition "ON". Record gauge pressure. (Pressure must hold steady, if not see the Fuel System diagnosis, Chart A-7, in Section A).
3. Turn injector on, by depressing button on injector tester, and note pressure at the instant the gauge needle stops.

Step 3.
1. Repeat step 2 on all injectors and record pressure drop on each.
Retest injectors that appear faulty (Any injectors that have a 10 kPa difference, either more or less, in pressure from the average). If no problem is found, review Symptoms Section B.



— EXAMPLE —

CYLINDER	1	2	3	4	5	6
1ST READING	225	225	225	225	225	225
2ND READING	100	100	100	90	100	115
AMOUNT OF DROP	125	125	125	135	125	110
	OK	OK	OK	FAULTY, RICH (TOO MUCH) (FUEL DROP)	OK	FAULTY, LEAN (TOO LITTLE) (FUEL DROP)

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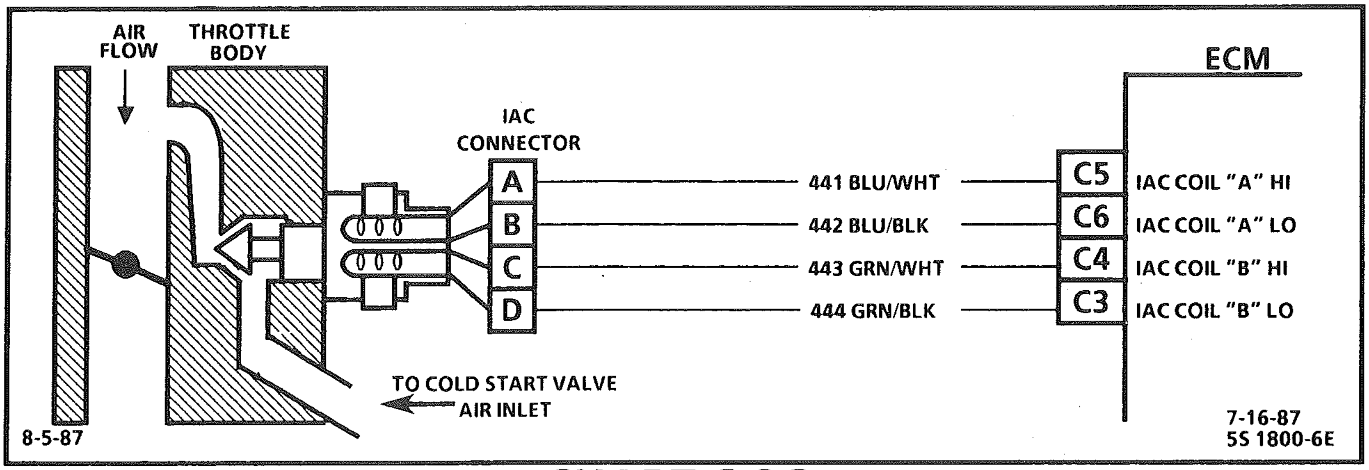

CHART C-2C
IDLE AIR CONTROL
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The ECM will control engine idle speed by moving the IAC valve to control air flow around the throttle plate. It does this by sending voltage pulses to the proper motor winding for each IAC motor. This will cause the motor shaft and valve to move in or out of the motor a given distance for each pulse received. ECM pulses are referred to as "counts".

- To increase idle speed - ECM will send enough counts to retract the IAC valve and allow more air to flow through the idle air passage and bypass the throttle plate until idle speed reaches the proper RPM. This will increase the ECM counts.
- To decrease idle speed - ECM will send enough counts to extend the IAC valve and reduce air flow through the idle passage around the throttle plate. This will reduce the ECM counts.

Each time the engine is started and then the ignition is turned "OFF" the ECM will reset the IAC valve. This is done by sending enough counts to seat the valve. The fully seated valve is the ECM reference zero. A given number of counts are then issued to open the valve, and normal ECM control of IAC will begin from this point. The number of counts are then calculated by the ECM. This is how the ECM knows what the motor position is for a given idle speed.

The ECM uses the following information to control idle speed.

- Battery voltage
- Engine Speed
- Coolant Temperature
- A/C clutch signal
- Throttle Position Sensor

Don't apply battery voltage across the IAC motor terminals. It will permanently damage the IAC motor windings.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Continue with test even if engine will not idle. If idle is too low, "Scan" will display 80 or more counts, or steps. If idle is high it will display "0" counts.
   Occasionally an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault. There is a system problem. Proceed to diagnostic aids below.
2. When the engine was stopped, the IAC valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 140 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the CKTs is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the Ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

Engine idle speed can be adversely affected by the following:

- Park/Neutral Switch - If ECM thinks the car is always in neutral, then idle will not be controlled to the specified rpm when in drive range.
- Leaking injector(s) will cause fuel imbalance and poor idle quality due to excess fuel. See CHART A-7.
- Vacuum or crankcase leaks can affect idle.
- When the throttle shaft or throttle position sensor is binding or sticking in an open throttle position, the ECM does not know if the vehicle has stopped and does not control idle.
- Check AIR management system for intermittent air to ports while in "Closed Loop".
- In addition to electrical control of EGR, be sure to examine the EGR valve for proper seating.
- Faulty battery cables can result in voltage variations. The ECM will try to compensate, which results in erratic idle speeds.
- The ECM will compensate for A/C compressor clutch loads. Loss of this signal would be most apparent in neutral.
- Contaminated fuel can adversely affect idle.
- Perform injector balance test CHART C-2A.

If all OK, refer to "Rough, Unstable, Incorrect Idle or Stalling" "Symptoms" in Section "B".

CHART C-2C

IDLE AIR CONTROL
2.8L (VIN S) "F" SERIES (PORT)

(1)
- ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
- NOTE RPM IN PARK OR NEUTRAL.

(2)
- IGNITION "OFF" FOR 10 SEC.
- START ENGINE AND IMMEDIATELY NOTE RPM.

IDLE RPM, NO INCREASE

IDLE RPM , INCREASE

- IDLE ENGINE FOR 1 MINUTE AND NOTE RPM.

WILL NOT RETURN TO IDLE RPM RECORDED ABOVE .

RETURNS TO IDLE RPM RECORDED ABOVE .

IDLE AIR CONTROL CIRCUIT OK.
SEE FACING PAGE "DIAGNOSTIC AIDS".

(3)
- IGNITION "OFF".
- DISCONNECT IAC VALVE HARNESS.
- IGNITION "ON" , ENGINE STOPPED.
- GROUND DIAGNOSTIC TEST TERMINAL.
- CONNECT A TEST LIGHT BETWEEN EACH IAC HARNESS CONNECTOR TERMINAL AND GROUND.

NO LIGHTS, ONE OR MORE CIRCUITS.

CHECK FOR OPEN OR SHORT TO GROUND IN CIRCUIT WITH NO LIGHT.

ARE ALL CIRCUITS OK?

YES

CHECK RESISTANCE ACROSS IAC COILS. SHOULD BE MORE THAN 20 OHMS BETWEEN IAC TERMINALS OPPOSITE HARNESS CONNECTOR TERMS. "A" TO "B" AND "C" TO "D".

OK

FAULTY ECM CONN. OR ECM.

NOT OK

REPLACE IAC VALVE AND RETEST.

NO

REPAIR WIRING AND RECHECK.

(4) LIGHT STEADY OR FLASHING ALL CIRCUITS.

FAULTY IAC CONNECTION OR IAC VALVE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C3
EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic Evaporative Emission Control System (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

VAPOR CANISTER

The canister used on these engines has a diaphragm operated purge valve and a solenoid to control purge (See Figure C3-1). When the engine is running, ported manifold vacuum is supplied to the top of the purge valve (Control Vacuum Signal) which lifts the valve diaphragm and opens the valve when the throttle is above a specified opening. The lower tube on the purge valve (PCV tube) is connected to the solenoid valve.

EVAPORATIVE EMISSION SYSTEM

Under cold engine or idle conditions, the solenoid is turned "ON" by the ECM, which closes the purge passage preventing canister purge. The ECM turns "OFF" the solenoid valve and allows purge when the following occur:

- The engine is warm.
- After the engine has been running a specified length of time.
- The vehicle is above a specified road speed.
- Throttle valve is past a specified opening.

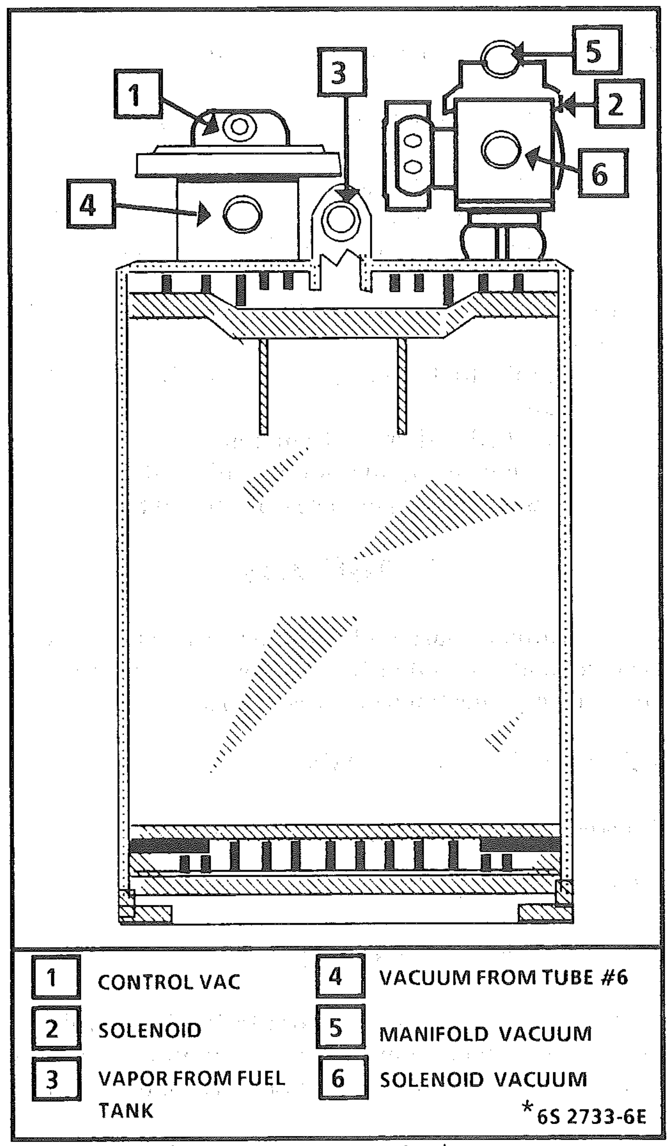


Figure C3-1 - Vapor Canister With Non-Encapsulated Solenoid

The "CONTROL VAC" tube on the purge valve of the canister is connected to a ported vacuum source. When the engine is above idle speed, sufficient vacuum is available to open the purge valve diaphragm. Vapors are purge through the solenoid to the combustion chamber.

This system also has a Tank Pressure Control Valve to control the flow of vapors to the canister.

TANK PRESSURE CONTROL VALVE

The Fuel Tank Pressure Control Valve (Figure C3-3) is located near the canister and is connected to the fuel tank vapor line. When the engine is running, manifold vacuum is supplied to the control vacuum tube and the valve is opened allowing fuel vapors too vent to the canister. When the engine is "OFF", the valve closes and vapors tend to remain in the tank.

RESULTS OF INCORRECT OPERATION

Poor idle, stalling and poor driveability can be caused by:

- Inoperative purge solenoid
- Damaged canister
- Hoses split, cracked and, or not connected to the proper tubes.

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines, or fuel pump.
- Cracked or damaged canister
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

DIAGNOSIS

The canister purge solenoid operation is covered in the charts at the end of this section. A failure in the solenoid or connections may result in a Code 26.

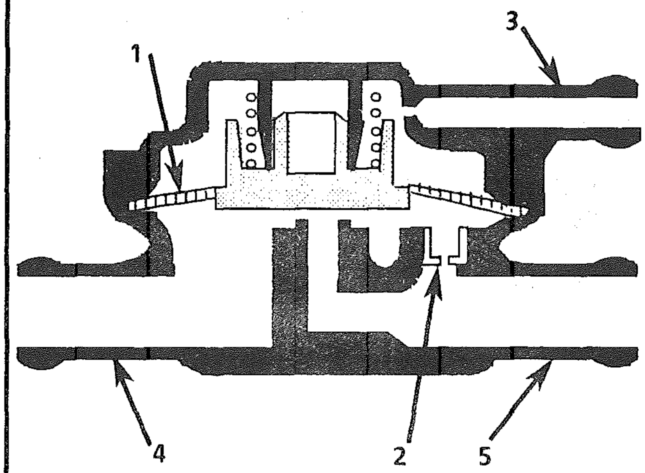
VISUAL CHECK OF CANISTER

Cracked or damaged , replace canister.

FUNCTIONAL TEST

Vapor Canister Purge Valve

Apply a short length of hose to the lower tube of purge valve, and atempt to blow through it. Little or no air should pass into the canister. (A small amount



1 DIAPHRAGM
2 VENT RESTRICTION
3 CONTROL VACUUM TUBE
4 TUBE TO FUEL TANK
5 TUBE TO CANISTER

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Figure C3-3 Fuel Tank Pressure Control Valve

of air will pass if the canister has a constant purge hole).

With hand vacuum pump, apply vacuum (15"Hg. or 51 kPa) through the control valve tube (upper tube). The diaphragm should hold vacuum for at least 20 seconds. If not the canister must be replaced. If the diaphragm holds vacuum, again try to blow through the hose connected to the lower tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister must be replaced.

Tank Pressure Control Valve

With a hand vacuum pump apply vacuum (15" or 51 kPa) to the control vacuum tube. The diaphragm should hold vacuum for at least 20 seconds. If it does not hold vacuum the diaphragm is leaking and the valve must be replaced.

With the vacuum still applied to the control vacuum tube, apply a short hose to the valve's tank tube side, blow into the tube. You should feel the air pass through the valve. If the air does not pass through, the valve should be replaced.

ON-CAR SERVICE

FUEL VAPOR CANISTER

Remove or Disconnect

1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

Install or Connect

1. Canister as removed.
2. Hoses. Make sure connections are correct.

FUEL VAPOR CANISTER SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector and hoses from solenoid.
3. Solenoid.

Install or Connect

1. Hoses and electrical connector on solenoid.
2. Solenoid, cover, and bolt.
3. Negative battery cable

CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister	3.140
Valve, Fuel Tank Pressure Control	3.140

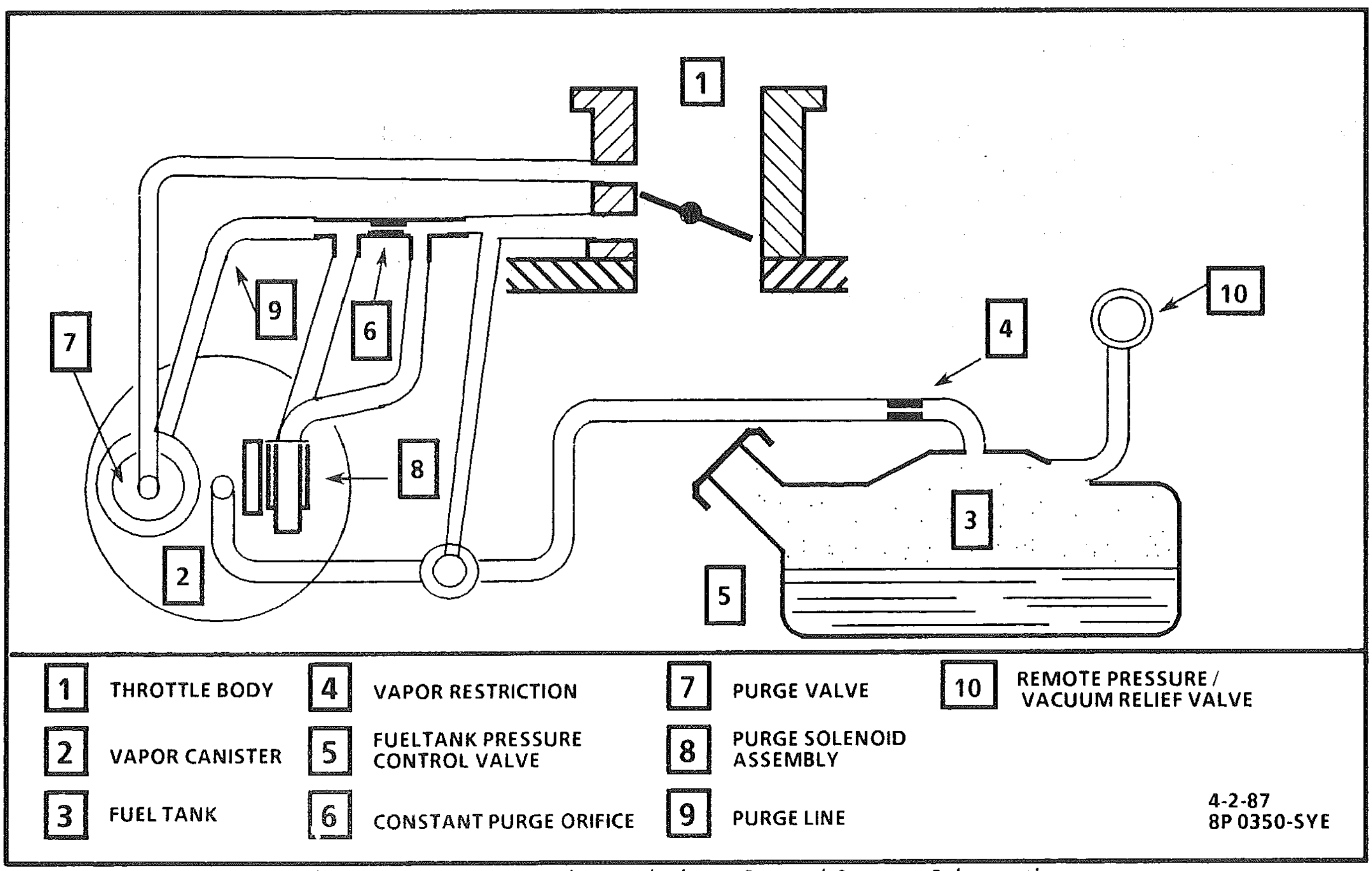

Figure C3-4 - Evaporative Emissions Control System Schematic

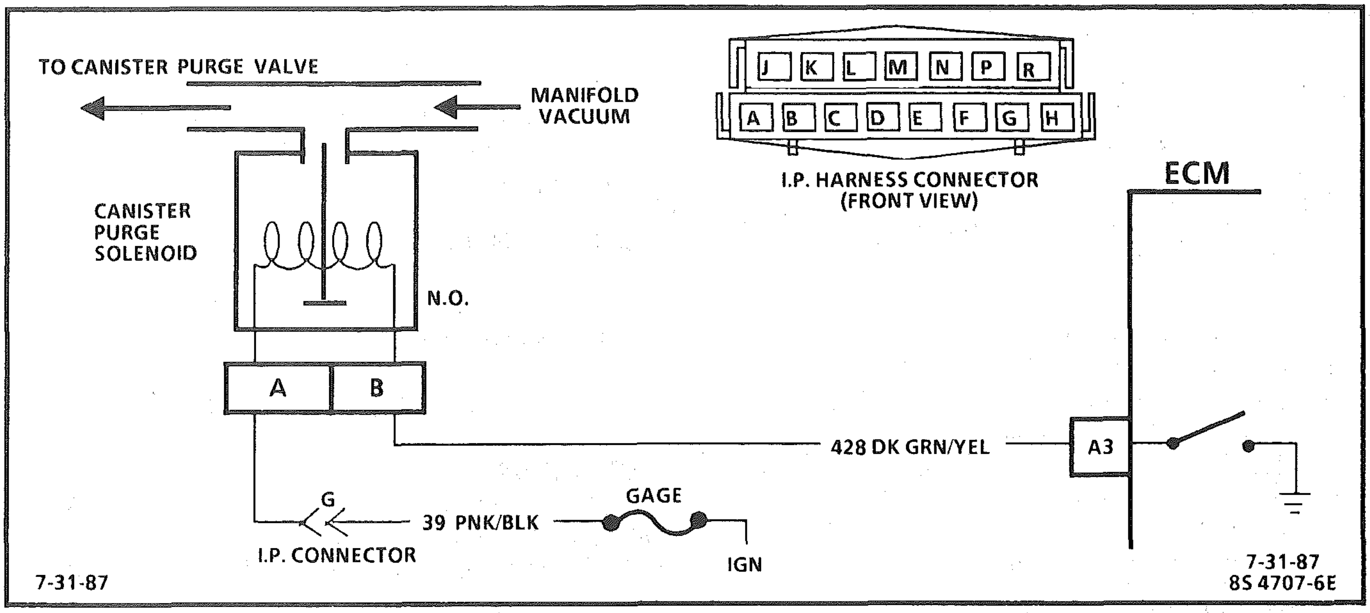

CHART C-3

CANISTER PURGE VALVE CHECK
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when de-energized. The ECM supplies a ground to energize the solenoid (purge "OFF").

If the diagnostic test terminal is ungrounded with the engine stopped or the following is met with the engine running, the purge solenoid is de-energized (purge "ON").

- Engine run time after start more than 1 minute.
- Coolant temperature above 75°C.
- Vehicle speed above 15 mph.
- Throttle off idle.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks to see if the solenoid is opened or close. The solenoid is normally energized in this step; so it should be closed.
2. Checks for a complete circuit. Normally there is ignition voltage on CKT 39 and the ECM provides a ground on CKT 428. A shorted solenoid could cause an open circuit in the ECM.
3. Completes functional check by ungrounding test terminal. This should normally de-energize the solenoid and allow the vacuum to drop (purge "ON").

CHART C-3

CANISTER PURGE VALVE CHECK 2.8L (VIN S) "F" SERIES (PORT)

NOTE: THIS CHART ONLY COVERS THE SOLENOID PORTION OF THE CANISTER CONTROL PURGE SYSTEM. TO TEST THE CONTROL VALVE(S) SEE DIAGNOSIS UNDER GENERAL DESCRIPTION

1
- IGNITION "ON". ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL.
- DISCONNECT VACUUM HOSES FROM PURGE SOLENOID.
- AT THE SOLENOID, APPLY VACUUM (10" Hg OR 34 kPa) TO THROTTLE BODY SIDE OF PURGE SOLENOID.

UNABLE TO GET 10" Hg OR 34 kPa OF VACUUM.

2 DISCONNECT PURGE SOLENOID. CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS.

NO LIGHT

- PROBE EACH HARNESS CONNECTOR TERMINAL WITH A TEST LIGHT TO GROUND..

LIGHT "ON" ONE TERMINAL.

OPEN CKT 428, FAULTY CONNECTION OR FAULTY ECM. SEE QUAD DRIVER CHECK (CHART C-1)

LIGHT BOTH TERMINALS.

REPAIR SHORT TO VOLTAGE IN CKT 428.

NO LIGHT

CHECK FOR OPEN CKT 39.

LIGHT

FAULTY SOLENOID CONNECTOR OR SOLENOID.

ABLE TO GET 10" Hg OR 34 kPa OF VACUUM.

3
- UNGROUND DIAGNOSTIC TERMINAL.
- NOTE VACUUM.

NO DROP

- DISCONNECT SOLENOID.

DROPS

PROBE CKT 428 WITH A TEST LIGHT TO 12 VOLTS.

LIGHT "ON"

CKT 428 SHORTED TO GROUND OR FAULTY ECM. SEE QUAD DRIVER CHECK (CHART C-1)

LIGHT "OFF"

FAULTY SOLENOID

NO DROP

REPLACE SOLENOID.

DROPS

NO TROUBLE FOUND.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT

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SECTION C4

IGNITION SYSTEM / EST

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The High Energy Ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the Electronic Spark Timing (EST) system.

Only the Electronic Spark Timing (EST) system will be described here. Additional information on the HEI system is found in Section "6D".

To properly control ignition/combustion timing the ECM needs to know:

- Crankshaft position
- Engine speed (rpm)
- Mass Air Flow
- Engine temperature

OPERATION

The EST system consists of the distributor module, ECM, and connecting wires. The connector terminals are lettered as shown in Figure C4-1 for the 2.8L.

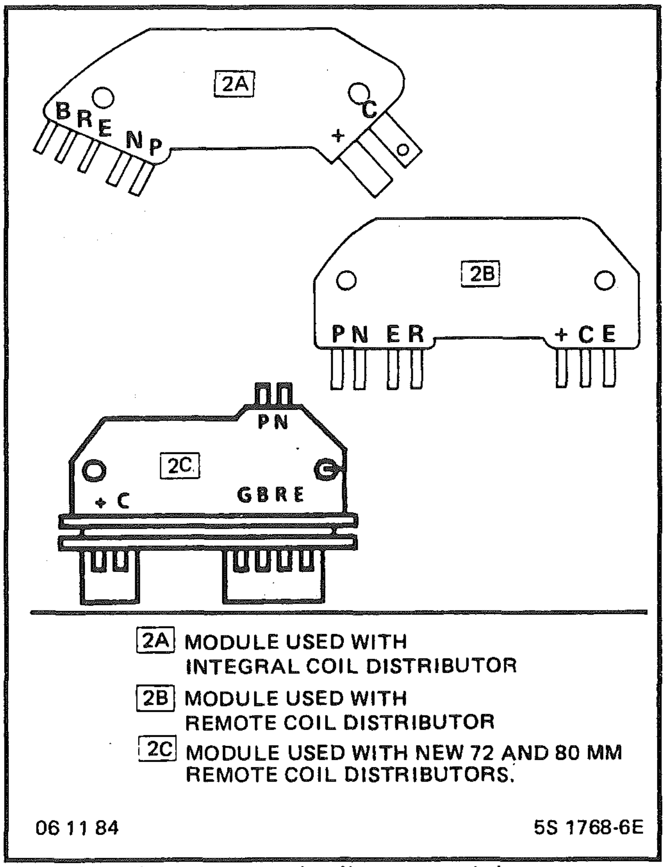

Figure C4-1 Distributor Modules

These circuits perform the following functions:

- Distributor reference (CKT 430).

This provides the ECM with rpm and crankshaft position information. If the wire becomes open or grounded the engine will not run, because the ECM will not operate the injectors. If the engine cranks but won't run, see CHART A-3.

- Reference ground (CKT 453).

This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.

- By-Pass (CKT 424).

At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. The wire goes through a connector between the 4 wire connector and the ECM. This is disconnected to the set base timing. An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.

- EST (CKT 423).

This circuit triggers the HEI module. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the entire spark curve will be incorrect.

RESULTS OF INCORRECT OPERATION

An open or ground in the EST circuit will set a Code 42 and cause the engine to run on the HEI module timing. This will cause reduced performance and poor fuel economy.

The ECM uses information from the MAF and coolant sensors in addition to rpm to calculate spark advance as follows:

- Cold engine = more spark advance.
- Engine under minimum load based on rpm and low amount of air flow- more spark advance.
- Hot engine = less spark advance.
- Engine under heavy load based on rpm and high amount of air flow- less spark advance.

DIAGNOSIS

The description, operation, and diagnosis of the HEI system are found in Section "6D" of this manual.

CODE 12

Code 12 is used during the Diagnostic Circuit Check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON" and the engine not running.

The "Reference" signal also triggers the fuel injection system. Without the "Reference" signal the engine cannot run.

ON-CAR SERVICE

SETTING TIMING

The initial base timing is set by disconnecting the timing connector, located near the blower motor. Refer to Emission Control Information Label for procedure. This will cause Code 42 to store in the code memory of the ECM. The memory must be cleared after setting timing.

How Code 42 Is Determined

When the system is running on the HEI module, that is no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm) the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module so the EST voltage should be varying.

If the bypass line is open or grounded, the HEI module will not switch to EST mode so the EST voltage will be low and Code 42 will be set. Refer to Section "6D" for on vehicle service.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM (Remanufactured)	3.670
Distributor	2.361
Module, Distr	2.383
Coil, Distr	2.170

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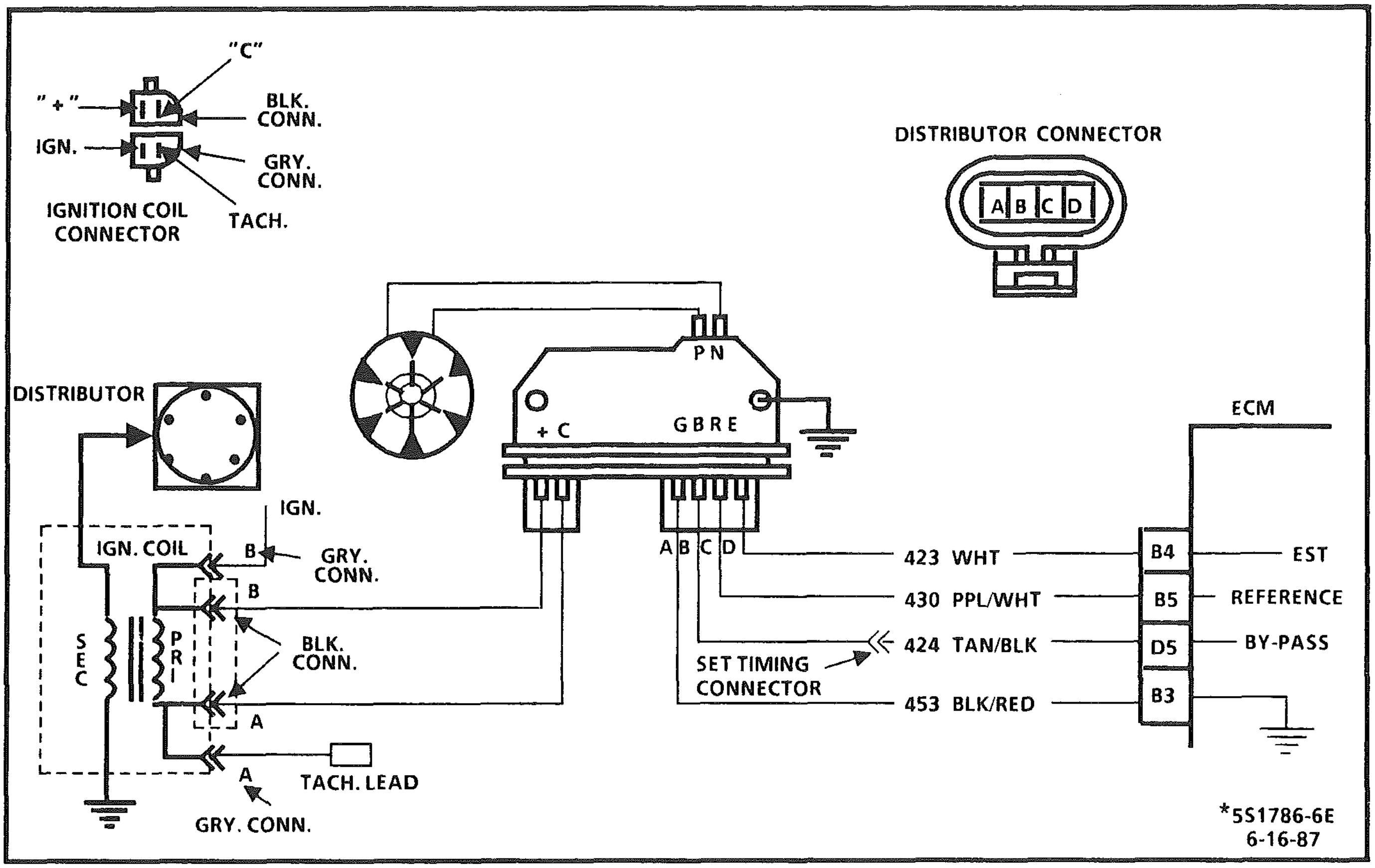

CHART C-4A

IGNITION SYSTEM CHECK
(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)
2.8L (VIN S) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with EST connector disconnected, pick-up coil output is too low for EST operation.

2. A spark indicates the problem must be the distributor cap or rotor.
3. Normally, there should be battery voltage at the "C" and "+" terminals. Low voltage would indicate an open or a high resistance circuit from the distributor to the coil or ignition switch. If "C" term. voltage was low, but "+" term. voltage is 10 volts or more, circuit from "C" term. to Ign. coil or ignition coil primary winding is open.
4. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF", so normal voltage should be about 12 volts.
   If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat.
   With an open ignition coil primary winding, a small amount of voltage will leak through the module from the "Bat." to the tach terminal.
5. Applying a voltage (1.5 to 8V) to module terminal "P" should turn the module "ON" and the tach. term. voltage should drop to about 7-9 volts. This test will determine whether the module or coil is faulty or if the pick-up coil is not generating the proper signal to turn the module "ON". This test can be performed by using a DC battery with a rating of 1.5 to 8 volts. The use of the test light is mainly to allow the "P" terminal to be probed more easily.
   Some digital multi-meters can also be used to trigger the module by selecting ohms, usually the diode position. In this position the meter may have a voltage across it's terminals which can be used to trigger the module. The voltage in the ohm's position can be checked by using a second meter or by checking the manufacture's specification of the tool being used.
6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4A
IGNITION SYSTEM CHECK
(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)
2.8L (VIN S) "F" SERIES (PORT)

(1)
- Perform Diagnostic Circuit Check before proceeding with this test. (If a tachometer is connected to the Tach term., disconnect it before proceeding with the test).
- Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire) A few sparks and then nothing is considered no spark.

Spark → Check fuel, spark plugs, etc. See section "B" symptoms.

No Spark ↓

(1A)
- Disconnect 4 term. distributor connector and check for spark.

Spark → Replace pick-up coil

No spark ↓

(2)
- Check for spark at coil wire with tester while cranking. (Leave spark tester connected to coil wire for Steps 3-6).

Spark → Inspect cap for water, cracks, etc. If OK, replace rotor.

No Spark ↓

(3)
- Disconnect distributor 2 term. "C / +" connector.
- Ignition switch "on", Engine stopped.
- Check volts at "+" and "C" term's. of dist. harn. conn.

Both term's. under 10 volts → Repair wire from module "+" term. to "B" term. of black Ign. coil connector or primary ckt. to ign. sw.

Under 10 volts "C" term. only → Check for open or gnd. in ckt. from "C" term. to ign. coil. If Ckt. is OK, fault is. ign. coil or conn..

Both term's. 10 volts or more ↓

(4)
- Reconnect dist. 2 term. conn.
- With ign. "ON", check voltage from tach. term. to gnd. (term. may be taped back in harness).

Under 1 volt → Repair open tach. lead or conn and repeat test #4.

1 to 10 volts → Replace module and check for spark from coil as in Step 6.
- Spark → System OK
- No Spark → Replace ign. coil, it too is faulty

Over10 volts ↓
- Connect test light from tach. term. to ground.
- Crank engine and observe light.

Light blinks → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..

Light on steady ↓

(5)
- Disconnect distributor 4 term. connector.
- Remove dist. cap.
- Disconnect pick-up coil connector from module.
- Connect voltmeter from tach. term. to ground.
- Ignition on.
- Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).

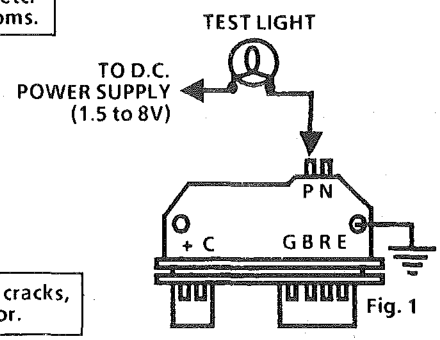

Fig. 1

No drop in voltage → Check module ground. If OK, replace module.

Voltage drops ↓

(6)
- Check for spark from coil wire with spark tester as test light is removed from module term.

Spark ↓
- Is rotating pole piece still magnetized?
  - Yes → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
  - No → Replace pole piece and shaft assy.

No Spark ↓
- If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
  - No Spark → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
  - Spark → System OK
- If module tester (J24642) is available: test module
  - OK → Check coil wire from cap to coil. If OK, replace coil.
  - Not OK → Replace module

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SECTION C6
AIR INJECTION REACTION (A.I.R.) SYSTEM MANUAL TRANSMISSION ONLY

CONTENTS

GENERAL DESCRIPTION

PURPOSE

These systems are used to reduce carbon monoxide (CO), hydrocarbon (HC) and oxides of nitrogen (NO_x) emissions. They also heat up the catalytic converter quickly "ON" engine start-up so conversion of exhaust gases will start quickly.

A.I.R. PUMP OPERATION

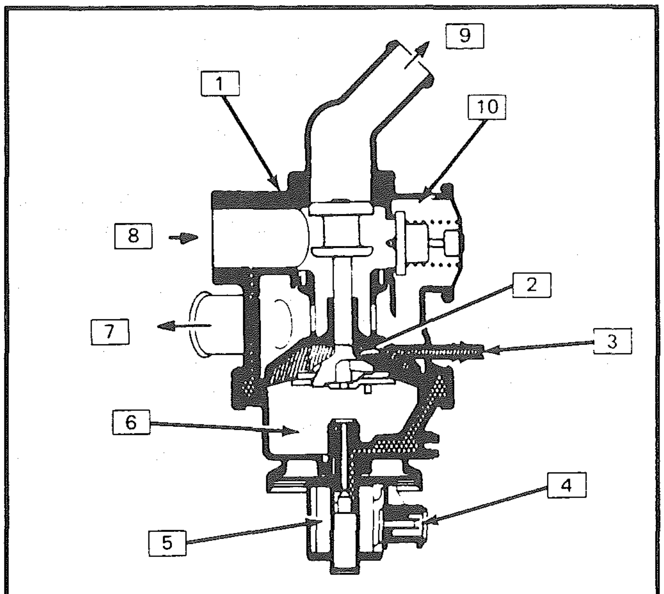
The system (Figure C6-1) includes:

- An Air Pump
  The air pump is driven by a belt on the front of the engine and supplies the air to the system. Intake air passes through a centrifugal filter fan at the front of the pump; where foreign materials are separated from the air by centrifugal force.
- A Control Valve
  Air flows from the pump through an ECM controlled valve (called a control valve) through check valves to either the exhaust ports or the silencer (overboard).
- Check Valves
  The check valves prevent back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.
- Necessary Plumbing

AIR CONTROL

Electric Air Control Valve (EAC)

The electric air control valve combines electronic control with the normal diverter valve function. This valve can be electronically controlled to provide divert air under any driving mode.



1 ELECTRIC AIR CONTROL VALVE
2 DECEL TIMING ASSEMBLY
3 VERY HIGH VACUUM SIGNAL PORT
4 ELECTRICAL TERMINAL
5 SOLENOID
6 DECEL TIMING CHAMBER
7 DIVERT AIR TO AIR CLEANER
8 AIR FROM PUMP
9 AIR TO EXHAUST PORTS
10 PRESSURE RELIEF ASSEMBLY

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Figure C6-1 - Electric Air Control Valve

When the solenoid is energized, the valve will perform like a standardized diverter valve. Air from the air pump is directed to the exhaust ports, unless there is a great sudden rise in manifold vacuum due to throttle deceleration.

When the solenoid is de-energized, the pressurized air from the air pump is allowed to enter the decel timing chamber. This places sufficient pressure on the metering valve diaphragm to overcome spring tension, closing the valve,causing air to divert to the silencer.

At higher engine speeds, excess air is exhausted to the silencer through the pressure relief valve. (Figure C6-1)

Deceleration Valve

To help prevent backfiring during high vacuum conditions a deceleration (gulp) valve is used to allow air to flow into the intake manifold (shown in Figure C6-2). This air enters the air/fuel mixture to lean the rich condition created by high vacuum when the throttle valve closes on deceleration.

The vacuum draws the deceleration valve diaphragm down and opens the valve allowing air inlet duct to flow into the intake manifold.

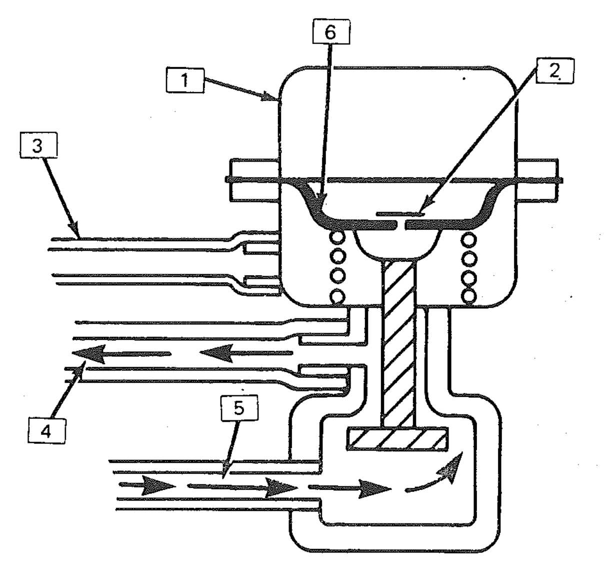


Figure C6-2 - Deceleration Valve

RESULTS OF INCORRECT OPERATION

- If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels will be too high.
- Air flowing to the exhaust ports at all times could cause a rich ECM command and increased temperature of the converter. This may also cause a Code 44 due to oxygen being pumped passed the oxygen sensor. There should be no air going to the exhaust ports while operating in the closed loop mode.

DIAGNOSIS

The diagnosis of the AIR system is covered in CHART C-6 at the end of this section.

OPERATIONAL CHECKS

A.I.R. Pump

1. The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 rpm's and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

For proper drive belt tension.

2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked "OFF" to prevent liquids from entering the pump.

Inspect

3. For a seized Air Injection Pump.
4. Hoses, tubes and all connections for leaks and proper routing.
5. For air flow from control/switching valve.
6. AIR injection pump for proper mounting and bolt torque.
7. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

CAUTION: **Do Not Oil Air Pump**

Hoses and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.

4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

Deceleration Valve

1. Connect tachometer, start engine and allow idle to stabilize.
2. With the engine running at specified idle speed, remove the small deceleration valve signal hose from the manifold vacuum source.
3. Reconnect the signal hose and listen for air flow through the ventilation pipe and into the deceleration valve. There should also be a noticeable speed drop when the signal hose is reconnected.
4. If the air flow does not continue for at least one second or the engine speed does not drop noticeably, check the deceleration valve hoses for restrictions or leaks.
5. If no restrictions or leaks are found, replace the deceleration valve.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected form a check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the exhaust manifold) then attempt to suck back through the check valve. Flow should only be in one direction(toward the exhaust manifold). Replace valve which does not operate properly.

ON-CAR SERVICE

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for ware, cracks or deterioration and replace if required. When installing new belt, it must be seated and fully secured in grooves of A/C compressor, AIR pump, generator, and crankshaft pulleys.

A.I.R. PUMP

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Loosen bolt, holding pump to mounting brackets, release tension on drive belts.
3. Move belts out of the way, then remove pump hoses, vacuum and electrical connections, and control valve.
4. Pulley, then pump.
5. If required, insert needle nose pliers and pull filter fan from hub.

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Hoses, vacuum and electrical connections, and control valve.
3. New filter fan on pump hub.
4. Spacer and pump pulley against centrifugal filter fan.
5. Pump pulley bolts and tighten equally to 13 N · m (10 lb. ft.). This will compress the centrifugal filter fan onto the pump hole. Do not drive filter fan on with a hammer. A slight amount of interference with the housing bore is normal. After a new filter fan has been installed, it may squeal upon initial operation or until O.D. sealing lip has worn in. This may require a short period of pump operation at various engine speeds.
6. Pump drive belt and adjust.
7. Check air injection system for proper operation (see CHART C-6)

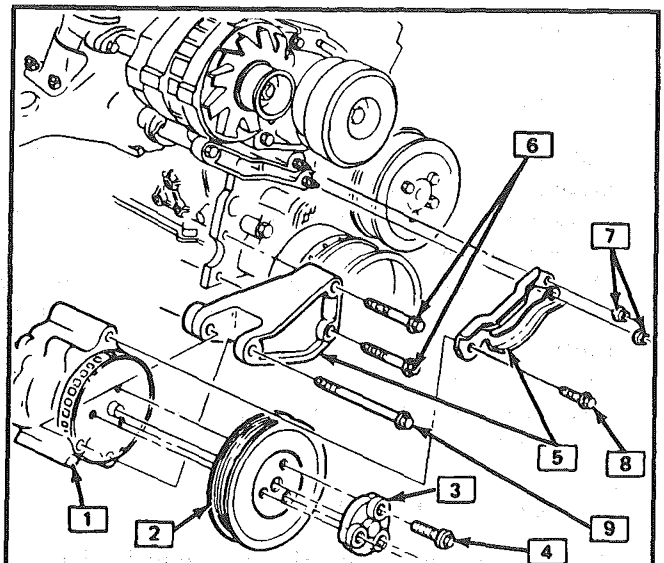
AIR CONTROL VALVE

Remove or Disconnect

1. Battery ground cable.
2. Adapter bolts (See Figure C6-3).
3. Air outlet hoses from valve.
4. Adapter.
5. Electrical connectors and vacuum hoses from valve.
6. Control valve.

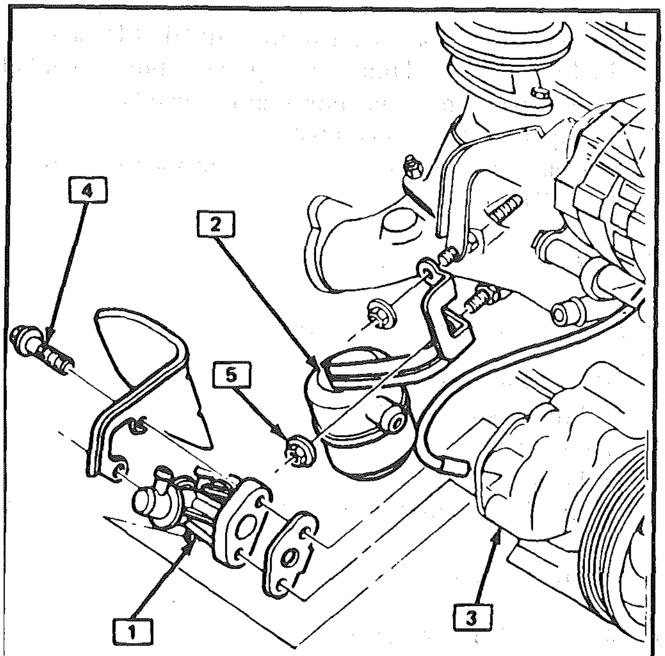
Install or Connect

1. Control valve.
2. Electrical connectors and vacuum hoses.
3. Adapter.
4. Air hoses to valve.
5. Adapter bolts to pump.
6. Battery ground cable.
7. Check system operation (see CHART C-6).



1 A.I.R. PUMP ASM
2 PULLEY
3 SPACER
4 PULLEY BOLT 27 N·m (20 FT. LBS.)
5 BRACKETS (UPPER AND LOWER)
6 BOLTS (2) 80 N·m (60 FT. LBS.)
7 NUTS (2) 50 N·m (36 FT. LBS.)
8 UPPER PUMP BOLT 35 N·m (26 FT. LBS.)
9 LOWER PUMP BOLT 35 N·m (26 FT. LBS.) 7S 3317-6E

Figure C6-3 - Air Pump Mounting



1 CONTROL VALVE
2 DIVERT SILENCER
3 A.I.R. PUMP ASM
4 BOLT (2) 16 N·m (12 FT. LBS.)
5 NUTS (2) 24 N·m (18 FT. LBS.) 7S 3315-6E

Figure C6-4 - Control Valve Service

CHECK VALVE

Remove or Disconnect

1. Any parts required for access.
2. Release clamp and disconnect air hoses from check valve.
3. Unscrew check valve from air injection pipe.

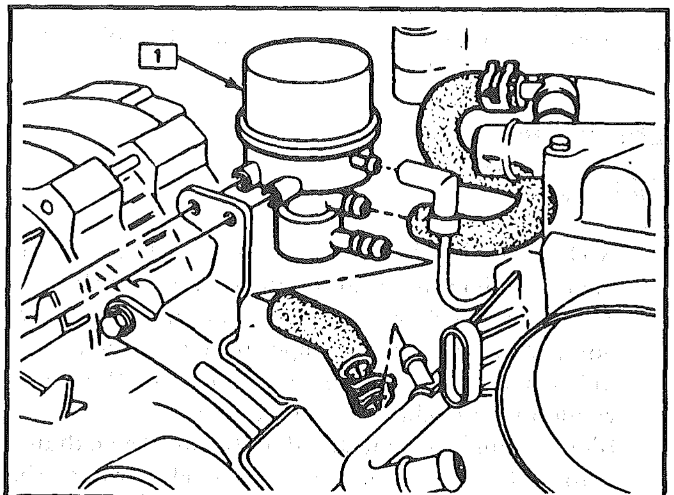
Install or Connect

1. Screw check valve onto air injection pipe.
2. Position air hoses on check valve and secure with clamp.
3. Any parts removed for access.

DECELERATION VALVE

Remove or Disconnect

1. Vacuum hoses from valve.
2. Screws securing valve to engine bracket.
3. Deceleration valve.



1 DECELERATION VALVE ASM 7S 3316-6E

Figure C6-5 - Control Valve Service

Install or Connect

1. Deceleration valve.
2. Screws securing valve to engine bracket.
3. Vacuum hoses to valve.

PARTS INFORMATION

PART NAME	GROUP
Bracket, AIR Inj Pump Supt (RR)	3.655
Bracket, AIR Inj Pump (Frt)	3.655
Bracket, Dclr Vlv	3.671
Gasket, AIR Cont Vlv	3.671
Hose, AIR Inj Cont Vlv	3.675
Hose, C/case Vent Pipe to Dclr Vlv	3.675
Pipe, AIR Inj Ctltc Conv Chk Vlv	3.690
Pipe, AIR Inj Cont Vlv	3.675
Pulley, AIR Inj Pump	3.650
Pump, AIR Inj	3.660
Silencer, AIR Inj Cont Vlv	3.675
Valve, AIR Inj Cont	3.670
Valve, AIR Inj Eng Chk	3.670
Valve, Dclr	3.670

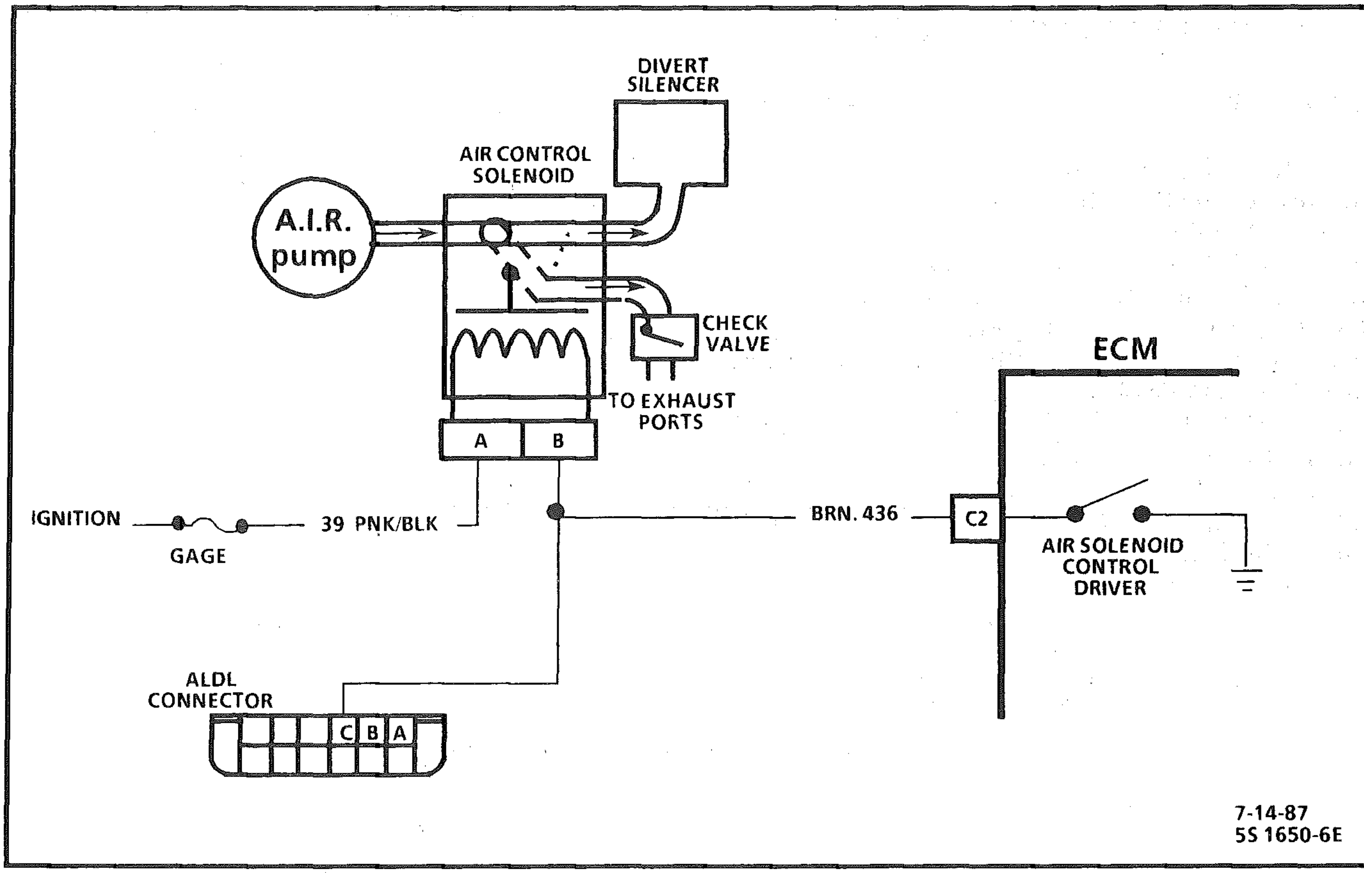


CHART C-6

ELECTRIC CONTROL (DIVERT) (MANUAL TRANSMISSION) 2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

This system uses a single bed converter and Air Management is controlled by an Air Control Valve (divert valve).

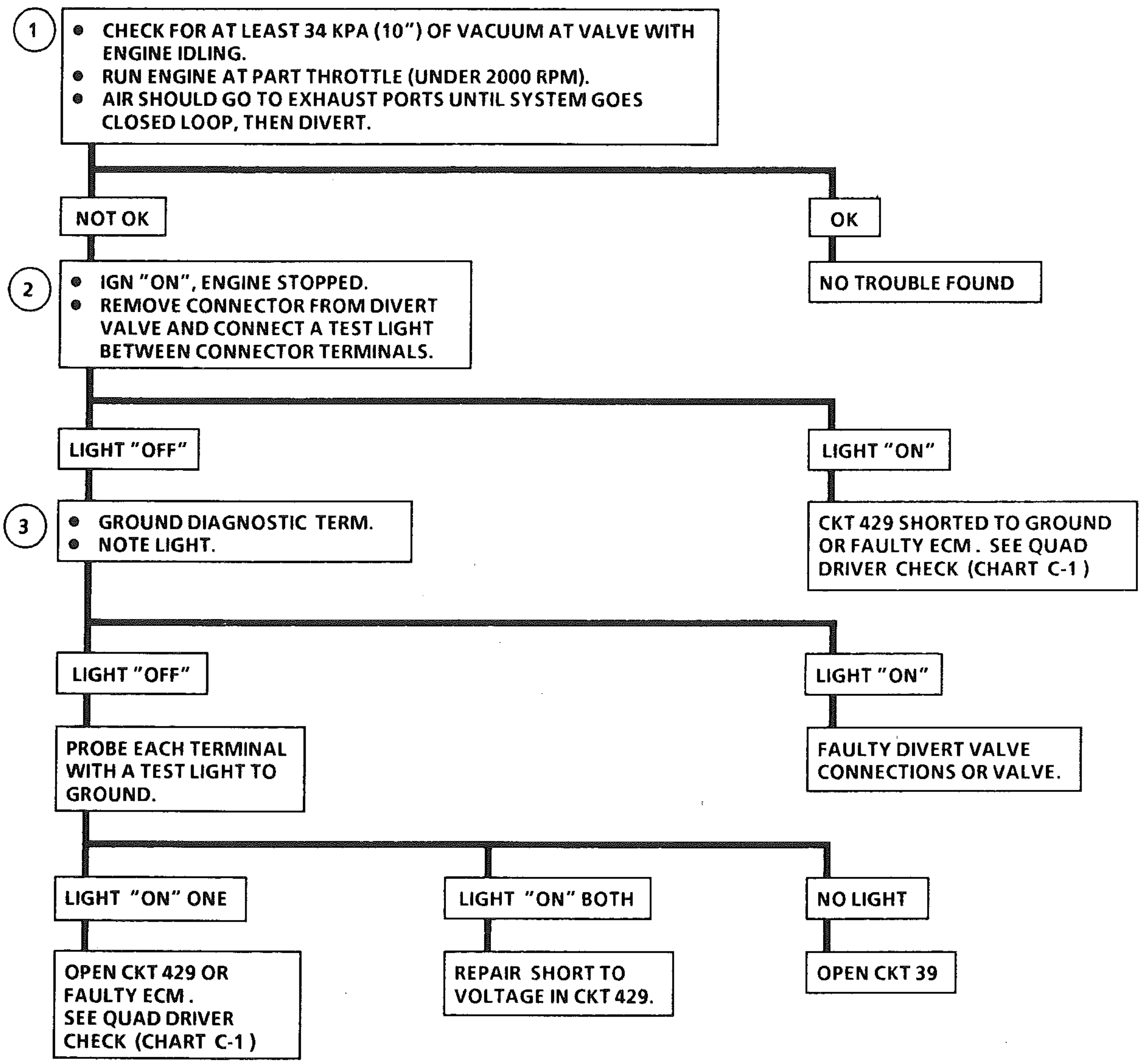
When grounded by the ECM, the solenoid causes the valve to direct air to the exhaust ports. When de-energized air diverts to the atmosphere, air will go to the ports provided the valve has a ground to the ECM and good manifold vacuum.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This is a system performance test. When vehicle goes to closed loop, air will switch from the ports to divert.
2. Tests for a grounded electric divert circuit. Normal system light will be "OFF".
3. Checks for an open control circuit. Grounding test terminal will energize the solenoid if ECM and circuits are normal. In this step, if test light is "ON", circuits are normal and faulty is in valve connections or valve.

CHART C-6

ELECTRIC CONTROL (DIVERT)
(MANUAL TRANSMISSION)
2.8L (VIN S) "F" SERIES (PORT)



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8S 4705-6E

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NO_x (oxides of nitrogen) emission levels caused by high combustion temperature. It does this by decreasing combustion temperature.

The main element of the system is the EGR valve operated by vacuum and mounted "ON" the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

OPERATION

The EGR valve is opened by vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open during warm engine operation and when the vehicle is above idle speed.

The amount of exhaust gas recirculated is controlled by variations in vacuum and the EGR vacuum control solenoid.

ELECTRONIC VACUUM REGULATOR VALVE

The Electronic Vacuum Regulator Valve (EVRV) uses "pulse width modulation" to control EGR flow. This means the ECM turns the solenoid "ON" and "OFF many times a second and varies the amount of "ON" time ("pulse width") to vary the amount of EGR.

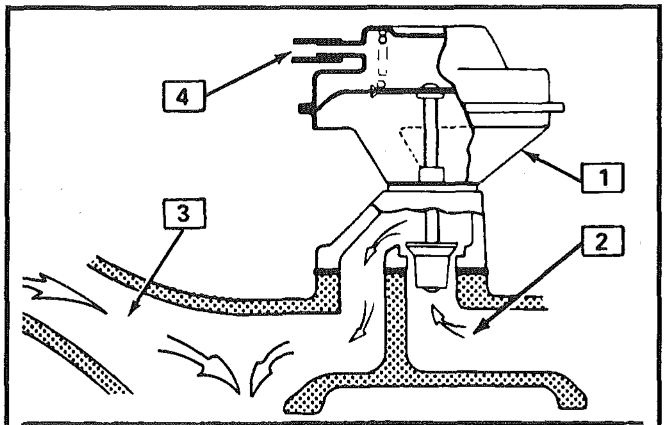


Figure C7-1 Exhaust Gas Recirculation

The ECM uses information from the following sensors to enable the EVRV:

- Throttle position sensor (TPS)
- P/N Switch
- Manifold absolute temperature (MAT)

The ECM uses information from the following sensors to regulate the EVRV:

- Engine Load
- Coolant Temperature
- Distributor (rpm Signal)
- Torque Converter Clutch (TCC)

A diagnostic switch is part of the control and monitors vacuum to the EGR valve. This switch will trigger a "Service Engine Soon" light, and set a Code 32 in the event of a vacuum circuit failure.

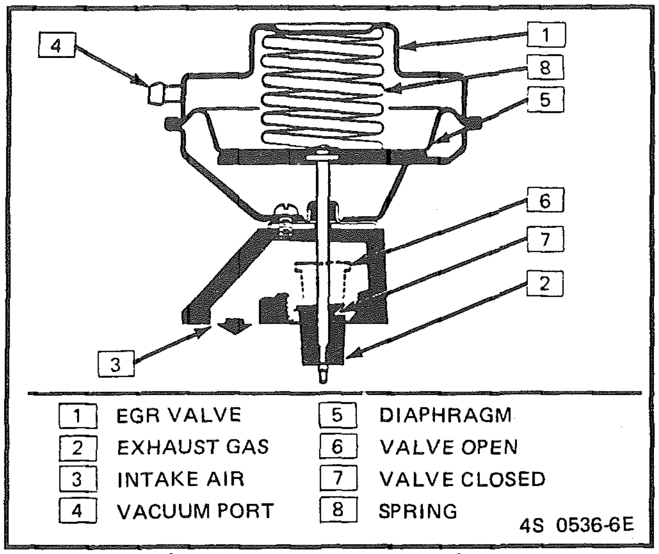


Figure C7-2 - Port EGR Valve

PORT EGR VALVE

The port EGR valve (Figure C7-2) is controlled by a flexible diaphragm which is spring loaded to hold the valve closed. Ported vacuum applied to the top side of the diaphragm overcomes the spring pressure and opens the valve in the exhaust gas port. This allows exhaust gas to be pulled into the intake manifold and enter the engine cylinders.

EGR VALVE IDENTIFICATION

- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number (Figure C7-4).
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.
- Port EGR valves have no identification stamped after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

RESULTS OF INCORRECT OPERATION

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may happen:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

If the EGR valve should stay open all of the time, the engine may not idle.

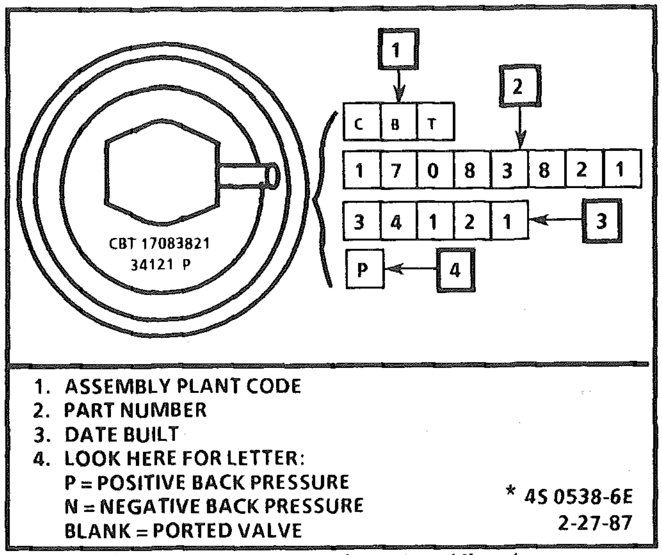


Figure C7-4 - EGR Valve Identification

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

DIAGNOSIS

Diagnosis of the EGR system is covered in CHART C-7 for the 2.8L at the end of this section.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Vacuum line
2. Bolts
3. EGR valve

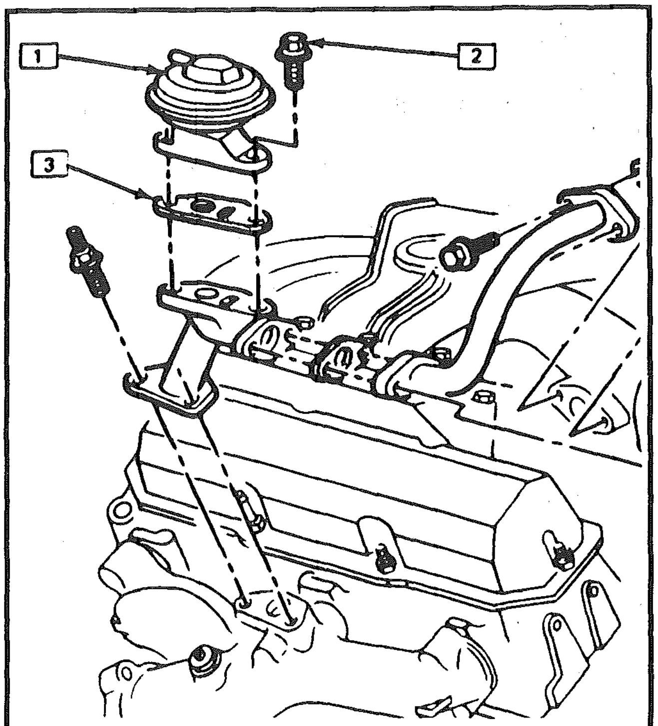
Install or Connect

1. EGR valve
2. Bolts
3. Vacuum line

EGR Manifold Passage

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.



[1] EGR VALVE
[2] BOLTS (2) 31 N·m (23 FT. LBS.)
[3] GASKET

7S 3320-6E

Figure C7-5 - EGR to Manifold Mounting

Do not wash EGR valve in solvents or degreaser--permanent damage to valve diaphragm may result. Also sand blasting of the valve is not recommended, since this can affect the operation of the valve.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

EGR Manifold Passage

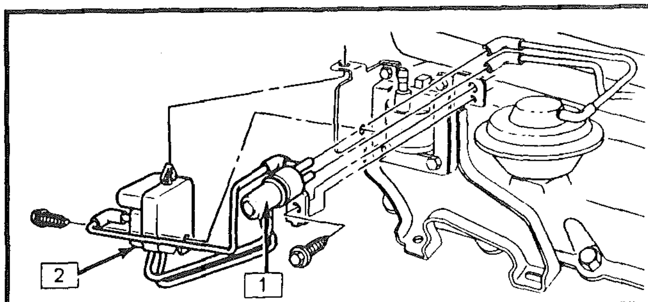
Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser--permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

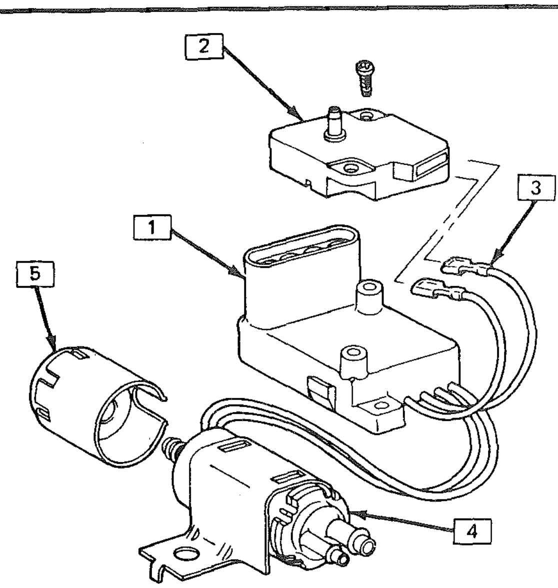


[1] EGR CONTROL SOLENOID
[2] EGR DIAGNOSTIC VACUUM SWITCH

05 24 84

5S 1488-6E

Figure C7-6 - EGR Control Solenoid



[1] EGR VACUUM CONTROL ASSEMBLY BASE
[2] EGR VACUUM DIAGNOSTIC SWITCH
[3] DIAGNOSTIC SWITCH CONNECTORS
[4] EGR SOLENOID
[5] FILTER

4S 1182-6EA

Figure C7-7 - EGR Vacuum Control Assembly

ELECTRONIC VACUUM REGULATOR VALVE

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at regulator valve
3. Vacuum hoses.
4. Nut and regulator valve.

Install or Connect

1. Regulator valve and bracket, tighten nut to 24 N · m (17 lb. ft.).
2. Vacuum hoses
3. Electrical connector
4. Negative battery cable

EVRV FILTER REPLACEMENT

The EVRV filter should be replaced every 30, 000 miles.

1. Grasp and pull filter "OFF" with a rocking motion.
2. Push . ew filter "ON", making sure cut-out for wires is properly aligned.

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Gasket, EGR Valve	3.680
Control, EGR Vacuum	3.670

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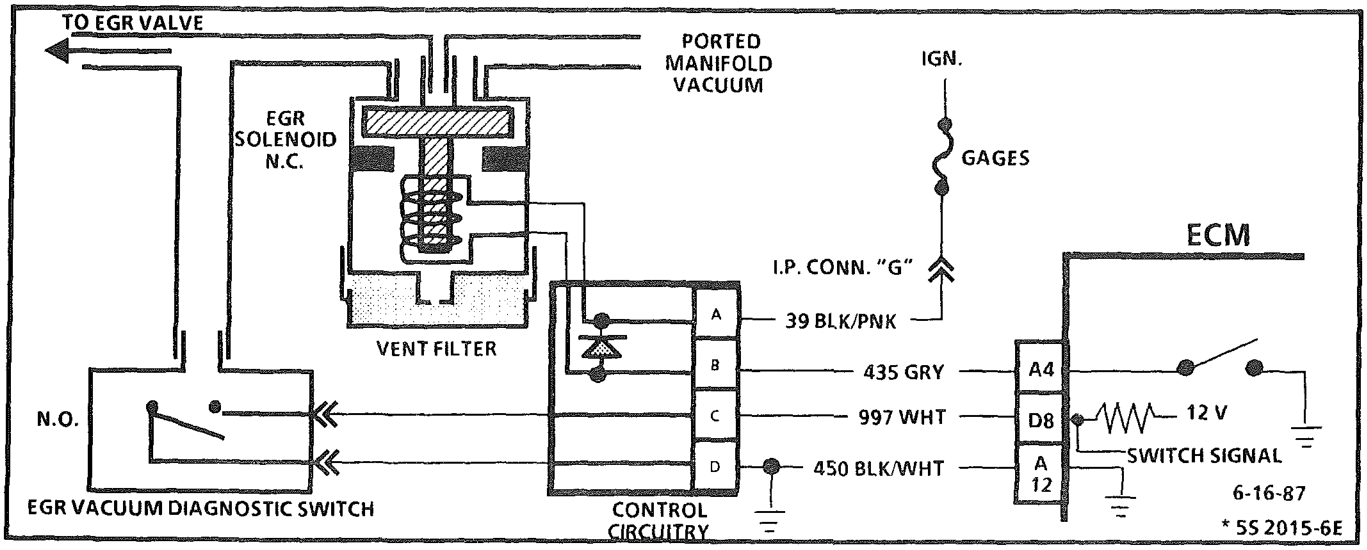

CHART C-7

EXHAUST GAS RECIRCULATION CHECK
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The EGR valve is controlled by a normally closed solenoid (allow a vacuum to pass when energized). The ECM energizes the solenoid to turn the EGR "ON", and monitors vacuum to the EGR with the EGR diagnostic switch. Code 32 will detect a faulty solenoid, vacuum switch or vacuum supply. CHART C-7 checks for plugged EGR passages, a sticking EGR valve, or a stuck open solenoid.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. With the ignition "ON" engine stopped, the solenoid should not be energized and vacuum should not pass to the EGR valve.
2. Grounding the diagnostic terminal will energize the solenoid and allow vacuum to pass to valve.
3. Checks for pluged EGR passages. If passages are plugged, the engine may have severe detonation on acceleration.
4. The EGR solenoid will not be energized in Park or Neutral. This test will determine if the Park/Neutral switch input is being received by the ECM.

CHART C-7

EXHAUST GAS RECIRCULATION CHECK 2.8L (VIN S) "F" SERIES (PORT)

ASSUMES NO CODE 32 IS STORED

(1)
- DISCONNECT EGR SOLENOID VACUUM HARNESS.
- ROTATE HARNESS AND REINSTALL ONLY THE EGR VALVE SIDE.
- CHECK PORTED VACUUM SOURCE TO SOLENOID (IF NOT OK, REPAIR).
- INSTALL A HAND HELD VACUUM PUMP WITH GAGE ON MANIFOLD SIDE OF EGR SOLENOID.
- IGNITION "ON", ENGINE STOPPED.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- APPLY VACUUM.
- OSBSERVE EGR VALVE.
- VALVE SHOULD NOT MOVE.

VALVE DOES NOT MOVE

(2)
- GROUND DIAGNOSTIC TERMINAL.
- REPEAT TEST.

VALVE MOVES

(3)
- START AND IDLE ENGINE.
- LIFT UP ON EGR VALVE AND OBSERVE IDLE.

IDLE ROUGHENS

(4)
- RECONNECT EGR SOLENOID.
- CONNECT VACUUM GAGE TO VACUUM HARNESS AT EGR VALVE,
- ENGINE AT NORMAL OPERATING TEMP.
- IN DRIVE (AUTOMATIC TRANS.)
- HOLD BRAKES AND ACCELERATE MOMENTARILY UP TO ABOUT 1800 RPM.
- OBSERVE GAGE
- SHOULD HAVE OVER 2" VACUUM BUT LESS THAN 10".

OK

NO TROUBLE FOUND. EGR SYSTEM OK.

NOT OK

OVER 10" VACUUM

REPLACE EGR FILTER.

NO VACUUM OR LESS THAN 2".

IF THERE ARE NO RESTRICTIONS IN VACUUM LINES, PERFORM P/N SWITCH CHECK. CHART C-1A A/T ONLY.

NO CHANGE

- REMOVE EGR VALVE.
- CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED REPLACE EGR VALVE.

VALVE DOES NOT MOVE

REPLACE EGR VALVE.

VALVE MOVES

- DISCONNECT EGR SOLENOID ELECTRICAL CONNECTOR.
- REPEAT TEST.

VALVE MOVES

REPLACE SOLENOID.

VALVE DOES NOT MOVE

CHECK CKT 435 FOR SHORT TO GROUND. IF NOT SHORTED, IT IS A FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-31-87
8S 4696-6E

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SECTION C8

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM AND MANUAL TRANSMISSION SHIFT LIGHT

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The transmission converter clutch (TCC) system uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission thru the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section "7A". This section will cover only the electrical operation of the TCC system.
- The ECM grounds a switch internally to turn on a solenoid in the transmission. This moves a check ball, which will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

The ECM controls the TCC apply solenoid by looking at several sensors:

- Speedo Buffer Sensor (also called vehicle speed sensor (VSS). Speed must be above a certain value before the clutch can apply.
- Coolant Temperature Sensor. Engine must be warmed up before clutch can apply about 65°C (149°F).
- Throttle position sensor (TPS). After the converter clutch applies, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.
- The brake switch is also part of the TCC circuit as it will remove battery voltage to the TCC solenoid when the brake pedal is depressed.
- Gear Select Switch. The 4th gear switch is used to send a signal to the ECM telling it when the transmission is in 4th gear. The ECM uses this information to vary the conditions under which the clutch applies or releases. However, the transmission does not have to be in fourth gear in order for the ECM to turn the clutch on.

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel ecomony may be lower than expected. If the vehicle speed sensor fails, the TCC will not apply. If the 4th gear switch does not operate, the TCC may not apply at the right time.

DIAGNOSIS

The diagnosis of the TCC system is covered in CHART C-8 . If the ECM detects a problem in the system, a Code 24 should set. In this case see Code 24 CHART.

SHIFT LIGHT (M/T) DESCRIPTION

The purpose of the shift light is to provide a display which indicates the optimum fuel economy point for up shifting the manual transmission based on engine speed and load. The display is a lamp on the instrument panel. Activation of the ECM driver turns the lamp on.

DIAGNOSIS

The shift light circuit can be checked using CHART C-8C.

ON-CAR SERVICE

- See Section "8B" if the shift light bulb needs replacement.
- See Section "6E" to repair wiring problem.
- See Section "6C" if ECM is to be replaced.

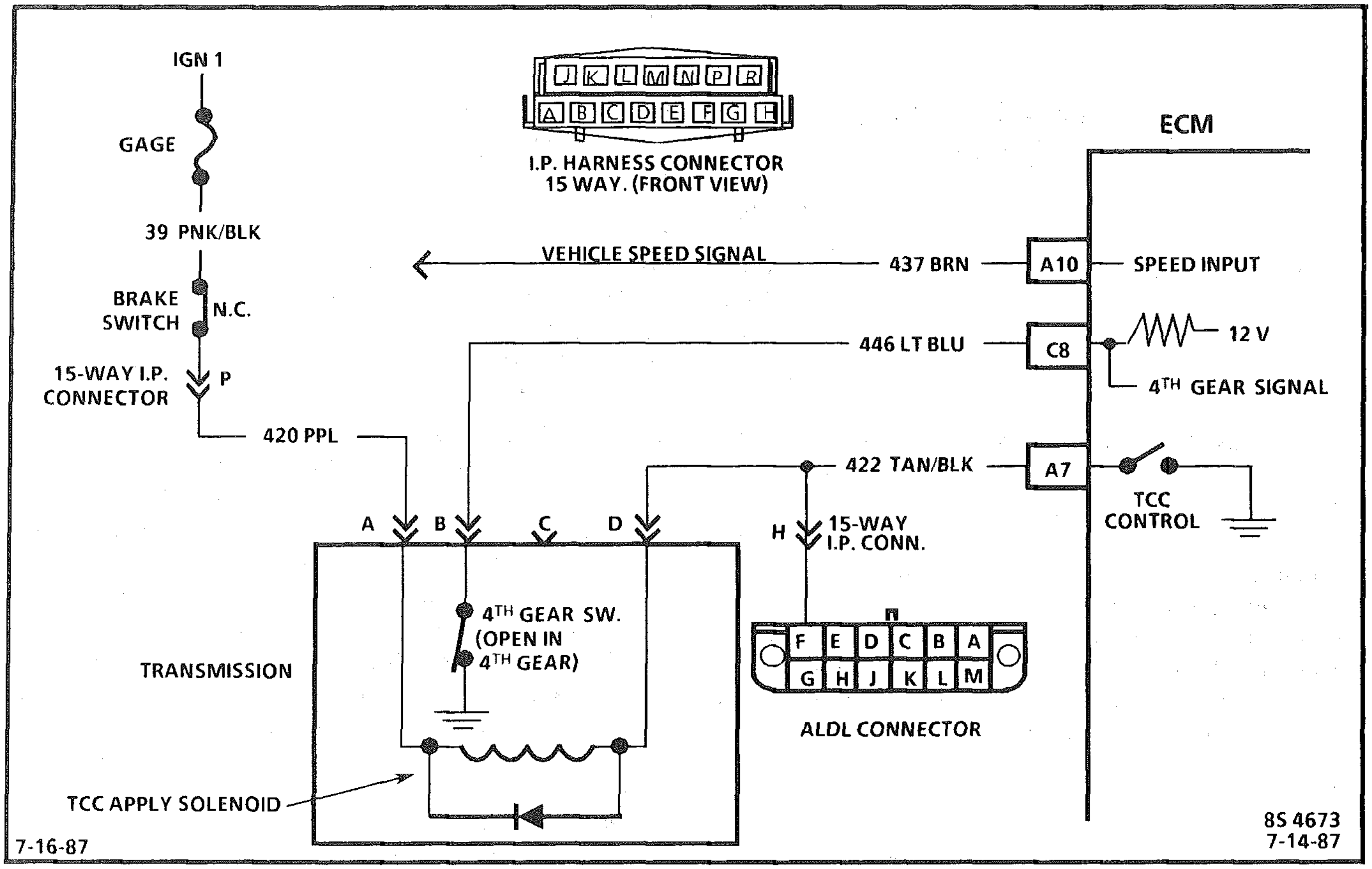

CHART C-8

(Page 1 of 2)
AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter stage when the vehicle is in a cruise condition. This allows the convenience of the automatic transmission and the fuel economy of a manual transmission. The heart of the system is a solenoid located inside the automatic transmission which is controlled by the ECM.

When the solenoid coil is activated ("ON"), the torque converter clutch is applied which results in straight through mechanical coupling from the engine to transmission. When the transmission solenoid is deactivated, the torque converter clutch is released which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

The ECM turns "ON" the TCC when coolant temperature is above 65°C (149°F), TPS not changing, and vehicle speed above a specified value.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. When a test light is connected from ALDL terminal "F" to ground, a test light "ON" indicates battery voltage is OK and the TCC solenoid is disengaged.
2. When the diagnostic terminal is grounded, the ECM should energize the TCC solenoid and the test light should go out.

Diagnostic Aids:

A "Scan" tool only indicates when the ECM has turned "ON" the TCC driver (grounded CKT 422), but this does not confirm that the TCC has engaged. To determine if TCC is functioning properly, engine rpm should decrease when the "Scan" indicates the TCC driver has turned "ON". To determine if the 4th gear switch is functioning properly, perform the checks in CHART C-8A (Page 2 of 2). The switches will not prevent TCC from functioning but will affect TCC lock and unlock points. If the 4th gear switch CKT is always open the TCC may engage as soon as sufficient oil pressure is reached.

CHART C-8

(Page 1 of 2)
AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC) 2.8L (VIN S) "F" SERIES (PORT)

- USING A "SCAN" TOOL CHECK THE FOLLOWING AND CORRECT IF NECESSARY.
- COOLANT TEMPERATURE SHOULD BE ABOVE 65°C.
- TPS - BE SURE TPS SIGNAL IS NOT ERRATIC.
- VSS - BE SURE "SCAN" DISPLAYS VSS WITH DRIVE WHEELS TURNING. IF CODE 24 IS PRESENT, SEE CODE CHART 24.

(1)
- MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
- IGN. "ON".
- CONNECT TEST LIGHT TO ALDL CONNECTOR TERMINAL "F" AND GROUND.
- BULB SHOULD "LIGHT."

DOES IT?

YES

- DEPRESS BRAKE PEDAL.
- LIGHT SHOULD GO OUT.

DOES IT?

YES

(2)
- IGN. "ON", ENGINE "OFF."
- RELEASE BRAKE PEDAL.
- GROUND DIAG. TERMINAL.
- LIGHT SHOULD GO OUT.

DOES IT?

YES

TCC CIRCUIT OK. BE SURE VEHICLE IS EQUIPPED WITH THE CORRECT PROM OR MEM-CAL. TO CHECK 4TH GEAR SWITCH, SEE CHART C-8A (2 OF 2).

NO

OPEN CKT 422 OR FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

NO

BRAKE SWITCH OUT OF ADJUSTMENT OR FAULTY, OR CKT 422 SHORTED TO VOLTAGE.

NO

- DISCONNECT TCC ELECTRICAL CONNECTOR.
- CONNECT TEST LIGHT BETWEEN TERM. "A & D".
- BULB SHOULD NOT "LIGHT."

DOES IT?

NO

- CONNECT TEST LIGHT FROM TERM. "A" TO GROUND.
- BULB SHOULD "LIGHT."

DOES IT?

YES

- GROUND ALDL TERM. "F".
- WITH TEST LIGHT CONNECTED BETWEEN TRANS. CONNECTOR TERMINALS "A & D".
- THE BULB SHOULD "LIGHT"

DOES IT?

YES

FAULTY TCC CONNECTION OR TCC SOLENOID.

NO

REPAIR OPEN CKT BETWEEN TRANS. & ALDL TERM. "F"

NO

OPEN IN CKT 39, TCC BRAKE SWITCH CKT, OR ADJUST SWITCH.

YES

CKT 422 SHORTED TO GROUND OR FAULTY ECM. SEE ECM QUAD DRIVER CHECK (CHART C-1).

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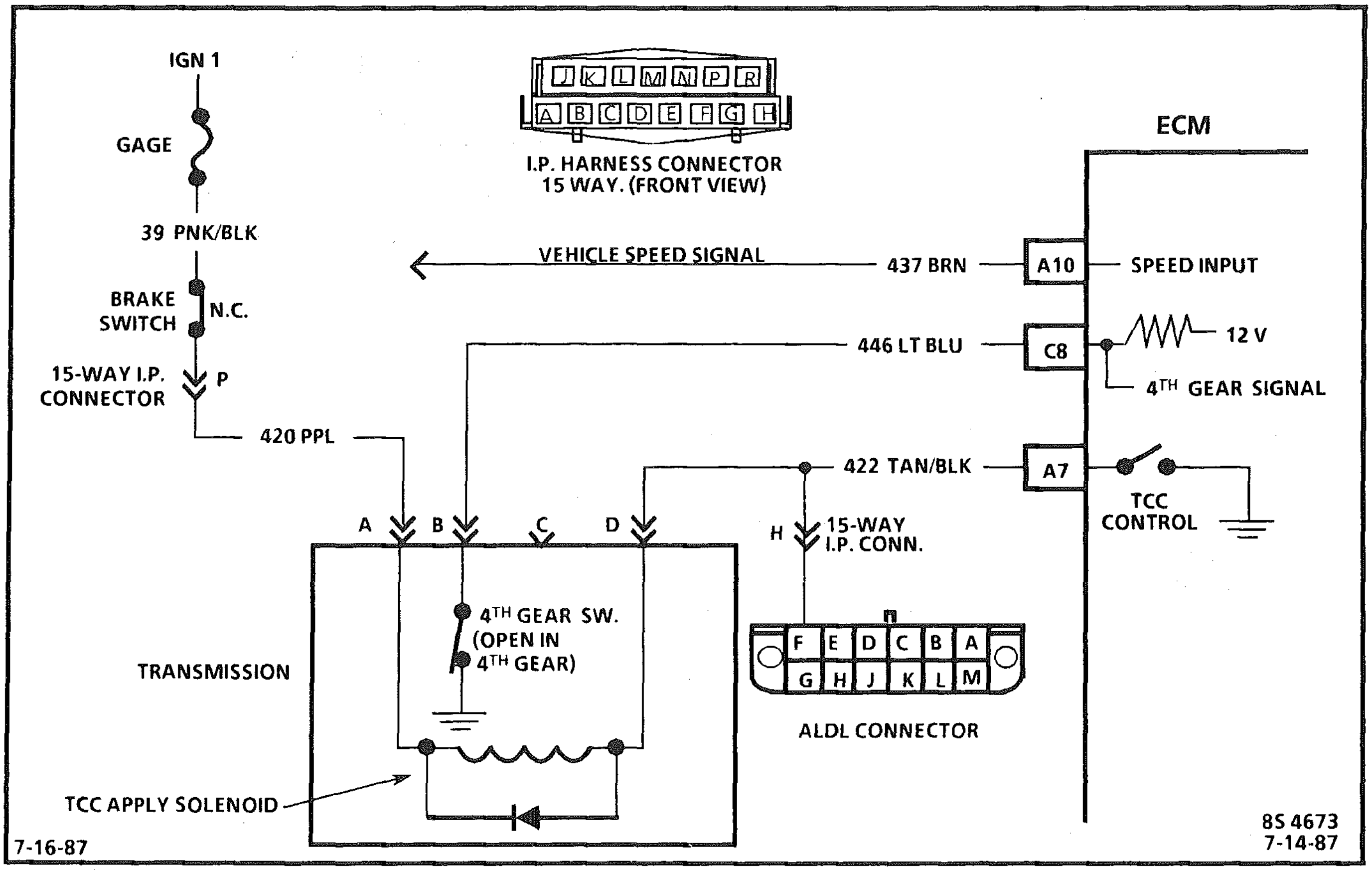


CHART C-8

(Page 2 of 2)

AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC)
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

A 4th gear switch (mounted in the trans.) opens when the trans. shifts into 4th gear, and this switch is used by the ECM to modify TCC lock and unlock points, when in a 4-3 downshift maneuver.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

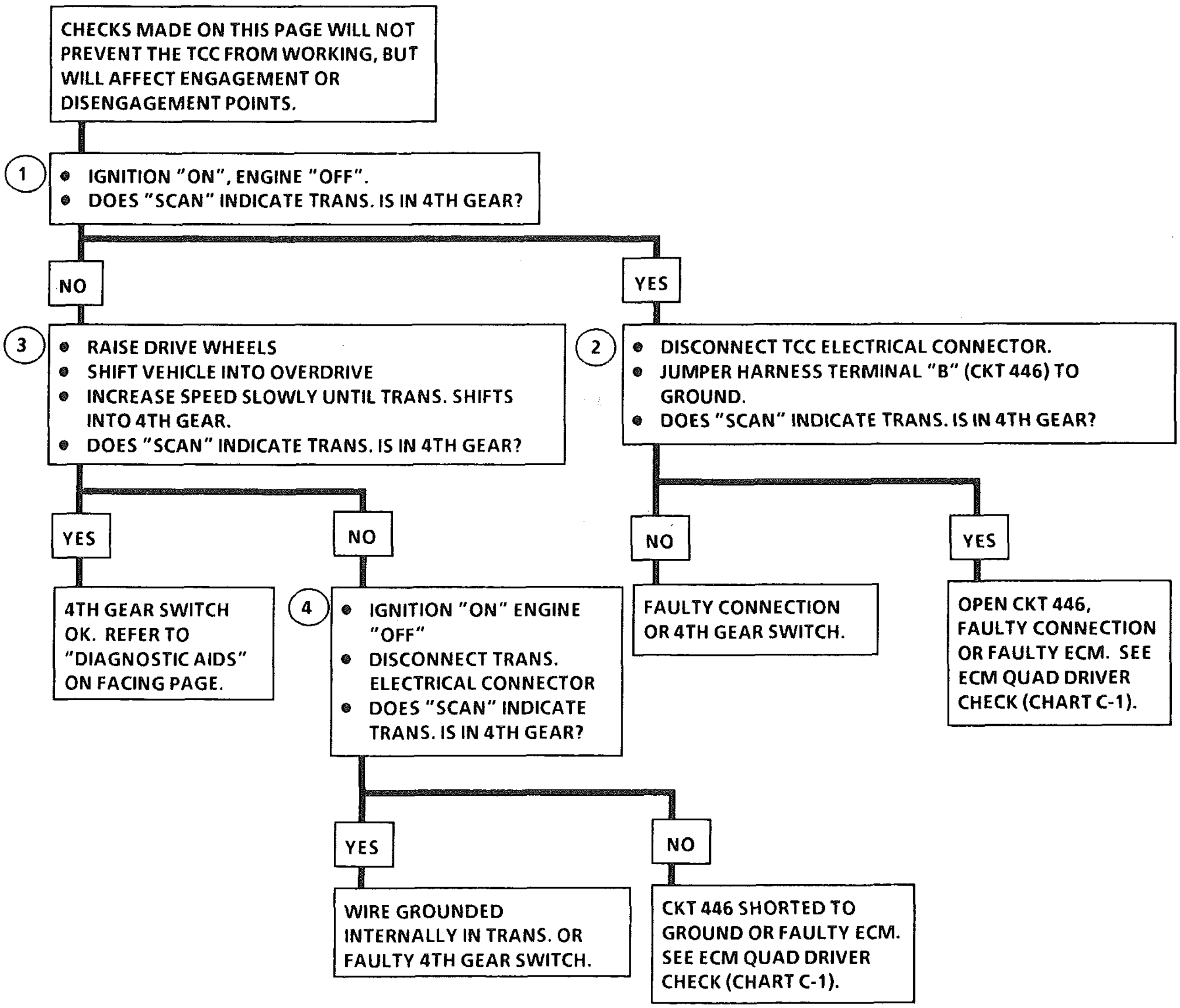
1. Unless the switch or CKT 446 is open the "Scan" should display "NO," indicating the trans. is not in 4th gear. The 4th gear switch should only be open while in 4th gear.
2. This step determines if the ECM and wiring are OK. Grounding CKT 446 should cause the "Scan" to display "NO," indicating the trans. is not in 4th gear.
3. Checks the operation of the 4th gear switch. When the trans. shifts into 4th gear the switch should open and the "Scan" should display "YES".
4. Disconnecting the TCC conne tor simulates an open switch to determine if CKT 446 is shorted to ground or the problem is in the transmission.

Diagnostic Aids:

A road test may be necessary to verify the customer complaint. If the "Scan" indicates TCC is turning "ON" and "OFF" erratically, check the state of the 4th gear switch to be sure it is not changing states under a steady throttle position. If the switch is changing states, check connections and wire routing carefully. Also if the 4th gear switch is always open the TCC may engage as soon as sufficient oil pressure is reached.

CHART C-8

(Page 2 of 2)
AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC) 2.8L (VIN S) "F" SERIES (PORT)



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SECTION C10

ECM CONTROLLED AIR CONDITIONING

CONTENTS

GENERAL DESCRIPTION

In order to improve idle quality and wide open throttle performance, the A/C compressor is controlled by the ECM.

There are two different types of A/C systems used in GM vehicles. One is referred to as C.C.O.T. (cycling clutch orifice tube), which uses a fixed displacement compressor. The other type of system uses a compressor with a variable displacement, and is referred to as the V-5 type system. The V-5 type meets A/C requirements without cycling. For descriptions of both types, and an explanation of the components used, refer to Section "1B" of the service manual.

OPERATION

The 2.8L engine uses the C.C.O.T. type A/C system, and is controlled by the ECM. When A/C is requested, 12V power is supplied to the pressure cycling switch and to the A/C power relay. The ECM controls the A/C clutch by energizing the A/C control relay. This allows the ECM to increase idle speed before turning on A/C to improve idle quality.

The high pressure cut-out switch (normally closed) opens when head pressure gets too high. This disables the A/C clutch, before damage can occur to the system. This switch opens, when pressure is greater than about 440 psi (3034 kPa).

See CHART C-10 for diagnosis and wiring diagram of the electrical portion of the A/C circuit.

DIAGNOSIS

CHART C-10 should be used for diagnosing the electrical portion of the A/C circuit. Section "1B" should be used for diagnosing the refrigerant portion of the system.

The "Scan" tool will be used in diagnosing the system, as it has the ability to read the A/C request input to the ECM, as well as displaying when the ECM has commanded the A/C clutch "ON".

ON-CAR SERVICE

For removal and replacement procedures of A/C components, refer to Section "1" of the service manual.

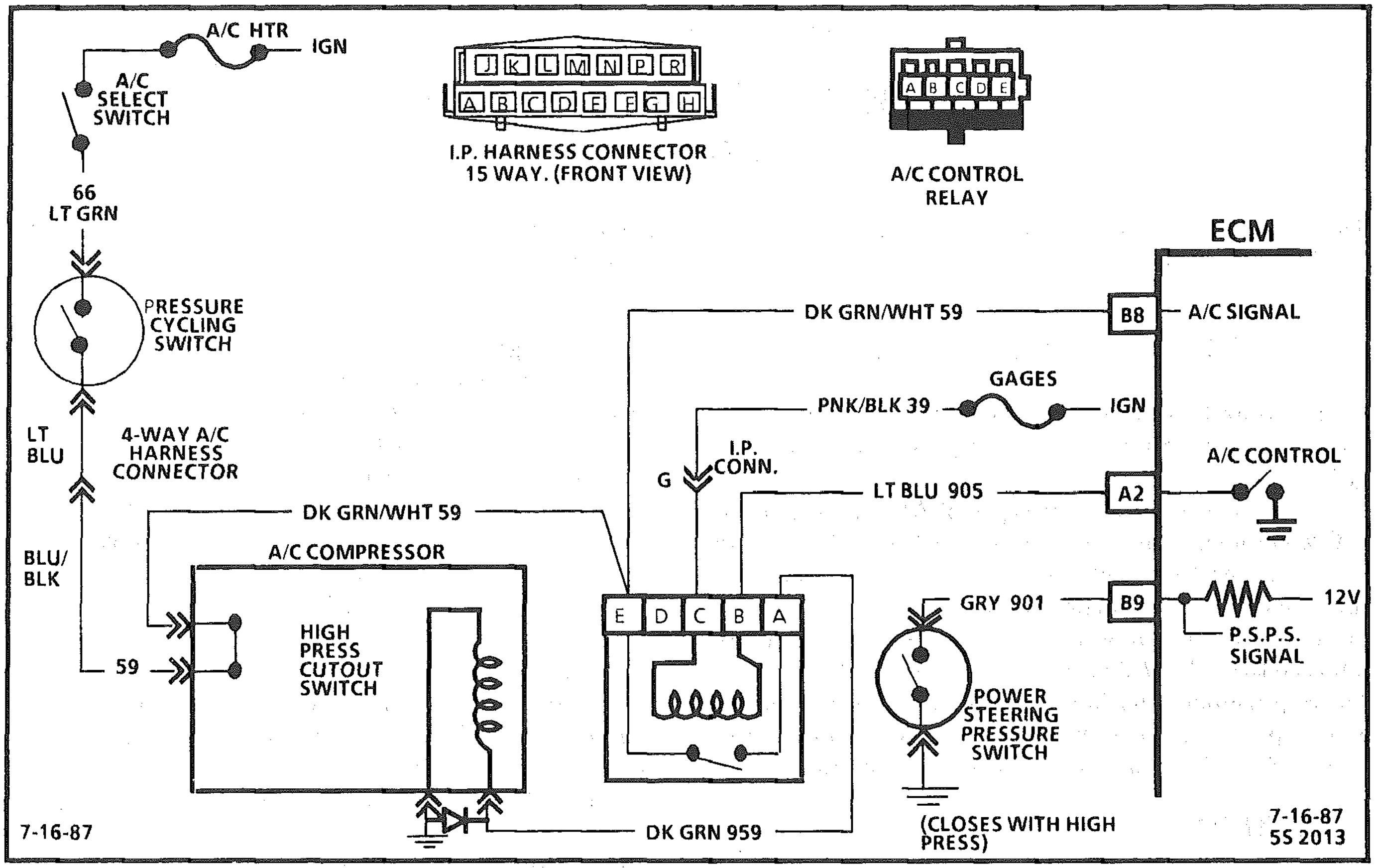


CHART C-10

A/C CLUTCH CONTROL
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

ECM control of the A/C clutch improves idle quality and performance by:

- Delaying clutch apply until the idle air rate is increased.
- Releasing clutch when idle speed is too low or during high power steering loads.
- Releasing clutch at wide open throttle.
- smooths cycling of the compressor by providing additional fuel at the instant clutch is applied.

Voltage is supplied to the A/C Clutch Control relay on CKT 59 by the A/C Control Switch. This same voltage is supplied as a signal to ECM pin B8. After a time delay of about 1/2 second the ECM will ground terminal "A2," CKT 905, and close the A/C relay contacts.

When relay is energized battery voltage from CKT 59 is supplied to the A/C clutch through the relay and CKT 959.

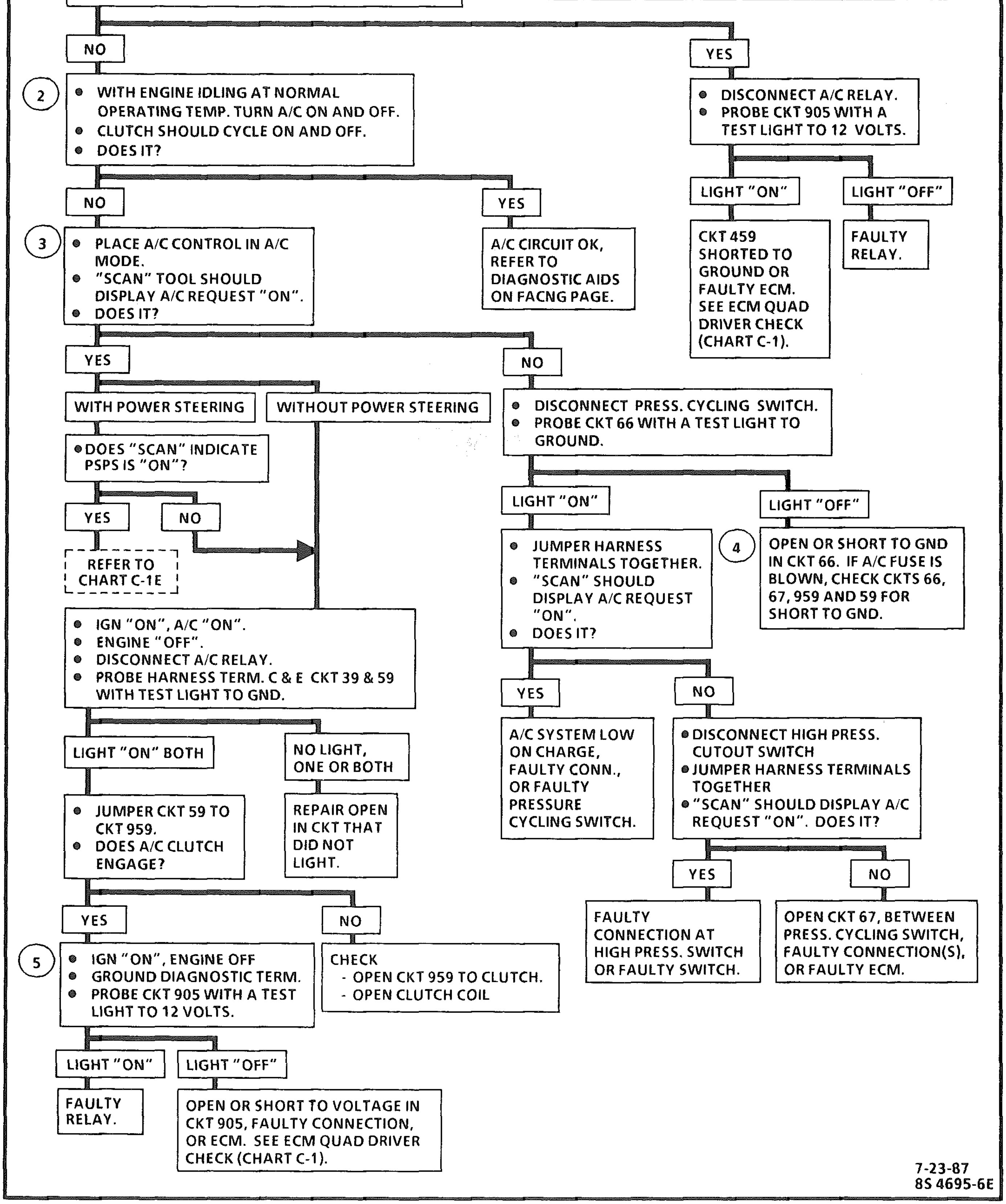
Test Description:
Numbers below refer to circled numbers on the diagnostic chart.

1. The ECM will only energize the A/C relay, when the engine is running. This test will determine if the relay, or CKT 905, is faulty.
2. In order for the clutch to properly be engaged, the pressure cycling switch must be closed to provide 12 volts to the relay, and the high pressure switch must be closed, so the A/C request (12 volts) will be present at the ECM.
3. Determines if the signal is reaching the ECM on CKT 59 from the A/C control panel. Signal should only be present when the A/C mode or defrost mode has been selected.
4. A short to ground in any part of the A/C request circuit, CKT 67 to the relay CKT 59, CKT 959 to the A/C clutch, or the A/C clutch, could be the cause of the blown fuse.
5. With the ignition "ON" and the diagnostic terminal grounded, the ECM should be grounding CKT 905 which should cause the test light to be "ON".

Diagnostic Aids:

If complaint was insufficient cooling, the problem may be caused by an inoperative cooling fan. The engine cooling fan should turn "ON," when A/C is "ON" and A/C head pressure exceeds about 233 psi. If not, see CHART C-12 for diagnosing the cooling fan.

CHART C-10
A/C CLUTCH CONTROL
2.8L (VIN S) "F" SERIES (PORT)



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SECTION C12

COOLING FAN CONTROL

CONTENTS

GENERAL DESCRIPTION

The fan is used for engine and A/C condenser cooling but the fan only operates under certain conditions.

OPERATION

The electric cooling fan on this engine is controlled by the ECM. The ECM will ground the cooling fan relay, which turns on the fan, when the following conditions are met.

- Coolant temperature sensor signal indicating a temperature greater than 106°C (222°F).
- Or: A/C head pressure greater than about 200 psi and vehicle speed less than 40 mph.
- When the cooling fan is turned on, it will stay on for a minimum time of 15 seconds on the 2.8L.
- The 2.8L also uses an override switch which will also turn on the cooling fan if the ECM fails.

DIAGNOSIS

The following charts will diagnose the ECM controlled cooling fan.

PARTS INFORMATION

PART NAME	GROUP
Fan, Engine	1.055
Motor, Fan	1.055
Relay, Engine Fan	1.055

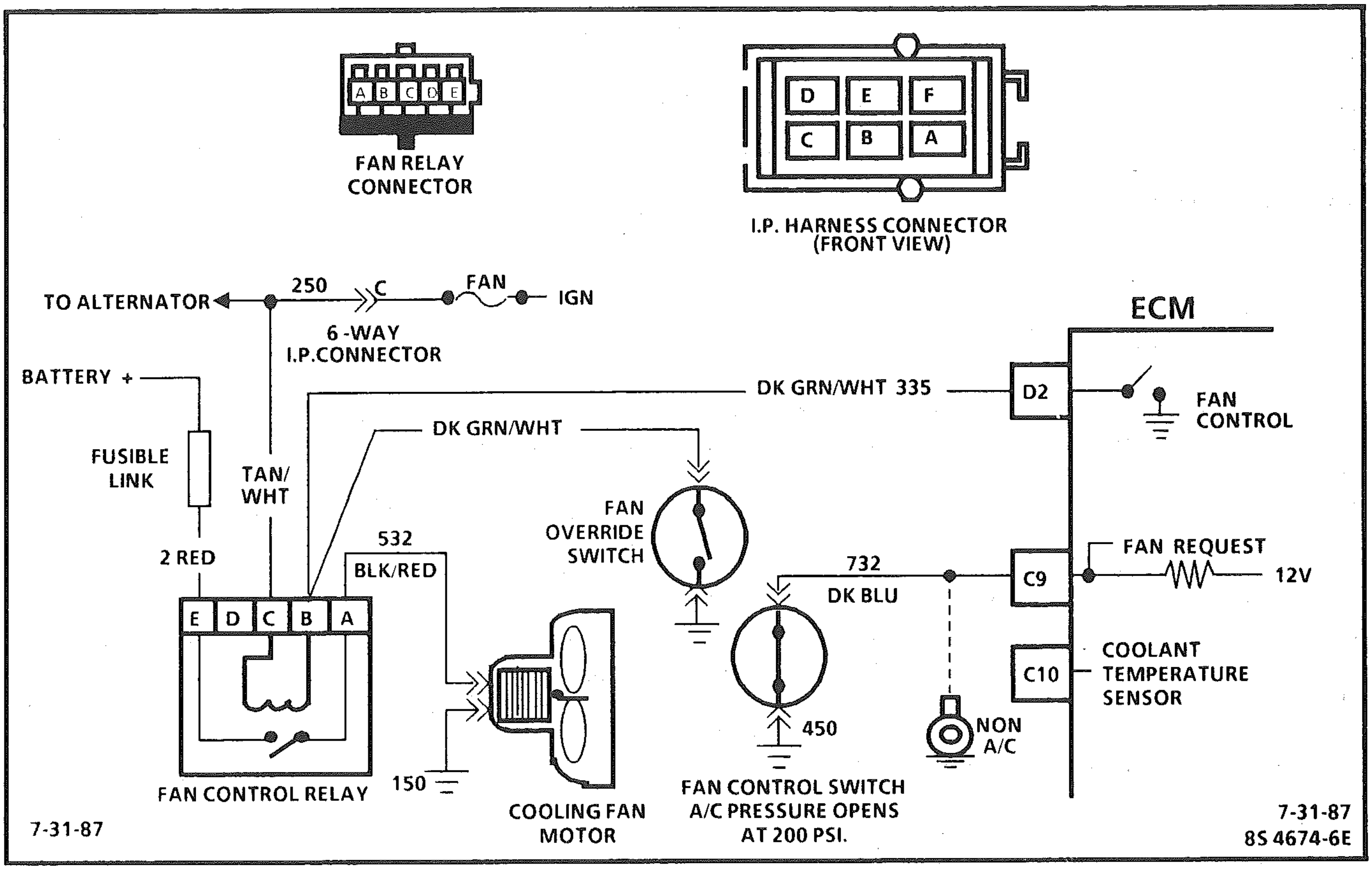


CHART C-12

(Page 1 of 2)
COOLING FAN CONTROL CIRCUIT
2.8L (VIN S) "F" SERIES (PORT)

Circuit Description:

The electric cooling fan is controlled by the ECM, based on inputs from the coolant temperature sensor, the A/C fan control switch, and vehicle speed. The ECM controls the fan by grounding CKT 335, which energizes the fan control relay. Battery voltage is then supplied to the fan motor.

The ECM grounds CKT 335, when coolant temp. is over about 106°C (223°F), or when A/C has been requested, and the fan control switch opens with high A/C pressure, about 200 psi (1380 kPa). Once the ECM turns the relay "ON", it will keep it "ON" for a minimum of 30 seconds, or until vehicle speed exceeds 70 mph.

Also, if Code 14 or 15 sets, or the ECM is in throttle body back up, the fan will run at all times.

On a vehicle not equipped with A/C, CKT 732 is jumpered to ground so that the fan does not run at all times.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. With the diagnostic terminal grounded, the cooling fan control driver will close, which should energize the fan control relay.
2. If the A/C fan control switch or circuit is open, the fan would run whenever the engine is running.
3. With A/C clutch engaged, the A/C fan control switch should open, when A/C high pressure exceeds about 200 psi (1380 kPa). This signal should cause the ECM to energize the fan control relay.

Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boilover, or the hot light, or temperature gage indicated over heating.

If the gage, or light, indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can, also, be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

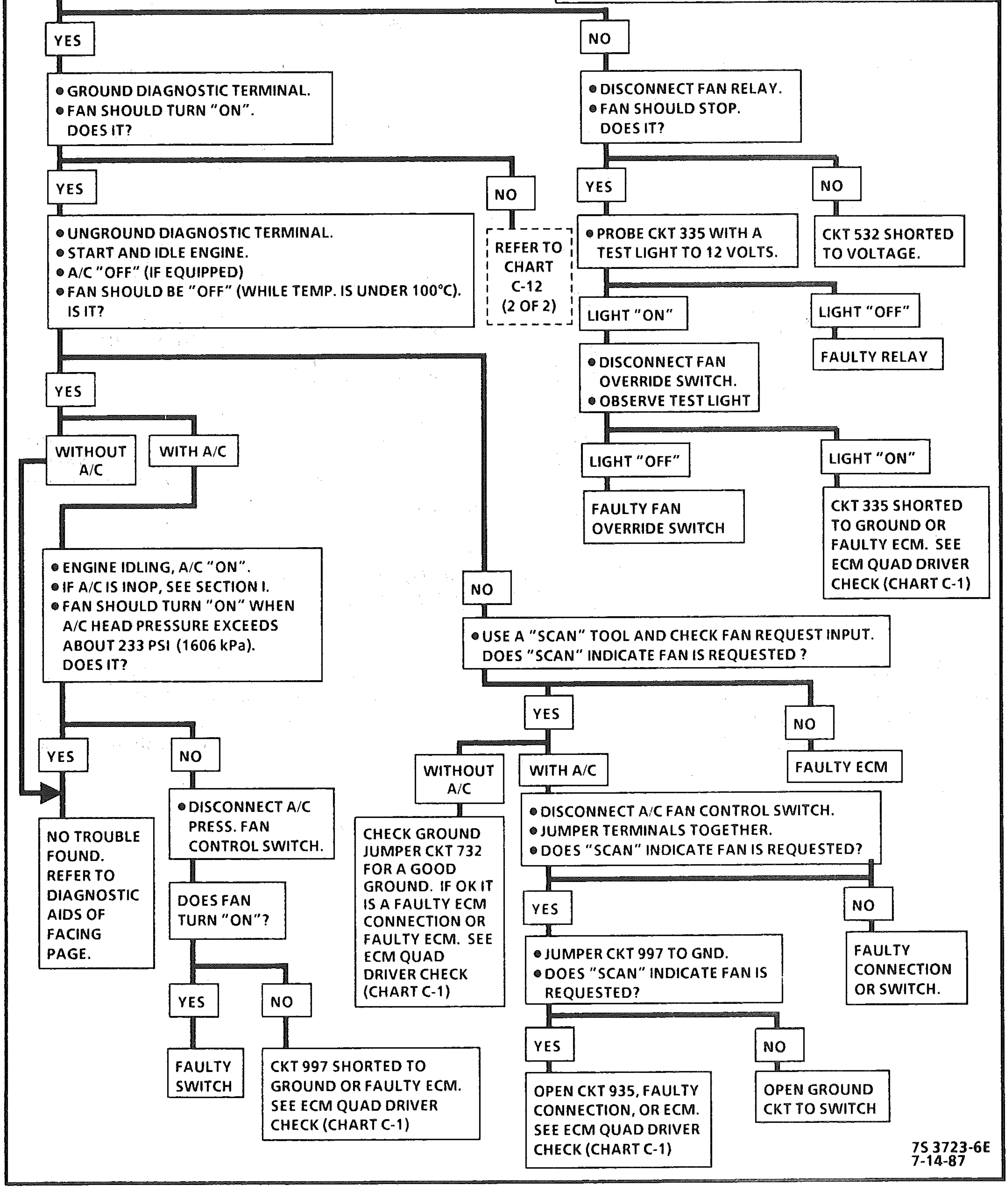
If the engine is actually overheating, and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating, and the cooling fan is "ON", the cooling system should be checked.

CHART C-12

(Page 1 of 2)

COOLING FAN CONTROL CIRCUIT 2.8L (VIN S) "F" SERIES (PORT)



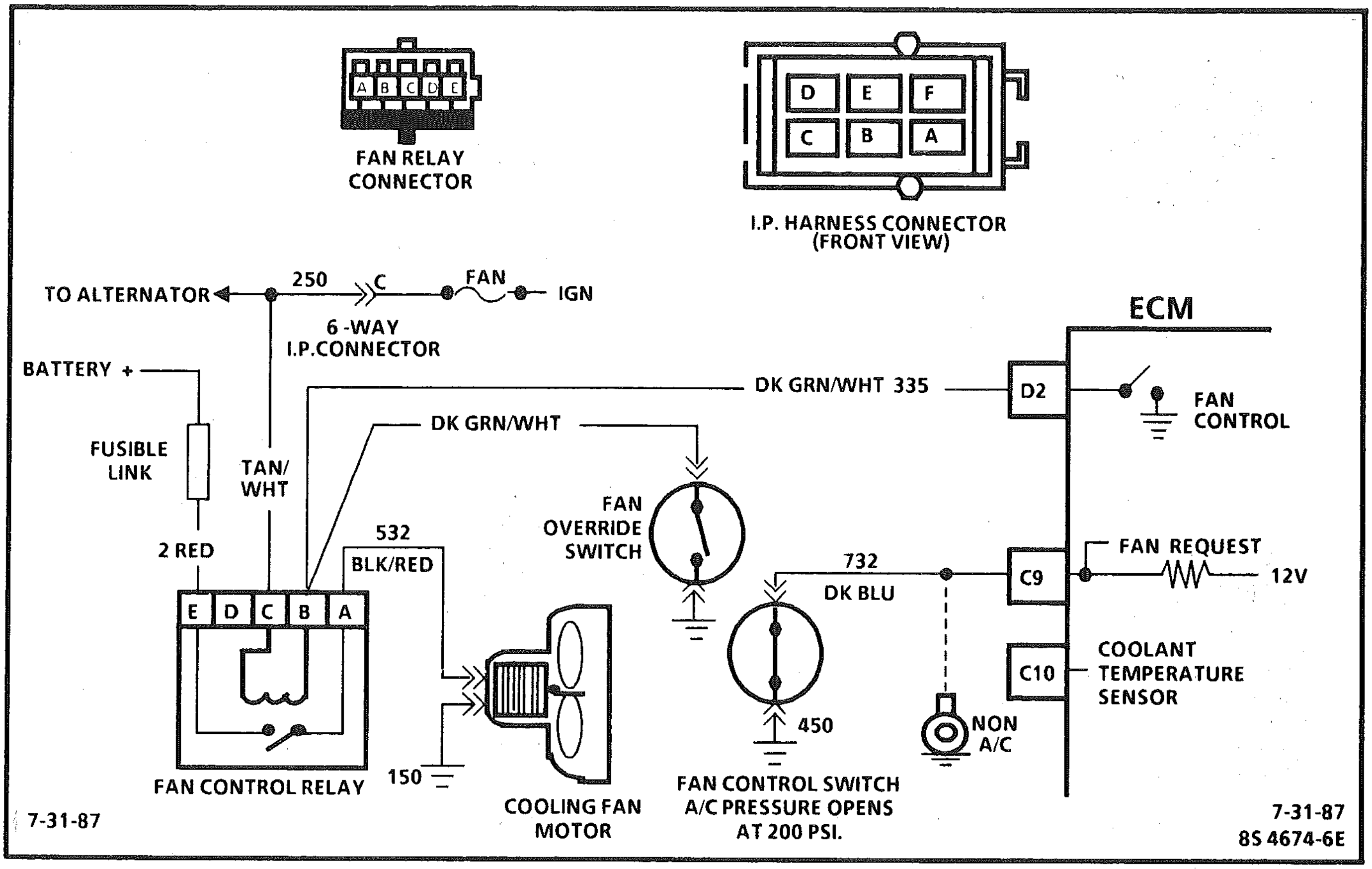


CHART C-12

(Page 2 of 2)
COOLING FAN CONTROL CIRCUIT
2.8L (VIN S) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. 12 volts should be available to both terminal "E" & "C", when the ignition is "ON".
2. This test checks the ability of the ECM to ground CKT 335. The SES light should also be flashing, at this point. If it isn't flashing, see CHART A-2.
3. If the fan does not turn "ON", at this point, CKT 936 or CKT 150 is open, or the cooling fan motor is faulty.

FROM CHART C-12 (1 OF 2)

CHART C-12

(Page 2 of 2)

COOLING FAN CONTROL CIRCUIT 2.8L (VIN S) "F" SERIES (PORT)

1

- DISCONNECT FAN CONTROL RELAY.
- IGNITION "ON", ENGINE STOPPED.
- PROBE "A" AND "D" HARNESS TERMINALS WITH A TEST LIGHT CONNECTED TO GROUND.

LIGHT "ON" BOTH

2

- DIAGNOSTIC TERMINAL GROUNDED.
- PROBE CKT 335 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.

LIGHT "ON"

3

- JUMPER HARNESS TERMINALS "A" AND "E" TOGETHER USING A FUSED JUMPER.
- FAN SHOULD RUN. DOES IT?

NO

- WITH "A-E" STILL JUMPERED, CONNECT A TEST LIGHT ACROSS THE COOLING FAN MOTOR HARNESS CONNECTOR TERMINALS.

LIGHT "OFF"

- PROBE EACH TERMINAL WITH A TEST LIGHT CONNECTED TO GROUND.

LIGHT "ON" ONE

OPEN IN GROUND CKT 150

LIGHT "OFF"

REPAIR OPEN IN CKT BETWEEN RELAY AND COOLING FAN MOTOR.

LIGHT "ON"

FAULTY MOTOR

YES

FAULTY RELAY OR RELAY CONNECTION

LIGHT "OFF"

OPEN OR SHORT TO VOLTAGE IN CKT 335, FAULTY CONNECTION AT ECM OR A FAULTY ECM.

NO LIGHT "ON" ONE OR BOTH

REPAIR OPEN OR SHORT TO GROUND IN CIRCUIT THAT DID NOT LIGHT.

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SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION

A "closed" crankcase ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-1).

The primary control is through the PCV valve (Figure C13-2) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

RESULTS OF INCORRECT OPERATION

A plugged valve or hose may cause:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in engine.

A leaking valve or hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

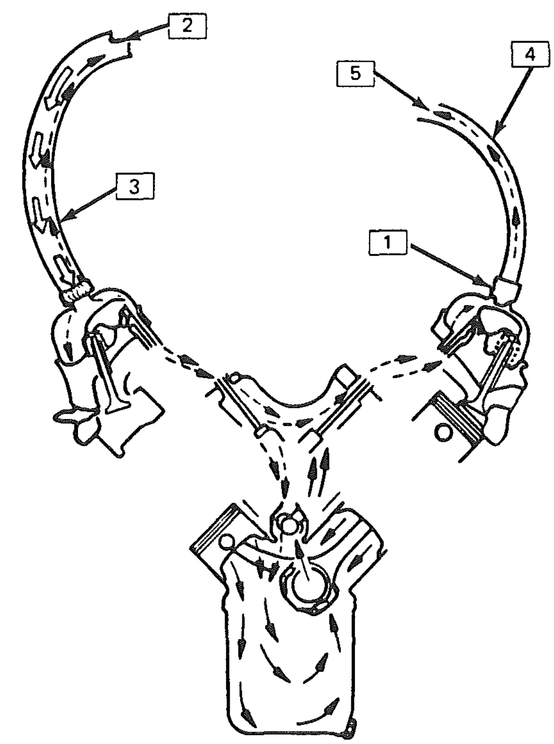
DIAGNOSIS

FUNCTIONAL CHECK OF PCV VALVE

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn "OFF" the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.



CLEAN AIR
VOLATILE OIL FUMES
MIXTURE OF AIR AND FUMES

1 PCV VALVE
2 TO THROTTLE BODY
3 CRANKCASE VENT HOSE
4 PCV VALVE HOSE
5 TO INTAKE MANIFOLD

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Figure C13-1 PCV Flow

Proper operation of the PCV System is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV System is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

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Figure C13-2 PCV Valve Cross Section

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve at intervals shown in Section "OB".

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Valve Asm, C/Case Vent	1.745
Tube, C/Case Vent	1.762
Hose, C/Case Vent Vlv	1.762
Breather, A/C and Sil	3.410

SECTION A
5.0L & 5.7L ENGINE

DIAGNOSTIC CIRCUIT CHECK

The "Diagnostic Circuit Check" verifies the system is functioning correctly. Some special considerations to keep in mind while making the "Diagnostic Circuit Check" are:

Blocking Drive Wheels

The vehicle drive wheels must be blocked while checking the system.

Cold Oxygen Sensor

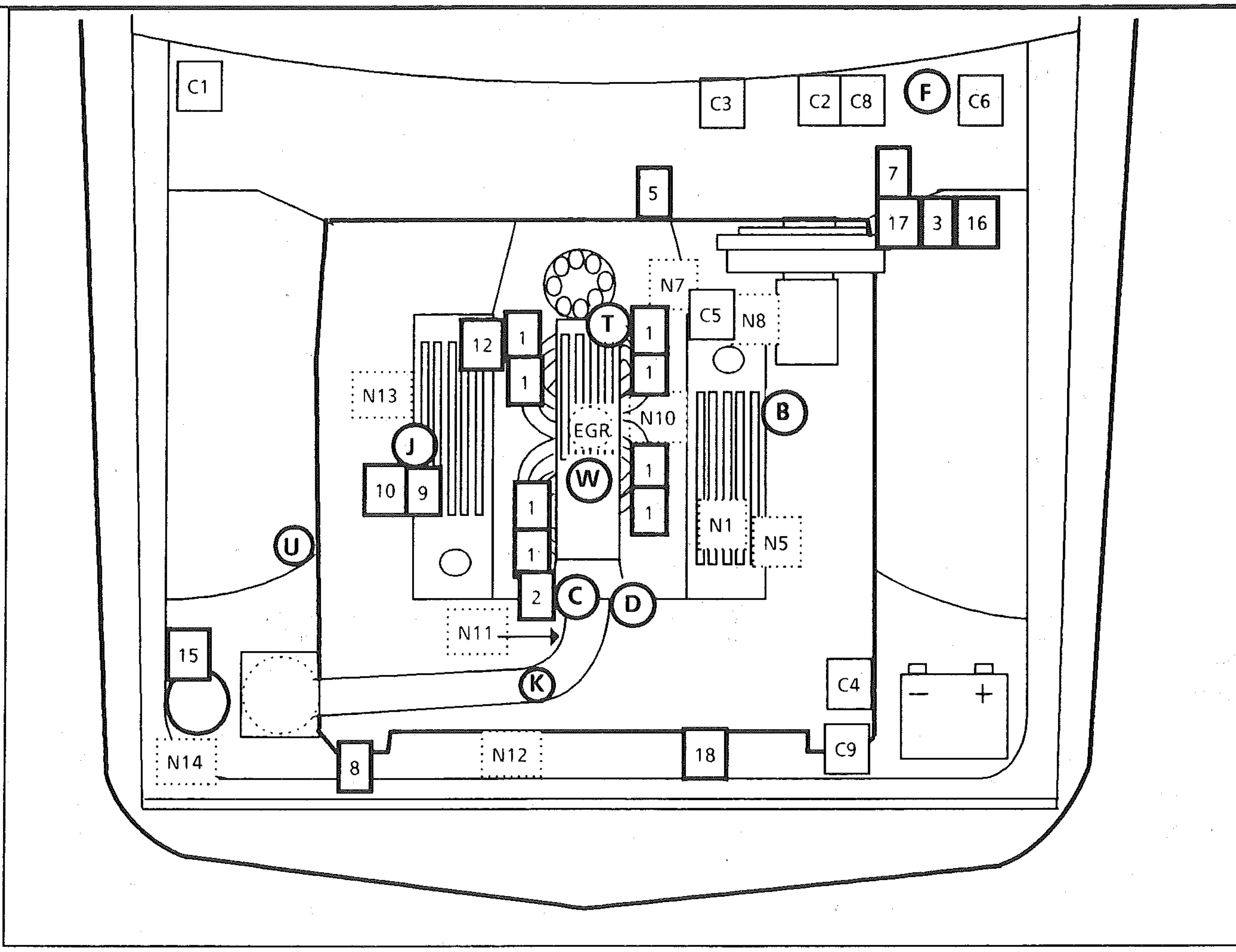
On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

Basic Procedure

If you have not reviewed the Basic Information on how to use the Diagnostic Procedures, go to the Introduction of this section.

SECTION A
ENGINE COMPONENTS / WIRING DIAGRAMS / DIAGNOSTIC CHARTS

'F' SERIES RPO: LB9 & L98 VIN CODE: F & 8 5.0L, 5.7L V8 PFI



COMPUTER HARNESS

- C1 Electronic Control Module (ECM)
- C2 ALDL diagnostic connector
- C3 "SERVICE ENGINE SOON" light
- C4 ECM power
- C5 ECM harness ground
- C6 Fuse panel
- C8 Fuel pump test connector (ALDL "G")
- C9 Fuel pump/ECM fuse

NOT ECM CONNECTED

- N1 Crankcase vent valve (PCV)
- N5 Engine temp. sensor (gage overheat)
- N7 Oil pressure sensor (gage)
- N8 Oil pressure switch (fuel pump)
- N10 Cold start valve
- N11 Cold start fuel injection switch
- N12 Secondary cooling fan
- N13 Cooling fan temperature switch
- N14 Secondary cooling fan relay

CONTROLLED DEVICES

- 1 Fuel injector
- 2 Idle air control motor
- 3 Fuel pump relay
- 5 Trans. Converter Clutch connector
- 7 Electronic Spark Control module
- 8 Primary cooling fan relay
- 9 Air injection converter/divert solenoid
- 10 Air injection port solenoid
- 12 EGR vacuum solenoid
- 15 Fuel vapor canister solenoid
- 16 MAF sensor power relay
- 17 MAF sensor burn-off relay
- 18 Primary cooling fan

INFORMATION SENSORS

- B Exhaust oxygen
- C Throttle position
- D Coolant temperature
- F Vehicle speed
- J ESC knock
- K Mass Air Flow
- T Manifold Air Temperature
- U A/C pressure fan switch
- W EGR temp. diagnostic switch

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Figure A-1 - Component Locations - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series

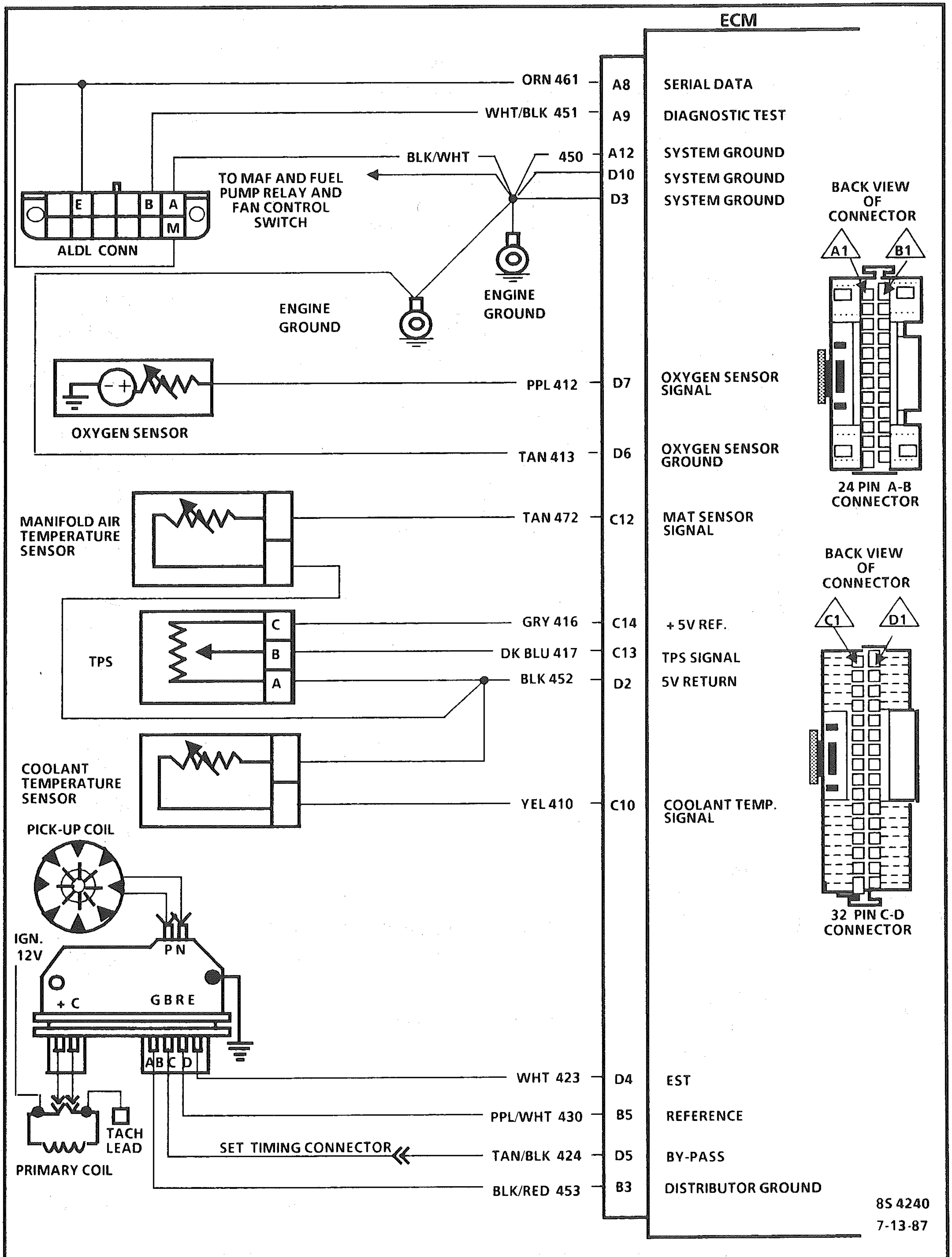


Figure A-2 - Wiring Diagram - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series (1 of 4)

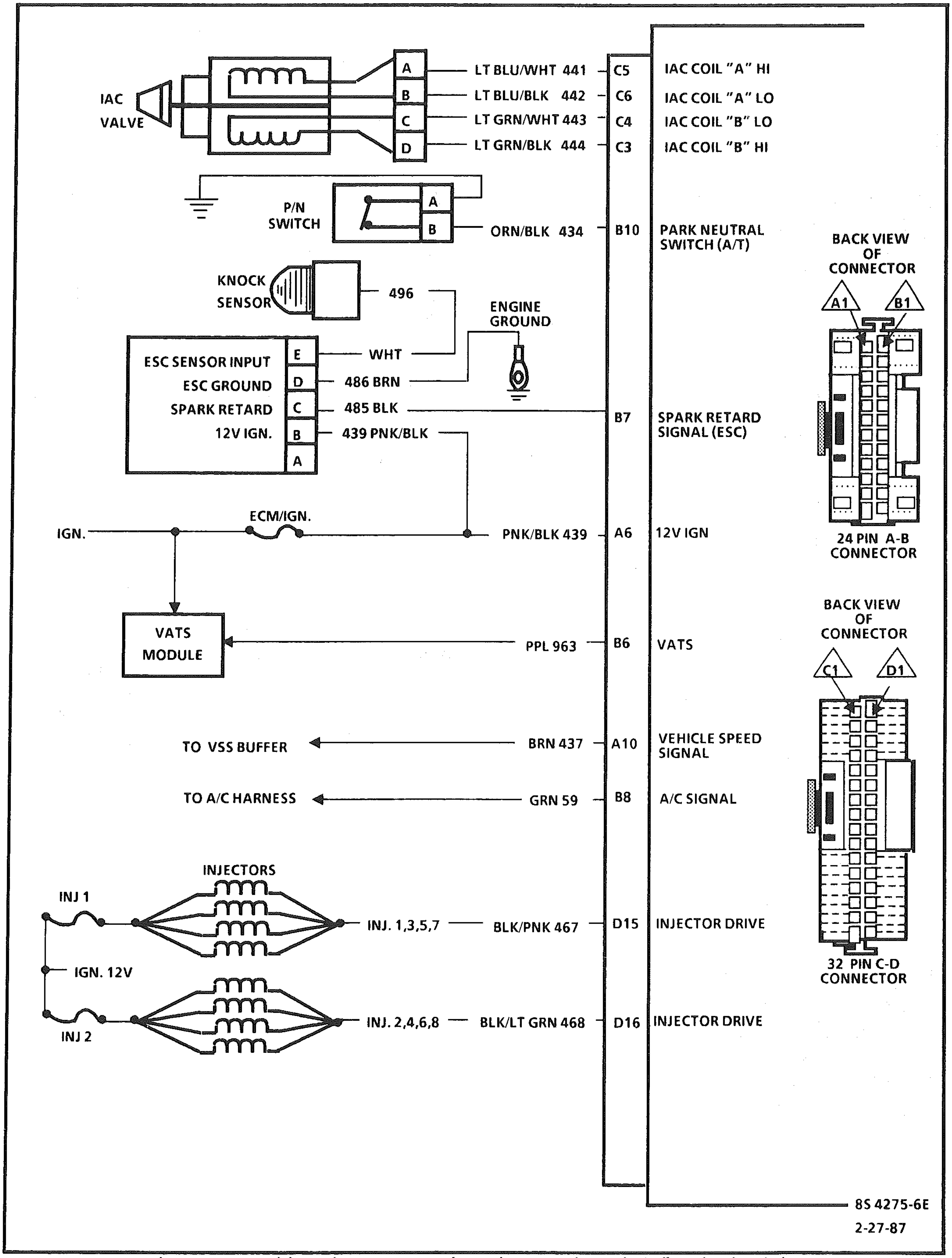


Figure A-3 - Wiring Diagram - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series (2 of 4)

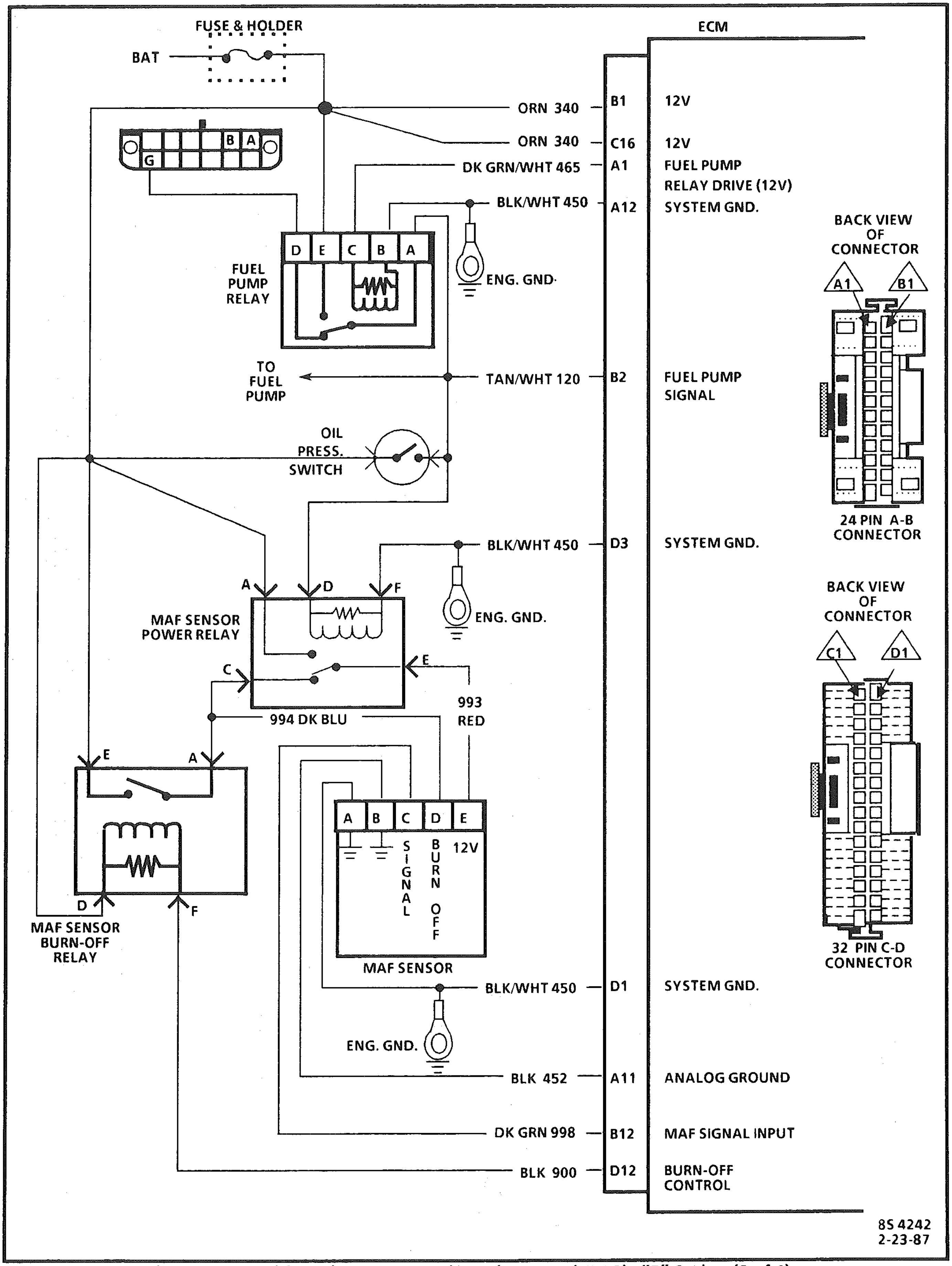


Figure A-4 - Wiring Diagram - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series (3 of 4)

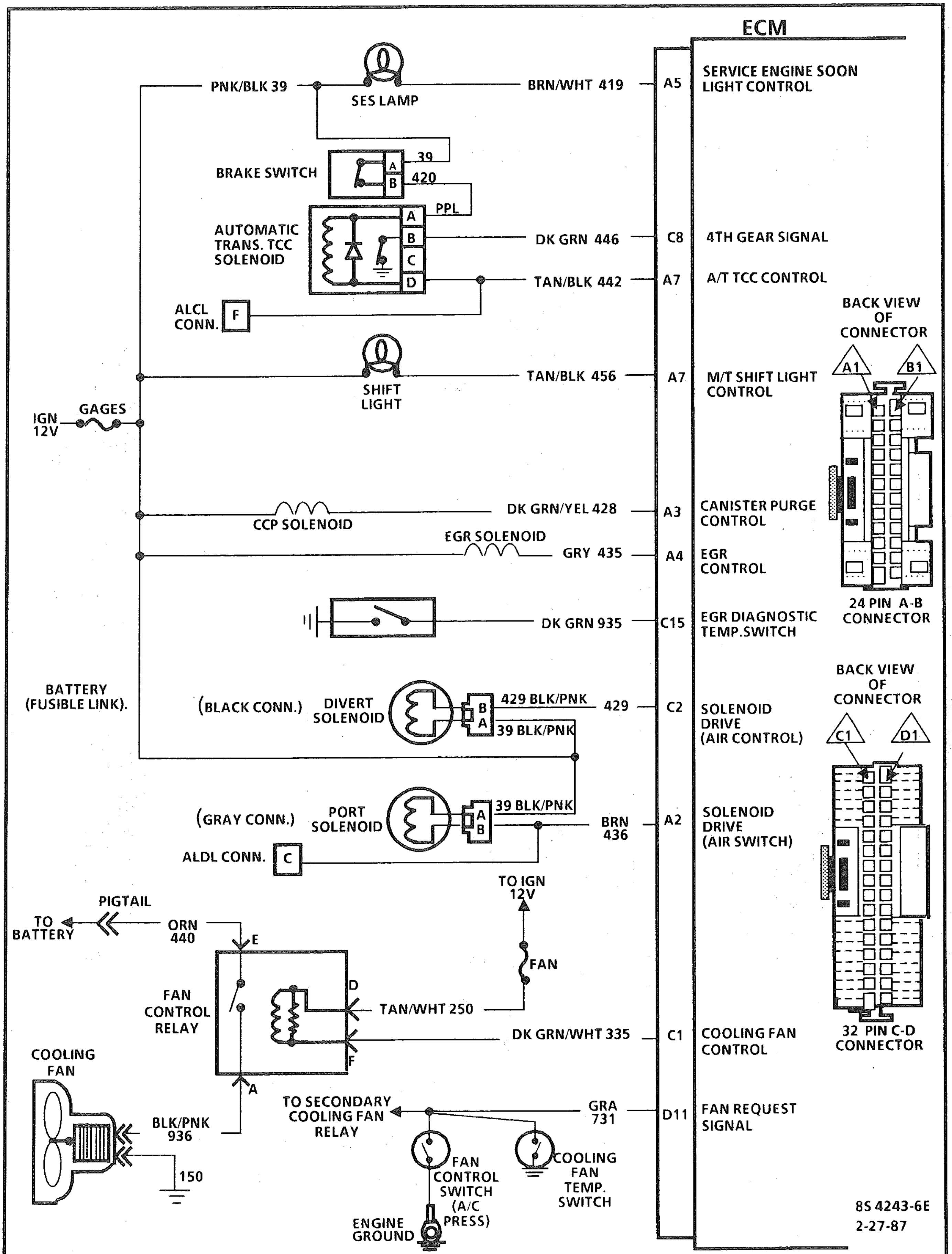


Figure A-5 - Wiring Diagram - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series (4 of 4)

PORT FUEL INJECTION ECM CONNECTOR IDENTIFICATION

This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

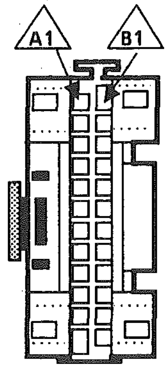
B + in Chart refers to system voltage.

THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

• Engine at operating temperature • Engine idling in "Closed Loop" (for "Engine Run" column) in park or neutral • Test terminal not grounded • "Scan" tool not installed

Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
3	0*	B+	FUEL PUMP RELAY	A1	GRN/WHT
	B+	B+	AIR SWITCH SOLENOID	A2	BRN
	B+	B+	CANISTER PURGE SOLENOID	A3	GRN/YEL
	B+	1∇	EGR SOLENOID	A4	GRY
	1∇	B+	"SERVICE ENGINE SOON" LIGHT	A5	BRN/WHT
	B+	B+	IGNITION	A6	PNK/BLK
	B+	B+	M/T SHIFT LIGHT A/T TCC CONTROL	A7	TAN/BLK
	2-5 varies	2-5 varies	SERIAL DATA	A8	ORN
	5	5	DIAG. TERM.	A9	WHT/BLK
1			SPEED SENSOR SIGNAL	A10	BRN
	0*	0*	MAF SENSOR GROUND	A11	BLK/PNK
	0*	0*	ECM GROUND	A12	BLK/WHT

BACK VIEW OF CONNECTOR

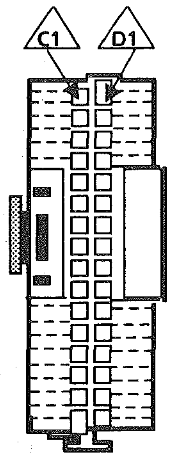


24 PIN A-B CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
ORN	B1	CONTINUOUS BATTERY VOLTAGE	B+	B+	
TAN/WHT	B2	FUEL PUMP SIGNAL	0*	B+	3
BLK/RED	B3	IGNITION GROUND	0*	0*	
	B4	NOT USED			
PPL/WHT	B5	DISTRIBUTOR REFERENCE	0*	1.3	
PPL	B6	VATS	2.5	2.5	
BLK	B7	ESC SIGNAL	9.2	9.3	
GRN	B8	A/C SIGNAL (OFF) (ON)	0* B+	0* B+	
	B9	NOT USED			
ORN/BLK	B10	PARK/NEUTRAL P/N SW.SIGNAL (A/T) D	0* B+	0* B+	
	B11	NOT USED			
DK GRN	B12	MAF SENSOR SIGNAL	2.5	.4-1	2

Note	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	CIRCUIT	PIN	WIRE COLOR
	B+	B+	FAN RELAY	C1	DK GRN/WHT
	B+	1∇	AIR CONTROL SOLENOID	C2	BLK/PNK
	NOT USEABLE		IAC "B" LO	C3	LT GRN/BLK
	NOT USEABLE		IAC "B" HI	C4	LT GRN/WHT
	NOT USEABLE		IAC "A" HI	C5	LT BLU WHT
	NOT USEABLE		IAC "A" LO	C6	LT BLU BLK
			NOT USED	C7	
	0*	0*	4TH GR. SIG. (A/T)	C8	DK GRN
			NOT USED	C9	
4	1.7	1.7	COOLANT TEMP. SIGNAL	C10	YEL
			NOT USED	C11	
4	2.0	2.0	MAT SIGNAL	C12	TAN
	.54V ± .08V	.54V ± .08V	TPS SIGNAL	C13	DK BLU
	5	5	TPS 5 VOLT REFERENCE	C14	GRY
	B+	B+	EGR DIAG.SWITCH	C15	DK GRN
	B+	B+	CONTINUOUS BATTERY VOLTAGE	C16	ORN

BACK VIEW OF CONNECTOR



32 PIN C-D CONNECTOR

WIRE COLOR	PIN	CIRCUIT	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	Note
BLK/WHT	D1	ECM GROUND	0*	0*	
BLK	D2	TPS,CTS,MAT SENSOR GROUND	0*	0*	
BLK/WHT	D3	ECM GROUND	0*	0*	
WHT	D4	EST	0*	1.3	
TAN/BLK	D5	BYPASS	0*	4.75	
TAN	D6	O_2 GROUND	0*	0*	
PPL	D7	O_2 SENSOR SIGNAL	.35-.55	.01-.99	2
	D8	NOT USED			
	D9	NOT USED			
BLK/WHT	D10	ECM GROUND	0*	0*	
GRA	D11	A/C PRESSURE FAN SWITCH	B+	B+	
BLK	D12	MAF BURN-OFF RELAY	B+	B+	
	D13	NOT USED			
	D14	NOT USED			
BLK/PNK	D15	INJ.1,3,5,7.	B+	B+	
BLK/GRN	D16	INJ.2,4,6,8.	B+	B+	

∇ Less than 1 volt.
* Less than .5 volts.
1. Varies from .60 to battery voltage depending on position of drive wheels.
2. Varies.
3. 12V First two seconds.
4. Varies with temperature.

ENGINE: 5.0L LB9 / 5.7L L98

CARLINE: F

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Figure A-6 - ECM Connector Terminal End View - 5.0L (VIN F) & 5.7L (VIN 8) "F" Series

DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach to identifying a problem created by an Electronic Engine Control System malfunction. It must be the starting point for any driveability complaint diagnosis, because it directs the Service Technician to the next logical step in diagnosing the complaint.

The "Scan Data" listed in the table may be used for comparison, after completing the Diagnostic Circuit Check and finding the on-board diagnostics functioning properly and no trouble codes displayed. The "Typical Values" are an average of display values recorded from normally operating vehicles and are intended to represent what a normally functioning system would typically display.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED, AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Only the parameters listed below are used in this manual for diagnosing. If a "Scan" reads other parameters, the values are not recommended by General Motors for use in diagnosing. For more description on the values and use of the "Scan" to diagnosis ECM inputs, refer to the applicable diagnosis section in Section C. If all values are within the range illustrated, refer to symptoms in Section B.

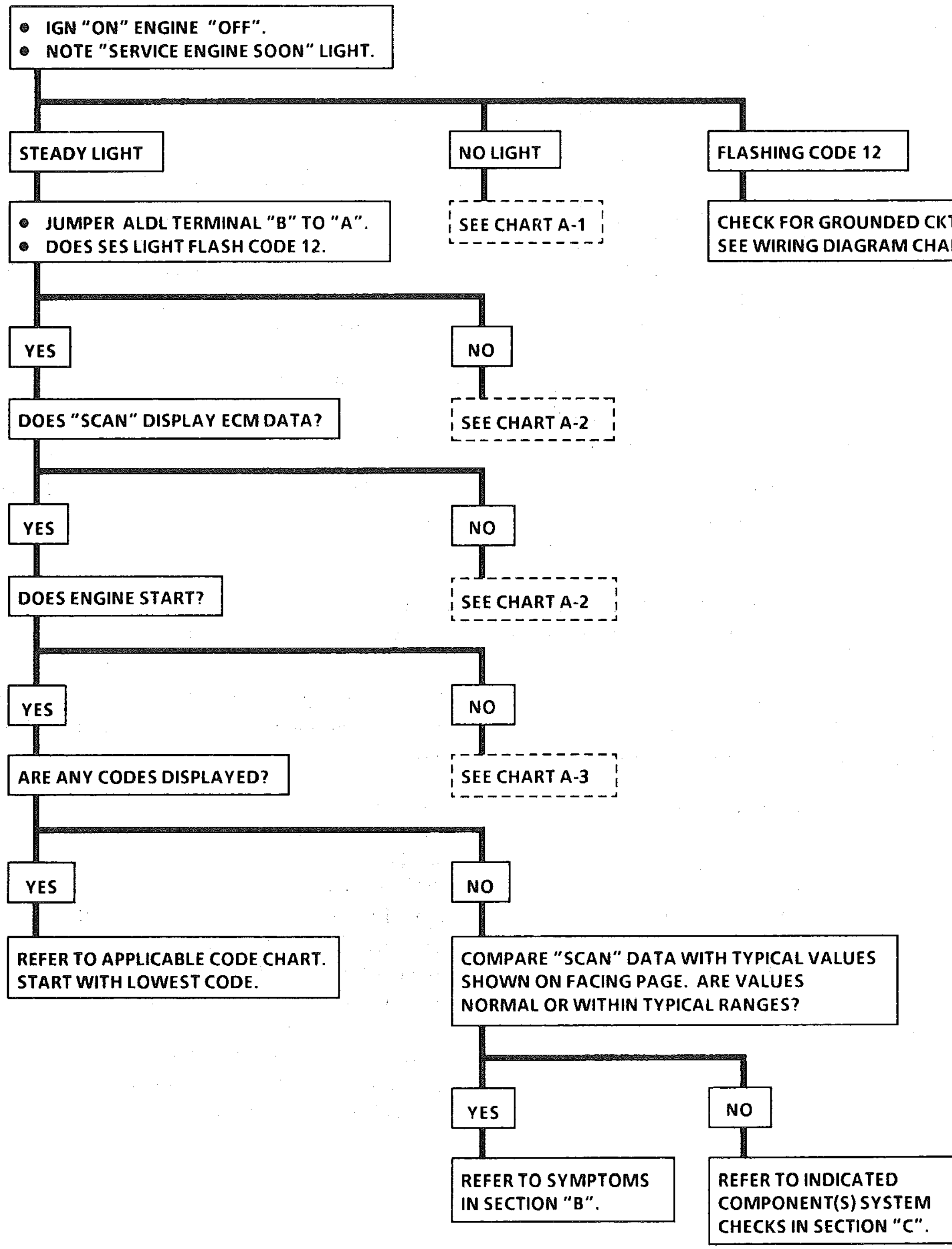
"SCAN" DATA

Idle / Upper Radiator Hose Hot / Closed Throttle / Park or Neutral / Closed Loop / Acc. off

"SCAN" Position	Units Displayed	Typical Data Value
Desired RPM	RPM	ECM idle command (varies with temp.)
RPM	RPM	± 100 RPM from desired RPM (± 50 in drive)
Coolant Temp.	C°	85° - 105°
MAT Temp.	C°	10° - 90° (depends on underhood temp.)
MAF	Gm/Sec	4 - 7
Air Flow	Gm/Sec	4 - 7
BPW (base pulse width)	M/Sec	1 - 4 and varying
O_2	Volts	1-1000 and varying
TPS	Volts	.46 - .62
IAC	Counts (steps)	5 - 50
INT (Integrator)	Counts	Varies
BLM (Block Learn)	Counts	118 - 138
Open/Closed Loop	Open/Closed	Closed Loop (may go open with extended idle)
BLM Cell	Cell Number	0 or 1 (depends on Air Flow & RPM)
VSS	MPH	0
TCC	On/Off	Off/ (on with TCC commanded)
Battery	Volts	13.5 - 14.5
PPSW	Volts	13.5 - 14.5
LV8	Counts	30 - 60
Knock Retard	Degrees of Retard	0
Spark Advance	# of Degrees	Varies
P/N Switch	P/N and RDL	Park/Neutral (P/N)
A.I.R. Control	Normal/Divert	Normal
A.I.R. Switch	Port/Converter	Converter
A/C Request	Yes/No	No (yes, with A/C requested)
Fan Request	Yes/No	No (yes, with A/C high pressure)
EGRDC	0 - 100%	0 at idle
EGR Diagnostic	On/Off	off
Fan	On/Off	Off (below 108°C)
CCP duty cycle	0 - 100%	0
Knock Signal	Yes/No	No (yes, when knock is detected)
Shift Light (M/T)	On/Off	Off
4th Gear	Yes/No	No (yes, when in 4th gear)

DIAGNOSTIC CIRCUIT CHECK

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



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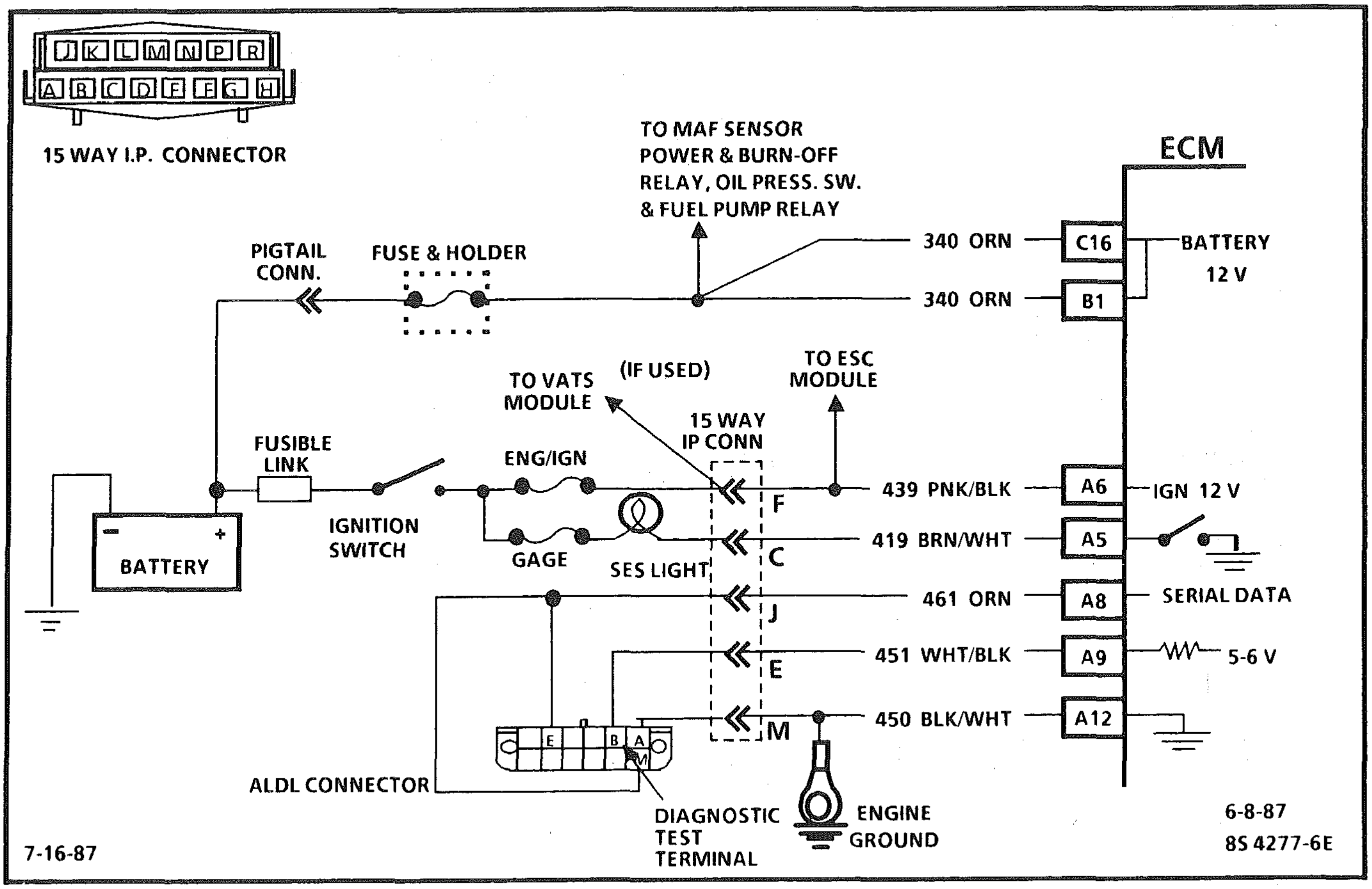


CHART A - 1

NO "SERVICE ENGINE SOON" LIGHT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Ignition voltage is supplied directly to the light bulb. The electronic control module (ECM) will control the light and turn it "ON" by providing a ground path through CKT 419 to the ECM.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the fuse in holder is blown, refer to facing page of Code 54 for complete circuit.
2. Using a test light connected to 12 volts probe each of the system ground circuits to be sure a good ground is present. Refer to the ECM terminal end view in front of this section for ECM pin locations of ground circuits.

Diagnostic Aids:

Engine runs OK, check:

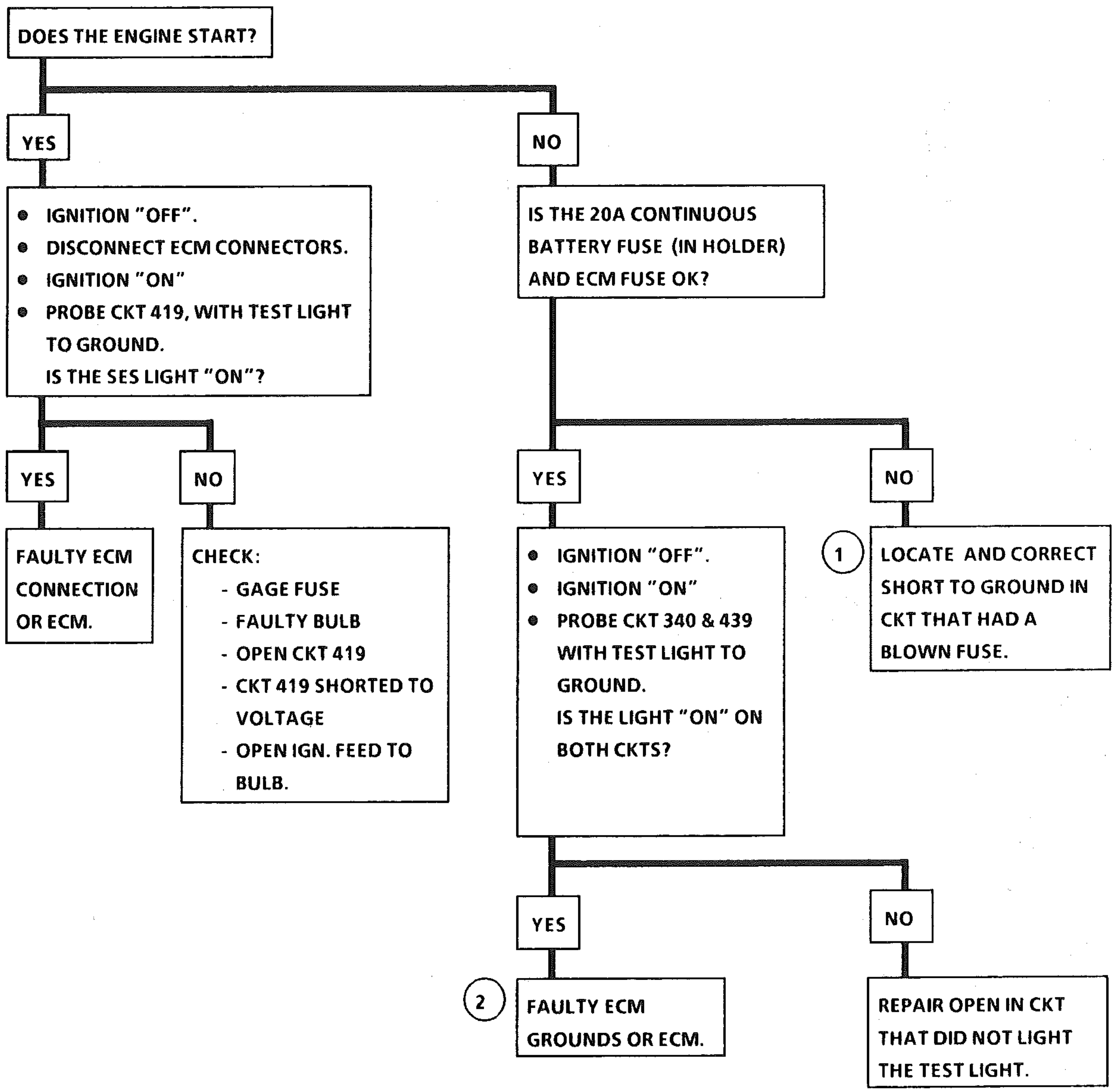
- Faulty light bulb.
- CKT 419 open.
- Gage fuse blown. This will result in no oil or generator lights, seat belt reminder, etc.

Engine cranks but will not run, check:

- Continuous battery - fuse or fusible link open.
- ECM ignition fuse open.
- Battery CKT 340 to ECM open.
- Ignition CKT 439 to ECM open.
- Poor connection to ECM.

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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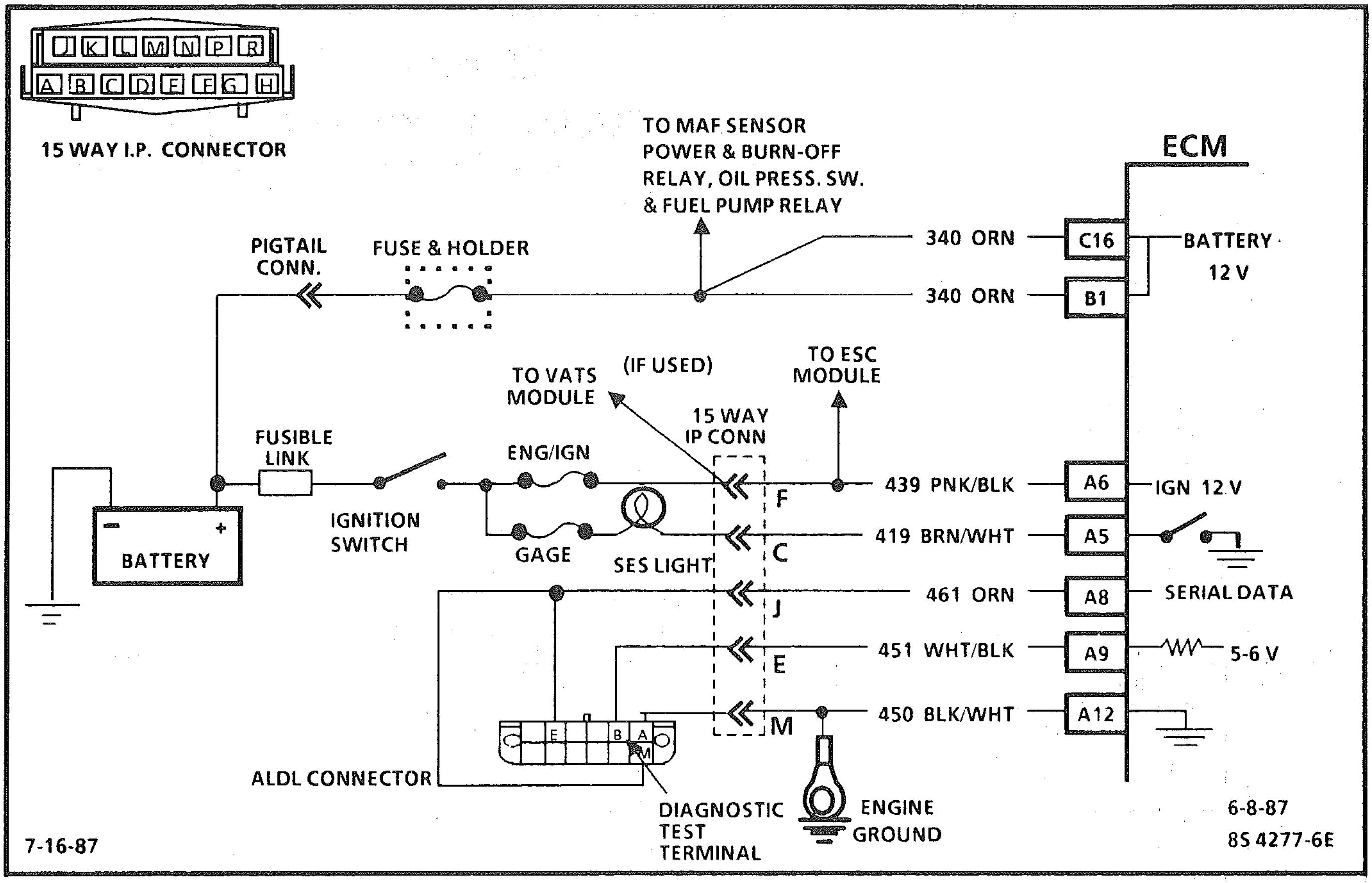

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT "ON" STEADY
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

There should always be a steady "Service Engine Soon" light when the ignition is "ON" and engine stopped. Ignition voltage is supplied to the light bulb. The electronic control module (ECM) will turn the light "ON" by grounding CKT 419 at the ECM.

With the diagnostic terminal grounded, the light should flash a Code 12, followed by any trouble code(s) stored in memory.

A steady light suggests a short to ground in the light control CKT 419, or an open in diagnostic CKT 451.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If there is a problem with the ECM that causes a "Scan" tool to not read Serial data, the ECM should not flash a Code 12. If Code 12 is flashing check for CKT 451 short to ground. If Code 12 does flash be sure that the "Scan" tool is working properly on another vehicle. If the "Scan" is functioning properly and CKT 461 is OK, the Mem-Cal or ECM may be at fault for the NO ALDL symptom.
2. If the light goes "OFF" when the ECM connector is disconnected, CKT 419 is not shorted to ground.
3. This step will check for an open diagnostic CKT 451.
4. At this point the "Service Engine Soon" light wiring is OK. The problem is a faulty ECM or Mem-Cal. If Code 12 does not flash, the ECM should be replaced using the original Mem-Cal. Replace the Mem-Cal only after trying an ECM, as a defective Mem-Cal is an unlikely cause of the problem.

CHART A-2

NO ALDL DATA OR WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT "ON" STEADY
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

- IGNITION "ON". ENGINE "OFF". IS THE "SERVICE ENGINE SOON" LIGHT "ON"?

NO

GO TO CHART A-1

YES

- GROUND DIAGNOSTIC TERMINAL. DOES LIGHT FLASH CODE 12?

YES

1
- IF PROBLEM WAS NO ALDL DATA:
- CHECK SERIAL DATA CKT 461 FOR OPEN OR SHORT TO GROUND BETWEEN ECM AND ALDL CONNECTOR. IF OK, IT IS A FAULTY ECM OR MEM-CAL.

NO

2
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON" AND NOTE "SERVICE ENGINE SOON" LIGHT.

LIGHT "ON"

REPAIR SHORT TO GROUND IN CKT 419.

LIGHT "OFF"

3
- IGNITION "OFF'.
- RECONNECT ECM.
- IGNITION "ON", ENGINE STOPPED.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- BACK PROBE ECM, CKT 451, WITH TEST LIGHT TO GROUND.

CODE 12

- CHECK FOR OPEN IN ALDL DIAGNOSTIC TERMINAL "B" AND CKT 451 TO ECM.
- IF OK, CHECK FOR OPEN IN ALDL TERMINAL "A" TO ECM.

NO CODE 12

4
- CHECK MEM-CAL FOR PROPER INSTALLATION.
- IF OK, REPLACE ECM USING ORIGINAL MEM-CAL.
- RECHECK FOR CODE 12.

CODE 12

SYSTEM OK

NO CODE 12

REPLACE MEM-CAL

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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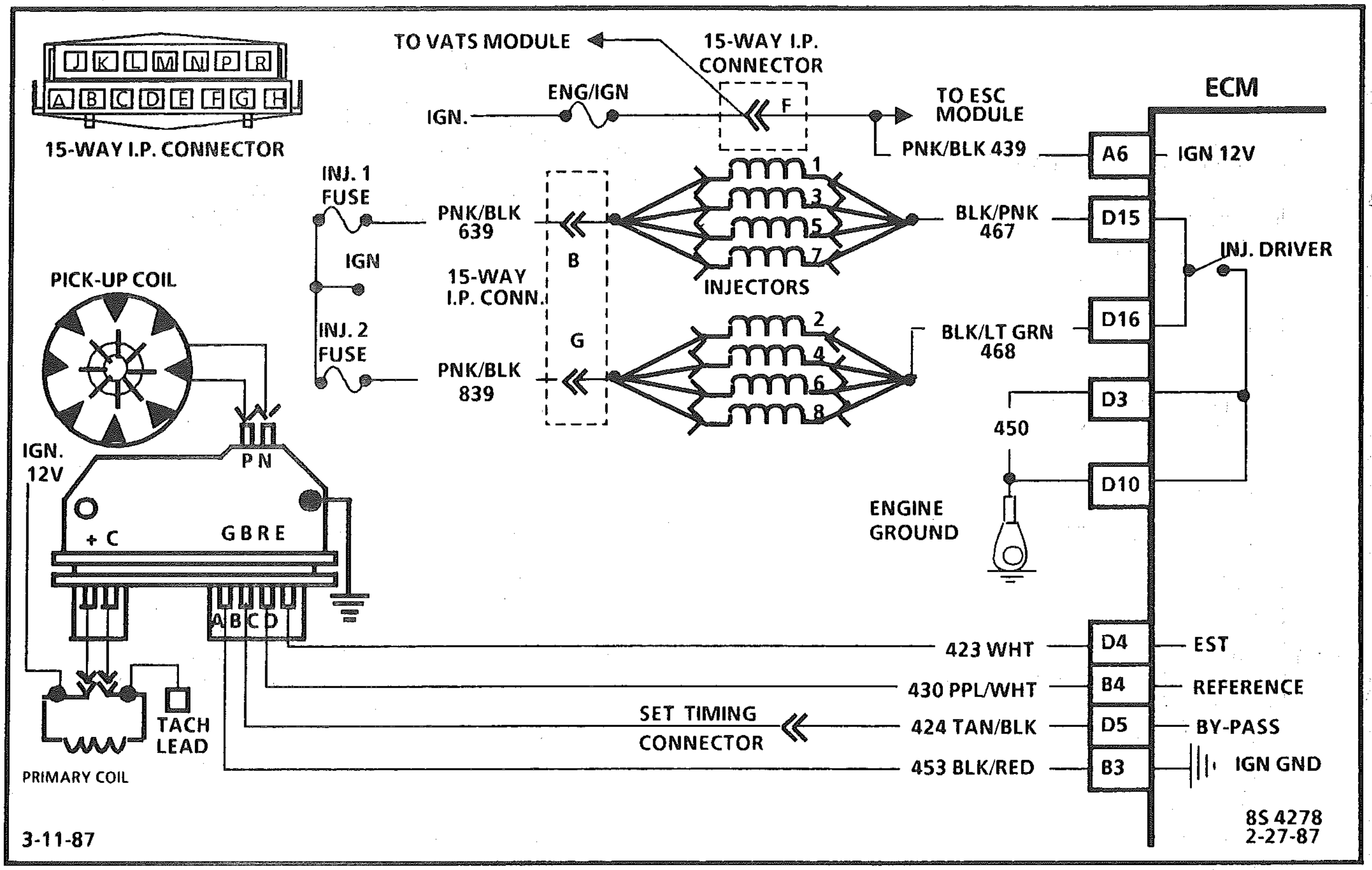

CHART A-3

(Page 1 of 2)
ENGINE CRANKS BUT WON'T RUN
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

This chart assumes that battery condition and engine cranking speed are OK, and there is adequate fuel in the tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. A "Service Engine Soon" light "ON" is a basic test to determine if there is a 12 volt supply and ignition 12 volts to ECM. No ALDL may be due to an ECM problem and CHART A-2 will diagnose the ECM. If TPS is over 2.5 volts the engine may be in the clear flood mode which will cause starting problems. The engine will not start without reference pulses and therefore the "Scan" should read rpm (reference) during crank.
2. No spark may be caused by one of several components related to the Ignition System. CHART C-4 will address all problems related to the causes of a no spark condition.
3. The test light should blink, indicating the ECM is controlling the injectors ok. How bright the light blinks is not important. However, the test light should be a J-34730-3 or equivalent.
4. Use fuel pressure gage J-34730-1 or equivalent. Wrap a shop towel around the fuel pressure tap to absorb any small amount of fuel leakage that may occur when installing the gage.

Diagnostic Aids:

- An EGR valve sticking open can cause a low air/fuel ratio during cranking. Unless engine enters "Clear Flood" at the first indication of a flooding condition, it can result in a no start.
- Check for fouled plugs.
- A defective cold start circuit or water in fuel line can cause a no start in cold weather. See CHART A-9.
- A defective MAF Sensor may cause a no start or a stall after start. To determine if the sensor is causing the problem, disconnect it. The ECM will then use a default value for the sensor, and if the condition is corrected and the connections are OK, replace the sensor.
- Also check that injectors on both sides of engine will cause a test light to "blink". If not OK, check injector fuses.

If above are all OK, refer to "Symptoms" in Section "B", Hard Start.

CHART A-3

(Page 1 of 2)

ENGINE CRANKS BUT WON'T RUN
5.0L (VIN F) & 5.7L (VIN 8)
"F" SERIES (PORT)

(1)
- FUEL QUANTITY OK.
- IGNITION "ON". IF "SERVICE ENGINE SOON" LIGHT IS "OFF", USE CHART A-1.
- INSTALL "SCAN" TOOL. IF "NO ALDL", USE CHART A-2.
  CHECK THE FOLLOWING:
- IF A CODE 46 OR 54 IS SET, REFER TO APPLICABLE CHART.
- TPS - IF OVER 2.5 VOLTS AT CLOSED THROTTLE, USE THE CODE 21 CHART.
  IS RPM IDICATED DURING CRANKING?

YES

- USING A ST-125 (SPARK CHECKER), J-26792 OR EQUIVALENT, CHECK FOR SPARK WHILE CRANKING (CHECK TWO WIRES)
  IS SPARK PRESENT?

YES

(3)
- DISCONNECT ONE INJECTOR
- CONNECT TEST LIGHT J-34730-2 OR EQUIVALENT TO INJECTOR HARNEES CONNECTOR.
- CHECK FOR BLINKING LIGHT WHILE CRANKING.

BLINKING LIGHT

(4)
- IGNITION "OFF".
- INSTALL FUEL PRESSURE GAGE AND NOTE PRESSURE AFTER IGNITION "ON".
  SHOULD BE 32-47 psi (220-325 kPa)

OK

- REVIEW THE "DIAGNOSTIC AIDS" ON FACING PAGE FOR ADDITIONAL ITEMS TO CHECK. IF ALL ARE OK, EFI SYSTEM IS OK.
  REFER TO "HARD START "IN SECTION "B".

NOT OK

USE CHART A-7

NO BLINKING LIGHT

USE CHART A-3 (2 OF 2)

NO

(2) BASIC HEI PROBLEM. REFER TO CHART C-4

NO

- USING A ST-125 (SPARK CHECKER), J-26792 OR EQUIVALENT, CHECK FOR SPARK WHILE CRANKING (CHECK TWO WIRES)
  IS SPARK PRESENT?

YES

- IGNITION "OFF".
- DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
- IGNITION "ON".
- MOMENTARILY TOUCH HARNESS CONNECTOR TERMINAL (CKT 430) WITH A TEST LIGHT TO 12 VOLTS.
- "SCAN" SHOULD INDICATE RPM WHEN TEST IS PERFORMED.
  DOES IT?

YES

- FAULTY CONNECTION OR IGNITION MODULE.

NO

CKT 430 OPEN, SHORTED TO GROUND, OR FAULTY ECM.

NO

(2) CHECK FOR BATTERY VOLTAGE TO IGNITION SYSTEM. IF OK, THERE IS A BASIC HEI PROBLEM. REFER TO CHART C-4.

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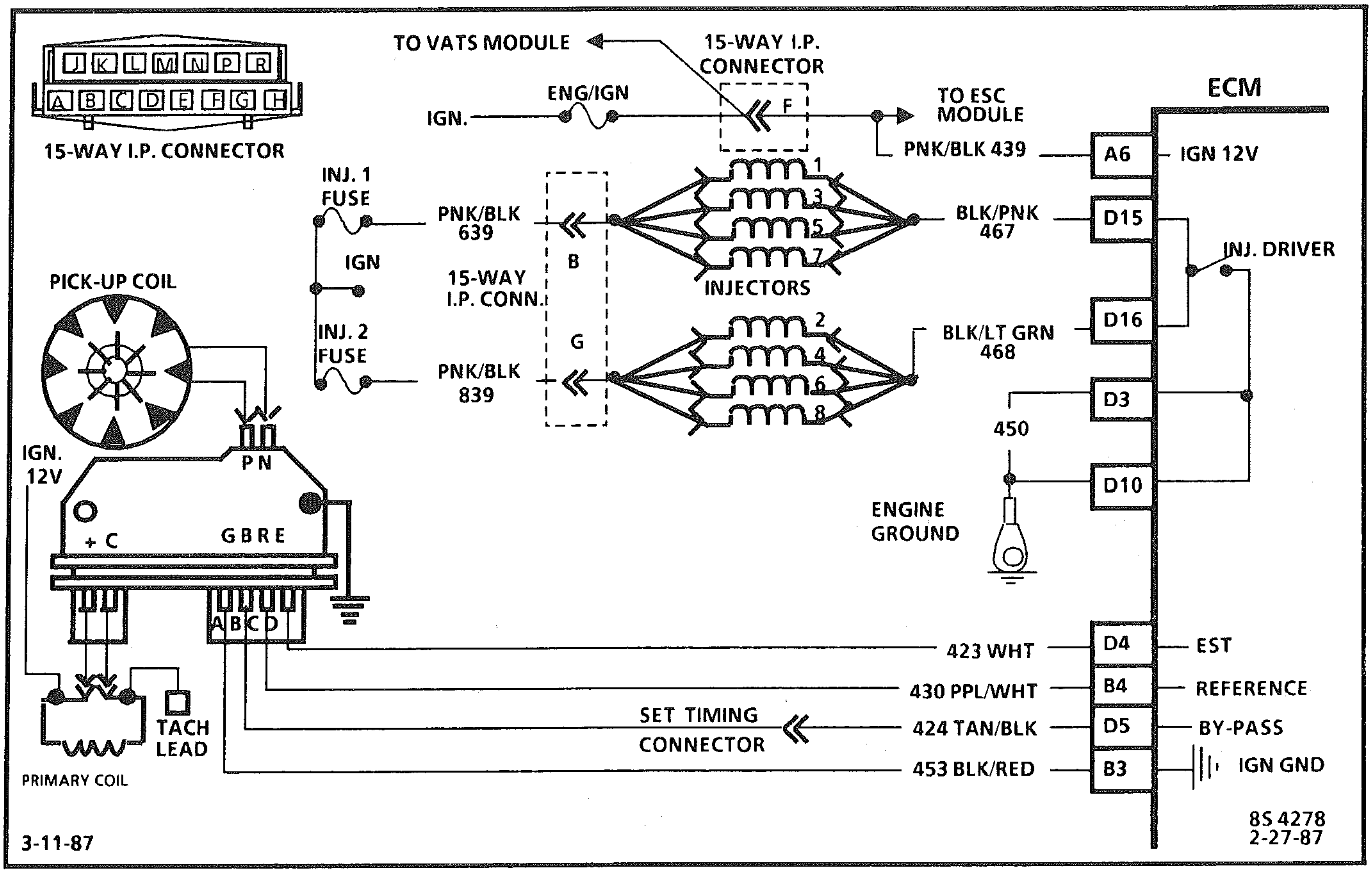

CHART A-3

(Page 2 of 2)
ENGINE CRANKS BUT WON'T RUN
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for 12 volt supply to injectors. Due to the injectors wired in parallel there should be a light "ON" on both terminals.
2. Checks continuity of CKT 467 and 468.
3. All checks made to this point would indicate that the ECM is at fault. However, there is a possibility of CKT 467 or 468 being shorted to a voltage source either in the engine harness or in the injector harness.

To test for this condition:

- Disconnect all injectors
- Ignition "ON".
- Probe CKTs 467 and 468 on the ECM side of injector harness with a test light connected to ground. (Test one injector harness on each side of engine). There should be no light. If light is "on" repair short to voltage.
- If OK, check the resistance of the injectors.
- Should be 10 ohms or more.
- Check injector harness connector. Be sure terminals are not backed out of connector and contacting each other.
- If all OK, replace ECM.

CHART A-3

(Page 2 of 2)

ENGINE CRANKS BUT WON'T RUN
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

FROM A-3 (1 OF 2)

NO BLINKING LIGHT AT INJECTOR

NO LIGHT

1
- IGNITION "ON"
- PROBE INJECTOR HARNESS TERMINALS WITH A TEST LIGHT TO GROUND.
- LIGHT SHOULD BE "ON" AT BOTH TERMINALS.

STEADY LIGHT

- CHECK INJECTOR DRIVER CIRCUIT WITH STEADY LIGHT FOR SHORT TO GROUND.
- IF CIRCUIT IS NOT SHORTED, CHECK RESISTANCE ACROSS EACH INJECTOR IN THE CIRCUIT.
- RESISTANCE SHOULD BE GREATER THAN 10 OHMS.

OK

FAULTY ECM

NOT OK

REPAIR SHORT TO GROUND OR REPLACE ANY INJECTOR THAT MEASURES UNDER 10 OHMS.

LIGHT "ON" BOTH

2
- RECONNECT INJECTOR(S)
- IGNITION "OFF".
- DISCONNECT ECM
- IGNITION "ON".
- PROBE TERMINALS "D15" AND "D16" WITH A TEST LIGHT TO GROUND.

LIGHT "ON" ONE

DUE TO INJECTORS WIRED IN PARALLEL, THERE SHOULD BE A LIGHT ON BOTH TERMINALS.

IF NOT, THE PROBLEM IS AN OPEN IN THE HARNESS TO THE TESTED INJECTOR.

LIGHT "OFF" BOTH

REPAIR OPEN IN INJECTOR FEED CIRCUIT.

LIGHT "ON"

3 REFER TO FACING PAGE.

LIGHT "OFF"

OPEN CKT 467 OR 468

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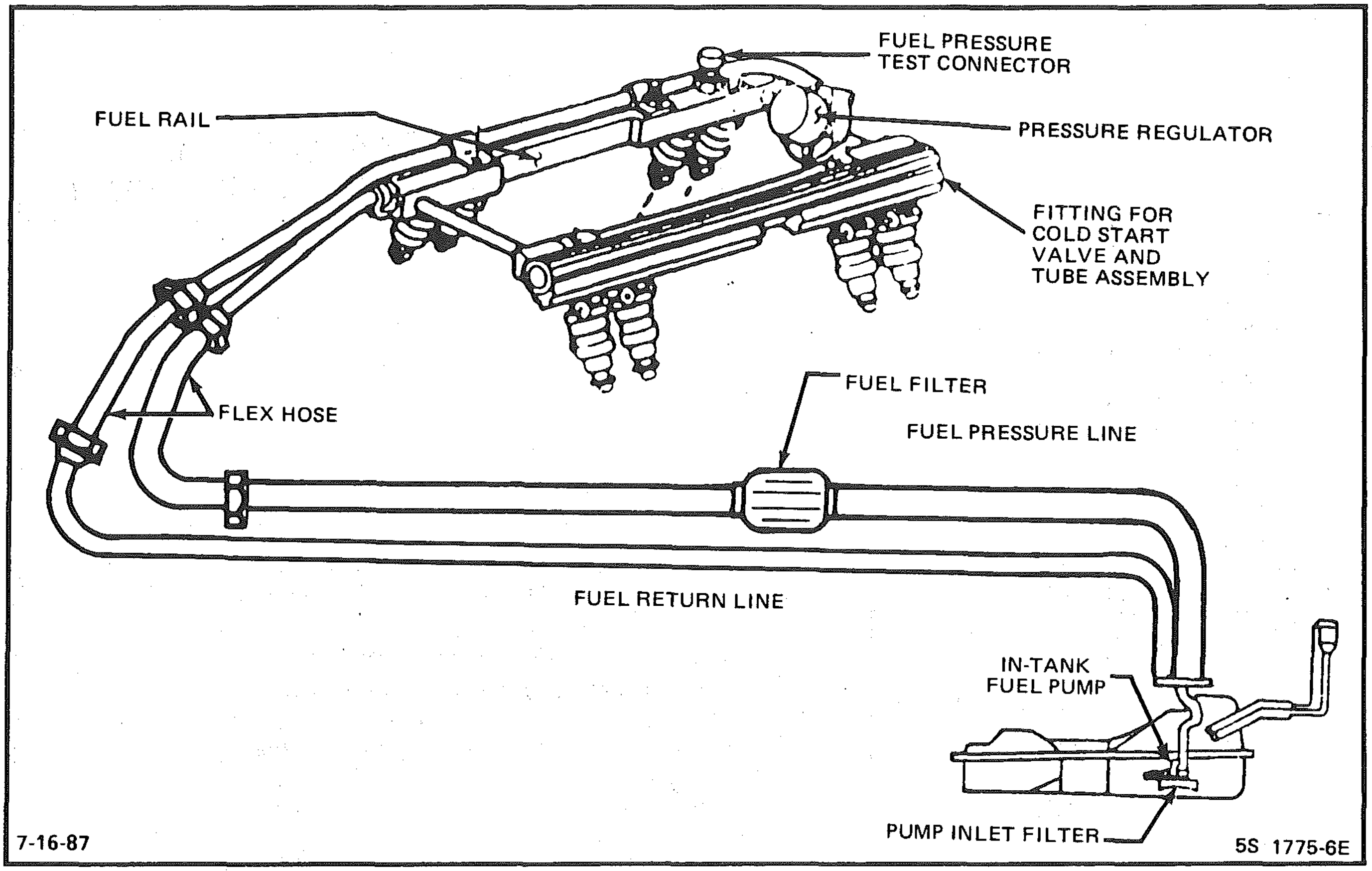


CHART A-7

(Page 1 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

When the ignition switch is turned "ON", the electronic control module (ECM) will turn "ON" the in-tank fuel pump. It will remain "ON" as long as the engine is cranking or running, and the ECM is receiving reference pulses. If there are no reference pulses, the ECM will shut "OFF" the fuel pump within 2 seconds after ignition "ON" or engine stops.

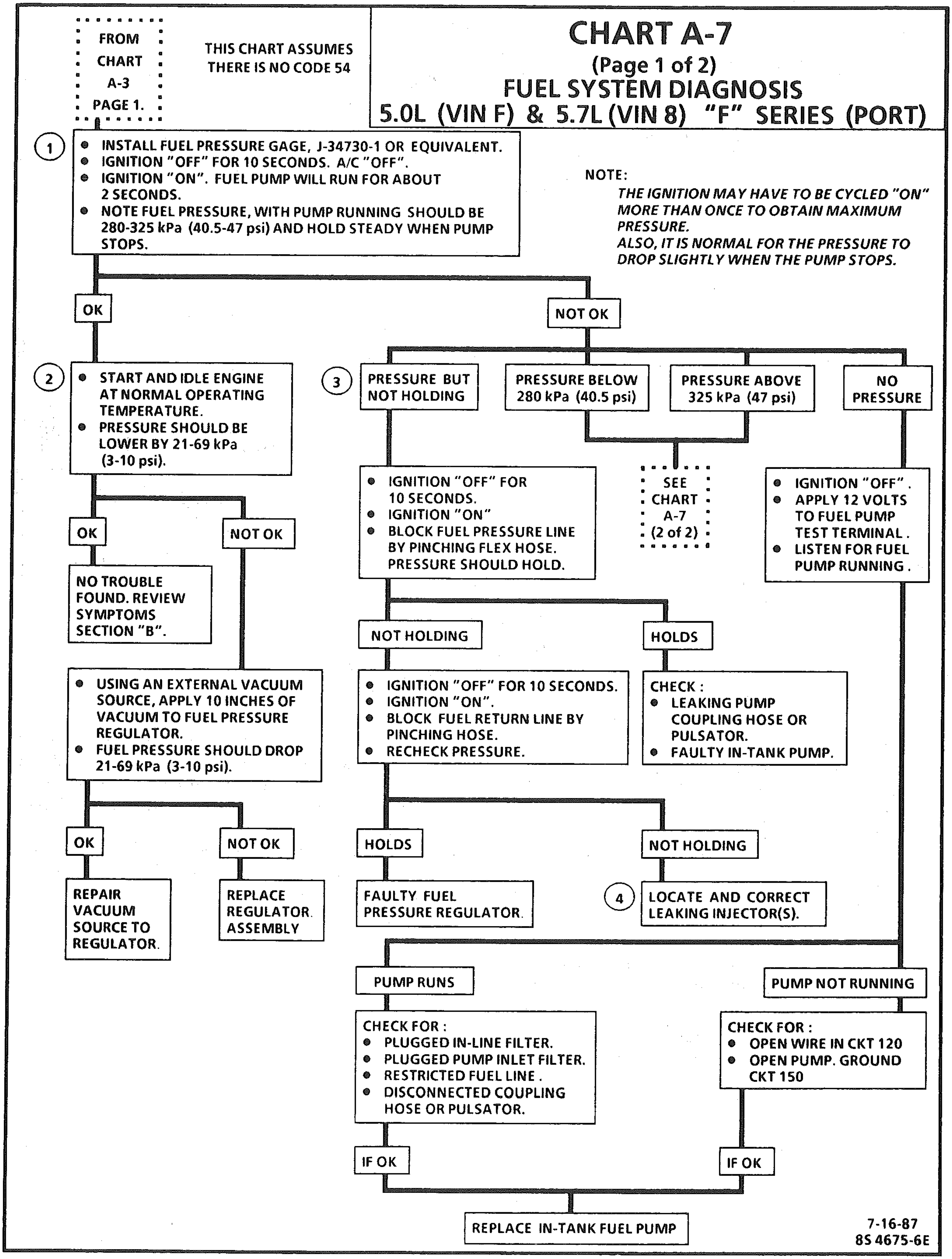
The pump will deliver fuel to the fuel rail and injectors, then to the pressure regulator, where the system pressure is controlled at 234 to 325 kPa (34 to 47 psi). Excess fuel is then returned to the fuel tank.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Wrap a shop towel around the fuel pressure connector to absorb any small amount of fuel leakage that may occur when installing the gage. Ignition "ON", pump pressure should be 280-325 KPa (40.5-47 psi). This pressure is controlled by spring pressure within the regulator assembly.
2. When the engine is idling, the manifold pressure is low (high vacuum) and is applied to the fuel regulator diaphragm. This will offset the spring and result in a lower fuel pressure.This idle pressure will vary somewhat depending on barometric pressure; however, the pressure idling should be less, indicating pressure regulator control.
3. Pressure that continues to fall is caused by one of the following:
   - In-tank fuel pump check valve not holding.
   - Pump coupling hose or pulsator leaking.
   - Fuel pressure regulator valve leaking.
   - Injector(s) sticking open.
4. An injector sticking open can best be determined by checking for a fouled or saturated spark plug(s). If a leaking injector cannot be determined by a fouled or saturated spark plug, the following procedure should be used:
   - Remove Plenum, and remove fuel rail bolts. Follow the procedures in the Fuel Control Section of this manual, but leave fuel lines connected.
   - Lift fuel rail out just enough to observe injector nozzles in the ports.

CAUTION: ***BE SURE INJECTOR(S) ARE NOT ALLOWED TO SPRAY ON ENGINE AND THAT INJECTOR RETAINING CLIPS ARE INTACT. THIS SHOULD BE CAREFULLY FOLLOWED TO PREVENT FUEL SPRAY ON ENGINE WHICH WOULD CAUSE A FIRE HAZARD.***

- Pressurize the fuel system and observe injector nozzles.


FROM CHART A-3 PAGE 1.
THIS CHART ASSUMES THERE IS NO CODE 54
CHART A-7
(Page 1 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)
1
• INSTALL FUEL PRESSURE GAGE, J-34730-1 OR EQUIVALENT.
• IGNITION "OFF" FOR 10 SECONDS. A/C "OFF".
• IGNITION "ON". FUEL PUMP WILL RUN FOR ABOUT 2 SECONDS.
• NOTE FUEL PRESSURE, WITH PUMP RUNNING SHOULD BE 280-325 kPa (40.5-47 psi) AND HOLD STEADY WHEN PUMP STOPS.
NOTE:
THE IGNITION MAY HAVE TO BE CYCLED "ON" MORE THAN ONCE TO OBTAIN MAXIMUM PRESSURE.
ALSO, IT IS NORMAL FOR THE PRESSURE TO DROP SLIGHTLY WHEN THE PUMP STOPS.
OK
NOT OK
2
• START AND IDLE ENGINE AT NORMAL OPERATING TEMPERATURE.
• PRESSURE SHOULD BE LOWER BY 21-69 kPa (3-10 psi).
OK
NOT OK
NO TROUBLE FOUND. REVIEW SYMPTOMS SECTION "B".
• USING AN EXTERNAL VACUUM SOURCE, APPLY 10 INCHES OF VACUUM TO FUEL PRESSURE REGULATOR.
• FUEL PRESSURE SHOULD DROP 21-69 kPa (3-10 psi).
OK
NOT OK
REPAIR VACUUM SOURCE TO REGULATOR.
REPLACE REGULATOR ASSEMBLY
3
PRESSURE BUT NOT HOLDING
PRESSURE BELOW 280 kPa (40.5 psi)
PRESSURE ABOVE 325 kPa (47 psi)
NO PRESSURE
SEE CHART A-7 (2 of 2)
• IGNITION "OFF" FOR 10 SECONDS.
• IGNITION "ON"
• BLOCK FUEL PRESSURE LINE BY PINCHING FLEX HOSE. PRESSURE SHOULD HOLD.
NOT HOLDING
HOLDS
• IGNITION "OFF" FOR 10 SECONDS.
• IGNITION "ON".
• BLOCK FUEL RETURN LINE BY PINCHING HOSE.
• RECHECK PRESSURE.
CHECK :
• LEAKING PUMP COUPLING HOSE OR PULSATOR.
• FAULTY IN-TANK PUMP.
HOLDS
NOT HOLDING
FAULTY FUEL PRESSURE REGULATOR.
4
LOCATE AND CORRECT LEAKING INJECTOR(S).
• IGNITION "OFF".
• APPLY 12 VOLTS TO FUEL PUMP TEST TERMINAL.
• LISTEN FOR FUEL PUMP RUNNING.
PUMP RUNS
PUMP NOT RUNNING
CHECK FOR :
• PLUGGED IN-LINE FILTER.
• PLUGGED PUMP INLET FILTER.
• RESTRICTED FUEL LINE.
• DISCONNECTED COUPLING HOSE OR PULSATOR.
CHECK FOR :
• OPEN WIRE IN CKT 120
• OPEN PUMP. GROUND CKT 150
IF OK
IF OK
REPLACE IN-TANK FUEL PUMP
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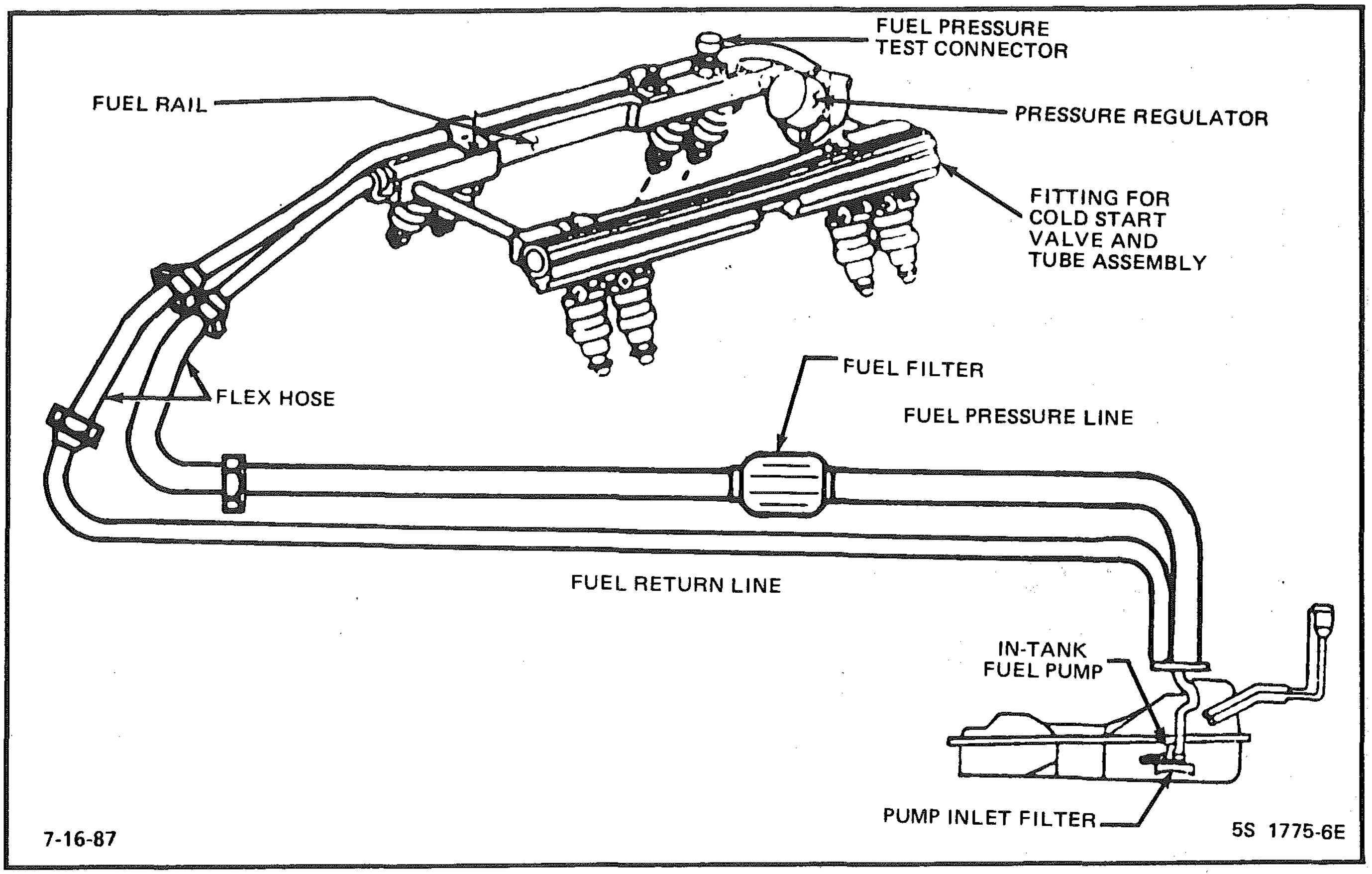

CHART A-7

(Page 2 of 2)
FUEL SYSTEM DIAGNOSIS
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Fuel pressure less than 280 kPa (40.5 psi) falls into two areas:
   - Regulated pressure less than 280 kPa (40.5 psi) - Amount of fuel to injectors OK but pressure is too low. System will be lean and may set Code 44. Also, hard starting cold and overall poor performance.
   - Restricted flow causing pressure drop - Normally, a vehicle with a fuel pressure of less than 165 kPa (24 psi) at idle will not be driveable. However, if the pressure drop occurs only while driving, the engine will normally surge then stop running as pressure begins to drop rapidly. This is most likely caused by a restricted fuel line or plugged filter.
2. Restricting the the fuel return line allows the fuel pump to develop its maximum pressure (dead head pressure). When battery voltage is applied to the pump test terminal, pressure should be above 414 kPa (60 psi).
3. This test determines if the high fuel pressure is due to a restricted fuel return line or a pressure regulator problem.

CHART A-7

(Page 2 of 2)

FUEL SYSTEM DIAGNOSIS 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

NOTICE: *THE FUEL SYSTEM IS UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVICE PROCEDURES IN SECTION "C2" FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

FROM CHART A-7 (1 of 2)

(1) PRESSURE LESS THAN 280 kPa (40.5 psi).

CHECK FOR RESTRICTED FUEL LINES OR IN-LINE FILTER.

- OK
- NOT OK
  - REPLACE FILTER OR REPAIR FUEL LINE AND RECHECK.

(2)
- IGNITION "OFF".
- BLOCK FUEL RETURN LINE .
- APPLY 12 VOLTS TO FUEL PUMP RELAY HARNESS TERMINAL "A" OR TO THE FUEL PUMP TEST CONNECTOR, AND NOTE FUEL PRESSURE .

PRESSURE ABOVE 325 kPa (47 psi).

FAULTY PRESSURE REGULATOR.

PRESSURE LESS THAN 280 kPa (40.5 psi).

FAULTY IN-TANK
- FUEL PUMP
- COUPLING HOSE OR PULSATOR
- INLET FILTER
- WRONG FUEL PUMP.

PRESSURE ABOVE 325 kPa (47 psi).

(3)
- DISCONNECT FUEL RETURN LINE FLEXIBLE HOSE.
- ATTACH $^5/_{16}$ I.D. FLEX HOSE TO PRESSURE REGULATOR SIDE OF RETURN LINE. INSERT THE OTHER END IN AN APPROVED GASOLINE CONTAINER.

  NOTE FUEL PRESSURE WITHIN 2 SECONDS AFTER IGNITION "ON".

PRESSURE ABOVE 325 kPa (47 psi)

CHECK FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR TO POINT WHERE FUEL LINE WAS DISCONNECTED.

IF LINE IS OK, REPLACE THE FUEL PRESSURE REGULATOR.

PRESSURE BETWEEN 280-325 kPa (40.5-47 psi)

LOCATE AND CORRECT RESTRICTED FUEL RETURN LINE TO FUEL TANK.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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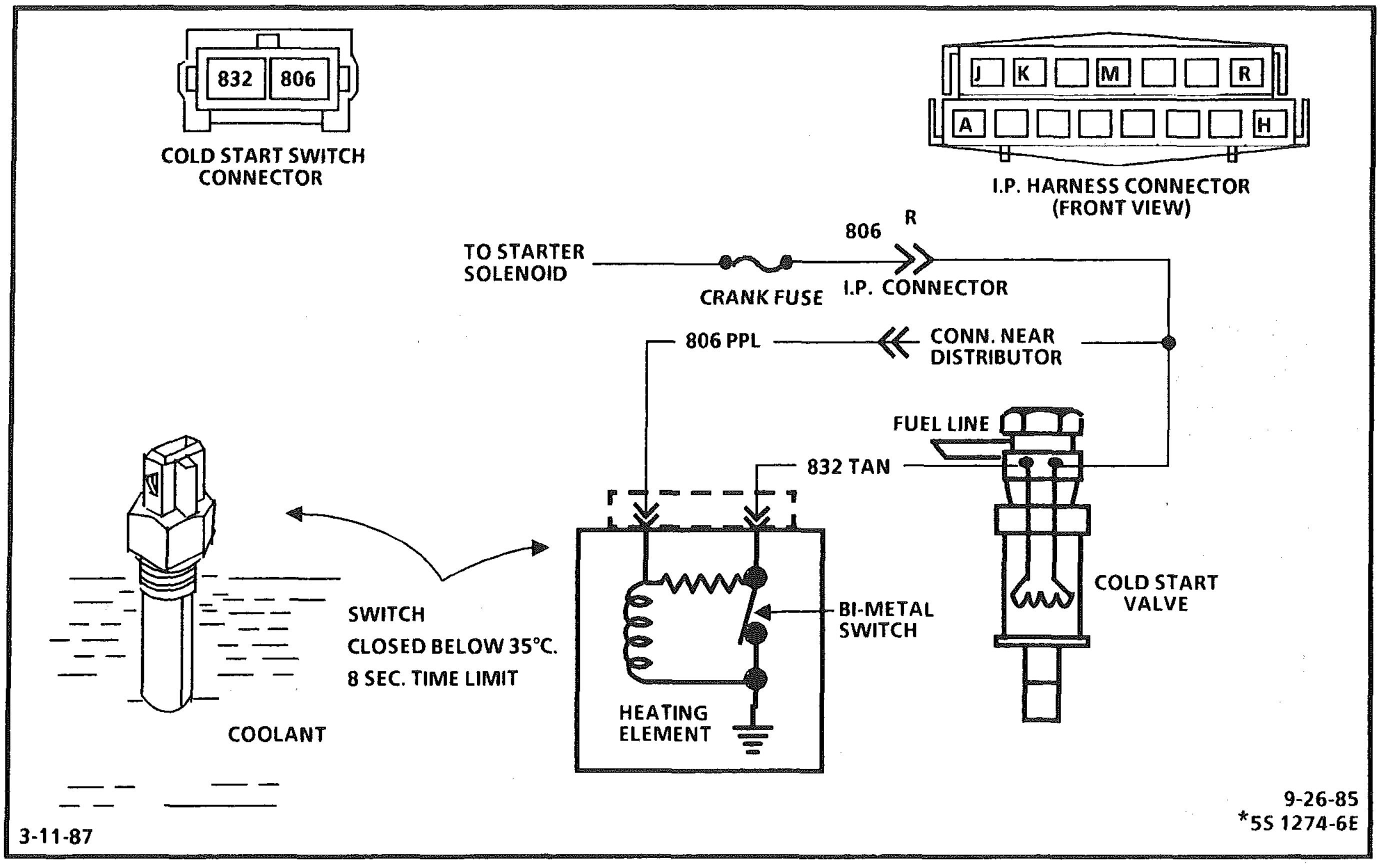


CHART A-9

COLD START VALVE CIRCUIT TEST
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The cold start valve is used to provide additional fuel during the crank mode to improve cold start-ups. This circuit is important when engine coolant temperature is low because the other injectors are not pulsed "ON" long enough to provide the needed amount of fuel to start.

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by a fuse. The system is controlled by a cold start fuel injection switch which provides a ground path for the valve during cranking when engine coolant is below 35°C (95°F).

The cold start fuel injection switch consists of a bimetal material which opens at a specified coolant temperature. This bimetal is also heated by the winding in the thermal switch which allows the valve to stay "ON" for 8 seconds at -20°C (-4°F) coolant. The time the switch will stay closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up, the cold start valve "ON" time goes down.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Disconnecting the distributor 4-way connector will disable the other injectors. The amount of pressure drop depends on the temperature of the engine. This test could also be performed by removing the two injector fuses.
2. This test will determine the continuity through the switch to ground.

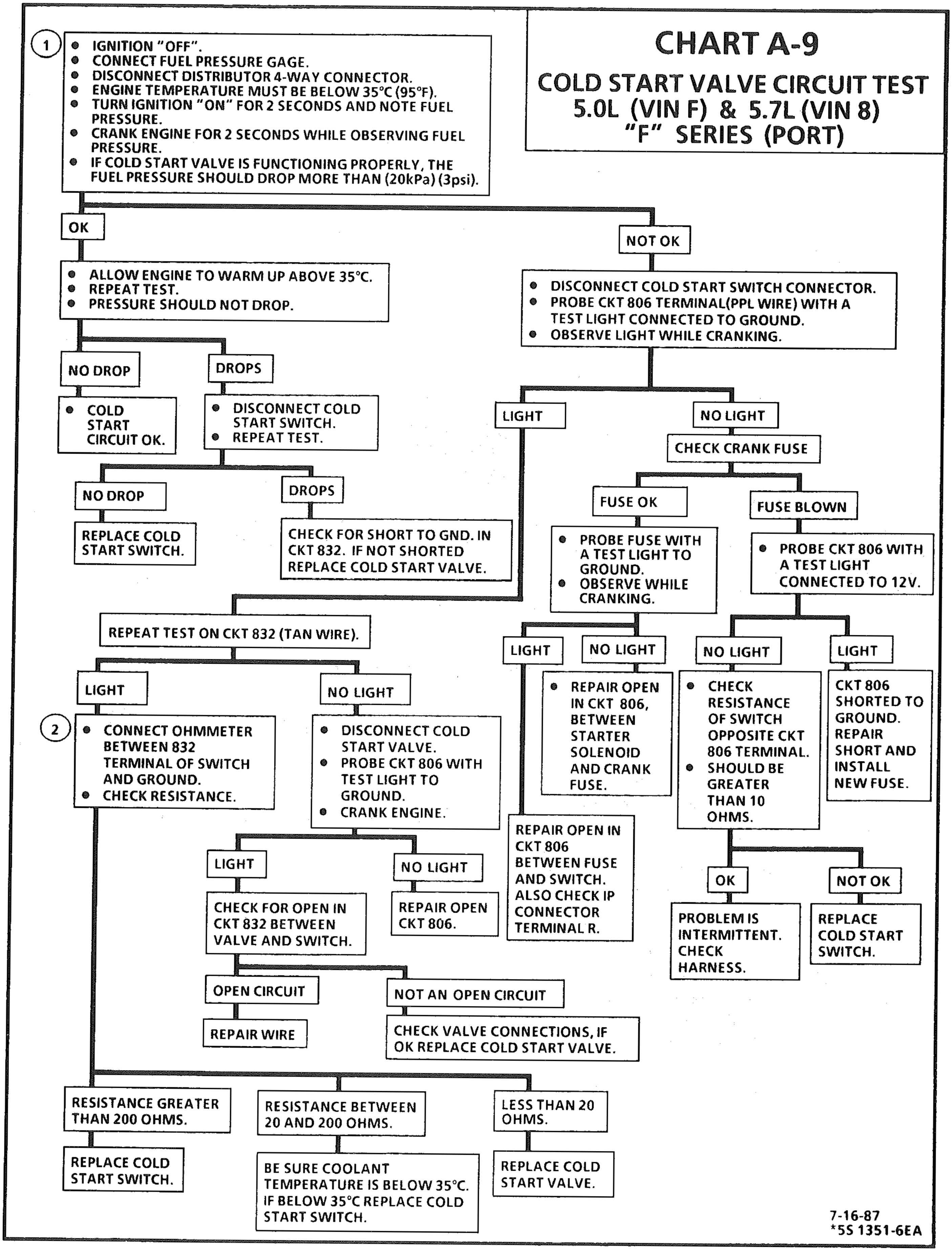
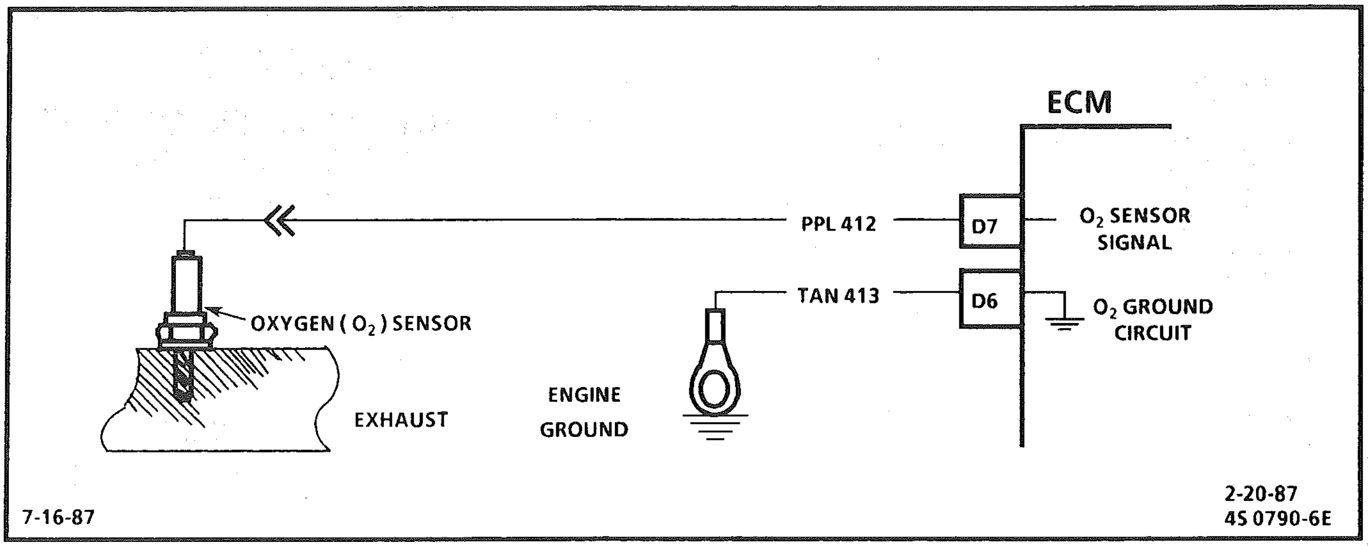


CHART A-9
COLD START VALVE CIRCUIT TEST
5.0L (VIN F) & 5.7L (VIN 8)
"F" SERIES (PORT)
1
• IGNITION "OFF".
• CONNECT FUEL PRESSURE GAGE.
• DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
• ENGINE TEMPERATURE MUST BE BELOW 35°C (95°F).
• TURN IGNITION "ON" FOR 2 SECONDS AND NOTE FUEL PRESSURE.
• CRANK ENGINE FOR 2 SECONDS WHILE OBSERVING FUEL PRESSURE.
• IF COLD START VALVE IS FUNCTIONING PROPERLY, THE FUEL PRESSURE SHOULD DROP MORE THAN (20kPa) (3psi).
OK
• ALLOW ENGINE TO WARM UP ABOVE 35°C.
• REPEAT TEST.
• PRESSURE SHOULD NOT DROP.
NO DROP
• COLD START CIRCUIT OK.
DROPS
• DISCONNECT COLD START SWITCH.
• REPEAT TEST.
NO DROP
REPLACE COLD START SWITCH.
DROPS
CHECK FOR SHORT TO GND. IN CKT 832. IF NOT SHORTED REPLACE COLD START VALVE.
NOT OK
• DISCONNECT COLD START SWITCH CONNECTOR.
• PROBE CKT 806 TERMINAL(PPL WIRE) WITH A TEST LIGHT CONNECTED TO GROUND.
• OBSERVE LIGHT WHILE CRANKING.
LIGHT
REPEAT TEST ON CKT 832 (TAN WIRE).
LIGHT
2
• CONNECT OHMMETER BETWEEN 832 TERMINAL OF SWITCH AND GROUND.
• CHECK RESISTANCE.
RESISTANCE GREATER THAN 200 OHMS.
REPLACE COLD START SWITCH.
RESISTANCE BETWEEN 20 AND 200 OHMS.
BE SURE COOLANT TEMPERATURE IS BELOW 35°C. IF BELOW 35°C REPLACE COLD START SWITCH.
LESS THAN 20 OHMS.
REPLACE COLD START VALVE.
NO LIGHT
• DISCONNECT COLD START VALVE.
• PROBE CKT 806 WITH TEST LIGHT TO GROUND.
• CRANK ENGINE.
LIGHT
CHECK FOR OPEN IN CKT 832 BETWEEN VALVE AND SWITCH.
OPEN CIRCUIT
REPAIR WIRE
NOT AN OPEN CIRCUIT
CHECK VALVE CONNECTIONS, IF OK REPLACE COLD START VALVE.
NO LIGHT
REPAIR OPEN CKT 806.
NO LIGHT
CHECK CRANK FUSE
FUSE OK
• PROBE FUSE WITH A TEST LIGHT TO GROUND.
• OBSERVE WHILE CRANKING.
LIGHT
REPAIR OPEN IN CKT 806 BETWEEN FUSE AND SWITCH. ALSO CHECK IP CONNECTOR TERMINAL R.
NO LIGHT
• REPAIR OPEN IN CKT 806, BETWEEN STARTER SOLENOID AND CRANK FUSE.
FUSE BLOWN
• PROBE CKT 806 WITH A TEST LIGHT CONNECTED TO 12V.
NO LIGHT
• CHECK RESISTANCE OF SWITCH OPPOSITE CKT 806 TERMINAL.
• SHOULD BE GREATER THAN 10 OHMS.
OK
PROBLEM IS INTERMITTENT. CHECK HARNESS.
NOT OK
REPLACE COLD START SWITCH.
LIGHT
CKT 806 SHORTED TO GROUND. REPAIR SHORT AND INSTALL NEW FUSE.
7-16-87
*5S 1351-6EA



CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D7" and "D6". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below 360 ° C(600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 13 WILL SET:
   - Engine at normal operating temperature (above 70°C)
   - At least 2 minutes engine time after start.
   - O_2 signal voltage steady between .35 and .55 volts.
   - Throttle position sensor signal above 5%. (about .3 volts above closed throttle voltage).
   - All conditions must be met for about 60 seconds.

   If the conditions for a Code 13 exist, the system will not go "Closed Loop".
2. This will determine if the sensor is at fault or the wiring or ECM is the cause of the Code 13.
3. For this test use only a high impedance digital voltohm meter. This test checks the continuity of CKTs 412 and 413. If CKT 413 is open, the ECM voltage on CKT 412 will be over .6 volts (600 mV).

Diagnostic Aids:

Normal "Scan" voltage varies between 100mV to 999mV (.1 and 1.0 volt) while in "Closed Loop". Code 13 sets in one minute if voltage remains between .35 and .55 volts, but the system will go "Open Loop" in about 15 seconds.

Refer to "Intermittents" in Section "B".

CODE 13

OXYGEN SENSOR CIRCUIT
(OPEN CIRCUIT)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1. ENGINE AT NORMAL OPERATING TEMPERATURE (ABOVE 80°C).
   - RUN ENGINE ABOVE 1200 RPM FOR TWO MINUTES.

   DOES "SCAN" INDICATE "CLOSED LOOP"?

YES → CODE 13 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO →

2.
   - DISCONNECT O_2 SENSOR.
   - JUMPER HARNESS CKT 412 TO GROUND.
   - "SCAN" SHOULD DISPLAY O_2 VOLTAGE BELOW .2 VOLTS (200 mV) WITH ENGINE RUNNING.

   DOES IT?

YES → FAULTY O_2 SENSOR CONNECTION OR SENSOR.

NO →

3.
   - IGNITION "ON", ENGINE "OFF".
   - CHECK VOLTAGE OF CKT 412 (ECM SIDE) AT O_2 SENSOR HARNESS CONNECTOR USING A DVM.

   IT SHOULD BE .3-.6 VOLTS (300 - 600 mV).

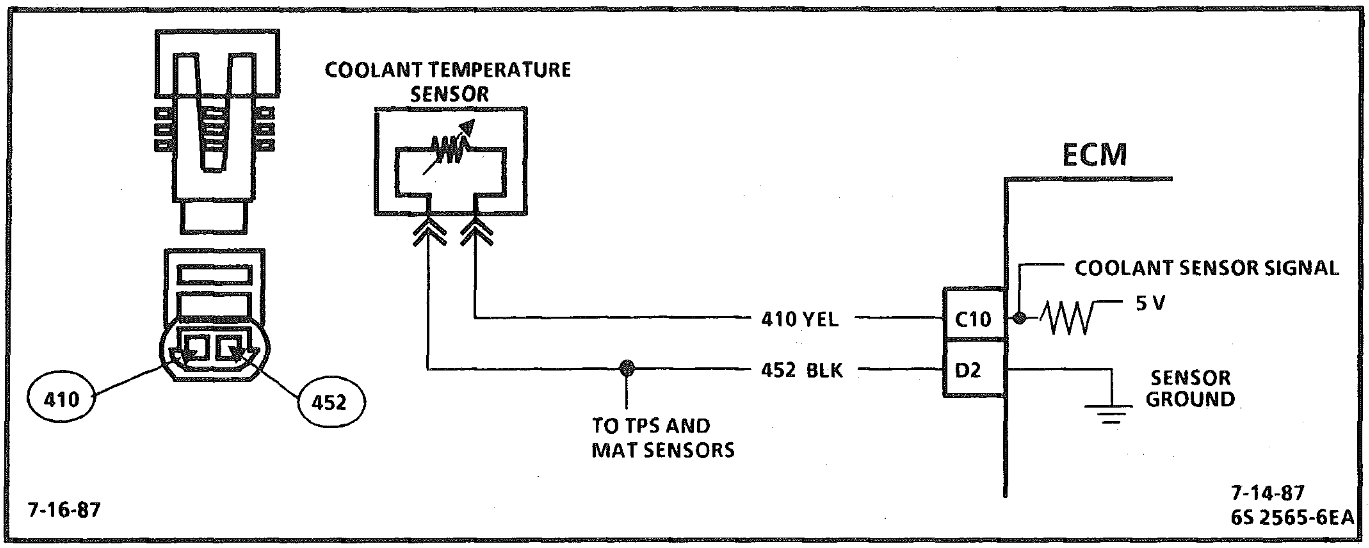
.3-.6 VOLTS (300 - 600 mV) → FAULTY ECM

OVER .6 VOLT (600 mV) → OPEN CKT 413, FAULTY CONNECTION OR FAULTY ECM.

LESS THAN .3 VOLT (300 mV) → OPEN CKT 412, FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-23-87
• 7S 3054-6E



CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C), the voltage will measure about 1.5 to 2.0 volts.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 14 will set if:
   - signal voltage indicates a coolant temperature above 130°C (266°F) for 3 seconds
2. This test will determine if CKT 410 is shorted to ground which will cause the conditions for Code 14.

Diagnostic Aids:

Check harness routing for a potential short to ground in CKT 410.

"SCAN" tool displays engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens.

Refer to "Intermittents" in Section "B".

CODE 14

COOLANT TEMPERATURE SENSOR CIRCUIT

(HIGH TEMPERATURE INDICATED)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1 DOES "SCAN" DISPLAY 130°C OR HOTTER?

YES

2 • DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMP. BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 410 SHORTED TO GROUND.
OR
CKT 410 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

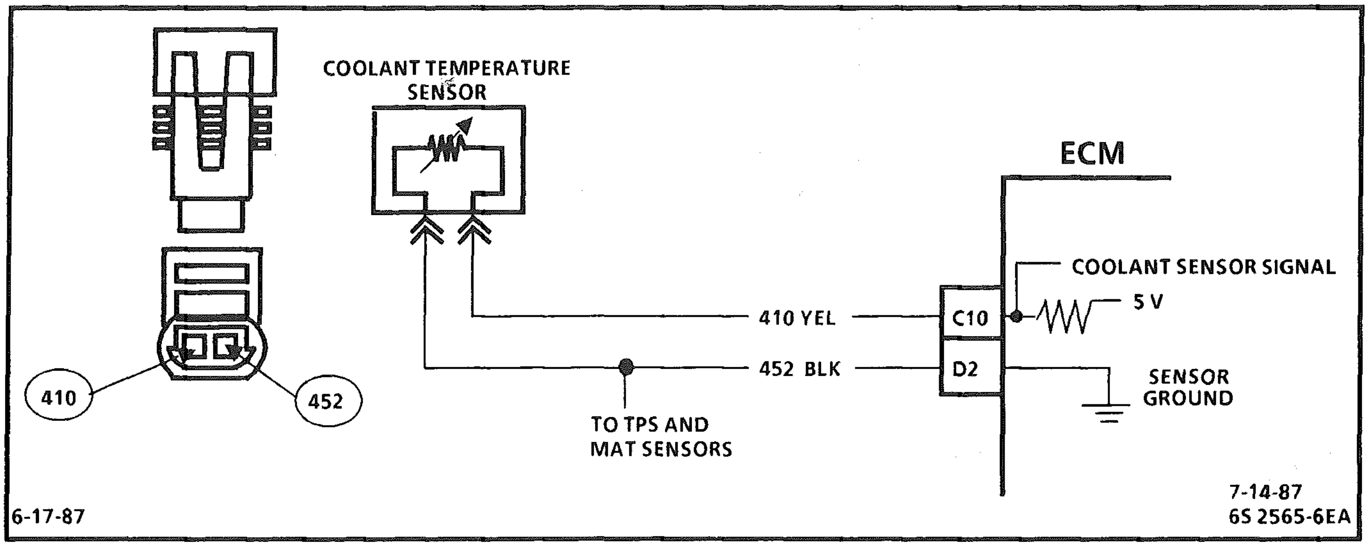
CODE 14 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The coolant temperature sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage on CKT 410 to the sensor. When the engine is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see high signal voltage.

As the engine warms, the sensor resistance becomes less, and the voltage drops. At normal engine operating temperature (85°C to 95°C), the voltage will measure about 1.5 to 2.0 volts at the ECM.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 15 will set if:
   - signal voltage indicates a coolant temperature less than -44° C (-47° F) for 3 seconds.
2. This test simulates a Code 14. If the ECM recognizes the low signal voltage, (high temp.) and the "Scan" reads 130°C or above, the ECM and wiring are OK.
3. This test will determine if CKT 410 is open. There should be 5 volts present at sensor connector if measured with a DVM.

Diagnostic Aids:

A "SCAN" tool reads engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90°C then stabilize when thermostat opens.

A faulty connection, or an open in CKT 410 or 452 will result in a Code 15.

If Code 22 or 23 is also set, check CKT 452 for faulty wiring or connections. Check terminals at sensor for good contact. Refer to "Intermittents" in Section "B".

CODE 15

COOLANT TEMPERATURE SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1 DOES "SCAN" DISPLAY COOLANT -30°C OR COLDER?

YES

2
- DISCONNECT SENSOR
- JUMPER HARNESS TERMINALS TOGETHER "SCAN" SHOULD DISPLAY 130°C OR MORE. DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

3
- JUMPER CKT 410 TO GROUND. "SCAN" SHOULD DISPLAY OVER 130°C. DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT , FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 410, FAULTY CONNECTION AT ECM, OR FAULTY ECM.

NO

CODE 15 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

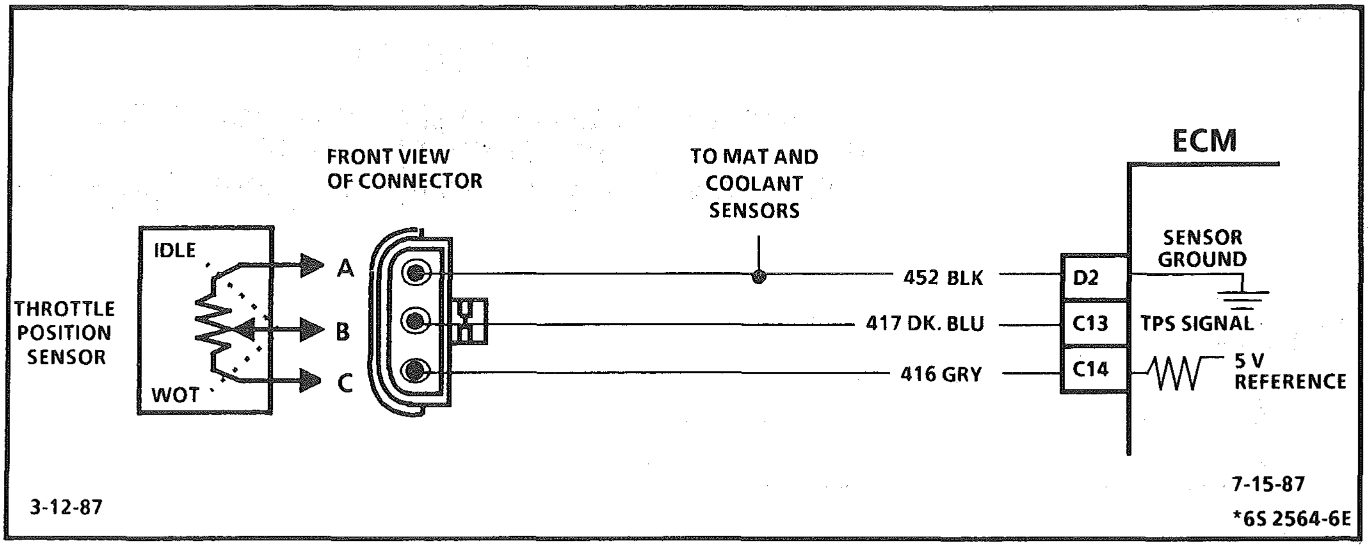
DIAGNOSTIC AID

COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-11-87
● 7S 3261-6E



CODE 21

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 21 will set if:
   - TPS signal voltage is greater than 2.5 volts
   - Engine is running
   - Air flow is less than 12 GM/sec.
   - All conditions met for 3 seconds.

     OR
   - TPS signal voltage over about 4.8 volts with ignition "ON".

   With throttle closed, the TPS should read less than .62 volts. If it doesn't check adjustment.
2. With the TPS sensor disconnected, the TPS voltage should go low if the ECM and wiring is OK.
3. Probing CKT 452 with a test light checks the 5V return CKT, because a faulty 5V return will cause a Code 21.

Diagnostic Aids:

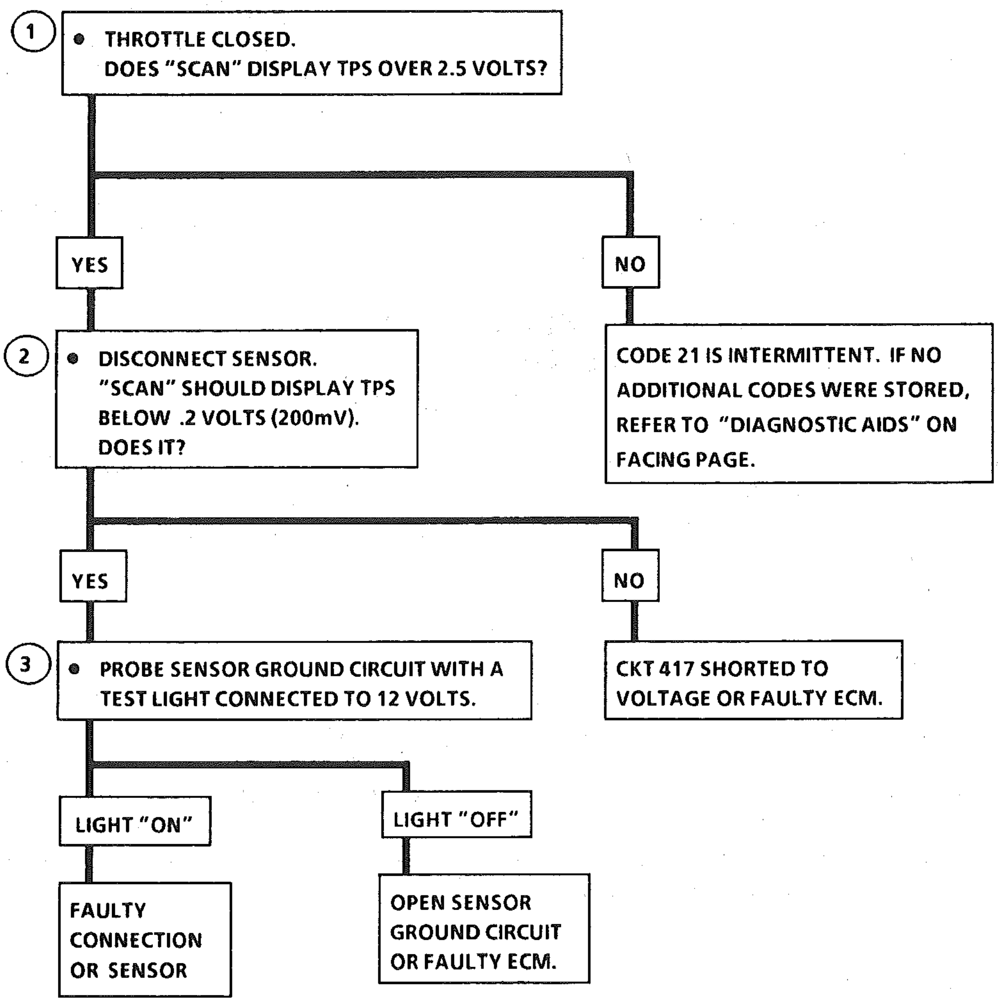
A "SCAN" tool reads throttle position in volts. Should read .54V ± .08V with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open in CKT 452 will result in a Code 21.

Refer to "Intermittents" in Section "B".

CODE 21

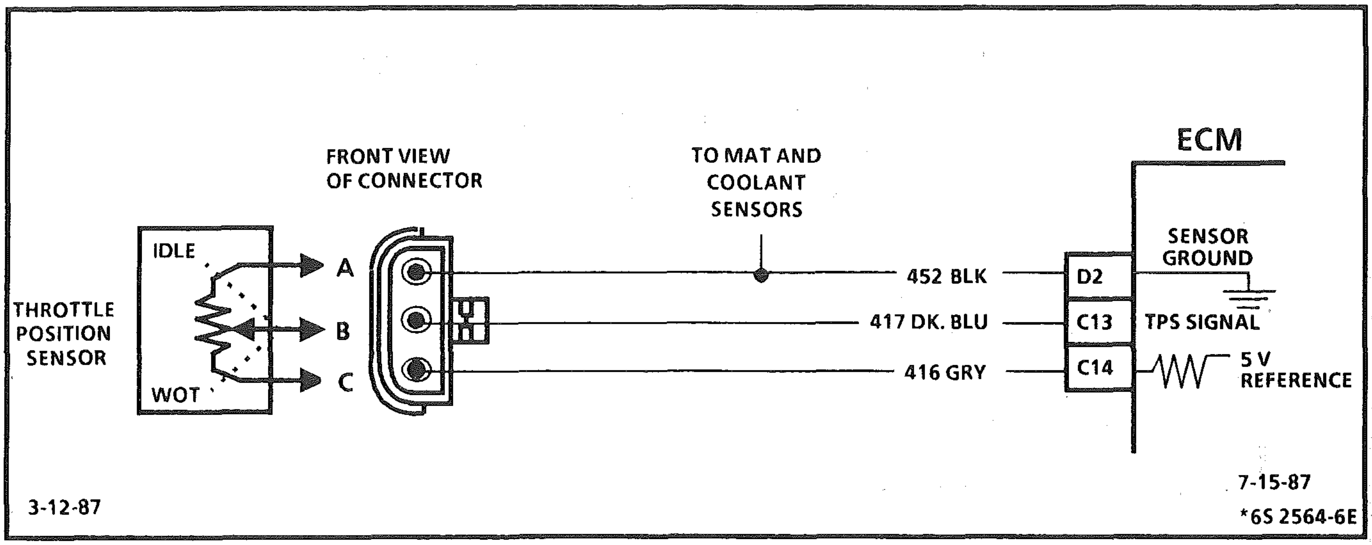
THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE HIGH)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-24-87

• 7S 3057-6E



CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The throttle position sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from about .5 at idle to about 5 volts at wide open throttle.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM control outputs.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 22 will set if:
   - Engine running
   - TPS signal voltage is less than about .2 volt for 3 seconds.
2. Simulates Code 21: (high voltage) If the ECM recognizes the high signal voltage the ECM and wiring are OK.
3. TPS adjustment: With throttle closed, the TPS voltage reading should be .54V ± .08V.
4. This simulates a high signal voltage to check for an open in CKT 417.

Diagnostic Aids:

A "Scan" tool reads throttle position in volts. Should read .54V ± .08V with throttle closed and ignition "ON" or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT.

An open or short to ground in CKTs 416 or 417 will result in a Code 22.

Refer to "Intermittents" in Section "B".

CODE 22

THROTTLE POSITION SENSOR (TPS) CIRCUIT
(SIGNAL VOLTAGE LOW)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1
- THROTTLE CLOSED

DOES "SCAN" DISPLAY TPS .2V (200 mV) OR BELOW?

YES

2
- DISCONNECT TPS SENSOR.
- JUMPER CKTS 416 & 417 TOGETHER.

"SCAN" SHOULD DISPLAY TPS OVER 4.0 V (4000 mV).
DOES IT?

NO

- CODE 22 IS INTERMITTENT.

IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

NO

4
- PROBE CKT 417 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.

"SCAN" TOOL SHOULD DISPLAY TPS OVER 4.0V (4000 mV)
DOES IT?

YES

3
- REFER TO FACING PAGE FOR SPECIFIC INSTRUCTIONS.

YES

CKT 416 OPEN.
OR
SHORTED TO GROUND.
OR
FAULTY CONNECTION.
OR
FAULTY ECM.

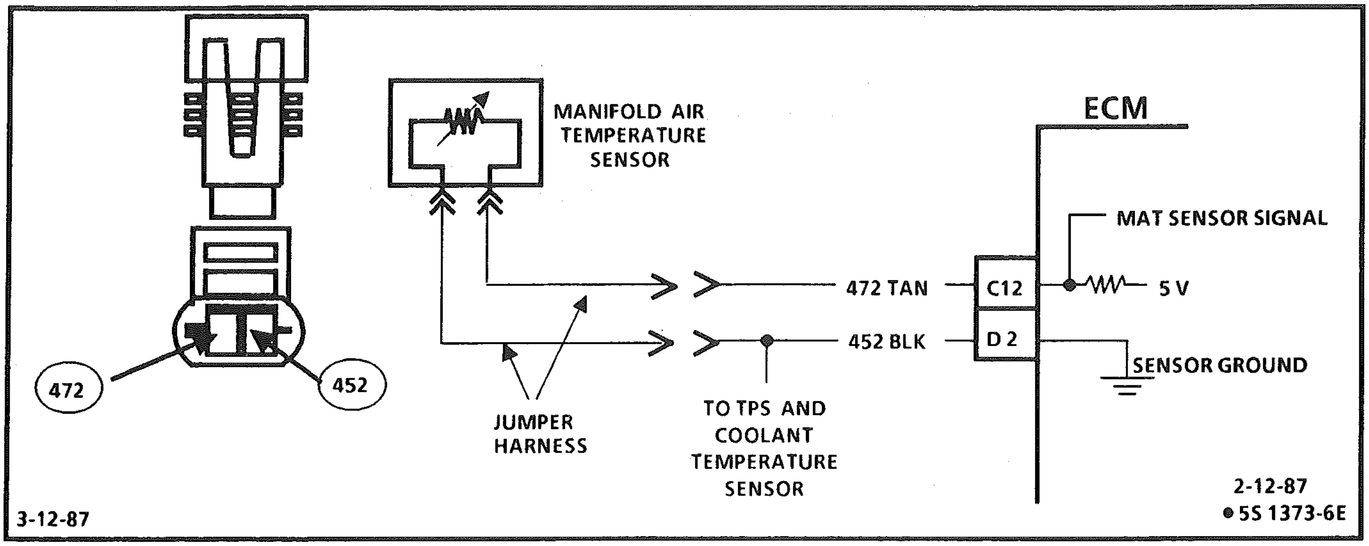
NO

CKT 417 OPEN.
OR
SHORTED TO GROUND.
OR
SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM CONNECTION.
OR
FAULTY ECM.

6-25-87

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

- 7S 3365-6E



CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(LOW TEMPERATURE INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The MAT sensor uses a thermistor to control the signal voltage to the ECM. The ECM applies a voltage (4-6 volts) on CKT 472 to the sensor. When the air is cold, the sensor (thermistor) resistance is high, therefore, the ECM will see a high signal voltage. If the air is warm, the sensor resistance is low, therefore, the ECM will see a low voltage.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 23 will set if:
   - A signal voltage indicates a manifold air temperature below −30°C (-22°F) for 12 seconds.
   - Time since engine start is 1 minute or longer.
   - No VSS (vehicle not moving)
2. A Code 23 will set, due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK. The MAT sensor is difficult to reach and this test can be performed by disconnecting the MAT jumper harness connector. If the "Scan" indicates a temperature of over 130°C the jumper harness to the sensor should be checked before replacing the sensor.
3. This will determine if the signal CKT 472 or the 5V return CKT 452 is open.

Diagnostic Aids:

A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rises as underhood temperature increases.

Carefully check harness and connections for possible open CKT 472 or 452.

Refer to "Intermittents" in Section "B".

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT

(LOW TEMPERATURE INDICATED)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1 • DOES "SCAN" TOOL DISPLAY MAT -30°C OR COLDER?

YES

2 • DISCONNECT SENSOR.
• JUMPER HARNESS TERMINALS TOGETHER.
"SCAN" SHOULD DISPLAY TEMPERATURE OVER 130°C.
DOES IT?

YES

FAULTY CONNECTION OR SENSOR.

NO

3 • JUMPER CKT 472 TO GROUND.
"SCAN" SHOULD DISPLAY TEMP. OVER 130°C.
DOES IT?

YES

OPEN SENSOR GROUND CIRCUIT, FAULTY CONNECTION OR FAULTY ECM.

NO

OPEN CKT 472, FAULTY CONNECTION OR FAULTY ECM.

NO

CODE 23 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

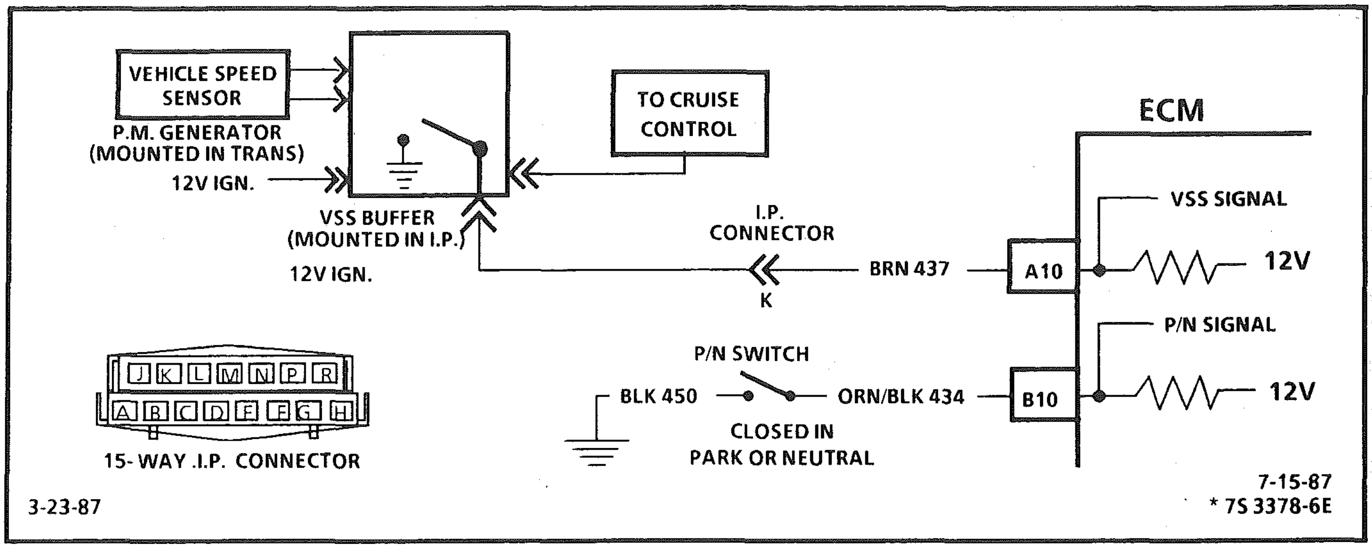
DIAGNOSTIC AID

MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-25-87
• 7S 3285



CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The ECM applies and monitors 12 volts on CKT 437. CKT 437 connects to the vehicle speed sensor buffer which alternately grounds CKT 437 when drive wheels are turning. This pulsing action takes place about 2000 times per mile and the ECM will calculate vehicle speed based on the time between "pulses".

A "SCAN" tool reading should closely match with speedometer reading with drive wheels turning.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 24 will set if:
   - CKT 437 voltage is constant.
   - Engine speed between 1400 and 3600 rpm.
   - Less than 2% throttle opening, about .10V (100mV) above close throttle.
   - Low load condition (low air flow).
   - Not in park or neutral.
   - All conditions must be met for 4 seconds.

   These conditions are met during a road load deceleration.
2. A voltage of less than 1 volt at the 15-way connector indicates that the CKT 437 wire may be shorted to ground. Disconnect CKT 437 at the VSS buffer. If voltage now reads above 10 volts, the VSS buffer is faulty. If voltage remains less than 10 volt, then CKT 437 wire is grounded or open. If 437 is not grounded or open, check for a faulty ECM connector or ECM.

Diagnostic Aids:

If "Scan" displays vehicle speed, check park/neutral switch CHART C-1A on vehicle with auto trans. If switch is OK check for intermittent connections. An open or short to ground in CKT 437 will result in a Code 24. If the customer also complained about a loss of mph on the I.P., check the P.M. generator circuit. Refer to Section "8A" for complete wiring diagram.

Refer to "Intermittents" in Section "B".

CODE 24

VEHICLE SPEED SENSOR (VSS) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

NOTE: TO PREVENT MISDIAGNOSIS, THE TECHNICIAN SHOULD REVIEW ELECTRICAL SECTION "8A" OR THE ELECTRICAL TROUBLESHOOTING MANUAL AND IDENTIFY THE TYPE OF VEHICLE SPEED SENSOR USED PRIOR TO USING THIS CHART. DISREGARD CODE 24 IF SET WHEN DRIVE WHEELS ARE NOT TURNING.

1

- ASSUMES SPEEDOMETER IS WORKING OK.
- RAISE DRIVE WHEELS.
- WITH ENGINE IDLING IN GEAR, "SCAN" SHOULD DISPLAY MPH ABOVE 0.
  DOES IT?

NO

- ENGINE STILL IDLING IN GEAR.
- BACKPROBE 15 WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- IS VOLTAGE VARYING BETWEEN 6 AND 11 VOLTS?

YES

CODE 24 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO " DIAGNOSTIC AIDS " ON FACING PAGE .

NO

2

- IGNITION "OFF".
- DISCONNECT VSS BUFFER
- IGNITION "ON."
- BACK PROBE 15-WAY I.P. CONNECTOR TERMINAL "K" WITH VOLTMETER TO GROUND.
- SHOULD DISPLAY 10 VOLTS OR MORE.
  DOES IT?

YES

FAULTY ECM

YES

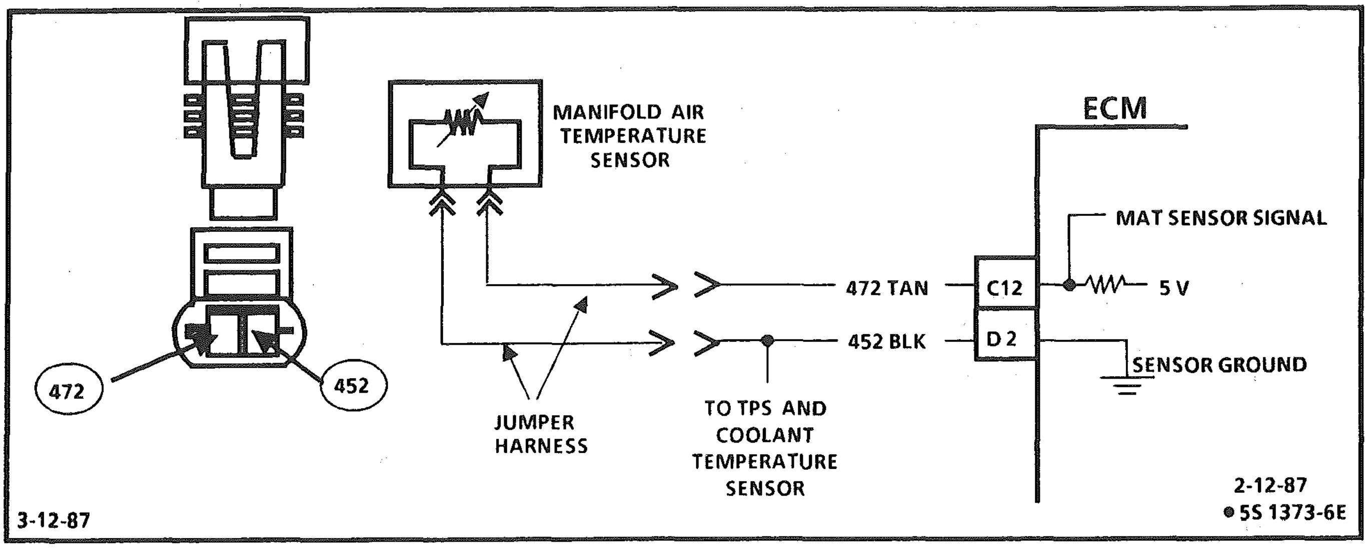
CKT 437 OPEN BETWEEN I.P. 15-WAY CONNECTOR AND VSS BUFFER CONNECTOR OR FAULTY BUFFER.

NO

CKT 437 SHORTED TO GROUND, OPEN BETWEEN ECM AND I.P. 15-WAY CONNECTOR, OR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP " OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*8S 4684-6E
7-16-87



CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT
(HIGH TEMPERATURE INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The manifold air temperature sensor uses a thermistor to control the signal-voltage to the ECM. The ECM applies a voltage (4-6) on CKT 472 to the sensor. When manifold air is cold, the sensor (Thermistor) resistance is high, therefore, the ECM will see a high signal voltage. As the air warms, the sensor resistance becomes less, and the voltage drops.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 25 will set if:
   - Signal voltage indicates a manifold air temperature greater than 150°C (302° F) for 2 seconds.
   - Time since engine start is 1 minute or longer.
   - A vehicle speed is present.

Diagnostic Aids:

A "SCAN" tool reads temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases.

Check harness routing for possible short to ground in CKT 472.

Refer to "Intermittents" in Section "B".

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) SENSOR CIRCUIT

(HIGH TEMPERATURE INDICATED)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1 • DOES "SCAN" TOOL DISPLAY MAT 145°C OR HOTTER?

YES

• DISCONNECT SENSOR.
"SCAN" SHOULD DISPLAY TEMPERATURE BELOW -30°C.
DOES IT?

YES

FAULTY SENSOR.

NO

CKT 472 SHORTED TO GROUND.
OR
CKT 472 SHORTED TO SENSOR GROUND CIRCUIT.
OR
FAULTY ECM.

NO

CODE 25 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

DIAGNOSTIC AID

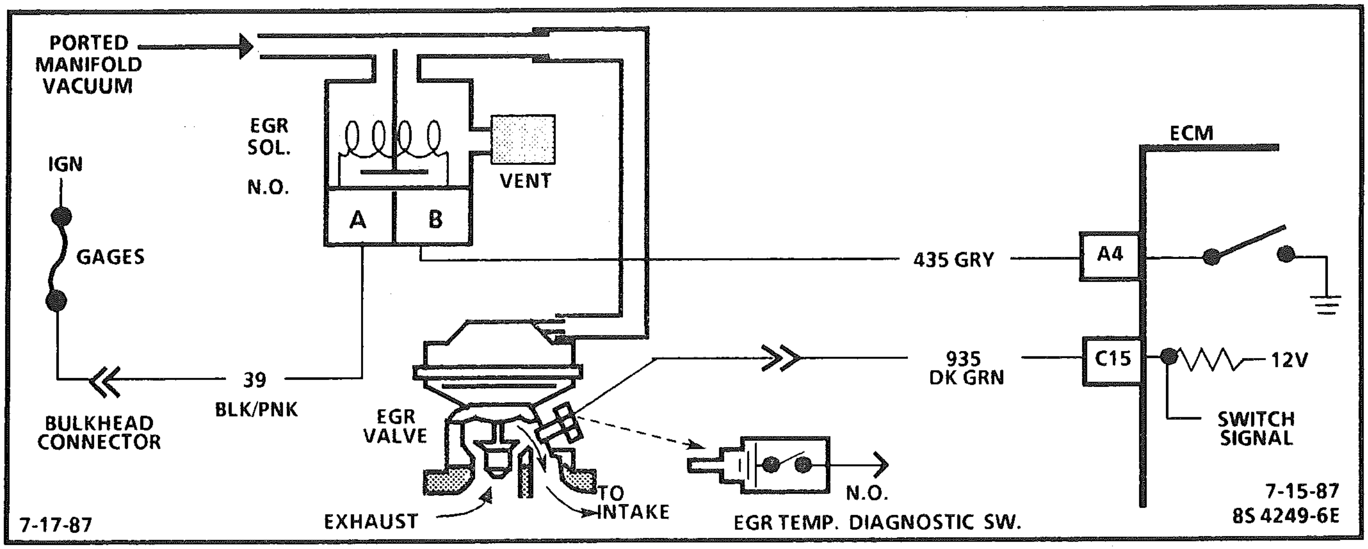
MAT SENSOR

TEMPERATURE TO RESISTANCE VALUES (APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,800
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-17-87
• 7S 3190-6E



CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The EGR valve vacuum is controlled by an ECM controlled solenoid. The ECM will turn the EGR "ON" and "OFF" (Duty Cycle) by grounding CKT 435. The duty cycle is calculated by the ECM, based on information from the coolant and mass air flow sensor and engine RPMs. There should be (NO EGR) when in park or neutral, TPS input below a specified value or TPS indicating wide open throttle (WOT).

With the ignition "ON", engine stopped, the EGR solenoid is de-energized and, by grounding the diagnostic terminal, the solenoid is energized.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

Code 32 means that the EGR diagnostic switch was closed during start-up or that the switch was not detected closed under the following conditions:

- Coolant temperature greater than 80°C (176°F).
- EGR duty cycle commanded by the ECM is greater than 48%.
- TPS less than wide open throttle (WOT), but not at idle.
- Codes 21,22,33,34 not present.
- All conditions above must be met for about 4 minutes.

If the switch is detected closed during start-up, or if the switch is detected open when the above conditions are met, the "Service Engine Soon" light will remain "ON" unless the switch changes state.

1. This test will determine if the ECM set the code due to CKT 935 being grounded on start-up. If the "Scan" does not indicate the switch is closed but the customer complained of a "Service Engine Soon" light after start-up, then this circuit should be checked carefully for an intermittent grounded condition.
2. If the "Scan" indicates the switch is no longer closed after disconnecting it, be sure the switch is not closed due to heat. (EGR being "ON" prior to test).
3. This test will check for a possible open in CKT 935. The ECM supplies 9-12 volts to CKT 935 and the "Scan" should indicate switch being closed when CKT 935 is grounded.
4. By grounding the diagnostic terminal, the EGR solenoid should close, and allow vacuum to be applied and the vacuum should hold.
5. This test will determine if the electrical control part of the system is at fault or if the connector or solenoid are at fault.
6. By plugging the EGR valve side and ungrounding the diagnostic terminal, the solenoid valve should open and allow vacuum to bleed off through the vent.
7. With the engine not running and vacuum is applied to the valve, the valve should move to the fully open position.
8. This engine uses a negative back pressure valve and the valve should close when the engine is cranked over.

CODE 32

EXHAUST GAS RECIRCULATION (EGR) CIRCUIT 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

(1)
- BEFORE USING THIS CHART, CHECK VACUUM HOSES FOR LEAKS , RESTRICTIONS, AND CHECK PORTED VACUUM SOURCE TO EGR SOLENOID; SHOULD HAVE AT LEAST 7" Hg VACUUM (23.7 kPa) AT 2000 RPM.
- USING A "SCAN" TOOL, CHECK EGR DIAGNOSTIC SWITCH INPUT.

DOES "SCAN" INDICATE SWITCH IS CLOSED?

NO

(3)
- DISCONNECT EGR TEMP. DIAGNOSTIC SWITCH.
- JUMPER HARNESS TERMINAL TO GND.
- DOES "SCAN" INDICATE SWITCH IS CLOSED?

- **YES**
  - (4)
    - IGNITION "ON", ENGINE STOPPED.
    - GROUND DIAGNOSTIC TERMINAL.
    - DISCONNECT VACUUM HARNESS AT THE EGR SOLENOID.
    - APPLY VACUUM TO THROTTLE BODY SIDE OF SOLENOID.
  - **UNABLE TO GET 10" VACUUM**
    - (5)
      - DISCONNECT EGR SOLENOID.
      - CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMS.
    - **LIGHT "OFF"** — PROBE EACH HARNESS CONNECTOR TERMINAL WITH A TEST LIGHT CONNECTED TO GROUND.
      - **LIGHT "ON" ONE** — OPEN CKT 435, FAULTY CONNECTION, OR FAULTY ECM.
      - **LIGHT "OFF"** — REPAIR OPEN CKT 39.
      - **LIGHT "ON" BOTH** — REPAIR SHORT TO VOLTAGE IN CKT 435.
    - **LIGHT "ON"** — FAULTY SOLENOID CONNECTION OR SOLENOID.
  - **ABLE TO GET 10" VACUUM**
    - (6)
      - PLUG EGR SIDE OF SOLENOID.
      - UNGROUND DIAGNOSTIC TERMINAL.
      - NOTE VACUUM (SHOULD BLEED OFF). DOES IT?
    - **YES**
      - (7)
        - IGNITION "OFF".
        - CONNECT A VACUUM PUMP TO EGR VALVE.
        - USING A MIRROR, OBSERVE EGR DIAPHRAGM WHILE APPLYING VACUUM.
        - DIAPHRAGM SHOULD MOVE FREELY AND HOLD VACUUM FOR AT LEAST 20 SECONDS. DOES IT?
      - **YES**
        - (8)
          - APPLY VACUUM TO EGR VALVE.
          - START ENGINE AND IMMEDIATELY OBSERVE VACUUM GAGE ON VACUUM PUMP .
          - VALVE IS GOOD IF DIAPHRAGM HAS MOVED TO SEATED POSITION (VALVE CLOSED) AND VACUUM DROPPED WHILE STARTING ENGINE.
        - **VACUUM DROPPED** — FAULTY EGR TEMPERATURE SWITCH.
        - **NO VACUUM DROP**
          - REMOVE EGR VALVE.
          - CHECK PASSAGES FOR BEING PLUGGED. IF NOT PLUGGED, REPLACE VALVE.
      - **NO** — REPLACE EGR VALVE.
    - **NO**
      - DISCONNECT SOLENOID ELECTRICAL CONNECTOR.
      - NOTE VACUUM.
      - **NO DROP** — REPLACE SOLENOID
      - **DROPS** — REPAIR SHORT TO GROUND IN CKT 435. IF NOT SHORTED, IT IS A FAULTY ECM.
- **NO** — CKT 935 OPEN, SHORTED TO VOLTAGE , FAULTY ECM CONN., OR ECM.

YES

(2)
- DISCONNECT EGR TEMP. DIAGNOSTIC SWITCH CONNECTOR .
- DOES "SCAN" INDICATE SWITCH IS CLOSED?

- **YES** — CKT 935 SHORTED TO GND, OR FAULTY ECM.
- **NO** — WIRE TO SWITCH SHORTED TO GND, SWITCH ALREADY CLOSED DUE TO HEAT, OR FAULTY SWITCH.

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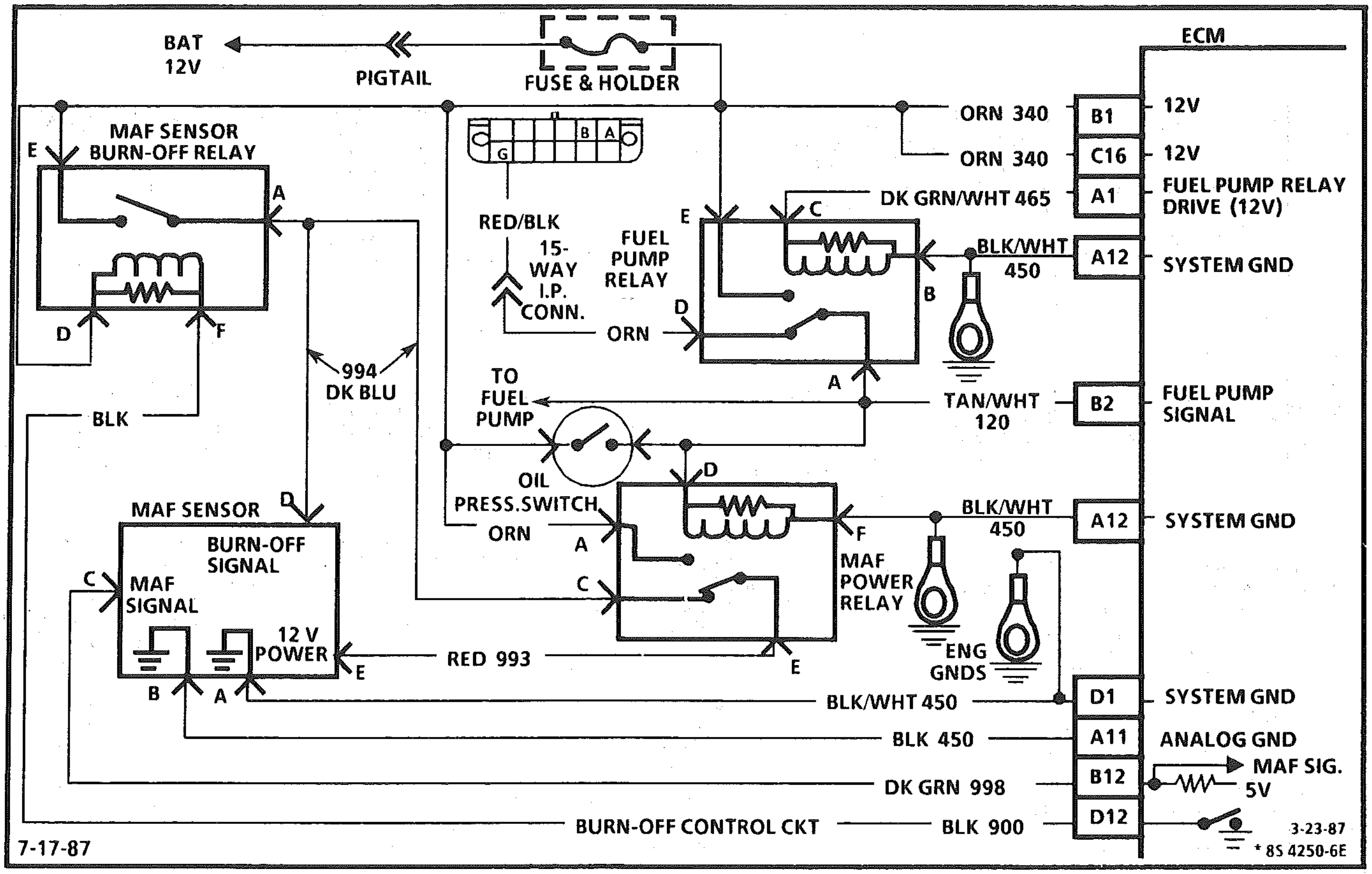
*7S 3286-6E



CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC HIGH)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine to control fuel delivery. For a detailed description of the MAF sensor operation refer to Section "C".

The oil pressure switch or the ECM, through control of the fuel pump relay, will provide 12 volts for the MAF power relay which provides the 12 volts needed by the MAF sensor.

The ECM provides a current limiting 5V on the signal line (CKT 998). The MAF sensor then changes the signal by dropping the voltage, so that with low air flow the ECM sees a low voltage and a high air flow will cause the ECM to see near the 5 volt supply.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

Code 33 indicates: ECM has seen flow in excess of 45 grams per second (above about 2.2 volts) for one second when:

- Engine is first started

  OR
- TPS is less than $\frac{1}{4}$ throttle.
- RPM is less than 2000.

Due to the 5 volt pull-up resistor in the ECM if CKT 998 becomes open, the ECM will see a high voltage signal and set a Code 33.

1. This test will determine if the conditions to set the code still exist.
2. With the ALDL terminal "G" jumpered to 12 volts, there should be 12 volts at the sensor. If no voltage is present, make sure that the fuel pump is running. If not, repair fuel pump circuit.
3. If a burn-off signal is present at the MAF sensor with the engine running, a Code 33 will set. Be sure no voltage is present on CKT 994 for the first 2 seconds after the ignition is turned "ON", or after the 2 second period.
4. The ECM sources a voltage (4-6 volts) to the MAF sensor on CKT 998. This test checks for that voltage.

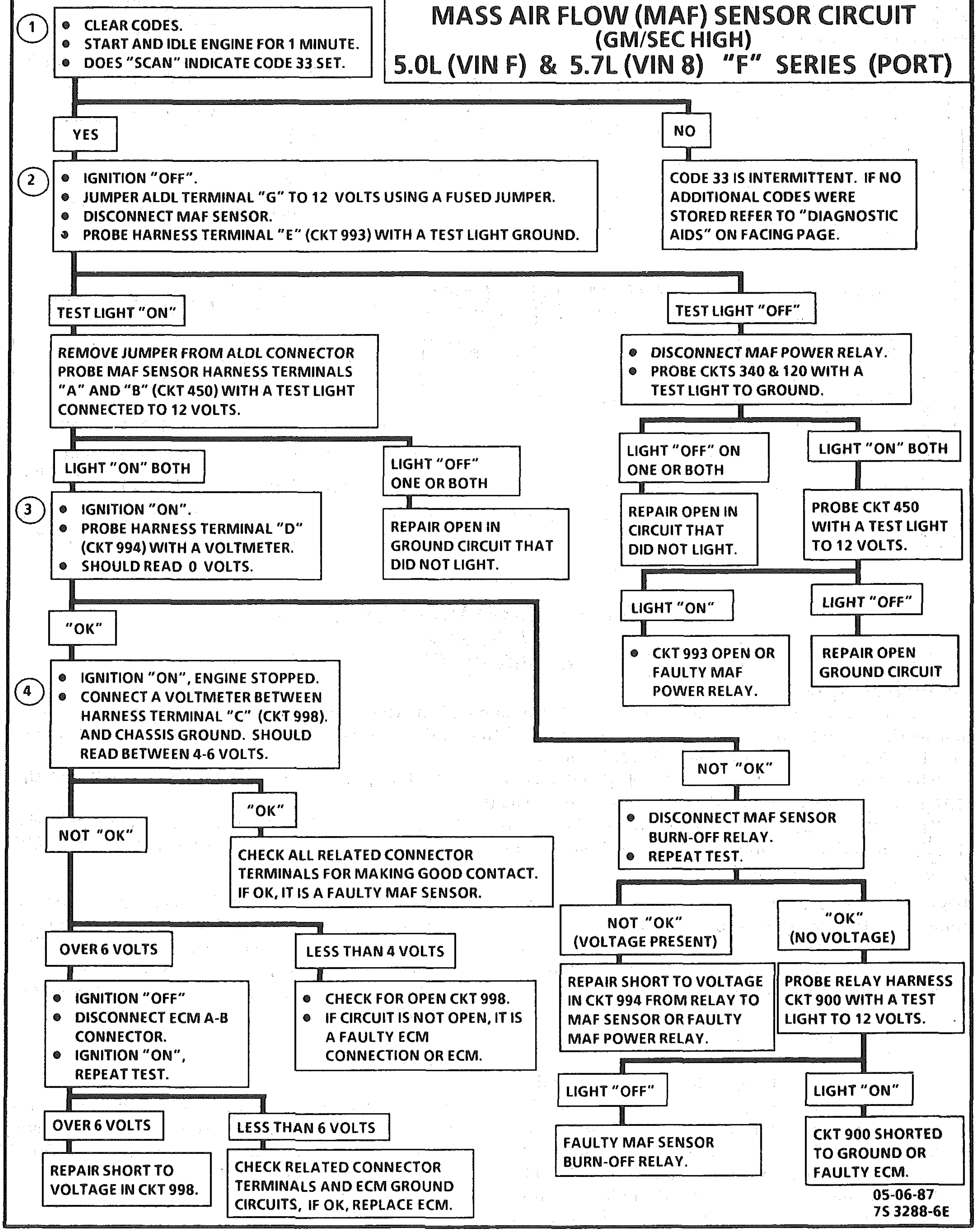
Diagnostic Aids:

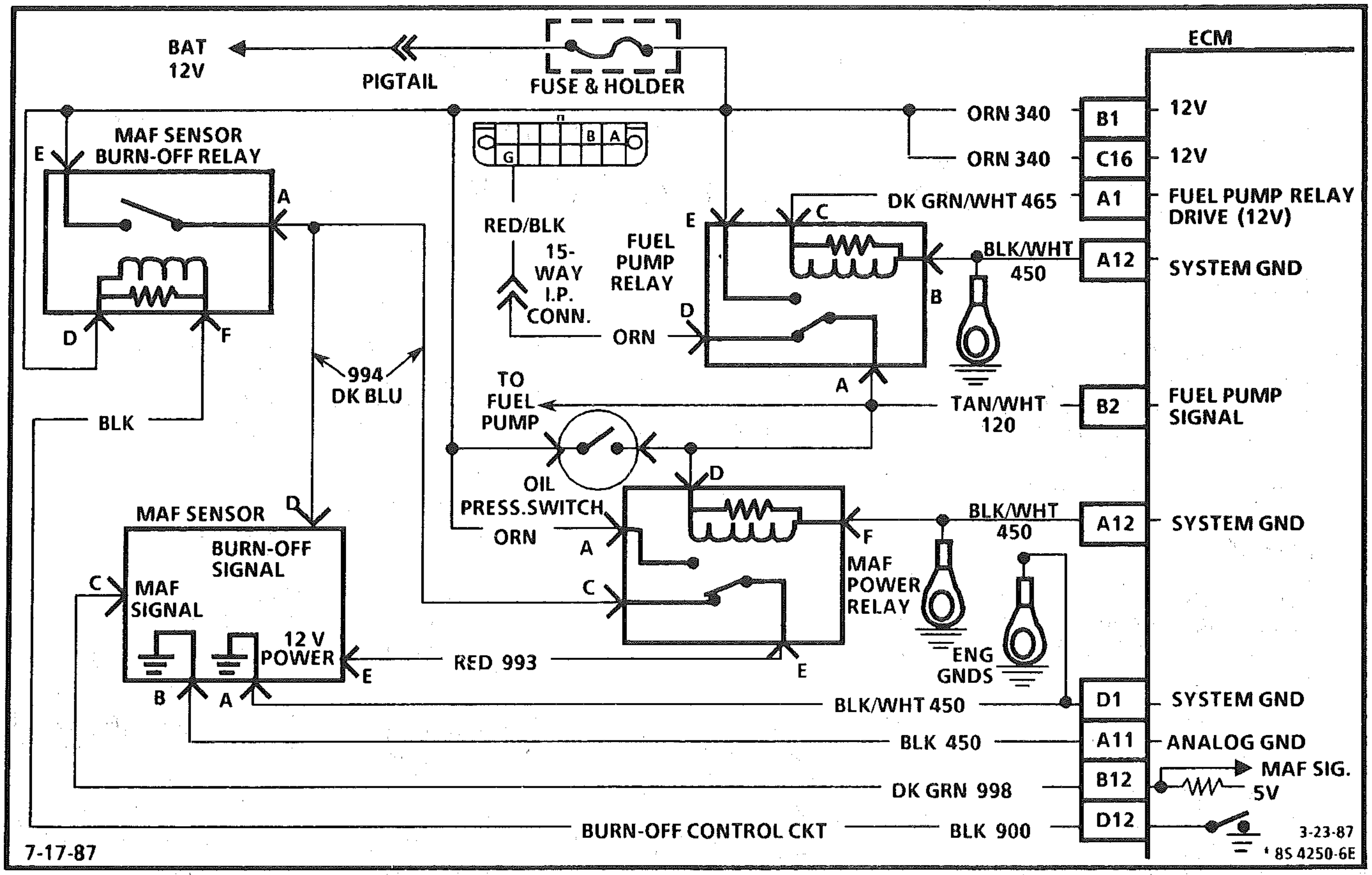
Intermittent: By jumpering the fuel pump test terminal (G term. of ALDL) to 12 volts, the MAF sensor will stay powered up and the signal line should see a low voltage, less than 250 mv or low grams per second on a "SCAN" tool. By wiggling the related wiring the intermittent may be detected. Also, an erratic signal with the engine running may indicate faulty wiring or components.

CODE 33

MASS AIR FLOW (MAF) SENSOR CIRCUIT (GM/SEC HIGH)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)





CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC LOW)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. For a detailed description of the MAF sensor operation refer to Section C.

The oil pressure switch or the ECM, through control of the fuel pump relay, will provide 12 volts for the MAF power relay which provides the 12 volts needed by the MAF sensor.

The ECM provides a current limiting 5V on the signal line (CKT 998). The MAF sensor then changes the signal by dropping the voltage so that with low air flow the ECM sees a low voltage and a high air flow will cause the ECM to see near the 5 volt supply.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

Code 34 indicates: ECM has seen low air flow less than 2.5 gm/sec. (low voltage) for one second when:

- Engine is first started

  OR
- RPM above 600
- TPS above 6%. To obtain 6%, the engine has to be running at about 2300 rpm in neutral.

1. A Code 34 may be caused by an engine that exhibits a low, rough, unstable or incorrect idle problem. If this condition exists, disconnect the MAF sensor. If the unstable idle still exists, refer to Symptoms in Section "B". (Rough, unstable, incorrect idle, or stalling.) If the idle improved with the sensor disconnected, replace it.
2. This test will determine if the conditions still exist to set a code or if the problem is intermittent.
3. With the MAF sensor disconnected, the ECM should see a high signal voltage and set a Code 33. If a Code 34 resets then the wiring or the ECM is at fault.

Diagnostic Aids:

A low, rough or unstable idle could result in a Code 34. Also be sure air ducts are tight and not cracked. Check CKT 998 for short to ground. Refer to "Intermittents" in Section "B".

CODE 34

MASS AIR FLOW (MAF) SENSOR CIRCUIT
(GM/SEC LOW)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1
- CHECK FOR LOOSE OR DAMAGED AIR DUCT BETWEEN MAF SENSOR AND THROTTLE BODY.
- SEE TEST DESCRIPTION #1 ON FACING PAGE.
- CLEAR CODES
- START AND RUN ENGINE ABOVE 2300 RPM FOR 1 MINUTE OR UNTIL CODE 34 SETS.

DOES CODE SET?

YES

2
- IGNITION "OFF"
- DISCONNECT MAF SENSOR
- REPEAT TEST
- CODE 33 SHOULD SET.

DOES IT?

YES

3
WITH ENGINE RUNNING BE SURE 12 VOLTS ARE AVAILABLE TO MAF SENSOR (TERMINAL "E"). IF OK, IT IS FAULTY MAF SENSOR.

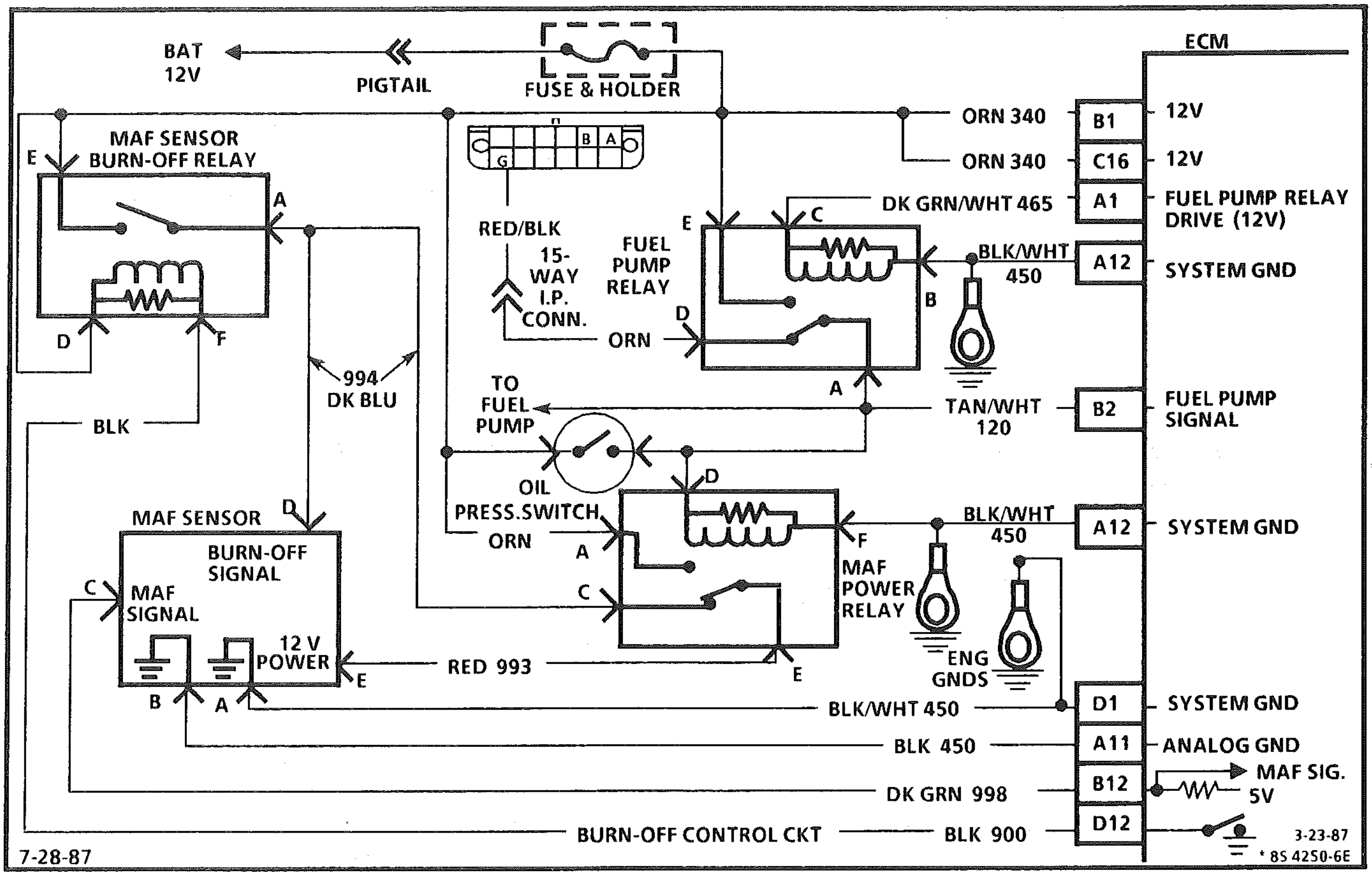
NO

CKT 998 SHORTED TO GROUND, OR FAULTY ECM.

NO

CODE 34 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

2-13-87
*7S 3289-6E



CODE 36

MASS AIR FLOW (MAF) BURN-OFF CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. For a detailed description of the MAF sensor operation see Section "C".

Due to contaminates in the atmosphere, a residue may build up on the MAF sensor sensing wire. To maintain an accurate reading from the sensor, a "burn-off" cycle will occur when the ignition is turned "OFF" after the engine had been running a specified amount of time and engine warmed up. The burn-off function is enabled when the ECM grounds CKT 900 which energizes the MAF sensor burn-off relay. With the MAF sensor burn-off relay energized, voltage will be supplied to the MAF sensor terminal "D". Voltage will also be supplied through the normally closed set of contacts in the MAF power relay which will supply 12 volts to terminal "E" of the MAF sensor.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This test will determine if the burn-off function is operative or if the Code was set due to an intermittent condition.
2. Check for continuous 12 volt supply to burn-off relay.
3. Grounding CKT 900 should energize the relay and close the contacts. CKT 900 should be grounded by using a jumper wire at ECM connector "D12". If the test light is dim, check for corroded or faulty connections. If OK, replace relay.
4. With the burn-off relay energized there should be 12 volts supplied to the MAF sensor on terminal "D" & "E" (CKTs 993 and 994). If the test light is dim, check for corroded or faulty connections. If OK, replace relay.

Diagnostic Aids:

The Code 36 could have been set due to a poor connection at any of the relays or the MAF sensor. Be sure that these connections and terminals are OK. A faulty MAF sensor should not be considered as the cause if Code 36 is set.

Refer to "Intermittents" in Section "B".

CODE 36

MASS AIR FLOW (MAF) BURN-OFF CIRCUIT 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1
- IGNITION "OFF", CLEAR CODES.
- START ENGINE AND RUN UNTIL SYSTEM GOES "CLOSED LOOP".
- TURN IGNITION "OFF" AND WAIT 20 SECONDS.
- START AND IDLE ENGINE FOR 30 SECONDS OR UNTIL S.E.S. LIGHT COMES "ON".

IS CODE 36 SET?

YES

2
- DISCONNECT MAF SENSOR BURN-OFF RELAY.
- PROBE BOTH 340 CKTS WITH A TEST LIGHT TO GROUND.

LIGHT "ON" BOTH

3
- RECONNECT RELAY.
- DISCONNECT MAF SENSOR.
- GROUND BURN-OFF RELAY CKT 900.
- PROBE MAF SENSOR HARNESS TERMINAL "D" WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

4
- CKT 900 STILL GROUNDED.
- PROBE TERMINAL "E" (CKT 993) WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

- DISCONNECT BURN-OFF RELAY.
- IGNITION "ON".
- PROBE CKT 900 WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

REPAIR SHORT TO VOLTAGE IN CKT 900

LIGHT "OFF"

FAULTY ECM CONNECTION OR ECM. CODE 36 CAN SET DUE TO A POOR CONNECTION AT ANY OF THE RELAYS OR THE MAF SENSOR, OR COULD BE CAUSED BY HIGH RESISTANCE IN THE RELAY CONTACTS OR CONNECTIONS. BE SURE THAT THESE CONNECTIONS AND TERMINALS ARE OK BEFORE REPLACING ECM.

LIGHT "OFF" (after step 4)

- OPEN CKT 993, OPEN CIRCUIT BETWEEN MAF SENSOR RELAY AND THE BURN-OFF RELAY, FAULTY CONNECTION, OR FAULTY MAF SENSOR POWER RELAY.

LIGHT "OFF" (after step 3)

CKT 900 OPEN, CKT 994 OPEN OR SHORTED TO GROUND, OR FAULTY CONNECTION OR FAULTY RELAY.

LIGHT "OFF" ON ONE OR BOTH (after step 2)

REPAIR OPEN IN CIRCUIT THAT DID NOT LIGHT.

NO (after step 1)

CODE 36 IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CODE 41

CYLINDER SELECT ERROR
(FAULTY OR INCORRECT MEM-CAL)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. The ECM used for this engine can also be used for other engines, and the difference is in the Mem-Cal. If a Code 41 sets, the incorrect Mem-Cal has been installed, may not be installed properly, or it is faulty and it must be replaced.

Diagnostic Aids:

Check mem-cal to be sure locking tabs are secure.

Also check the pins on both the Mem-Cal and ECM to assure they are making proper contact. Check the Mem-Cal part number to assure it is the correct part. If the Mem-Cal is faulty, it must be replaced. It is also possible that the ECM is faulty, however, it should not be replaced until all of the above have been checked. For additional information, refer to "Intermittents" in Section "B".

CODE 41

CYLINDER SELECT ERROR
(FAULTY OR INCORRECT MEM-CAL)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1
- IGNITION "OFF", CLEAR CODES.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL CODE 41 SETS.

DOES CODE 41 SET?

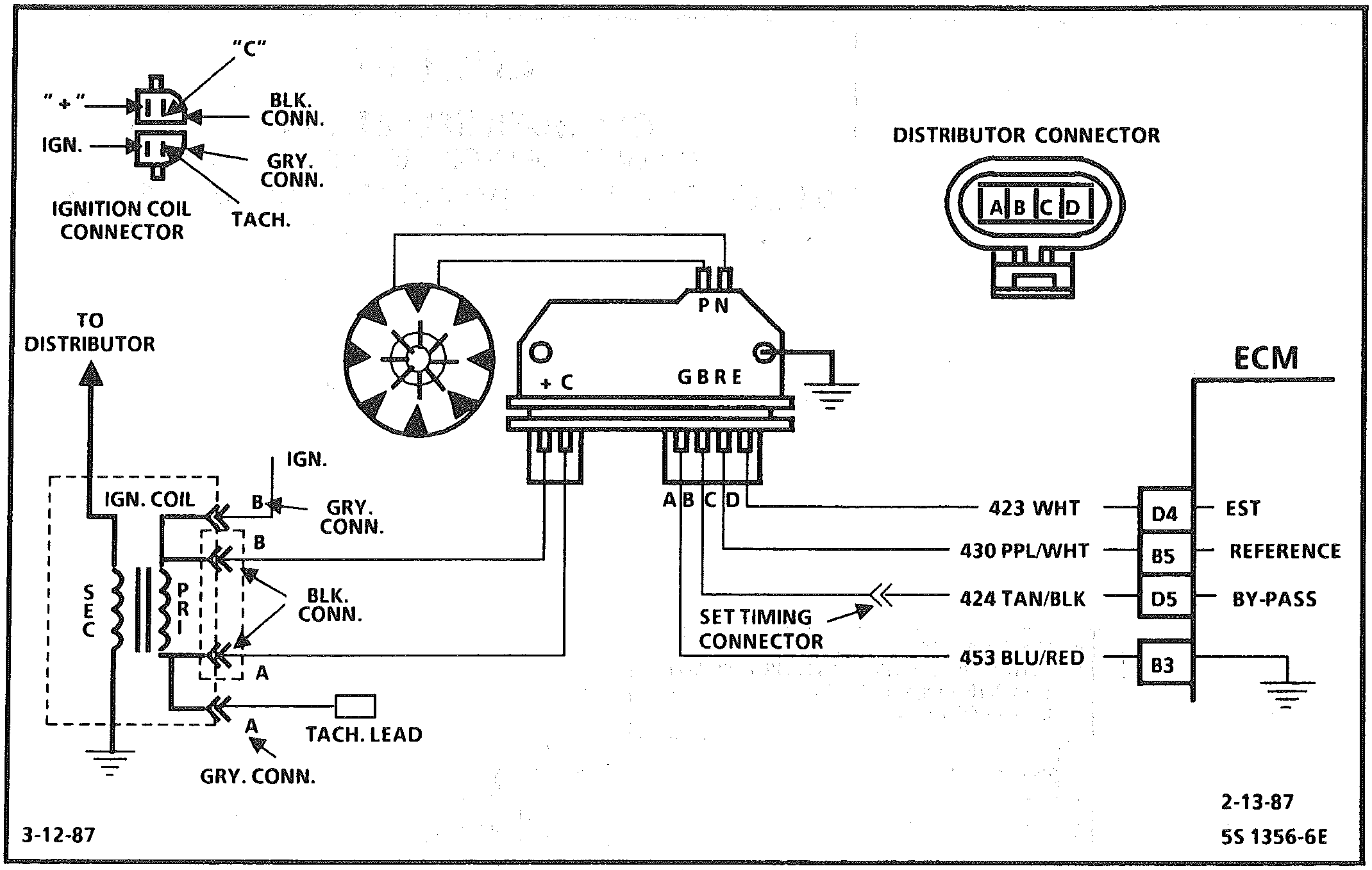
YES

FAULTY CONNECTIONS DUE TO MEM-CAL NOT LOCKED IN PLACE, OR INCORRECT MEM-CAL INSTALLED.

NO

CODE 41 IS INTERMITTENT. REVIEW "DIAGNOSTIC AIDS" ON FACING PAGE.

7-15-87
*7S 3152-6E



CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

When the system is running on the ignition module, that is, no voltage on the bypass line, the ignition module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets Code 42 and will not go into the EST mode.

When the rpm for EST is reached (about 400 rpm), and bypass voltage applied, the EST should no longer be grounded in the ignition module, so the EST voltage should be varying.

If the bypass line is open or grounded, the ignition module will not switch to EST mode so the EST voltage will be low and Code 42 will be set.

If the EST line is grounded, the ignition module will switch to EST but, because the line is grounded, there will be no EST signal. A Code 42 will be set.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits. This test confirms Code 42 and that the fault causing the code is present.
2. Checks for a normal EST ground path through the ignition module. An EST CKT 423 shorted to ground will also read less than 500 ohms; however, this will be checked later.
3. As the test light voltage touches CKT 424 the module should switch, causing the ohmmeter to "overrange" if the meter is in the 1000-2000 ohms position. Selecting the 10-20,000 ohms position will indicate above 5000 ohms. The important thing is that the module "switched".
4. The module did not switch and this step checks for:
   - EST CKT 423 shorted to ground.
   - Bypass CKT 424 open.
   - Faulty ignition module connection or module.
5. Confirms that Code 42 is a faulty ECM and not an intermittent in CKTs 423 or 424.

Diagnostic Aids:

The "Scan" tool does not have any ability to help diagnose a Code 42 problem.

A Mem-Cal not fully seated in the ECM can result in a Code 42.

Refer to "Intermittents" in Section "B".

CODE 42

ELECTRONIC SPARK TIMING (EST) CIRCUIT 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE 42 SET?

NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

YES:

2
- IGNITION "OFF".
- DISCONNECT ECM CONNECTORS.
- IGNITION "ON".
- OHMMETER SELECTOR SWITCH IN THE 1000 TO 2000 OHMS RANGE.
- PROBE ECM HARNESS CONNECTOR CKT 423 WITH AN OHMMETER TO GROUND.
  IT SHOULD READ LESS THAN 500 OHMS.
  DOES IT?

NO: OPEN CKT 423, FAULTY CONNECTION OR FAULTY IGNITION MODULE.

YES:
- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

LIGHT "ON":
- DISCONNECT IGNITION MODULE 4-WAY CONNECTOR.

  LIGHT "ON": CKT 424 SHORTED TO GROUND.

  LIGHT "OFF": FAULTY IGNITION MODULE.

LIGHT "OFF":

3
- WITH OHMMETER STILL CONNECTED TO ECM HARNESS CKT 423 AND GROUND. AGAIN PROBE ECM HARNESS CKT 424 WITH THE TEST LIGHT CONNECTED TO 12 VOLTS. (AS TEST LIGHT CONTACTS CKT 424, RESISTANCE SHOULD SWITCH FROM UNDER 500 TO OVER 5,000 OHMS,)
  DOES IT?

NO:

4
- DISCONNECT DIST. 4-WAY CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD HAVE GONE HIGH (OPEN CIRCUIT) .
  DOES IT?

  YES: CKT 424 OPEN, FAULTY CONNECTIONS OR FAULTY IGNITION MODULE.

  NO: CKT 423 SHORTED TO GROUND.

YES:

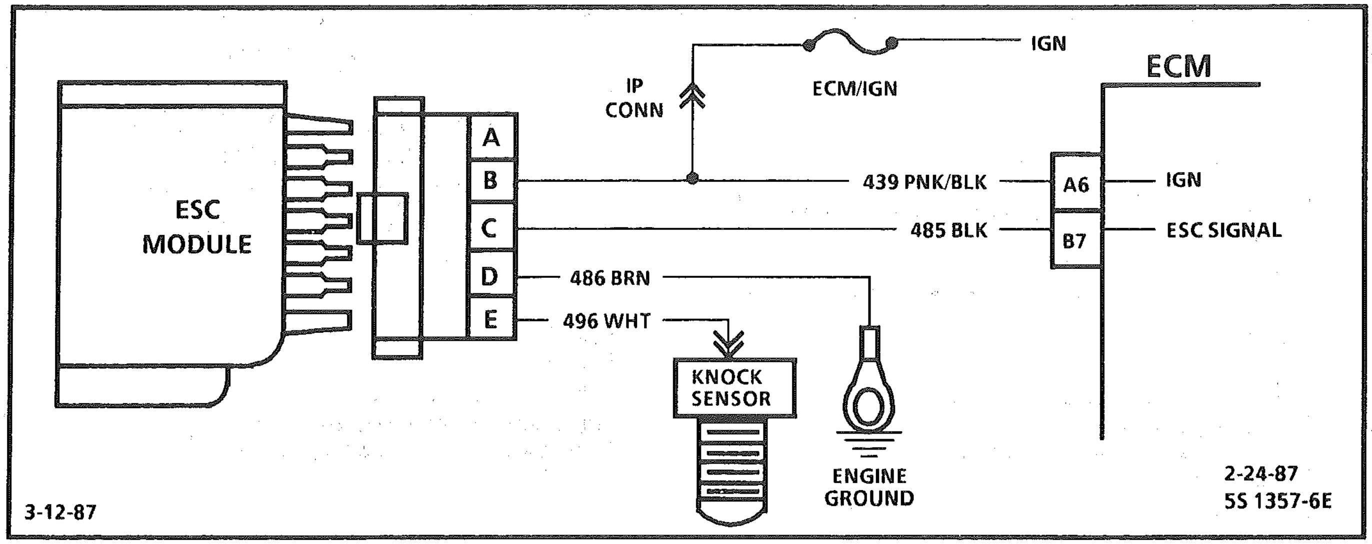
5
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL CODE 42 SETS.
  DOES CODE SET?

  YES: FAULTY ECM

  NO: CODE 42 INTERMITTENT. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

2-12-87
* 7S 3291-6E



CODE 43

ELECTRONIC SPARK CONTROL (ESC) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM drops, and this signals the ECM to retard timing. The ECM will retard the timing when knock is detected and rpm is above about 900 rpm.

Code 43 means the ECM has been low voltage at CKT 485 terminal "B7" for longer than 5 seconds, with the engine running, or the system has failed the functional check.

This system performs a functional check once per start up to check the ESC system. To perform this test the ECM will advance the spark when coolant is above 95°C and at a high load condition (near WOT). The ECM then checks the signal at "B7" to see if a knock is detected. The functional check is performed once per start up and if knock is detected when coolant is below 95°C (194°F) the test has passed and the functional check will not be run. If the functional check fails, the "Service Engine Soon" light will remain "ON" until ignition is turned "OFF", or until a knock signal is detected.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

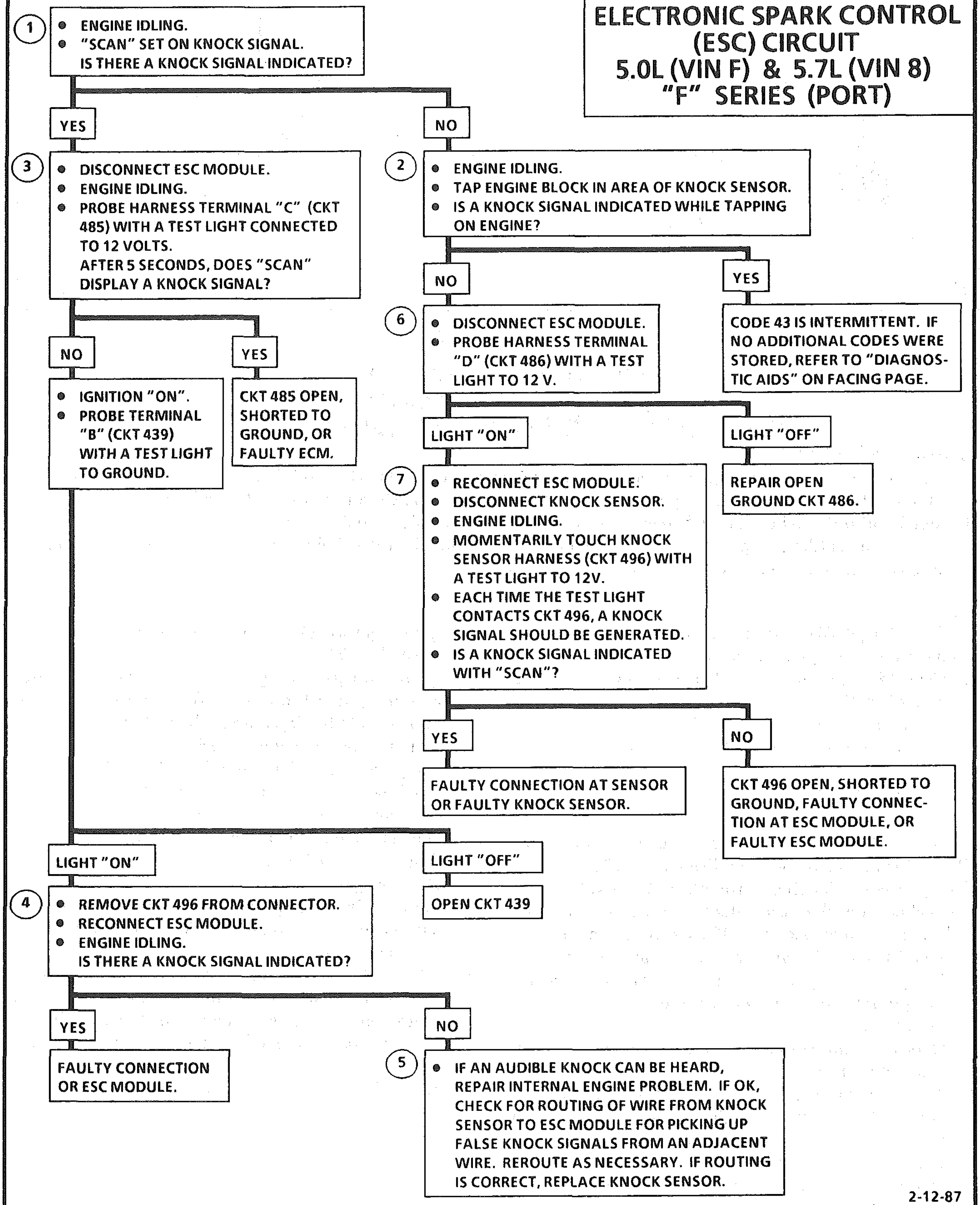
1. If the conditions for a Code 43 are present, the "Scan" will always display "yes". There should not be a knock at idle unless an internal engine problem, or a system problem exists.
2. This test will determine if the system is functioning at this time. Usually a knock signal can be generated by tapping on the right exhaust manifold. If no knock signal is generated try tapping on block close to the area of the sensor.
3. Because Code 43 sets when the signal voltage on CKT 485 remains low, this test should cause the signal on CKT 485 to go high. The 12 volts signal should be seen by the ECM as "no knock" if the ECM and wiring are OK.
4. This test will determine if the knock signal is being detected on CKT 496 or if the ESC module is at fault.
5. If CKT 496 is routed to close to secondary ignition wires, the ESC module may see the interference as a knock signal.
6. This checks the ground circuit to the module. An open ground will cause the voltage on CKT 485 to be about 12 volts, which would cause the Code 43 functional test to fail.
7. Contacting CKT 496 with a test light to 12 volts should generate a knock signal. This will determine if the ESC module is operating correctly.

Diagnostic Aids:

Code 43 can be caused by a faulty connection at the knock sensor at the ESC module or at the ECM. Also check CKT 485 for possible open or short to ground.

Refer to "Intermittents" in Section "B".

CODE 43
ELECTRONIC SPARK CONTROL (ESC) CIRCUIT 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



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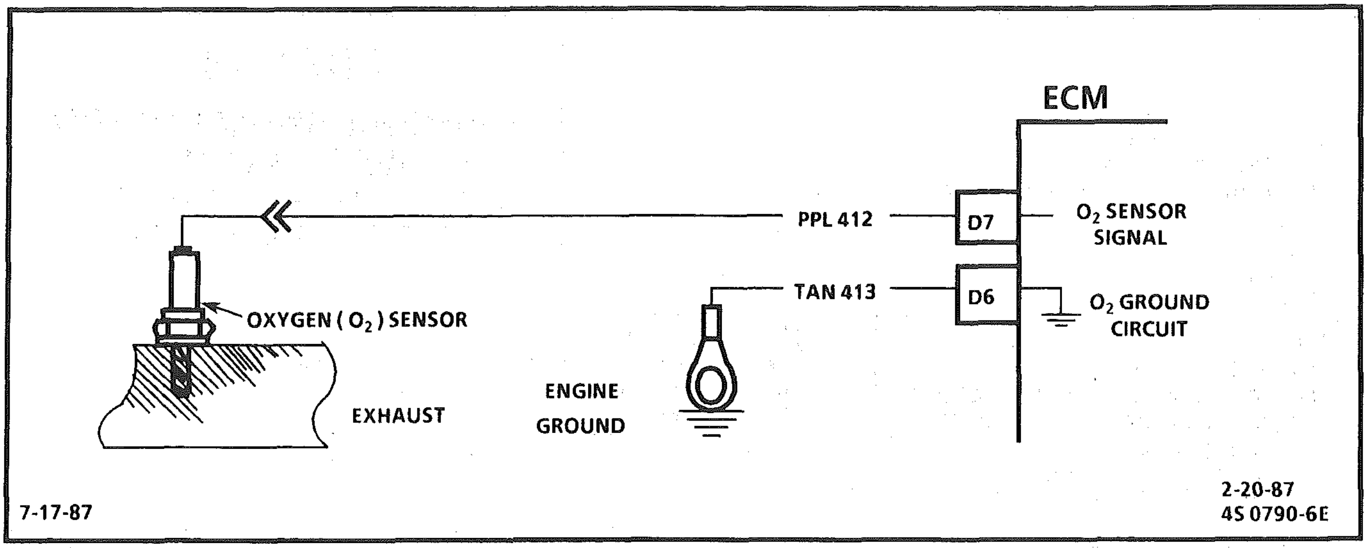
* 7S 3292-6E



CODE 44

OXYGEN SENSOR CIRCUIT

(LEAN EXHAUST INDICATED)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Code 44 is set when the O_2 sensor signal voltage on CKT 412.
   - Remains below .2 volt for 50 seconds.
   - And the system is operating in "Closed Loop".

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 44 may have been set. If the conditions for Code 44 exist, the block learn values will be around 150.

- O_2 sensor wire. Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for intermittent ground in wire between connector and sensor.
- MAF Sensor. A mass air flow (MAF) sensor output that causes the ECM to sense a lower than normal air flow will cause the system to go lean. Disconnect the MAF sensor and, if the lean condition is gone, replace the MAF sensor.
- Lean Injector(s). Perform injector balance test CHART C-2A.
- Fuel Contamination. Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injectors. The water causes a lean exhaust and can set a Code 44.
- Fuel Pressure. System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/or loads to confirm. See Fuel System diagnosis CHART A-7.
- Exhaust Leaks. If there is an exhaust leak, outside air can be pulled into the exhaust and past the sensor. Vacuum or crankcase leaks can cause a lean condition.
- AIR System. Be sure air is not being directed to the exhaust ports while in "Closed Loop". If the block learn value goes down while squeezing air hose to left side exhaust ports, refer to CHART C-6.
- If the above are OK, it is a faulty oxygen sensor.

CODE 44

OXYGEN SENSOR CIRCUIT
(LEAN EXHAUST INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" INDICATE O_2 SENSOR VOLTAGE FIXED BELOW .35 VOLTS (350 mV)?

YES

- DISCONNECT O_2 SENSOR.
- WITH ENGINE IDLING "SCAN" SHOULD DISPLAY O_2 SENSOR BETWEEN .35 VOLTS AND .55 VOLTS (350 mV AND 550 mV).
  DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE..

NO

CKT 412 SHORTED TO GROUND OR FAULTY ECM.

NO

CODE 44 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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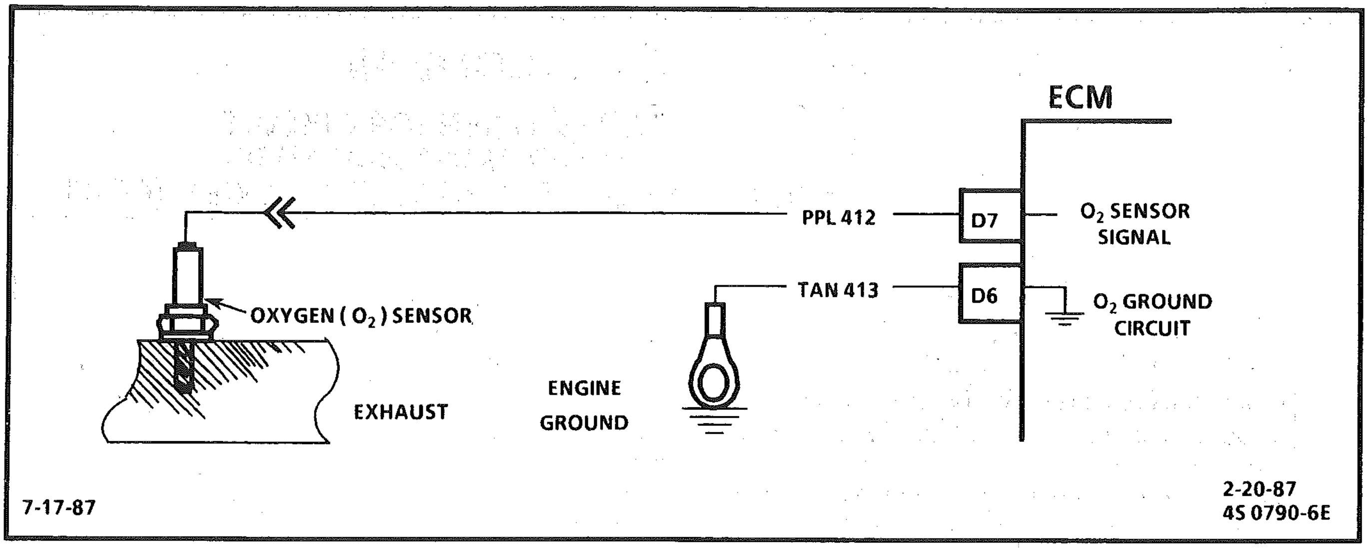
*7S 3191-6E



CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The ECM supplies a voltage of about .45 volt between terminals "D6" and "D7". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O_2 sensor varies the voltage within a range of about 1 volt if the exhaust is rich, down through about .10 volt if exhaust is lean.

The sensor is like an open circuit and produces no voltage when it is below about 360°C (600°F). An open sensor circuit or cold sensor causes "Open Loop" operation.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. Code 45 is set when the O_2 sensor signal voltage or CKT 412.
   - Remains above .7 volt for 50 seconds; and in "Closed Loop".
   - Engine time after start is 1 minute or more.
   - Throttle angle greater than 2% (about .2 volts above idle voltage)

Diagnostic Aids:

Using the "Scan", observe the block learn values at different rpm and air flow conditions. The "Scan" also displays the block cells, so the block learn values can be checked in each of the cells to determine when the Code 45 may have been set. If the conditions for Code 45 exists, the block learn values will be around 115.

- Fuel Pressure. System will go rich if pressure is too high. The ECM can compensate for some increase. However, if it gets too high, a Code 45 may be set.

Use the Fuel System diagnosis CHART A-7.

- Rich injector. Perform injector balance test CHART C-2A.
- Leaking injector. See CHART A-7.
- Check for fuel contaminated oil.
- HEI Shielding. An open ground CKT 453 (ignition system reflow) may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as reference pulses. The additional pulses result in a higher than actual engine speed signal. The ECM then delivers too much fuel, causing system to go rich. Engine tachometer will also show higher than actual engine speed, which can help in diagnosing this problem.
- Canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses. See canister purge Section "C3".
- MAF sensor. An output that causes the ECM to sense a higher than normal airflow can cause the system to go rich. Disconnecting the MAF sensor will allow the ECM to set a fixed value for the sensor. Substitute a different MAF sensor if the rich condition is gone while the sensor is disconnected.
- Check for leaking fuel pressure regulator diaphram by checking vacuum line to regulator for fuel.
- TPS. An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.

CODE 45

OXYGEN SENSOR CIRCUIT
(RICH EXHAUST INDICATED)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

1

- RUN WARM ENGINE (75°C TO 95°C) AT 1200 RPM.
- DOES "SCAN" TOOL DISPLAY O_2 SENSOR FIXED ABOVE .75 VOLTS (750 mV)?

YES

- DISCONNECT O_2 SENSOR AND JUMPER HARNESS CKT 412 TO GROUND.
- "SCAN" SHOULD DISPLAY O_2 BELOW .35 VOLTS (350 mV).

DOES IT?

YES

REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

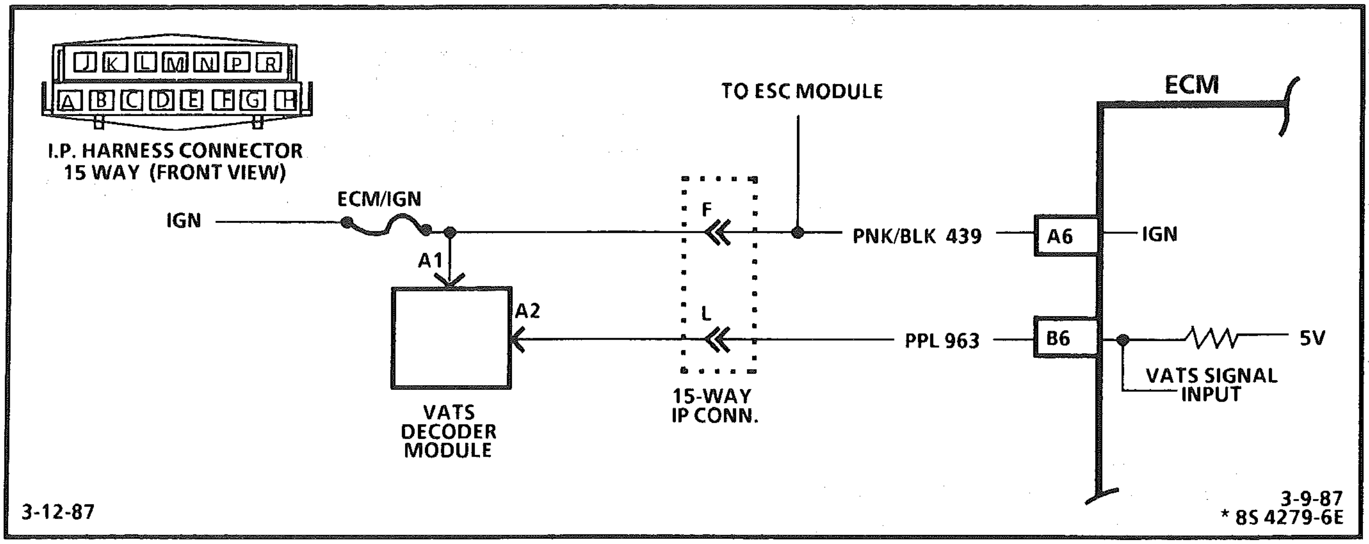
NO

FAULTY ECM.

NO

CODE 45 IS INTERMITTENT.
IF NO ADDITIONAL CODES WERE STORED, REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 46

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The VATS system is designed to disable vehicle operation if the incorrect key or starting procedure is used. The VATS decoder module sends a signal to the ECM if the correct key is being used. If the proper signal does not reach the ECM on CKT 963, the ECM will not pulse the injectors "ON" and thus not allow the vehicle to be started.

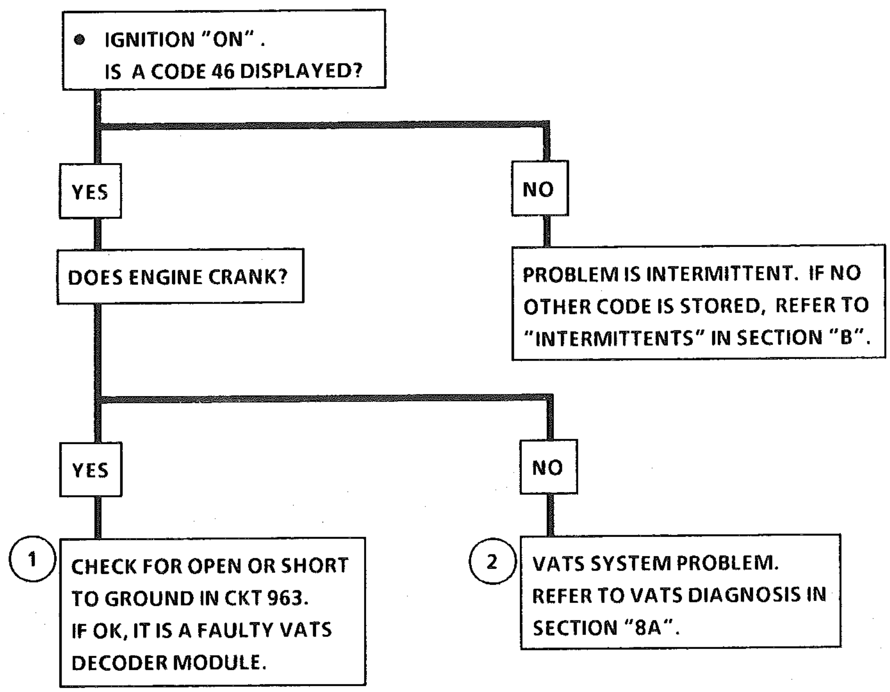
Code 46 will set, if the proper signal is not being received at ECM terminal "B6" when the ignition is turned "ON". Code 46 does not store in the ECM memory but is only present when the conditions stated above are met.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If the engine cranks, and a Code 46 is stored, it indicates that the portion of the module which generates the signal to the ECM is not operating or CKT 963 is open or shorted to ground. If the decoder module is found to be OK, as determined from Section "8A", the ECM may be at fault, but this is not a likely condition.
2. If Code 46 is stored, and the engine will not crank, it indicates that there is a VATS problem or an incorrect key or starting procedure is being used.

CODE 46

VEHICLE ANTI-THEFT SYSTEM (VATS) CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



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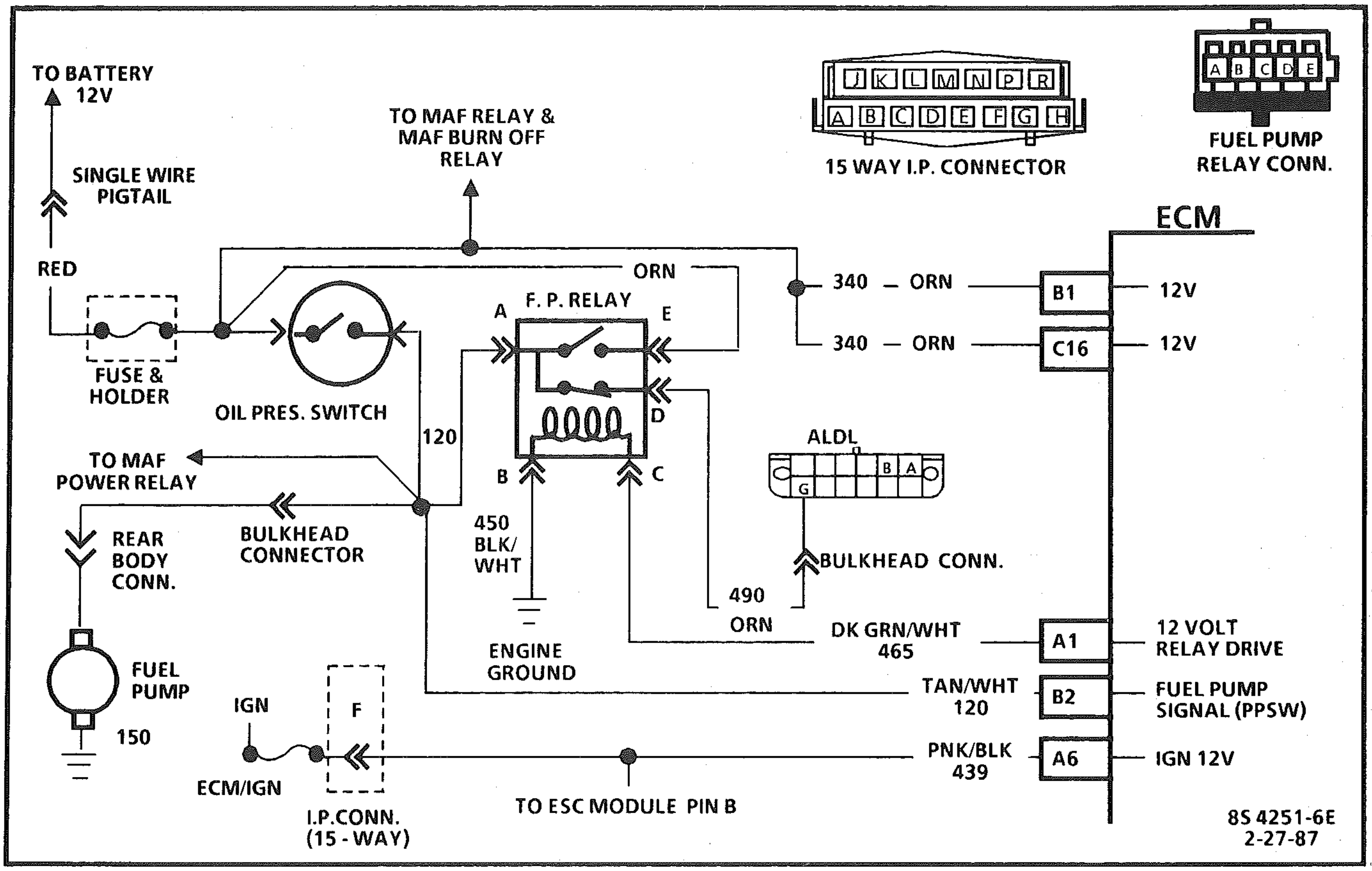

CODE 54

FUEL PUMP CIRCUIT
(LOW VOLTAGE)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The status of the fuel pump CKT 120 (PPSW) is monitored by the ECM at terminal "B2" and is used to compensate fuel delivery based on system voltage. This signal is also used to store a trouble code if the fuel pump relay is defective or fuel pump voltage is lost while the engine is running. There should be about 12 volts on CKT 120 for 2 seconds after the ignition is turned "ON", or any time references pulses are being received by the ECM.

Code 54 will set, if the voltage at terminal "B2" is less than 2 volts for 1.5 seconds since the last reference pulse was received. This code is designed to detect a faulty relay, causing extended crank time, and the code will help the diagnosis of an engine that "CRANKS BUT WILL NOT RUN".

If a fault is detected during start-up, the "Service Engine Soon" light will stay "ON" until the ignition is cycled "OFF". However, if the voltage is detected below 2 volts, with the engine running, the light will only remain "ON" while the condition exists.

CODE 54

FUEL PUMP CIRCUIT (LOW VOLTAGE) 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

- IGNITION "OFF" FOR 10 SECONDS.
- IGNITION "ON".
- LISTEN FOR IN-TANK FUEL PUMP.
- PUMP SHOULD RUN FOR 2 SECONDS AFTER IGNITION "ON". DOES IT?

NO

- IGNITION "OFF".
- USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONNECTOR TO 12 VOLTS.
- DOES PUMP RUN?

  - **YES**
    - IGNITION "OFF".
    - USING A FUSED JUMPER WIRE, CONNECT FUEL PUMP TEST CONN. TO 12 VOLTS.
    - DOES PUMP RUN?
      - **LIGHT "ON"** – CONNECT TEST LIGHT BETWEEN CKTS 340 & 450
        - **LIGHT "ON"**
          - CONNECT TEST LIGHT BETWEEN HARNESS CKT 465 AND GROUND.
          - IGNITION "OFF" FOR 10 SECONDS.
          - NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
            - **LIGHT "ON"**
              - FAULTY RELAY.

              NOTE: IF ORIGINAL COMPLAINT WAS "CRANKS BUT WILL NOT RUN" MAKE THE FOLLOWING ADDITIONAL CHECKS:

              - ENGINE IDLING AT NORMAL OPERATING TEMPERATURE.
              - OIL PRESSURE NORMAL.
              - DISCONNECT FUEL PUMP RELAY.
              - ENGINE SHOULD CONTINUE TO RUN.
              - DOES IT?
                - **YES** – FUEL PUMP CIRCUIT OK
                - **NO** – FAULTY OIL PRESSURE SWITCH
            - **LIGHT "OFF"** – CKT 465 OPEN, SHORTED TO GROUND, OR FAULTY ECM.
        - **LIGHT "OFF"** – REPAIR OPEN CKT 450
      - **LIGHT "OFF"** – REPAIR OPEN IN CKT 340
  - **NO**
    - DISCONNECT FUEL PUMP RELAY.
    - USING THE FUSED JUMPER WIRE, CONNECT CKT 120 TO 12 VOLTS. DOES PUMP RUN?
      - **YES** – FAULTY RELAY
      - **NO** – OPEN CKT 120, FAULTY IN-TANK PUMP OR FAULTY PUMP GROUND.

YES

- CLEAR CODES.
- START AND RUN ENGINE FOR 30 SECONDS OR UNTIL CODE 54 SETS. DOES CODE SET?

  - **YES**
    - AT THE ECM, BACK PROBE CKT 120 WITH A TEST LIGHT TO GROUND.
    - IGNITION "OFF" FOR 10 SECONDS.
    - NOTE LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".
      - **LIGHT "ON"** – FAULTY CONNECTION AT ECM OR FAULTY ECM.
      - **LIGHT "OFF"** – OPEN CKT 120 TO ECM.
  - **NO** – CODE 54 IS INTERMITTENT. REFER TO "INTERMITTENTS" IN SECTION "B".

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CODE 51
CODE 52
CODE 53
5.0L (VIN F) & 5.7L (VIN 8)
"F" SERIES (PORT)

CODE 51

MEM-CAL ERROR
(FAULTY OR INCORRECT MEM-CAL)

CHECK THAT ALL PINS ARE FULLY INSERTED IN THE SOCKET AND THAT MEM-CAL IS PROPERLY LATCHED. IF OK, REPLACE MEM/CAL, CLEAR MEMORY, AND RECHECK. IF CODE 51 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 52

CALPAK ERROR
(FAULTY OR INCORRECT CALPAK)

CHECK THAT THE MEM-CAL IS FULLY SEATED AND LATCHED INTO THE MEM-CAL SOCKET. IF OK, REPLACE MEM-CAL, CLEAR MEMORY, AND RECHECK. IF CODE 52 REAPPEARS, REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

CODE 53

SYSTEM OVER VOLTAGE

THIS CODE INDICATES THERE IS A BASIC GENERATOR PROBLEM.

- CODE 53 WILL SET, IF VOLTAGE AT ECM IGNITION INPUT PIN IS GREATER THAN 17.1 VOLTS FOR 2 SECONDS.
- CHECK AND REPAIR CHARGING SYSTEM. REFER TO SECTION "6D".

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION B
SYMPTOMS

TABLE OF CONTENTS

BEFORE STARTING

Before using this section you should have performed the DIAGNOSTIC CIRCUIT CHECK and found out that:

1. The ECM and "Service Engine Soon" light are operating.
2. There are no trouble codes stored, or there is a trouble code but no "Service Engine Soon" light.

Verify the customer complaint, and locate the correct SYMPTOM below. Check the items indicated under that symptom.

If the ENGINE CRANKS BUT WILL NOT RUN, see CHART A-3.

Several of the symptom procedures below call for a Careful Visual Check. This check should include:

- ECM grounds for being clean and tight
- Vacuum hoses for splits, kinks, and proper connections, as shown on Emission Control Information label.
- Air leaks at throttle body mounting and intake manifold.
- Air leaks between MAF sensor and throttle body.
- Ignition wires for cracking, hardness, proper routing, and carbon tracking.
- Wiring for proper connections, pinches, and cuts.

The importance of this step cannot be stressed too strongly - it can lead to correcting a problem without further checks and can save valuable time.

INTERMITTENTS

Problem may or may not turn "ON" the "Service Engine Soon" light, or store a code.

DO NOT use the Trouble Code Charts in Section A for intermittent problems. The fault must be present to locate the problem. If a fault is intermittent, use of Trouble Code Charts may result in replacement of good parts.

- Most intermittent problems are caused by faulty electrical connections or wiring. Perform careful check as described at start of Section "B". Check for:
  - Poor mating of the connector halves, or terminals not fully seated in the connector body (backed out).
  - Improperly formed or damaged terminals. All connector terminals in problem circuit should be carefully reformed or replaced to insure proper contact tension.
  - Poor terminal to wire connection. This requires removing the terminal from the connector body to check. See "Introduction" to Section "6E".
- If a visual check does not find the cause of the problem, the car can be driven with a voltmeter connected to a suspected circuit. A "Scan" tool can also be used for monitoring input signals to the ECM to help detect intermittent conditions. An abnormal voltage, or "Scan" reading, when the problem occurs, indicates the problem may be in that circuit. If the wiring and connectors check OK and a Trouble Code was stored for a circuit having a sensor, except for Codes 43, 44, and 45, substitute a known good sensor and recheck.

An intermittent "Service Engine Soon" light with no stored code may be caused by:

- Ignition coil shorted to ground and arcing at spark plug wires or plugs.
- "Service Engine Soon" light wire to ECM shorted to ground. (CKT 419).
- Diagnostic "Test" Terminal wire to ECM, shorted to ground.(CKT 451)
- ECM power grounds. See ECM wiring diagrams.

- Loss of trouble code memory. To check, disconnect TPS and idle engine until "Service Engine Soon" light comes on. Code 22 should be stored, and kept in memory when ignition is turned "OFF". If not, the ECM is faulty.
- Check for an electrical system interference caused by a defective relay, ECM driven solenoid, or switch. They can cause a sharp electrical surge. Normally, the problem will occur when the faulty component is operated.
- Check for improper installation of electrical options, such as lights, 2-way radios, etc.
- EST wires should be kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from ECM to distributor (CKT 453) should be a good connection.
- Check for open diode across A/C compressor clutch, and for other open diodes (see wiring diagrams).

HARD START

Definition: Engine cranks OK, but does not start for a long time. Does eventually run, or may start but immediately dies.

- Perform careful check as described at start of Section "B".
- Make sure driver is using correct starting procedure.
- **CHECK:**
  - TPS for sticking or binding or a high TPS voltage with the throttle closed (should read less than .700 volts).
  - High resistance in coolant sensor circuit or sensor itself. See Code 15 chart or with a "Scan" tool compare coolant temperature with ambient temperature on a cold engine.
  - Fuel pressure CHART A-7.
  - Water contaminated fuel.
  - EGR operation. Be sure valve seats properly and is not staying open. See CHART C-7.
  - Both injector fuses (visually inspect).
  - Ignition system - Check distributor for:
    - Proper Output with ST-125.
    - Worn shaft.
    - Bare and shorted wires.
  - Pickup coil resistance and connections.
    - Loose ignition coil ground.
    - Moisture in distributor cap.
- If problem exists in cold weather, check cold start valve. See CHART A-9 .

- A faulty in-tank fuel pump check valve will allow the fuel in the lines to drain back to the tank after the engine is stopped. To check for this condition:
  Perform Fuel System Diagnosis, CHART A-7.
- Remove spark plugs. Check for wet plugs, cracks, wear, improper gap, burned electrodes, or heavy deposits. Repair or replace as necessary.
- If engine starts but then immediately stalls open distributor by-pass line. If engine then starts and runs OK, replace pickup coil.
- If engine starts and stalls disconnect MAF sensor. If engine then runs and sensor connections are OK, replace the sensor.
- Basic engine problem.

HESITATION, SAG, STUMBLE

Definition: Momentary lack of response as the accelerator is pushed down. Can occur at all car speeds. Usually most severe when first trying to make the car move, as from a stop sign. May cause the engine to stall if severe enough.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Fuel pressure. See CHART A-7. Also, check for water contaminated fuel.
  - Air leaks at air duct between MAF sensor and throttle body.
  - Spark plugs for being fouled or faulty wiring.
  - Mem-Cal number. Also check service bulletins for latest Mem-Cal.
  - TPS for binding or sticking. Voltage should increase at a steady rate as throttle is moved toward WOT.
  - Ignition timing. See emission control information label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - HEI ground, CKT 453.
  - Canister purge system for proper operation. See CHART C-3.
  - EGR - See CHART C-7.
- Perform injector balance test CHART C-2A.

SURGES AND/OR CHUGGLE

Definition: Engine power variation under steady throttle or cruise. Feels like the car speeds up and slows down with no change in the accelerator pedal.

- Be sure driver understands transmission converter clutch and A/C compressor operation in owner's manual.
- Perform careful visual inspection as described at start of Section "B".
- **CHECK:**
  - Loose or leaking air duct between MAF sensor and throttle body.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - EGR - There should be no EGR at idle. See CHART C-7.
  - Vacuum lines for kinks or leaks.
  - Ignition timing. See emission control information label.
  - In-line fuel filter. Replace if dirty or plugged.
  - Fuel pressure while condition exists. See CHART A-7.
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor may have a white, powdery coating and result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Remove spark plugs. Check for cracks, wear, improper gap, burned electrodes, or heavy deposits. Also check condition of distributor cap, rotor, and spark plug wires.
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

LACK OF POWER, SLUGGISH, OR SPONGY

Definition: Engine delivers less than expected power. Little or no increase in speed when accelerator pedal is pushed down part way.

- Perform careful visual check as described at start of Section "B".
- Compare customer's car to similar unit. Make sure the customer's car has an actual problem.
- Remove air cleaner and check air filter for dirt, or for being plugged. Replace as necessary.
- **CHECK:**
  - For loose or leaking air duct between MAF sensor and throttle body.
  - Ignition timing. See emission control information label.
  - Restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM Ground circuits - See ECM wiring diagrams.
  - EGR operation for being open, or partly open all the time - CHART C-7.
  - Exhaust system for possible restriction: See CHART B-1.
    - Inspect exhaust system for damaged or collapsed pipes.
    - Inspect muffler for heat distress or possible internal failure.
  - For possible plugged catalytic convertor by comparing exhaust system backpressure on each side at engine. Check backpressure by removing A.I.R check valves near exhaust manifolds. See CHART B-1 for procedure.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - Engine valve timing and compression.
  - Engine for proper or worn camshaft. See Section "6A".
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.
  - Check for excessive knock retard. See CHART C-5.

DETONATION /SPARK KNOCK

Definition: A mild to severe ping, usually worse under acceleration. The engine makes sharp metallic knocks that change with throttle opening. Sounds like popcorn popping.

- Check for obvious overheating problems:
  - Low coolant.
  - Loose water pump belt.
  - Restricted air flow to radiator, or restricted water flow thru radiator.
  - Inoperative electric cooling fan circuit. See CHART C-12.
- **CHECK:**
  - Ignition timing. See vehicle emission control information label.
  - EGR system for not opening - CHART C-7.
  - TCC operation - CHART C-8.
  - Fuel system pressure. See CHART A-7.
  - Mem-Cal - Be sure it's the correct one. (See "Service Bulletins").
  - Valve oil seals for leaking.
- Check for incorrect basic engine parts such as cam, heads, pistons, etc.
- Check for poor fuel quality.
- Remove carbon with top engine cleaner. Follow instructions on can.
- Check ESC system
  See CHART C-5
- To help determine if the condition is caused by a rich or lean system, the car should be driven at the speed of the complaint. Monitoring block learn at the complaint speed will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

CUTS OUT, MISSES

Definition: Steady pulsation or jerking that follows engine speed, usually more pronounced as engine load increases. The exhaust has a steady spitting sound at idle or low speed.

- Perform careful visual check as described at start of Section "B".
- Check for missing cylinder by:
  1. Disconnect IAC valve. Start engine. Remove one spark plug wire at a time using insulated pliers.
  2. If there is an rpm drop on all cylinders (equal to within 50 rpm), go to "ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING" symptom. Reconnect IAC valve.
  3. If there is no rpm drop on one or more cylinders, or excessive variation in drop, check for spark on the suspected cylinder(s) with J 26792 (ST-125) Spark Gap Tool or equivalent. If no spark, see Section 6D for Intermittent Operation or Miss. If there is spark, remove spark plug(s) in these cylinders and check for:
     - Cracks
     - Wear
     - Improper Gap
     - Burned Electrodes
     - Heavy Deposits
- Perform compression check on questionable cylinder(s) found above. If compression is low, repair as necessary. See Section "6".
- Disconnect all injector harness connectors. Connect J-34730-2 Injector Test Light or equivalent 6 volt test light between the harness terms, of each injector connector and note light while cranking. If test light fails to blink at any connector, it is a faulty injector drive circuit harness, connector, or terminal.
- Perform the Injector Balance Test. See CHART C-2A.
- **CHECK:**
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Fuel System - Plugged fuel filter, water, low pressure. See CHART A-7.
  - Valve timing.
  - Secondary voltage using a shop ocilliscope or a spark tester J-26792 (ST-125) or equivalent.
- Visually inspect distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
- A miss condition can be caused by EMI (Electromagnetic Interference) on the reference circuit. EMI can usually be detected by monitoring engine rpm with a "Scan" tool. A sudden increase in rpm with little change in actual engine rpm change, indicates EMI is present.
  If the problem exists, check routing of secondary wires, check all distributor ground circuits.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section "6A".

BACKFIRE

Definition: Fuel ignites in intake manifold, or in exhaust system, making a loud popping noise.

- **CHECK:**
  - Loose wiring connector or air duct at MAF sensor.
  - Compression - Look for sticking or leaking valves.
  - EGR operation for being open all the time. See CHART C-7.
  - EGR gasket for faulty or loose fit.
  - Valve timing.
  - Output voltage of ignition coil using a shop ocilliscope or spark tester J-26792 (ST-125) or equivalent.
  - Spark plugs for crossfire also inspect (distributor cap, spark plug wires, and proper routing of plug wires).
  - Ignition system for intermittent condition. (See Section "6D").
  - Engine timing - see emission control information label.
  - Perform fuel system diagnosis check, CHART A-7A.
  - Perform injector balance test CHART C-2A.
  - A.I.R. system check valves - See Section "C-6".

POOR FUEL ECONOMY

Definition: Fuel economy, as measured by an actual road test, is noticeably lower than expected. Also, economy is noticeably lower than it was on this car at one time, as previously shown by an actual road test.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Coolant level.
  - Engine thermostat for faulty part (always open) or for wrong heat range. See Section "6B".
  - Compression
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. A "Scan" should indicate an rpm drop when the TCC is commanded "ON". See CHART C-8.
  - Induction system and crankcase for air leaks.
- Check for exhaust restriction See CHART B-1.

DIESELING, RUN-ON

Definition: Engine continues to run after key is turned off, but runs very roughly. If engine runs smoothly, check ignition switch and adjustment.

- Check injectors for leaking. See CHART A-7.

ROUGH, UNSTABLE, OR INCORRECT IDLE, STALLING

Definition: The engine runs unevenly at idle. If bad enough, the car may shake. Also, the idle may vary in rpm (called "hunting"). Either condition may be bad enough to cause stalling. Engine idles at incorrect speed.

- Perform careful visual check as described at start of Section "B".
- **CHECK:**
  - Throttle linkage for sticking or binding.
  - Ignition timing. See emission control information label.
  - ECM ground circuits.
  - IAC system. See CHART C-2C.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - P/N switch circuit. See CHART C-1A, or use "Scan" tool.
  - Injector balance. See CHART C-2A.
  - PCV valve for proper operation by placing finger over inlet hole in valve end several times. Valve should snap back. If not, replace valve.
  - Evaporative emission control system. CHART C-3.
  - A/C signal to ECM terminal "B8". "Scan" tool should indicate A/C is being requested when ever A/C is selected and the pressure cycling switch is closed.
  - Minimum idle speed. See Section "C2".
  - Loose or damaged MAF sensor duct between sensor and throttle body.
  - Check A.I.R. system. There should be no A.I.R to ports while in "Closed Loop". See CHART C6.
  - EGR valve: There should be no EGR at idle.
- Run a cylinder compression check-see Section "6".
- Inspect oxygen sensor for silicon contamination from fuel, or use of improper RTV sealant. The sensor will have a white, powdery coating, and will result in a high but false signal voltage (rich exhaust indication). The ECM will then reduce the amount of fuel delivered to the engine, causing a severe driveability problem.
- Check for fuel in pressure regulator hose. If present replace regulator assembly.
- Check ignition system; wires, plugs, rotor, etc.
- Check for loose or damaged air duct between MAF sensor and throttle body.
- Disconnect MAF sensor and if condition is corrected replace sensor.
- Clean injectors.
- Monitoring block learn will help identify the cause of the problem. If the system is runnig lean (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44. If the system is running rich (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.

EXCESSIVE EXHAUST EMISSIONS OR ODORS

Definition: Vehicle fails an emission test. Vehicle has excessive "rotten egg" smell. Excessive odors do not necessarily indicate excessive emissions.

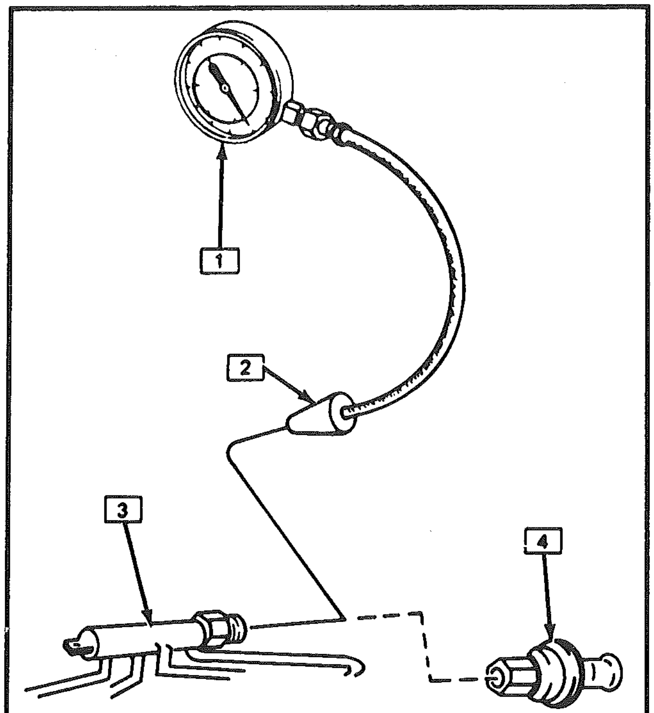
- Perform "Diagnostic Circuit Check."
- IF TEST SHOWS EXCESSIVE CO AND HC, (or also has excessive odors):
  - Check items which cause car to run RICH.
    - Make sure engine is at normal operating temperature.
- **CHECK:**
  - Fuel pressure. See CHART A-7.
  - Incorrect timing. See vehicle emission control information label.
  - Canister for fuel loading. See CHART C-3.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose, or fuel in the crankcase.
  - Spark plugs, plug wires, and ignition components. See Section "6D".
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
  - Check for properly installed fuel cap.
  - If the system is running rich, (block learn less than 118), refer to "Diagnostic Aids" on facing page of Code 45.
- IF TEST SHOWS EXCESSIVE NOx:
  - Check items which cause car to run LEAN, or to run too hot.
    - EGR valve for not opening. See CHART C-7.
    - Vacuum leaks.
    - Coolant system and coolant fan for proper operation. See CHART C-12.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See emission control information label.
- If the system is running lean, (block learn greater than 138), refer to "Diagnostic Aids" on facing page of Code 44.

CHART B-1
RESTRICTED EXHAUST SYSTEM CHECK
ALL ENGINES

Proper diagnosis for a restricted exhaust system is essential before any components are replaced. Either of the following procedures may be used for diagnosis, depending upon engine or tool used:

CHECK AT A. I. R. PIPE:

1. Remove the rubber hose at the exhaust manifold A.I.R. pipe check valve. Remove check valve.
2. Connect a fuel pump pressure gauge to a hose and nipple from a Propane Enrichment Device (J26911) (see illustration).
3. Insert the nipple into the exhaust manifold A.I.R. pipe.

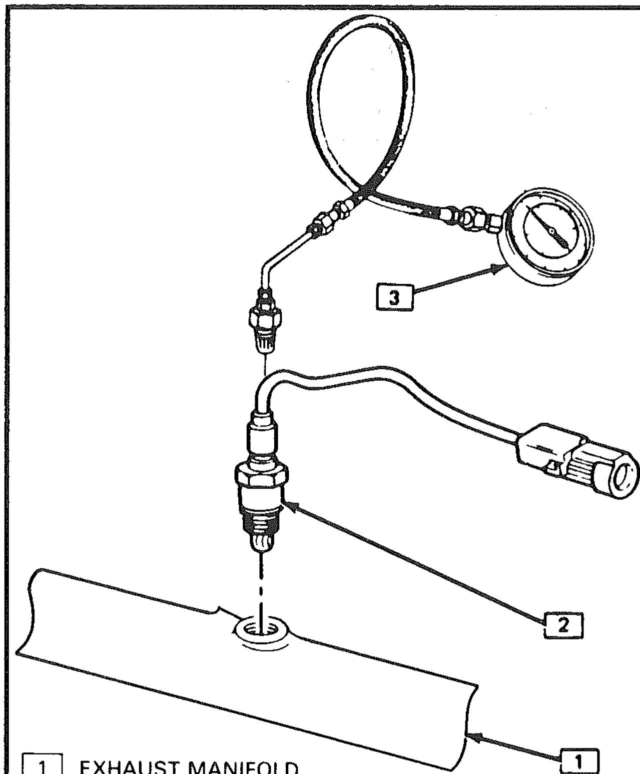


1 GAGE
2 HOSE AND NIPPLE ADAPTER
3 A.I.R. PIPE (EXHAUST PORT)
4 CHECK VALVE
7S 3363-6E

OR

CHECK AT O_2 SENSOR:

1. Carefully remove O_2 sensor.
2. Install Borroughs Exhaust Backpressure Tester (BT 8515 or BT 8603) or equivalent in place of O_2 sensor (see illustration).
3. After completing test described below, be sure to coat threads of O_2 sensor with anti-seize compound P/N 5613695 or equivalent prior to re-installation.



1 EXHAUST MANIFOLD
2 OXYGEN (O_2) SENSOR
3 BACK PRESSURE GAGE
7S 3338-6E

DIAGNOSIS:

1. With the engine idling at normal operating temperature, observe the exhaust system backpressure reading on the gauge. Reading should not exceed 1 ¼ psi (8.6 kPa).
2. Accelerate engine to 2000 RPM and observe gauge. Reading should not exceed 3 psi (20.7 kPa).
3. If the backpressure, at either RPM, exceeds specification, a restricted exhaust system is indicated.
4. Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.
5. If there are no obvious reasons for the excessive backpressure, a restricted catalytic converter should be suspected and replaced using current recommended procedures.

BLANK

SECTION C
COMPONENT SYSTEMS

Section "C" provides information on the following:

- General description of components and systems.
- On-vehicle service.
- Part names and group numbers.
- Diagnostic charts. These include a functional check of the system as well as diagnosis of any problem found in the functional check.

For locations of components, wiring diagrams, and ECM Terminal End View, refer to the front on the "A" section of the engine being diagnosed.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car service and parts information at the back of each section. Following are the charts found in this section.

SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

CONTENTS

GENERAL DESCRIPTION

ELECTRONIC CONTROL MODULE (ECM)

The electronic control module (ECM) (Figure C1-1), located under the instrument panel, is the control center of the fuel injection system. It constantly looks at the information from various sensors, and controls the systems that affect vehicle performance. The ECM performs the diagnostic function of the system.

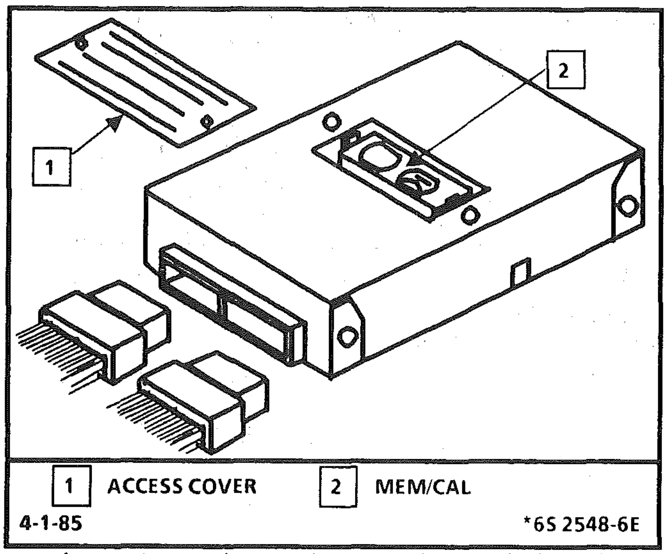


Figure C1-1 - Electronic Control Module (ECM)

It can recognize operational problems, alert the driver through the "Service Engine Soon" light, and store a code or codes which identify the problem areas to aid the technician in making repairs. See Section "6E" for more information on using the diagnostic function of the ECM.

For service, this ECM only consists of two parts: a controller (the ECM without a Mem-Cal) and an assembly called a Mem-Cal. (This stands for "Memory and Calibration" Unit).

MEM-CAL

This assembly contains both the functions of the PROM and CalPak. Like the PROM, it contains the calibrations needed for a specific vehicle as well as the back-up fuel control circuitry required if the rest of the ECM becomes damaged or faulty.

ECM Function

The ECM supplies either 5 or 12 volts to power various sensors or switches. This is done through resistances in the ECM which are so high in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a 10 meg ohm input impedance digital voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the injector, IAC, cooling fan relay, etc. by controlling the ground circuit through transistors in the ECM.

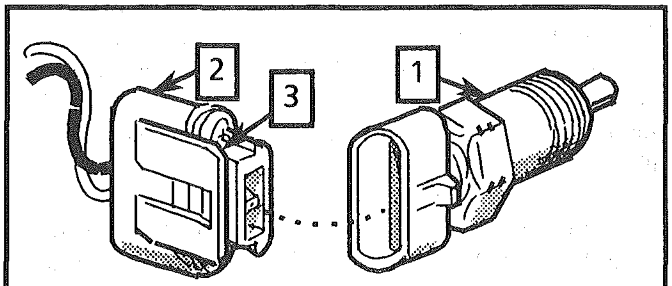
INFORMATION SENSORS

Engine Coolant Temperature Sensor (Figure C1-2)

The coolant sensor is a thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance (100,000 ohms at -40°C/-40°F), while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the coolant sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the engine is cold, and low when the engine is hot. By measuring the voltage, the ECM knows the engine coolant temperature. Engine coolant temperature affects most systems the ECM controls.

A failure in the coolant sensor circuit should set either a Code 14 or Code 15. Remember, these codes indicate a failure in the coolant temperature circuit, so proper use of the chart will lead to either repairing a wiring problem or replacing the sensor, to properly repair a problem.



1 ENGINE COOLANT TEMPERATURE SENSOR
2 HARNESS CONNECTOR TO ECM
3 LOCKING TAB

4-2-85 *5S 1640-6EA

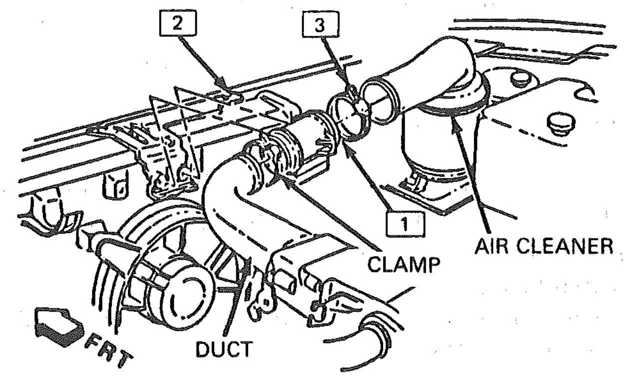
Figure C1-2 - Engine Coolant Temperature Sensor

Mass Air Flow (MAF) Sensor (Figure C1-3)

The mass air flow (MAF) sensor measures the amount of air which passes through it. The ECM uses this information to determine the operating condition of the engine, to control fuel delivery. A large quantity of air indicates acceleration, while a small quantity indicates deceleration or idle.

The Bosch mass air flow (MAF) sensor used in this vehicle is of the hot wire type. Current is supplied to the sensing wire to maintain a calibrated temperature, and as air flow increases or decreases the current will vary. This varying of current causes a voltage drop within the meter circuitry which isdirectly proportional to air mass. The ECM supplies a current limiting 5-volt source on the signal line, and the MAF sensor pulls the voltage low (about .4V) with low air flow and up to about 5 volts with high air flow such as WOT. The voltage drop is then processed by the ECM for calculating fuel delivery. If the sensor fails, a Code 33 or 34 should be stored in memory.

Due to the sensor's hot wire being exposed to air, which always contains some contaminants, there can be deposits form on the sensing wire. This can affect the accuracy of the meters measurement. To keep the system functioning properly, the wire is heated to about 1000°F after engine shut down. This burn-off cycle is controlled by the ECM, which energizes the burn-off relay. The ECM will ground the relay winding after engine shut down, if the engine had been running a specified amount of time. With the relay energized, the ECM then monitors the MAF signal line to determine if the burn-off function took place. If it didn't, then a Code 36 will be stored and the "Service Engine Soon" light will come "ON" the next time the engine is started.



1 MAF SENSOR ASM (PONTIAC)
2 BRACKET MAF SENSOR
3 CLAMP 1.4-2.0 N·m (1-1.4 LBS. FT.)

8S 4690-6E

Figure C1-3 - Mass Air Flow (MAF) Sensor

Manifold Air Temperature (MAT) Sensor

The air temperature sensor (MAT) is a thermistor (a resistor which changes value based on temperature) is mounted in the plenum. Low temperature produces a high resistance (100,000 ohms at -40°C/-40°F) while high temperature causes low resistance (70 ohms at 130°C/266°F).

The ECM supplies a 5-volt signal to the sensor through a resistor in the ECM and measures the voltage. The voltage will be high when the manifold air is cold, and low when the air is hot. By measuring the voltage, the ECM knows the manifold air temperature.

The MAT sensor signal is used by the ECM to delay EGR until the manifold air temperature reaches about 5°C (40°F).

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Oxygen (O_2) Sensor (Figure C1-4)

The exhaust oxygen sensor (O_2) is mounted in the exhaust system, where it can monitor the oxygen content of the exhaust gas stream. The oxygen content in the exhaust reacts with the sensor to produce a voltage output. This voltage ranges from approximately .1 volt (high O_2 - lean mixture) to .9 volts (low O_2 - rich mixture). This voltage can be measured with a digital voltmeter having at least 10 meg ohms input impedance. Use of standard shop type voltmeters will result in very inaccurate readings.

By monitoring the voltage output of the O_2 sensor, the ECM will know what fuel mixture command to give to the Injector (lean mixture-low O_2 voltage = rich command, rich mixture-high O_2 voltage = lean command).

The O_2 sensor, if open, should set a Code 13. A low voltage in the sensor circuit should set a Code 44. A high voltage in the circuit should set a Code 45. Codes 44 and 45 could also be set as a result of fuel system problems. See Code Charts.

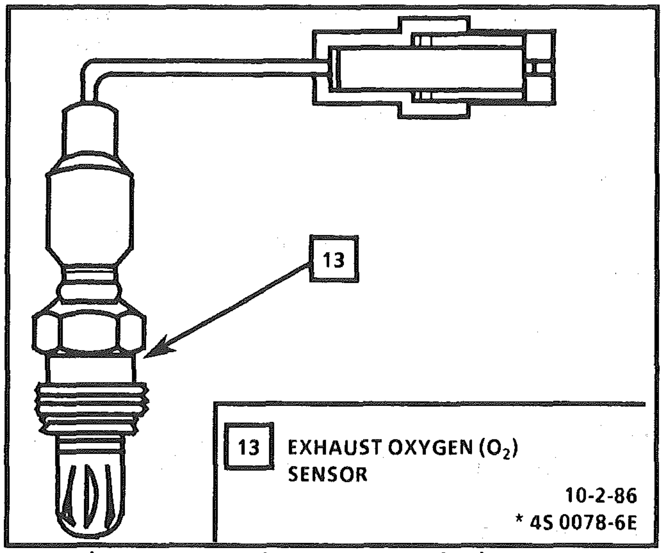


Figure C1-4 E- xhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS) (Figure C1-5)

The throttle position sensor (TPS) is connected to the throttle shaft on the throttle body. It is a potentiometer with one end connected to 5 volts from the ECM and the other to ECM ground. A third wire is connected to the ECM to measure the voltage from the TPS. As the throttle valve angle is changed (accelerator pedal moved), the output of the TPS also changes. At a closed throttle position, the output of the TPS is low (approximately .5 volts). As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand). A broken or loose TPS can cause intermittent bursts of fuel from the injector and an unstable idle, because the ECM thinks the throttle is moving. A problem in any of the TPS circuits will set either a Code 21 or 22. Once a trouble code is set, the ECM will use an artificial default value for TPS, and some vehicle performance will return.

See "On-Car Service" for replacement or adjustment of TPS.

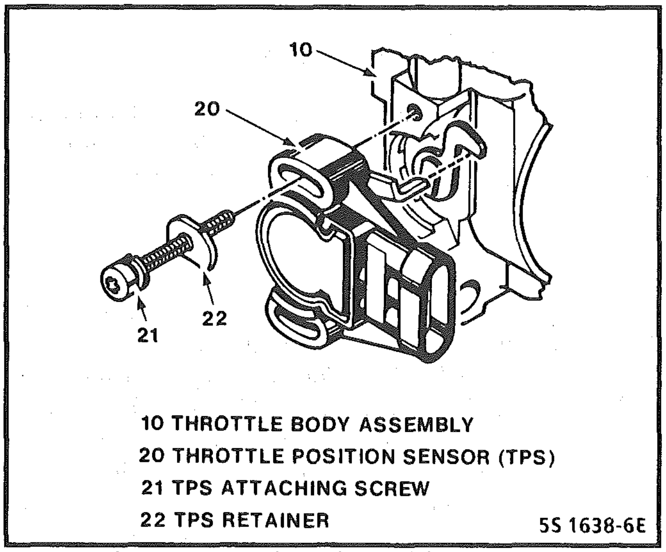


Figure C1-5 - Throttle Position Sensor

Knock Sensor

This sensor is used to control engine detonation. Refer to Section "C5", for description.

Vehicle Speed Sensor

The vehicle speed sensor (VSS), part of the digital cluster, sends a pulsing voltage signal to the ECM, which the ECM converts to miles per hour. This sensor mainly controls the operation of the TCC system. See Code 24 or Section "C8" for more information.

Park/Neutral Switch (Auto Only)

The park/neutral (P/N) switch indicates to the ECM when the transmission is in park or neutral. This information is used for the TCC and the IAC valve operation.

Important

Vehicle should not be driven with park/neutral switch disconnected, as idle quality will be affected and a possible false Code 24 (VSS).

See Section "8A" for more information on the P/N switch, which is part of the neutral/start and backup light switch assembly.

A/C "ON" Signal

This signal tells the ECM that the A/C selector switch is turned "ON", and that the pressure cycling switch is closed. The ECM uses this to adjust the idle speed when the air conditioning is working.

If this signal is not available to the ECM, idle may be rough, especially when the A/C compressor cycles. The voltage at ECM terminal "B8" should equal battery voltage on a C60 system and about 5 volts on a C68 option, when A/C is requested and the pressure cycling switch is closed.

Distributor Reference Signal

The distributor sends a signal to the ECM to tell it both engine rpm and crankshaft position. See ignition system Section "C4" for further information.

DIAGNOSIS

To read the codes, use a "Scan" tool or ground the diagnostic terminal with the engine not running and the ignition "ON". The "Service Engine Soon" light will flash Code 12 three times and then flash each code stored in memory three times. All codes stored in memory would have been read when Code 12 was flashed again. No new codes can be stored when in the diagnostics mode (diagnostics lead grounded). This eliminates confusion while the system is being worked on.

To clear the codes from memory:

- Ignition "OFF".
- Disconnect battery pigtail, located near the battery, for 30 seconds.

Since the ECM can have a failure which may affect only one circuit, following the diagnostic procedures in this section will determine which circuit has a problem and where it is.

If a diagnostic chart indicates that the ECM connections or ECM is the cause of a problem,and the ECM is replaced, but does not correct the problem, one of the following may be the reason:

- There is a problem with the ECM terminal connections. - The diagnostic chart will say ECM connections or ECM. The terminals may have to be removed from the connector in order to check them properly.
- The ECM, or Mem-Cal is not correct for the application. - The incorrect components may cause a malfunction and may or may not set a code.
- The problem is intermittent. - This means that the problem is not present at the time the system is being checked. In this case, refer to the "Symptoms" portion of the manual and make a careful physical inspection of all portions of the system involved.
- Shorted solenoid, relay coil, or harness. - Solenoids and relays are turned "ON" and "OFF" by the ECM, using internal electronic switches called "Drivers".
  A shorted solenoid, relay coil, or harness in a GMP4 computer will not damage the ECM, but will cause the circuit and controlled component to be inoperative. When the circuit fault is not present or has been repaired, the "Quad-Driver" will again operate in a normal manner due to it's fault protected design. If a fault has been repaired in a circuit controlled by a "Quad-Driver", the original ECM should be reinstalled and the circuit checked for proper operation. ECM replacement will not be necessary if the repaired circuit or component now operates correctly.
  J34636 or BT 8405 testers or equivalent provide a fast, accurate means of checking for a shorted coil or a short to battery voltage.
- The Mem-Cal may be faulty. - Although these rarely fail, it operates as part of the ECM. Therefore, it could be the cause of the problem. Substitute a known good Mem-Cal.
- The replacement ECM may be faulty - After the ECM is replaced, the system should be rechecked for proper operation. If the diagnostic chart again indicates the ECM is the problem, substitute a known good ECM. Although this is a rare condition, it could happen.

ECM

A faulty ECM will be determined in the diagnostic charts.

MEM-CAL

An incorrect or faulty Mem-Cal, which is part of the ECM, may set a Code 41 or 52. Also, be sure Mem-Cal is fully seated and latched in the socket.

ECM INPUTS

All of the sensors and input switches can be diagnosed by the use of a "Scan" tool. Following is a short description of how the sensors and switches can be diagnosed by the use of a "Scan" tool. The "Scan" can also be used to compare the values for a normal running engine with the engine you're diagnosing.

Coolant Temperature Sensor

A "Scan" tool displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C then stabilize when thermostat opens. If the engine has not been run for several hours (overnight), the coolant temperature and MAT temperatures should read close to each other. A fault in the coolant sensor circuit should set a Code 14 or 15. The code charts also contain a chart to check for sensor resistance values relative to temperature.

MAF Sensor

A "Scan" tool reads the MAF value and displays it in grams per second and should read between 4-7 on a fully warmed up idling engine. Values should change rather quickly on acceleration, but values should remain fairly stable at any given rpm. Most "Scan" tools will have 2 positions for reading MAF sensor values (MAF & air flow). Both values should read the same if no Code 33 or 34 is set, but if a code is set, the MAF values will be the default value and the air flow parameter will lock on the value at which the ECM recognized the fault. A failure in the MAF sensor or circuit should set a Code 33 or 34.

MAT Sensor

A "Scan" tool displays temperature of the air entering the engine and should read close to ambient air temperature when engine is cold, and rise as underhood temperature increases. If the engine has not been run for several hours (overnight) the MAT sensor temperature and coolant temperature should read close to each other. A failure in the MAT sensor circuit should set a Code 23 or 25. The code charts also contain a chart to check for sensor resistance values relative to temperature.

O_2 Sensor

The "Scan" has several positions that will indicate the state of the exhaust gases, O_2 voltage, integrator, and block learn. See "Scan" position information in introduction, Section "6E".

A problem in the O_2 sensor circuit or fuel system should set a Code 13 (open circuit), Code 44 (lean indication), Code 45 (rich indication). Refer to applicable chart if any of these codes were stored in memory.

TPS

A "Scan" tool displays throttle position in volts. The value should read .54volts ± .08 (.46V-.62V), with throttle closed and ignition "ON", or at idle. Voltage should increase at a steady rate as throttle is moved toward WOT (about 4.6 volts).

The ECM has the ability to auto-zero the TPS voltage if it is below about .7V (700 mV). This means that any voltage less than .7 volts will be determined by the ECM to be 0% throttle. A failure in the TPS or circuit should set a Code 21 or 22.

VSS

A "Scan" tools reading should closely match with speedometer reading with drive wheels turning. A failure in the VSS circuit should set a Code 24.

P/N Switch

A "Scan" tool should read "P/N" when in park or neutral and "R.D.L." when in Drive. This reading may vary with different makes of tools. Refer to CHART C-1A for P/N switch diagnosis.

A/C Request Signal

"Scan" tool should indicate A/C "ON", when A/C is requested and the pressure cycling switch is closed.

Reference Signal

A "Scan" tool will read this signal and is displayed in rpm. See Section "C4" for more information on the ignition system.

ON-CAR SERVICE

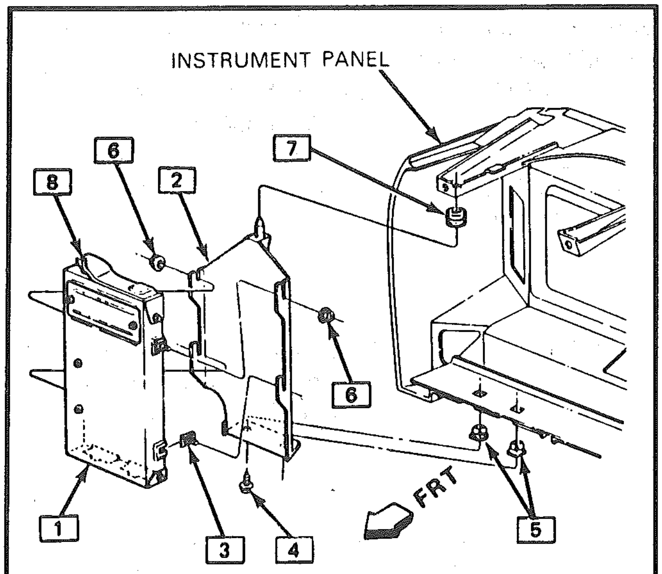
ELECTRONIC CONTROL MODULE (ECM)

Service of the ECM should, normally, consist of either replacement of the ECM or a Mem-Cal change.

If the diagnostic procedures call for the ECM to be replaced, the engine calibrator (Mem-Cal) and ECM should be checked first to see if they are the correct parts. If they are, remove the Mem-Cal from the faulty ECM and install it in the new service ECM. THE SERVICE ECM WILL NOT CONTAIN A MEM-CAL. Trouble Code 51 indicates the Mem-Cal is installed improperly or has malfunctioned. When Code 51 is obtained, check the Mem-Cal installation for bent pins or pins not fully seated in the socket. If it is installed correctly and Code 51 still shows, replace the Mem-Cal.

Important

When replacing the production ECM with a service ECM (controller), it is important to transfer the broadcast code and production ECM number to the service ECM label.



1 MODULE ASM ECM (PFI)
2 BRACKET
3 BOLT/SCREW (4)
4 BOLT/SCREW (2) 4.7-7.0 N·m (3.3-5.1 LBS. FT.)
5 BOLT/SCREW RETAINER (2)
6 NUT (4) 4.7-7.0 N·m (3.3-5.1 LBS. FT.)
7 SPACER
8 COVER ECM

8S 4667-6E

Figure C1-7 - ECM LOCATION

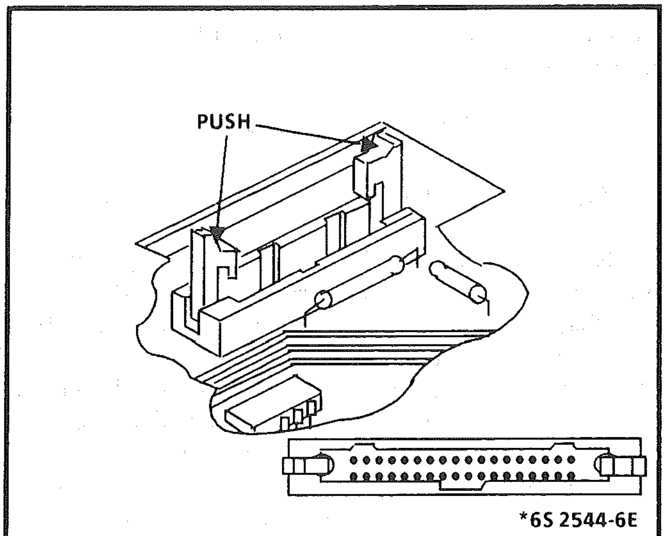


Figure C1-8 - Mem/Cal Unit Socket

Please do not record on ECM cover. This will allow positive identification of ECM parts throughout the service life of the vehicle.

Important

To prevent internal ECM damage, the ignition must be "OFF", when disconnecting or reconnecting power to ECM (for example, battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

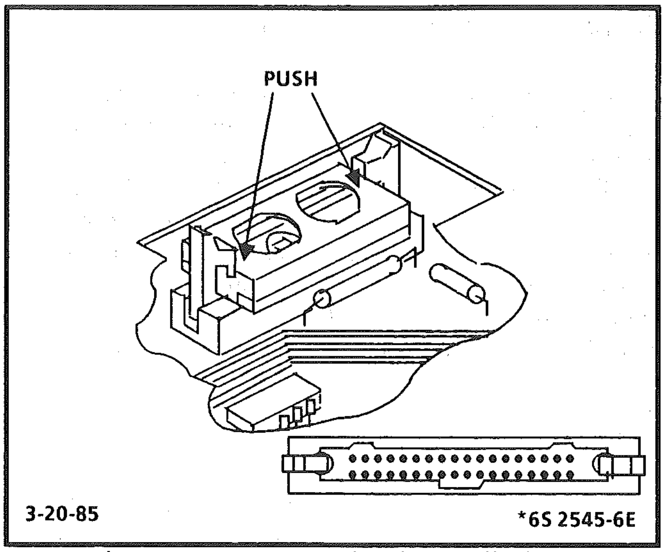


Figure C1-9 - Mem/Cal Unit Installation

ECM OR MEM-CAL REPLACEMENT FIGURE C1-7

Remove or Disconnect

1. Negative battery cable.
2. Right hand hush panel.
3. Connectors from ECM.
4. ECM mounting hardware.
5. ECM from passenger compartment.
6. ECM access cover. (Figure C1-1).
7. Mem-Cal removal. (Figure C1-8).

Important

Replacement ECM is supplied without a Mem-Cal, so care should be used when removing it from the defective ECM because it will be reused in the new ECM.

Using two fingers, push both retaining clips back away from the Mem-Cal. At the same time, grasp it at both ends and lift it up out of the socket. Do not remove the cover of the Mem-Cal. Use of unapproved Mem-Cal removal methods may cause damage to the Mem-Cal or socket.

Inspect

For alignment notches of the Mem-Cal and carefully set it aside. Do not open the Mem-Cal.

IF ECM IS BEING REPLACED:

Remove or Disconnect

1. New ECM from its packaging and check the service number to make sure it is the same as the defective ECM.
2. Access Cover.

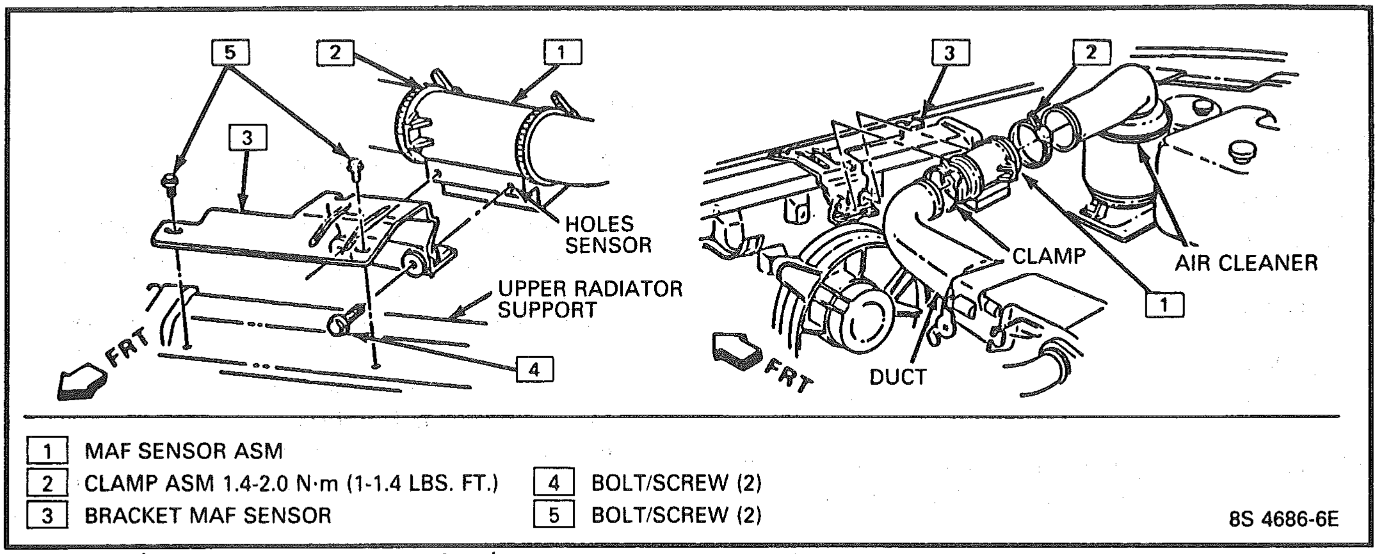


Figure C1-10 MAF Sensor Service

Install or Connect (Figure C1-9)

1. Mem-Cal in Mem-Cal socket.

Important

Press only on the ends of the Mem-Cal.

Small notches in the Mem-Cal must be aligned with the small notches in the Mem-Cal socket. Press on the ends of the Mem-Cal until the retaining clips snap into the ends of the Mem-Cal. Do not press on the middle of the Mem-Cal, only on the ends.

2. Access cover on ECM.
3. ECM in passenger compartment.
4. Connectors to ECM.
5. Right hand hush panel.
6. Negative battery cable.

Functional Check

1. Turn ignition "ON".
2. Enter diagnostics.
   A. Allow Code 12 to flash four times to verify no other codes are present.
   This indicates the Mem-Cal is installed properly and the ECM is functioning.
   B. If trouble Code 51 occurs, or if the "Service Engine Soon" light is "ON" constantly with no codes, the Mem-Cal is not fully seated or is defective.
   - If not fully seated, press firmly on the ends of the Mem-Cal.
   - If it is necessary to remove the Mem-Cal, follow the previous removal instructions.

COOLANT SENSOR

NOTICE: Care must be taken when handling coolant sensor. Damage to coolant sensor will affect proper operation of the fuel injection system.

Remove or Disconnect

1. Negative battery cable.
2. Air inlet duct.
3. Electrical connector.
4. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. Air inlet tube.
4. Negative battery cable.

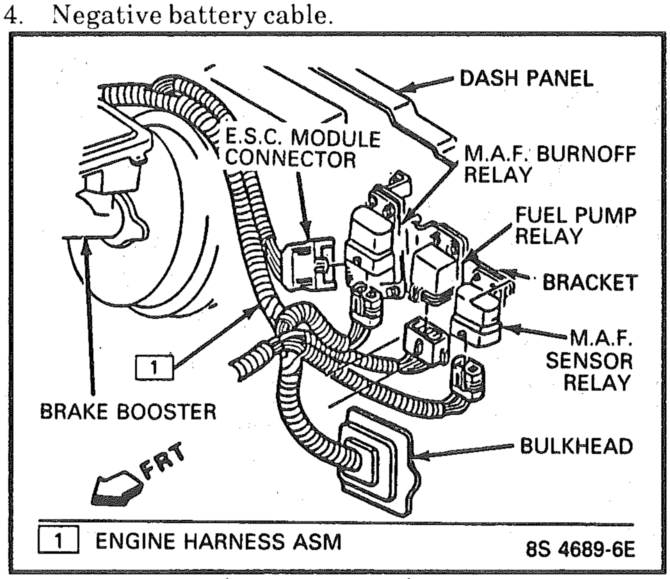


Figure C1-11 Relays

MAF SENSOR

Replacement of the MAF sensor is shown in Figure C1-10.

MAF SENSOR POWER & BURN-OFF RELAY

Refer to Figure C1-11 for relay location

OXYGEN SENSOR (Figure C1-12)

NOTICE: The oxygen sensor uses a permanently attached pigtail and connector. This pigtail should not be removed from the oxygen sensor. Damage or removal of the pigtail or connector could affect proper operation of the oxygen sensor.

Important

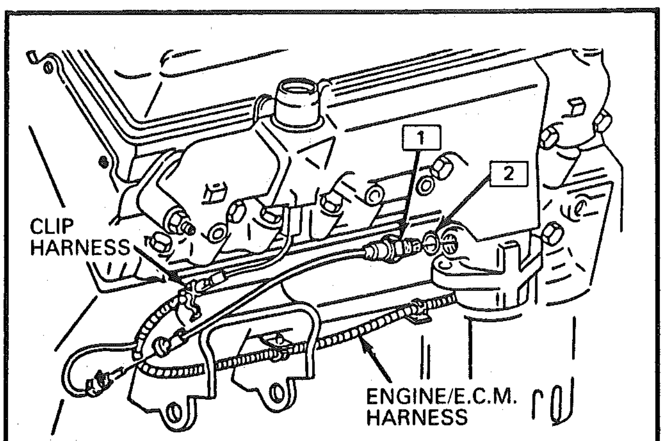
Take care when handling the oxygen sensor. The in-line electrical connector and louvered end must be kept free of grease, dirt, or other contaminants. Also, avoid using cleaning solvents of any type. Do not drop or roughly handle the oxygen sensor.

Remove or Disconnect

The oxygen sensor may be difficult to remove when engine temperature is below 48°C (120°F).

Excessive force may damage threads in exhaust manifold or exhaust pipe.

1. Negative battery cable.
2. Electrical connector.
3. Carefully back out oxygen sensor.



1 OXYGEN SENSOR 38-46 N·m (28-33 LBS. FT.)
2 GASKET 8S 4688-6E

Figure C1-12 - O_2 Sensor

Install or Connect

Important

A special anti-seize compound is used on the oxygen sensor threads. The compound consists of a liquid graphite and glass beads. The graphite will burn away, but the glass beads will remain, making the sensor easier to remove.

New, or service, sensors will already have the compound applied to the threads. If a sensor is removed from an engine, and, if for any reason it is to be reinstalled, the threads must have anti-seize compound applied before reinstallation.

1. Coat threads of oxygen sensor with anti-seize compound P/N 5613695, or equivalent, if necessary.
2. Sensor, and torque to 41 N•m (30 ft. lbs.).
3. Electrical connector.
4. Negative battery cable.

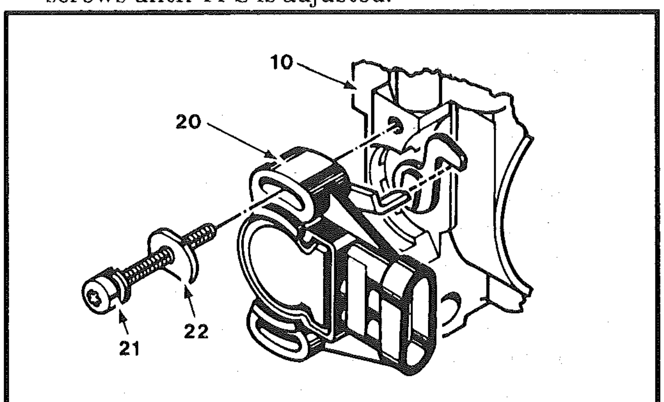
THROTTLE POSITION SENSOR (TPS)

Remove or Disconnect

1. Electrical connector.
2. Two TPS attaching screws and retainers.
3. Sensor.

Install or Connect

1. With throttle valve in the normal closed idle position, install throttle position sensor on throttle body assembly, making sure TPS pickup lever lines up with tang on throttle actuator lever. (See Figure C1-13)
2. Retainers and two TPS screws. DO NOT tighten screws until TPS is adjusted.



10 THROTTLE BODY ASSEMBLY
20 THROTTLE POSITION SENSOR (TPS)
21 TPS ATTACHING SCREW
22 TPS RETAINER
5S 1638-6E

Figure C1-13 - Throttle Position Sensor Service

Adjust

1. Install "Scan" tool or 3 jumper wires.
2. With ignition "ON", adjust TPS to obtain .54 volts ± .08 volts.
3. Tighten screws, then recheck reading to insure adjustment has not changed.

PARK/NEUTRAL SWITCH

See Section "8A" for location of park/neutral switch. On-car service and adjustment procedures are also listed there.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Memory Calibration Unit, Mem/Cal	3.670
Sensor, Coolant Temp	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manif Air Temp (MAT)	3.682
Sensor, Mass Air Flow (MAF)	3.682
Relay - MAF Burn-Off	3.682
Relay - MAF Power	3.682
Sensor, Throttle Position: Part of	
Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

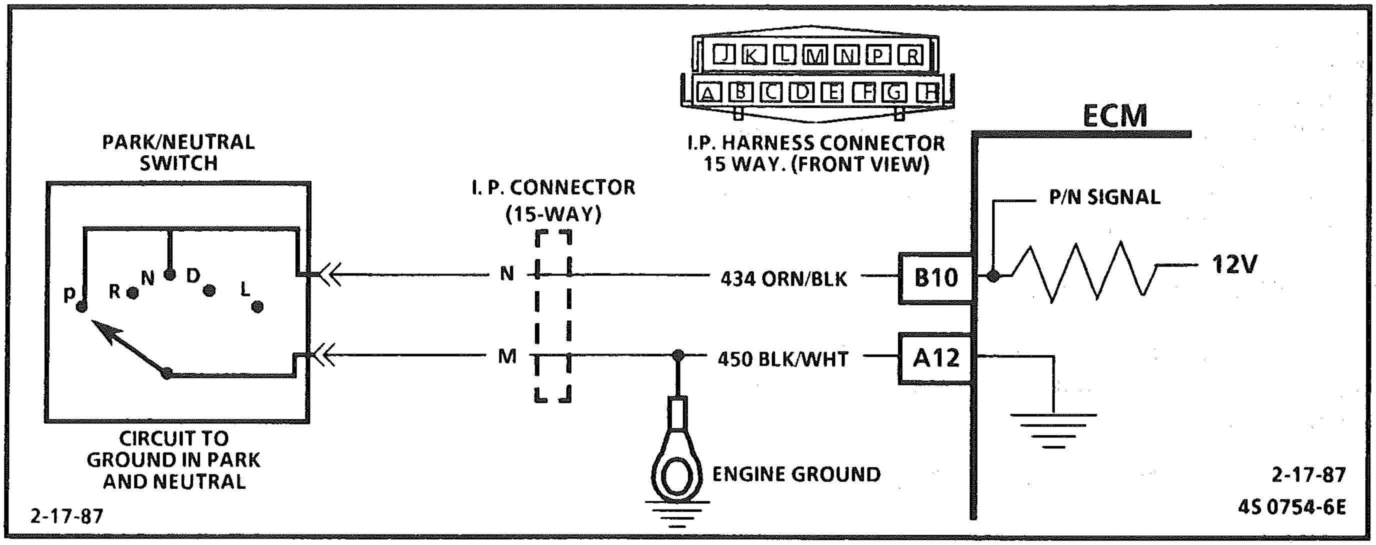


CHART C-1

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSMISSION ONLY)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The park/neutral switch contacts are a part of the neutral start switch, and are closed to ground in park or neutral and open in drive ranges.

The ECM supplies ignition voltage through a current limiting resistor to CKT 434 and senses a closed switch when the voltage on CKT 434 drops to less than one volt.

The ECM uses the P/N signal as one of the inputs to control:

Idle air control
VSS diagnostics
EGR

If CKT 434 indicates P/N (grounded), while in drive range, the EGR would be inoperative, resulting in possible detonation.

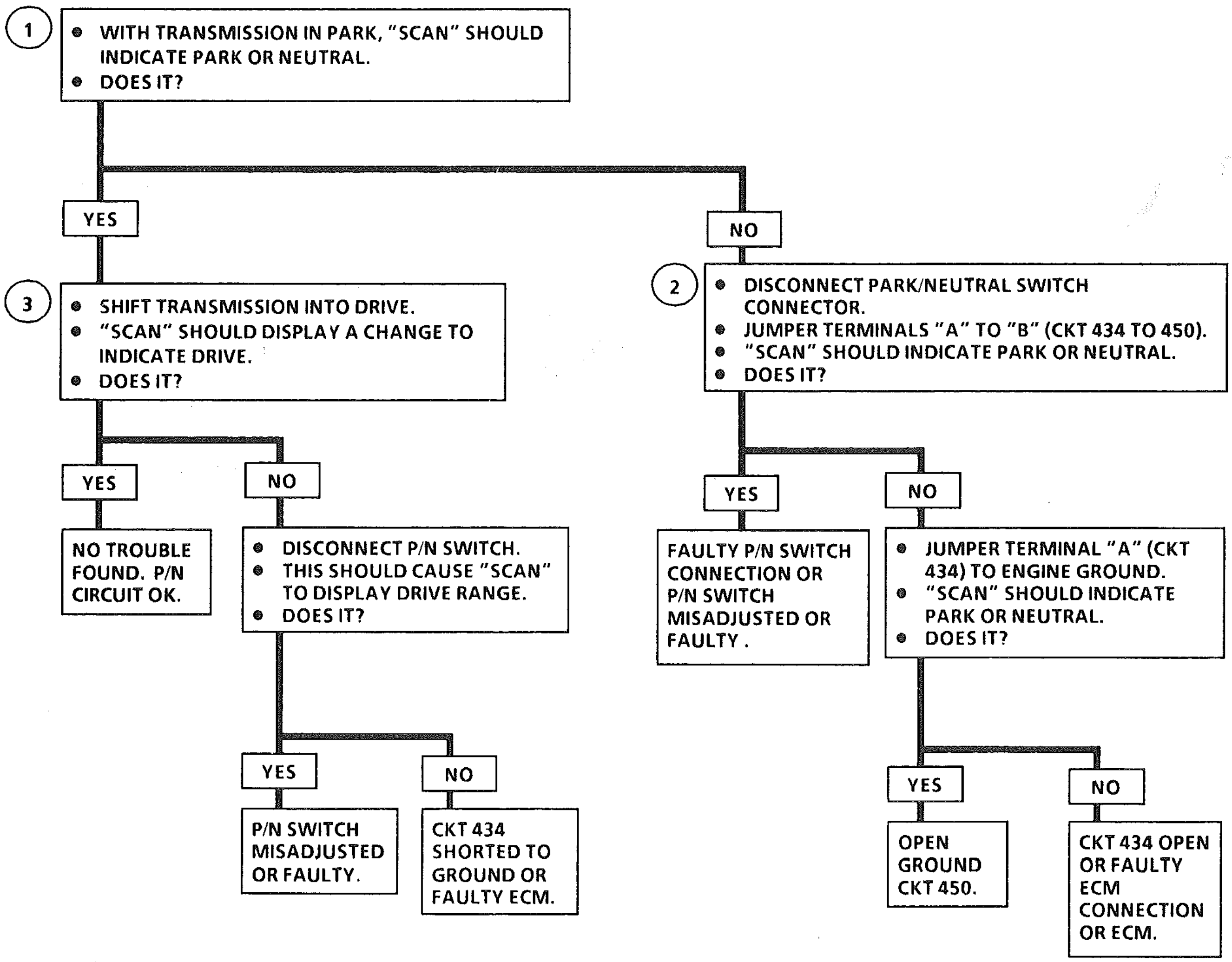
If CKT 434 always indicates drive (open), a drop in the idle may exist when the gear selector is moved into drive range.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for a closed switch to ground in park position. Different makes of "Scan" tools will read P/N differently. Refer to "Operators Manual" for type of display used for a specific tool.
2. Checks for an open switch in drive range.
3. Be sure "Scan" indicates drive, even while wiggling shifter to test for an intermittent or misadjusted switch in drive range.

CHART C-1

PARK/NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSMISSION ONLY)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



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BLANK

SECTION C2

FUEL CONTROL SYSTEM

CONTENTS

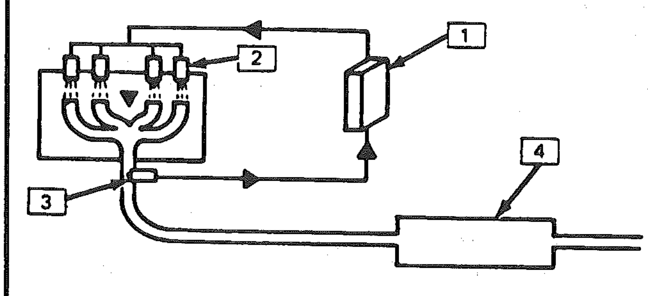
GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is to control fuel delivery to the engine.

Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each cylinder.

The main control sensor is the oxygen (O_2) sensor, which is located in the exhaust manifold. The O_2 sensor tells the electronic control module (ECM) how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by controlling the fuel injectors. The best mixture to minimize exhaust emissions is 14.7 to 1, which allows the catalytic converter to operate the most efficiently. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "Closed Loop" system (shown in Figure C2-1).



1 ELECTRONIC CONTROL MODULE (ECM)
2 FUEL INJECTORS
3 EXHAUST OXYGEN O_2 SENSOR
4 CATALYTIC CONVERTER

4S 0997-6E

Figure C2-1 "Closed Loop" System

MODES OF OPERATION

The ECM looks at voltages from several sensors to determine how much fuel to give the engine. The fuel is delivered under one of several conditions, called "modes". All the modes are controlled by the ECM and are described below.

Starting Mode

When the ignition is first turned "ON", the ECM will turn "ON" the fuel pump relay for two seconds, and the fuel pump will build up pressure. The ECM then checks the coolant temperature sensor, throttle position sensor, and determines the proper air/fuel ratio for starting. This ranges from 1.5 : 1 at -36°C (-33°F) to 14.7:1 at 94°C (201°F). The ECM controls the amount of fuel delivered in the starting mode by changing how long the injectors are pulsed "ON".

The cold start valve (Figure C2-2), not controlled by the ECM, is used to provide additional fuel during the starting mode to improve cold start-ups. This circuit is important, when the engine coolant temperature is very low, because the other injectors would not be pulsed "ON" long enough to provide the needed amount of fuel to start. The cold start valve is somewhat different from the other injectors in that it causes the fuel to be vaporized for a better combustible mixture.

The circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and is protected by the crank fuse. The system is controlled by a cold start fuel injection switch which provides a ground path for the valve during cranking whenever engine coolant is below 35° C (95°F).

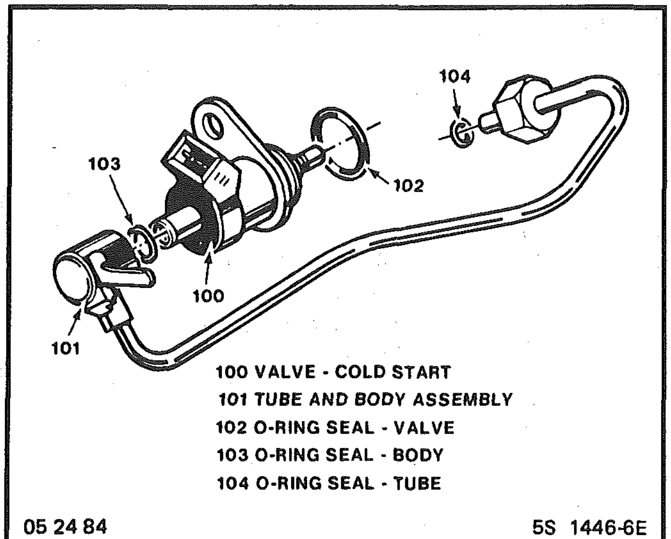


Figure C2-2 Cold Start Valve

The cold start fuel injection switch contains a bimetal switch which opens the circuit at specified coolant temperature. This bimetal is also heated by the winding in the switch, which would allow the valve to stay "ON" 8 seconds at -20° C or below. The time the switch stays closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

Clear Flood Mode

If the engine floods, clear it by pushing the accelerator pedal down all the way. The ECM then pulses the injectors at an air/fuel ratio of 20:1. The ECM holds this injector rate as long as the throttle stays wide open, and the engine rpm is below 600. If the throttle position becomes less than 80%, the ECM returns to the starting mode.

Run Mode

The RUN mode has two conditions called "Open Loop" and "Closed Loop".

When the engine is first started, and rpm is above 400 rpm, the system goes into "Open Loop" operation. In "Open Loop", the ECM will ignore the signal from the Oxygen (O_2) sensor, and calculate the air/fuel ratio based on inputs from the coolant and MAF sensors.

The system will stay in "Open Loop" until the following conditions are met:

1. The O_2 sensor has varying voltage output, showing that it is hot enough to operate properly. (This depends on temperature.)
2. The coolant sensor is above a specified temperature about 40°C (104°F).
3. A specific amount of time has elapsed after starting the engine.

The specific values for the above conditions vary with different engines, and are stored in the mem-cal. When these conditions are met, the system goes into "Closed Loop" operation. In "Closed Loop", the ECM will calculate the air/fuel ratio (injector on-time) based on the signal from various sensors but mainly the O_2 sensor. This allows the air / fuel ratio to stay very close to 14.7:1 .

Acceleration Mode

The ECM looks at rapid changes in throttle position and air flow, and provides extra fuel.

Deceleration Mode

The ECM looks at changes in throttle position and air flow to reduce the amount of fuel. When deceleration is very fast, the ECM may shut off fuel completely for short periods.

Battery Voltage Correction Mode

When battery voltage is low, the ECM can compensate for the weak spark delivered by the distributor by:

- Increasing the amount of fuel delivered;
- Increasing the idle rpm; and
- Increasing ignition dwell time.

Fuel Cutoff Mode

No fuel is delivered by the injector when the ignition is "OFF". This prevents dieseling. Also, fuel is not delivered if no reference pulses are seen from the distributor, which means the engine is not running. This prevents flooding.

FUEL CONTROL SYSTEM

Basic System Operation

The fuel system (Figure C2-3) starts with the fuel in the fuel tank.

An electric fuel pump, located in the fuel tank with the gage sending unit, pumps fuel to the fuel rail through an in-line fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A pressure regulator in the fuel rail keeps fuel available to the injectors at a constant pressure, depending on manifold pressure. Unused fuel is returned to the fuel tank by a separate line. For further information on the fuel tank, in-line filter, and fuel lines, see Section "6C".

The injectors are controlled by the ECM. They deliver fuel in one of several modes, as described above.

In order to properly control the fuel supply, the fuel pump is operated by the ECM through the fuel pump relay and oil pressure switch (see Fuel Pump Electrical Circuit Code 54).

Throttle Body Unit

The throttle body has a throttle valve to control the amount of air delivered to the engine. The TPS and the IAC valve are also mounted on the throttle body.

The throttle body contains vacuum ports located at, above, or below the throttle valve. These ports generate the vacuum signals needed by various

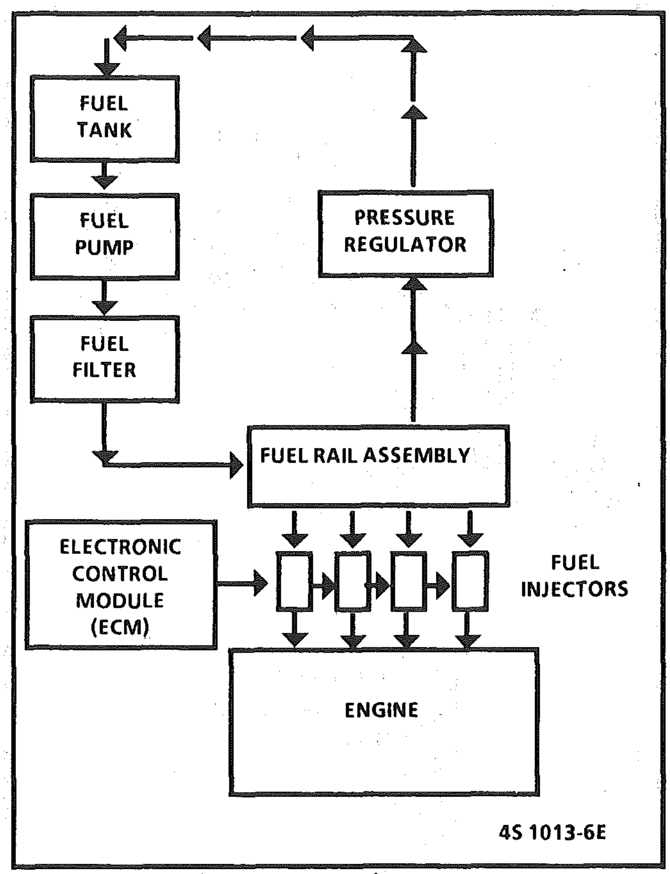


Figure C2-3 Fuel System

components. Engine coolant is directed through the coolant cavity, on the bottom of the throttle body, to warm the throttle valve and prevent icing.

Fuel Rail

The fuel rail is mounted to the top of the engine. It distributes fuel to the individual injectors. Fuel is delivered to the input end of the rail by the fuel lines, goes through the rail, then to the pressure regulator. Remaining fuel is then returned to the fuel tank.

Fuel Injectors

The fuel injector is a solenoid operated device controlled by the ECM (see Figure C2-4). The ECM turns "ON" the solenoid, which opens a valve to allow fuel delivery. The fuel, under pressure, is injected in a conical spray pattern at the opening of the intake valve. The fuel, which is not used by the injectors, passes through the pressure regulator before being returned to the fuel tank.

An injector which is stuck partly open will cause loss of pressure after engine shut down, so long crank times would be noticed on some engines. Also, dieseling could occur because some fuel could be delivered to the engine after the ignition is turned "OFF".

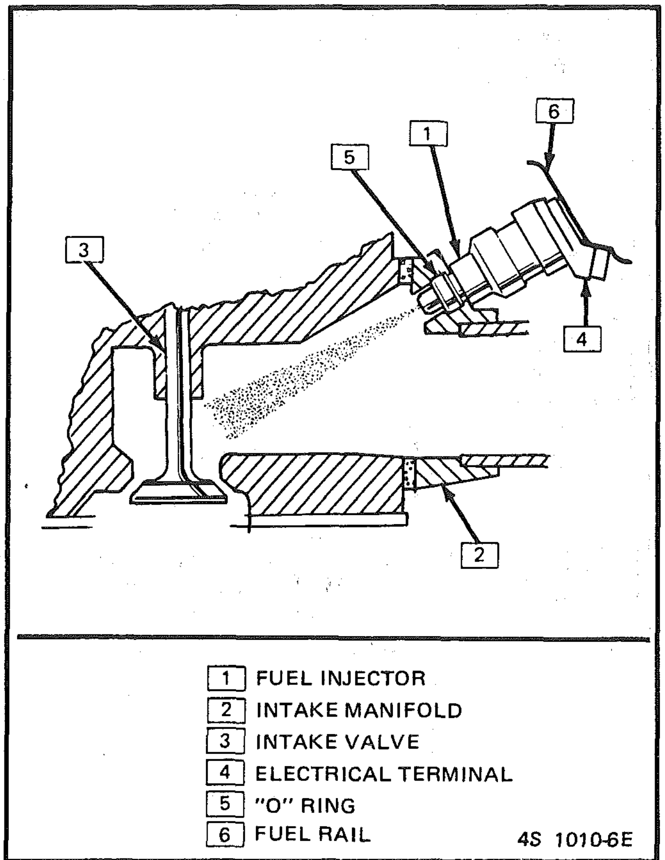


Figure C2-4 Fuel Injector

Pressure Regulator

The pressure regulator is a diaphragm-operated relief valve with injector pressure on one side and manifold pressure on the other. The function of the regulator is to maintain a constant pressure at the injector at all times. The pressure regulator compensates for engine load by increasing fuel pressure when it sees low engine vacuum.

The pressure regulator is mounted on the fuel rail, and is serviced separately.

If the pressure is too low, poor performance could result. If the pressure is too high, excessive odor and a Code 45 may result. CHART A-7 has information on diagnosing fuel pressure conditions.

Idle Air Control (IAC) Valve

The purpose of the idle air control (IAC) valve (shown in Figure C2-5) is to control engine idle speed, while preventing stalls due to changes in engine load.

The IAC valve, mounted in the throttle body, controls bypass air around the throttle valve. By moving a conical valve IN (to decrease air flow) or OUT (to increase air flow), a controlled amount of air can move around the throttle plate. If rpm is too low, more air is bypassed around the throttle valve to increase rpm. If rpm is too high, less air is bypassed around the throttle valve to decrease rpm.

The IAC valve moves in small steps called "counts", which can be monitored by a "Scan" tool.

During idle, the proper position of the IAC valve is calculated by the ECM based on battery voltage, coolant temperature, and engine rpm. If the rpm drops below a specified rpm, and the throttle plate is closed, the ECM senses a near stall condition. The ECM will then calculate a new valve position to prevent stalls.

If the IAC valve is disconnected and reconnected with the engine running, the idle rpm may be wrong. In this case, the IAC valve can be reset by starting the engine momentarily and then turning the ignition "OFF".

When servicing the IAC, it should only be disconnected or connected with the ignition "OFF". This will keep from having to reset the IAC.

The IAC valve affects only the idle characteristics of the vehicle. If it is open fully, too much air will be allowed into the manifold and idle speed will be high. If it is stuck closed, too little air will be allowed in the manifold, and idle speed will be too low. If it is stuck part way open, the idle may be rough, and will not respond to engine load changes.

Different designs are used for the IAC valve. Be sure to use the correct design when replacement is required.

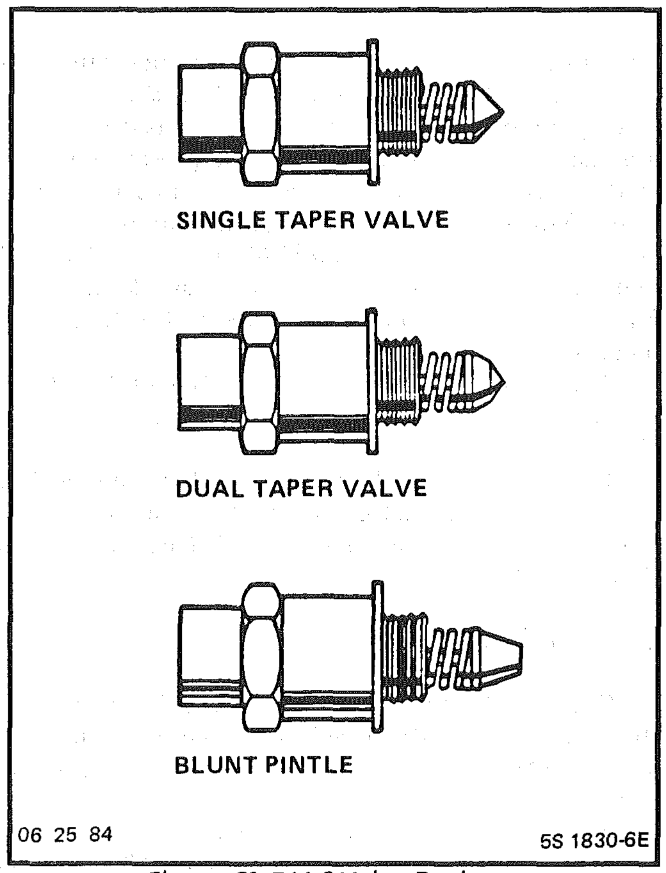


Figure C2-5 IAC Valve Designs

Fuel Pump Electrical Circuit

When the ignition is first turned "ON", without the engine running, the ECM will turn the fuel pump relay "ON" for two seconds. This builds up the fuel pressure quickly. If the engine is not started within two seconds, the ECM will shut the fuel pump "OFF" and wait until the engine is cranking. As soon as the engine is cranked, the ECM will turn the relay "ON" and run the fuel pump.

As a backup system to the fuel pump relay, the fuel pump can also be turned "ON" by the oil pressure switch. The oil pressure switch is a normally open switch which closes when oil pressure reaches about 28 kPa (4 psi). If the fuel pump relay fails, the oil pressure switch will close, and run the fuel pump.

An inoperative fuel pump relay can result in long cranking times, particularly if the engine is cold but should result in a Code 54.

An inoperative fuel pump would cause a no start condition. A fuel pump which does not provide enough pressure can result in poor performance.

DIAGNOSIS

FUEL CONTROL SYSTEM

Some failures of this system will result in an "Engine Cranks But Won't Run". If this condition exists see CHART A-3. This chart will determine if the problem is caused by the ignition system, ECM, or fuel pump circuit. If it's determined to be a fuel problem CHART A-7 will be used. This includes the injectors, pressure regulator, fuel pump, and fuel pump relay. The fuel system wiring schematic is covered on the facing page of Code CHART 54.

If a malfunction occurs in the fuel control system, it usually results in either a rich or a lean exhaust condition. This condition is sensed by the oxygen sensor and the ECM will change the fuel calculation (injector pulse width) based on the O_2 sensor reading. The change made to the fuel calculation will be indicated by a change in the block learn values, which can be monitored by a "Scan" tool. The normal block learn values are around 128, and if the O_2 sensor is sensing a lean condition, the ECM will add fuel which will result in a block learn value above 128. If the O_2 sensor is sensing a rich exhaust the ECM will reduce fuel to the engine and this will result in block learn values below 128. Some variations in block learn values are normal because all engines are not exactly the same. However, if the block learn values are ± 10 counts from 128 a system problem exists. If the block learn values are greater than 138 see Code 44, for items which can cause a lean system.

If the block learn values are less than 118 see Code 45 for items which can cause the system to run rich.

If a driveability symptom exists, refer to the particular symptom in Section "B" for additional items to check.

IDLE AIR CONTROL VALVE

A "Scan" tool will read IAC position in steps (counts). "0" steps indicates the ECM is commanding the IAC to be driven all the way in, to a fully seated position, and this is usually caused by a vacuum leak. The higher the number of counts the more air being allowed to pass the IAC valve. CHART C-2C can be used to diagnosis the IAC valve. Also refer to "Rough, Unstable, or Incorrect Idle, Stalling" in symptoms, Section "B" for other possibilities for the cause of idle problems.

FUEL SYSTEM PRESSURE TEST

A fuel system pressure test is part of several of the diagnostic charts and symptom checks. To perform this test, use the procedure in CHART A-7.

ON-CAR SERVICE

PORT FUEL INJECTION COMPONENTS

CAUTION: **Before servicing an injector, fuel rail, or pressure regulator, it is necessary to relieve the pressure in the fuel system, to minimize the risk of fire and personal injury. (See "Fuel Pressure Relief Procedure" below). To reduce the chance of personal injury, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container.**

FUEL PRESSURE RELIEF PROCEDURE

1. Connect fuel gage J 34730-1 or equivalent to fuel pressure valve. Wrap a shop towel around fitting while connecting gage to avoid spillage.
2. Install bleed hose into an approved container and open valve to bleed system pressure.

Plenum (Figure C2-6)

←→ Remove or Disconnect

1. Negative battery cable.
2. Throttle, T.V., and cruise control cable.
3. Cable retaining bracket.
4. Throttle body retaining bolts (4).
5. TPS and IAC valve electrical connectors.
6. Vacuum hoses.

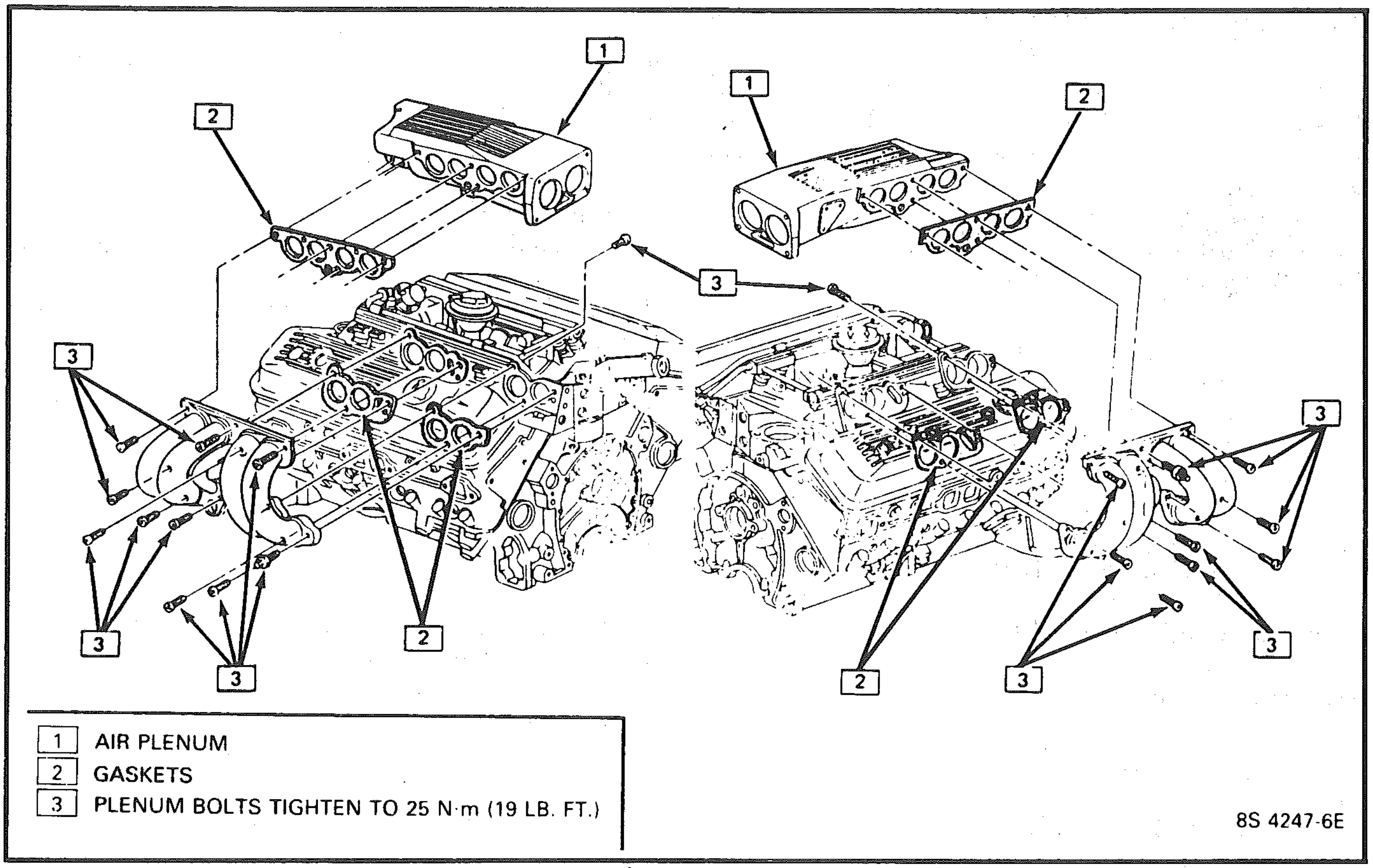


Figure C2-6

7. Right runners.
8. Plenum retaining bolts.
9. Plenum and gaskets (discard gaskets).

Install or Connect

1. New gaskets.
2. Reverse removal procedures. See Figure C2-6 for bolt torque specifications.

FUEL RAIL ASSEMBLY

Fuel Rail (Figure C2-7)

Remove or Disconnect

1. Negative battery cable.
2. Fuel system pressure following "Fuel Pressure Relief procedure".
3. Plenum. (Refer to Plenum Removal).
4. Cold start valve line.
5. Runners.
6. Cold start valve.
7. Fuel lines and injector harness connectors.
8. Loosen rail retaining bolts and raise rail.
9. Rail and injectors.
10. Injector O-ring seal (86) (Figure C2-9) from each injector spray tip and discard.

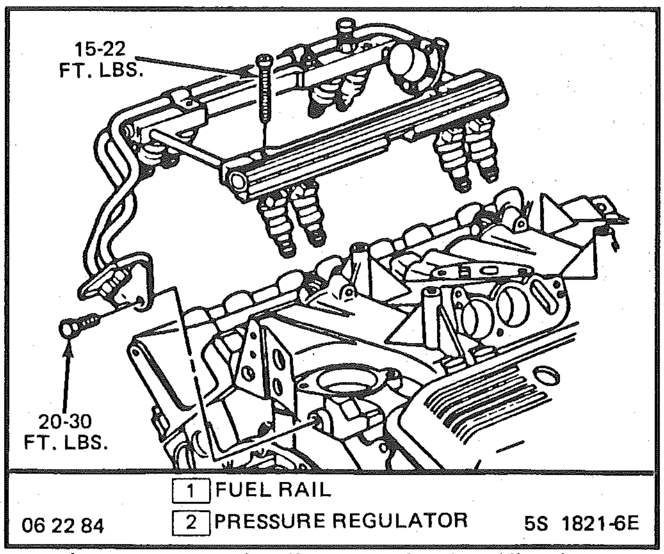


Figure C2-7 Fuel Rail Assembly Identification

Install or Connect

1. New injector O-rings.
2. Coat injector O-rings with engine oil.
3. Reverse removal instructions.
   Refer to Figure C2-7 for torque specifications.

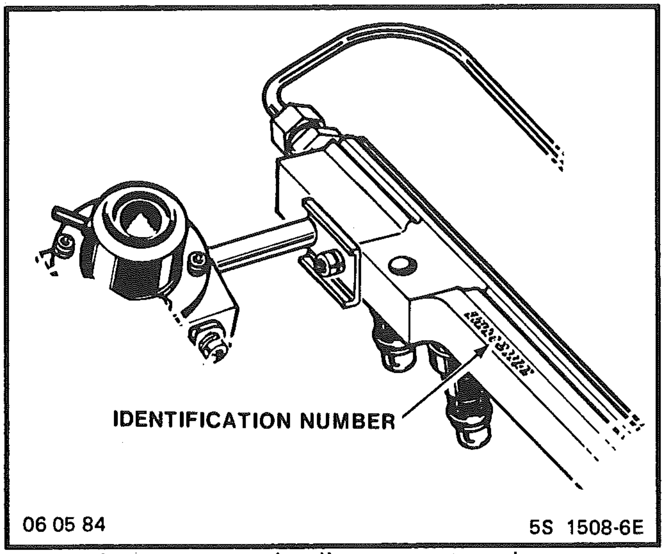


Figure C2-8 Fuel Rail Pressure Regulator

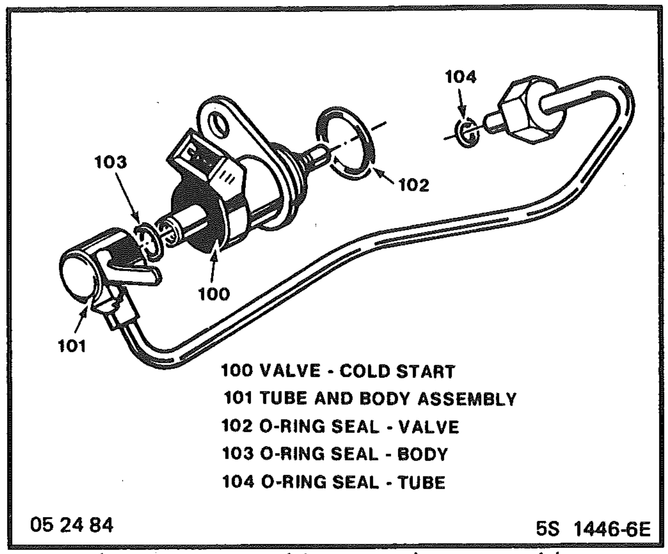


Figure C2-10 Cold Start Valve Assembly

FUEL RAIL SERVICE

IDENTIFICATION

An eight digit identification number is stamped on the fuel rail assembly, as shown in Figure C2-8. Refer to this model identification number if servicing or part replacement is required.

Names of component parts will be found on the numbered list that accompanies the dis-assembled view, (Figure C2-9). Numbers used to identify parts there will be used to identify the same parts in other illustrations of this section of the manual.

UNIT SERVICE PROCEDURES

Important

When servicing the fuel rail assembly, precautions must be taken to prevent dirt and other contaminants from entering the fuel passages. It is recommended that fittings be capped, and holes be plugged during servicing.

Important

At any time the fuel system is opened for service, the O-ring seals used with the related component(s) should be replaced.

Cleaning and Inspection

Before disassembly, the fuel rail assembly may be cleaned with a spray type engine cleaner, such as AC Delco X-30A or equivalent, following package instructions. The fuel rail should not be immersed in liquid solvent.

COLD START TUBE AND VALVE ASSEMBLY (Figure C2-10)

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure, following "Fuel Pressure Relief Procedure".
3. Plenum, per previous instructions.
4. Brake booster line.
5. Tube and body assembly (101) at fitting on fuel rail.
6. Electrical connector from cold start valve (100).
7. PVC hose.
8. Cold start valve retaining bolt.
9. Cold start valve assembly from fuel rail and intake manifold.

Disassemble

1. Raise tab on tube and body assembly (101) to clear electrical connector and unscrew cold start valve (100).
2. O-ring seals (102, 103, and 104) from tube and body assembly (101), cold start valve (100), and fuel rail fitting. Discard seals.

Assemble

1. Lubricate new O-ring seals (102, 103, and 104) with engine oil and install at following locations:
   - O-ring seal (102) goes on end of cold start valve (100).
   - O-ring seal (103) goes inside body of tube and body assembly (101).
   - O-ring seal (104) goes up against collar of tube and body assembly.

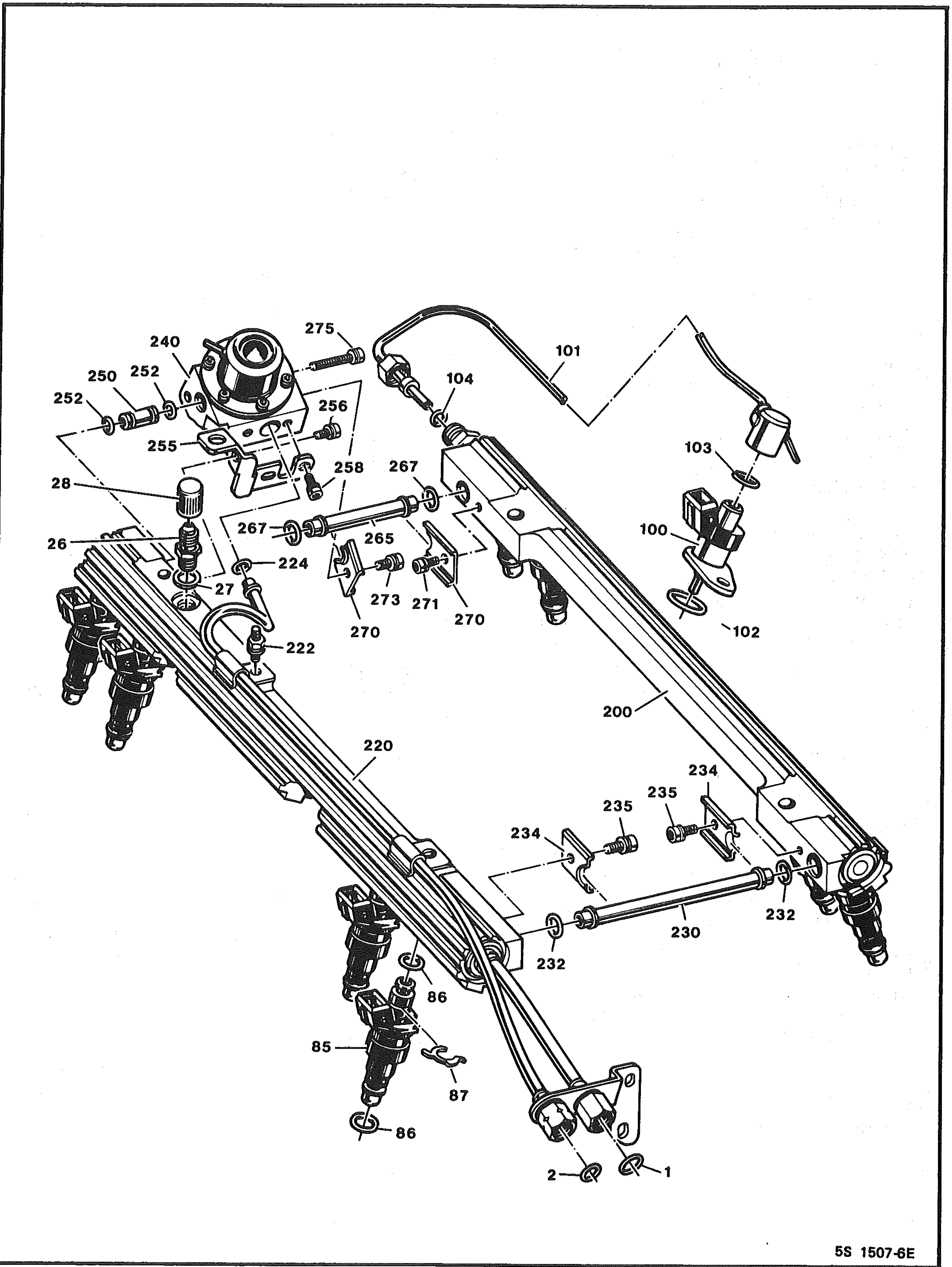


Figure C2-9 Fuel Rail Assembly

2. Cold start valve (100) onto tube and body assembly.
   - Screw in until valve bottoms, then back off until hole in mounting lug on valve will be aligned properly with hole in fuel rail when mounted.
   - Bend tang over cold start valve to lock it in position.

Clean

- Areas around valve and connection with AC Delco X-30A or equivalent.

Install or Connect

1. Cold start (100) valve in intake manifold.
2. Cold start valve retaining bolt.

Tighten

- Retaining bolt to 27 N•m (20 ft. lbs.).

3. PVC hose.
4. Tube and body assembly (101) at fitting on fuel rail.

Tighten

- Nut on fitting to 27 N•m (20 ft. lbs.).

6. Brake booster line.
6. Electrical connector on cold start valve (100).
7. Negative battery cable.

Inspect

- Energize fuel pump and inspect for leaks.

8. Intake manifold plenum, per previous instructions.

FUEL RAIL SERVICE
FIGURE C2-9
PARTS INFORMATION

PART NAME	PART #
O-ring - Fuel Inlet Line	1
O-ring - Fuel Return Line	2
Assembly - Fuel Pressure Connection	26
Seal - Fuel Pressure Connection	27
Cap - Fuel Pressure Connection	28
Injector - Port	85
Seal - O-Ring - Injector	86
Clip - Injector Retainer	87
Valve - Cold Start	100
Assembly - Tube & Body 101 Seal - O-ring Valve	102
Seal - O-Ring - Body	103
Seal - O-Ring - Tube	104
Assembly - Fuel Rail & Plug (LH)	200
Assembly - Fuel Rail & Plug (RH)	220
Stud Assembly - Rear Bracket Attaching	222
Seal - O-Ring - Fuel Outlet Tube	224
Tube - Front Crossover	230
Seal - O-Ring - Fuel Crossover Tube	232
Retainer - Crossover Tube	234
Screw Assembly - Retainer Attaching	235
Assembly - Pressure Regulator and Base	240
Seal - O-Ring - Connector	252
Connector - Base to Rail	250
Bracket - Pressure Regulator & Base Assembly	255
Screw Assembly - Bracket to rail Attaching	256
Screw Assembly - Bracket to Base Attaching	258
Tube - Rear Crossover	265
Seal - O-Ring - Crossover Tube	267
Retainer - Rear Crossover Tube	270
Screw Assembly - Retainer to LH Rail	271
Screw Assembly - Retainer to Base	273
Screw Assembly - Base to RH Rail	275

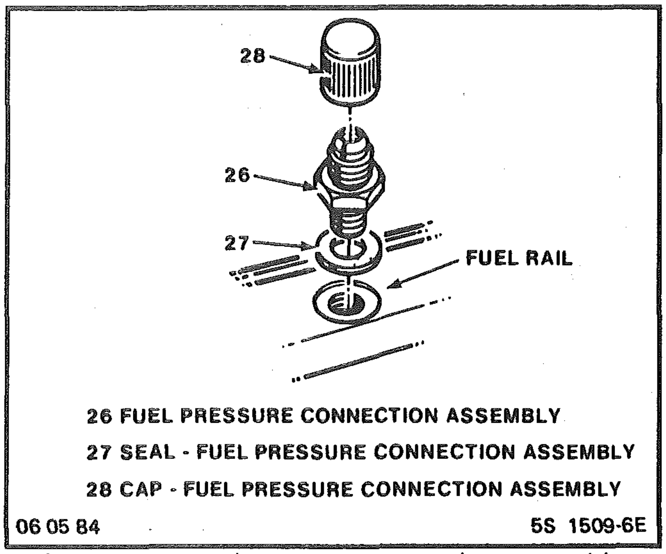


Figure C2-11 Fuel Pressure Connection Assembly

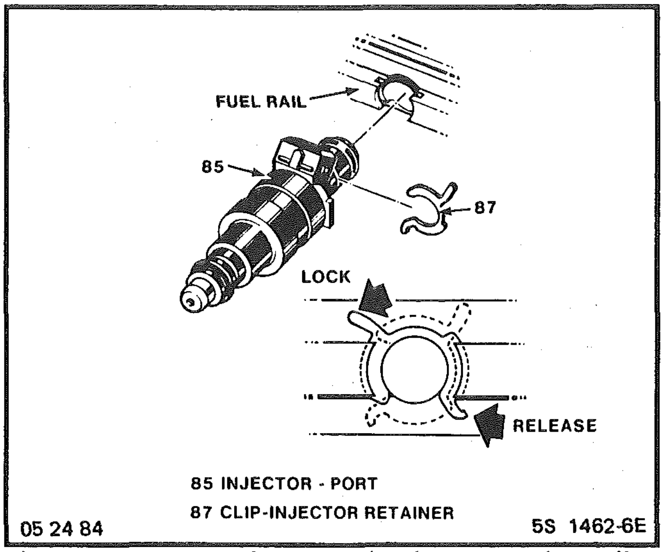


Figure C2-12 Port Injector with Injector Retainer Clip

FUEL PRESSURE CONNECTION ASSEMBLY (Figure C2-11)

Remove or Disconnect

1. Negative battery cable.
2. Relieve fuel system pressure following "Fuel Pressure Relief" procedure.

Clean

- Area around valve and connection with AC Delco X-30A or equivalent.

3. Fuel pressure connection assembly (26) and seal (27). Discard seal

Install or Connect

1. New seal (27) on fuel pressure connection assembly (26).
2. Fuel pressure connection assembly (26)in fuel rail.

Tighten

- Fuel pressure connection assembly to 10.0 N•m (88.0 in. lbs.)

3. Negative battery cable.

Inspect

- Energize fuel pump and check for leaks.

FUEL INJECTORS (With Fuel Rail Removed)

Each port injector is located and held in position by a retainer clip that must be rotated to release and/or lock the injector in place, as shown in Figure C2-12.

Remove or Disconnect

1. Rotate injector retaining clip(s) (87) to unlocked position.
2. Injectors (85).

Disassemble

1. Injector O-ring seals (86) from both ends of injectors (85) and discard.

Assemble

- New O-ring seals (86) and install on injectors (85).

Install or Connect

1. Injectors to fuel rail and pressure regulator assembly (11).
2. Rotate injector retainer clips (87) to locking position (Figure C2-12).

PRESSURE REGULATOR (With Fuel Rail Removed)

Important

The pressure regulator is factory adjusted and is not serviceable. Do not attempt to remove regulator cover.

Remove or Disconnect

1. Front crossover tube retainer attaching screw assembly (235) and crossover tube retainer (234) on right hand rail side.
2. Retainer to base screw assembly (273) and rear crossover tube retainer (270) at pressure regulator and base assembly (240).

3. Separate left hand fuel rail and plug assembly (200) from right hand fuel rail and plug assembly (220).
4. Bracket-to-rail attaching screw assembly (256), two bracket-to-base attaching screw assemblies (258) and pressure regulator and base assembly bracket (255).
5. Screw assembly (235), which attaches fuel outlet tube to right hand rail (220).
6. Base to right hand rail screw assembly (275).
7. Pressure regulator and base assembly (240) from right hand rail assembly (220).
8. Rotate regulator and base assembly to remove from fuel outlet tube.
9. Base to rail connector (250).
10. O-ring seals and discard:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).

Important

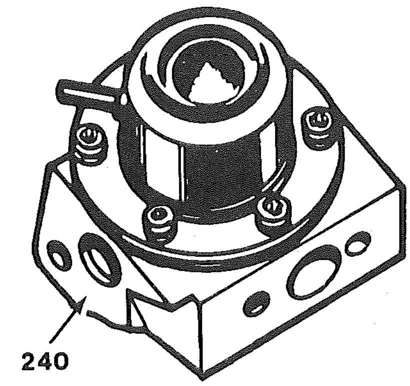
When removing O-ring seals, note locations and sizes, to assure correct replacement and re-assembly.

Inspect

- O-rings and sealing surfaces, for damage that could prevent proper sealing.
  - Replace any damaged O-ring seals.

Install or Connect

1. Lubricate with engine oil, and install O-ring seals:
    - Connector (252).
    - Fuel outlet tube (224).
    - Rear crossover tube (267).
    - Front crossover tube (232).
2. Base-to-rail connector (250) in pressure regulator and base assembly (240).
3. Regulator and base assembly on fuel outlet tube.
4. Rotate the regulator and base assembly to install base to rail connector (250) into right hand rail assembly (220).
5. Base to right hand rail screw assembly (275).
6. Pressure regulator and base assembly bracket (255), two brackets to base attaching screw assembly (258) and bracket to rail attaching screw assembly (256).
7. Rear bracket attaching screw assembly (235).
8. Left hand rail and plug assembly (200), with front and rear crossover tubes (230) and 265), to right hand rail and tube assembly (220).
9. Rear crossover tube retainer (270) and retainer to base screw assembly (273).



240 PRESSURE REGULATOR AND BASE ASSEMBLY

06 05 84 5S 1510-6E

Figure C2-13 Fuel Pressure Regulator

10. Front crossover tube retainer (234) and retainer attaching screw assembly (235).

Tighten

- Above mentioned seven assemblies to 5 N•m (44 in. lbs.).

COLD START FUEL INJECTION SWITCH

Remove or Disconnect

1. Air inlet duct.
2. Alternator bracket.
3. Electrical connector.
4. Switch.

Install or Connect

1. Coat threads with pipe sealant.
2. Reverse removal procedure to reinstall.

THROTTLE BODY

Remove or Disconnect

1. Air inlet duct.
2. IAC and TPS connectors.
3. Vacuum lines.
4. Coolant hoses (2).
5. Throttle, TV, and cruise control cables.
6. Throttle body retaining bolts.

Install or Connect

1. Reverse procedure to reinstall.
2. Refill radiator with lost coolant. Refer to Figure C2-14 for torque specifications.

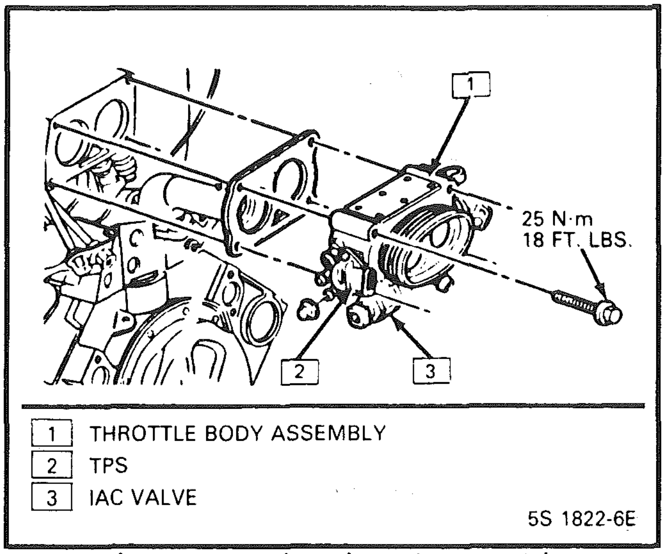


Figure C2-14 Throttle Body Removal

THROTTLE BODY SERVICE IDENTIFICATION

An eight digit identification number is stamped on the throttle body casting, next to the coolant cover, as shown in Figure C2-15. Refer to this model identification number if servicing or part replacement is required.

Names of component parts will be found on the numbered list that accompanies the exploded view (Figure C2-18). Numbers used to identify parts in the exploded views also are used to identify the same parts in other illustrations of this manual.

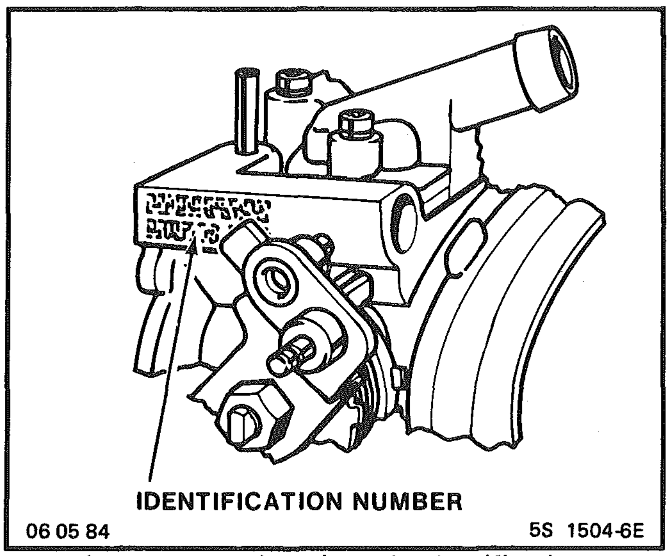


Figure C2-15 Throttle Body Identification

UNIT REPAIR PROCEDURES

TPS Adjustment

Refer to Section "C-1" for TPS replacement or adjustment.

The unit repair procedures cover component replacement with the unit on the vehicle. However, throttle body replacement requires that the complete unit be removed from the engine. If removed, it may be placed on a holding fixture, such as J-9789-118, BT-3553, or equivalent, to prevent damage to the throttle valve.

Cleaning and Inspection

Throttle body parts, except as noted below, may be cleaned in a cold immersion-type cleaner such as AC Delco X-55 or equivalent.

NOTICE: The throttle position sensor (TPS), idle air control (IAC) valve, throttle body with cover and seals or gaskets in place, should NOT be soaked in liquid solvent or cleaner, as they may be damaged. If TPS or IAC valve is still mounted in the throttle body, do not immerse throttle body.

1. Clean all metal parts throughly and blow dry with shop air. Be sure all air passages are free of burrs and dirt.
2. Inspect mating casting surfaces for damage that could affect gasket sealing.

MINIMUM IDLE SPEED CHECK

The idle stop screw (16), used to regulate minimum idle speed of the engine, is adjusted at the factory, then is covered with a plug (15) to discourage unnecessary readjustment. However, if it is necessary to gain access to the idle stop screw assembly, proceed as shown in Figure C2-16.

Before checking minimum idle speed, be sure ignition timing is correct and, before making any idle speed adjustments, be sure throttle body is clean around the throttle plates.

Adjust

1. Pierce the idle stop screw plug (15) with an awl, and apply leverage to remove it.
2. Adjust idle stop screw assembly (16) as required.

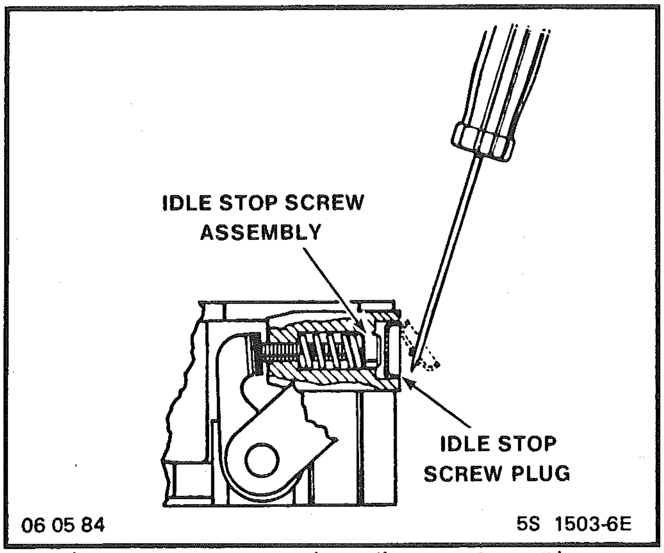


Figure C2-16 Removing Idle Stop Srew Plug

3. With IAC motor connected, ground diagnostic terminal.
4. Turn "ON" ignition, do not start engine. Wait at least 30 seconds.
5. With ignition "ON", disconnect IAC electrical connector.

Important

6. Disconnect the distributor set-timing connector.
7. Start engine and allow to go "Closed Loop".
8. Remove ground from diagnostic terminal.
9. Adjust idle stop screw to 400 rpm 5.0L, 450 rpm 5.7L in neutral for manual or automatic transmission vehicles.
10. Turn ignition "OFF" and reconnect connector at IAC motor.
11. Adjust TPS, if necessary:
    - With ignition "ON", use a "Scan" tool or 3 jumper wires and adjust TPS to obtain .54 volt $\pm$ .08 volt.
    - Tighten screws, then recheck reading to insure adjustment has not changed.
12. Start engine and inspect for proper idle operation.

IDLE AIR CONTROL VALVE ASSEMBLY AND GASKET

Remove or Disconnect

1. Electrical connector at idle air control valve assembly (70).
2. IAC valve assembly from IACV/coolant cover assembly.
3. IAC valve assembly gasket (71) and discard.

NOTICE: Before installing new idle air control valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur.

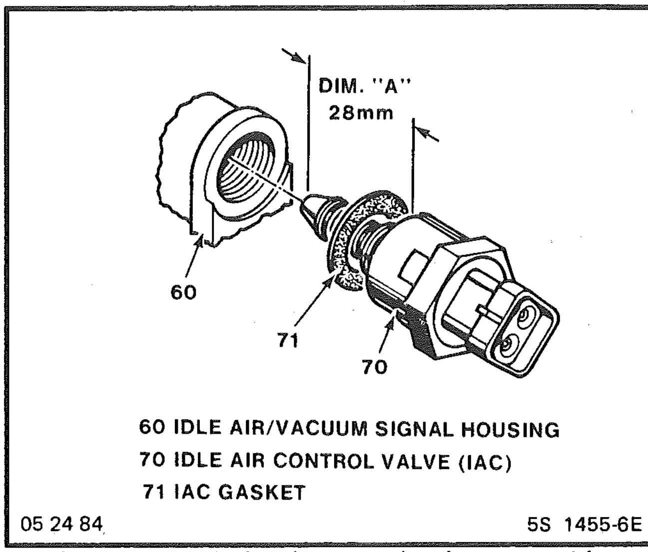


Figure C2-17 Idle Air Control Valve Assembly

Measure

- Distance from gasket mounting surface of IAC valve assembly (70) to tip of pintle, (Dimension "A" in Figure C2-17).

Adjust

If distance is greater that 28 mm (1 1/8 in.), reduce it as follows:

a. If IAC valve assembly has a "collar" around electrical connector end, use firm hand pressure on pintle to retract it. (A slight side-to-side motion may help.)
b. If IAC valve assembly has no "collar", compress pintle-retaining spring toward body of IAC valve and try to turn pintle clockwise.
    - If pintle will turn, continue turning until 28mm (1 1/8 in.) is reached. Return spring to original position, with straight part of spring end lined up with flat surface under pintle head.
    - If pintle will not turn, use firm hand pressure to retract it.

Install or Connect

1. New IAC valve assembly gasket (71) on IAC valve assembly (70).
2. IAC valve assembly in IACV/coolant cover assembly (61).

Tighten

- IAC valve assembly to 18N•m (13 ft. lbs.), with wrench on hex surface only.

3. Electrical connector at IAC valve assembly (70).

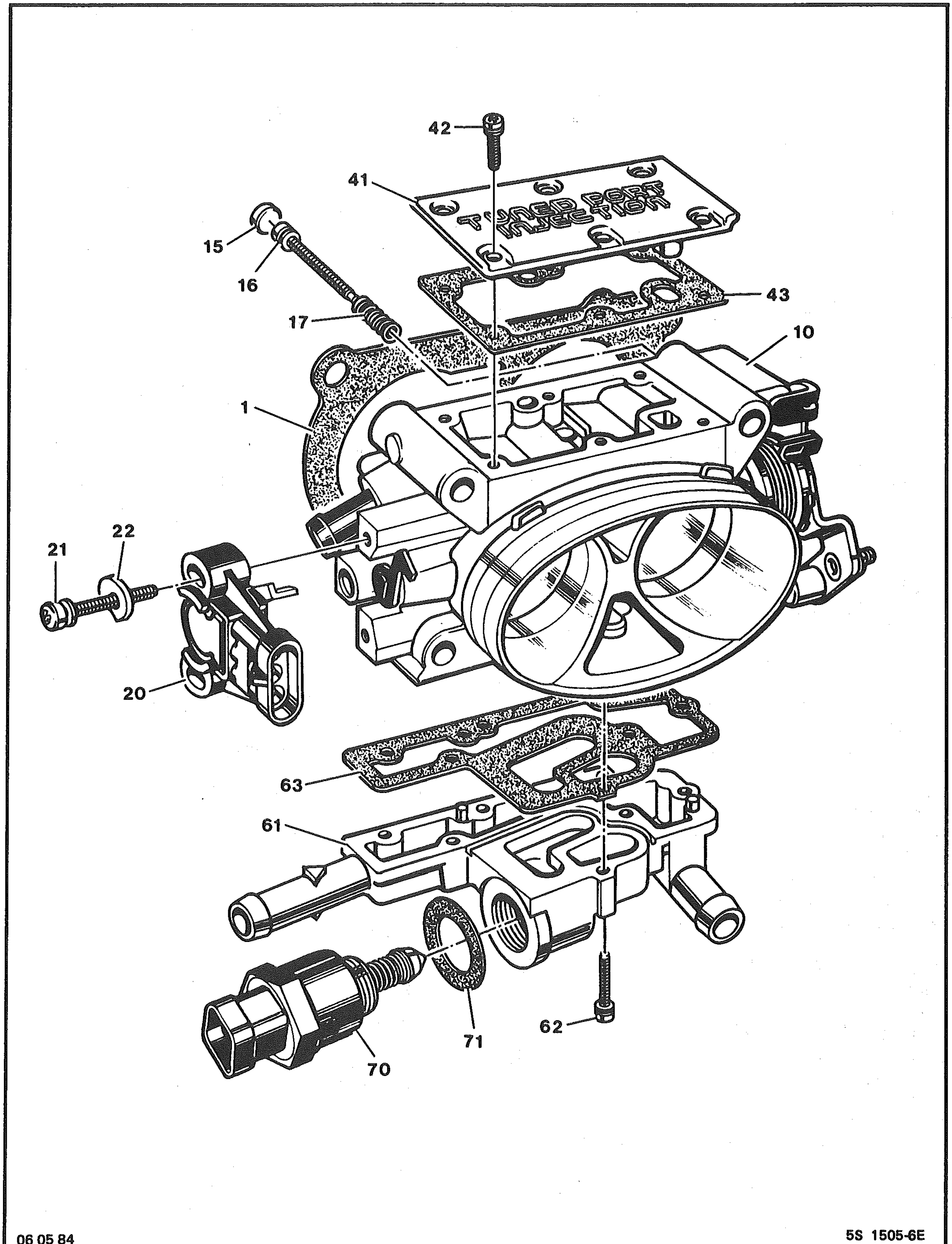


Figure C2-18 Throttle Body

Important

No physical adjustment is made to the IAC assembly after installation. IAC valve resetting occurs after reinstallation on the vehicle, and is reset after the engine is started and then the ignition turned "OFF".

THROTTLE BODY PARTS INFORMATION
FIGURE C2-18

PART NAME	PART #
Gasket - Flange	1
Throttle Body Assembly	10
Plug - Idle Stop Screw	15
Screw Assembly - Idle Stop	16
Spring - Idle Stop Screw	17
Sensor - Throttle Position (TPS)	20
Screw Assembly - TPS Attaching	21
Retainer - TPS Attaching Screw	22
Cover - Clean Air	41
Screw Assembly - Clean Air Cover Attaching	42
Gasket - Clean Air Cover	43
IACV/Coolant Cover Assembly	61
Screw Assembly - IACV Cover Assembly to Throttle Body	62
Gasket - IACV/Coolant Cover to Throttle Body	63
Valve Assembly - Idle Air Control (IAC)	70
Gasket - IAC Valve Assembly	71

CLEAN AIR COVER AND GASKET

Remove or Disconnect

1. Clean air cover attaching screw assemblies (42).
2. Clean air cover (41).
3. Clean air cover gasket (43).

Clean

- Cover mounting surface to ensure a good seal.

Install and Connect

1. New clean air cover gasket (43) on throttle body assembly (10).
2. Clean air cover (41).
3. Clean air cover attaching screw assemblies (42).

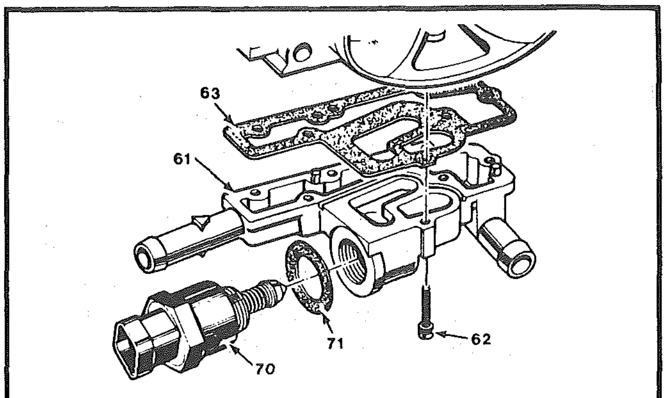


Figure C2-19 Idle Air Control/Coolant Cover Assembly

IDLE AIR CONTROL/COOLANT COVER ASSEMBLY (Figure C2-19) (With Throttle Body Removed From Engine)

Remove or Disconnect

1. Idle air control (IAC) valve assembly (70) from IACV/coolant cover assembly. (See "Idle Air Control Valve and Gasket" instructions.)
2. IACV cover assembly to throttle body screw assemblies (62).
3. Cover assembly (61).
4. Cover assembly to throttle body gasket (63) and discard.

Install or Connect

Clean

- Throttle body gasket mounting surface to ensure a good seal.
- Sealing surface for damage that could prevent sealing properly or cause coolant leak.

Install and Connect

1. New IACV/coolant cover assembly to throttle body gasket (63).
2. IACV/coolant cover assembly (61).
3. IACV cover assembly to throttle body screw assemblies (62).

Tighten

- Screw assemblies to 3.0 N•m (27.0 in. lbs.).

4. IAC valve assembly (70). (See "Idle Air Control Valve and Gasket" instructions).

NOTICE: Before installing the IAC valve assembly, the position of its pintle MUST be checked. If pintle is extended too far, damage to the assembly may occur. (See "Idle Air Control Valve and Gasket" instructions.)

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (see Figure C2-20). Other than checking for loose connectors, the only service possible is replacement.

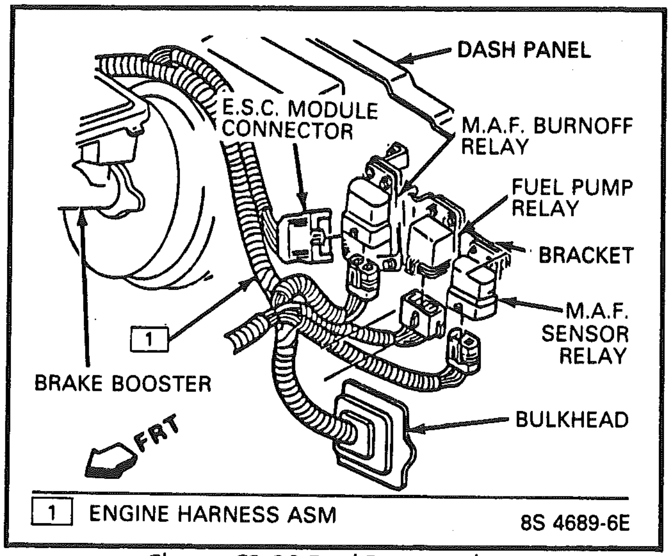


Figure C2-20 Fuel Pump Relay

OIL PRESSURE SWITCH

The oil pressure switch is mounted as shown in Figures C2-21.

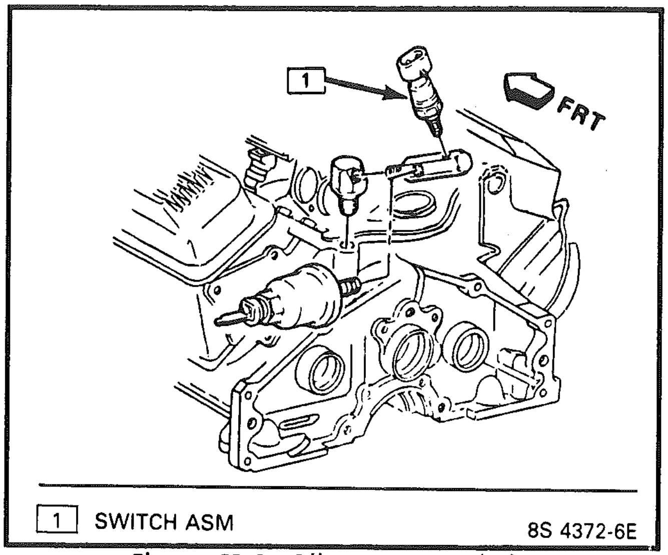


Figure C2-21 Oil Pressure Switch

Remove or Disconnect

1. Electrical connector.
2. Oil pressure switch.

Install or Connect

1. Make sure fittings (41) are properly aligned to allow switch installation.
2. Oil pressure switch.
3. Electrical connector.

PARTS INFORMATION

PART NAME	GROUP
Injector, fuel	3.300
Pump, Fuel (In-Tank)	3.900
Relay, Fuel Pump	3.900
Switch, Oil Pressure	1.800
Valve Asm, Idle Air Control: Part Of Control Kit, Idle Air Valve	3.820
Regulator, Fuel Pressure	3.164
Rail, Fuel Feed	3.330

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CHART C-2A

INJECTOR BALANCE TEST

The injector balance tester is a tool used to turn the injector on for a precise amount of time, thus spraying a measured amount of fuel into the manifold. This causes a drop in fuel rail pressure that we can record and compare between each injector. All injectors should have the same amount of pressure drop (± 10 kPa). Any injector with a pressure drop that is 10 kPa (or more) greater or less than the average drop of the other injectors should be considered faulty and replaced.

STEP 1

Engine "cool down" period (10 minutes) is necessary to avoid irregular readings due to "Hot Soak" fuel boiling. With ignition "OFF" connect fuel gauge J347301 or equivalent to fuel pressure tap. Wrap a shop towel around fitting while connecting gage to avoid fuel spillage.

Disconnect harness connectors at all injectors, and connect injector tester J-34730-3, or equivalent, to one injector. On turbo equipped engines, use adaptor harness furnished with injector tester to energize injectors that are not accessible. Follow manufacturers instructions for use of adaptor harness. Ignition must be "OFF" at least 10 seconds to complete ECM shutdown cycle. Fuel pump should run about 2 seconds after ignition is turned "ON". At this point, insert clear tubing attached to vent valve into a suitable container and bleed air from gauge and hose to insure accurate gauge operation. Repeat this step until all air is bled from gauge.

STEP 2

Turn ignition "OFF" for 10 seconds and then "ON" again to get fuel pressure to its maximum. Record this initial pressure reading. Energize tester one time and note pressure drop at its lowest point (Disregard any slight pressure increase after drop hits low point.). By subtracting this second pressure reading from the initial pressure, we have the actual amount of injector pressure drop.

STEP 3

Repeat step 2 on each injector and compare the amount of drop. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10kPa, either more or less than the average of the other injectors on the engine. Replace any injector that also fails the retest. If the pressure drop of all injectors is within 10kPa of this average, the injectors appear to be flowing properly. Reconnect them and review symptoms, section "B".

NOTE: ***The entire test should not be repeated more than once without running the engine to prevent flooding. (This includes any retest on faulty injectors).***

CHART C-2A

INJECTOR BALANCE TEST 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

NOTE: If injectors are suspected of being dirty, they should be cleaned using an approved tool and procedure prior to performing this test. The fuel pressure test in section "A", CHART A-7, should be completed prior to this test.

Step 1. If engine is at operating temperature, allow a 10 minute "cool down" period then connect fuel pressure gauge and injector tester.

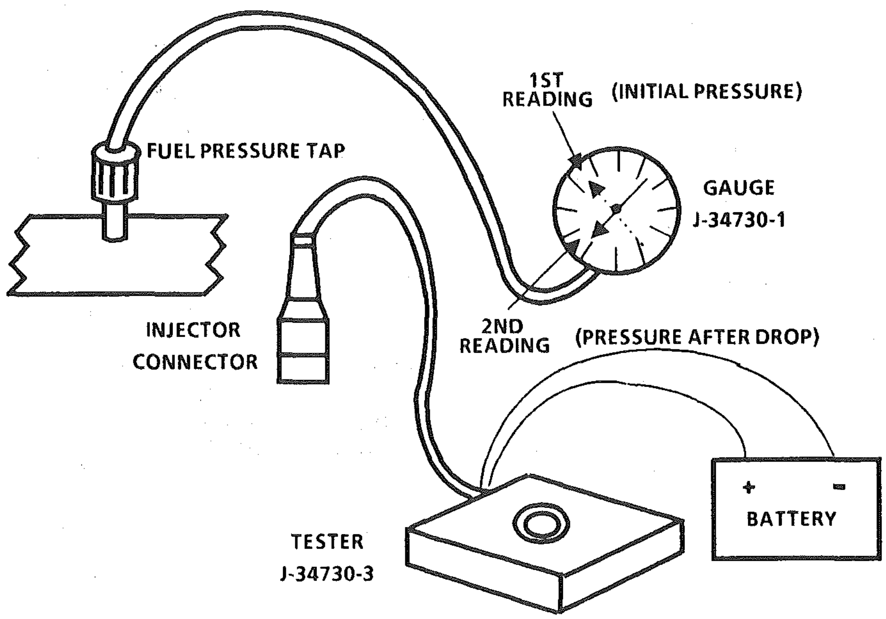
1. Ignition "OFF".
2. Connect fuel pressure gauge and injector tester.
3. Ignition "ON".
4. Bleed off air in gauge. Repeat until all air is bled from gauge.

Step 2. Run test:

1. Ignition "OFF" for 10 seconds.
2. Ignition "ON". Record gauge pressure. (Pressure must hold steady, if not see the fuel system diagnosis, CHART A-7, in section "A").
3. Turn injector "ON", by depressing button on injector tester, and note pressure at the instant the gauge needle stops.

Step 3.

1. Repeat step 2 on all injectors and record pressure drop on each.
   Retest injectors that appear faulty (any injectors that have a 10 kPa difference, either more or less, in pressure from the average). If no problem is found, review symptoms, section "B".



— EXAMPLE —

CYLINDER	1	2	3	4	5	6
1ST READING	225	225	225	225	225	225
2ND READING	100	100	100	90	100	115
AMOUNT OF DROP	125	125	125	135	125	110
	OK	OK	OK	FAULTY, RICH (TOO MUCH) (FUEL DROP)	OK	FAULTY, LEAN (TOO LITTLE) (FUEL DROP)

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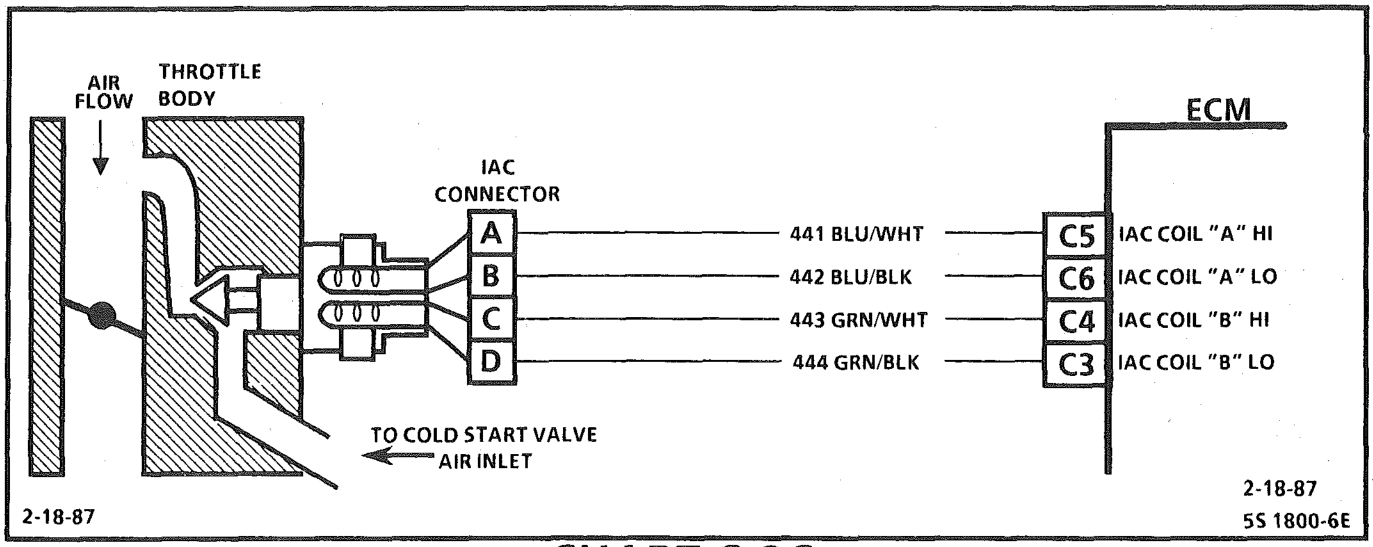


CHART C-2C
IDLE AIR CONTROL (IAC) SYSTEM CHECK
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The ECM will control engine idle speed by moving the IAC valve to control air flow around the throttle plates. It does this by sending voltage pulses to the proper motor winding for each IAC motor. This will cause the motor shaft and valve to move "IN" or "OUT" of the motor a given distance for each pulse received. ECM pulses are referred to as "counts".

- To increase idle speed - ECM will send enough counts to retract the IAC valve and allow more air to flow through the idle air passage and bypass the throttle plates until idle speed reaches the proper rpm. This will increase the ECM counts.
- To decrease idle speed - ECM will send enough counts to extend the IAC valve and reduce air flow through the idle passage around the throttle plates. This will reduce the ECM counts.

Each time the engine is started and then the ignition is turned "OFF", the ECM will reset the IAC valve. This is done by sending enough counts to seat the valve. The fully seated valve is the ECM reference zero. A given number of counts are then issued to open the valve, and normal ECM control of IAC will begin from this point. The number of counts are then calculated by the ECM. This is how the ECM knows what the motor position is for a given idle speed.

The ECM uses the following information to control idle speed.

- Battery voltage
- Engine speed
- Coolant temperature
- Throttle position sensor
- P/N switch
- A/C clutch signal

Don't apply battery voltage across the IAC motor terminals. It will permanently damage the IAC motor windings.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Continue with test, even if engine will not idle. If idle is too low, "Scan" will display 80 or more counts, or steps. If idle is high, it will display "0" counts.
   Occasionally an erratic or unstable idle may occur. Engine speed may vary 200 rpm or more up and down. Disconnect IAC. If the condition is unchanged, the IAC is not at fault. There is a system problem. Proceed to "Diagnostic Aids" below.
2. When the engine was stopped, the IAC valve retracted (more air) to a fixed "Park" position for increased air flow and idle speed during the next engine start. A "Scan" will display 140 or more counts.
3. Be sure to disconnect the IAC valve prior to this test. The test light will confirm the ECM signals by a steady or flashing light on all circuits.
4. There is a remote possibility that one of the circuits is shorted to voltage which would have been indicated by a steady light. Disconnect ECM and turn the ignition "ON" and probe terminals to check for this condition.

Diagnostic Aids:

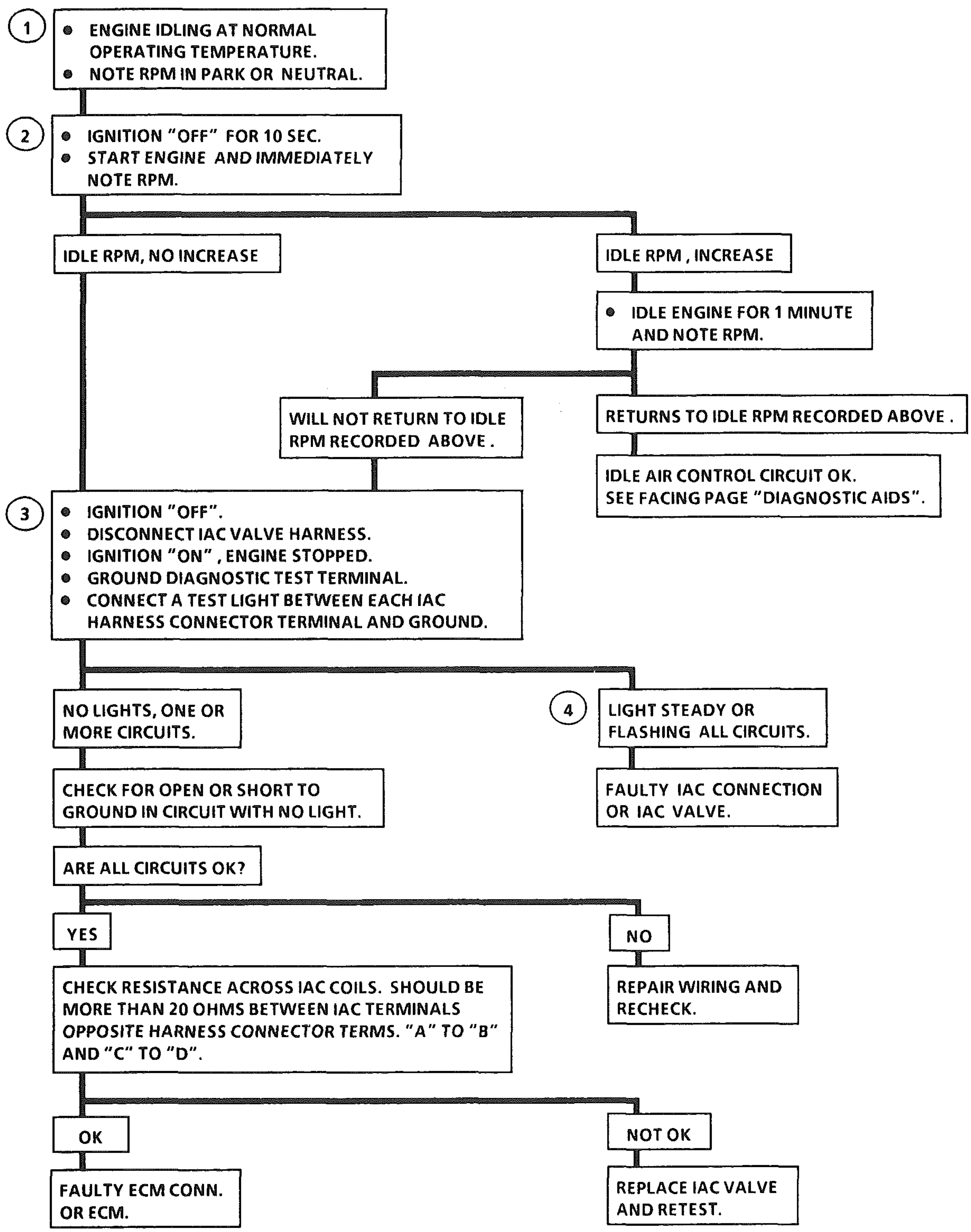
Engine idle speed can be adversely affected by the following:

- Park/Neutral switch - If ECM thinks the car is always in neutral, then idle will not be controlled to the specified rpm when in drive range.
- Leaking injector(s) will cause fuel imbalance and poor idle quality due to excess fuel. See CHT. A-7.
- Vacuum or crankcase leaks can affect idle.
- When the throttle shaft or throttle position sensor is binding or sticking in an open throttle position, the ECM does not know if the vehicle has stopped and does not control idle.
- Check A.I.R. management system for intermittent air to ports while in "Closed Loop".
- In addition to electrical control of EGR, be sure to examine the EGR valve for proper seating.
- Faulty battery cables can result in voltage variations. The ECM will try to compensate, which results in erratic idle speeds.
- The ECM will compensate for A/C compressor clutch loads. Loss of the A/C request signal would be most apparent in neutral.
- Contaminated fuel can adversely affect idle.
- Perform injector balance test CHART C-2A.

If all OK, refer to "Rough, Unstable, Incorrect Idle or Stalling" symptoms in Section "B".

CHART C-2C

IDLE AIR CONTROL (IAC)SYSTEM CHECK
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C3
EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The basic evaporative emission control system (EECS) used on all vehicles is the charcoal canister storage method. This method transfers fuel vapor from the fuel tank to an activated carbon (charcoal) storage device (canister) to hold the vapors when the vehicle is not operating. When the engine is running, the fuel vapor is purged from the carbon element by intake air flow and consumed in the normal combustion process.

VAPOR CANISTER

Gasoline vapors from the fuel tank flow into the tube labeled tank. Any liquid fuel goes into a reservoir in the bottom of the canister to protect the integrity of the carbon bed above (Figure C3-1). These vapors are absorbed into the carbon. The canister is purged when the engine is running above idle speed. Ambient air is allowed into the canister through the air tube in the top. The air mixes with the vapor and the mixture is drawn into the intake manifold.

EVAPORATIVE EMISSION SYSTEM

The canister is equipped with a normally closed solenoid to control canister purge. The ECM operates the solenoid which controls vacuum to the purge valve in the charcoal canister. Under cold engine or idle conditions, the solenoid is turned "OFF" by the ECM, which closes the solenoid and blocks vacuum to the canister purge valve.

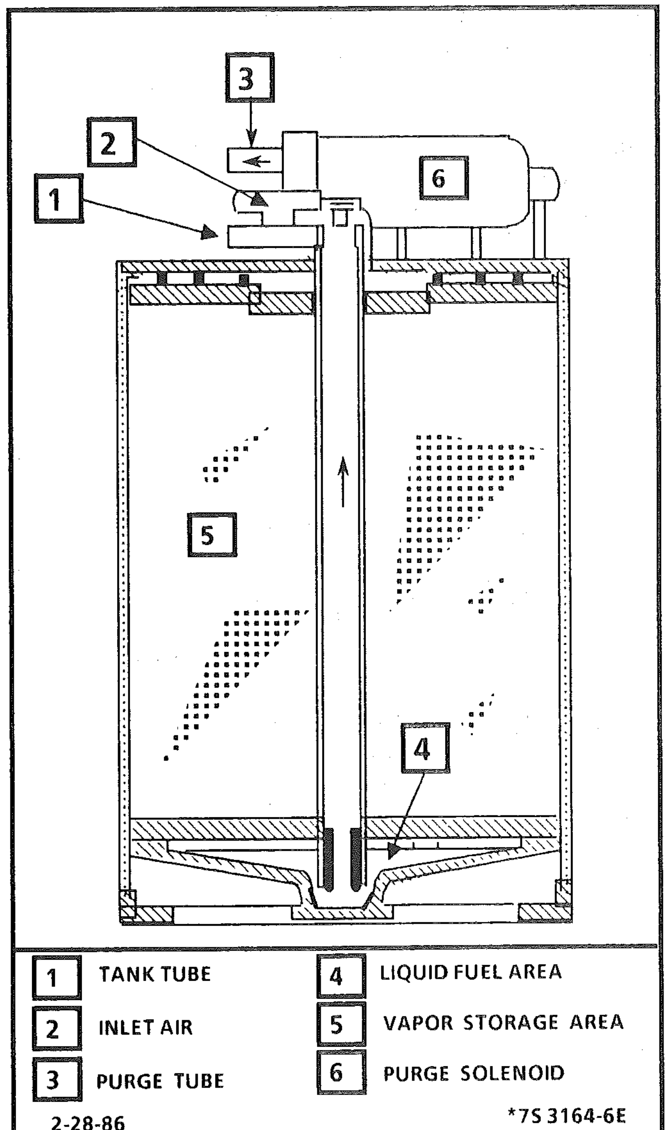


Figure C3-1 - Inverted Function Vapor Canister - With Encapsulated Purge Solenoid

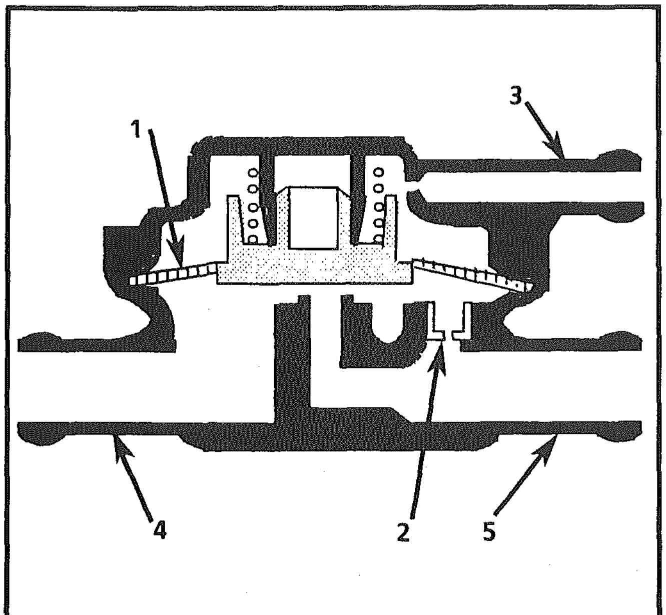
The ECM turns "ON" the solenoid valve and allows purge when:

- Above a specified road speed.
- Engine is warm
- After the engine has been running a specified time.
- Above a specified throttle opening.

This is an ECM feedback system that increases purge until the ECM senses a rich condition from the O_2 sensor. The purge is then regulated until the ECM no longer receives a rich signal from the O_2 sensor. This system uses an in-tank pressure control valve to control the flow of vapors from the fuel tank to the canister.

IN-TANK PRESSURE CONTROL VALVE

The in-tank pressure control valve, a combination roll-over, integral pressure and vacuum relief valve, is located with the fuel sending unit in the fuel tank. When vapor pressure in the tank exceeds 1" Hg (5 kPa) the valve opens and allows vapors to vent to the canister and then be purged. When the tank pressure drops below the opening point of the valve it will close, keeping vapors in the fuel tank. The valve provides vacuum relief to protect against vacuum build up in the fuel tank and roll-over protection to prevent liquid fuel from entering the canister during normal driving maneuvers.



1 DIAPHRAGM
2 VENT RESTRICTION
3 CONTROL VACUUM TUBE
4 TUBE TO FUEL TANK
5 TUBE TO CANISTER

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Figure C3-2 Fuel Tank Pressure Control Valve

RESULTS OF INCORRECT OPERATION

Poor idle, stalling and poor driveability can be caused by:

- Inoperative purge solenoid
- Damaged canister
- Hoses split, cracked and, or not connected to the proper tubes.

Evidence of fuel loss or fuel vapor odor can be caused by:

- Liquid fuel leaking from fuel lines.
- Cracked or damaged canister
- Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses.

DIAGNOSIS

The canister purge solenoid operation is covered in the charts at the end of this section.

VISUAL CHECK OF CANISTER

Cracked or damaged , replace canister.

FUNCTIONAL TEST

Vapor Canister Purge Valve

Apply a short length of hose to the lower tube of purge valve, and atempt to blow through it. Little or no air should pass into the canister. (A small amount of air will pass if the canister has a constant purge hole).

With hand vacuum pump, apply vacuum (15" Hg or 51 kPa) through the control valve tube (upper tube). The diaphragm should hold vacuum for at least 20 seconds. If not the canister must be replaced. If the diaphragm holds vacuum, again try to blow through the hose connected to the lower tube while vacuum is still being applied. An increased flow of air should be observed. If not, the canister must be replaced.

Tank Pressure Control Valve

With a hand vacuum pump apply vacuum (15" or 51 kPa) to the control vacuum tube. The diaphragm should hold vacuum for at least 20 seconds. If it does not hold vacuum the diaphragm is leaking and the valve must be replaced.

With the vacuum still applied to the control vacuum tube, apply a short hose to the valve's tank tube side, blow into the tube. You should feel the air pass through the valve. If the air does not pass through, the valve should be replaced.

ON-CAR SERVICE

FUEL VAPOR CANISTER

Remove or Disconnect

1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

Install or Connect

1. Canister as removed.
2. Hoses. Make sure connections are correct.

CANISTER HOSES

Refer to Vehicle Emission Control Information Label for routing of canister hoses.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130
Solenoid, Fuel Vapor Canister	3.140
Valve, Fuel Tank Pressure Control	3.140

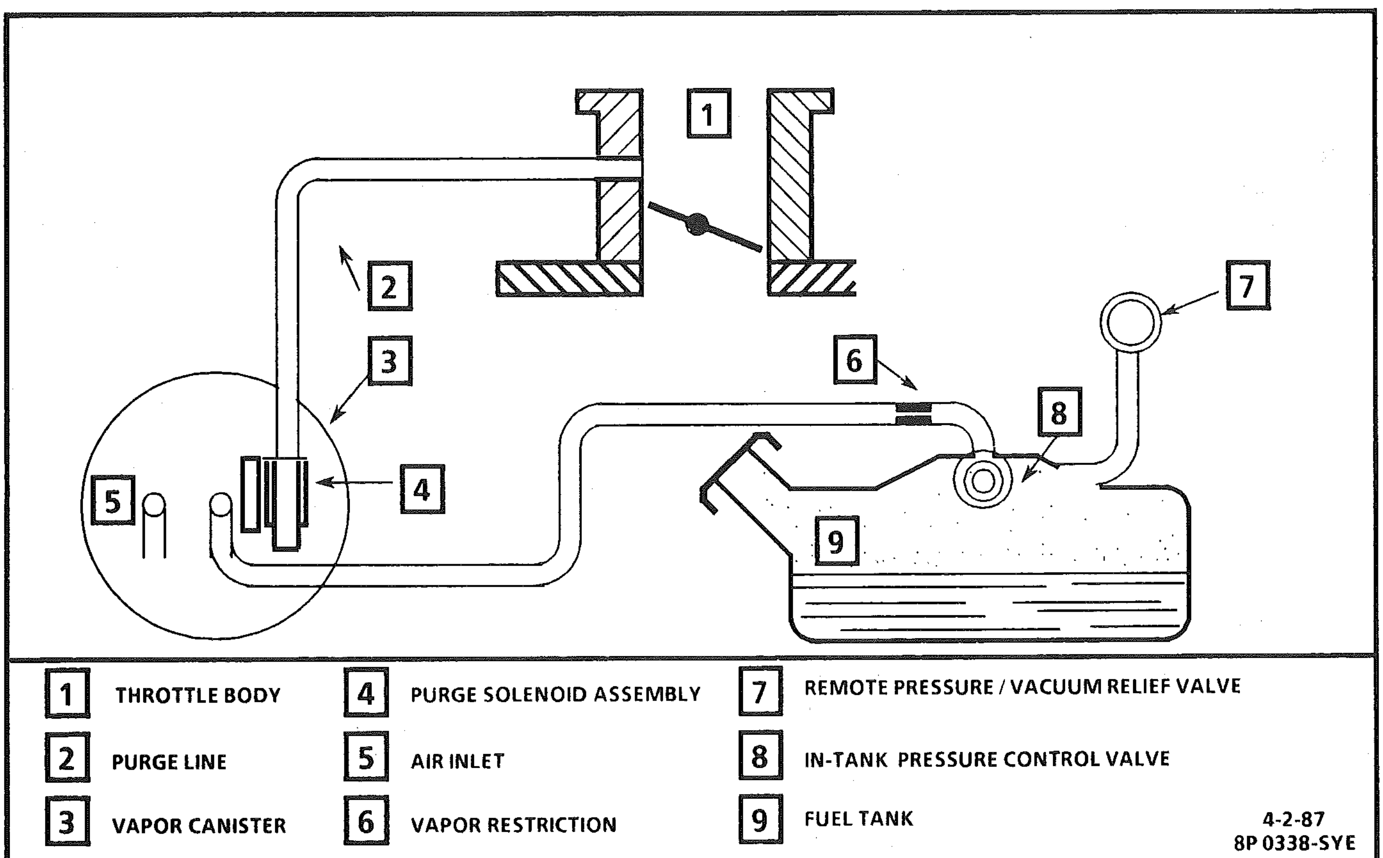


Figure C3-3 - Evaporative Emissions Control System Schematic

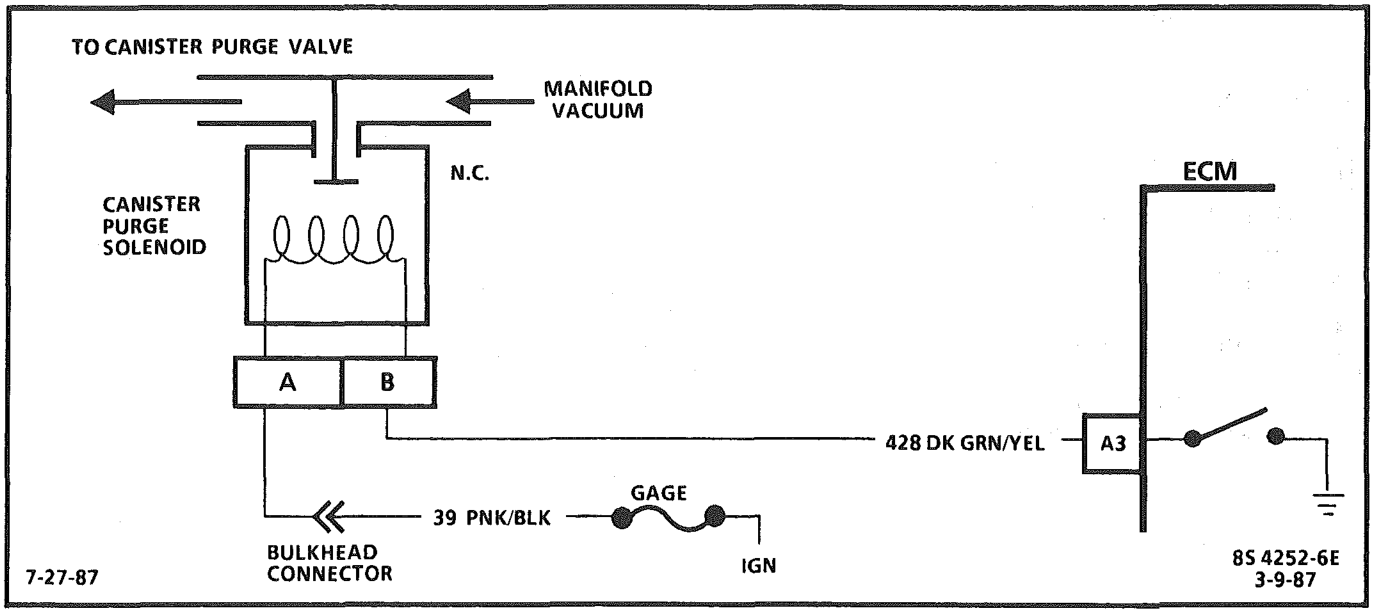


CHART C-3

CANISTER PURGE SOLENOID CHECK
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

Canister purge is controlled by a solenoid that allows manifold vacuum to purge the canister when de-energized. The ECM supplies a ground to energize the solenoid (purge "ON").

If the diagnostic test terminal is grounded, with the engine stopped, or the following conditions are met with the engine running, the purge solenoid will be energized (purge "ON").

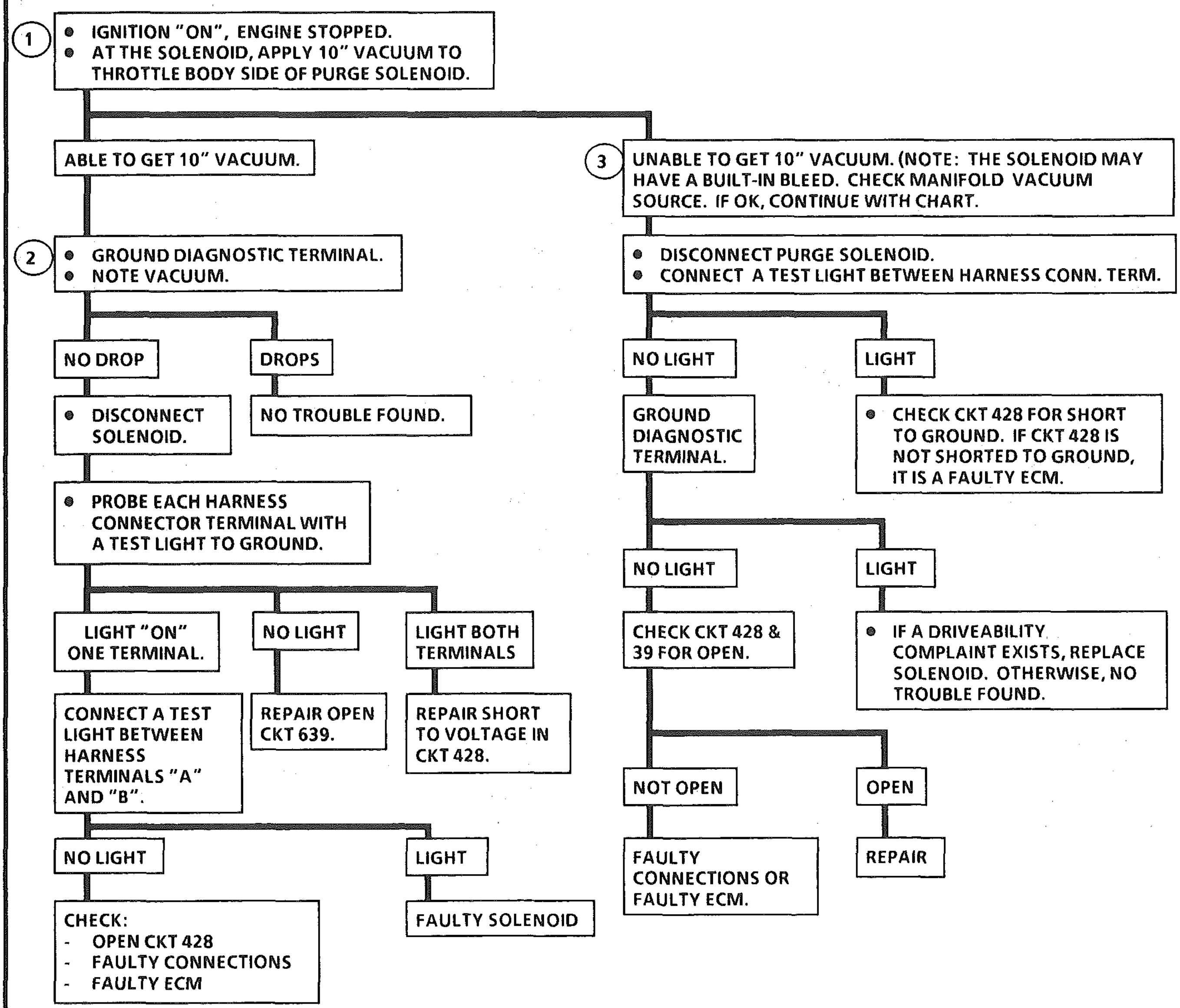
- Engine run time after start more than 1 minute.
- Coolant temperature above 75°C.
- Vehicle speed above 15 mph.
- Throttle position is above idle.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. The external vacuum source must be applied to the purge solenoid at the canister.
2. Grounding the diagnostic terminal will energize the solenoid and allow vacuum to pass.
3. Some solenoids may have a large enough bleed built into them to appear to be operating incorrectly.

CHART C-3

CANISTER PURGE SOLENOID CHECK
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C4

IGNITION SYSTEM / EST

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The high energy ignition (HEI) system controls fuel combustion by providing a spark to ignite the compressed air/fuel mixture at the correct time. To provide improved engine performance, fuel economy, and control of exhaust emissions, the ECM controls distributor spark advance (timing) with the electronic spark timing (EST) system.

Only the electronic spark timing (EST) system will be described here. Additional information on the HEI system is found in Section "6D".

To properly control ignition/combustion timing the ECM needs to know:

- Crankshaft position
- Engine speed (rpm)
- Mass Air Flow
- Engine temperature

OPERATION

The EST system consists of the distributor module, ECM, and connecting wires. The connector terminals are lettered as shown in CHART C-4.

These circuits perform the following functions:

- Distributor reference (CKT 430).

This provides the ECM with rpm and crankshaft position information. If the wire becomes open or grounded the engine will not run, because the ECM will not operate the injectors. If the engine cranks but won't run, see CHART A-3.

- Reference ground (CKT 453).

This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop which could affect performance. If it is open, it may cause poor performance.

- Bypass (CKT 424).

At about 400 rpm, the ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. The wire goes through a connector between the 4 wire connector and the ECM. This is disconnected to the set base timing.

An open or grounded bypass circuit will set a Code 42 and the engine will run at base timing, plus a small amount of advance built into the HEI module.

- EST (CKT 423).

This circuit triggers the HEI module after the engine is started and no Code 42 detected. The ECM does not know what the actual timing is, but it does know when it gets the reference signal. It then advances or retards the spark from that point. Therefore, if the base timing is set incorrectly, the entire spark curve will be incorrect.

RESULTS OF INCORRECT OPERATION

An open or ground in the EST circuit will set a Code 42 and cause the engine to run on the HEI module timing. This will cause reduced performance and poor fuel economy.

The ECM uses information from the MAF and coolant sensors in addition to rpm to calculate spark advance as follows:

- Cold engine = more spark advance.
- Engine under minimum load based on rpm and low amount of air flow- more spark advance.
- Hot engine = less spark advance.
- Engine under heavy load based on rpm and high amount of air flow- less spark advance.

DIAGNOSIS

The description, operation, and repair procedures of the HEI system are found in Section "6D" of this manual. For an ignition system check, refer to CHART C-4 at the end of this section.

CODE 12

Code 12 is used during the diagnostic circuit check procedure to test the code display ability of the ECM. This code indicates that the ECM is not receiving the engine rpm (REFERENCE) signal. This occurs with the ignition key "ON", and the engine not running.

The "Reference" signal also triggers the fuel injection system. Without the "Reference" signal the engine cannot run. This signal can be checked by using a "Scan" tool which will help determine the cause of an engine that cranks but won't start.

ON-CAR SERVICE

SETTING TIMING

The initial base timing is set by disconnecting the timing connector. Then set the timing to the specification shown on emmision control information label. This will cause Code 42 to be stored in the memory of the ECM. The memory must be cleared after setting timing.

How Code 42 Is Determined

When the system is running on the HEI module, that is, no voltage on the bypass line, the HEI module grounds the EST signal. The ECM expects to see no voltage on the EST line during this condition. If it sees a voltage, it sets code 42 and will not go into the EST mode.

When the rpm for EST is reached, (about 400 rpm), the ECM applies 5 volts to the bypass line and the EST should no longer be grounded in the HEI module, so the EST voltage should be varying.

If the bypass line is open or grounded, the HEI module will not switch to EST mode, so the EST voltage will be low and Code 42 will be set.

PARTS INFORMATION

PART NAME	GROUP
Coil, Distr	2.170
Controller, ECM (Remanufactured)	3.670
Distributor	2.361
Module, Distr	2.383

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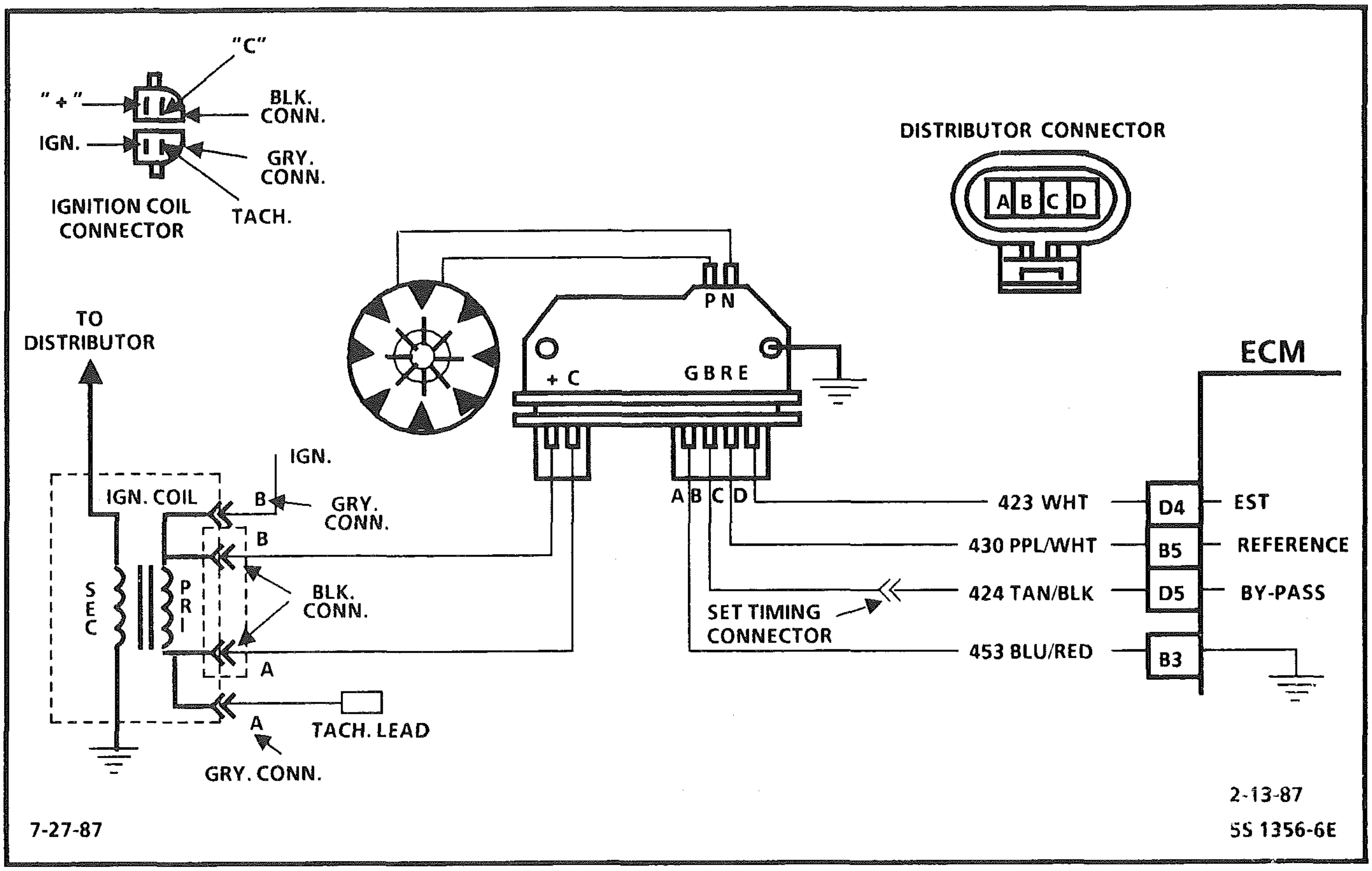

CHART C-4

IGNITION SYSTEM CHECK
(INTEGRAL COIL)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Checks for proper output from the ignition system. The spark tester requires a minimum of 25,000 volts to fire. This check can be used in case of an ignition miss because the system may provide enough voltage to run the engine but not enough to fire a spark plug under heavy load.

1A. If spark occurs with EST connector disconnected, pick-up coil output is too low for EST operation.

2. Normal reading during cranking is about 8-10 volts.
3. Checks for a shorted module or grounded circuit from the ignition coil to the module. The distributor module should be turned "OFF", so normal voltage should be about 12 volts. If the module is turned "ON", the voltage would be low, but above 1 volt. This could cause the ignition coil to fail from excessive heat. With an open ignition coil primary winding, a small mount of voltage will leak through the module from the battery to the tach. terminal.
4. Checks the voltage output with the pick-up coil triggering the module. A spark indicates that the ignition system has sufficient output, however, intermittent no-starts or poor performance could be the result of incorrect polarity between the ignition coil and the pick-up coil.

   The color of the pick-up coil connector has to be yellow, if one of the ignition coil leads is yellow. If the ignition coil has a white lead, any pick-up coil connector color, except yellow, is OK.
5. Checks for an open module or circuit to it. 12 volts applied to the module "P" terminal should turn the module "ON" and the voltage should drop to about 7-9 volts.
6. This should turn "OFF" the module and cause a spark. If no spark occurs, the fault is most likely in the ignition coil, because most module problems would have been found before this point in the procedure. A module tester could determine which is at fault.

CHART C-4
IGNITION SYSTEM CHECK
(INTEGRAL COIL)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

(1)
- Perform Diagnostic Circuit Check before proceeding with this test. (If a tachometer is connected to the Tach term., disconnect it before proceeding with the test).
- Check spark at plug with spark tester J-26792 or equivalent (ST-125) while cranking (if no spark on one wire, check a second wire) A few sparks and then nothing is considered no spark.

- **No Spark** →
  - **(1A)** Disconnect 4 term. distributor connector and check for spark.
    - **No spark** → **(2)** Check for spark at coil wire with tester while cranking. (Leave spark tester connected to coil wire for Steps 3-6).
      - **No Spark** → **(3)**
        - Disconnect distributor 2 term. "C / +" connector.
        - Ignition switch "on", Engine stopped.
        - Check volts at " + " and "C" term's. of dist. harn. conn.
          - **Both term's. 10 volts or more** → **(4)**
            - Reconnect dist. 2 term. conn.
            - With ign. "ON", check voltage from tach. term. to gnd. (term. may be taped back in harness).
              - **Over10 volts** →
                - Connect test light from tach. term. to ground.
                - Crank engine and observe light.
                  - **Light on steady** → **(5)**
                    - Disconnect distributor 4 term. connector.
                    - Remove dist. cap.
                    - Disconnect pick-up coil connector from module.
                    - Connect voltmeter from tach. term. to ground.
                    - Ignition on.
                    - Insulate a test light probe to 1/4" from tip and note voltage, as test light is momentarily connected from a voltage source (1.5 to 8V) to module term. "P". (Fig. 1).
                      - **Voltage drops** → **(6)** Check for spark from coil wire with spark tester as test light is removed from module term.
                        - **No Spark** →
                          - If no module tester (J24642) is available; Replace ign. coil and repeat Step 5.
                            - **No Spark** → Ign. coil removed is OK, reinstall coil and check coil wire from dist. cap. if OK, replace dist. module.
                            - **Spark** → System OK
                          - If module tester (J24642) is available: test module
                            - **OK** → Check coil wire from cap to coil. If OK, replace coil.
                            - **Not OK** → Replace module
                        - **Spark** → Is rotating pole piece still magnetized?
                          - **Yes** → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
                          - **No** → Replace pole piece and shaft assy.
                      - **No drop in voltage** → Check module ground. If OK, replace module.
                  - **Light blinks** → Replace ignition coil and recheck for spark with spark tester. If still no spark, re-install original coil and replace dist. module..
              - **Under 1 volt** → Repair open tach. lead or conn and repeat test #4.
              - **1 to 10 volts** → Replace module and check for spark from coil as in Step 6.
                - **Spark** → System OK
                - **No Spark** → Replace ign. coil, it too is faulty
          - **Both term's. under 10 volts** → Repair wire from module " + " term. to "B" term. of black Ign. coil connector or primary ckt. to ign. sw.
          - **Under 10 volts "C" term. only** → Check for open or gnd. in ckt. from "C" term. to ign. coil. If Ckt. is OK, fault is. ign. coil or conn..
      - **Spark** → Inspect cap for water, cracks, etc. If OK, replace rotor.
    - **Spark** → Replace pick-up coil
- **Spark** → Check fuel,spark plugs, etc. See section "B" symptoms.

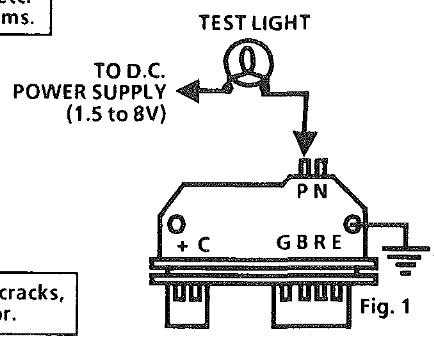

Fig. 1

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SECTION C5

ELECTRONIC SPARK CONTROL (ESC) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

Varying octane levels in today's gasoline can cause detonation in high performance engines. Detonation is sometimes called spark knock.

To control spark knock, an electronic spark control (ESC) system has been added. This system is designed to retard spark timing up to 20°, if necessary, to reduce spark knock in the engine. This allows the engine to use maximum spark advance to improve driveability and fuel economy.

GENERAL DESCRIPTION

The ESC system has two major components:

- ESC module
- ESC knock sensor

The ESC knock sensor detects abnormal vibration (spark knocking) in the engine. The sensor is mounted in the engine block near the cylinders. The ESC module receives the knock sensor information and sends a signal to the ECM. The ECM then adjusts the electronic spark timing (EST) to reduce spark knocking.

The ESC module sends a voltage signal (8 to 10 volts) to the ECM when NO spark knock is detected by the knock sensor, and the ECM provides normal spark advance.

When the knock sensor detects spark knock, the module turns "OFF" CKT 485 to the ECM. The ECM then retards EST to reduce spark knock.

Loss of the ESC knock sensor signal or loss of ground at ESC module terminal "D" would cause the signal on CKT 485 to the ECM to remain high. This condition would cause the ECM to control EST as if no spark knock was occuring. No retard would occur, and spark knock could become severe under heavy engine load conditions. This condition should, however, cause a Code 43 to set.

Loss of the ESC signal to the ECM would cause the ECM to constantly retard EST. This will result in sluggish performance and set a Code 43.

DIAGNOSIS

Code 43 indicates that the ECM terminal "B7" is receiving less than 6 volts for a 4 second period with the engine running. This is CKT 485, which normally provides a 8 to 10 volt signal from the ESC module to the ECM. See Code 43 CHART for diagnosis if the code is present.

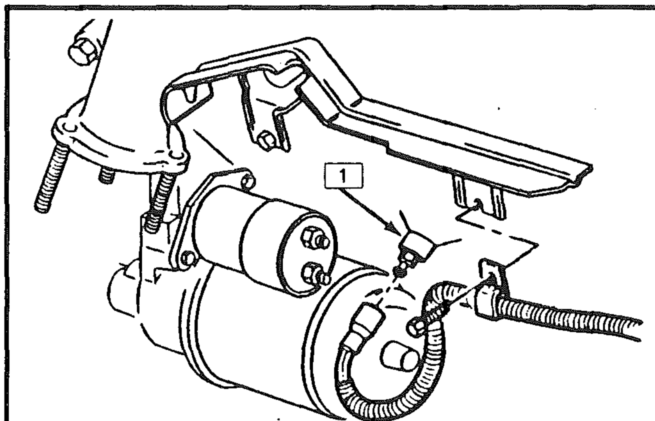
When no Code 43 is present but the ESC system is a potential cause of excessive spark knock, see CHART C-5 which follows.

ON-CAR SERVICE

ESC SENSOR

←→ Remove or Disconnect

1. Negative battery cable.
2. Raise car.
3. ESC wiring harness connector from ESC sensor.
4. ESC sensor from engine block.



1 KNOCK SENSOR
14 FT. LBS. (19 N·m)

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Figure C5-1 ESC Sensor

Install or Connect

1. ESC sensor into engine block.
   - Tighten to 14 ft. lbs. (19 N·m).
2. ESC wiring harness connector to the ESC sensor.
3. Lower car.
4. Negative battery cable.

ESC MODULE AND BRACKET

Refer to Figure C5-2 for ESC module replacement.

PARTS INFORMATION

PART NAME	GROUP
Bracket, Elek Spark Cont Mdl	2.383
Module, Elek Spark Cont	2.383
Sensor, ESC Knock	2.383
Shield, Elek Spark Cont Knock	2.383

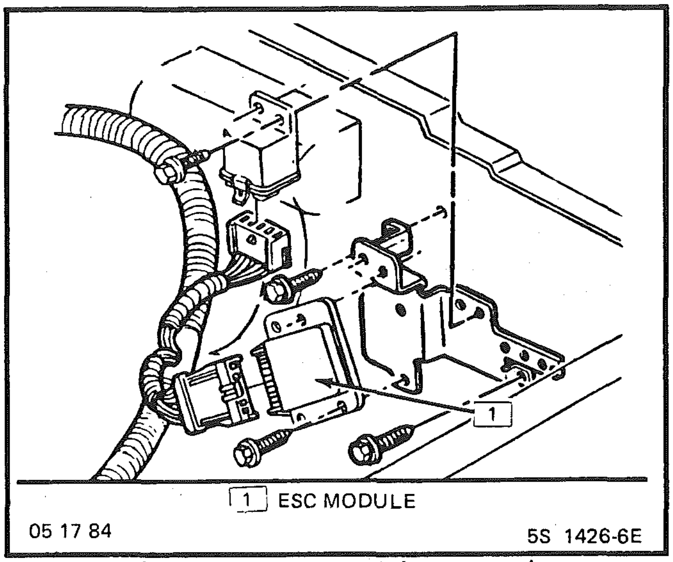

Figure C5-2 ESC Module Removal

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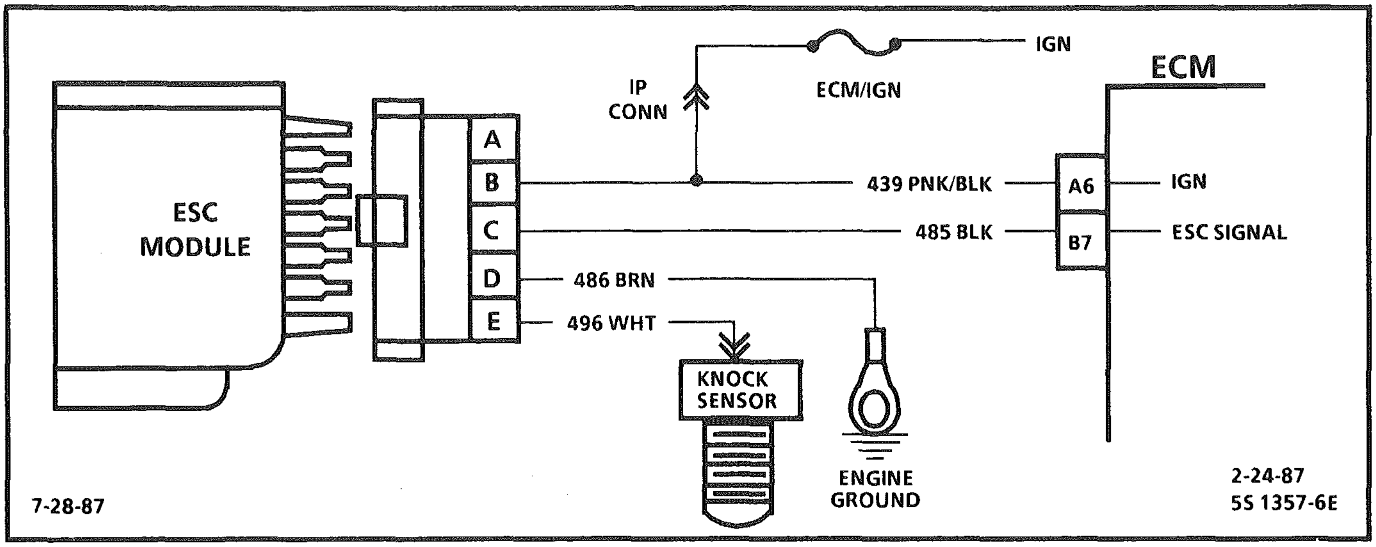

CHART C-5

ELECTRONIC SPARK CONTROL
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

Electronic spark control is accomplished with a module that sends a voltage signal to the ECM. As the knock sensor detects engine knock, the voltage from the ESC module to the ECM is shut "OFF" and this signals the ECM to retard timing, if engine rpm is over about 900.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. If a Code 43 is not set, but a knock signal is indicated while running at 1500 rpm, listen for an internal engine noise. Under a no load condition, there should not be any detonation, and if knock is indicated, an internal engine problem may exist.
2. Usually a knock signal can be generated by tapping on the right exhaust manifold. This test can also be performed at idle. Test number 1 was run at 1500 rpm to determine if a constant knock signal was present, which would affect engine performance.
3. This tests whether the knock signal is due to the sensor, a basic engine problem, or the ESC module.
4. If the module ground circuit is faulty, the ESC module will not function correctly. The test light should light indicating the ground circuit is OK.
5. Contacting CKT 496, with a test light to 12 volts, should generate a knock signal to determine whether the knock sensor is faulty, or the ESC module can't recognize a knock signal.

Diagnostic Aids:

"Scan" tools have two positions to diagnose the ESC system. The knock signal can be monitored to see if the knock sensor is detecting a knock condition and if the ESC module is functioning, knock signal should display "YES", whenever detonation is present. The knock retard position on the "Scan" displays the amount of spark retard the ECM is commanding. The ECM can retard the timing up to 20 degrees.

If the ESC system checks OK, but detonation is the complaint, refer to "Detonation/Spark Knock" in Section "B".

CHART C-5

ELECTRONIC SPARK CONTROL
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

THIS CHART SHOULD BE USED AFTER ALL OTHER CAUSES OF SPARK KNOCK HAVE BEEN CHECKED. I.E., TIMING, EGR, ENGINE TEMPERATURE OR EXCESSIVE ENGINE NOISE,ETC. IF CODE 43 IS SET, USE THAT CHART FIRST.

1
- IF A CODE 43 WAS SET USE THAT CHART FIRST. THIS CHART ASSUMES CODE 43 IS NOT PRESENT.
- "SCAN" TOOL SET ON KNOCK SIGNAL.
- ENGINE RUNNING AT ABOUT 1500 RPM.
- IS THERE A KNOCK SIGNAL INDICATED?

NO → 2
- ENGINE RUNNING AT 1500 RPM.
- TAP ENGINE BLOCK IN AREA OF KNOCK SENSOR.
- DOES "SCAN" INDICATE A KNOCK SIGNAL WHILE TAPPING ON ENGINE?

YES → 3
- DISCONNECT KNOCK SENSOR.
- REPEAT TEST.
- IS THERE A KNOCK SIGNAL INDICATED?

(3) YES: CHECK FOR ROUTING OF WIRE FROM KNOCK SENSOR TO ESC MODULE FOR PICKING UP FALSE KNOCK SIGNALS FROM AN ADJACENT WIRE. REROUTE AS NECESSARY. IF ROUTING IS CORRECT, REPLACE ESC MODULE.

(3) NO: INTERNAL ENGINE KNOCK OR FAULTY SENSOR.

(2) YES: ESC SYSTEM OK.

(2) NO → 4
- DISCONNECT ESC MODULE.
- PROBE HARNESS TERMINAL "D" (CKT 486) WITH A TEST LIGHT TO 12 V.

(4) LIGHT "OFF": REPAIR OPEN GROUND CKT 486.

(4) LIGHT "ON" → 5
- RECONNECT ESC MODULE.
- DISCONNECT KNOCK SENSOR.
- ENGINE IDLING.
- MOMENTARILY TOUCH KNOCK SENSOR HARNESS (CKT 496) WITH A TEST LIGHT TO 12V.
- EACH TIME THE TEST LIGHT CONTACTS CKT 496, A KNOCK SIGNAL SHOULD BE GENERATED.
- IS A KNOCK SIGNAL INDICATED WITH "SCAN"?

(5) YES: FAULTY CONNECTION AT SENSOR OR FAULTY KNOCK SENSOR.

(5) NO: CKT 496 OPEN, SHORTED TO GROUND, FAULTY CONNECTION AT ESC MODULE, OR FAULTY ESC MODULE.

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SECTION C6

AIR INJECTION REACTION (A.I.R.) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The A.I.R. system helps reduce hydrocarbon (HC), carbon monoxide (CO), and oxides of nitrogen (NO_x) exhaust emissions. It also heats up the catalytic converter quickly on engine start-up so conversion of exhaust gases can occur sooner.

A dual bed converter is used. It consists of a three way catalyst (which controls all three emissions) in series with a two way catalyst (which controls only HC and CO) both are in one housing. A pipe between the two converters allows air to be injected into the second (two way) converter to increase its efficiency to further control HC and CO (Figure C6-1).

As shown in Figure C6-1, air can be directed to:

- A divert silencer.
- Exhaust ports; or
- Catalytic converter.

OPERATION

The system (Figure C6-1) includes:

- An Air Pump
  The air pump is driven by a belt on the front of the engine and supplies the air to the system. Intake air passes through a centrifugal filter fan at the front of the pump; where foreign materials are separated from the air by centrifugal force.
- A Control Valve (PEDES)
  Air flows from the pump through an ECM controlled valve (called a PEDES valve) through check valves to either the exhaust ports or the converter.
- Check Valves
  The check valves prevent back flow of exhaust into the pump in the event of an exhaust backfire or pump drive belt failure.
- Necessary Plumbing

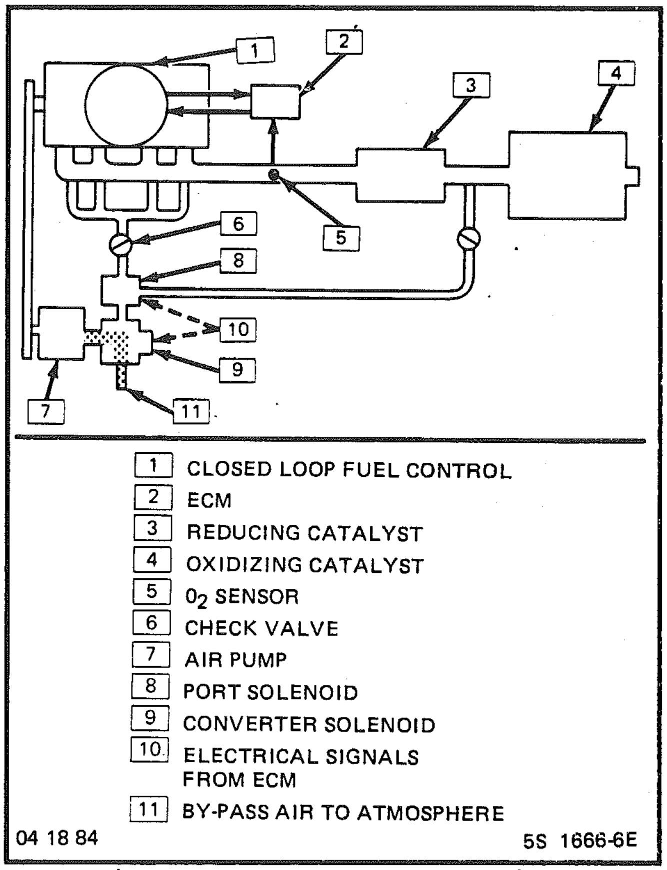

Figure C6-1 - A.I.R. System Operation

AIR CONTROL PEDES VALVE

Pressure operated electric divert/electric air switching (PEDES) valves are used on these engines. The diverting and switching functions are electronically controlled by the ECM,which grounds to complete the circuit and energize the solenoid. Self-generated pressure from the A.I.R. pump is used to operate the valve, which is completely independent of manifold vacuum.

Air enters the body of the valve from the pump. Air pressure builds against the control valve and for:

- Cold Mode - The port solenoid is energized which in turn opens the port valve and allows flow to the exhaust ports.
- Warm Mode - The port solenoid is de-energized and the converter solenoid energized which closes the port valve and keeps the converter valve seated, thus forcing flow past the converter valve and to the converter.
- Divert Mode - Both solenoids are de-energized which opens the converter valve, allowing air to take the path of least resistance, i.e., out the divert/relief tube to atmosphere.

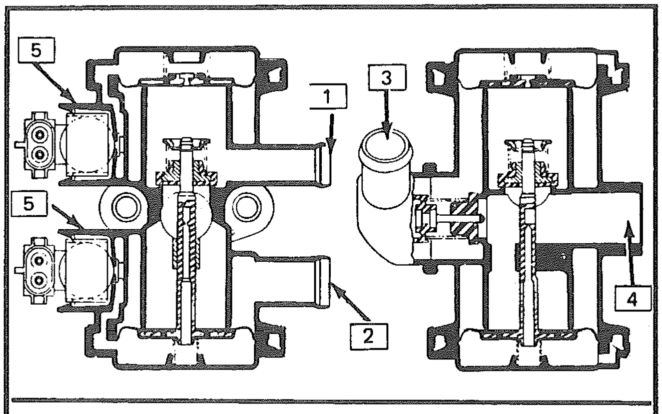

Figure C6-2 - A.I.R. System Control Valve

Air is diverted to the atmosphere under the following conditions:

- Rich operation.
- When the ECM recognizes a problem and sets a trouble code.
- During deceleration.
- During high rpm operation when air pressure is greater than the setting for the internal relief valve.

RESULTS OF INCORRECT OPERATION

If no air (oxygen) flow enters the exhaust stream at the exhaust ports, HC and CO emission levels will be too high.

Air flowing to the exhaust ports at all times could increase temperature of the converter.

Air flowing at all times to the catalytic converter may cause converter overheating during rich operation.

Mechanical failures in the valves could cause the air to flow incorrectly to the exhaust ports or the converter.

Electrical failure (open circuit) of the control valve will divert air flow overboard at all times. Air will flow to the converter at all times if an open circuit occurs to the switching valve (converter solenoid).

DIAGNOSIS

The diagnosis of the AIR system is covered in CHART C-6 at the end of this section.

OPERATIONAL CHECKS

Air Pump

The air pump is a positive displacement vane type which is permanently lubricated and requires no periodic maintenance.

Accelerate engine to approximately 1500 rpm's and observe air flow from hose(s). If air flow increases as engine is accelerated, pump is operating satisfactorily. If air flow does not increase or is not present, proceed as follows:

Inspect

1. For proper drive belt tension.
2. For a leaky pressure relief valve. Air may be heard leaking with the pump running.

NOTICE: If the engine or underhood compartment is to be cleaned with steam or high-pressure detergent, the centrifugal filter fan should be masked off to prevent liquids from entering the pump (see Figure C6-3).

NOTICE: The AIR system is not completely noiseless. Under normal conditions, noise rises in pitch as engine speed increases. To determine if excessive noise is the fault of the air injection reactor system, operate the engine with the pump drive belt removed. If excessive noise does not exist with the belt removed proceed as follows:

Inspect

3. For a seized air injection pump.
4. Hoses, tubes and all connections for leaks and proper routing.
5. For air flow from control/switching valve.
6. AIR injection pump for proper mounting and bolt torque.
7. If no irregularities exist and the AIR injection pump noise is still excessive, remove and replace pump.

CAUTION: **Do Not Oil Pump**

Hoses and Pipes

Inspect

1. Hose or pipe for deterioration or holes.
2. All hoses or pipe connections, and clamp tightness.
3. Hose or pipe routing. Interference may cause wear.
4. If a leak is suspected on the pressure side of the system or if a hose or pipe has been disconnected on the pressure side, the connections should be checked for leaks with a soapy water solution. With the pump running, bubbles will form if a leak exists.

Check Valve

Inspect

1. A check valve should be inspected whenever the hose is disconnected from a check valve or whenever check valve failure is suspected. (A pump that had become inoperative and had shown indications of having exhaust gases in the pump would indicate check valve failure).
2. Blow through the check valve (toward the cylinder head) then attempt to suck back through the check valve. Flow should only be in one direction(toward the exhaust manifold). Replace valve which does not operate properly.

ON-CAR SERVICE

DRIVE BELT

Remove or Disconnect

1. Inspect drive belt for wear, cracks or deterioration and replace if required. When installing a new belt, it must be seated and fully secured in grooves of all belt driven components.

AIR INJECTION PUMP

Remove or Disconnect

1. Hold pump pulley from turning by compressing drive belt, then loosen pump pulley bolts.
2. Drive belt and pulley.
3. Hoses, vacuum, and electrical connections from air injection control valve.
4. Air pump mounting bolts, and pump assembly (See Figure C6-3).

Install or Connect

1. Air pump assembly, and tighten mounting bolts.
2. Spacer and pump pulley against centrifugal filter fan.
3. Pump pulley bolts and tighten equally to 13 N·m (10 lb. ft).
4. Check air injection system for proper operation (see CHART C-6).

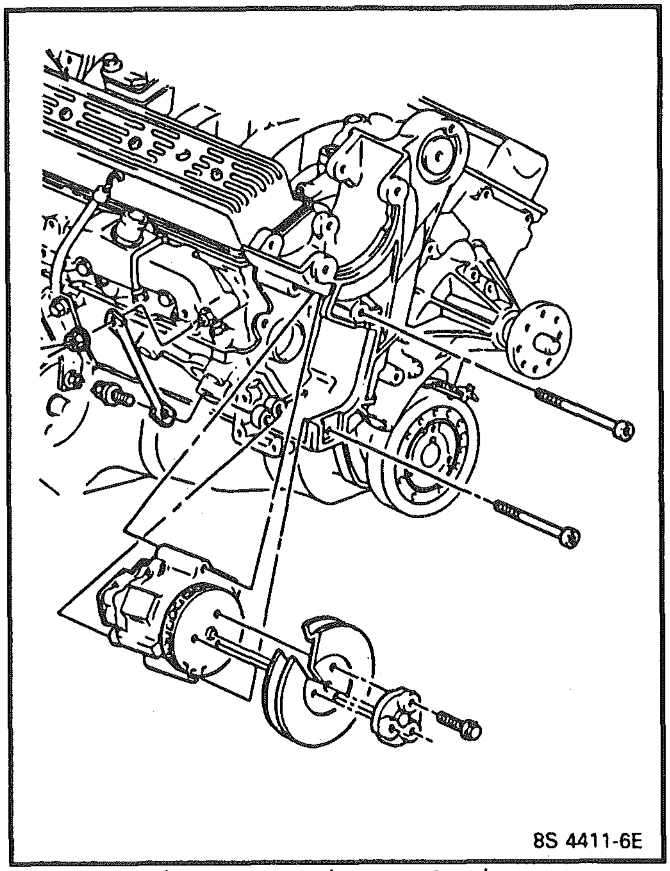

Figure C6-3 - Air Pump Service

AIR INJECTION CONTROL (PEDES) VALVE

Remove or Disconnect

1. Battery ground cable.
2. Adapter bolts (See Figure C6-4).
3. Air outlet hoses from valve.
4. Splash guard/cover
5. Electrical connectors and vacuum hoses from valve.
6. Control valve.

Install or Connect

1. Control valve.
2. Electrical connectors.
3. Splash guard/cover.
4. Air hoses to valve.
5. Battery ground cable.
6. Check system operation (see CHART C-6).

AIR INJECTION CHECK VALVE

Remove or Disconnect

1. Release clamp and disconnect air hoses from check valve.
2. Unscrew check valve from air injection pipe.

Install or Connect

1. Screw check valve onto air injection pipe. 23 N·m (17 lb. ft.).
2. Position air hoses on check valve and secure with clamp.

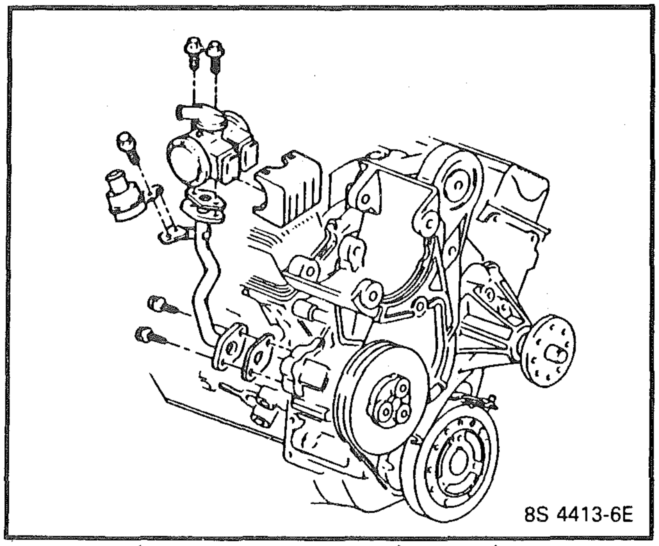

Figure C6-4 - PEDES Valve Service

PARTS INFORMATION

PART NAME	GROUP
Adapter, AIR Inj Cont Vlv	3.671
Brace, AIR Inj Pump	3.655
Bracket, AIR Inj Pump	3.655
Gasket, AIR Inj Dvtr Vlv El	3.671
Harness, AIR Inj Cont Vlv Vac	3.675
Hose, AIR Inj Cont Vlv	3.675
Hose, AIR Inj Cont Vlv Dvtr	3.675
Hose, Ctltc Conv AIR Inj Chk Vlv	3.675
Pipe, AIR Inj Ctltc Conv Chk Vlv	3.690
Pipe, Ctltc Conv AIR Inj	3.675
Pulley, AIR Inj Pump	3.650
Pump, AIR Inj	3.660
Silencer AIR Inj Cont Vlv	3.660
Support, AIR Inj Pump	3.660
Valve, AIR Inj Cont	3.670
Valve, AIR Inj Eng Chk	3.670
Valve, Ctltc Conv AIR Inj Chk	3.670

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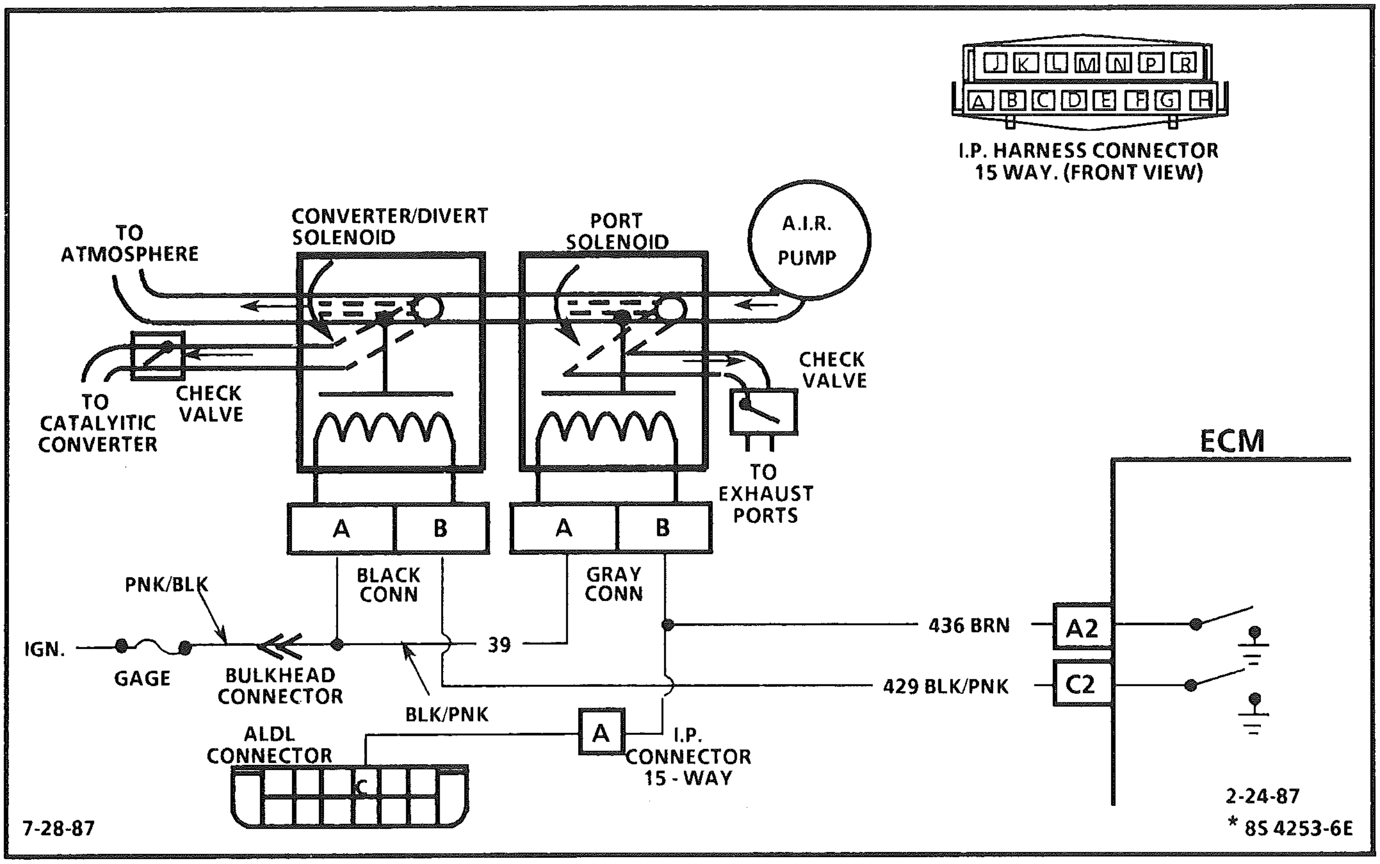


CHART C-6

AIR MANAGEMENT CHECK (PEDES)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

Air management is controlled by a pressure operated port valve and a converter valve, each with an ECM controlled solenoid. When the solenoid is grounded by the ECM, AIR pressure will activate the valve and allow pump air to be directed as follows:

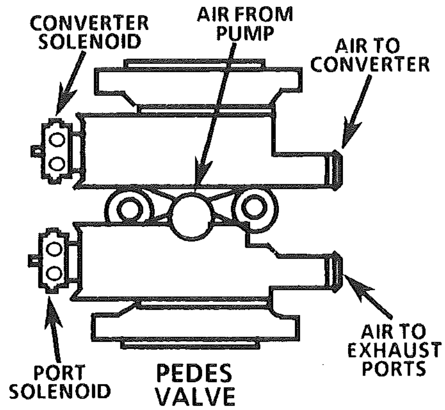
- Cold Mode - The port solenoid is energized which in turn opens the port valve and allows flow to the exhaust ports.
- Warm Mode - The port solenoid is de-energized and the converter solenoid energized which closes the port valve and keeps the converter valve seated, thus forcing flow past the converter valve and to the converter.
- Divert Mode - Both solenoids are de-energized, which opens the converter valve, allowing air to take the path of least resistnance, i.e., out the divert/relief tube to atmosphere.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This is a system functional check. Air is directed to ports during "Open Loop" and all engines start in "Open Loop" even on a warm engine. Since the air to the ports may be very short, prepare to observe port air prior to engine start up. This can be done by squeezing a hose.
2. This should normally set a Code 22. When any code is set, the ECM opens the ground to the converter solenoid and allows air to divert. This checks for ECM response to a fault. A ground in the control valve circuit to the ECM would prevent divert action.
3. This checks for a grounded circuit to the ECM. Test light "OFF" is normal and would indicate the circuit is not grounded.
4. Checks for an open in the solenoid control circuits. Grounding the test terminal should ground both solenoid circuits. Normally, the test light should be "ON", which indicates the problem is not in the ECM or wiring but at the solenoid connections or valve itself.
5. Checks for a grounded solenoid circuit. Test light "OFF" would indicate the circuit is normal and fault is in the valve.

CHART C-6B

AIR MANAGEMENT CHECK (PEDES)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



(1)
- "DIAGNOSTIC" TERMINAL UNGROUNDED.
- START ENGINE, RUNNING AT PART THROTTLE, BELOW 2000 RPM, AIR SHOULD BE FELT AT OUTLET TO EXHAUST PORTS DURING "OPEN LOOP" OPERATION (FROM 6 SECONDS TO 3 MINUTES ON WARM ENGINE DEPENDING ON APPLICATION) AND SWITCH TO CONVERTER WHEN SYSTEM GOES "CLOSED LOOP".

OK

(2)
- DISCONNECT TPS CONNECTOR AT IDLE AND AIR SHOULD DIVERT TO ATMOSPHERE AFTER A FEW SECONDS.

NO DIVERT

(3)
- IGNITION "ON", ENGINE STOPPED.
- DISCONNECT CONVERTER SOLENOID ELECT. CONNECTOR (BLACK CONNECTOR) AND CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS
- NOTE LIGHT.

LIGHT "ON"

CHECK CKT 429 FOR SHORT TO GROUND. IF NOT GROUNDED, IT IS A FAULTY ECM.

LIGHT "OFF"

REPLACE PEDES VALVE.

OK

NO TROUBLE FOUND. CLEAR MEMORY AND REVIEW SYMPTOMS SECTION "B".

PORT THEN DIVERT ONLY

(4)
- IGNITION "ON", ENGINE STOPPED.
- GROUND "DIAGNOSTIC" TERMINAL.
- DISCONNECT CONVERTER VALVE SOLENOID (BLACK CONNECTOR).
- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS AND NOTE LIGHT.

LIGHT "OFF"

- CONNECT TEST LIGHT BETWEEN CKT 39 AND GROUND.

LIGHT "OFF"

OPEN CKT 39

LIGHT "ON"

OPEN IN CKT 429. FAULTY ECM CONNECTION OR ECM.

LIGHT "ON"

FAULT IS CONVERTER VALVE SOLENOID, CONNECTION, OR VALVE.

CONSTANT PORT OR CONVERTER AIR

(5)
- IGNITION "ON", ENGINE STOPPED.
- "DIAGNOSTIC " TERMINAL NOT GROUNDED.
- DISCONNECT PORT VALVE SOLENOID (GRAY CONNECTOR).
- CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMINALS AND NOTE LIGHT.

LIGHT "OFF"

- GROUND "DIAGNOSTIC" TERMINAL.
- NOTE TEST LIGHT.

LIGHT "OFF"

- CONNECT TEST LIGHT BETWEEN CKT 39 AND GROUND.

LIGHT "OFF"

REPAIR OPEN CKT 39

LIGHT "ON"

OPEN CKT 436. FAULTY CONNECTION OR ECM.

LIGHT "ON"

FAULTY CONNECTION AT PORT SOLENOID OR FAULTY PEDES VALVE.

LIGHT "ON"

GROUNDED CKT 436 OR FAULTY ECM.

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NO_x (oxides of nitrogen) emission levels caused by high combustion temperature. It does this by decreasing combustion temperature.

The main element of the system is the EGR valve operated by vacuum and mounted on the intake manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

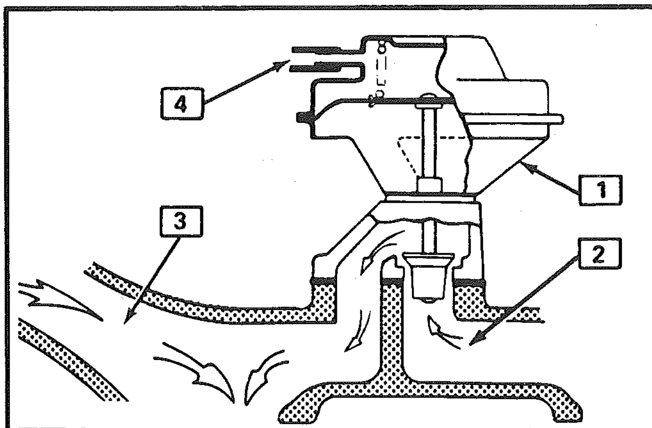


Figure C7-1 Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by vacuum to let exhaust gas flow into the intake manifold. The exhaust gas then moves with the air/fuel mixture into the combustion chamber. If too much exhaust gas enters, combustion will not occur. For this reason, very little exhaust gas is allowed to pass through the valve, especially at idle. The EGR valve is usually open during warm engine operation and when the vehicle is above idle speed.

The amount of exhaust gas recirculated is controlled by variations in vacuum and the EGR vacuum control solenoid.

EGR CONTROL

The EGR vacuum control has a vacuum solenoid that uses "pulse width modulation". This means the ECM turns the solenoid "ON" and "OFF" many times a second and varies the amount of "ON" time ("pulse width") to vary the amount of EGR.

A diagnostic switch is part of the control and monitors vacuum to the EGR valve. This switch will trigger a "Service Engine Soon" light, and set a Code 32 in the event of a vacuum circuit failure.

During cold operation and at idle, the solenoid circuit is not grounded by the ECM. This blocks vacuum to the EGR valve.

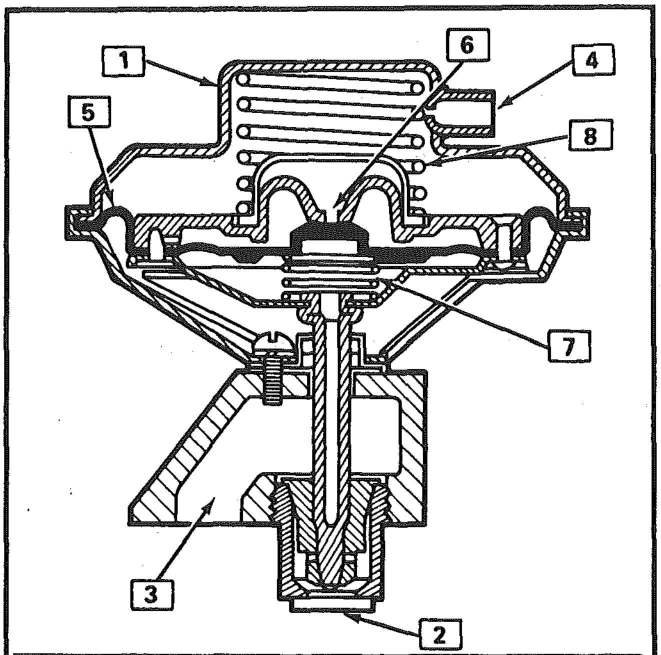
Grounding the ALDL diagnostic "test" terminal, with the ignition "ON" and the engine not running, will energize the solenoid and block vacuum to the EGR valve.

NEGATIVE BACKPRESSURE EGR VALVE

The valve on this engine is called a negative backpressure valve. It varies the amount of exhaust gas flow into the manifold depending on manifold vacuum and variations in exhaust backpressure.

The diaphragm on this valve (shown in Figure C7-2) has an internal vacuum bleed hole which is held closed by a small spring when there is no exhaust backpressure. The amount of vacuum to the valve is controlled by the ECM controlling a solenoid.

Engine vacuum opens the EGR valve against the pressure of a large spring. When manifold vacuum combines with negative exhaust backpressure, the vacuum bleed hole opens and the EGR valve closes.



1 EGR VALVE
2 EXHAUST GAS
3 INTAKE AIR
4 VACUUM PORT
5 DIAPHRAGM
6 AIR BLEED HOLE
7 SMALL SPRING
8 LARGE SPRING

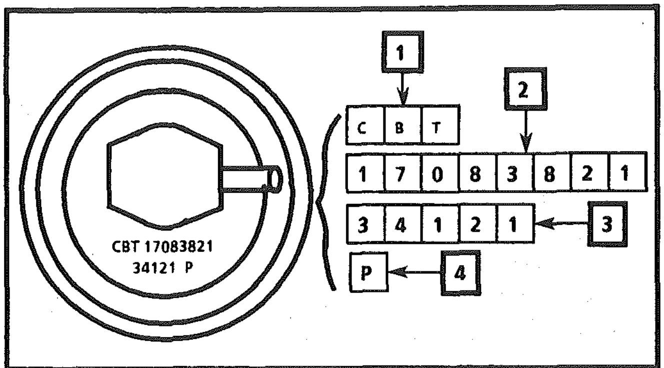
4S 0113-6E

Figure C7-2 - Negative Backpressure EGR Valve

EGR VALVE IDENTIFICATION

- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number (Figure C7-3).
- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve, after the part number.
- Port EGR valves have no identification stamped after the part number.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.



1. ASSEMBLY PLANT CODE
2. PART NUMBER
3. DATE BUILT
4. LOOK HERE FOR LETTER:
   P = POSITIVE BACK PRESSURE
   N = NEGATIVE BACK PRESSURE
   BLANK = PORTED VALVE

* 4S 0538-6E
2-27-87

Figure C7-3 - EGR Valve Identification

RESULTS OF INCORRECT OPERATION

Too much EGR flow tends to weaken combustion, causing the engine to run roughly or stop. With too much EGR flow at idle, cruise, or cold operation, any of the following conditions may happen:

- Engine stops after cold start.
- Engine stops at idle after deceleration.
- Car surges during cruise.
- Rough idle.

If the EGR valve should stay open all of the time, the engine may not idle.

Too little or no EGR flow allows combustion temperatures to get too high during acceleration and load conditions. This could cause:

- Spark knock (detonation).
- Engine overheating.
- Emission test failure.

DIAGNOSIS

Diagnosis of the EGR system is covered in CHART C-7 at the end of this section.

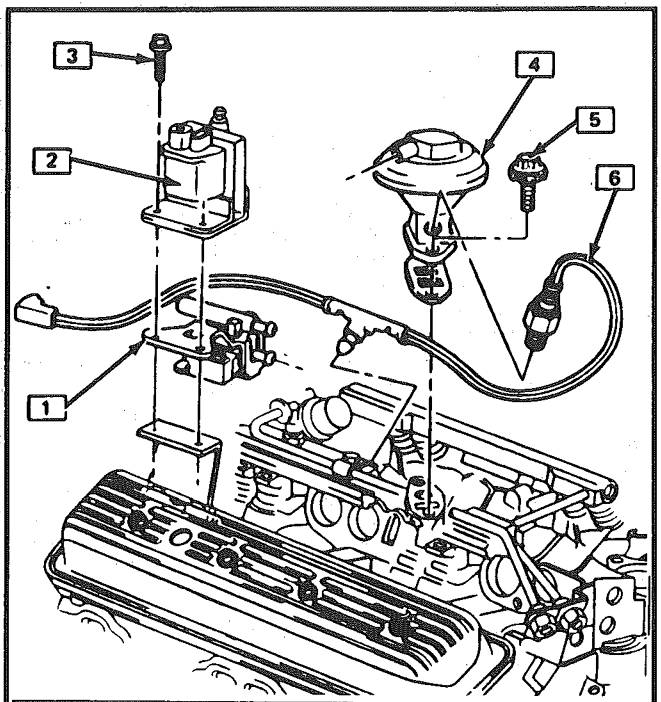
EGR VALVE

Remove or Disconnect

1. Plenum (See Plenum R&R).
2. Vacuum line.
3. Retaining bolts.
4. EGR valve.

Install or Connect

1. Reinstall valve or replacement EGR valve on intake manifold using new gasket.
2. Bolts and tighten to 18 N·m (14 lb. ft.).
3. Vacuum line to valve.
4. Plenum.



1 EGR SOLENOID
2 COIL
3 BOLT (2) 21 N·m (16 FT. LBS.)
4 EGR VALVE
5 BOLTS (2)
6 EGR DIAG TEMP SWITCH 12 N·m (105 IN. LBS.)

7S 3321-6E

Figure C7-4 - EGR and Solenoid Service

EGR Manifold Passage

Inspect

If EGR passages in the inlet manifold indicate excessive build-up of deposits, the passages should be cleaned. Care should be taken to ensure that all loose particles are completely removed to prevent them from clogging the EGR valve or from being ingested into the engine.

Do not wash EGR valve in solvents or degreaser--permanent damage to valve diaphragm may result. Also, sand blasting of the valve is not recommended since this can affect the operation of the valve.

Clean

1. With a wire wheel, buff the exhaust deposits from the mounting surface and around the valve.
2. Look for exhaust deposits in the valve outlet. Remove deposit build-up with a screwdriver.
3. Clean mounting surfaces of intake manifold and valve assembly.

EGR CONTROL SOLENOID

Remove or Disconnect

1. Negative battery cable.
2. Electrical connector at solenoid
3. Vacuum hoses.
4. Nut and solenoid.

Install or Connect

1. Solenoid and bracket, tighten nut to 24 N·m (17 lb. ft.).
2. Vacuum hoses.
3. Electrical connector.
4. Negative battery cable.

PARTS INFORMATION

PARTS NAME	GROUP
Control, EGR Vacuum	3.670
Gasket, EGR Valve	3.680
Valve, EGR	3.670

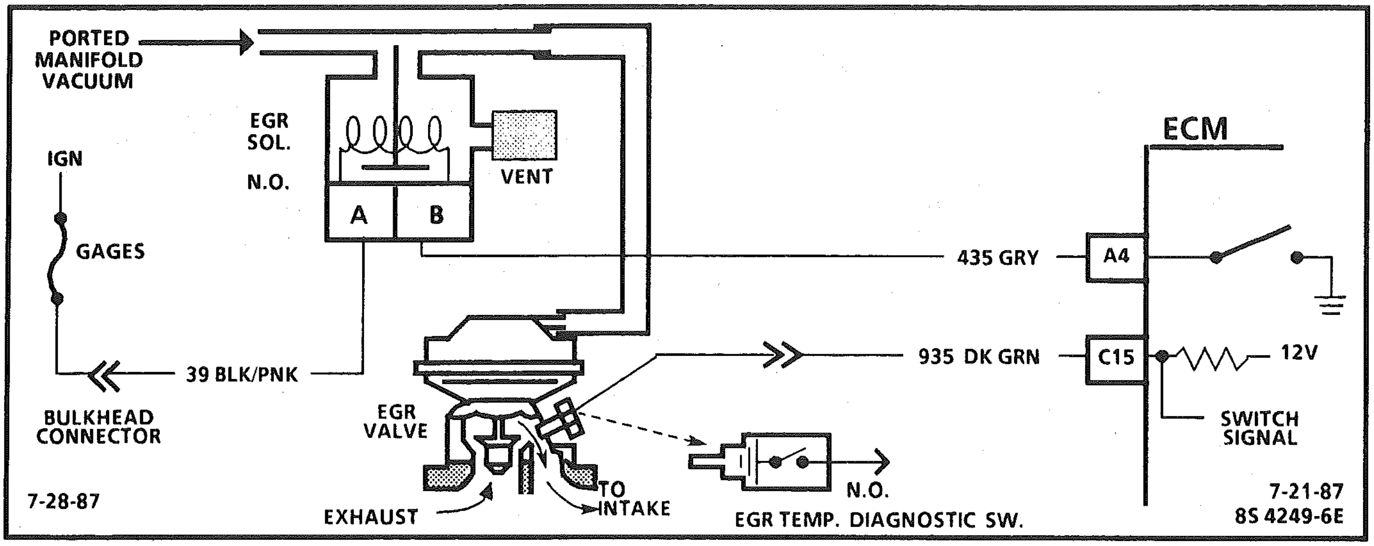


CHART C-7

EXHAUST GAS RECIRCULATION CHECK
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The exhaust gas recirculation (EGR) valve is controlled by a normally open pulse width modulated (PWM) solenoid. The ECM turns the solenoid "OFF" to allow vacuum to pass to the EGR and turns the solenoid "ON" to prohibit EGR operation. When EGR is commanded, the solenoid is turned "ON" and "OFF" many times a second (duty cycle).

The duty cycle is calculated by the ECM based on information from the coolant, MAT, TPS, and MAF sensors. Also, engine rpm's and the P/N switch input affect EGR. There should be no EGR when in park or neutral, TPS below a calibrated value or TPS indicating WOT.

With the ignition "ON" and engine stopped, the EGR solenoid is de-energized. The solenoid, however, should be energized if the diagnostic terminal is grounded with the ignition "ON" and engine not running.

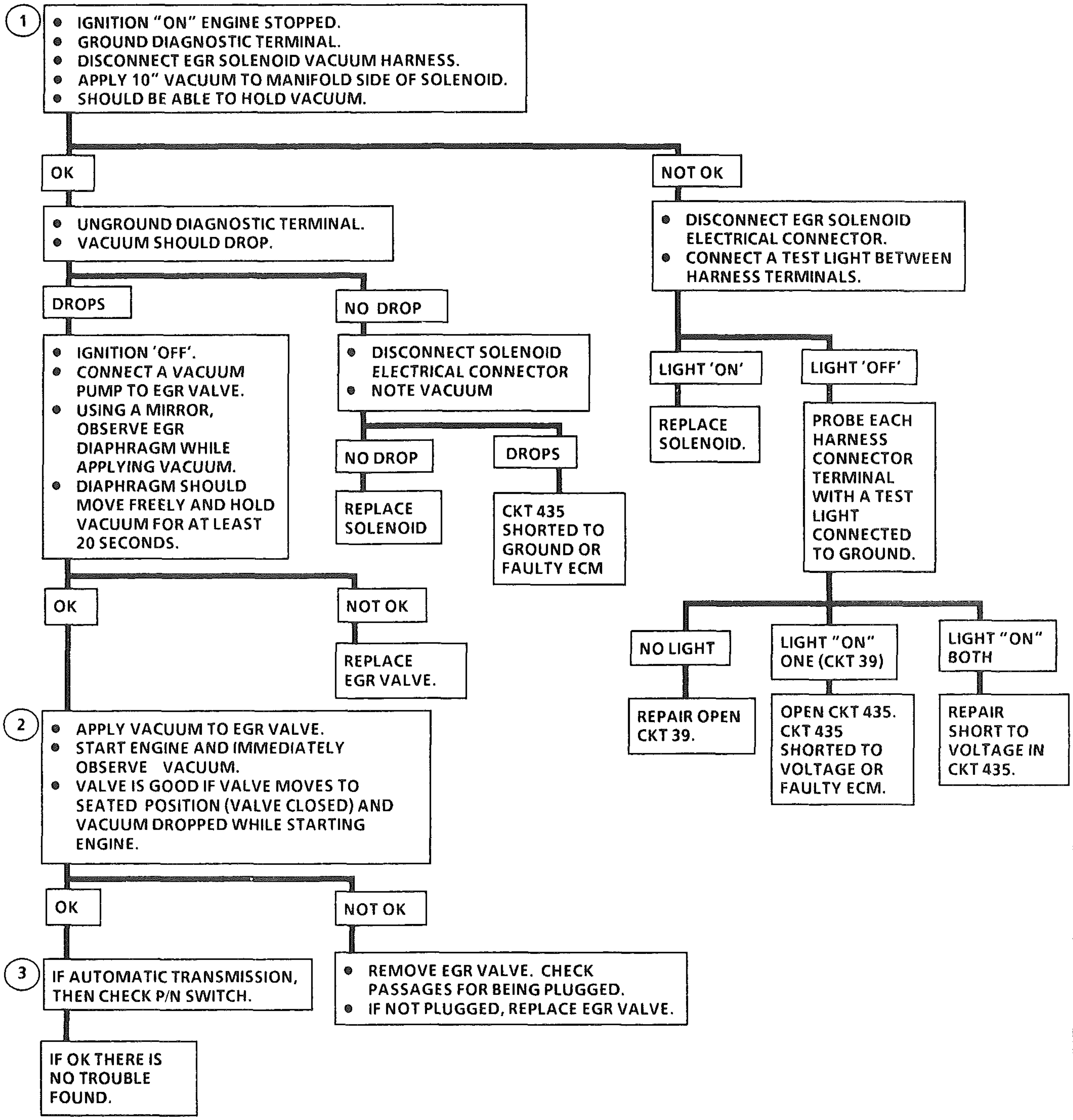
Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This will test the solenoid value to determine if it is capable of closing off the manifold vacuum from the EGR valve. The vacuum may bleed off slowly but this should not be considered a fault.
2. As soon as back pressure is available at the EGR valve, the bleed portion in the valve should open and cause the valve to go to its heated position.
3. The EGR will be inoperative if the P/N switch is misadjusted or faulty. Use "Scan" tool and check P/N switch. Refer to CHART C-1.

CHART C-7

EXHAUST GAS RECIRCULATION CHECK 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 7" HG VACUUM AT 2000 RPM. THIS CHART ASSUMES THERE IS NO CODE 32.



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C8

TRANSMISSION CONVERTER CLUTCH (TCC) SYSTEM AND MANUAL TRANSMISSION SHIFT LIGHT 5.0L ONLY

CONTENTS

GENERAL DESCRIPTION

PURPOSE

The transmission converter clutch (TCC) system uses a solenoid operated valve in the automatic transmission to couple the engine flywheel to the output shaft of the transmission thru the torque converter. This reduces the slippage losses in the converter, which increases fuel economy.

OPERATION

For the converter clutch to apply, two conditions must be met:

- Internal transmission fluid pressure must be correct. For information on internal transmission operation, see Section "7A". This section will cover only the electrical operation of the TCC system.
- The ECM grounds a switch internally to turn "ON" a solenoid in the transmission. This moves a check ball, which will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

The ECM controls the TCC apply solenoid by looking at several sensors:

- Speedo Buffer Sensor (also called Vehicle Speed Sensor (VSS)) Speed must be above a certain value before the clutch can apply.
- Coolant Temperature Sensor Engine must be warmed up before clutch can apply about 65° C (149°F).
- Throttle Position Sensor (TPS) After the converter clutch applies, the ECM uses the information from the TPS to release the clutch when the car is accelerating or decelerating at a certain rate.
- The brake switch is also part of the TCC circuit as it will remove battery voltage to the TCC solenoid when the brake pedal is depressed.
- Gear Select Switch The 4th gear switch is used to send a signal to the ECM telling it when the transmission is in 4th gear.

The ECM uses this information to vary the conditions under which the clutch applies or releases. However, the transmission does not have to be in fourth gear in order for the ECM to turn the clutch "ON".

If the converter clutch is applied at all times, the engine will stall immediately, just as in a manual transmission with the clutch applied.

If the converter clutch does not apply, fuel ecomony may be lower than expected. If the vehicle speed sensor fails, the TCC will not apply. If the 4th gear switch does not operate, the TCC may not apply at the right time.

DIAGNOSIS

The diagnosis of the TCC system is covered in CHART C-8A. If the ECM detects a problem in the system, a Code 24 should set. In this case, see Code 24 CHART.

SHIFT LIGHT (M/T) DESCRIPTION

The purpose of the shift light is to provide a display which indicates the optimum fuel economy point for up shifting the manual transmission based on engine speed and load. The display is a lamp on the instrument panel. Activation of the ECM driver turns the lamp "ON".

DIAGNOSIS

The shift light circuit can be checked using CHART C-8B.

ON-CAR SERVICE

- See Section "8B" if the shift light bulb needs replacement.
- See Section "6E" to repair wiring problem.
- See Section "C-1" if ECM is to be replaced.

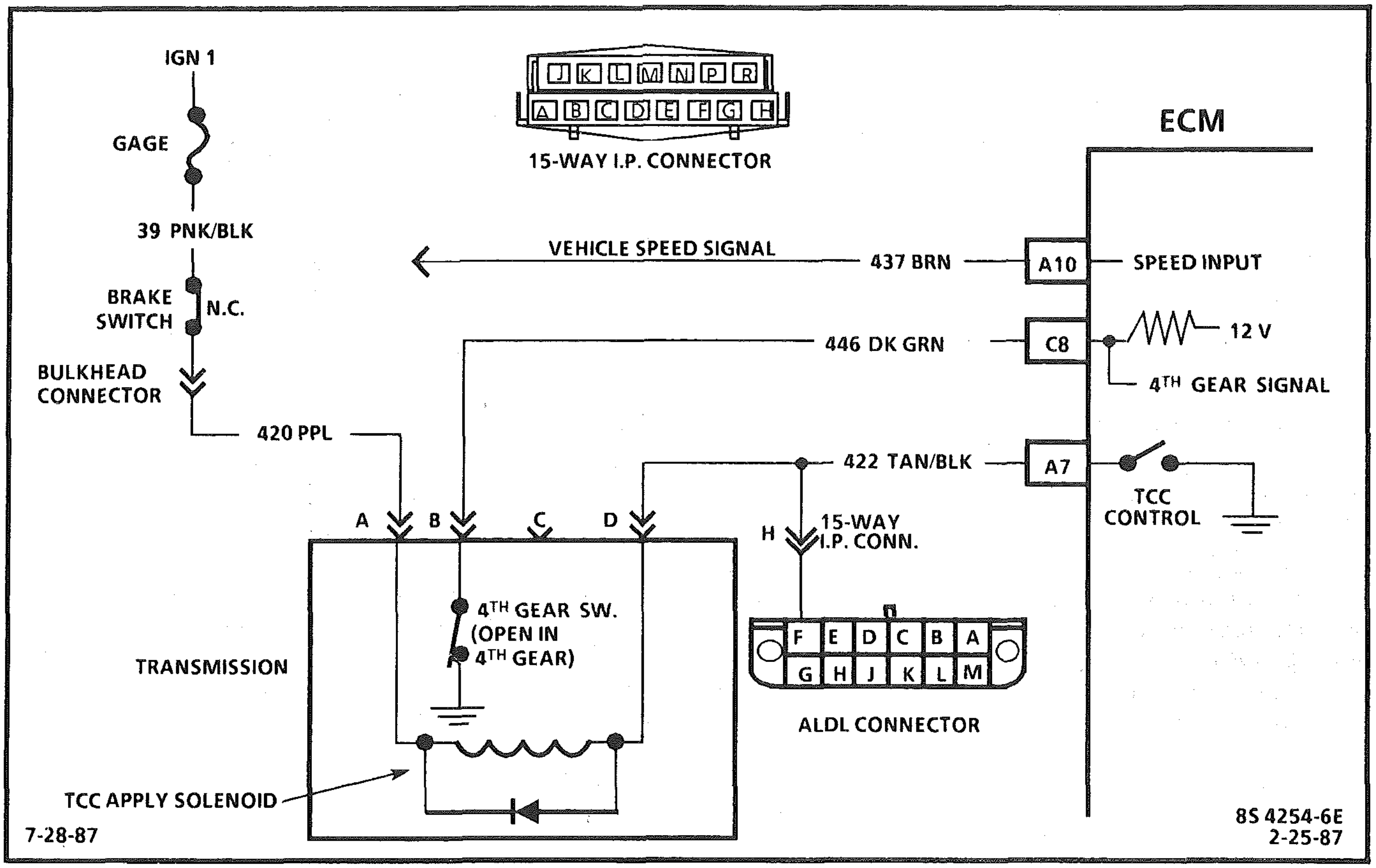


CHART C-8A

(Page 1 of 2)
AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC)
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

The purpose of the automatic transmission torque converter clutch feature is to eliminate the power loss of the torque converter stage when the vehicle is in a cruise condition. This allows the convenience of the automatic transmission and the fuel economy of a manual transmission. The heart of the system is a solenoid located inside the automatic transmission which is controlled by the ECM.

When the solenoid coil is activated ("ON"), the torque converter clutch is applied which results in straight through mechanical coupling from the engine to transmission. When the transmission solenoid is deactivated, the torque converter clutch is released, which allows the torque converter to operate in the conventional manner (fluidic coupling between engine and transmission).

The ECM turns "ON" the TCC when coolant temperature is above 65° C (149° F), TPS not changing ,and vehicle speed above a specified value.

Test Description:

Numbers below refer to circled numbers on the diagnostic chart.

1. When a test light is connected from ALDL terminal "F" to ground, a test light "ON" indicates battery voltage is OK and the TCC solenoid is disengaged.
2. When the diagnostic terminal is grounded, the ECM should energize the TCC solenoid and the test light should go out.

Diagnostic Aids:

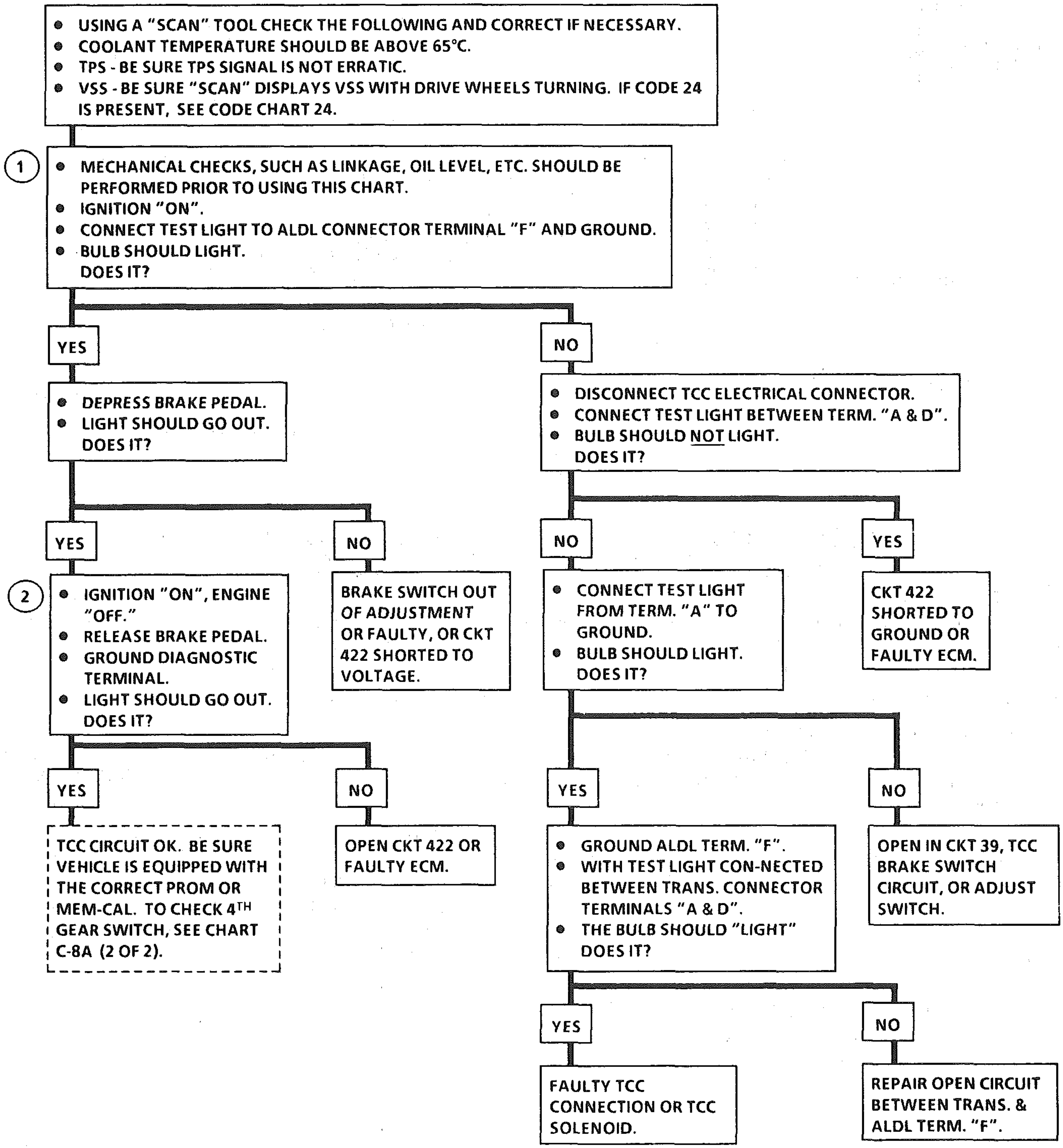
A "Scan" tool only indicates when the ECM has turned "ON" the TCC driver (grounded CKT 422) but this does not confirm that the TCC has engaged. To determine if TCC is functioning properly, engine rpm should decrease when the "Scan" indicates the TCC driver has turned "ON". To determine if the 4th gear switch is functioning properly, perform the checks in CHART C-8A (Page 2 of 2). The switches will not prevent TCC from functioning but will affect TCC lock and unlock points. If the 4th gear switch circuit is always open, the TCC may engage as soon as sufficient oil pressure is reached.

CHART C-8A

(Page 1 of 2)

AUTOMATIC TRANSMISSION CONVERTER CLUTCH (TCC)

5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)



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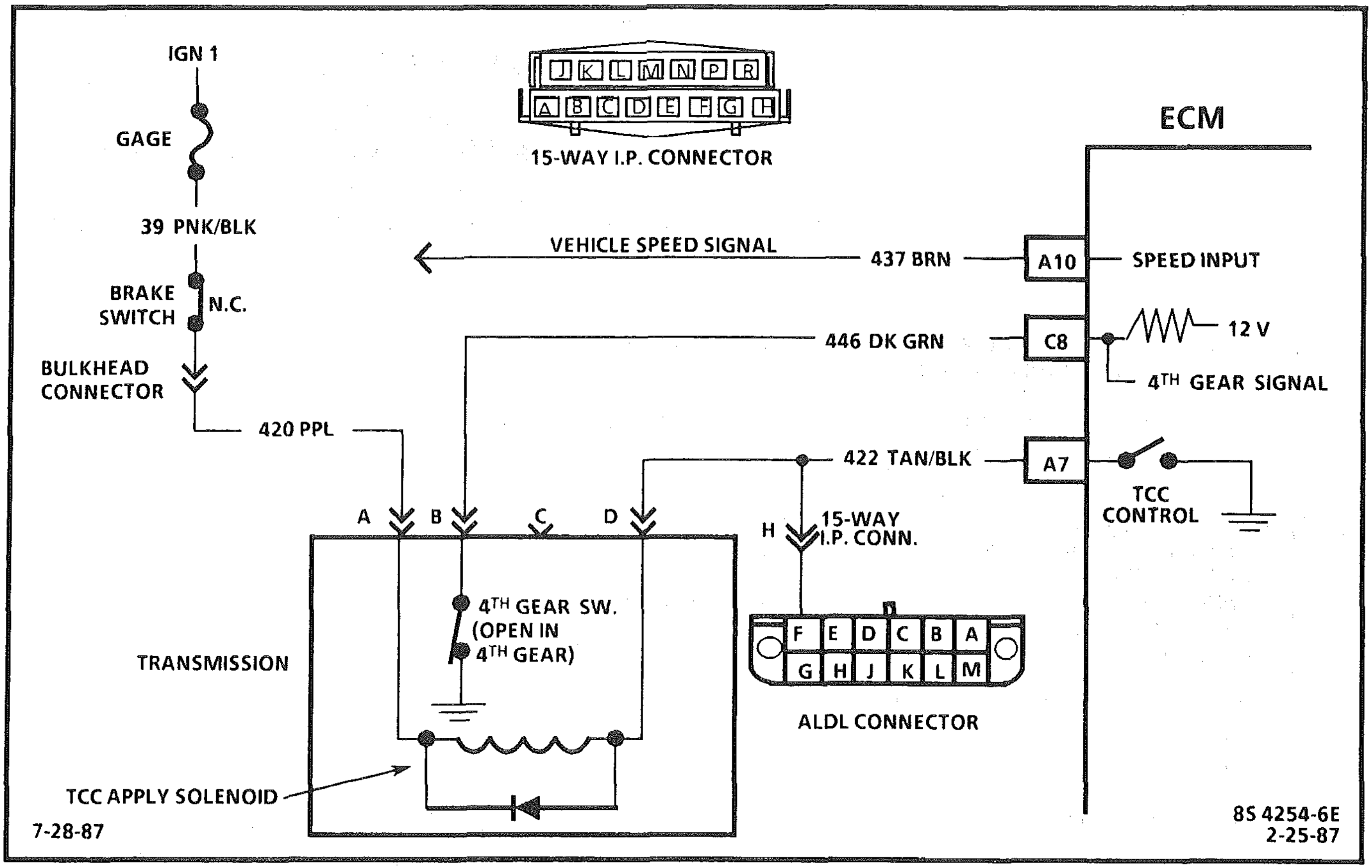

CHART C-8A

(Page 2 of 2)

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

A 4th gear switch (mounted in the trans.) opens when the trans. shifts into 4th gear, and this switch is used by the ECM to modify TCC lock and unlock points, when in a 4-3 downshift maneuver.

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. Unless the switch or CKT 446 is open, the "Scan" should display "NO", indicating the trans. is not in 4th gear. The 4th gear switch should only be open while in 4th gear.
2. This step determines if the ECM and wiring are OK. Grounding CKT 446 should cause the "Scan" to display "NO", indicating the trans. is not in 4th gear.
3. Checks the operation of the 4th gear switch. When the trans. shifts into 4th gear the switch should open and the "Scan" should display "YES".
4. Disconnecting the TCC connector simulates an open switch to determine if CKT 446 is shorted to ground or the problem is in the transmission.

Diagnostic Aids:

A road test may be necessary to verify the customer complaint. If the "Scan" indicates TCC is turning "ON" and "OFF" erratically, check the state of the 4th gear switch to be sure it is not changing states under a steady throttle position. If the switch is changing states, check connections and wire routing carefully. Also, if the 4th gear switch is always open the TCC may engage as soon as sufficient oil pressure is reached.

CHART C-8A

(Page 2 of 2)

TRANSMISSION CONVERTER CLUTCH (TCC) ELECTRICAL DIAGNOSIS 5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

CHECKS MADE ON THIS PAGE WILL NOT PREVENT THE TCC FROM WORKING, BUT WILL AFFECT ENGAGEMENT OR DISENGAGEMENT POINTS.

1
- IGNITION "ON", ENGINE "OFF".
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

NO:

3
- RAISE DRIVE WHEELS
- SHIFT VEHICLE INTO OVERDRIVE
- INCREASE SPEED SLOWLY UNTIL TRANS. SHIFTS INTO 4TH GEAR.
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

  YES: 4TH GEAR SWITCH OK. REFER TO "DIAGNOSTIC AIDS" ON FACING PAGE.

  NO:

  4
  - IGNITION "ON" ENGINE "OFF"
  - DISCONNECT TRANS. ELECTRICAL CONNECTOR
  - DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

    YES: WIRE GROUNDED INTERNALLY IN TRANS. OR FAULTY 4TH GEAR SWITCH.

    NO: CKT 446 SHORTED TO GROUND OR FAULTY ECM.

YES:

2
- DISCONNECT TCC ELECTRICAL CONNECTOR.
- JUMPER HARNESS TERMINAL "B" (CKT 446) TO GROUND.
- DOES "SCAN" INDICATE TRANS. IS IN 4TH GEAR?

  NO: FAULTY CONNECTION OR 4TH GEAR SWITCH.

  YES: OPEN CKT 446, FAULTY CONNECTION OR FAULTY ECM.

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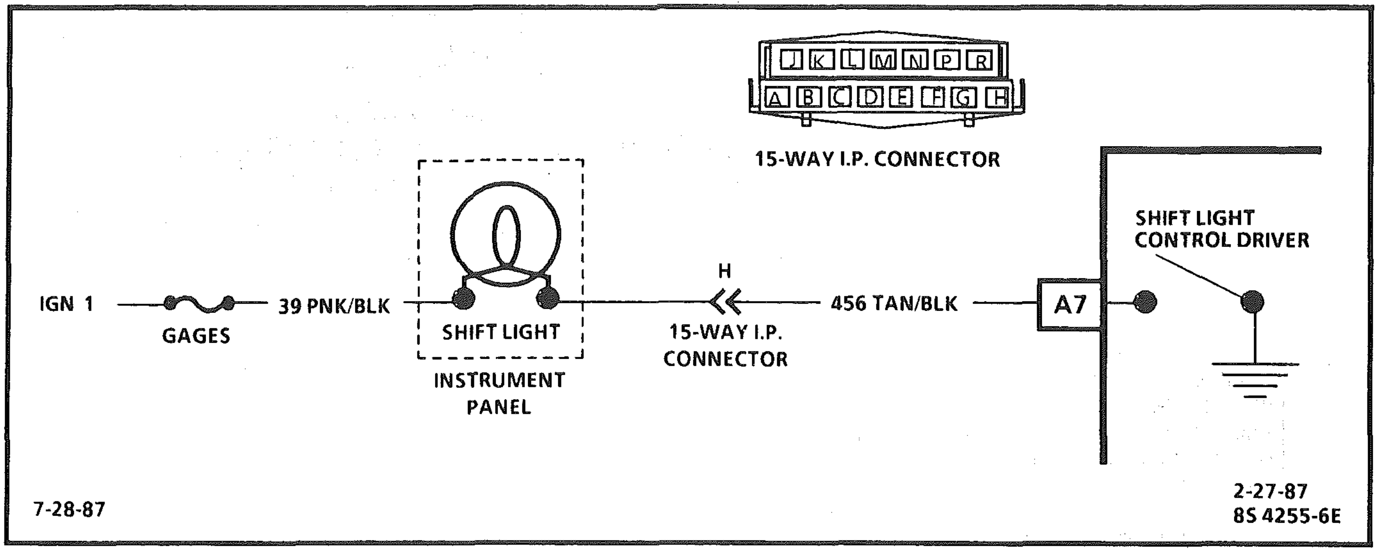


CHART C-8B

M/T SHIFT LIGHT CHECK
5.0L (VIN F) "F" SERIES (PORT)

Circuit Description:

The shift light indicates the best transmission shift point for maximum fuel economy. The light is controlled by the ECM and is turned "ON" by grounding CKT 456.

The ECM uses information from the following inputs to control the shift light:

- Coolant temperature
- TPS
- VSS
- rpm

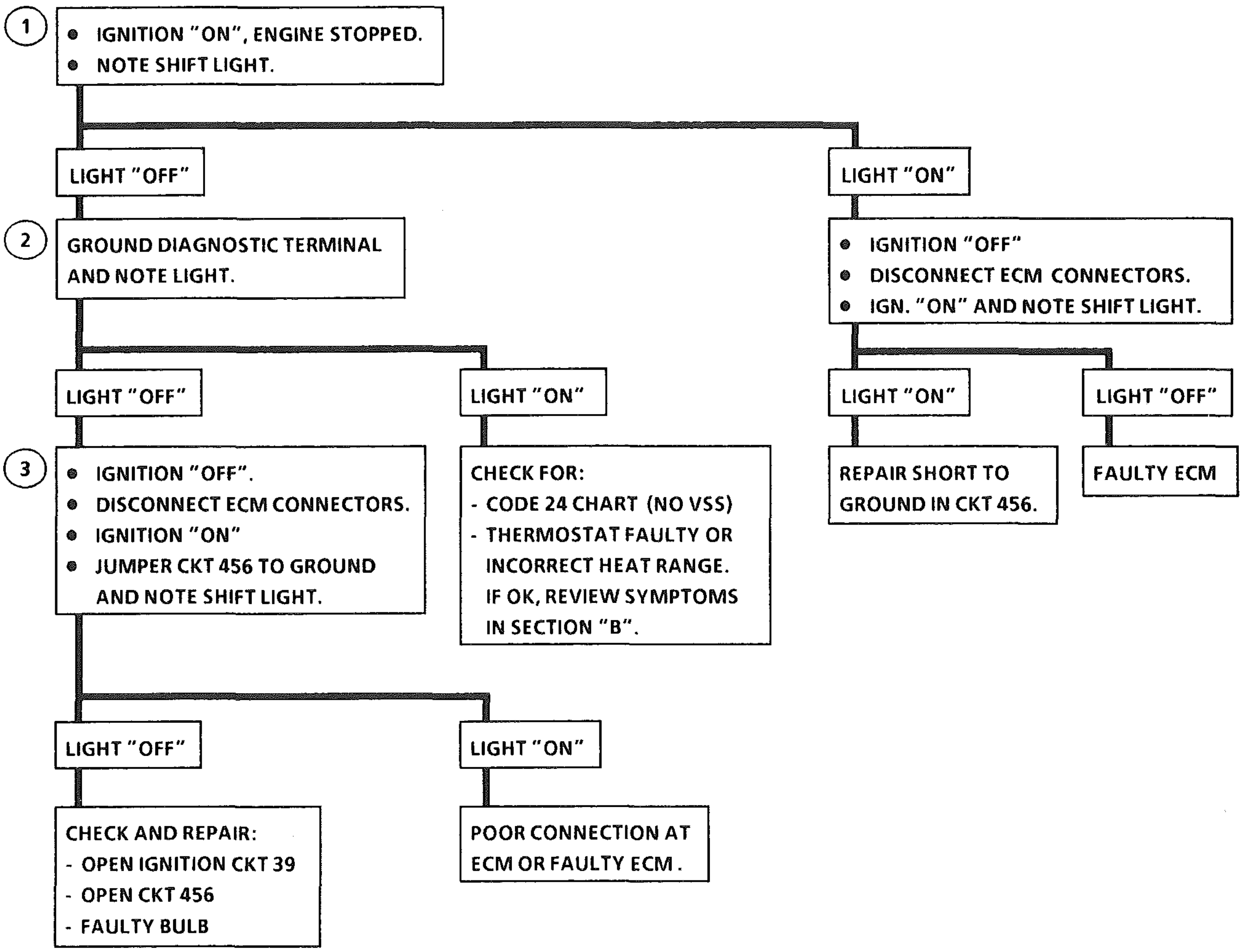
The ECM uses the measured rpm and the vehicle speed to calculate what gear the vehicle is in. It's this calculation that determines when the shift light should be turned "ON".

Test Description: Numbers below refer to circled numbers on the diagnostic chart.

1. This should not turn "ON" the shift light. If the light is "ON", there is a short to ground in CKT 456 wiring or a fault in the ECM.
2. When the diagnostic terminal is grounded, the ECM should ground CKT 456 and the shift light should come "ON".
3. This checks the shift light circuit up to the ECM connector. If the shift light illuminates, then the ECM connector is faulty or the ECM does not have the ability to ground the circuit.

CHART C-8B

M/T SHIFT LIGHT CHECK
5.0L (VIN F) "F" SERIES (PORT)



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SECTION C12

COOLING FAN CONTROL

CONTENTS

GENERAL DESCRIPTION

The fan is used for engine and A/C condenser cooling but the fan only operates under certain conditions.

OPERATION

The electric cooling fan on this engine is controlled by the ECM. The ECM will ground the cooling fan relay, which turns "ON" the fan, when the following conditions are met.

- Coolant temperature sensor signal indicating a temperature greater than 106°C (222°F).
- A/C head pressure greater than 233 psi and vehicle speed less than 40 mph.
- When the cooling fan is turned "ON", it will stay "ON" for a minimum time of 15 seconds.

DIAGNOSIS

The following charts will diagnose the ECM controlled cooling fan.

Use Section "8A" to diagnose the secondary cooling fan.

ON-CAR SERVICE

Cooling system component replacement can be found in Section "6B".

PARTS INFORMATION

PART NAME	GROUP
Fan, Engine	1.055
Motor, Fan	1.055
Relay, Engine Fan	1.055

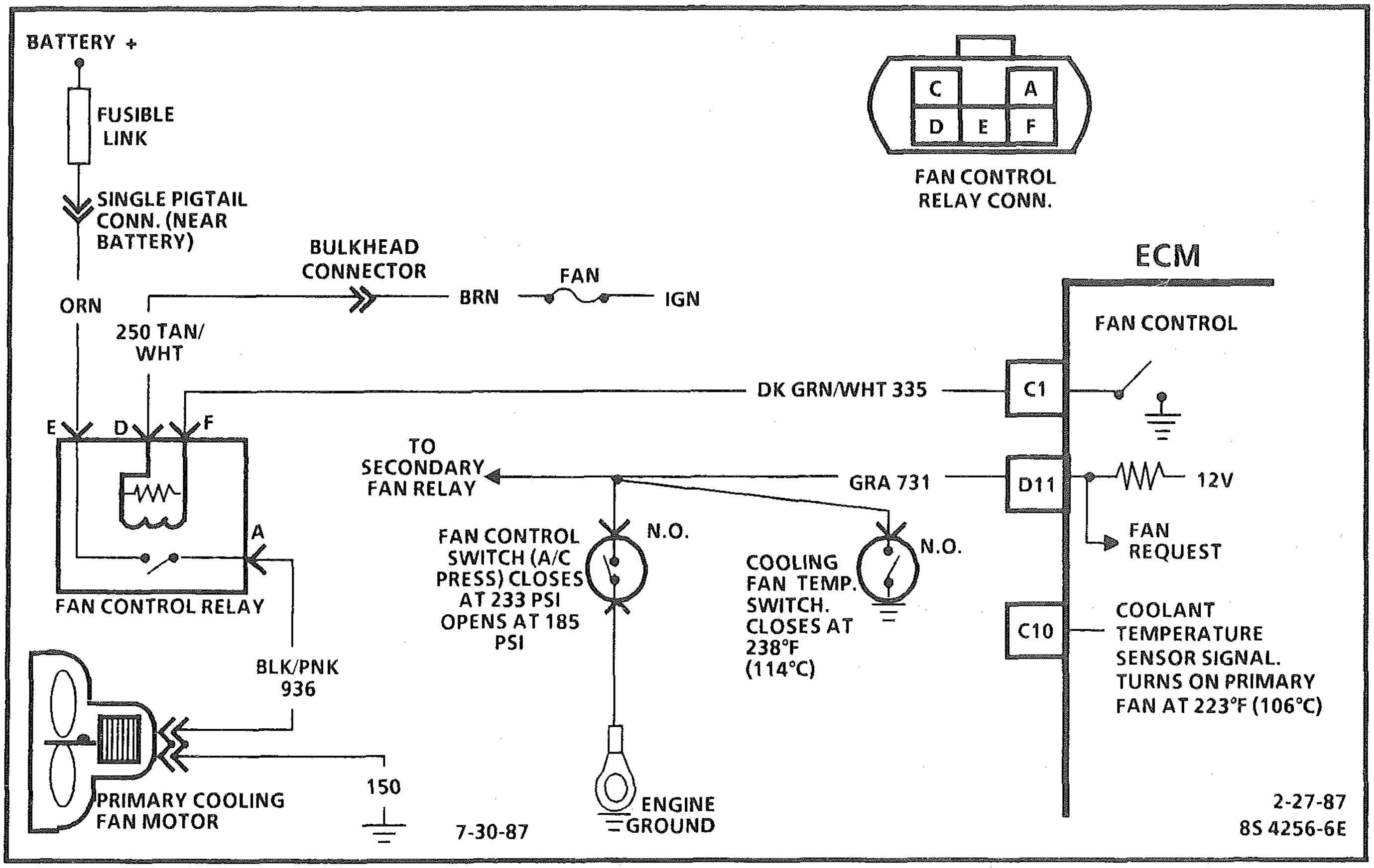


CHART C-12

(Page 1 of 2)
COOLING FAN CONTROL CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

- The primary cooling fan is totally controlled by the ECM based on inputs from the coolant sensor and fan control switch. The fan should run, if coolant temperature is greater than 106°C (223°F).
- Battery voltage is supplied to the fan relay on terminal "E" and ignition voltage to terminal "D".
- Grounding CKT 335 (relay terminal "F") will energize the relay and supply battery voltage to the fan motor. Once the fan relay is energized by the ECM, it will remain "ON" for a minimum of 15 seconds.
- The ECM will remove the ground to CKT 335 if vehicle speed is over 40 mph unless the engine is overheating.
- The fan control switch, mounted in the A/C high pressure line, will close when head pressure exceeds 233 psi (1600 kPa) and this input causes the ECM to ground CKT 335.
- If a Code 14 or 15 sets, or if the ECM is operating in the fuel back-up mode, the ECM will turn "ON" the cooling fan.

Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over or the hot light or temperature gage indicated overheating.

If the gate or light indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can also be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

If the engine is actually overheating and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating, and the cooling fan is "ON", the cooling system should be checked.

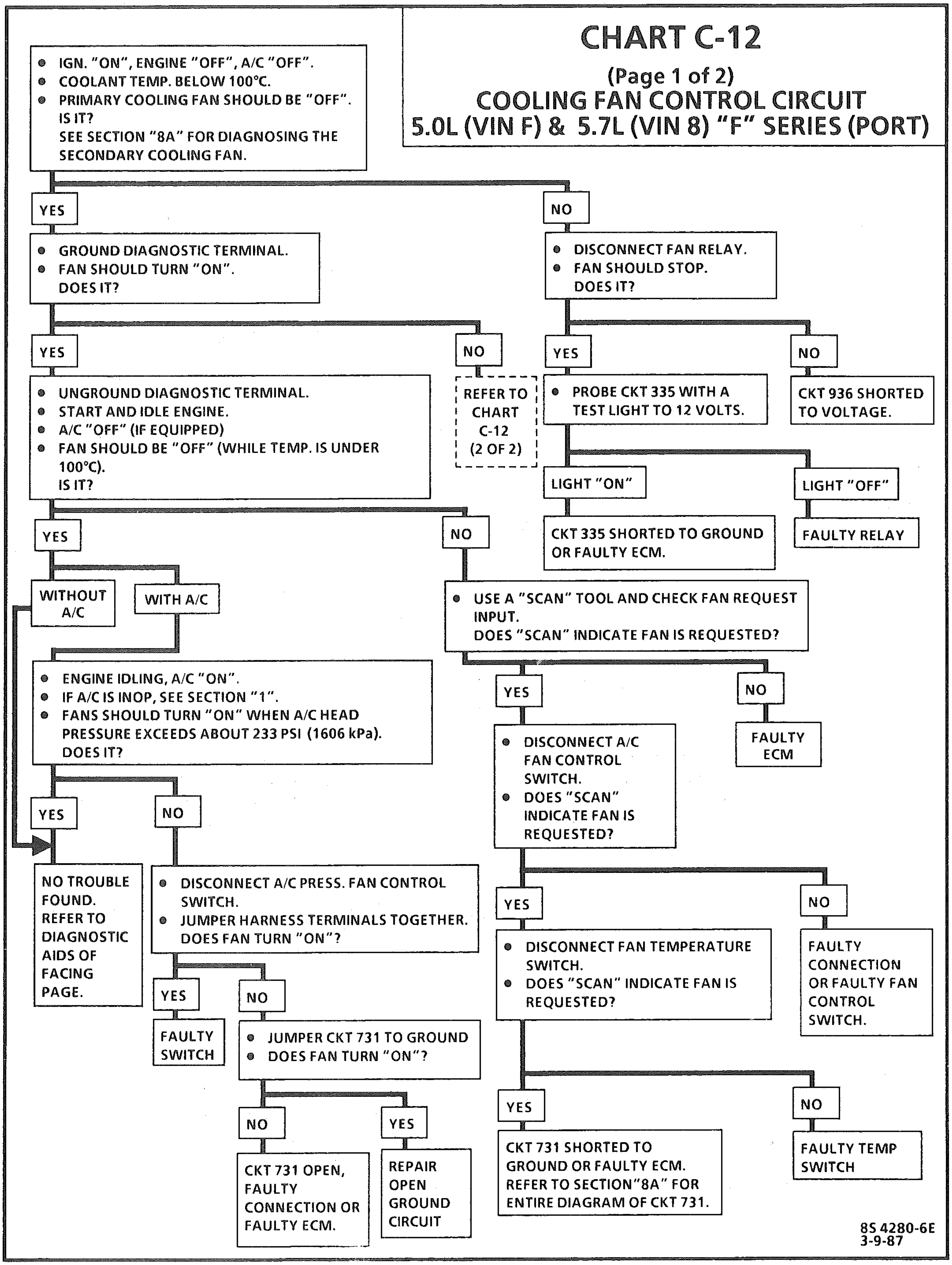


CHART C-12
(Page 1 of 2)
COOLING FAN CONTROL CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)
• IGN. "ON", ENGINE "OFF", A/C "OFF".
• COOLANT TEMP. BELOW 100°C.
• PRIMARY COOLING FAN SHOULD BE "OFF". IS IT? SEE SECTION "8A" FOR DIAGNOSING THE SECONDARY COOLING FAN.
YES
NO
• GROUND DIAGNOSTIC TERMINAL.
• FAN SHOULD TURN "ON". DOES IT?
• DISCONNECT FAN RELAY.
• FAN SHOULD STOP. DOES IT?
YES
NO
YES
NO
• UNGROUND DIAGNOSTIC TERMINAL.
• START AND IDLE ENGINE.
• A/C "OFF" (IF EQUIPPED)
• FAN SHOULD BE "OFF" (WHILE TEMP. IS UNDER 100°C). IS IT?
REFER TO CHART C-12 (2 OF 2)
• PROBE CKT 335 WITH A TEST LIGHT TO 12 VOLTS.
CKT 936 SHORTED TO VOLTAGE.
LIGHT "ON"
LIGHT "OFF"
YES
NO
CKT 335 SHORTED TO GROUND OR FAULTY ECM.
FAULTY RELAY
WITHOUT A/C
WITH A/C
• USE A "SCAN" TOOL AND CHECK FAN REQUEST INPUT. DOES "SCAN" INDICATE FAN IS REQUESTED?
• ENGINE IDLING, A/C "ON".
• IF A/C IS INOP, SEE SECTION "1".
• FANS SHOULD TURN "ON" WHEN A/C HEAD PRESSURE EXCEEDS ABOUT 233 PSI (1606 kPa). DOES IT?
YES
NO
FAULTY ECM
• DISCONNECT A/C FAN CONTROL SWITCH.
• DOES "SCAN" INDICATE FAN IS REQUESTED?
YES
NO
NO TROUBLE FOUND. REFER TO DIAGNOSTIC AIDS OF FACING PAGE.
• DISCONNECT A/C PRESS. FAN CONTROL SWITCH.
• JUMPER HARNESS TERMINALS TOGETHER. DOES FAN TURN "ON"?
YES
NO
• DISCONNECT FAN TEMPERATURE SWITCH.
• DOES "SCAN" INDICATE FAN IS REQUESTED?
FAULTY CONNECTION OR FAULTY FAN CONTROL SWITCH.
YES
NO
FAULTY SWITCH
• JUMPER CKT 731 TO GROUND
• DOES FAN TURN "ON"?
YES
NO
NO
YES
CKT 731 OPEN, FAULTY CONNECTION OR FAULTY ECM.
REPAIR OPEN GROUND CIRCUIT
CKT 731 SHORTED TO GROUND OR FAULTY ECM. REFER TO SECTION "8A" FOR ENTIRE DIAGRAM OF CKT 731.
FAULTY TEMP SWITCH
8S 4280-6E
3-9-87

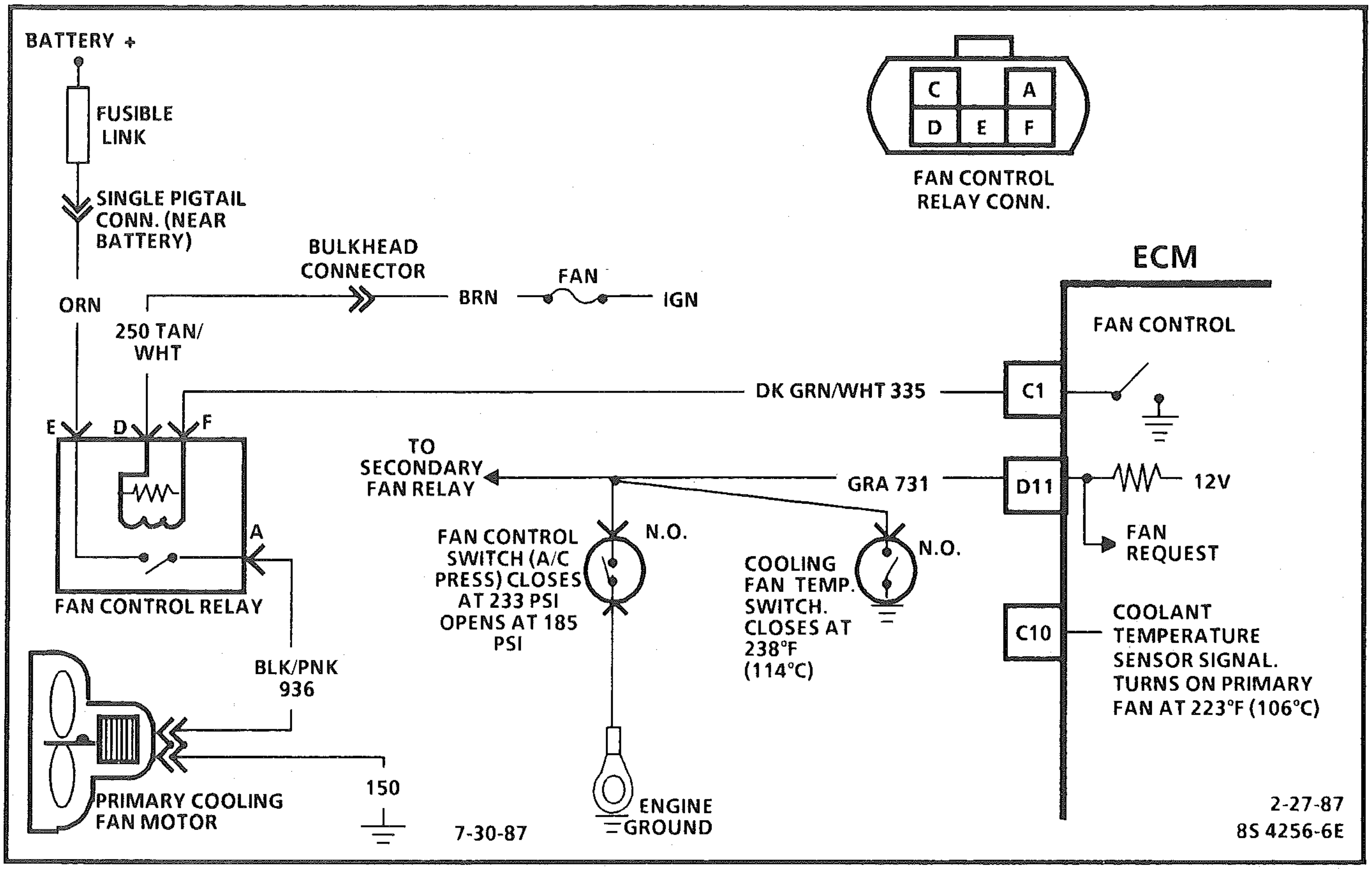


CHART C-12

(Page 2 of 2)
COOLING FAN CONTROL CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)

Circuit Description:

- The primary cooling fan is totally controlled by the ECM based on inputs from the coolant sensor and fan control switch. The fan should run, if coolant temperature is greater than 106°C (223°F).
- Battery voltage is supplied to the fan relay on terminal "E" and ignition voltage to terminal "D".
- Grounding CKT 335 (relay terminal "F") will energize the relay and supply battery voltage to the fan motor. Once the fan relay is energized by the ECM, it will remain "ON" for a minimum of 15 seconds.
- The ECM will remove the ground to CKT 335 if vehicle speed is over 40 mph unless the engine is overheating.
- The fan control switch, mounted in the A/C high pressure line, will close when head pressure exceeds 233 psi (1600 kPa) and this input causes the ECM to ground CKT 335.
- If a Code 14 or 15 sets, or if the ECM is operating in the fuel back-up mode, the ECM will turn "ON" the cooling fan.

Diagnostic Aids:

If the owner complained of an overheating problem, it must be determined if the complaint was due to an actual boil over or the hot light or temperature gage indicated overheating.

If the gate or light indicates overheating, but no boilover is detected, the gage circuit should be checked. The gage accuracy can also be checked by comparing the coolant sensor reading using a "Scan" tool and comparing its reading with the gage reading.

If the engine is actually overheating and the gage indicates overheating, but the cooling fan is not coming "ON", the coolant sensor has probably shifted out of calibration and should be replaced.

If the engine is overheating, and the cooling fan is "ON", the cooling system should be checked.

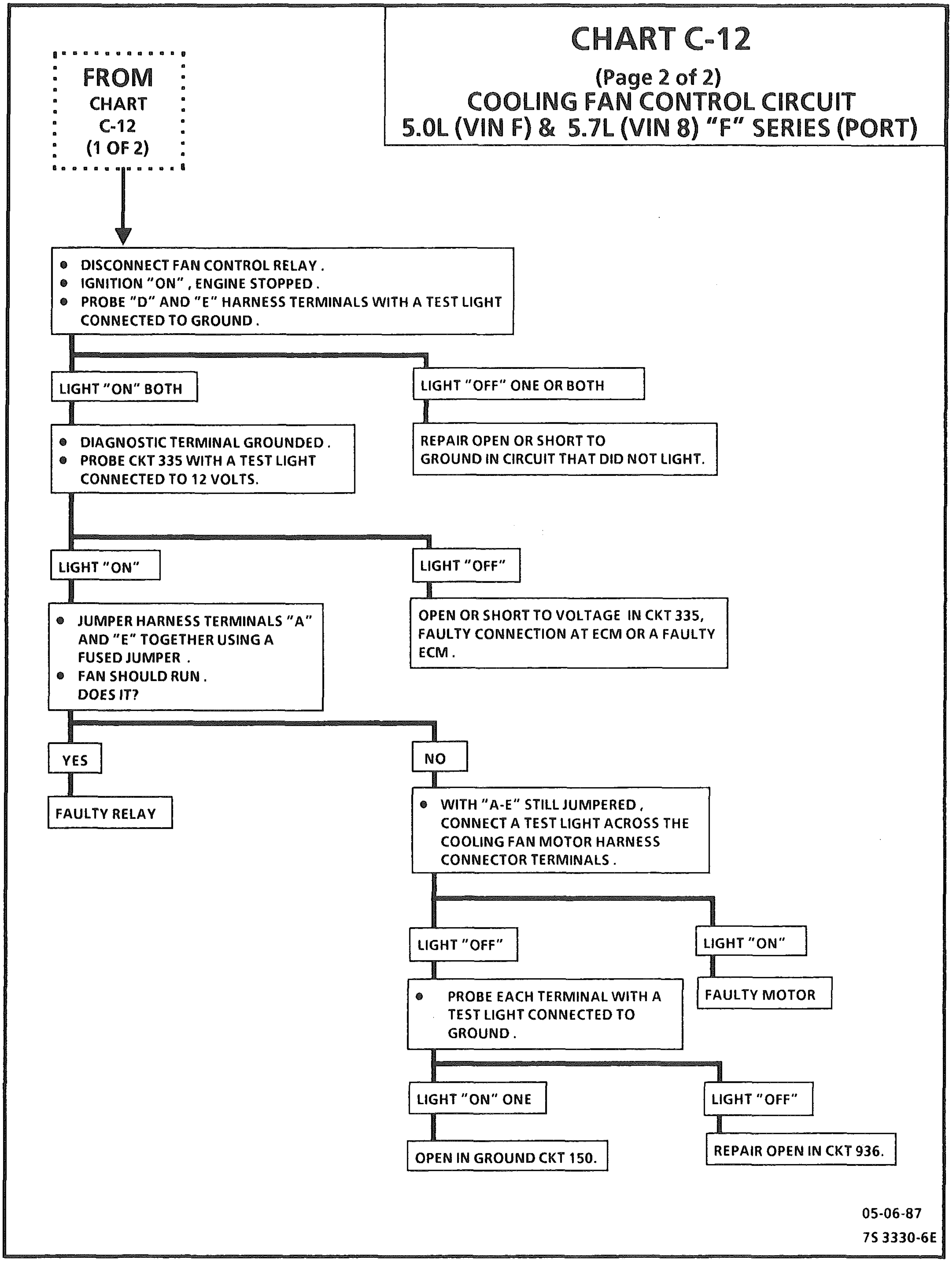


CHART C-12
(Page 2 of 2)
COOLING FAN CONTROL CIRCUIT
5.0L (VIN F) & 5.7L (VIN 8) "F" SERIES (PORT)
FROM CHART C-12 (1 OF 2)
• DISCONNECT FAN CONTROL RELAY. • IGNITION "ON", ENGINE STOPPED. • PROBE "D" AND "E" HARNESS TERMINALS WITH A TEST LIGHT CONNECTED TO GROUND.
LIGHT "ON" BOTH
LIGHT "OFF" ONE OR BOTH
REPAIR OPEN OR SHORT TO GROUND IN CIRCUIT THAT DID NOT LIGHT.
• DIAGNOSTIC TERMINAL GROUNDED. • PROBE CKT 335 WITH A TEST LIGHT CONNECTED TO 12 VOLTS.
LIGHT "ON"
LIGHT "OFF"
OPEN OR SHORT TO VOLTAGE IN CKT 335, FAULTY CONNECTION AT ECM OR A FAULTY ECM.
• JUMPER HARNESS TERMINALS "A" AND "E" TOGETHER USING A FUSED JUMPER. • FAN SHOULD RUN. DOES IT?
YES
FAULTY RELAY
NO
• WITH "A-E" STILL JUMPERED, CONNECT A TEST LIGHT ACROSS THE COOLING FAN MOTOR HARNESS CONNECTOR TERMINALS.
LIGHT "OFF"
LIGHT "ON"
FAULTY MOTOR
• PROBE EACH TERMINAL WITH A TEST LIGHT CONNECTED TO GROUND.
LIGHT "ON" ONE
OPEN IN GROUND CKT 150.
LIGHT "OFF"
REPAIR OPEN IN CKT 936.
05-06-87
7S 3330-6E

BLANK

SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

CONTENTS

GENERAL DESCRIPTION

A "closed" crankcase ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air cleaner is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the intake manifold (Figure C13-1).

The primary control is through the PCV valve (Figure C13-2) which meters the flow at a rate depending on manifold vacuum.

To maintain idle quality, the PCV valve restricts the flow when intake manifold vacuum is high. If abnormal operating conditions arise, the system is designed to allow excessive amounts of blow-by gases to back flow through the crankcase vent tube into the engine air inlet to be consumed by normal combustion.

RESULTS OF INCORRECT OPERATION

A plugged valve or hose may cause:

- Rough idle.
- Stalling or slow idle speed.
- Oil leaks.
- Sludge in engine.

A leaking valve or hose would cause:

- Rough idle.
- Stalling.
- High idle speed.

DIAGNOSIS

FUNCTIONAL CHECK OF PCV VALVE

If an engine is idling rough, check for a clogged PCV valve or plugged hose. Replace as required. Use the following procedure:

1. Remove PCV valve from rocker arm cover.
2. Run the engine at idle.
3. Place your thumb over end of valve to check for vacuum. If there is no vacuum at valve, check for plugged hoses or manifold port, or PCV valve. Replace plugged or deteriorated hoses.
4. Turn "OFF" the engine and remove PCV valve. Shake valve and listen for the rattle of check needle inside the valve. If valve does not rattle, replace valve.

With this system, any blow-by in excess of the system capacity (from a badly-worn engine, sustained heavy load, etc.) is exhausted into the air cleaner and is drawn into the engine.

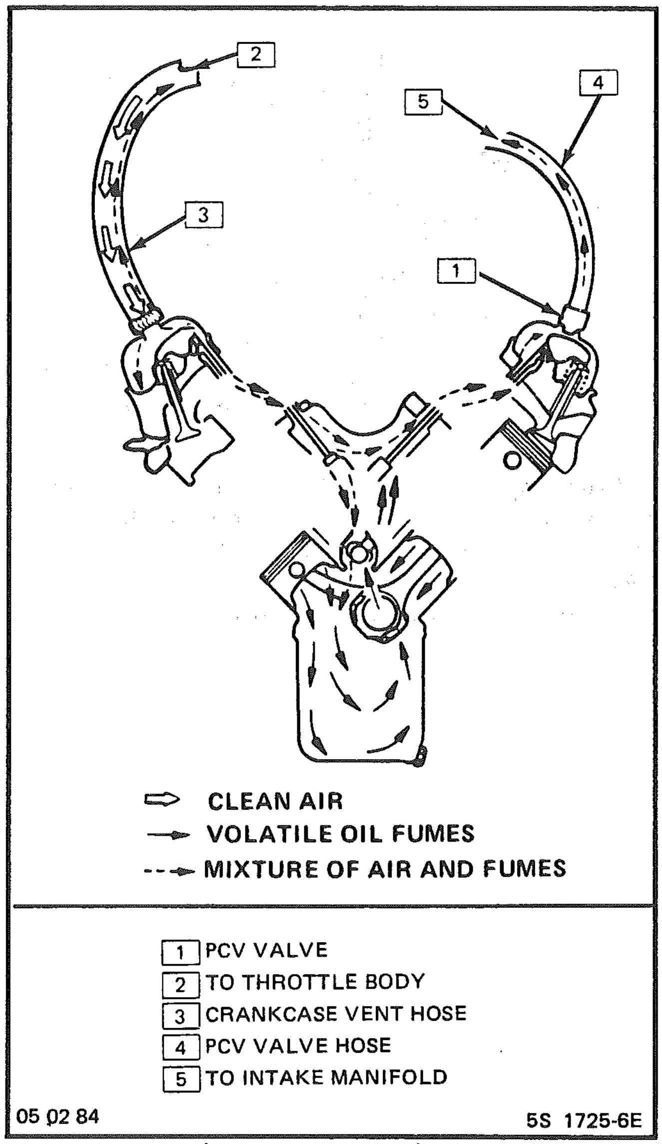


Figure C13-1 PCV Flow

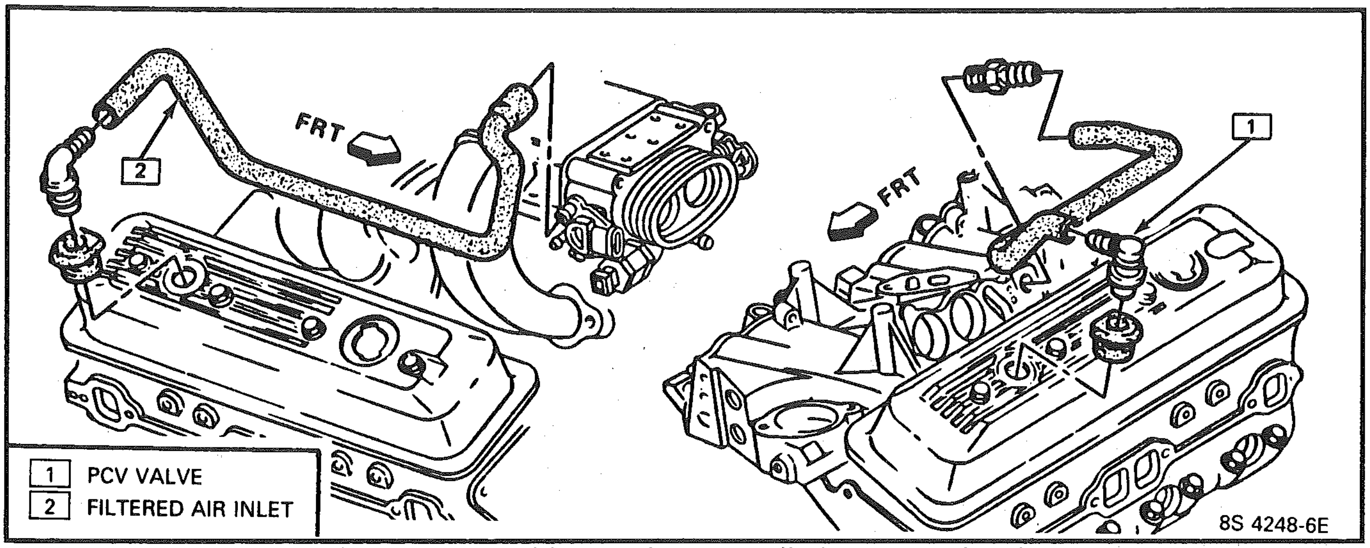


Figure C13-3 Positive Crankcase Ventilation System (5.7L)

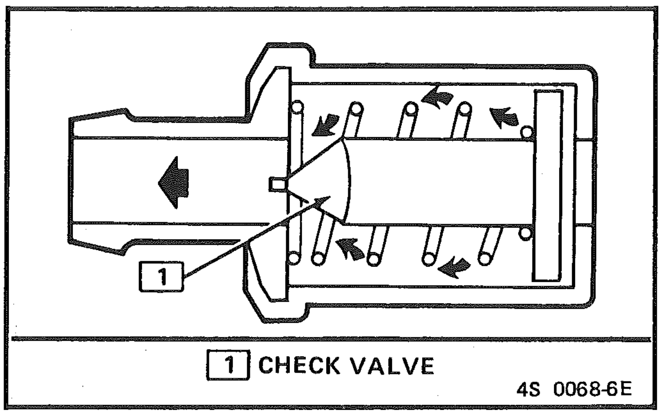


Figure C13-2 PCV Valve Cross Section

Proper operation of the PCV system is dependent upon a sealed engine. If oil sludging or dilution is noted, and the PCV system is functioning properly, check engine for possible cause and correct to ensure that system will function as intended.

ON-CAR SERVICE

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve at intervals shown in Section "OB".

Periodically, inspect the hoses and clamps and replace any showing signs of deterioration.

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Breather, A/C and Sil	3.410
Hose, C/Case Vent Vlv	1.762
Tube, C/Case Vent	1.762
Valve Asm, C/Case Vent	1.745

SECTION 6E
DRIVEABILITY AND EMISSIONS
CONTENTS
General Information - Section 6E
Driveability and Emissions - Fuel Injected (TBI) - Section 6E2
Driveability and Emissions - Fuel Injected (PORT) - Section 6E3
6E CONTENTS

DRIVEABILITY

The driveability diagnosis procedures apply to various systems in current GM vehicles. The procedures assume that the vehicle worked right at one time and the problem is due to time, wear, dirt or other causes. Start with the introduction that follows. This will describe a systematic diagnostic procedure.

Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

EMISSIONS

The exhaust emission control systems used on General Motors engines perform a specific function to lower exhaust emissions while maintaining good fuel economy and driveability.

MAINTENANCE SCHEDULE

Refer to the General Motors Maintenance Schedule in Section "0B" of the Chassis Service Manual for the maintenance service that should be performed to retain emission control performance.

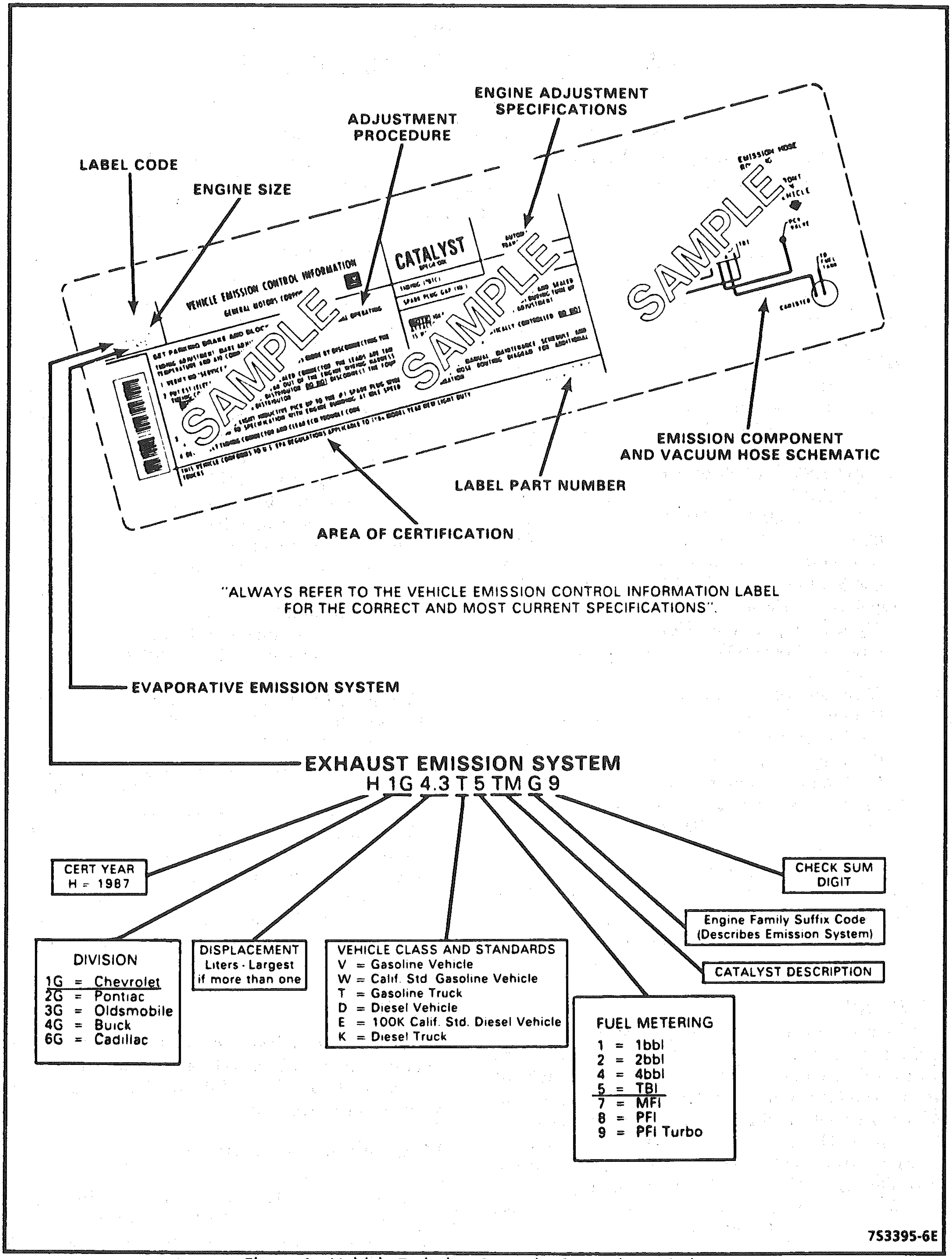


Figure 1 - Vehicle Emission Control Information Label

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Figure 1) contains important emission specifications and setting procedures. In the upper left corner is exhaust emission information which identifies the year, the manufacturing division of the engine, the displacement in liters of the engine, the class of vehicle and type of fuel metering. Also there is an illustrated emission component and vacuum hose schematic. A similar label is located in the engine compartment of every General Motors Corporation vehicle. If the label has been removed, it can be ordered from the parts division. (WDDGM)

INTRODUCTION

Electronic Engine Control

Each engine has an electronic engine control module (ECM) to control the fuel system. The ECM varies the air/fuel ratio by controlling the fuel flow through the injector(s).

In addition, the ECM controls the ignition timing as well as the fuel pump and other systems.

It is important to review the component sections and wiring diagrams in Section "6E2" and "6E3" for a specific engine, to determine what is controlled by the ECM and what systems are non-ECM controlled.

What This Section Contains

Each General Motors engine has system controls to reduce exhaust emissions while maintaining good driveability and fuel economy. This section explains:

- How to use the Driveability and Emission Sections "6E2" for TBI, and "6E3" for Port Fuel engines.
- A brief description of systems used to control fuel and emissions.
- Abbreviations that are used in "Driveability and Emissions".
- Wiring harness service information for harnesses used with the ECM.
- Special tools used to diagnosis and repair a system.

Before checking the system, observe the following:

Blocking Drive Wheels

The vehicle drive wheels always should be blocked, and parking brake firmly set, while checking the system.

Cold Oxygen Sensor

On some engines, the oxygen sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop". To restore "Closed Loop" operation, run the engine at part throttle and accelerate from idle to part throttle a few times until the system goes "Closed Loop".

VISUAL/PHYSICAL UNDERHOOD INSPECTION

One of the most important checks that must be done as part of any diagnostic procedures or finding the cause of, an emissions test failure is a careful visual/physical underhood inspection. This can often lead to fixing a problem without further steps. Inspect all vacuum hoses for correct routing, pinches, cuts, or disconnects. Be sure to inspect hoses that are difficult to see beneath the air cleaner, compressor, generator, etc. Inspect all the wires in the engine compartment for correct and good connections, burned or chafed spots, pinched wires, or contact with sharp edges or hot exhaust manifolds. This visual/physical inspection is very important. It must be done carefully and thoroughly.

BASIC KNOWLEDGE REQUIRED

Before using this section of the service manual, there are some areas that you should be familiar with. Without this basic knowledge, you will have trouble using the diagnostic procedures contained in this section.

Basic Electric Circuits

You should understand the basic theory of electricity, and know the meaning of voltage, amps,

ALL NEW GENERAL MOTORS VEHICLES ARE CERTIFIED BY THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY AS CONFORMING TO THE REQUIREMENTS OF THE REGULATIONS FOR THE CONTROL OF AIR POLLUTION FROM NEW MOTOR VEHICLES. THIS CERTIFICATION IS CONTINGENT ON CERTAIN ADJUSTMENTS BEING SET TO FACTORY STANDARDS. IN MOST CASES, THESE ADJUSTMENT POINTS EITHER HAVE BEEN PERMANENTLY SEALED AND/OR MADE INACCESSIBLE TO PREVENT INDISCRIMINATE OR ROUTINE ADJUSTMENT IN THE FIELD. FOR THIS REASON, THE FACTORY PROCEDURE FOR TEMPORARILY REMOVING PLUGS, CAPS, ETC., FOR PURPOSES OF SERVICING THE PRODUCT, MUST BE STRICTLY FOLLOWED AND, WHEREVER PRACTICABLE, RETURNED TO THE ORIGINAL INTENT OF THE DESIGN.

and ohms. You should understand what happens in a circuit with an open or a shorted wire. You should be able to read and understand a wiring diagram. A short to ground is referred to as a ground to distinguish it from a short between wires.

Use of Circuit Testing Tools

You should know how to use a test light, how to connect and use a tachometer, and how to use jumper wires to by-pass components to test circuits. Care should be taken to not deform the terminal when testing.

Use of Digital Volt-Ohm Meter (DVM)

You should be familiar with the digital volt-ohm Meter, particularly essential tool J-29125-A, J34029A or equivalent. You should be able to measure voltage, resistance, and current, and know how to use the meter correctly.

The digital volt-ohm meter is covered in the "Special Tools"portion of this section.

DIAGNOSTIC INFORMATION

The electronic control module (ECM) is equipped with a self-diagnosis system which detects system failure and aids the technician by identifying the circuit at fault via a trouble code. Below is information about the way the ECM displays a problem and how this corresponds to a trouble code in the ECM. The ECM can also indicate an "Open Loop" or "Closed Loop" mode.

"Service Engine Soon" Light

This light is on the instrument panel, and has two functions:

- It is used to tell the driver that a problem has occurred, and that the vehicle should be taken for service as soon as reasonably possible.
- It is used by the technician to read out "Trouble Codes" to help diagnose system problems.

As a bulb and system check, the light will come "ON" with the key "ON" and the engine not running. When the engine is started, the light will turn "OFF". If the light remains "ON", the self-diagnostic system has detected a problem. If the problem goes away, the light will go out in most cases after 10 seconds, but a Trouble Code will remain stored in the ECM.

Intermittent "Service Engine Soon" Light

The diagnostic charts in Section "A" are set up to check whether or not a stored trouble code is "intermittent" or "hard".

An "intermittent" code is one which does not always reset when the code setting parameters are met, or is not present while you are working on the vehicle. This is often caused by a loose connection. The facing page will contain diagnostic aids to help in detecting intermittents.

A "hard" code is one which is present when you are working on the vehicle and the condition still exists while working on the vehicle. The chart with the stored trouble code number will lead you to the cause of the problem.

Trouble Codes

The engine control module (ECM) is really a computer. It uses sensors to look at many engine operating conditions. It has a memory and it knows what certain sensor readings should be under certain conditions. These conditions are described on the facing page of each Trouble Code chart. If a sensor reading is not what the ECM thinks it should be, the ECM will turn "ON" the "Service Engine Soon" light on the instrument panel, and will store a Trouble Code in the memory. The Trouble Code tells which circuit the trouble is in. A circuit consists of a sensor (such as coolant temperature), the wiring and connectors to it, and the ECM.

To get a Trouble Code out of the ECM, we use the assembly line diagnostic link (ALDL) connector.

ALDL Connector

The assembly line diagnostic link (ALDL) is a diagnostic connector located in the passenger compartment (Figure 2). It has terminals which are used in the assembly plant to check that the engine is operating properly before it leaves the plant.

Terminal "B" is the Diagnostic terminal, and it can be connected to terminal "A", or ground, to enter the Diagnostic mode, or the Field Service Mode.

The ALDL connector is also used by "Scan" tools to read information from the ECM via the Serial Data Line. Serial Data information is used extensively throughout the manual.

Diagnostic Mode

If the Diagnostic terminal is grounded with the ignition "ON" and the engine stopped, the system will enter the Diagnostic Mode. In this mode the ECM will:

1. Display a Code 12 by flashing the "Service Engine Soon" light (indicating the system is operating). A Code 12 consists of one flash, followed by a short pause, then two flashes in quick succession. This code will be flashed three times. If no other codes

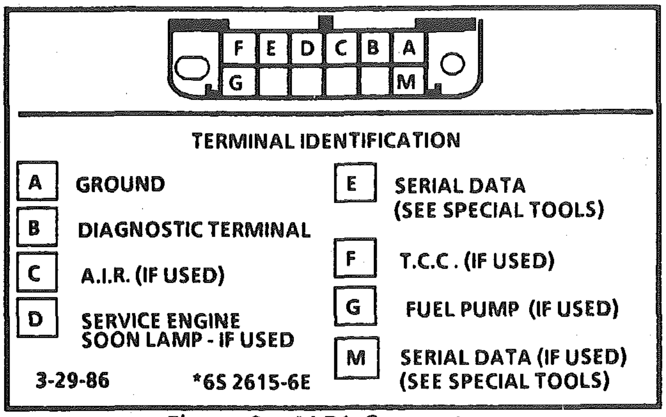


Figure 2 - ALDL Connector

are stored, Code 12 will continue to flash until the Diagnostic terminal is ungrounded.

Codes can only be obtained with the engine stopped. Grounding the Diagnostic terminal with the engine running gives the "field service mode".

2. Display any stored trouble codes by flashing the "Service Engine Soon" light. Each code will be flashed three times, then Code 12 will be flashed again.

   If a trouble code is displayed, the memory is cleared, then the engine is run to see if the code is a "hard" or "intermittent" failure. If it is a "hard" failure, a Diagnostic Code chart is used to find the problem. If it is an intermittent failure, the charts are not used. Diagnostic aids are usually included on the facing page. Section "B" also covers the topic of "Intermittents". A physical inspection of the applicable system most often will resolve the problem.
3. Energize all ECM controlled relays and solenoids except fuel pump relay .
4. The IAC valve on most models also moves to the fully extended position.

Field Service Mode

If the Diagnostic terminal is grounded with the engine running, the system will enter the Field Service mode. In this mode, the "Service Engine Soon" light will show whether the system is in "Open" or "Closed Loop".

In "Open Loop" the "Service Engine Soon" light flashes two and one-half times per second.

In "Closed Loop", the light flashes once per second: Also, in "Closed Loop", the light will stay OUT most of the time if the system is too lean. It will stay "ON" most of the time if the system is too rich.

While the system is in Field Service Mode, the ECM will be in the following mode:

1. New trouble codes cannot be stored in the ECM.
2. The "Closed Loop" timer is bypassed.

Clearing Trouble Codes

When the ECM sets a trouble code, the "Service Engine Soon" light will come "ON" and a trouble code will be stored in memory. If the problem is intermittent, the light will go out 10 seconds after the fault goes away. However, the trouble code will stay in the ECM memory until the battery voltage to the ECM is removed. Removing battery voltage for 30 seconds will clear all stored trouble codes.

Trouble Codes should be cleared after repairs have been completed. Also, some diagnostic charts will tell you to clear the codes before using the chart. This allows the ECM to set the code while going thru the chart, which will help to find the cause of the problem more quickly.

NOTICE: To prevent ECM damage, the key must be "OFF" when disconnecting or reconnecting power to ECM (for example battery cable, ECM pigtail, ECM fuse, jumper cables, etc.).

ECM Learning Ability

The ECM has a "learning" ability which allows it to make corrections for minor variations in the fuel system to improve driveability. If the battery is disconnected to clear diagnostic codes, or for repair, the "learning" process has to begin all over again. A change may be noted in the vehicle's performance. To "teach" the vehicle, make sure the engine is at operating temperature, and drive at part throttle, with moderate acceleration and idle conditions, until normal performance returns.

DRIVEABILITY AND EMISSIONS

SECTIONS 6E2 and 6E3 SUMMARY

The Driveability and Emissions sections are subdivided into three sub-sections:

SECTION A: STARTING POINT AND CODE CHARTS

- Diagnostic circuit check (Starting Point)
- No-start and fuel system check charts
- Code Charts

SECTION B: SYMPTOMS

- Based on driveability symptoms, when no codes, or intermittent codes, are stored.

SECTION C: COMPONENT SYSTEMS

- Circuit descriptions
- On-car service
- Functional check/Diagnosis charts

SECTION A

Diagnostic Procedure Summary

This is the starting point for the diagnostic procedures or an emissions test failure. The diagnostic charts are related to the ECM and will determine if the ECM is working properly. This section diagnoses the fuel system controlled by the ECM and has charts to diagnose a circuit when the ECM has displayed a trouble code.

The way to approach a problem is to follow three basic steps (shown in Figure 3):

1. Are the On-Vehicle Diagnostics working? We find this out by performing the "Diagnostic Circuit Check". Since this is the starting point for the diagnostic procedures or finding the cause of an emissions test failure, always begin here. If the On-Vehicle Diagnostics aren't working, the "Diagnostic Circuit Check" will lead you to a chart in Section "A" to correct the problem. If the On-Vehicle Diagnostics are OK, the next step is:
2. Is there a Trouble Code stored? If a trouble code is stored, go directly to the numbered code chart in Section "A". This will determine if the fault is still present. If no trouble code is stored, then:
3. "Scan" Serial Data. This involves reading the various pieces of information available on the Serial Data Stream with one of the tools available for that purpose. Information on these tools and the meaning of the various displays can be found in the succeeding paragraphs. Expected readings can be found on the facing page for the Diagnostic Circuit Check.

This short procedure will help lead you to repair the problem in the least amount of time.

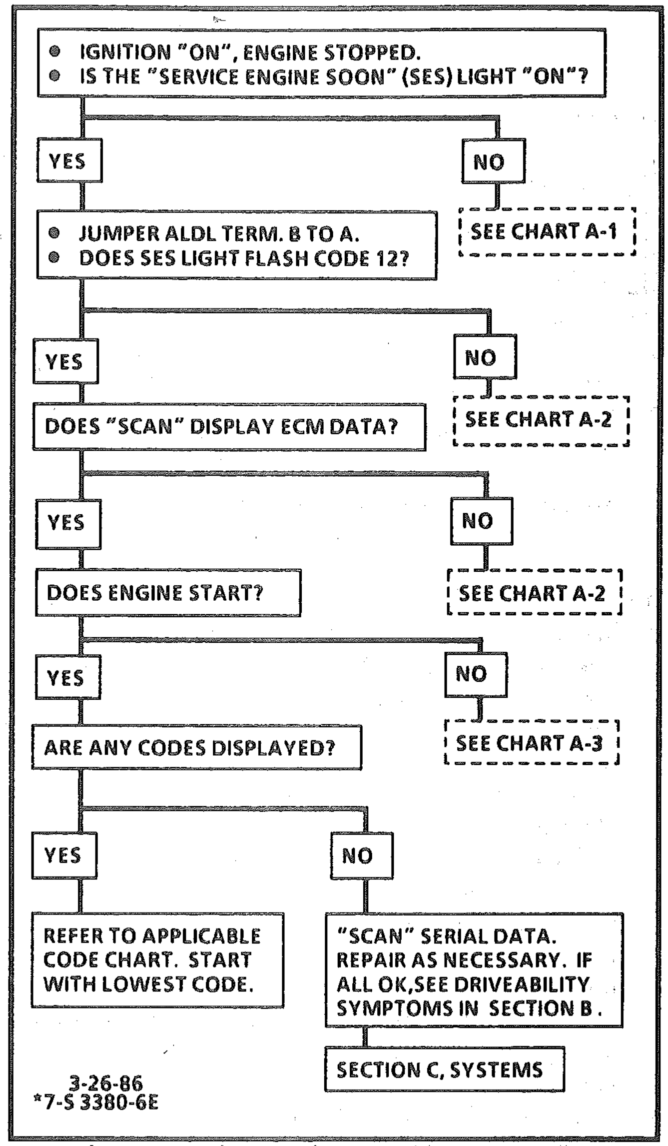


Figure 3 - Diagnostic Procedure Summary

ALDL "SCAN" TOOLS

The ALDL connector under the dash has a variety of information available on terminal "E" or "M" (depending on engine). There are several tools on the market for reading this information.

"Scan" tools do not make the use of diagnostic charts unnecessary. They do not tell exactly where a problem is in a given circuit. However, with an understanding of what each position on the equipment measures, and knowledge of the circuit involved, the tools can be very useful in getting information which would be more time consuming to get with other equipment.

In some cases, "Scan" tools will provide information that is either extremely difficult or impossible to get with other equipment.

A "SCAN" TOOL THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM SHOULD BE REPORTED TO THE MANUFACTURER. THE USE OF A FAULTY "SCAN" TOOL CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

Trouble Tree Charts incorporate diagnosis procedures using an ALDL "Scan" tool where possible. Most charts require use of a "Scan" tool when it is applicable. Unless instructed otherwise, code charts in "6E" Section "A" should not be used for diagnosis unless the fault is still present (a "hard" failure).

Some ECM's have three modes for transmitting information but some only read data in the open mode.

The following information will describe each of the three modes where applicable and the effects they may cause.

Normal (Open) Mode

Not all engines and ECM families will transmit information on the Serial Data Line while in this mode.

On engines that can be monitored in the open mode, it allows certain parameters to be obtained without changing the engine operating characteristics. The parameters capable of being read vary from engine family to engine family. Most "Scan" tools are programmed so that the system will go directly into the special mode if the "open" mode is not available.

ALDL (10K, or Special) Mode (not used on all engines)

In this mode, all information incorporated into a specific engine and ECM is obtainable. However, in this mode the system operating characteristics are modified as follows.

- "Closed Loop" timers are bypassed
- EST (spark) is advanced
- IAC will control engine idle to 1000 rpm ± 50 rpm (if applicable)
- On some engines, canister purge solenoid will be enabled
- P/N restrict functions will be disabled.

Factory Test (Back-up or 3.9 K) Mode (TBI, Port)

In this mode, the ECM is operating on the fuel back-up logic and is calibrated by the Calpak or Mem-cal. These are used to control the fuel delivery if the ECM fails. This mode verifies that the back-up feature is OK. The parameters that can be read on a "Scan" tool in this mode are not of much use for service.

"SCAN" TOOL LIMITATIONS AND USE

The "Scan" tool allows a quick check of sensors and switches which are inputs to the ECM. However, on some applications the data update rate makes the tool less effective as a voltmeter when trying to detect an intermittent which lasts for a very short time. However, the "Scan" tool allows one to manipulate wiring harnesses or components under the hood while observing the "Scan" readout. This helps in locating intermittents with the engine not running.

Intermittent Conditions

The "Scan" tool is helpful in cases of intermittent operation. The tool can be plugged in and observed while driving the vehicle under the condition where the light comes "ON" momentarily, or the engine driveability is poor momentarily. If the problem seems to be related to certain areas that can be checked on the "Scan" tool, then those are the positions that should be checked while driving the vehicle. If there does not seem to be any correlation between the problem and any specific circuit, the "Scan" tool can be checked on each position, watching for a period of time to see if there is any change in the readings that indicates intermittent operation.

The "Scan" tool is also a useful and quick way of comparing operating parameters of a poorly operating engine with a known good one. For example; A sensor may shift in value but not set a code. Comparing with a known good vehicle may uncover the problem.

The "Scan" tool has the ability to save time in diagnosis and prevent the replacement of good parts. The key to using the "Scan" tool successfully for diagnosis lies in the technician's ability to understand the system he is trying to diagnose as well as an understanding of the "Scan" tool's limitations. Therefore, the technician should read the tool manufacturer's operating manual to become familiar with the operation. The following information will describe most of the "Scan" tool positions and how they can be helpful in diagnosis.

"SCAN" TOOL POSITIONS

The following positions may not be applicable to all engines. See the facing page of the diagnostic circuit check for a particular engine to decide which positions apply to that engine.

Mode

Check with the manufacturer to determine what the function of this mode is. In most cases it allows the user to place the ECM in different operating modes.

Injector Pulse Width

In this position, the reading is given in milliseconds, which is the "ON" time that the ECM is commanding to the injector(s).

Closed Loop/Open Loop

This position will indicate whether the engine control system is operating in "Open Loop" or "Closed Loop". Most systems go "Closed Loop" after a certain amount of running time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Exhaust (Rich/Lean Indicator)

This indicates the O_2 sensor voltage at the instant that the data stream is sampled. If voltage is less than 350 mv, the value will be lean. If above 550 mv, a rich exhaust is indicated.

Trouble Codes

This will display any trouble codes stored in the ECM memory.

Throttle Position Sensor (TPS)

Values read will be the voltage as seen by the ECM. The voltage should be the TPS specification with the throttle closed and go up to about 5 volts with throttle wide open (WOT).

Throttle Angle

Displayed, in percent, is the amount the throttle is open. 0% is closed throttle, 100% is wide open throttle.

Oxygen (O_2) Sensor

The reading will be read out in millivolts (mv) with a range from 1 to 999 mv. If the reading is consistently below 350 (350 mv), the fuel system is running lean as seen by the ECM; and if the reading is consistently above 550 (550 mv), the system is running rich.

PROM ID

In this position, information is used for assembly verification only. PROM ID is useful only when the vehicle is equipped with the original ECM and PROM or Mem-Cal.

RPM

Reading displays engine rpm. It is often useful if extra reference pulses are suspected. A sudden high rpm indication while at a steady throttle would indicate electrical interference (EMI) in the reference circuit. This interference is usually caused by ECM wires too close to ignition secondary wires or an open distributor ground circuit.

MPH

Displayed is vehicle speed, useful in checking TCC application speed or speedometer accuracy.

MAF

This displays the amount of air passing the Mass Air Flow (MAF) sensor, in grams per second. It is useful when comparing the airflow between a problem vehicle and a known good one. Normal readings at idle are about 4 to 8 grams. If a MAF code is set, this reading will display the ECM default value.

Airflow

This display should be the same as MAF when there are no failures in the MAF sensor circuit. When an MAF code is set, however, this value will not change, and will indicate the gm/sec that the failure has detected.

Coolant Temperature

Engine temperature is displayed in Celsius degrees. After the engine is started, temperature should rise steadily to about 85-95° C, then stabilize when the thermostat opens.

Manifold Air Temperature (MAT) Sensor

This displays temperature of the intake manifold air. It should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperatures increase.

Manifold Absolute Pressure (MAP)

The MAP sensor produces a low signal voltage when manifold pressure is low (high vacuum) and a high voltage when the pressure is high (low vacuum).

With the ignition "ON" and the engine stopped, the manifold pressure is equal to atmospheric pressure, and the signal voltage will be high. This information is used by the ECM as an indication of vehicle altitude and is referred to as BARO. Comparison of this BARO reading with a known good vehicle with the same sensor is a good way to check accuracy of a "suspect" sensor *. Readings should be the same ±.4 volt.

* A MAP sensor has a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector color also should be the same as the sensor insert color.

Vacuum (Differential Pressure) Sensor

The vacuum sensor produces a low signal voltage when manifold vacuum is low, and a high voltage when the vacuum is high .

With the ignition "ON" and the engine stopped, there is no vacuum, so the voltage is low (under 1 volt). With the engine idling the vacuum is high so the voltage is high (over 3 volts).

A vacuum sensor has a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector color also should be the same as the sensor insert color.

Baro

This displays barometric pressure. The ECM uses this information to adjust for altitude and pressure. This value will vary depending on barometric pressure and altitude. Some vehicles use a dedicated baro sensor, while others take a MAP reading before the engine is started, and at various times during engine operation.

Park/Neutral Switch

The indication in this mode may vary with manufacturer so the type of reading for a particular tool should be checked in the operator's manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from park/neutral to drive or reverse.

Torque Convertor Clutch (TCC)

In this position, the tool will indicate when the TCC has been commanded by the ECM to turn "ON". This does not necessarily mean that the clutch was engaged but only that the ECM grounded the circuit internally. The best way to determine if the clutch has engaged is to monitor engine rpm when the TCC comes "ON".

EGR (Duty Cycle)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NO_x. Like all ECM outputs, the "Scan" tool only indicates that the ECM has commanded the function, and does not indicate that the function has really happened.

EGR Position

This indicates the position of the EGR pintle.

Integrator and Block Learn

Normal readings for these positions are around 128. If higher, it indicates that the ECM is adding fuel to the base fuel calculation because the system is lean, and if the numbers are below 128, the ECM is taking out fuel from the base calculation because the system is rich. The integrator gives short term corrective action, while the block learn portion (which is a long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

Block Learn Multiplier (BLM) Cell - or - Block Learn Memory (BLM)

There are up to sixteen different cells, corresponding to ranges of rpm and engine load (indicated by MAF or MAP signals), and other conditions, such as A/C or P/N switch "ON" or "OFF", etc. The ECM learns how much adjustment is needed in each cell, and retains it in memory, so that the adjustment will immediately be made when the engine operates in that cell (or rpm/load range). This parameter will display what cell the ECM is currently using for the fuel calculation.

IAC (Idle Air Control)

This system is used to control engine idle speed to the desired rpm, for different operating conditions. In this mode, the numbers will indicate the position to which the ECM has moved the valve pintle. The ECM moves the IAC in counts, or steps, and the number of these counts are displayed on a "Scan" tool.

Desired RPM

This indicates the rpm to which the ECM is trying to control the idle.

Shift Light

This displays "yes" when the ECM is commanding the shift light to turn "ON".

PPSW (Pump Prime Switch)

This is the voltage on the fuel pump feed circuit. The ECM will adjust fuel injector base pulse width from this voltage value rather than from battery voltage.

A/C Request

The state of the A/C signal line to the ECM is shown. It should read "yes" whenever the A/C is requested.

A/C Clutch

"ON" is displayed when the ECM has commanded the A/C clutch "ON".

Knock Retard

This indicates the number of degrees the ECM is retarding the electronic spark timing (EST).

Knock Signal

This displays a "yes" when knock is detected by the ECM, and a "no" when knock is not detected.

Battery Voltage

This displays the battery voltage detected at the ECM ignition input.

Fan

"ON" is displayed when the cooling fan has been commanded "ON".

CCP (Carbon Canister Purge)

This displays "ON" when the canister purge solenoid is commanding purge. Some display duty cycle from 0-100%.

2nd Gear

This displays the state of the 2nd gear switch. Yes = 2nd gear applied. It remains applied in 3rd and 4th gears.

3rd Gear

This displays the state of the 3rd gear switch. Yes = 3rd gear applied. It remains applied in 4th gear.

4th Gear

This displays the state of the 4th gear switch. Yes = 4th gear applied.

Fan Request

State of the A/C fan control switch is displayed. It should read "yes" when fan is requested. Some engines may display the state of the 2nd fan, if used.

Power Steering Pressure Switch

This reading displays the state of switch, and may vary with the tool used, and the type of switch installed on the vehicle. The important thing is that the reading changes state (switches) when the steering is moved against the stops.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section "A" "Diagnostic Circuit Check" before proceeding to the driveability symptoms or an emissions test failure. Section "A" checks the ECM, which may cause the driveability problem. A definition of each symptom is included. This will then lead to the most probable causes of the driveability problem.

SECTION C - COMPONENT SYSTEMS

There are many component systems that are used to control fuel and emissions. Section "C" introduces each component system or control with a general description, diagnosis, and on-vehicle service.

Each of the Section "C" diagnosis sections contain information on how the "Scan" tool can be used for diagnosing a particular component when a trouble code has not been set. (example: Section "C1" under diagnosis will explain how the "Scan" tool can be used for diagnosis as well as what the normal readings would be for the ECM sensors.)

Electronic Control Module (ECM)

This section describes the ECM and the information sensors in the system. Figure 4 shows the operating conditions which the ECM may sense and the systems that the ECM may control. (See specific engines to determine which are applicable to that engine.)

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber by controlling the fuel flow through the injector(s).

Electric Fuel Pump (In-tank)

The in-tank fuel pump is controlled by the ECM. When ignition is turned "ON", the pump will run for 2 seconds, then stop unless the ECM is receiving ignition pulses, as when cranking or running.

Evaporative Emission Control

This system has a canister which stores fuel vapor from the fuel tank. The fuel vapor is removed from the canister and consumed in the normal combustion process when the engine is running. This system is used on all engines and may or may not be controlled by the ECM.

Electronic Spark Timing (EST)

This system is controlled by the ECM, which controls spark advance (timing), and is used on all engines.

Electronic Spark Control (ESC)

This system uses a knock sensor in connection with the ECM to control spark timing, to allow the engine to have maximum spark advance without spark knock. This improves driveability and fuel economy, but will retard spark if detonation (spark knock) is detected.

Air Injection Reaction (A.I.R.)

The system provides additional oxygen to the exhaust gases to continue the combustion process. The system also supplies additional air to the catalytic converter under certain conditions. The A.I.R. system is not on all engines.

Early Fuel Evaporation (EFE)

The EFE system heats the engine induction system electrically or with exhaust gas during cold

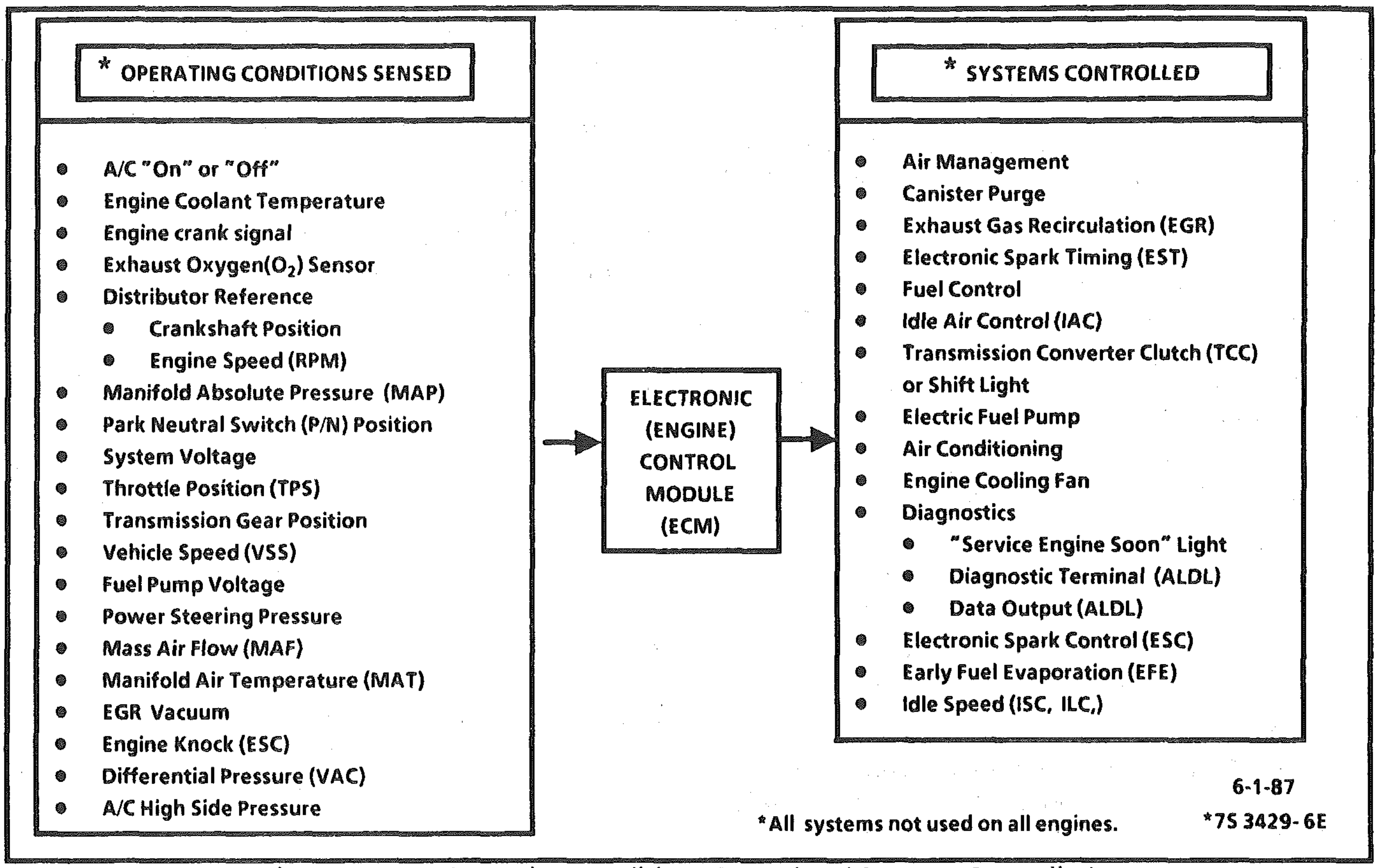


Figure 4 - ECM Operating Conditions Sensed and Systems Controlled

driveaway. This system is not used on all engines and may or may not be controlled by the ECM.

Exhaust Gas Recirculation (EGR)

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NO_x.

Transmission Converter Clutch (TCC)

The TCC is ECM controlled and is used on all engines with an automatic transmission. This system reduces slippage losses in the torque converter by coupling the engine flywheel to the output shaft of the transmission.

Shift Light Control

The ECM controls the shift light on some manual transmission vehicles to indicate the best shift point for maximum fuel economy. This control is not on all applications.

A/C Clutch Control

The ECM may control the A/C clutch on the compressor to improve idle quality. This control is not on all engines.

Electric Cooling Fan Control

Under certain conditions, the ECM may control the electric cooling fan to cool the engine and A/C condenser. At cruising speed, the ECM may turn the fan off for better fuel economy. This control is on transverse engine front wheel drive vehicles.

Positive Crankcase Ventilation (PCV) or Crankcase Ventilation (CV)

The PCV or CV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on all engines.

Thermostatic Air Cleaner (THERMAC)

The THERMAC system regulates heated air through the air cleaner to provide uniform inlet air temperature, which gives good driveability under various climatic conditions. This system is not controlled by the ECM.

ABBREVIATIONS AND GLOSSARY OF TERMS

Abbreviations used in this section are listed below in alphabetical order with an explanation of the abbreviation. There are some variations in the use of periods and in capitalization (as mph, m.p.h., Mph, and MPH) for abbreviations used in this Section, but all types are acceptable.

A/F - AIR/FUEL (A/F RATIO)

A.I.R. - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust emissions.

ALDL - ASSEMBLY LINE DIAGNOSTIC LINK - Used at assembly to evaluate Computer Command Control, and for service to flash the "Service Engine Soon" light if there are trouble codes. It also is used by "Scan" tools to obtain ECM serial data.

BARO - BAROMETRIC ABSOLUTE PRESSURE SENSOR - Reads atmospheric pressure.

B + - Battery Positive Terminal (12 Volts) or system voltage with the engine running (approximately 13.8 v.)

CALPAK - A device used with fuel injection to allow fuel delivery in the event of a PROM or ECM malfunction.

CALIBRATOR - (PROM) - An electronic component that can be specifically programmed to meet engine operating requirements for a specific vehicle model. It plugs into the Engine Control Module (ECM).

CCC - COMPUTER COMMAND CONTROL - has an electronic control module to control air/fuel and emission systems.

CLCC - CLOSED LOOP CARBURETOR CONTROL - Used to describe oxygen sensor to ECM to M/C solenoid circuit operation.

C³I - Computer Controlled Coil Ignition. Produces the ignition spark without the aid of an ignition distributor.

CCP - CONTROLLED CANISTER PURGE - ECM controlled solenoid valve that permits manifold vacuum to purge the evaporative emissions from the charcoal canister.

CID - CUBIC INCH DISPLACEMENT - Used to describe engine size.

C/L OR C/LOOP - "CLOSED LOOP" - Describes ECM fuel control when using oxygen sensor information.

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the engine control module.

CONV. - CATALYTIC CONVERTER, THREE-WAY - EXHAUST CONVERTER. Containing platinum and palladium to speed up conversion of HC and CO, and rhodium to accelerate conversion of NO_x.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

CV - CRANKCASE VENTILATION - Prevents fumes in crankcase from passing into the atmosphere, by drawing them into the intake manifold and burning them in the the combustion process.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing "Service Engine Soon" light or displaying on a "Scan" tool. This code can be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALDL Connector which is grounded to get a Trouble Code. It is grounded with the engine running to enter the "Field Service Mode".

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DVM (10 Meg.) - Digital Voltmeter with 10 Million ohms resistance - used for measurement in electronic systems.

DWELL - The amount of time (recorded on a dwell meter in degrees of crankshaft rotation) that current passes through a closed switch; for example, ignition contact points or internal switch in an electronic control module.

EAC - ELECTRIC AIR CONTROL - Used on A.I.R. system to direct air flow to air switching valve or to atmosphere.

EAS - ELECTRIC AIR SWITCHING - used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ENGINE CONTROL MODULE (ELECTRONIC) - A metal case (located in passenger compartment) containing electronic circuitry which electrically controls and monitors air/fuel and emission systems on computer command control, and turns "ON" the "Service Engine Soon" light when a malfunction occurs in the system.

EFI - ELECTRONIC FUEL INJECTION - Computer Command Control using throttle body fuel injection.

EGR - EXHAUST GAS RECIRCULATION - Method of reducing NO_x emission levels by causing exhaust gas to be added to air/fuel mixture in combustion chamber, thus cooling combustion.

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION - Method of warming the intake manifold during cold engine operation. Provides efficient air/fuel mixing.

ENERGIZE/DE-ENERGIZE - When current is passed through a coil (energized) such as the canister purge solenoid, the plunger is pulled into the solenoid.

When the voltage to the solenoid is turned off, (de-energized), a spring raises the plunger.

ESC - ELECTRONIC SPARK CONTROL - Used to sense detonation and retard spark advance when detonation occurs.

EST - ELECTRONIC SPARK TIMING - ECM controlled timing of ignition spark.

EVRV - ELECTRONIC VACUUM REGULATOR VALVE - Controls EGR vacuum.

FED - FEDERAL - Vehicle/Engine available in all states except California.

GROUND - The negative (-) side of the battery. Also could be a wire (conductor) shorted to ground.

HC - HYDROCARBONS - One of the pollutants found in engine exhaust.

HIGH IMPEDANCE VOLTMETER - Has high opposition to the flow of electrical current. Good for reading circuits with low current flow, such as found in electronic systems because it allows tests to be made without affecting the circuit.

HEI - HIGH ENERGY IGNITION - A distributor that uses an electronic module and pick-up coil in place of contact points.

Hg - MERCURY - A calibration material used as a standard for vacuum measurement.

IAC - IDLE AIR CONTROL - A valve installed in the throttle body of fuel injected systems and controlled by the ECM to regulate idle speed.

IDEAL MIXTURE - The air/fuel ratio which provides the best performance, while maintaining maximum conversion of exhaust emissions. Typically it is 14.7:1.

IDI - INTEGRATED DIRECT IGNITION - Produces the ignition spark without the aid of an ignition distributor or spark plug wires.

IDLE AIR BLEED VALVE - Controls the amount of air let into the idle fuel mixture prior to the mixture entering the carburetor idle system, when the M/C solenoid is energized.

IGN - IGNITION

ILC - IDLE LOAD COMPENSATOR - Device used to control throttle angle during long deceleration, such as coasting down a long grade; it extends at wide open throttle position or to prevent engine stalls at idle.

INPUTS - Information from sources (such as coolant temperature sensors, exhaust oxygen sensor, etc.) to the ECM that indicate how the systems are performing.

INTERMITTENT - Occurs now and then; not continuously. In electrical circuits, refers to occasional open, short, or ground.

I.P. - INSTRUMENT PANEL

ISC - IDLE SPEED CONTROL - Regulates throttle valve position to control idle speed. Idle speed is controlled by the ECM and is not adjustable.

KM/HR - KILOMETER PER HOUR - A metric unit measuring speed needed to travel distance of one kilometer (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - FOUR CYLINDER IN-LINE ENGINE

MAF - MASS AIR FLOW - Sensor which measures the amount of air entering the engine.

MALFUNCTION - A problem that causes the system to operate incorrectly. Typical malfunctions are wiring harness opens or shorts, failed sensors or circuit components.

MANIFOLD VACUUM SENSOR - Indicates vacuum in the intake manifold by measuring the pressure in intake manifold in relation to barometric pressure. It is also called a differential pressure sensor because it measures the difference between the two pressures. It puts out a voltage which is highest when the vacuum is highest. The maximum voltage is between 4 and 5 volts.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero pressure. It puts out a voltage which is highest when the pressure is highest. The maximum voltage is between 4 and 5 volts.

MAT - Manifold Air Temperature Sensor. Measures temperature of air in the intake manifold.

M/C - MIXTURE CONTROL

MEM-CAL - MEMORY CALIBRATOR - Contains specific calibrations to meet the requirements of a specific engine.

MFI - MULTIPORT FUEL INJECTION - Individual injectors for each cylinder are mounted in the intake manifold. The injectors are fired in groups rather than individually.

MIXTURE CONTROL (M/C) SOLENOID - Device, installed in carburetor, to regulate the air/fuel ratio.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring speed needed to travel distance of one mile (5280 feet) in one hour.

N.C. - NORMALLY CLOSED - State of relay contacts or solenoid plunger when no voltage is applied.

N·m - NEWTON METER (Torque) - A metric unit describing force.

N.O. - NORMALLY OPEN - State of relay contacts or solenoid plunger when no voltage is applied.

NO_x - NITROGEN, OXIDES OF - One of the pollutants found in engine exhaust.

O_2 - OXYGEN (Sensor) - Monitors the oxygen content of the exhaust system and generates a voltage signal to the ECM.

O/L or O/LOOP - OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Result of a function typically controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (O_2) in the exhaust stream.

P.A.I.R - PULSE AIR INJECTION REACTOR system - pulsed air directed into engine to reduce exhaust emissions.

PCV - POSITIVE CRANKCASE VENTILATION - Prevent fumes in crankcase from passing into atmosphere.

PFI - PORT FUEL INJECTION

P/N - PARK/NEUTRAL

PORT - EXHAUST OR INTAKE PORT

PROM - PROGRAMABLE READ ONLY MEMORY- an electronic term used to describe the engine calibration unit.

RPM - REVOLUTIONS PER MINUTE - A measure of rotational speed.

RVB - REAR VACUUM BRAKE - is used to control choke operation during cold engine conditions.

SELF-DIAGNOSTIC CODE - The ECM can detect malfunctions in the system. If a malfunction occurs, the ECM turns on the "Service Engine Soon" light. A diagnostic code can be obtained from the ECM through the "Service Engine Soon" light, or by use of a "Scan" tool. This code will indicate the area of the malfunction.

SES - SERVICE ENGINE SOON LIGHT - Lights when a malfunction occurs in Computer Command Control system.

TACH - TACHOMETER

TBI - THROTTLE BODY INJECTION (Unit) - is controlled by the ECM to supply precise air/fuel mixture into the intake manifold.

TCC - TRANSMISSION / TRANSAXLE CONVERTER CLUTCH - ECM controlled solenoid in transmission which positively couples the transmission to the engine.

THERMAC - THERMOSTATIC AIR CLEANER - provides preheated air to intake manifold to provide better driveability when engine is cold.

TPS - THROTTLE POSITION SENSOR - Device that tells the ECM the throttle position.

TVS - THERMAL VACUUM SWITCH - Used to control vacuum in relationship to engine temperature.

V - VOLT

V-6 - SIX CYLINDER ENGINE - Two banks of cylinders, arranged in a "V".

V-8 - EIGHT CYLINDER ENGINE - Two banks of cylinders, arranged in a "V".

VACUUM - Negative pressure; less than atmospheric pressure.

VACUUM, MANIFOLD - Vacuum source in manifold below throttle plate.

VACUUM, PORTED - A vacuum source above (atmospheric side) of closed throttle plate.

VAC SENSOR - Abbreviation for differential pressure sensor which is a vacuum sensor.

VIN - VEHICLE IDENTIFICATION NUMBER.

VSS - VEHICLE SPEED SENSOR - Sensor which sends vehicle speed information to the ECM.

WASTEGATE - A means of controlling the amount of boost available for a Turbo charged engine.

WOT - WIDE OPEN THROTTLE.

WIRING HARNESS SERVICE

The ECM wire harness electrically connects the ECM to the various solenoids, switches, and sensors in vehicle engine compartment. The ECM is located inside the vehicle passenger compartment.

Most connectors in the engine compartment are protected against moisture and dirt which could create oxidation and deposits on the terminals. This protection is important because of the very low voltage and current levels found in the electronic system. The connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

GENERAL

Molded-on connectors (like Metri-Pack) require complete replacement of the connector. This means splicing a new connector assembly into the harness.

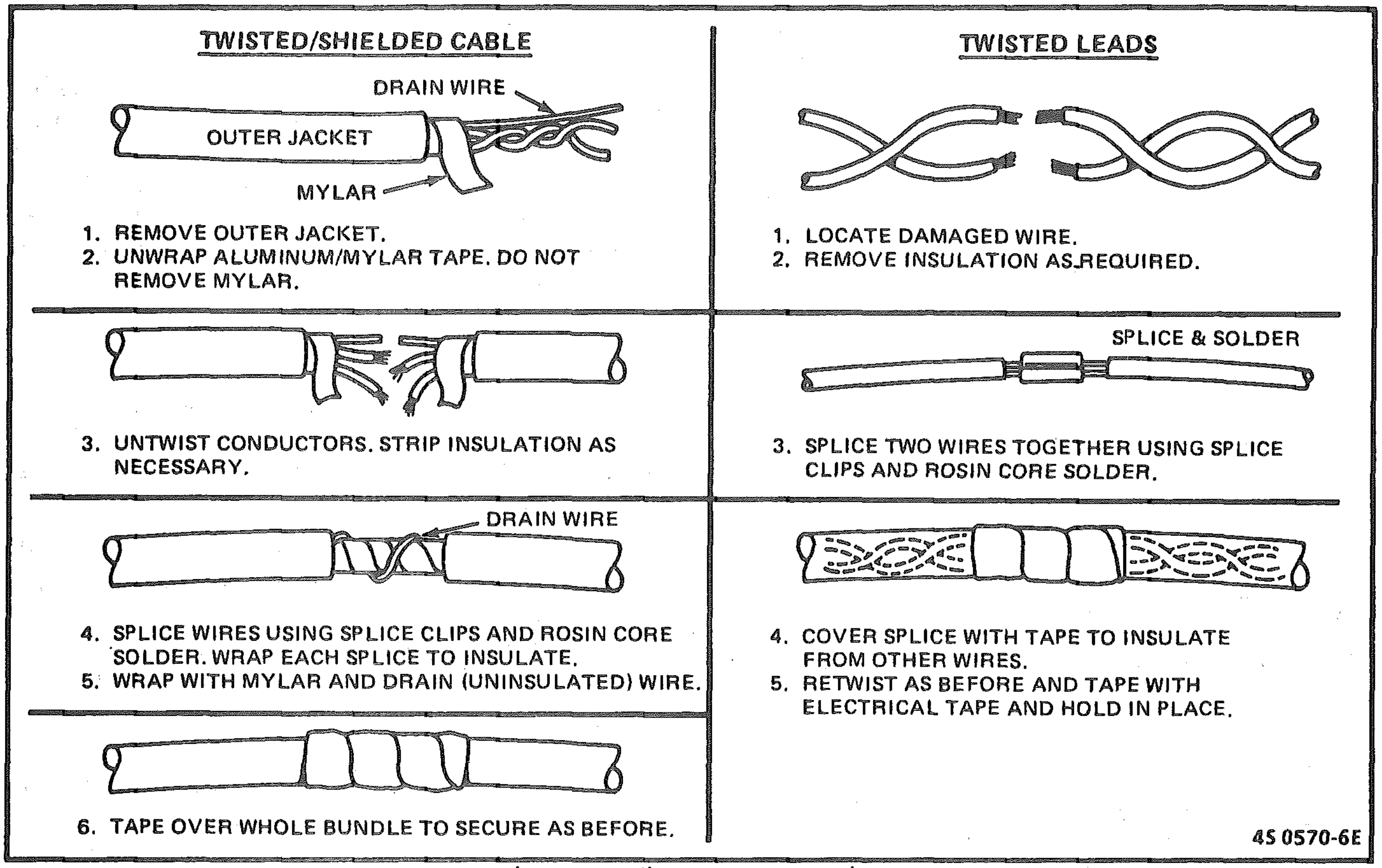


Figure 5 - Wire Harness Repair

WIRE HARNESS

Wire harnesses should be replaced with proper part number harnesses. When signal wires are spliced into a harness, use wire with high temperature insulation only. See Figure 5 for instructions.

With the low current and voltage levels found in the system, it is important that the best possible bond at all wire splices be made by soldering the splices as shown.

Use care when probing the connector or replacing terminals in them. It is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible to damage certain components. Always use jumper wires between connectors for circuit checking. NEVER probe through the Weather-Pack seals or insulation. Even microscopic damage or holes may result in eventual water intrusion, corrosion and/ or component or circuit failure.

When diagnosing, open circuits are often difficult to locate by sight because oxidation or terminal misalignment are hidden by the connectors. Merely wiggling a connector on a sensor or in the wiring harness may correct the open circuit condition. This should always be considered when an open circuit or failed sensor is indicated. Intermittent problems may also be caused by oxidized or loose connections.

Before making a connector repair, be certain of the type of connector. Weather-Pack and Compact Three connectors look similar but are serviced differently. Replacement connectors and terminals are listed in Group 8.965 of the Standard Parts Catalog.

CONNECTORS

Weather-Pack

Some connectors used with an ECM are called Weather-Pack. Figure 6 shows a Weather-Pack terminal and the tool (J-28742, BT-8234-A or equivalent) required to service it. This tool is used to remove the pin and sleeve terminals. If removal is attempted with an ordinary pick, there is a good chance that the terminal will be bent or deformed and, unlike standard blade type terminals, these terminals cannot be straightened once they are bent.

Make certain that the connectors are properly seated and all of the sealing rings in place when connecting leads. The hinge type flap provides a backup, or secondary locking feature for the connector.

They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Weather-pack connections cannot be replaced with standard connections. Instructions are provided with Weather-pack connector and terminal packages.

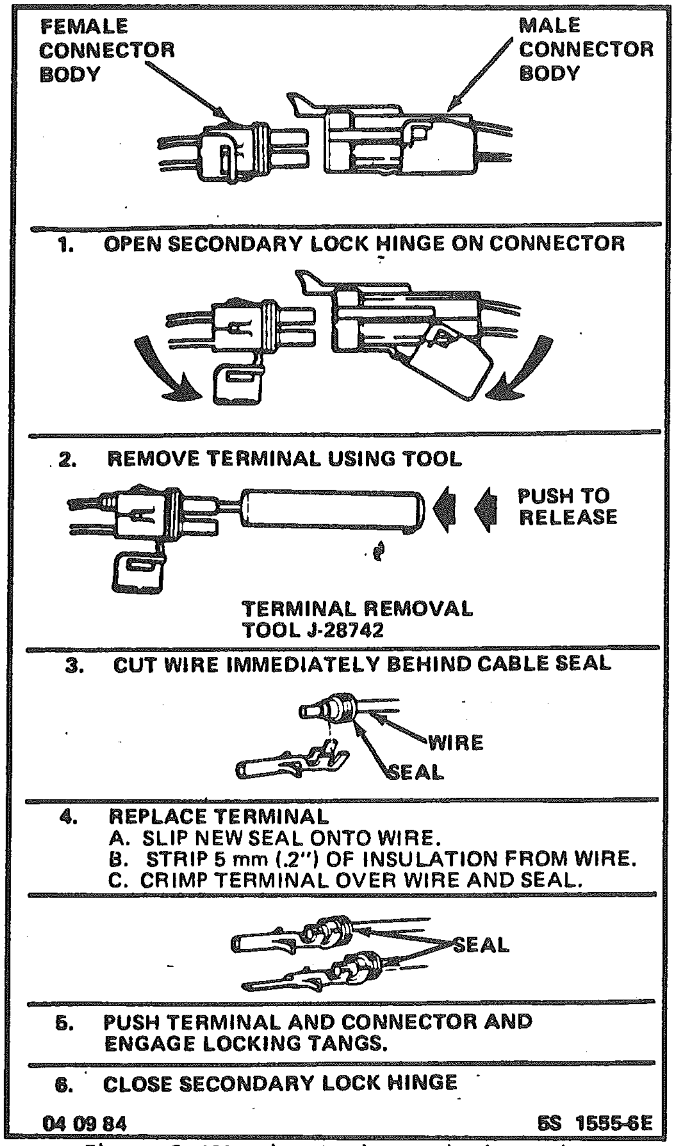


Figure 6 - Weather-Pack Terminal Repair

Compact Three

The compact three connector, which looks similar to a Weather-pack connector, is not sealed and is used where resistance to the environment is not required. This type of connector most likely is used at the air control solenoid. Use the standard method when repairing a terminal. Do not use the Weather-pack terminal tool J-28742.

Metri-Pack Series 150 - Terminal Removal

Some connectors used to connect various sensors to the ECM harness use terminals called "Metri-Pack" (Figure 7). These may be used at the Coolant Sensors as well as at ignition modules.

They are also called "Pull-To-Seat" terminals because, to install a terminal on a wire the wire is first inserted through the seal (5) and connector (4). The terminal is then crimped on the wire, and the terminal pulled back into the connector to seat it in place.

To remove a terminal:

1. Slide the seal back on the wire,
2. Insert tool (3) BT-8518 or J 35689, or equivalent, as shown in insert "A" and "B" to release the terminal locking tang (2).
3. Push the wire and terminal out through the connector.

If you are reusing the terminal, reshape the locking tang (2).

Micro-Pack

Some connectors used on harness to connect to the ECM are called Micro-Pack (Figure 8). Terminal replacement requires the use of special tool J-33095, BT-8234-A or equivalent.

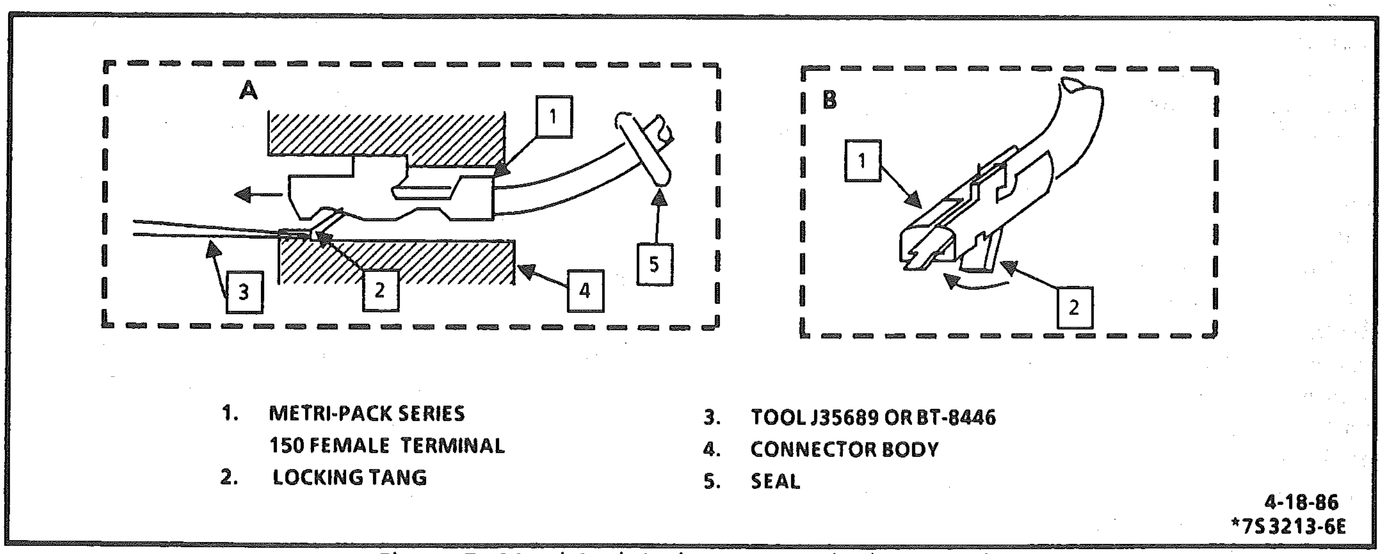
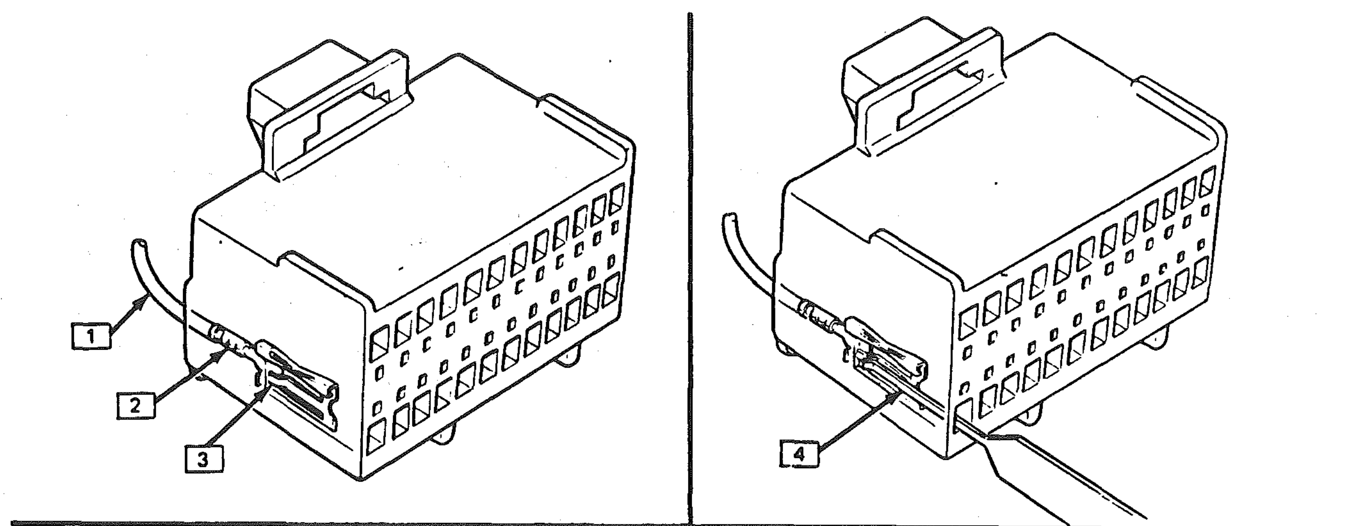


Figure 7 - Metri-Pack Series 150 Terminal Removal



1 CABLE
2 TERMINAL
3 LOCKING TANG
4 TOOL J33095

1. GRASP CABLE AND PUSH TERMINAL TO THE MOST FORWARD POSITION.
2. INSERT TOOL J33095 STRAIGHT INTO THE FRONT OF THE CONNECTOR CAVITY. DO NOT USE CONVENTIONAL PICK TO REMOVE TERMINAL.
3. WITH TOOL IN PLACE, GENTLY PULL ON THE CABLE TO REMOVE TERMINAL.
4. VISUALLY CHECK TERMINAL AND REPLACE IF TERMINAL CAVITY OR TANG IS DAMAGED.
5. INSTALL TERMINAL INTO CONNECTOR CAVITY UNTIL LOCKING TANG HAS SNAPPED INTO POSITION.

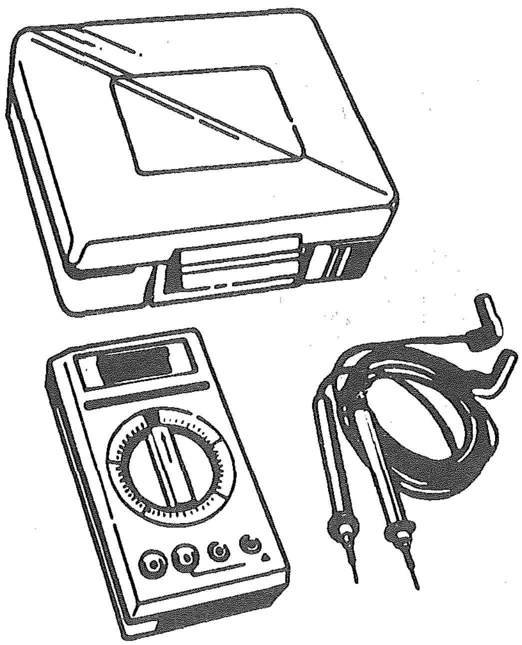
03 21 84

5S 1418-6E

Figure 8 - Micro-Pack Terminal Replacement

TOOLS NEEDED TO SERVICE THE SYSTEM

The system requires an ALDL read-out ("Scan") tool, tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A, J-34029A or equivalent), vacuum gage and jumper wires for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. See Figures 9 through 13 for Special Tools needed to diagnosis or repair a system. For more complete information on the operation of these tools, see the manufacturer's instructions.



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER-DVM)
J34029-A

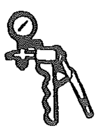
VOLTMETER - Voltage Position Measures amount of voltage. When connected in parallel to an existing circuit. A digital voltmeter with 10 meg ohm input impedence is used because this type of meter will not load down the circuit and result in faulty readings.some circuits require accurate low voltage readings, and some circuits in the ECM have a very high resistance .

AMMETER - When used as ammeter, this meter also accurately measures extremely low current flow. Refer to meter instructions for more information.

- Selector must be set properly for both function and range. DC is used for most automotive measurements.

OHMMETER - Measures resistance of circuit directly in ohms. Refer to meter for more information.

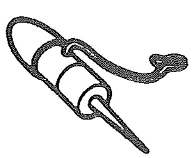
- OL Display in all ranges indicates open circuit.
- Zero display in all ranges indicates a short circuit.
- Intermittent connection in circuit may be indicated by digital reading that will not stabilize on circuit.
- Range Switch.
  - 200Ω - Reads ohms directly
  - 2K,20K,200KΩ - Reads ohms in thousands
  - 2M and 20MΩ - Reads ohms in millions



J23738

VACUUM PUMP (20 IN. HG. MINIMUM)

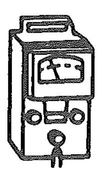
Use gage to monitor manifold engine vacuum and the hand pump to check vacuum sensors, solenoids and valves.



J34142-A

UNPOWERED TEST LIGHT

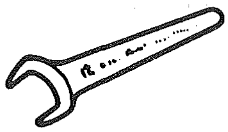
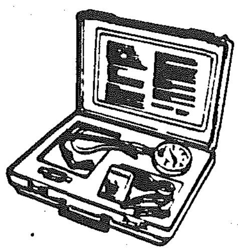
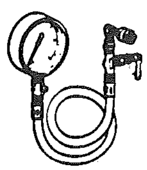
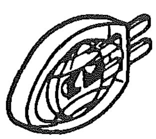
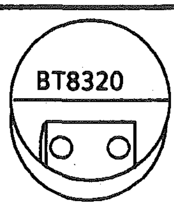
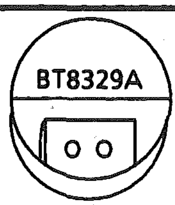
Used to check wiring for complete circuit and short to ground or voltage.

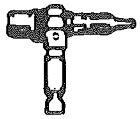
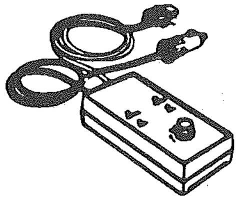
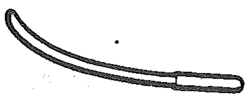
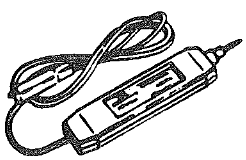
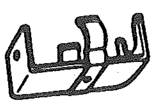
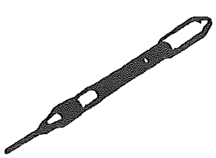
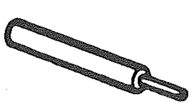
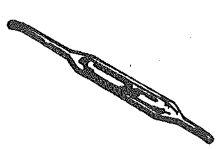


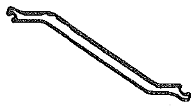
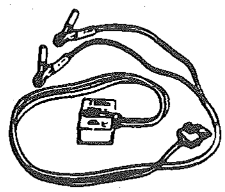
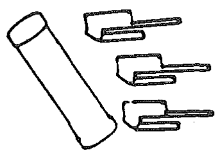
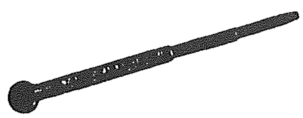
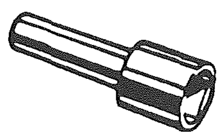
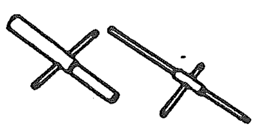
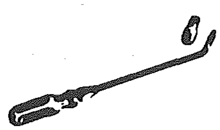
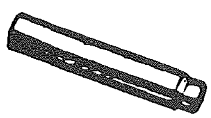
TACHOMETER

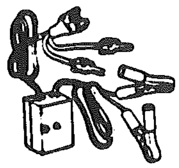
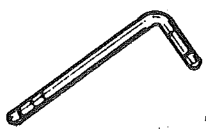
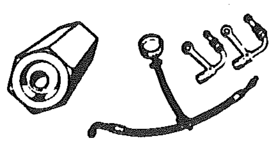
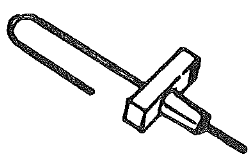
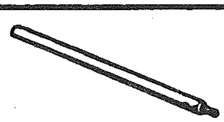
Use inductive trigger signal pickup type to check RPM.

5-2-86
*7S 3382-6E

 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 J34730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnose port fuel injection systems. The kit includes: • Fuel Pressure Gage - to check fuel pump pressure and compare injector pressure drop for equal fuel distribution. • Injector Test Light - to check electrical circuit to an injector. • Injector Tester - to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system. Part of Diagnostic Kit J34730-A
 J34730-2	**INJECTOR TEST LIGHT** Used to check electrical circuit to a port fuel injector Part of Diagnostic Kit J34730-A
 BT8320	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI fuel injector (except TBI 700)
 BT8329A	**INJECTOR TEST LIGHT** Used to check electrical circuit to a TBI 700 fuel injector and a port fuel injector. 5-2-86 7S 3396-6E

 J26792/BT7220-1	**SPARK TESTER** Use to check available secondary ignition voltage . Also called an ST125.
 J36101	**MASS AIR FLOW (MAF) SENSOR TESTER** Used for static test of MAF Sensor on vehicles equipped with an A/C type MAF Sensor.
 J36179	**CRANKSHAFT SENSOR ALIGNMENT TOOL (C^3I SYSTEMS)** Used to properly align crank or combination sensor to harmonic balancer interrupter.
 J35616	**CONNECTOR TEST ADAPTER KIT** Used to make electrical test connections in current Weather Pack, Metri - Pack and Micro-Pack style terminals.
 J34636	**CIRCUIT TESTER** Used to check all relays and solenoids before connecting them to a new ECM. Measures the circuit resistance and indicates pass or fail via green or red LED. Amber LED indicates current polarity. Can also be used as a non-powered continuity checker.
 J28687-A/BT8220	**OIL PRESSURE TRANSDUCER WRENCH** Used to remove or install oil pressure transducer on engine.
 J35689	**METRI-PACK TERMINAL REMOVER** Used to remove 150 series Metri-Pack "pull-to-seat " terminals from connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J28742/BT8234-A	**WEATHER PACK TERMINAL REMOVER** Used to remove Terminals from Weather Pack connectors. Refer to wiring harness service in Section 6E for removal procedure.
 J33095/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service Section 6E for removal procedure. 5-2-86 7S 3384-6E

 J29607/BT8022	**ISC ADJUSTING WRENCH** Used to adjust ISC on carburetor to obtain maximum specification RPM..
 J34025/BT8256A	**ISC MOTOR TESTER** Used to test operation of ISC Motor on carburetor in either direction, and condition of the internal switch.
 J9789-135/BT8104	**FLOAT LEVEL GAGE SET** Used to check float level on 2SE or E2SE carburetor.
 J34935/BT8420A	**FLOAT LEVEL GAGE** Used to check float level or M/C Solenoid travel on E2ME or E4ME carburetor.
 J29030-B/BT7610B	**IDLE MIXTURE SOCKET** Used to adjust idle mixture needle on an E2SE carburetor.
 J28696-B/BT7928	**MIXTURE ADJUSTMENT TOOL** Used to adjust lean mixture and rich mixture stop screws on E2SE, E2ME, and E4ME carburetors.
 J22646-02	**CARBURETOR ADJUSTMENT WRENCH** Used to adjust idle mixture on carburetor
 J33815-1/BT8253-A	**M/C SOLENOID GAGING TOOL** Used to adjust the Mixture Control Solenoid plunger on E2ME, and E4ME carburetors.

 J34730-3	**INJECTOR TESTER** Used to energize each fuel injector for a precise amount of time to perform injector balance test in CHART C-2A by checking each injector's pressure drop using pressure gage. Part of Diagnostic Kit J34730-A.
 J29698-A/BT8251	**FUEL LINE WRENCH** Used to disconnect or connect fuel lines at Throttle Body Unit by holding fuel nut at throttle body.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system.
 J33815-2/BT8253-A	**AIR BLEED VALVE GAGING TOOL** Used to adjust Idle Air Bleed Valve on E2ME, and E4ME carburetors.
 J25322/BT7523	**PUMP LEVER PIN PUNCH** Used to drive pump lever pin inward to allow removal of the pump lever on E2ME carburetor.

GENERAL SPECIFICATIONS

Many of the specifications used in this section are located on the Vehicle Emission Control Information label under the hood.

Listed on the chart below are locations of specifications used in this Section.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Spark Plug Type	See Owner's Manual, Section "7".
Spark Plug Gap	Vehicle Emission Control Information Label.
Engine Code	8th digit of VIN number. See Section "OA". Also Owner's Manual, Section "7".
Engine Family	Vehicle Emission Control Information label.
Filter Part Numbers	See Owner's Manual, Section "7".
Part Numbers of Major Components	WDD-GM Parts Book.
Replacement of Vehicle Emission Control Information Label	WDD-GM Label Catalog.

SECTION 6F

EXHAUST SYSTEM

CAUTION: *Exhaust system components should have enough clearance from the underbody to avoid overheating and possible damage to the passenger compartment carpets.*

CONTENTS

GENERAL DESCRIPTION

When inspecting or replacing exhaust system components, make sure there is adequate clearance from all points on the underbody to avoid possible overheating of the floor pan and possible damage to the passenger compartment insulation and trim materials.

Check complete exhaust system and nearby body areas and trunk lid for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections or other deterioration which could permit exhaust fumes to seep into the trunk or passenger compartment. Dust or water in the trunk may be an indication of a problem in one of these areas. Any defects should be corrected immediately. To help insure continued integrity, the exhaust system pipe rearward of the muffler must be replaced whenever a new muffler is installed.

EXHAUST PIPE

The exhaust manifold to crossover pipe connections are of the ball type, thus eliminating the need for gaskets.

MUFFLER

The mufflers are a tri-flow design. Some muffler installations have a slot in the inlet and/or outlet pipe which indexes to a key (tab) welded on the exhaust and/or tail pipe to help maintain alignment.

RESONATOR

A resonator is used on some series exhaust systems. It allows the use of mufflers with less back pressure and provides for optimum tuning characteristics of the exhaust system.

HANGER

Two types of hangers are used to support the exhaust system. One type is a conventional rubber strap and the second type is a "rubber block." The rubber block type provides a rigid hanger along with a feature that continues to support the exhaust system in the event a rubber insulator block is broken.

The installation of exhaust system supports is very important as improperly installed supports can cause annoying vibrations which are difficult to diagnose.

CLAMP

Two methods are used for connecting exhaust system slip joins, (1) clamp and (2) weld. When servicing a welded connection it should be cut and the new connection clamped when installing replacement parts. Also, coat slip joints with exhaust system sealer before assembling (Fig. 1).

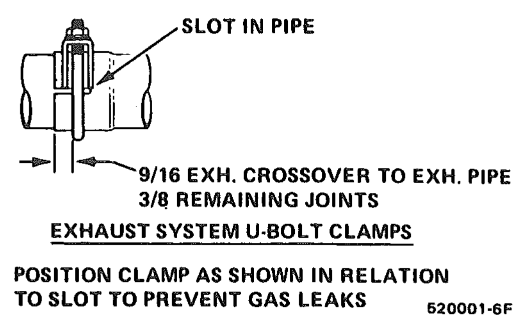


Fig. 1 Installation of Exhaust System Clamp

CATALYTIC CONVERTER

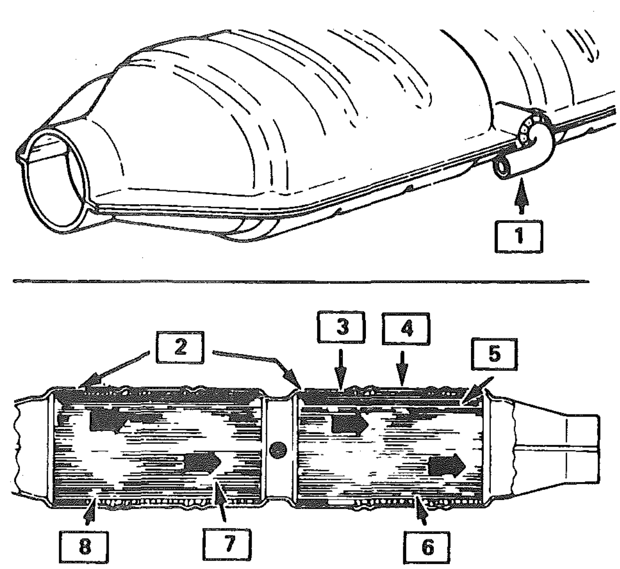
The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

NOTICE: THE CATALYTIC CONVERTER REQUIRES THE USE OF UNLEADED FUEL ONLY.

Periodic maintenance of the exhaust system is not required, however, if the car is raised for other service, it is advisable to check the general condition of the catalytic converter, pipes and mufflers.

Three different converter designs are used in combination with two different types of catalyst.

Converter Designs:



1–AIR MANAGEMENT SYSTEM AIR INLET
2–SEAL
3–METAL MESH
4–SHELL
5–OXIDATION CATALYST
6–REAR BED
7–THREE-WAY CATALYST
8–FRONT BED

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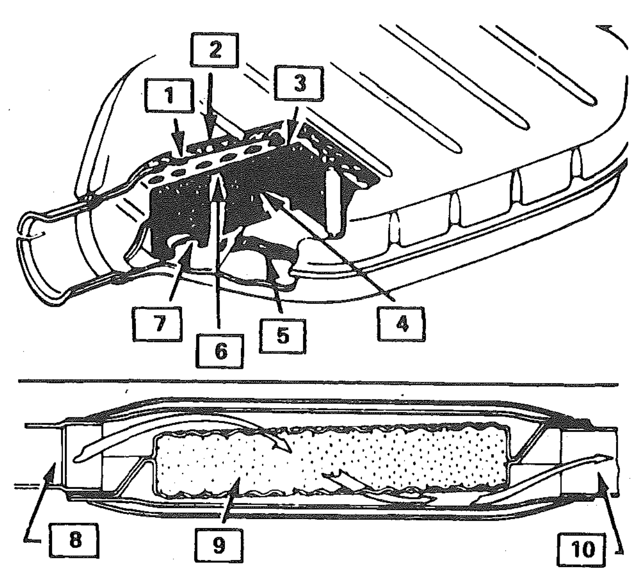
Fig. 2 Dual Bed Monolith



1– INSULATION
2– OUTER WRAP
3– CONVERTER SHELL
4– CATALYST
5– INSULATION
6– BED SUPPORT
7– FILL PLUG
8– INLET GAS
9– CATALYTIC PELLET COMPOUND
10– OUTLET GAS

520003-6F

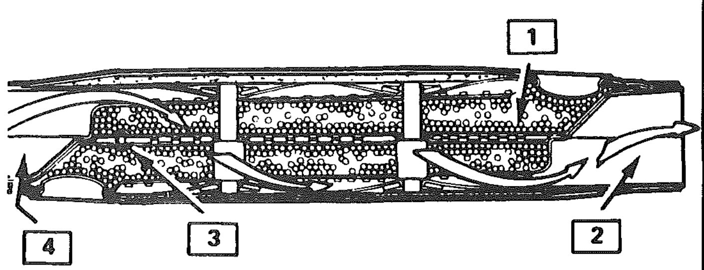
Fig. 3 Single Bed Pellet

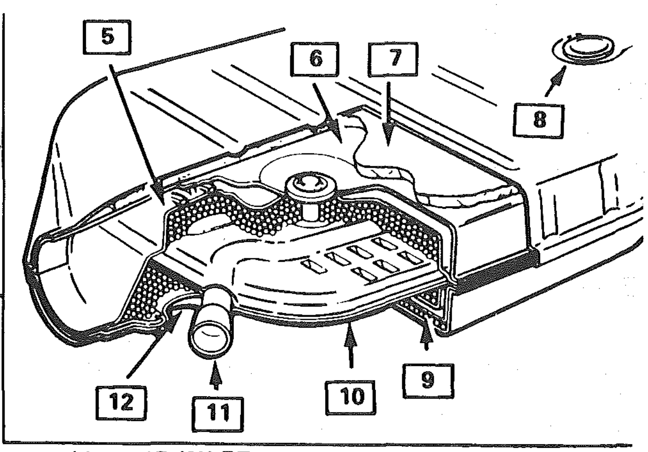
- Dual Bed Monolith
- Single Bed Pellet
- Dual Bed Pellet

Catalyst Types:

- Oxidation Catalyst
- Three-Way (Reduction) Catalyst

The oxidation catalyst is coated with a catalytic material containing platinum and palladium which lowers levels of hydrocarbon (HC) and carbon monoxide (CO). The catalyst coating on the three-way (reduction) catalyst contains platium and rhodium which lowers levels of oxide of nitrogen (NOX) as well as hydrocarbons (HC) and carbon monoxide (CO).

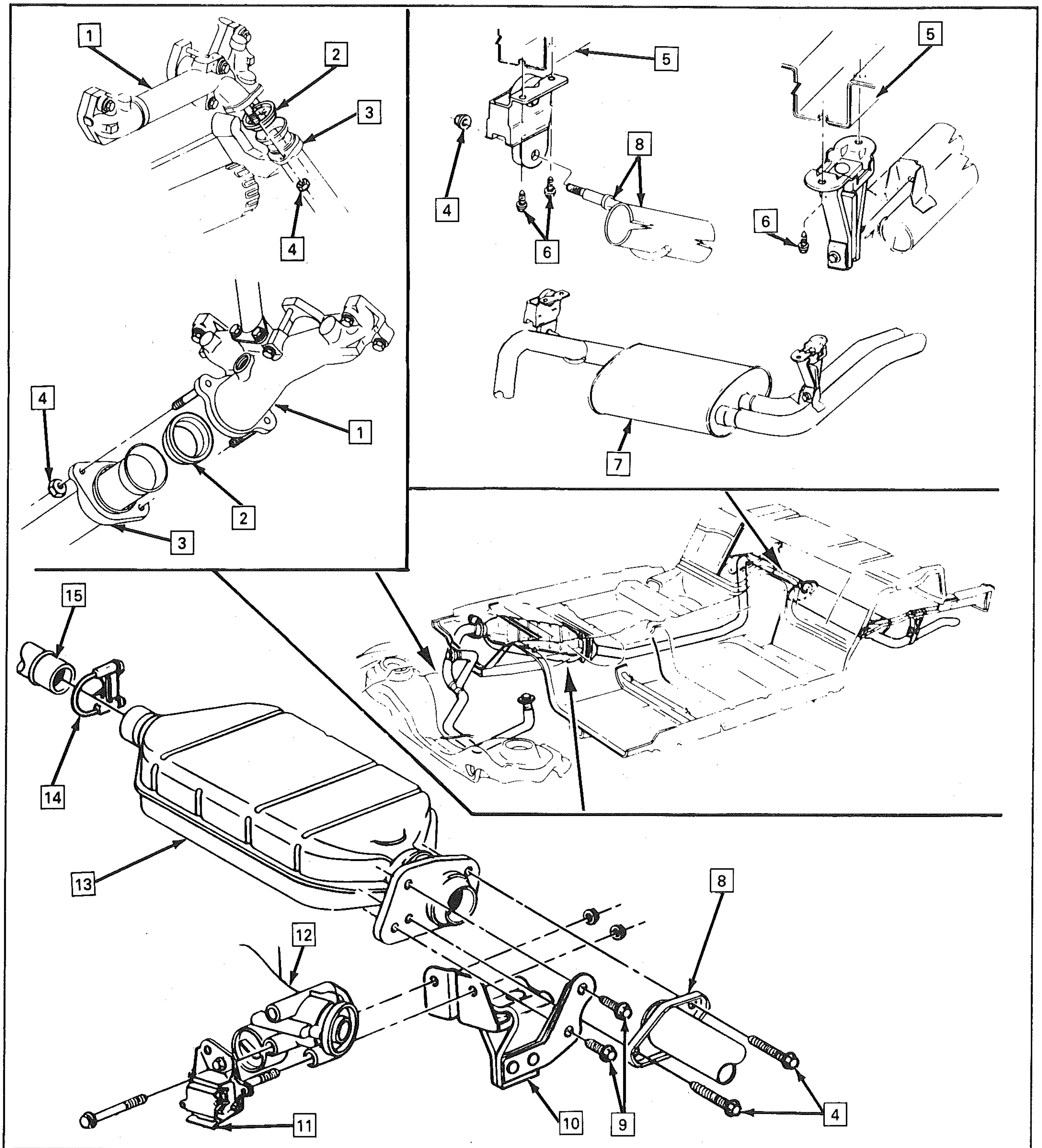




1– THREE-WAY CATALYST
2– OUTLET
3– OXIDATION CATALYST
4– INLET
5– RETAINER
6– CONVERTER SHELL
7– INSULATION
8– FILL PLUG
9– INSULATION
10– AIR PLENUM
11– AIR INLET (AIR MANAGEMENT SYSTEM)
12– FILL PLUG

520004-6F

Fig. 4 Dual Bed Pellet



1. MANIFOLD
2. SEAL
3. CROSSOVER PIPE
4. 20 N·m (15 LBS. FT.)
5. UNDERBODY
6. 10 N·m (8 LBS. FT.)
7. MUFFLER
8. INTERMEDIATE EXHAUST PIPE ASSEMBLY
9. 50 N·m (37 LBS. FT.)
10. HANGER
11. INNER BRACKET ASSEMBLY
12. TRANSMISSION
13. CONVERTER ASSEMBLY
14. 60 N·m (44 LBS. FT.)
15. FRONT EXHAUST PIPE

J10001-6F-F

Fig. 5 Exhaust System — V.I.N. S

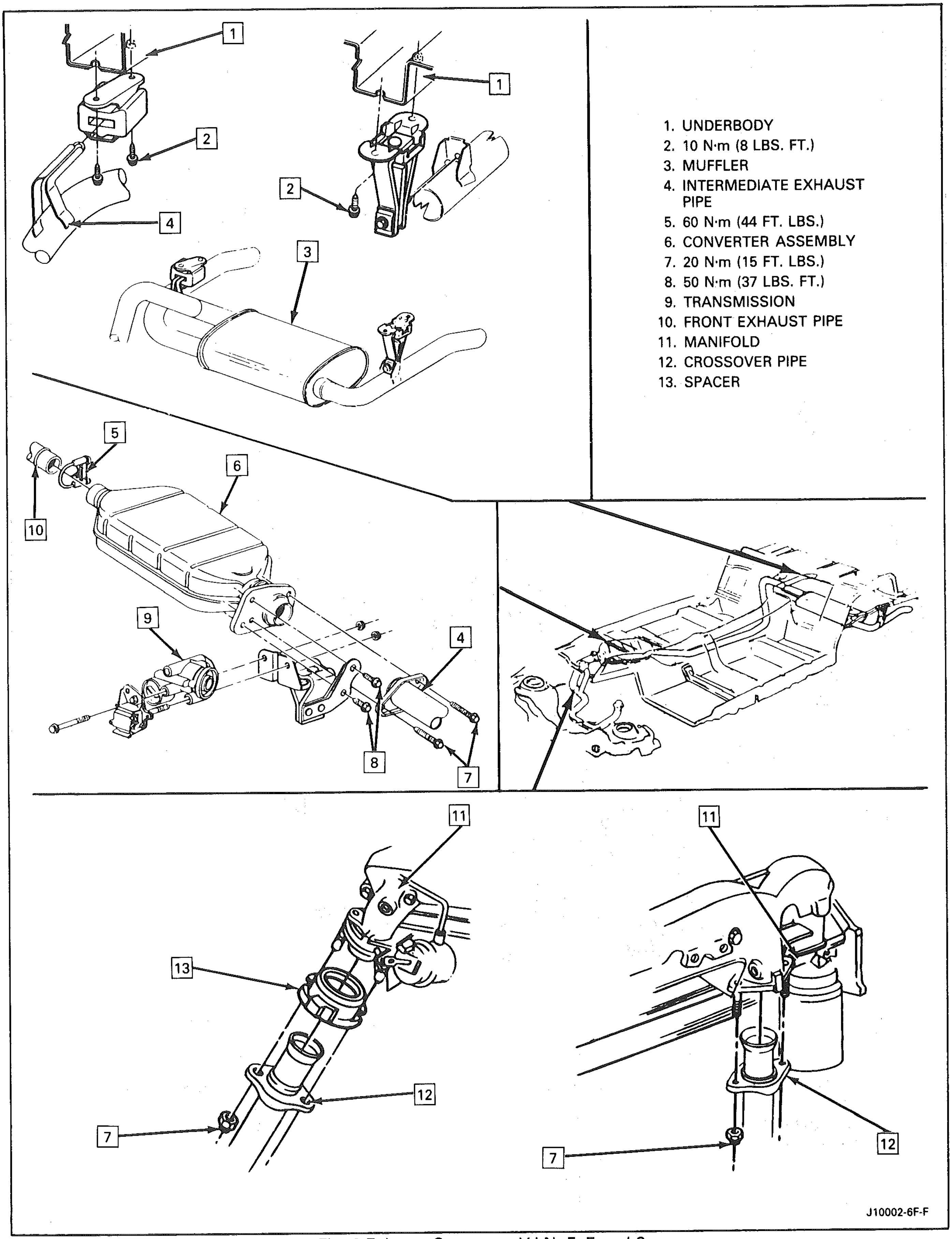


Fig. 6 Exhaust System — V.I.N. F, E and 8

SECTION 700-R4

MD8

AUTOMATIC TRANSMISSION HYDRAULIC DIAGNOSIS

CONTENTS

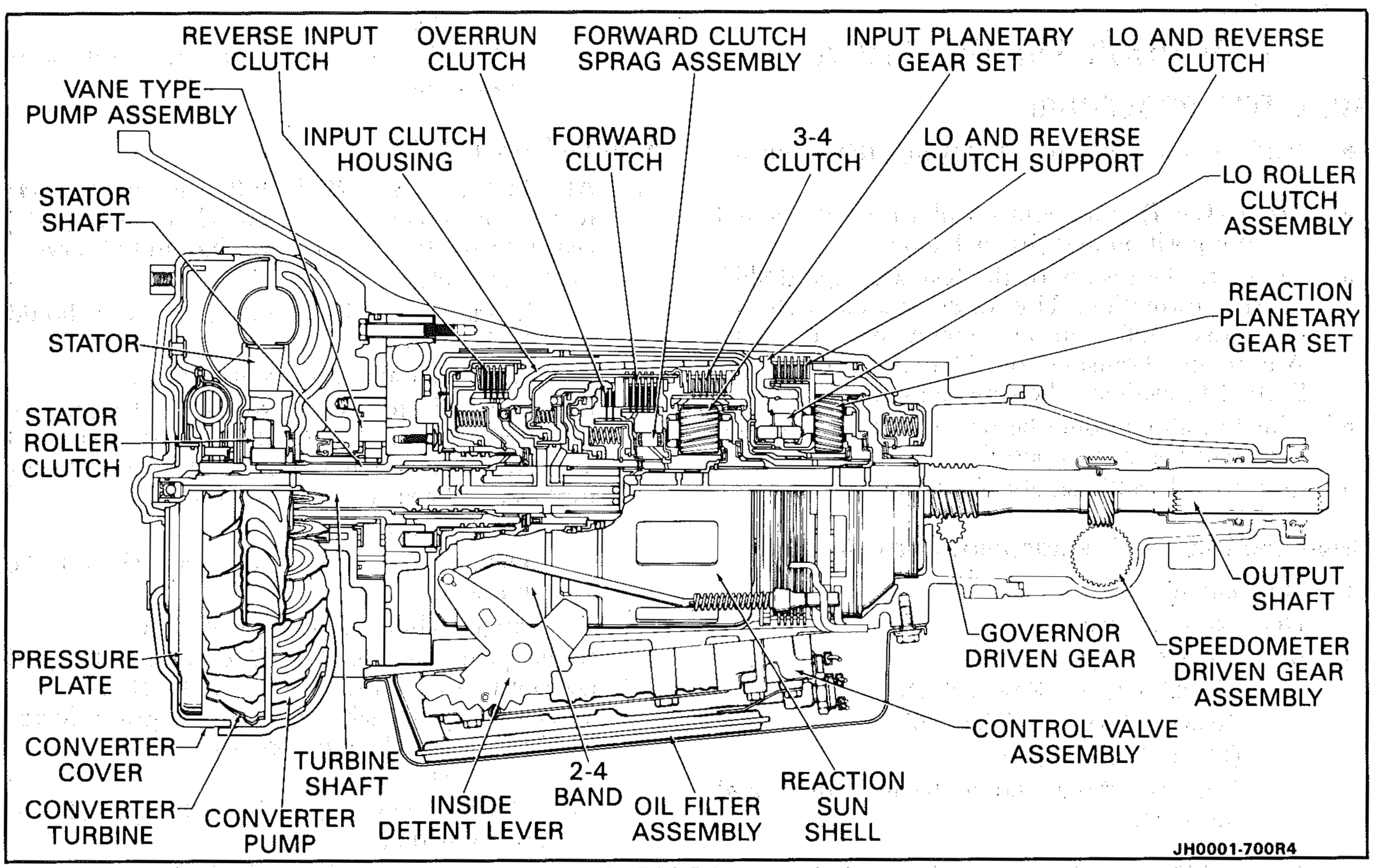


Figure 1 THM 700-R4 Transmission

GENERAL DESCRIPTION

The THM 700-R4 is a fully automatic transmission for rear wheel drive vehicles which provides four forward gear ranges and a reverse.

The major components of this transmission are:

- Torque Converter Clutch Asm.
- Vane Type Oil Pump
- 2-4 Band Asm.
- Five Multiple Disc Clutches
- Two Planetary Gear Sets
- One Sprag Clutch
- One Roller Clutch
- Valve Body Asm.

The oil pressure and shift points are controlled by throttle opening via a throttle valve cable. (See Section 7A1 for T.V. cable information).

The transmission can be operated in any one of the following seven modes:

P - Park position prevents the vehicle from rolling either forward or backward. (For safety reasons the parking brake should be used in addition to the park position).

R - Reverse allows the vehicle to be operated in a rearward direction.

N - Neutral allows the engine to be started and operated without driving the vehicle. If necessary this position may be selected if the engine must be restarted with the vehicle moving.

D - Overdrive is used for all normal driving conditions. It provides four gear ratios plus converter clutch operation. Downshifts are available for safe passing by depressing the accelerator.

D - Drive position is used for city traffic, hilly terrain, and trailer towing. It provides three gear ranges. Again, downshifts are available by depressing the accelerator.

2 - Manual second is used to provide acceleration and engine braking. This range may be selected at any vehicle speed.

1 - Manual Lo is used to provide maximum engine braking. This range may also be selected at any vehicle speed.

DIAGNOSIS INFORMATION

ROAD TEST PROCEDURE

- Perform the road test following the sequence given
- MPH (KPH) shift points will vary with actual throttle position and driver habits
- Compare the results of the test with speed shift chart information. Use these results with the diagnosis information contained in this Automatic Transmission Hydraulic Diagnosis Section to evaluate the transmission.
- This test should only be performed when traffic and road conditions permit
- Observe all traffic safety regulations

Drive and Reverse Engagement Shift Check

1. Start engine
2. Depress brake pedal
3. Move gear selector:
   - "Park" (P) to "Reverse" (R)
   - "Reverse" (R) to "Neutral" (N) to "Drive" (D)

   Gear selections should be immediate and not harsh.

Upshifts and Torque Converter Clutch (TCC) Apply (Figure 2)

With gear selector in "Overdrive" (D)

1. Accelerate using a steady increasing throttle pressure
2. Note the shift speed point gear engagements for:
   - 2nd gear
   - 3rd gear
   - Overdrive
3. Note the speed shift point for TCC apply. This should occur while in third gear or overdrive. If the apply is not noticed, refer to the Preliminary Torque Converter Clutch Diagnosis information contained in this section of the Service Manual.

Important

The torque converter clutch will not engage if engine coolant has not reached a minimum operating temperature of approximately 54°C (130°F).

Part Throttle Downshift

At vehicle speeds of 40-55 MPH (64-88 KPH) quickly depressed the accelerator to a half open position and observe:

- TCC releases
- Transmission downshift to 3rd gear immediately

Full Throttle (Detent) Downshift

At vehicle speeds of 48-55 MPH (77-88 KPH) quickly depress the accelerator to a wide open position and observe:

- TCC releases
- Transmission downshifts to 2nd gear immediately

Manual Downshift

1. At vehicle speeds of 40-55 MPH (64 to 88 KPH) release the accelerator pedal while moving the gear selector to "Third" gear (D) and observe:
   - TCC release
   - Transmission downshift to 3rd gear should be immediate
   - Engine should slow vehicle down
2. Move gear selector to "Overdrive" and accelerate to 40-45 MPH (64-72 KPH). Release the accelerator pedal while moving the gear selector to "Second" gear (2) and observe.
   - TCC release
   - Downshift to second gear should be immediate
   - Engine should slow vehicle down
3. Move gear selector to "Overdrive" (D) and accelerate to 25 MPH (40 KPH). Release the accelerator pedal while moving the gear selector to "First" gear (1) and observe:
   - TCC release
   - Transmission downshift to 1st gear should be immediate
   - Engine should slow vehicle down

Coastdown Downshift

1. With the gear selector in "Overdrive" (D) accelerate to 4th gear with TCC applied.
2. Release the accelerator pedal and lightly apply the brakes to observe:
   - TCC release
   - Shift points for downshifts.

Manual Gear Range Selection

MANUAL THIRD (D)

1. With vehicle stopped, place gear selector in "Third" (D) and accelerate to observe:

- The first to second gear shift point
- The second to third gear shift point

MANUAL SECOND (2)

2. With vehicle stopped, place gear selector in "Second" (2) and accelerate to observe:
   - The first to second gear shift point
3. Accelerate to 25 MPH (40 KPH) and observe:
   - That a second to third gear shift does not occur
   - That TCC does not engage

MANUAL FIRST (1)

1. With vehicle stopped, place gear selector in "First" (1) and accelerate to 15 MPH (24 KPH) and observe:
   - That no upshift occurs
   - That TCC does not engage

REVERSE

1. With vehicle stopped, place gear selector in "Reverse" (R) and slowly accelerate to observe reverse gear operation.
   All possible throttle positions and corresponding MPH shift point information has not been provided.

TRANSMISSION PRESSURE CHECK PROCEDURE

Inspect

- Fluid level
- TV cable adjustment
- Manual linkage
- Engine mechanical, emissions, electrical and fuel delivery systems

Install or Connect (Figure 3)

- Oil pressure gage
- Tachometer

1988 "THM 700-R4" SHIFT SPEED CHART

MODEL	1-2 MIN THROTTLE	2-3 MIN THROTTLE	3-4 MIN THROTTLE	1-2 W.O.T.	3-2 PART THROTTLE	4-3 COAST DOWN	3-2 COAST DOWN	2-1 COAST DOWN
FAM, FMM, MAM	12-15	19-26	41-51	31-43	37-55+	37-48	15-24	11-14
MFM, MRM, MXM	12-15	20-38	41-51	32-44	38-55+	37-48	17-28	11-14
MCM, MTM, PRM	10-13	14-22	40-49	24-37	26-46	37-47	10-18	9-12
MDM, MKM, MLM, TJM, TKM	13-15	22-30	43-54	33-46	42-55+	39-50	19-27	12-14
MPM, MWM, MZM, TUM, TXM	11-13	19-26	38-47	29-41	37-55	34-45	16-24	10-13
MHM, PAM, PBM, PCM, TNM	9-11	17-24	34-43	25-34	27-45	29-40	14-22	8-10
TAM, TBM	9-11	15-22	35-42	30-44	27-50	30-38	11-20	8-10
THM, TLM	12-14	20-27	48-55+	30-42	38-55+	44-54	17-24	11-13
YNM	10-11	17-23	37-54	28-46	29-55+	30-49	13-21	8-10
YKM	10-12	19-25	35-45	32-46	31-52	30-42	15-23	9-11
YTM	11-13	17-23	41-52	29-43	34-55	36-48	13-20	9-11
YPM	11-13	19-26	36-42	31-44	35-55	32-39	16-24	10-12
YXM	10-12	16-27	40-48	31-42	35-53	36-45	13-23	9-11
YZM	11-13	13-24	39-43	36-46	36-53	35-40	10-20	10-12
YWM	8-9	12-17	32-39	23-41	23-53	23-34	9-14	7-9
YDM	10-12	15-22	41-51	30-53	30-55+	30-44	12-18	9-11
YMM	9-10	13-19	32-39	23-41	23-52	21-33	10-16	7-9

NOTES:
1. ALL SPEEDS INDICATED ARE IN MILES PER HOUR. CONVERSION TO KPH = MPH × 1.609.
2. SHIFT POINTS WILL VARY SLIGHTLY DUE TO ENGINE LOADS AND VEHICLE OPTIONS.
3. SPEEDS LISTED WITH + EXCEED 55 MPH.

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Figure 2 Speed Shift Chart

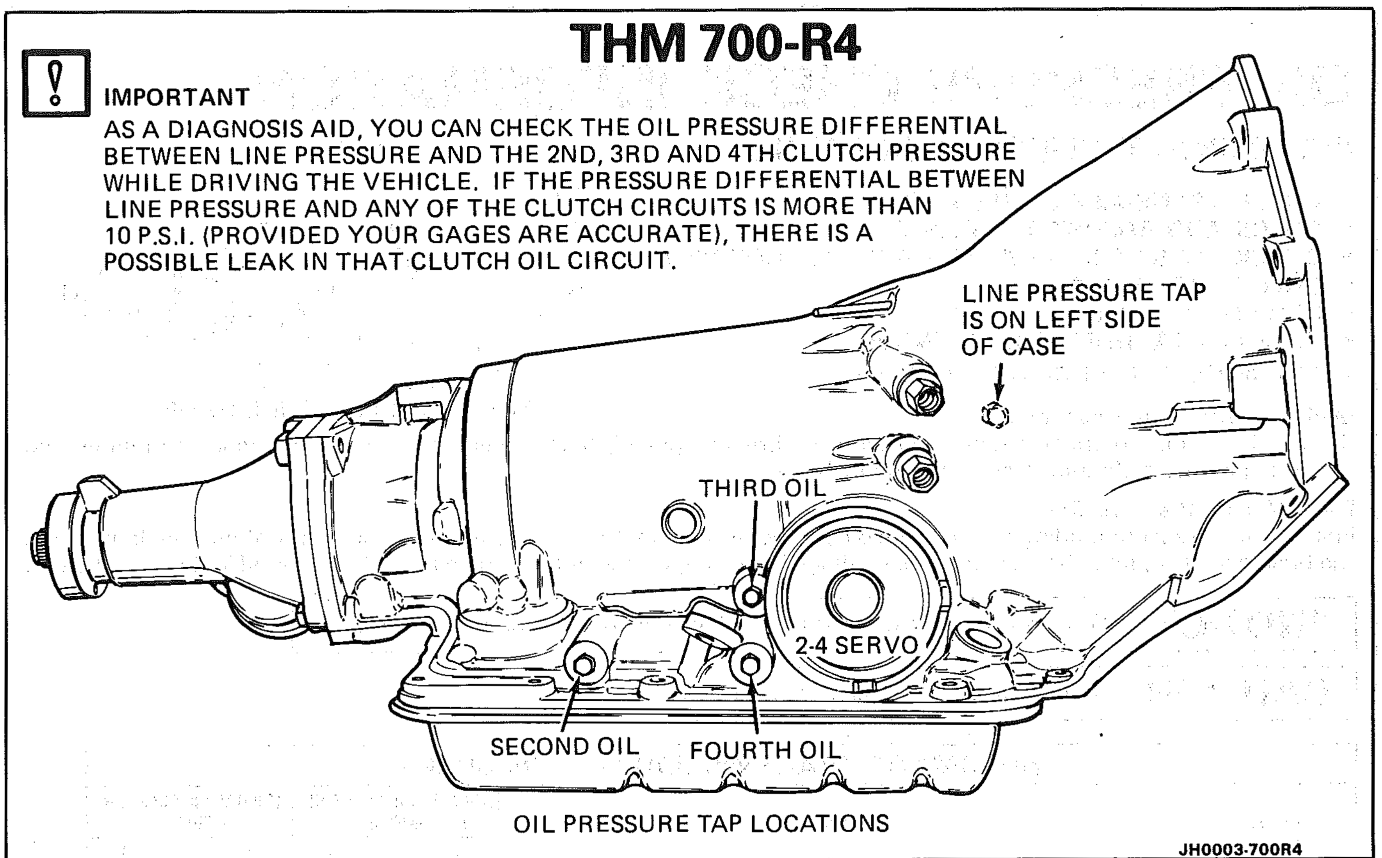
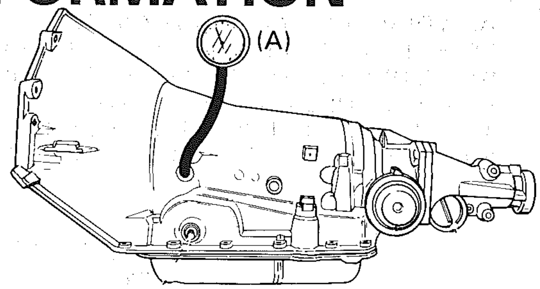


Figure 3 Oil Pressure Tap Locations

OIL PRESSURE CHECK INFORMATION

PRELIMINARY CHECK PROCEDURE



(A) ATTACH PRESSURE GAGE

- CHECK TRANSMISSION OIL LEVEL
- CHECK AND ADJUST T.V. CABLE
- CHECK OUTSIDE MANUAL LINKAGE AND CORRECT
- CHECK ENGINE TUNE
- INSTALL OIL PRESSURE GAGE
- CONNECT TACHOMETER TO ENGINE
- CHECK OIL PRESSURE AS FOLLOWS:

Minimum T.V. Line Pressure Check
Set the T.V. cable to specification; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

Full T.V. Line Pressure Check
Full T.V. line pressure readings are obtained by tying or holding the T.V. cable to the full extent of its travel; and with the brakes applied, take the line pressure readings in the ranges and at the engine r.p.m.'s indicated in the chart below.

***NOTICE** Total running time for this combination not to exceed 2 minutes.

CAUTION Brakes must be applied at all times.

AUTOMATIC TRANSMISSION OIL PRESSURES

RANGE	MODEL	NORMAL OIL PRESSURE AT MINIMUM T.V.		NORMAL OIL PRESSURE AT FULL T.V.	
		kPa	PSI	kPa	PSI
PARK, NEUTRAL, OVERDRIVE & MANUAL 3RD @ 1000 RPM	YTM	451-515	65-75	947-1185	137-172
	YMM	451-515	65-75	1073-1354	155-196
	YXM	451-515	65-75	1002-1267	145-184
	MCM, MHM, MTM, PAM, PBM, PCM, PRM, TAM, TBM, TNM,	451-515	65-75	844-1068	122-155
	FAM, FMM, MAM, MDM, MFM, MKM, MLM, MPM, MRM, MWM, MXM, MZM, THM, TJM, TKM, TLM, TUM, TXM	451-515	65-75	851-1063	123-154
	YPM	384-444	56-64	1006-1285	146-186
	YKM	384-444	56-64	883-1129	128-164
	YNM	384-444	56-64	962-1237	139-179
	YDM, YWM, YZM	384-444	56-64	1049-1359	152-197
REVERSE @ 1000 RPM *@ 2000 RPM	YTM	742-847	108-123	*1557-1948	226-283
	YMM	742-846	108-123	*1763-2225	256-323
	YXM	742-847	108-123	*1647-2082	239-302
	MCM, MHM, MTM, PAM, PBM, PCM, PRM, TAM, TBM, TNM	742-847	108-123	*1388-1755	201-254
	FAM, FMM, MAM, MDM, MFM, MKM, MLM, MPM, MRM, MWM, MXM, MZM, THM, TJM, TKM, TLM, TUM, TXM	742-847	108-123	*1399-1747	203-253
	YPM	632-730	92-106	*1654-2112	240-306
	YKM	632-730	92-106	*1452-1856	211-269
	YNM	632-730	92-106	*1581-2034	229-295
	YDM, YWM, YZM	632-730	92-106	*1724-2234	250-324
MANUAL 2ND & MANUAL LO @ 1000 RPM	YDM, YKM, YLM, YNM, YPM, YTM, YWM, YZM	1120-1293	162-187	1120-1293	162-187
	FAM,FMM,MAM,MCM,MDM,MHM,MKM,MLM,MPM,MRM,MSM,MTM,MWM,MXM, MZM,PAM,PBM,PCM,PRM,TAM,TBM,THM,TJM,TKM,TLM,TNM,TUM,TXM,YMM,YXM	1127-1286	163-186	1127-1286	163-186

Line pressure is basically controlled by pump output and the pressure regulator valve. In addition, line pressure is boosted in Reverse, Second and Lo by the reverse boost valve.

Also, in the Neutral, Drive, Intermediate and Reverse positions of the selector lever, the line pressure should increase with throttle opening because of the T.V. system. The pressure is controlled by the T.V. cable, the throttle lever and bracket assembly and the T.V. link, as well as the control valve assembly.

The main line pressure tap plug is located on the left side of the transmission above the outside manual lever.

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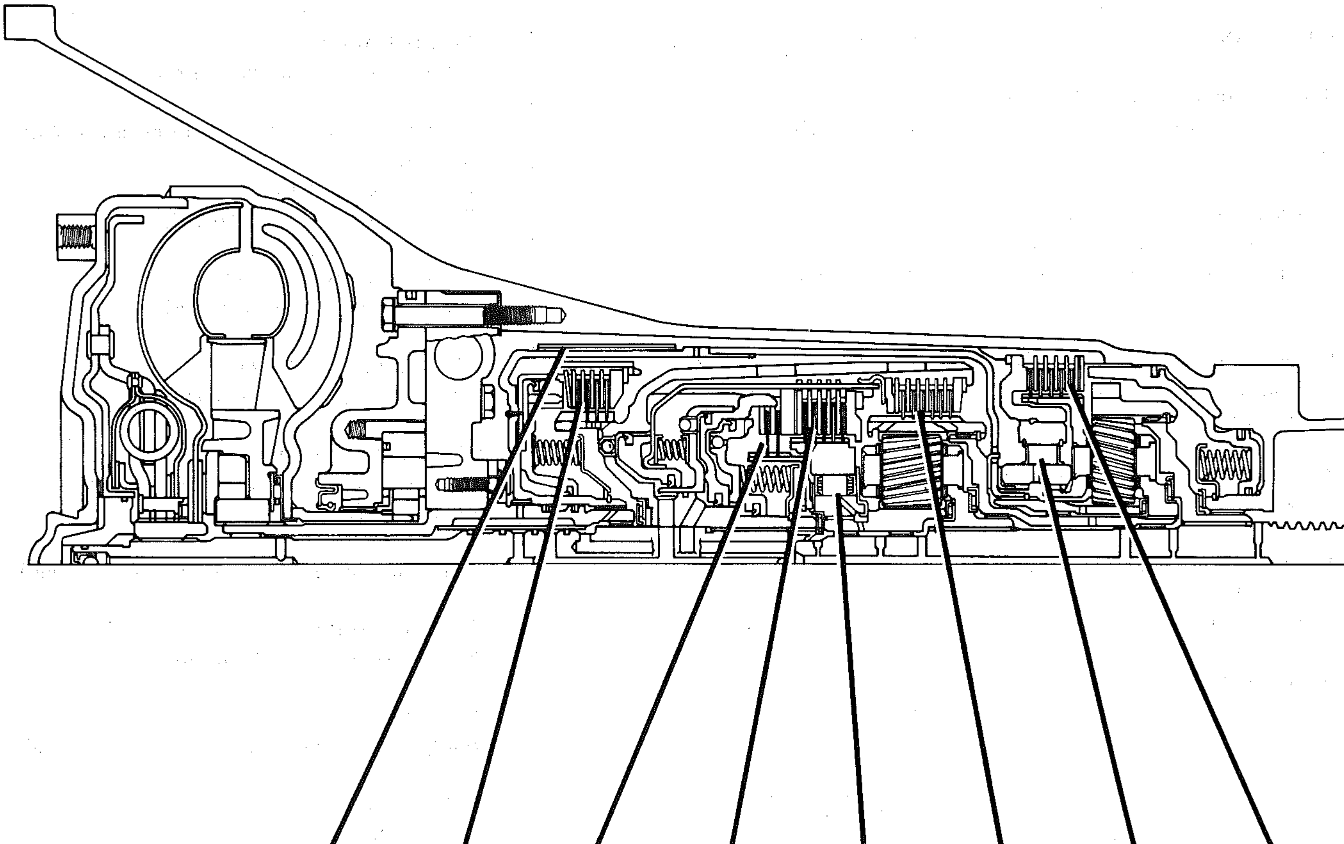
Figure 4 Oil Pressure Check Procedure

700 - GEAR RATIOS

FIRST	3.06		FOURTH	.70
SECOND	1.62		REVERSE	2.29
THIRD	1.00			



RANGE	GEAR	2-4 BAND	REVERSE INPUT CLUTCH	OVERRUN CLUTCH	FORWARD CLUTCH	FORWARD SPRAG CL. ASSEMBLY	3-4 CLUTCH	LO-ROLLER CLUTCH	LO-REV. CLUTCH
P-N									
$\boxed{D}$	1st				APPLIED	HOLDING		HOLDING	
	2nd	APPLIED			APPLIED	HOLDING			
	3rd				APPLIED	HOLDING	APPLIED		
	4th	APPLIED			APPLIED		APPLIED		
D	1st			APPLIED	APPLIED	HOLDING		HOLDING	
	2nd	APPLIED		APPLIED	APPLIED	HOLDING			
	3rd			APPLIED	APPLIED	HOLDING	APPLIED		
2	1st			APPLIED	APPLIED	HOLDING		HOLDING	
	2nd	APPLIED		APPLIED	APPLIED	HOLDING			
1	1st			APPLIED	APPLIED	HOLDING		HOLDING	APPLIED
R	REVERSE		APPLIED						APPLIED

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Figure 5 Clutch Application Chart

GENERAL DIAGNOSIS GUIDE

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL LEAK To Correctly Identify Oil Leaks, Perform the Following Procedure: • Clean all residual oil from the transmission with electramotive cleanser or equivalent. • Dust the transmission with leak tracing powder or spray foot powder. • Bring the engine to normal operating temperature. • Turn the engine off and let the vehicle set for thirty minutes. • Check for leaks.	• Oil Pan	– Low bolt torque. – Cut or damaged oil pan gasket.
	• T.V. Cable Connector	– Connector cocked and interfering with mount. – Connector cracked. – Seal missing, cut or damaged.
	• Fill Tube	– Fill tube cracked or damaged. – Seal missing, cut, or damaged.
	• Electrical Connector	– Electrical connector cracked. – Seal missing, cut or damaged.
	• Manual Shaft	– Manual shaft nicked or damaged. – Manual shaft seal assembly missing, cut or damaged.
	• Governor Cover	– Gaps in sealant. (Remove & Reseal.)
	• Speedo Fitting	– Low bolt torque. – Seal missing, cut or damaged.
	• Servo Cover	– Porosity. – Sharp edges on case cut "O" ring seal.
	• Cooler Fittings	– Low torque. – Cracked fitting.
	• Converter Assembly	– Hub or seam weld leak.
	• Vent	– Oil overfill. – Engine coolant in transmission oil.
	• Oil Pump Assembly	– Low bolt torque. – Cut or damaged oil pump to case seal. – Damaged seal. (Restricted drainback passage.) – Porosity.
	• Rear Extension	– Damaged extension to case seal. – Porosity. – Damaged oil seal assembly.

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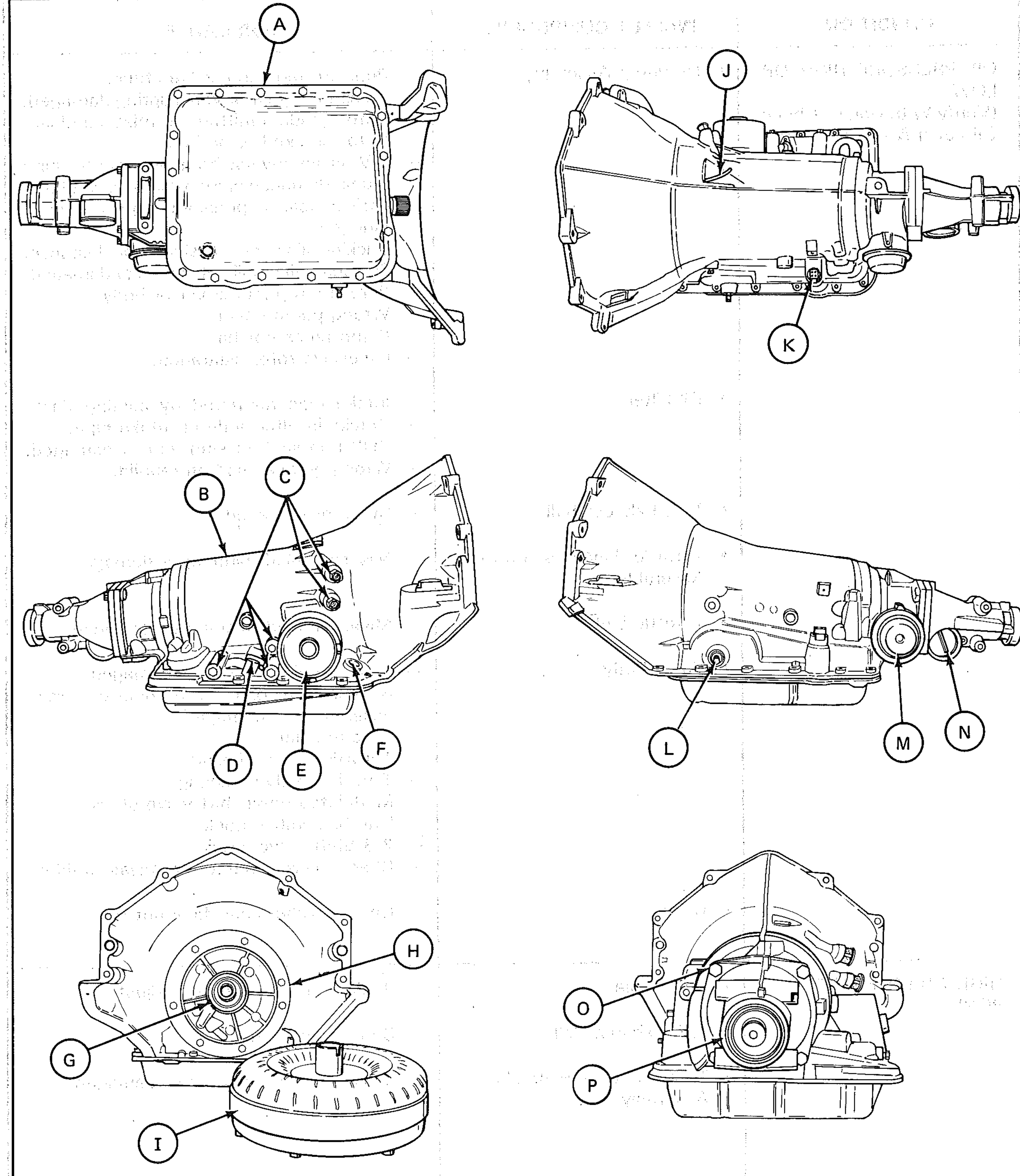
Figure 6 Diagnosis Chart A



A OIL PAN
B CASE
C COOLER CONNECTORS & PLUGS
D T.V. CABLE SEAL
E SERVO COVER
F OIL FILL TUBE SEAL
G OIL PUMP SEAL ASSEMBLY
H OIL PUMP TO CASE SEAL
I CONVERTER
J VENT
K ELECTRICAL CONNECTOR SEAL
L MANUAL SHAFT SEAL
M GOVERNOR COVER
N SPEEDO SEAL
O EXTENSION TO CASE SEAL
P EXTENSION OIL SEAL ASSEMBLY

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Figure 7 Possible Leak Points

CONDITION	INSPECT COMPONENT	FOR CAUSE
OIL PRESSURE HIGH OR LOW (Verify With Gage—Check Oil Level & Engine Tune.)	• Oil Pump Assembly	— Pressure regulator valve stuck. — Pressure regulator valve spring damaged. — Rotor guide omitted or misassembled. — Rotor cracked or broken. — T.V. valve, reverse boost valve or bushing stuck, damaged or incorrectly assembled. — Orifice hole in pressure regulator valve plugged. — Sticking slide or excessive rotor clearance. — Pressure relief ball not seated or damaged. — Porosity in pump cover or body. — Wrong pump cover. — Pump faces not flat. — Excessive rotor clearance.
	• Oil Filter	— Intake pipe restricted by casting flash. — Cracks in filter body or intake pipe. — "O" ring seal missing, cut or damaged. — Wrong grease used on rebuild.
	• T.V. Exhaust Ball	— Stuck or damaged.
	• Throttle Lever & Bracket Assembly	— Misassembled, binding or damaged.
	• Throttle Link	— Misassembled, binding or damaged.
	• Valve Body	— Manual valve scored or damaged. — Spacer plate or gaskets incorrect, misassembled or damaged. — Face not flat. — Throttle valve sticking. — T.V. limit valve sticking. — Modulated downshift valve stuck. — Line bias valve stuck. — 2-3 Shift valve stuck. — Check balls omitted or misassembled.
	• Case	— Case to valve body face not flat.
HIGH OR LOW SHIFT POINTS	• T.V. Cable	— Binding or not correctly adjusted.
	• T.V. Exhaust Ball	— Stuck or damaged.
	• Throttle Lever & Bracket Assembly	— Misassembled, binding or damaged.

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Figure 8 Diagnosis Chart B

CONDITION	INSPECT COMPONENT	FOR CAUSE
HIGH OR LOW SHIFT POINTS (Continued)	• Oil Pump Assembly	– Stuck pressure regulator valve or T.V. boost valve. – Sticking pump slide.
	• Valve Body Assembly	– Sticking throttle valve or plunger. – Modulated T.V. up or down valves sticking. – T.V. limit valve sticking. – Spacer plate or gaskets misassembled, damaged or incorrect. – Line bias valve sticking.
	• Case	– Porous or damaged valve body pad. – Governor screen restricted or damaged. – 2-4 Servo a. 2-4 accumulator porosity. b. Damaged servo piston seals. c. Apply pin damaged or improper length. – 2-4 Band assembly a. Burned. b. Anchor pin not engaged.
1ST GEAR RANGE ONLY – NO UPSHIFT	• Governor Assembly	– Governor valve sticking. – Governor driven gear loose or damaged: a. Wear on bottom of gear indicates pin is not pressed in deep enough. b. Wear of corner of gear indicates pin is missing. c. Wear resembles an apple core if wrong gear is used, or there is a burr on the output shaft. d. Wear on one side of gear indicates output shaft snap ring is missing or the governor has seized in the bore. – Governor driven gear retaining pin missing. – Nicks or burrs on output shaft. – Nicks or burrs on governor sleeve or case bore. – Governor support pin in case too long or short. – Governor weights or springs missing, binding or damaged.
	• Valve Body	– 1-2 Shift valve sticking. – Spacer plate or gaskets mispositioned or damaged.
	• Case	– Case to valve body face not flat or damaged. – Governor screen restricted or damaged.

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Figure 9 Diagnosis Chart C

CONDITION	INSPECT COMPONENT	FOR CAUSE
1ST GEAR RANGE ONLY — NO UPSHIFTS (Continued)	• 2-4 Servo Assembly	— Restricted or blocked apply passages in case. — Nicks or burrs on servo pin or pin bore in case. — 4th Servo piston in backwards.
	• 2-4 Band Assembly	— 2-4 Band worn or damaged. — Band anchor pin not engaged.
SLIPS IN 1ST GEAR	• Forward Clutch Assembly	— Clutch plates worn. — Porosity or damage in forward clutch piston. — Forward clutch piston inner and outer seals missing, cut or damaged. — Input housing to forward clutch housing "O" ring seal missing, cut or damaged. — Damaged forward clutch housing. — Forward clutch housing retainer and ball assembly not sealing or damaged.
	• Forward Clutch Accumulator	— Piston seal missing, cut or damaged. — Piston out of its bore. — Porosity in the piston or auxiliary valve body. — Stuck abuse valve.
	• Oil Pump	— Auxiliary accumulator valve tube leaks, not seated in pump cover or missing.
	• Input Housing & Shaft Assembly	— Turbine shaft seals missing, cut or damaged.
	• Valve Body	— Accumulator valve stuck. — Face not flat, damaged lands or interconnected passages. — Spacer plate or gaskets incorrect, mispositioned or damaged.
	• T.V. Cable	— Binding or broken.
	• Low Roller Clutch	— Damage to lugs or inner ramps. — Rollers not free moving. — Inadequate spring tension — Damage to inner splines. — Lube passage plugged.

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Figure 10 Diagnosis Chart D

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPS IN 1ST GEAR (Continued)	• 1-2 Accumulator Piston Assembly	— Porosity in piston or 1-2 accumulator cover and pin assembly. — Damaged ring grooves on piston. — Piston seal missing, cut or damaged. — 1-2 Accumulator cover gasket missing or damaged. — Leak between piston and pin. — Broken 1-2 accumulator spring.
	• Oil Pressure	— (See Causes of High or Low Oil Pressure.)
	• 2-4 Servo Assembly	— 4th Servo piston in backwards.
1-2 SHIFT SPEED — HIGH OR LOW	• T.V. Cable	— Binding or broken. — Not correctly adjusted.
	• Governor Assembly	— (See 1st Gear Range Only — No Upshift.)
	• Throttle Lever & Bracket Assembly	— Misassembled, binding or damaged. — T.V. link missing, binding or damaged.
	• Valve Body	— T.V. exhaust check ball stuck. — T.V. plunger sticking. — Face not flat.
	• Oil Pump Assembly or Case	— Face not flat.
SLIPPING OR ROUGH 1-2 SHIFT	• Throttle Lever & Bracket Assembly	— Incorrectly installed or damaged. — T.V. cable broken or binding.
	• Valve Body Assembly	— Throttle valve sticking. — T.V. bushing turned in its bore. — 1-2 Shift valve train stuck. — Gaskets or spacer plate incorrect, mis-positioned or damaged. — Line bias valve stuck. — Accumulator valve stuck. — T.V. limit valve stuck. — Face not flat.
	• 2-4 Servo Assembly	— Apply pin too long or too short. — Servo apply piston seal missing, cut or damaged. — Restricted or missing oil passages. — Servo bore in case damaged.
	• 2nd Accumulator	— Porosity in 1-2 accumulator housing or piston. — Piston seal or groove damaged. — Nicks or burrs in 1-2 accumulator housing. — Missing or restricted oil passage.

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Figure 11 Diagnosis Chart E

CONDITION	INSPECT COMPONENT	FOR CAUSE
SLIPPING OR ROUGH 1-2 SHIFT (Continued)	• 2-4 Band	— Worn or mispositioned.
	• Oil Pump Assembly or Case	— Faces not flat.
NO 2-3 SHIFT OR 2-3 SHIFT SLIPPING, ROUGH OR HUNTING	• Converter	— Internal damage.
	• Governor Assembly	— Valve stuck. — Drive gear retaining pin missing or loose. — Governor weights binding. — Governor drive gear damaged. — Governor support pin in case too long or too short.
	• Oil Pump	— Stator shaft sleeve scored or off location.
	• Valve Body	— 2-3 Valve train stuck. — Accumulator valve stuck. — Spacer plate or gaskets incorrect, mispositioned or damaged. — Throttle valve stuck. — T.V. limit valve stuck.
	• Input Housing Assembly	— Clutch plates worn (3-4 or forward). — Excessive clutch plate travel. — Cut or damaged piston seals (3-4 or forward). — Porosity in 3-4 clutch housing or piston. — 3-4 Piston check ball stuck, damaged or not sealing. — Restricted apply passages. — Forward clutch piston retainer and ball assembly not seating. — Sealing balls loose or missing.
	• Case	— 3rd Accumulator retainer and ball assembly not seating.
	• 2-4 Servo Assembly	— 2nd Apply piston seals missing, cut or damaged.
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT	• Governor	— Governor weights binding. — Governor valve stuck. — Governor drive gear retaining pin missing or loose. — Governor drive gear damaged. — Governor support pin in case too long or too short.

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Figure 12 Diagnosis Chart F

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO 3-4 SHIFT/SLIPPING OR ROUGH 3-4 SHIFT (Continued)	• Oil Pump Assembly	Faces not flat. — Pump cover retainer and ball assembly omitted or damaged.
	• Valve Body Assembly	— Valves stuck. • 2-3 Shift valve train. • Accumulator valve. • Throttle valve. • T.V. limit valve. • 1-2 Shift valve train. • 3-2 Control valve. — Manual valve link bent or damaged. — Spacer plates or gaskets incorrect, mispositioned or damaged.
	• 2-4 Servo Assembly	— Incorrect band apply pin. — Missing or damaged servo seals. — Porosity in pistons, cover or case. — Damaged piston seal grooves. — Plugged or missing orifice cup plug.
	• Case	— 3rd Accumulator retainer and ball assembly leaking. — Porosity in 3-4 accumulator piston or bore. — 3-4 Accumulator piston seal or seal grooves damaged. — Plugged or missing orifice cup plug. — Restricted oil passage.
	• Input Housing Assembly	— Refer to Slipping 2-3 Shift.
	• 2-4 Band Assembly	— Worn or misassembled.
NO REVERSE OR SLIPS IN REVERSE	• Input Housing Assembly	— 3-4 Apply ring stuck in applied position. — Forward clutch not releasing. — Turbine shaft seals missing, cut or damaged.
	• Manual Linkage	— Not adjusted.
	• Oil Pump Assembly	— Retainer and ball assembly missing or damaged. — Stator shaft seal rings or ring grooves damaged. — Stator shaft sleeve scored or damaged. — Reverse boost valve stuck, damaged or misassembled. — Cup plug missing. — Restricted oil passage. — Faces not flat. — Converter clutch apply valve stuck.

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Figure 13 Diagnosis Chart G

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO REVERSE OR SLIPS IN REVERSE (Continued)	• Valve Body Assembly	– 2-3 Shift valve stuck. – Manual linkage not adjusted. – Spacer plate and gaskets incorrect, mispositioned or damaged.
	• Reverse Input Clutch	– Clutch plate worn. – Reverse input housing and drum assembly cracked at weld. – Clutch plate retaining ring out of groove. – Return spring assembly retaining ring out of groove. – Seals cut or damaged. – Restricted apply passage. – Porosity in piston. – Belleville plate installed incorrectly. – Excessive clutch plate travel.
	• Auxiliary Valve Body	– Lo overrun valve stuck. – Orificed cup plug restricted, missing or damaged.
	• Lo And Reverse Clutch	– Clutch plates worn. – Clutch plate retaining ring mispositioned. – Porosity in piston. – Seals damaged. – Return spring assembly retaining ring mispositioned. – Restricted apply passage.
NO PART THROTTLE OR DELAYED DOWNSHIFTS	• T.V. Cable	– Loose or incorrectly installed.
	• T.V. Bracket Assembly	– Bent.
	• 2-4 Servo Assembly	– Servo cover retaining ring omitted or misassembled. – 4th Apply piston damaged or misassembled. – Servo inner housing damaged or misassembled.
	• Governor Assembly	– Governor weights binding. – Governor valve stuck.
	• Valve Body Assembly	– Valves stuck. • Throttle valve • 3-2 Control valve • T.V. modulated downshift – 4-3 Sequence valve body channel blocked.

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Figure 14 Diagnosis Chart H

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO OVERRUN BRAKING — MANUAL 3-2-1	• External Linkage	— Not adjusted properly.
	• Valve Body Assembly	— Valves stuck. • 4-3 Sequence valve • Throttle valve — Check ball #3 mispositioned. — Spacer plate and gaskets incorrect, damaged or mispositioned.
	• Input Clutch Assembly	— Turbine shaft oil passages plugged or not drilled. — Turbine shaft seal rings damaged. — Turbine shaft sealing balls loose or missing. — Porosity in forward or overrun clutch piston. — Overrun piston seals cut or damaged. — Overrun piston check ball not sealing.
NO CONVERTER CLUTCH APPLY	• Electrical	— 12 Volts not supplied to transmission. — Outside electrical connector damaged. — Inside electrical connector, wiring harness or solenoid damaged. — Electrical short (pinched solenoid wire). — Solenoid not grounded. — Incorrect or damaged pressure switches.
	• Converter	— Internal damage.
	• Oil Pump Assembly	— Converter clutch apply valve stuck or assembled backwards. — Converter clutch apply valve retaining ring mispositioned. — Pump to case gasket mispositioned. — Orifice cup plug restricted or damaged. — Solenoid "O" ring seal cut or damaged. — High or uneven bolt torque (pump body to cover).
	• Valve Body Assembly	— Valves stuck. * Converter clutch shift valve. * Throttle valve. (* Non ECM controlled vehicles)
	• Input Housing and Shaft	— Turbine shaft "O" ring seal cut or damaged. — Turbine shaft retainer and ball assembly restricted or damaged.

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Figure 15 Diagnosis Chart I

CONDITION	INSPECT COMPONENT	FOR CAUSE
CONVERTER SHUDDER	• Torque Converter Assembly	— Internal damage.
	• Valve Body	—*Converter clutch shift valve stuck. (* Non ECM controlled vehicles)
	• Oil Pump Assembly	— Converter clutch apply valve stuck. — Restricted oil passage.
	• Oil Filter	— Crack in filter body. — Flash restricting filter neck. — "O" ring seal cut or damaged.
	• Miscellaneous	— Low oil pressure. — Engine not tuned properly.
	• Input Housing and Shaft Assembly	— Turbine shaft "O" ring cut or damaged. — Turbine shaft retainer and ball assembly restricted or damaged.
NO CONVERTER CLUTCH RELEASE	• Solenoid	— External ground.
	• Converter	— Internal damage.
	• Oil Pump Assembly	— Converter clutch apply valve stuck.
DRIVES IN NEUTRAL	• Forward Clutch	— Not releasing.
	• Manual Linkage	— Incorrectly adjusted. — Disconnected.
	• Case	— Face not flat. — Internal leakage.
2ND GEAR START (DRIVE RANGE)	• Governor Assembly	— Valve stuck. — Governor support pin too long or missing.
	• Forward Sprag Clutch	— Sprag assembly installed backwards.
NO PARK	• Parking Linkage	— Actuator rod assembly bent or damaged. — Actuator rod spring binding or improperly crimped. — Actuator rod not attached to inside detent lever. — Parking bracket damaged or not torqued properly.

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Figure 16 Diagnosis Chart J

CONDITION	INSPECT COMPONENT	FOR CAUSE
NO PARK (Continued)	• Parking Linkage (Cont.)	— Inside detent lever not torqued properly. — Detent roller mispositioned or not torqued properly. — Parking pawl binding or damaged.
RATCHETING NOISE	• Parking Pawl	— Parking pawl return spring weak, damaged or misassembled.
OIL OUT THE VENT	• Oil Pump • Valve Body • Miscellaneous	— Chamfer in pump body rotor pocket too large. — T.V. limit valve stuck. — Fluid level - overfilled.
VIBRATION IN REVERSE AND WHINING NOISE IN PARK	• Oil Pump	— Broken vane rings.

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Figure 16A Diagnosis Chart K

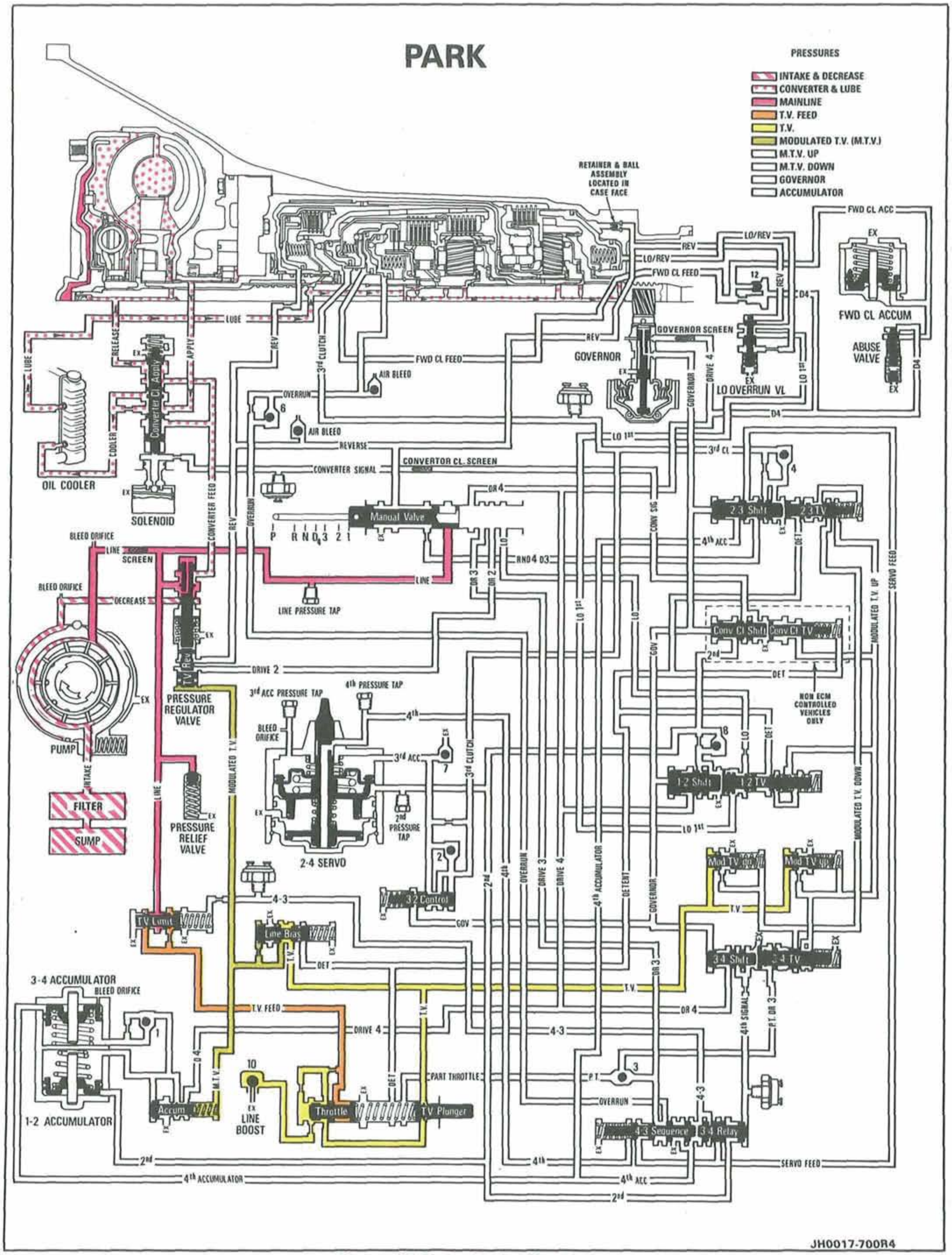

Figure 17 Park - Engine Running

PARK—ENGINE RUNNING

CONVERTER CLUTCH – RELEASED	**3-4 CLUTCH – RELEASED**	**2-4 BAND – RELEASED**
REVERSE INPUT CLUTCH – RELEASED	**LO AND REVERSE CLUTCH – RELEASED**	**OVERRUN CLUTCH – RELEASED**
FORWARD CLUTCH – RELEASED	**LO ROLLER CLUTCH – NOT HOLDING**	**FORWARD SPRAG CLUTCH – NOT HOLDING**

With the selector lever in the Park (P) position, oil from the pump is directed to the following:

1. Pressure Regulator Valve
2. Release Side of the Converter and the Lubrication System
3. Decrease Side of the Pump Slide
4. Manual Valve
5. T.V. System (Limit Valve, Throttle Valve, Line Bias Valve, M.T.V. Up Valve and M.T.V. Down Valve)
6. Pressure Relief Valve
7. Line Pressure Tap

Oil flows from the pump to the pressure regulator valve which regulates the pump pressure. When the pump output exceeds the demand of line pressure, oil from the pressure regulator valve is directed to the converter clutch apply valve. The converter clutch apply valve directs oil to the release side of the converter clutch. Converter return oil is directed to the transmission cooler by the converter clutch apply valve. Oil from the cooler is directed to the transmission lubrication system.

Oil is also directed from the pressure regulator valve to the pump slide to decrease pump output in relation to the combined pressure of M.T.V. oil and regulator valve spring force. Line pressure acts on the pressure relief valve which will exhaust any oil above 2,240 to 2,520 kPa (320 to 360 psi).

Line pressure at the manual valve is available for use in other drive ranges.

Line pressure at the T.V. limit valve is limited to 620 kPa (90 psi). This limited pressure is directed to the throttle valve where it is regulated to a variable pressure called throttle valve (T.V.) pressure. T.V. pressure increases with carburetor opening and is directed to the line bias, M.T.V. up and M.T.V. down valves.

At the line bias valve, T.V. pressure is modulated to M.T.V. pressure. M.T.V. pressure helps to control line pressure at the pressure regulator valve and accumulator pressure at the accumulator valve.

T.V. pressure at the M.T.V. up valve and M.T.V. down valve is available for use when accelerating in other ranges.

SUMMARY

The converter is filled from the release side; all clutches and the band are released. The manual linkage has the parking pawl engaged in the reaction internal gear lugs. At idle, there is not sufficient T.V. pressure to open the M.T.V. up or M.T.V. down valves.

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Figure 18 Park - Engine Running

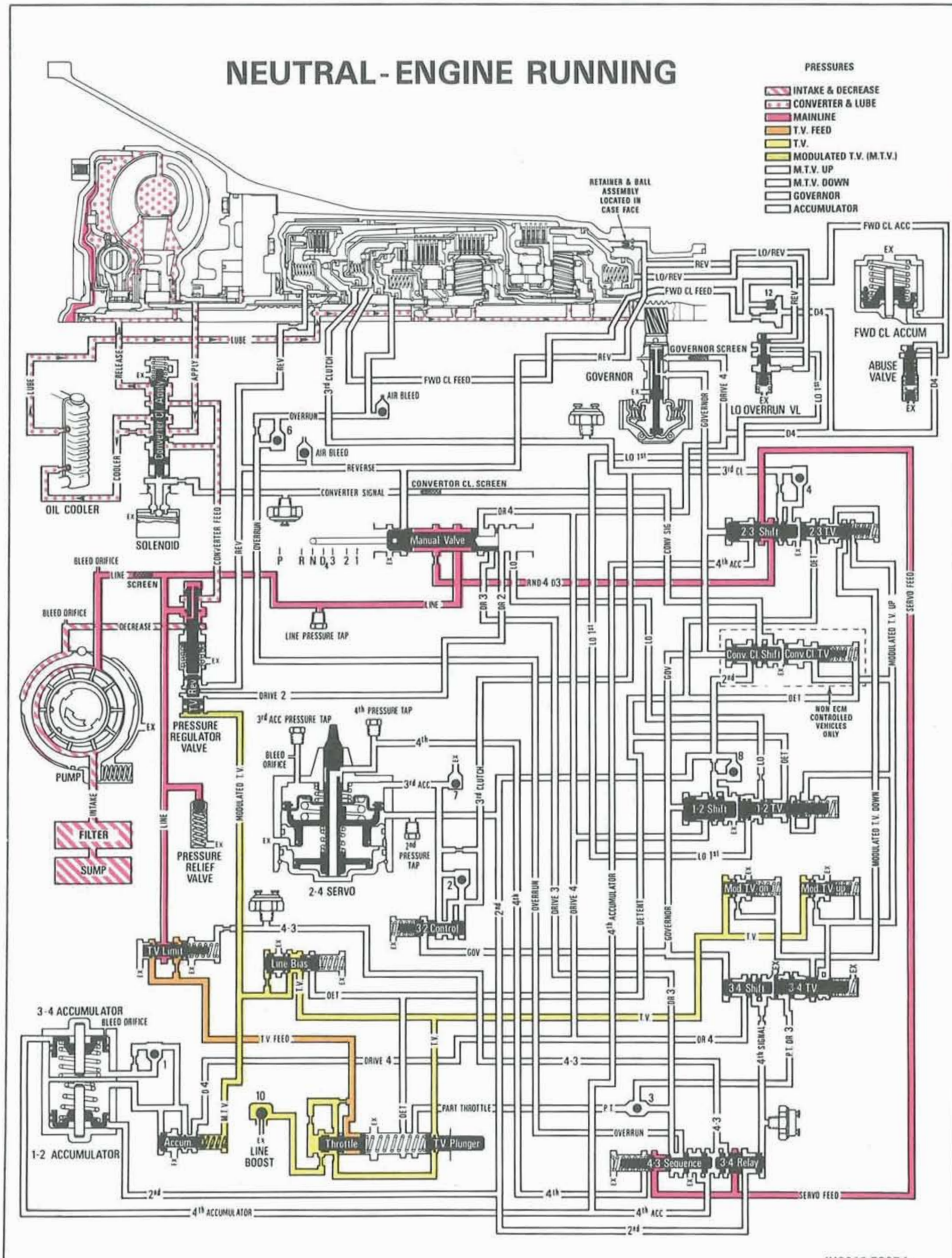

Figure 19 Neutral - Engine Running

NEUTRAL—ENGINE RUNNING

CONVERTER CLUTCH – RELEASED   3-4 CLUTCH – RELEASED   2-4 BAND – RELEASED

REVERSE INPUT CLUTCH – RELEASED   LO AND REVERSE CLUTCH – RELEASED   OVERRUN CLUTCH – RELEASED

FORWARD CLUTCH – RELEASED   LO ROLLER CLUTCH – NOT HOLDING   FORWARD SPRAG CLUTCH – NOT HOLDING

When the selector lever is moved to the Neutral (N) position, the line pressure is directed to the same areas as in Park, except in Neutral (N) the manual valve directs oil into the Reverse, Neutral, Drive 4, Drive 3 (RND4D3) oil is directed to the 2-3 shift valve which directs RND4D3 oil to the 3-4 relay valve through the servo feed passage. Oil at these valves is available for use in other ranges.

SUMMARY

The converter is filled from the release side; all clutches and the band are released. At idle, there is not sufficient T.V. pressure to open the M.T.V. up or M.T.V. down valves.

JH0176-700R4

Figure 20 Neutral - Engine Running

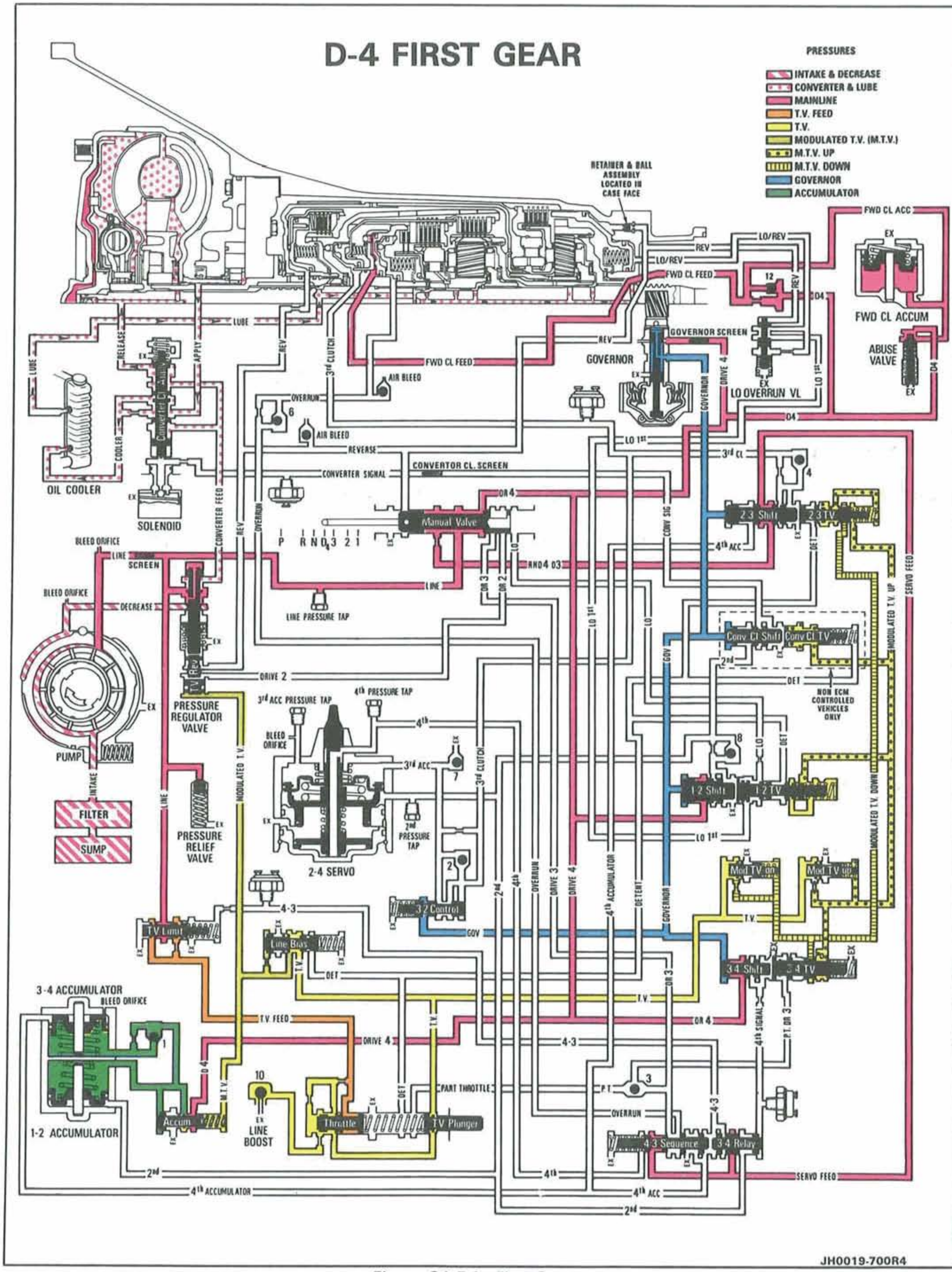

Figure 21 D4 - First Gear

D-4—FIRST GEAR

FORWARD CLUTCH – APPLIED **LO ROLLER CLUTCH – HOLDING** **FORWARD SPRAG CLUTCH – HOLDING**

When the selector lever is moved to the Drive (D) position, the manual valve is repositioned to allow line pressure to enter the Drive 4 (D4) passage. Drive 4 oil then flows to the following:

1. Forward Clutch Accumulator, Forward Clutch and Abuse Valve
2. Governor Valve
3. 1-2 Shift Valve
4. Accumulator Valve
5. 3-4 Shift Valve

BASIC CONTROL

Drive 4 oil is directed to the forward clutch accumulator where the #12 checkball seats, routing forward clutch feed through an orifice. This combines with the forward clutch accumulator to cushion the forward clutch apply.

During "Rock Cycle" conditions (stuck in mud or snow and "Rocking" out), an abuse valve routes D4 oil to forward clutch feed oil to quicken the apply of the forward clutch.

Drive 4 oil is directed to the 1-2 and 3-4 shift valves. Drive 4 oil is directed to the accumulator valve and is regulated to a pressure called accumulator pressure; this pressure is directed to the 1-2 and 3-4 accumulator pistons to act as a cushion for the band apply in second gear and overdrive.

Drive 4 oil is orificed into the governor passage, and is regulated to a variable pressure called governor pressure. Governor pressure increases with vehicle speed and acts against the 1-2, 2-3, 3-4, converter clutch and the 3-2 control valve springs.

In first gear, there could be sufficient throttle valve plunger travel to increase T.V. pressure enough to open the M.T.V. up and the M.T.V. down valves. In first gear, M.T.V. up exerts pressure against governor pressure at the 1-2, 2-3, 3-4, and converter clutch throttle valves. M.T.V. down pressure is stopped by a land at the 2-3 and 3-4 throttle valves.

SUMMARY

The converter clutch is released, the forward sprag clutch is holding, the forward clutch is applied; the transmission is in Drive (D) Range — First Gear.

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Figure 22 D4 - First Gear

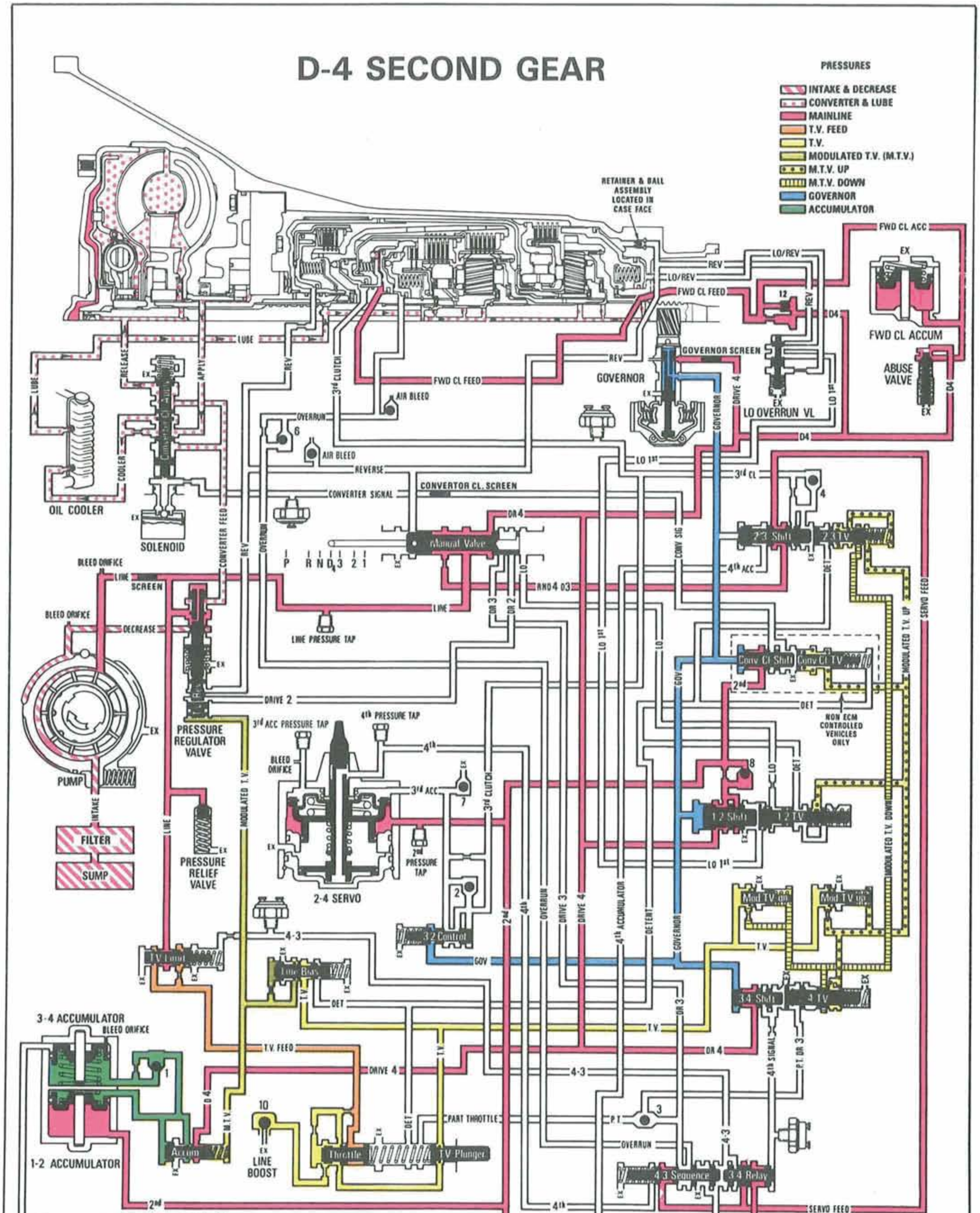


Figure 23 D4 - Second Gear

D-4—SECOND GEAR

2-4 BAND – APPLIED **FORWARD SPRAG CLUTCH – HOLDING** **FORWARD CLUTCH – APPLIED**

As both vehicle speed and governor pressure increase, the force of the governor oil acting on the 1-2 shift valve overcomes the pressure of M.T.V. up oil and the force of the 1-2 throttle valve spring. This allows the 1-2 shift valve to open and Drive 4 (D4) oil to enter the second (2nd) oil passage. This oil is called second (2nd) oil. Second oil from the 1-2 shift valve is directed to the following:

1. 1-2 Shift Checkball (8)
2. 2-4 Servo
3. 1-2 Accumulator Piston
4. Converter Clutch Shift Valve
5. 3-4 Relay Valve

BASIC CONTROL

Second oil from the 1-2 shift valve will seat the 1-2 shift checkball (8) forcing 2nd oil through an orifice. Second oil is then directed to the 2-4 servo to apply the 2-4 band. At the same time, 2nd oil moves the 1-2 accumulator piston against accumulator pressure and the accumulator spring to maintain a controlled build-up of pressure on the servo during the 1-2 shift for a smooth band apply. 2nd oil at the converter clutch shift valve and the 3-4 relay valve is available for use in other ranges.

SUMMARY

The converter clutch is released, the 2-4 band is applied, the forward clutch is applied, and the forward sprag clutch is holding; the transmission is in Drive (D) Range — Second Gear.

JH0178-700R4

Figure 24 D4 - Second Gear

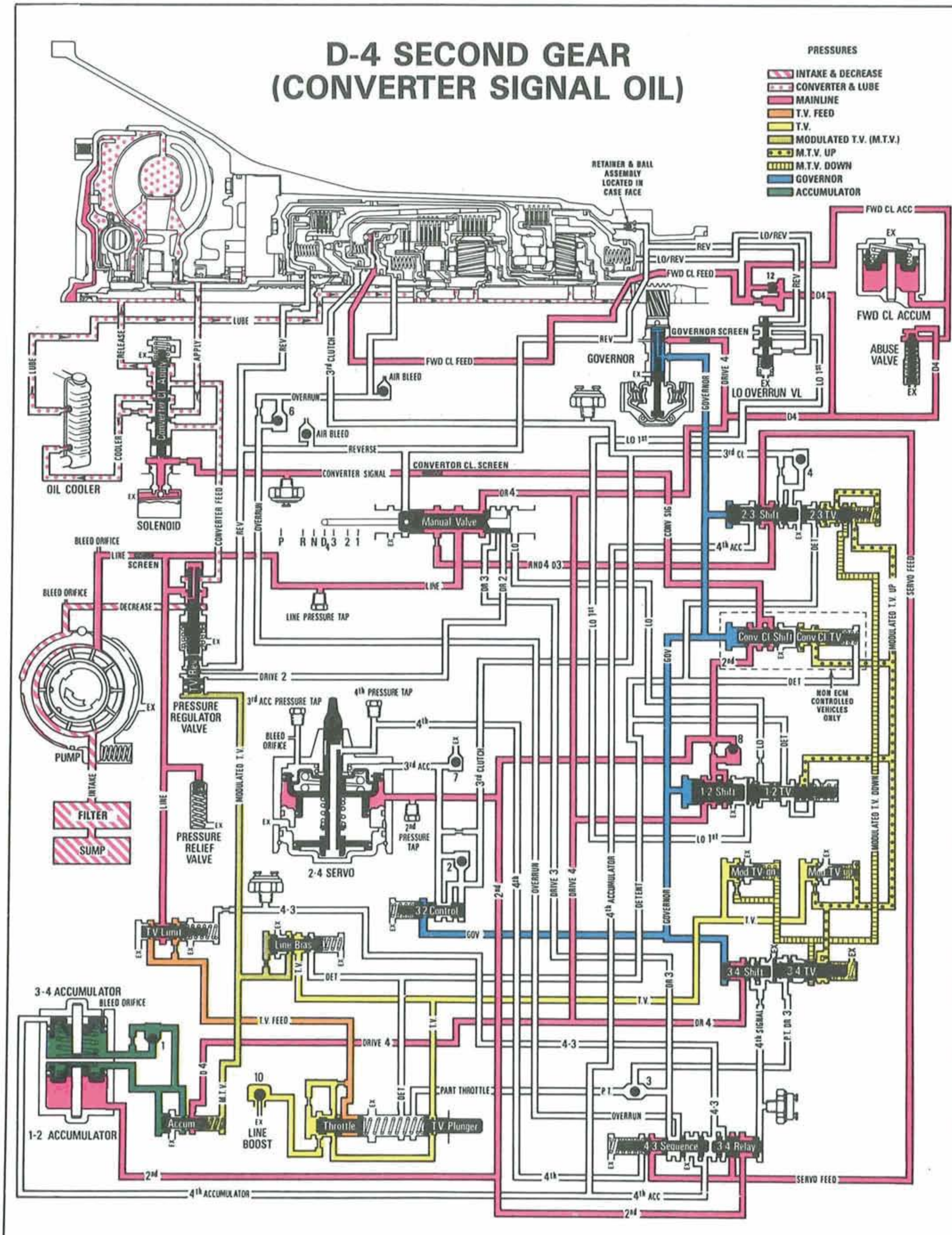


Figure 25 D4 - Second Gear - Converter Signal Oil

D-4—SECOND GEAR

(Converter Signal Oil)

CONVERTER CLUTCH – APPLIED

2-4 BAND – APPLIED

FORWARD CLUTCH – APPLIED

FORWARD SPRAG CLUTCH – HOLDING

NON E.C.M. CONTROLLED VEHICLES

As vehicle speed and governor pressure increase, the force of the governor oil acting on the converter clutch shift valve overcomes the pressure of M.T.V. up oil and the force of the converter clutch T.V. spring. This allows the converter clutch shift valve to open and 2nd oil to enter the converter clutch signal passage. Converter signal oil will exhaust at the T.C.C. solenoid until a signal is received from the vehicles external controls.

E.C.M. CONTROLLED VEHICLES

Second oil is rerouted into converter clutch signal oil at the bore plugs used in place of the converter clutch shift valve. Converter signal oil exhausts at this solenoid until a signal is received from the vehicles E.C.M.

JH0179-700R4

Figure 26 D4 - Second Gear - Converter Signal Oil

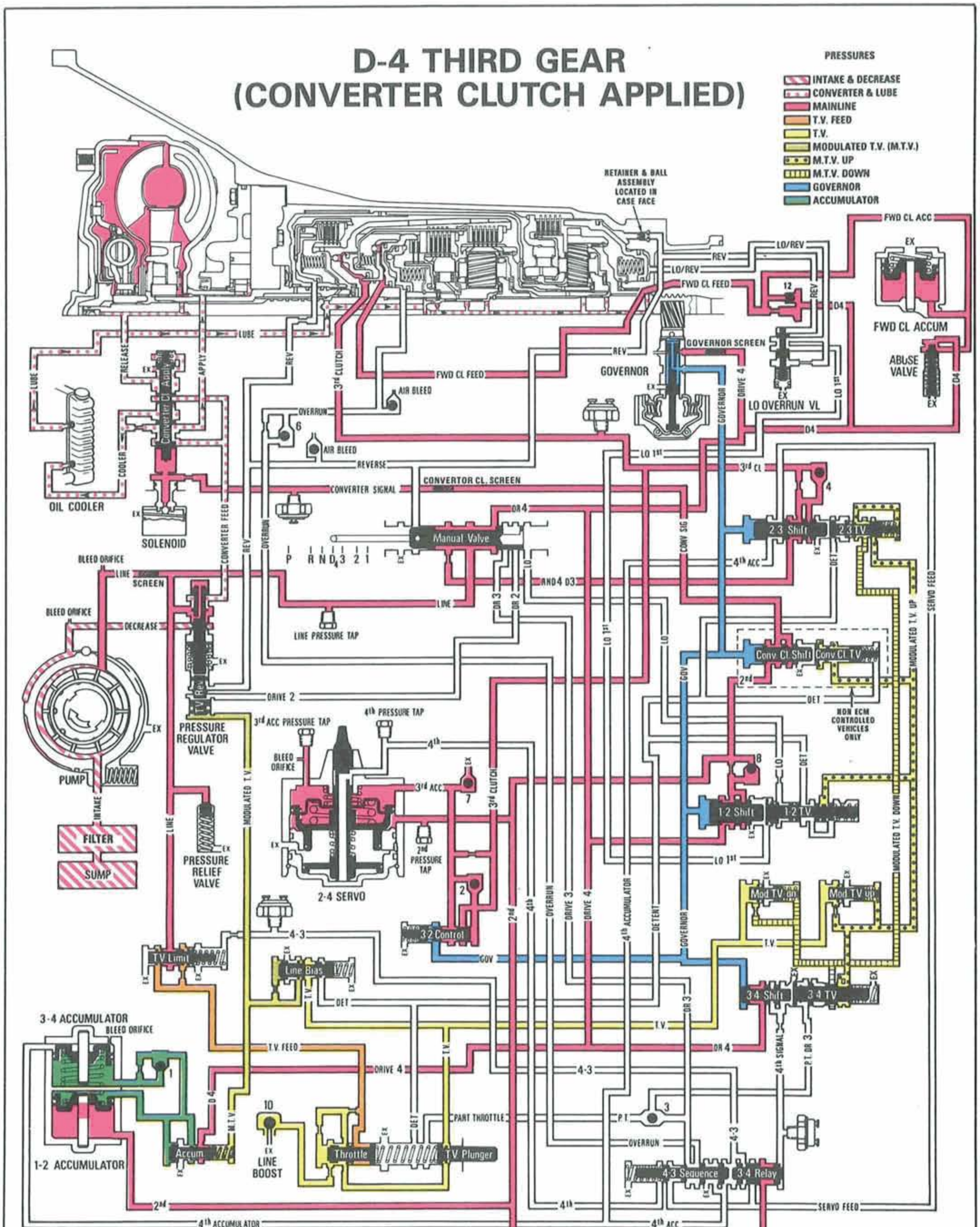


Figure 27 D4 - Third Gear - Converter Clutch Applied

D-4—THIRD GEAR
(Converter Clutch Applied)

CONVERTER CLUTCH – APPLIED

FORWARD CLUTCH – APPLIED

FORWARD SPRAG CLUTCH – HOLDING

3-4 CLUTCH – APPLIED

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 2-3 shift valve overcomes the force of the 2-3 T.V. spring and M.T.V. up oil. This allows the 2-3 shift valve to open and allows RND4D3 oil to enter the 3rd clutch passage.

Third clutch oil from the 2-3 shift valve is directed to the following:

1. 3-2 Exhaust Checkball (4)
2. 3-4 Clutch Piston
3. Third Clutch Accumulator Checkball (2)
4. Third Accumulator Exhaust Checkball (7)
5. 2-4 Servo (Release Side)
6. 3-2 Control Valve

BASIC CONTROL

Third clutch oil from the 2-3 shift valve flows past the 3-2 exhaust checkball (4), to the 3-4 clutch piston. At the same time, third clutch oil is directed past the third clutch accumulator checkball (2), seats the third accumulator exhaust check ball (7), and then into the release side of the 2-4 servo. This third clutch accumulator pressure combined with the servo cushion spring, moves the second apply piston, in the 2-4 servo, against second oil and acts as an accumulator for a smooth 2-4 band release and 3-4 clutch apply.

Third clutch oil is present at the 3-2 control valve in preparation of a third gear to second gear shift.

Once the solenoid receives a signal from the vehicles controls and solenoid is on, converter clutch signal oil will shift the converter clutch apply valve, and redirect converter feed oil into the apply passage. The apply oil flows between the stator shaft and converter hub to charge the converter with oil and push the converter pressure plate against the converter cover, causing a mechanical link between the engine and the turbine shaft. The rate of apply is controlled by the orifice checkball capsule in the end of the turbine shaft.

At the same time the converter clutch apply valve will direct converter feed oil through an orifice to the transmission cooler. Cooler oil is directed to the transmission lubrication system.

SUMMARY

The converter clutch is applied*, the forward clutch is applied, the forward sprag clutch is holding, the 3-4 clutch is applied and the 2-4 band is released; the transmission is in Drive (D) Range — Third Gear (direct drive).

*The converter clutch may or may not be applied, depending on shift calibration and solenoid operation.

JH0180-700R4

Figure 28 D4 - Third Gear - Converter Clutch Applied

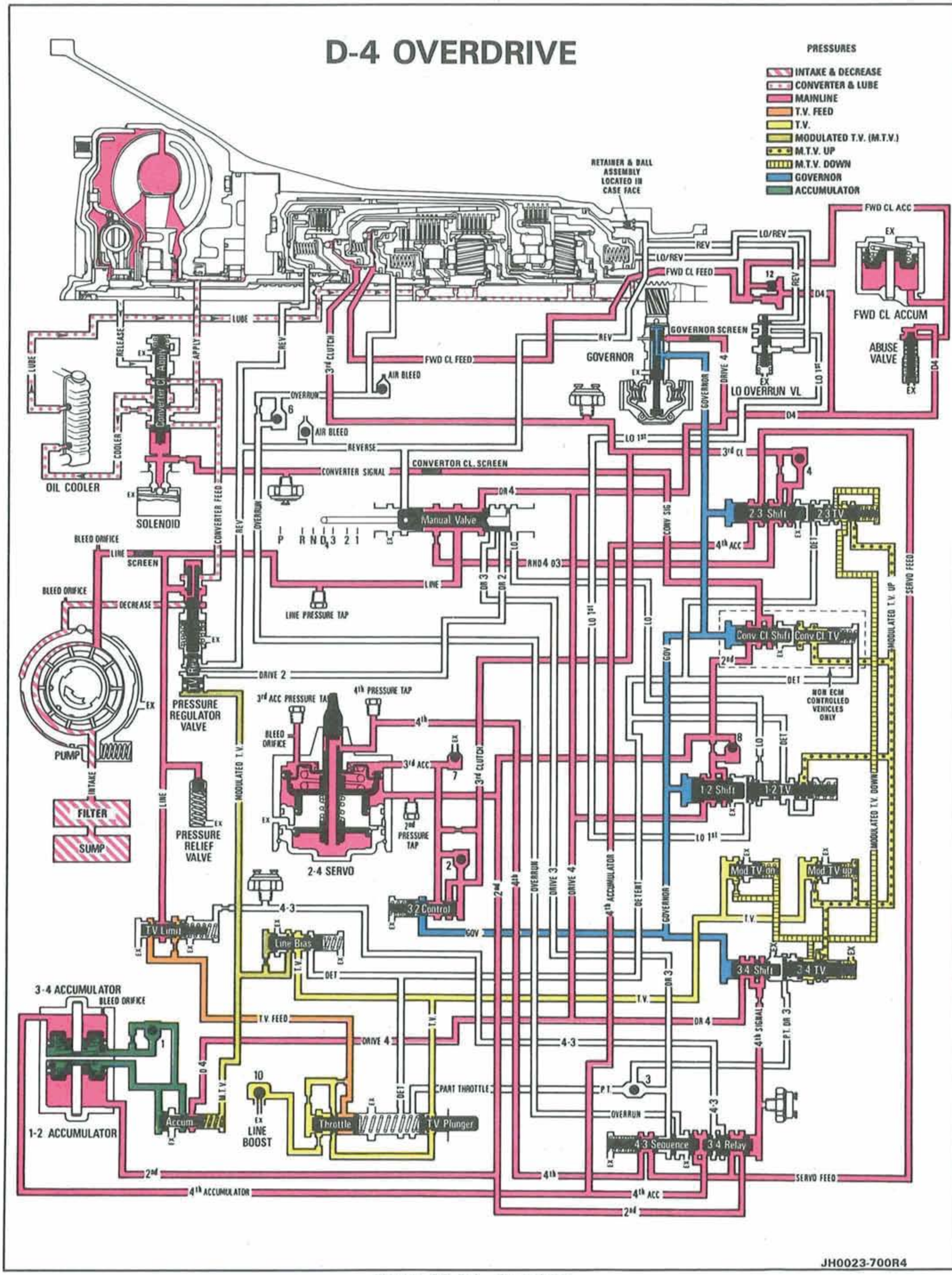


Figure 29 D4 - Overdrive

D-4—OVERDRIVE

CONVERTER CLUTCH — APPLIED
FORWARD CLUTCH — APPLIED

3-4 CLUTCH — APPLIED

2-4 BAND — APPLIED
FORWARD SPRAG CLUTCH — NOT HOLDING

As both vehicle speed and governor pressure increase, the force of governor oil acting on the 3-4 shift valve overcomes the force of the 3-4 T.V. spring and M.T.V. up oil. This opens the 3-4 shift valve sending Drive 4 (D4) into the fourth signal passage. Fourth signal oil will overcome the 4-3 sequence valve spring and open the 3-4 relay and the 4-3 sequence valves, allowing second oil to enter the servo feed passage.

Servo feed oil is directed to the following:

1. 2-3 Shift Valve
   a. Which directs oil to the:
      1) 3-4 Accumulator
      2) 4-3 Sequence Valve
2. 4-3 Sequence Valve
   a. Which directs oil to the:
      1) 4th Apply Piston (in the 2-4 servo)

BASIC CONTROL

Servo feed oil passes through the 4-3 sequence valve and becomes fourth oil. Fourth oil then enters the 2-4 servo, applies pressure on the fourth apply piston, and applies the 2-4 band.

SUMMARY

The converter clutch, 2-4 band, forward clutch, the 3-4 clutch are applied, and the forward sprag clutch is overrunning; the transmission is in Drive (D) Range — Overdrive.

*The converter clutch may or may not be applied, depending on solenoid operation.

JH0181-700R4

Figure 30 D4 - Overdrive

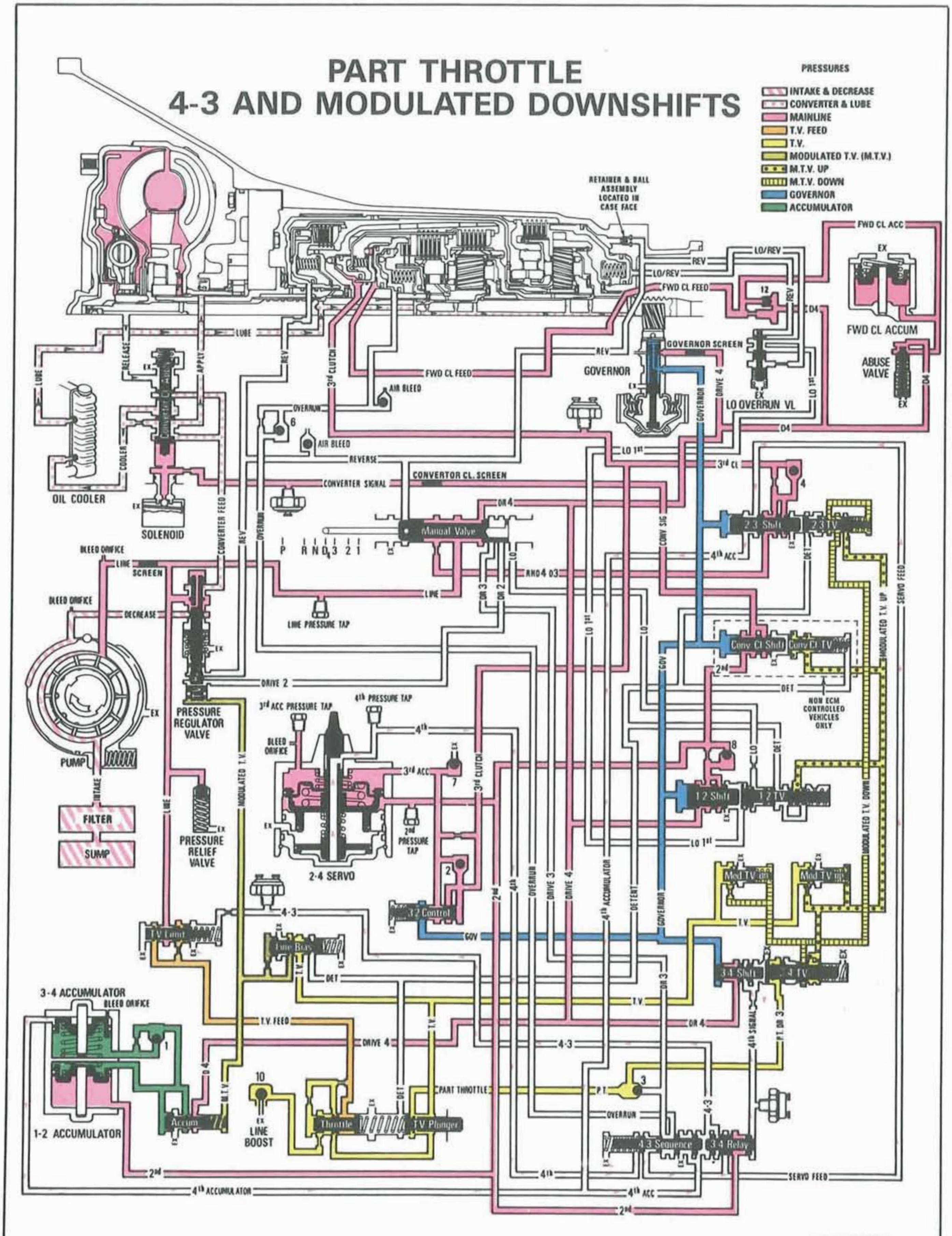


Figure 31 Part Throttle 4-3 and Modulated Downshifts, Valves Shown in Third Gear Position

PART THROTTLE 4-3 AND MODULATED DOWNSHIFTS

(Valves In Third Gear Position)

CONVERTER CLUTCH – APPLIED
FORWARD SPRAG CLUTCH – HOLDING

FORWARD CLUTCH – APPLIED
3-4 CLUTCH – APPLIED

A part throttle 4-3 downshift can be accomplished by depressing the accelerator pedal far enough to move the throttle valve (T.V.) plunger to allow the T.V. oil to enter the part throttle (P.T.) passage. This oil, called part throttle (P.T.) oil, is then routed to the 3-4 throttle valve.

Part throttle oil and the 3-4 throttle valve spring force will close the 3-4 shift valve against governor pressure, shutting off D4 oil to the fourth signal passage. Fourth accumulator oil will push the 3-4 relay valve closed and hold the 4-3 sequence valve open while it exhausts at an orifice at the T.V. limit valve. Fourth oil will pass through the 4-3 sequence valve to the servo feed passage to the 2-3 shift valve to the fourth accumulator passage. When fourth accumulator pressure is low enough, the 4-3 sequence valve spring will close the 4-3 sequence valve and the remaining fourth and fourth accumulator oil will exhaust at the 4-3 sequence valve.

A type of part throttle downshift can be accomplished in some ranges (4-3, and 3-2, shifts) by depressing the accelerator pedal far enough to raise M.T.V. down pressure. This pressure when combined with the throttle valve spring pressure can overcome governor pressure and cause a modulated downshift.

*The converter clutch may or may not be applied depending on shift calibration and solenoid operation.

JH0182-700R4

Figure 32 Part Throttle 4-3 and Modulated Downshifts

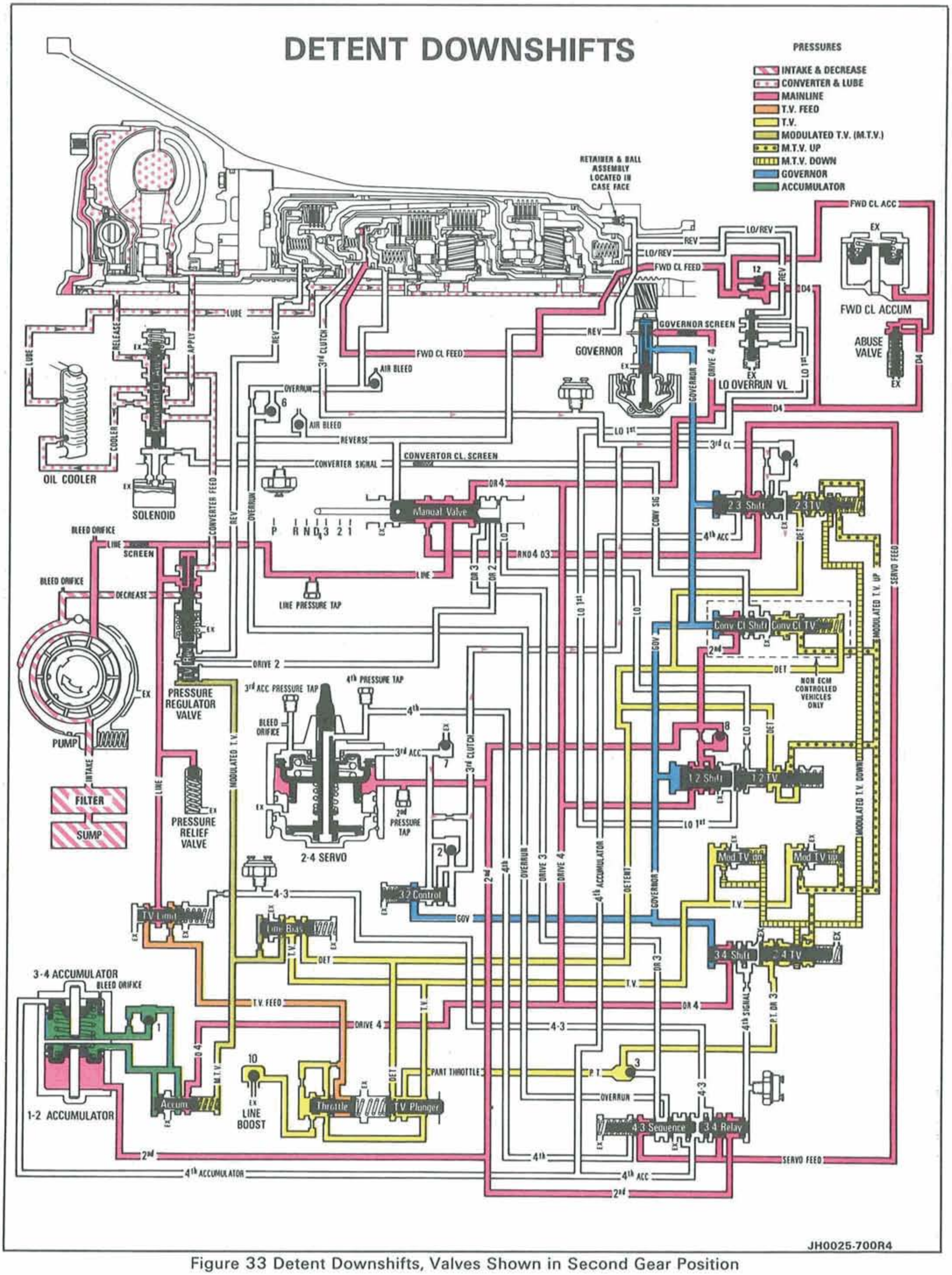


Figure 33 Detent Downshifts, Valves Shown in Second Gear Position

DETENT DOWNSHIFTS

(Valves In Second Gear Position)

CONVERTER CLUTCH – RELEASED

FORWARD CLUTCH – APPLIED

2-4 BAND – APPLIED

FORWARD SPRAG CLUTCH – HOLDING

While operating at speeds below approximately 60 mph (96 km/h), a forced or detent 3-2 downshift is possible by depressing the accelerator pedal fully. This will position the throttle valve (T.V.) plunger to allow T.V. oil to enter the detent passage. This oil, called detent oil, is then routed to the following:

1. Line Bias Valve
2. 2-3 Throttle Valve
3. 1-2 Throttle Valve
4. Converter Clutch Throttle Valve (Non E.C.M. Controlled Vehicles Only)

Detent oil from the T.V. plunger flows to the line bias valve to boost modulated T.V. (M.T.V.) pressure. M.T.V. oil acting on the T.V. boost valve will boost line pressure approximately 70 kPa (10 psi).

NON E.C.M. CONTROLLED VEHICLES

Detent oil at the converter clutch throttle valve will close the converter clutch shift valve train and release the converter clutch.

E.C.M. CONTROLLED VEHICLES

The E.C.M. will discontinue the signal provided to the solenoid to release the converter clutch.

Detent oil from the T.V. plunger flows to the 2-3 throttle valve. Detent and M.T.V. down oil, acting on separate areas of the 2-3 throttle valve, will close the 2-3 shift valve against governor oil and allow 3rd clutch and 3rd accumulator oil to pass through an orifice and exhaust at the 2-3 shift valve.

At vehicle speeds above approximately 50 mph (80 km/h), governor oil acting on the 3-2 control valve will close it. Now the exhausting 3rd clutch accumulator oil from the intermediate servo will seat the 3rd clutch accumulator checkball (2) and flow through another orifice controlling the intermediate band apply for a smooth 3-2 shift at high speed.

A detent 2-1 downshift can be accomplished at speeds below approximately 30 mph (48 km/h), because detent oil pressure and the 1-2 spring force acting on the 1-2 throttle valve will close the 1-2 shift valve, shifting the transmission to first gear.

JH0183-700R4

Figure 34 Detent Downshifts

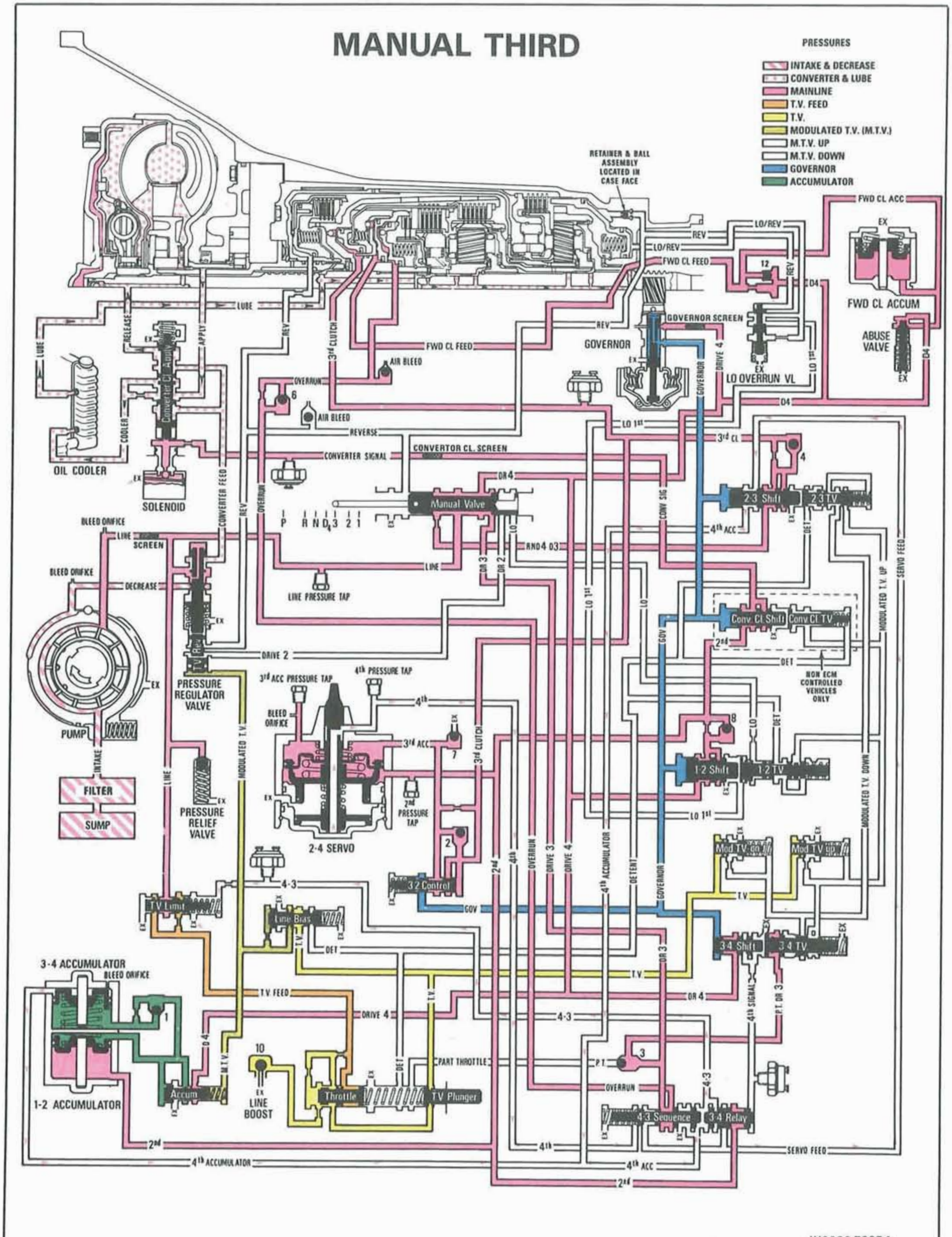


Figure 35 Manual Third

MANUAL THIRD

CONVERTER CLUTCH – RELEASED

FORWARD CLUTCH – APPLIED

OVERRUN CLUTCH – APPLIED

3-4 CLUTCH – APPLIED

A forced 4-3 downshift can be accomplished by moving the selector lever from Drive (D) Range to Third (3rd) Gear. When the selector lever is moved to the Third (3rd) Gear position, D3 oil from the manual valve is directed to the following:

1. 4-3 Sequence Valve
2. Part Throttle and Drive 3 (D3) Checkball (3)
3. 3-4 Shift Valve

D3 oil will close the 3-4 shift valve and allow the 4th signal oil to exhaust.

D3 oil combined with the 4-3 sequence valve spring force will close the 4-3 sequence valve to allow the fourth and fourth accumulator oil to exhaust and release the band. D3 oil then flows into the overrun clutch passage where it applies the overrun clutch to keep the forward sprag clutch from overrunning when engine braking is needed.

The forward and 3-4 clutches are applied. The 2-4 band is released. The transmission is in Manual Third, direct drive. The overrun clutch is applied to allow engine braking.

*NON E.C.M. CONTROLLED VEHICLES

In manual 3rd, the converter is shown released by the engine vacuum switch and there is no M.T.V. up or M.T.V. down pressure. This is assuming the throttle is released. If the throttle is opened sufficiently, the converter clutch could engage and the M.T.V. up and M.T.V. down valves could open.

JH0184-700R4

Figure 36 Manual Third

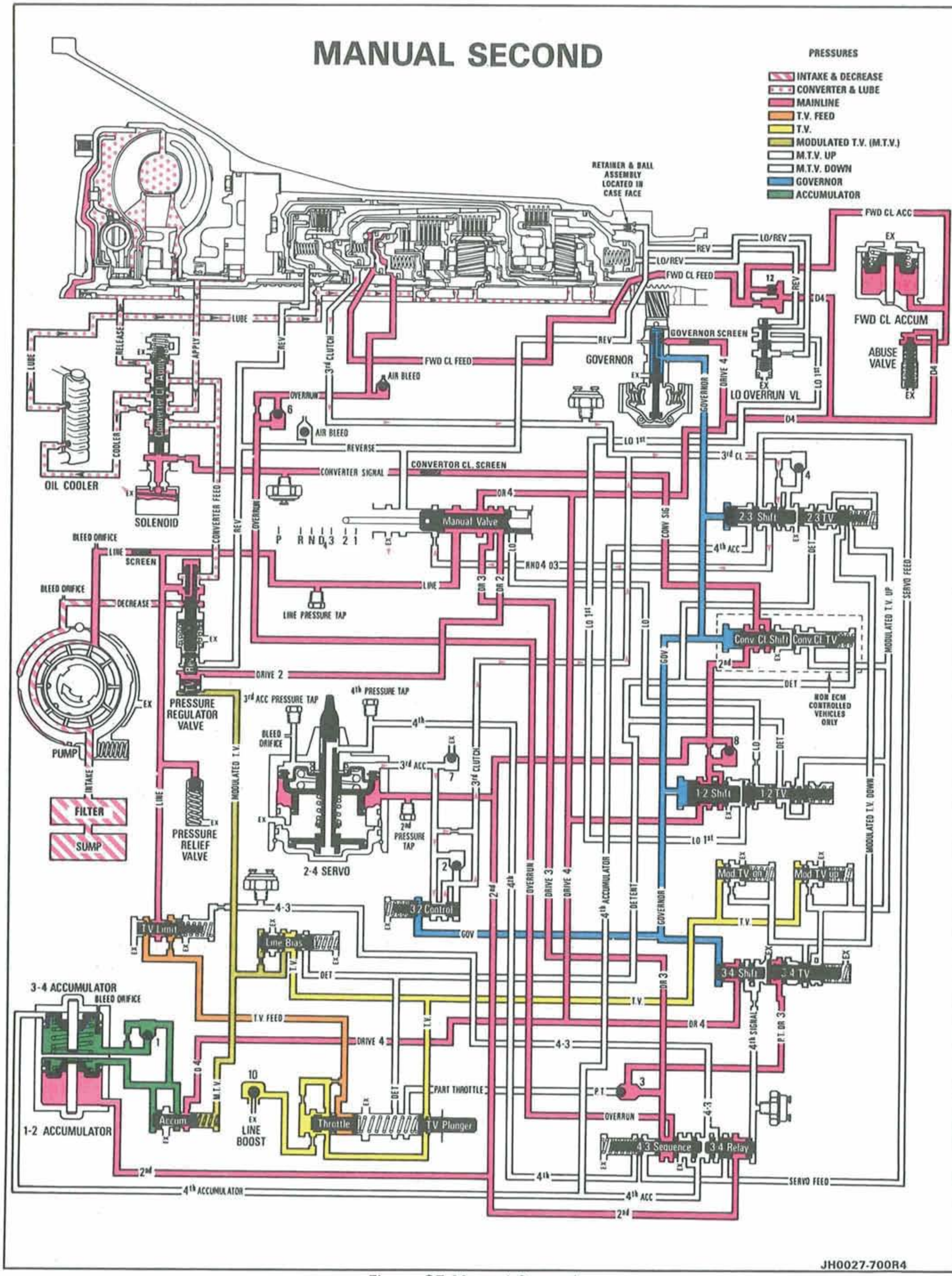


Figure 37 Manual Second

MANUAL SECOND

CONVERTER CLUTCH – RELEASED

OVERRUN CLUTCH – APPLIED

2-4 BAND – APPLIED

FORWARD CLUTCH – APPLIED

A forced 3-2 downshift can be accomplished by moving the selector lever from Third (3rd) Gear to Second (2nd) Gear position.

When the selector lever is moved to the Second (2nd) Gear position, RND4D3, 3rd clutch, and 3rd accumulator oil will exhaust at the manual valve. With no pressure to apply the 3-4 clutch, or release the 2-4 band, the transmission will shift to second gear.

The manual valve will also direct line pressure into the D2 passage. Drive 2 (D2) oil will act on the reverse boost valve to boost line pressure to 1206 kPa (175 psi) which is required to prevent the 2-4 band and forward clutch from slipping.

SUMMARY

The forward clutch and 2-4 band are applied. The transmission is in second gear. Also, the overrun clutch is still applied to allow engine braking when needed.

JH0185-700R4

Figure 38 Manual Second

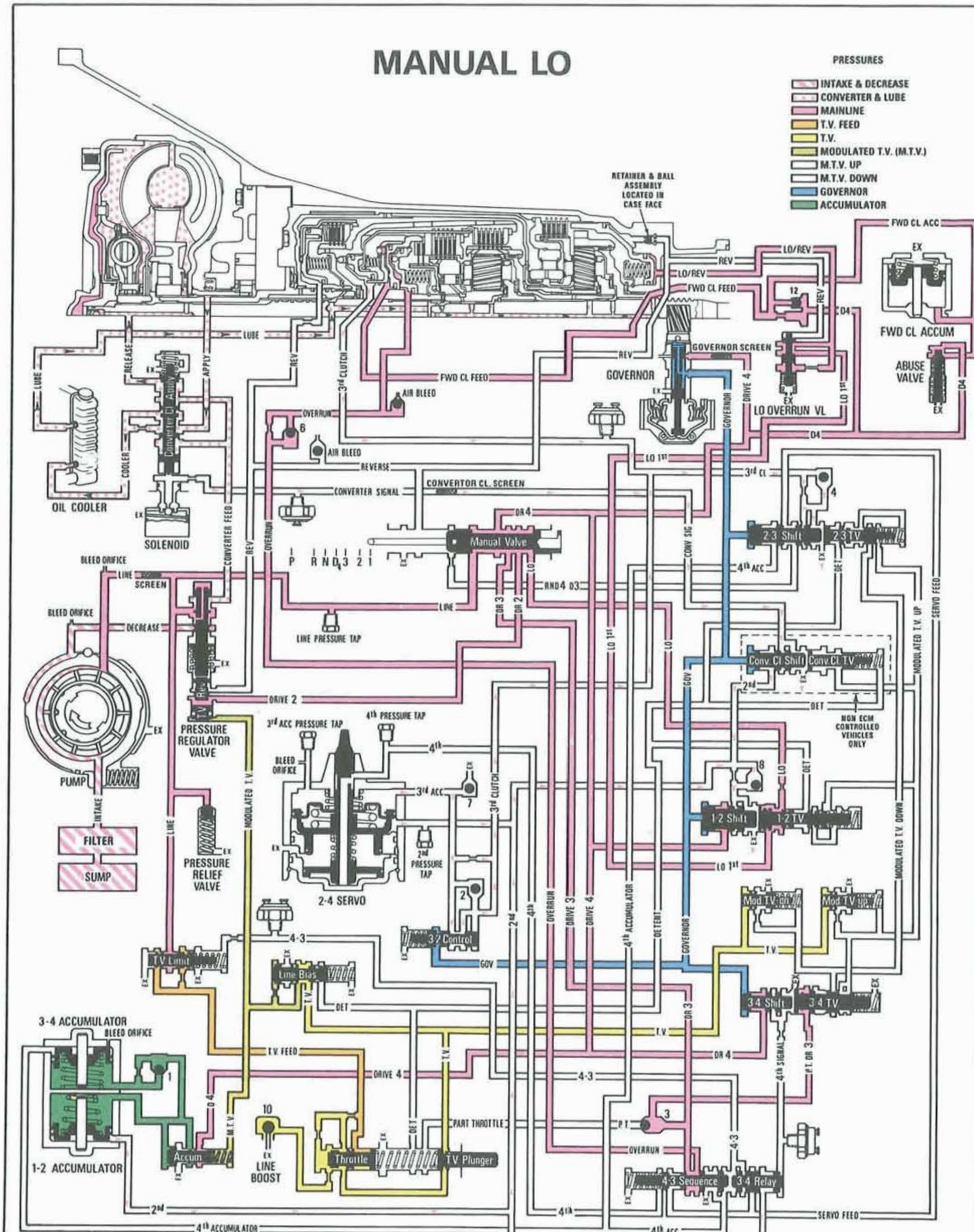


Figure 39 Manual Lo

MANUAL LO

CONVERTER CLUTCH – RELEASED

FORWARD CLUTCH – APPLIED

OVERRUN CLUTCH – APPLIED

LO ROLLER CLUTCH – APPLIED

Maximum downhill braking can be obtained at speeds below 30 mph (48 km/h) with the selector in Lo (1st) range. Lo/1st oil pressure, which is 1206 kPa (175 psi), is the same as second (2nd) oil pressure because second (D2) oil is still present.

Lo oil from the manual valve is directed to the following:

1. 1-2 Shift Valve Train
2. Lo and Reverse Clutch
3. Lo Overrun Valve

Lo oil at the 1-2 T.V. valve combined with the 1-2 throttle valve spring force will close the 1-2 shift valve at speeds approximately 35 mph (56 km/h) or below. This allows 2nd oil to exhaust, releasing the 2-4 band, and lo oil to apply the lo and reverse clutch.

Lo/1st oil coming off the 1-2 T.V. valve is directed toward the lo overrun valve that regulates lo/reverse oil. This smoothes the 2-1 manual downshift for maximum engine braking.

SUMMARY

The forward clutch is applied. The lo and reverse, and the overrun clutch are applied to allow engine braking. The 2-4 band is released, the transmission is in Lo Range – First Gear.

JH0186-700R4

Figure 40 Manual Lo

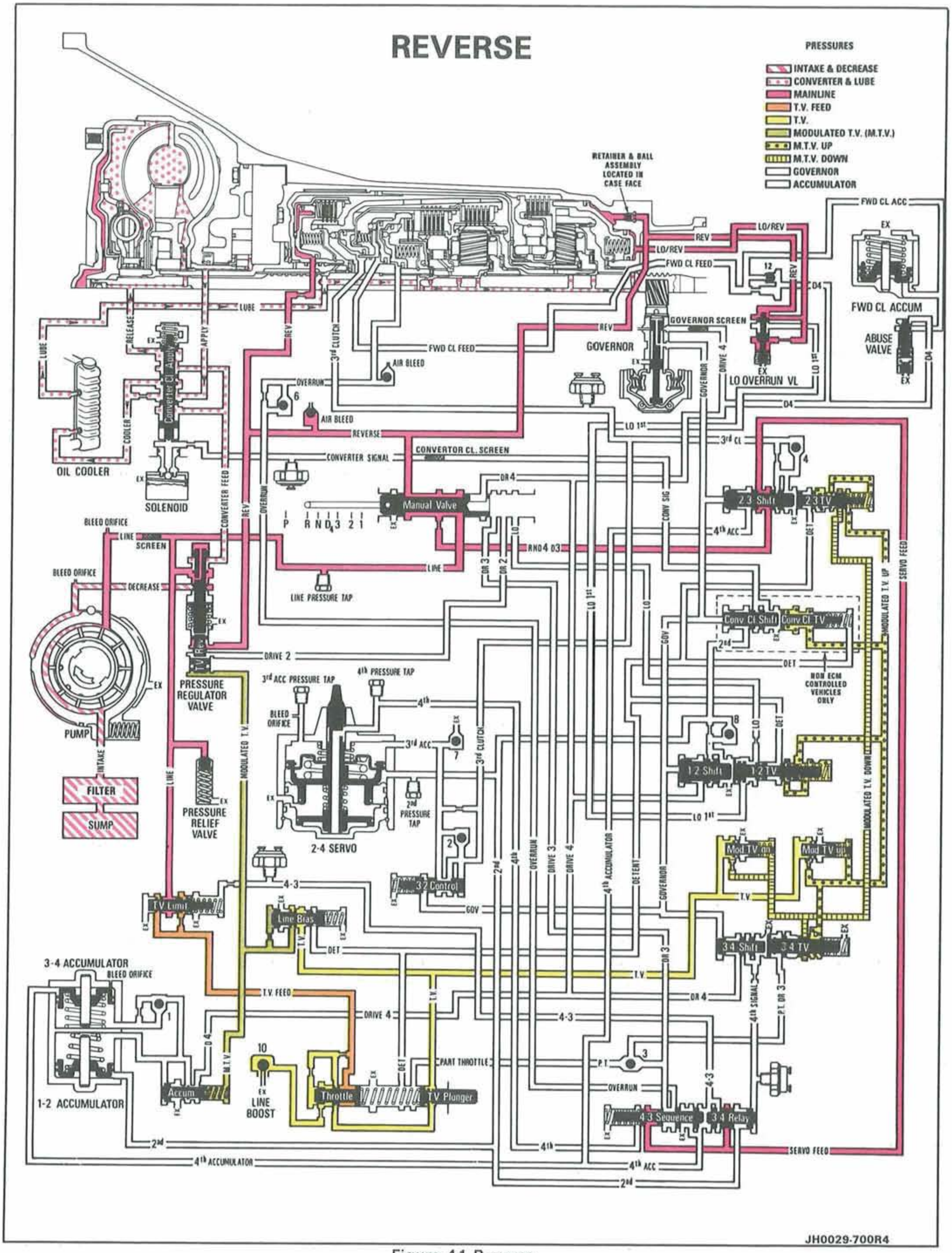


Figure 41 Reverse

REVERSE

REVERSE INPUT CLUTCH – APPLIED

LO AND REVERSE CLUTCH – APPLIED

When the selector lever is moved to the Reverse (R) position, the manual valve is repositioned to allow line pressure to enter the reverse passage which directs oil to the following:

1. Lo and Reverse Clutch
2. Reverse Input Clutch
3. Reverse Boost Valve
4. Lo Overrun Valve

Reverse oil is orificed at the retainer and ball assembly, and regulated at the lo overrun valve to apply the lo and reverse clutch.

Reverse oil is orificed into the reverse input clutch and orificed out of the reverse input piston for a smooth apply of the reverse input clutch during the shift.

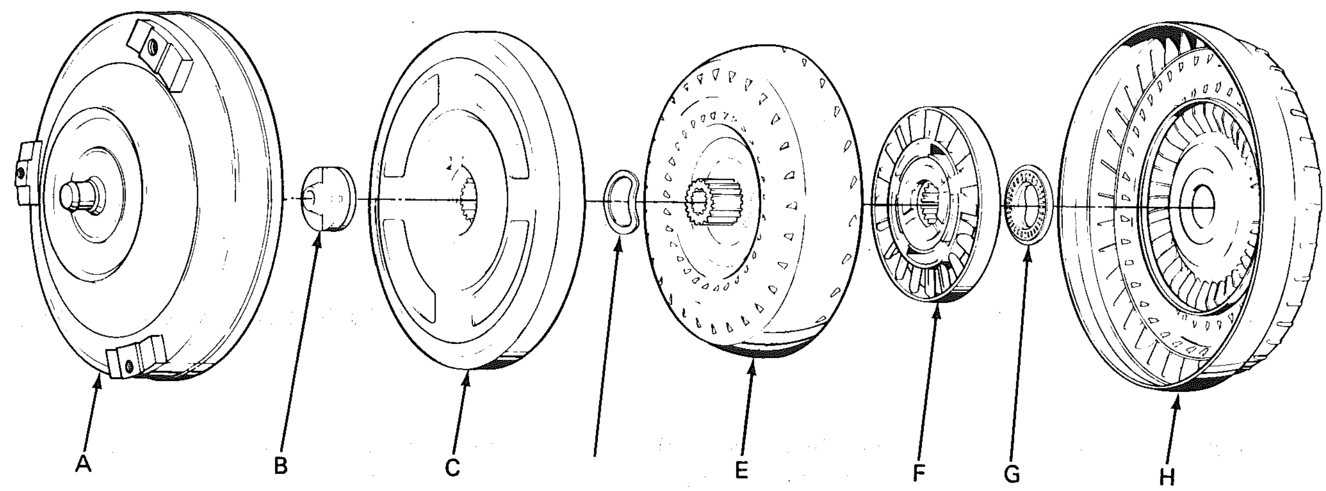
Reverse oil acting on the reverse boost valve in the pressure regulator will boost line pressure to approximately 670 kPa (100 psi). M.T.V. oil from the line bias valve acting on the T.V. boost valve, in the pressure regulator, will further boost line pressure from 670 kPa (100 psi) at idle to 1690 kPa (245 psi) at full throttle.

SUMMARY

The reverse input clutch is applied. The lo and reverse clutch is applied. The transmission is in Reverse (R).

JH0187-700R4

Figure 42 Reverse

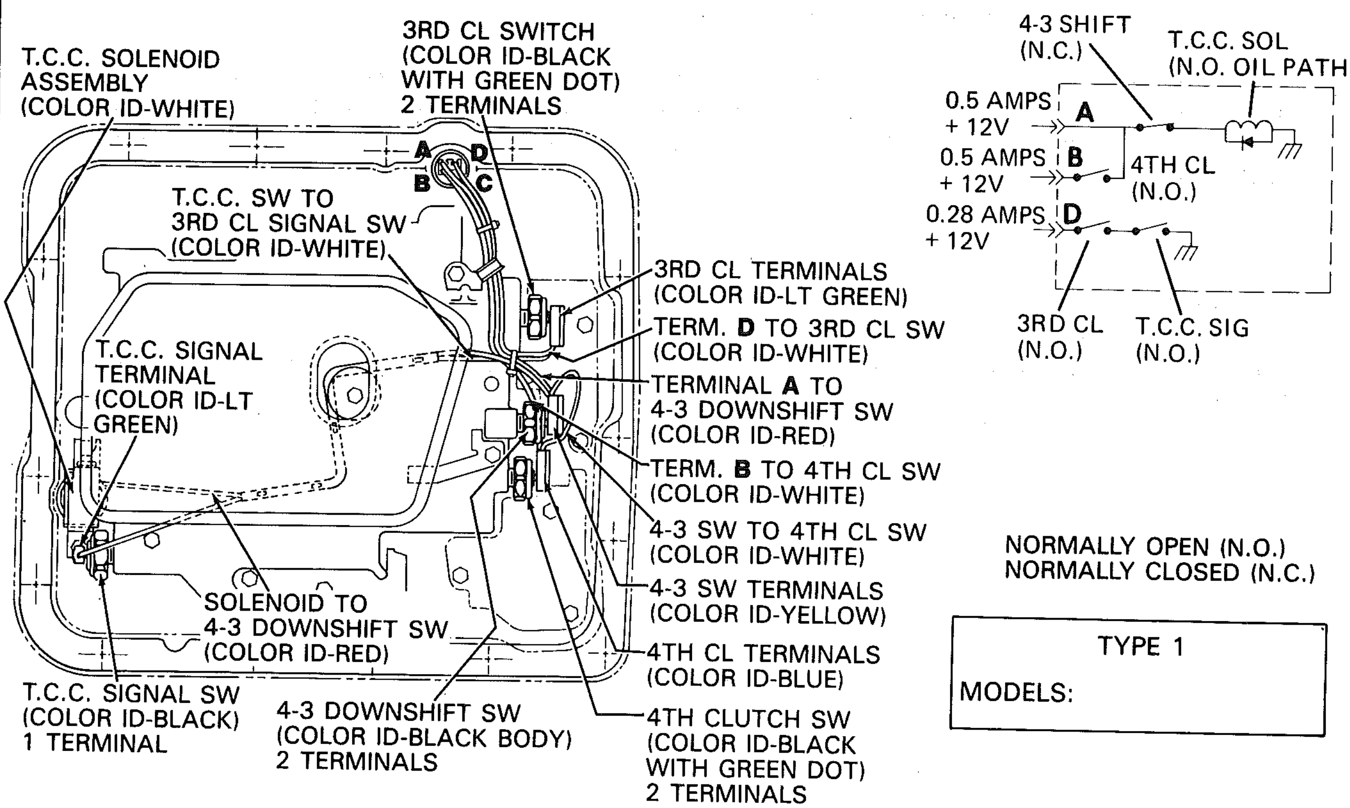


A HOUSING COVER ASSEMBLY, CONVERTER
B SPACER, TURBINE THRUST
C PRESSURE PLATE ASSEMBLY
D SPRING, PRESSURE PLATE
E TURBINE ASSEMBLY
F STATOR ASSEMBLY
G THRUST BEARING ASSEMBLY
H CONVERTER PUMP ASSEMBLY

*THE TORQUE CONVERTER CLUTCH ASSEMBLY CANNOT BE DISASSEMBLED. SHOWN HERE FOR INFORMATION ONLY. SEE SECTION 7A FOR MORE INFORMATION.

JH0030-700R4

Figure 43 Typical 298mm Converter



JH0031-700R4

Figure 44 Wiring Diagram - Type 1

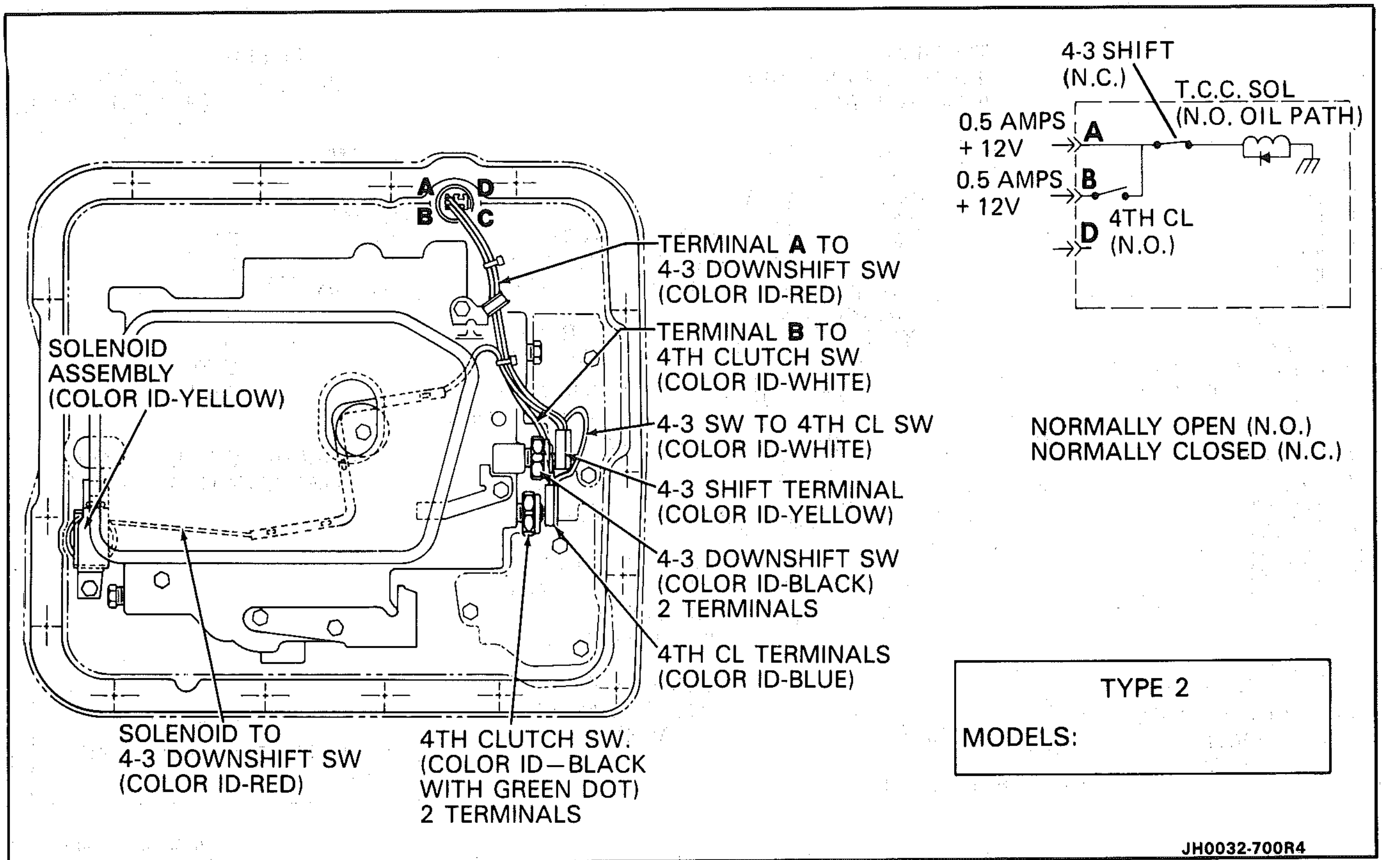


Figure 45 Wiring Diagram - Type 2

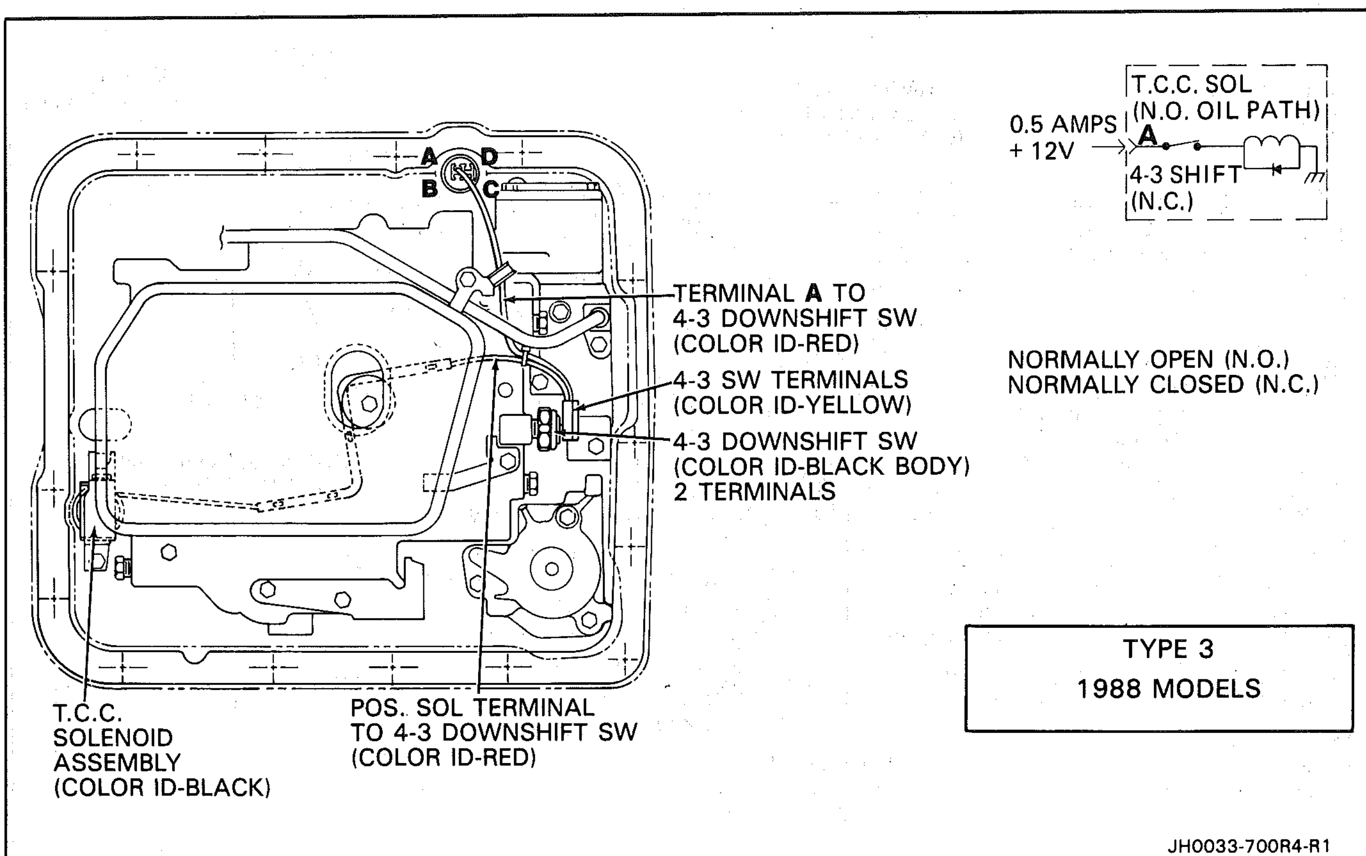


Figure 46 Wiring Diagram - Type 3

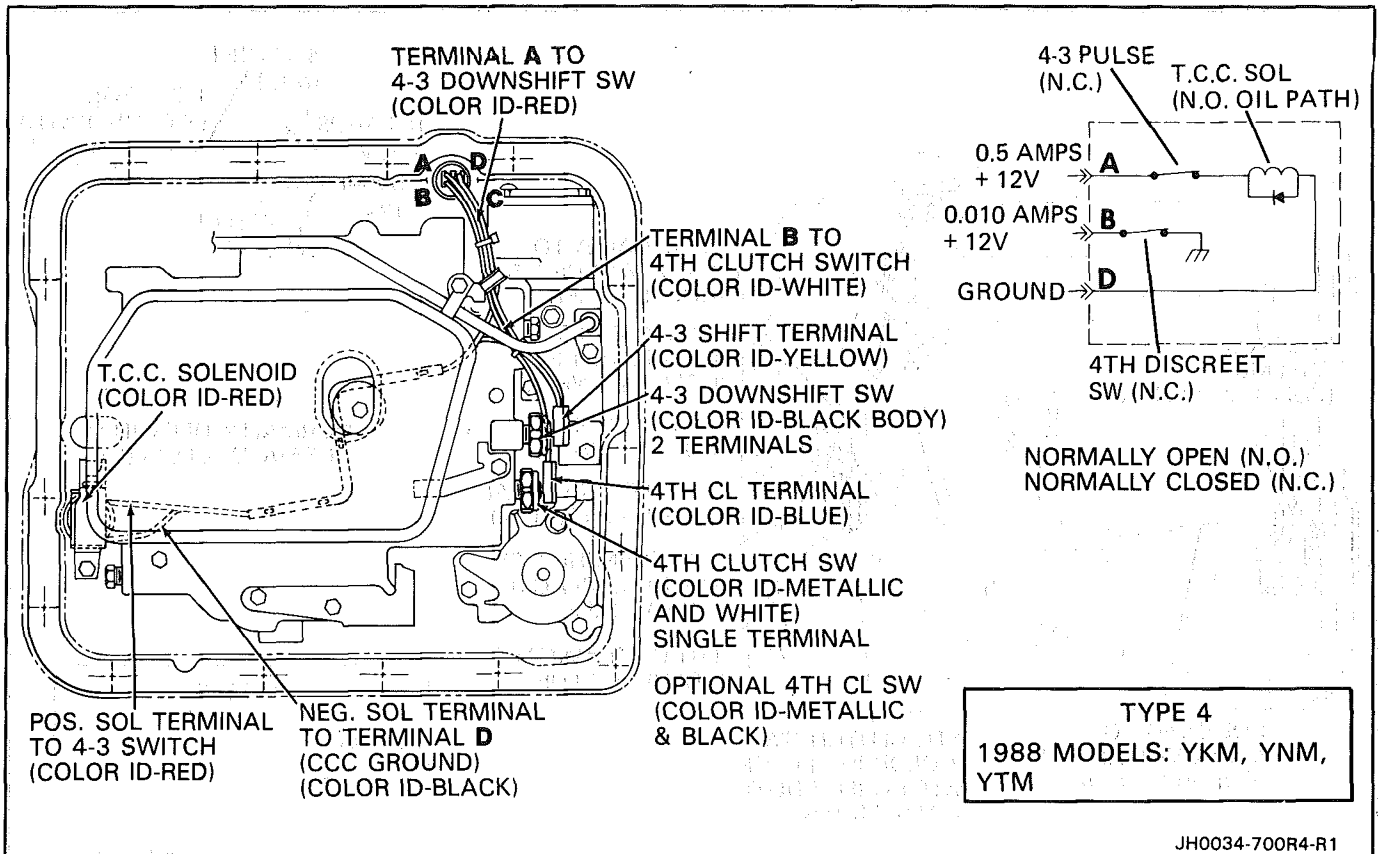


Figure 47 Wiring Diagram - Type 4

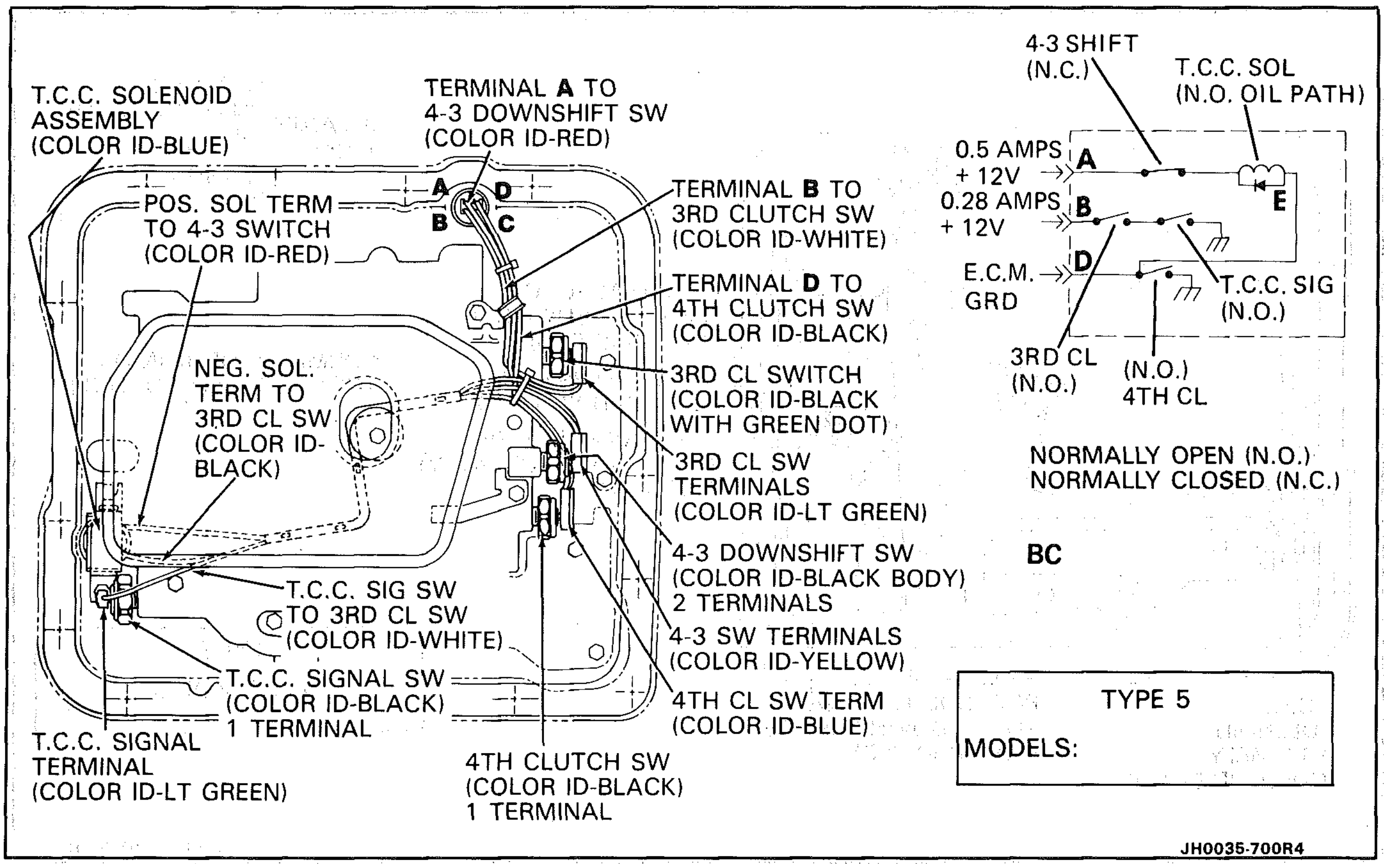


Figure 48 Wiring Diagram - Type 5

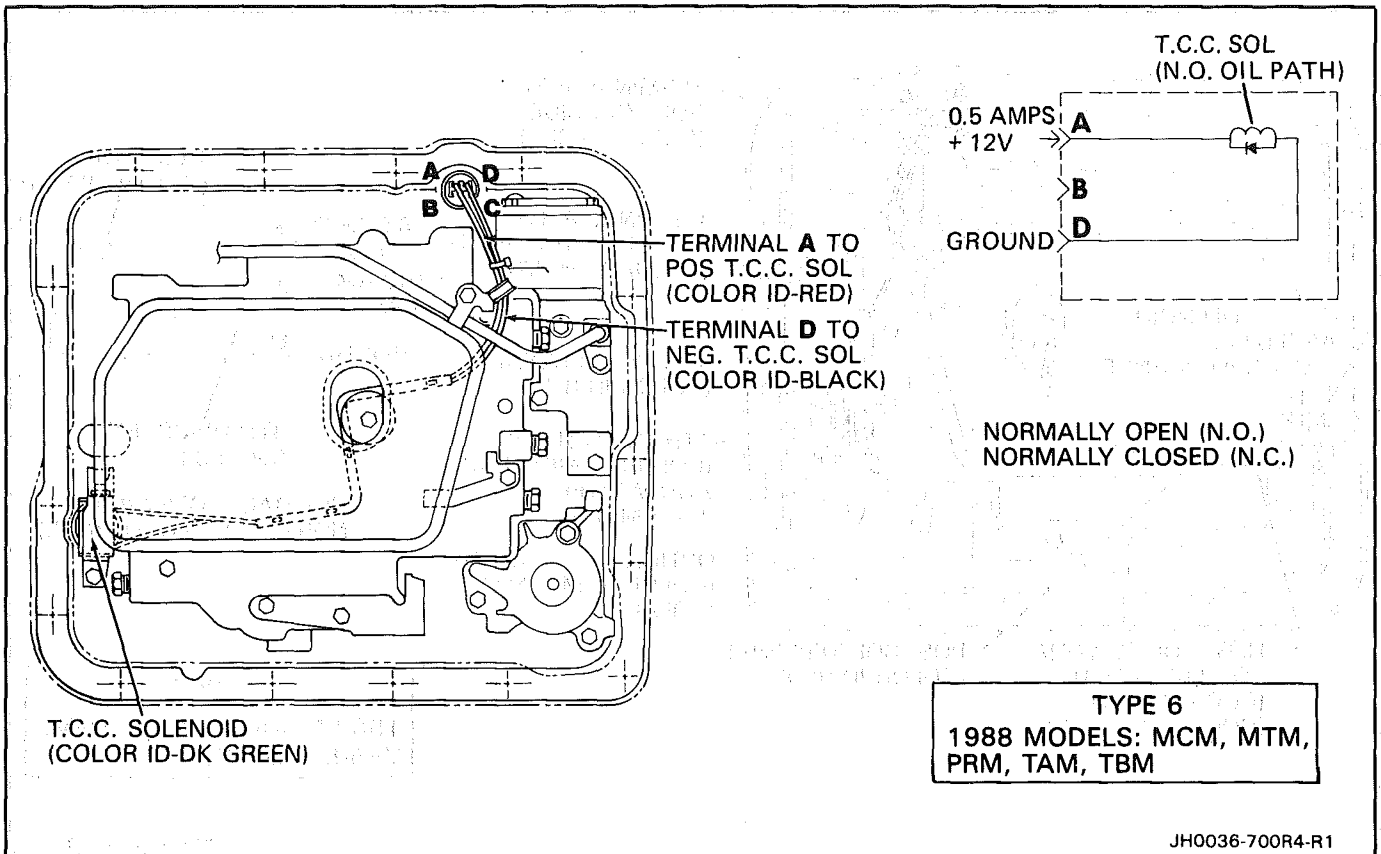


Figure 49 Wiring Diagram - Type 6

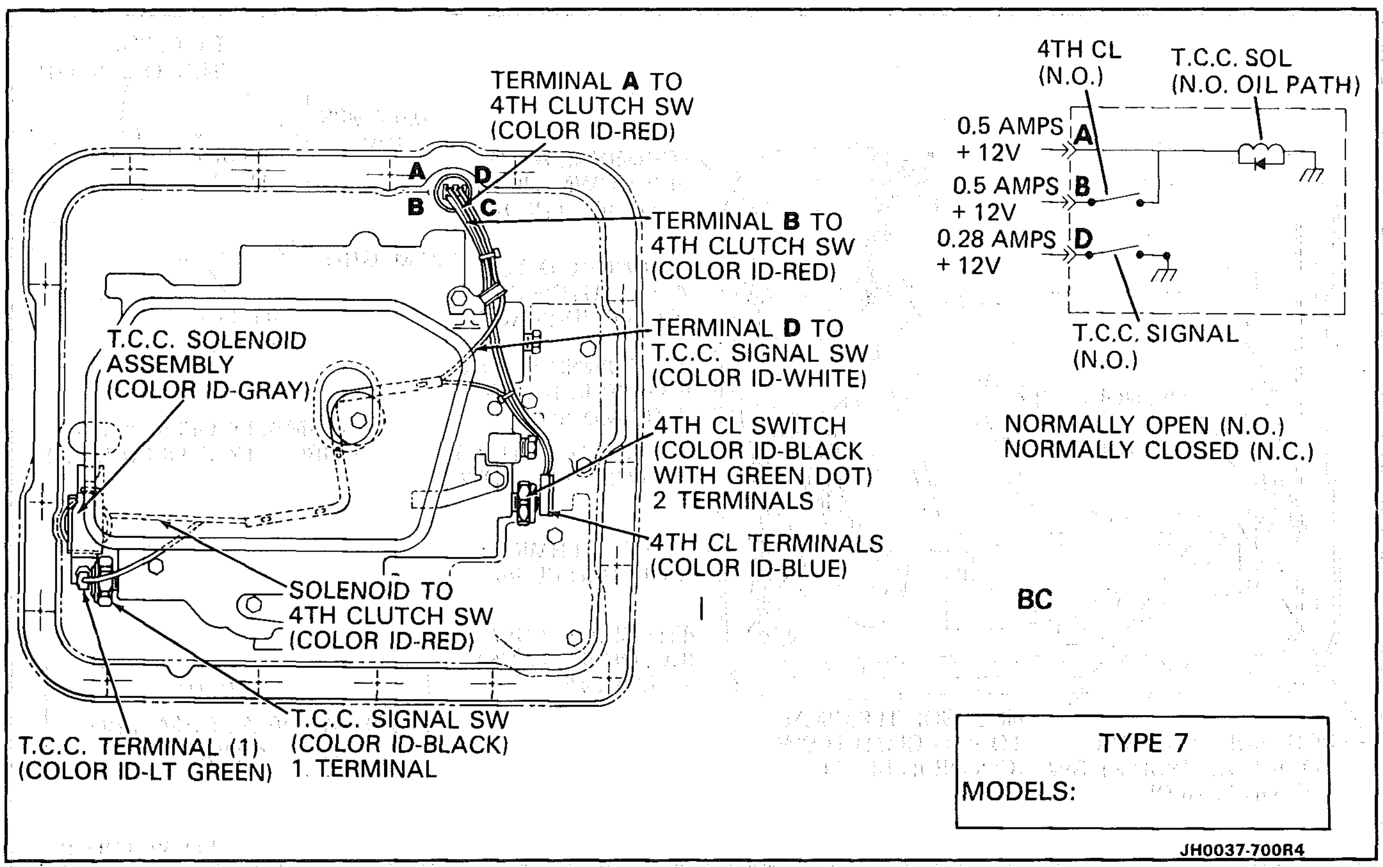


Figure 50 Wiring Diagram - Type 7

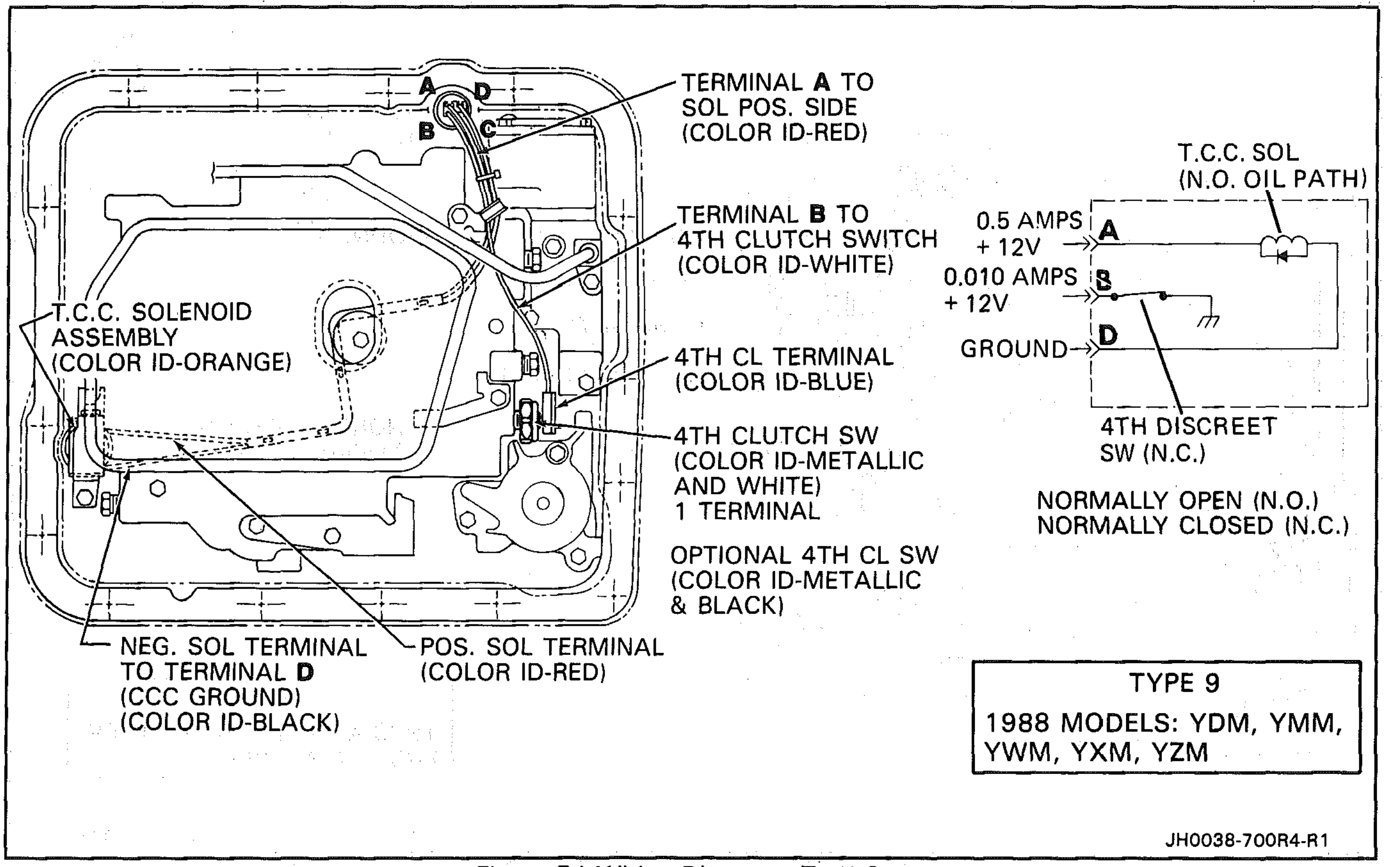


Figure 51 Wiring Diagram - Type 9

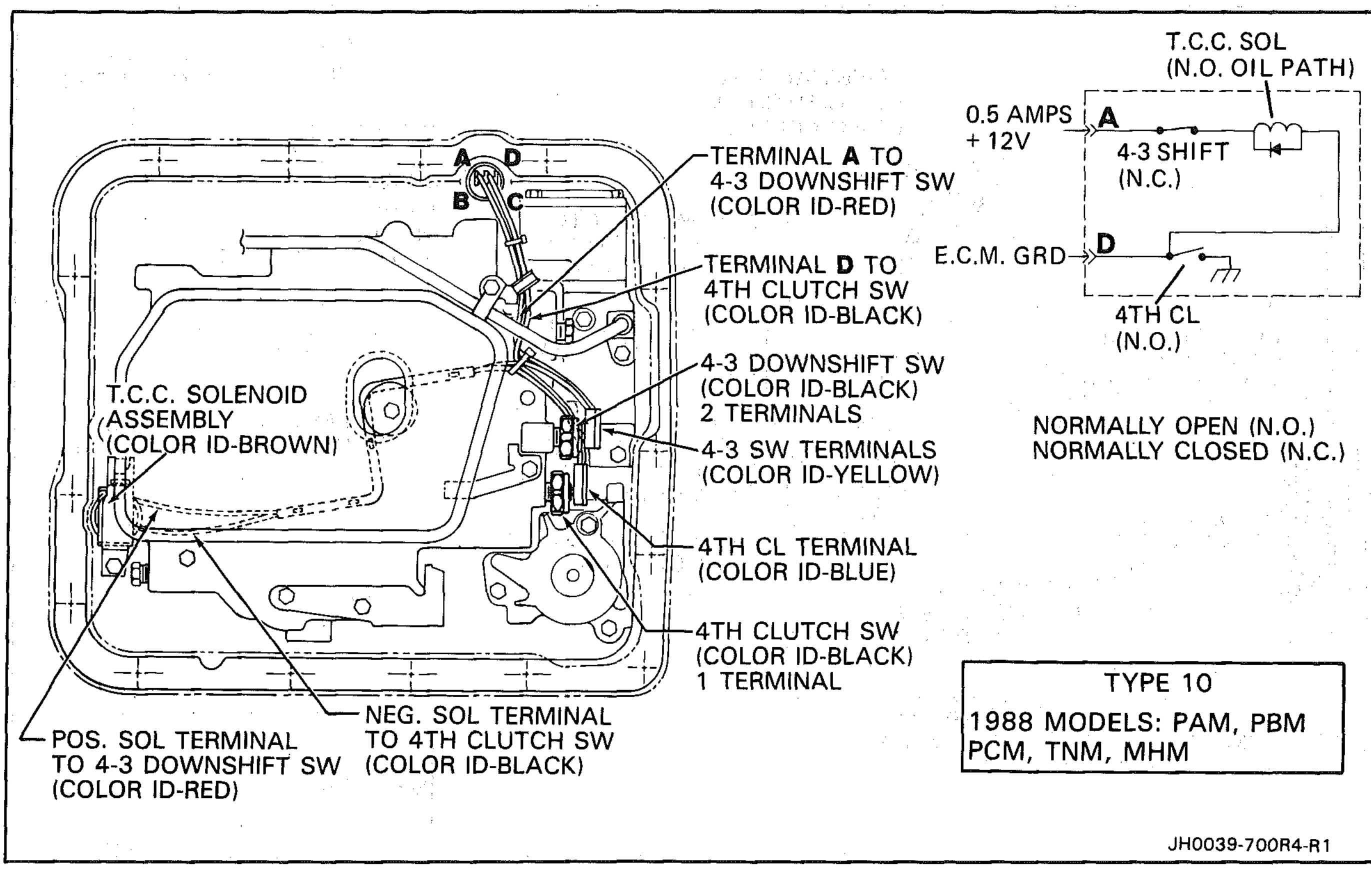


Figure 52 Wiring Diagram - Type 10

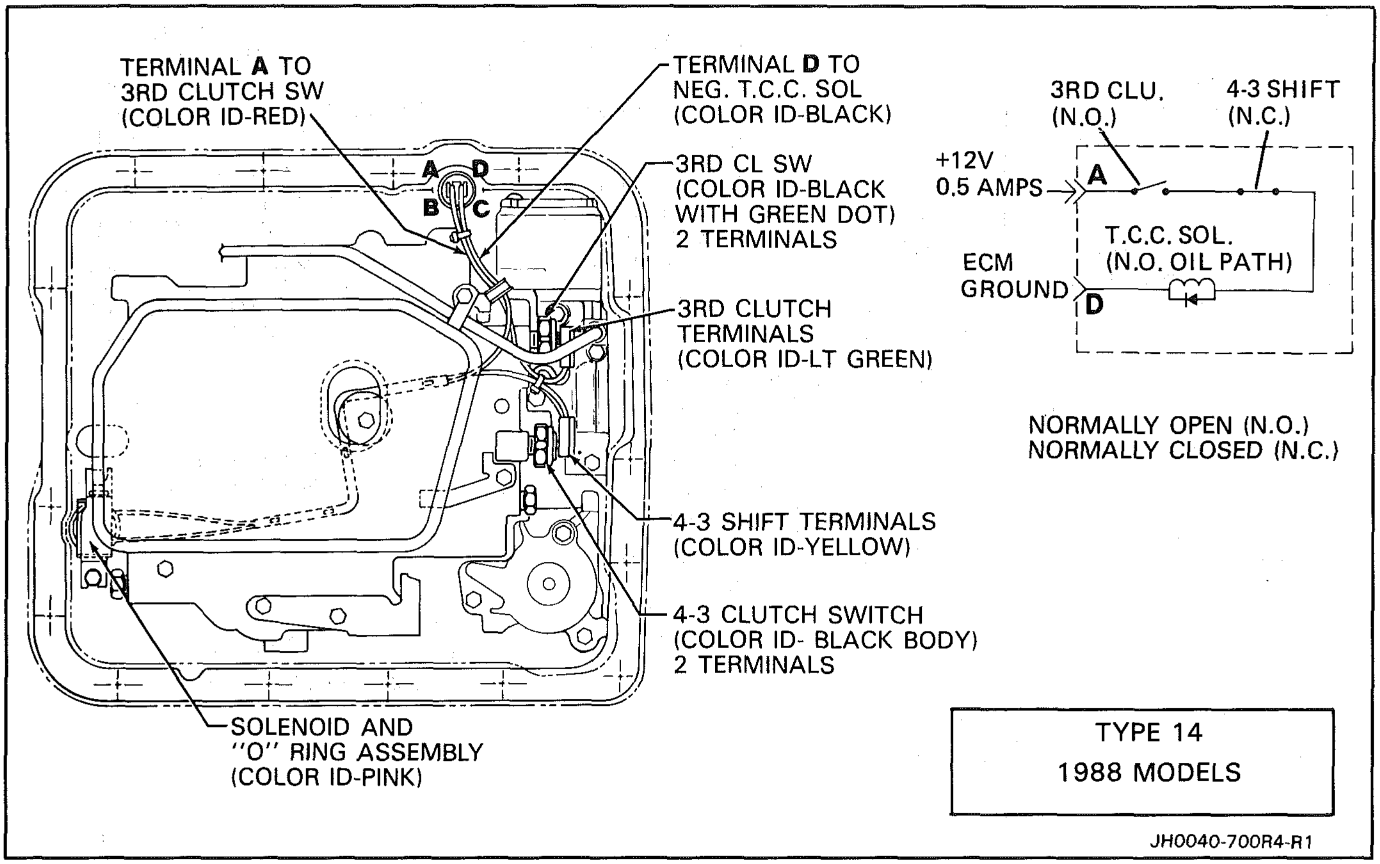


Figure 53 Wiring Diagram - Type 14

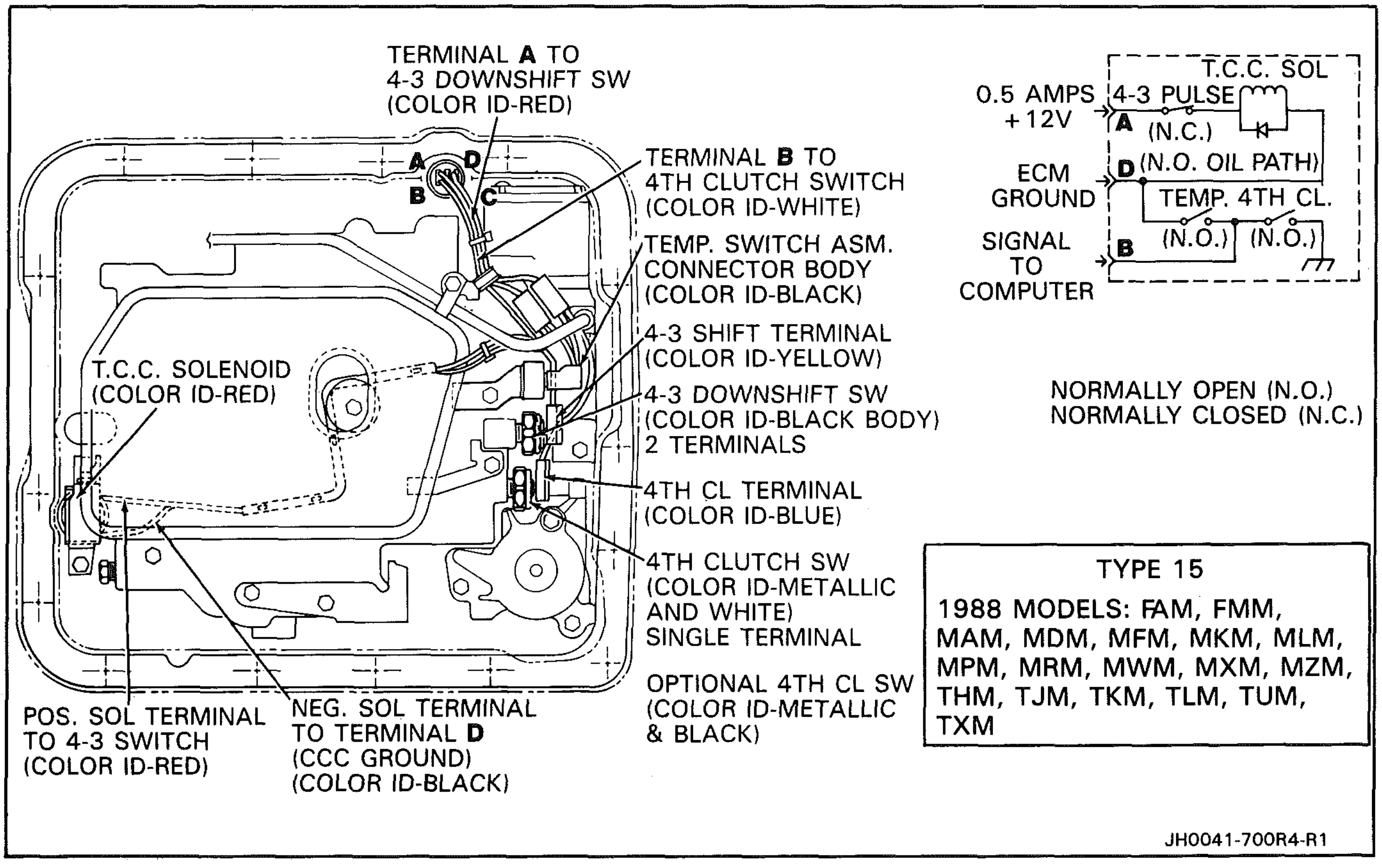


Figure 54 Wiring Diagram - Type 15

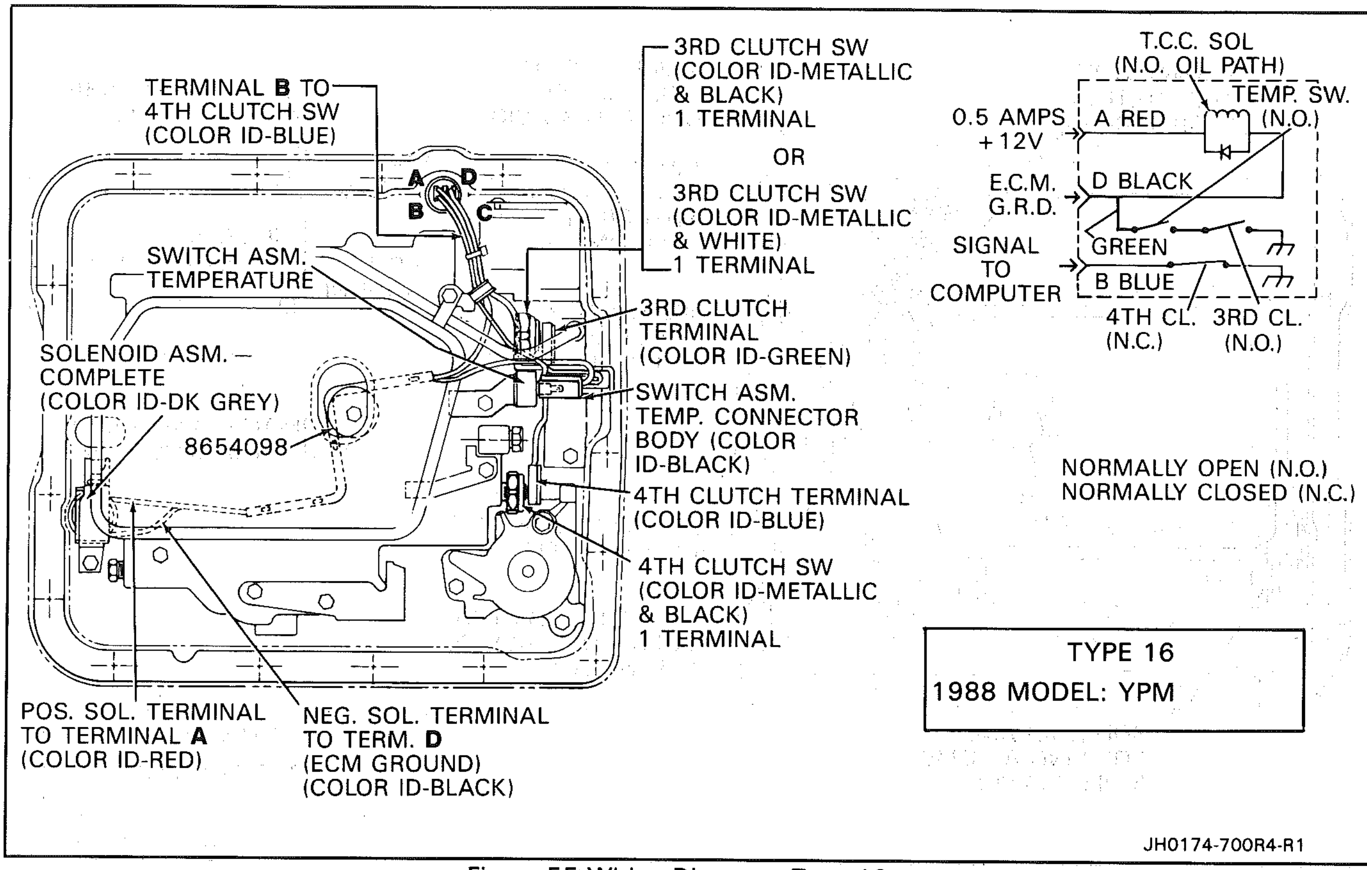
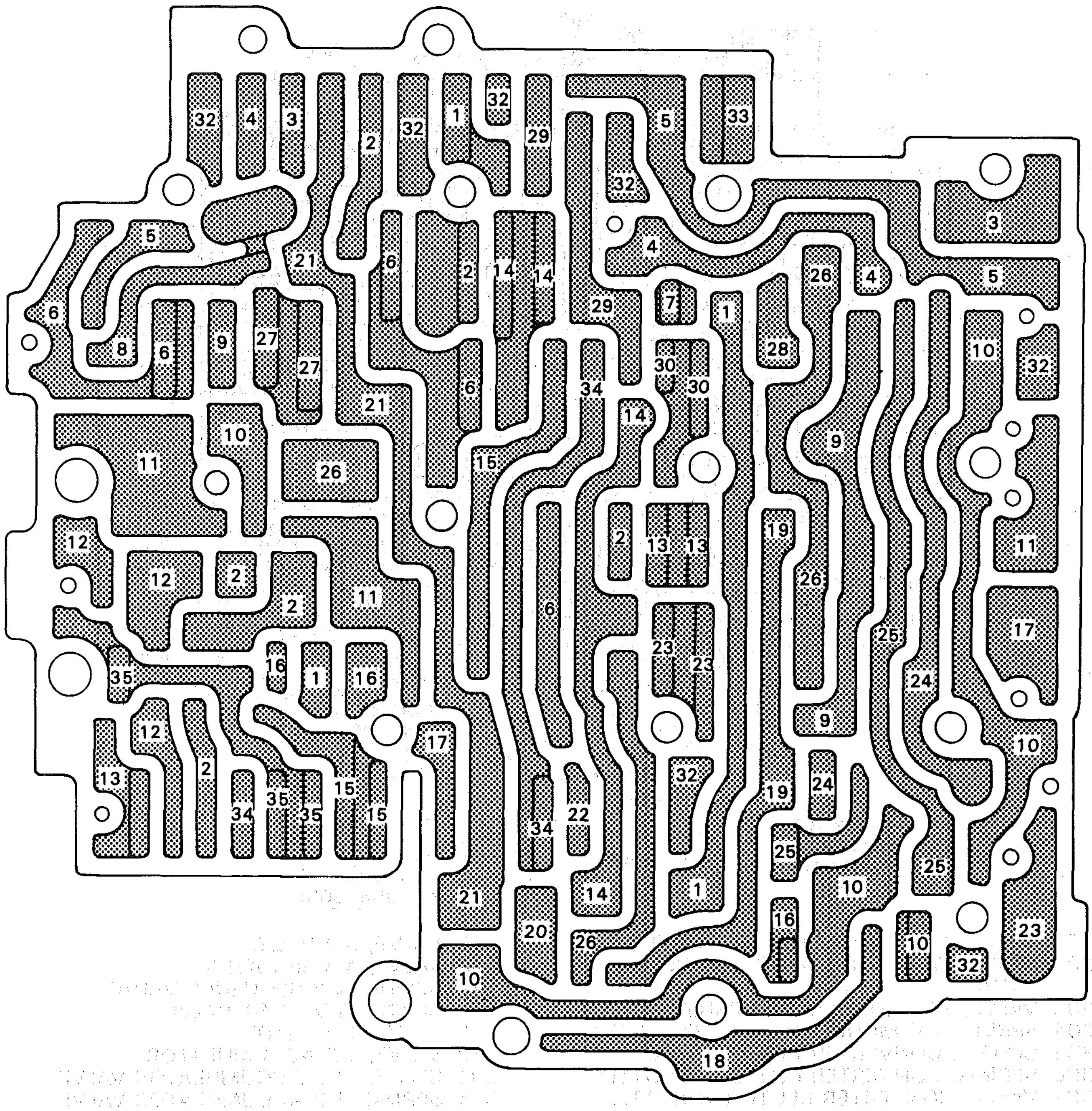


Figure 55 Wiring Diagram - Type 16



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
32 VOID
33 EXHAUST
34 SF
35 4-3
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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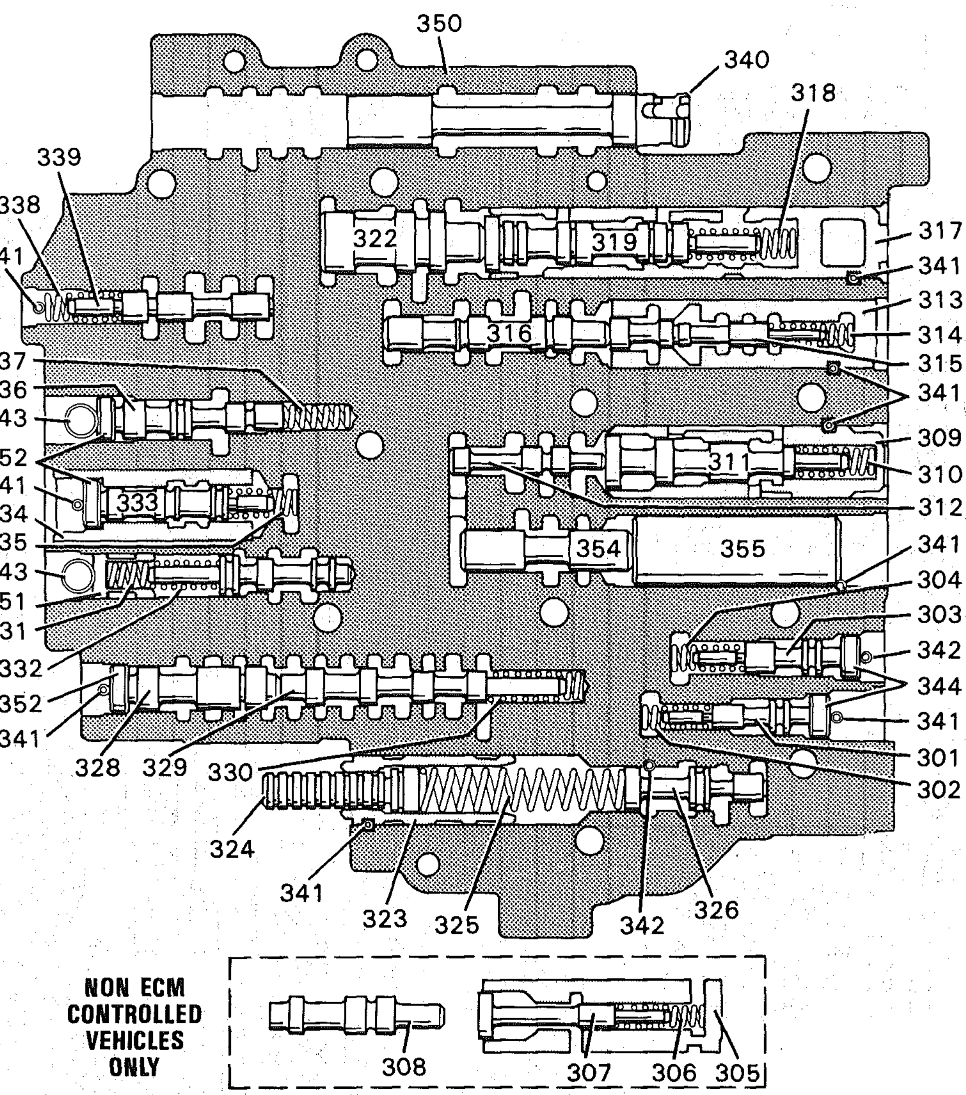
Figure 56 Valve Body Oil Passages



301 VALVE, T.V. MODULATOR DOWNSHIFT
302 SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303 VALVE, T.V. MODULATOR UPSHIFT
304 SPRING, T.V. MODULATOR UPSHIFT VALVE
305 SLEEVE, CONVERTER CLUTCH THROTTLE
306 SPRING, CONVERTER CLUTCH THROTTLE
307 VALVE, CONVERTER CLUTCH THROTTLE
308 VALVE, CONVERTER CLUTCH SHIFT
309 SLEEVE, 3-4 THROTTLE VALVE
310 SPRING, 3-4 THROTTLE VALVE
311 VALVE, 3-4 THROTTLE
312 VALVE, 3-4 SHIFT
313 SLEEVE, 2-3 THROTTLE VALVE
314 SPRING, 2-3 THROTTLE VALVE
315 VALVE, 2-3 THROTTLE
316 VALVE, 2-3 SHIFT
317 SLEEVE, 1-2 THROTTLE VALVE
318 SPRING, 1-2 THROTTLE VALVE
319 VALVE, 1-2 THROTTLE
322 VALVE, 1-2 SHIFT
323 SLEEVE, THROTTLE VALVE PLUNGER
324 PLUNGER, THROTTLE VALVE
325 SPRING, THROTTLE VALVE
326 VALVE, THROTTLE
328 VALVE, 3-4 RELAY
329 VALVE, 4-3 SEQUENCE
330 SPRING, 4-3 SEQUENCE VALVE
331 SPRING, T.V. LIMIT VALVE
332 VALVE, T.V. LIMIT
333 VALVE, 1-2 ACCUMULATOR
334 SLEEVE, 1-2 ACCUMULATOR VALVE
335 SPRING, 1-2 ACCUMULATOR VALVE
336 VALVE, LINE BIAS
337 SPRING, LINE BIAS VALVE
338 SPRING, 3-2 CONTROL
339 VALVE, 3-2 CONTROL
340 VALVE, MANUAL
341 PIN, COILED SPRING
342 PIN, COILED SPRING
343 RETAINER, SPRING (SLEEVE)
344 PLUG, VALVE BORE
350 BODY, CONTROL VALVE
351 PLUG, T.V. LIMIT
352 PLUG, VALVE BORE (12.5 - O.D.)
354 PLUG, CONVERTER CLUTCH SHIFT VALVE BORE (ECM CONTROLLED VEHICLES)
355 PLUG, CONVERTER CLUTCH T.V. BUSHING BORE (ECM CONTROLLED VEHICLES)

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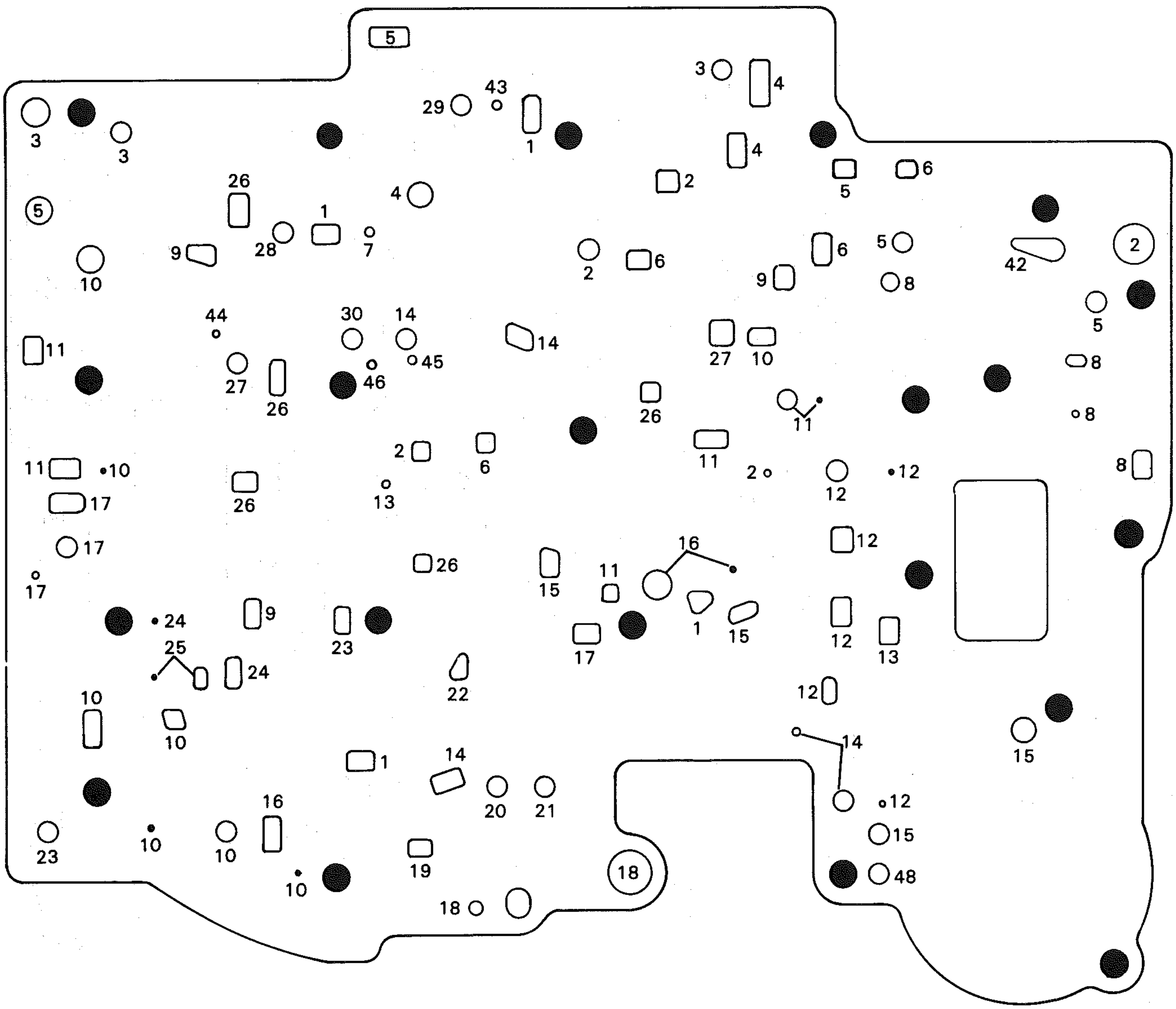
Figure 57 Valve Trains



ILL. NO.	DESCRIPTION
1	LINE
2	D4
3	D2
4	LO
5	REVERSE
6	GOVERNOR
7	LO - 1ST FEED
8	LO/REVERSE
9	3RD ACCUMULATOR
10	T.V.
11	M.T.V.
12	ACCUMULATOR
13	4TH SIGNAL
14	2ND CLUTCH
15	3-4 ACCUMULATOR
16	T.V.F.
17	OVERRUN CLUTCH
18	T.V. EX.
19	D3/PART THROTTLE
20	PART THROTTLE
21	D3
22	4TH CLUTCH
23	C.C. SIG.
24	MOD. UP
25	MOD. DOWN
26	DETENT
27	3-4 CLUTCH
28	DETENT/LO
29	RND4-3
30	3RD CLUTCH
31	IDENTIFICATION
42	D4 ABUSE
43	3RD FEED
44	3-2 HIGH SPEED
45	2ND FEED
46	3RD CL. EXHAUST
47	4TH FEED
48	1-2 ACCUMULATOR

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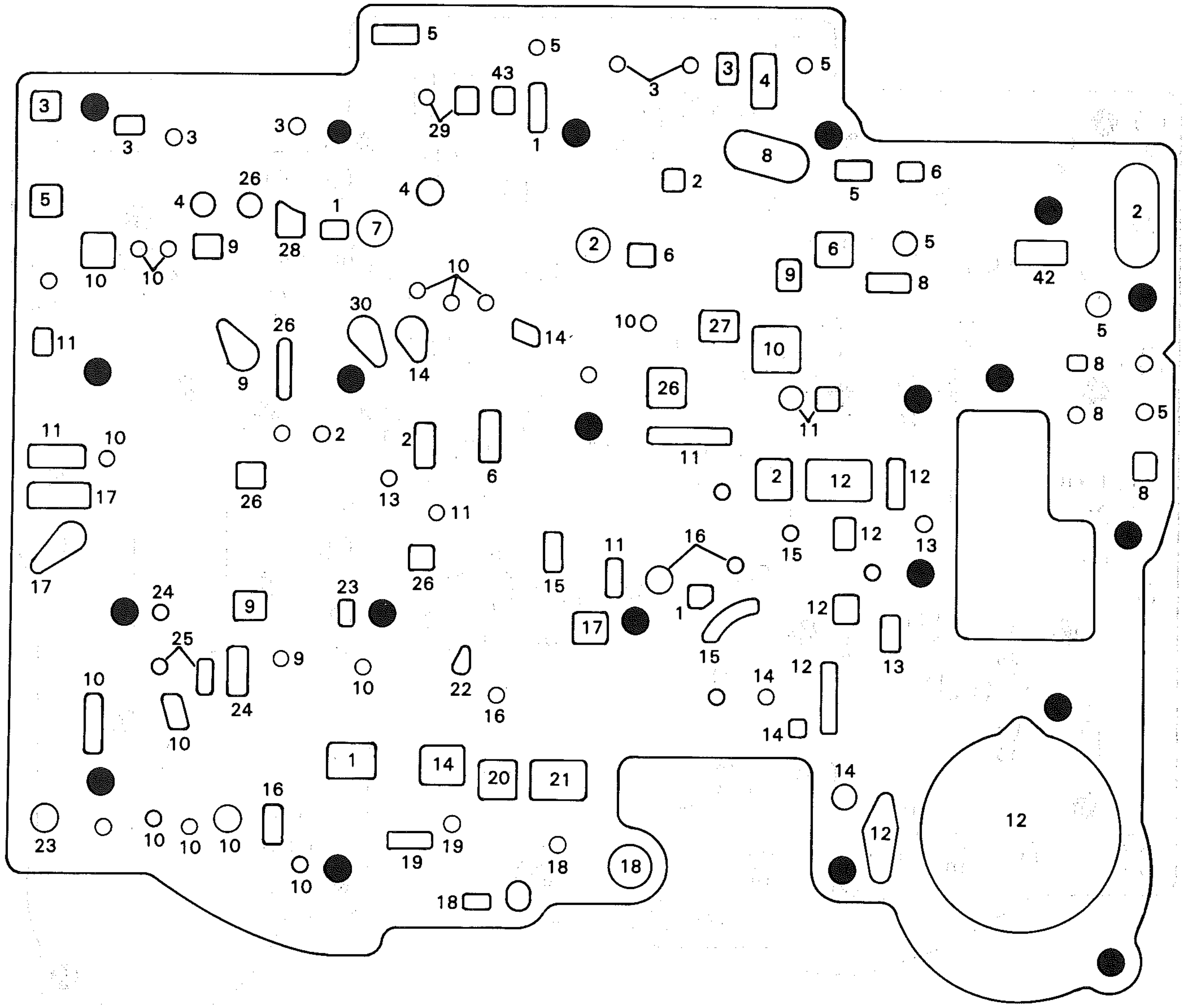
Figure 58 Typical Spacer Plate



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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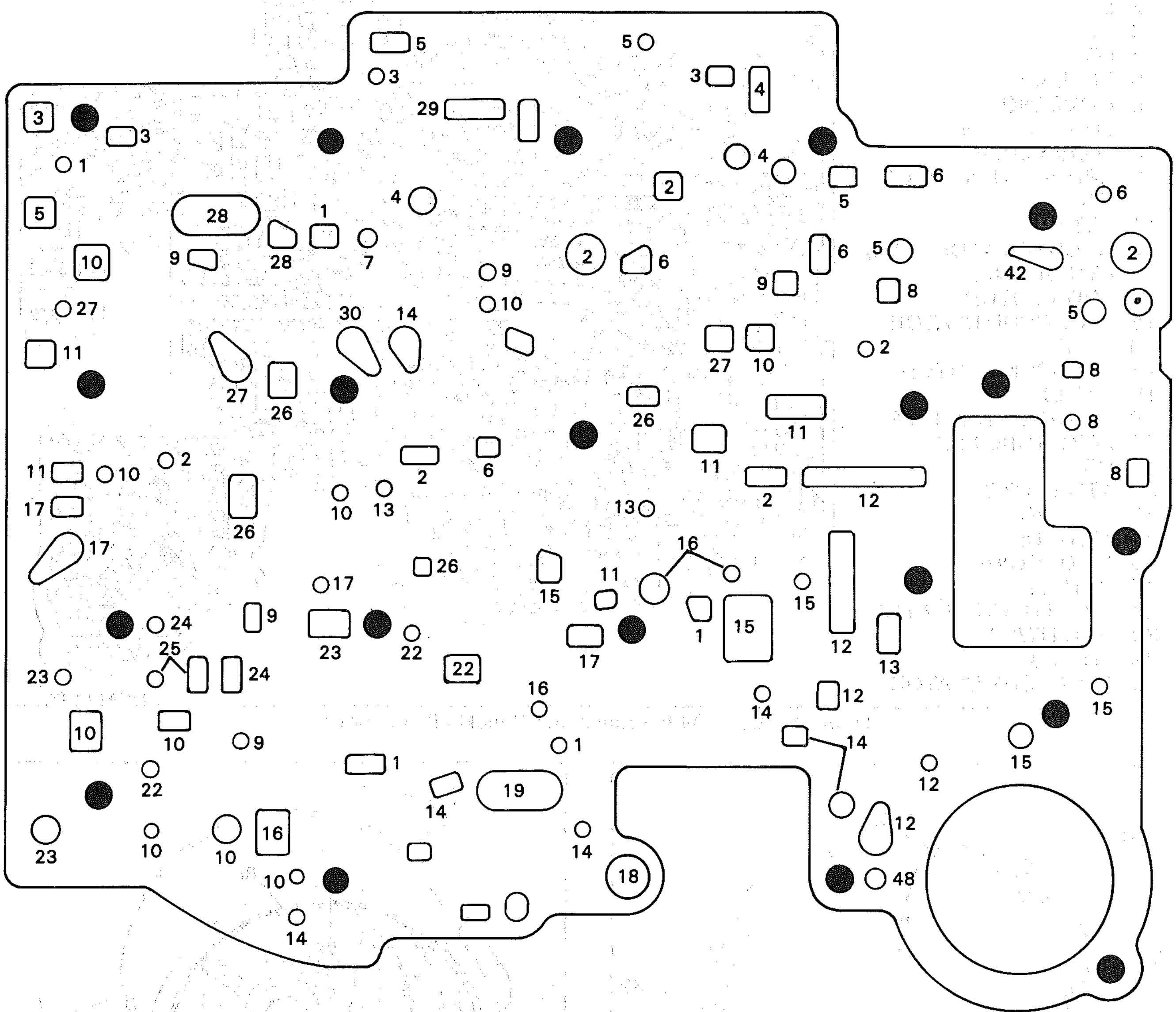
Figure 59 Spacer Plate to Valve Body Gasket



1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH
28 DETENT/LO
29 RND4-3
30 3RD CLUTCH
31 IDENTIFICATION
42 D4 ABUSE
43 3RD FEED
44 3-2 HIGH SPEED
45 2ND FEED
46 3RD CL. EXHAUST
47 4TH FEED
48 1-2 ACCUMULATOR

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Figure 60 Spacer Plate to Case Gasket

1 LINE
2 D4
3 D2
4 LO
5 REVERSE
6 GOVERNOR
7 LO - 1ST FEED
8 LO/REVERSE
9 3RD ACCUMULATOR
10 T.V.
11 M.T.V.
12 ACCUMULATOR (4TH)
13 4TH SIGNAL
14 2ND CLUTCH
15 3-4 ACCUMULATOR
16 T.V.F.
17 OVERRUN CLUTCH
18 T.V. EX.
19 D3/PART THROTTLE
20 PART THROTTLE
21 D3
22 4TH CLUTCH
23 C.C. SIG.
24 MOD. UP
25 MOD. DOWN
26 DETENT
27 3-4 CLUTCH (3-2 EX)
28 DETENT/LO
29 RND4-3
48 1-2 ACCUMULATOR

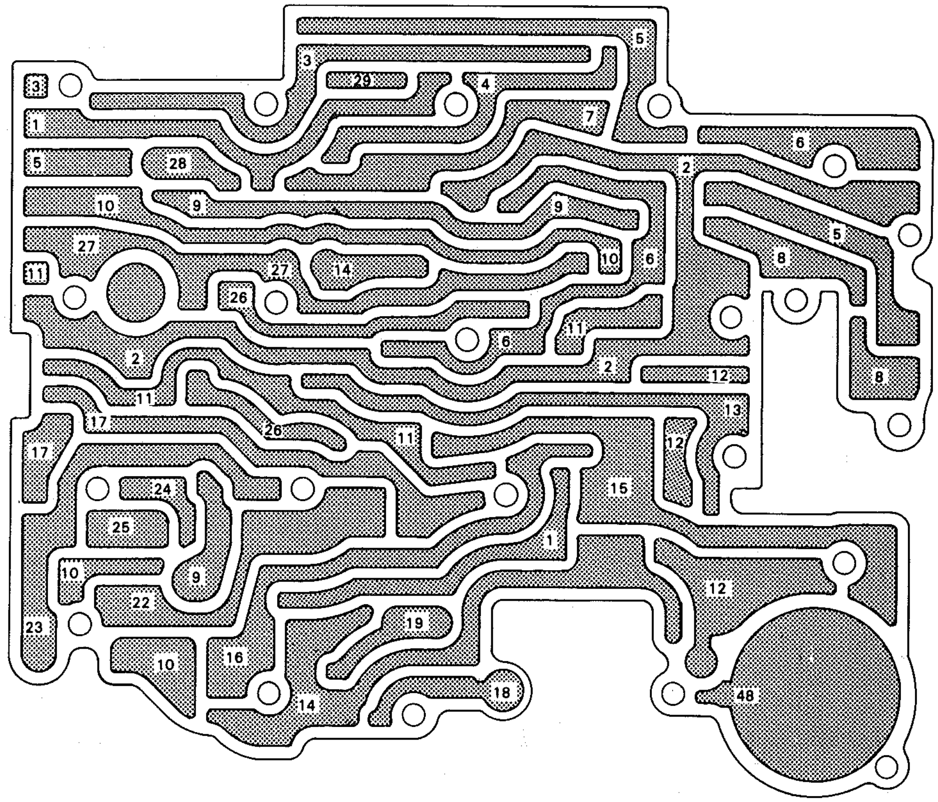

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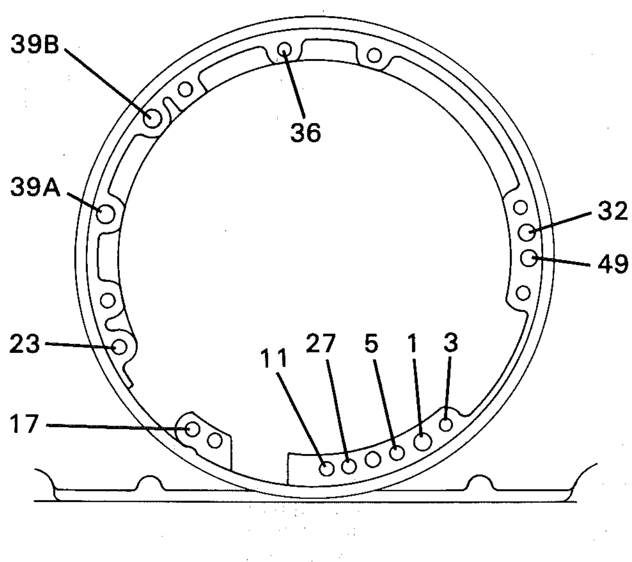
Figure 61 Case Oil Passages and Checkball Locations



1 LINE
3 DR-2
5 REVERSE
11 M.T.V.
17 O.R. CLUTCH
23 CONV. CL. SIG.
27 3-4 CLUTCH
32 VOID
36 VENT
39(a) LUBE TO COOLER
39(b) LUBE FROM COOLER
49 PRESSURE TAP

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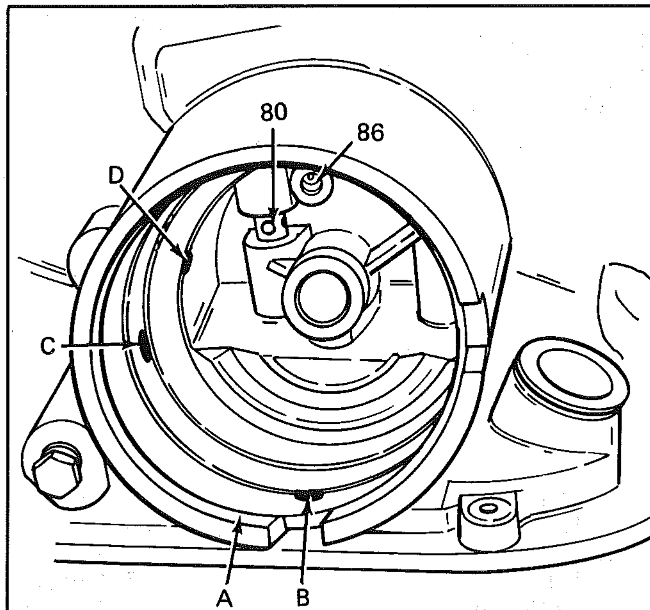
Figure 62 Pump to Case Oil Passages



A CASE SERVO BORE
B SERVO EXHAUST HOLE
C 2ND & 4TH BAND APPLY PASSAGE
D 3RD ACCUMULATOR PRESSURE TAP PASSAGE
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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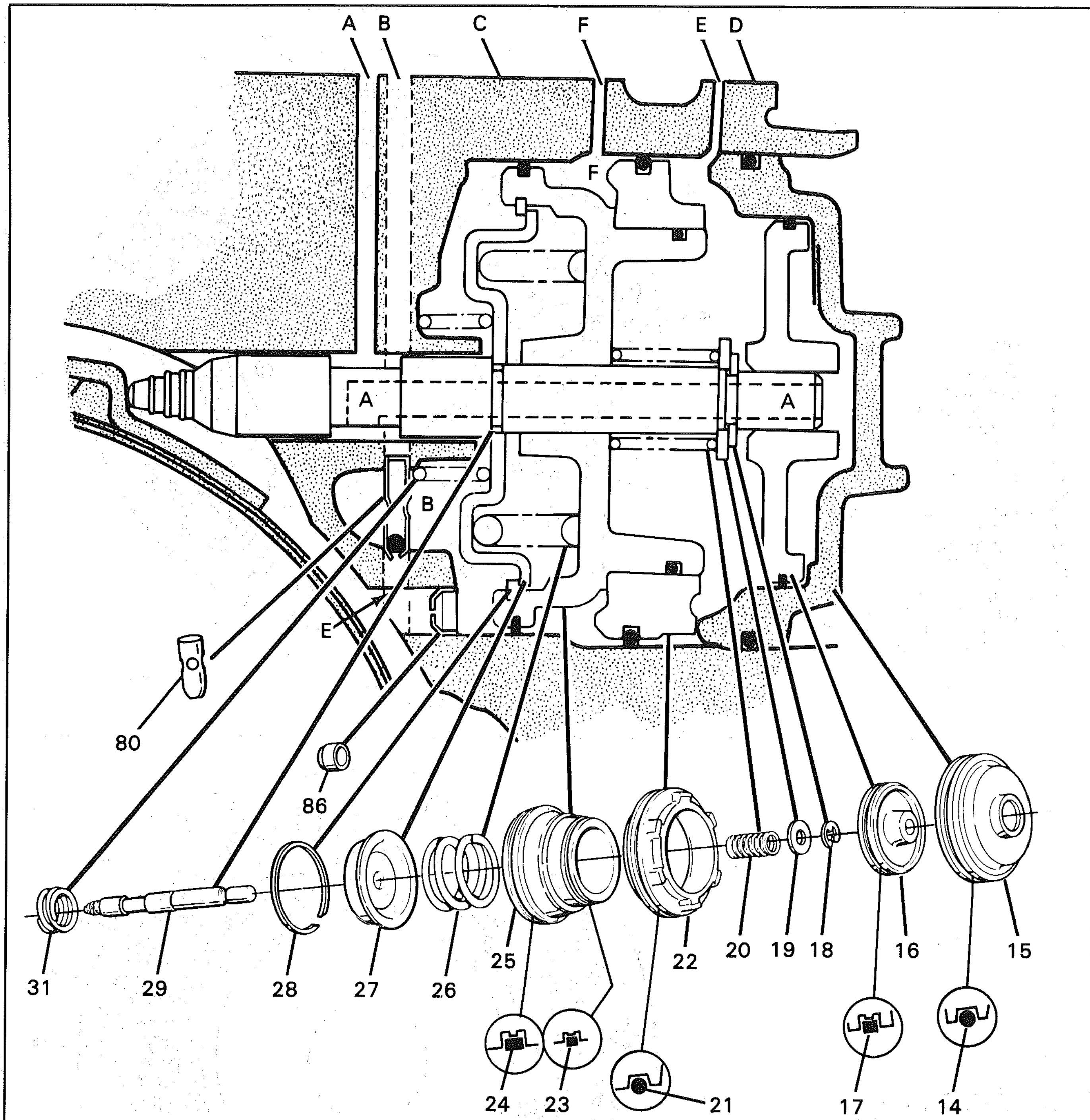
Figure 63 Servo Oil Passages



A 4TH OIL
B 3RD ACCUMULATOR OIL
C VALVE BODY FACE
D OIL PAN FLANGE
E EXHAUST
F 2ND OIL
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON (INNER)
23 RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24 RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
31 SPRING, SERVO RETURN
80 RETAINER & BALL ASSEMBLY, 3RD ACCUM.
86 PLUG, CASE SERVO

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Figure 64 Servo Assembly

- 1 LINE
- 3 D2
- 5 REVERSE
- 11 MODULATED T.V.
- 17 OVERRUN CLUTCH
- 23 CONVERTER CLUTCH SIGNAL
- 27 3-4 CLUTCH
- 32 VOID
- 33 EXHAUST
- 33(a) EXHAUST (T.C.C. RELEASE)
- 33(b) EXHAUST (PRESS. REG.)
- 36 VENT
- 37 DECREASE
- 38 SEAL DRAIN
- 39 LUBE
- 39(a) LUBE TO COOLER
- 39(b) LUBE FROM COOLER
- 40 CONVERTER CLUTCH RELEASE
- 41 CONVERTER CLUTCH FEED

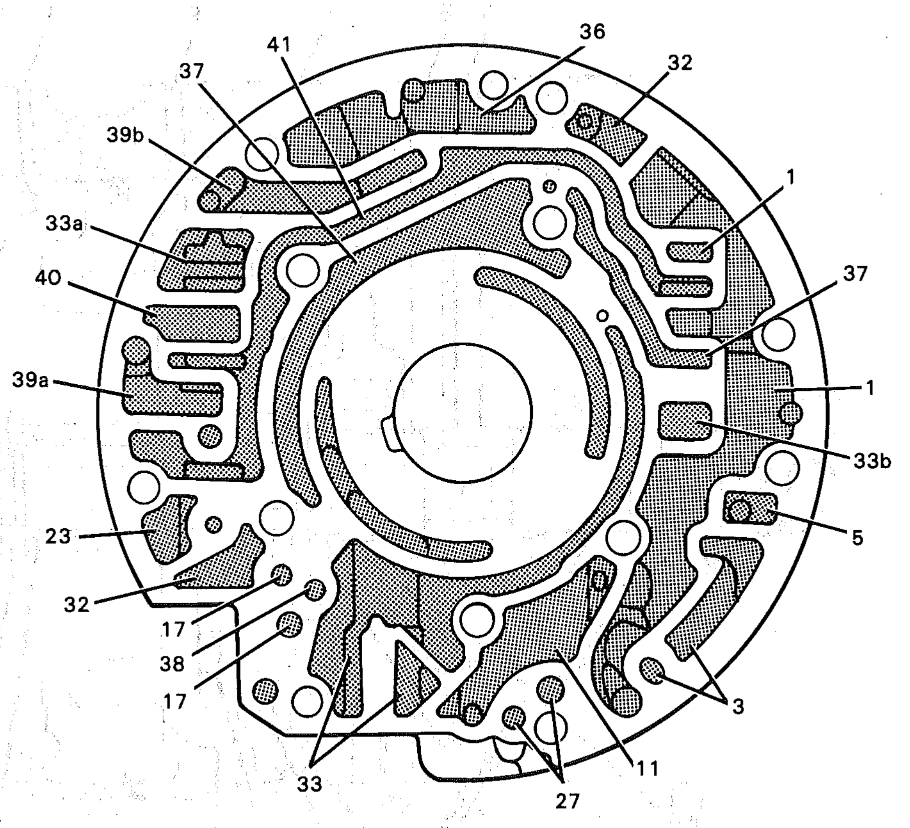

Figure 65 Pump Cover Oil Passages

- 1 LINE
- 3 D2
- 5 REVERSE
- 11 MODULATED T.V.
- 17 OVERRUN CLUTCH
- 23 CONVERTER CLUTCH SIGNAL
- 27 3-4 CLUTCH
- 32 VOID
- 33 EXHAUST
- 33(a) EXHAUST (T.C.C. RELEASE)
- 33(b) EXHAUST (PRESS. REG.)
- 36 VENT
- 37 DECREASE
- 38 SEAL DRAIN
- 39 LUBE
- 39(a) LUBE TO COOLER
- 39(b) LUBE FROM COOLER
- 40 CONVERTER CLUTCH RELEASE
- 41 CONVERTER CLUTCH FEED

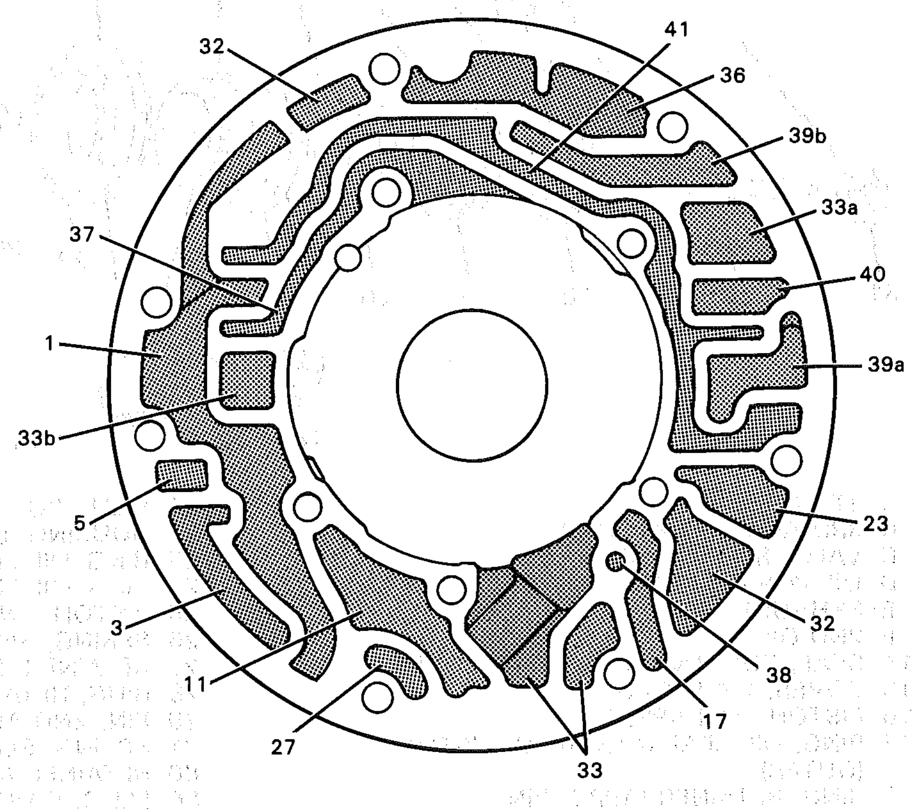

Figure 66 Pump Body Oil Passages

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system, perform all electrical testing first and then the hydraulic testing. Refer to the Torque Converter Section 6E2-C8 for additional information.

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Automatic Transmission assembly. The solenoid is energized or released by making or breaking an electrical circuit through a combination of switches and sensors.

TCC Electrical Diagnosis

- For electrical diagnosis of TCC, refer to the specific vehicle section in Section 8A, Electrical Diagnosis.
- For diagnosis of emission control related components of TCC, Refer to the specific section of 6E, Driveability and Emissions.
- For the diagnosis of TCC Hydraulic Controls, refer to the Procedure and Wiring Diagrams provided in this section.

Functional Check Procedure

Inspect

1. Install a tachometer
2. Operate the vehicle until proper operating temperature is reached
3. Drive vehicle at 50-55 mph (80-88 Km/h) with light throttle (road load)
4. Maintaining throttle lightly touch the brake pedal and check for a slight bump when the TCC releases and a slight increase in engine RPM.
5. Release the brake, slowly accelerate and check for a re-apply of the converter clutch and a slight decrease in engine RPM.

Preliminary Checking Procedure

The purpose of the preliminary checking procedure is to isolate external (electrical) problems from internal (electrical or mechanical) ones.

Important

- Use only a scale type ohmmeter. High impedance type ohmmeters and those with a digital readout will not work.
- An ALCL scanner may be used to verify the electrical circuit. Remember, a completed circuit does not indicate that the solenoid will apply.
- Do not bench test using an automotive type battery. Accidentally crossed wires will damage the internal diodes of the TCC solenoid.

External Controls

Inspect

- Connect voltmeter between transmission connector and ground.
- Turn key "ON"
- If 0 or low voltage is found, refer to Sections 6E and 8A for electrical diagnosis.
- If 12 volts are present at the connector, refer to the TCC hydraulic diagnosis.

TORQUE CONVERTER EVALUATION

Torque Converter Stator

The Torque Converter Stator roller clutch can have one of two different type malfunctions:

A. Stator Assembly freewheels in both directions.

B. Stator Assembly remains locked up at all times.

Condition A-Poor Acceleration Low Speed

The vehicle tends to have poor acceleration from a standstill. At speeds above 30-35 mph (50-55 km/h), the car may act normal. If poor acceleration is noted, it should first be determined that the exhaust system is not blocked, the engine timing is correct and the transmission is in first (1st) gear when starting out.

If the engine freely accelerates to high r.p.m. in "NEUTRAL" (N), it can be assumed that the engine and exhaust system are normal. Checking for poor performance in "Drive" and Reverse will help determine if the stator is freewheeling at all times.

Condition B-Poor Acceleration High Speed

Engine r.p.m. and car speed limited or restricted at high speeds. Performance when accelerating from a standstill is normal. Engine may over-heat. Visual examination of the converter may reveal a blue color from over-heating.

If the converter has been removed, the stator roller clutch can be checked by inserting a finger into the splined inner race of the roller clutch and trying to turn the race in both directions. The inner race should turn freely clockwise, but not turn or be very difficult to turn counterclockwise.

The Converter Should Be Replaced If:

- Leaks externally, such as at the hub weld area.
- Converter has an imbalance which cannot be corrected. (Refer to Converter Vibration Test Procedure).
- Converter is contaminated with engine coolant containing antifreeze.

The Converter Should Not Be Replaced If:

- The oil has an odor, is discolored, and there is no evidence of metal or clutch facing particles.
- The threads in one or more of the three converter bolt holes are damaged.
  - Correct with thread insert. (Refer to Section 6A).

SECTION 700-R4

MD8

AUTOMATIC TRANSMISSION - UNIT REPAIR

CONTENTS

***Designates significant product changes since the publication of the 1987 Service Manual.**

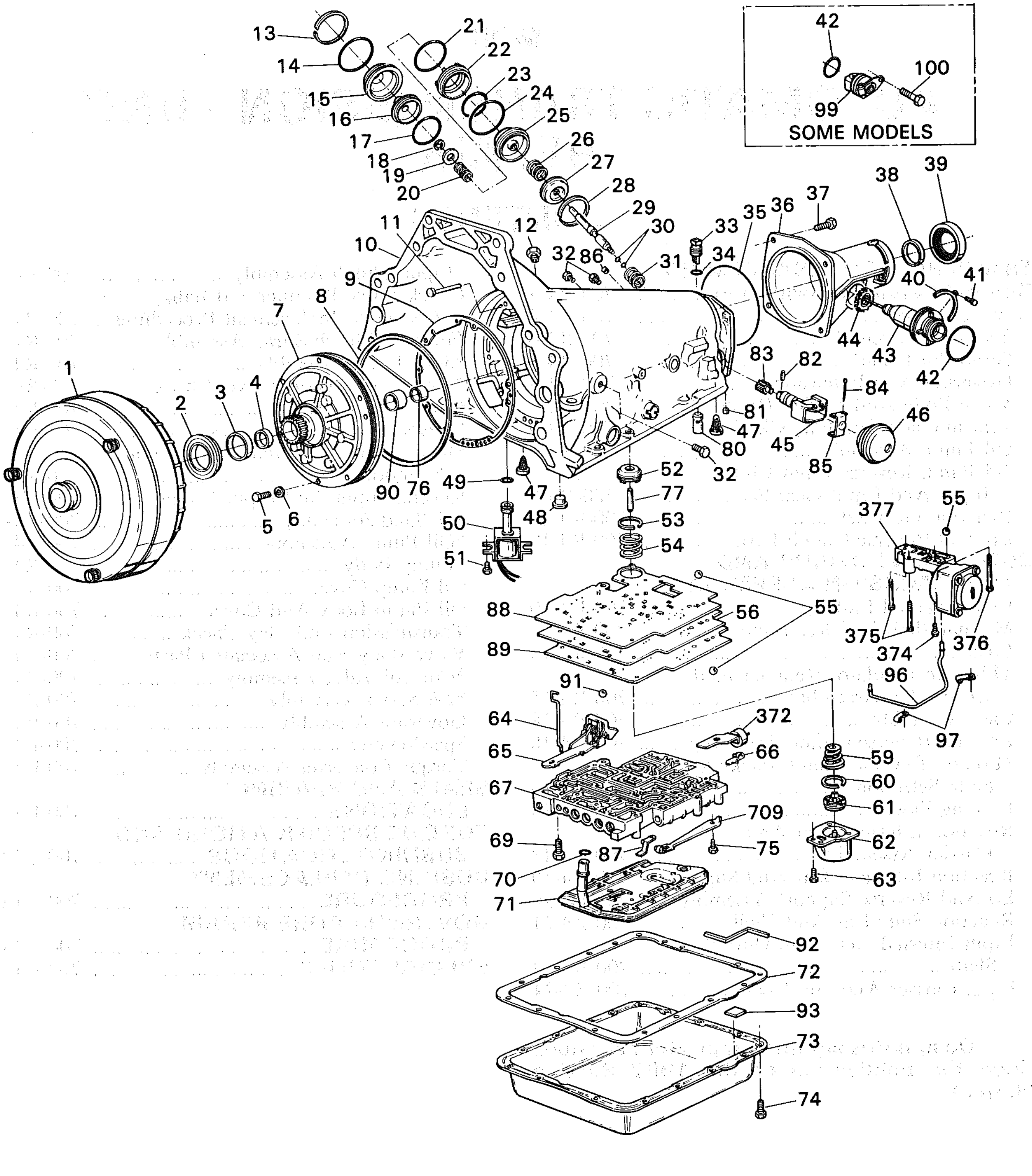

Figure 67 Case and External Parts

ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY
2	SEAL ASSEMBLY, OIL
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (FRONT)
5	BOLT, PUMP TO CASE
6	WASHER, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
11	VENT ASSEMBLY, TRANSMISSION
12	CONNECTOR, OIL COOLER PIPE
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18	RING, RETAINER (APPLY PIN)
19	WASHER, SERVO APPLY PIN
20	SPRING, SERVO APPLY PIN
21	SEAL, "O" RING
22	HOUSING, SERVO PISTON (INNER)
23	RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25	PISTON, 2ND APPLY
26	SPRING, SERVO CUSHION
27	RETAINER, SERVO CUSHION SPRING
28	RING, RETAINER (2ND APPLY PISTON)
29	PIN, 2ND APPLY PISTON
31	SPRING, SERVO RETURN
32	PLUG, PRESSURE
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING (ELECTRICAL CONNECTION)
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
38	BUSHING, CASE EXTENSION
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
47	SCREEN, TRANSMISSION OIL PRESSURE (CONVERTER & GOVERNOR)
48	PIN, BAND ANCHOR
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
51	BOLT, HEX WASHER HEAD (SOLENOID)
52	PISTON, 3-4 ACCUMULATOR
53	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54	SPRING, 3-4 ACCUMULATOR
55	BALL, .25 DIAMETER
56	PLATE, VALVE BODY SPACER
59	SPRING, 1-2 ACCUMULATOR
60	RING, OIL SEAL (1-2 ACCUMULATOR PISTON)
61	PISTON, 1-2 ACCUMULATOR
62	COVER & PIN ASSEMBLY, 1-2 ACCUM.
63	BOLT, ACCUMULATOR COVER
64	LINK, THROTTLE LEVER TO CABLE
65	LEVER & BRACKET ASSEMBLY, THROTTLE
66	CLIP, ELECTRICAL WIRE
67	VALVE ASSEMBLY, CONTROL BODY
69	BOLT, VALVE BODY
70	SEAL, FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
74	SCREW, SPEC. HEX WASHER HEAD (PAN)
75	BOLT, MANUAL DETENT SPRING
76	BUSHING, CASE
77	PIN, ACCUMULATOR PISTON
80	RETAINER & BALL ASSEMBLY, 3RD ACCUMULATOR
81	PLUG, TRANSMISSION CASE (ACCUMULATOR BLEED)
82	PIN, GOVERNOR GEAR RETAINER
83	GEAR, GOVERNOR DRIVEN
84	PIN, GOVERNOR WEIGHT
85	CAP, GOVERNOR THRUST
86	PLUG, CASE SERVO
87	CLIP, FILTER RETAINER
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
90	BUSHING, STATOR SHAFT (REAR)
91	BALL, CARBON STEEL (T.V. EXHAUST)
92	CONDUIT, SOLENOID WIRE
93	MAGNET, CHIP COLLECTOR
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, TUBE
98	NUT, FLANGED HEX
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
372	SWITCH, TEMPERATURE (SOME MODELS)
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUMULATOR VALVE BODY ASSEMBLY
709	SPRING ASSEMBLY, MANUAL DETENT

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Figure 68

TRANSMISSION DISASSEMBLY

General Service Information

- Teflon Oil Seal Rings
  If any seal rings are damaged, cut, or do not rotate freely in their groove be certain to check the ring groove for debris, burrs, or damage.
- Thrust Washer Surfaces
  The thrust washer and thrust bearing surfaces may appear to be polished. This is a normal condition and should not be considered damage.

Clean

- Thoroughly clean the exterior of the transmission.

Remove or Disconnect

- Torque Converter (1)

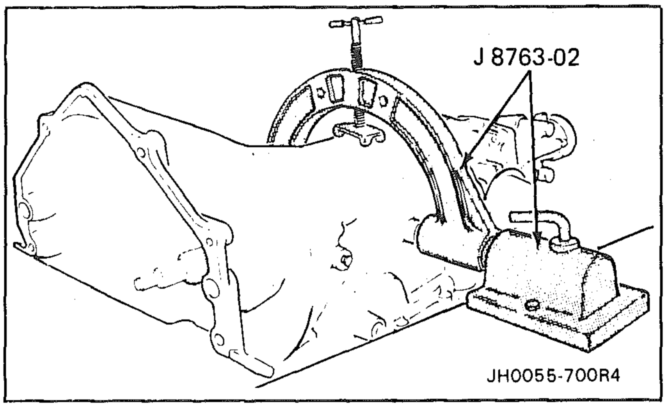


Figure 69 Holding Fixture

Install or Connect (Figure 69)

Tools Required:
J-8763-02 Holding Fixture and Base

1. J-8763-02 onto the transmission case.
2. Holding fixture into the base.

Remove or Disconnect

- Drain the transmission fluid.

2-4 Servo Assembly

Remove or Disconnect (Figures 67, 68, and 70)

TOOLS REQUIRED:
J-29714 Servo Cover Compressor

1. Install J-29714.
2. Servo cover retaining ring (13)
3. Servo cover and "O" ring seal (14 and 15)
4. 2-4 servo assembly (16-31)

Servo Pin Length

As a diagnostic aid, the servo pin length should now be checked. If the pin length is too short or too long be certain to inspect the 2-4 band and reverse input drum for damage or wear when disassembled.

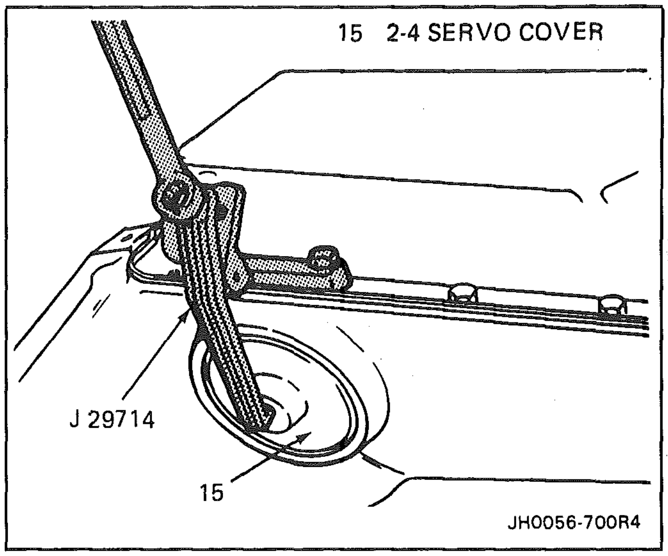


Figure 70 Servo Cover Removal

Remove or Disconnect (Figures 70, 71, 72, 73)

TOOLS REQUIRED:
J-22269-01 Piston Compressor

1. 4th apply piston (16)
2. Servo return spring (31)
3. Servo pin retainer ring (18), washer (19), and apply pin spring (20)
4. 2nd apply piston pin (29).
5. Install J-22269-01.
6. Retainer ring (28)
7. Cushion spring retainer (27) and cushion spring (26)

Measure (Figure 74)

TOOLS REQUIRED:
J-33037 Band Apply Pin Tool

1. Install J-33037 as shown with apply pin (29).
2. Apply 11 N·m (100 in. lbs.) torque.
3. If white line "A" appears in gage slot "B" pin length is correct.
4. Use pin selection chart to determine correct pin length.

Governor and Extension

Remove or Disconnect (Figure 75)

1. Governor cover (46)
   - tap around the cover flange with a punch to remove
   - DO NOT DAMAGE THE GOVERNOR COVER
2. Governor assembly (45)

Mechanical Speedometer:

3. Bolt and washer assembly (41) and retainer (40)
4. Speedometer driven gear assembly (43), speedo driven gear (44) and o-ring seal (42)

Internal Transmission Speed Sensor (I.T.S.S.)

3. Speed sensor retaining bolt (100)
4. Speed Sensor assembly (99) and o-ring seal (42)

5. Case extension bolts (37) and case extension (36)
6. Extension seal ring (35)
7. Output shaft sleeve (690) and output shaft o-ring seal (691)
   - Not all models use an output shaft sleeve and seal

↔ Remove or Disconnect (Figures 75)

Models with Mechanical Speedometer

1. Speedometer drive gear (689) and clip (688)
   - push tab of retaining clip and tap speedometer gear off the output shaft.
   - use care not to damage the speedo gear

Valve Body and Wiring Harness

↔ Remove or Disconnect (Figures 76, 77)

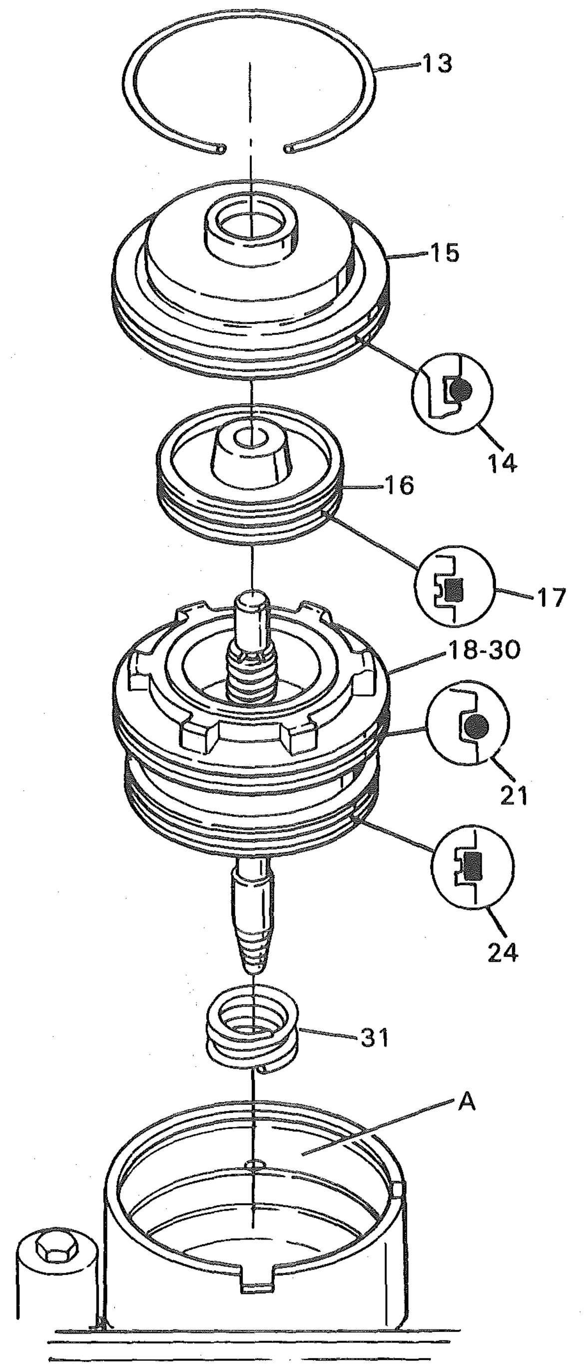
1. Screws (74), oil pan (73), and gasket (72).
2. Oil filter (71) and filter seal (70).
   - Filter seal may be stuck in the case
3. Outside electrical connector (33) and o-ring seal (34).
4. Electrical connections from switches.
   - refer to wiring diagrams in the Hydraulic Diagnosis Section for specific model applications
5. Solenoid bolts (51) and solenoid assembly (50) with o-ring seal (49) and wiring harness.
6. Accumulator cover bolts (63) and 1-2 accumulator cover and pin assembly (62).
7. 1-2 accumulator piston (61) and seal (60).
8. Spring (59).

↔ Remove or Disconnect (Figures 78, 79, 80 and 81)

1. Bolt (75) and manual detent spring assembly (709).
2. Electrical wire clips (66) and tube clamps (97).
3. Auxiliary valve tube (96).
4. Wiring harness retaining washer (A) and the filter retainer clips (87).
5. Bolts (69) and T.V. lever and bracket assembly (65)
6. T.V. link (64)

↔ Remove or Disconnect (Figures 78, 80, 81 and 82)

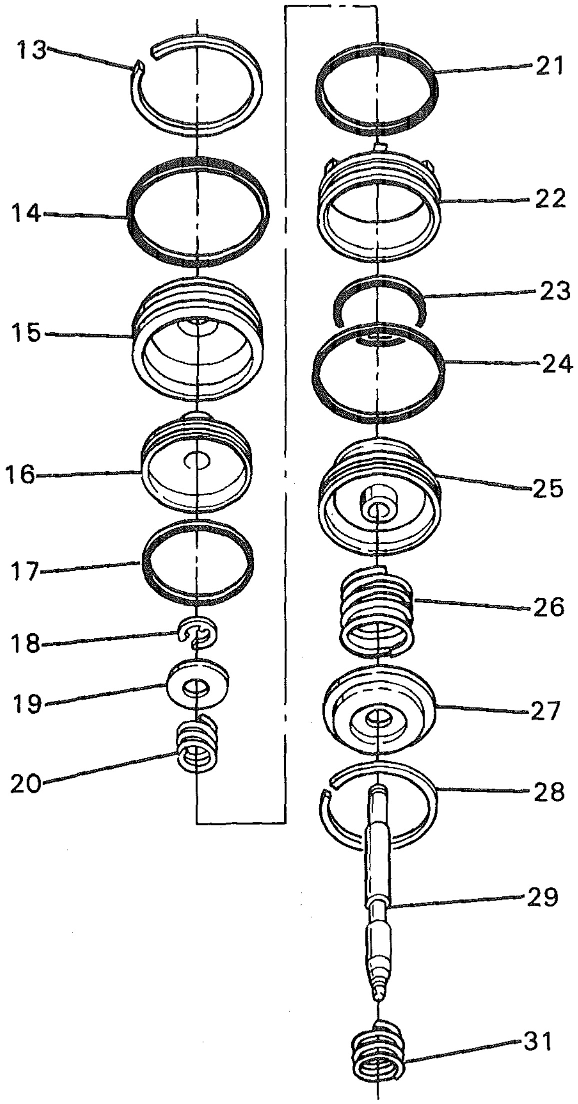
1. Remaining valve body bolts (69)
2. Manual valve link (705)
3. Control valve assembly (67)
4. Bolts (374-376), auxiliary valve body (377), and check ball (55)
5. Spacer plate (56) and spacer plate gaskets (88 and 89)
6. Check balls (55 and 91) spring (54), piston (52), seal (53) and pin
   - Three checkballs are located under the valve body, one in the auxiliary valve body and four are located in the case. The large copper flash colored ball is #10 check ball (91)



ILL. NO.	DESCRIPTION
A	CASE SERVO BORE
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18-30	2ND APPLY PISTON ASSEMBLY
21	SEAL, "O" RING
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
31	SPRING, SERVO RETURN

JH0057-700R4

Figure 71 Servo Removal

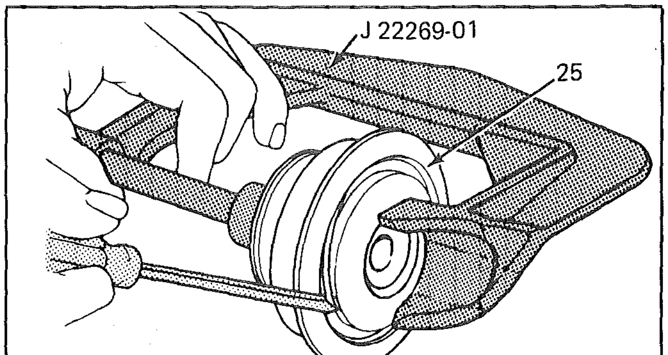


ILL. NO. | **DESCRIPTION**

13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON (INNER)
23 RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24 RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
31 SPRING, SERVO RETURN

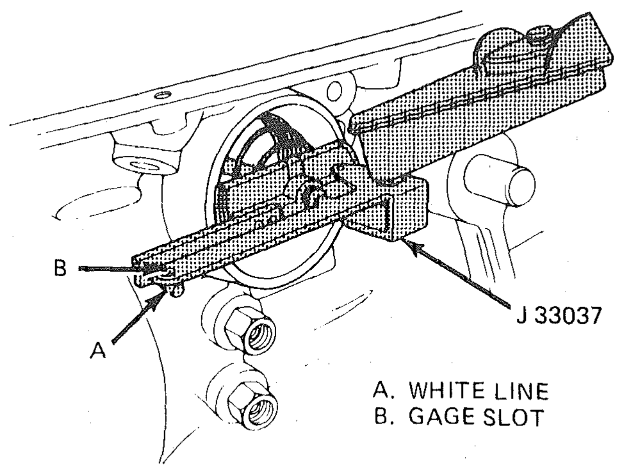
JH0058-700R4

Figure 72 Servo Assembly



25 SECOND APPLY PISTON ASM. JH0059-700R4

Figure 73 Second Servo Piston Retaining Ring Removal



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION		
PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

JH0060-700R4

Figure 74 Servo Pin Length

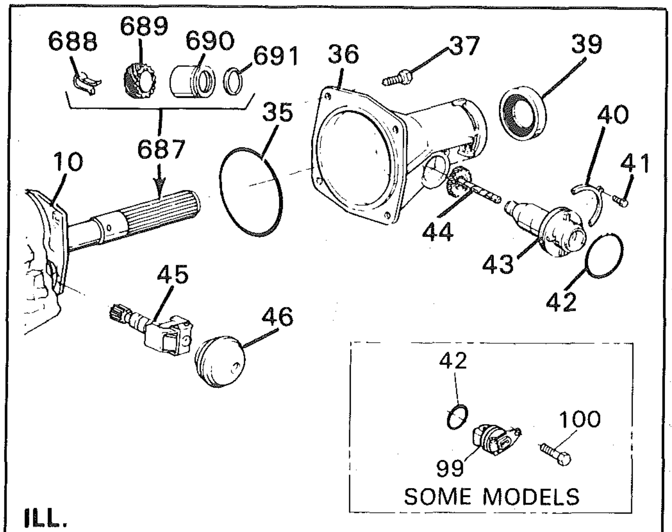
Transmission End Play Check

As a diagnostic aid transmission end play should be checked prior to removing the internal parts. If the end play is not within specifications you should watch for possible worn or misassembled parts during disassembly.

Tighten (Figures 84 and 85)

TOOLS REQUIRED:
- J-24773-A Oil Pump Remover
- J-25022-A End Play Adaptor (245 mm)
- J-34725 End Play Adaptor (298 mm)
- J-25025-7A Post
- Dial Indicator

1. Remove an oil pump bolt (5) and install a 278 mm (11 in.) bolt and locknut or J-25025-7A.



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT NOT USED ON
691	SEAL, OUTPUT SHAFT ALL MODELS

JH0061-700R4

Figure 75 Extension and Associated Parts

2. Install J-25022-A or J-34725 as shown.
3. Install J-24773-A as shown.
4. Install dial indicator.
   - set to zero
   - pull up on J-24773-A
   - end play should be 0.13/0.92 mm (.005/.036 in.).

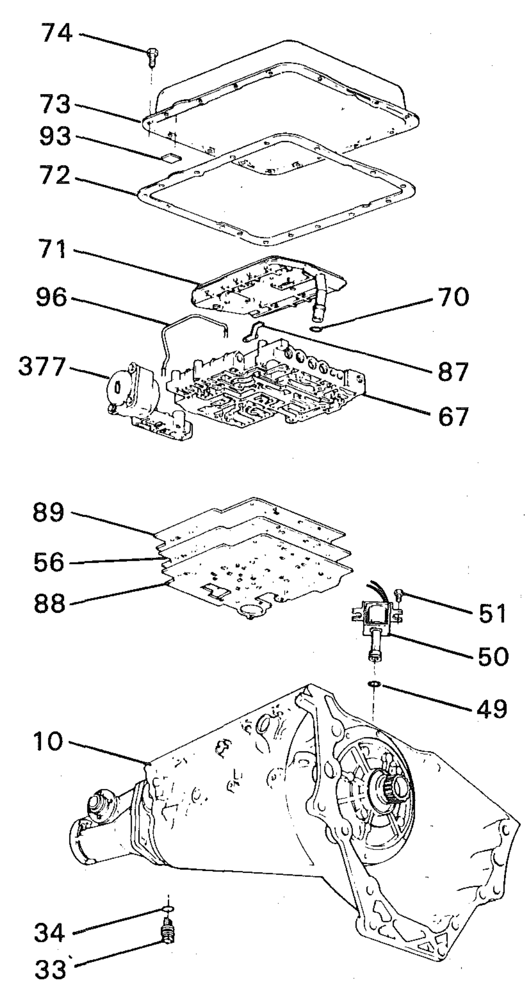
Oil Pump Assembly

Remove or Disconnect (Figures 88 and 89)

TOOLS REQUIRED:

J-24773-A Oil Pump Remover

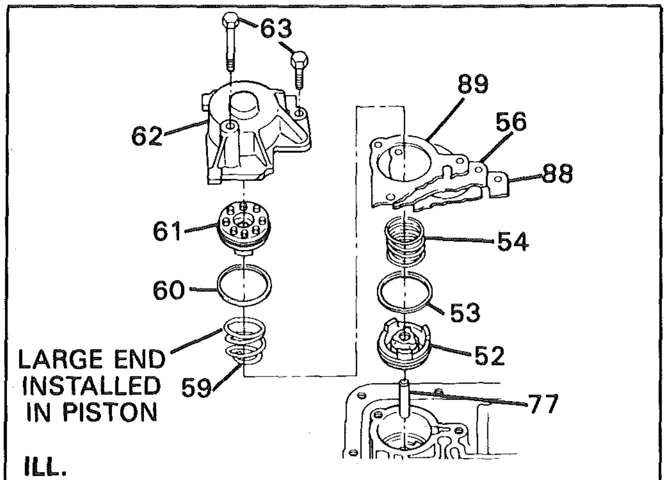
1. "O" ring seal (618)
2. All oil pump bolts (5) and washers (6)
3. Oil pump assembly (7) with J-24773-A
4. Oil pump to case seal (8) and gasket (9)
5. Reverse input clutch to oil pump thrust washer (601)



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
33	CONNECTOR, ELECTRICAL
34	SEAL, "O" RING (ELECTRICAL CONNECTION)
49	SEAL, "O" RING (SOLENOID)
50	SOLENOID ASSEMBLY
51	BOLT, HEX WASHER HEAD (SOLENOID)
56	PLATE, VALVE BODY SPACER
67	VALVE ASSEMBLY, CONTROL BODY
70	SEAL, FILTER
71	FILTER ASSEMBLY, TRANSMISSION OIL
72	GASKET, TRANSMISSION OIL PAN
73	PAN, TRANSMISSION OIL
74	SCREW, SPEC. HEX WASHER HEAD (PAN)
87	CLIP, FILTER RETAINER
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY
93	MAGNET, CHIP COLLECTOR
96	TUBE, AUXILIARY ACCUMULATOR VALVE
377	AUXILIARY ACCUMULATOR VALVE BODY ASSEMBLY

JH0062-700R4

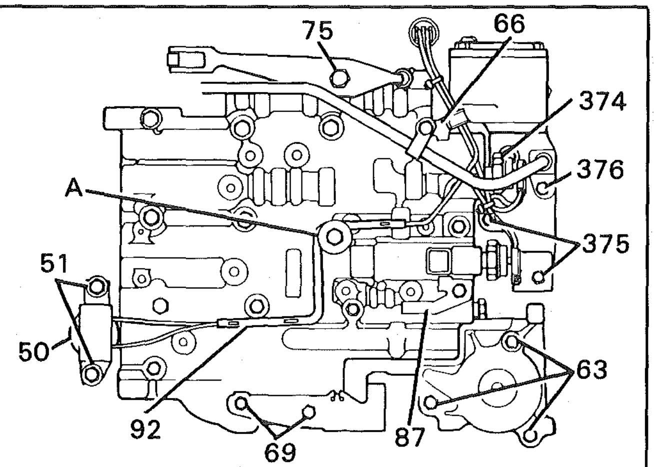
Figure 76 Case and Attaching Parts



ILL.
NO. DESCRIPTION
52 PISTON, 3-4 ACCUMULATOR
53 RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54 SPRING, 3-4 ACCUMULATOR
56 PLATE, VALVE BODY SPACER
59 SPRING, 1-2 ACCUMULATOR (CONICAL)
60 RING, OIL SEAL (1-2 ACCUM. PISTON)
61 PISTON, 1-2 ACCUMULATOR
62 COVER & PIN ASSEMBLY, 1-2 ACCUM.
63 BOLT, ACCUMULATOR COVER
77 PIN, ACCUMULATOR PISTON
88 GASKET, SPACER PLATE TO CASE
89 GASKET, SPACER PLATE TO VALVE BODY

JH0063-700R4

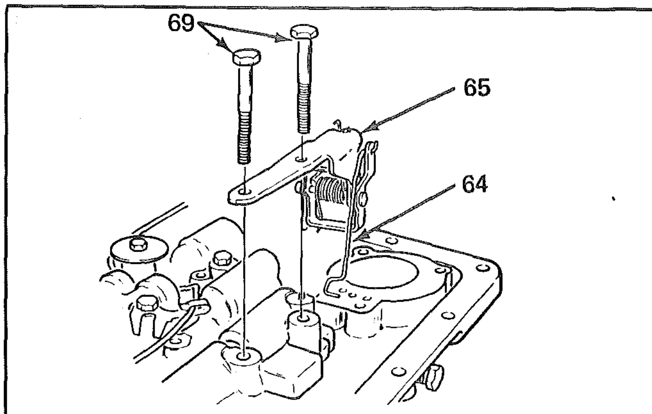
Figure 77 Accumulator Assembly



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
87 CLIP, FILTER RETAINER
92 CONDUIT, SOLENOID WIRE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 18)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

JH0064-700-R4

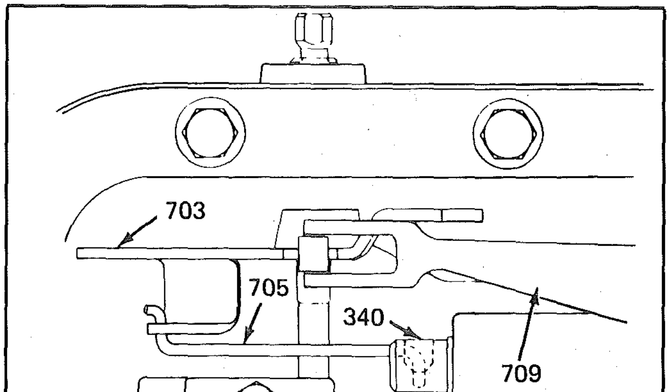
Figure 78 Valve Body Bolt Locations



64 LINK, THROTTLE LEVER TO CABLE
65 LEVER & BRACKET ASSEMBLY, THROTTLE
69 BOLTS, CONTROL VALVE ASSEMBLY

JH0065-700R4

Figure 79 T.V. Lever and Bracket



340 MANUAL VALVE
703 INNER DETENT LEVER
705 MANUAL VALVE LINK
709 MANUAL DETENT SPRING ASSEMBLY

JH0066-700R4

Figure 80 Manual Valve Link

2-4 Band Reverse Input Clutch, Input Clutch and Input Gear Set (Figures 88, 89 and 90)

1. Reverse input clutch (605) and input clutch (62) together
   - (grasp the turbine shaft and lift)
2. Band assembly pin (48)
3. The 2-4 band assembly (602)
4. Input sun gear (658)

Install or Connect (Figure 91)

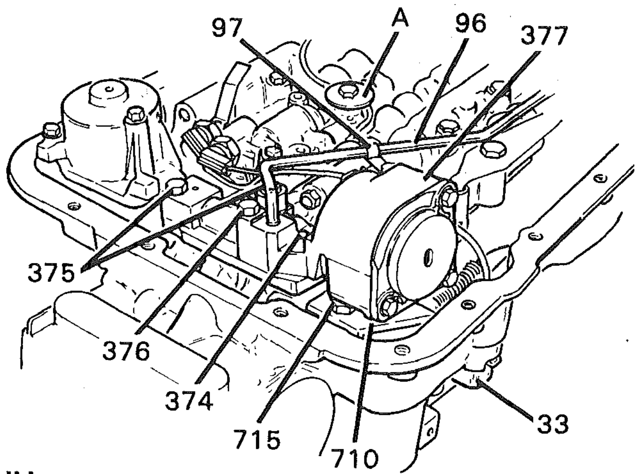
TOOLS REQUIRED:

J-29837 Output Shaft Support Fixture

- J-29837 as shown

Important

- Output shaft (687) may fall free when input carrier retaining ring (661) is removed if J-29837 is not used.

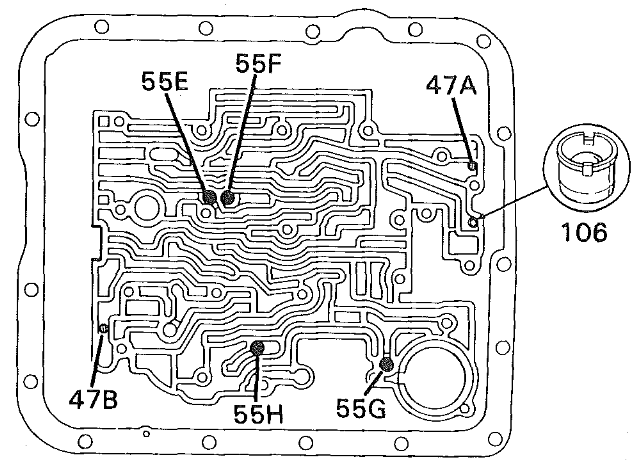


ILL. NO.	DESCRIPTION
A	WASHER, WIRE RETAINING
33	CONNECTOR, ELECTRICAL
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, TUBE
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUM. VALVE BODY ASM.
710	BRACKET, PARKING LOCK
715	BOLT, PARKING LOCK BRACKET

JH0067-700R4

Figure 81 Removing Auxiliary Valve Body Assembly

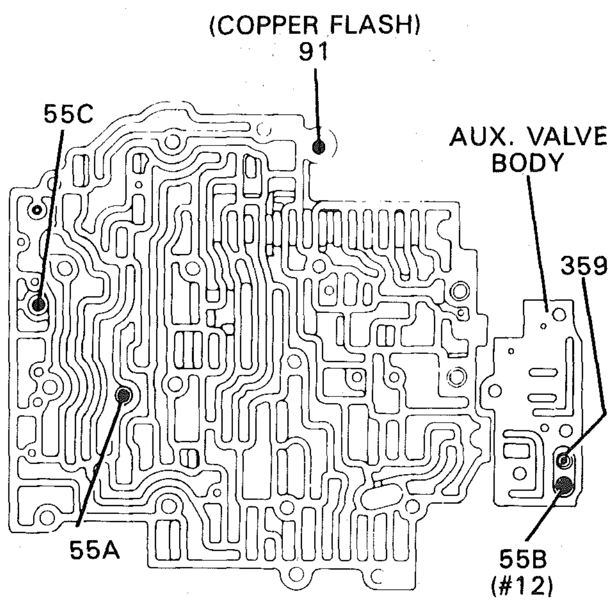
NOTE: #9 CHECKBALL (DETENT/LO) HAS BEEN REMOVED ON 1988 MODELS.



ILL. NO.	DESCRIPTION
47A	GOVERNOR FILTER LOCATION
47B	CONVERTER CLUTCH FILTER LOCATION
55E	#4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F	#8 CHECK BALL (2ND/1-2)
55G	#1 CHECK BALL (4TH ACCUMULATOR)
55H	#3 CHECK BALL (PART THROTTLE/DRIVE 3)
106	RETAINER & BALL ASM. (DOUBLE ORIFICE)

JH0069-700R4-R1

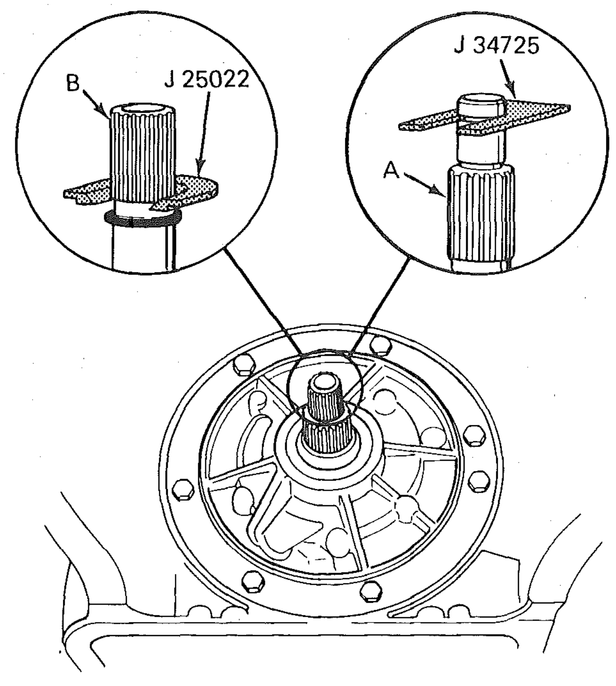
Figure 83 Case Checkballs and Filters



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #12 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)
359 CUP PLUG — ORIFICE

JH0068-700R4

Figure 82 Valve Body Checkballs



A 298mm TURBINE SHAFT
B 245mm TURBINE SHAFT

JH0070-700R4

Figure 84 End Play Tool

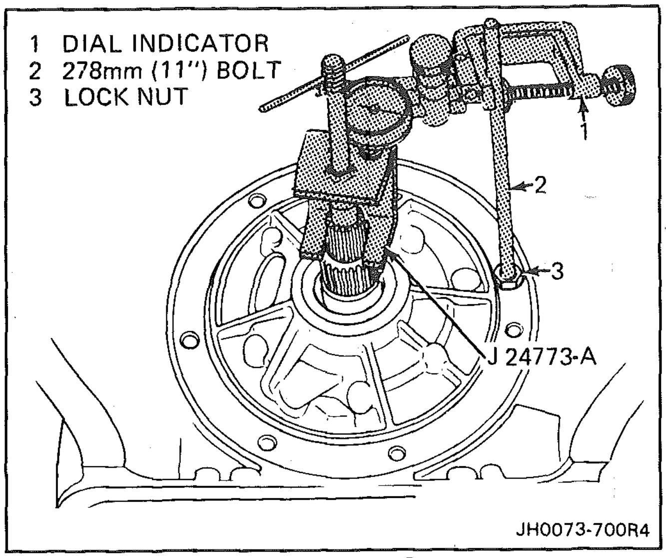


Figure 85 End Play Check

Remove or Disconnect (Figures 86, 87 and 90)

TOOLS REQUIRED:
J-34627 Snap Ring Pliers

1. Input carrier to output shaft retaining ring (661) with J-34627. Do not overexpand the ring.
2. Input carrier assembly (662)
3. J-29837 and output shaft (687)

Important

- The manufacturer assembles the output shaft and reaction internal gear with adhesive for ease of assembly. If these parts have not become separated during use, the output shaft will come out later along with the reaction internal gear.

4. Thrust bearing assembly (663)

Reaction Gear Set

Remove or Disconnect (Figures 86, 87, 92)

1. Input internal gear (664) and reaction carrier (666)
2. Reaction sun shell (670) and thrust washer (669)
3. Reaction sun shell to inner race thrust washer (674)
4. Lo and reverse support to case retainer ring (676)
5. Lo and reverse clutch support retainer spring (680)
6. Reaction sun gear (673)
7. Lo and reverse inner race (675), roller assembly (678), support assembly (679), and reaction carrier assembly (681)
8. Lo and reverse clutch plates (682)
9. Reaction internal gear (684) and thrust bearing assembly (683)
10. Reaction gear support to case bearing (692)

Lo and Reverse Clutch Parts

Remove or Disconnect (Figures 92, 93 and 94)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor

1. Bolts (715) and parking lock bracket (710)

Important

- Due to interference, the parking pawl may have to be removed before removing or installing the low and reverse piston.

2. Parking pawl shaft plug (713) with a #4 screw extractor
3. Parking pawl pivot shaft (712) with a magnet
4. Parking pawl (711) and return spring (714)
5. Install tool J-23327.
6. Lo and reverse clutch retainer ring (693)
7. Lo and reverse clutch spring assembly (694)
8. Lo and reverse clutch piston (695)
   - by application of air pressure in the case apply passage

COMPONENT REPAIR AND TRANSMISSION REASSEMBLY

Inner Manual Linkage

Remove or Disconnect (Figure 94)

1. Inside manual shaft nut (702)
2. Manual shaft (707) and manual shaft retainer (706)
3. Parking lock actuator assembly (701) and inside detent lever (703)

Manual Shaft Seal Replacement

Remove or Disconnect (Figure 95)

- Manual shaft seal (708)
  - pry out with a screwdriver

Install or Connect

- Tap a new seal in place
  - use a 14 mm socket

Inspect (Figures 94 and 95)

- Actuator rod (701) for damage
- Inside detent lever (703) for damage or cracks
- Manual shaft (707) for damage or burrs
- Manual detent spring assemby (709) for roller freeness or damage

Install or Connect (Figure 94)

- Parking lock actuator (701) onto inside detent lever (703)
- Manual shaft (707) into case (10) and inside detent lever (703)
- Inside manual shaft nut (702) onto manual shaft (707)
  - torque to 31 N·m (23 ft. lbs.)
- Manual shaft retainer (706) onto manual shaft (707)

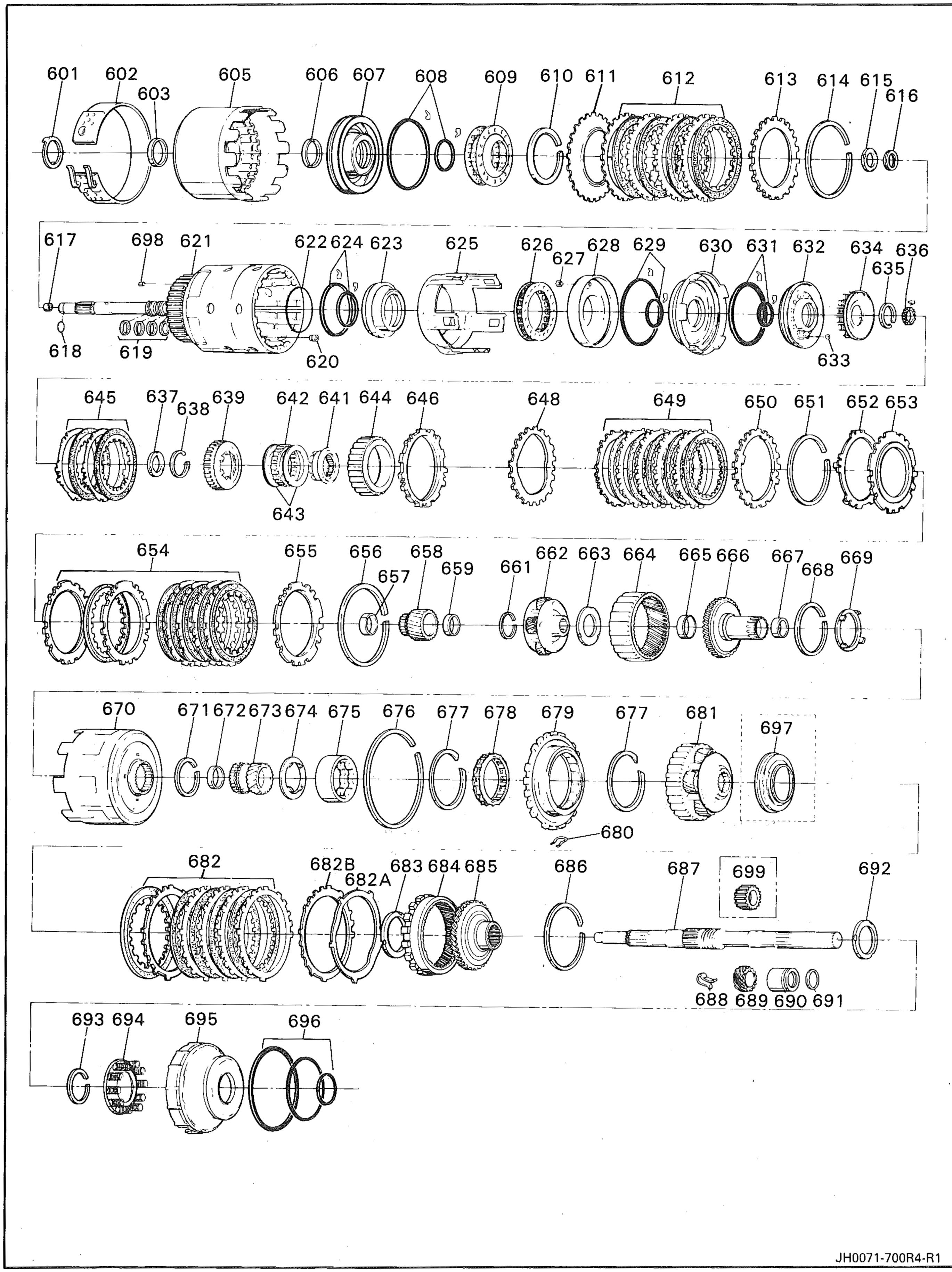


Figure 86 Transmission Internal Parts

ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
602	BAND ASSEMBLY, 2-4
603	BUSHING, REVERSE INPUT CL. (FRONT)
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CLUTCH (BELLEVILLE)
612	PLATE ASM., REVERSE INPUT CLUTCH
613	PLATE, REVERSE INPUT CLUTCH BACKING (SELECTIVE)
614	RING, REVERSE INPUT CL. RETAINING
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
617	RETAINER & BALL ASM., CHECK VALVE
618	SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
619	RING, OIL SEAL (SOLID)
620	RETAINER & CHECK BALL ASSEMBLY
621	HOUSING & SHAFT ASSEMBLY, INPUT
622	SEAL, "O" RING INPUT TO FORWARD HSG.
623	PISTON, 3RD & 4TH CLUTCH
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
627	RETAINER & BALL ASSEMBLY, FORWARD CLUTCH HOUSING
628	HOUSING, FORWARD CLUTCH
629	SEAL, FORWARD CLUTCH (INNER & OUTER)
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
632	PISTON, OVERRUN CLUTCH
633	BALL, OVERRUN CLUTCH
634	SPRING ASSEMBLY, OVERRUN CLUTCH
635	SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
638	SNAP RING, OVERRUN CL. HUB RETAINING
639	HUB, OVERRUN CLUTCH
641	RETAINER & RACE ASSEMBLY, SPRAG
642	FORWARD SPRAG ASSEMBLY
643	RETAINER RINGS, SPRAG ASSEMBLY
644	RACE, FORWARD CLUTCH (OUTER)
645	PLATE ASSEMBLY, OVERRUN CLUTCH
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING (SEL.)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)

ILL. NO.	DESCRIPTION
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657	BUSHING, INPUT SUN GEAR (FRONT)
658	GEAR, INPUT SUN
659	BUSHING, INPUT SUN GEAR (REAR)
661	RET., OUTPUT SHAFT TO INPUT CARRIER
662	CARRIER ASSEMBLY, INPUT (COMPLETE)
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
664	GEAR, INPUT INTERNAL
665	BUSHING, REACTION CARRIER SHAFT (FRONT)
666	SHAFT, REACTION CARRIER
667	BUSHING, REACTION CARRIER SHAFT (REAR)
668	RING, REACTION SHAFT/INTERNAL GEAR RETAINER
669	WASHER, THRUST (REACTION SHAFT/ SHELL)
670	SHELL, REACTION SUN
671	RING, REACTION SUN GEAR RETAINER
672	BUSHING, REACTION SUN
673	GEAR, REACTION SUN
674	WASHER, THRUST (RACE/REACTION SHELL)
675	RACE, LO & REVERSE ROLLER CLUTCH
676	RING, LO & REVERSE SUPPORT TO CASE RETAINER
677	RING, LO & REVERSE RETAINER (ROLLER ASSEMBLY/CAM)
678	CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679	SUPPORT ASM., LO & REVERSE CLUTCH
680	SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
682A	PLATE, LO & REVERSE CLUTCH (WAVED)
682B	PLATE, SPACER LO & REV. CL. (SELECTIVE)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
686	RING, REACTION GEAR/SUPPORT RETAINER
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT
691	SEAL, OUTPUT SHAFT
692	BRG., REACTION GEAR SUPPORT TO CASE
693	RING, LO & REVERSE CLUTCH RETAINER
694	SPRING ASSEMBLY, LO & REVERSE CLUTCH
695	PISTON, LO & REVERSE CLUTCH
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH — OUTER, CENTER, INNER)
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)
698	PLUG, ORIFICED CUP
699	ROTOR, INTERNAL TRANSMISSION SPEED SENSOR

JH0072-700R4-R1

Figure 87

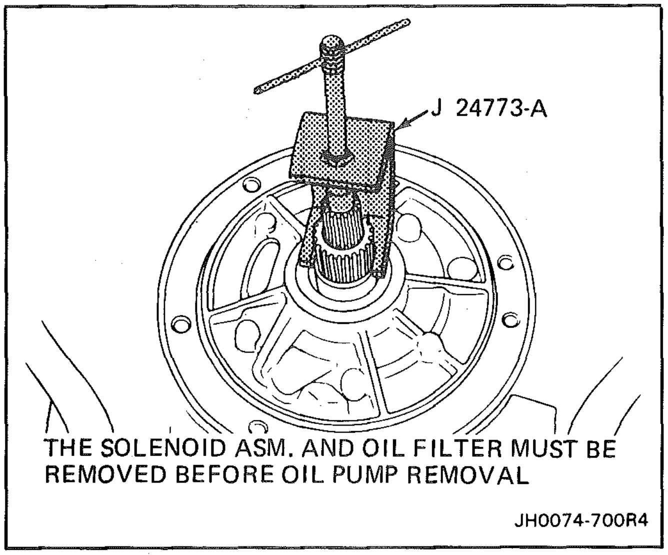
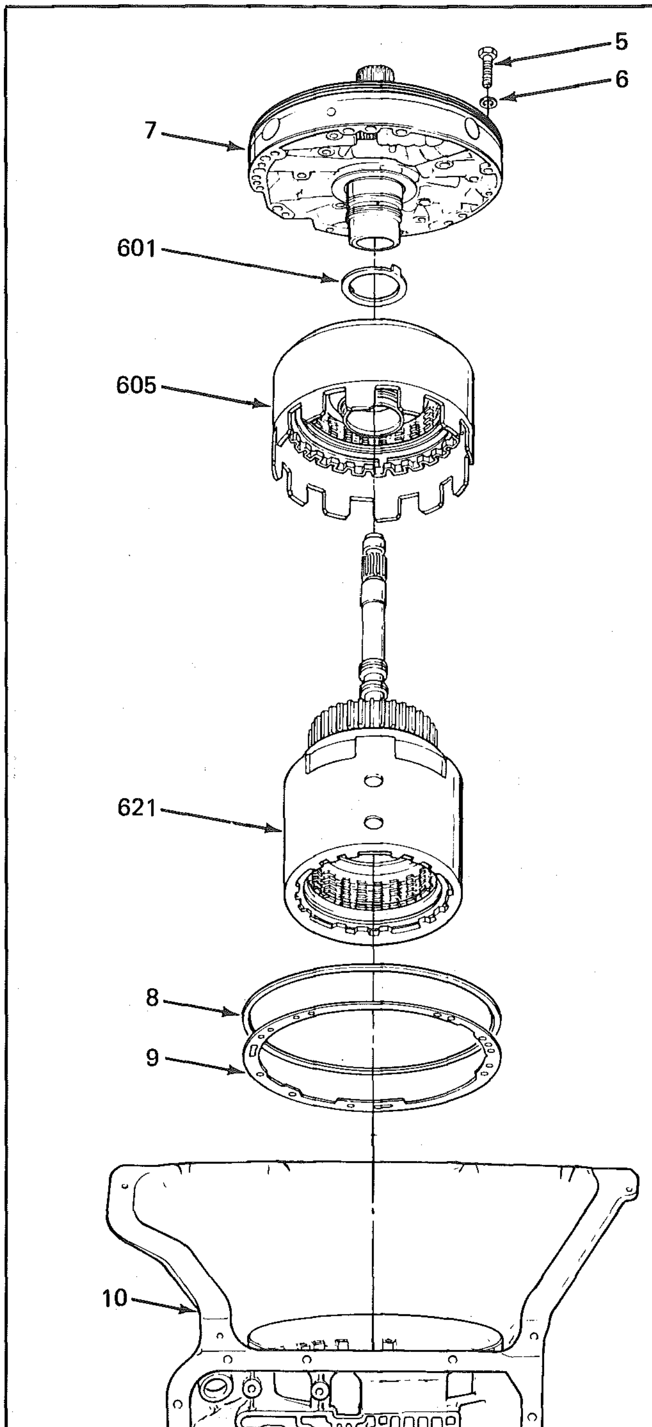


Figure 88 Oil Pump Removal

Case

Inspect (Figures 96, 97 and 98)

- Case (10) exterior for cracks or porosity
- Case to valve body face for damage, interconnected oil passages and flatness
  - the face flatness can be checked by inspecting the spacer plate to case gasket for proper land impressions.
- Vent assembly (11) for damage
- Air check all oil passages.
  - see diagnosis section for oil passage identification.
- 2-4 servo bore for
  - damage, porosity, or burrs
  - any sharp edges (i.e. - oil passages, slots for retaining ring removal - remove if found)
- Orifice cup plug (86) in servo bore for debris or damage
- Third accumulator bore for
  - porosity, damage, or burrs
  - pin damage (77)
  - orifice cup plug (81) damaged or plugged
- Speedometer bore
  - damaged
  - sharp edges
  - porosity
- All bolt holes for thread damage
  - Heli-coil to repair
- Cooler connectors (12) for
  - damage
  - proper torque 38 N·m (28 ft. lbs.)
- Case interior for
  - damaged ring grooves or casting flash
  - clutch plate lugs worn or damaged
  - bushing (76) scored, worn, or damaged (see Bushing Replacement)
  - governor support pin installation depth. (Incorrect installation depth will cause governor driven gear damage and shift problems.)



ILL. NO.	DESCRIPTION
5	BOLT, PUMP TO CASE
6	WASHER, PUMP TO CASE BOLT
7	PUMP ASSEMBLY, OIL
8	SEAL, OIL (PUMP TO CASE)
9	GASKET, PUMP COVER TO CASE
10	CASE, TRANSMISSION
601	WASHER, THRUST (PUMP TO DRUM)
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621	HOUSING & SHAFT ASSEMBLY, INPUT

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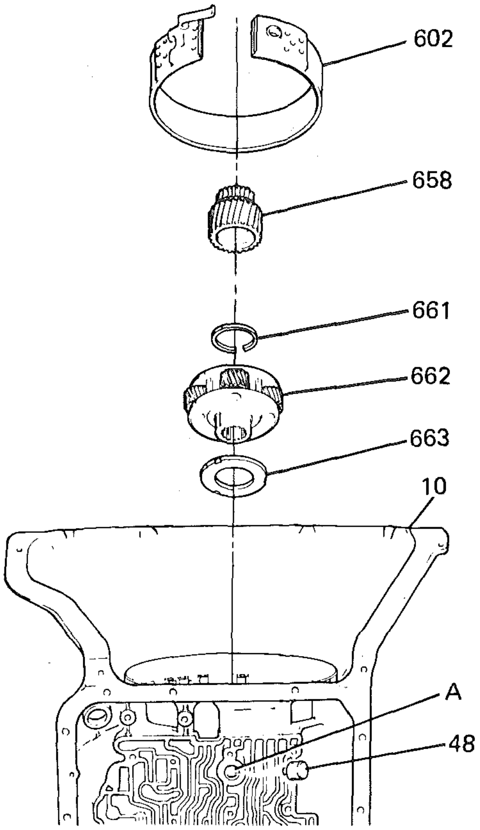
Figure 89 Input Clutch Removal



A BAND ANCHOR PIN LOCATION
10 CASE, TRANSMISSION
48 PIN, BAND ANCHOR
602 BAND ASSEMBLY, 2-4
658 GEAR, INPUT SUN
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)

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Figure 90 Input Carrier Removal

10 CASE, TRANS.
687 SHAFT, OUTPUT

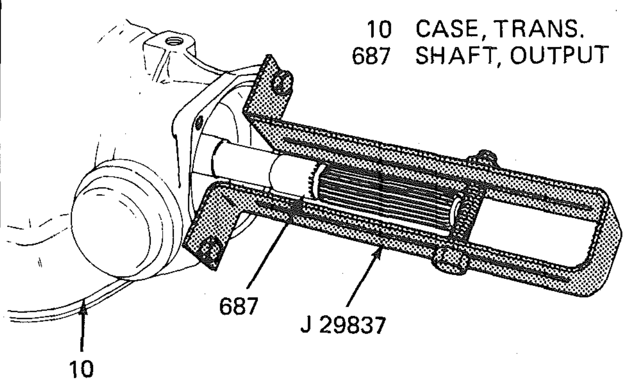

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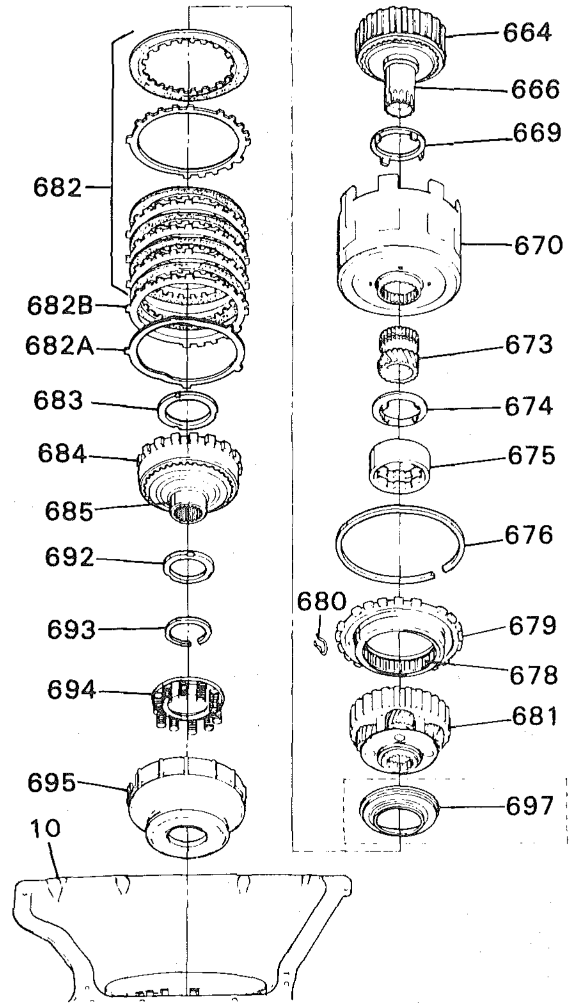
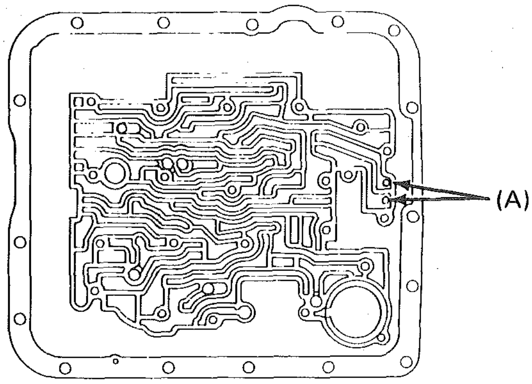
Figure 91 Output Shaft Support Fixture



10 CASE, TRANSMISSION
664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/ SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER
678 CLUTCH ASM., LO & REVERSE ROLLER
679 SUPPORT ASM., LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION (LO & REVERSE CLUTCH SUPPORT RETAINER)
681 CARRIER ASSEMBLY, REACTION
682 PLATE ASSEMBLY, LO & REVERSE CLUTCH
682A PLATE, LO & REVERSE CLUTCH (WAVED)
682B PLATE, LO & REVERSE CL. (SELECTIVE)
683 BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684 GEAR, INTERNAL REACTION
685 SUPPORT, INTERNAL REACTION GEAR
692 BRG., REACTION GEAR SUPPORT TO CASE
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASM., LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
697 DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

JH0078-700R4

Figure 92 Reaction Gear Set Removal



(A) APPLY AIR PRESSURE HERE TO REMOVE LO & REVERSE PISTON FROM THE CASE

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Figure 93 Piston Removal

Third Accumulator Retainer and Ball Assembly (80) (Figure 99)

Inspect

- Ball
  - missing
  - sticking or leaking
- Retainer
  - missing
  - loose
  - not seated correctly
  - feed slots restricted

Retainer and Ball Assembly Leak Check Procedure

Important (Figure 99)

1. Install the servo assembly into the servo bore.
2. Install the servo cover and retainer.
3. Pour a suitable solvent into the accumulator bore.
4, Watch for leakage inside the case.
5. If leakage is observed, replace the third accumulator retainer and ball assembly.

Replacement Procedure - Third Accumulator Retainer and Ball Assembly

Remove or Disconnect (Figure 99 and 100)

TOOLS REQUIRED:

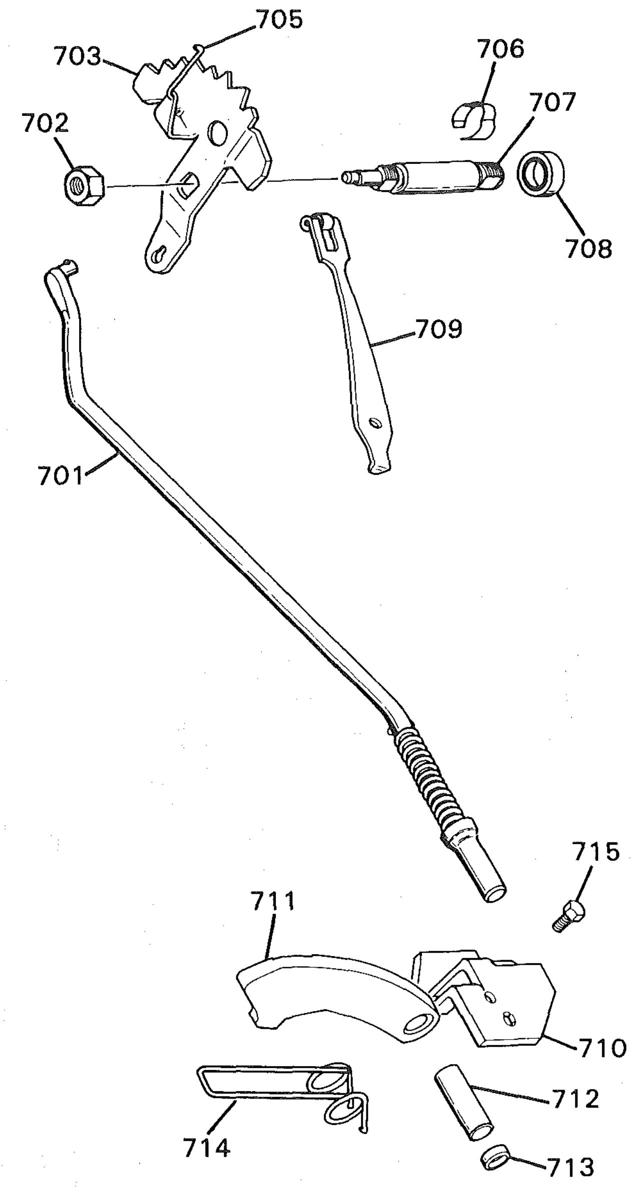
6.3 mm (#4) Screw Extractor

- Third accumulator retainer and ball assembly (80)
  - use 6.3 (#4) screw extractor

Install or Connect (Figure 99 and 100)

TOOLS REQUIRED:

9.5 mm (3/8 in.) Diameter Metal Rod



ILL. NO.	DESCRIPTION
701	ACTUATOR ASSEMBLY, PARKING LOCK
702	NUT, HEX HEAD
703	LEVER, INSIDE DETENT
705	LINK, MANUAL VALVE
706	RETAINER, MANUAL SHAFT
707	SHAFT, MANUAL
708	SEAL, MANUAL SHAFT
709	MANUAL DETENT ROLLER & SPRING ASM.
710	BRACKET, PARKING LOCK
711	PAWL, PARKING BRAKE
712	SHAFT, PARKING BRAKE PAWL
713	PLUG, STEEL CUP
714	SPRING, PARKING PAWL RETURN
715	BOLT, PARKING LOCK BRACKET

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Figure 94 Parking Linkage

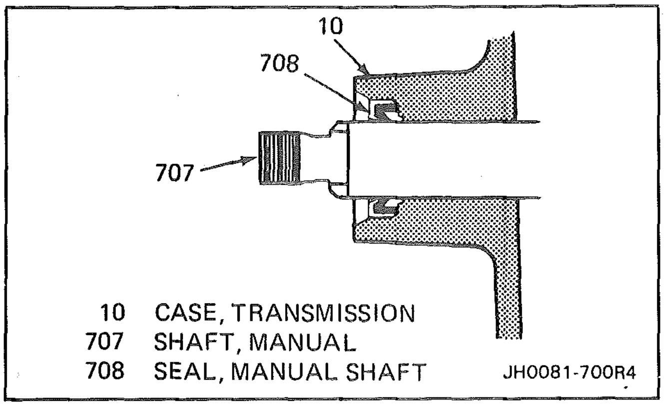


Figure 95 Manual Shaft Seal

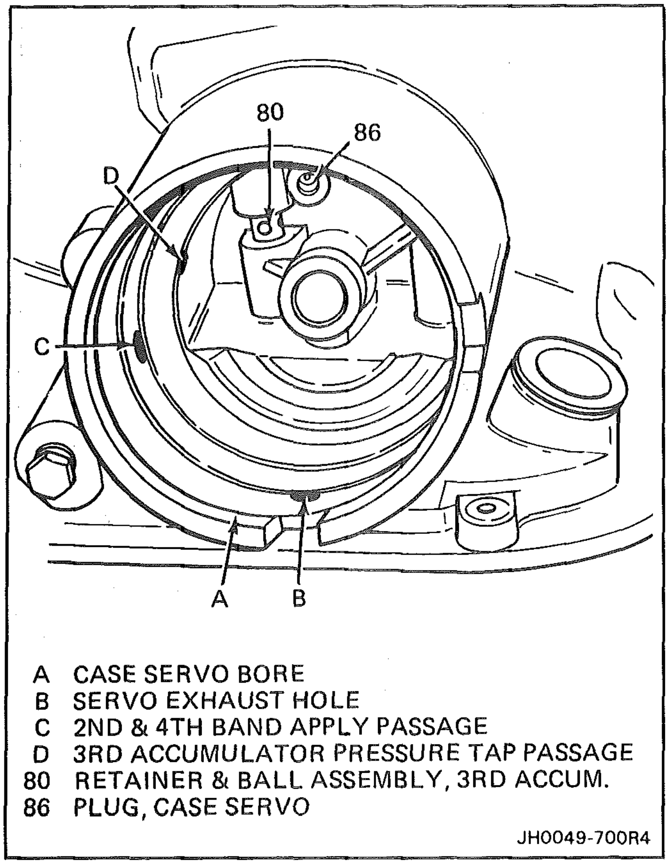


Figure 96 Servo Bore

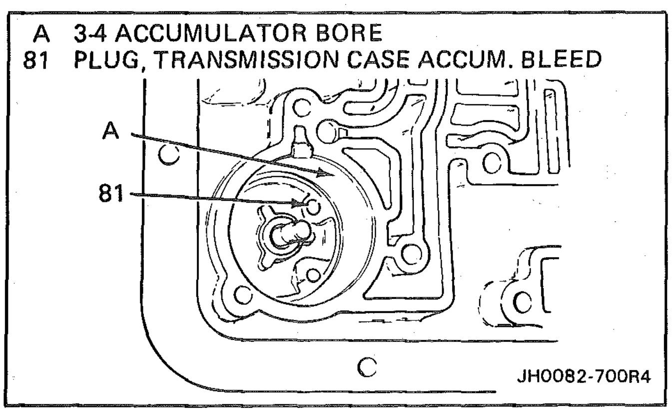


Figure 97 Third Accumulator Bore

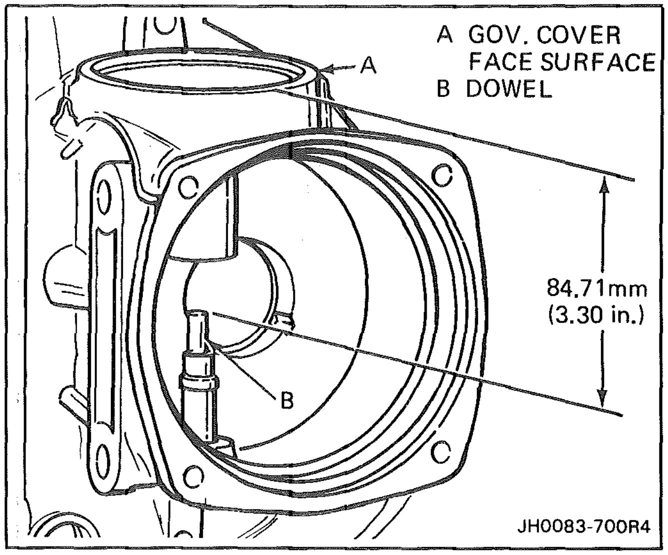


Figure 98 Governor Pin Location

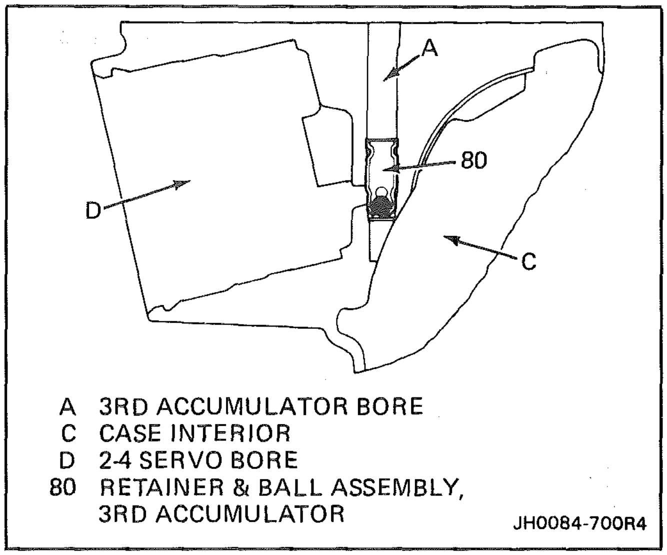


Figure 99 Leak Check - 3rd Accumulator

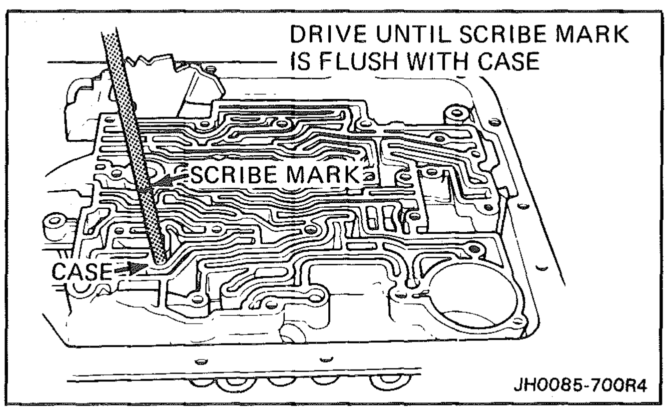


Figure 100 Third Accumulator Retainer and Ball Asm. - Installation

- A new third accumulator retainer and ball assembly

  oil feed slots in the retainer must line up with oil passage in the servo bore. To be certain of correct installation depth, scribe a mark at 42.0 mm (1. 653 in.) on the 9.5 mm (3/8") diameter metal rod. Use it to seat the third accumulator and ball assembly as shown. When the scribed line is flush with the case face, installation depth is correct.

Case Assembly

Clean

- Thoroughly with solvent
- Air dry
  - do not wipe with cloth.

Lo and Reverse Clutch Assembly

Inspect (Figure 101)

- Lo and reverse piston (695) for
  - porosity or damage
  - ring groove damage
- Piston seals (696) for nicks or cuts
- Spring assembly (694) for damage
- Retainer ring (693) overstressed

Install or Connect (Figure 101)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor

1. Piston seals (696) onto the piston (695)
   - lubricate with transmission fluid
2. Piston (695) into the case
   - index the piston with the notch in the bottom of the case.
3. Spring assembly (694) onto the piston
   - flat side of the retainer upward
4. J-23327 over the spring assembly
   - compress the spring assembly past the ring groove in the case hub.
5. Retainer ring (693) into the case hub ring groove

Parking Pawl

Inspect (Figure 102)

- Parking pawl (711) for cracks, burrs, or damage
- Parking pawl return spring (714) for distortion or damage
- Parking pawl pivot shaft (712) for damage and freeness of fit with the parking pawl

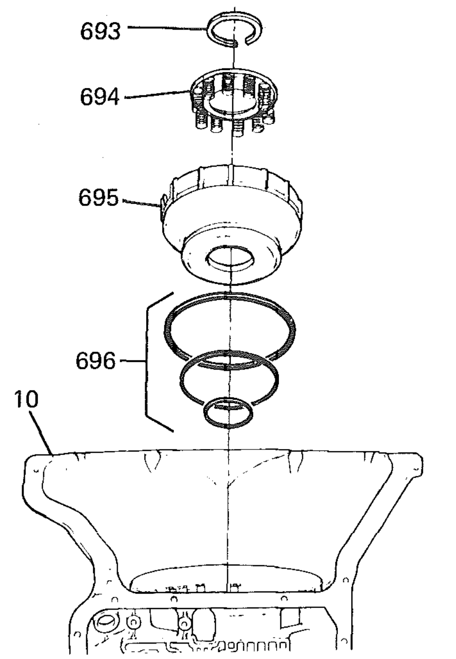
Install or Connect (Figure 102)

1. Parking pawl (711) and parking pawl return spring (714) into the case
2. Parking pawl pivot shaft (712) into the parking pawl (711) and the case
   - CHECK FOR PROPER OPERATION
3. Retaining plug (713) into the case
   - coat the plug with loc-tite sealant or equivalent and install it with a hammer and punch.

Reaction Internal Gear and Carrier Assembly

Inspect (Figures 103, 104, 105)

- Reaction internal gear (683) and support (684) for
  - proper assembly



10 CASE, TRANSMISSION
693 RING, LO & REVERSE CLUTCH RETAINER
694 SPRING ASSEMBLY, LO & REVERSE CLUTCH
695 PISTON, LO & REVERSE CLUTCH
696 SEALS, LO & REVERSE CLUTCH

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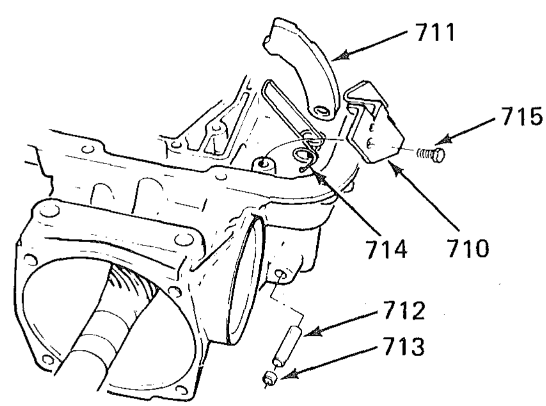
Figure 101 Lo and Reverse Piston



710 BRACKET, PARKING LOCK
711 PAWL, PARKING BRAKE
712 SHAFT, PARKING BRAKE PAWL
713 PLUG, STEEL CUP
714 SPRING, PARKING PAWL RETURN
715 BOLT, PARKING LOCK BRACKET

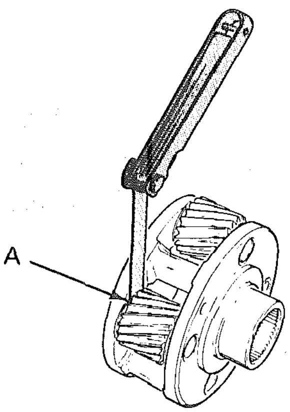
JH0088-700R4

Figure 102 Parking Pawl Installation

  - stripped splines
  - cracks
  - teeth or lug damage
- Thrust bearing assemblies (683 and 692) for damage
- Lo and reverse clutch plates (682)
  - Composition for wear, heat damage, or delamination

- Steel for heat damage or surface finish damage
- Reaction carrier assembly (681) for
  - pinion gear damage
  - excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)
  - proper pinion staking
  - keystoned pinion gears (pinions must turn free)
  - damaged or worn thrust bearing

    To check the captive thrust bearing in the carrier for wear, place a bushing or an output shaft sleeve on the bearing race (do not contact the pinion gears) and turn it with the palm of your hand. Any imperfections will be felt through the bushing.



A PINION GEAR END PLAY – .20/.60 MM (.008/.024 IN.)

JH0089-700R4

Figure 103 Pinion End Play Check

Reaction Internal Gear and Support

Install or Connect (Figures 106)

1. Reaction gear support to case bearing (692) onto the case hub as shown
   - Outside bearing race goes toward case hub.
   - retain with petrolatum.
2. Reaction internal gear and support (684 and 685) onto the bearing as shown
3. Reaction carrier to support thrust bearing assembly (683) onto the support (685)
   - outer bearing race goes toward the support
4. Reaction carrier (681) onto the thrust bearing

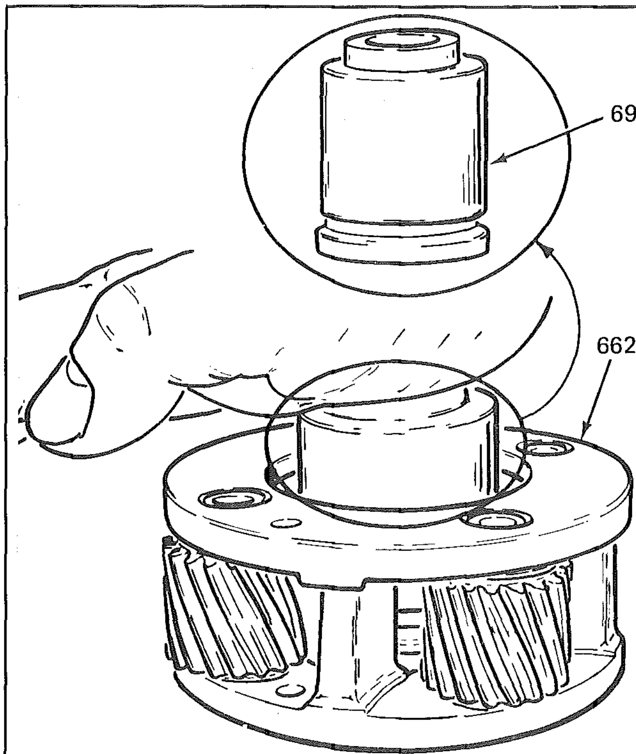
Lo and Reverse Clutch

Measure (Figure 107 and 108)

TOOLS REQUIRED

- Scale and straight edge

1. To Measure for proper selection backing plate, stack the lo and reverse assembly on a flat surface in the following order:
   - 1 waved plate (682B)



662 CARRIER ASSEMBLY, INPUT – COMPLETE
690 SLEEVE, OUTPUT SHAFT

JH0090-700R4

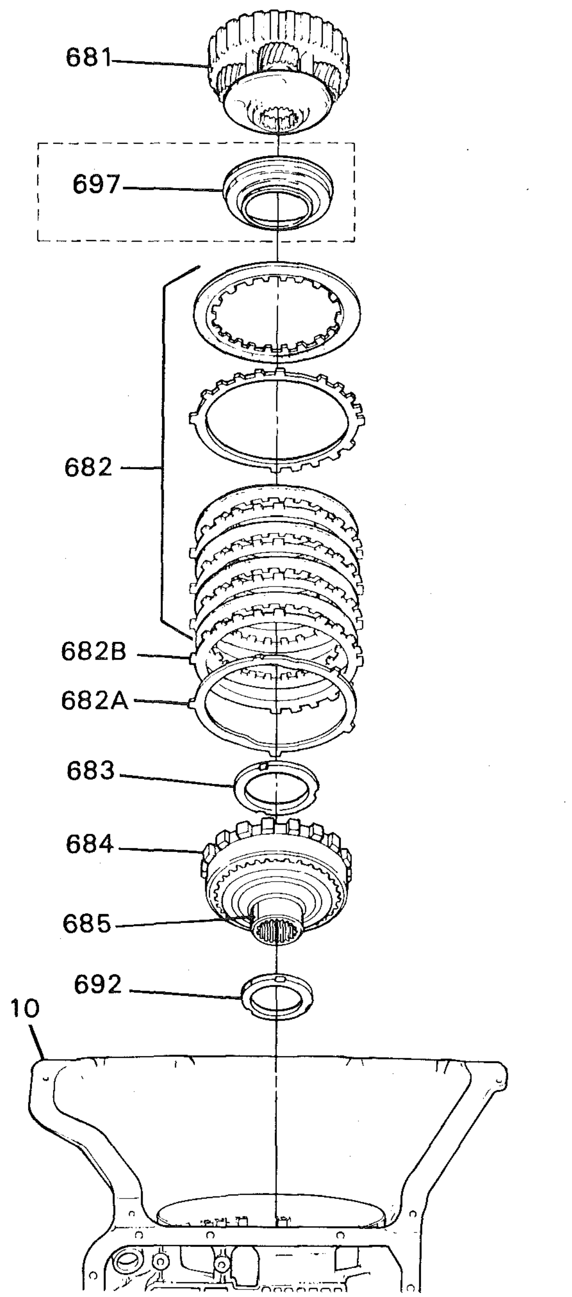
Figure 104 Captured Bearing Check

   - 5 fiber and 4 steal plates (682), starting with one fiber plate and alternating with a steal plate.
   - Lo and Reverse Clutch Support (679)
2. Apply an evenly distributed load to the top of the Lo and Reverse Support Assembly (679) Light pressure (5 lbs.) on the Lo and Reverse Support Assembly (679) will provide the correct dimension for measurement.

   CAUTION: EXCESSIVE PRESSURE WILL START TO FLATTEN THE WAVE PLATE RESULTING IN AN INACCURATE MEASUREMENT
3. Measure the height of the clutch pack from the work surface to the top of the Lo and Reverse Clutch Support (Dimension D)
4. Use dimension D to select the proper thickness of the selective spacer plate for assembly.
5. Install the proper selective spacer plate between the wave plate and the first fiber clutch plate with the identification side up.
6. The overall height for dimension D with the selective spacer plate included should be 30.515 mm - 31.401 mm (1.20" - 1.24).

Install or Connect (Figures 107, 108, 109 and 110)

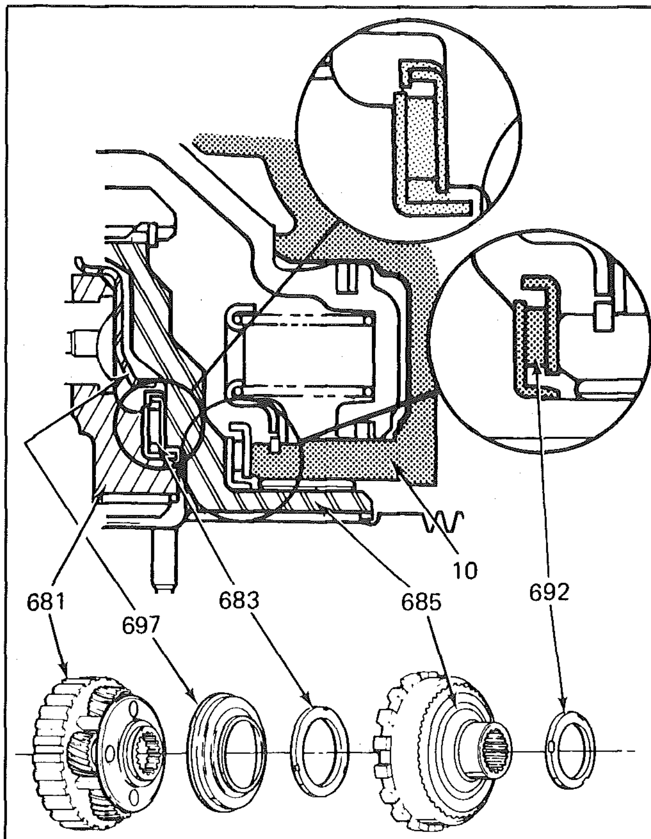
5. Lo and reverse clutch plates (682) into case lugs
   - start with a steel plate and alternate with composition.
   - index with the splines of the reaction carrier and the case as shown.



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
682	PLATE ASSEMBLY, LO & REVERSE CLUTCH
682A	PLATE, LO & REVERSE CLUTCH (WAVED)
682B	PLATE, LO & REVERSE CL. (SELECTIVE)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
684	GEAR, INTERNAL REACTION
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

JH0091-700R4

Figure 105 Reaction Internal Gear and Carrier Assembly Installation



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
681	CARRIER ASSEMBLY, REACTION
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
685	SUPPORT, INTERNAL REACTION GEAR
692	BRG., REACTION GEAR SUPPORT TO CASE
697	DEFLECTOR, OIL (HIGH OUTPUT MODELS ONLY)

JH0092-700R4

Figure 106 Reaction Internal Gear and Carrier Bearing Locations

Lo and Reverse Support Assembly

Remove or Disconnect (Figure 111)

1. Inner race (675) from the support assembly
2. One retainer ring (677)
3. Roller clutch assembly (678)

Inspect (Figure 111)

- Inner race (675) for damage and surface finish
- Roller clutch assembly (678) for
  - damaged rollers
  - broken springs
- Cam and support assembly for
  - loose cam
  - surface finish
  - cracks or damaged lugs.

Install or Connect (Figure 111 and 112)

1. Roller clutch assembly (678) into the cam and support assembly (679)

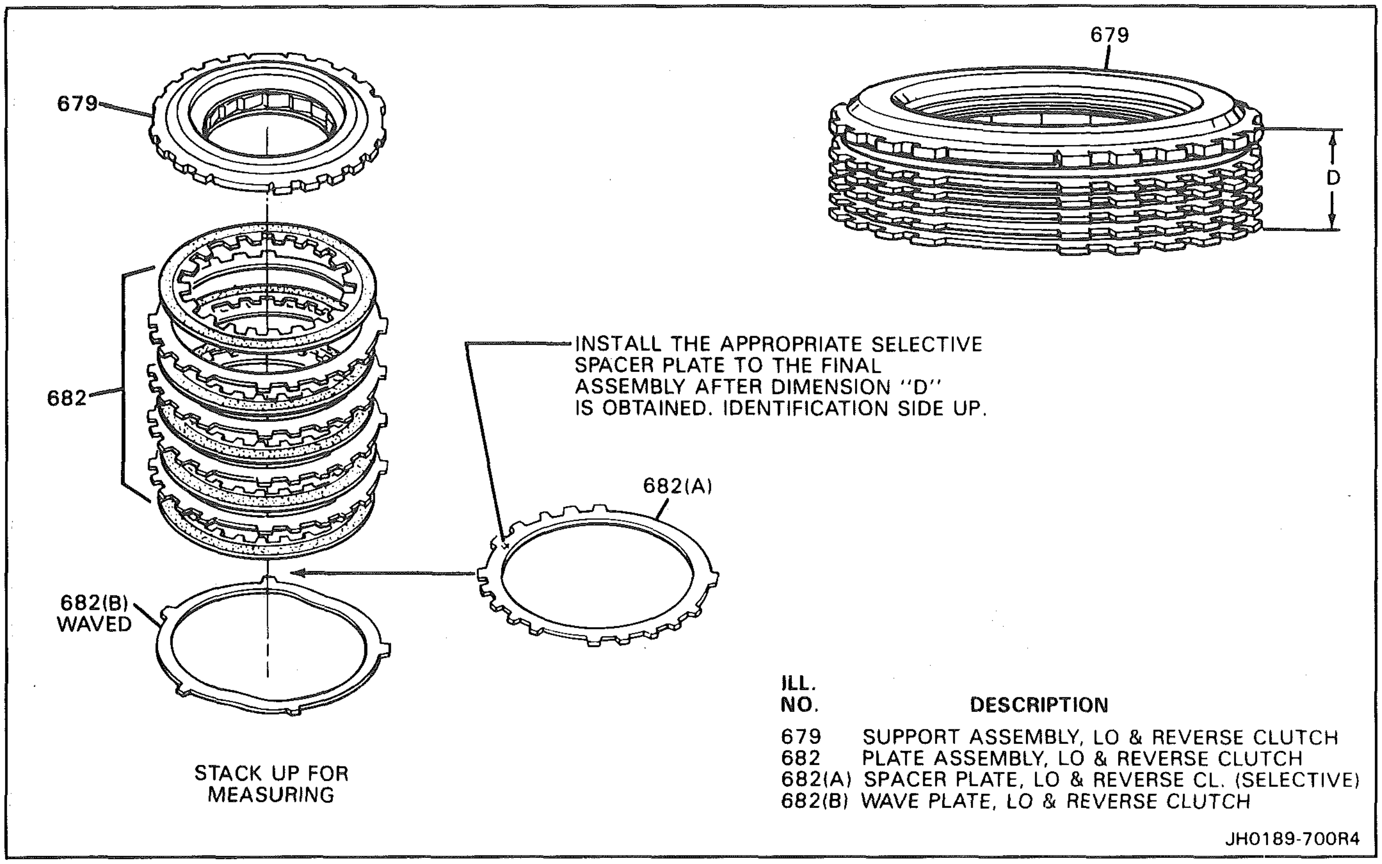


Figure 107 Measuring For Back Plate Selection

LO & REVERSE CLUTCH SPACER PLATE SELECTION CHART

IF GAGE DIMENSIONS 'D' IS		USE THIS SELECTIVE PLATE		
FROM	TO	IDENTIFICATION	PLATE THICKNESS	
29.559mm (1.164")	28.844mm (1.136")	NONE	1.671mm (.066")	1.842mm (.073")
28.844mm (1.136")	28.129mm (1.107")	4	2.386mm (.094")	2.557mm (.101")
28.129mm (1.107")	27.414mm (1.079")	5	3.101mm (.122")	3.272mm (.129")

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Figure 108 Lo and Reverse Backing Plate Selection Chart

2. Support and roller assembly into the case with the hub down
3. Inner race (675) into the roller assembly
4. Turn inner race (675) while inserting
   - push down for full engagement.
   - bottom tangs will be flush with carrier hub when properly installed.
   - check for proper operation by rotating the inner race as shown in Figure 111.
5. Support retainer spring (680) into the case
   - insert between the case lug and the one open notch in the support.

Reaction Sun Gear and Shell

Inspect (Figure 114)

- Reaction Sun Gear (673) for
  - nicked, scored, or worn bushing. (See Bushing Replacement).
  - damaged spline or teeth
  - loose or weak retaining ring (do not remove this ring, except to replace it.)
- Reaction sun shell (670) for
  - stripped or worn splines

LO & REVERSE CLUTCH		
	QTY.	THICKNESS
PLATE—FLAT STEEL	4	1.77mm (.069")
PLATE—COMP. FACED	5	2.25mm (.088")
PLATE—SELECTIVE	1	SEE FIG. 108
PLATE—WAVED	1	2.43mm (.096")

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Figure 109 Lo and Reverse Clutch Plate Chart

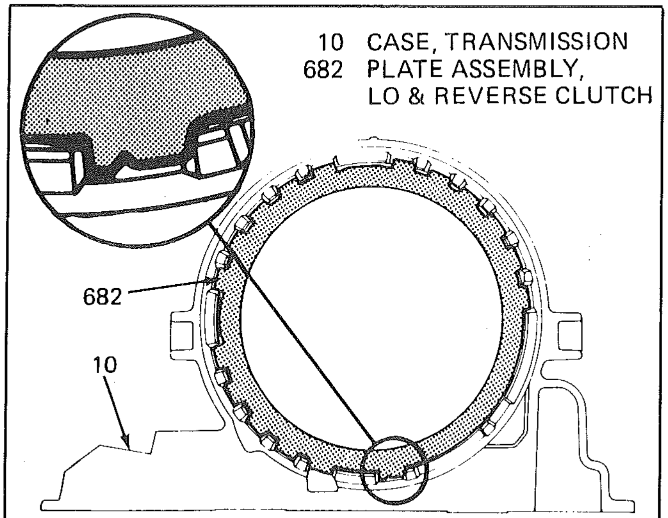


Figure 110 Lo and Reverse Clutch Plates Properly Installed

- broken hub
- bent tangs

- Lo and reverse inner race to reaction sun gear shell thrust washer (674) for wear or damage
- Reaction shaft to reaction sun gear shell thrust washer (669) for wear or damage (bronze thrust washer).

Install or Connect (Figure 114 and 115)

1. Reaction sun gear retainer ring (671) onto the reaction sun gear, if previously removed.
2. Reaction sun gear (673) into the reaction carrier
   - index the teeth with the pinion gears.
3. Thrust washer (674) onto the lo and reverse support inner race
   - index the four locating ears into the inner race.
4. Reaction gear shell (670) onto the reaction sun gear
5. (Bronze) thrust washer (669) onto the reaction sun shell
   - index tangs into the shell.

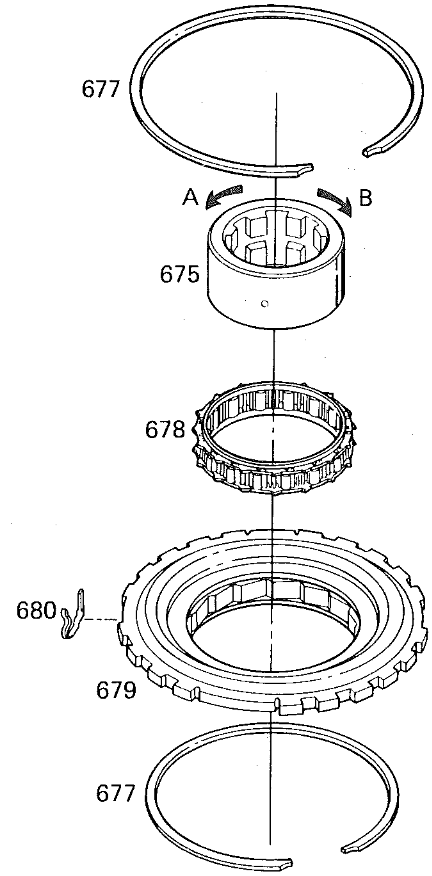


Figure 111 Lo and Reverse Clutch Support Assembly

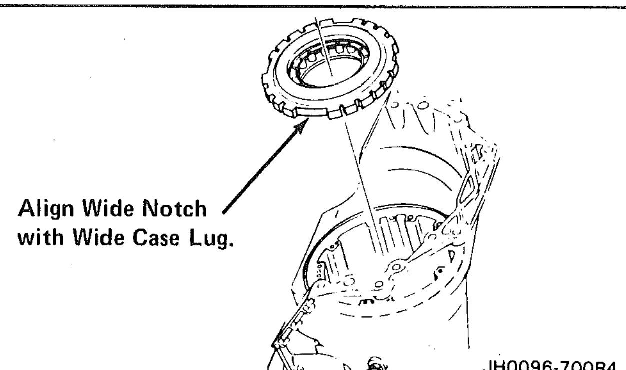
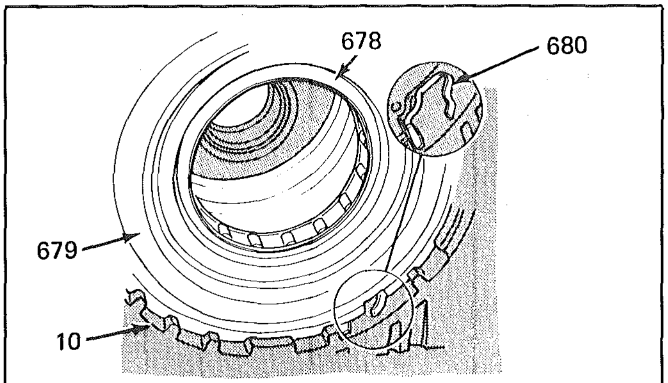


Figure 112 Lo and Reverse Support and Roller Asm. Installation

Input Internal Gear and Output Shaft

Remove or Disconnect (Figure 116)

1. Retainer ring (668) from input internal gear (664)
2. Reaction carrier shaft (666) from the input internal gear



10 CASE, TRANSMISSION
678 CLUTCH ASSEMBLY, LO & REVERSE ROLLER
679 SUPPORT ASSEMBLY, LO & REVERSE CLUTCH
680 SPRING, TRANSMISSION LO & REVERSE CLUTCH SUPPORT RETAINER

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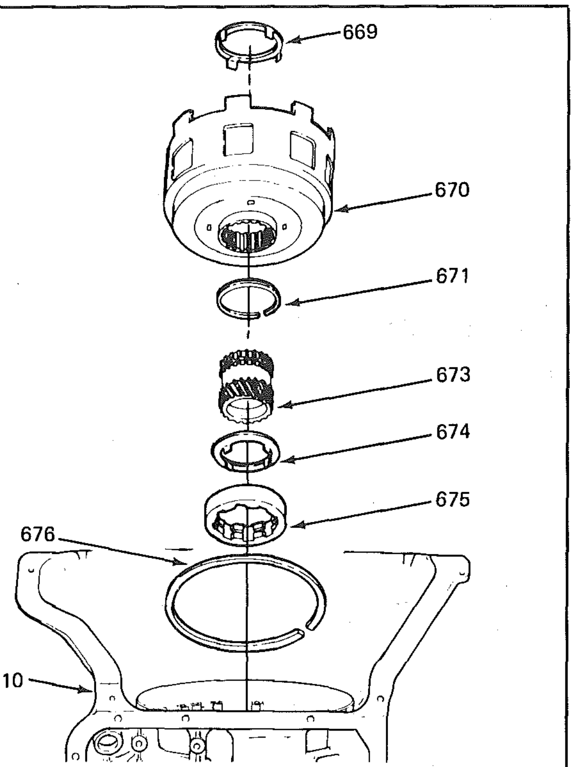
Figure 113 Support Spring - Installed



10 CASE, TRANSMISSION
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
671 RING, REACTION SUN GEAR RETAINER
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH
676 RING, LO & REVERSE SUPPORT TO CASE RETAINER

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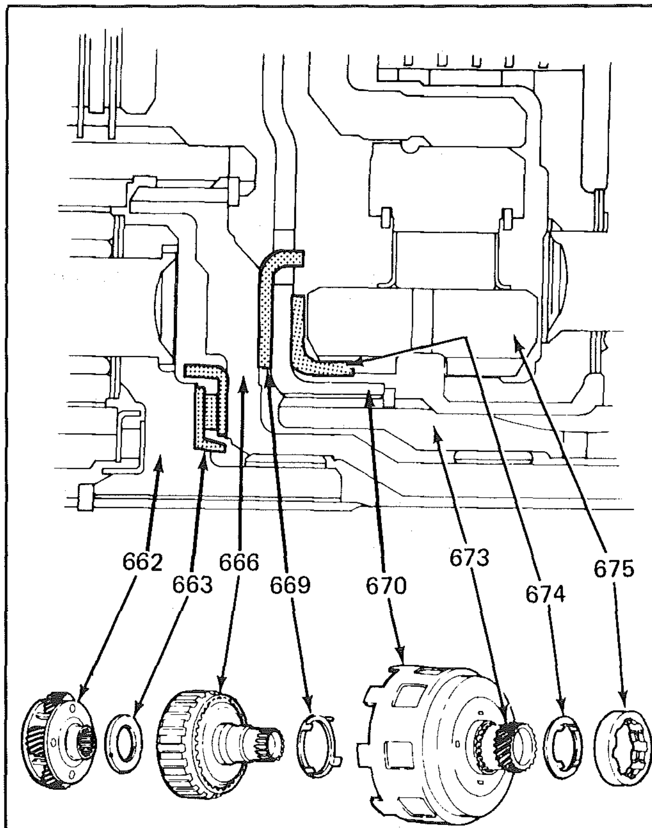
Figure 114 Sun Gear and Shell Installation



662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
666 SHAFT, REACTION CARRIER
669 WASHER, THRUST (REACTION SHAFT/SHELL)
670 SHELL, REACTION SUN
673 GEAR, REACTION SUN
674 WASHER, THRUST (RACE/REACTION SHELL)
675 RACE, LO & REVERSE ROLLER CLUTCH

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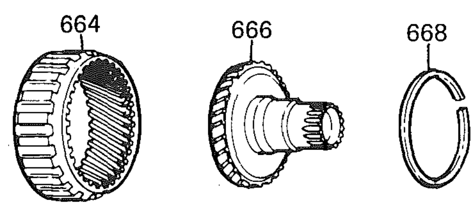
Figure 115 Input Carrier and Reaction Shell Bearing and Thrust Washer Locations



664 GEAR, INPUT INTERNAL
666 SHAFT, REACTION CARRIER
668 RING, REACTION SHAFT/INTERNAL GEAR RETAINER

JH0100-700R4

Figure 116 Input Internal Gear and Reaction Shaft

Inspect (Figures 115, 116, and 118)

- Reaction Carrier Shaft (666) for
  - scored, damaged, or worn bushings (see Bushing Replacement)
  - cracked shaft
  - damaged spline or gear teeth
  - under cut around the shaft from interference with the sun gear
- Input internal gear (664) for

- cracks
- damaged spline or gear teeth

- Input carrier to reaction shaft thrust bearing (663) for wear or damage
- Ouput shaft (687)
  - plugged or restrictred lube passages
  - damaged splines or ring groove
  - damaged governor drive gear teeth
  - burrs or damage to the front of the shaft at seal area. (Polish with crocus cloth if necessary)
  - burrs or damage to bearing journals
  - damaged teeth on speed sensor rotor

Internal Transmission Speed Sensor Rotor

REMOVE ONLY IF DAMAGED

TOOLS REQUIRED:

J-21427-01 speedometer gear puller adapter
J-8433 speedometer gear puller
J-36352 speedometer gear installater & "C" washer
Mechanical press

1. Install J-21427 with J-8433 and remove rotor.
2. Place new rotor over output shaft.
3. Place J-36352-1 in groove on output shaft.
   - **DO NOT REUSE ROTOR**
4. Place J-36352-2 on shaft and press to make contact with J-36352-1.

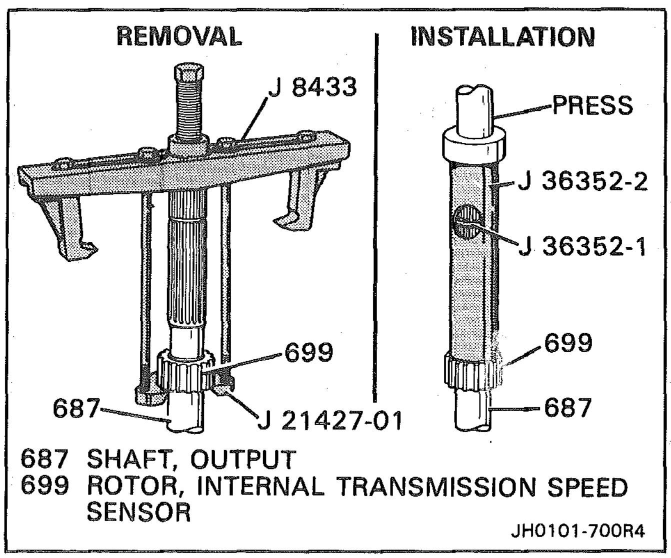


Fig. 117 Internal Transmission Speed Sensor Rotor

Install or Connect (Figures 116 and 118)

1. Reaction shaft (666) into the input internal gear (664)
2. Retainer ring (668) into the input internal gear
3. Input internal gear and shaft assembly into the sun gear shell
   - index the shaft spline into the reaction carrier.
4. Thrust Bearing (663) onto the reaction carrier shaft.
   - outer race goes toward the reaction carrier shaft.
5. Output shaft (687) into the transmission
   - index the splines with the mating parts.
6. J-29837 onto the case
   - position upwards as far as possible to support the output shaft.

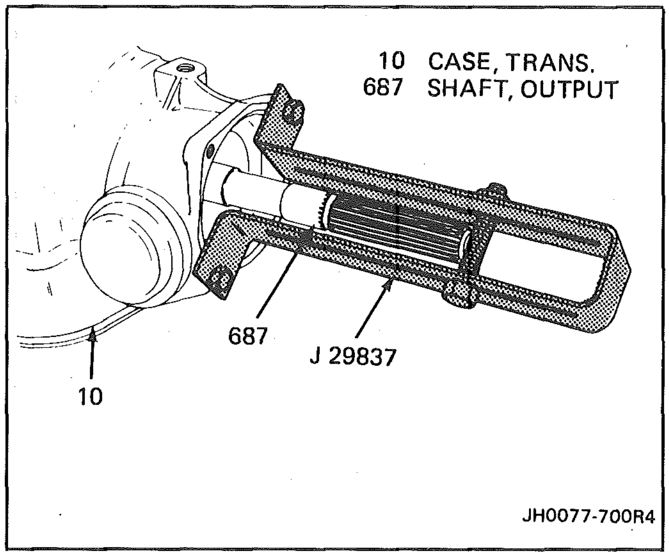


Figure 118 Output Shaft - Installation

Input Carrier and Sun Gear

Inspect (Figures 119 and 120)

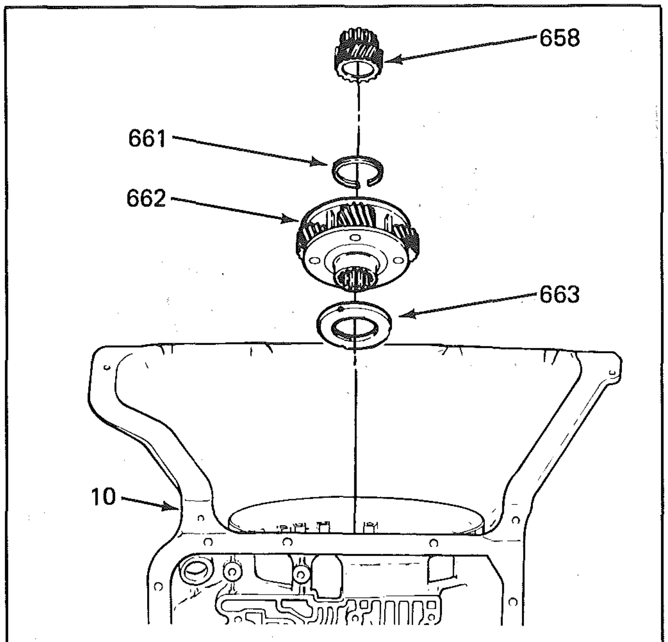
- Input carrier assembly (662) for
  - pinion gear damage
  - excessive pinion washer wear (end play .20-.61 mm/.008-.024 in.)
  - proper pin stake
  - keystoned pinion gears (pinion gears must rotate freely)
  - damaged or worn thrust bearing
- Input sun gear (658) for
  - bushing damage or wear (see Bushing Replacement Procedure).
  - cracks
  - damaged spline or gear teeth

Install or Connect (Figure 119)

TOOLS REQUIRED:

J-34627 Snap Ring Pliers

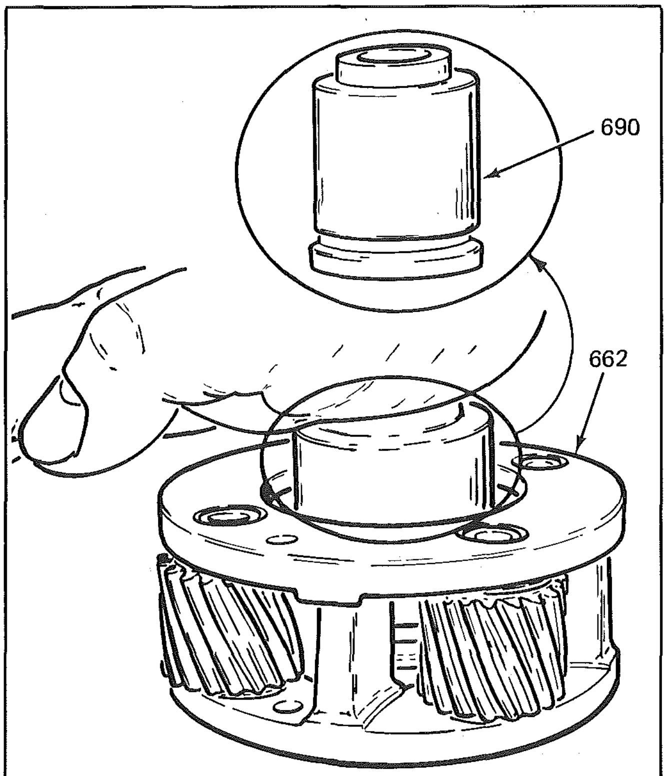
1. Input carrier assembly (662) onto the output shaft
2. Retainer ring (661) into the output shaft ring groove
   - Do not reuse the old retainer ring if it has been overexpanded.
   - Use care not to overexpand the ring during installation.
3. Remove J-29837.
4. Input sun gear (658) into the input carrier
   - index the sun gear teeth into the pinion gear teeth.



10 CASE, TRANSMISSION
658 GEAR, INPUT SUN
661 RET., OUTPUT SHAFT TO INPUT CARRIER
662 CARRIER ASSEMBLY, INPUT – COMPLETE
663 BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)

JH0102-700R4

Figure 119 Input Carrier and Sun Gear - Installation



662 CARRIER ASSEMBLY, INPUT – COMPLETE
690 SLEEVE, OUTPUT SHAFT

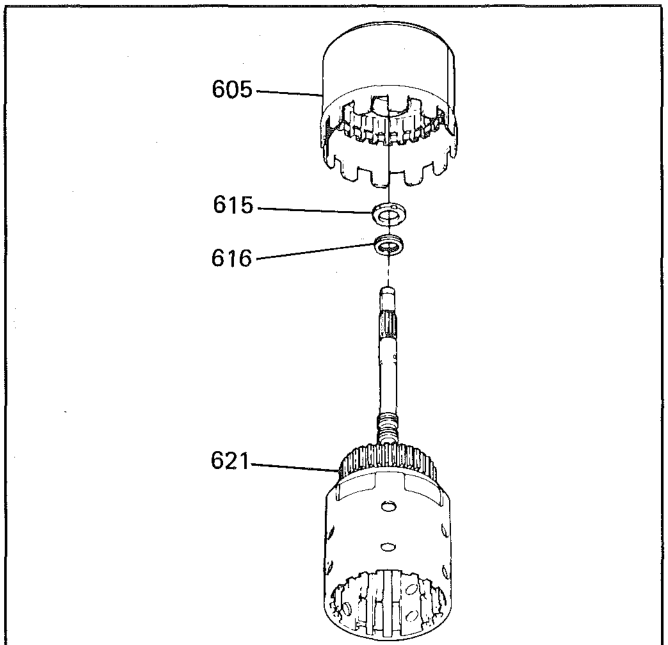
JH0090-700R4

Figure 120 Checking Captured Thrust Bearing

Input Clutch Assembly

Remove or Disconnect (Figure 121)

- Reverse input clutch assembly (605) from the input clutch assembly (621)
- Oil pump to selective washer thrust bearing (615)
- Selective washer (616)



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

JH0103-700R4

Figure 121 Reverse Input and Input Clutches

Disassemble (Figures 123 and 124)

TOOLS REQUIRED:
- J-23456 Clutch Spring Compressor Press
- J-25018 Clutch Spring Compressor

1. Place the input clutch assembly (621) on the bench with the turbine shaft through the bench hole.
2. The 3-4 clutch plate retainer ring (656) and the backing plate (655)
3. The 3-4 clutch plates (654)
4. The 3-4 clutch apply plate (653)
5. The 3-4 clutch ring retainer plate (652)
6. Forward clutch backing plate retainer ring (651) and backing plate (650)
7. Forward clutch sprag assembly (638 - 644)

Disassemble

1. Input sun gear bearing assembly (637)
2. Input housing to output shaft lip seal (636).
3. Forward clutch plates (649)
4. Forward wave plate (648)
5. Forward clutch apply plate (646)

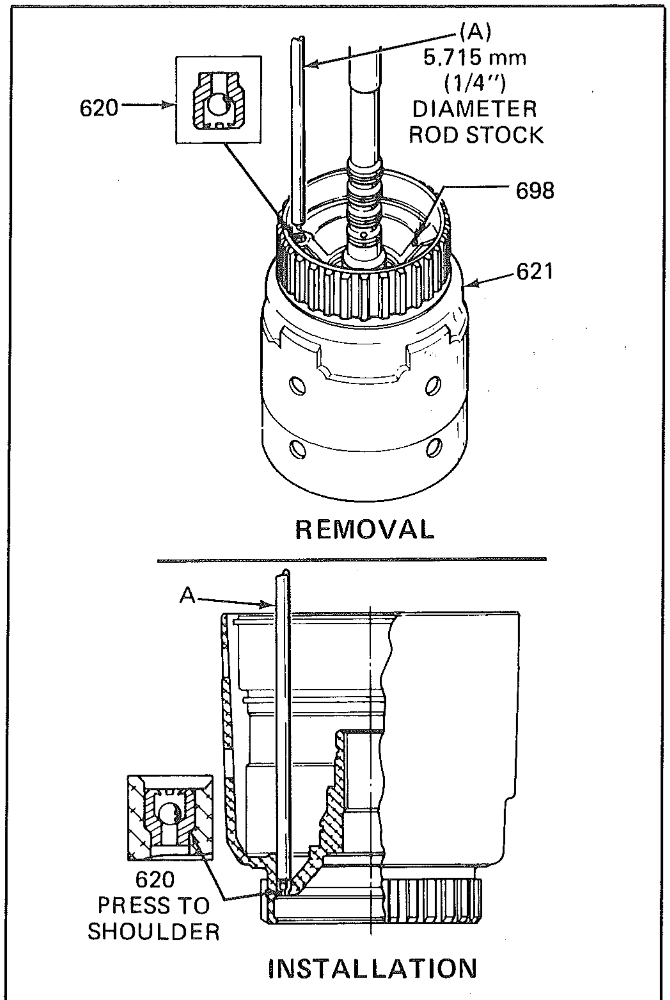


Figure 122 Retainer and Check Ball Removal/Installation

6. Overrun clutch plates (645)

Disassemble

1. Install J-23456 and J-25018
   - Compress overrun clutch spring assembly (634).
2. Overrun clutch retainer ring (635).
3. Overrun clutch spring assembly (634).
4. Overrun clutch piston (632)
   - inner and outer lip seals (631)
5. Forward clutch piston assembly (630)
   - inner and outer lip seals (629)
6. Forward clutch housing (628)
7. The 3-4 clutch spring assembly (626)
8. The 3-4 clutch apply ring (625) and piston (623)
   - inner and outer lip seals (624) from piston
9. Forward clutch to input housing "O" ring seal (622)
10. Four turbine shaft oil seal rings (619)

Inspect (Figure 126 and 127)

1. Input housing for porosity or damage
2. Input housing and shaft assembly (621)
   - all splines for wear or damage
   - air check feed passages.
   - three turbine shaft sealing balls
     - the balls must **not** be loose or leaking.
     - the open hole is the lube oil passage which feeds the output shaft.
   - Presence of orificed cup plug (698)
   - Cracks at lube holes.
   - Four turbine shaft oil seal rings (619) and their ring grooves for damage, burrs, or cuts
     - these seals must fit freely into the ring grooves.
   - Check valve retainer and ball assembly (617) for damage
     - the ball must move freely in the retainer.
     - the retainer must be tight in the turbine shaft.

Check Valve Retainer and Ball Assembly - Replacement Procedures

Remove or Disconnect (Figure 125)

TOOLS REQUIRED:
#4 Screw extractor

1. Straighten the tangs of the retainer and remove the ball.
2. Check valve retainer
   - use #4 Screw Extractor

Install or Connect (Figure 125)

TOOLS REQUIRED:
9.5 mm (3/8") diameter metal rod

- New check valve retainer and ball assembly (617)
  - use the 9.5 mm (3/8") metal rod.
  - seat the retainer 3.0 mm (1/8 in.) below top surface of the turbine shaft.
  - be certain the ball is loose.

Inspect (Figure 126 and 127)

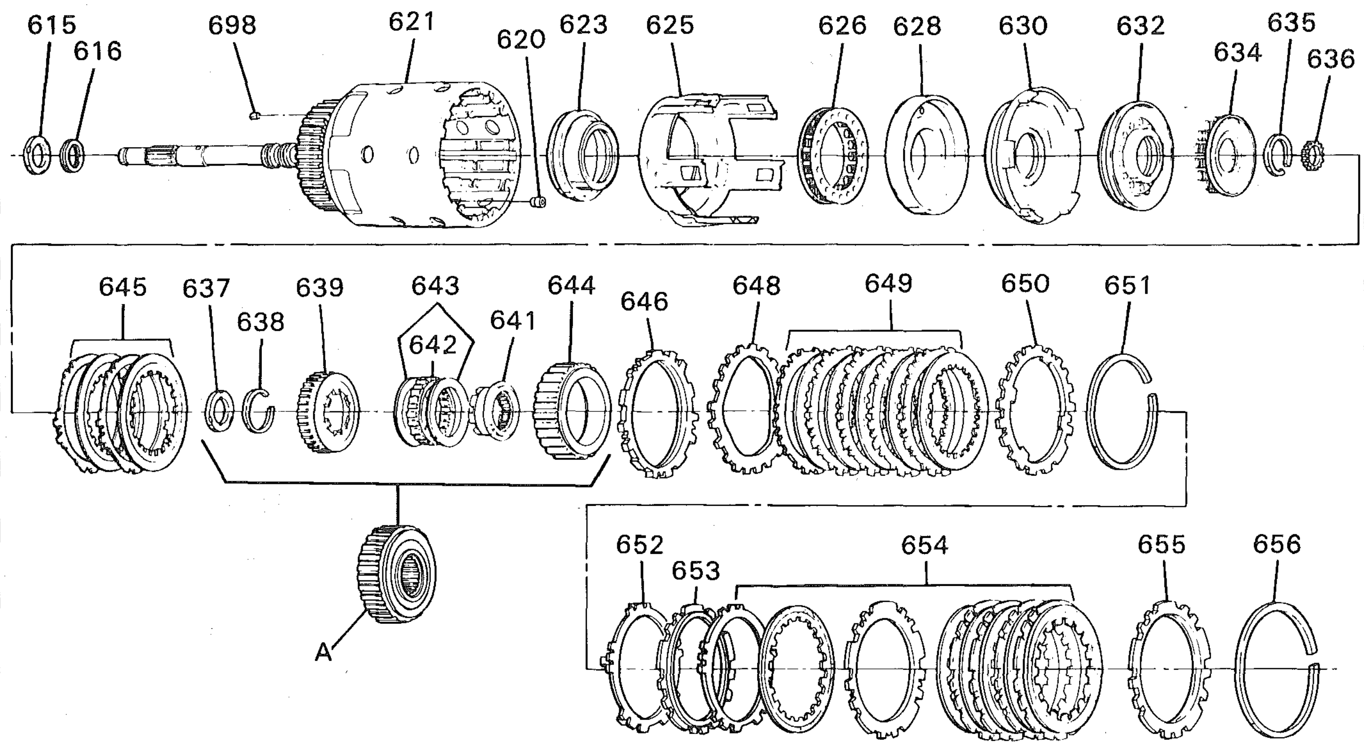
- Turbine shaft "O" ring seal (618) for nicks, cuts, or damage
- Input housing check valve ball (620).
  - the ball must move freely.
  - leak check the ball with solvent.

Important (Figure 126)

- If the 3-4 clutch plates are burned or worn and a cause is not found during diagnosis or disassembly, replacement of the retainer and check ball assembly may be required.

Remove or Disconnect (Figure 122)

TOOLS REQUIRED:
5.715 mm (1/4") diameter rod or drift hammer



ILL. NO. **DESCRIPTION**

615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD & 4TH CLUTCH
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
630 PISTON, FORWARD CLUTCH
632 PISTON, OVERRUN CLUTCH
634 SPRING ASSEMBLY, OVERRUN CLUTCH
635 SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
645 PLATE ASSEMBLY, OVERRUN CLUTCH
A FORWARD CLUTCH SPRAG ASSEMBLY
637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RET.
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
646 PLATE, FORWARD CLUTCH APPLY
648 PLATE, FORWARD CLUTCH (WAVED)
649 PLATE ASSEMBLY, FORWARD CLUTCH
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
652 PLATE, 3RD & 4TH CLUTCH RING RETAINER
653 PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656 RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER
657 BUSHING, INPUT SUN GEAR (FRONT)
698 PLUG, ORIFICED CUP

JH0105-700R4

Figure 123 Input Clutch Assembly

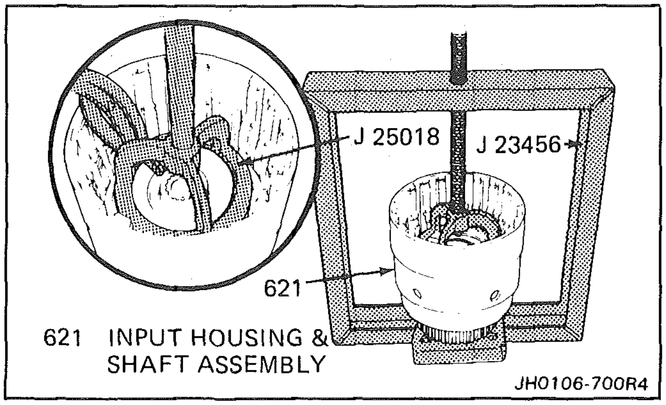
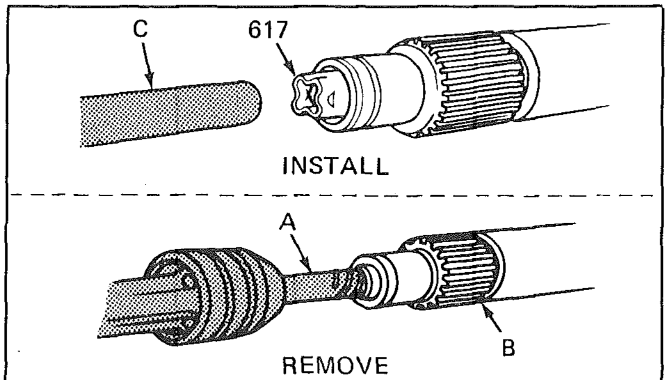


Figure 124 Overrun Clutch Retainer Ring - Removal



A #4 EASY OUT
B TURBINE SHAFT
C 9.5MM (3/8 IN.) METAL ROD
617 CHECK VALVE RETAINER & BALL ASSEMBLY
JH0107-700R4

Figure 125 Retainer and Ball Assembly - Replacement

1. Tap out retainer and ball assembly.

Install or Connect (Figures 122 and 126)

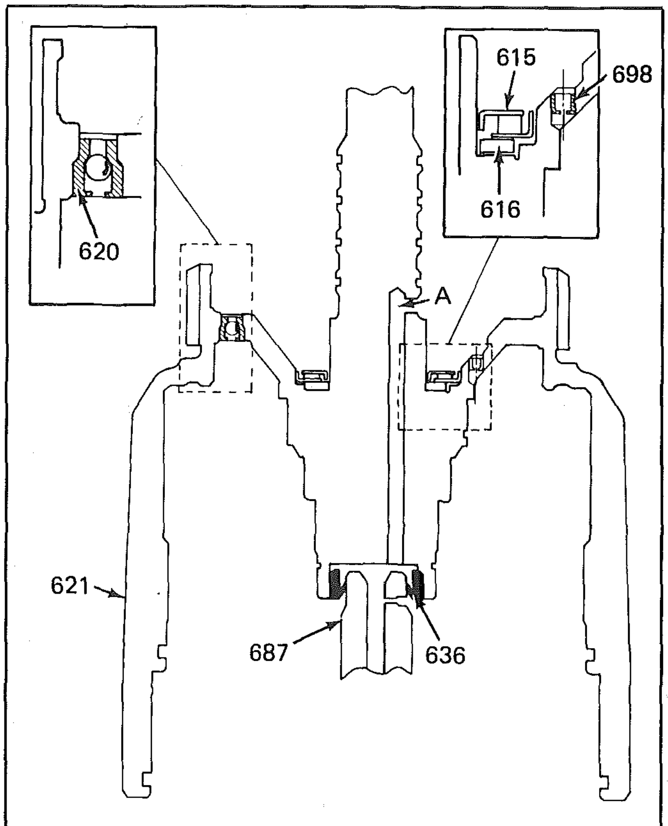
1. Using same tools, tap in retainer and ball assembly until shoulder is seated in housing.

Inspect (Figure 123)

- The 3-4 clutch piston (623) for damage or porosity
- The 3-4 clutch apply ring (625) for
  - bent tangs
- The 3-4 clutch spring assemby for damage or distortion

Assemble (Figure 128)

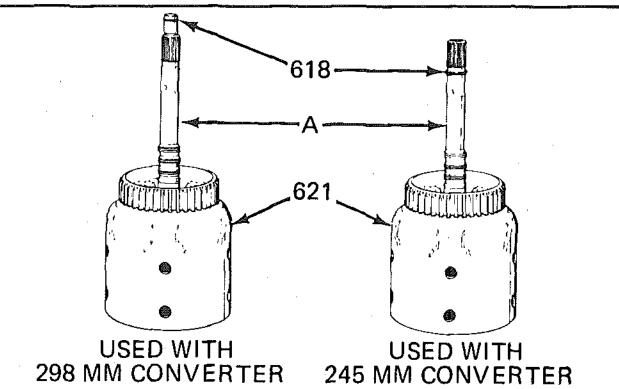
1. Position the input housing and shaft assembly on the bench with the turbine shaft through a bench hole.
2. Inner and outer 3-4 clutch lip seals (624) on the 3-4 clutch piston
   - seal lips must face away from the piston hub.
   - lubricate the seals with transmission fluid.
3. The 3-4 clutch piston (623) into the input housing as shown



A LUBE PASSAGE

615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
687 SHAFT, OUTPUT
698 PLUG, ORIFICED CUP
JH0108-700R4

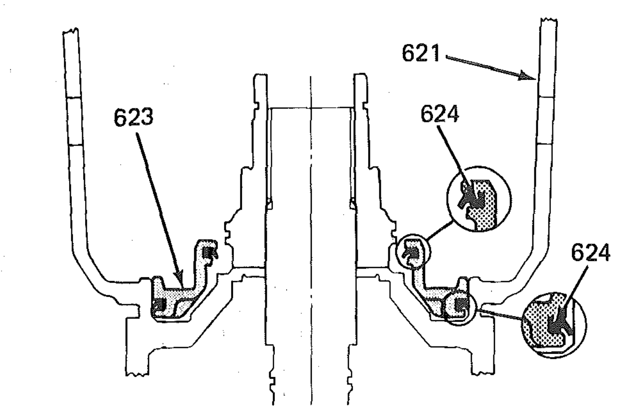
Figure 126 Input Housing Check Valve Ball



A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT
JH0109-700R4

Figure 127 Views of the Input Housing

- use care not to damage the seals.



621 HOUSING & SHAFT ASSEMBLY, INPUT
623 PISTON, 3RD & 4TH CLUTCH
624 SEALS, 3RD & 4TH CLUTCH (INNER & OUTER)

JH0111-700R4

Figure 128 Input Housing and 3-4 Piston

Inspect (Figures 123, 129, 131)

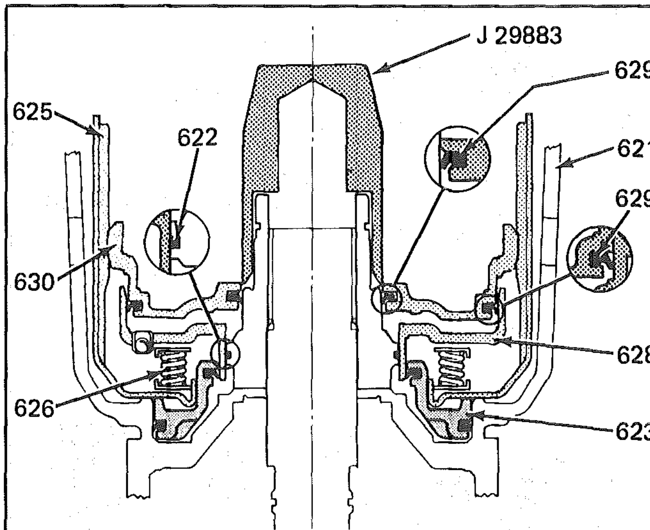
- Forward clutch housing (628) for
  - proper check ball operation
  - damage or distortion
  - burrs in seal areas
  - cracks
- Forward clutch piston (630) and overrun clutch piston (632) for
  - porosity or damage
  - ring groove damage
  - apply leg damage
- Overrun spring assembly (634) for damage or distortion
- Input housing to output shaft lip seal (636) for damage or wear

Assemble (Figures 129 and 130)

TOOLS REQUIRED:

J-23456 Clutch Spring Compressor Press
J-25018 Clutch Spring Compressor
J-29882 Overrun Clutch Inner Seal Protector
J-29883 Forward Clutch Inner Seal Protector

1. Forward clutch housing to input clutch housing "O" ring seal (622) as shown
   - lubricate with transmission fluid.
2. Inner and outer seals (629) on forward clutch piston
   - seal lips must face away from the piston tangs as shown.
   - lubricate with transmission fluid.
3. Forward clutch piston (630) into the forward clutch housing
   - use care not to damage the outer lip seal.
4. The 3-4 clutch spring assembly (626) onto the 3-4 clutch apply ring
5. Forward clutch assembly onto the 3-4 clutch spring assembly
   - the forward clutch piston apply legs must be indexed with the 3-4 clutch apply ring legs.
6. J-29883 on the input housing as shown
7. Apply ring and forward clutch assembly into the input housing as shown
   - hold the assembly by the apply ring legs during installation.
   - do not let the forward clutch piston separate from the housing.
   - firmly seat the assembly.
8. J-29882 on the input housing as shown
9. Overrun clutch piston (632)
   - hub facing upward as shown.
   - if all parts are properly seated to this point, the overrun piston hub will be approximately 3/16 in. below the snap ring groove in the input housing hub.



621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, O-RING (INPUT/FWD. HSG.)
623 PISTON, 3RD & 4TH CLUTCH
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEALS, FWD. CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH

JH0112-700R4

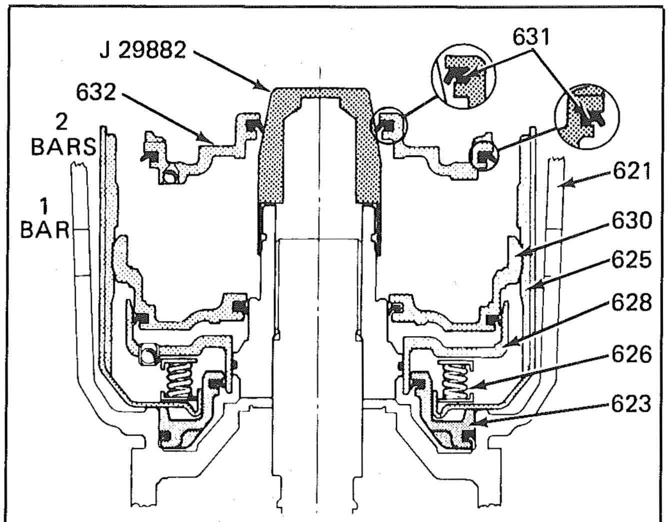
Figure 129 Forward Clutch and 3-4 Apply Ring - Installed

Assemble (Figures 131 and 132)

1. Overrun clutch spring assembly (634) onto the overrun clutch piston.
   - locate the springs on the piston tabs
2. J-23456 and J-25018 onto the overrun spring assembly.
   - compress springs (Do not over-compress).
3. Retainer snap ring (635) into the snap ring groove
4. Input housing to output shaft lip seal (636)

Inspect

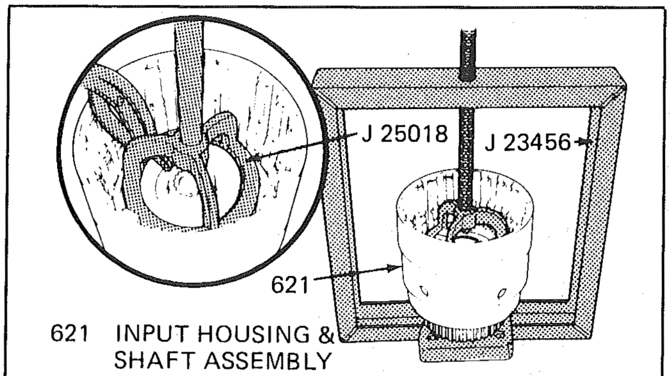
- Overrun clutch plates (645)



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
623	PISTON, 3RD & 4TH CLUTCH
625	RING, 3RD & 4TH CLUTCH APPLY
626	SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628	HOUSING, FORWARD CLUTCH
630	PISTON, FORWARD CLUTCH
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
632	PISTON, OVERRUN CLUTCH

JH0113-700R4

Figure 130 Overrun Piston - Installed



621 INPUT HOUSING & SHAFT ASSEMBLY

JH0106-700R4

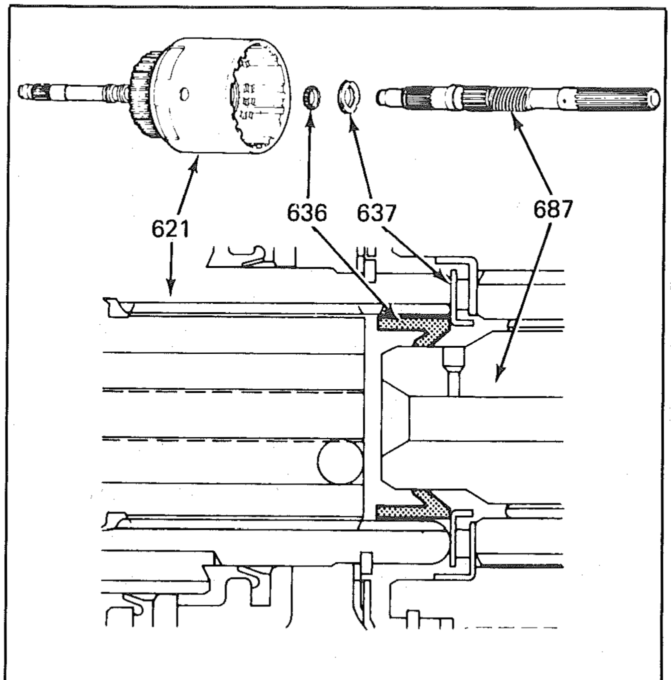
Figure 131 Overrun Clutch Retaining Ring - Installed

- Composition plates for damaged tangs, delamination, or excessive wear
- Steel plates for damaged tangs, wear, or heat damage

- Input sun gear bearing assembly (637) for wear, flatness or damage

Assemble (Figures 133 and 134)

1. Overrun clutch plates (645) into the input housing.
   - overrun clutch plates are the smallest of the three sets of plates in the input housing.
   - index the plate as shown.
2. Thrust bearing assembly (637) onto the input clutch hub
   - the inside race must face the input housing hub.



621	HOUSING & SHAFT ASSEMBLY, INPUT
636	SEAL, INPUT HOUSING TO OUTPUT SHAFT
637	BEARING ASSEMBLY, INPUT SUN GEAR
687	SHAFT, OUTPUT

JH0114-700R4

Figure 132 Input Hsg. to Output Shaft Lip Seal

   - retain with petrolatum.
3. Align the tangs on the two composition overrun clutch plates.

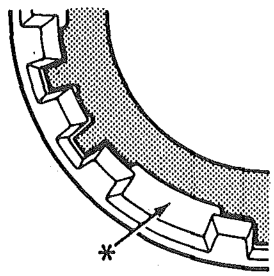
Forward Clutch Sprag Assembly

Disassemble (Figure 135)

1. Forward sprag outer race (644)
2. Overrun clutch hub retaining snap ring (638) and clutch hub (639)
3. Forward clutch retainer and race assembly (641)

Inspect

- Forward clutch sprag assembly (642) for
  - wear or damage
  - weak or broken springs
  - damaged or missing retainer caps (brass)
- Overrun clutch hub (639) for
  - spline damage
  - plugged lubrication holes
  - damaged tangs
  - cracks
- Forward clutch retainer and race assembly (641) for
  - spline damage
  - ring groove damage
  - surface finish damage
  - loose retainer
- Forward sprag outer race (644) for
  - spline damage

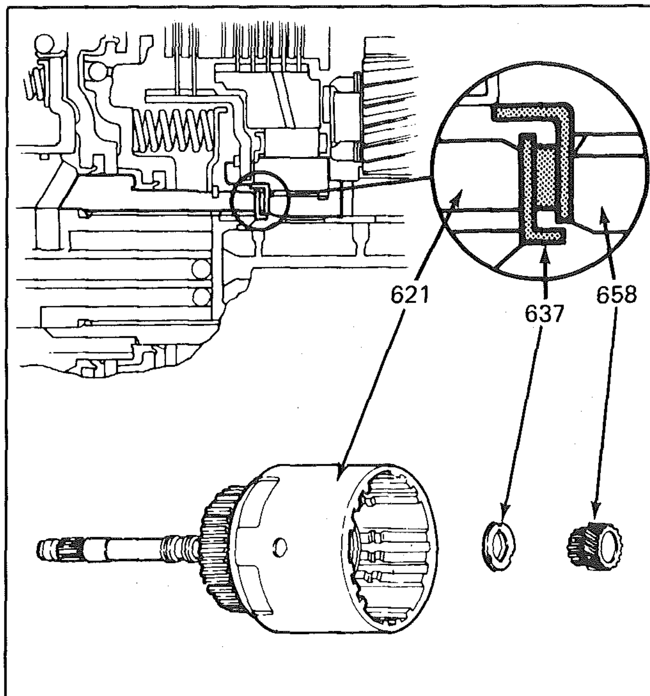


* ALIGN WIDE NOTCHES TO CASE LUGS

OVERRUN CLUTCH				
MODEL	FLAT STEEL		COMP. FACED	
	NO.	THICK-NESS	NO.	THICK-NESS
ALL MODELS	2	2.34 mm (.091")	2	2.03 mm (.079")

JH0115-700R4

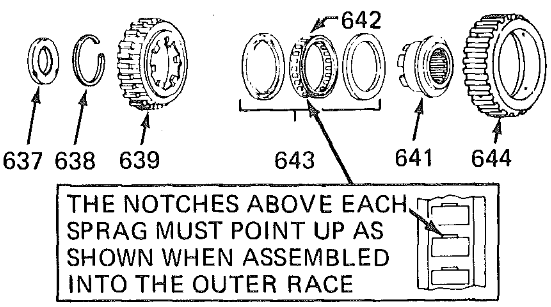
Figure 133 Overrun Clutch Plate Chart



621 HOUSING & SHAFT ASSEMBLY, INPUT
637 BEARING ASSEMBLY, INPUT SUN GEAR
658 GEAR, INPUT SUN

JH0116-700R4

Figure 134 Input Sun Gear Thrust Bearing



637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CLUTCH HUB RET.
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CL – OUTER

JH0117-700R4

Figure 135 Forward Clutch Sprag Assembly

- surface finish damage
- plugged lubrication holes

Assemble (Figures 136, 137, 138)

1. Forward clutch sprag assembly (642) into the outer race
   - to correctly install, the notches in the sprag cage must face upward as shown.
2. One sprag retainer ring (643) onto the race and retainer assembly
   - the flange on the retainer ring must face away from the retainer.
3. Race and retainer assembly into the sprag assembly
   - to assemble, hold the outer race in your left hand with your fingers supporting the sprag at the recessed side of the outer race.
   - insert the race and retainer assembly by pushing in and turning to the left.
4. The remaining retainer ring onto the sprag assembly
5. Overrun clutch hub (639) onto the wear plate
6. Overrun clutch hub retaining snap ring (638) into the snap ring groove of the race and retainer assembly
7. Test the assembly for proper operation as shown.
   - If the assembly operates backwards, you have installed the sprag backwards. Reassemble correctly.

Assemble

- Forward clutch sprag assembly into the input clutch housing
  - index the overrun clutch hub into the overrun clutch plates.

Inspect (Figure 139 and 140)

- Forward (649) and 3-4 clutch plates (654)
  - Composition plates for damaged tangs, delamination, or wear

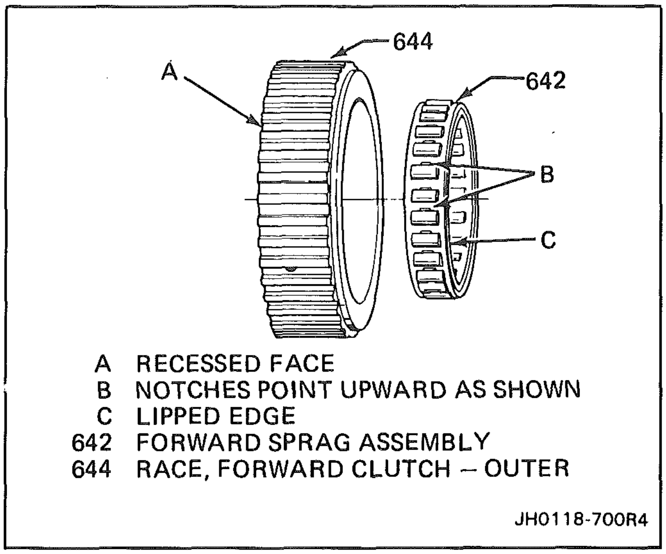


Figure 136 Sprag Assembly Procedure

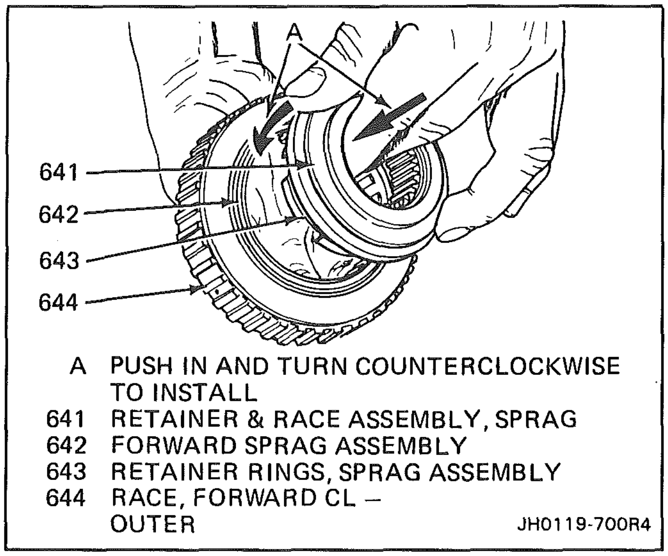


Figure 137 Sprag Race and Retainer Assembly Procedure

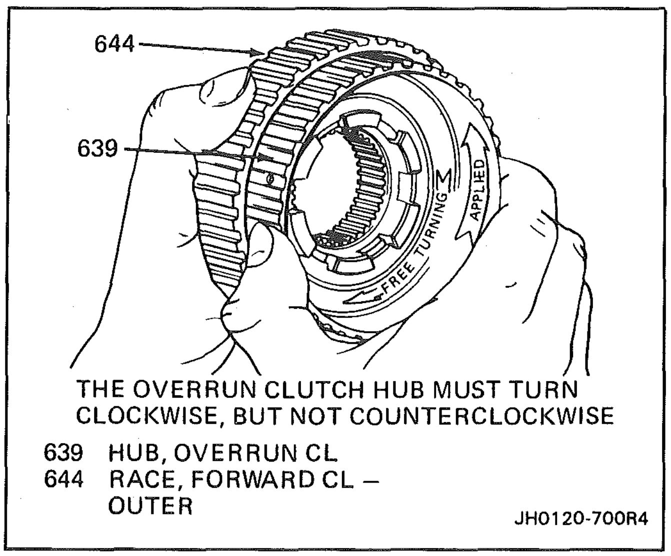


Figure 138 Check Sprag for Proper Operation

- Steel plates for damaged tangs, wear, or heat damage

- Forward (650) and 3-4 clutch backing plates (655) for
  - flatness
  - surface finish damage
  - burrs or nicks
- Forward clutch apply plate (646) and spacer plate (647) for
  - flatness
  - surface finish damage
  - burrs or nicks
- The 3-4 clutch apply plate (653) for
  - flatness
  - surface finish damage
- The 3-4 clutch ring retainer plate (652) for
  - bent tangs
  - flatness

Assemble (Figures 139, 140, 141 and 142)

1. Forward clutch apply plate (646) into the input clutch housing
   - index as shown.
2. Waved steel forward clutch plate (648) into the input clutch housing
   - index as shown.
3. The remaining forward clutch plates (649) into the input clutch housing
   - start with steel plate and alternate with a composition
4. Forward clutch selective backing plate (650)
5. Forward clutch retaining ring (651)

Forward Clutch Piston Travel Check

Measure (Figure 142)

Check the end clearance between the backing plate (650) and the retaining ring (651) with two feeler gages.

- Select the proper backing plate from the chart to obtain the correct clearance

Assemble (Figure 143 and 147)

1. The 3-4 ring retainer plate (652)
   - index each leg into the apply ring legs.
2. The 3-4 clutch apply plate (653)
3. The 3-4 clutch plates (654)
   - start with composition and alternate with steel
4. The 3-4 boost springs (600) (some models only)
5. The 3-4 clutch backing plate (655) and retainer ring (656)
   - chamfered side up.

3-4 Clutch Piston Travel Check

Measure (Figure 144)

- Check the end clearance between the backing plate (655) and the first composition plate with a feeler gage.

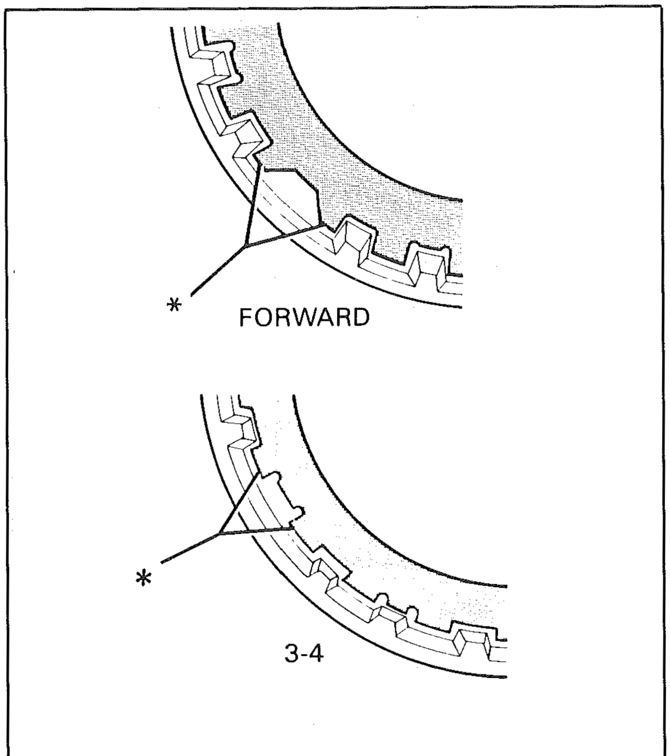


Figure 139 Forward and 3-4 Clutch Plates - Installed

- Select the proper backing plate from the chart to obtain the correct clearance.

Clutch Air Check

(Figure 145)

Air check the 3-4, forward, and overrun clutches by applying air pressure at the feed holes in the turbine shaft. (When the overrun clutch is checked, the air will blow by the forward clutch piston lip seals and exit out the forward clutch feed hole in the turbine shaft.)

Assemble (Figure 146)

TOOLS REQUIRED:

J-36418-1 seal installer

J-36418-2A seal sizer

1. Install four turbine shaft oil seal rings (619) using J-36418-1
   - Adjust screw to obtain proper height
2. Use J-36418-2A to size the seals after installation

Reverse Input Clutch Assembly

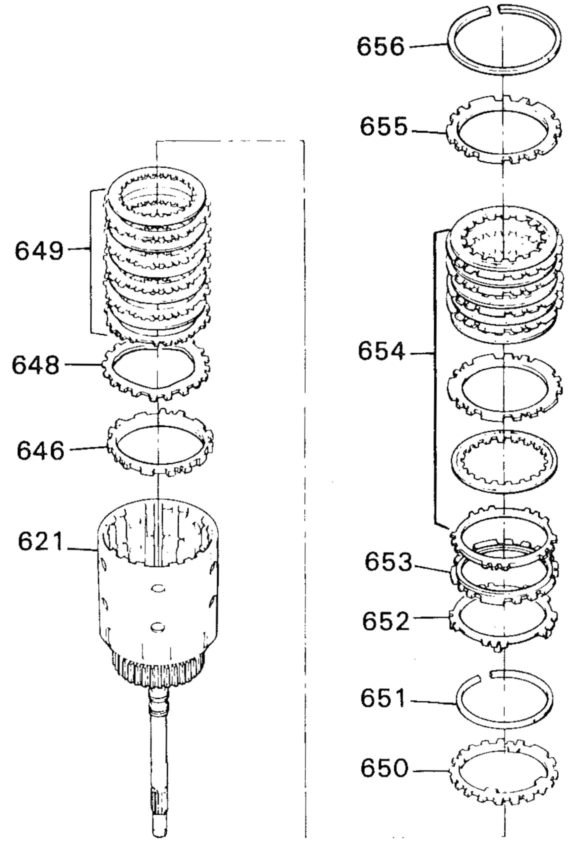
Disassemble (Figure 148 and 149)

TOOLS REQUIRED:

J-23327 Clutch Spring Compressor

J-25018 Clutch Spring Compressor Adaptor

1. Retaining ring (614) from reverse input housing
2. Backing plate (613)
3. Clutch plates (612) and belleville steel plate (611)



ILL. NO.	DESCRIPTION
621	HOUSING & SHAFT ASSEMBLY, INPUT
646	PLATE, FORWARD CLUTCH APPLY
648	PLATE, FORWARD CLUTCH (WAVED)
649	PLATE ASSEMBLY, FORWARD CLUTCH
650	PLATE, FORWARD CLUTCH BACKING (SELECTIVE)
651	RING, FORWARD CLUTCH BACKING PLATE RETAINER
652	PLATE, 3RD & 4TH CLUTCH RING RETAINER
653	PLATE, 3RD & 4TH CLUTCH APPLY (STEPPED)
654	PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655	PLATE, 3RD & 4TH CLUTCH BACKING (SELECTIVE)
656	RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

JH0122-700R4

Figure 140 Input Housing with Forward and 3-4 Clutch Plates

FORWARD CLUTCH INFORMATION CHART

PLATE TYPE	THICK-NESS	QUANTITY REQUIRED ALL MODELS
FLAT STEEL CLUTCH PLATE	2.29mm (.090")	5
COMPOSITION FACED CLUTCH PLATES	1.78mm (.070")	5
APPLY PLATE	6.44mm (.251")	1
WAVED STEEL CLUTCH PLATE	2.03mm (.079")	1
BACKING PLATE	SELEC-TIVE	1

JH0123-700R4

Figure 141 Forward Clutch Plate Chart

4. Install J-23327 and J-25018.
   - compress the spring assembly.
5. Spring assembly retainer ring (610) and spring assembly (609)
6. Reverse input clutch piston (607)
   - inner and outer lip seals (608) from piston

Inspect (Figures 148 and 150)

- Backing plate (613) for
  - damage
  - distortion or flatness
  - burrs or surface finish damage
- Clutch Plates (612)
  - Composition for tang damage, delamination, or wear
  - Steel for tang damage, wear, or heat damage
- Spring assembly (609) for distortion or damage
- Piston (607) for
  - poposity
  - damaged lip seals
- Housing and drum assembly (605) for
  - damaged or worn bushings (603 and 606)
  - surface on the hub and outer housing
  - leak at the weld

Assemble (Figures 148, 149, 151, 152 and 152A)

TOOLS REQUIRED:
J-23327 Clutch Spring Compressor
J-25018 Clutch Spring Compressor Adaptor

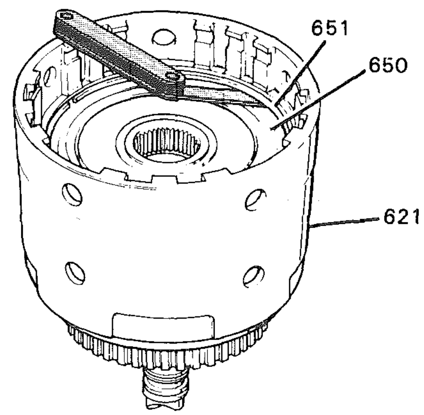
1. Inner and outer seals (608) on the piston
   - lips must face away from the hub as shown.
   - lubricate with transmission fluid.
2. Piston (607) into the housing and drum assembly
   - use an 8 mm feeler gage to position the lip seals.

FORWARD CLUTCH BACKING PLATE SELECTION

ALL MODELS

BACKING PLATE TRAVEL = .75mm - 1.60mm (.030" - .063")

PLATE THICKNESS	IDENTIFICATION
6.92mm - 7.07mm (.272" - .278")	A
6.33mm - 6.48mm (.249" - .255")	B
5.74mm - 5.89mm (.225" - .232")	C
5.15mm - 5.30mm (.203" - .208")	D
4.56mm - 4.71mm (.180" - 185")	E



621 HOUSING & SHAFT ASSEMBLY, INPUT
650 PLATE, FORWARD CLUTCH BACKING
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER

JH0124-700R4

Figure 142 Forward Clutch Backing Plate Travel

   - use care not to damage the seals.
3. Spring assembly (609)
   - large opening in the assembly goes towards the piston.
4. Install J-23327 and J-25018.
   - compress the spring assembly
   - install the retainer ring (610).
5. Belleville steel clutch plate (611)
6. Clutch plates (612). (4 steel and 4 composition plates required)
   - start with a composition and alternate with steel
7. Backing plate (613)
   - chamfered side up
8. Retaining ring (614)

Measure (Figure 151, 152, 152A and 153)

1. With the Reverse Input Clutch fully assembled, apply an evenly distributed load to the Clutch Pack in the direction shown in Figure 1. Medium pressure (approximately 20 lbs.) on the Backing Plate applied by hand on five evenly distributed

3-4 CLUTCH INFORMATION CHART			
PLATE TYPE	THICK-NESS	QUANTITY REQUIRED	
		*A-MODELS	*B-MODELS
FLAT STEEL CLUTCH PLATE	1.97mm (.077")	6	5
COMPOSITION FACED CLUTCH PLATES	2.03mm (.079")	5	6
STEPPED APPLY PLATE	3.30mm (.130")	1	1
BACKING PLATE	SELEC-TIVE	1	1
†FLAT STEEL CLUTCH PLATES	1.97mm (.070")	1	1
*A-MODELS	FAM, FMM, MAM, MFM, MRM, MXM, MCM, MTM, PRM, TAM, TBM, YXM		
*B-MODELS	ALL OTHERS		
†SAME SPLINE CONFIGURATION AS APPLY PLATE			

JH0125-700R4

Figure 143 3-4 Clutch Plate Chart

points will obtain the Backing Plate Travel for measurement.

CAUTION: (Excessive pressure will distort the Belleville plate resulting in an inaccurate measurement.)

2. Using a Feeler Gage, measure between the Snap Ring and the Backing Plate. Backing Plate Travel should be 1.02mm - 1.94mm (.040" - .076").
3. Select the proper Backing Plate to obtain the specified travel.

Reverse Input and Input Clutches

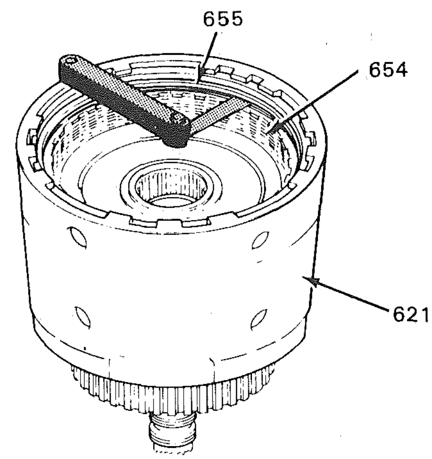
Assemble (Figures 154 and 155)

1. Selective thrust washer (616) onto the input housing
2. Bearing assembly (615)
   - inside (black race) goes toward the oil pump.
3. Reverse input clutch assembly (605) onto the input clutch assembly
   - index the reverse input clutch plates with the input clutch hub.
   - make certain all clutches are fully engaged.

Assemble (Figure 156)

- Reverse input and input clutch assembly into the transmission case
  - index the 3-4 clutch plates with the input internal gear.
  - make sure all clutch plates are fully engaged.
  - when properly assembled, the reverse input clutch housing will be located just below the case oil pump face.

3-4 BACKING PLATE SELECTION			
MODEL	BACKING PLATE TRAVEL	*BACKING PLATE	
		Use Backing Plate Which Gives Correct Travel	
		DIM.	I.D.
FAM, FMM, MAM, MFM, MRM, MXM, MCM, MTM, PRM, TAM, TBM, YXM	2.42mm - 1.61mm (.095" - .063")	6.58mm-6.38mm (.259"-.251")	5
		5.75mm-5.55mm (.226"-.218")	6
ALL OTHERS	2.40mm - 1.52mm (.094" - .060")	4.92mm-4.72mm (.194"-.186")	7
		4.09mm-3.89mm (.161"-.153")	8



621 HOUSING & SHAFT ASSEMBLY, INPUT
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING

JH0126-700R4

Figure 144 Backing Plate Selection Chart

2-4 Band Assembly

Inspect

- 2-4 band assembly (602) for damage or wear

Assemble (Figure 156, 157)

1. The 2-4 band assembly (602) into the case
   - index the band anchor pin end with the case pin hole.
2. Band anchor pin (48) into the case
   - index the pin into the 2-4 band.

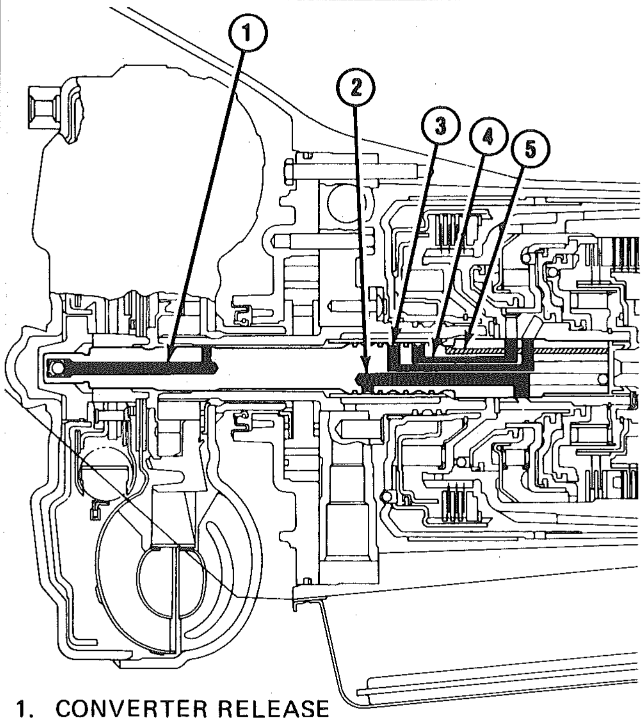


Figure 145 Turbine Shaft Oil Passages

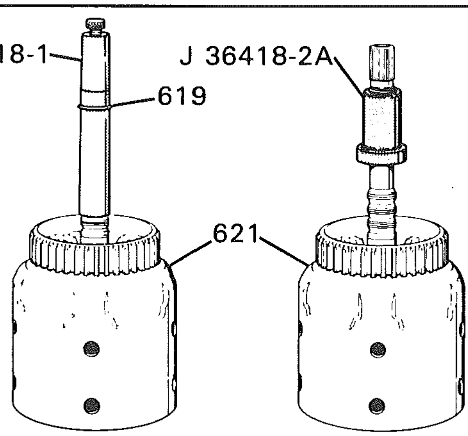


Figure 146 Turbine Shaft Oil Seal Rings

Oil Pump Assembly

Remove or Disconnect (Figure 160)

1. Thrust washer (601)
2. Pump cover to case gasket (9)
3. Pump to case oil seal (8)
4. Pump cover bolts (236)
5. Pump cover (217) from pump body (203)

Pump Body

Disassemble (Figure 160)

1. Pump slide spring (209)
   - compress with needle nose pliers.
   - pull straight out.

   CAUTION: Spring is under very high pressure. Place covering over spring to prevent possible injury.
2. From the pump pocket
   - Pump guide rings (212)
   - Pump vanes (215)
   - Pump rotor (214)
   - Pump guide (213)
   - Slide (206)
   - Slide Seal (211)
   - Seal Support (210)
   - Pivot slide pin (208) and spring (207)
   - Slide seal ring (204) and slide back up seal (205)
3. Retainer (94), oil seal assembly (2)
   - pry out with a screwdriver.

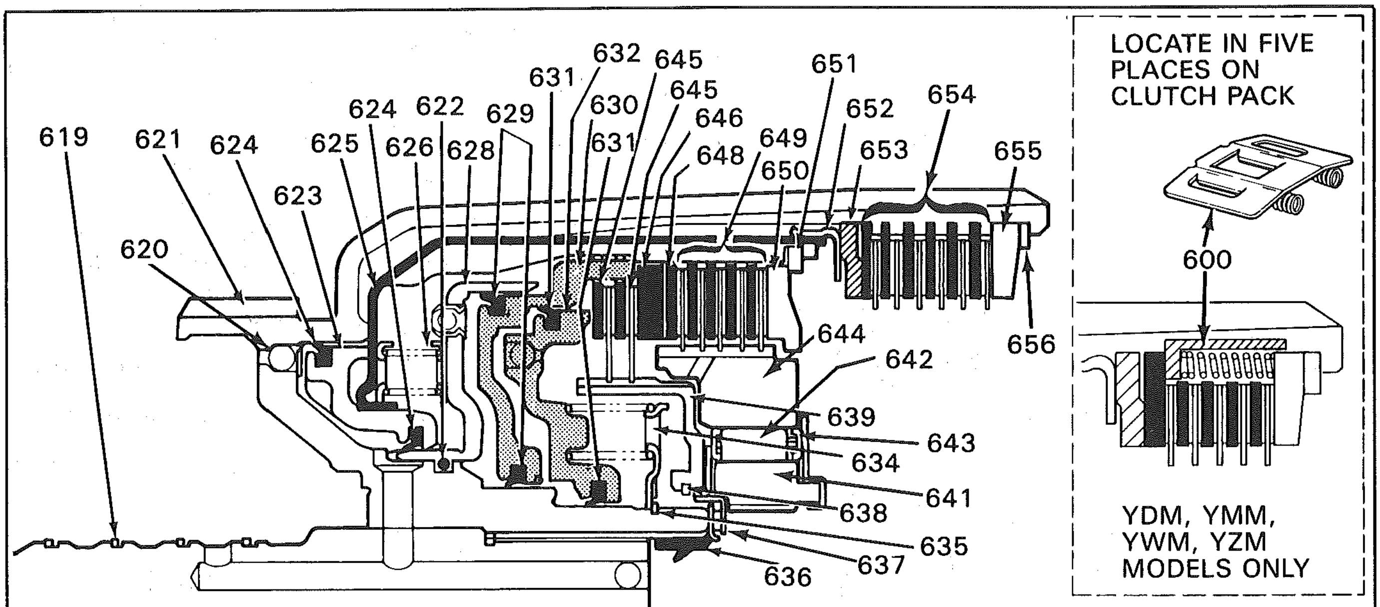
Oil Pump Cover

Disassemble (Figure 160)

1. Converter clutch apply valve train
   - compress converter clutch apply valve spring (228) with a screwdriver.
   - remove retaining ring (225).
   - slowly release the spring tension.
   - stop valve (226), converter clutch apply valve (227), and two converter clutch valve springs.
2. Pressure relief ball (231)
   - ball is under strong spring pressure.
   - cover the ball with a cloth when removed.
3. Pressure regulator assembly (218-224).
   - follow the same procedure used to remove the converter clutch valve.

Inspect (Figure 160)

- Pressure regulator valve assembly (218-224) and converter clutch apply valve assembly (225-229) for
  - chips, burrs, distortion, plugged oil passage, and free movement in bore
  - remove burrs with lapping compound
- Pressure relief assembly (230-232) for damage or distortion
- Pump cover (217) and pump body (203) for
  - worn or damaged bushings (see Bushing Replacement Procedure)
  - foreign material or debris
  - porosity
  - scored or irregular mating faces
  - cross channel leaks
  - ring groove damage
- Rotor (214) and slide (206) for cracks



600 SPRING ASM., BOOST 3-4 CLUTCH
619 RING, OIL SEAL (TURBINE SHAFT)
620 RETAINER & CHECK BALL ASSEMBLY
621 HOUSING & SHAFT ASSEMBLY, INPUT
622 SEAL, "O" RING INPUT TO FORWARD HSG.
623 PISTON, 3RD & 4TH CLUTCH
624 SEAL, 3RD & 4TH CL. (INNER & OUTER)
625 RING, 3RD & 4TH CLUTCH APPLY
626 SPRING ASSEMBLY, 3RD & 4TH CLUTCH
628 HOUSING, FORWARD CLUTCH
629 SEAL, FORWARD CLUTCH (INNER & OUTER)
630 PISTON, FORWARD CLUTCH
631 SEAL, OVERRUN CLUTCH (INNER & OUTER)
632 PISTON, OVERRUN CLUTCH
634 SPRING ASSEMBLY, OVERRUN CLUTCH
635 SNAP RING, OVERRUN CLUTCH SPRING RETAINER
636 SEAL, INPUT HOUSING TO OUTPUT SHAFT
637 BEARING ASSEMBLY, INPUT SUN GEAR
638 SNAP RING, OVERRUN CL. HUB RETAINING
639 HUB, OVERRUN CLUTCH
641 RETAINER & RACE ASSEMBLY, SPRAG
642 FORWARD SPRAG ASSEMBLY
643 RETAINER RINGS, SPRAG ASSEMBLY
644 RACE, FORWARD CLUTCH (OUTER)
645 PLATE ASSEMBLY, OVERRUN CLUTCH (STEEL & COMP.)
646 PLATE, FORWARD CLUTCH APPLY
648 PLATE, FORWARD CLUTCH (WAVED)
649 PLATE ASSEMBLY, FORWARD CLUTCH
650 PLATE, FORWARD CLUTCH BACKING (SEL.)
651 RING, FORWARD CLUTCH BACKING PLATE RETAINER
652 PLATE, 3RD & 4TH CLUTCH RING RETAINER
653 PLATE, 3RD & 4TH CL. APPLY (STEPPED)
654 PLATE ASSEMBLY, 3RD & 4TH CLUTCH
655 PLATE, 3RD & 4TH CLUTCH BACKING (SEL.)
656 RING, 3RD & 4TH CLUTCH BACKING PLATE RETAINER

JH0129-700R4

Figure 147 Input Clutch Assembly

- Oil seal assembly for damage or wear

Clean

- Wash and air dry all parts.
  - do not wipe dry with a cloth.

Measure (Figure 159)

TOOL REQUIRED:

One inch Mircormeter

- Oil pump rotor (214) thickness
- Oil pump slide (206) thickness

Important

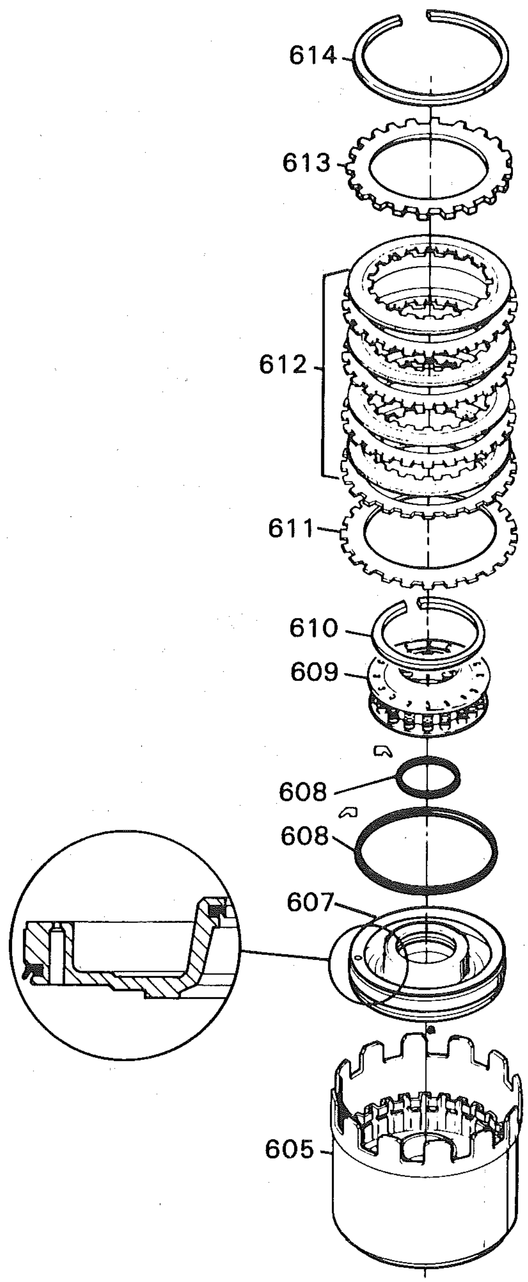
Measurement of rotor/slide must be made on undamaged surfaces. Select similar size replacements. Lightly hone both sides of replacement rotor or slide to remove any nicks or burrs.

Pump Body

Assemble (Figures 160, 161 and 162)

TOOL REQUIRED:
J-25016 Seal Installer

1. "O" ring seal (205) and oil seal ring (204) into the groove on the back side of the slide
   - retain with petrolatum.
2. Pivot pin spring (207) and pivot pin (208) into the pump body
3. Slide (206)
   - index the notch in the slide with the pivot pin.
   - the oil seal ring must face downward into the pump pocket.
4. Slide seal (211) and support (210)
5. Vane guide ring (212)
6. Rotor guide (213) onto the rotor
   - retain with petrolatum.
7. Rotor (214)
   - with guide toward the pump pocket.



ILL. NO.	DESCRIPTION
605	HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607	PISTON ASM., REVERSE INPUT CLUTCH
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
609	SPRING ASM., REVERSE INPUT CLUTCH
610	RING, REVERSE INPUT CLUTCH SPRING RETAINER
611	PLATE, REVERSE INPUT CL. (BELLEVILLE)
612	PLATE ASM., REVERSE INPUT CLUTCH
613	PLATE, REVERSE INPUT CLUTCH BACKING
614	RING, REVERSE INPUT CL. RETAINING

JH0130-700R4

Figure 148 Reverse Input Clutch Assembly

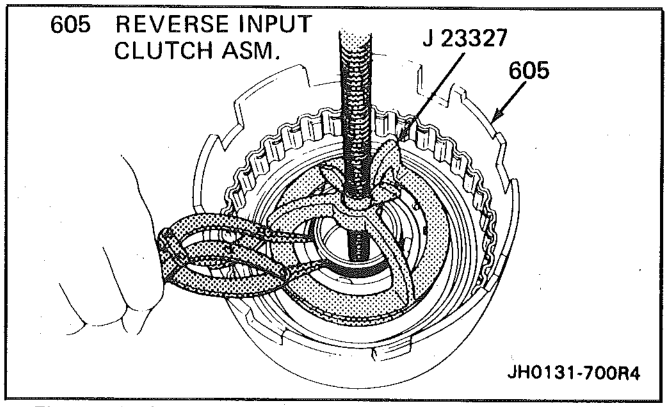
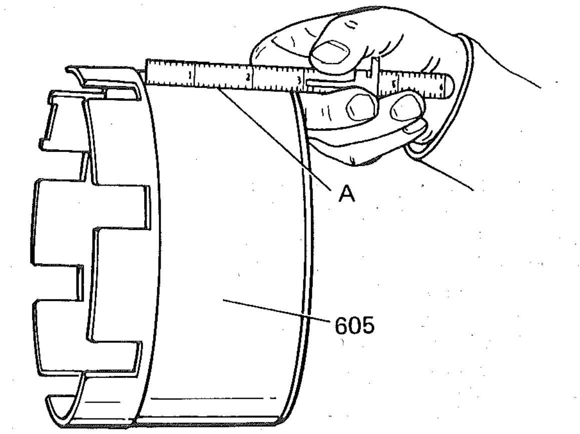


Figure 149 Reverse Input Retainer Ring - Removal



A CHECK FOR DISHING AT THIS POINT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH

JH0132-700R4

Figure 150 Check Reverse Input Housing For Dishing

8. Vanes (215)
9. Vane guide ring (212)
10. Pump slide spring (209)
11. Oil seal assembly (2), retainer (94).
    - use J-25016

Oil Pump Cover

Assemble (Figures 160 and 163)

1. Pressure relief ball (231), spring (232) and rivet (230)
2. Inner (229) and outer (228) converter clutch valve springs into the converter clutch valve bore
3. Converter clutch valve (227)
4. Stop valve (226)
5. Retaining ring (225)
6. Pressure regulator valve (218) into the pressure regulator bore
7. Pressure regulator valve spring (219)
8. T.V. boost valve (222) into the T.V. bushing
    - long land of the valve into the large hole of the bushing.
    - retain with petrolatum.
9. Reverse boost valve (220) into the reverse boost valve sleeve
    - small end of the valve first.

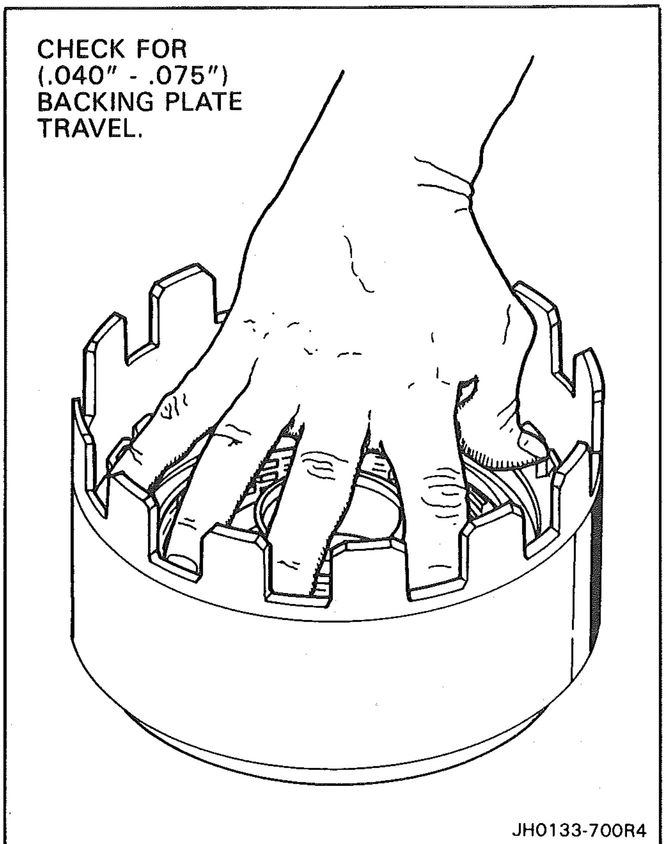


Figure 151 Reverse Input Backing Plate Selection

REVERSE INPUT CLUTCH	NO.	THICKNESS
FLAT STEEL CLUTCH PLATE	4	2.045mm (.081") 1.892mm (.075")
COMPOSITION FACED CLUTCH PLATE	4	1.880mm (.074") 1.730mm (.068")
BELLEVILLE PLATE	1	2.311mm (.091") 2.210mm (.087")
BACKING PLATE	1	SELECTIVE

JH0134-700R4

Figure 152 Reverse Input Clutch Plate Chart

- retain with petrolatum.

10. Reverse boost valve sleeve (221) into the pressure regulator bore
11. T.V. boost valve sleeve (223) into the pressure regulator bore
12. Retainer ring (224)

Oil Pump Cover and Body

Assemble (Figures 160, 164, 165 and 166)

TOOLS REQUIRED:

J-21368 Oil Pump Body and Cover Alignment Band

1. Oil pump cover (217) onto oil pump body
   - stator shaft through a bench hole.
2. Pump cover bolts (236)

REVERSE INPUT CLUTCH BACKING PLATE SELECTION

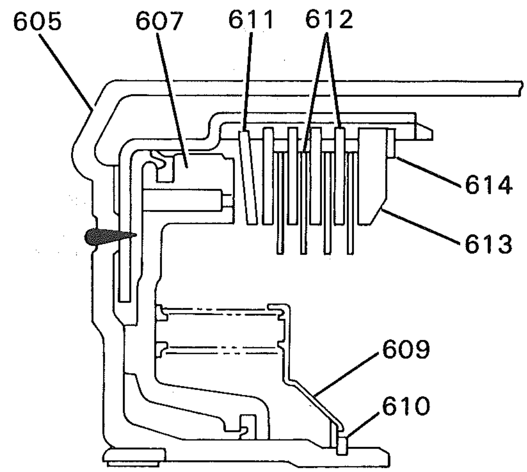
ALL MODELS

BACKING PLATE TRAVEL = 1.02mm - 1.94mm (.040" - .076")

PLATE THICKNESS	IDENTIFICATION
7.60mm - 7.45mm (.299" - .293")	5
6.94mm - 6.79mm (.273" - .267")	6
6.28mm - 6.13mm (.247" - .241")	7
5.62mm - 5.47mm (.221" - .215")	8

JH0191-700R4

Figure 152A Reverse Input Backing Plate Selection Chart



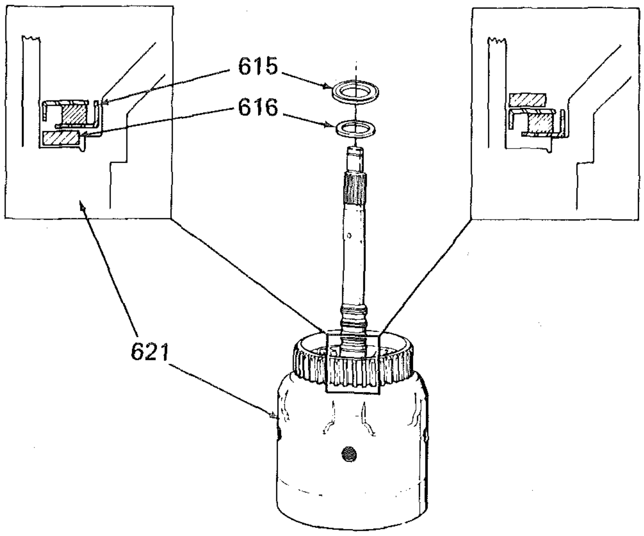
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
607 PISTON ASM., REVERSE INPUT CLUTCH
609 SPRING ASM., REVERSE INPUT CLUTCH
610 RING, REVERSE INPUT CLUTCH SPRING RETAINER
611 PLATE, REVERSE INPUT CL. (BELLEVILLE)
612 PLATE ASM., REVERSE INPUT CLUTCH
613 PLATE, REVERSE INPUT CLUTCH BACKING
614 RING, REVERSE INPUT CL. RETAINING

JH0135-700R4

Figure 153 Reverse Input Clutch

- leave finger tight.

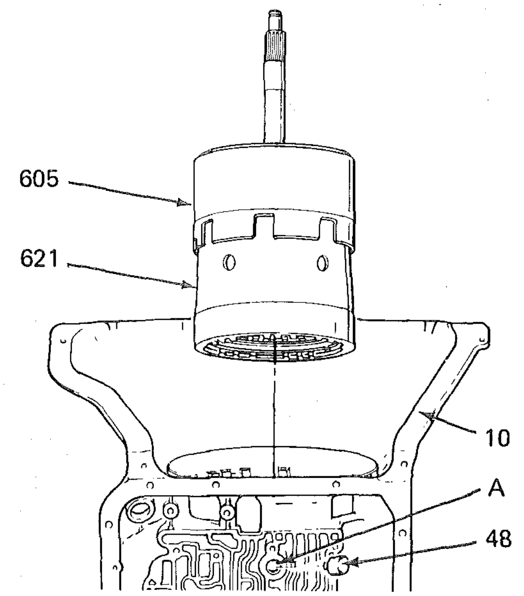
3. Align pump cover and pump body with J-21368.
   - place a screwdriver through a bolt hole and into a hole in the bench.
4. Torque attaching bolts to 22 N·m (18 ft. lbs.)
5. Pump to case gasket (009) onto case
   - retain with petrolatum.
6. Oil seal rings (233), if removed previously, onto the pump cover hub
   - retain with petrolatum.
7. Pump to case oil seal (008)



ILL. NO.	DESCRIPTION
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
621	HOUSING & SHAFT ASSEMBLY, INPUT

JH0136-700R4

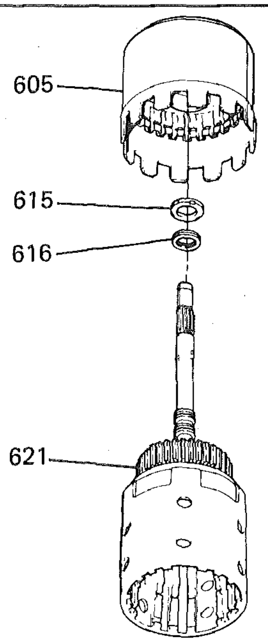
Figure 154 Thrust Bearing and Selective Washer Location



A BAND ANCHOR PIN LOCATION
10 CASE, TRANSMISSION
48 PIN, BAND ANCHOR
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
621 HOUSING & SHAFT ASSEMBLY, INPUT

JH0137-700R4

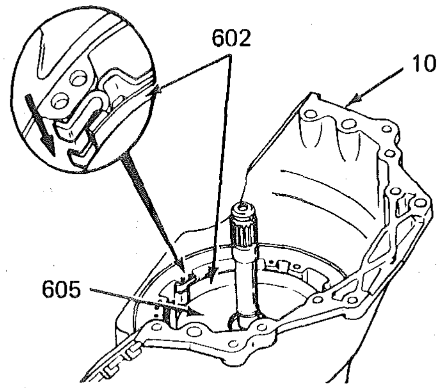
Figure 156 Installing Input Clutch



605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

JH0103-700R4

Figure 155 Reverse Input and Input Clutches



10 CASE, TRANSMISSION
602 BAND ASSEMBLY, 2-4
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH

JH0138-700R4

Figure 157 2-4 Band Assembly - Installed

- do not twist the seal.
- lubricate with transmission fluid.

8. Thrust washer (601)

Install or Connect (Figure 167)

TOOLS REQUIRED:

J-25025-1 Alignment Pins

1. J-25025-1 into the case as shown
2. Oil pump assembly into the case
   - align all holes properly.
3. Bolts and washers (5 and 6)

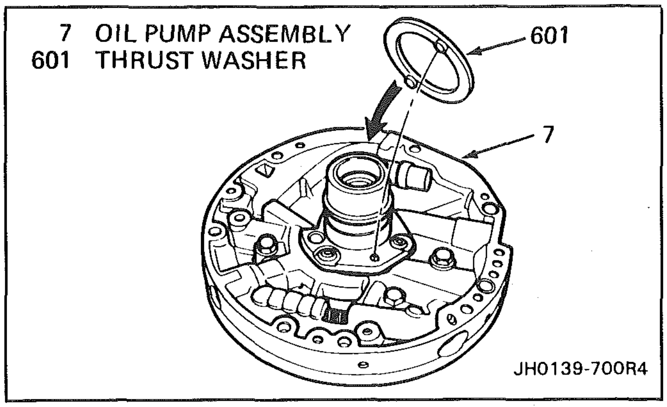


Figure 158 Oil Pump Thrust Washer Location

OIL PUMP ROTOR SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

OIL PUMP SLIDE SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.948 - 17.961	0.7066 - 0.7071
17.961 - 17.974	0.7071 - 0.7076
17.974 - 17.987	0.7076 - 0.7081
17.987 - 18.000	0.7081 - 0.7086
18.000 - 18.013	0.7086 - 0.7091

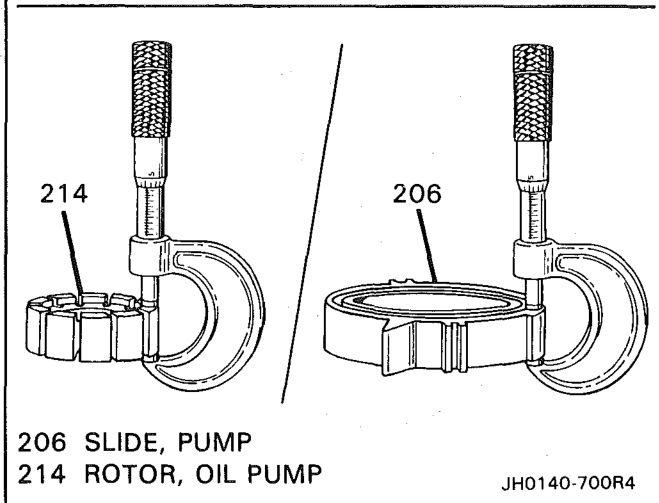


Figure 159 Oil Pump Rotor and Slide Selection

- torque to 22 N·m (18 ft. lbs.)

Important

Rotate the transmission to a horizontal position. If the transmission is assembled properly the turbine shaft should turn by hand. If not identify and correct the misassembly now.

Transmission End Play Check

Measure (Figures 168, 169, 170, 171)

TOOLS REQUIRED:

J-24773-A End Play Checking Fixture
J-25022 End Play Checking Fixture Adaptor (245 mm)
J-34725 End Play Checking Fixture Adaptor (298 mm)
278 mm (11 in.) Bolt and Nut or J-25025-7A Post
Dial Indicator

1. Remove an oil pump to case bolt and install a 278 mm (11 in.) bolt and lock nut or J-25025-7A.
2. Install J-25022-A or J-34725 as shown.
3. Install J-24773-A as shown.
4. Install a dial indicator.
   - set to zero.
5. Pull up on J-24773-A.
   - End play should be 0.13 - 0.92 mm (.005 - .036 in.).

   The selective washer which controls end play is located between the input housing and the thrust bearing on the oil pump hub. If more or less end play is required, select the proper washer from the chart and install. If dial indicator shows no end play, the selective washer and thrust bearing have been misassembled.

Assemble (Figure 172)

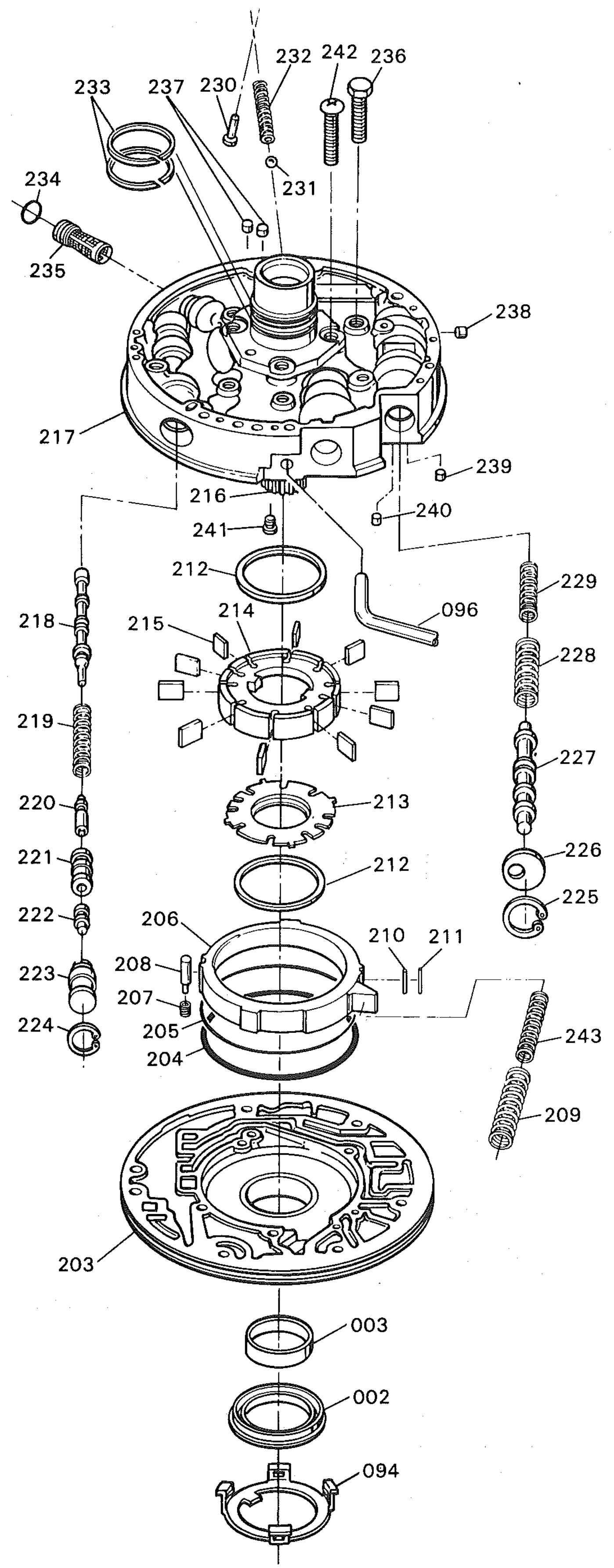
1. "O" ring seal (618) into the groove in the end of the turbine shaft.

Important (Figure 173)

- There should be clearance between the reverse input clutch and the reaction sun gear shell. This clearance can be observed at the point shown in-700-R4 Figure 173. **Do not** try to shim the internal parts because of this clearance.

Inspect (Figure 175, 176 and 177)

- The 1-2 accumulator cover and pin assembly (62) for
  - porosity or damage
  - scored piston wall
  - plugged oil passage
- 1-2 accumulator piston (61) and the 3-4 accumulator piston (52) for
  - porosity
  - ring groove damage
  - pin hole damage
- 1-2 accumulator spring (59) and 3-4 accumulator spring (54) for distortion or damage
- Spacer plate (56) and gaskets (88 and 89) for damage



ILL. NO.	DESCRIPTION
002	SEAL ASSEMBLY, OIL
003	BUSHING, PUMP BODY
094	RETAINER, FRONT HELIX SEAL
096	TUBE, AUXILIARY ACCUMULATOR VALVE
203	BODY, PUMP
204	RING, OIL SEAL (SLIDE TO WEAR PLATE)
205	SEAL, "O" RING (SLIDE SEAL BACK-UP)
206	SLIDE, PUMP
207	SPRING, PIVOT PIN
208	PIN, PIVOT SLIDE
209	SPRING, PUMP SLIDE (OUTER)
210	SUPPORT, PUMP SLIDE SEAL
211	SEAL, PUMP SLIDE
212	RING, PUMP VANE
213	GUIDE, ROTOR
214	ROTOR, OIL PUMP
215	VANE, PUMP
216	SHAFT, STATOR
217	COVER, PUMP
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	VALVE, STOP
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)
230	RIVET, PRESSURE RELIEF BOLT
231	BALL, PRESSURE RELIEF
232	SPRING, PRESSURE RELIEF
233	RING, OIL SEAL (STATOR SHAFT)
234	SEAL, OIL PUMP COVER SCREEN
235	SCREEN, OIL PUMP COVER
236	BOLT, M8 x 1.25 x 40 (COVER TO BODY)
237	PLUG, OIL PUMP AIR BLEED
238	PLUG, OIL PUMP COVER
239	PLUG, OIL PUMP COOLER FEED
240	PLUG, OIL PUMP CONVERTER CLUTCH SIGNAL
241	RETAINER & BALL ASSEMBLY, PUMP COVER
242	SCREW, STATOR SHAFT (M6 x 1 x 16.0)
243	SPRING, PUMP SLIDE (INNER)

JH0141-700R4

Figure 160 Oil Pump Assembly

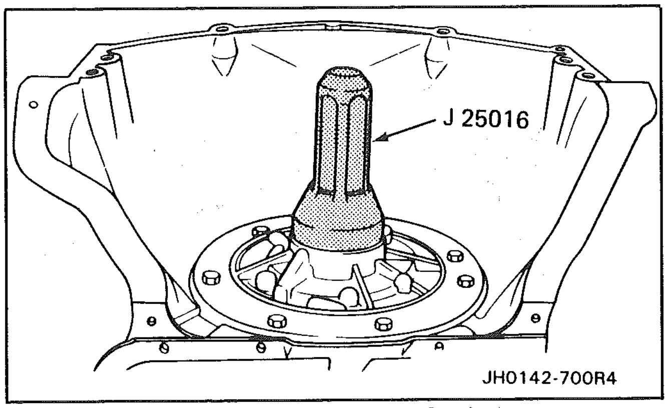
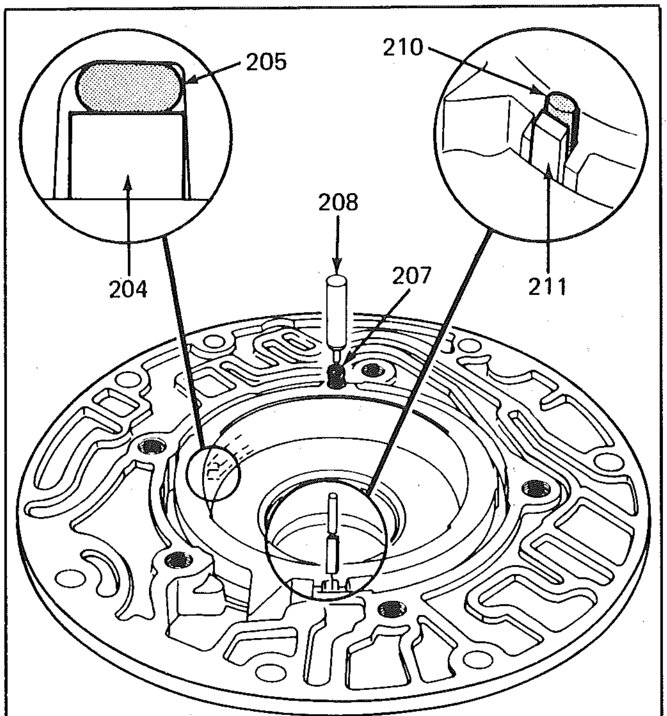


Figure 161 Oil Pump Seal

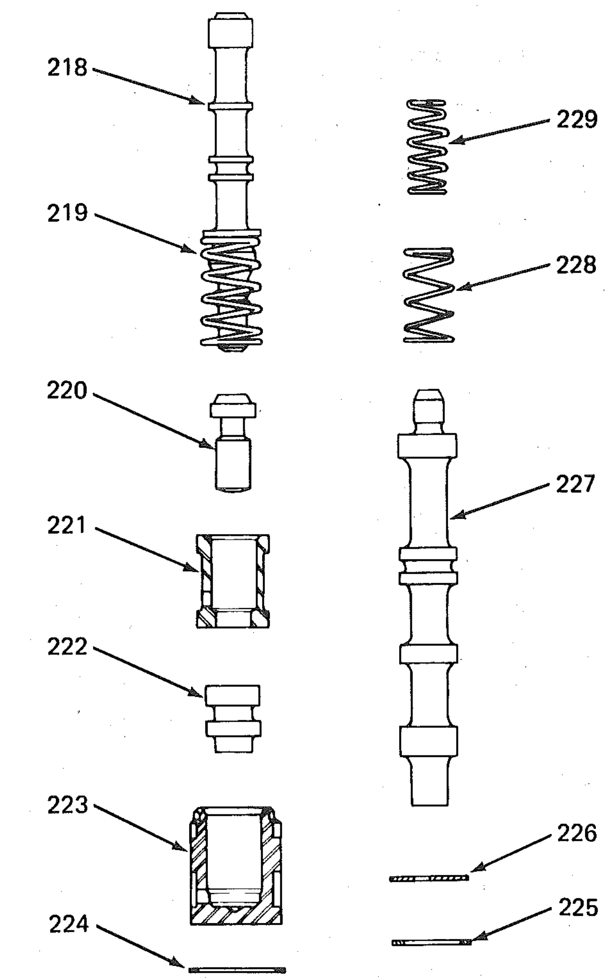


204	SLIDE BACK UP	208	PIVOT PIN
205	SEAL AND RING	210	SUPPORT
207	SPRING	211	SLIDE SEAL

JH0143-700R4

Figure 162 Slide Back Up and Slide Seal

- Checkballs (55) for damage
- T.V. Link (64) for damage
- Manual detent spring (709) for damage
- Oil filter (71) for
  - cut or damaged filter seal (70)
  - cracks in the neck or body
  - casting flash in the neck
- Solenoid assembly (50) for
  - damage
  - cut or pinched wires
  - damaged connectors
  - cut or damaged "O" ring (49)



ILL. NO.	DESCRIPTION
218	VALVE, PRESSURE REGULATOR
219	SPRING, PRESSURE REGULATOR VALVE
220	VALVE, REVERSE BOOST
221	SLEEVE, REVERSE BOOST VALVE
222	VALVE, T.V. BOOST
223	BUSHING, T.V. BOOST
224	RING, OIL PUMP REVERSE BOOST VALVE RETAINING
225	RING, OIL PUMP CONVERTER CLUTCH VALVE RETAINING
226	STOP VALVE
227	VALVE, CONVERTER CLUTCH
228	SPRING, CONVERTER CLUTCH VALVE (OUTER)
229	SPRING, CONVERTER CLUTCH VALVE (INNER)

JH0144-700R4

Figure 163 Pressure Regulator and Converter Clutch Apply Valve Trains

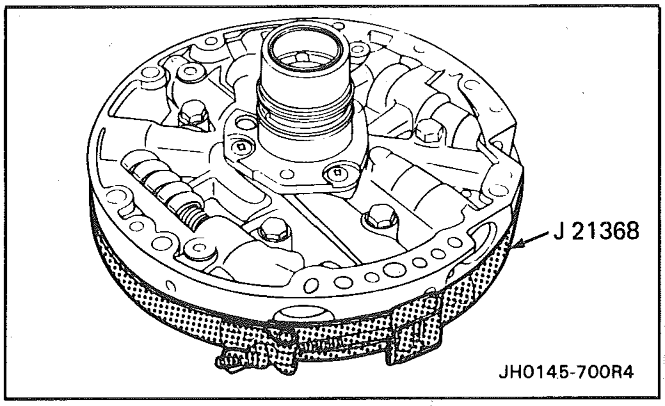


Figure 164 Assembly of Oil Pump

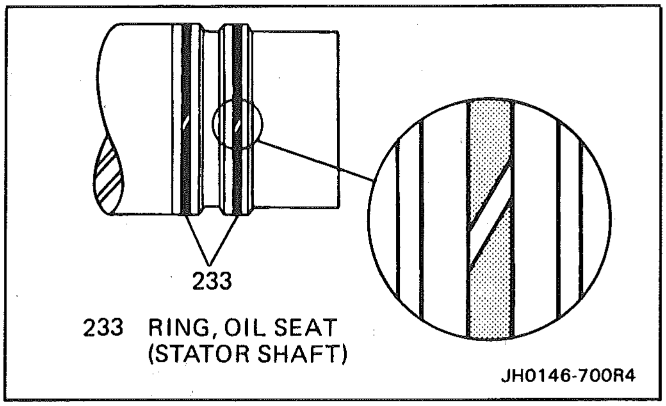


Figure 165 Oil Pump Hub Seal Rings

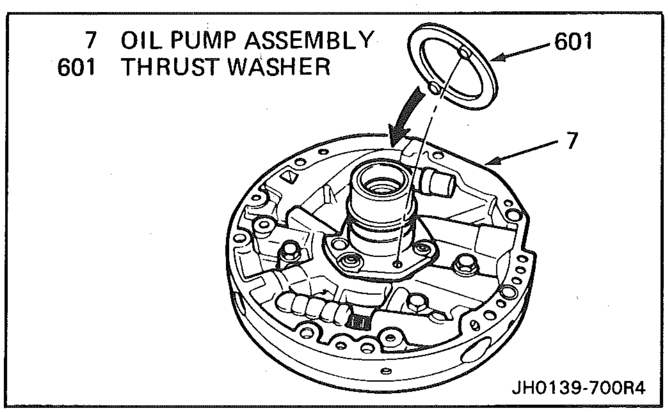


Figure 166 Oil Pump Thrust Washer

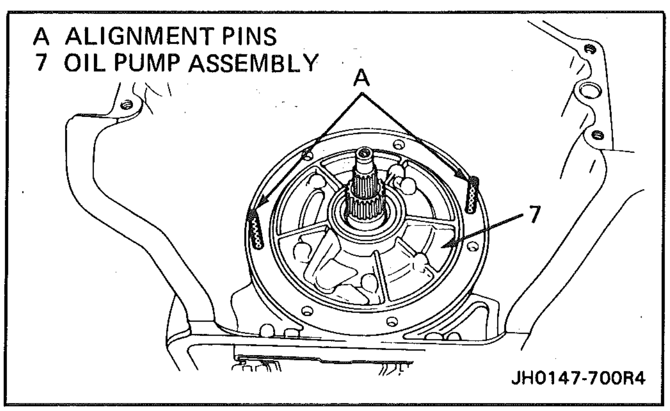


Figure 167 Oil Pump and Case

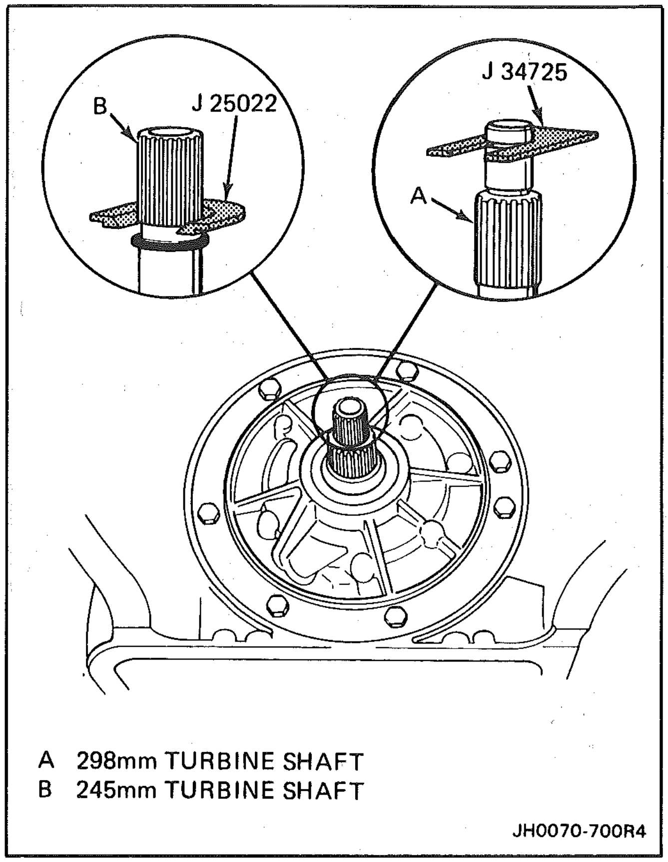


Figure 168 End Play Tool

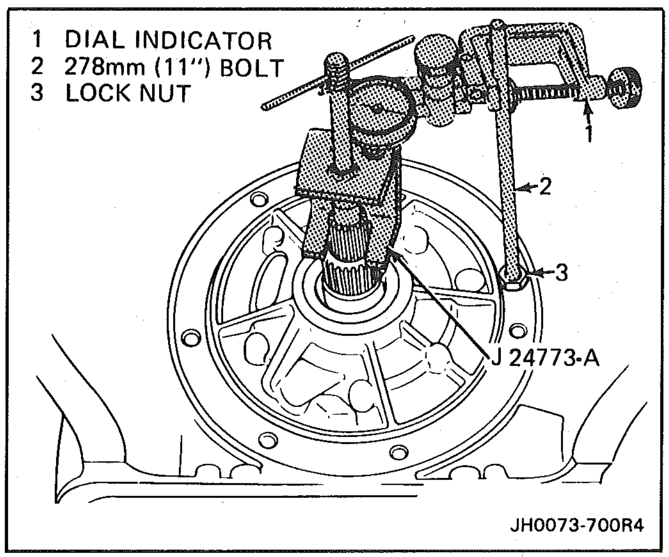


Figure 169 J-25022-A Installed

Valve Body and Associated Parts

Install or Connect (Figure 178 and 179)

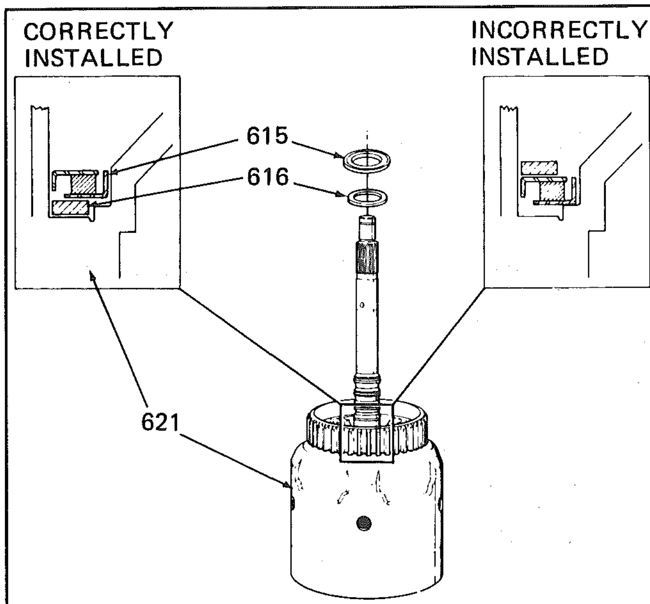
1. The 3-4 accumulator pin (77) into the case
2. The 3-4 accumulator piston seal (53) onto the 3-4 accumulator piston
3. The 3-4 accumulator piston (52) onto the pin
   - the end with three legs must face the valve body.
4. The 3-4 accumulator piston spring (54)

TRANSMISSION END PLAY WASHER SELECTION CHART

WASHER THICKNESS		I.D.
1.87 - 1.97 mm	(.074" - .078")	67
2.04 - 2.14 mm	(.080" - .084")	68
2.21 - 2.31 mm	(.087" - .091")	69
2.38 - 2.48 mm	(.094" - .098")	70
2.55 - 2.65 mm	(.100" - .104")	71
2.72 - 2.82 mm	(.107" - .111")	72
2.89 - 2.99 mm	(.113" - .118")	73
3.06 - 3.16 mm	(.120" - .124")	74

JH0148-700R4

Figure 170 End Play Chart



ILL. NO. DESCRIPTION
615 BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616 WASHER, THRUST (SELECTIVE)
621 HOUSING & SHAFT ASSEMBLY, INPUT

JH0136-700R4

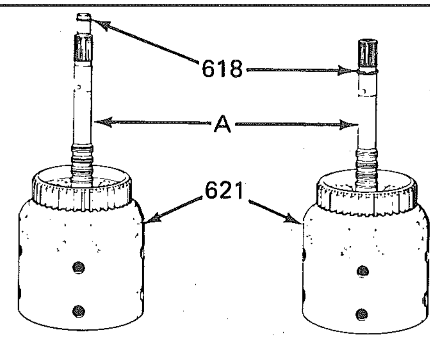
Figure 171 Selective Washer and Thrust Bearing Properly Installed

Install or Connect (Figures 177)

TOOLS REQUIRED:

J-25025-5 Guide Pins

1. Governor and converter clutch oil screens (47)
2. Four checkballs (55) into the case as shown
3. J-25025-5 into the case
4. Spacer plate to case gasket (88)
   - gasket identified by a "C"
5. Spacer plate (56)
6. Valve body to spacer plate gasket (89)
   - gasket indentified by a "V"

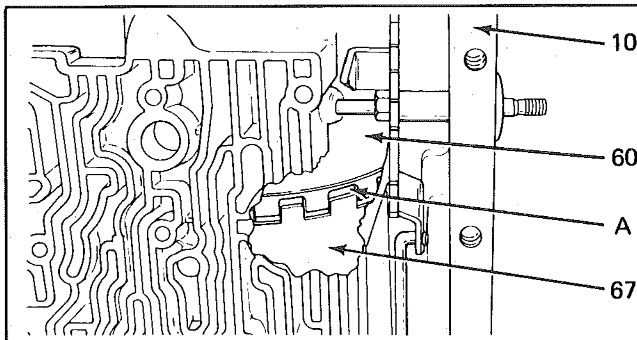


USED WITH 298 MM CONVERTER | USED WITH 245 MM CONVERTER

A SHAFT, TURBINE
618 SEAL, "O" RING (TURBINE SHAFT/ SELECTIVE WASHER)
621 HOUSING & SHAFT ASSEMBLY, INPUT

JH0109-700R4

Figure 172 Turbine Shaft "O" Ring Seal



A AS INSTALLED THESE TWO PARTS HAVE A NORMAL END CLEARANCE OF APPROX. 3.8 MM (.150 IN)
10 CASE, TRANSMISSION
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
670 SHELL, REACTION SUN

JH0149-700R4

Figure 173 Clearance Between Reverse Input Clutch and the Sun Gear Shell

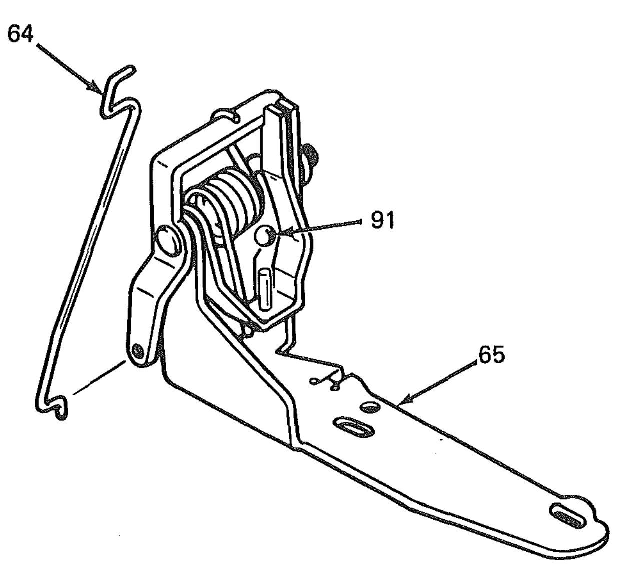
Control Valve Assembly

Clean

- Control valve assembly (67) thoroughly in clean solvent-move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
- Air Dry

Disassemble (Figures 178 & 179)

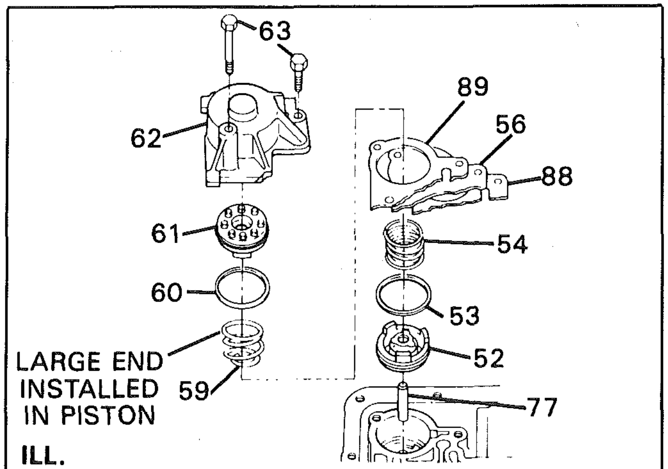
- Control Valve Assembly
  - Position as shown on a clean surface
  - Remove valve trains beginning with the upper left hand corner. **NOTE** : Some valves are under pressure - cover the bores while removing the roll pins
  - Remove blind hole roll pins with a modified drill bit
  - Valves, springs and bushings must be laid out on a clean surface in the exact sequence they are removed



64 THROTTLE LINK
65 LEVER & BRACKET ASSEMBLY, THROTTLE
91 BALL, CARBON STEEL – T.V. EXHAUST (LOCATED IN VALVE BODY)

JH0150-700R4

Figure 174 Throttle Lever and Bracket Assembly



ILL. NO.	DESCRIPTION
52	PISTON, 3-4 ACCUMULATOR
53	RING, OIL SEAL (3-4 ACCUMULATOR PISTON)
54	SPRING, 3-4 ACCUMULATOR
56	PLATE, VALVE BODY SPACER
59	SPRING, 1-2 ACCUMULATOR (CONICAL)
60	RING, OIL SEAL (1-2 ACCUM. PISTON)
61	PISTON, 1-2 ACCUMULATOR
62	COVER & PIN ASSEMBLY, 1-2 ACCUM.
63	BOLT, ACCUMULATOR COVER
77	PIN, ACCUMULATOR PISTON
88	GASKET, SPACER PLATE TO CASE
89	GASKET, SPACER PLATE TO VALVE BODY

JH0063-700R4

Figure 175 1-2 and 3-4 Accumulator Assembly

1988 MODELS	1-2 ACCUMULATOR SPRING COLOR	3-4 ACCUMULATOR SPRING COLOR
MHM, MPM, MWM, MZM, PAM, PBM, PCM, TNM, TUM, TXM	RED	VIOLET
MCM, MTM, PRM, YPM, YTM, YWM	YELLOW	RED
FAM, FJM, FMM, MAM, MDM, MFM, MKM, MLM, MRM, MXM, THM, TJM, TKM, TLM, YKM, YNM	RED	RED
TAM, TBM	RED	DK. GREEN
YAM	DK. GREEN	YELLOW
YDM	DK. GREEN	DK. GREEN
YXM	DK. GREEN	RED
YMM	YELLOW	YELLOW
YZM	YELLOW	VIOLET

JH0151-700R4

Figure 176 1-2 and 3-4 Accumulator Spring Chart

- Remove pressure switches

Clean

- All valves, springs, bushings and control valve body in clean solvent
- Dry using compressed air

Inspect

- All Valves and Bushings For:
  - Porosity
  - Scoring
  - Nicks
  - Scratches
- Springs for Damaged or Distorted Coils
- Valve Body Casting For:
  - Porosity
  - Cracks
  - Interconnected Oil Passages
  - Damaged Machined Surfaces

Assemble (Figures 178, 179)

- Control valve assembly (67) exactly as shown. Notice the position of the valve lands and bushing passages.

Install or Connect (Figures 180, 182)

1. Two checkballs (55) and one checkball (91) into the valve body assembly and one checkball (55 B) into the Auxiliary Valve Body as shown. Checkball (91) is the larger copper colored ball shown as #10 on Figure 180.
   - retain with petrolatum.
2. Valve body assembly (67)
   - connect the manual valve link (705) to the inside detent lever (703).

Auxiliary Accumulator Valve Body Assembly

Clean (Figure 181)

- Auxiliary valve assembly (377) thoroughly in clean solvent
  - move the valves with a pick or small screwdriver to dislodge any dirt or debris that may have accumulated
- Air dry

Disassemble (Figure 181)

1. (3) Bolts (373)
   - Cover (371) is under spring pressure
2. Cover (371) and accumulator piston spring (370)
3. Piston (367)
4. Piston oil seal ring (53)

Disassemble (Figure 181)

- Position the auxiliary accumulator valve body on a clean surface. Remove valve trains beginning with the lower left hand corner. NOTE; valves are under pressure-cover bores while removing the roll pin.
- Valves and springs must be laid out on a clean surface in the exact sequence as they are remvoed

Clean

- All valves and springs in clean solvent
- Air dry

Inspect

- Piston (367) for:
  - cracks
  - porosity
  - damage
- Valves for:
  - scoring
  - nicks
  - scratches
- Springs for damaged or distorted coils
- Auxiliary valve body (377) for:
  - porosity
  - damaged machined surfaces
- Orifice cup plug (359)
  - remove only if damaged

Remove or Disconnect

Tools Required
#3 Screw Extractor

- Orifice cup plug (359). Use modified #3 screw extractor.

Install or Connect

Tools Required
3/8″ Rod

- Orifice cup plug (359). Use 3/8″ rod.
  - seat flush

Assemble (Figure 181)

- Auxiliary accumulator valve train exactly as shown. Notice the valve lands

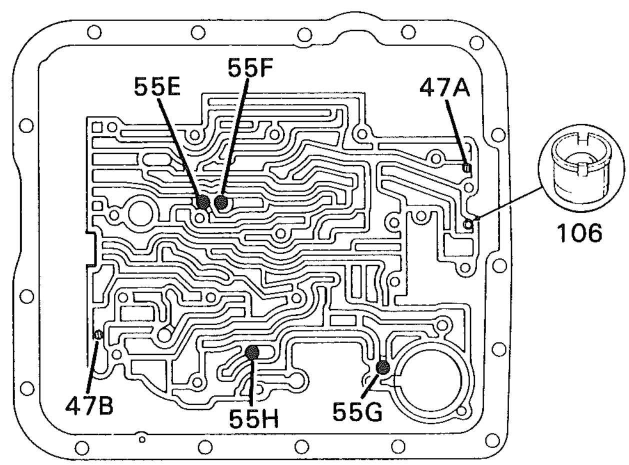
Assemble (Figure 181)

1. Piston oil seal ring (369) onto piston (367)
   - lubricate with petrolatum
2. Piston (367)
3. Accumulator spring (370)
4. Cover (371) and (3) bolts (373)

Install or Connect (Figures 181, 184 and 185)

1. Check ball (55) into auxiliary accumulator valve (377)
   - do not block orifice cup plug
   - retain with petrolatum
2. Bolts (374-376) and auxiliary valve body (377)
   - torque to 11 N·m (8 lbs.-ft.)

NOTE: #9 CHECKBALL (DETENT/LO) HAS BEEN REMOVED ON 1988 MODELS.



ILL. NO.	DESCRIPTION
47A	GOVERNOR FILTER LOCATION
47B	CONVERTER CLUTCH FILTER LOCATION
55E	#4 CHECK BALL (3-4 CLUTCH/3-2 EX.)
55F	#8 CHECK BALL (2ND/1-2)
55G	#1 CHECK BALL (4TH ACCUMULATOR)
55H	#3 CHECK BALL (PART THROTTLE/DRIVE 3)
106	RETAINER & BALL ASM. (DOUBLE ORIFICE)

JH0069-700R4-R1

Figure 177 Case Checkballs and Oil Screens - Location

Inspect (Figure 174)

- The throttle lever and bracket assembly (65) for
  - sticking, binding or damage
- Make sure it operates freely without restrictions
- Replace if necessary

Install or Connect (Figures 183, 184 and 185)

1. T.V. link (64) onto the T.V. lever and bracket as shown

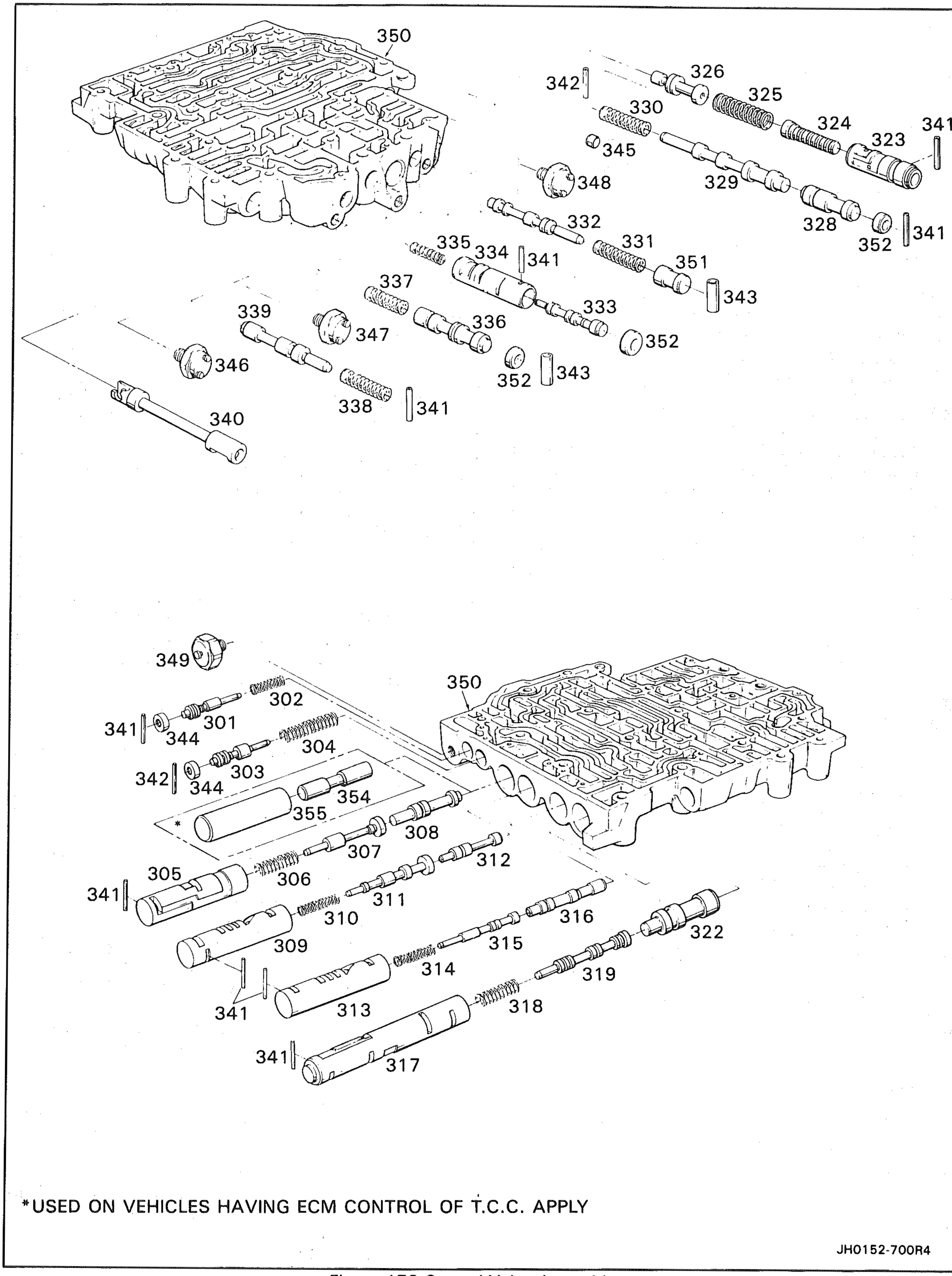
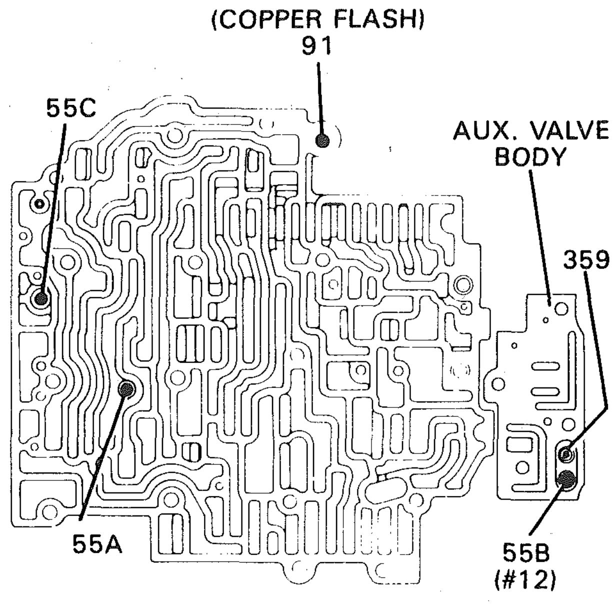


Figure 178 Control Valve Assembly

ILL. NO.	DESCRIPTION
301	VALVE, T.V. MODULATOR DOWNSHIFT
302	SPRING, T.V. MODULATOR DOWNSHIFT VALVE
303	VALVE, T.V. MODULATOR UPSHIFT
304	SPRING, T.V. MODULATOR UPSHIFT VALVE
305	SLEEVE, CONVERTER CLUTCH THROTTLE
306	SPRING, CONVERTER CLUTCH THROTTLE
307	VALVE, CONVERTER CLUTCH THROTTLE
308	VALVE, CONVERTER CLUTCH SHIFT
309	SLEEVE, 3-4 THROTTLE VALVE
310	SPRING, 3-4 THROTTLE VALVE
311	VALVE, 3-4 THROTTLE
312	VALVE, 3-4 SHIFT
313	SLEEVE, 2-3 THROTTLE VALVE
314	SPRING, 2-3 THROTTLE VALVE
315	VALVE, 2-3 THROTTLE
316	VALVE, 2-3 SHIFT
317	SLEEVE, 1-2 THROTTLE VALVE
318	SPRING, 1-2 THROTTLE VALVE
319	VALVE, 1-2 THROTTLE
322	VALVE, 1-2 SHIFT
323	SLEEVE, THROTTLE VALVE PLUNGER
324	PLUNGER, THROTTLE VALVE
325	SPRING, THROTTLE VALVE
326	VALVE, THROTTLE
328	VALVE, 3-4 RELAY
329	VALVE, 4-3 SEQUENCE
330	SPRING, 4-3 SEQUENCE VALVE
331	SPRING, T.V. LIMIT VALVE
332	VALVE, T.V. LIMIT
333	VALVE, 1-2 ACCUMULATOR
334	SLEEVE, 1-2 ACCUMULATOR VALVE
335	SPRING, 1-2 ACCUMULATOR VALVE
336	VALVE, LINE BIAS
337	SPRING, LINE BIAS VALVE
338	SPRING, 3-2 CONTROL
339	VALVE, 3-2 CONTROL
340	VALVE, MANUAL
341	PIN, COILED SPRING
342	PIN, COILED SPRING
343	RETAINER, SPRING (SLEEVE)
344	PLUG, VALVE BORE
345	PLUG, CUP (.33 DIA.)
346	SWITCH ASM., PRESSURE (3RD CLUTCH)
347	SWITCH ASM., PRESSURE (4-3 PULSE)
348	SWITCH ASM., PRESSURE (4TH CLUTCH)
349	SWITCH ASM., PRESSURE (T.C.C. SIGNAL)
350	BODY, CONTROL VALVE
351	PLUG, T.V. LIMIT
352	PLUG, VALVE BORE (12.5 - O.D.)
354	PLUG, CONVERTER CLUTCH SHIFT VALVE BORE (ECM CONTROLLED VEHICLES)
355	PLUG, CONVERTER CLUTCH T.V. BUSHING BORE (ECM CONTROLLED VEHICLES)

JH0153-700R4

Figure 179 Control Valve Assembly-Legend



55A #2 CHECKBALL (3RD CLUTCH ACCUM.)
55B #12 CHECKBALL (FORWARD CLUTCH)
55C #6 CHECKBALL (DRIVE 3)
91 #10 CHECKBALL (T.V. EXHAUST)
359 CUP PLUG – ORIFICE

JH0068-700R4

Figure 180 Valve Body Checkball Locations

2. T.V. lever and bracket assembly (65) onto the valve body as shown
   - attach with two valve body to case bolts (69).
3. Wire harness clips (66), filter retaining clip (87), manual spring assembly (68), wire retaining washer, and all remaining valve body to case bolts (69)
   - Torque to 11.0 N·m (8 ft.lbs.).
4. "O"ring seal (34) onto the electrical connector (33)
   - lubricate with transmission fluid.
5. Electrical connector (33) into the case
6. "O" ring seal (49) on the solenoid assembly (50)
7. Solenoid assembly (50) into the case
   - attach with two solenoid bolts (51)
   - torque to 11 N·m (8 ft. lbs.)
   - to correctly route and hook up the wires see the wiring diagrams in the 700-R4 diagnosis section.

   The wire connectors are color coded to correspond to the information in the wiring diagram. On switches which take two connectors, the terminals are reversible. It will be necessary to identify and use the wiring diagram chart which corresponds to the type of vehicle you are working on. (See the Diagnosis Section for the wiring diagrams.)

Install or Connect (Figure 183, and 184)

1. Parking bracket (710)

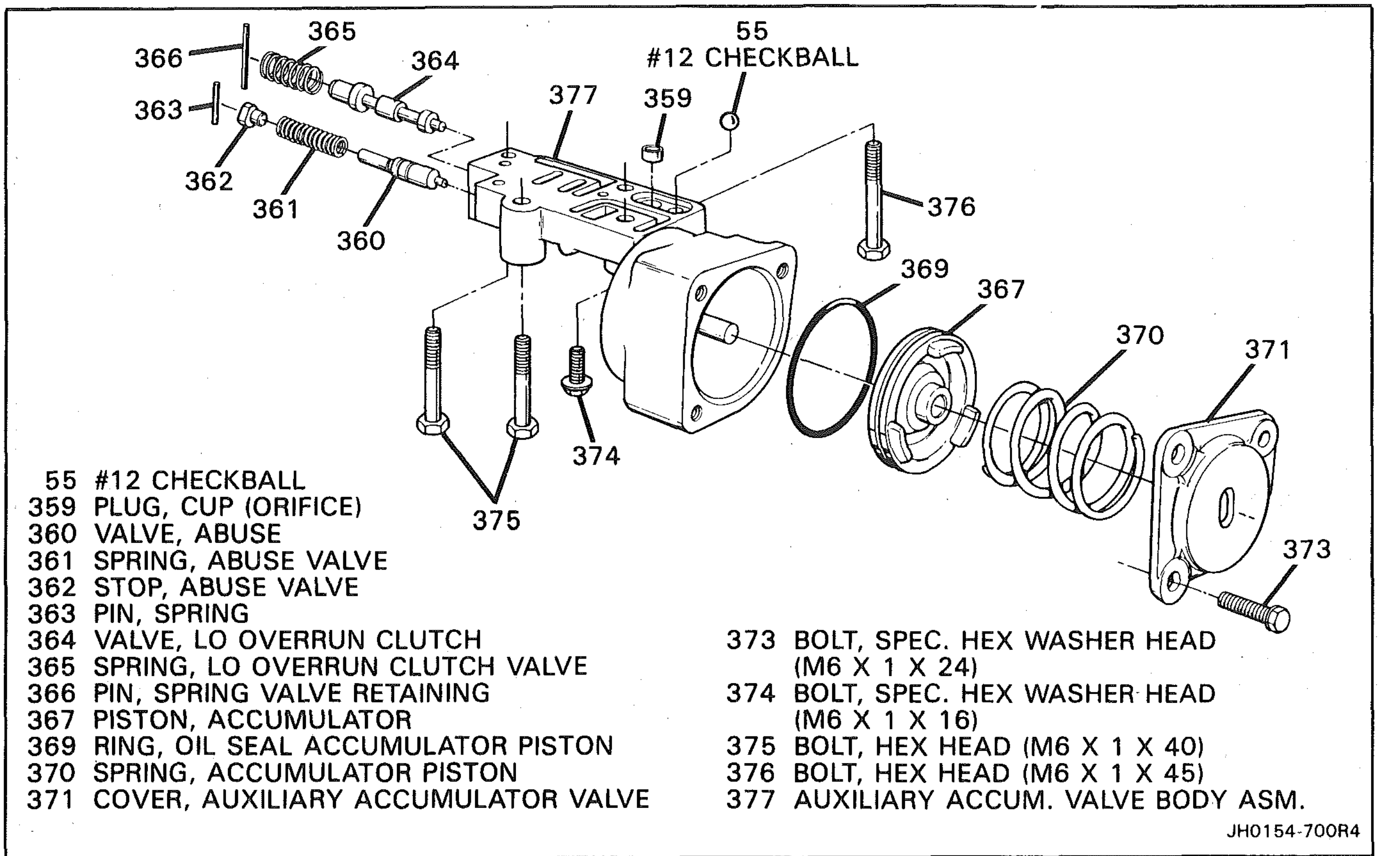


Figure 181 Auxiliary Valve Body Assembly

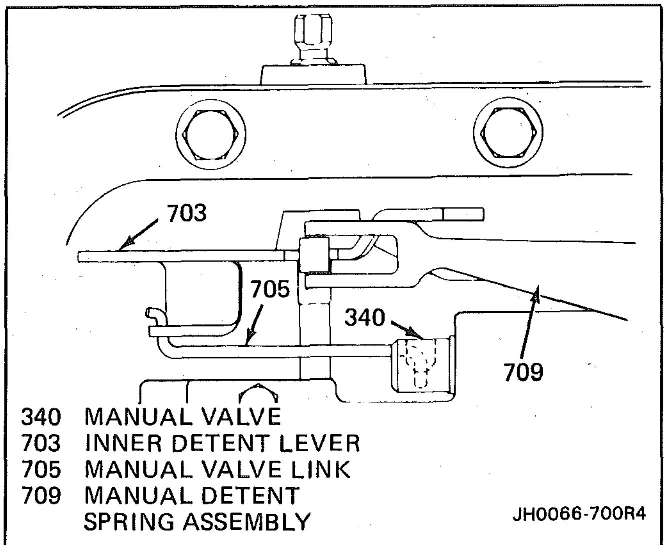


Figure 182 Manual Valve Link

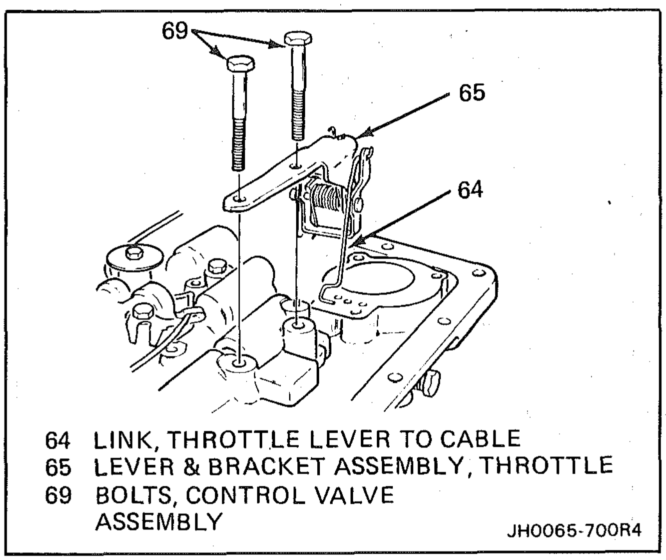


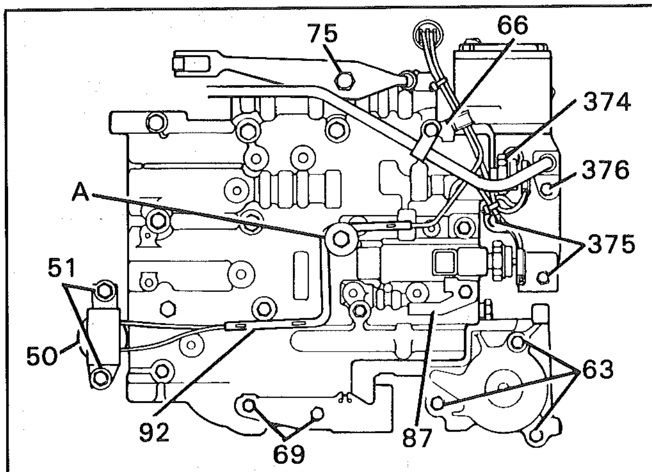
Figure 183 T.V. Lever and Bracket

- torque to 22 N·m (18 ft. lbs.)

2. The 1-2 accumulator piston seal (60) onto the 1-2 accumulator piston ((61)
3. The 1-2 accumulator piston (61) into the 1-2 accumulator cover and pin assembly (62)
   - the three legs on the piston must face up toward the case when installed.
4. The 1-2 accumulator spring (59) onto the piston
5. The 1-2 accumulator cover and pin assembly (62) onto the case
   - torque to 11 N·m (8 ft. lbs.)

Install or Connect (Figure 186)

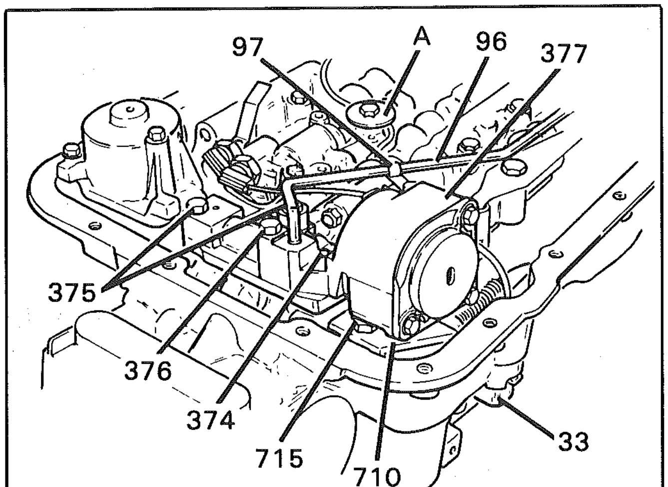
1. filter seal (70) onto the oil filter
   - lubricate with transmission fluid.
2. Oil filter (71)
3. Oil pan gasket (72)
4. Chip magnet (93) into oil pan (73)
5. Oil pan (73) and bolts (74)
   - torque to 16 N·m (12 ft. lbs.)



A WASHER WIRE RETAINER
50 SOLENOID ASSEMBLY
51 BOLT, HEX WASHER HEAD (SOLENOID)
63 BOLT, ACCUMULATOR COVER
66 CLIP, ELECTRICAL WIRE
69 BOLT, VALVE BODY
75 BOLT, MANUAL DETENT SPRING
87 CLIP, FILTER RETAINER
92 CONDUIT, SOLENOID WIRE
374 BOLT, SPEC. HEX WASHER HEAD (M6 X 1 X 18)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)

JH0064-700-R4

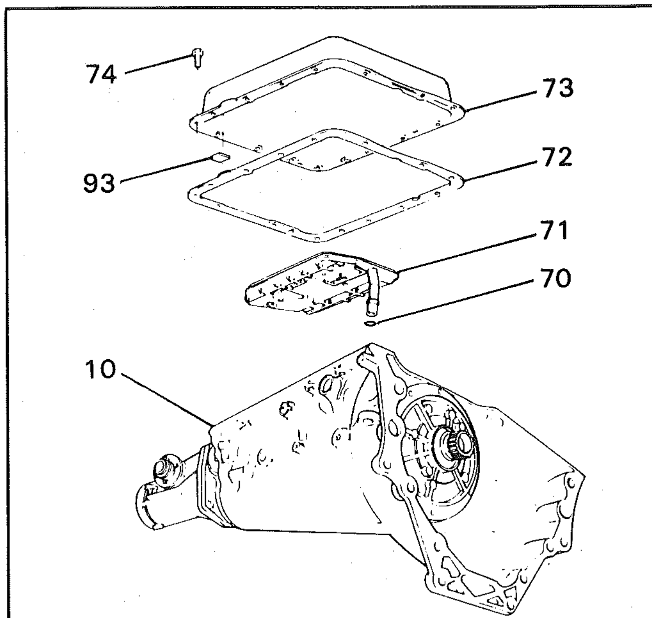
Figure 184 Valve Body Bolt Locations



ILL. NO.	DESCRIPTION
A	WASHER, WIRE RETAINING
33	CONNECTOR, ELECTRICAL
96	TUBE, AUXILIARY ACCUMULATOR VALVE
97	CLAMP, TUBE
374	BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375	BOLT, HEX HEAD (M6 X 1 X 35)
376	BOLT, HEX HEAD (M6 X 1 X 45)
377	AUXILIARY ACCUM. VALVE BODY ASM.
710	BRACKET, PARKING LOCK
715	BOLT, PARKING LOCK BRACKET

JH0067-700R4

Figure 185 Outside Electrical Connector



10 CASE, TRANSMISSION
70 SEAL, FILTER
71 FILTER ASSEMBLY, TRANSMISSION OIL
72 GASKET, TRANSMISSION OIL PAN
73 PAN, TRANSMISSION OIL
74 SCREW, SPEC. HEX WASHER HEAD (PAN)
93 MAGNET, CHIP COLLECTOR

JH0155-700R4

Figure 186 Case, Pan and Filter Assembly

2-4 Servo Assembly

Measure (Figure 187)

TOOLS REQUIRED:

J-33037 Band Apply Pin Tool

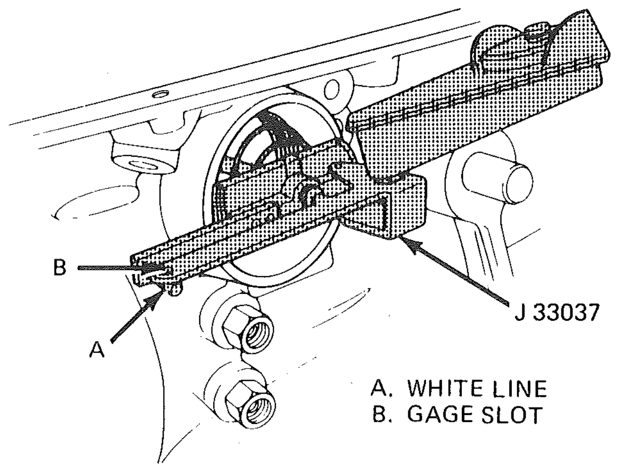
1. Install J-33037 as shown with apply pin (29).
2. Apply 11.0 N·m (100 in. lbs.) torque.
3. If white line "A" appears in the gage slot "B", pin length is correct.
4. Use pin selection chart to determine the correct pin length.

Inspect

- Pistons for
  - porosity or damage
  - ring groove damage
- Cover (15) for porosity or damage
- Seals for
  - nicks or cuts
  - freeness in the seal groove
- Springs for distortion
- Pin for wear or burrs

Important

Check servo bore in the case for any wear which may cut the servo seals.



PIN IS PRESET AT FACTORY AND MUST NOT BE READJUSTED

2-4 SERVO PIN SELECTION		
PIN LENGTH		PIN I.D.
mm	INCH	
66.37-66.67	2.61-2.62	2 RINGS
67.74-68.04	2.67-2.68	3 RINGS
69.11-69.41	2.72-2.73	WIDE BAND

JH0060-700R4

Figure 187 Servo Pin Length

Measure (Figure 188)

TOOLS REQUIRED:
Vernier Calipers
Scale

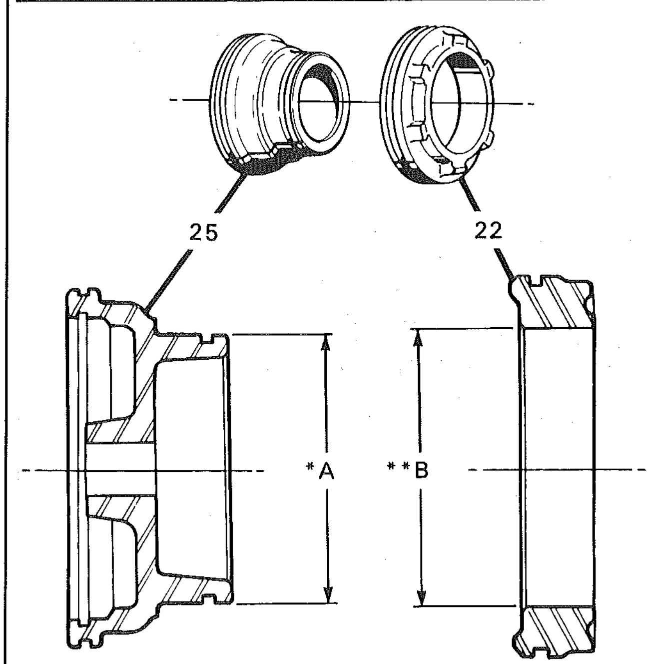
1. Measure Piston (25) Dimension *A
2. Measure housing (22) Dimension **B
3. Check Model Application

Assemble (Figures 189, 190, 191 and 192)

TOOLS REQUIRED:
J-22269-01
J-29714

1. Cushion spring (26) into the 2nd apply piston (25)
2. Cushion spring retainer (27) on the cushion spring
3. Install J-22269-01.
   - compress the retainer past the snap ring groove in the 2nd apply piston.
   - install the retainer ring (28).
4. The 2nd apply piston (25) onto the apply pin (29)
   - retainer goes toward the shoulder of the pin.
5. Servo apply pin spring (20) on the pin
6. Servo apply pin washer (19) and retaining clip (18)
7. Inner (23) and outer (24) seals on the 2nd apply piston
   - retain with petrolatum.
8. "O" ring seal (21) on servo piston housing

2ND APPLY PISTON & HOUSING APPLICATION		
MODEL	PISTON DIMENSION *A	HOUSING DIMENSION **B
YAM, YDM, YMM	44.64 mm (1.78")	45.54 mm (1.79")
FAM, FMM, MAM, MCM, MDM, MFM, MKM, MLM, MRM, MTM, MXM, PRM, TAM, TBM, THM, TJM, TKM, TLM, YNM, YPM, YTM, YXM	57.85 mm (2.28")	58.74 mm (2.31")
FJM, MHM, MPM, MWM, MZM, PAM, PBM, PCM, TNM, TUM, TXM, YKM, YWM, YZM	63.10 mm (2.48")	64.00 mm (2.52")



22 HOUSING, SERVO PISTON (INNER)
25 PISTON, 2ND APPLY

JH0156-700R4

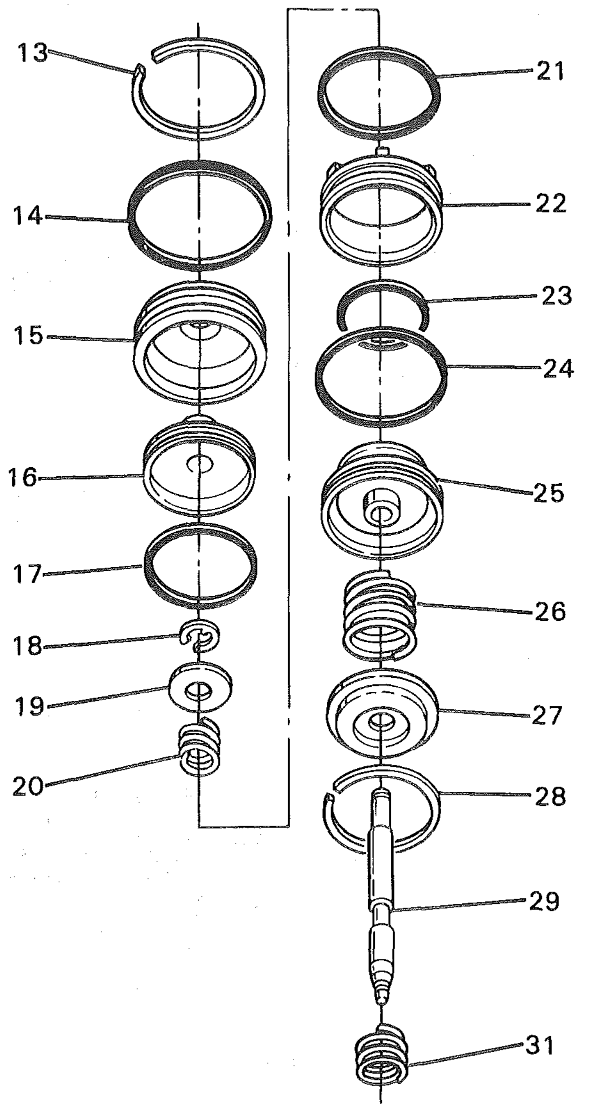
Figure 188 2nd Apply Piston and Housing Measurement

9. Servo piston inner housing (22) on the 2nd apply piston
10. Seal ring (17) onto the 4th apply piston
11. The 4th apply piston (16) onto the apply pin
12. Return spring (31) on the pin
13. Servo piston assembly into the servo bore
14. "O" ring seal (14) on the servo cover
    - lubricate the seal with transmission fluid.
15. Servo cover (15) into the servo bore
16. Install J-29714.
    - compress the servo cover.
    - install the retainer ring (13)

Governor Assembly

Inspect (Figure 193)

- Valve for free operation
- Weights for free operation
- Springs - missing or distorted
- Sleeve for nicks, burrs, scored or galled
- Driven gear for damage



ILL.
NO. DESCRIPTION

13 RING, SERVO COVER RETAINING
14 SEAL, "O" RING (2-4 SERVO COVER)
15 COVER, 2-4 SERVO
16 PISTON, 4TH APPLY
17 RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18 RING, RETAINER (APPLY PIN)
19 WASHER, SERVO APPLY PIN
20 SPRING, SERVO APPLY PIN
21 SEAL, "O" RING
22 HOUSING, SERVO PISTON (INNER)
23 RING, OIL SEAL (2ND APPLY PISTON) (INNER)
24 RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
25 PISTON, 2ND APPLY
26 SPRING, SERVO CUSHION
27 RETAINER, SERVO CUSHION SPRING
28 RING, RETAINER (2ND APPLY PISTON)
29 PIN, 2ND APPLY PISTON
31 SPRING, SERVO RETURN

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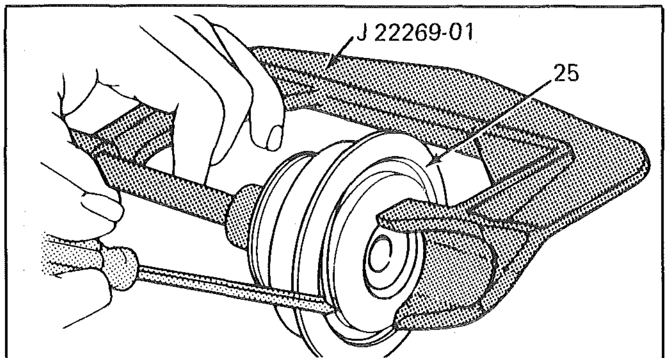
Figure 189 2-4 Servo Assembly



25 SECOND APPLY PISTON ASM. JH0059-700R4

Figure 190 2nd Servo Piston - Assembly

Disassemble

DO NOT DISASSEMBLE EXCEPT, FOR CLEANING OR PART REPLACEMENT.

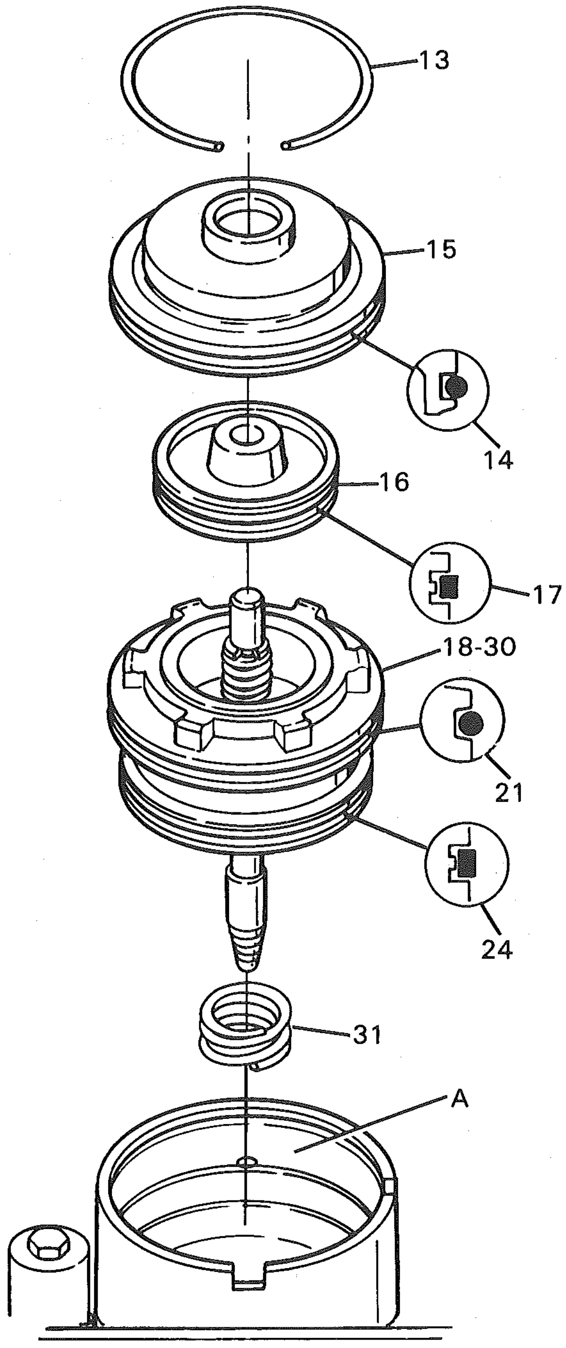
1. Cut off one end of each governor weight pin.
2. Pins (84)
3. Weights
4. Valve
5. Driven gear (83)
   - Drive out the retainer pin (82) with a small punch.
   - Support the governor assembly sleeve on plates installed in the exhaust slots. Push out the gear with an arbor press and a long punch.

Clean

- Wash all parts in solvent.
- Air dry and blow out passages.

Assemble

1. Install a new governor drive gear.
   - support the governor or plates through the exhaust slots.
   - press gear (83) into the sleeve until seated.
   - drill a new retaining pin hole in the sleeve ninety degrees from the existing hole. Use a 3.0 mm (1/8 in.) drill.
   - Install retainer pin (82) and stake.
2. Valve into the sleeve
3. Weights, springs, and thrust cap onto the governor assembly
4. Retaining pins (84) into the thrust cap (85) and governor assembly
5. Stake the retaining pins (84).
6. Check for free operation of the valve and weights.



ILL. NO.	DESCRIPTION
A	CASE SERVO BORE
13	RING, SERVO COVER RETAINING
14	SEAL, "O" RING (2-4 SERVO COVER)
15	COVER, 2-4 SERVO
16	PISTON, 4TH APPLY
17	RING, OIL SEAL (4TH APPLY PISTON) (OUTER)
18-30	2ND APPLY PISTON ASSEMBLY
21	SEAL, "O" RING
24	RING, OIL SEAL (2ND APPLY PISTON) (OUTER)
31	SPRING, SERVO RETURN

JH0057-700R4

Figure 191 2-4 Servo Bore

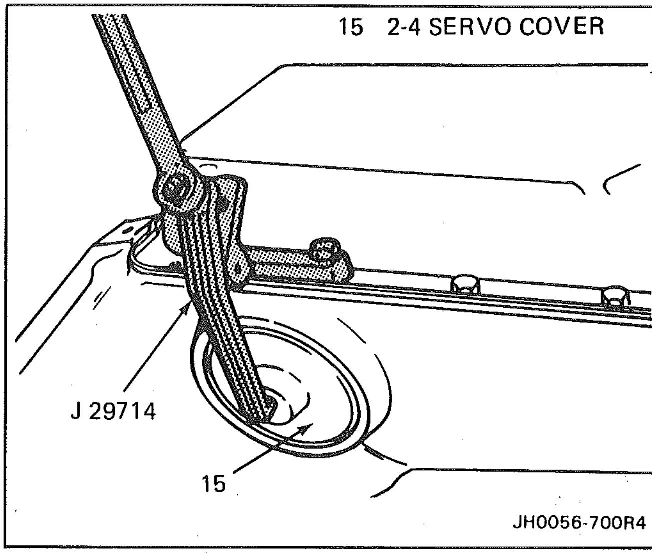
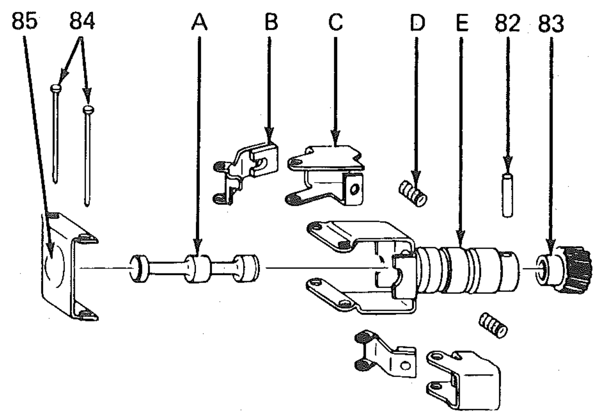


Figure 192 Servo Cover - Installed



GOVERNOR ASSEMBLY

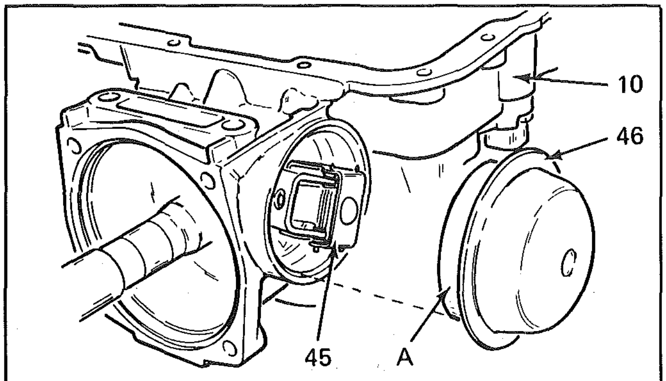
- A VALVE
- B SECONDARY WEIGHT
- C PRIMARY WEIGHT
- D WEIGHT SPRING
- E SLEEVE AND CARRIER
- 82 DRIVEN GEAR RETAINING PIN
- 83 DRIVEN GEAR
- 84 WEIGHT PINS
- 85 THRUST CAP

JH0157-700R4

Figure 193 Governor Assembly

Install or Connect (Figures 193, 194)

1. Governor assembly (45) into the governor bore
2. Governor Cover (46)
   - apply sealant, such as loctite cup plug sealant #11 or equivalent to cover flange before installation.



A APPLY SEALANT ON THIS FLANGE BEFORE INSTALLATION
10 CASE, TRANSMISSION
45 GOVERNOR ASSEMBLY
46 COVER, GOVERNOR

JH0158-700R4

Figure 194 Governor Cover

Install or Connect (Figures 195 thru 201)

MECHANICAL SPEEDOMETER

TOOLS REQUIRED:

J-23103 or J-25016 Seal Installer
J-21426 Seal Installer

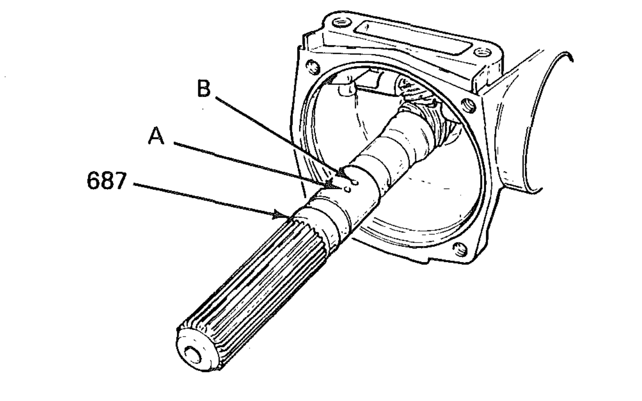
1. Speedometer drive gear (689) and clip (688)
   - if the output shaft has two speedometer locating holes, use the hole nearest the yoke spline for Corvette vehicles only.
2. "O" ring seal (691) on the output shaft sleeve
3. Output shaft sleeve (690) on the output shaft
   - use J-25016 or J-23103.
   - do not push the sleeve past the machined surface on the output shaft.
4. Seal ring (35) on the case extension
5. Case extension (36) and bolts (37) or, stud (100) and nut (98)
   - position extension so the speedometer bore is on the governor side of the case.
   - torque to 35 N·m (26 ft. lbs.)
6. Remove case extension oil seal (89)
   - pry out with a screwdriver
   - install new seal with J-21426
7. Speedometer driven gear (44) and assembly (43) or speed sensor (99)
8. Retainer (40) bolt and washer (41)
9. Outside electrical connector, manual lever and nut

Torque Converter Assembly

Inspect

The torque converter assembly (1) must be replaced for any of the following conditions:

- Evidence of damage to the pump assembly
- Metal particles are found after flushing the cooler and cooler pipes
- External leaks in hub weld area
- Converter pilot is broken, damaged or poor fit into crankshaft
- Converter hub is scored or damaged
- Internal damage to stator
- Contamination from engine coolant
- Excess end play

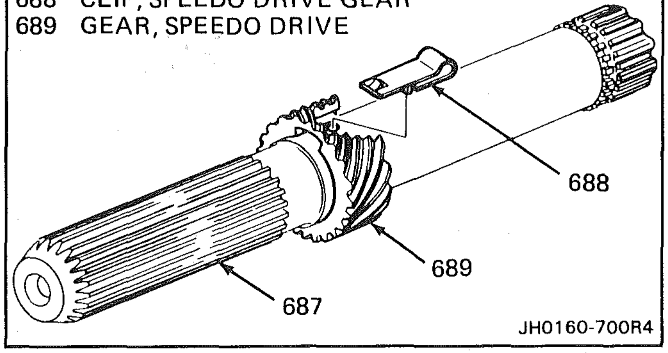


A SPEEDO CLIP HOLE FOR CORVETTE ONLY
B SPEEDO CLIP HOLE FOR ALL OTHER VEHICLES
687 SHAFT, OUTPUT

JH0159-700R4

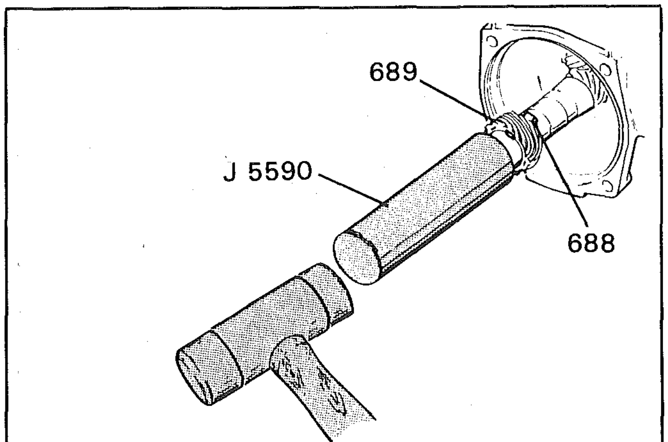
Figure 195 Speedo. Clip Holes

687 SHAFT, OUTPUT
688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE



JH0160-700R4

Figure 196 Speedometer Gear



688 CLIP, SPEEDO DRIVE GEAR
689 GEAR, SPEEDO DRIVE

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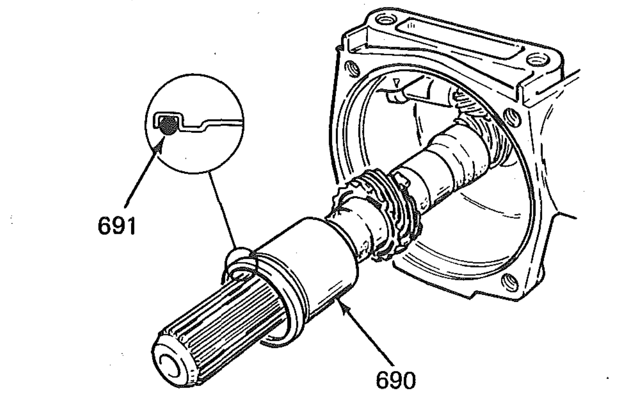
Figure 197 Speedo. Gear - Installation



690 SLEEVE, OUTPUT SHAFT
691 SEAL, OUTPUT SHAFT

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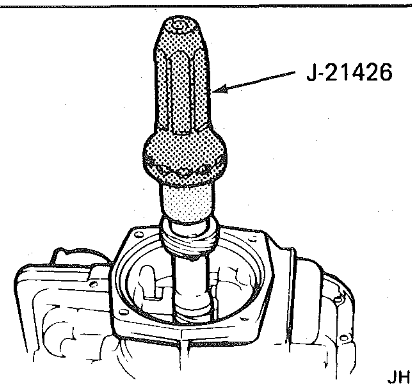
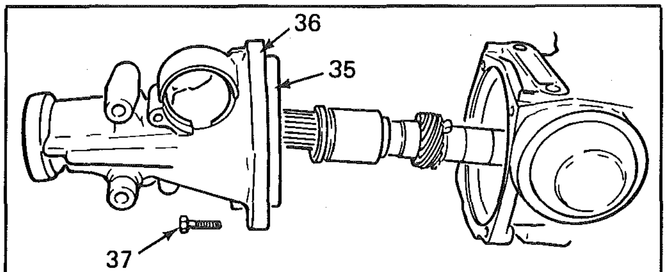
Figure 198 Output Shaft Sleeve and Seal



JH0163-700R4

Figure 199 Output Shaft Sleeve - Installation



35 SEAL, CASE EXTENSION TO CASE
36 EXTENSION, CASE
37 BOLTS, CASE EXTENSION

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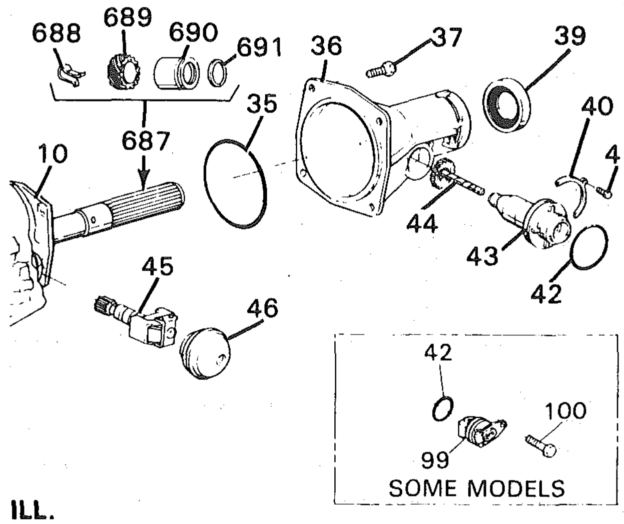
Figure 200 Case Extension and Seal



ILL. NO.	DESCRIPTION
10	CASE, TRANSMISSION
35	SEAL, CASE EXTENSION TO CASE
36	EXTENSION, CASE
37	BOLT, CASE EXTENSION TO CASE
39	SEAL ASSEMBLY, CASE EXTENSION OIL
40	RETAINER, SPEEDO DRIVEN GEAR FITTING
41	BOLT & WASHER ASSEMBLY
42	SEAL, "O" RING (SPEEDO FITTING TO CASE EXTENSION)
43	FITTING ASSEMBLY, SPEEDO DRIVEN GEAR
44	GEAR, SPEEDO DRIVEN
45	GOVERNOR ASSEMBLY
46	COVER, GOVERNOR
99	SPEED SENSOR, INTERNAL TRANSMISSION
100	BOLT, SPEEDO SENSOR RETAINING
687	SHAFT, OUTPUT
688	CLIP, SPEEDO DRIVE GEAR
689	GEAR, SPEEDO DRIVE
690	SLEEVE, OUTPUT SHAFT NOT USED ON
691	SEAL, OUTPUT SHAFT ALL MODELS

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Figure 201 Case Extension and Associated Parts

Measure (Figure 203)

Tool Required:
J-35138 Torque Converter End Play Checking Tool

- Install J-35138 and measure end play
  - 0mm - .5mm (.020") for 245mm Torque Converters
  - 0mm - .6mm (.024") for 298mm Torque Converters

The Torque Converter Should Not Be Replaced If:

- The fluid has an odor, discolored or no evidence of metal or clutch plate material
  - Drain out as much fluid as possible
  - Replace the oil filter and pan gasket
  - Fill to proper level (Refer to Section 7A)
- The converter bolt hole threads are damaged
  - Correct with thread insert (Refer to Section 6A)

Flushing the torque converter is not recommended.

Install or Connect

1. Torque converter (1)
2. J-21366 converter holding strap
3. Remove transmission from holding fixture

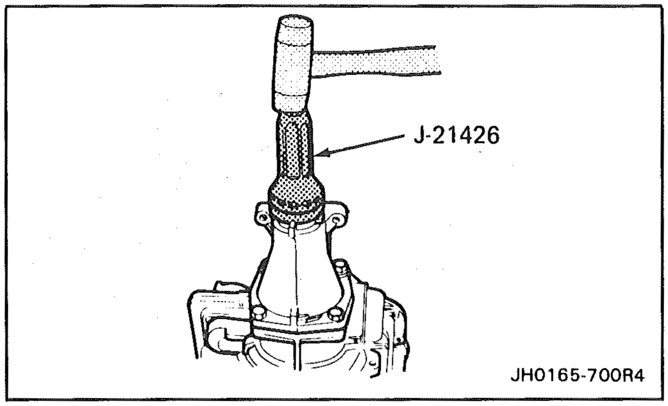


Figure 202 Case Extension Oil Seal Assembly

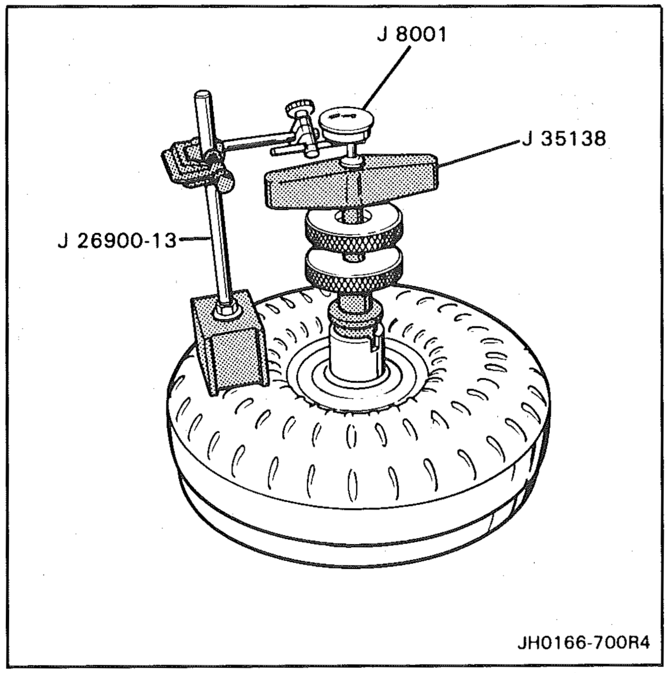
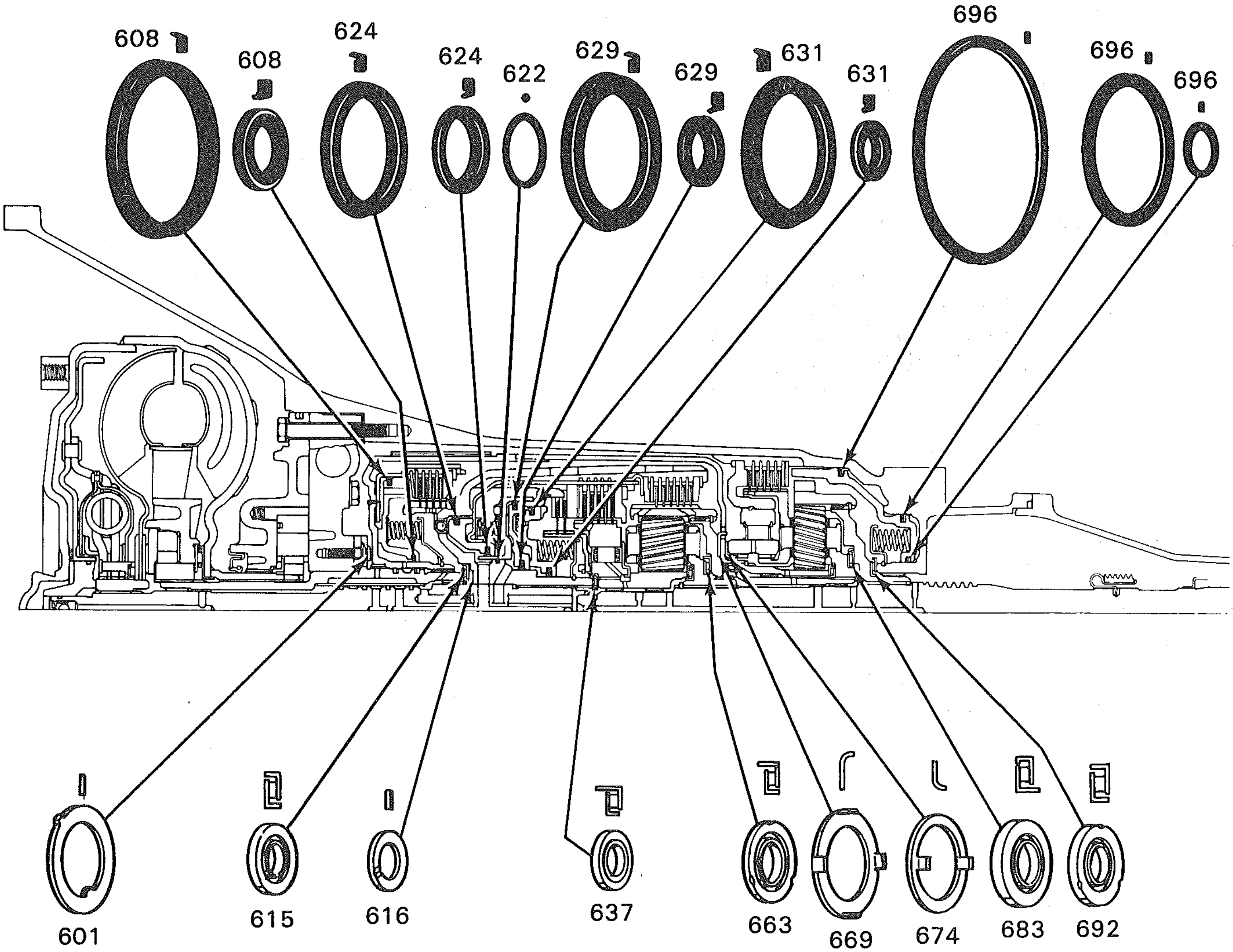


Figure 203 Checking Torque Converter End Play



ILL. NO.	DESCRIPTION
601	WASHER, THRUST (PUMP TO DRUM)
608	SEALS, REVERSE INPUT CLUTCH (INNER & OUTER)
615	BEARING ASSEMBLY, STATOR SHAFT/ SELECTIVE WASHER
616	WASHER, THRUST (SELECTIVE)
622	SEAL, "O" RING INPUT TO FORWARD HSG.
624	SEAL, 3RD & 4TH CL. (INNER & OUTER)
629	SEAL, FORWARD CLUTCH (INNER & OUTER)
631	SEAL, OVERRUN CLUTCH (INNER & OUTER)
637	BEARING ASSEMBLY, INPUT SUN GEAR

ILL. NO.	DESCRIPTION
663	BEARING ASSEMBLY, THRUST (INPUT CARRIER TO REACTION SHAFT)
669	WASHER, THRUST (REACTION SHAFT/ SHELL)
674	WASHER, THRUST (RACE/REACTION SHELL)
683	BEARING ASSEMBLY, THRUST (REACTION CARRIER/SUPPORT)
692	BRG., REACTION GEAR SUPPORT TO CASE
696	SEAL, TRANSMISSION (LO & REVERSE CLUTCH — OUTER, CENTER, INNER)

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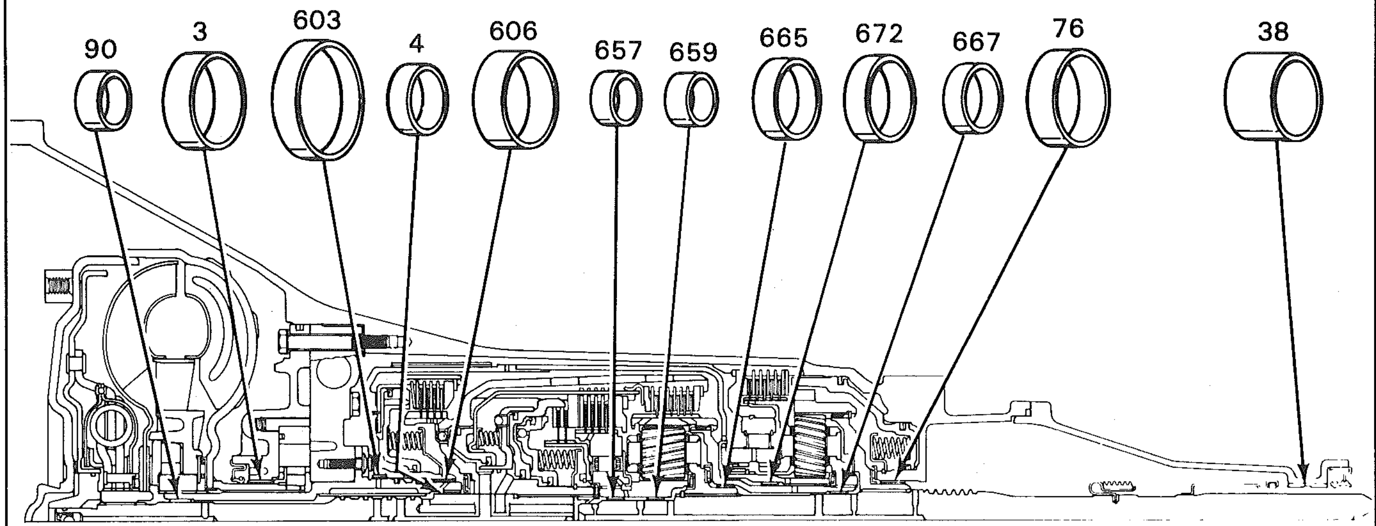
Figure 204 Seals and Bearing Locations



ILL. NO.	DESCRIPTION
3	BUSHING, OIL PUMP BODY
4	BUSHING, STATOR SHAFT (REAR)
38	BUSHING, CASE EXTENSION
76	BUSHING, CASE
90	BUSHING, STATOR SHAFT (FRONT)
603	BUSHING, REVERSE INPUT CLUTCH (FRONT)
606	BUSHING, REVERSE INPUT CLUTCH (REAR)
657	BUSHING, INPUT SUN GEAR (FRONT)
659	BUSHING, INPUT SUN GEAR (REAR)
665	BUSHING, REACTION SHAFT (FRONT)
667	BUSHING, REACTION SHAFT (REAR)
672	BUSHING, REACTION SUN GEAR

TORQUE SPECIFICATIONS

LOCATION	QTY.	SIZE	TORQUE	LOCATION	QTY.	SIZE	TORQUE
ACCUMULATOR COVER TO CASE	2	M6 1.0x35.0	11 N·m (8 FT.-LB.)	PARK BRAKE BRACKET TO CASE	2	M8 1.25x20.0	22 N·m (18 FT.-LB.)
ACCUMULATOR COVER TO CASE	1	M6 1.0x65.0	11 N·m (8 FT.-LB.)	PUMP COVER TO BODY	5	M8 1.25x40.0	22 N·m (18 FT.-LB.)
DETENT SPRING TO VALVE BODY	1	M8 1.75x20.0	22 N·m (18 FT.-LB.)	PUMP ASSY. TO CASE	7	M8 1.25x60.0	22 N·m (18 FT.-LB.)
VALVE BODY TO CASE	15	M6 1.0x50.0	11 N·m (8 FT.-LB.)	CASE EXTENSION TO CASE	4	M10 1.50x30.0	34 N·m (26 FT.-LB.)
OIL PASSAGE COVER TO CASE	3	M6 1.0x16.0	11 N·m (8 FT.-LB.)	MANUAL SHAFT TO INSIDE DET. LEVER	1	M10 1.50 NUT	31 N·m (23 FT.-LB.)
SOLENOID ASSY. TO PUMP	2	M6 1.0x12.0	11 N·m (8 FT.-LB.)	PRESSURE PLUGS	1-4	⅛ - 27	11 N·m (8 FT.-LB.)
TRANSMISSION OIL PAN TO CASE	16	M8 1.25x19.3	11 N·m (8 FT.-LB.)	PRESSURE PLUGS	3	¼ - 18	24 N·m (18 FT.-LB.)
PRESSURE SWITCHES	1-3	⅛ - 27	11 N·m (8 FT.-LB.)	CONNECTOR COOLER PIPE	2	¼ - 18	38 N·m (28 FT.-LB.)

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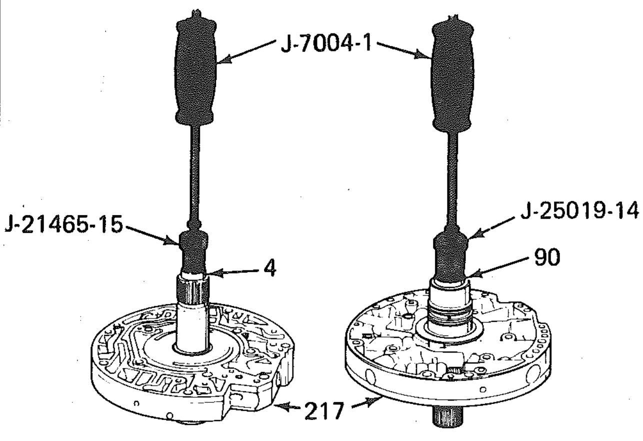
Figure 205 Torque Specifications and Bushing Locations

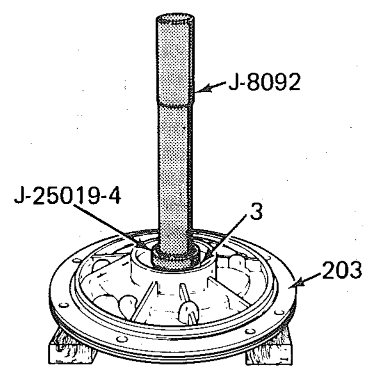
BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

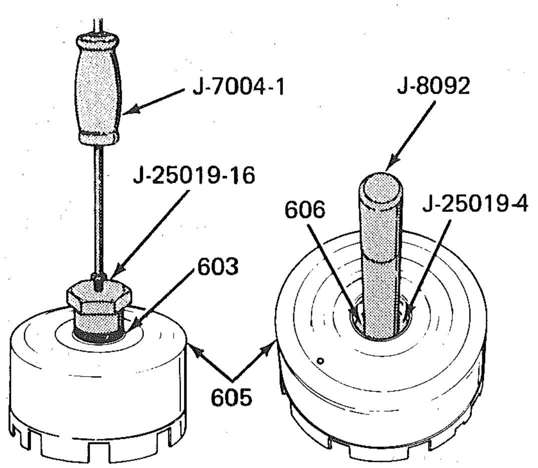
REMOVE AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP

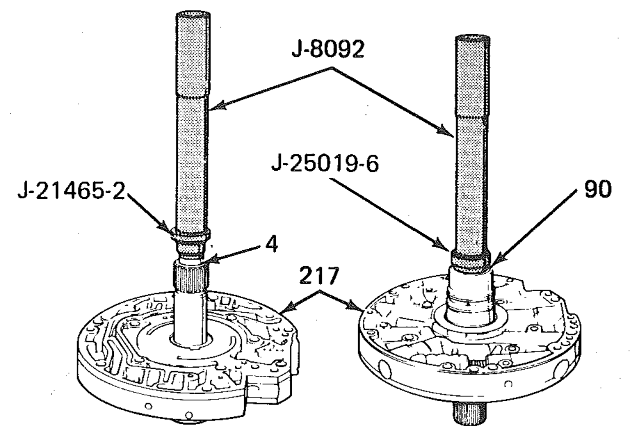


3 BUSHING, OIL PUMP BODY
203 BODY, PUMP

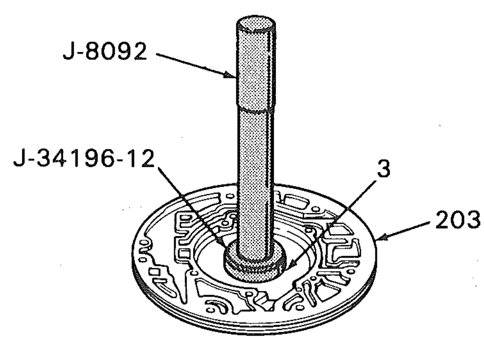


603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

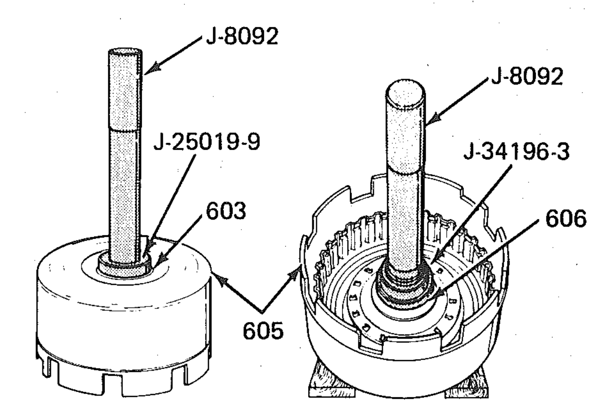
INSTALL AS SHOWN



4 BUSHING, STATOR SHAFT – FRONT
90 BUSHING, STATOR SHAFT – REAR
217 COVER, PUMP



3 BUSHING, OIL PUMP BODY
203 BODY, PUMP



603 BUSHING, REVERSE INPUT CLUTCH – FRONT
605 HOUSING & DRUM ASSEMBLY, REVERSE INPUT CLUTCH
606 BUSHING, REVERSE INPUT CLUTCH – REAR

JH0169-700R4

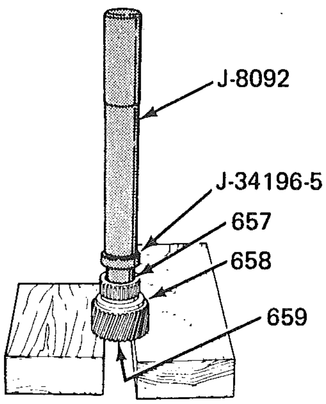
Figure 206 Bushing Replacement Procedure

BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

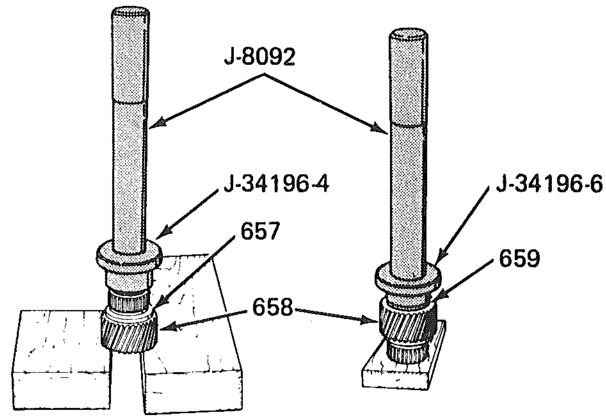
REMOVE AS SHOWN	INSTALL AS SHOWN

REMOVE AS SHOWN



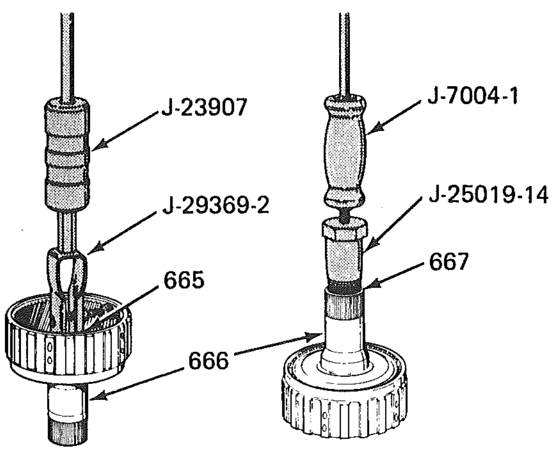
657 BUSHING, INPUT SUN GEAR – FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR – REAR

INSTALL AS SHOWN



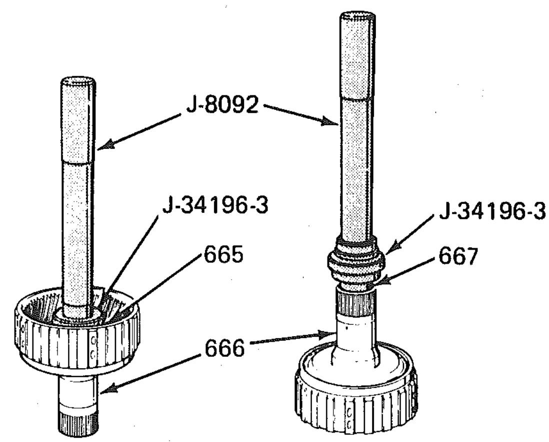
657 BUSHING, INPUT SUN GEAR – FRONT
658 GEAR, INPUT SUN
659 BUSHING, INPUT SUN GEAR – REAR

REMOVE AS SHOWN



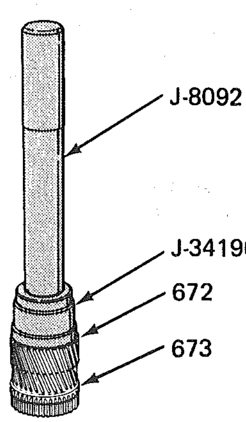
665 BUSHING, REACTION CARRIER SHAFT – FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT – REAR

INSTALL AS SHOWN



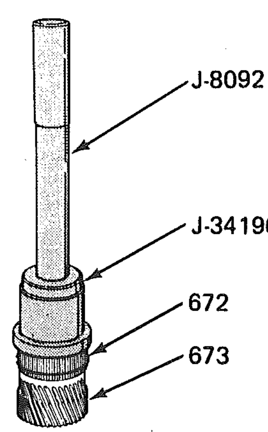
665 BUSHING, REACTION CARRIER SHAFT – FRONT
666 SHAFT, REACTION CARRIER
667 BUSHING, REACTION CARRIER SHAFT – REAR

REMOVE AS SHOWN



672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

INSTALL AS SHOWN



672 BUSHING, REACTION SUN
673 GEAR, REACTION SUN

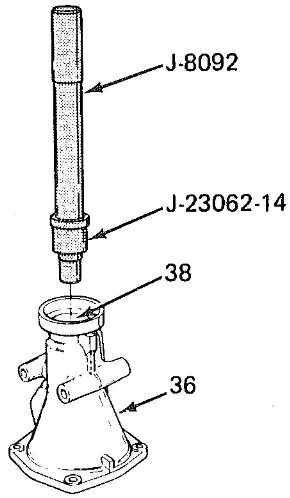
JH0170-700R4

Figure 207 Bushing Replacement Procedure

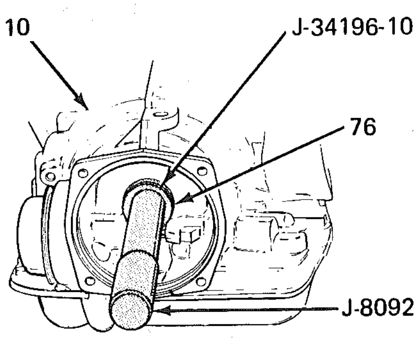
BUSHING REPLACEMENT PROCEDURE

PROTECT PARTS WITH WOOD BLOCKS OR CLOTH AS NECESSARY

REMOVE AS SHOWN

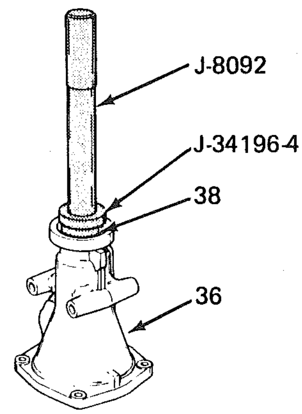


36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION

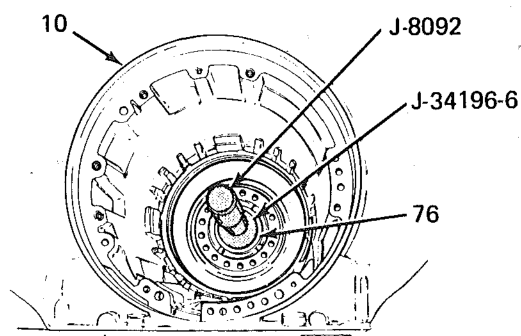


10 CASE, TRANSMISSION
76 BUSHING, CASE

INSTALL AS SHOWN



36 EXTENSION, CASE
38 BUSHING, CASE EXTENSION



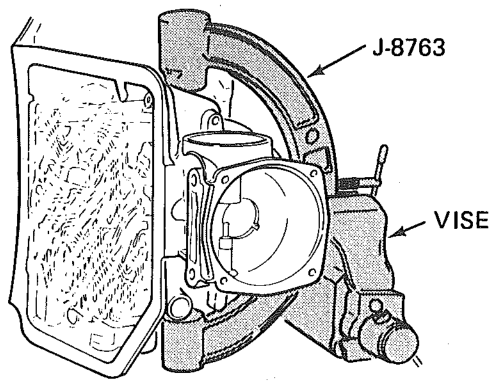
10 CASE, TRANSMISSION
76 BUSHING, CASE

JH0171-700R4

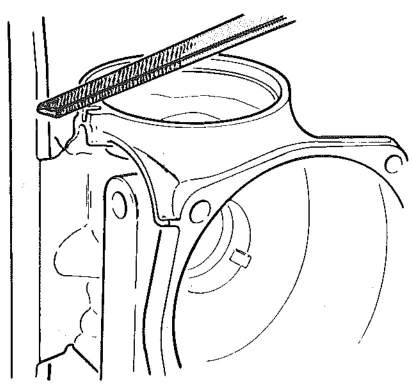
Figure 208 Bushing Replacement Procedure

GOVERNOR BORE REPAIR PROCEDURE

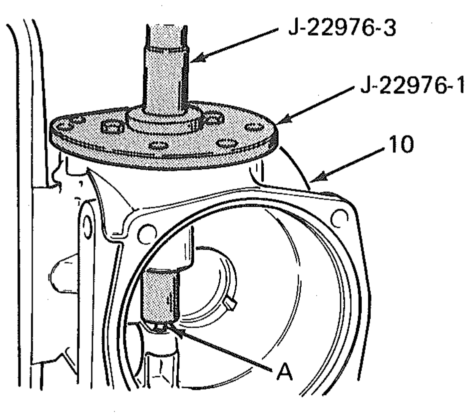
FOLLOW STEPS 1-6 TO REPAIR THE GOVERNOR BORE



STEP 1 Install holding fixture J-8763 and mount in vise.

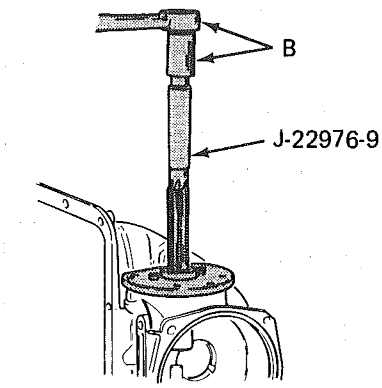


STEP 2 Remove (file) any excess material from the governor face.



A PIN, GOVERNOR SUPPORT
10 CASE, TRANSMISSION

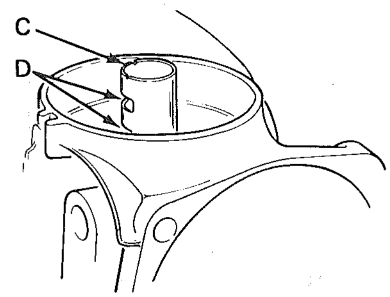
STEP 3 Install J-22976-3 and J-22976-1. Torque bolts to 13 N·m (10 ft.-lbs.). Make sure J-22976-3 rotates freely and then remove it.



B RATCHET & SOCKET

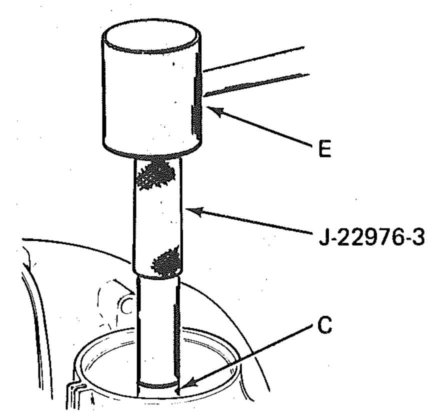
STEP 4 Ream the governor bore as follows:

- Oil J-22976-9, J-22976-1 and the governor bore with transmission fluid.
- After each ten revolutions, remove the reamer and dip in transmission fluid to clean.
- After the reamer reaches the end of the bore and bottoms on the governor support pin, rotate the reamer ten additional revolutions.
- Remove the reamer. Be certain to rotate during removal to prevent scoring the bore.
- Remove the tools and thoroughly clean the case.



C BUSHING
D SLOTS

STEP 5 Align the slots in the bushing with the slots in the governor bore.



C BUSHING
E BRASS HAMMER

STEP 6 Install the bushing until the slots in the bushing align with the feed holes in the governor bore.

JH0172-700R4

Figure 209 Governor Bore Repair Procedure

Figure 210 Special Tools

SECTION 7

AUTOMATIC TRANSMISSION

CONTENTS

SECTION 7A

TRANSMISSION GENERAL INFORMATION

CONTENTS

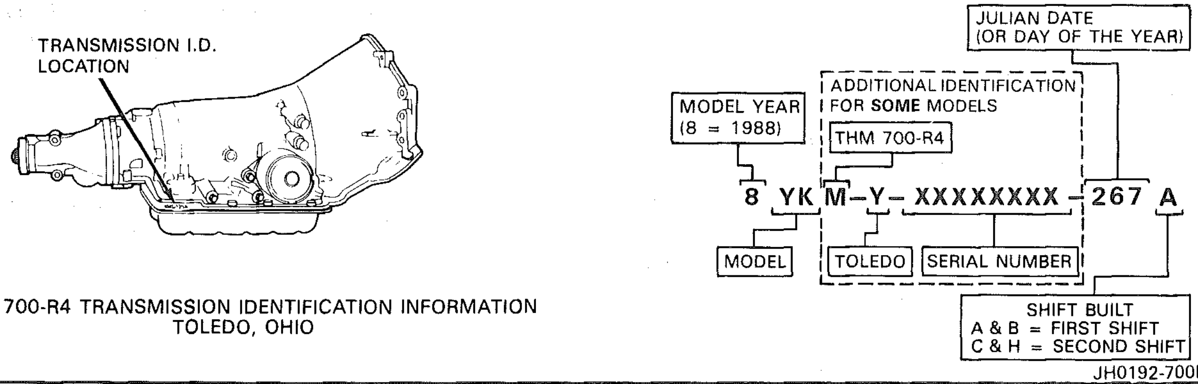
The information contained in this section is common to all automatic transmissions. For on-vehicle service procedures refer to Section 7A1. For complete Diagnosis and Unit Repair refer to the specific transmission sections.

For vehicles sold in Canada also refer to the appropriate Canadian Service Manual Supplement for driveability diagnosis.

TRANSMISSION IDENTIFICATION INFORMATION

All automatic transmissions have a metal identification nameplate attached to the case exterior. The location of this name plate is shown in Figure 1. The information on the nameplate will assist in the servicing and determination of replacement parts when ordered through a GM Parts Catalog.

Additional Transmission identification is provided on the Service Parts Identification label. This label contains information on the regular production options (RPO) as well as standard and mandatory options. This label is affixed to the inside of each vehicle at the assembly plant. Refer to Section 0A of this Service Manual for label location and information.



THM 700-R4 TRANSMISSION IDENTIFICATION INFORMATION
TOLEDO, OHIO

Figure 1 Transmission Identification Information

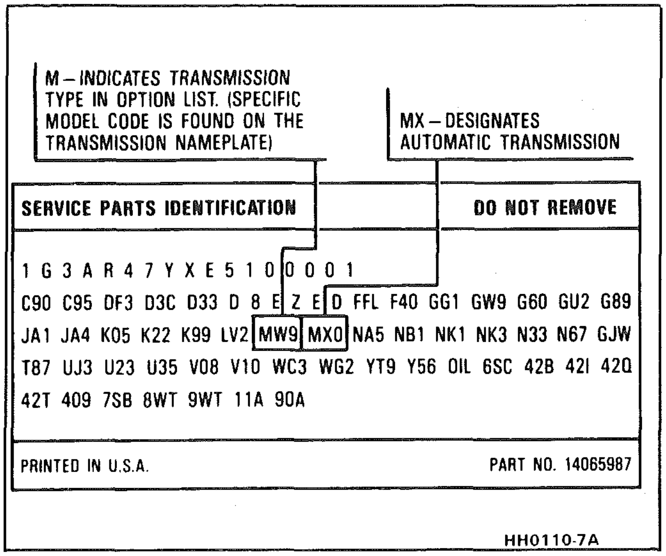


Figure 2 Service Parts Identificaiton Label

TRANSMISSION DEFINITIONS

The following definitions are being provided to establish a common language and assist the user in describing transmission related conditions. Some of these terms or conditions are used in the transmission sections of this Service Manual.

Throttle Positions

- **Minimum Throttle** - the least amount of throttle opening required for an upshift.
- **Light Throttle** - approximately 1/4 of accelerator pedal travel.
- **Medium Throttle** - approximately 1/2 of accelerator pedal travel.
- **Heavy Throttle** - approximately 3/4 of the accelerator pedal travel.
- **Wide Open Throttle (WOT)** - full travel of the accelerator pedal.
- **Full Throttle Detent Downshift** - a quick apply of the accelerator pedal to its full travel, forcing a downshift.
- **Zero Throttle Coastdown** - a full release of the accelerator pedal while the vehicle is in motion and in drive range.
- **Engine Braking** - a condition where the engine is used to slow the vehicle by manually downshifting during a zero throttle coastdown.

Shift Conditions

- **Bump** - a sudden and forceful apply of a clutch or band.
- **Chuggle** - a bucking or jerking condition that may be engine related. May be most noticeable when the converter clutch is engaged. Similar to the feel of towing a trailer.
- **Delayed** - a condition where a shift is expected but does not occur for a period of time. Samples of this condition could be described as clutch or band engagement does not occur as quickly as expected during a part throttle or wide open throttle apply of the accelerator or, when manually downshifting to a lower range. Also defined as "LATE" or, "EXTENDED."
- **Double Bump ("Double Feel")** - two sudden and forceful applies of a clutch or band.
- **Early** - a condition where the shift occurs before the vehicle has reached a proper speed and tends to labor the engine after the upshift.
- **End Bump** - a firmer feel at the end of a shift as compared to the feel at the start of the shift. Also defined as "END FEEL" or, "SLIP BUMP."
- **Firm** - a noticeable quick apply of a clutch or band that is considered **normal** with a medium to heavy throttle shift. Should not be confused with "HARSH" or "ROUGH."
- **Flare** - a quick increase in engine rpm accompanied with a momentary loss of torque. This most generally occurs during a shift. Also defined as "SLIPPING."
- **Harsh ("Rough")** - a more noticeable apply of a clutch or band as compared to "FIRM." This condition is considered undesireable at any throttle position.
- **Hunting** - a repeating quick series of upshifts and downshifts that causes a noticeable change in engine rpm. An example could be described as a 4-3-4 shift pattern. Also defined as "BUSYNESS."
- **Initial Feel** - a distinct firmer feel at that start of a shift as compared to the finish of the shift.
- **Late** - a shift that occurs when the engine is at a higher than normal rpm for a given amount of throttle.
- **Shudder** - a repeating jerking sensation similar to "CHUGGLE" but more severe and rapid in nature. This condition may be most noticeable during certain ranges of vehicle speed. May also be used to define the condition after converter clutch engagement.
- **Slipping** - a noticeable increase in engine rpm without a vehicle speed increase. A slip usually occurs during or after initial clutch or band engagement.
- **Soft** - a slow, almost unnoticeable clutch apply with very little shift feel.
- **Surge** - a repeating engine related feeling of acceleration and deceleration that is less intense than "CHUGGLE."
- **Tie-Up** - a condition where two opposing clutches are attempting to apply at the same time causing the engine to labor with a noticeable loss of engine rpm.

Noise Conditions

- **Gear Noise** - a whine, most noticeable in first gear and reverse that is related to vehicle speed. A gear noise condition may become less noticeable or go away after an upshift.
- **Pump Noise** - a high pitch whine that increases in intensity with engine rpm. This condition may also be noticeable in "PARK" and "NEUTRAL" operating ranges with the vehicle stationary.

PRELIMARY CHECKING PROCEDURE

The condition of an automatic transmission not operating properly may be influenced by one, or a combination of the following items:

- Fluid level high/low
  (Refer to Section 7A1)
- Engine performance
  (Refer to Sections 6 and 6E)
- T.V. cable adjustment
  (Refer to Section 7A1)
- Manual linkage adjustment
  (Refer to Section 7A1)
- Internal fluid leaks
  (Refer to Transmission Unit Repair section)
- Electrical system
  (Refer to Section 6E and 8A)
- Transmission or other mechanical component
  (Refer to Transmission Unit Repair section)
- Vacuum modulator
  (Refer to appropriate Hydraulic Diagnosis Section)

NOISE AND VIBRATION ANALYSIS

A noise or vibration that is noticeable when the vehicle is in motion, MAY NOT be the result of the transmission.

If noise or vibration is noticeable in "Park" (P) and "Neutral" (N) with engine at idle, but is less noticeable as RPM's increase, the cause may be from poor engine performance.

Inspect

- Tires for
  - Uneven wear
  - Imbalance
  - Mixed sizes
  - Mixed radial and bias ply
    (Refer to Section 3E)
- Suspension components for
  - Alignment and wear
  - Loose fasteners
    (Refer to Section 3C)
- Engine/Transmission mounts for
  - Damage
  - Loose bolts
    (Refer to Sections 6A and 7A2)
- Transmission case mounting holes for:
  - Missing bolts, nuts, studs
  - Stripped threads
  - Cracks
- Flywheel for:
  - Missing or loose bolts
  - Cracks
  - Imbalance
    (Refer to Section 6A)
- Torque converter for:
  - Missing or loose bolts or lugs
  - Missing or loose balance weights
  - Imbalance

TRANSMISSION FLUID LEVEL INFORMATION

Checking fluid level, color and condition at regular intervals will provide early diagnosis information about the transmission. This information may then be used to correct a condition that, if not detected early, could result in major transmission repairs.

When adding or changing fluid, use only DEXRON® II, or equivalent. Refer to Section 0B of this Service Manual for maintenance information and servicing intervals.

- Fluid level should be checked when it reaches normal operating temperatures of 190-200°F. (88-93°C). This temperature is reached after approximately 15 miles (24 km) of highway driving.
- Fluid color
  - Should be dark red (may be dark green)

NOTICE: Do not overfill. Overfilling will cause foaming, loss of fluid and possible damage to the transmission.

- Inaccurate fluid level readings will result if checked immediately after the vehicle has been operated:
  - In high abmient temperatures above 90°F (32°C)
  - At sustained high speeds
  - In heavy city traffic during hot weather
  - As a towing vehicle
  - In commercial service (taxi or police use)

TRANSMISSION FLUID CHECKING PROCEDURE

(Refer to Figure 3)

1. Park vehicle on level ground.
2. Apply parking brake and block wheels.
3. Start engine and operate vehicle for 15 minutes or until a normal operating temperature is reached.
4. Move gear selector through all gear positions.
5. Move gear selector to "Park" (P).
6. Check fluid level, color and condition.

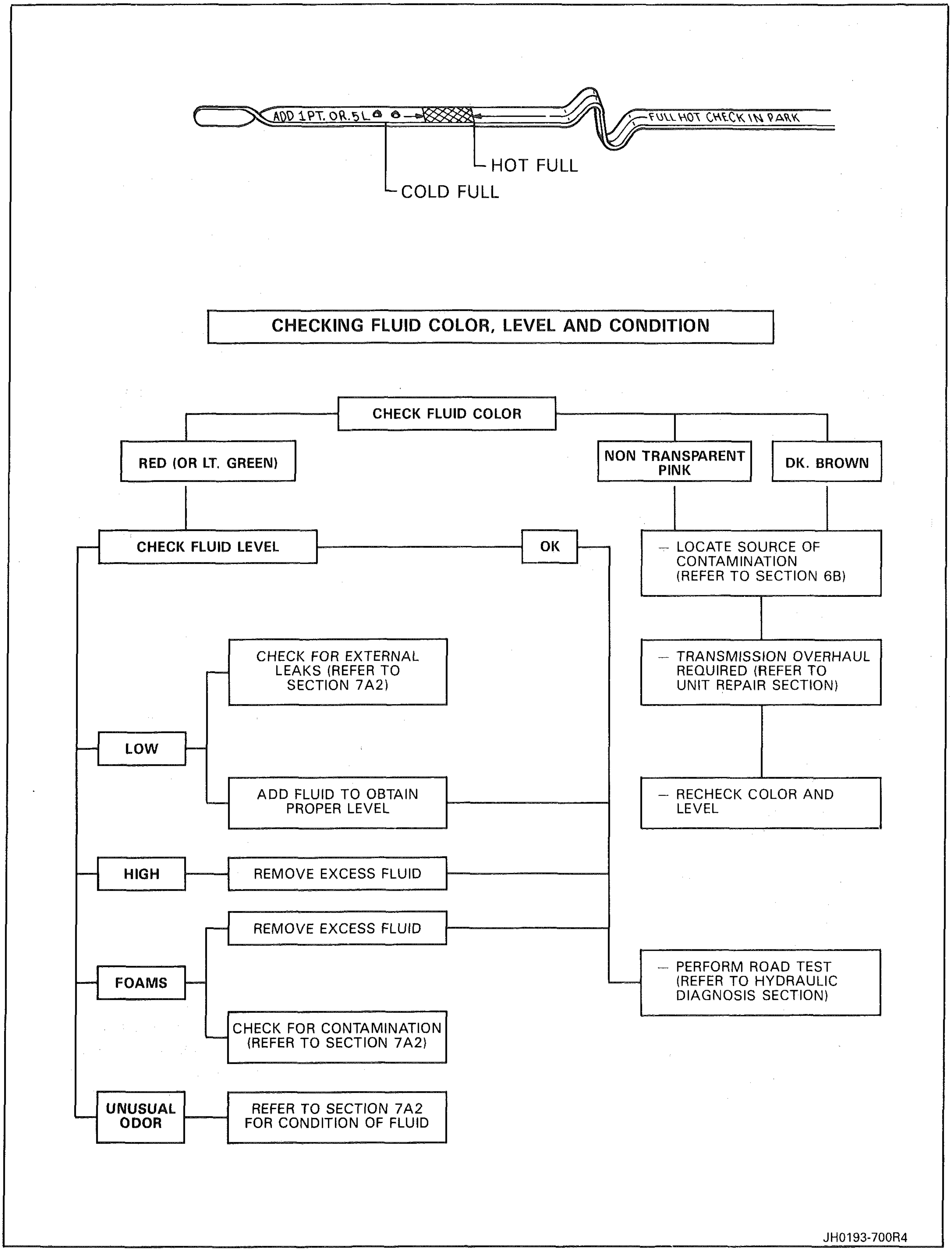


Figure 3 Checking Fluid Color, Level and Condition

SECTION 7A1

AUTOMATIC TRANSMISSION ON VEHICLE SERVICE

RPO-MD8

CONTENTS

GENERAL SERVICE PROCEDURES

PARTS CLEANING, INSPECTION AND REPLACEMENT

- Use appropriate safety equipment such as:
  - Safety glasses
  - Safety shoes
  - Gloves
- Keep work area and tools clean
- Clean transmission exterior before removing parts
- Do not use wipe cloths or rags
- Do not use solvents on:
  - Rubber seals
  - Plastic/Teflon® thrust washers
- Blow out all passages with compressed air
- Clean out small passages with fine wire
- Handle parts carefully to prevent damage
- Lubricate all internal parts with transmission fluid during assembly
- When installing screws, bolts or studs into aluminum always dip the threads in transmission fluid
- Always use a torque wrench for proper torque
- Recondition damaged or stripped aluminum threads with thread inserts
- Replace all gaskets and o-ring seals
  - Do not use gasket cement or sealers
- Replace Teflon® and rubber lip seals only when necessary and install using the appropriate seal protector

Inspect

- Manual linkage for:
  - Wear at pivoting points
  - Bent or broken links and rods
- All seals, gaskets, o-rings and mating surfaces for:
  - Nicks
  - Cuts
  - Damage
- Snap rings for:
  - Expansion or compression
  - Distortion
  - Nicks
  - Proper ring to groove fit
- Bearings and thrust surfaces for:
  - Wear
  - Scoring

Pitting

FLEXPLATE/TORQUE CONVERTER VIBRATION TEST PROCEDURE

1. Start engine
2. With engine at idle speed and the transmission in "Park" (P) or "Neutral" (N), observe vibration.
3. Shut off engine.

Remove or Disconnect

- Flexplate cover attaching bolts
- Flexplate to torque converter attaching bolts
- Rotate torque converter 120 (1/3 turn)

Install or Connect

- Flexplate to torque converter attaching bolts
  - Torque bolts to 47 N·m (35 lbs. ft.)
- Flexplate cover bolts
  - Torque bolts to 6 N·m (53 lbs. in.)

4. Start engine and check for vibration. Repeat this procedure until the best possible balance is obtained.

NOTICE: Some engine/transmission combinations cannot be balanced in this manner due to limited clearances between the torque converter bolts and engine. Be sure bolts do not bottom out in lug nuts or the torque converter cover could be dented and cause internal damage.

FLUID LEAK DIAGNOSIS

The cause of most external leaks can generally be located and repaired with the transmission in the car.

METHODS FOR LOCATING LEAKS

General Method

- Verify that the leak is transmission fluid.
- Thoroughly clean the suspected leak area.
- Operate the car for about 15 miles or until normal operating temperatures are reached.
- Park the car over clean paper or cardboard.
- Shut off engine and look for fluid spots on paper.
- Make necessary repairs.

Powder Method

- Thoroughly clean the suspected leak area with solvent.
- Apply an aerosol type powder (foot powder) to the suspected leak area.
- Operate the car for about 15 miles or until normal operating temperatues are reached.
- Shut off engine.
- Inspect suspected leak area and trace the leak path through the powder to find the source.
- Make necessary repairs.

Dye And Black Light Method

A fluid dye and black light kit is available from various tool manufacturers.

- Follow the manufacturer's recommendations for the amount of dye to be used.
- Detect the leak with the black light.
- Correct cause of leak.

REPAIRING THE LEAK

Once the leak has been pinpointed and traced back to its source, the cause of the leak must be determined in order for it to be repaired properly. If a gasket is replaced, but the sealing flange is bent, the new gasket will not repair the leak. The bent flange must be repaired also. Before attempting to repair a leak, check to be sure that the following conditions are correct as they may cause a leak.

Gaskets

- Fluid level/pressure is too high.
- Plugged vent or drain-back holes.
- Improperly torqued fasteners or dirty/damaged threads.
- Warped flanges or sealing surface.
- Scratches, burrs or other damage to the sealing surface.
- Damaged or worn gasket.
- Cracking or porosity of the component.
- Improper sealant used (where applicable).

Seals

- Fluid level/pressure is too high.
- Plugged vent or drain-back holes.
- Damaged seal bore (scratched, burred or nicked).
- Damaged or worn seal.
- Improper installation.
- Cracks in component.
- Manual or output shaft surface scratched, nicked or damaged.
- Loose or worn bearing causing excess seal wear.

Possible Points of Oil Leak

1. **Transmission/Transmission oil pan** :
   - Attaching bolts not correctly torqued
   - Improperly installed or damaged gasket
   - Oil pan or mounting face not flat
2. **Case Leak** :
   - Filler pipe "multi-lip seal" damaged or missing
   - Filler pipe bracket mislocated
   - T.V. cable "multi-lip" seal missing, damaged or improperly installed
   - Governor cover or "O" ring damaged or missing
   - Speedometer driven gear/speed sensor seal damaged
   - Manual shaft seal damaged
   - Oil cooler connector fittings loose or damaged

- Propeller shaft oil seal worn or damaged
- Governor cover
- Line pressure pipe plug loose
- Porous casting

3. **Leak at converter end:**

   Converter seal damaged
   - Seal lip cut. (Check converter hub for damage.)
   - Bushing moved forward and damaged
   - Garter spring missing from seal
   - Converter leak in weld area. (Refer to Torque Converter.)
   - Porous casting (Case or pump)

4. **Fluid comes out vent pipe or fill tube:**
   - Over-filled
   - Water or coolant in fluid. Fluid will appear milky.
   - Case porous
   - Incorrect fluid level indicator
   - Plugged vent
   - Drain back holes plugged
   - Mispositioned oil pump to case gasket (if equipped)

Case Porosity Repair

1. Clean the leak area with solvent and air dry.

   CAUTION: Epoxy adhesive may cause skin irritations and eye damage. Read and follow all information on the container label as provided by the manufacturer.
2. Mix a sufficient amount of epoxy adhesive, #1052533, or equivalent, following the manufacturer's recommendations.
3. While the transmission case is hot, apply epoxy adhesive with a clean, dry soldering acid brush.
4. Allow the epoxy adhesive to cure for three hours before starting the engine.
5. Repeat fluid leak diagnosis procedures.

TORQUE CONVERTER CLUTCH ELECTRICAL CONTROLS

The Torque Converter Clutch (TCC) system uses controls that are internal as well as external to the transmission. For internal control components of the TCC system, refer to the Hydraulic Diagnosis Section for for wiring diagrams and switch locations.

The external control components of the TCC system include:

1. **Brake Release Switch** - To avoid stalling the engine when braking, the converter clutch is released any time the brakes are applied.
2. **Electronic Control Module** - Receives input signals and grounds TCC solenoid to apply clutch when proper operating conditions are met.
3. **Throttle Position Sensor** - Sends throttle position information to Electronic Control Module.
4. **Vacuum Sensor** - Sends engine vacuum (load) information to Electronic Control Module.
5. **Vehicle Speed Sensor** - Sends vehicle speed information to Electronic Control Module.
6. **Coolant Temperature Sensor** - Sends engine coolant temperature information to Electronic Control Module.

TORQUE CONVERTER CLUTCH DIAGNOSIS

To properly diagnose the Torque Converter Clutch (TCC) system perform all electrical testing first and then the hydraulic testing. Refer to the appropriate Driveability and Emissions Section (6E) for additional Torque Converter Clutch Information

ON-VEHICLE SERVICE

SHIFT CONTROL CABLE

Remove or Disconnect (Fig. 1)

1. Negative battery cable.
2. Raise car, see Section OA.
3. Cable attachments at transmission.
4. Lower car.
5. Console, see Section 8C.
6. Cable at control lever and base.
7. Cable from floor.

Install or Connect

1. Cable to floor.
2. Cable at base and control lever.
3. Console, see Section 8C.
4. Place control lever in "NEUTRAL".
5. Raise car.
6. Cable attachments at transmission.
7. Adjust cable.
8. Lower car.
9. Negative battery cable.

Adjust (Fig. 1)

1. Place control lever in "N" (Neutral).
2. Raise car, see Section OA.
3. Loosen cable attachment at shift lever.
4. Rotate shift lever "clockwise" to park detent and then back to neutral.
5. Tighten cable attachment.
   - 15 N·m (11 lbs. ft.)

   Important

   Levar must be held out of "PARK" when torquing nut.
6. Lower car.
7. Check cable adjustment by rotating control lever thru the detents.

FLOORSHIFT CONTROL

Remove or Disconnect (Fig. 2)

1. Negative battery cable.
2. Console, see Section 8C.
3. Cable at control lever and base.

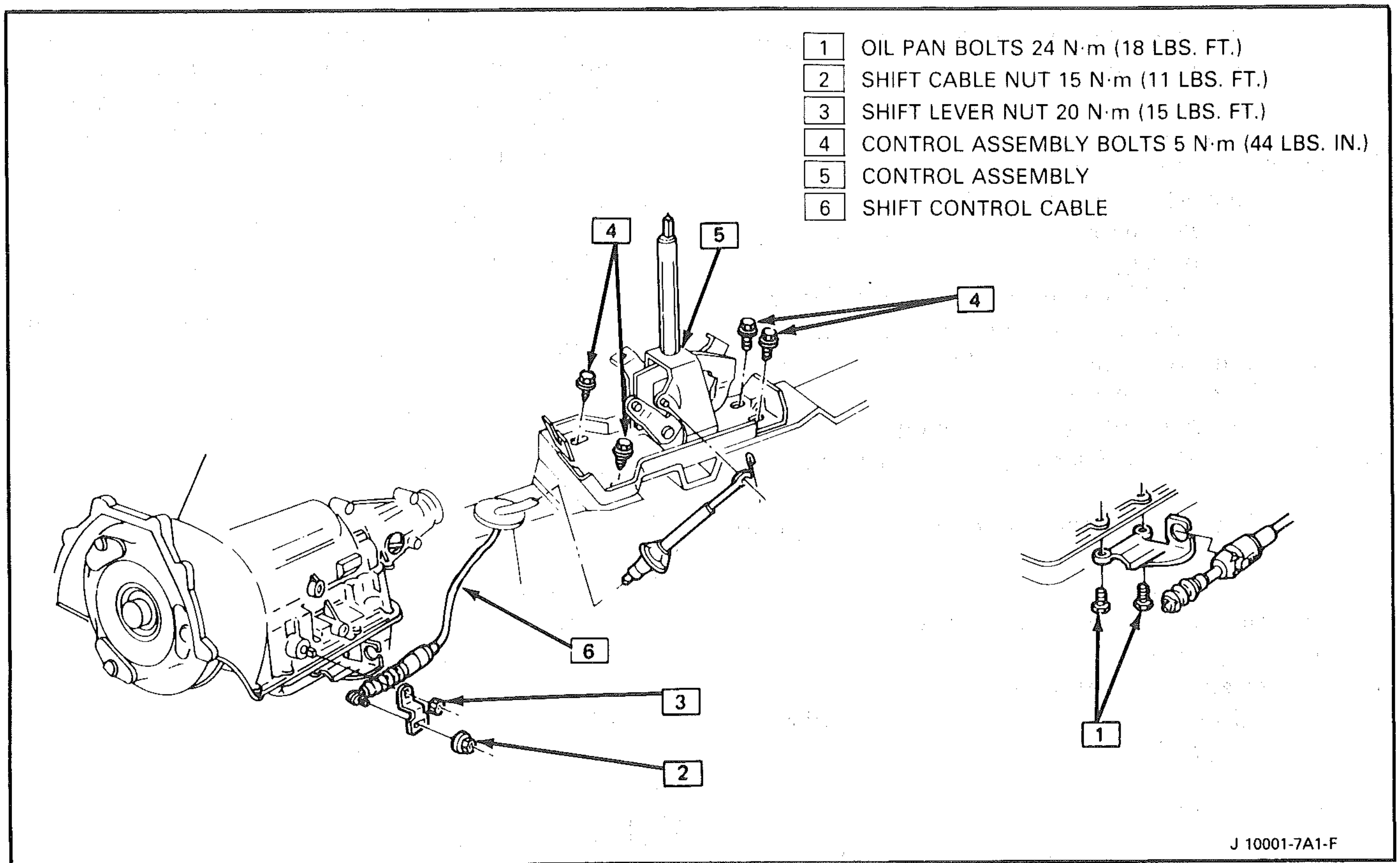


Fig. 1 Shift Control Cable Attachments

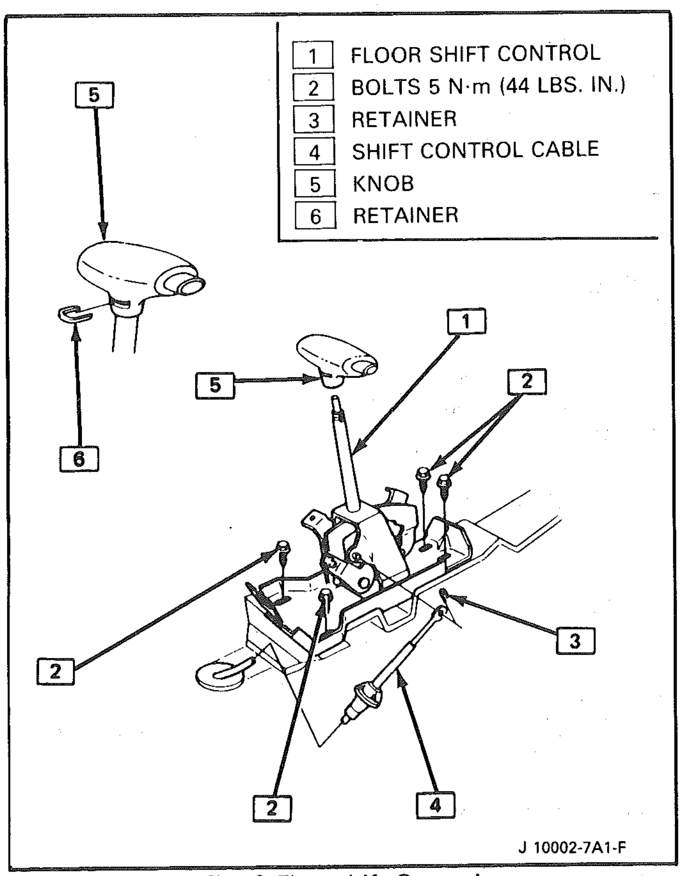


Fig. 2 Floorshift Control

4. Neutral start/back-up lamp switch.
5. Floorshift control bolts.

Install or Connect

1. Floorshift control bolts.
   - 5 N·m (44 lbs. in.)
2. Neutral start/back-up lamp switch.
   - 2 N·m (18 lbs. in.)
   - Adjust switch
3. Cable at base and control lever.
4. Console, see Section 8C.
5. Adjust shift control cable.
6. Negative battery cable.

PARK/LOCK CONTROL CABLE

Remove or Disconnect (Fig. 3)

1. Negative battery cable
2. Place transmission control lever in "Park".
3. Turn ignition key to "run" position.

Important

- Do not attempt to proceed to Step 4 with key in any other position.

4. Slip a screwdriver blade into slot provided in ignition switch inhibitor, depress cable latch and pull cable from inhibitor.
5. Push cable connector lock button at the shifter base to the up position.
6. Snap cable from park lock lever pin.

7. Depress two cable connector latches and remove from shifter base.
8. Cable clips

Install or Connect

1. With cable lock button in the up position and shift lever in the "Park" position, snap cable connector into shifter base.
2. With ignition key in "run" position, snap cable into inhibitor housing.

Important

- Do not attempt to insert cable with key in any other position.

3. Turn ignition key to "Lock".
4. Snap cable end onto shifter park lock lever pin.
5. Push cable connector hose forward to remove slack.
6. With no load applied to connector nose, snap cable connector lock button down.

Inspect

- Functional Operation
  1. With the shift lever in "Park" and the key in "Lock" position, make sure that you cannot move the shifter lever to another position. Ignition key should be removable from column.
  2. With the key in "run" and the shift lever in "Neutral", make sure that you cannot turn the key to "Lock".
  3. If the above conditions are met, the system is properly adjusted. Proceed to Step 5.
  4. If the above conditions are not met, put cable connector lock back to the up position and readjust as indicated in Steps 5 and 6 above, then push cable connector lock button down and recheck operation.
  5. If key cannot be removed in "Park" position, snap connector lock button to up position and move cable connector nose rearward until key can be removed from ignition.
  6. Snap lock button down.
  7. Reinstall cable into clips to provide correct routing.

PARK/NEUTRAL AND BACK-UP LAMP SWITCH

Remove or Disconnect (Fig. 4)

1. Negative battery cable.
2. Console, see Section 8C.
3. Mounting bolts.
4. Switch

Using Old Switch

Install or Connect

1. Place shift control lever shaft in "NEUTRAL".
2. Align carrier tang on switch with tang slot on shift control.
3. Assemble mounting bolts-to-case, loosely.
4. Rotate switch to align service adjustment hole with carrier tang hole.
5. Insert gage pin (2.34mm/3/32") in service adjustment hole and rotate switch until pin drops in to a depth of 15 mm (19/32").
6. Torque bolts.
   - 2 N·m (18 lbs. in.).
7. Gage pin
8. Console, see Section 8C.
9. Negative battery cable.

Important

- After switch adjustment, verify that engine will only start in "PARK" or "NEUTRAL". If engine will start in any other position readjust switch.

Using New Switch

Install or Connect

1. Place shift control lever in "NEUTRAL".
2. Insert carrier tang on switch in slot on shifter.
3. Mounting bolts and torque.
   - 2 N·m (18 lbs. in.)

   If bolt holes do not align with shift control verify shift control lever is in "NEUTRAL" position, do not rotate switch. Switch is pinned in "NEUTRAL" position.
   - If switch has been rotated and pin broken, switch can be adjusted by using the Using Old Switch" procedure.
4. Move shift control lever out of ""Neutral" position to shear plastic pin.

Important

- After switch installation verify that engine will only start in "PARK" and "NEUTRAL". If engine will start in any other position, readjust switch using "Old Switch" procedure.

5. Console, see Section 8C.
6. Negative battery cable.

T.V. CABLE

The T.V. cable used on the 700-R4 transmission controls line pressure, shift points, shift feel, part throttle downshifts and detent downshifts. The T.V. cable operates the throttle valve lever and bracket assembly in the control valve.

The Throttle Valve Lever and Bracket Assembly serves two (2) basic functions:

1. To transfer the throttle lever movement to the T.V. plunger in the control valve assembly. This causes T.V. pressure and line pressure to increase according to engine throttle opening and controls part throttle and detent downshifts.
2. To prevent the transmission from operating at low (idle) pressures, if the T.V. cable should

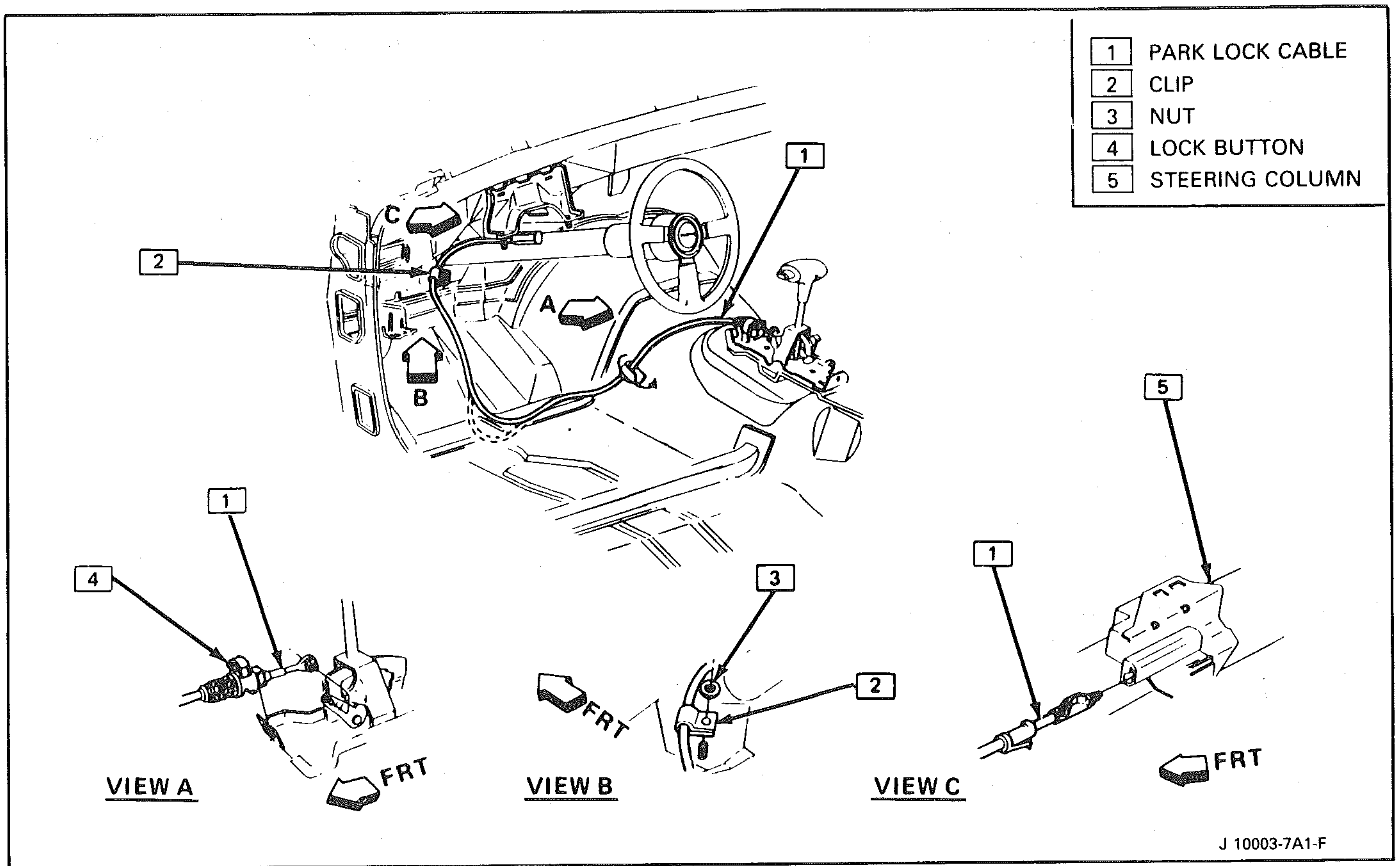


Fig. 3 Park Lock Cable

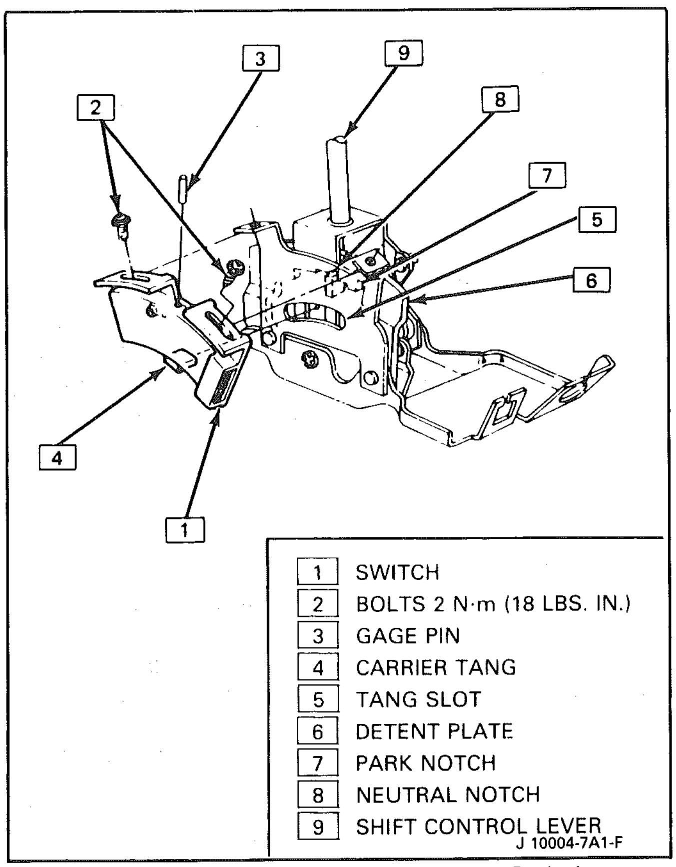


Fig. 4 Park/Neutral & Backup Lamp Switch

become broken or disconnected. If the cable is not connected or broken, the T.V. lifter rod will not move from its normal position which holds the T.V. exhaust check ball off its seat. The T. V. lifter rod will drop down to allow the T.V. exhaust ball to seat only if the cable is broken, disconnected or out of adjustment. With the transmission pan removed, pull down on the T.V. exhaust valve lifter rod and the spring should return the rod to its normal up position. If the throttle valve lever and bracket assembly or lifter rod binds or sticks so that the T.V. lifter rod cannot lift the exhaust ball off its seat, high line pressures and delayed upshifts will result. The T.V. lifter rod must not be bent or it will not function properly.

T.V. CABLE SYSTEM DIAGNOSIS

Inspect

CAUTION: To avoid possible personal injury and/or damage to the car, brakes must be applied at all times during the test.

1. Install oil pressure gage.
2. Install engine tachometer.
3. Warm up engine to proper operating temperature.
4. Run engine at 1000 RPM.
5. Apply parking brake.
6. Place gear selector in "PARK" and note oil pressure.

7. Place gear selector into "DRIVE". Oil Pressure should be equal or not more than 10 psi (34 kPa) higher than in "PARK".
8. Increase engine speed to 1400 RPM. If oil pressure does not increase, adjust T.V. cable. Refer to T.V. Cable Adjustment.

Remove or Disconnect (Figs. 5 thru 7)

1. Air cleaner.
2. T.V. cable terminal from throttle lever.
3. Cable housing from bracket while compressing locking tangs.
4. Routing clips or straps.
5. Raise car, see Section 0A.
6. Bolt securing T.V. cable to transmission.
   - Pull up on cable cover at transmission until cable is visible.
7. Cable from transmission link.
8. Cable seal.

Install or Connect

1. New seal into transmission case hole.
2. Transmission end of cable to T.V. link and secure to transmission case with bolt and washer assembly. Torque to 10 N·m (7 lb. ft.).
3. Cable routing clips or straps.
4. Lower car.
5. Pass cable through engine bracket and engage locking tangs of cable on bracket.
6. Avoid damaging or kinking wire cable.
7. Cable terminal to throttle lever.

Inspect

- Pull on upper end of cable. It should travel a short distance with light resistance caused by the small return spring on the T.V. lever. When releasing the upper end of the T.V. cable, it should return to the zero T.V. position.

Adjust

- T.V. cable. Refer to Figs. 5 thru 7.

CHANGING FLUID AND FILTER

Remove or Disconnect

1. Raise the car and support properly, see Section 0A.
2. Place drain pan under transmission oil pan.
3. Oil pan bolts from the front and sides only.
4. Loosen rear oil pan bolts approximately 4 turns.

NOTICE: Do not damage the transmission case or oil pan sealing surfaces.

5. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
   - Inspect fluid color
   - Refer to chart in Section 7A
6. Remaining oil pan bolts, oil pan and gasket.
7. Oil filter and o-ring
   - O-ring may be stuck in the case

Clean

- Transmission case and oil pan gasket surfaces with solvent and air dry.
  - All traces of old gasket material must be removed

Install or Connect

- Coat o-ring seal with a small amount of petrolatum
- New o-ring onto filter
- New filter into case
- Oil pan and new gasket
- Oil pan bolts 20 N·m (15 lbs. ft.)

8. Lower car.
9. Fill transmission to proper level with DEXRON® II fluid or equivalent, see Section 7A.
10. Check "Cold" fluid level reading for initial fill. Do not overfill.
11. Follow the "Transmission Fluid Level Checking Procedure" in Section 7A of this Service Manual.
12. Check oil pan gasket for leaks.

700-R4 SERVICEABLE COMPONENTS

The following parts can be serviced with the transmission in the vehicle:

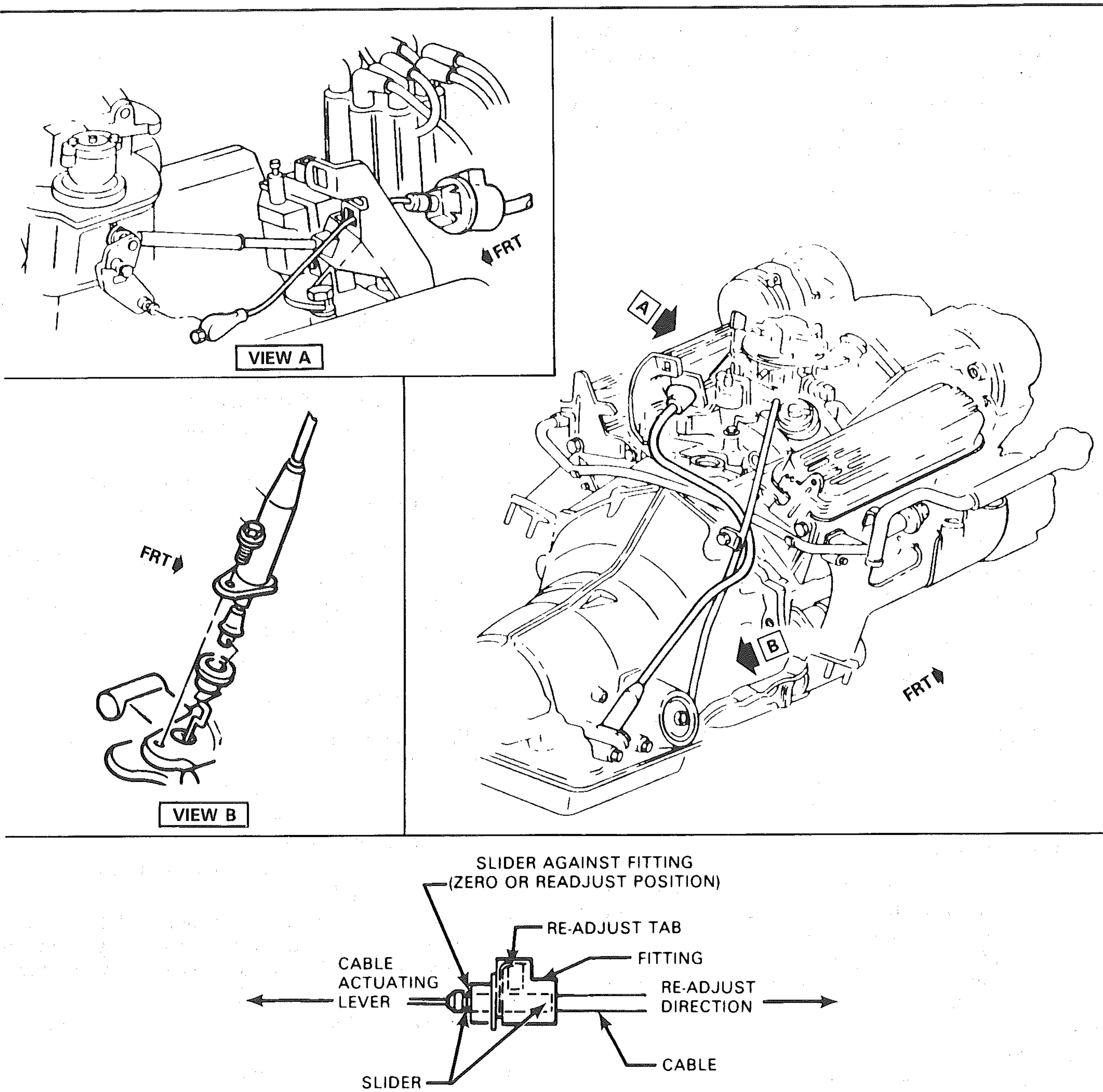
- Throttle valve control cable and/or sleeve seal
- Fill tube and/or seal
- Governor assembly
- Speedometer drive and/or driven gear
- Servo assembly
- Valve body assembly, spacer plate, gaskets, throttle lever and bracket assembly, auxiliary valve body, TCC solenoid, switch and wiring.
- Converter to flexplate bolts.
- Oil pan and/or gasket, strainer assembly and "O" ring.
- Pressure Regular Valve.
- Rear Oil Seal.

SERVO ASSEMBLY

Remove or Disconnect (Fig. 8)

Tool Required:
J 29714-A

1. Raise car and suitably support, see Section 0A.
2. Torque Arm, see Section 3D.
3. Propeller Shaft, see Section 4A.
4. Exhaust hanger.
5. Support transmission.
6. Crossmember and transmission mount.
7. Two transmission oil pan bolts below servo cover.
8. Install J 29714-A on oil pan and reinstall oil pan bolts.
9. Depress servo cover and remove retaining ring.
10. J 29714-A.



ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION OF CABLE TO THE TRANSMISSION, ENGINE BRACKET, AND CABLE ACTUATING LEVER, CHECK TO ASSURE THAT THE CABLE SLIDER IS IN THE ZERO OR FULLY RE-ADJUSTED POSITION (IF NOT, REFER TO RE-ADJUSTMENT PROCEDURE).
2. ROTATE THE CABLE ACTUATING LEVER TO ITS "**FULL TRAVEL POSITION**".
3. SLIDER MUST MOVE (RATCHET) TOWARD LEVER WHEN LEVER IS ROTATED TO "FULL TRAVEL POSITION".
4. RELEASE LEVER.

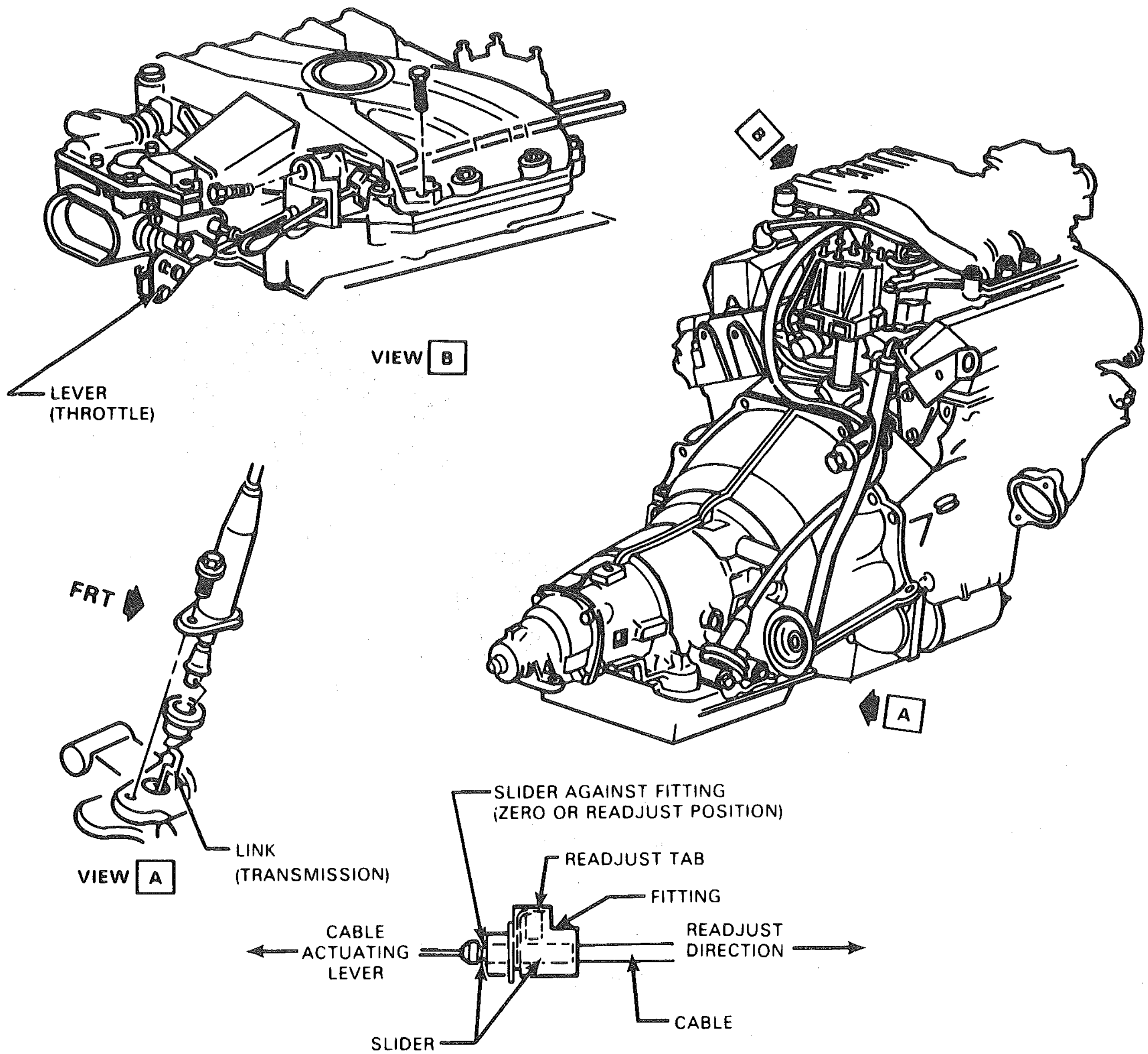
RE-ADJUSTMENT PROCEDURE

IN CASE RE-ADJUSTMENT IS NECESSARY BECAUSE OF INADVERTANT ADJUSTMENT BEFORE OR DURING ASSEMBLY, OR FOR REPROCESSING, PERFORM THE FOLLOWING:

1. DEPRESS AND HOLD METAL RE-ADJUST TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM CABLE ACTUATING LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE METAL RE-ADJUST TAB.
4. REPEAT STEPS 2 AND 3 OF ADJUSTMENT PROCEDURE.

J10005-7A1-F

Fig. 5 T.V. Cable — V.I.N. E



ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION OF CABLE TO THE TRANSMISSION, ENGINE BRACKET, AND CABLE ACTUATING LEVER, CHECK TO ASSURE THAT THE CABLE SLIDER IS IN THE ZERO OR FULLY RE-ADJUSTED POSITION (IF NOT, REFER TO RE-ADJUSTMENT PROCEDURE).
2. ROTATE THE CABLE ACTUATING LEVER TO ITS **"FULL TRAVEL POSITION"**.
3. SLIDER MUST MOVE (RATCHET) TOWARD LEVER WHEN LEVER IS ROTATED TO "FULL TRAVEL POSITION".
4. RELEASE LEVER.

RE-ADJUSTMENT PROCEDURE

IN CASE RE-ADJUSTMENT IS NECESSARY BECAUSE OF INADVERTANT ADJUSTMENT BEFORE OR DURING ASSEMBLY, OR FOR REPROCESSING, PERFORM THE FOLLOWING:

1. DEPRESS AND HOLD METAL RE-ADJUST TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM CABLE ACTUATING LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE METAL RE-ADJUST TAB.
4. REPEAT STEPS 2 AND 3 OF ADJUSTMENT PROCEDURE.

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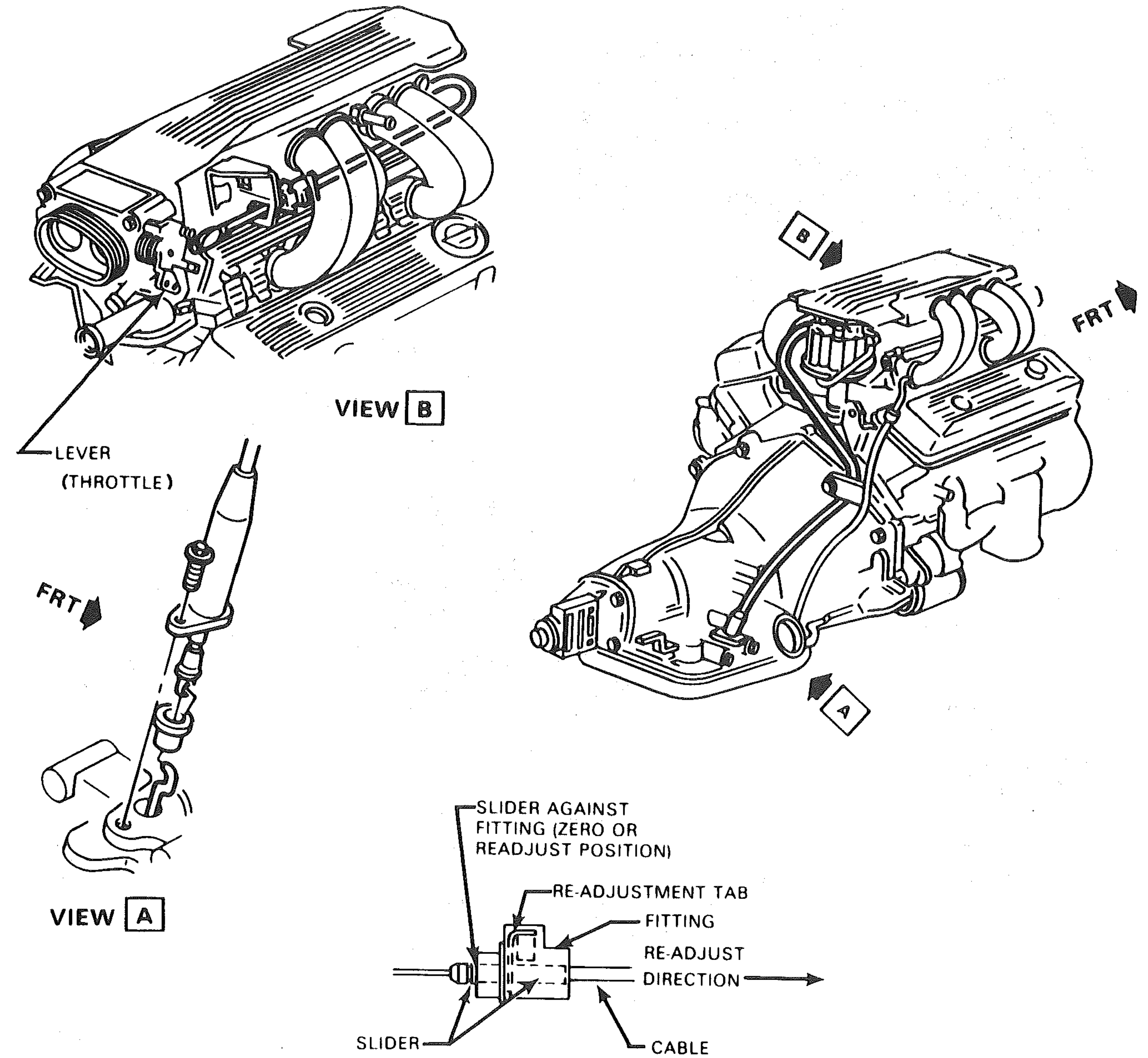
Fig. 6 T.V. Cable — V.I.N. S



ADJUSTMENT PROCEDURE

1. AFTER INSTALLATION OF CABLE TO THE ENGINE BRACKET AND THROTTLE IDLER LEVER, CHECK TO ASSURE THAT THE CABLE SLIDER IS IN THE ZERO OF FULLY RE-ADJUSTED POSITION (IF NOT, REFER TO THE RE-ADJUSTMENT PROCEDURE).
2. ROTATE THE THROTTLE IDLER LEVER TO THE "FULL TRAVEL STOP" POSITION.
3. SLIDER MUST MOVE (RATCHET) TOWARD LEVER WHEN LEVER IS ROTATED TO "FULL TRAVEL STOP POSITION".
4. RELEASE LEVER

RE-ADJUSTMENT PROCEDURE

1. DEPRESS AND HOLD METAL RE-ADJUSTMENT TAB.
2. MOVE SLIDER BACK THROUGH FITTING IN DIRECTION AWAY FROM THROTTLE IDLER LEVER UNTIL SLIDER STOPS AGAINST FITTING.
3. RELEASE RE-ADJUSTMENT TAB.
4. REPEAT STEP 2 & 3 OF ADJUSTMENT PROCEDURE.

G20014-7A2

Fig. 7 T.V. Cable — V.I.N. F and 8

11. Cover and seal ring.
    - Seal may stick in case.
12. Servo piston and bore apply pin assembly.

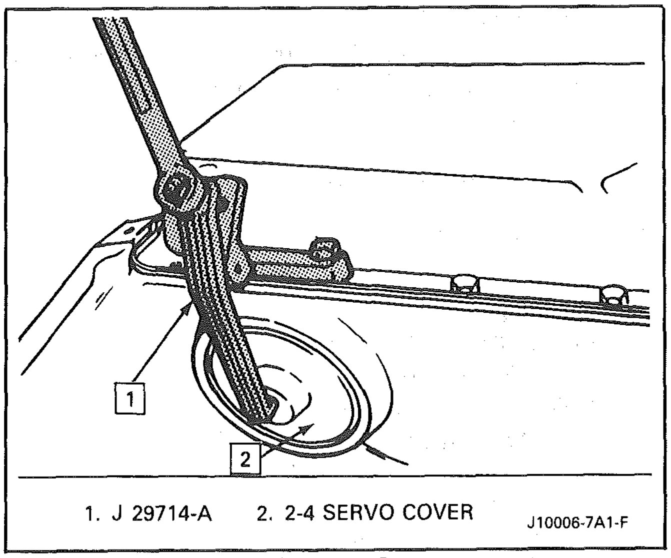


Fig. 8 Servo Cover

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Servo piston and bore apply pin assembly.
2. Seal ring and cover.
3. J 29714-A and two oil pan bolts.
4. Depress cover and install retaining ring.
5. Remove J 29714-A and bolts.
6. Oil pan bolts.
    - 20 N·m (15 lbs. ft.)
7. Crossmember and transmission mount.
    - Crossmember Bolts
        - 54 N·m (40 lbs. ft.)
    - Mount to Crossmember Nut
      47 N m (35 lbs. ft.)
    - Mount to Transmission Bolts
        - 54 N·m (40 lbs. ft.)
8. Remove transmission support.
9. Exhaust hanger.
10. Propeller Shaft, see Section 4A.
11. Torque Arm, see Section 3D.
12. Lower car.

Adjust

- Check and adjust fluid level, see Section 7A.
    - Dexron II Automatic Transmission Fluid.

SPEEDOMETER DRIVE GEAR

Remove or Disconnect (Fig. 9)

1. Raise car, see Section 0A.
2. Speedometer cable from transmission.
3. Speedometer driven gear and sleeve assembly.
4. Torque arm, see Section 3D.
5. Propeller Shaft, see Section 4A.
6. Extension housing bolts.
7. Extension housing.
8. Speedometer drive gear and retaining clip.

Install or Connect (Fig. 10)

1. Speedometer drive gear and retaining clip.
2. Seal ring and extension housing.
3. Extension housing bolts.
    - 34 N·m (26 lbs. ft.).
4. Propeller Shaft, see Section 4A.
5. Torque Arm, see Section 3D.
6. Speedometer driven gear and sleeve assembly.
7. Speedometer cable.
8. Lower car.

Adjust

- Check and adjust fluid level, see Section 7A.
    - Dexron II Automatic Transmission Fluid

SPEEDOMETER DRIVEN GEAR

Remove or Disconnect (Fig. 9)

1. Raise car, see Section 0A.
2. Speedometer cable.
3. Speedometer driven gear and sleeve assembly.

Install or Connect

1. Speedometer driven gear and sleeve assembly.
    - Use new "O" ring on sleeve.
2. Speedometer cable.
3. Lower car.

GOVERNOR

Remove or Disconnect (Fig. 9)

1. Raise car and suitably support, see Section 0A.
2. Governor cover and "O" ring using a screwdriver.
    - Use extreme care not to damage cover and case.
3. Governor assembly.
4. Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Governor assembly.
2. Governor cover with a new "O" ring.
    - Apply sealant such as Loctite Cup Plug Sealant II or equivalent to the cover.
3. Lower car.

Adjust

- Check and adjust fluid level, see Section 7A.
- Inspect for leaks at cover.

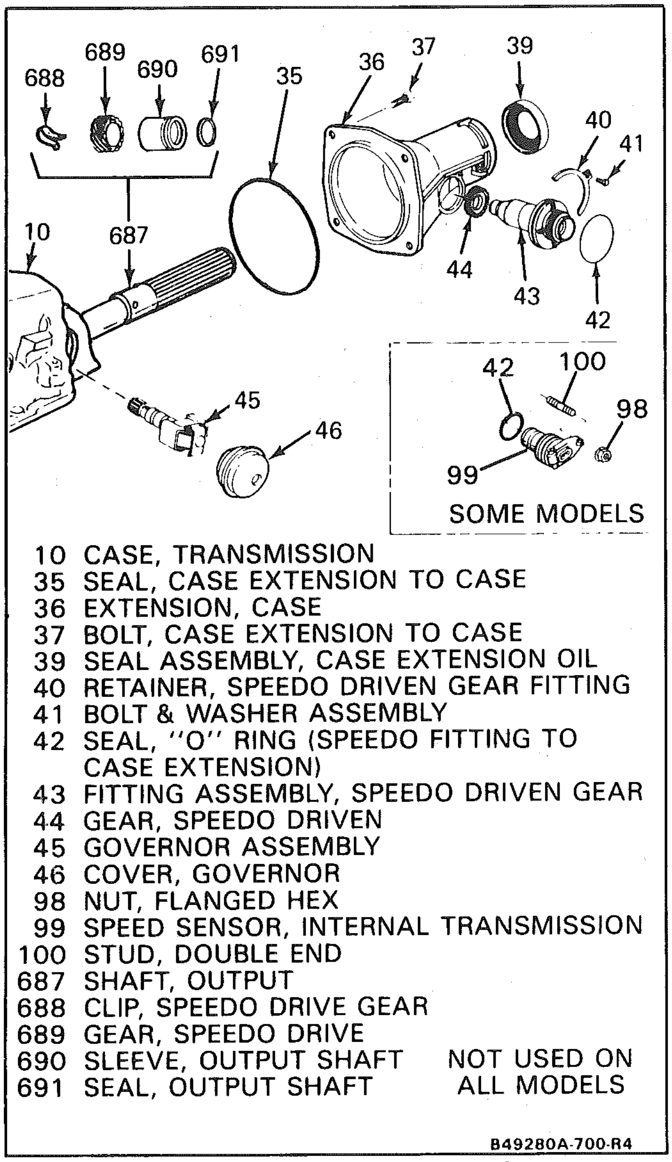


Fig. 9 Speedometer Drive/Driven Gears

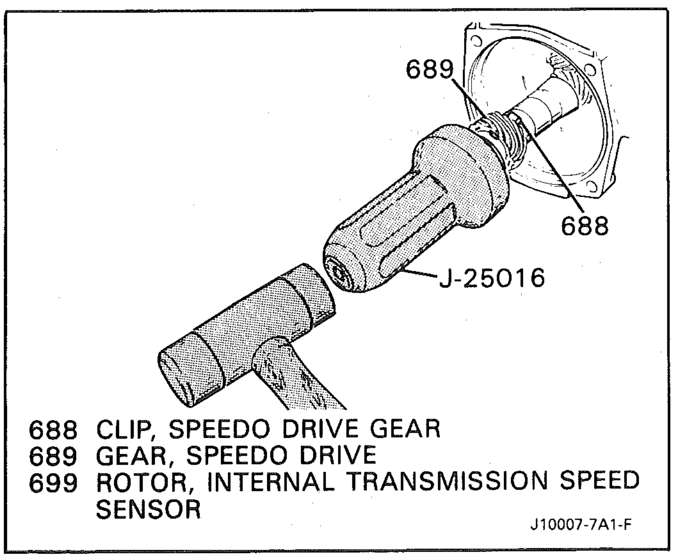


Fig. 10 Drive Gear

FILLER TUBE

Remove or Disconnect (Fig. 11)

1. Fluid level indicator.
2. Raise car and suitably support, see Section 0A.
3. Bolt retaining filler tube to transmission.
4. Loosen tube from transmission.
5. Lower car.
6. Pull tube out of car from the top.

Install or Connect

1. Filler tube.
2. Raise car.
3. Locate filler tube on transmission.
   - Use new filler tube seal.
4. Filler tube bolt to transmission.
   - 47 N·m (35 lbs. ft.) — V8
   - 75 N·m (55 lbs. ft.) — V6
5. Lower car.
6. Fluid level indicator.

- Check and adjust fluid level, see Section 7A.
- Inspect for leaks.

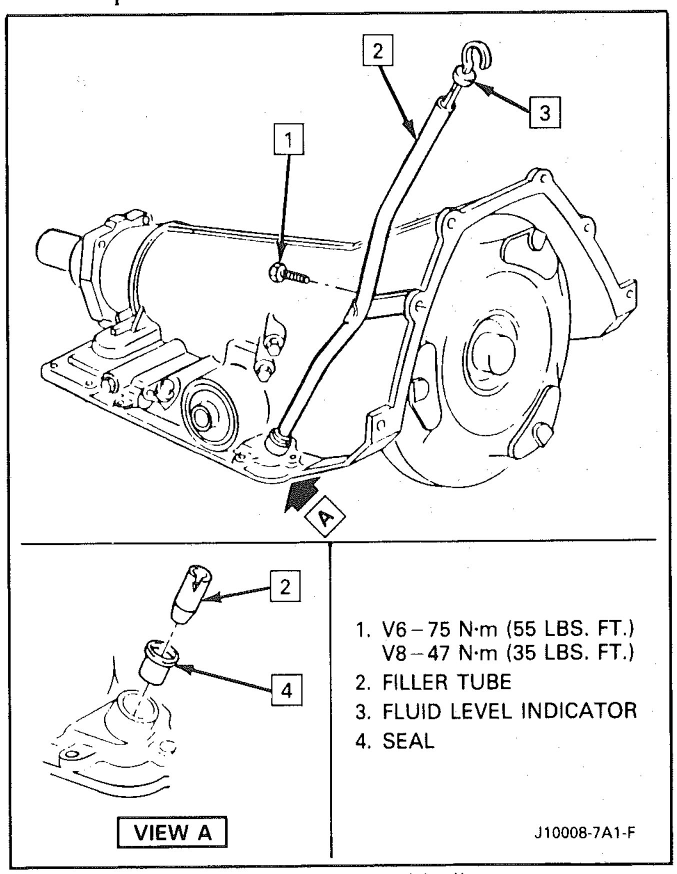
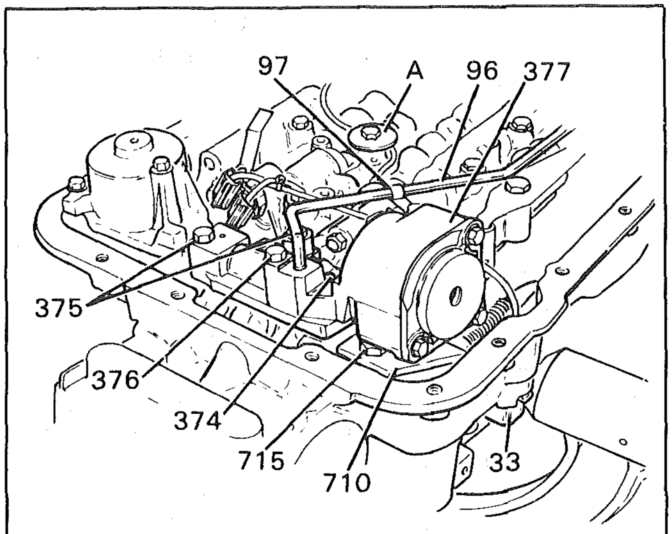


Fig. 11 Filler Tube and Indicator

PRESSURE REGULATOR VALVE

Remove or Disconnect

1. Raise car and suitably support, see Section 0A.
2. Drain transmission oil pan.
3. Oil pan and screen.
4. Compress pressure regulator valve with small screwdriver.



A WASHER, WIRE RETAINING
33 CONNECTOR, ELECTRICAL
96 TUBE, AUXILIARY ACCUMULATOR VALVE
97 CLAMP, TUBE
374 BOLT, SPECIAL HEX HEAD (M6 X 1 X 16)
375 BOLT, HEX HEAD (M6 X 1 X 35)
376 BOLT, HEX HEAD (M6 X 1 X 45)
377 AUXILIARY ACCUM. VALVE BODY ASM.
710 BRACKET, PARKING LOCK
715 BOLT, PARKING LOCK BRACKET

49239A-700-R4

Fig.12 Auxiliary Accumulator Valve Body

5. Retaining ring and slowly release spring tension.
6. Pressure regulator bore plug, valve, spring and guide. Refer to the specific Unit Repair Section for inspection procedures.

Install or Connect

1. Pressure regulator valve assembly.
2. Compress valve and insert retaining ring.
3. Oil pan and screen, using a new gasket.
4. Lower car.

Adjust

- Transmission fluid level.
  - Dexron II Automatic Transmission Fluid

AUXILLARY VALVE BODY

Remove or Disconnect (Fig. 12)

1. Negative battery cable
2. Raise car and suitably support, see Section 0A.
3. Place drain pan under transmission oil pan.
4. Oil pan bolts from the front and sides only.
5. Loosen rear bolts approximately (4) turns.

NOTICE: Do not damage case or oil pan sealing surfaces.

6. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
7. Remaining oil pan bolts, oil pan and gasket.
8. Oil filter and "O" ring.
   - "0" ring may be stuck in case.
9. Tube clamp (97).
10. Tube (96).
11. Bolts (374 thru 376), auxiliary valve body (377), and check ball.

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Check ball in valve body.
   - If necessary, use petroleum jelly to hold in place.
2. Auxiliary valve body to valve body with bolts (374 thru 376).
   - 11 N·m (8 lbs. ft.)
3. Tube (96)
4. Clamp (97)
5. New oil filter and "0"-ring.
   - Coat "0" with petrolatum.
6. Oil pan with new gasket.
   - All traces of old gasket material must be removed from case and pan.
7. Oil pan bolts.
   - 20 N·m (15 lbs. ft.)
8. Lower car.
9. Fill transmission to proper level with Dexron II fluid or equivalent, see Section 7A.
10. Negative battery cable

VALVE BODY

Remove or Disconnect

1. Negative battery cable.
2. T.V. cable at throttle lever.
3. Raise car, see Section 0A.
4. Place drain pan under transmission oil pan.
5. Oil pan bolts from the front and sides.
6. Loosen rear oil pan bolts approximately 4 turns.

NOTICE: Do not damage transmission case or oil pan sealing surfaces.

7. Lightly tap oil pan with rubber mallet or pry to allow fluid to drain.
8. Remaining oil pan bolts, oil pan and gasket.
9. Oil filter and "O" ring.
   - "O" may be stuck in case.
10. Valve body bolts.
    - Manual control valve link from range selector inner lever.
    - Throttle lever bracket from T.V. link.
    - Spacer plate and check balls.

Clean

- Oil pan and case of gasket material.
- Valve body components.

Inspect

- Refer to the Unit Repair Section for disassembly and inspection procedures.

Install or Connect

1. Valve body, spacer, check balls and bolts as outlined in the Unit Repair Section.
2. New "O" ring seal and oil filter.
   - Coat "O" ring seal with petrolatum.
3. New gasket, oil pan and bolts.
   - 20 N·m (15 lbs. ft.)
4. Lower car.
5. Fill transmission to proper level with Dexron II fluid or equivalent, see Section 7A.

Adjust

- T.V. cable, see Figs. 5 thru 7.

REAR OIL SEAL

Remove or Disconnect

Tool Required:
J 21426 Seal Installer

1. Raise car and suitably support, see Section 0A.
2. Propeller shaft, see Section 4A.
3. Pry out lip seal with a suitable tool.

Install or Connect

1. Coat outer casing of new lip oil seal with non-hardening sealer and tap in place with J 21426.
2. Propeller shaft, see Section 4A.
3. Lower car.

Adjust

- Transmission fluid level.
  - Dexron II Automatic Transmission Fluid

OIL COOLER LINES AND/OR FITTINGS

Figs. 13 and 14

If replacement of transmission cooler lines is required, use only double wrapped and brazed steel tubing meeting GM specification 123M or equivalent. Tubing should be double flared.

NOTICE: Allow sufficient clearance around cooler lines to prevent damage or wear which may cause fluid loss.

OIL COOLER FLUSHING

Tools Required:

J 35944 Cooler Flushing Tool
J 35944-20 Flushing Solution
Water Supply
Air Supply (with water and oil filter)
Oil Drain Container
5 Gallon Pail

1. Remove the fill cap on J 35944 and fill with .6 liters (20-21 ounces) of J 35944-20 flushing solution.
   - Do not over fill
   - Follow manufacture's suggested procedures for solution handling.
2. Replace cap on J 35944 and pressurize it to 550-700 kPa (80-100 psi).
3. Connect J 35944 to the transaxle end of the oil cooler pipe that feeds the BOTTOM fitting of the oil cooler.
4. Connect the discharge hose to the TOP oil cooler pipe and clip the discharge hose to the oil drain container.
5. With the water valve on J 35944 in the "off" position, connect the water supply to the tool.
6. Turn the water valve off.
7. Flush the transaxle fluid by opening the water valve to the "on" position for about 10 seconds.

Important

- If water does not flow thru the cooler the system is completely plugged. Do not complete the flushing procedure. Replace the cooler and/or the cooler pipes as required.

8. Close the water valve and clip the discharge hose to the 5 gallon pail. Cover the pail with a shop towel to prevent splash.
9. Turn the water valve to the "on" positon and depress the trigger to mix flushing solution into the water flow. Use the bail clip provided to hold the trigger down.
10. Flush the cooler with water and solution for 2 minutes. During this flush, attach the air supply to the air valve located on the tool, for 3 to 5 seconds every 15-20 seconds. This will create a surging action to ensure complete cleaning.
11. Release the trigger and turn the water valve off.
12. Disconnect both hoses from the oil cooler pipes.
13. Reconnect the hoses to the pipes opposite the initial flush to preform a backflush.
14. Repeat steps 9 and 10
15. Release the trigger and allow water to rinse for one minute.
16. Turn the water valve off.
17. Attach the air supply to the air valve and dry the system out with air until no moisture is seen leaving the discharge hose.
18. Connect the Cooler Feed Pipe to the transaxle.
19. Clip the discharge hose to the oil drain container.
20. After filling the transaxle with fluid, start the engine and run for 30 seconds. This will remove any residual moistrue from the oil cooler. A minimum of 2 quarts of fluid should flow during the 30 second period. If fluid flow is sufficient, check the fluid flow by disconnecting the feed

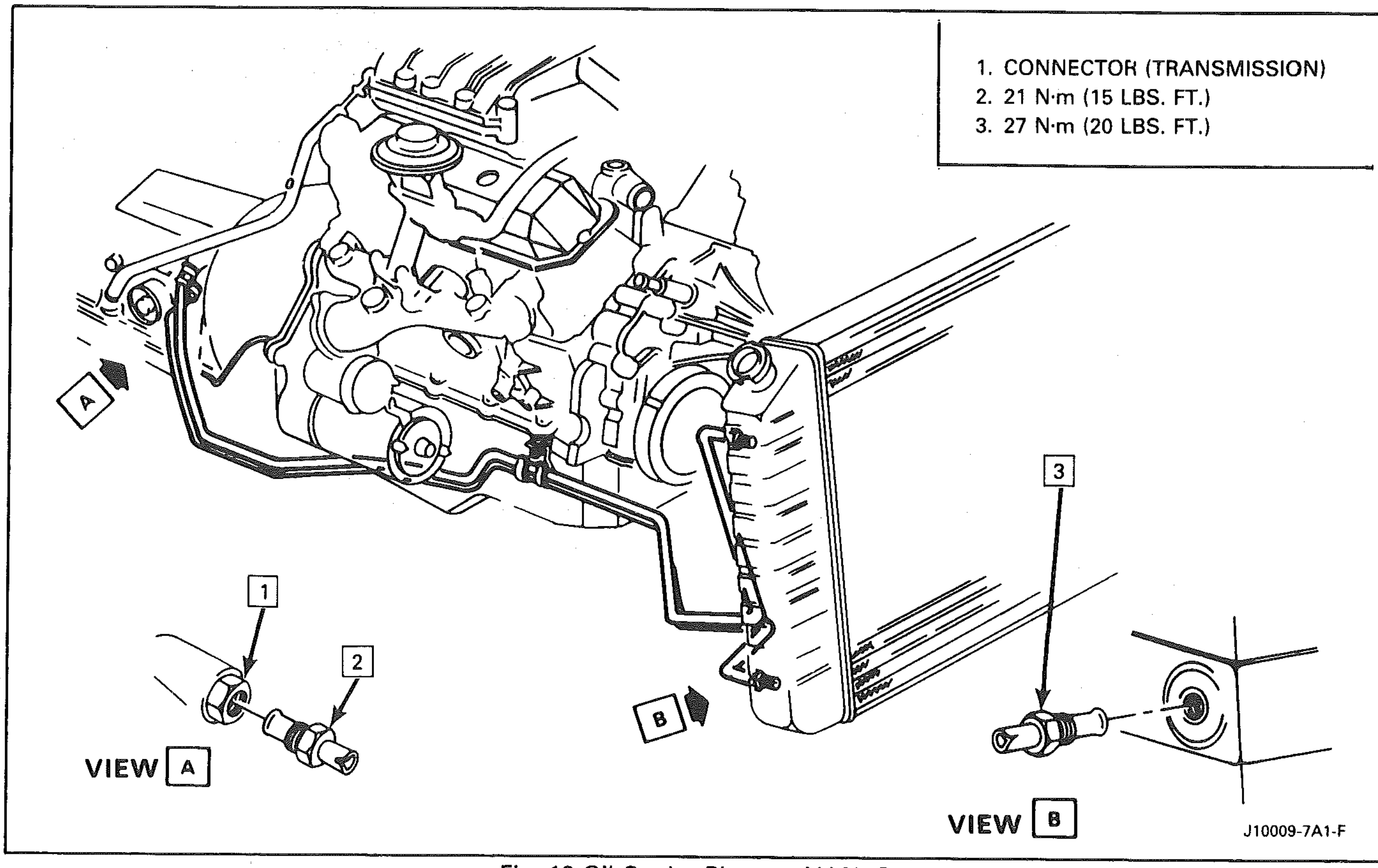


Fig. 13 Oil Cooler Pipes — V.I.N. S

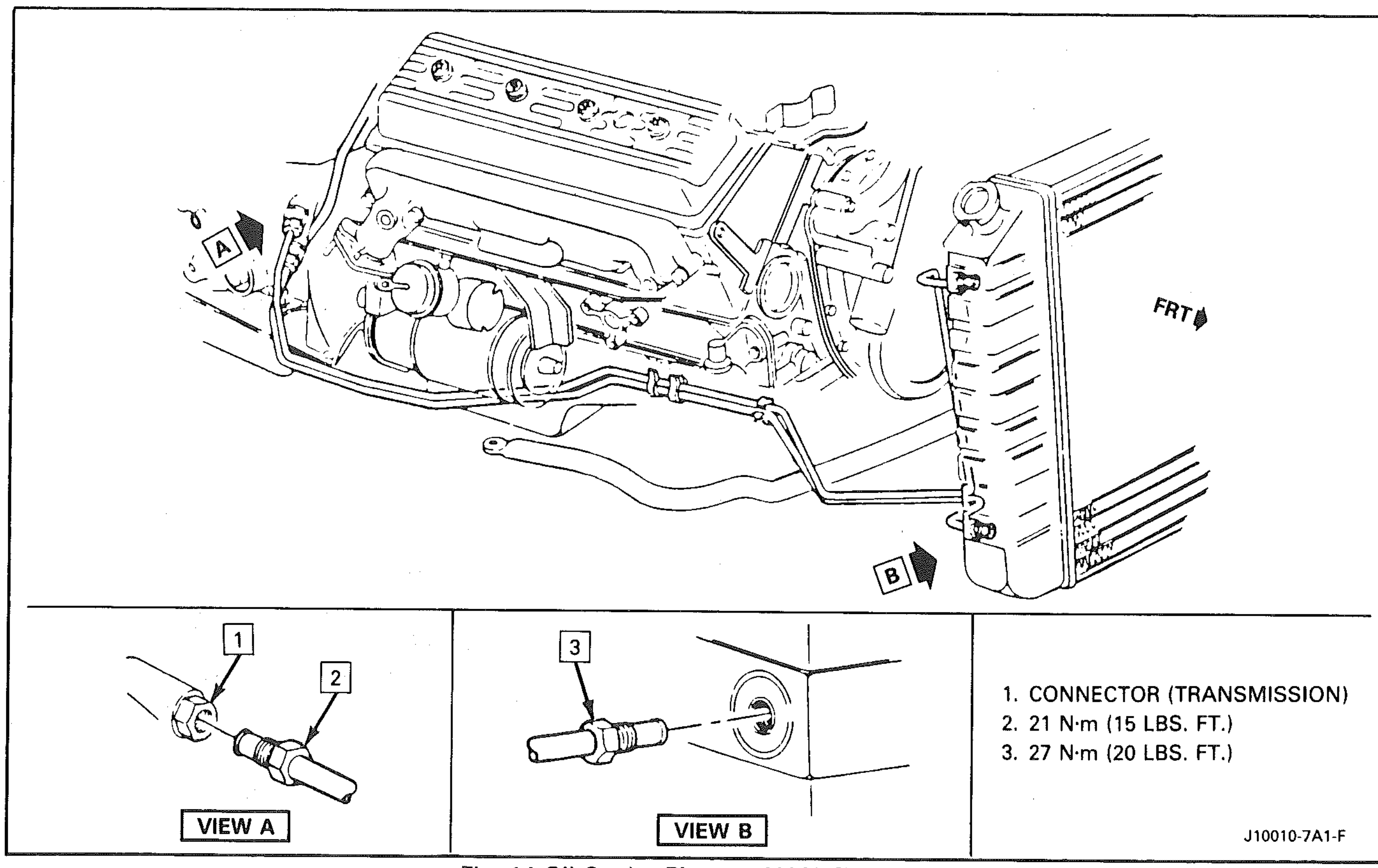


Fig. 14 Oil Cooler Pipes — V.I.N. E, F and 8

line at the cooler and observe the flow with the engine running.

- Insufficient flow: inspect cooler pipes, fittings and repeat cooler flushing procedure. If the flow is still insufficient, replace the cooler.

21. Remove the discharge hose and reconnect the cooler pipe. Adjust fluid level as needed.

TRANSMISSION ASSEMBLY

Figs. 13 thru 17

A pressure test should be performed before transmission removal to aid in diagnosis.

Tools Required:

J 21366 Torque Converter Holding Fixture

Remove or Disconnect

1. Negative battery cable.
2. Air cleaner.
3. T.V. cable at throttle lever.
4. Transmission fluid level indicator.
5. Raise car and suitably support, see Section 0A.
6. Speedometer cable.
7. Shift control cable.
8. Electrical leads at transmission.
9. Flexplate cover.
   - Mark flywheel to torque converter.
10. Torque converter bolts.
11. Torque arm, see Section 3D.
12. Propeller shaft, see Section 4A.
13. Support transmission.
14. Crossmember and mount bolts.
15. Oil cooler pipes at transmission.
16. T.V. cable at transmission.
17. Transmission to engine bolts.
18. Transmission.
    - Install J 21366 and remove transmission.

Clean

Transmission oil cooler and lines should be flushed with J35944 or equivalent whenever the transmission has been removed for overhaul or replacement of the torque converter, pump or case.

Install or Connect

1. Attach transmission jack.
2. Raise transmission.
   - Remove J 21366
3. Transmission to engine bolts.
   - 47 N·m (35 lbs. ft.)
4. Crossmember, mount and bolts.
   - Crossmember to body.
     - 54 N·m (40 lbs. ft.)
   - Mount to crossmember.
     - 47 N·m (35 lbs. ft.)
   - Mount to transmission.
     - 54 N·m (40 lbs. ft.)
5. Torque converter to flexplate bolts.
   - 47 N·m (35 lbs. ft.)
   - Align marks made during disassembly.
   - Flexplate cover.
6. Oil cooler lines.
7. T.V. cable.
8. Electrical leads at transmission.
9. Speedometer cable.
10. Shift control cable.
11. Propeller shaft, see Section 4A.
12. Torque arm, see Section 3D.
13. Lower car.
14. T.V. cable at throttle lever.
15. Negative battery cable.
16. Air cleaner.

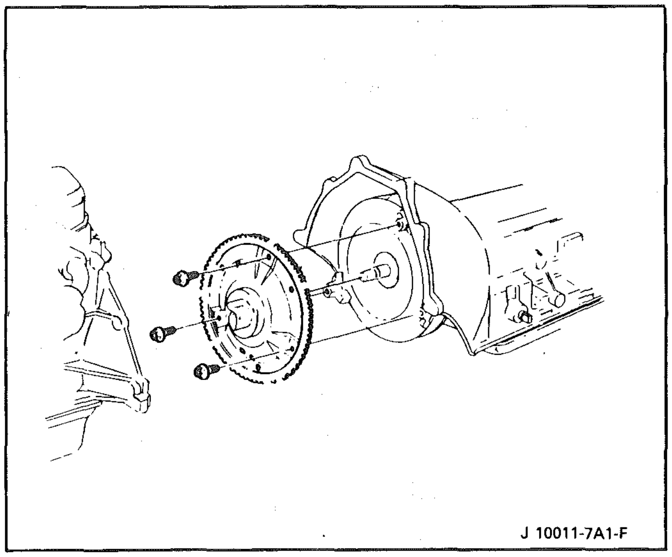


Fig. 15 Converter to Flexplate

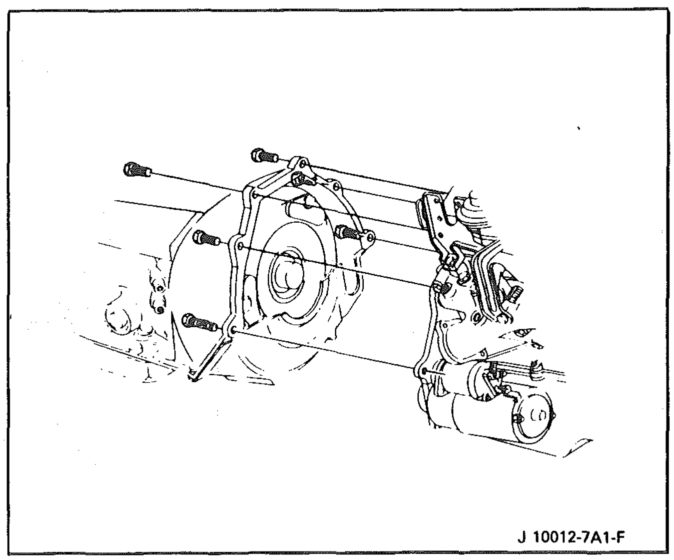


Fig. 16 Trans. to Engine

Fluid Capacity

- Pan Removal .... 10 pints (4.7 Litres)
- Overhaul .... 23 pints (10.9 Litres)

Recommended Fluid

Dexron II Automatic Transmission Fluid #1051855

Adjust

- Shift control cable.
- T.V. cable
- Fluid level
  - Dexron II Automatic Transmission Fluid

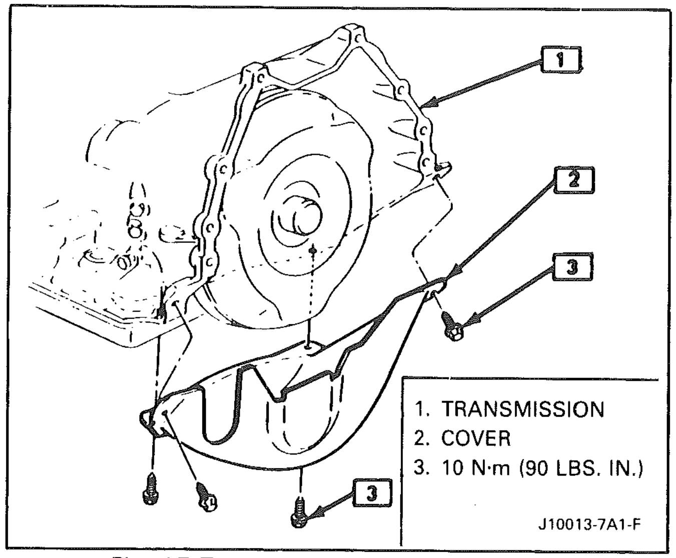


Fig. 17 Transmission Converter Shield

SECTION 7B

5-SPEED 77MM TRANSMISSION
RPO-M39 MK6 AND MB1

CONTENTS

GENERAL DESCRIPTION

Manual transmissions are identified by (A) the number of forward gears and (B) the measured distance between centerlines of the mainshaft and the countergear.

The 5-speed 77mm transmission is a fully synchronized unit with blocker ring synchronizers and a sliding mesh reverse gear. First and second gears have three-piece synchronizer rings, consisting of steel inner and outer cones and a tapered metal ring that is lined on both sides with friction material similar to automatic transmission friction plates. The cones are independent of the gears and can be replaced separately. Third and fourth gear blocker rings are more conventional in appearance, but are also lined with friction material. The fifth gear blocker ring is brass.

NOTICE: No lubricant other than Dexron II #1051855 or equivalent should be used in this transmission. Other lubricants or additives may damage the blocker ring friction material or its adhesive.

The mainshaft and the countershaft are supported on tapered roller bearings and must be shimmed for proper end play. First through fourth speed mainshaft gears ride on caged roller bearings. An aluminum transmission case houses the various gears and bearings. The gearshift lever assembly is floor-mounted and is located on top of the extension housing. The shift mechanism does not require adjustment and can be serviced independently of the transmission.

Condition	Possible Cause	Correction
TRANSMISSION SHIFTS HARD	Clutch travel incorrect	Refer to Clutch Section
	Clutch housing bore to crankshaft pilot misaligned	Check alignment and adjust as necessary
	Shift rail binding	Check for mispositioned selector arm roll pin, loose cover bolts, worn shift rail bores, worn shift rail, distorted oil seal, or extension housing not aligned with case. Repair as necessary.
	Internal bind in transmission caused by shift forks, selector plates, or synchronizer assemblies	Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
	Incorrect lubricant	Drain and refill transmission.
GEAR CLASH WHEN SHIFTING FROM ONE GEAR TO ANOTHER	Clutch travel incorrect	Refer to clutch section
	Lubricant level low or incorrect lubricant	Drain and refill transmission and check for lubricant leaks if level was low. Repair as necessary.
	Gearshift components, or synchronizer assemblies worn or damaged	Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
TRANSMISSION NOISY	Lubricant level low or incorrect lubricant	Drain and refill transmission. If lubricant level was low, check for leaks and repair as necessary.
	Clutch housing-to-engine, or transmission-to-clutch housing bolts loose	Check and correct bolt torque as necessary.
	Clutch housing bore to cranksahft pilot misaligned	Check alignment and adjust as necessary
	Gearshift mechanism, transmission gears, or bearing components worn or damaged	Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
JUMPS OUT OF GEAR	Offset lever plastic insert worn or lever loose	Remove gearshift lever and check for loose offset lever or worn insert. Repair or replace as necessary.
	Gearshift mechanism, shift forks, selector plates, interlock plate, selector arm, shift rail, springs or shift cover worn or damaged	Remove, disassemble and inspect transmission cover assembly. Replace worn or damaged components as necessary.
	Gear teeth worn or tapered, synchronizer assemblies worn or damaged, excessive end play caused by worn thrust washers or output shaft gears	Remove, disassemble and inspect transmission. Replace worn or damaged components as necessary.
WILL NOT SHIFT INTO ONE GEAR	Gearshift selector plates, interlock plate, or selector arm, worn, damaged, or incorrectly assembled	Remove, disassemble, and inspect transmission cover assembly. Repair or replace components as necessary.
	Synchronizer sleeves or hubs, damaged or worn	Remove, disassemble and inspect transmission. Replace worn or damaged components.
LOCKED IN ONE GEAR - CAN NOT BE SHIFTED OUT	Shift rail(s) worn or broken, shifter fork bent or worn	Inspect and replace worn or damaged parts.
	Gearshift lever worn, shift mechanism in cover incorrectly assemble or broken, worn damaged gear train components	Disassemble transmission. Replace damaged parts or assemble correctly.

J10040-7B-F

Figure 1 Diagnosis

ON-VEHICLE SERVICE

SHIFT CONTROL LEVER

Remove or Disconnect

1. Screws from transmission shift lever boot retainer and slide boot up lever.
2. Shift lever attaching bolts at transmission and remove lever.

NOTICE: The upper lever is no longer threaded to the lower lever. The levers are bonded together. Separation of the levers will damage the shifter requiring replacement of the shifter assembly.

Install or Connect

1. Shift lever and attaching bolts to transmission.
2. Shift lever boot, boot retainer and retainer screws to transmission.

TRANSMISSION

Figure 2

Remove or Disconnect

1. Negative cable at battery.
2. Shift lever attaching bolts from transmission.

NOTICE: The upper lever is no longer threaded to the lower lever. The levers are bonded together. Separation of the levers will damage the shifter requiring replacement of the shifter assembly.

3. Raise vehicle.
4. Torque arm. (See Section 3D)
5. Propeller shaft. (See Section 4A)
6. Speedometer cable at transmission.
7. Electrical connection at transmission.
8. Support transmission with suitable jack stand.
9. Transmission mount attaching bolts.
10. Catalytic converter hanger.
11. Crossmember attaching bolts.
12. Crossmember.
13. Dust cover bolts.
14. Transmission to engine attaching bolts.
15. Transmission.

NOTICE: Inspection of clutch components should be made after transmission removal. If the clutch requires repair, see section 7C before transmission is reinstalled.

Install or Connect

1. Transmission.
2. Transmission to engine attaching bolts.
3. Dust cover bolts.
4. Crossmember
5. Crossmember attaching bolts.
6. Catalytic converter hanger.
7. Transmission mount attaching bolts.
8. Remove jack stand supporting transmission.
9. Electrical connection to transmission.
10. Speedometer cable to transmission.
11. Propeller shaft. (See Section 4A)
12. Torque arm. (See Section 3D)
13. Lower vehicle.
14. Shift lever attaching bolts to transmission.
15. Negative cable to battery.

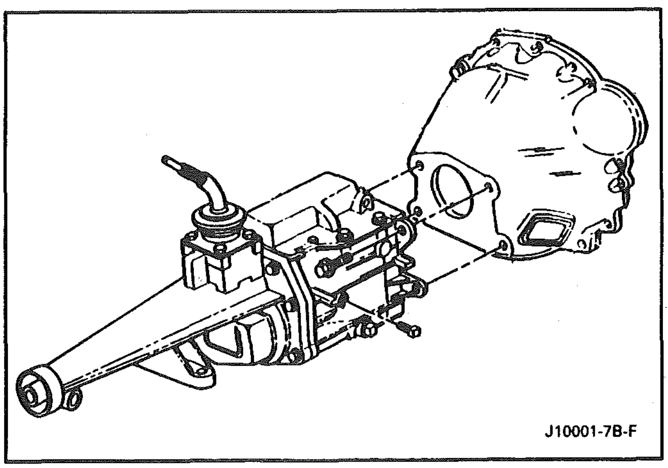


Figure 2 Transmission To Engine Attachment

EXTENSION HOUSING OIL SEAL

Figure 3

Remove or Disconnect

1. Raise vehicle.
2. Propeller shaft. (See Section 4A)
3. Pry seal out of extension housing using a screwdriver.

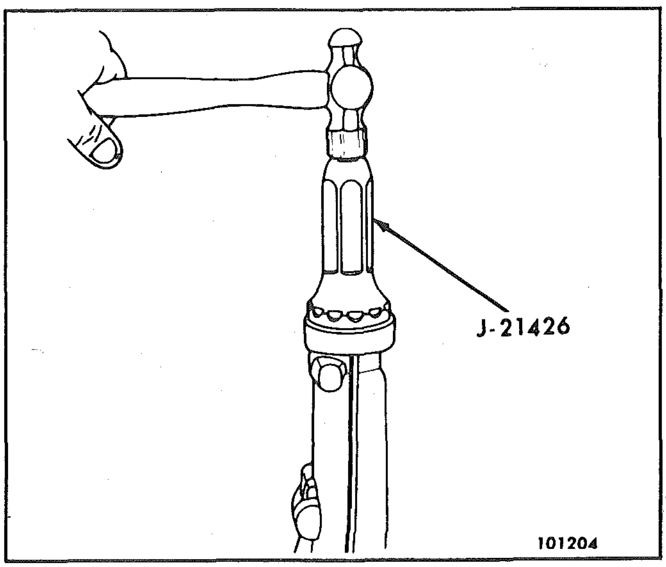


Figure 3 Extension Housing Oil Seal

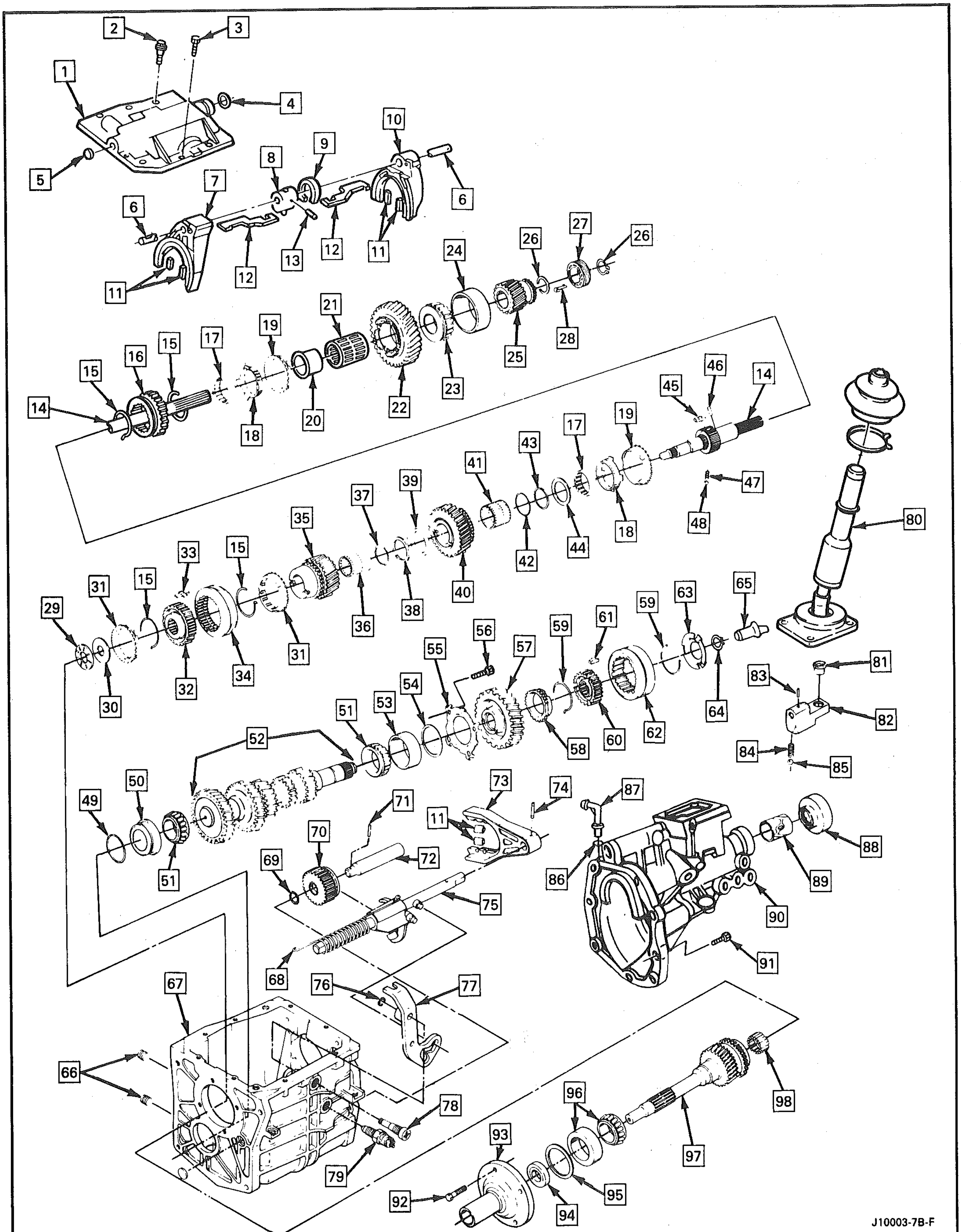


Figure 4 5-Speed 77mm Transmission

1. COVER, TRANSMISSION
2. BOLT, ALIGNMENT DOWEL
3. BOLT
4. SEAL, O-RING
5. PLUG, SHIFT RAIL
6. RAIL, SHIFT
7. FORK, 3RD AND 4TH SHIFT
8. ARM, SELECTOR
9. PLATE, GEAR SELECT INTERLOCK
10. FORK, 1ST AND 2ND SHIFT
11. INSERT, SHIFT FORK
12. PLATE, SHIFT FORK
13. PIN, ROLL – SELECTOR ARM
14. SHAFT, MAIN WITH 1ST AND 2ND SYNCHRONIZER HUB
15. SPRING, SYNCHRONIZER
16. GEAR, REVERSE SLIDING
17. CONE, INNER – 1ST AND 2ND SYNCHRONIZER
18. CONE, OUTER – 1ST AND 2ND SYNCHRONIZER
19. RING, BLOCKER – 1ST AND 2ND SYNCHRONIZER
20. SLEEVE, 1ST GEAR BEARING
21. BEARING, 1ST GEAR
22. GEAR, 1ST SPEED
23. BEARING, MAINSHAFT REAR
24. RACE, MAINSHAFT REAR BEARING
25. GEAR, 5TH SPEED DRIVEN
26. RING, SNAP
27. GEAR, SPEEDOMETER DRIVE
28. CLIP, SPEEDOMETER DRIVE GEAR
29. BEARING, MAIN DRIVE GEAR THRUST
30. RACE, MAIN DRIVE GEAR THRUST BEARING
31. RING, BLOCKER – 3RD AND 4TH SYNCHRONIZER
32. HUB, 3RD AND 4TH SYNCHRONIZER
33. KEY, SYNCHRONIZER
34. SLEEVE, 3RD AND 4TH SYNCHRONIZER
35. GEAR, 3RD SPEED
36. BEARING, 3RD GEAR
37. SPACER, 3RD GEAR BEARING
38. RING, SNAP 2ND GEAR THRUST WASHER
39. WASHER, THRUST – 2ND GEAR
40. GEAR, 2ND SPEED
41. BEARING, 2ND GEAR
42. SPACER, 2ND GEAR BEARING
43. RING, SPIRAL RETAINING – 2ND SYNCHRONIZER
44. WASHER, THRUST – 2ND SYNCHRONIZER
45. KEY, 1ST-2ND SYNCHRONIZER
46. PIN, LOCATING – 1ST SPEED BEARING SLEEVE
47. SPRING, ANTI-RATTLE
48. BALL, ANTI-RATTLE
49. O-RING, BEARING RACE
50. RACE, FRONT COUNTERSHAFT BEARING
51. BEARING, COUNTERSHAFT
52. GEAR CLUSTER, COUNTERSHAFT
53. RACE, REAR COUNTERSHAFT
54. SHIM, COUNTERSHAFT BEARING ADJUSTMENT
55. RETAINER, COUNTERSHAFT
56. BOLT, COUNTERSHAFT RETAINER
57. GEAR, 5TH SPEED DRIVE
58. RING, BLOCKER – 5TH SYNCHRONIZER
59. SPRING, 5TH SYNCHRONIZER
60. HUB, 5TH SYNCHRONIZER
61. KEY, 5TH SYNCHRONIZER
62. SLEEVE, 5TH SYNCHRONIZER
63. RETAINER, 5TH SYNCHRONIZER
64. RING, SNAP – 5TH SYNCHRONIZER RETAINER
65. FUNNEL, TRANSMISSION OILING
66. PLUG, FILL AND DRAIN
67. CASE, TRANSMISSION
68. SPRING, REVERSE LOCK
69. O-RING, REVERSE IDLER
70. GEAR, REVERSE IDLER
71. PIN, ROLL – REVERSE IDLER
72. SHAFT, REVERSE IDLER
73. FORK, 5TH SHIFT
74. PIN, ROLL – SHIFT FORK
75. RAIL, 5TH AND REVERSE SHIFT
76. RETAINER, SPRING CLIP – 5TH AND REVERSE LEVER
77. LEVER, 5TH AND REVERSE SHIFT
78. BOLT, 5TH AND REVERSE SHIFT LEVER PIVOT
79. SWITCH, REVERSE LAMP
80. CONTROL, TRANSMISSION SHIFT LEVER AND HOUSING
81. SLEEVE, SHIFT LEVER DAMPER
82. LEVER, OFFSET SHIFT
83. PIN, ROLL – OFFSET LEVER
84. SPRING, DETENT
85. BALL, DETENT
86. O-RING, EXTENSION HOUSING VENT
87. VENT, EXTENSION HOUSING
88. SEAL, EXTENSION HOUSING REAR OIL
89. BUSHING, EXTENSION HOUSING
90. HOUSING, EXTENSION
91. BOLT, EXTENSION HOUSING
92. BOLT, DRIVE GEAR BEARING RETAINER
93. RETAINER, DRIVE GEAR BEARING
94. SEAL, DRIVE GEAR BEARING RETAINER OIL
95. SHIM, MAINSHAFT BEARING ADJUSTMENT
96. BEARING, FRONT MAIN DRIVE GEAR
97. GEAR, MAIN DRIVE
98. ROLLERS, BEARING – MAIN DRIVE GEAR PILOT

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Figure 5 5-Speed 77mm Transmission

Install or Connect

1. New seal using Tool J 21426.
2. Propeller shaft. (See Section 4A)
3. Lower vehicle.
4. Check transmission fluid level.

SPEEDOMETER DRIVEN GEAR

Remove or Disconnect

1. Raise vehicle.
2. Speedometer cable.
3. Lock plate and retaining bolt.
4. Pry gear fitting and shaft from housing.
5. O-ring from fitting.

Install or Connect

1. Coat driven gear shaft and new O-ring with transmission lubricant.
2. New O-ring.
3. Insert shaft.
4. Position fitting into extension housing.
5. Lock plate and retaining bolt.
6. Speedometer cable.
7. Lower vehicle.

UNIT REPAIR

TRANSMISSION

Figure 4

Disassemble

Clean

- Exterior of the transmission assembly thoroughly with appropriate solvent.

1. Remove drain bolt on transmission case and drain lubricant.
2. Position offset lever in neutral gate (centered).

NOTICE: Removal of offset lever in position other than neutral (centered) may result in driving the roll pin into the detent plate without releasing lever, making further disassembly extremely difficult.

3. Using pin punch and hammer, remove roll pin attaching offset lever to shift rail (Figure 6).

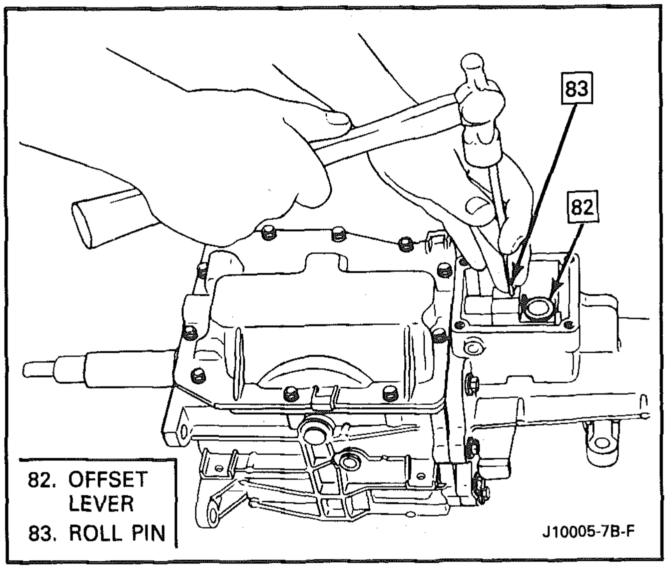


Figure 6 Offset Lever (Removal and Installation)

4. Extension housing-to-transmission case bolts.
5. Housing and offset lever as an assembly (Figure 7).

NOTICE: Do not attempt to remove the offset lever while the extension housing is still bolted in place. The lever has a positioning lug engaged in the housing detent plate which prevents moving the lever far enough for removal.

6. Detent ball and spring from offset lever (Figure 8).
7. Roll pin from extension housing or offset lever.
8. Carefully pry oiling funnel from rear of counter-shaft (Figure 9).
9. Bolts attaching transmission cover and shift fork assembly to case.

NOTICE: Two of the transmission cover attaching bolts are alignment-type dowel bolts. Note the location of these bolts for assembly reference.

10. Cover (Figure 10).

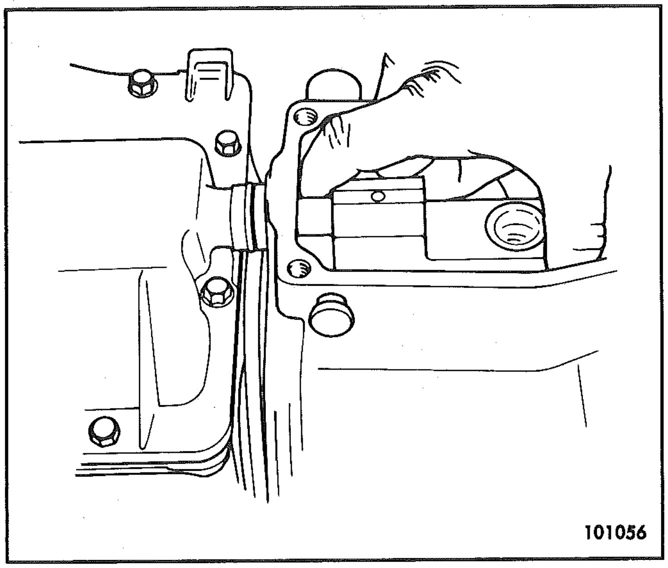


Figure 7 Extension Housing to Transmission Case

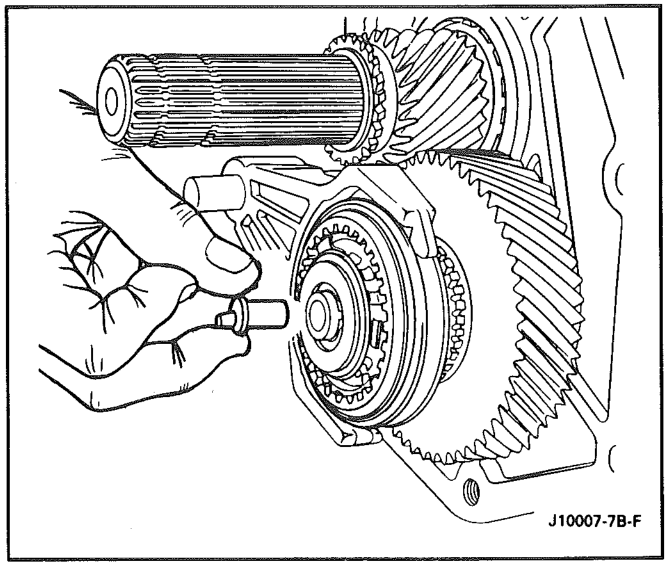


Figure 9 Oiling Funnel

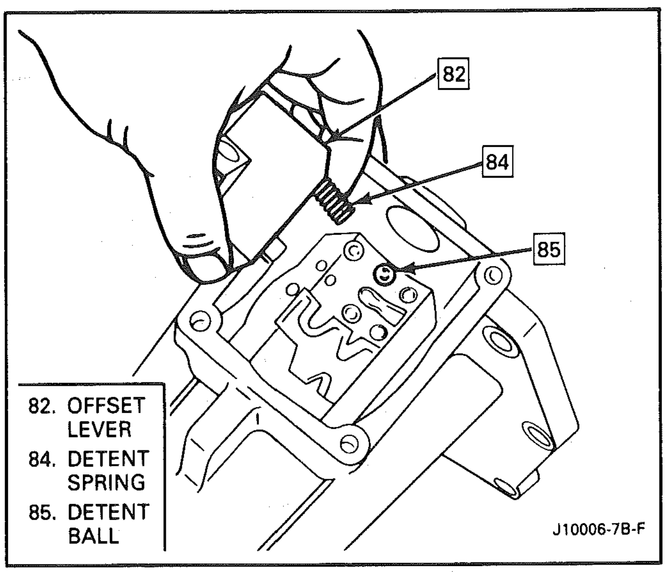


Figure 8 Detent

11. Reverse lever C-clip,pivot bolt and shift lever (Figure 11).
12. Reverse lamp switch.
13. Fifth gear synchronizer snap ring and retainer from rear of countershaft (Figure 12).
14. Unhook reverse lock spring from front of transmission case (Figure 13).

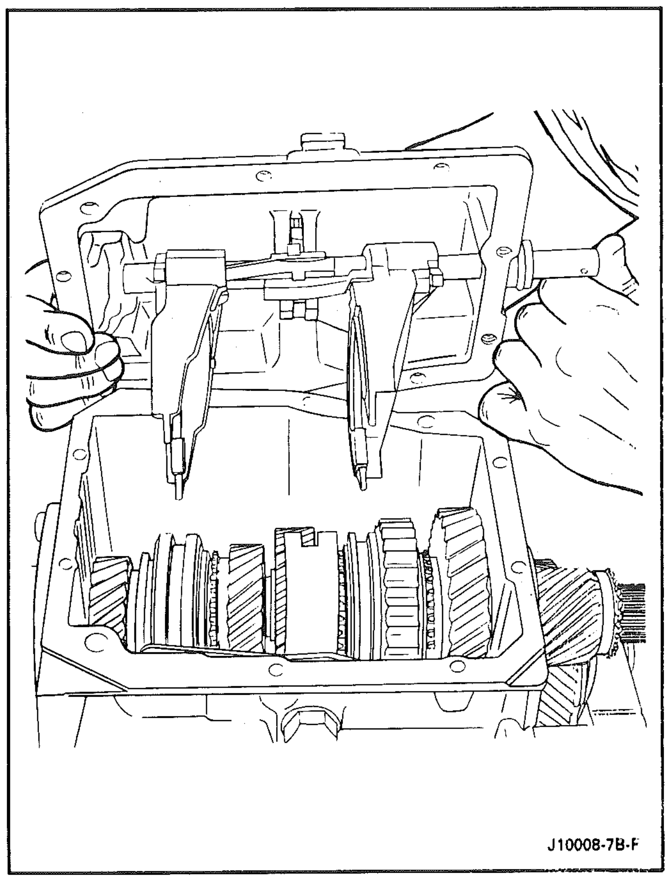


Figure 10 Transmission Cover

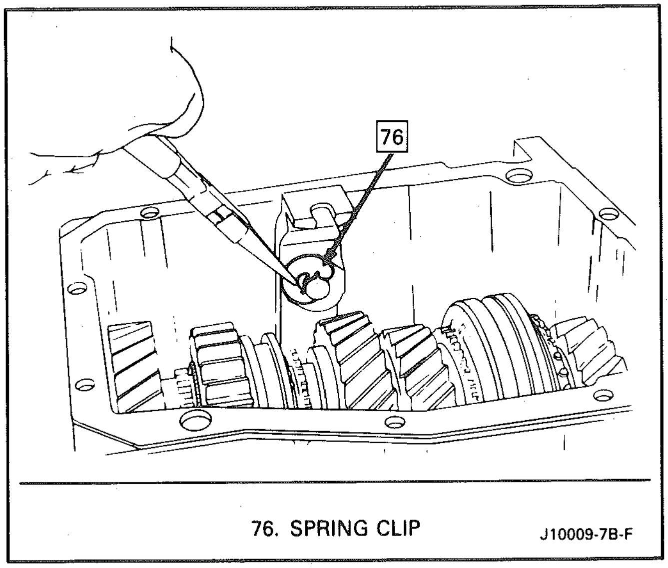


Figure 11 Reverse Lever Retaining Clip

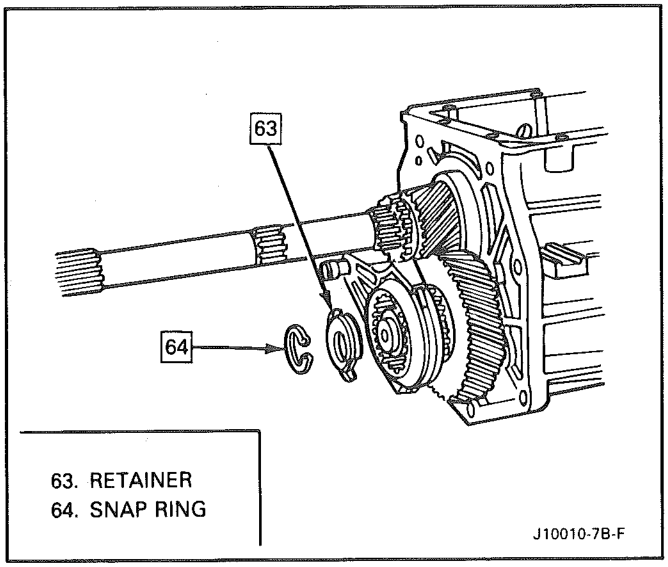


Figure 12 Fifth Gear Synchronizer

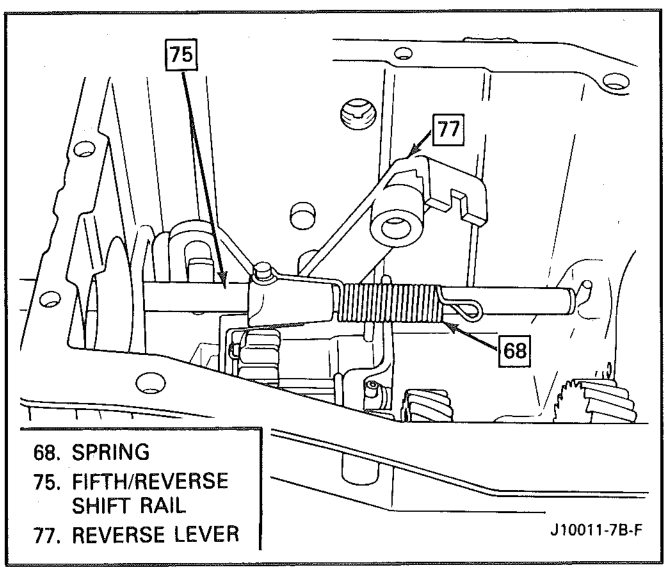


Figure 13 Reverse Lock Spring

15. Fifth gear, synchronizer, shift fork and shift rail as an assembly. If necessary, rotate rail to disengage from reverse lever assembly (Figure 14).

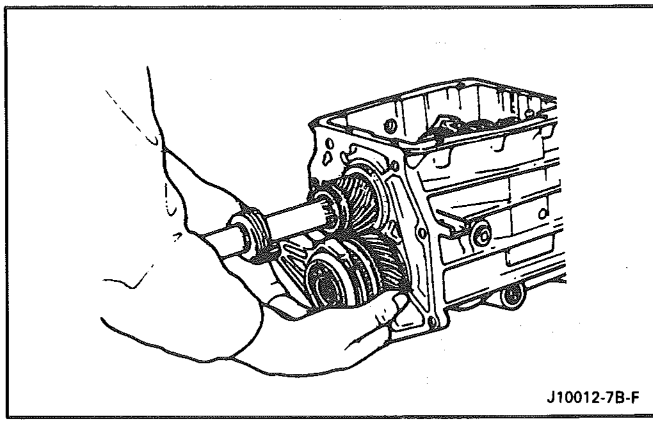


Figure 14 Fifth Gear Synchronizer (Removal and Installation)

16. Snap ring, speedometer gear and retaining clip.
17. Remove snap ring from fifth speed driven gear (Figure 15).

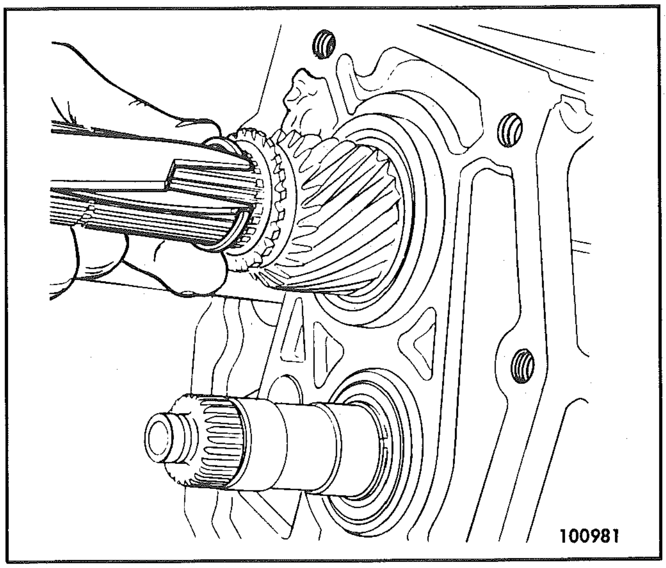


Figure 15 Fifth Gear Snap Ring

18. Front bearing retainer bolts.
19. Front bearing retainer.
20. Front bearing race and end play shims from front bearing retainer (Figure 16).
21. Rotate drive gear until flat surface faces countershaft and remove drive gear from transmission case. Be careful not to drop the 15 roller bearings, thrust bearing, or race from rear of drive gear (Figure 17).
22. Fourth gear blocker ring from third/fourth synchronizer.
23. Mainshaft rear bearing race. If race sticks, it is probably misaligned in the case bore. To free the race, work the shaft back and forth in the case.

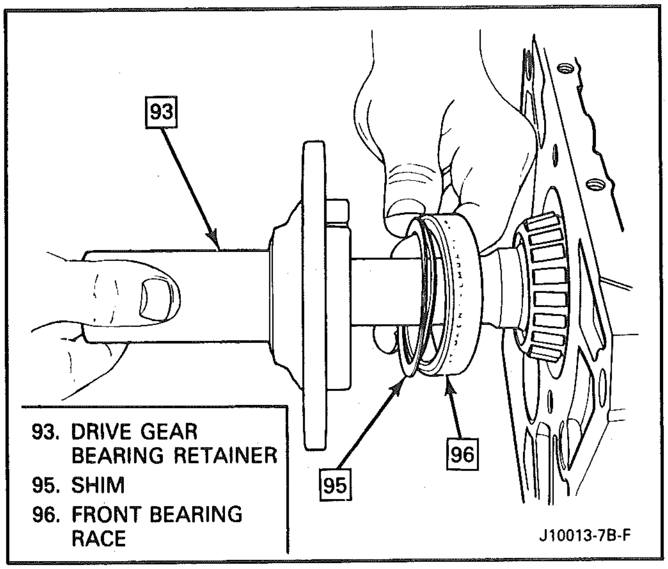


Figure 16 Bearing Retainer and Shims

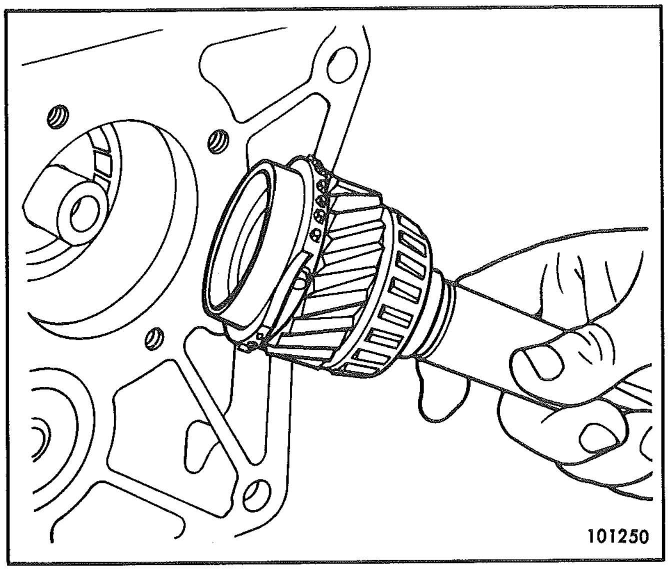


Figure 17 Drive Gear (Removal and Installation)

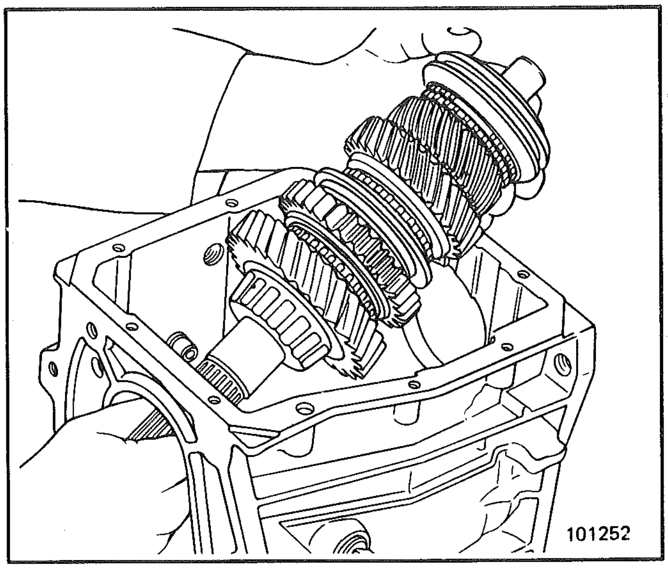


Figure 18 Mainshaft (Removal and Installation)

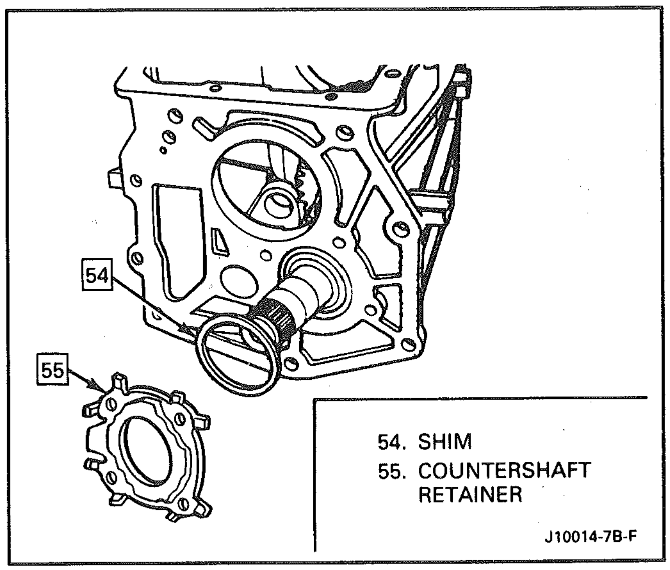


Figure 19 Countershaft Retainer

24. Tilt mainshaft upward and remove assembly from transmission case (Figure 18).
25. Reverse fork assembly from transmission case.
26. Countershaft retainer and shims (Figure 19).
27. Using hammer and punch, drive roll pin from forward end of reverse idler shaft and remove reverse idler shaft, rubber O-ring and gear from the transmission case (Figure 20).
28. Rear countershaft bearing race.
29. Countershaft bearing using appropriate pullers (Figure 21).
30. Move countershaft assembly rearward, tilt countershaft upward and remove from case.
31. Rear countershaft bearing from shaft using tool J 37359 with J 22912-01.

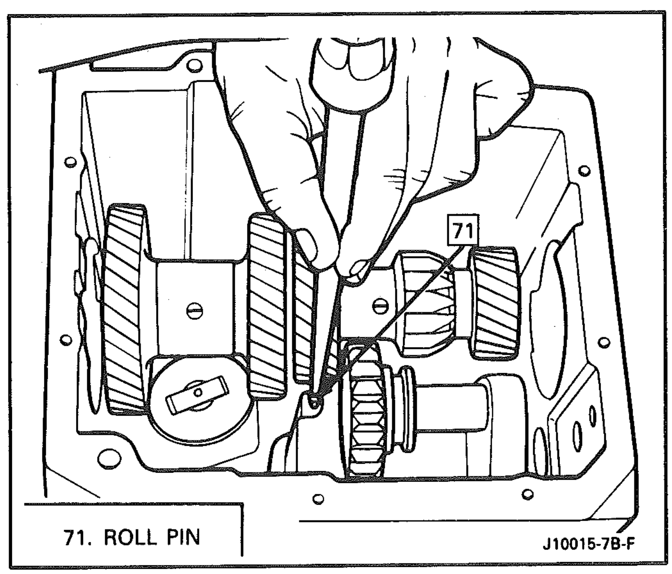


Figure 20 Reverse Idler Gear Shaft

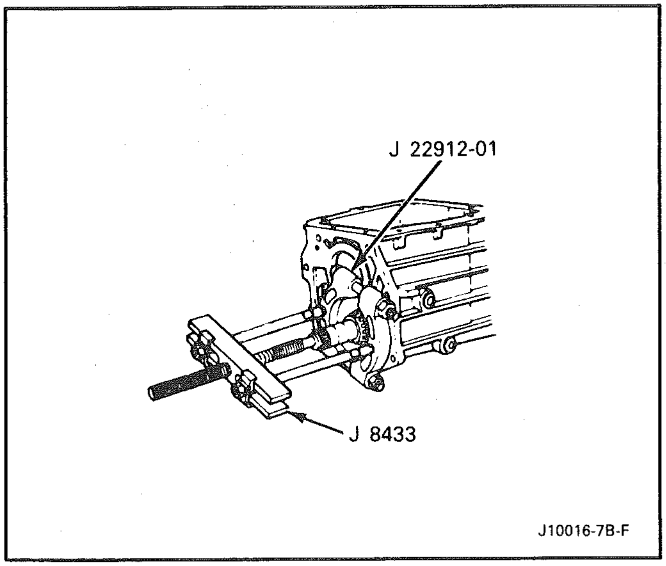


Figure 21 Countershaft Bearing Removal

MAINSHAFT

Disassemble

1. Thrust bearing washer from front end of mainshaft.
2. Scribe reference mark on third-fourth synchronizer hub and sleeve for reassembly.
3. Remove third-fourth synchronizer blocker ring, sleeve, hub and third gear as an assembly from mainshaft (Figure 22).
4. Needle bearing assembly and spacer (Figure 23).
5. Second gear snap ring and thrust washer.
6. Second gear, spacer and needle bearing.
7. Spiral snap ring.
8. Thrust washer.
9. Three-piece second gear blocker ring assembly.
10. Scribe reference mark on first-second synchronizer hub and sleeve for reassembly.
11. Synchronizer spring and keys from first-reverse sliding gear.
12. Sleeve from mainshaft hub.
13. Anti-rattle spring and ball from hub.

NOTICE: Do not attempt to remove the first-second-reverse hub from mainshaft. The hub and shaft are permanently assembled and machined as a matched set.

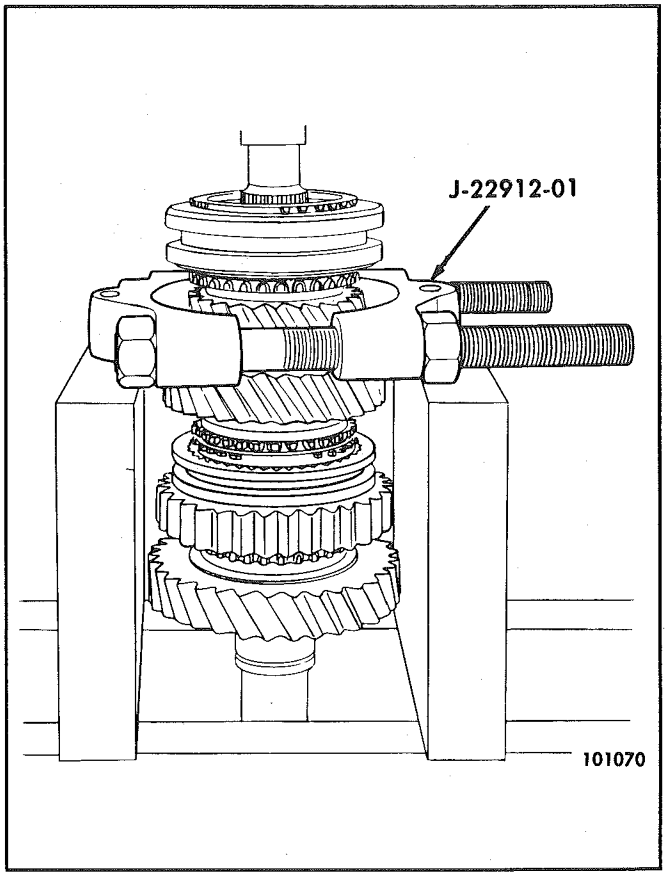


Figure 22 Third-Fourth Synchronizer Removal

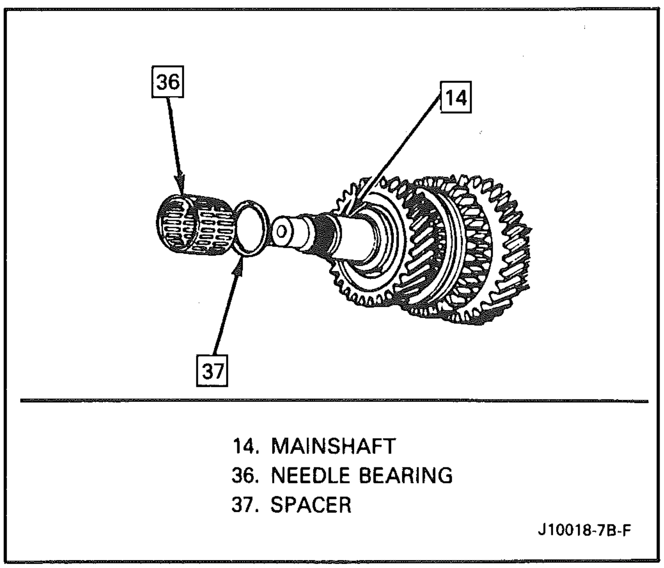


Figure 23 Needle Bearing Removal

14. Fifth gear, using J 22912-01 and press.
15. Rear bearing.
16. First gear.
17. Needle bearing and sleeve.
18. Locating pin.
19. Three-piece first gear blocker ring assembly (Figure 24).

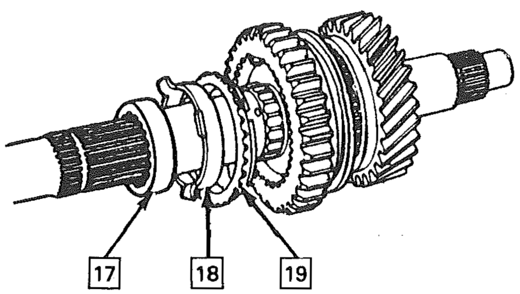


Figure 24 Three-piece Blocker Ring

DRIVE GEAR

Disassemble

1. Bearing race.
2. Thrust bearing.
3. Roller bearings from cavity of drive gear (Figure 25).

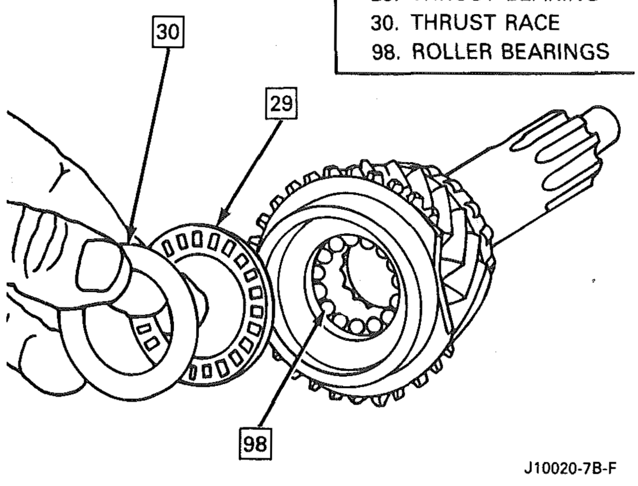


Figure 25 Drive Gear

4. Using Tool J 22912-01 and arbor press, remove bearing from drive gear (Figure 26).

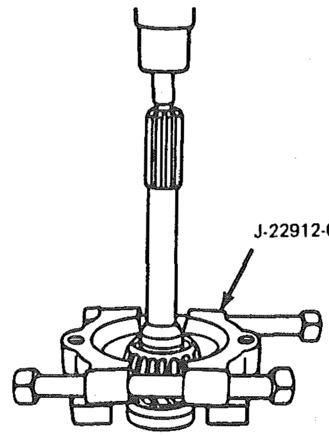


Figure 26 Drive Gear Bearing Removal

Clean

- Parts in appropriate solvent.

Inspect

- Gear teeth and drive shaft pilot for wear.

CLEANING AND INSPECTION

Transmission Case

Clean

1. Transmission case thoroughly inside and outside with appropriate solvent.
2. Magnetic disk at bottom of transmission case.

Inspect

1. Case for cracks.
2. Front and rear faces of the transmission case for burrs, and if present, dress them off with a fine mill file.

Bearing Rollers and Spacers

Inspect

The following should be inspected and replaced if worn:

- drive gear bearing rollers
- reverse idler shaft
- spacers

Gears

Inspect

- Drive gear bearing rollers for chips, cracks, or excessive wear and replace if necessary.
- Clutch sleeves to insure that they slide freely on their hubs.

Front and Rear Bearings

Clean

- Front and rear bearings thoroughly with appropriate solvent.

1. Blow out bearings with compressed air.

NOTICE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the race and rollers.

2. Lubricate bearings with transmission lubricant.

Inspect

- Bearings for roughness by slowly turning race by hand.

Synchronizer Blocking Rings

Inspect

First/second and third/fourth blocker rings are lined with friction material and cannot be checked visually for wear. Replacement is necessary when gap between blocker teeth and adjacent clutch teeth is significantly less than specified. Fifth gear blocker ring is brass and can be checked visually for wear or damage.

Third/Fourth Blocker Rings

Assemble

1. Third gear blocker ring to third gear with twisting motion to fully seat.
2. Fourth gear blocker ring to main drive gear with twisting motion to fully seat.

Measure

Gap between vertical faces of blocker teeth and clutch teeth. Nominal gap is .035 -.059 inches (.88 - 1.5mm) for new blocker rings (Figure 30).

First/Second Blocker Rings

Assemble

1. Three-piece first gear blocker ring assembly with twisting motion to fully seat.
2. Three-piece first gear blocker ring assembly, with needle bearing and bearing sleeve, to first gear.
3. Three-piece second gear blocker ring assembly with twisting motion to fully seat.
4. Three-piece second gear blocker ring assembly, with thrust washer, to second gear.

Measure

Gap between vertical faces of blocker teeth and clutch teeth. Nominal gap is .032 -.056 inches (.81 -1.4mm) for new blocker ring assemblies (Figure 30).

REPAIRS

Synchronizer Keys and Springs

Figures 27,28,29

NOTICE: The synchronizer hubs and sliding sleeves are a selected assembly and should be kept together as originally assembled, but the keys and springs may be replaced if worn or broken.

Remove or Disconnect

1. If relation of hub and sleeve are not already marked, mark for assembly purposes.
2. Push the sliding sleeve from the hub, the keys will fall free and the springs may be easily removed.

Install or Connect

1. Place a blocker ring on side of the hub and sleeve and install keys and retain with a spring.
2. Place blocker ring on opposite side of hub and sleeve and install remaining spring.

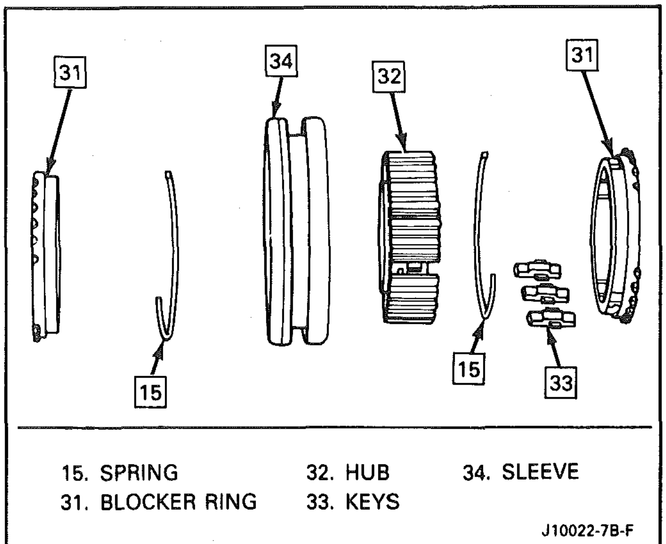


Figure 27 Third-Fourth Synchronizer Assembly

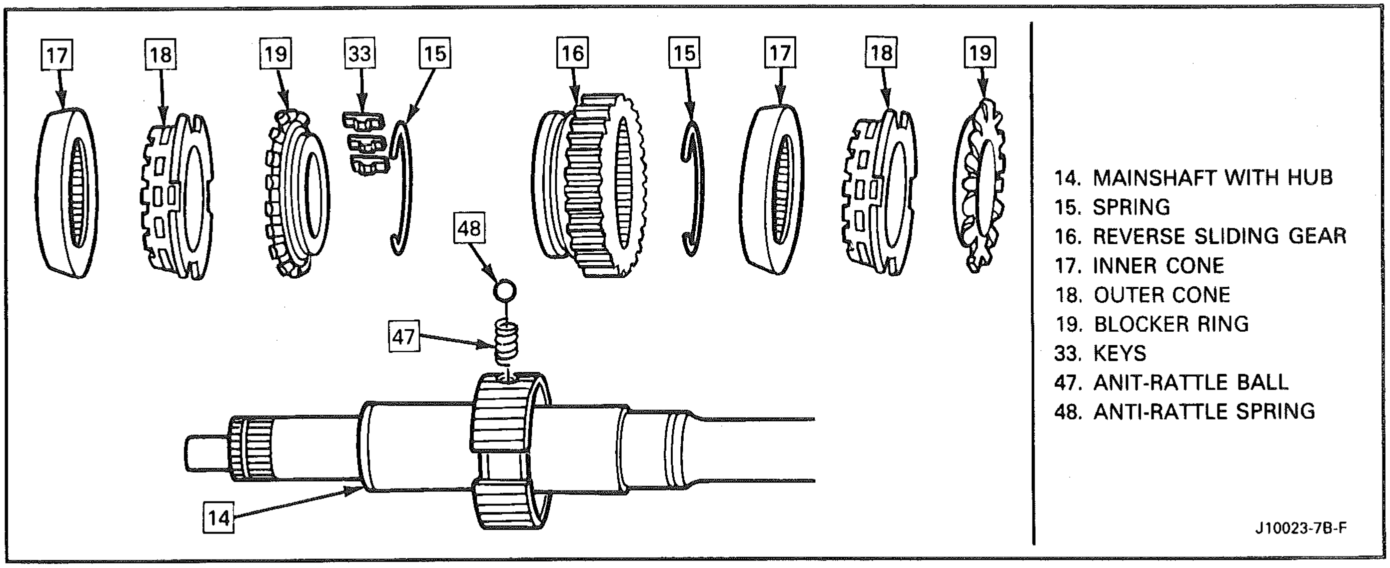


Figure 28 First-Second Synchronizer Assembly

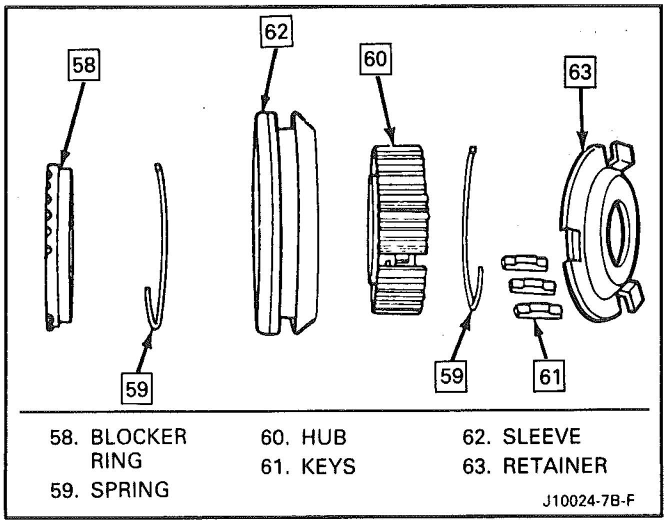


Figure 29 Fifth Gear Synchronizer Assembly

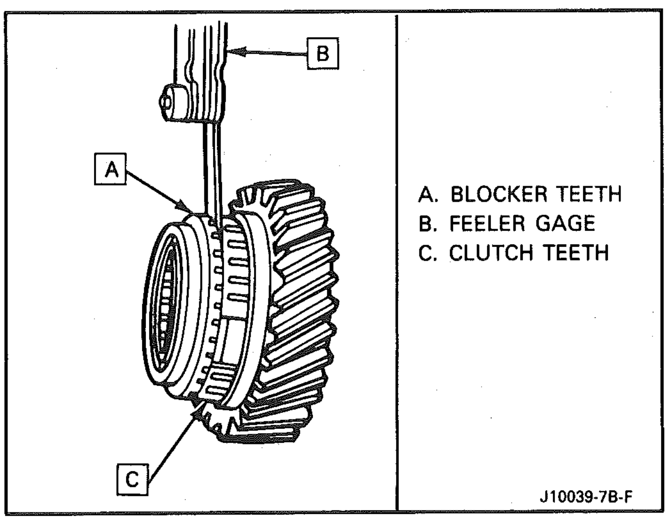


Figure 30 Blocker Ring Wear Gap Measurement

Extension Housing Oil Seal

Figure 31

Remove or Disconnect

1. Pry oil seal out of extension housing, using a screwdriver or small chisel.

Install or Connect

1. New oil seal into extension housing using Tool J 21426.
2. Lubricate I.D. of seal with transmission lubricant.

Extension Housing Bushing

Figure 32

Remove or Disconnect

1. Pry oil seal out of extension housing, using a screwdriver or small chisel.
2. Drive the bushing out of housing, using Tool J 8092 with J 23062-14.

Install or Connect

1. Bushing in housing, using Tool J 8092 with J 23062-14.
2. New oil seal into extension housing using Tool J 21426.
3. Lubricate I.D. of seal with transmission lubricant.

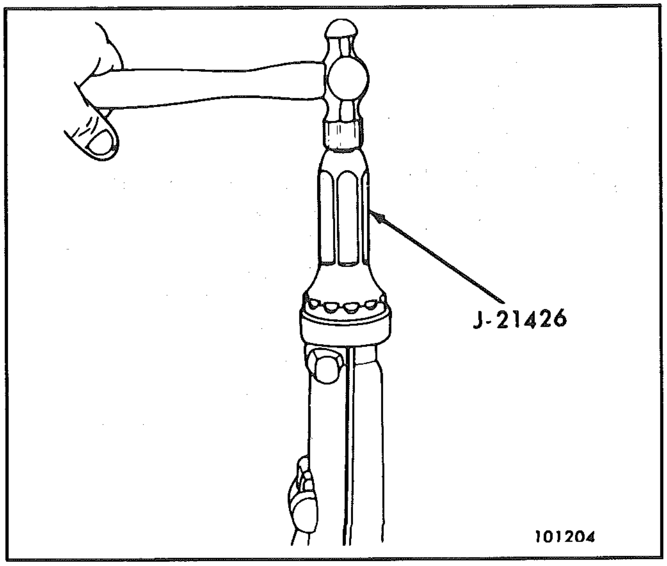


Figure 31 Extension Housing Seal

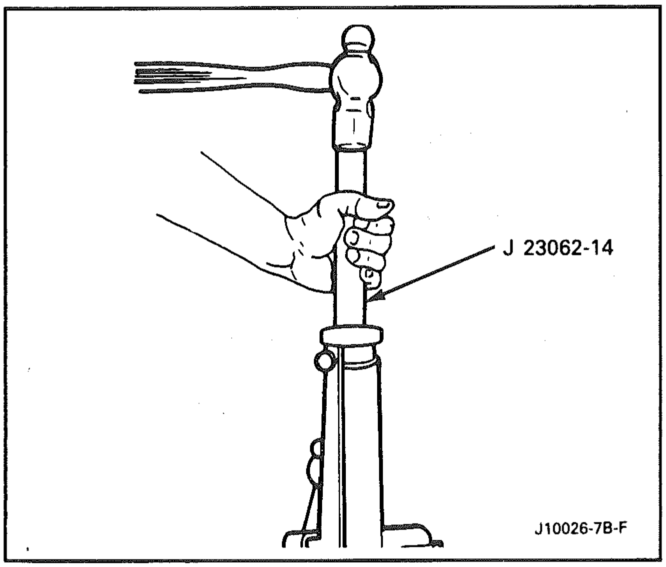


Figure 32 Extension Housing Bushing

Drive Gear Bearing Retainer Oil Seal

Figure 33

Remove or Disconnect

1. Pry oil seal out, using a screwdriver or small chisel.

Install or Connect

1. New seal into retainer using Tool J 23096 until it bottoms in bore.
2. Lubricate I.D. of seal with transmission lubricant.

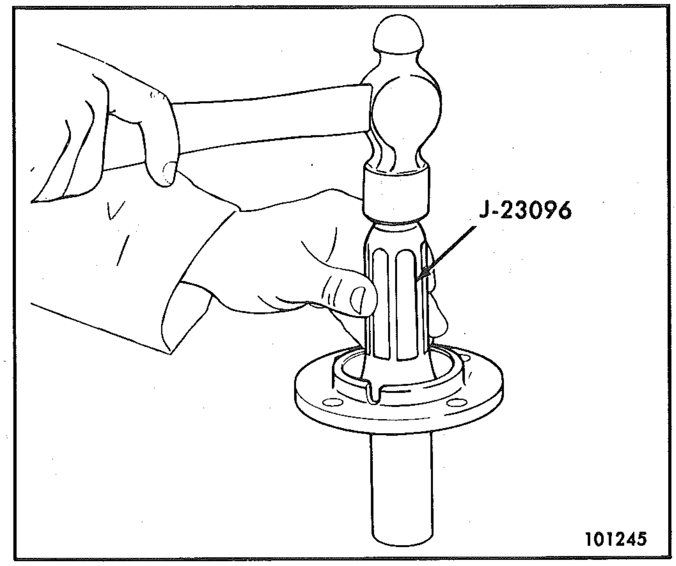


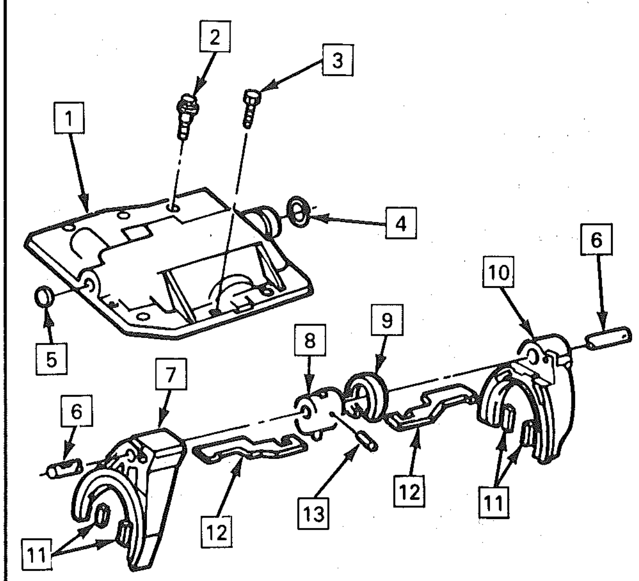
Figure 33 Bearing Retainer Oil Seal Installation

Transmission Cover

Figure 34

Disassemble

1. Place selector arm plates and shift rail in neutral position (centered).



1. TRANSMISSION COVER
2. ALIGNMENT BOLT
3. 13 N·m (10 LBS. FT.)
4. O-RING
5. SHIFT RAIL PLUG
6. SHIFT RAIL
7. 3RD/4TH SHIFT FORK
8. SELECTOR ARM
9. INTERLOCK PLATE
10. 1ST/2ND SHIFT FORK
11. INSERT
12. SHIFT FORK PLATE
13. ROLL PIN

J10028-7B-F

Figure 34 Transmission Cover

2. Rotate shift rail until selector arm disengages from selector arm plates and roll pin is accessible.
3. Selector arm roll pin using a pin punch and hammer (Figure 35).

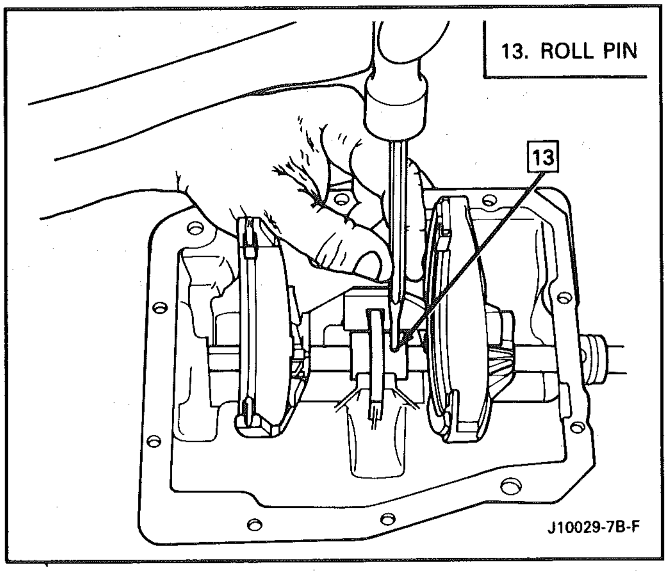


Figure 35 Selector Arm (Removal and Installation)

4. Shift rail, shift forks, selector arm plates, selector arm, interlock plate and roll pin.
5. Transmission cover to extension housing O-ring seal using a screwdriver.
6. Nylon inserts and selector arm plates from shift forks. Note position of inserts and plates for assembly reference.

Assemble

1. Nylon inserts and selector arm plates in shift forks.
2. If removed, Coat edges of shift rail plug with sealer #1052624 or equivalent before installing.
3. Coat shift rail and rail bores with transmission lubricant.
4. Shift rail in cover until flush with inside edge of cover.
5. Place first-second shift fork in cover with fork offset facing rear of cover and push shift rail through fork. The first-second shift fork is the larger of the two forks.
6. Position selector arm and C-shaped interlock plate in cover and insert shift rail through arm. Widest part of interlock plate must face away from cover, and selector arm roll pin hole must face downward and toward rear of cover.
7. Position third-fourth shift fork in cover with fork offset facing rear of cover. Third-fourth shift fork selector arm plate must be under first-second shift fork selector arm plate.
8. Push shift rail through third-fourth shift fork and into front bore in cover.
9. Rotate shift rail until selector arm plate at forward end of rail faces away from, but is parallel to cover.
10. Align roll pin holes in selector arm and shift rail and install roll pin. Roll pin must be flush with surface of selector arm to prevent pin from contacting selector arm plates during shifts.
11. New transmission cover to extension housing O-ring seal.
12. Coat O-ring seal with transmission lubricant.

Front Countershaft Bearing

Remove or Disconnect

NOTICE: Remove the front countershaft bearing race only if it is worn or damaged.

1. Using a press and Bearing Remover J 8092 with Bearing Receiver and case support J 37358 or equivalent, remove bearing race and O-ring from case (Figure 36).

NOTICE: Failure to support the case properly will result in permanent distortion of the case during bearing race removal.

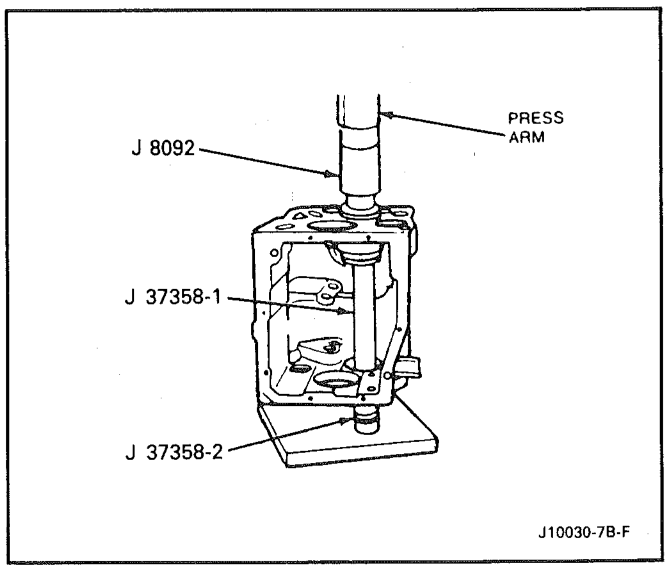


Figure 36 Front Countershaft Bearing Removal

Install or Connect

1. New O-ring onto bearing race and lubricate with petroleum jelly.
2. Position bearing race in case (Figure 37).
3. Keeping race square with case bore, install race with hand pressure until O-ring is below edge of case.
4. Support transmission case on press, and using Bearing Installation Tool J 37357 and Remover/Installer J 8092 or equivalent press bearing race until flush with case (Figure 38).

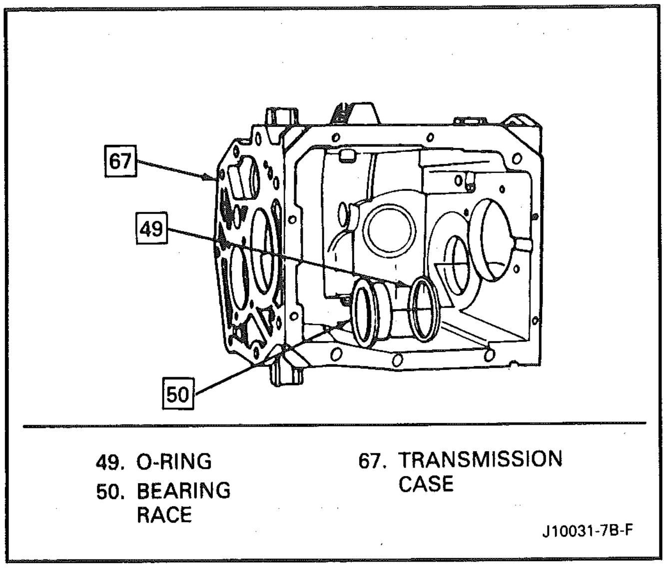


Figure 37 Front Countershaft Bearing Assembly

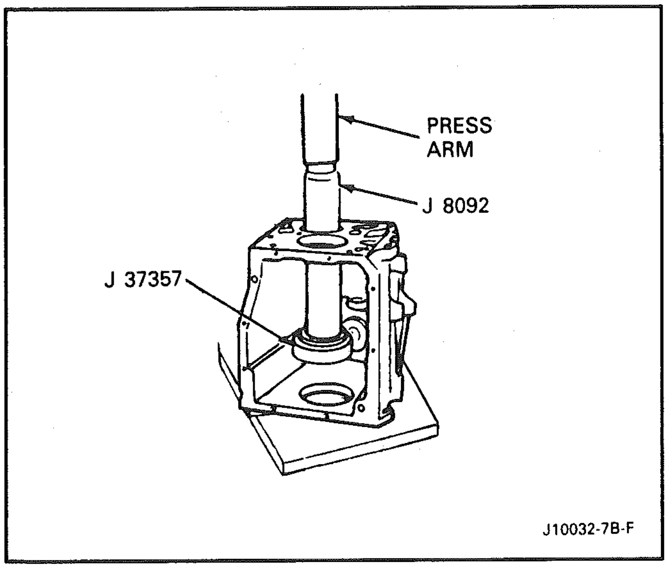


Figure 38 Front Countershaft Bearing Installation

DRIVE GEAR

Assemble

1. Using Tool J 22912-01 (between clutch teeth and gear teeth), Tool J 6133-A and an arbor press, install bearing on drive gear.
2. Coat roller bearings and drive gear bearing bore with light weight grease.
3. Roller bearings into bore of drive gear.
4. Thrust bearing and race in drive gear.

MAINSHAFT

NOTICE: If replacing first/second or third/fourth synchronizer blocking rings, soak new blocker ring assemblies for 10 minutes in Dexron II or equivalent before assembly on mainshaft.

Assemble

1. Coat mainshaft and gear bores with transmission lubricant.
2. Anti-rattle spring and ball in hub.
3. Slide first-second synchronizer sleeve on mainshaft hub aligning marks made at disassembly.
4. First-second synchronizer keys and springs. Engage tang end of each spring in same synchronizer key but position open end of springs opposite of each other (Figure 39).

NOTICE: Use care in synchronizer spring placement. Synchronizer can be assembled with improper spring placement, but hard shifting will result.

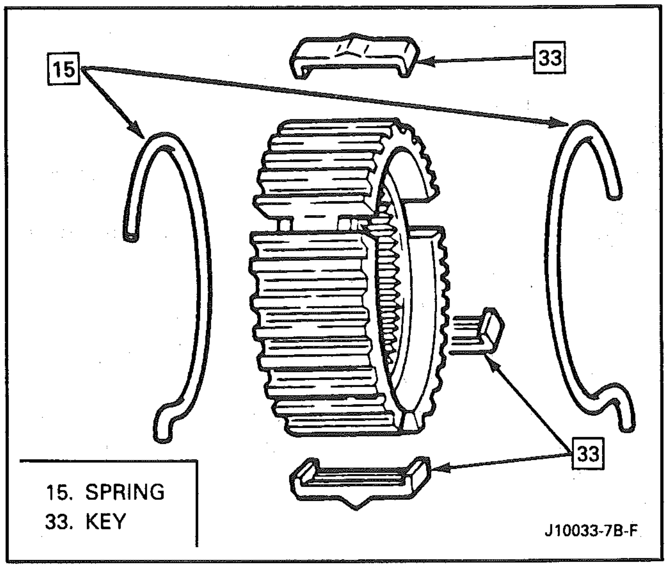


Figure 39 Synchronizer Spring Installation

5. Three-piece first gear blocker ring assembly.
6. Drop locating pin into mainshaft.
7. Slide sleeve and bearing onto mainshaft, aligning notch in sleeve with locating pin.
8. First gear, aligning slots in first gear with tabs on blocker ring assembly.
9. Rear mainshaft bearing with taper facing rear of shaft.
10. Lubricate fifth gear splines with petroleum jelly.
11. Position fifth gear on mainshaft.
12. Using a press and Tool J 25234, press fifth gear onto mainshaft.

NOTICE: Carefully align the mainshaft and gear splines. If splines are improperly aligned, damage could occur when the gear is pressed onto the mainshaft.

13. Fifth gear snap ring.
14. Three-piece second gear blocker ring assembly and thrust washer (Figure 24).

15. Spiral snap ring, using Tool J 37360.
16. Second gear spacer, needle bearing and gear, aligning slots in second gear with tabs on blocker ring assembly.
17. Second gear thrust washer and snap ring.
18. Third gear, spacer and needle bearing assembly. Make sure the bearing spacer is not trapped between the gear face and snap ring. The spacer runs inside the gear bore.
19. Using a press and Tool J 37372, install third/fourth synchronizer, third blocker ring and third gear as an assembly.

Important

Before pressing components together, make sure the synchronizer hub faces the short end of the mainshaft. Hold third gear against the synchronizer to maintain blocker ring alignment with keys.

TRANSMISSION

Assemble

1. Using a press and Bearing Installation Tools J 37357 and J 8092 or equivalent, install front countershaft bearing onto countershaft.
2. Position countershaft in case.
3. Using a press and Bearing Installation Tool J 37372 or equivalent, install countershaft rear bearing to countershaft (Figure 40).

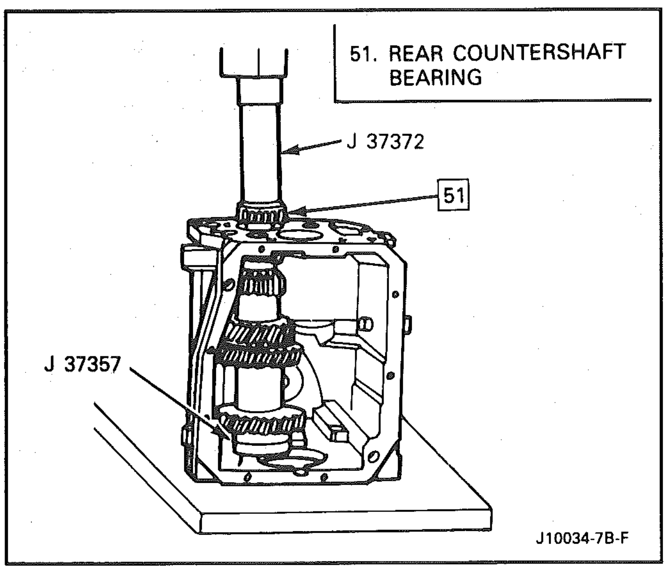


Figure 40 Rear Countershaft Bearing Installation

Important

Support the countershaft with Tool J 37357 or equivalent.

NOTICE: Failure to properly support the countershaft may result in permanent distortion of the case during bearing installation.

4. Rear countershaft bearing race.
5. Position rubber O-ring and reverse idler gear in case with shift lever groove facing rear of case.
6. Reverse idler shaft from rear of case.
7. Install roll pin in idler shaft.
8. Install countershaft retainer (without shims) to transmission housing.

Tighten

- Torque bolts to 20 N•m (15 lbs. ft.)

Measure

- Countershaft end play using dial indicator J 8001. (Figure 41)

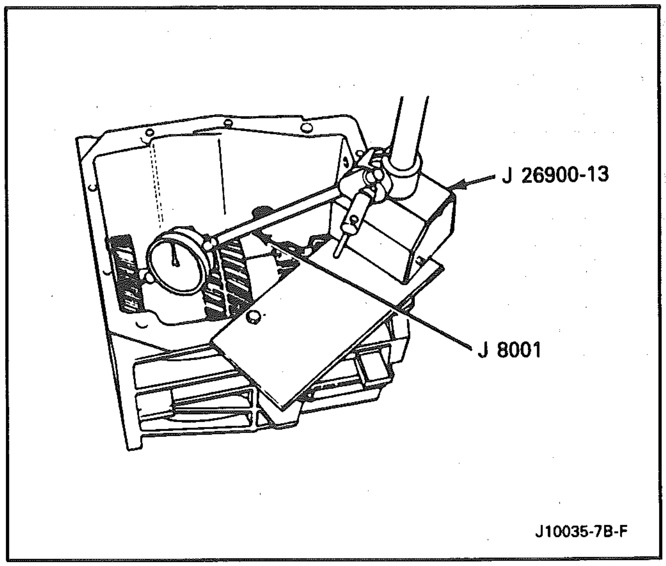


Figure 41 Countershaft End Play Measurement

9. Remove retainer and install shim(s) as necessary to provide proper end play. Zero end play with no preload is ideal, but up to .004 in.(.10mm) end play is allowable. Do not preload bearing with shim(s) larger than original end play measurement. Reinstall retainer, re-torque and bend tabs over the four attaching bolts.
10. Position reverse shift fork in case.
11. Assembled mainshaft in transmission case.
12. Rear mainshaft bearing race in case.
13. Drive gear in case (make sure rollers, thrust bearing and washer are in place), and engage in third-fourth synchronizer sleeve and blocker ring.
14. Front bearing race in front bearing retainer. Do not install shims in front bearing retainer at this time.
15. Temporarily install front bearing retainer.
16. Fifth gear on countershaft. Slide shift rail/fifth gear shift fork assembly into case. As shift rail enters case, align reverse shift fork and slide rail through fork. Position lever return spring in case with long end of spring to rear, and slide rail through spring (Figure 13).

17. Blocker ring and fifth gear synchronizer in fifth gear shift fork. Slide fork rail assembly and synchronizer into position. (Figure 20)
18. Fifth gear synchronizer retainer and snap ring (Figure 12).
19. Oiling funnel into rear of countershaft (Figure 9).
20. Position fifth/reverse shift lever in case.
21. Connect lever return spring to front of case. Make sure reverse shift fork pin and fifth gear shift rail pin are engaged with shift lever and install fifth gear/reverse lever, pivot bolt and retaining clip. Coat pivot bolt threads with pipe thread sealant #1052080 or equivalent.
22. Reverse lamp switch. Coat threads with pipe thread sealant #1052080 or equivalent.
23. Speedometer gear and retaining clip.
24. Circlip.
25. Apply 3mm (1/8in.) bead of RTV Sealant, #1052751 or equivalent,to transmission cover assembly.
26. Make sure all synchronizers are in the neutral position and that the shift forks in the cover are in the neutral (center) position. Lower cover onto case while aligning shift forks and synchronizer sleeves.
27. Center cover and install two dowel bolts.
28. Remaining cover bolts.

Tighten

- Torque all cover bolts to 14 N•m (10 lbs. ft.).

29. Apply 3mm (1/8 in.) bead of RTV Sealant, #1052751 or equivalent, to extension housing mating surface.
30. Coat detent spring with petroleum jelly and insert in offset lever. Lubricate detent plate and install detent ball in neutral position on plate. Position offset lever in extension housing with spring over detent ball. Slide lever and extension housing into position as an assembly.
31. Extension housing vent.
32. Press downward on offset lever to compress detent spring and push lever and housing into position.
33. Extension housing bolts. Apply pipe thread sealant #1052080 or equivalent to threads of top two bolts.

Tighten

- Torque extension housing bolts to 30 N•m (23 lbs. ft.)

34. Align and install roll pin in offset lever and shift rail.
35. Damper sleeve in offset lever.
36. Turn transmission case on end, and mount a dial indicator on extension housing with indicator on the end of mainshaft (Figure 42).

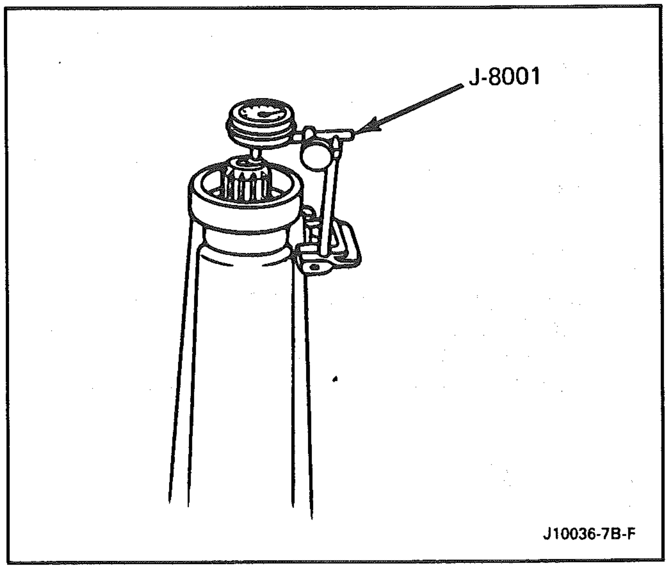


Figure 42 Measuring End Play

Measure

- Rotate mainshaft and zero dial indicator. Pull upward on mainshaft until end play is removed and record reading.
- Ideal mainshaft end play is zero, with plus or minus .001in. (.03mm) allowable. To set preload, select a shim pack equal to the dial indicator reading recorded.

37. Remove front bearing retainer and front bearing race.
38. Install necessary shims and reinstall bearing race.
39. Apply a 3mm diameter (1/8 inch) bead of RTV sealant, #1052751 or equivalent, on case mating surface of front bearing retainer.
40. Bearing retainer with narrow or smaller notch facing upward.

NOTICE: Sealer must not cover notch in bearing retainer.

Tighten

- Torque attaching bolts to 20 N•m (15 lbs. ft.).

41. Fill transmission to its proper level with Dexron II #1051855 or equivalent. Apply pipe thread sealant #1052080 or equivalent to threads of drain/fill plugs before installation.

TRANSMISSION TO ENGINE	75 N·m	55 LBS. FT.
EXTENSION HOUSING TO CASE	30 N·m	25 LBS. FT.
TRANSMISSION COVER TO CASE	14 N·m	10 LBS. FT.
FRONT BEARING RETAINER TO CASE	20 N·m	15 LBS. FT.
COUNTERSHAFT RETAINER TO CASE	20 N·m	15 LBS. FT.
REVERSE PIVOT BOLT TO CASE	27 N·m	20 LBS. FT.
FILL PLUG TO CASE	27 N·m	20 LBS. FT.
CROSSMEMBER TO FRAME	50 N·m	35 LBS. FT.
TRANSMISSION MOUNT TO TRANSMISSION	50 N·m	35 LBS. FT.
TRANSMISSION MOUNT TO CROSSMEMBER	50 N·m	35 LBS. FT.
LUBE CAPACITY (APPROXIMATELY)	2.8 LITRES	2.9 QTS.
LUBE RECOMMENDED	DEXRON II #1051855 OR EQUIVALENT	

MAINSHAFT END PLAY SHIMS
(Thickness in Inches)

.012	.022	.027	.032	.037	.042
.014	.023	.028	.033	.038	.043
.016	.024	.029	.034	.039	.044
.018	.025	.030	.035	.040	
.020	.026	.031	.036	.041	

COUNTERSHAFT END PLAY SHIMS
(Thickness in Inches)

.1005	.1095	.1185	.1275	.1365	.1455
.102	.111	.120	.129	.138	.147
.1035	.1125	.1215	.1305	.1395	.1485
.105	.114	.123	.132	.141	.150
.1065	.1155	.1245	.1335	.1425	.1515
.108	.117	.126	.135	.144	.1530

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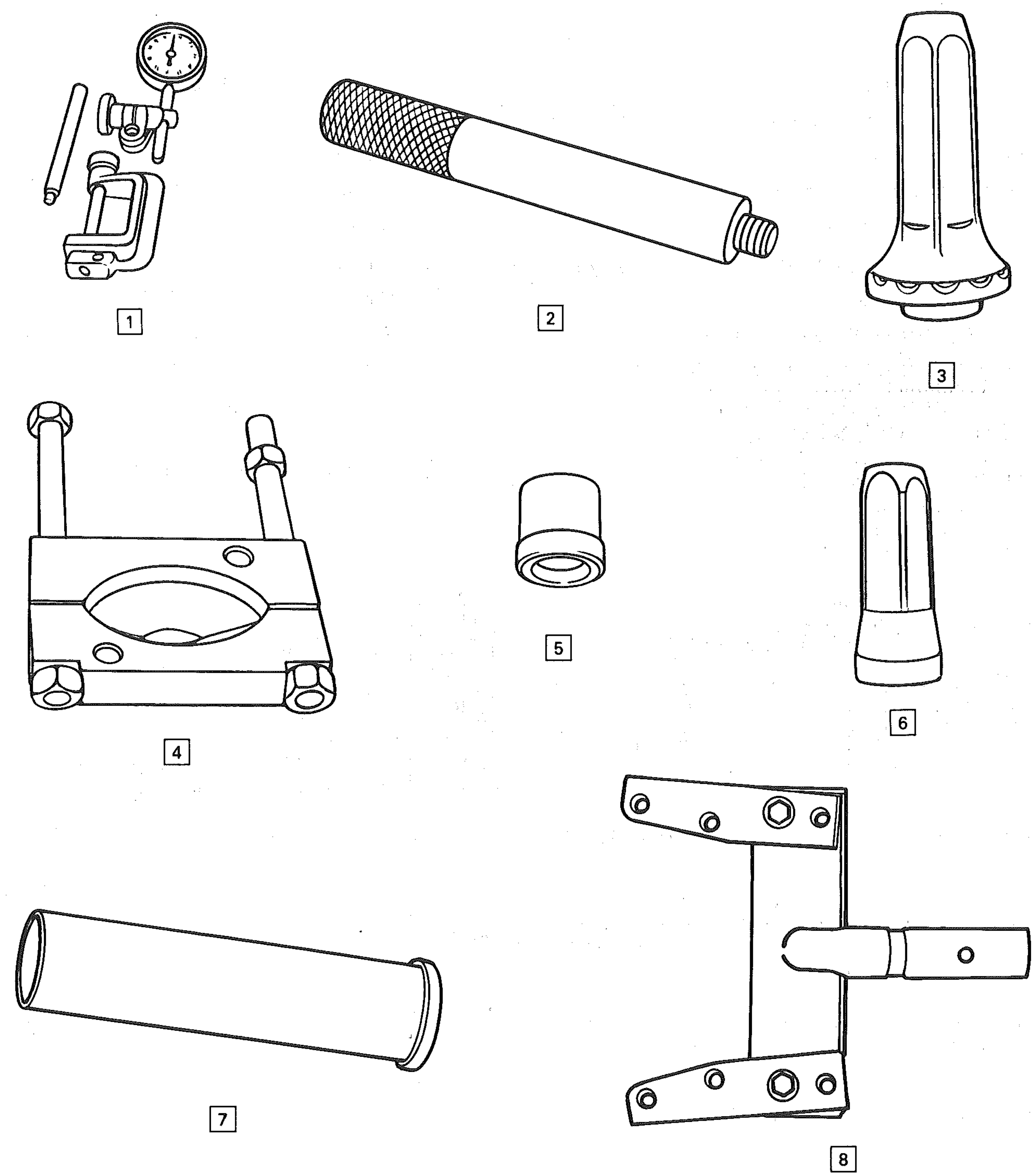
Figure 43 Specifications



1. J 8001 DIAL INDICATOR
2. J 8092 DRIVER HANDLE
3. J 21426 EXTENSION HOUSING SEAL INSTALLER
4. J 22912-01 BEARING PULLER
5. J 23062-14 EXTENSION HOUSING BUSHING INSTALLER
6. J 23096 DRIVE GEAR OIL SEAL INSTALLER
7. 25234 BEARING INSTALLER
8. J 36842 OR J34162 HOLDING FIXTURE
9. J 6133-A BEARING INSTALLER
10. J 8433 UNIVERSAL PULLER BAR
11. J 37372 BEARING INSTALLER
12. J 26900-13 DIAL INDICATOR STAND
13. J 37358 BEARING REMOVER
14. J 37359 BEARING REMOVER
15. J 37360 SNAP RING TOOL
16. J 37375 BEARING INSTALLER

J10038-7B-F

Figure 44 Special Tools

SECTION 7C

CLUTCH

CONTENTS

GENERAL DESCRIPTION

COMPONENTS

The principal parts of a clutch system are: the driving member and the operating members. Figure 7C-1 shows an exploded view of the clutch system.

DRIVEN MEMBERS (FIGURES 7C-1 AND 7C-2)

The driven member is the clutch disc with a splined hub which is free to slide lengthwise along the splines of the input shaft, but which drives the input shaft through these same splines.

The driving and driven members are held in contact by spring pressure. This pressure is exerted by a diaphragm spring in the pressure plate assembly.

OPERATING MEMBERS (FIGURE 7C-3)

The clutch release system is operated by hydraulic pressure and consists of the clutch pedal, clutch master cylinder, clutch slave cylinder, clutch fork and clutch release bearing.

HYDRAULIC CLUTCH (FIGURE 7C-3)

A hydraulic clutch operating mechanism is used on all models. The mechanism consist of a remote reservoir, clutch master cylinder and slave cylinder. The remote reservoir is mounted to a bracket which bolts to the power brake booster. The clutch master cylinder is mounted on the cowl panel and the slave cylinder is mounted on the bell housing. The clutch master cylinder is operated directly off the clutch pedal.

When the clutch pedal is pressed down, hydraulic fluid under pressure from the clutch master cylinder flows into the slave cylinder. Since the piston is also connected to the clutch fork this lever moves the release bearing into contact with the clutch cover release fingers to disengage the clutch. The hydraulic clutch system locates the clutch pedal height and provides automatic clutch adjustment. No adjustment of clutch linkage or pedal position is required.

HYDRAULIC CLUTCH FLUID

When adding fluid to or refilling the system after service operations use GM Delco Supreme No. 11 brake fluid or an equivalent fluid that meets DOT 3 specifications.

NOTICE: Do not use mineral or paraffin base oil in the Clutch Hydraulic System. These fluids will damage the rubber parts in the cylinders.

DIAGNOSIS

PRELIMINARY CHECKS

Before attempting to repair the clutch, transmission or related hydraulic components for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transmission problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or transmission blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished and the following checks and adjustments performed in the presented sequence before removing the clutch or transmission for repairs.

Before removal of the clutch hydraulic system, verify the malfunction by removing the clutch housing dust shield and measure the travel of the clutch slave cylinder push rod. With clutch pedal pushed fully to the floor, the **slave cylinder** push rod should extend **14.53mm (0.57 inch)** minimum against the clutch release lever. Do not replace the hydraulic system if push rod travel exceeds this distance.

If slave cylinder does not meet the travel requirements, check the reservoir fluid level. The slave cylinder must be in place when checking the fluid level. The proper level is indicated by a step on the reservoir. Fill to the specified level with GM Delco Supreme No. 11 Brake Fluid or an equivalent fluid that meets DOT 3 specifications. Do not overfill. The upper portion of the reservoir must accept fluid that is displaced from the slave cylinder as the clutch wears.

NOTICE: Carefully clean the top and sides of the reservoir before opening to prevent contamination of the system with dirt, water or other foreign material. Remove the reservoir diaphragm before adding fluid. Carefully replace the diaphragm, cover gasket and cover after filling.

If the reservoir requires any fluid, check the hydraulic system components for leakage. Remove the rubber boots from the cylinder and check for leakage past the pistons. A slight wetting of the surfaces is acceptable. Replace the system, if excessive leakage is evident.

BLEEDING CLUTCH SYSTEM

The process of removing air from the line and cylinders is known as "bleeding" and is necessary whenever the level of fluid in the reservoir has been allowed to fall so low that air has been drawn into the master cylinder.

NOTICE: Never, under any circumstances, use fluid which has been bled from a system to fill the reservoir as it may be aerated, have too much moisture content and possibly be contaminated.

1. Clean dirt and grease from the cap to ensure no foreign substances enter the system.
2. Remove cap and diaphragm and fill reservoir to the top with approved brake fluid only. (Brake fluid must be certified to DOT 3 specifications).
3. Fully loosen bleed screw which is in the slave cylinder body next to the inlet connection.
4. Fluid will now begin to move from the master cylinder down the tube to the slave. It is important that for efficient gravity fill, the reservoir must be kept full at all times.
5. It will be noticeable at this point that bubbles will appear at the bleed screw outlet. This means that air is being expelled. When the slave is full, a steady stream of fluid will come from the slave outlet. At this point tighten bleed screw to a torque of 2 N·m.
6. Assemble diaphragm and cap to the reservoir, fluid in reservoir should be level with step.
7. Exert a light load (approximately 20 lbs.) to the slave cylinder piston by pushing release lever towards the cylinder and loosen bleed screw. Maintain a constant light load, fluid and any air that is left will be expelled through the bleed port. Tighten bleed screw when a steady flow of fluid and no air is being expelled.
8. Renew fluid level in reservoir, assemble diaphragm and cap. If necessary, repeat Steps 7 and 8.
9. Exert light load to release lever as in Step 7 (do not open bleed screw), piston in slave will move slowly down bore. Repeat 2-3 times, fluid movement will force any air left in the system into the reservoir.
10. The hydraulic system should now be fully bled and should release the clutch. Check vehicle by starting, pushing clutch pedal to the floor and selecting reverse gear. There should be no grating of gears, if there is, the hydraulic system could still contain air. If this is the case, repeat bleed procedure.

Check push rod travel at the slave cylinder to insure the minimum travel of 14.53mm (0.57 inch) for V-8 and 11mm (0.43 inch) for V-6.

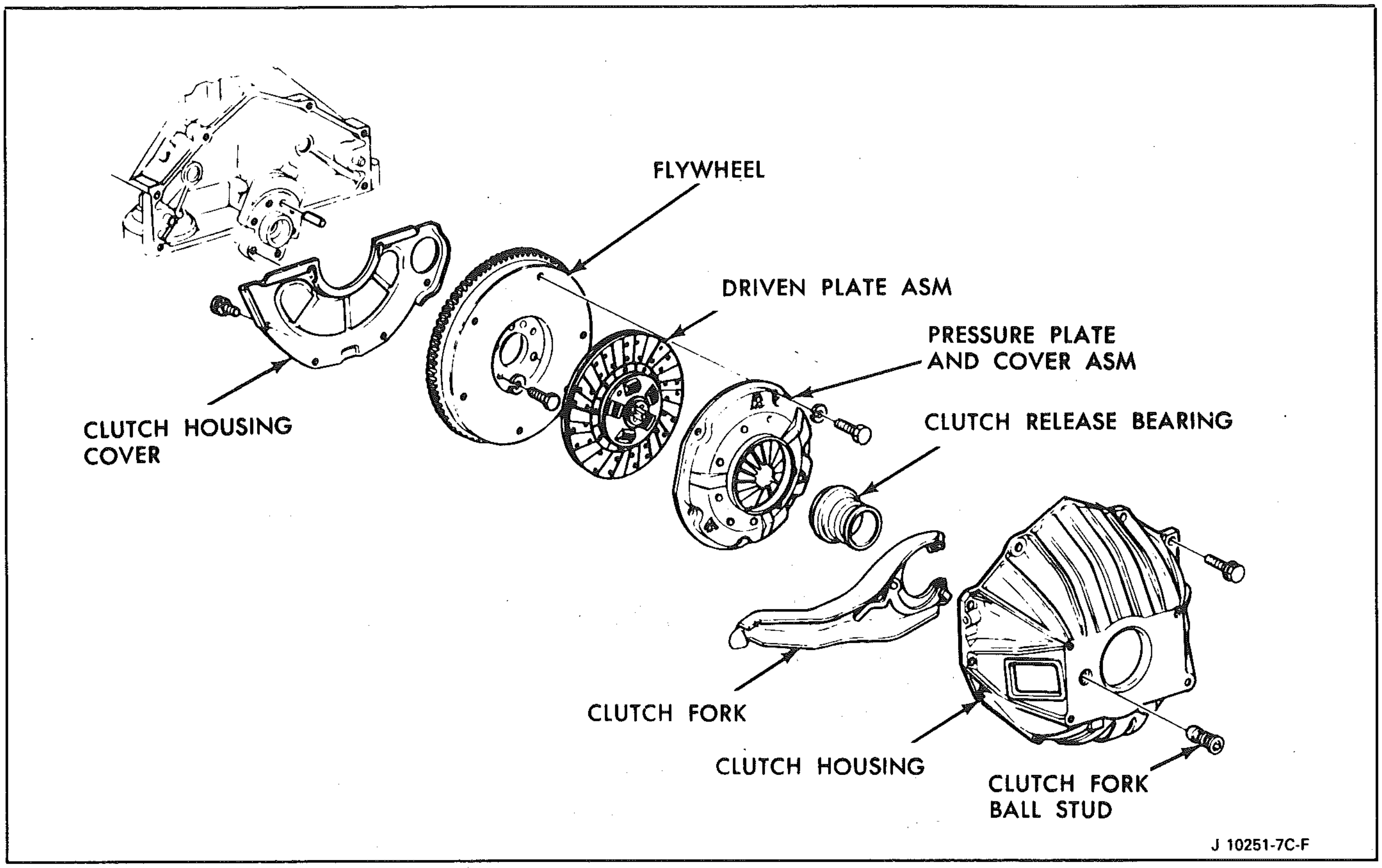


Figure 7C-1 Exploded View of Clutch System

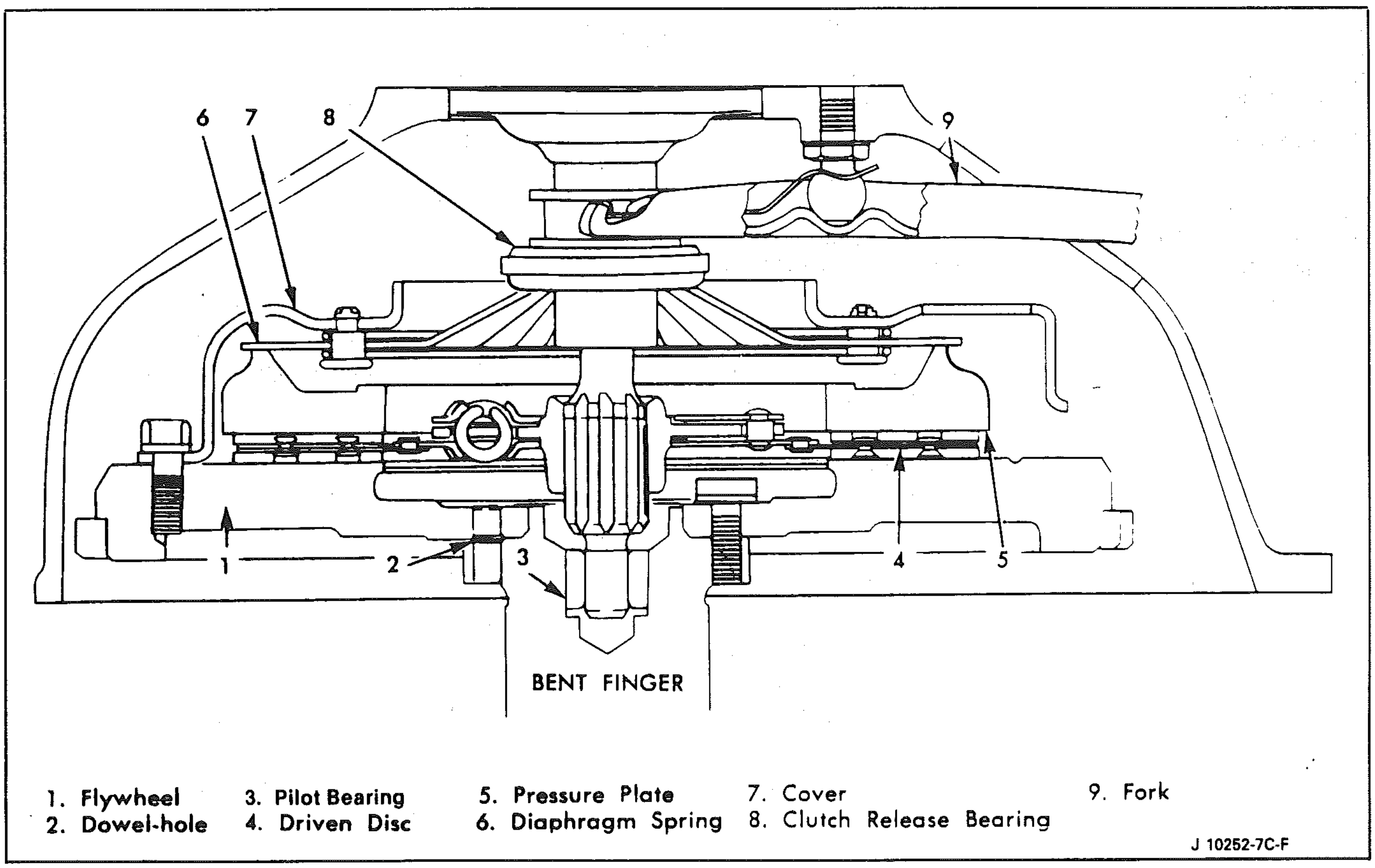


Figure 7C-2 Cross-Section of Clutch Assembly

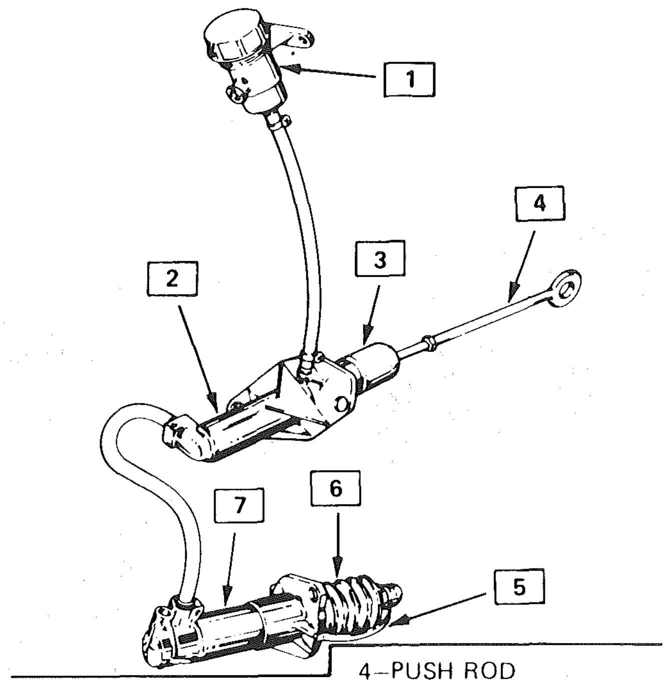


Figure 7C-3 Clutch Hydraulic System

CLUTCH DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (Pedal pressed to floor shift lever does not move freely in and out of reverse gear)	a. Faulty pilot bearing.	a. Replace bearing.
	b. Faulty driven disc.	b. Replace disc.
	c. Fork off ball stud.	c. Install properly and* lubricate fingers at release bearing and ball stud.
	d. Clutch disc hub binding on clutch gear spline.	d. Repair or replace clutch gear and/or disc.
	e. Clutch disc warped or bent.	e. Replace disc (run-out should not exceed .020"). * Very lightly lubricate fingers.
Slipping	a. Oil soaked driven disc.	a. Install new disc and correct leak at its source.
	b. Worn facing or facing torn from disc.	b. Replace disc.
	c. Warped pressure plate or flywheel.	c. Replace pressure plate or flywheel.
	d. Weak diaphragm spring.	d. Replace pressure plate
	e. Driven plate not seated in.	e. Make 30 to 40 normal starts. CAUTION: Do not overheat.
	f. Driven plate over-	f. Allow to cool.

	heated.	
Grabbing (Chattering)	a. Oil on facing. Burned or glazed facings.	a. Install new disc and correct leak.
	b. Worn splines on clutch gear.	b. Replace transmission clutch gear.
	c. Warped pressure plate or flywheel.	c. Replace pressure plate or flywheel.
	d. Burned or smeared resin on flywheel or pressure plate.	d. Sand off if superficial, replace burned or heat checked parts.
Rattling - Transmission Click	a. Weak retracting springs.	a. Replace pressure plate.
	b. Release fork loose on ball stud or in bearing groove.	b. Check ball stud and retaining.
	c. Oil in driven plate damper.	c. Replace driven disc.
	d. Driven plate damper spring failure.	d. Replace driven disc.
Release Bearing Noise with Clutch Fully Engaged	a. Release bearing binding on transmission bearing retainer.	a. Clean, relubricate, check for burrs, nicks, etc.
	b. Fork improperly installed.	b. Install properly.
Noisy	a. Worn release bearing.	a. Replace bearing.
	b. Fork off ball stud (heavy clicking).	b. Install properly and lubricate fork fingers and bearing.
	c. Pilot bearing loose in crankshaft.	c. See Section 6 for bearing fits.
Pedal Stays on Floor When Disengaged	a. Bind in release bearing.	Lubricate and free-up release bearing.
	b. Springs weak in pressure plate.	b. Replace pressure plate.

ON-VEHICLE SERVICE

CLUTCH HYDRAULIC SYSTEM

NOTICE: The clutch hydraulic system is serviced as a complete unit, it has been bled of air and filled with fluid. Individual components of the system are not available separately.

Prior to any vehicle service that requires removal of the slave cylinder (i.e., transmission and clutch housing removal), the **master cylinder push rod must be disconnected from the clutch pedal**. If not disconnected, permanent damage to the slave cylinder will occur if the clutch pedal is depressed while the slave cylinder is disconnected.

Removal

1. Disconnect negative battery cable.
2. Remove the steering column trim cover.
3. Remove the hush panel.
4. Discoonect the master cylinder push rod from clutch pedal.
5. Remove the clutch master cylinder to cowl nuts.
6. Remove the brake booster to cowl nuts.
7. Remove the clutch fluid reservoir from bracket.
8. Pull brake master cylinder forward for access to clutch master cylinder.
9. Remove the clutch master cylinder from cowl.
10. Hoist vehicle.
11. Remove the slave cylinder heat shield.
12. Remove the slave cylinder from bell housing.
13. Lower vehicle.
14. Remove the clutch hydraulic system from engine compartment.

Installation

1. Position hydraulic clutch master cylinder at cowl and feed slave cylinder drown to bell housing area.
2. Pilot clutch master cylinder push rod through cowl and position master cylinder to cowl with U bolt.
3. Connect brake booster to cowl.
4. Pilot clutch master cylinder U bolt through clutch braces and torque nuts.
5. Torque brake master cylinder to cowl nuts.

6. Clutch master cylinder push rod to clutch pedal.
7. Install brake switch.
8. Install hush panel.
9. Install steering column trim cover.
10. Install clutch reservoir to bracket.
11. Hoist vehicle.
12. Pilot slave cylinder into clutch fork.

NOTICE: With a new system, the slave cylinder contains a shipping strap that pre-positions the push rod for installation, and also provides a bearing insert. Following installation of the slave cylinder, the first actuation of the clutch pedal will break the shipping strap and give normal system operation.

13. Install slave cylinder and heat shield to bell housing.
14. Lower vehicle.
15. Connect negative battery cable.

CLUTCH ASSEMBLY

Removal

1. Remove the transmission as outlined in transmission section.
2. Remove the slave cylinder heat shield and slave cylinder from flywheel housing.
3. Remove the flywheel housing.
4. Slide clutch fork from ball stud and remove fork from dust boot. Ball stud is threaded into clutch housing and is easily replaced, if necessary.
5. Install Tool J-33169 to support the clutch assembly during removal. Look for mark or white painted letter on clutch cover and "X" mark on flywheel. If "X" or letter is not evident, mark flywheel and clutch cover for indexing purposes during installation.
6. Loosen clutch-to-flywheel attaching bolts evenly 1 turn at a time until spring pressure is released.
7. Remove clutch and pressure plate assembly.

Inspection

Inspect the flywheel for cracks, heat checking or other defects. Replace or repair as required.

Installation

Pressure plate and flywheel face, (They should be free of oil, grease, metal deposits or burned spots.)

Installation

1. Position clutch disc and pressure plate in relative installed position and support them with alignment Tool J-33169 or a drive gear.
   The driven disc is installed with the damper springs to the transmission. The flywheel side is marked.
2. Turn clutch assembly until "X" mark or white painted letter on cover lines up with "X" mark on flywheel, then align cover bolt holes to nearest flywheel holes.
3. Install a bolt in every hole and tighten down evenly and gradually until tight to avoid possible clutch distortion. (Cover loads are as high as 1-1/4 tons).
4. Remove the pilot tool.
5. Unhook clutch fork and lubricate ball socket and fork fingers at release bearing end with a high melting point grease such as graphite and reinstall fork on ball stud.
6. Lubricate recess on inside of release bearing collar and the clutch fork groove with light coat of graphite grease. Refer to Figure 7C-6.
7. Install the clutch fork and dust boot into clutch housing and install release bearing to fork, then install flywheel housing.
8. Install the transmission as outlined in transmission section.
9. Install the clutch slave cylinder and bracket.

CLUTCH PEDAL

Removal

1. Disconnect the negative cable at battery.
2. Remove the steering column trim cover.
3. Remove the hush panel from under dash.
4. If equipped, disconnect cruise control switch at clutch pedal.
5. Disconnect the neutral start switch at clutch pedal.
6. Remove the turn signal and hazard flasher mounting bracket attaching screws.
7. Disconnect the clutch master cylinder push rod from pedal.
8. Remove the nut from clutch pedal pivot bolt. Pull bolt out far enough for pedal removal.

Inspection

Clean and inspect all components and replace as necessary. Do not clean bushings with a cleaning solvent, simply wipe with a clean cloth. Relubricate all bushings and moving parts.

Installation

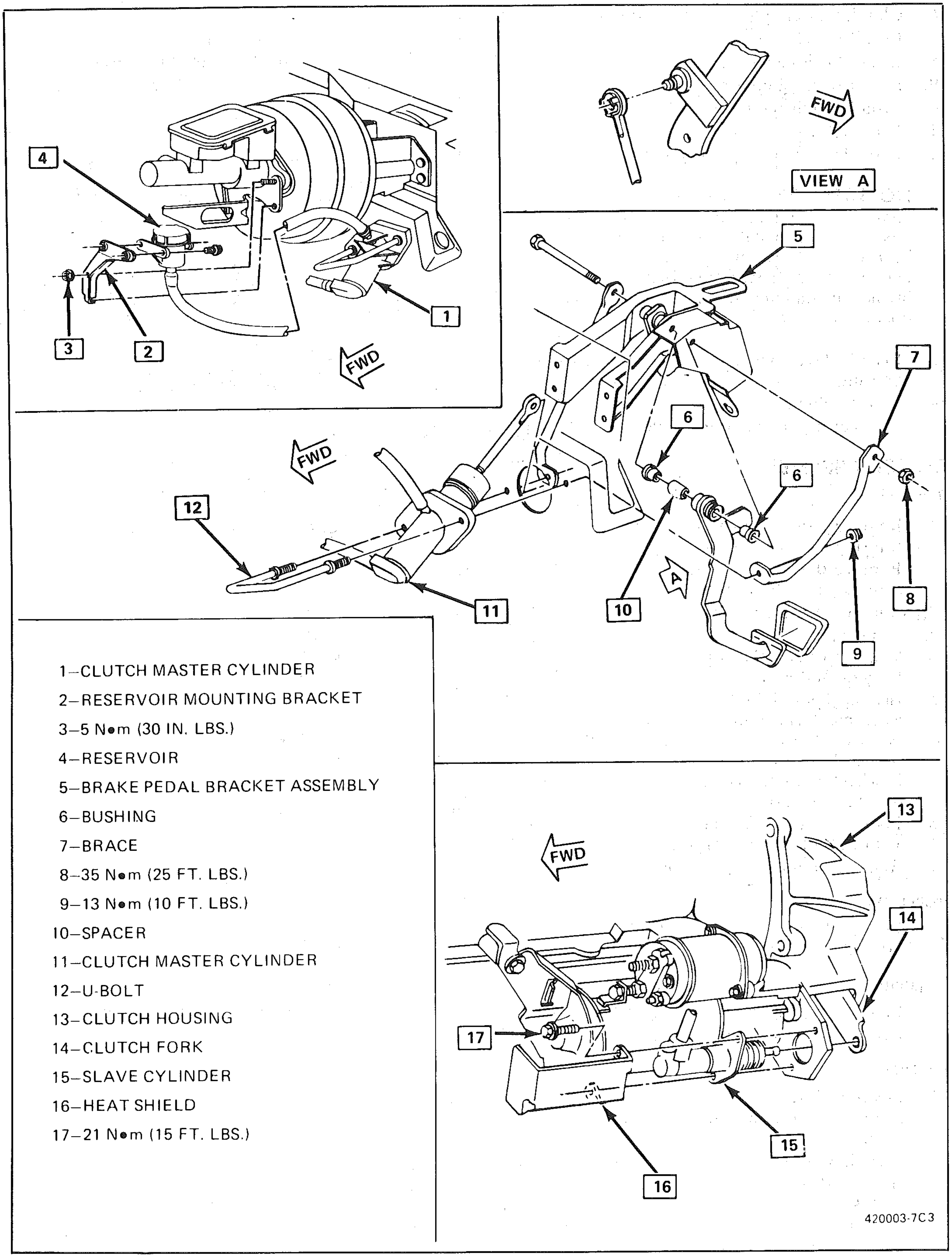
1. Reverse the removal procedure.

PILOT BEARING (FIGURE 7C-7)

Replacement

The clutch pilot bearing is an oil impregnated type bearing pressed into the crankshaft. This bearing requires attention when the clutch is removed from the vehicle, at which time it should be cleaned and inspected for excessive wear or damage and should be replaced if necessary.

To remove, install Tool J 23907 and remove bearing from crankshaft, as shown in Figure 7C-7. In replacing this bearing, use Tool J 1522. Place bearing on pilot of tool with radius in bore of bearing next to shoulder on tool and drive into crankshaft. Lubricate with several drops of machine oil.



1–CLUTCH MASTER CYLINDER
2–RESERVOIR MOUNTING BRACKET
3–5 N•m (30 IN. LBS.)
4–RESERVOIR
5–BRAKE PEDAL BRACKET ASSEMBLY
6–BUSHING
7–BRACE
8–35 N•m (25 FT. LBS.)
9–13 N•m (10 FT. LBS.)
10–SPACER
11–CLUTCH MASTER CYLINDER
12–U-BOLT
13–CLUTCH HOUSING
14–CLUTCH FORK
15–SLAVE CYLINDER
16–HEAT SHIELD
17–21 N•m (15 FT. LBS.)

Figure 7C-5 Clutch System Components

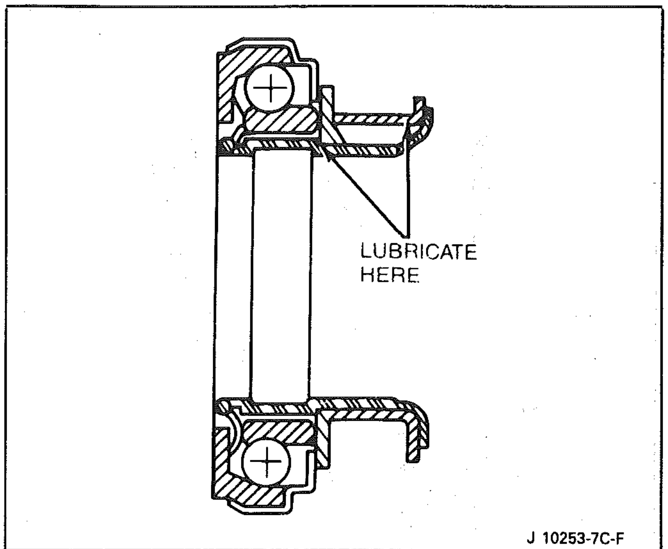


Figure 7C-6 Release Bearing Lubrication Areas

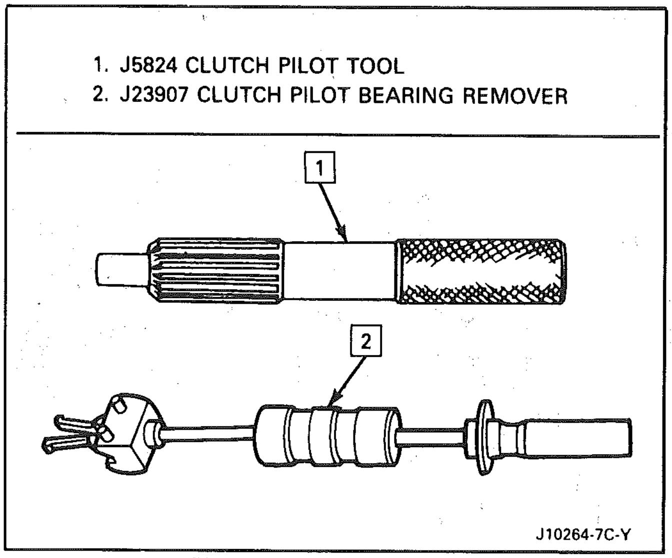


Figure 7C-7 Special Tools

SPECIFICATIONS

	N·m	(Ft.Lb.)	(In.Lb.)
Clutch Reservoir to Mounting Bracket	5	—	30
Clutch Master Cylinder to Cowl	13	10	
Heat Shield to Bell Housing	21	15	
Slave Cylinder to Bell Housing	21	15	
Clutch Pedal to Mounting Bracket	35	25	
Neutral Start Switch	3	—	26
Pressure Plate to Flywheel			
V6	21	15	
V8	40	30	
Flywheel to — Crankshaft V6	70	50	
Flywheel to — Crankshaft V8	100	75	
Bell Housing to Engine			
V6	75	55	
V8	92	68	

SECTION 8A
ELECTRICAL DIAGNOSIS
FIREBIRD

INDEX

INTRODUCTION

DIAGNOSTIC INFORMATION

This manual contains the following kinds of diagnostic information:

- Electrical Schematics
- Component Location Lists
- Harness Connector Faces
- Troubleshooting Hints
- System Checks
- System Diagnoses
- Circuit Operation Descriptions
- Harness Routing Views

Using these elements together will make electrical troubleshooting faster and easier. Each element is described below.

The **Electrical Schematic** should always be your starting point in using this Electrical Troubleshooting Manual. The schematic shows the electrical current paths when a circuit is operating properly. It is essential to understand how a circuit *should* work before trying to figure out why it doesn't.

The **Harness Connector Faces** show the cavity or terminal locations in all the multi-pin connectors shown in the schematic. Together with the wire colors and terminals given in the schematic, they help you locate test points. The drawings show the connector faces you see after the harness connector has been disconnected from a component. When more than one connector is connected to a component the connectors are all shown together.

The **Troubleshooting Hints** offer short-cuts or checks to help you determine the cause of a complaint. They are not intended to be a rigid procedure for solving an electrical situation. Rather, Troubleshooting Hints represent a common-sense approach, based on an understanding of the circuit.

The **System Check** gives a summary of how the circuit should be operated and what should happen. This is especially important when you are working on a new system. The System Check will help you identify symptoms, lead you to diagnosis and confirm the system after repair.

The **System Diagnosis** provides a procedure to follow that will locate the condition in a circuit. If your own knowledge of the system and the Troubleshooting Hints have not produced a quick fix, follow the System Diagnosis. All procedures are based on symptoms to assist you in locating the condition as fast as possible.

The **Circuit Operation** will help you understand the circuit. It describes the components and how the circuit works.

The **Component Location List** helps you find where the parts of the circuit are in the vehicle. A brief statement of the location is given and also a reference to a drawing that shows the component and its connecting wires. These **Component Location Views** are in cell 201.

Harness Routing Views are found in cell 203. These views show the routing of the major wiring harnesses and the in-line connectors between the major harnesses. These views will make troubleshooting easier when you are not sure about harness routing.

PAGE NUMBER

This section is organized into cells with most cells containing a circuit schematic and the text for that circuit. This makes the section easy to use, since the page number for a schematic will normally stay the same year after year, and it will also be the same in all the GM publications about that circuit. For example, the Cruise Control schematics will always be the first pages of cell 34. The other information for Cruise Control follows them on pages 34-2, 34-3, etc.

Some cells may have more than one circuit schematic, such as Power Distribution, Interior Lights, and Air Conditioning. The circuit you want can either be located by using the index, or by a quick look through the related cell.

All the engine circuits for a particular engine VIN type are in the same cell. This makes that cell easy to use, since schematics for other cars are not in your way. The instrument panel schematics are organized similarly. If you are working on a car with a Digital Cluster, only the schematics that apply to that car's Digital Cluster will be in the cell you use. Information on the Indicators and Gages Clusters will be in other cells.

SCHEMATICS

These schematics break the entire electrical system down into individual circuits. You are not distracted by wiring which is not part of the circuit you're working on.

It is important to realize that no attempt is made on the schematic to represent components and wiring as they physically appear on the car. For example, a 4-foot length of wire is treated no differently in a schematic from one which is only a few inches long. The number of cavities for each connector is listed in the Component Location List. Similarly, switches and other components are shown as simply as possible, with regard to function only.

The following example shows how to read a Horn schematic, see figure 1. Locate the Horn schematic using the Index. The circuit schematic will look somewhat like the one to the right. The schematic is read from top to bottom.

Voltage is applied to the Horn Relay at all times. When the relay coil is grounded by closing the Horn Switch, the relay contacts close. When the relay contacts are closed, both the LH and RH Horns are energized.

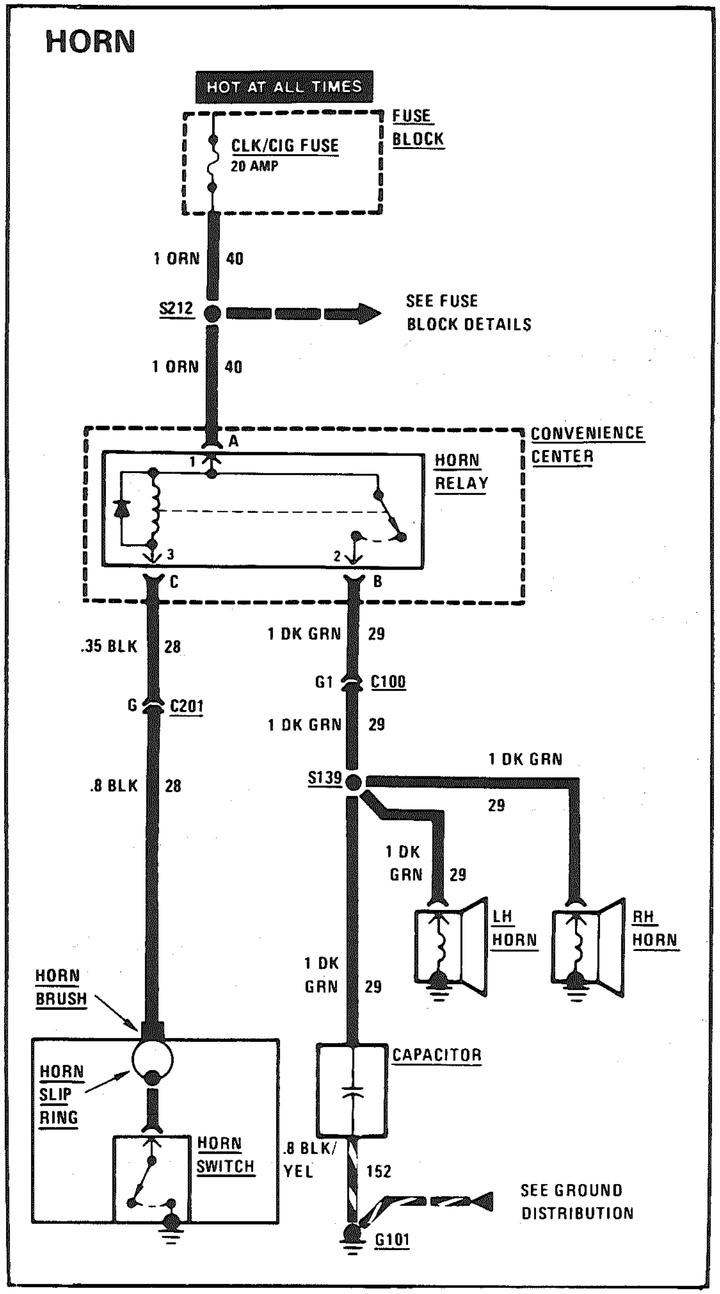


Figure 1 - Typical Horn Schematic

COMPONENT LOCATIONS

When you are ready to locate the schematic components on the car, use the Component Locations List, see figure 2.

Listed in the left hand column are the components shown on the schematic. Next to the Convenience Center is the location, "Under LH side of I/P." Reference to LH and RH is made as though the troubleshooter was sitting in the driver's seat. On the same line, in the far right column, is a page-figure reference. In this case, you are directed to figure A on page 201-6.

Where connectors are listed, the number of cavities is provided. This represents the total number of cavities in the connector, regardless of how many are actually used. This information is provided to help you identify connectors on the car.

Grounds are listed next in the table. The location description for G101 reads, "LH front of engine compartment, behind headlights panel." You are directed to page 201-8, figure D.

Nearly every component, connector, ground or splice shown on a schematic can be pinpointed visually by using the Component Location Views' figures.

COMPONENT LOCATION		Page-Figure
COMPONENTS		
Convenience Center	Under LH side of I/P	201-6-A
Fuse Block	Under LH side of I/P	201-6-A
Horn Brush/Slip Ring	Under steering wheel	201-5-E
Horn Switch	Under steering wheel	201-5-E
CONNECTORS		
C100 (46 cavities)	LH side of dash	201-5-B
C201 (11 cavities)	Under LH side of I/P, near C100	201-5-F
GROUNDS		
G101	LH front of engine compartment, behind headlights panel	201-8-D
SPLICES		
S139	Front lights harness, behind LH front light panel	201-8-C
S212	I/P harness, behind I/P, above steering column	201-6-B

Figure 2 - Typical Entries In The Component Location List

HARNESS CONNECTOR FACES

The connectors, see figure 3, are labeled with the component they are connected to, or the connector number from the schematic where they appear, and their color. The identifying number is for reference only; it is not the connector part number. For in-line connectors, the half shown is usually the Socket half. If both views are shown, the other half is the Pin Half.

Only connectors that have two or more terminals are shown.

If you need to backprobe a connector while it is on the component, the order of the terminals must be mentally reversed. The wire color is a help in this situation. If there is more than one wire of the same color, you may need to locate a test point from its terminal number. A useful trick is to imagine that you are probing a terminal from behind the page you are looking at. Then mentally locate that terminal with respect to the keyway or other reference mark.

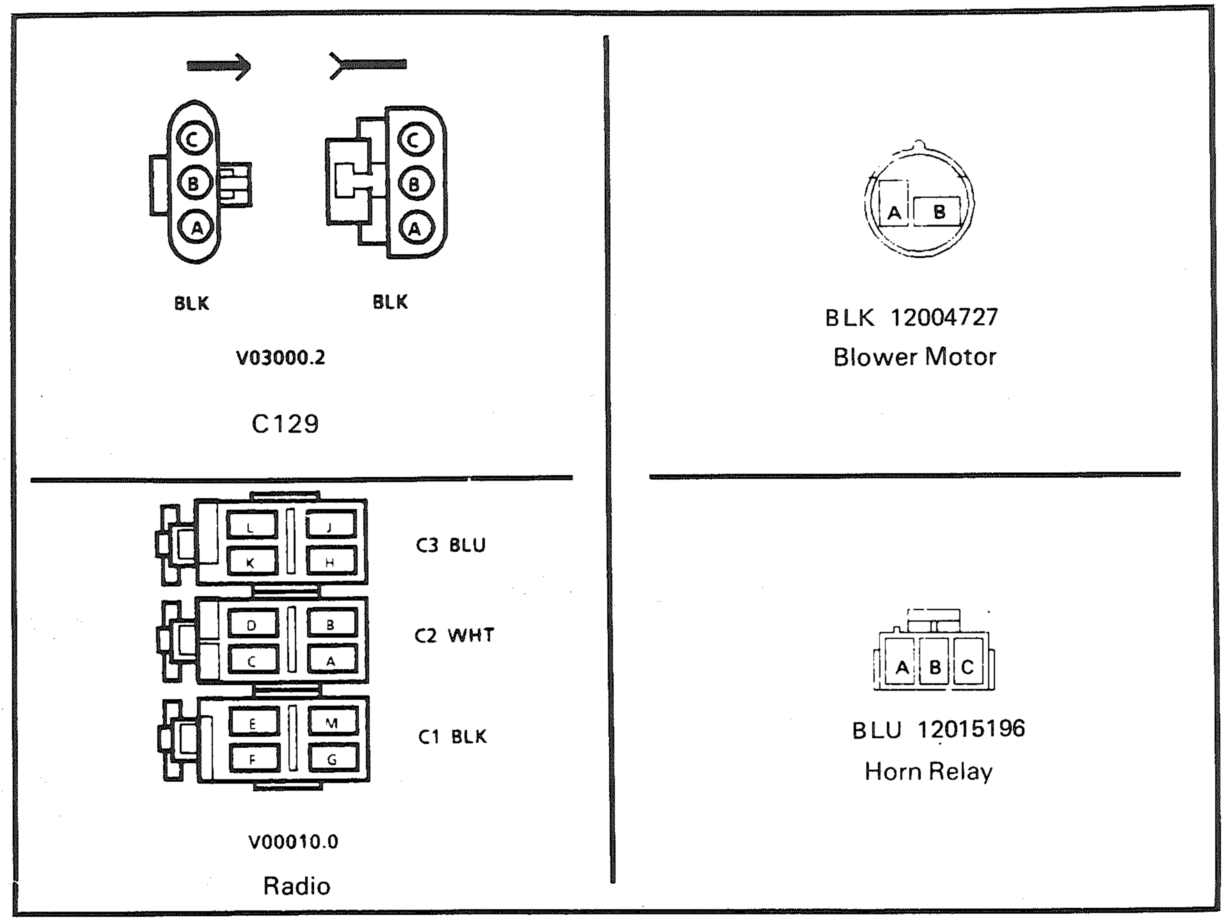


Figure 3 -Typical Harness Connector Faces

OTHER INFORMATION

Body Part Names

Refer to figure 4 for the correct body part names.

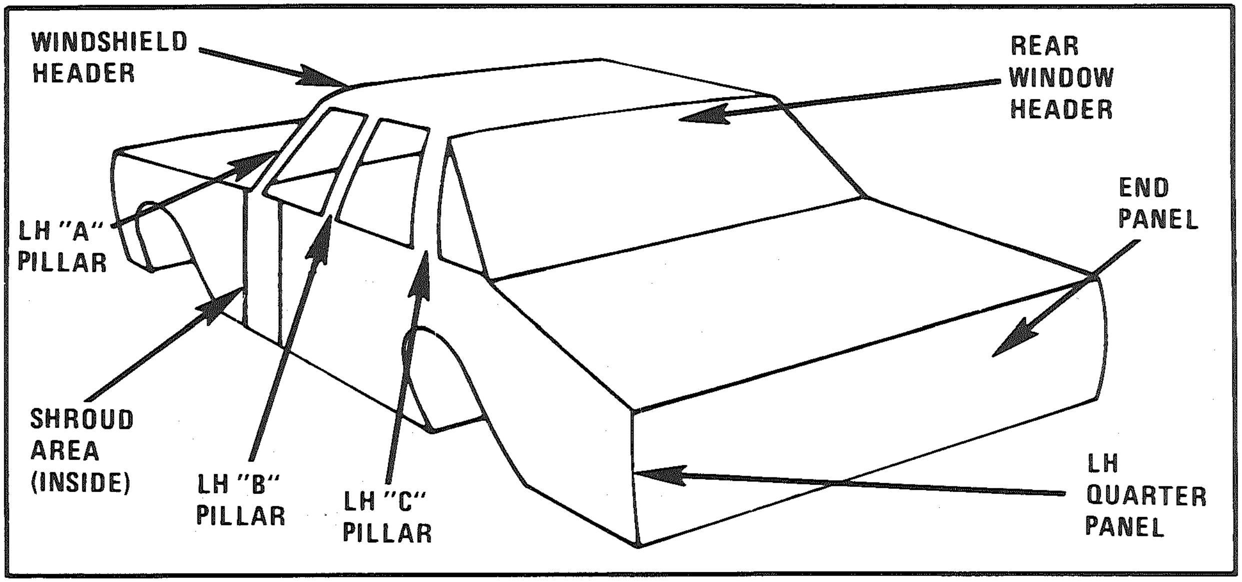


Figure 4 - Body Part Names

VIN References

If schematics for more than one variation of an engine type—V6, for example—are shown, then the schematics will be labeled with VIN designations to distinguish the variations.

Service Parts Identification Label

To aid service and parts personnel in identifying options and parts originally installed, a Service Parts Identification Label has been placed in the car. See the General Information Section 0A of the Chassis Service Manual for the location of the label and the definition of the option codes.

Abbreviations

A/C — Air Conditioning
BCM — Body Computer Module
ECM — Electronic Control Module or Engine Control Module
I/P — Instrument Panel
RH — Right Hand, as seen from driver's seat
LH — Left Hand
Not Used — The connector cavity has no function.

Power Distribution

The Power Distribution schematic shows the wiring from the Battery and Generator to the Starter Solenoid, Fuse Block, Ignition Switch and Light Switch. The first component after a Fusible Link is also shown. In certain instances, the first component after a Fuse Block fuse and Light Switch is also shown.

The Power Distribution schematic refers to Fuse Block Details and Light Switch Details schematics. By using these three (3) schematics, power distribution wiring can be followed from the Battery and Generator to the first component after a Fusible Link, Fuse and Light Switch. The ability to follow the power distribution wiring to the first component in each circuit is extremely helpful in locating short circuits which cause fusible links and fuses to open.

Figure 5 is a sample Power Distribution schematic. It shows how voltage is applied from the positive Battery terminal to the various circuits on the car. For example, Battery voltage is applied to the Starter Solenoid, Fusible Link D, the RED wire and connector C100 to Fuse 1 and Fuse 2 in the Fuse Block and the Light Switch in the LH Pod. These fuses are said to be "Hot At All Times", since Battery voltage is always applied to them.

Notice that Battery voltage is also applied to Fusible Link F and the RED wire to the Coolant Fan Relay.

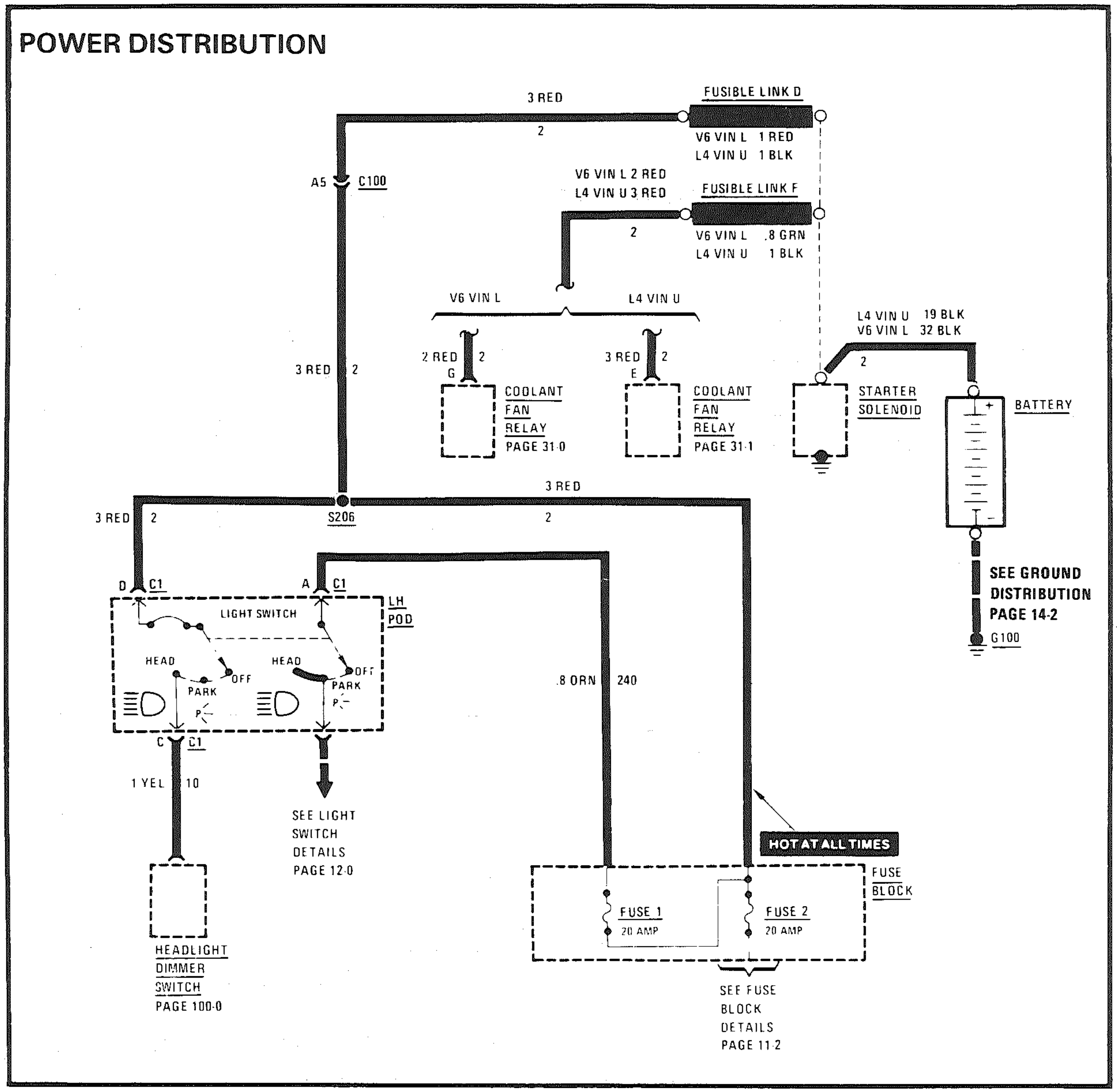


Figure 5 - Typical Power Distribution Schematic

Fuse Block Details

The Fuse Block Details schematic, see figure 6, shows all the wiring between a fuse and the components connected to the output of the fuse. In certain instances where space permits, this detail is shown on the Power Distribution schematic. The Fuse Block Details schematic is extremely helpful in locating a short circuit that causes a fuse to open.

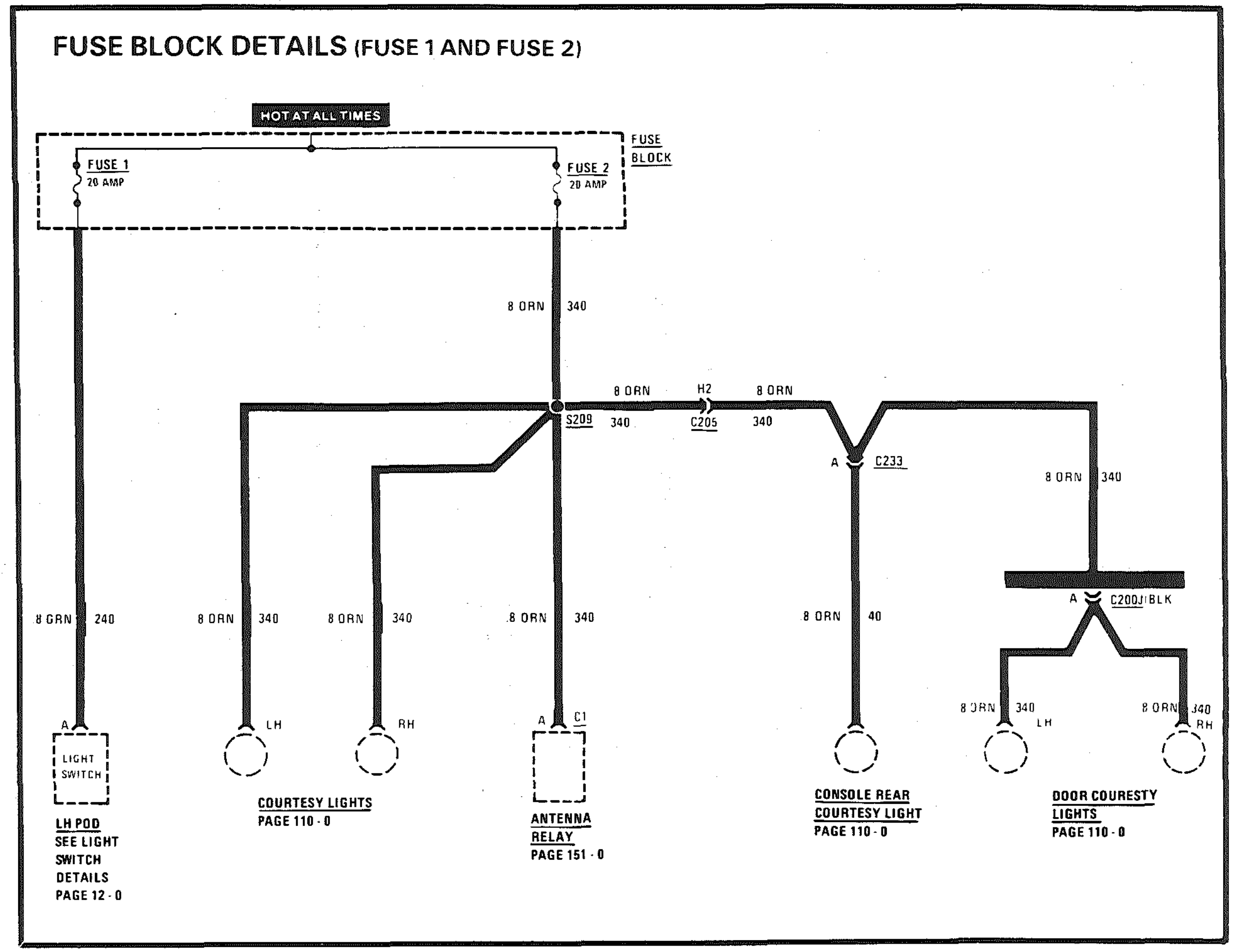


Figure 6 - Typical Fuse Block Details Schematic

INTRODUCTION

Light Switch Details

The Light Switch Details schematic, see figure 7, shows the wiring between the Light Switch and the components connected to the output of the Light Switch. In certain instances where space permits, some of this detail may be shown on the Power Distribution schematic. The Light Switch Details schematic helps you understand the many wires that come from the Light Switch. This schematic is also helpful in locating a short circuit that causes the fuse ahead of the Light Switch to open.

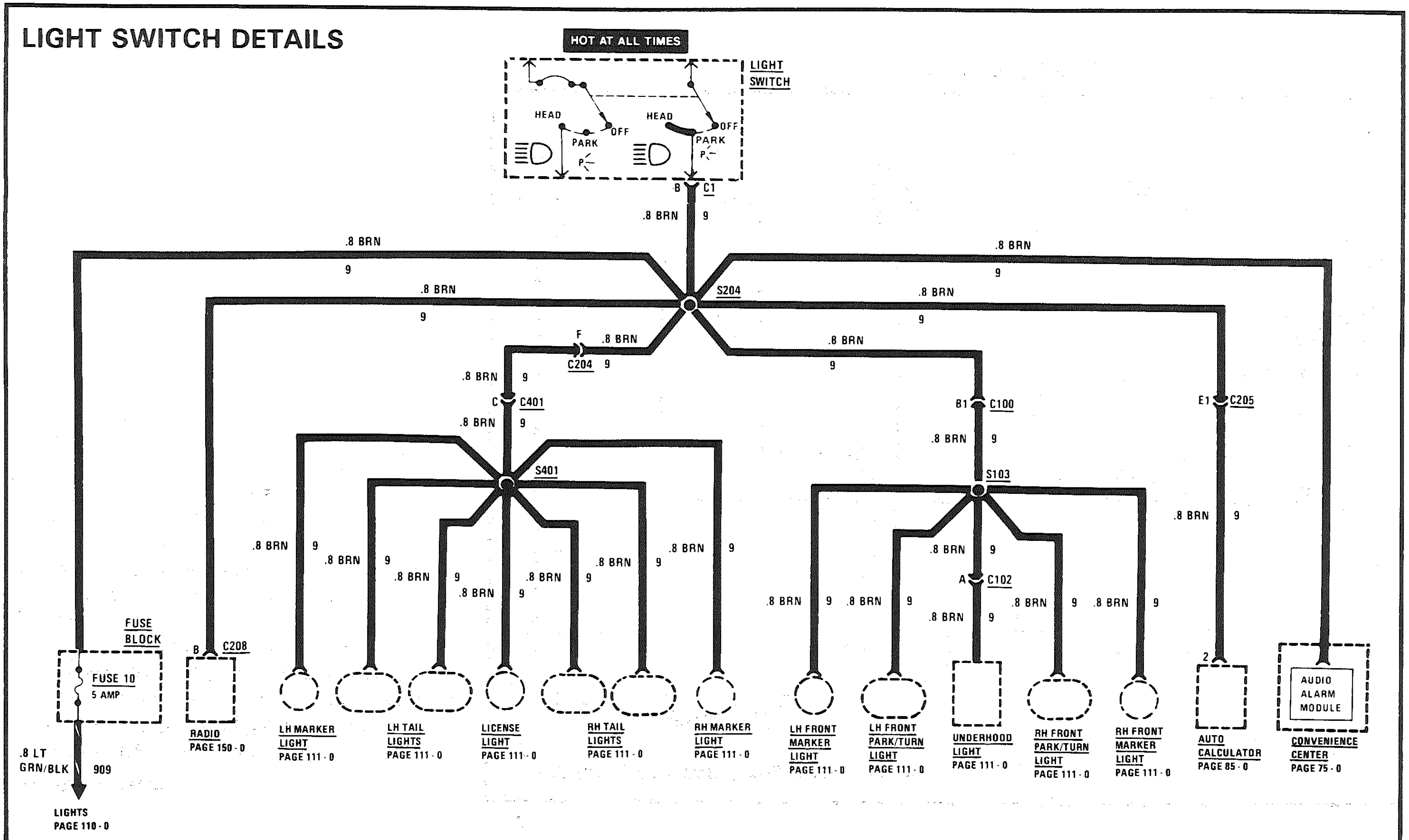


Figure 7 - Typical Light Switch Details Schematic

Ground Distribution

Figure 8 is a sample Ground Distribution schematic for the Headlights. It shows exactly which components share each ground. This information can often be a time-saver when troubleshooting ground circuits.

For example, if both Headlights and the Park/Turn Light on one side are all out, you could suspect an open in their common ground wire or the ground connection itself. On the other hand, if one of the lights works, you know that the ground and the wire up to the splice are good. You have learned this just by inspecting the schematic and knowing the vehicle's symptoms. No actual work on the lighting system was needed.

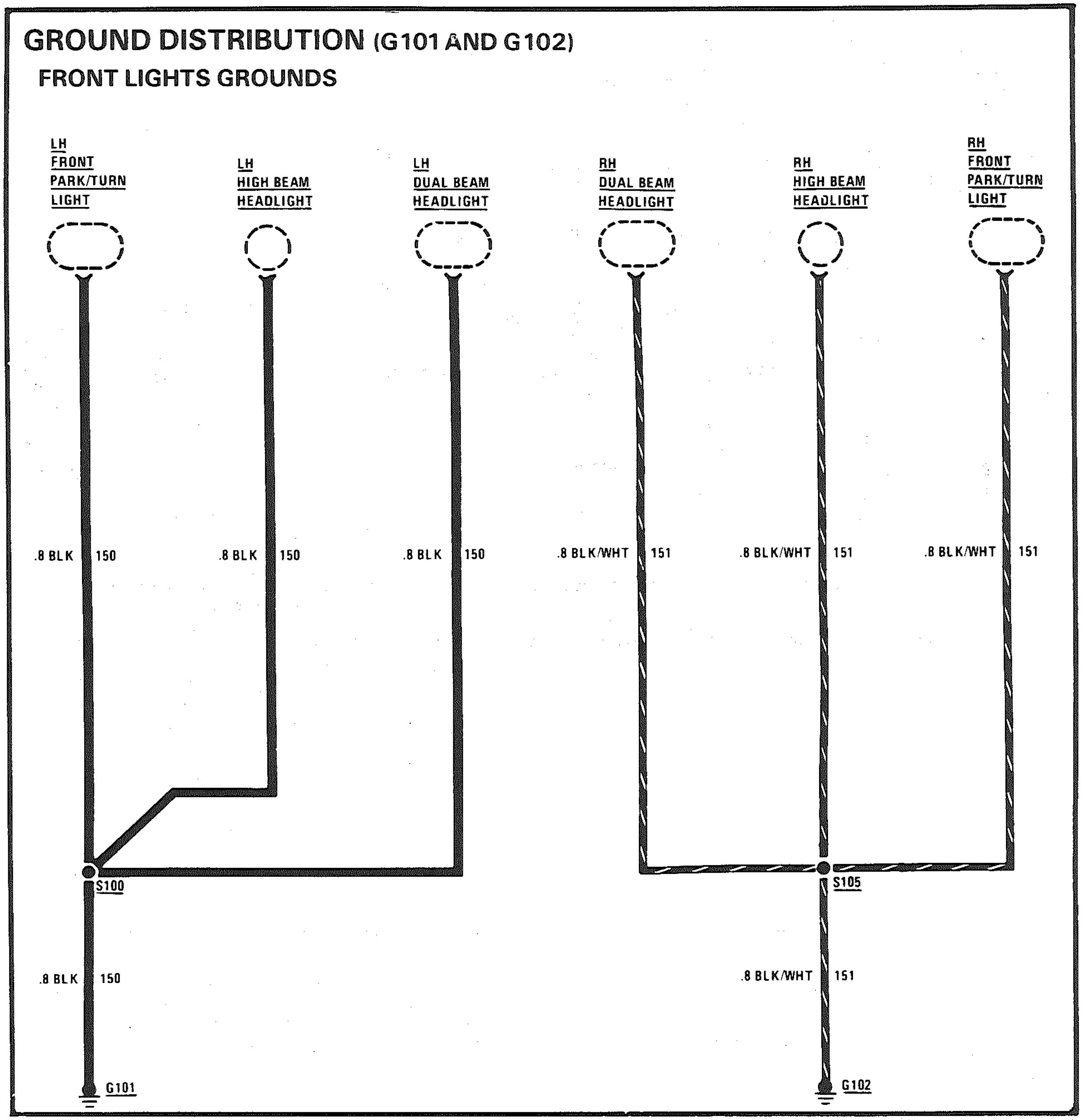
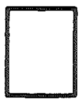
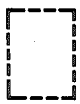


Figure 8 - Typical Ground Distribution Schematic

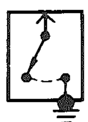
SYMBOLS



ENTIRE COMPONENT SHOWN

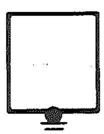


PART OF A COMPONENT SHOWN



PARK BRAKE SWITCH — NAME OF COMPONENT

CLOSED WITH PARKING BRAKE ON — DETAILS ABOUT COMPONENT OR ITS OPERATION



COMPONENT CASE IS DIRECTLY ATTACHED TO METAL PART OF CAR (GROUNDED)

WIRE IS ATTACHED TO METAL PART OF CAR (GROUNDED)

GROUND IS NUMBERED FOR REFERENCE ON COMPONENT LOCATION TABLE

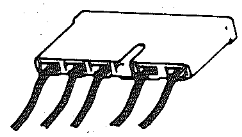
SEE GROUND DISTRIBUTION

WIRE IS INDIRECTLY CONNECTED TO GROUND

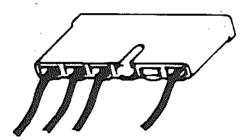
WIRE MAY HAVE ONE OR MORE SPLICES BEFORE IT IS GROUNDED

CONNECTOR REFERENCE NUMBER FOR COMPONENT LOCATION TABLE

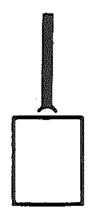
TABLE ALSO SHOWS TOTAL NUMBER OF TERMINALS POSSIBLE: C103 (6 CAVITIES)



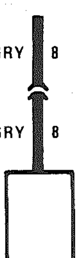
5 CAVITY CONNECTOR (5 OUT OF 5 CAVITIES ARE USED)



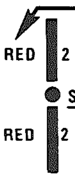
5 CAVITY CONNECTOR (4 OUT OF 5 CAVITIES ARE USED)



CONNECTOR ATTACHED TO COMPONENT



CONNECTOR ON COMPONENT LEAD (PIGTAIL)



INSULATION COLOR IS BOTH SHOWN AND LABELED

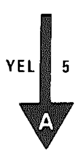
SPLICES ARE SHOWN AND NUMBERED

CIRCUIT NUMBER IS SHOWN TO HELP IN TRACING CIRCUITS

A WAVY LINE MEANS A WIRE IS TO BE CONTINUED

WIRE INSULATION IS ONE COLOR WITH ANOTHER COLOR STRIPE (RED WITH YELLOW)

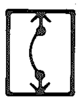
WIRE SIZE AND INSULATION COLOR ARE LABELED



CURRENT PATH IS CONTINUED AS LABELED. THE ARROW SHOWS THE DIRECTION OF CURRENT FLOW AND IS REPEATED WHERE CURRENT PATH CONTINUES.

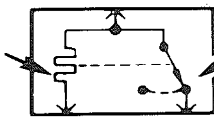
A WIRE WHICH CONNECTS TO ANOTHER CIRCUIT. THE WIRE IS SHOWN AGAIN ON THAT CIRCUIT.

SYMBOLS

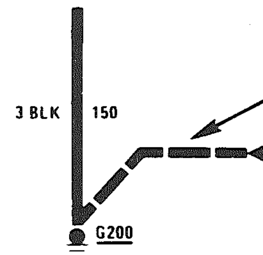


CIRCUIT BREAKER

HEATING ELEMENT

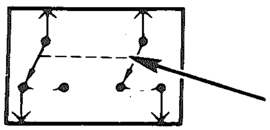


HEAT ACTUATED CONTACT



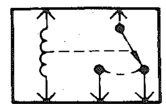
INDICATES THAT THE CIRCUITRY IS NOT SHOWN IN COMPLETE DETAIL BUT IS COMPLETE IN THE INDICATED CELL

SEE GROUND DISTRIBUTION



SWITCH CONTACTS THAT MOVE TOGETHER

DASHED LINE SHOWS A MECHANICAL CONNECTION BETWEEN SWITCH CONTACTS

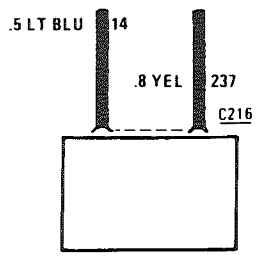


RELAY SHOWN WITH NO CURRENT FLOWING THROUGH COIL

NORMALLY CLOSED CONTACT

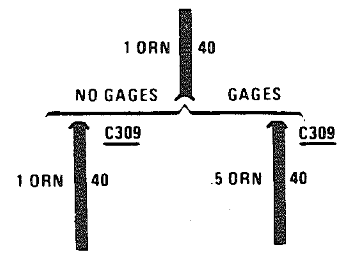
NORMALLY OPEN CONTACT

WHEN CURRENT FLOWS THROUGH COIL, CONTACT MOVES TO NORMALLY OPEN POSITION



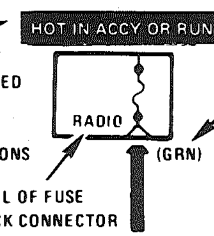
TWO TERMINALS IN THE SAME CONNECTOR

DASHED LINE SHOWS A PHYSICAL CONNECTION BETWEEN PARTS (SAME CONNECTOR)



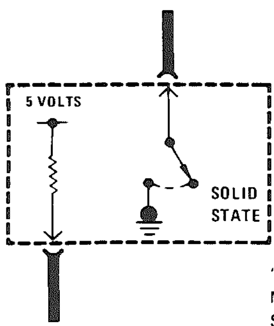
WIRE CHOICES FOR OPTIONS OR DIFFERENT MODELS ARE SHOWN AND LABELED

COLOR OF FUSE BLOCK CONNECTOR



INDICATES THAT POWER IS SUPPLIED WITH IGNITION SWITCH IN ACCY AND RUN POSITIONS

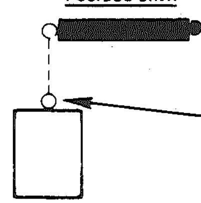
LABEL OF FUSE BLOCK CONNECTOR CAVITY



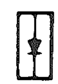
ELECTRONIC CONTROL MODULE (ECM) SOLID STATE

"SOLID STATE" IDENTIFIES MODULE AS ELECTRONIC. SIMPLIFIED COMPONENTS WITHIN THE MODULE SHOW HOW EACH CIRCUIT IS COMPLETED. DO NOT MEASURE RESISTANCE OF CIRCUITS INSIDE SOLID STATE MODULES.

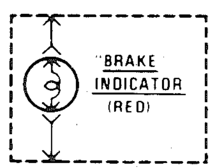
FUSIBLE LINK



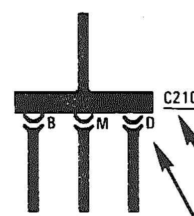
FUSIBLE LINK CONNECTS TO SCREW TERMINAL, SHOWN SEPARATED



DIODE CURRENT CAN FLOW ONLY IN THE DIRECTION OF THE ARROW



AN INDICATOR WHICH DISPLAYS THE LIGHTED WORD "BRAKE"

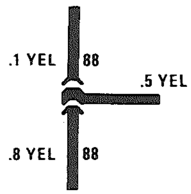


3 CONNECTORS ARE SHOWN CONNECTED TOGETHER AT A JUNCTION BLOCK. FOURTH WIRE IS SOLDERED TO COMMON CONNECTION ON BLOCK.

CONNECTOR NUMBER

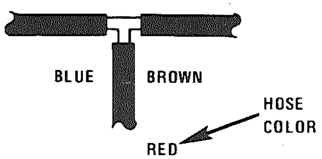
LETTERS FOR EACH CAVITY

SYMBOLS

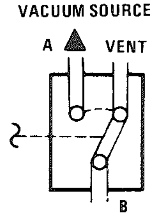


3 WIRES ARE SHOWN CONNECTED TOGETHER WITH A PIGGYBACK CONNECTOR

VACUUM JUNCTION



VACUUM SOURCE

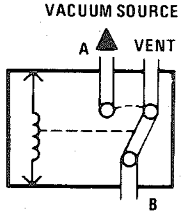


MECHANICAL VACUUM VALVE

WHEN THE VALVE IS IN THE " AT REST " POSITION, PORT B IS VENTED. THE VACUUM AT PORT A HAS NO EFFECT.

WHEN THE VALVE IS MOVED TO THE "OPERATED" POSITION VACUUM FROM PORT A IS CONNECTED TO PORT B

VACUUM SOURCE

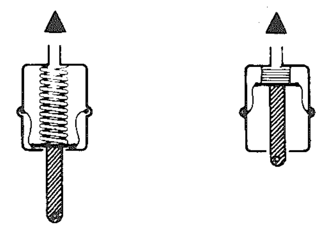


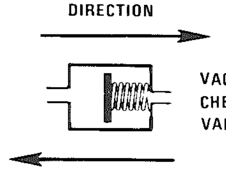
SOLENOID VACUUM VALVE

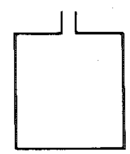
THE SOLENOID VACUUM VALVE USES THE SOLENOID TO MOVE THE VALVE

Vacuum motors operate like electrical solenoids, mechanically pushing or pulling a shaft between two fixed positions. When vacuum is applied, the shaft is pulled in. When no vacuum is applied, the shaft is pushed all the way out by a spring.

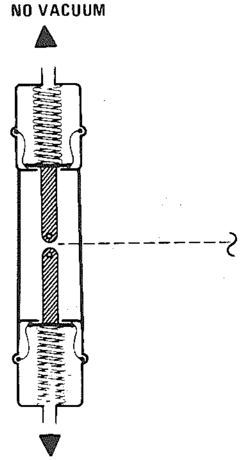
SINGLE DIAPHRAGM MOTOR





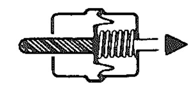


DOUBLE DIAPHRAGM MOTOR



Double diaphragm motors can be operated by vacuum in two directions. When there is no vacuum, the motor is in the center "at rest" position.

SERVO MOTOR



Some vacuum motors such as the servo motor in the Cruise Control can position the actuating arm at any position between fully extended and fully retracted. The servo is operated by a control valve that applies varying amounts of vacuum to the motor. The higher the vacuum level, the greater the retraction of the motor arm. Servo motors work like the two position motors; the only difference is in the way the vacuum is applied. Servo motors are generally larger and provide a calibrated control.

The following four-step troubleshooting procedure is recommended:

Step 1: Check the problem.

Perform a System Check to be sure you understand what's wrong. Don't waste time fixing part of the problem! Do not begin disassembly or testing until you have narrowed down the possible causes.

Step 2: Read the Electrical Schematic.

Study the schematic. Read the Circuit Operation text if you do not understand how the circuit *should* work. Check circuits that share wiring with the problem circuit. The names of circuits that share the same fuse, ground, switch, etc., are included on each electrical schematic. (Shared circuits are also shown on Power Distribution, Ground Distribution, Fuse Block Details, and Light Switch pages.) Try to operate the shared circuits. If the shared circuits work, then the shared wiring is OK. The cause must be within the wiring used only by the problem circuit. If several circuits fail at the same time, chances are the power (fuse) or ground circuit is faulty.

Step 3: Find the Cause and Repair.

- Narrow down the possible causes.
- Use the Troubleshooting Hints.
- Make the necessary measurements as given in the System Diagnosis.
- Before you replace a component, check power, signal, and ground wires at the component harness connector. If these are OK, the component must be bad.

Step 4: Test the Repair

Repeat the System Check to be sure you have fixed the whole problem.

Example

A customer brings in a car and says that the high beams do not work.

Step 1: Perform a System Check on the Headlights Circuit. You may discover that both low beams operate. In "Hi," you may notice that the High Beam Indicator comes on, but neither high beam operates.

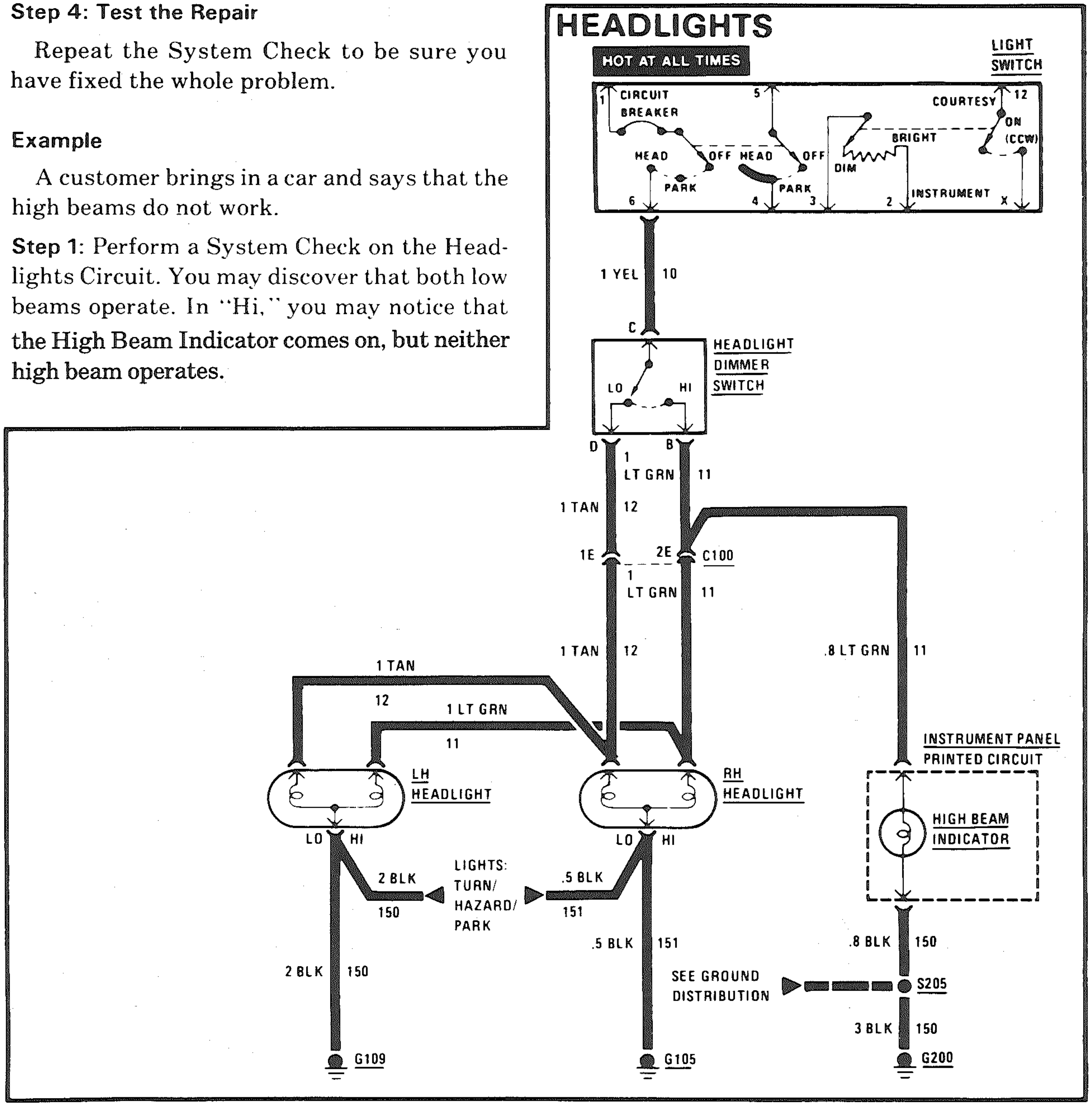


Figure 9 - Typical Headlights Schematic

Step 2: Read the Headlights electrical schematic, see figure 9. This is the step that will save you time and labor. Remember, it is essential to understand how a circuit *should* work, before trying to figure out why it doesn't.

After you understand how the circuit should operate, read the schematic again, this time keeping in mind what you have learned by operating the circuit.

Since both low beams work, you know that the Light Switch, the YEL wire, the Lo contacts of the Headlight Dimmer Switch, terminal 1E of C100, the TAN wires, and grounds G105 and G109 are all good.

Furthermore, since you saw that the High Beam Indicator came on when the Headlight Dimmer Switch was moved to Hi, you know that the Hi contacts of the dimmer switch and the LT GRN wire between the dimmer switch and C100 are good.

At this point, you could test for voltage at the RH Headlight with the dimmer switch in Hi. However, it is extremely unlikely that the high beam filaments have burned out in *both* headlights, or that *both* headlight connections are bad. The cause must be a bad connection at C100, or a break in the LT GRN wire between C100 and the RH Headlight.

You have quickly narrowed the possible causes down to one specific area, and have *done* absolutely *no* work on the car itself.

Step 3: Find the cause and repair it. Using the Component Location List and the corresponding figure, you can quickly find C100 and the LT GRN wire, locate the exact trouble point, and make the repair.

Step 4: Check the repair by performing a system check on the Headlights circuit. This, of course, means making sure that both high beams, both low beams, and the High Beam Indicator are all working.

Now suppose that the symptoms were different. You may have operated the Headlights and found that the low beams were working, but neither the high beams nor the High Beam Indicator were working. Looking at the schematic, you might conclude the following.

It is unlikely that both high beam filaments and the High Beam Indicator have all burned out at once. The cause is probably the dimmer switch or its connector.

TROUBLESHOOTING TOOLS

Electrical troubleshooting requires the use of common electrical test equipment.

TEST LIGHT/VOLTMETER

Use a test light to check for voltage. A Test Light (BT-7905 or equivalent) is made up of a 12-Volt light bulb with a pair of leads attached. After grounding one lead, touch the other lead to various points along the circuit where voltage should be present. When the bulb goes on, there is voltage at the point being tested.

A voltmeter can be used instead of a test light. While a test light shows whether or not voltage is present, a voltmeter indicates how much voltage is present.

An increasing number of circuits include solid state control modules. One example is the Electronic Control Module (ECM) used with Computer Command Control and Electronic Fuel Injection. Voltages in these circuits should be tested only with a 10-megohm or higher impedance digital voltmeter or multimeter (J-29125 or equivalent). Never use a test light on circuits that contain solid state components, since damage to these components may result.

When testing for voltage or continuity at a connection, you do not have to separate the two halves of the connector. Unless you are testing a "weather-pack" connector, you should probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems.

CONNECTOR TEST ADAPTERS

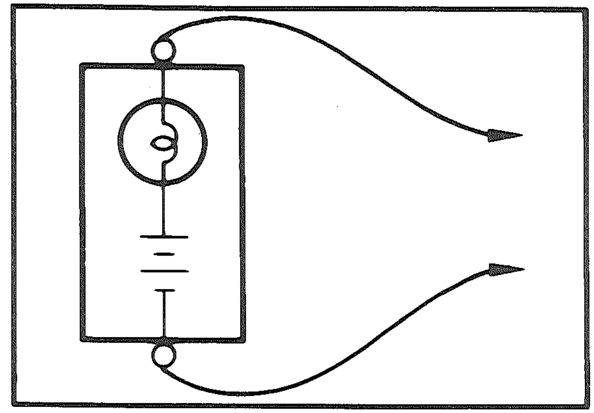
A connector Adapter Kit is available (J35616) for making tests and measurements at separated connectors. This kit contains an assortment of probes which mate with many of the types of connectors you will see. Avoid using paper clips and other substitutes since they can damage terminals and cause incorrect measurements.

SELF-POWERED TEST LIGHT

Use a self-powered test light (J-21008 or equivalent) to check for continuity. This tool is made up of a light bulb, battery, and two leads. If the leads are touched together, the bulb will go on.

A self-powered test light is used only on an unpowered circuit. First disconnect the car's Battery, or remove the fuse which feeds the circuit you're working on. Select two specific points along the circuit through which there should be continuity. Connect one lead of the self-powered test light to each point. If there is continuity, the test light's circuit will be completed and the bulb will go on.

Never use a self-powered test light on circuits that contain solid state components, since damage to these components may result.



Self-Powered Test Light

OHMMETER

An ohmmeter can be used instead of a self-powered test light. The ohmmeter shows how much resistance there is between two points along a circuit. Low resistance means good continuity.

Circuits which include any solid state control modules, such as the Electronic Control Module (ECM), should be tested only with a 10-megohm or higher impedance digital multimeter (J-29125 or equivalent).

When measuring resistance with a digital multimeter, the vehicle Battery should be disconnected. This will prevent incorrect readings. Digital meters apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

Diodes and solid state components in a circuit can cause an ohmmeter to give a false reading. To find out if a component is affecting a measurement, take a reading once, reverse the leads and take a second reading. If the readings differ, the solid state component is affecting the measurement.

FUSED JUMPER WIRE

A fused jumper is available (J-36169 or equivalent) with small clamp connectors providing adaptation to most connectors without damage. This fused jumper wire is supplied with a 20 amp fuse which may not be suitable for some circuits. Do not use a fuse with a higher rating than the fuse that protects the circuit being tested.

CAUTION: Do not use fused jumper wire in any instance to substitute for inputs or outputs at the ECM (Electronic Control Module), BCM (Body Control Module), or any microprocessor device.

SHORT FINDER

Short Finders are available (J-8681 or equivalent) to locate hidden shorts to ground. The short finder creates a pulsing magnetic field in the shorted circuit and shows you the location of the short through body trim or sheet metal.

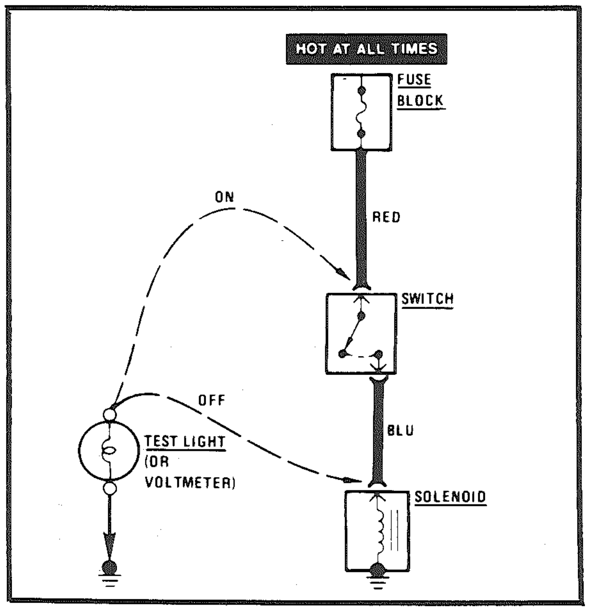
FUSE TESTER

A simple tester that indicates a blown fuse is available (J-34764 or equivalent). To check a fuse the tester is applied directly to the fuse in the fuse block. Two probes contact the fuse. The probes are either placed into the slots of a flat fuse or to the metal ends of a glass fuse. With power on, a red LED in the tester lights if the fuse is open. The handle of the tester is a tool for removing either type of fuse.

TROUBLESHOOTING TESTS

TESTING FOR VOLTAGE

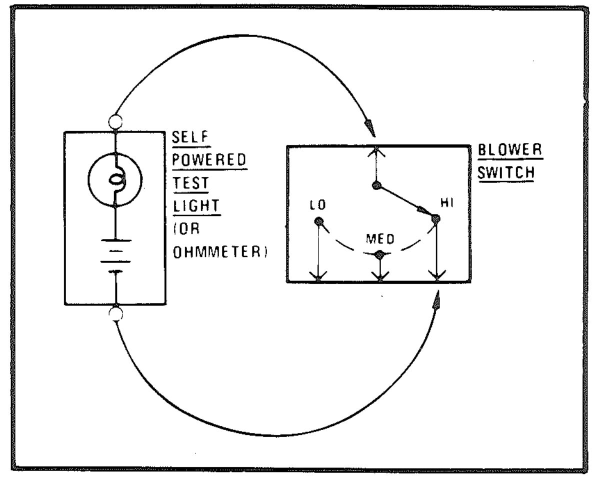
1. Connect one lead of a test light to a known good ground. If you are using a voltmeter, be sure it is the voltmeter's negative lead that you have connected to ground.
2. Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).
3. If the test light glows, there is voltage present. If you are using a voltmeter, note the voltage reading. It should be within one volt of measured Battery voltage. A loss of more than one volt indicates a problem.



Voltage Check

TESTING FOR CONTINUITY

1. Disconnect the car battery.
2. Connect one lead of a self-powered test light or ohmmeter to one end of the part of the circuit you wish to test.
3. Connect the other lead to the other end of the circuit.
4. If the self-powered test light glows, there is continuity. If you are using an ohmmeter, low or no resistance means good continuity.



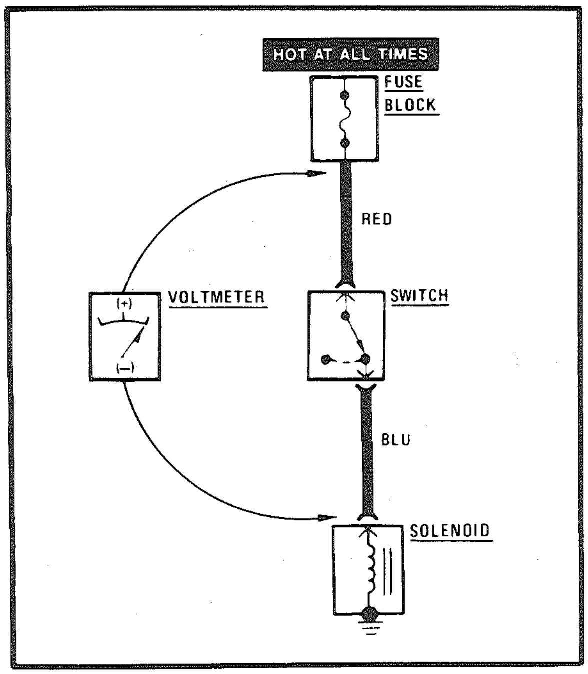
Continuity Check Through A Switch

TROUBLESHOOTING TESTS

TESTING FOR VOLTAGE DROP

This test checks for voltage being lost along a wire, or through a connection or switch.

1. Connect the positive lead of a voltmeter to the end of the wire (or to one side of the connection or switch) which is closer to the Battery.
2. Connect the negative lead to the other end of the wire (or the other side of the connection or switch).
3. Operate the circuit.
4. The voltmeter will show the difference in voltage between the two points. A difference (or drop) of more than one volt indicates a problem.

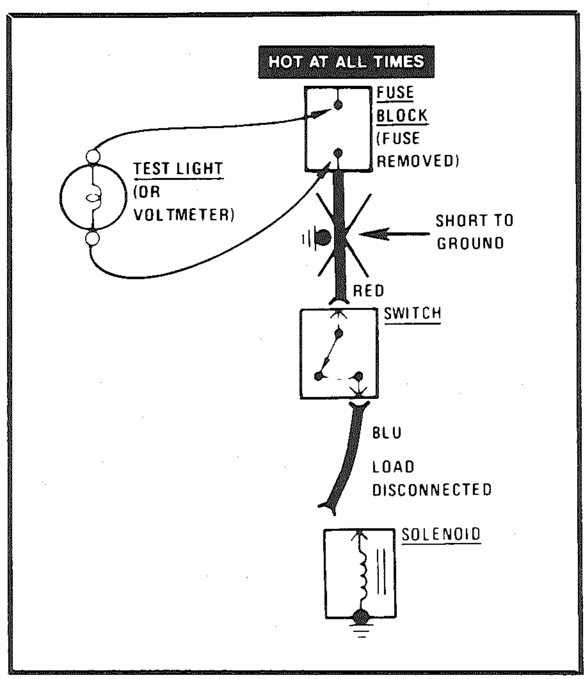


Voltage Drop Test

TESTING FOR SHORT TO GROUND

With a Test Light or Voltmeter

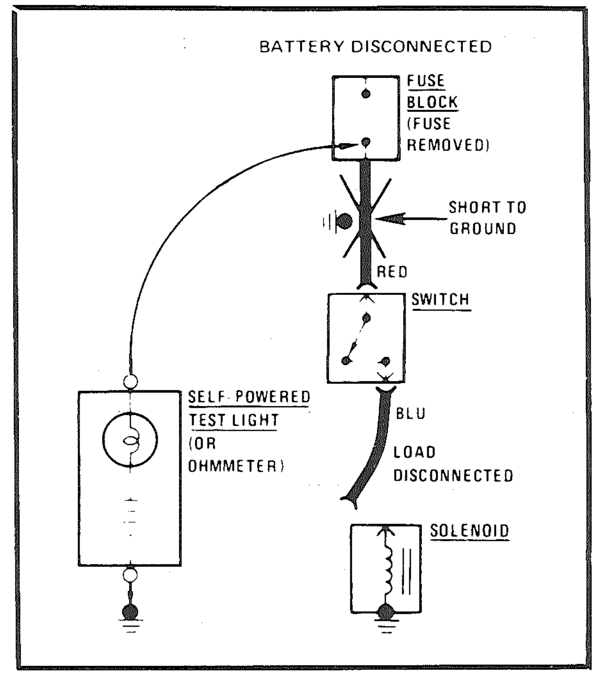
1. Remove the blown fuse and disconnect the load.
2. Connect a test light or voltmeter across the fuse terminals (be sure that the fuse is powered).
3. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test light or voltmeter.
4. When the test light glows, or the voltmeter registers, there is a short to ground in the wiring near that point.



Testing For Short With Test Light or Voltmeter

With a Self-Powered Test Light or Ohmmeter

1. Remove the blown fuse and disconnect the battery and load.
2. Connect one lead of a self-powered test light or ohmmeter to the fuse terminal on the load side.
3. Connect the other lead to a known good ground.
4. **Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the self-powered test light or ohmmeter.**
5. When the self-powered test light glows, or the ohmmeter registers, there is a short to ground in the wiring near that point.



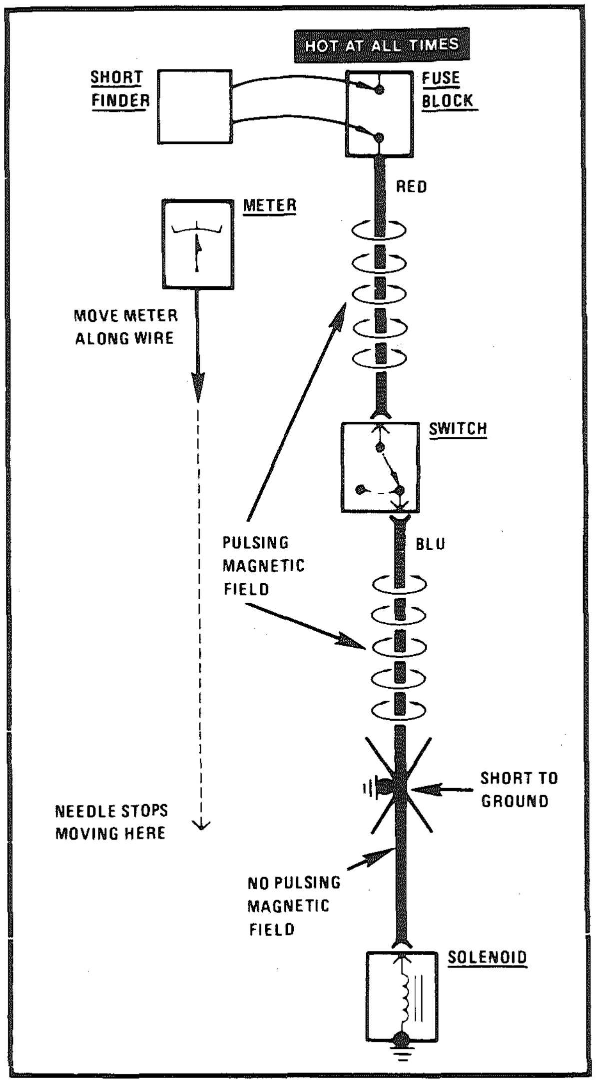
Testing For Short With Self-Powered Test Light or Ohmmeter

With a Short Finder

1. Remove the blown fuse, leaving the Battery connected.
2. Connect the Short Finder across the fuse terminals.
3. Close all switches in series with the circuit you are troubleshooting.
4. Operate the Short Finder. The Short Finder will pulse current to the short. This creates a pulsing magnetic field surrounding the circuit wiring between the fuse block and the short.
5. Beginning at the fuse block, slowly move the Short Finder meter along the circuit wiring. The meter will show current pulses through sheet metal and body trim. As long as the meter is between the fuse block and the short, the needle will move with each current pulse. When you have moved the meter past the point of the short, the needle will stop moving. Examine the wiring in that area for the short to ground.

Fuses Powering Several Loads

1. Find the schematic in Fuse Block Details (8A-11) for the fuse that has blown.
2. Open the first connector or switch leading from the fuse to each load.
3. Replace the fuse.
   - If the fuse blows, the short is in the wiring leading to the first connector or switch. Use a test light, meter, or short finder as described above.
   - If fuse does not blow, go to next step.
4. Close each connector or switch until the fuse blows, to find which circuit the short is in. Connect test lamp, meter, or short finder at the connector to the suspect circuit (disconnected) rather than at the fuse terminals.



Finding Short With Short Finder

PROPER JUMP STARTING PROCEDURES

With the use of electronic components (such as solid-state radios, electronic control modules, and others) becoming more wide-spread each model year, the potential for damage caused by improper jump starts increases. The following guidelines are presented to reduce the likelihood of such damage.

JUMP START ONLY IF BUILT-IN HYDROMETER "EYE" ON BATTERY IS DARK. If the "eye" is clear or yellow, do not attempt to jump start. If the "eye" is green, the Battery is charged and does not require a jump start. Both the booster and the discharged Battery should be treated carefully when using jumper cables.

CAUTION: Do not expose the Battery to open flame or sparks. Serious personal injury, particularly to the eyes, may result from a Battery explosion, Battery acid, or electrical burns.

- The Ignition Switch must be in OFF when connecting or disconnecting the jumper cables.
- All accessories, including the Radio, should be turned off before jump starting.
- Cable polarity must be correct. Component damage can occur if the polarity is reversed, even if only briefly.
- Connect the positive jumper cable first, then connect the negative cable to the engine ground (not the negative terminal of the dead Battery).

ELECTRICAL REPAIRS

This section provides instruction in the following repairs:

- Circuit Protection
- Typical Electrical Repairs
- Splicing Copper Wire
- Splicing Aluminum Wire
- Splicing Twisted Shielded Cable
- Repairing Connectors (Except Weather Pack®) and
- Repairing Weather Pack® (Environmental) Connectors

Note: After any electrical repair is made, always test the circuit by operating the devices in the circuit. This confirms not only that the repair is correct, but also that the cause of the complaint was correctly identified.

CIRCUIT PROTECTION

All electrical circuits are protected against excessive loads which might occur because of shorts or overloads in the wiring system. Such protection is provided by a fuse, circuit breaker, or fusible link.

Fuses

The most common method of automotive wiring circuit protection is the fuse. Whenever there is an excessive amount of current flowing through a circuit the fusible element will melt and create an open or incomplete circuit (see Figure 1). Fuses are a "one time" protection device and must be replaced each time the circuit is overloaded.

Auto-fuses are color coded. The standardized color identification and ratings are shown in Figure 2.

For service replacement, non-color coded fuses of the same respective current rating can be used. The current rating of each fuse is molded into its head.

To determine whether or not an auto-fuse is blown, remove the suspect fuse and examine the element in the fuse for a break, (see Figure 1). If the element is broken, replace the fuse with one of equal current rating.

There are, however, additional specific circuits with in-line fuses. In-line fuses are located within the individual wiring harness. They are usually housed in spring-loaded, twist-type receptacles.

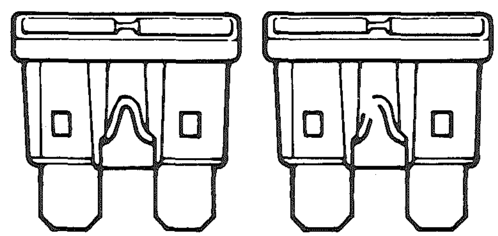


Figure 1 - Sample Fuses

CURRENT RATING (AMPERES)	COLOR
3	VIOLET
5	TAN
7.5	BROWN
10	RED
15	BLUE
20	YELLOW
25	WHITE
30	GREEN

Figure 2 - Fuse Rating And Color

Circuit Breakers

A circuit breaker is a protective device designed to open the circuit when a current load is in excess of rated breaker capacity. If there is a short or other type of overload condition in the circuit, the excessive current will open the circuit between the circuit breaker terminals. The circuit breaker will remain open until the trouble is found and corrected. The circuit breaker will close automatically when the excessive current is removed. The condition of a circuit breaker may be verified by removing it from the circuit and checking the resistance. A good circuit breaker will have less than 1 ohm resistance between the two terminals.

Fusible Links

In addition to circuit breakers and fuses, some circuits use fusible links to protect the wiring. Like fuses, fusible links are "one time" protection devices that will melt and create an open circuit (see Figure 3).

Not all fusible link open circuits can be detected by observation. Always inspect that there is Battery voltage past the fusible link to verify continuity.

Fusible links are used instead of a fuse in wiring circuits that are not normally fused, such as the ignition circuit. Each fusible link is four wire-gauge sizes smaller than the cable it is designed to protect. Links are marked on the insulation with wire-gauge size because the heavy insulation makes the link appear to be a heavier gauge than it actually is. The same wire size fusible link must be used when replacing a blown fusible link.

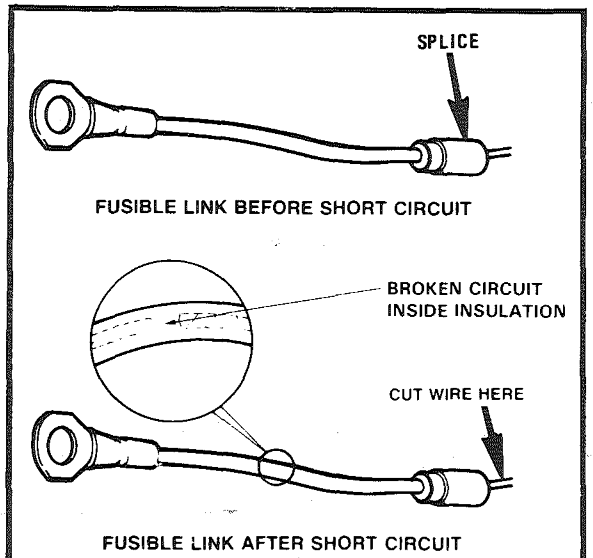


Figure 3 - Good And Damaged Fusible Links

Fusible links are available with two types of insulation: Hypalon® and Silicone/GXL (SIL/GXL). Service fusible links made with SIL/GXL may be used to replace either Hypalon® or SIL/GXL fusible links. Service fusible links made with Hypalon® may only be used to replace Hypalon® fusible links. To determine the fusible link type: nick the insulation of the blown fusible link with a knife. SIL/GXL will have a white inner core under the outer color. Hypalon® insulation is one color. Service fusible links are available in many lengths. Choose the shortest length that is suitable. If the fusible link is to be cut from a spool, NEVER make a fusible link longer than 228 mm (9 in).

CAUTION: Fusible links cut longer than 228 mm (9 in) will not provide sufficient overload protection.

To replace a damaged fusible link, cut it off beyond the splice. Replace with a repair link. When connecting the repair link, strip wire and use staking-type pliers to crimp the splice securely in two places (see Figure 4). For more details on splicing procedures see Splicing Copper Wire.

To replace a damaged fusible link which feeds two harness wires, cut them both off beyond the splice. Use two repair links, one spliced to each harness wire (see Figure 5).

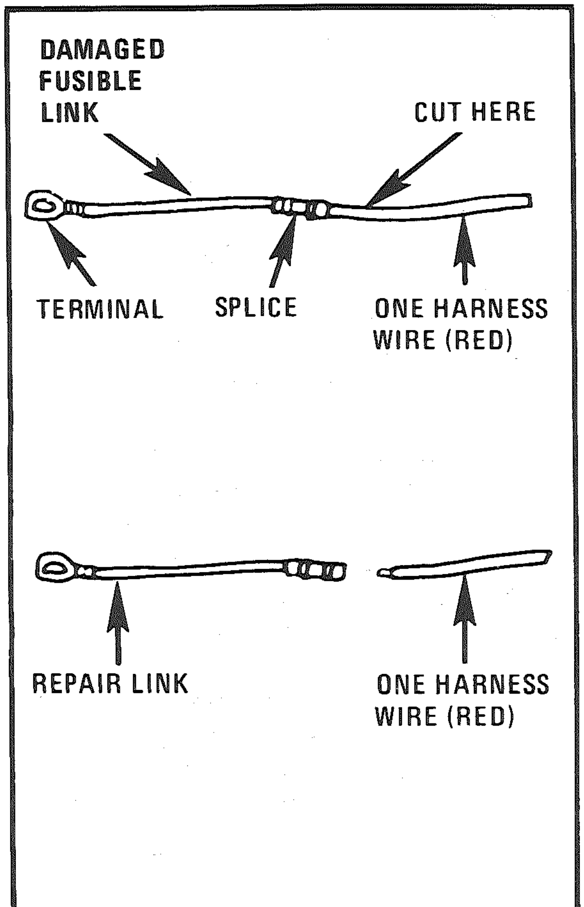


Figure 4 - Single Wire Feed Fusible Link

TYPICAL ELECTRICAL REPAIRS

An open circuit is an incomplete circuit. Power cannot reach the load or reach ground. If a circuit is open, active components do not energize. A short circuit is an unwanted connection between one part of the circuit and either ground or another part of the circuit. A **short circuit causes a fuse to blow or a circuit breaker to open.**

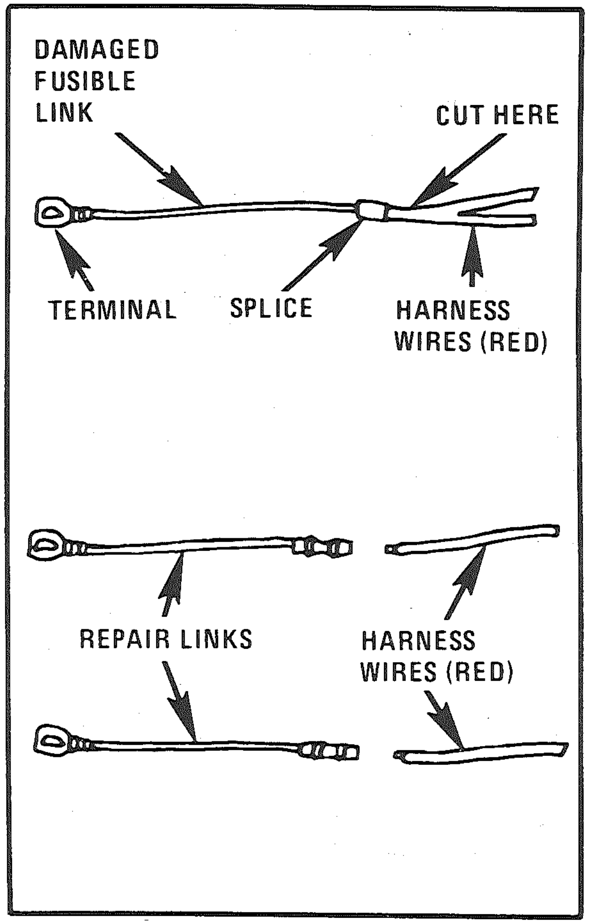


Figure 5 - Double Wire Feed Fusible Link

Short Circuits Caused by Damaged Wire Insulation

- —Locate the damaged wire.
- —Find and correct the cause of the wire insulation damage.
- —For minor damage, tape over the wire. If damage is more extensive, replace the faulty segment of the wire. (Refer to the splicing instructions for copper, aluminum, or shielded cable for the correct splicing procedure.)

SPLICING COPPER WIRE

Step One: Open the Harness

If the harness is taped, remove the tape. To avoid wire insulation damage, use a sewing "seam ripper" to cut open the harness (available from sewing supply stores).

If the harness has a black plastic conduit, simply pull out the desired wire. Note that aluminum wire is enclosed in brown conduit. Refer to Splicing Aluminum Wire if necessary.

Step Two: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40mm (1 1/2") away from other splices, harness branches, or connectors.

Step Three: Strip the Insulation

When replacing a wire, use a wire of the same size as the original wire or larger. The schematics list wire size in metric units. The following table (see Figure 6) shows the commercial (AWG) wire sizes that can be used to replace each metric wire size. Each AWG size is either equal to or larger than the equivalent metric size.

METRIC WIRE SIZES	AWG SIZES
.22	24
.35	22
.5	20
.8	18
1.0	16
2.0	14
3.0	12
5.0	10
8.0	8
13.0	6
19.0	4
32.0	2

Figure 6 - Wire Size Conversion Table

To find the correct wire size either find the wire on the schematic page and convert the metric size to the AWG size, or use an AWG wire gage.

If you aren't sure of the wire size, start with the largest opening in your wire stripper and work down until you get a clean strip of the insulation. Be careful to avoid nicking or cutting any of the wires.

Check the stripped wire for nicks or cut strands. If the wire is damaged, repeat the procedure on a new section of wire. The two stripped wire ends should be equal in length.

Step Four: Crimp the Wires

Select the proper clip to secure the splice. To determine the proper clip size for the wire being spliced, follow the directions included with your clips. Select the correct anvil on the crimper. (On most crimpers your choice is limited to either a small or large anvil.) Overlap the two stripped wire ends and hold them between your thumb and forefinger as shown in Figure 7. Then, center the splice clip under the stripped wires and hold it in place.

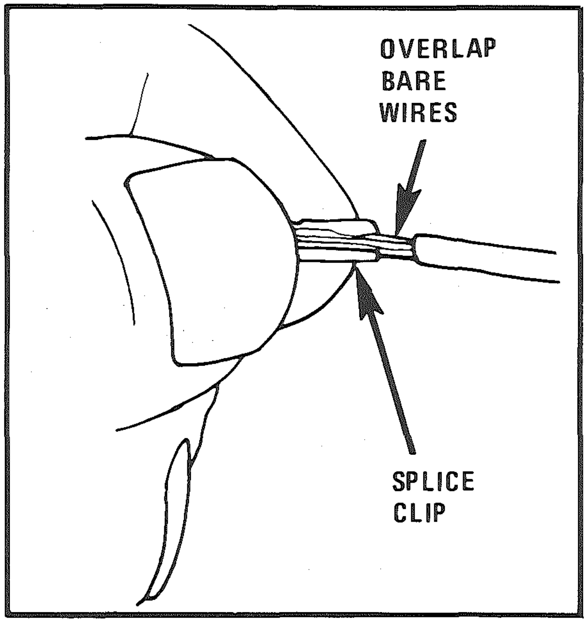


Figure 7 - Centering The Splice Clip

- —Open the crimping tool to its full width and rest one handle on a firm flat surface.
- —Center the back of the splice clip on the proper anvil and close the crimping tool to the point where the former touches the wings of the clip.
- —Make sure that the clip and wires are still in the correct position. Then, apply steady pressure until the crimping tool closes (see Figure 8).

Before crimping the ends of the clip, be sure that:

- —The wires extend beyond the clip in each direction.
- —No strands of wire are cut loose, and
- —No insulation is caught under the clip.

Crimp the splice again, once on each end. Do not let the crimping tool extend beyond the edge of the clip or you may damage or nick the wires (see Figure 9).

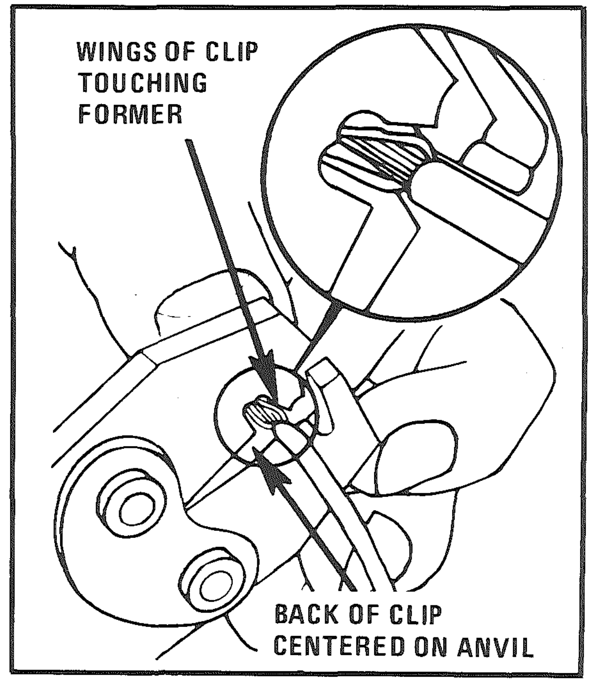


Figure 8 - Crimping The Splice Clip

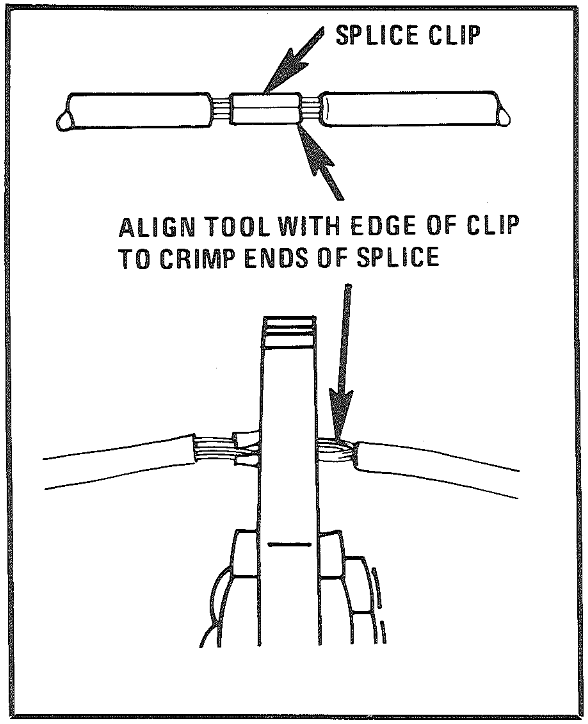


Figure 9 - Completing The Crimp

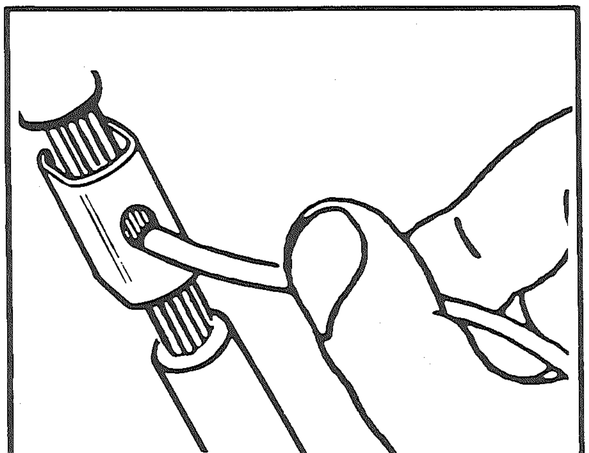


Figure 10 - Applying The Solder

Step Five: Solder

Apply 60/40 rosin core solder to the opening in the back of the clip (see Figure 10). Follow the manufacturer's instructions for the solder equipment you are using.

Step Six: Tape the Splice

Center and roll the splicing tape. The tape should cover the entire splice. Roll on enough tape to duplicate the thickness of the insulation on the existing wires. Do not flag the tape. Flagged tape may not provide enough insulation, and the flagged ends will tangle with the other wires in the harness (see Figure 11).

If the wire does not belong in a conduit or other harness covering, tape the wire again. Use a winding motion to cover the first piece of tape (see Figure 12).

SPLICING ALUMINUM WIRE

General Motors cars have a front body wiring harness made of 2.0 metric and 1.0 metric (14 and 16 gauge) insulated solid cable aluminum wires. These wires are enclosed in a brown solid plastic conduit from behind the instrument panel to the rear of the car..

A special repair kit (1684873-GR.2.530-KIT-ALUM-WIRE TERMINAL REPAIR) is available to help make repairs on aluminum wires. This kit contains materials and instructions that can be used either to splice wire or crimp on new terminals. The kit includes the following parts:

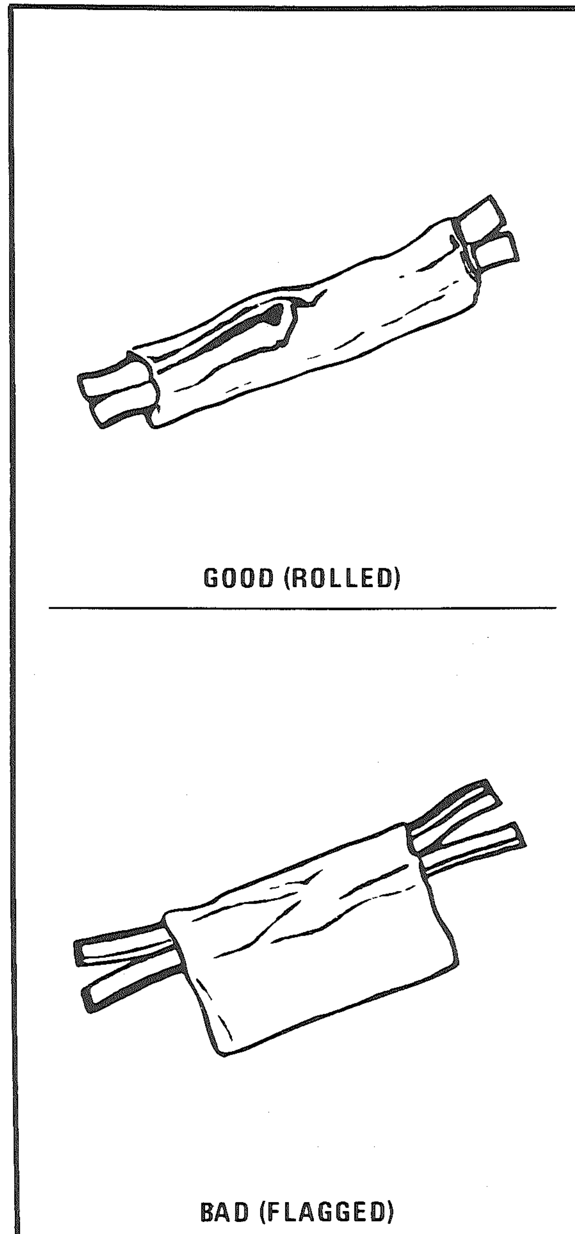


Figure 11 - Proper First Taping

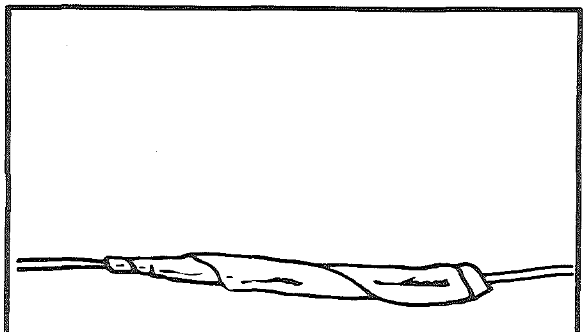


Figure 12 - Proper Second Taping

—Small cylindrical metal splice clips.
—A plastic tube of petroleum jelly.
—Ten 2.0 metric (14 gauge) DK GRN leads: 150mm (6") long with terminals.
—Ten 1.0 metric (16 gauge) BRN leads:150 mm (6") long with terminals.

Use of the special materials in this kit will help prevent galvanic corrosion. Galvanic corrosion causes increased resistance between the terminal and wire, or the splice clip and wire, or both. Increased resistance would affect the operation of the electrical components in the repaired circuit.

Step One: Open the Harness

Because the harness has a solid plastic conduit, simply cut the conduit open with diagonal cutters and pull out the desired wire. Be careful not to damage any of the wires when cutting open the conduit.

Step Two: Cut the Wire

Begin by cutting as little wire off the harness as possible. You may need the extra length of wire later if you decide to cut more wire off to change the location of a splice. You may have to adjust splice locations to make certain that each splice is at least 40mm (1 1/2") away from the other splices, harness branches, or connectors.

Step Three: Strip the Insulation

When replacing a wire or lead, use a wire of the same size as the original wire, or larger. Look up the metric wire size on the schematic and select the proper-sized leads from the special repair kit. Remember that the wires in this harness can only be one of two sizes-2.0 metric or 1.0 metric (14 or 16 gauge).

Use wire strippers of the proper gauge to strip approximately 6mm (1/4") of insulation from each wire end.

When stripping the outer jacket from the aluminum wire core, be careful not to nick or damage the core. A damaged core will weaken the assembly at this point.

Step Four: Coating the Splice/Terminal

To prevent corrosion, apply a generous coating of petroleum jelly to the splice area. If you are replacing a lead, also thoroughly coat the terminal crimp area and aluminum core with petroleum jelly. Both areas are shown in Figure 13 and identified with the letter "A."

Step Five: Crimp the Wires

—Select the proper-sized splice clip (follow the instructions included in the special repair kit).
—Place one wire end in each end of the splice clip.
—Crimp the clip firmly to the wire using 10" slip joint pliers. Do NOT solder the splice (see Figure 14).
—Repeat this procedure for the second wire or lead in the splice clip.

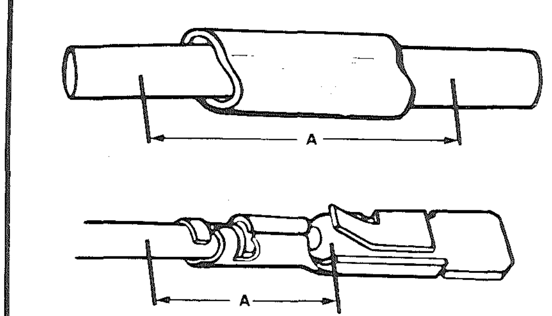


Figure 13 - Where To Apply Petroleum Jelly

Step Six: Tape Splice/Insert Terminal

Tape over both the splice clip and the petroleum jelly to seal out moisture and insulate the splice (see Figure 15). If you have replaced a lead, do not tape over the terminal crimp area but insert the lead into the connector body.

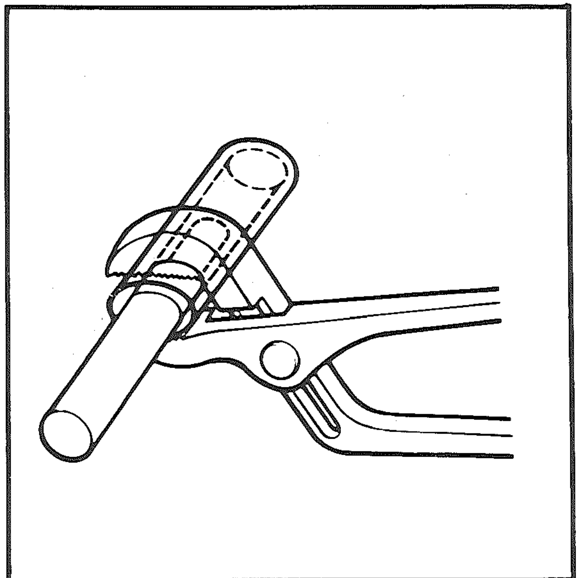


Figure 14 - Crimping The First Half Of The Splice Clip (Aluminum Wire)

SPLICING TWISTED/ SHIELDED CABLE

Twisted/shielded cable is sometimes used to protect wiring from electrical noise (stray signals). For example, two-conductor cable of this construction is used between the ECM and the distributor. See Figure 16 for a breakdown of twisted/shielded cable construction.

Step One: Remove Outer Jacket

Remove the outer jacket and discard it. Be careful to avoid cutting into the drain wire or the mylar tape.

Step Two: Unwrap the Tape

Unwrap the aluminum/mylar tape, but do not remove it. The tape will be used to rewrap the twisted conductors after the splices have been made.

Step Three: Prepare the Splice

Untwist the conductors. Then, prepare the splice by following the splicing instructions for copper wire presented earlier. Remember to stagger splices to avoid shorts (see Figure 17).

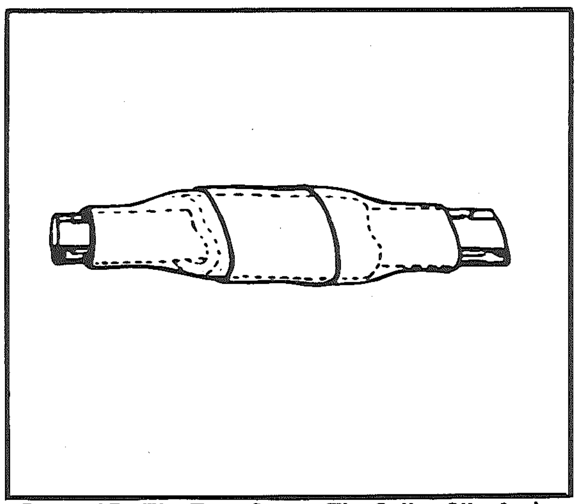


Figure 15 - The Tape Covers The Splice Clip And The Petroleum Jelly To Seal And Insulate

Step Four: Re-Assemble the Cable

After you have spliced and taped each wire, rewrap the conductors with the mylar tape. Be careful to avoid wrapping the drain wire in the tape.

Next, splice the drain wire following the splicing instructions for copper wire. Then, wrap the drain wire around the conductors and mylar tape (see Figure 18).

Step Five: Tape the Cable

Tape over the entire cable using a winding motion (see Figure 19). This tape will replace the section of the jacket you removed to make the repair.

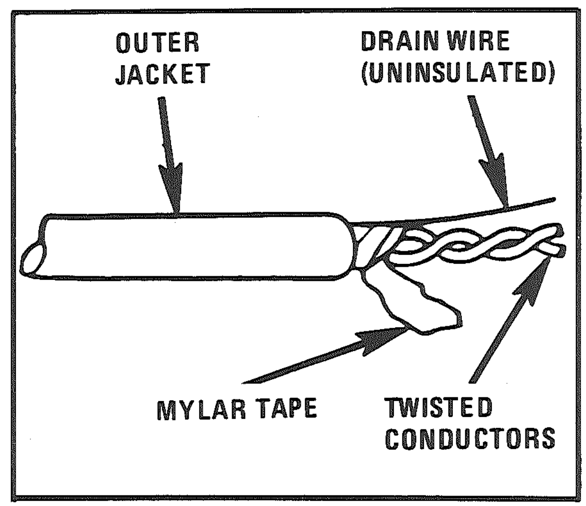


Figure 16 - Twisted/Shielded Cable

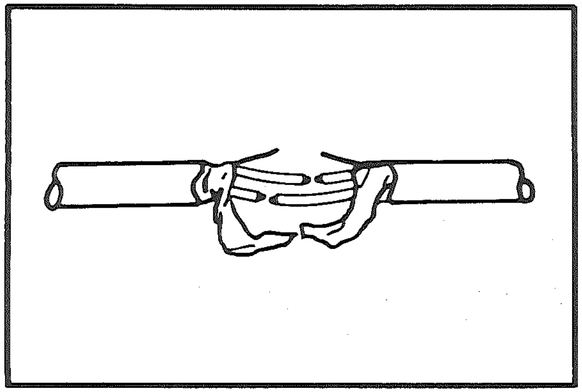


Figure 17 - The Untwisted Conductors

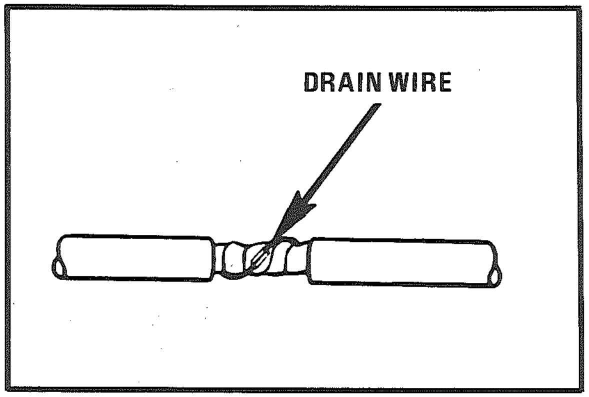


Figure 18 - The Re-Assembled Cable

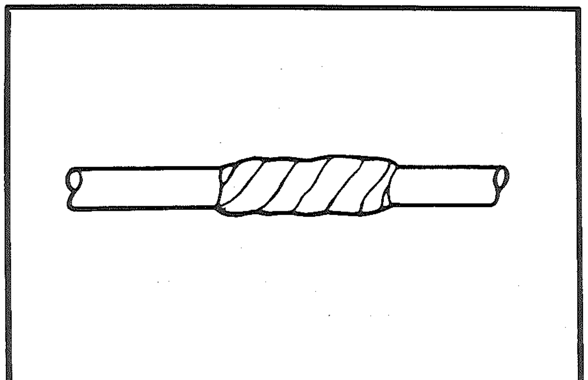


Figure 19 - Proper Taping

REPAIRING CONNECTORS

(Except Weather Pack® and Metri-Pack Series 150 Pull-to-Seat Type)

The following general repair procedures can be used for High Density, Printed Circuit and Bulkhead connectors. Prior to starting any repairs, separate connector halves and remove any terminal covers or retainers.

Instruction in the disassembly, repair, and assembly of connectors follows. Consult the figures for details on each specific type of connector. The instruction is divided into steps. Only perform those steps necessary to make the repair.

Step One: Remove the Lead

Depress the terminal locking tang using the proper size pick.

CAUTION: Do not place fingers or other parts of the body next to or around the back of the connector. If too much force is used, the pick and terminal both could be pushed out the back of the connector and cause injury.

—Place the pick between the locking tang of the terminal and the plastic of the connector body.
—Ease the lead back enough to release the locking tang.
—Pull the pick out.
—Gently pull the lead out of the back of the connector body.

Step Two: Re-Form the Locking Tang

If the lead and terminal are in good condition, reform the locking tang:

—Hold the lead firmly to prevent the splice between the terminal and the wire from flexing.
—Use the pick to bend the locking tang back into its original shape. Also check to see that the remainder of the terminal is still in its original shape.

Step Three: Make the Repair

When you make a repair, use the correct types of terminals and wires.

—Attach a new wire or a new terminal using the procedures in Splicing Copper Wire or Splicing Aluminum Wire.

Step Four: Insert the Lead

Before inserting the lead, make certain that the terminal is correctly shaped. Be careful to insert terminals in their proper locations.

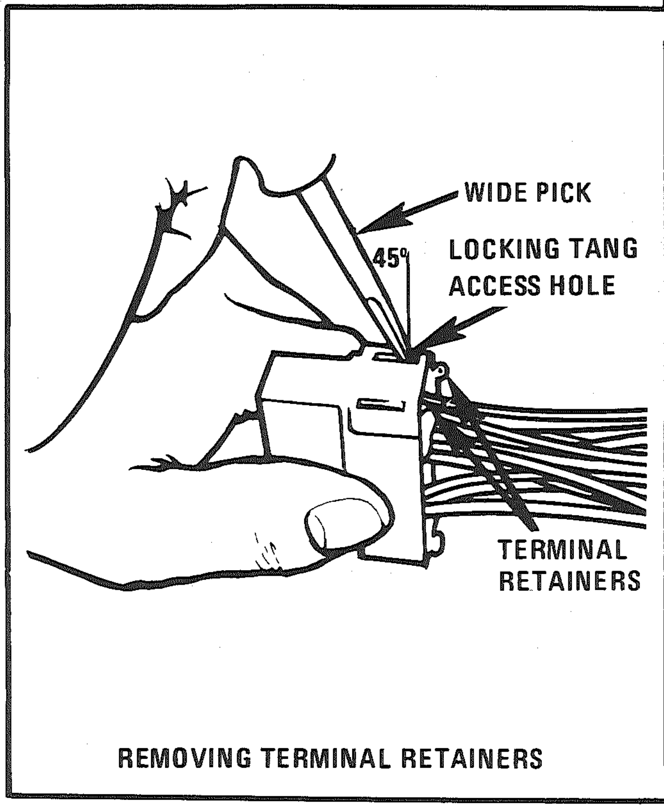
—Gently insert the lead from the back.

The terminal should stop or "catch" about halfway through the connector body.

Note: With bulkhead connectors, in many cavities it is possible for the terminal to be inserted in two ways. Be sure it is inserted in the same direction as it was removed, or to mate correctly with the facing terminal.

—Push back and forth gently on the lead to be sure the terminal is held in place in both directions. If the terminal easily pushes or pulls out, review Step Two: "Re-Form the Locking Tang."

Before mating the connector halves replace any terminal covers or retainers that were removed, and apply grease to prevent corrosion.



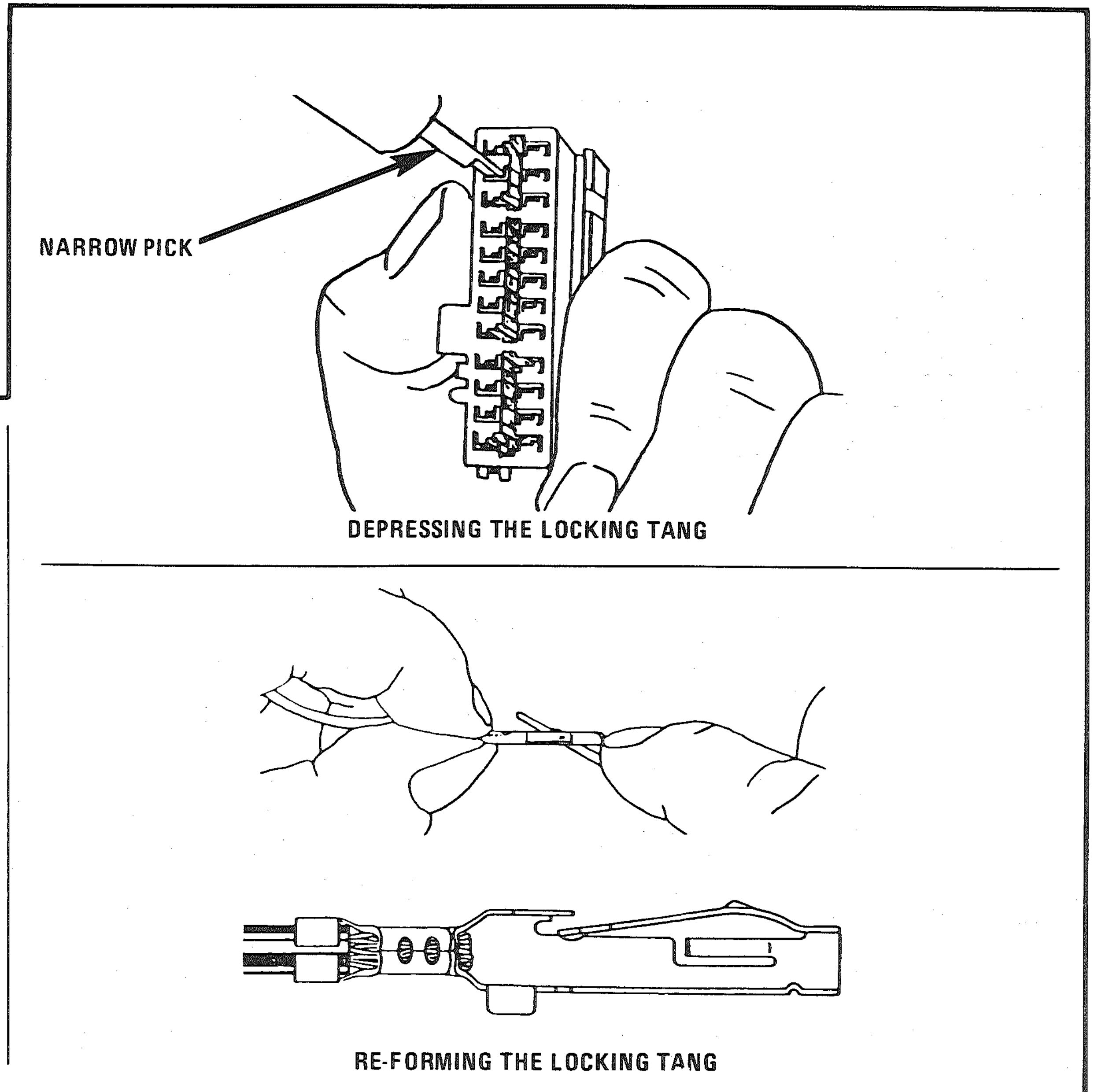


Figure 20 - High Density Connectors

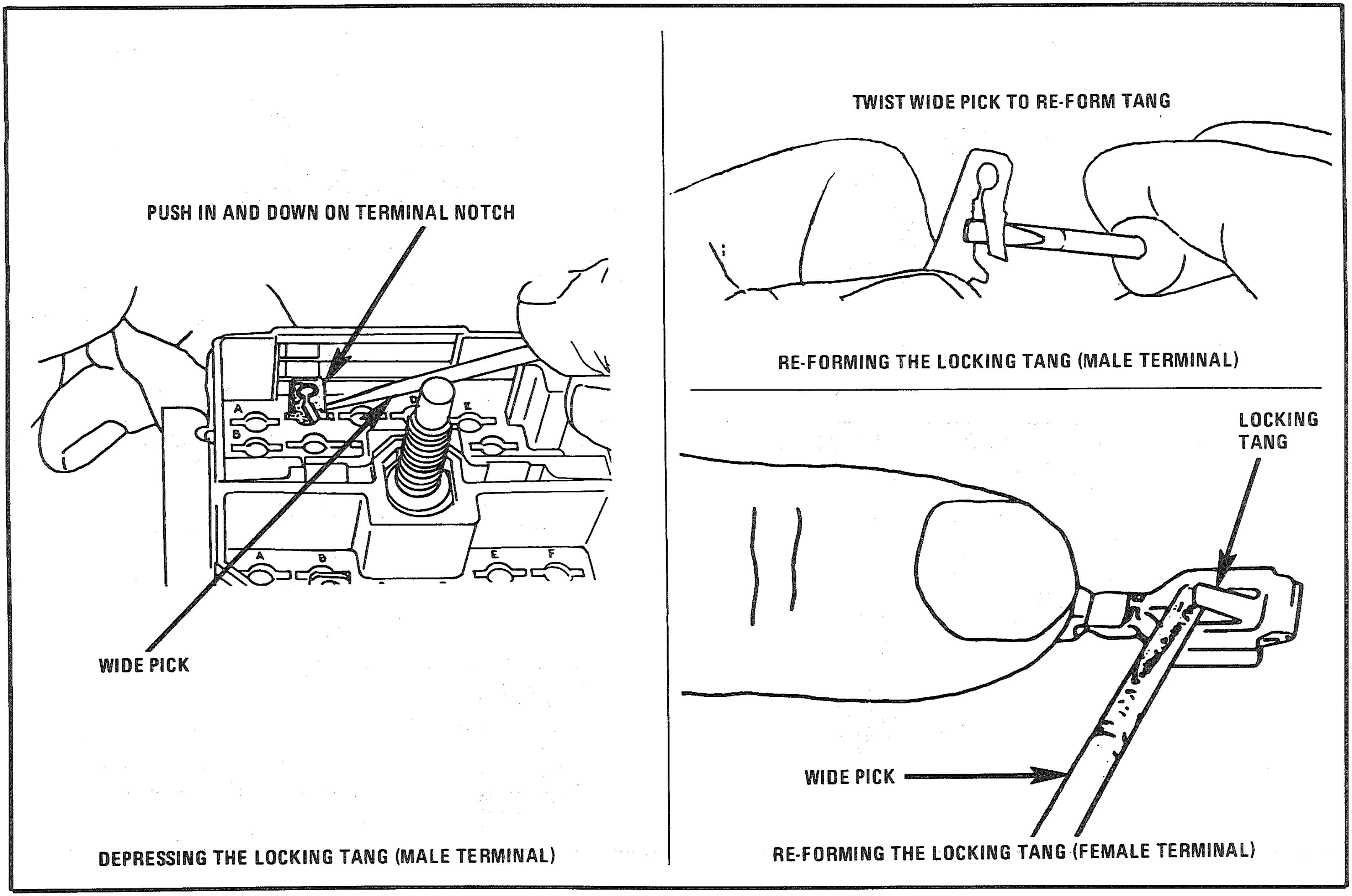


Figure 21 - Bulkhead Type Connectors

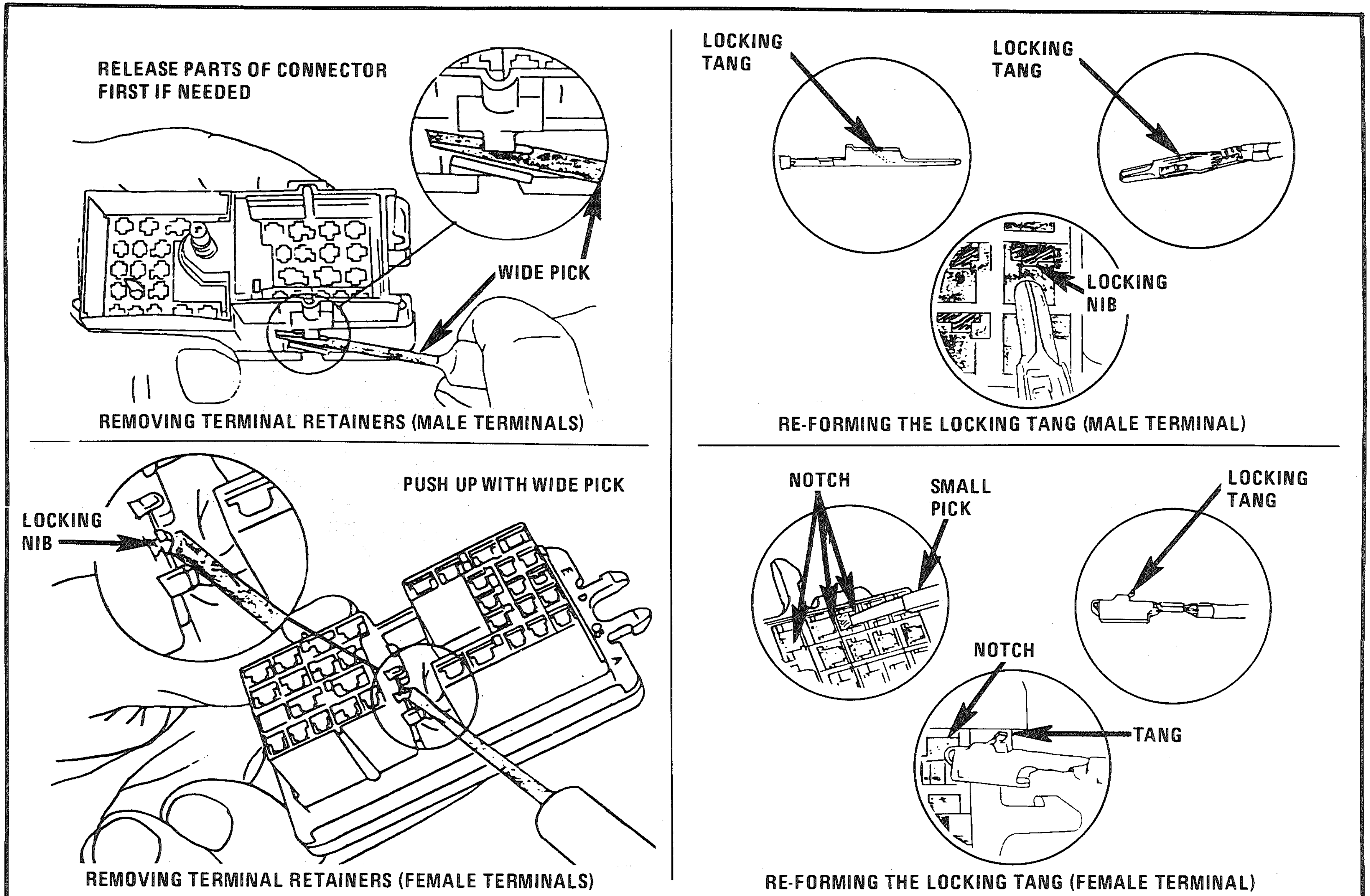


Figure 22 - Metri-pack Type Connectors – Push-To-Seat Type

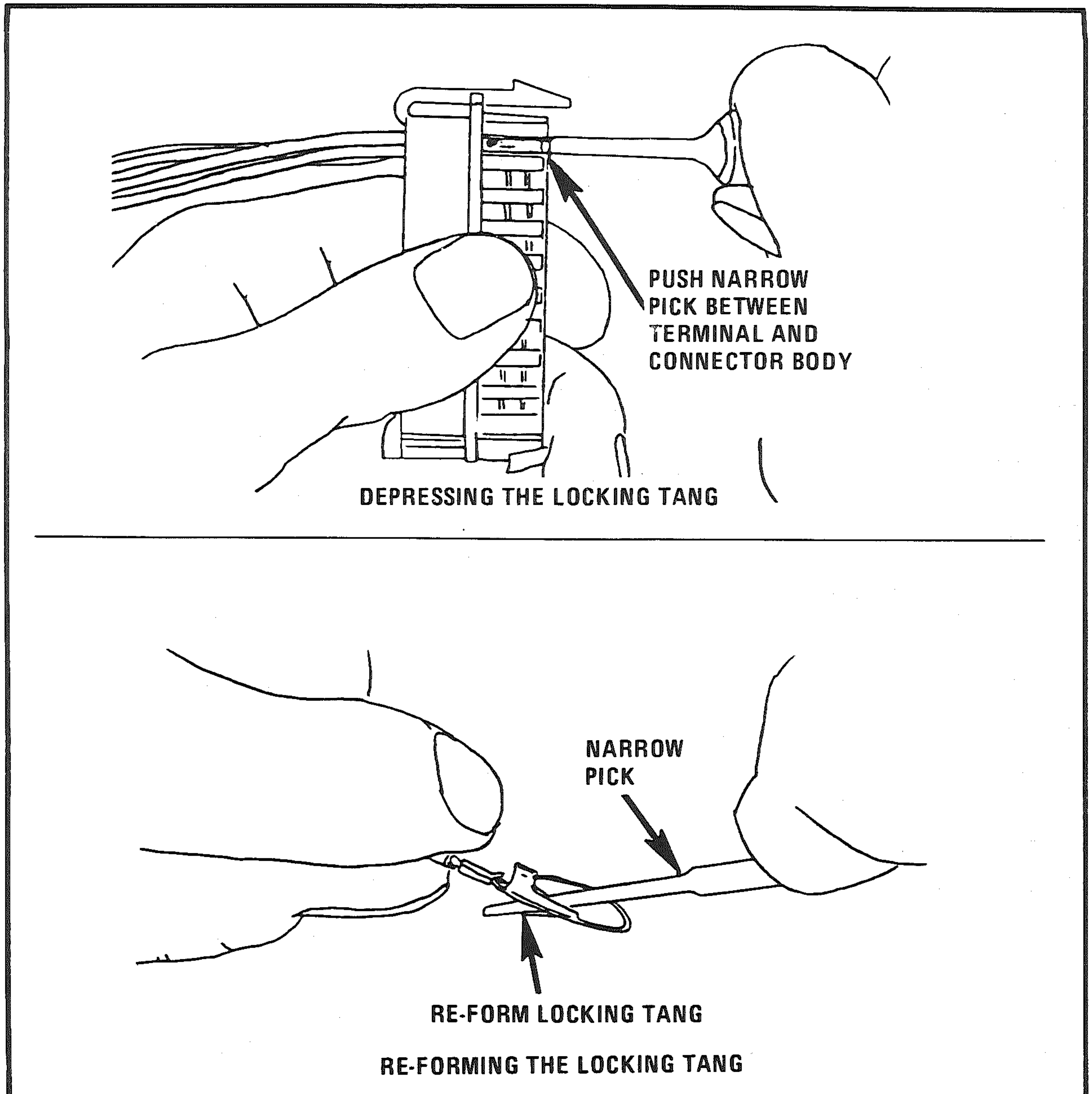


Figure 23 - Printed Circuit Type Connectors

REPAIRING WEATHER PACK® (Environmental) CONNECTORS

Weather Pack® or weatherproof connectors provide environmental protection on certain electrical circuits. This protection consists of a moisture-proof rubber flexible seal between the two connector halves and rubber cable seals attached to each terminal. The terminals and the cable seals are secured by a hinged secondary lock on small Weather Pack® connectors and by plastic terminal retainers on large Weather Pack® connectors.

If a Weather Pack® connector requires repair, do not replace the Weather Pack® parts with other types of connectors and temrinals. Also, do not omit either the large seal or the cable seals when making a repair.

Instruction in the disassemly, repair, and assembly of both small and large Weather Pack® connectors follows. The instruction is divided into steps. Only perform those steps necessary to make the repair.

Step One: Separate the Connector Halves

To separate a large connector, unscrew the bolt in the center of the connector body. Then pull the two halves apart. To separate a small connector, simply pull up on the primary lock and simultaneously pull the two halves apart.

Step Two: Remove the Terminal Retainer(s) (Large Connectors)/Open the Secondary Locks (Small Connectors)

To remove a terminal retainer, press a wide pick at a 45° angle against the locking nib (see Figure 24). Push the nib up as far as possible. Then, pull the retainer out.

To open the secondary locks on small connectors, flip down the lock hinges as shown in Figure 25.

Step Three: Remove the Lead

Depress the terminal locking tangs using a Weather Pack™ pick(J28742-A or the equivalent):

- Push the hollow cylinder of the pick into the terminal cavity from the front until it stops (see Figures 26 and 27).The pick should surround the terminal (see Figure 28 for drawings of locking tangs).
- Pull the pick out.
- Gently pull the lead out of the back of the connector body.

Note that the male connector body half contains female terminals and the female half houses male terminals.

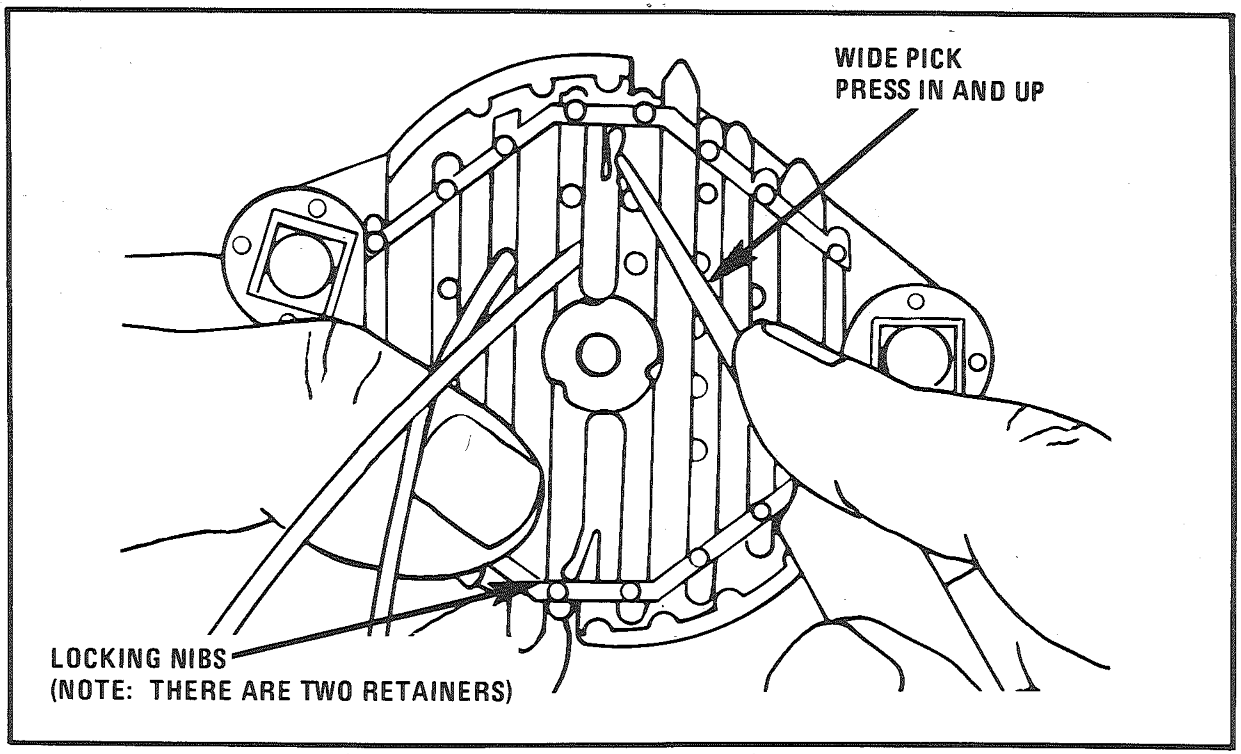


Figure 24 - Releasing the Terminal Retainers (Large Connectors)

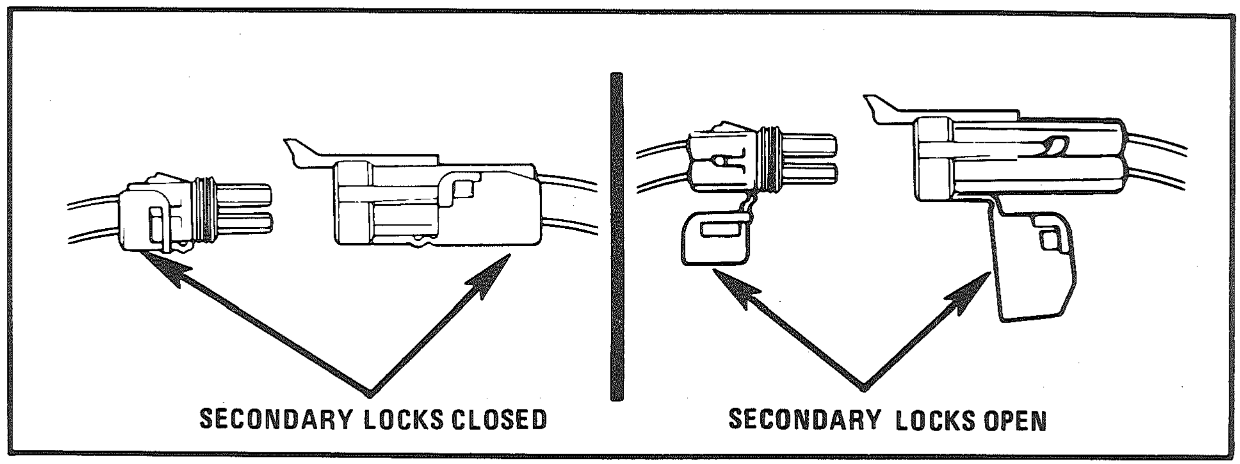


Figure 25 - Opening the Secondary Locks (Small Connectors)

Step Four: Re-Form the Locking Tang

If the lead and terminal are in good condition, re-form the locking tang.

—Hold the lead firmly to prevent the splice between the terminal and the wire from flexing.

—Use the pick (J28742-A or the equivalent) to bend the locking tang back into its original shape (see Figure 28). Also, check to see that the remainder of the terminal is still in its original shape. (See Step Six for instruction in inserting the lead.)

Step Five: Make the Repair

When you make a repair, use the correct types of terminals, wires, and seals.

To add a new lead, cut the wire and crimp and solder on the Weather Pack® lead assembly (see Figure 29) using rosin core solder. (Follow the instructions for splicing wire outlined earlier in this section for a review of splicing procedures.)

If Weather Pack® lead assemblies are not available, splice a new terminal and cable seal onto the existing wire.

—Cut the wire immediately behind the cable seal.

—Slip the new cable seal onto the wire and push it back out of the way.

—Strip 5.0mm (3/16") of insulation from the wire.

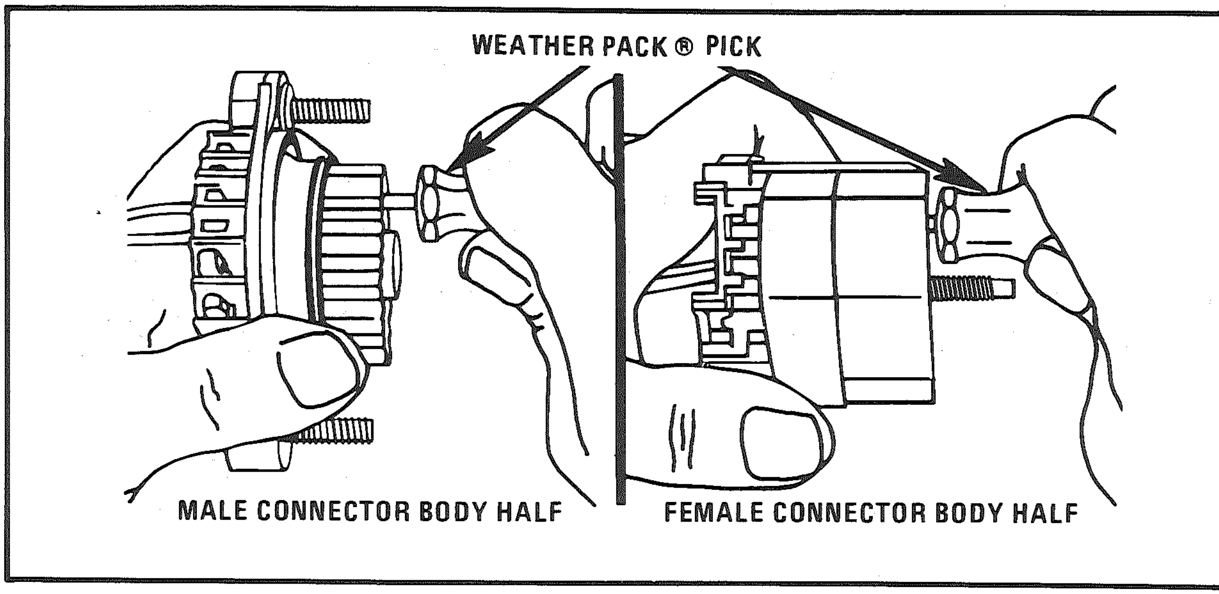


Figure 26 - Releasing The Terminal Locking Tangs (Large Connector)

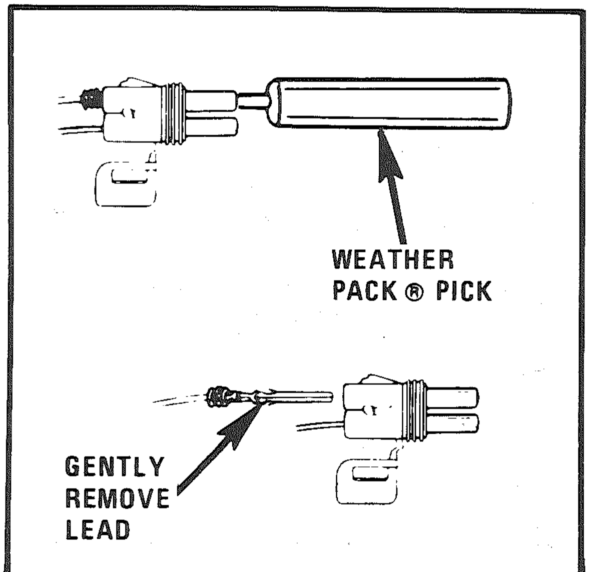


Figure 27 - Releasing The Terminal Locking Tangs (Small Connectors)

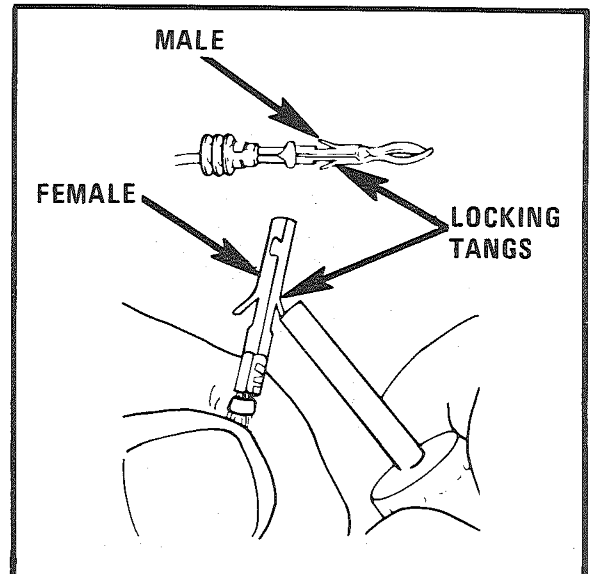


Figure 28 - Re-Forming The Locking Tang

—Crimp the new terminal over the copper strands (core crimp) as shown in Figure 30. (Use a standard crimping tool, number J25563 in the Kent-Moore catalog.)
—Solder with rosin core solder.
—Move the cable seal to edge of the insulation.
—Crimp the grips at the end of the terminal around the cable seal and insulated wire as shown in Figure 30 (insulation crimp). Apply light pressure for this crimp.

Remember to use the proper types of terminals and seals for this repair.

Step Six: Insert the Lead

Before inserting the lead, make certain that the terminal is correctly shaped (see Figure 28). Then, gently insert the lead from the back. The terminal should stop or "catch" about halfway through the connector body. Gently push back and forth on the lead to be sure the terminal is held in place in both directions. If the terminal easily pushes or pulls out, review Step Four: "Re-Form the Locking Tang."

Be careful to insert leads in their proper locations.

Step Seven: Replace the Terminal Retainer(s) (Large Connectors)/Secondary Locks (Small Connectors)

Replace the terminal retainers by slipping the retainer halves into the connector body (as shown in Figure 31).

To close the secondary locks on small connectors, flip the hinges back to their original positions (see Figure 32).

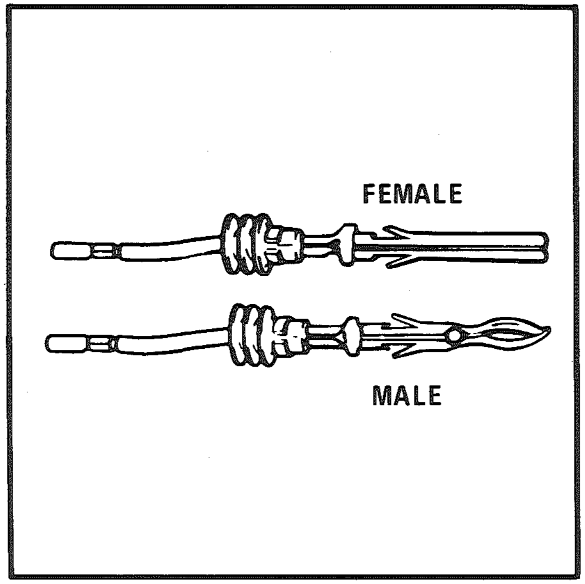


Figure 29 - Lead Assemblies

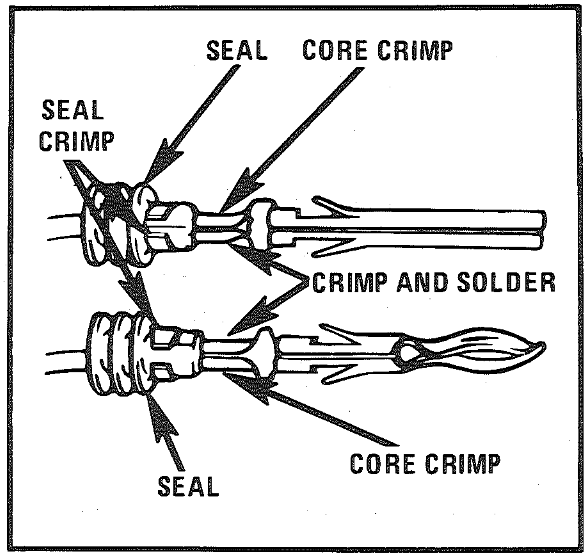


Figure 30 - Replacing The Terminal

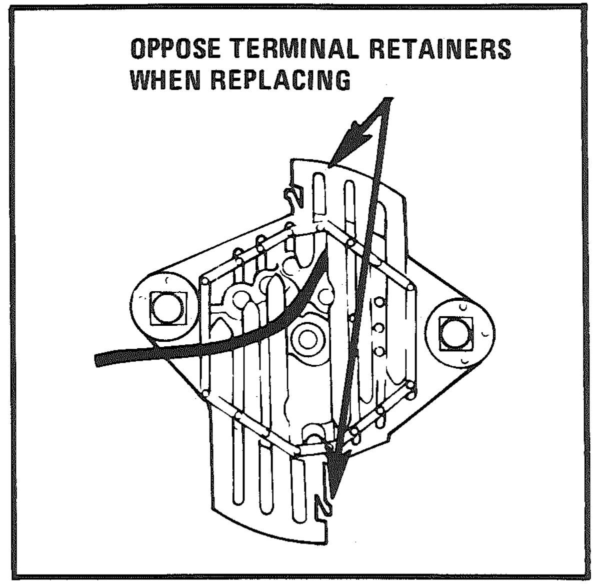


Figure 31 - Replacing The Terminal Retainers (Large Connectors)

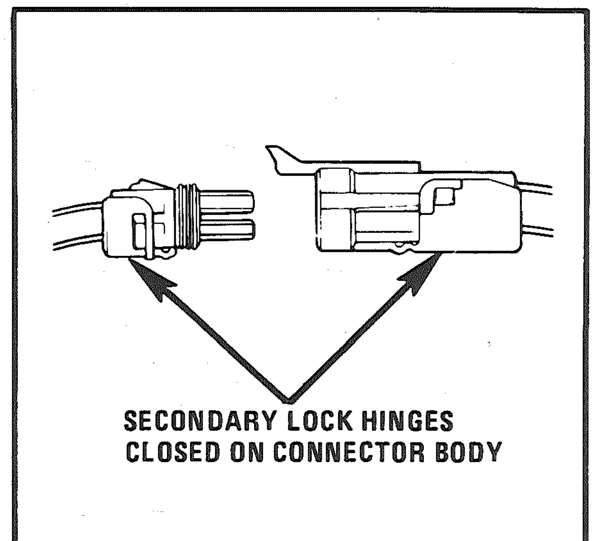


Figure 32 - Closing The Secondary Locks

REPAIRING METRI-PACK SERIES 150 CONNECTORS
(Pull-to-Seat Type)

Metri-Pack connectors are used to connect various sensors such as the cam, crankshaft and coolant sensors to primary harnesses in the engine compartment. The Metri-Pack connector consists of three parts (see Figure 35): a Pull to Seat type terminal, a connector body and a rubber seal which is inserted in the back of the connector body to provide environmental protection.

Do not replace the Metri-Pack parts with parts of other types of connectors and terminals or omit the environmental seals when repairing Metri-Pack connectors.

Repair instructions are divided into two steps, connector disassembly and terminal removal and connector assembly and terminal insertion. (Refer to figures 33 to 36)

Step One: Connector Disassembly and Terminal Removal

Insert tool BT-8446 or J35689 into the connector (Figure 33). Pull back on the wire slightly, pry up the locking tang and then push the wire through the front of the connector. If the terminal will be reused, reshape the locking tang.

Step 2: Connector Assembly and Terminal Insertion

Insert the wire through the seal and the connector body (Figure 35). Crimp the terminal to the stripped wire. Pull the wire and the terminal back through the connector body until it locks in place (Figure 36).

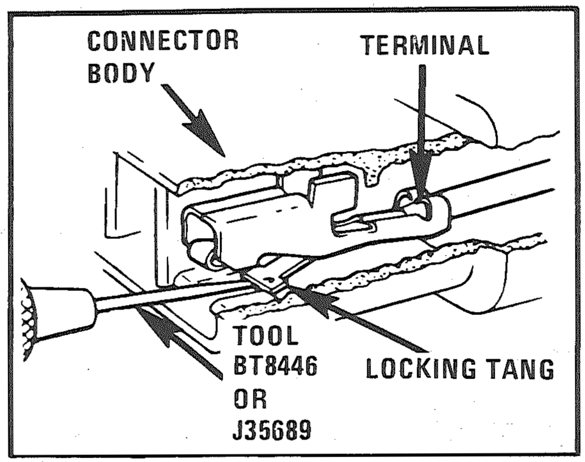


Figure 33 - Terminal Removal From Connector Body

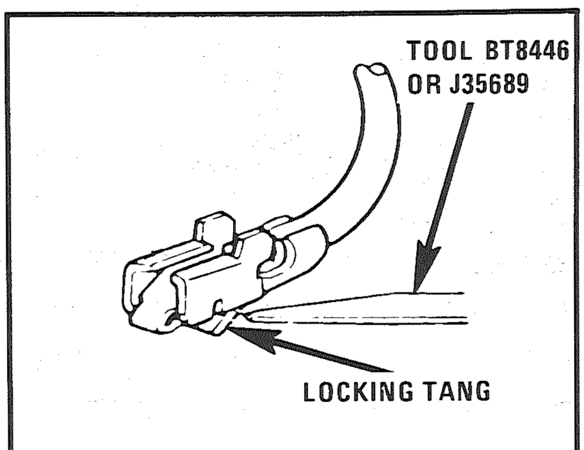


Figure 34 - Reforming The Locking Tang

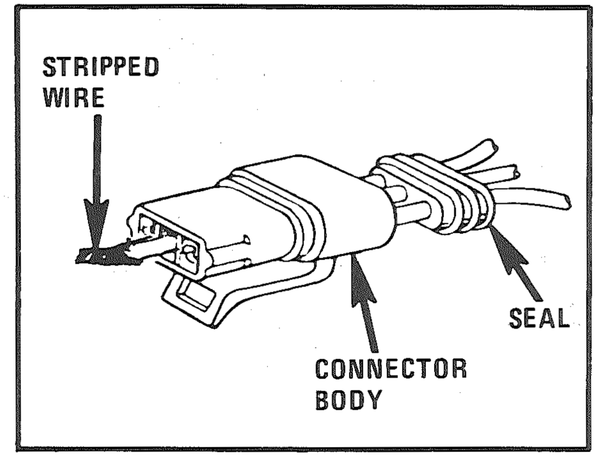


Figure 35 - Connector Reassembly

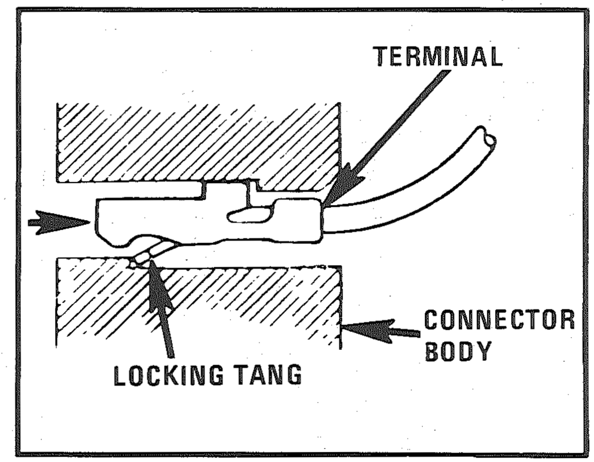


Figure 36 - Terminal Reinsertion

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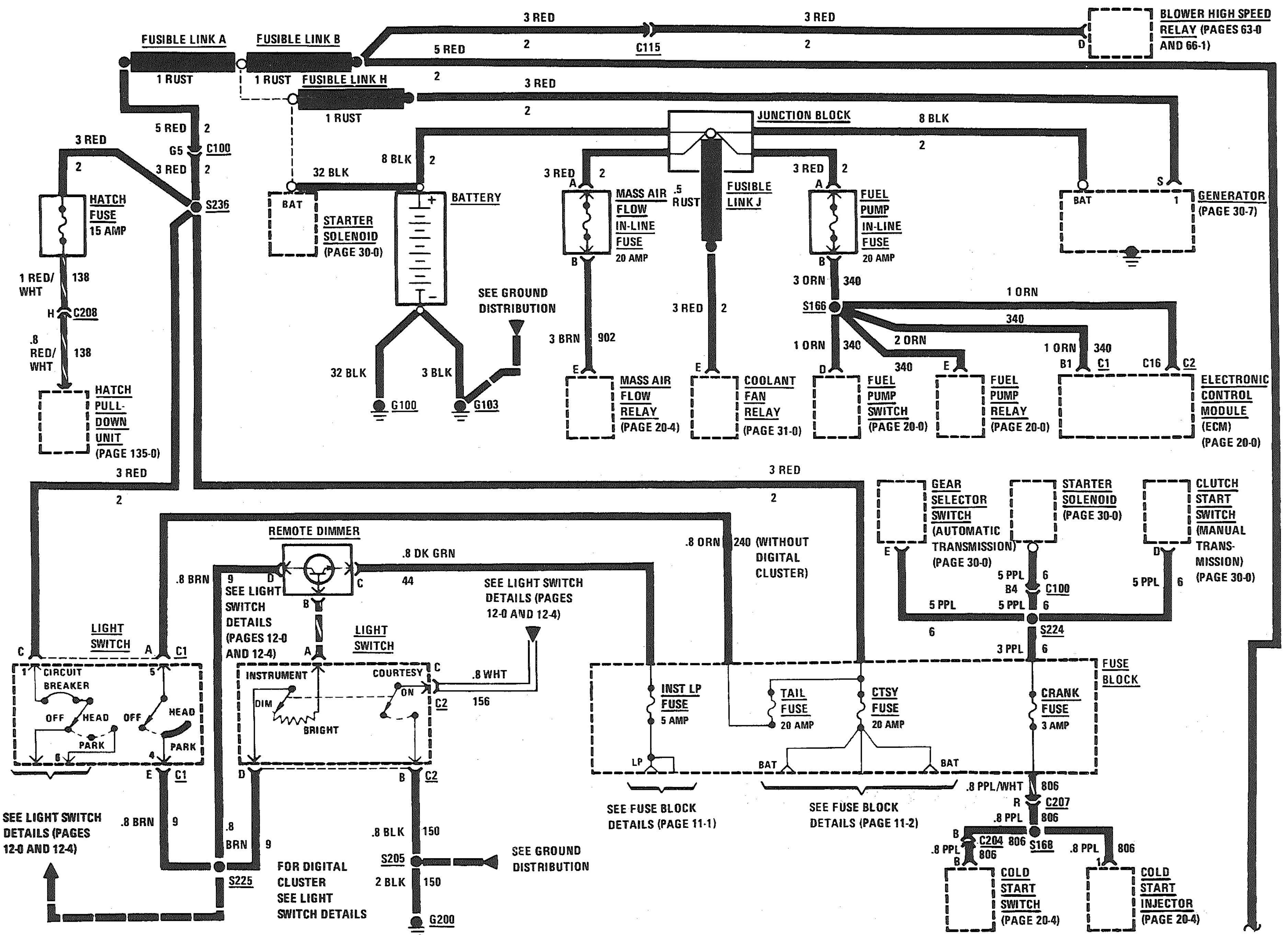
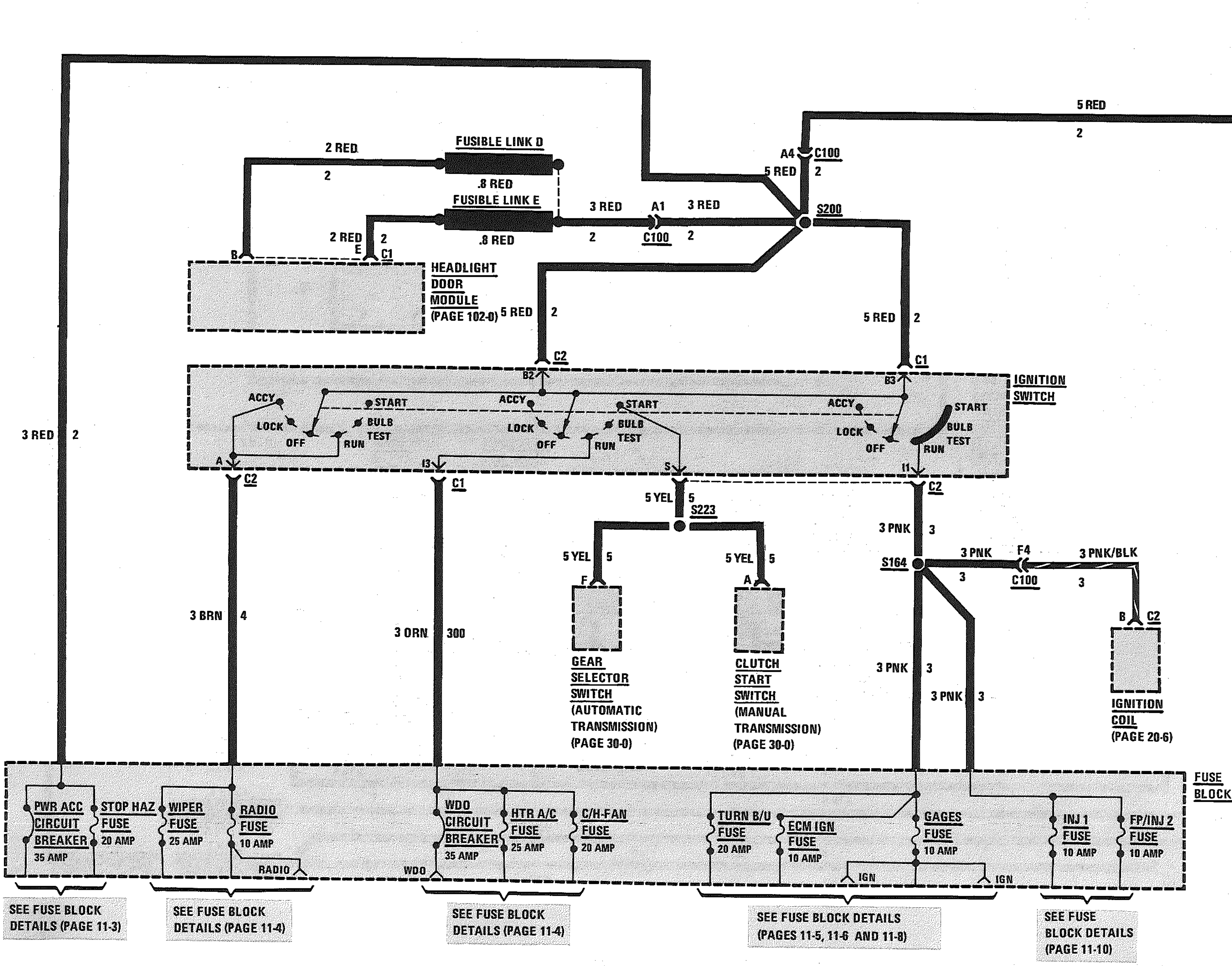
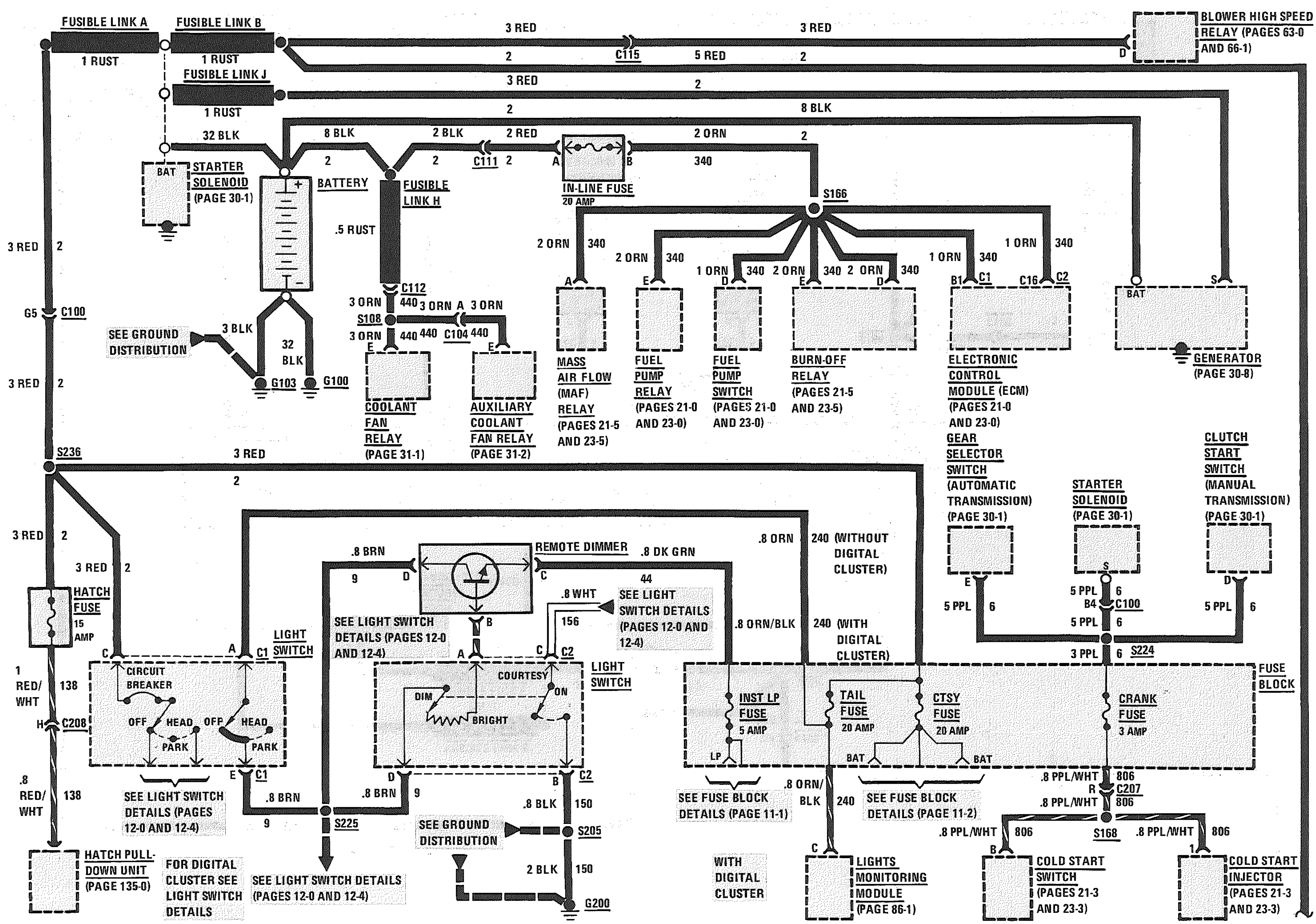
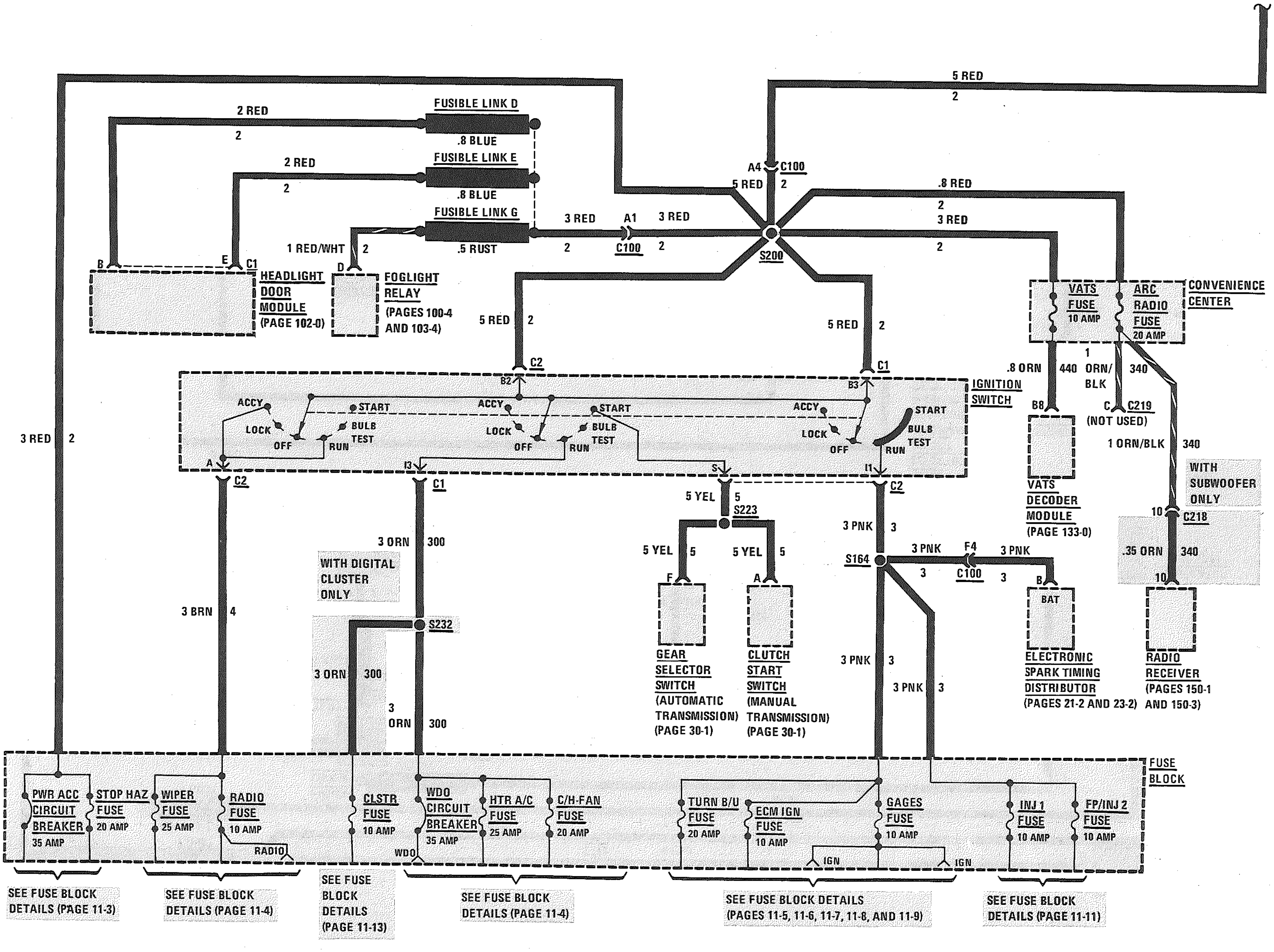




5 RED
2
2 RED
FUSIBLE LINK D
2
.8 RED
FUSIBLE LINK E
A4
C100
5 RED
2
3 RED
A1
3 RED
S200
2 RED
2
E
C1
B
2
C100
2
.8 RED
HEADLIGHT DOOR MODULE (PAGE 102-0)
5 RED
2
5 RED
2
C2
C1
B2
B3
IGNITION SWITCH
ACCY
START
LOCK
BULB TEST
OFF
RUN
A
I3
S
I1
3 RED
2
C2
C1
5 YEL
5
S223
C2
3 PNK
3
5 YEL
5
5 YEL
5
S164
3 PNK
F4
C100
3 PNK/BLK
3
3
F
A
B
C2
3 BRN
4
3 ORN
300
GEAR SELECTOR SWITCH (AUTOMATIC TRANSMISSION) (PAGE 30-0)
CLUTCH START SWITCH (MANUAL TRANSMISSION) (PAGE 30-0)
3 PNK
3
3 PNK
3
IGNITION COIL (PAGE 20-6)
FUSE BLOCK
PWR ACC CIRCUIT BREAKER 35 AMP
STOP HAZ FUSE 20 AMP
WIPER FUSE 25 AMP
RADIO FUSE 10 AMP
RADIO
WDO
WDO CIRCUIT BREAKER 35 AMP
HTR A/C FUSE 25 AMP
C/H-FAN FUSE 20 AMP
TURN B/U FUSE 20 AMP
ECM IGN FUSE 10 AMP
GAGES FUSE 10 AMP
IGN
IGN
INJ 1 FUSE 10 AMP
FP/INJ 2 FUSE 10 AMP
SEE FUSE BLOCK DETAILS (PAGE 11-3)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGES 11-5, 11-6 AND 11-8)
SEE FUSE BLOCK DETAILS (PAGE 11-10)

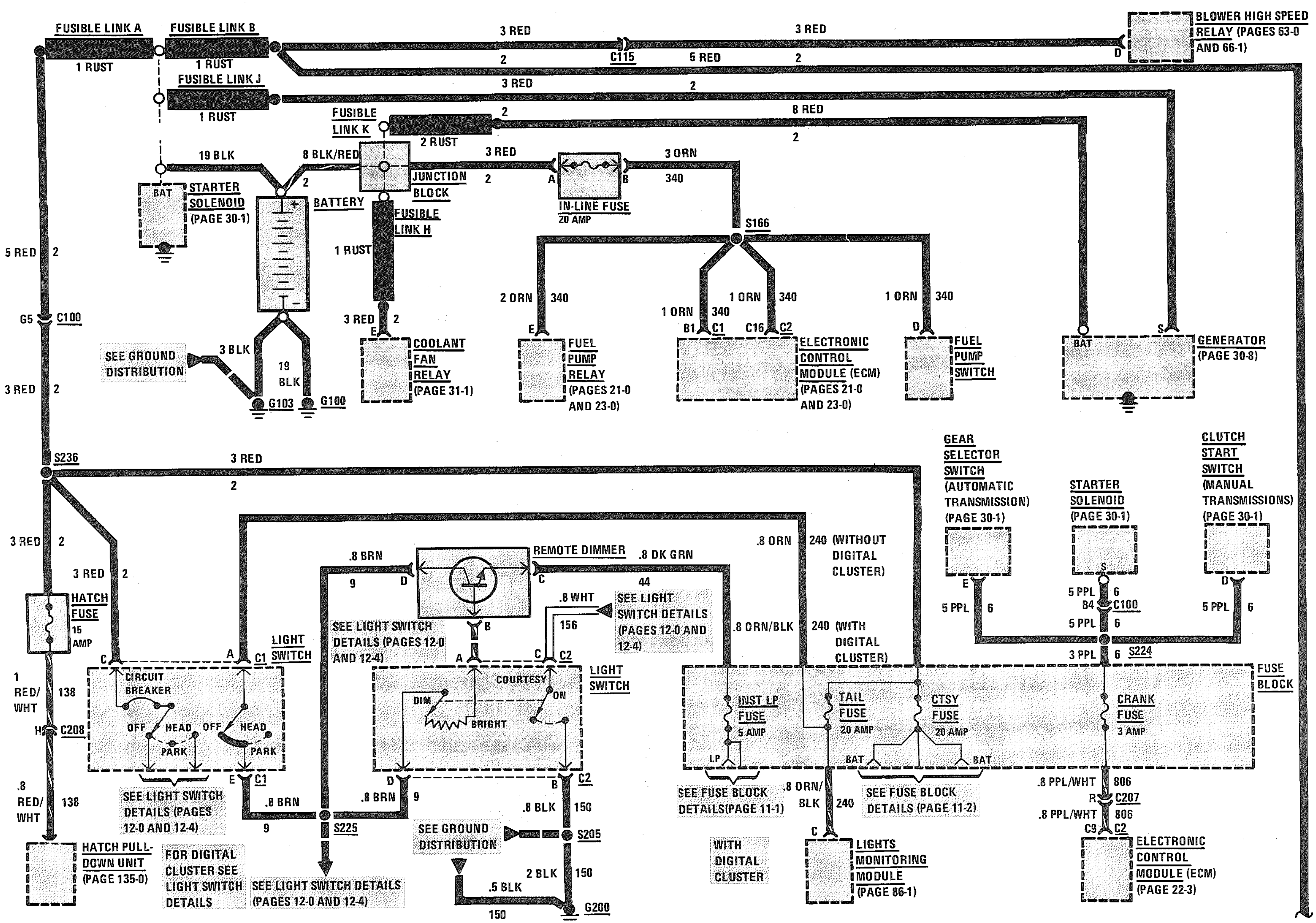
POWER DISTRIBUTION: V8 VIN F, V8 VIN 8

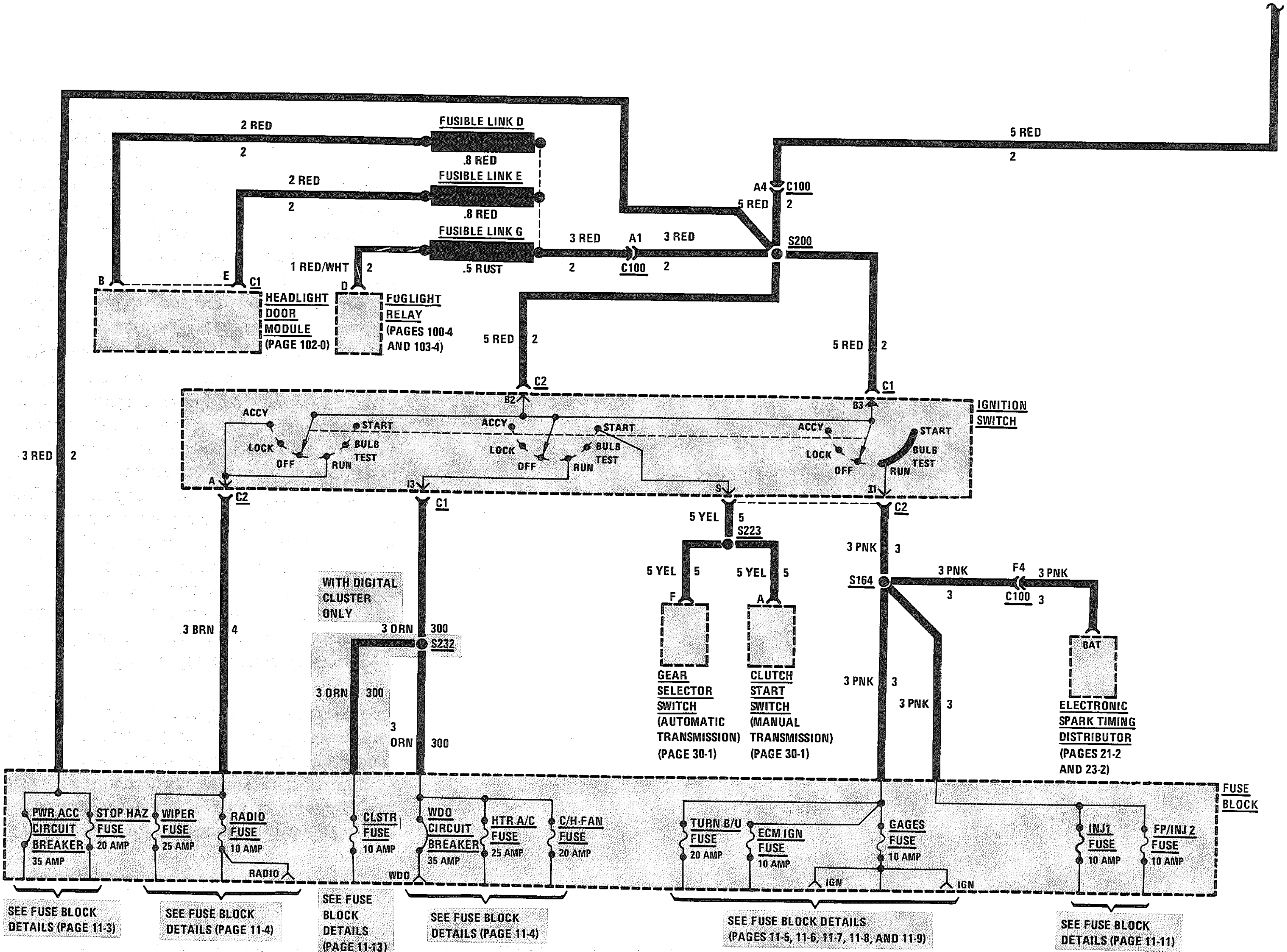




FUSIBLE LINK D
FUSIBLE LINK E
FUSIBLE LINK G
2 RED
2
.8 BLUE
.5 RUST
1 RED/WHT
3 RED
A1
C100
A4
5 RED
.8 RED
S200
HEADLIGHT DOOR MODULE (PAGE 102-0)
FOGLIGHT RELAY (PAGES 100-4 AND 103-4)
VATS FUSE 10 AMP
ARC RADIO FUSE 20 AMP
CONVENIENCE CENTER
IGNITION SWITCH
ACCY
LOCK
OFF
RUN
START
BULB TEST
C1
C2
B2
B3
B8
.8 ORN
440
1 ORN/BLK
340
C219 (NOT USED)
VATS DECODER MODULE (PAGE 133-0)
WITH SUBWOOFER ONLY
C218
.35 ORN
RADIO RECEIVER (PAGES 150-1 AND 150-3)
3 RED
3 BRN
4
3 ORN
300
WITH DIGITAL CLUSTER ONLY
S232
5 YEL
S223
GEAR SELECTOR SWITCH (AUTOMATIC TRANSMISSION) (PAGE 30-1)
CLUTCH START SWITCH (MANUAL TRANSMISSION) (PAGE 30-1)
3 PNK
S164
F4
BAT
ELECTRONIC SPARK TIMING DISTRIBUTOR (PAGES 21-2 AND 23-2)
FUSE BLOCK
PWR ACC CIRCUIT BREAKER 35 AMP
STOP HAZ FUSE 20 AMP
WIPER FUSE 25 AMP
RADIO FUSE 10 AMP
RADIO
CLSTR FUSE 10 AMP
WDO CIRCUIT BREAKER 35 AMP
WDO
HTR A/C FUSE 25 AMP
C/H-FAN FUSE 20 AMP
TURN B/U FUSE 20 AMP
ECM IGN FUSE 10 AMP
GAGES FUSE 10 AMP
IGN
INJ 1 FUSE 10 AMP
FP/INJ 2 FUSE 10 AMP
SEE FUSE BLOCK DETAILS (PAGE 11-3)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGE 11-13)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGES 11-5, 11-6, 11-7, 11-8, AND 11-9)
SEE FUSE BLOCK DETAILS (PAGE 11-11)

POWER DISTRIBUTION: V8 VIN E




2 RED
FUSIBLE LINK D
.8 RED
2 RED
FUSIBLE LINK E
.8 RED
FUSIBLE LINK G
1 RED/WHT
.5 RUST
3 RED
A1
C100
5 RED
A4
C100
5 RED
S200
HEADLIGHT DOOR MODULE (PAGE 102-0)
FOGLIGHT RELAY (PAGES 100-4 AND 103-4)
5 RED
5 RED
C2
C1
IGNITION SWITCH
ACCY
LOCK
OFF
RUN
START
BULB TEST
3 RED
C2
C1
5 YEL
S223
5 YEL
5 YEL
3 PNK
S164
3 PNK
F4
C100
3 PNK
GEAR SELECTOR SWITCH (AUTOMATIC TRANSMISSION) (PAGE 30-1)
CLUTCH START SWITCH (MANUAL TRANSMISSION) (PAGE 30-1)
BAT
ELECTRONIC SPARK TIMING DISTRIBUTOR (PAGES 21-2 AND 23-2)
WITH DIGITAL CLUSTER ONLY
3 BRN
3 ORN
S232
3 ORN
3 ORN
3 PNK
3 PNK
FUSE BLOCK
PWR ACC CIRCUIT BREAKER 35 AMP
STOP HAZ FUSE 20 AMP
WIPER FUSE 25 AMP
RADIO FUSE 10 AMP
RADIO
CLSTR FUSE 10 AMP
WDO
WDO CIRCUIT BREAKER 35 AMP
HTR A/C FUSE 25 AMP
C/H-FAN FUSE 20 AMP
TURN B/U FUSE 20 AMP
ECM IGN FUSE 10 AMP
GAGES FUSE 10 AMP
IGN
IGN
INJ1 FUSE 10 AMP
FP/INJ 2 FUSE 10 AMP
SEE FUSE BLOCK DETAILS (PAGE 11-3)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGE 11-13)
SEE FUSE BLOCK DETAILS (PAGE 11-4)
SEE FUSE BLOCK DETAILS (PAGES 11-5, 11-6, 11-7, 11-8, AND 11-9)
SEE FUSE BLOCK DETAILS (PAGE 11-11)

POWER DISTRIBUTION

CIRCUIT OPERATION

Electrical power for the car is provided by the Generator when the engine is running. The schematic diagram shows how each circuit gets its power. For more details about the Generator, and connections to the Battery and Starter, see Starter and Charging System, Section 8A-30.

The car's Power Distribution System consists of Fusible Links, Fuses, Circuit Breakers, the Light Switch and the Ignition Switch. Fusible Links are short pieces of wire to which they supply power. They are covered with a special high-temperature insulation. When conducting a high current, the Fusible Link will melt and stop current flow. They are designed to protect the car's electrical system from electrical shorts where it is not protected by the Circuit Breakers and Fuses. See Fuse Block Details and Light Switch Details for complete wiring to the first component in each circuit.

The Ignition Switch has six positions, five of which have detents. The BULB TEST position is after the RUN position and just before the START position. BULB TEST does not have a detent. As shown in the schematic, circuits which are supplied from the Ignition Switch are On (Hot) for different switch positions. Individual schematics show their fuses supplied from headings such as "Hot In Run." The heading corresponds to the Ignition Switch position in which power is On.

COMPONENT LOCATION

Component	Location	Page-Figure
Auxiliary Coolant Fan Relay	RH front side of engine compartment	201- 5-A
Blower High Speed Relay	RH front of dash, near Blower Motor	201-14-A
Burn-Off Relay	LH rear corner of engine compartment, on relay bracket	201- 7-A
Clutch Start Switch	Above clutch pedal, on clutch pedal support	
Cold Start Injector (VIN F) (VIN 8)	Top LH side of engine	201- 7-A
Cold Start Injector (VIN S)	Top LH rear of engine	201- 0-C
Cold Start Switch (VIN F) (VIN 8)	Top center of engine	201- 8-C
Cold Start Switch (VIN S)	Top of engine	
Convenience Center	Behind I/P, to right of steering column	201-10-A
Coolant Fan Relay (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 3-A
Coolant Fan Relay (VIN F) (VIN 8)	Front of engine compartment, RH side of radiator support	201- 5-A
Coolant Fan Relay (VIN S)	LH rear corner of engine compartment, on relay bracket	201- 0-A
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Electronic Spark Timing (EST) Distributor (VIN E)	Top rear of engine	201- 3-A
Electronic Spark Timing (EST) Distributor (VIN F) (VIN 8)	Top rear of engine	201- 5-A
Fog Light Relay	LH front of engine compartment, on fender	201-16-A
Fuel Pump In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Fuel Pump Relay (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 3-A
Fuel Pump Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Fuel Pump Relay (VIN S)	LH rear corner of engine compartment, on relay bracket	201- 0-A
Fuel Pump Switch (VIN E)	Lower LH rear of engine	201- 3-A
Fuel Pump Switch (VIN F) (VIN 8)	Lower LH side of engine	201- 8-A
Fuel Pump Switch (VIN S)	Lower LH side of engine	201- 0-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link A (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link A (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B

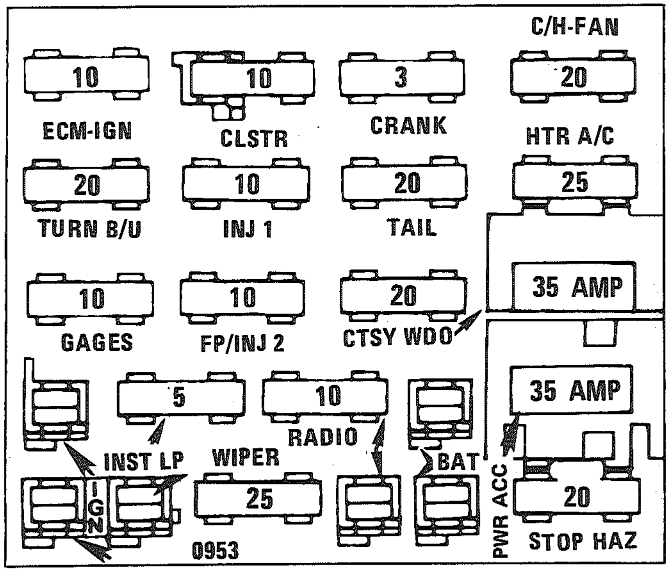
COMPONENT LOCATION

Component	Location	Page-Figure
Fusible Link A (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link B (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link B (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link B (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link D	Front lights harness, near LH side of dash	201-16-A
Fusible Link E	Front lights harness, near LH side of dash	201-16-A
Fusible Link G	Front lights harness, near LH side of dash	201-16-A
Fusible Link H (VIN E)	RH front of engine compartment, at Junction Block	201- 3-B
Fusible Link H (VIN F) (VIN 8)	LH front of engine compartment, behind battery	201- 5-C
Fusible Link H (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link J (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link J (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link J (VIN S)	RH side of radiator support, at Junction Block	201- 1-A
Fusible Link K	RH front of engine compartment, at Junction Block	201- 3-B
Gear Selector Switch	In console, at base of gear selector	201-11-E
Hatch Fuse	Attached to side of Fuse Block	
Hatch Pull-Down Unit	Center of end panel, in cargo compartment	201-17-B
Headlight Door Module	LH front of dash	201-16-A
Ignition Coil (VIN S)	Rear RH side of engine	201- 1-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
In-Line Fuse (VIN F)(VIN 8)	On LH side of radiator support, forward of battery	201- 5-C
Junction Block	RH front of engine compartment, behind headlight	201- 1-A
Lights Monitoring Module	Behind I/P, at base of steering column	
Mass Air Flow (MAF) Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Mass Air Flow (MAF) Relay (VIN S)	Front of engine compartment, on RH side of radiator bracket	201- 1-A
Mass Air Flow In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Remote Dimmer	RH side of steering column, on I/P retainer	201-10-A
Starter Solenoid (VIN E)	Lower RH side of engine	201- 2-A
Starter Solenoid (VIN F) (VIN 8)	Lower RH side of engine	201- 6-B

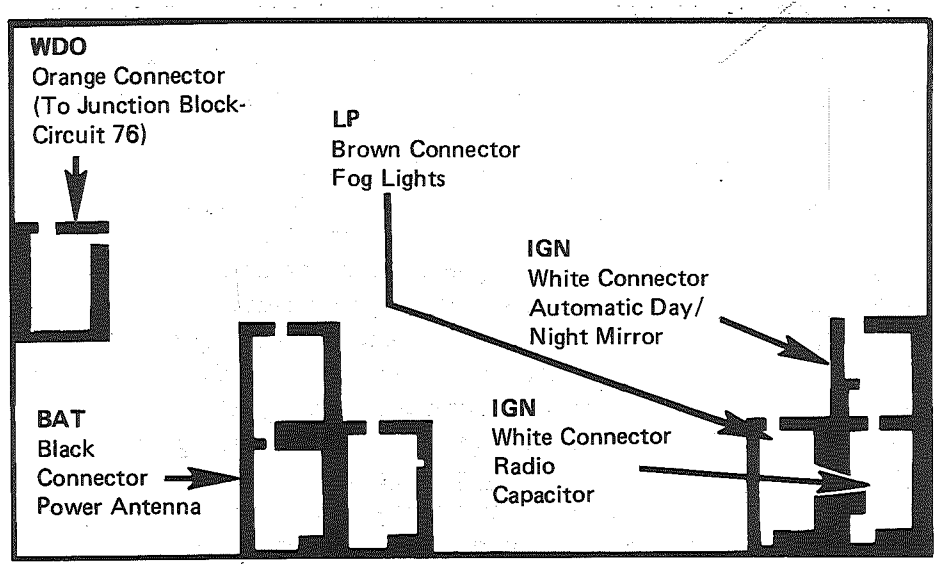
COMPONENT LOCATION

Component	Location	Page-Figure
Starter Solenoid (VIN S)	Lower RH side of engine	201- 1-A
VATS Decoder Module	Behind LH side of I/P, above steering column	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C104 (6 cavities)	Front of engine compartment, RH side of radiator	201- 5-A
C111 (1 cavity)	Behind battery, near positive battery cable	201- 7-A
C115 (1 cavity)	Center front of dash	201-14-A
C204 (4 cavities)	Above LH rear corner of engine	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C208 (8 cavities)	Behind LH side of rear seat	201-17-C
C218	Behind center of I/P	201-12-A
C219 (6 cavities)	Behind RH side of I/P, near Subwoofer Amplifier	201-13-B
G100 (VIN E)	RH front of engine	201- 4-B
G100 (VIN F) (VIN 8)	Lower LH front of engine	201- 8-B
G100 (VIN S)	Lower LH front of engine	201- 1-B
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
S108	Engine harness, lower RH side of engine	201- 5-A
S164	I/P harness, above Fuse Block	201-10-A
S166 (VIN E)	Engine harness, above rear of engine	201- 3-C
S166 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S166 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S168 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S168 (VIN S)	Engine harness, top rear of engine	201- 1-C
S200	I/P harness, behind LH side of I/P	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S223	I/P harness, above Fuse Block	201- 9-A
S224	I/P harness, near LH shroud	
S225	I/P harness, behind instrument cluster	201-10-A
S232	I/P harness, behind LH side of I/P, above Fuse Block	201-10-A
S236	I/P harness, below light switch	201-10-A

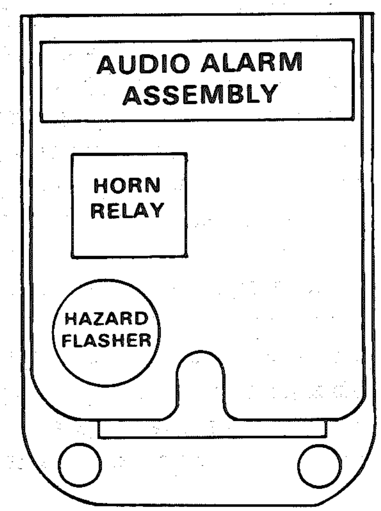
FUSE DATA DETAILS: FUSE DATA



FRONT VIEW OF
FUSE BLOCK

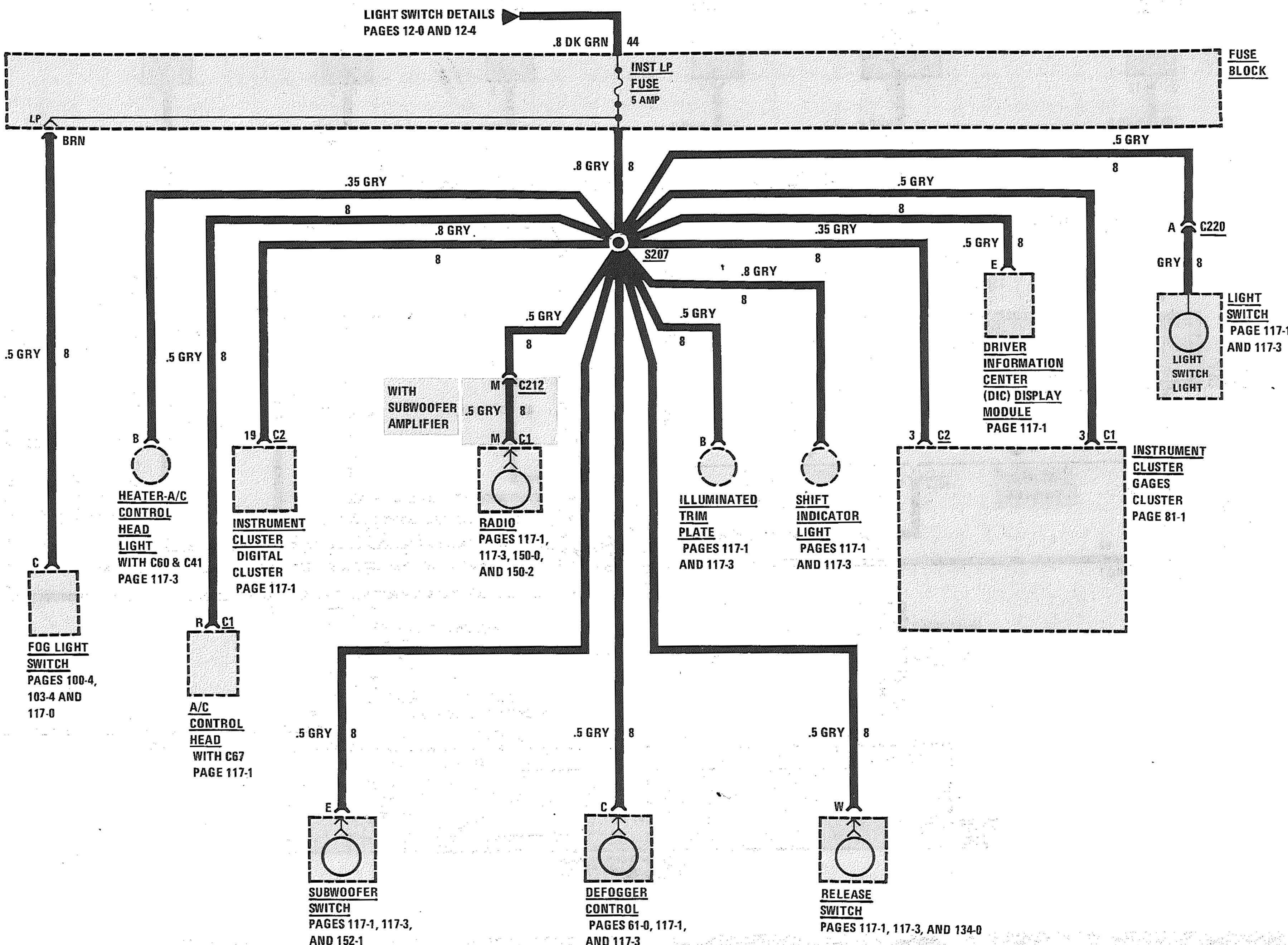


REAR VIEW OF FUSE BLOCK
Cavity and Connector Locations

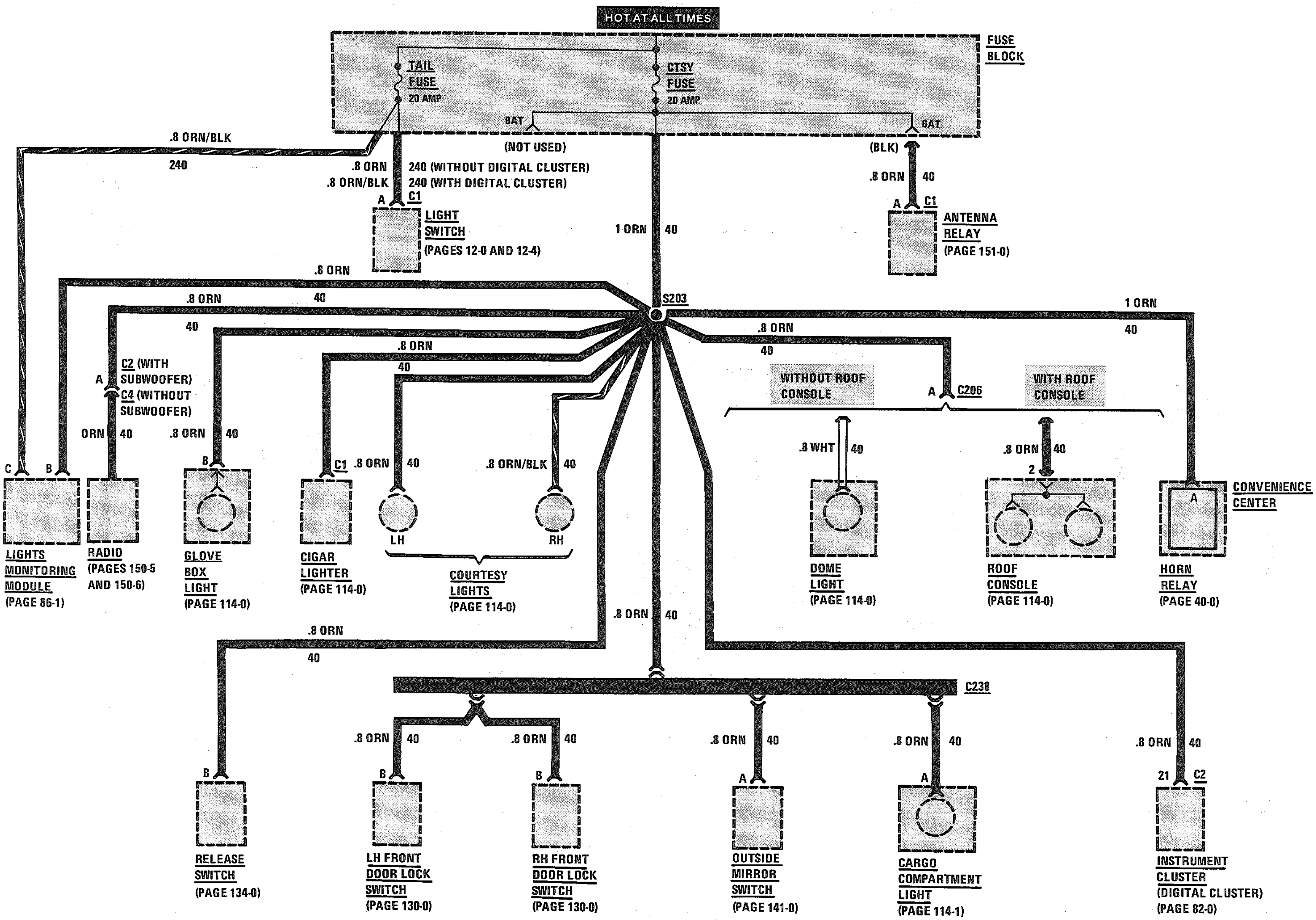


CONVENIENCE CENTER

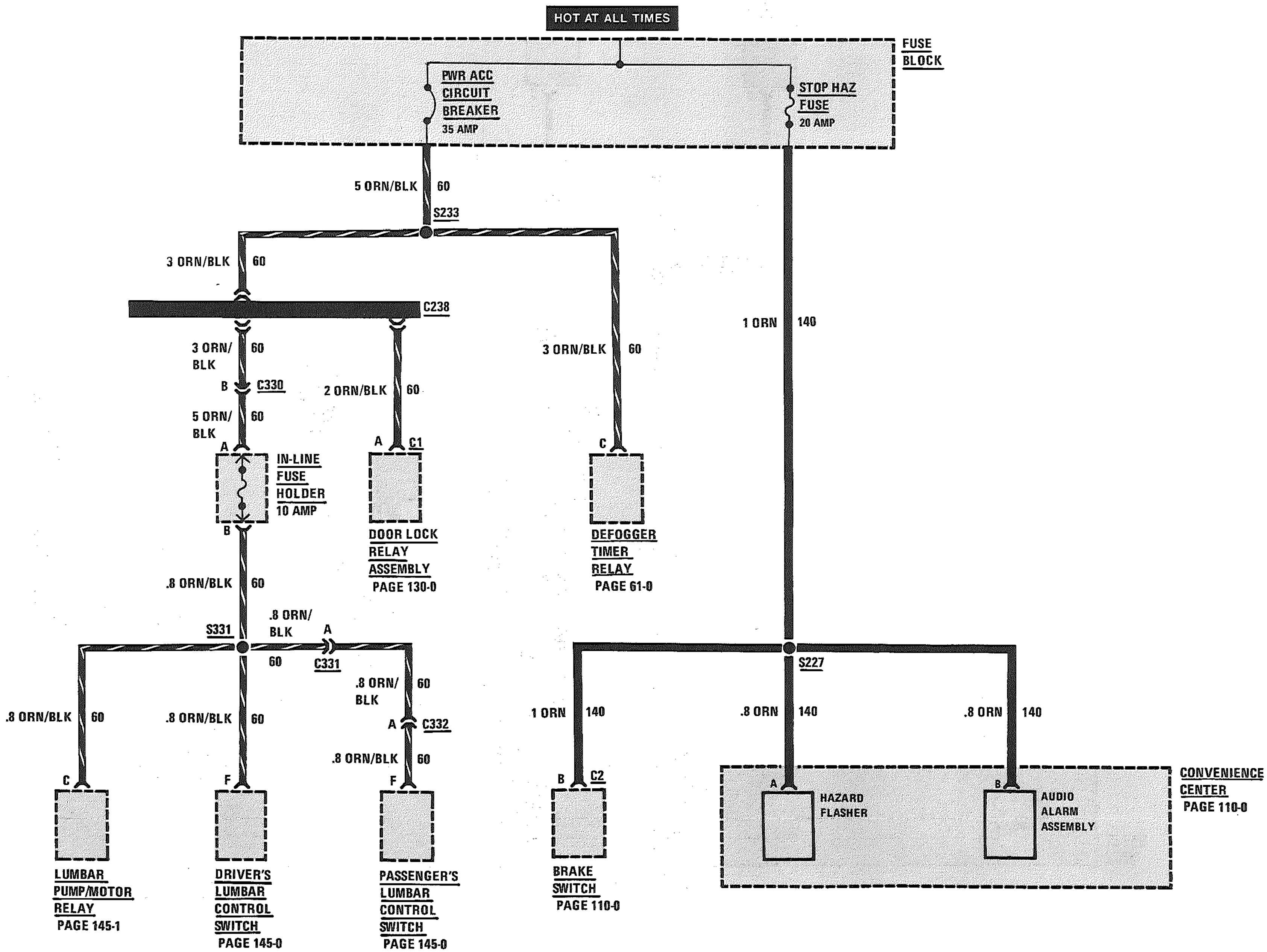
FUSE BLOCK DETAILS: INST LP FUSE



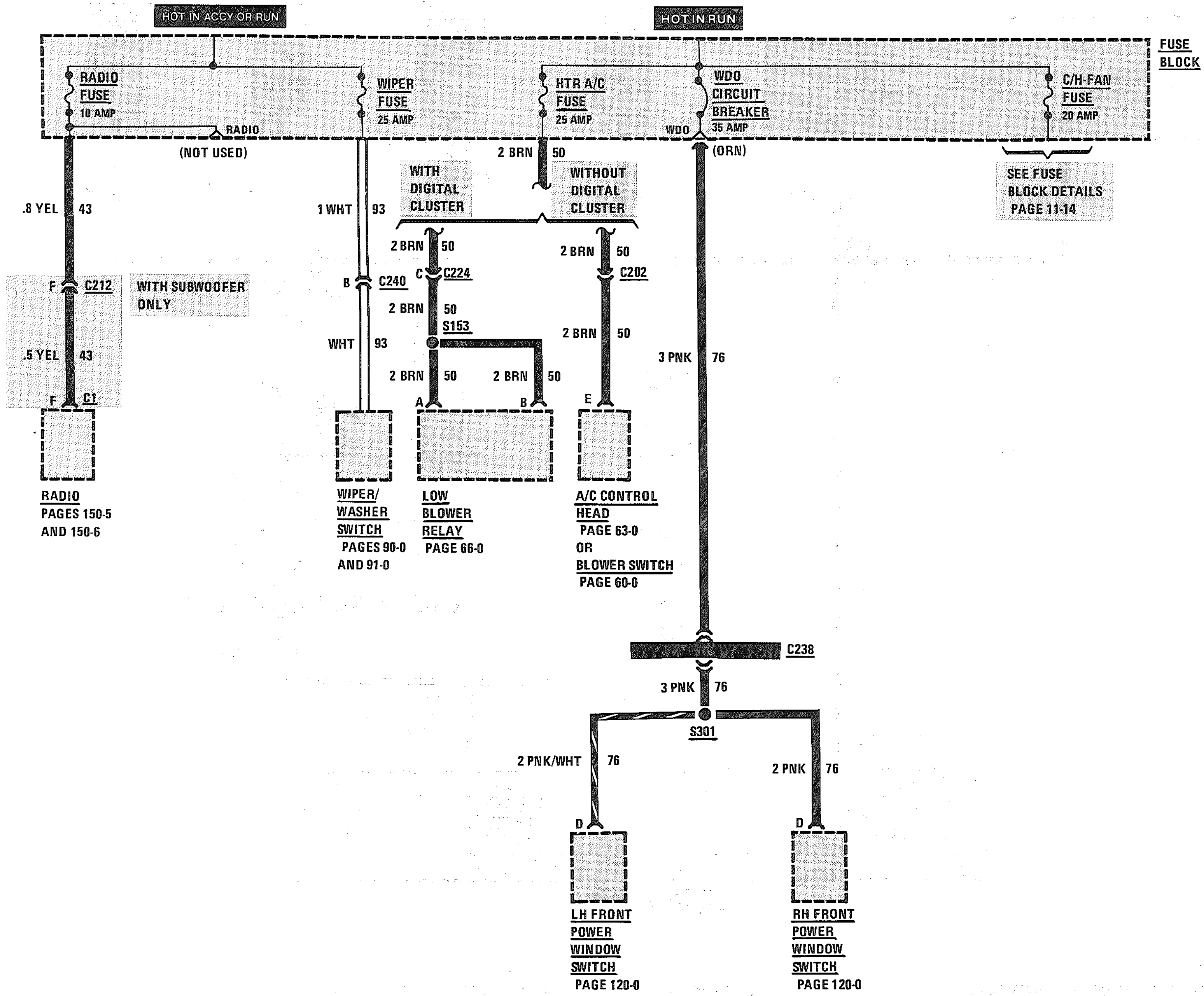
FUSE BLOCK DETAILS: CTSY FUSE AND TAIL FUSE



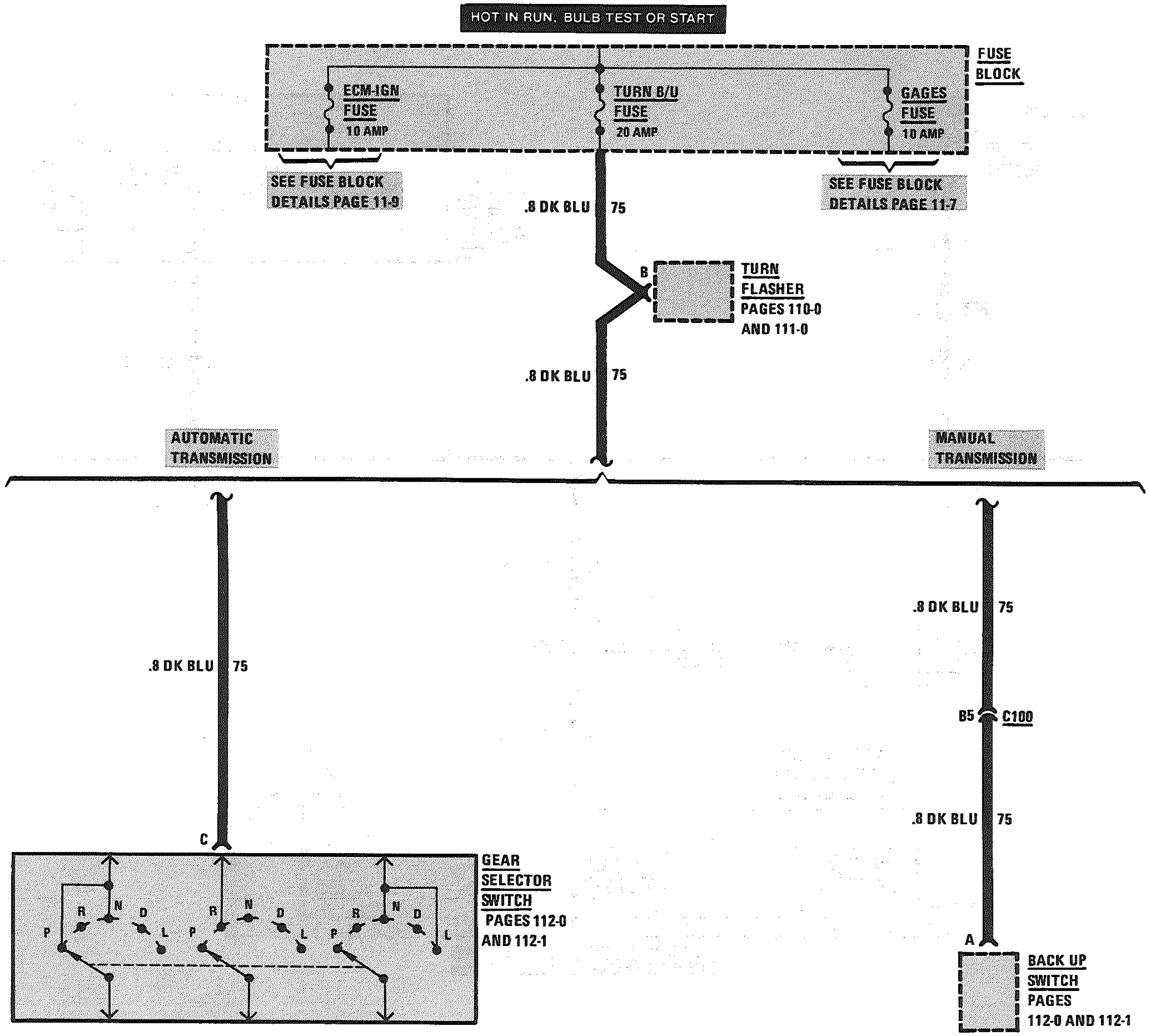
FUSE BLOCK DETAILS: PWR ACC CIRCUIT BREAKER AND STOP HAZ FUSE



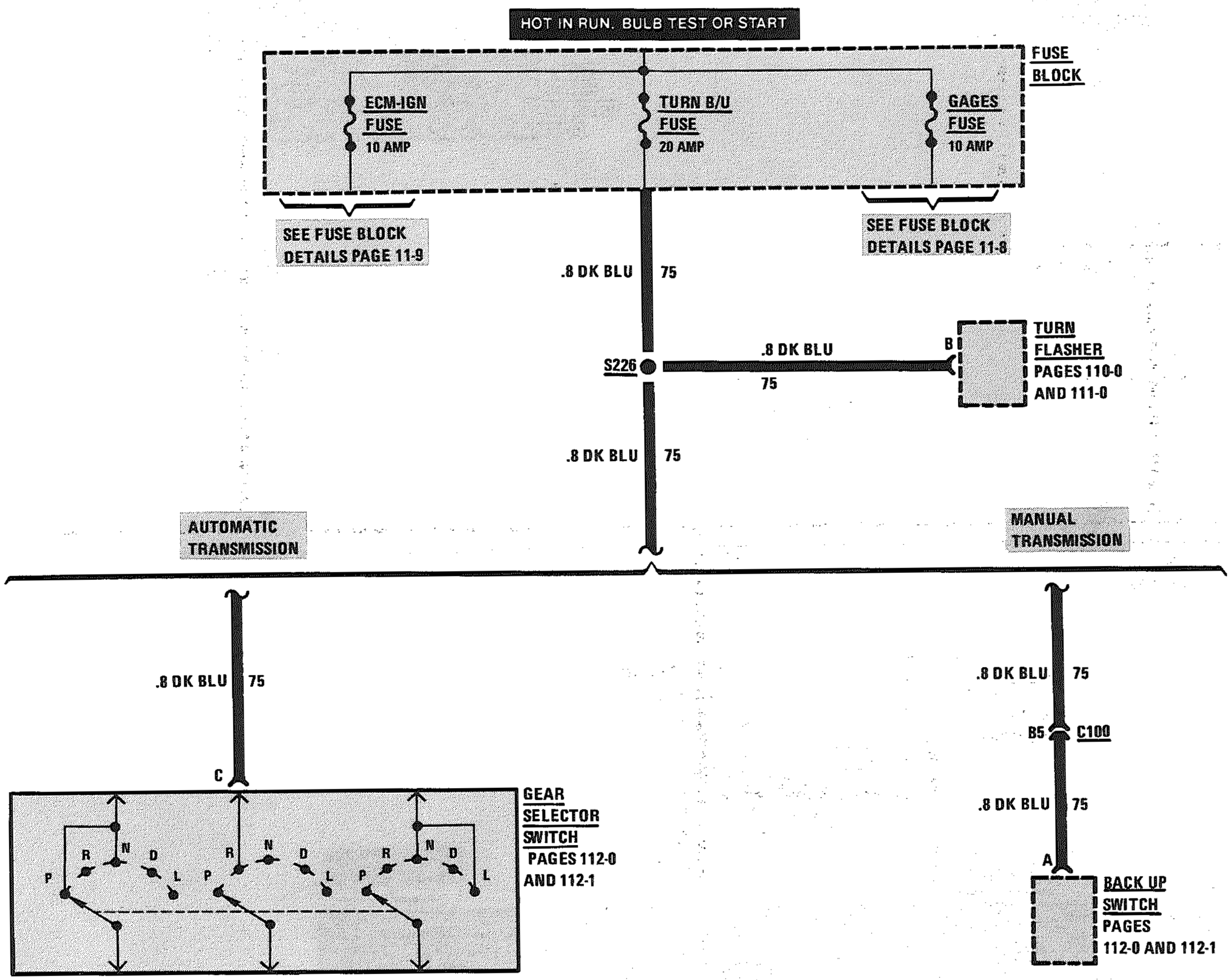
FUSE BLOCK DETAILS: WDO CIRCUIT BREAKER, HTR A/C FUSE, RADIO FUSE, AND WIPER FUSE



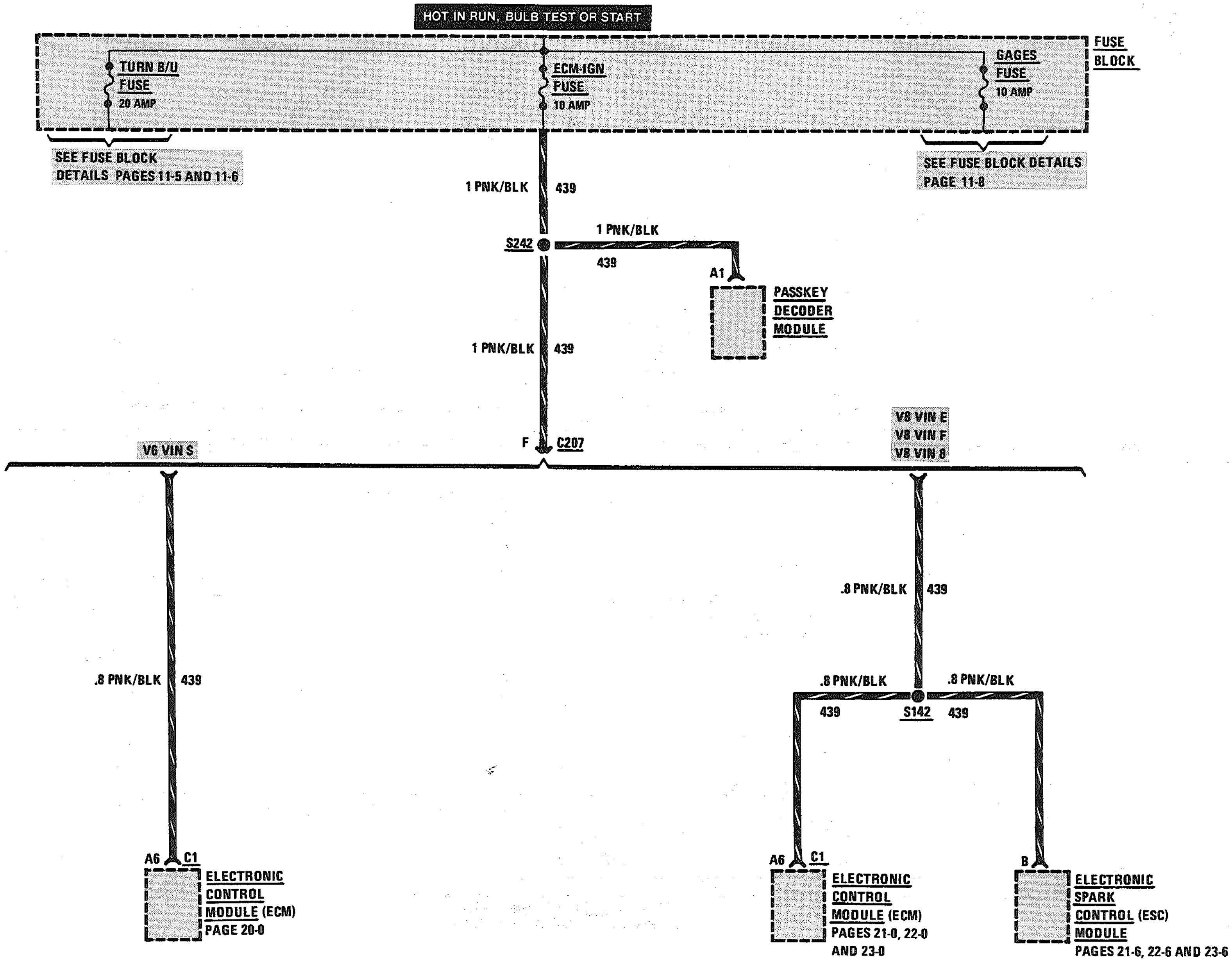
FUSE BLOCK DETAILS: TURN B/U FUSE
WITH DIGITAL CLUSTER



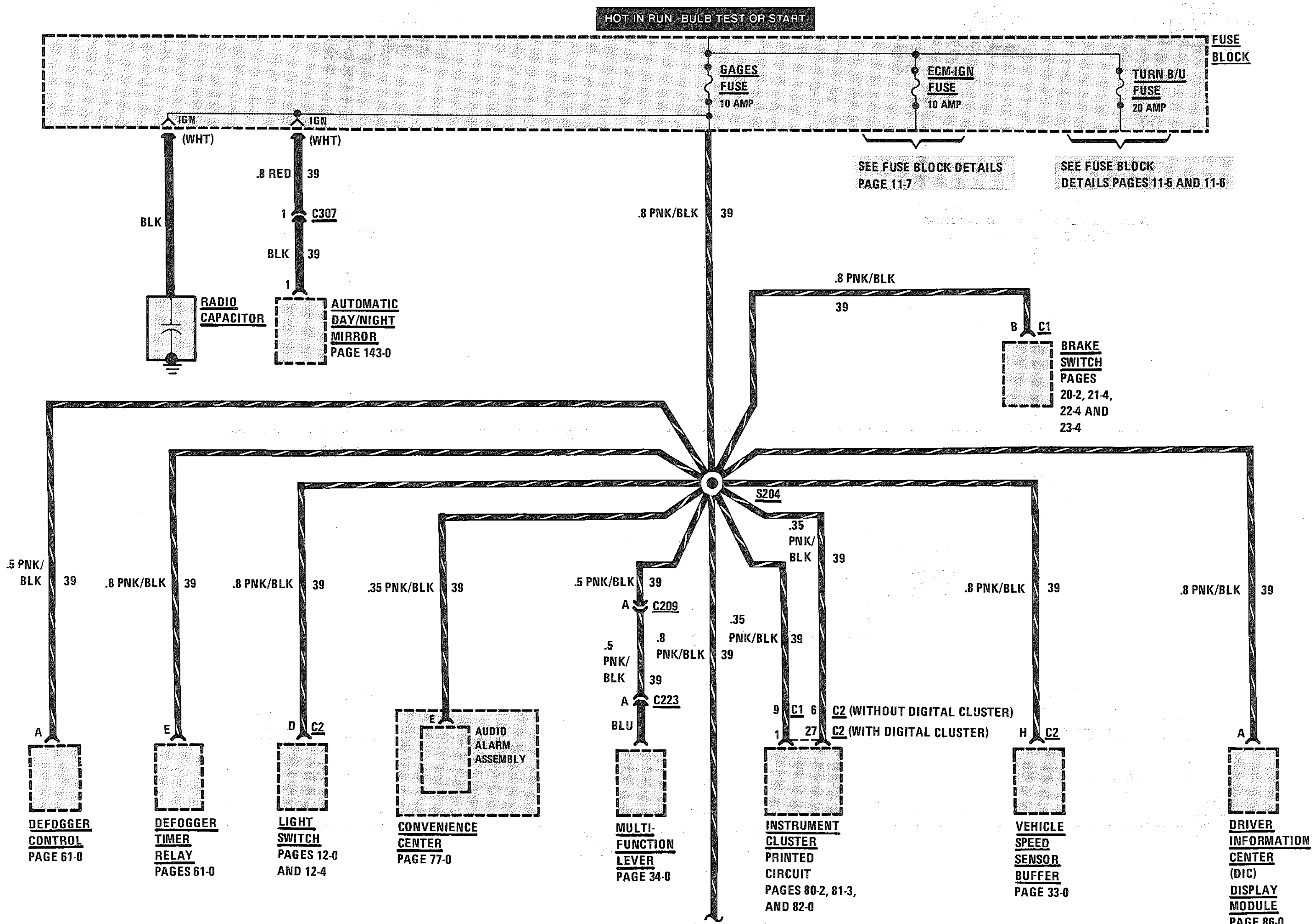
FUSE BLOCK DETAILS: TURN B/U FUSE
WITHOUT DIGITAL CLUSTER

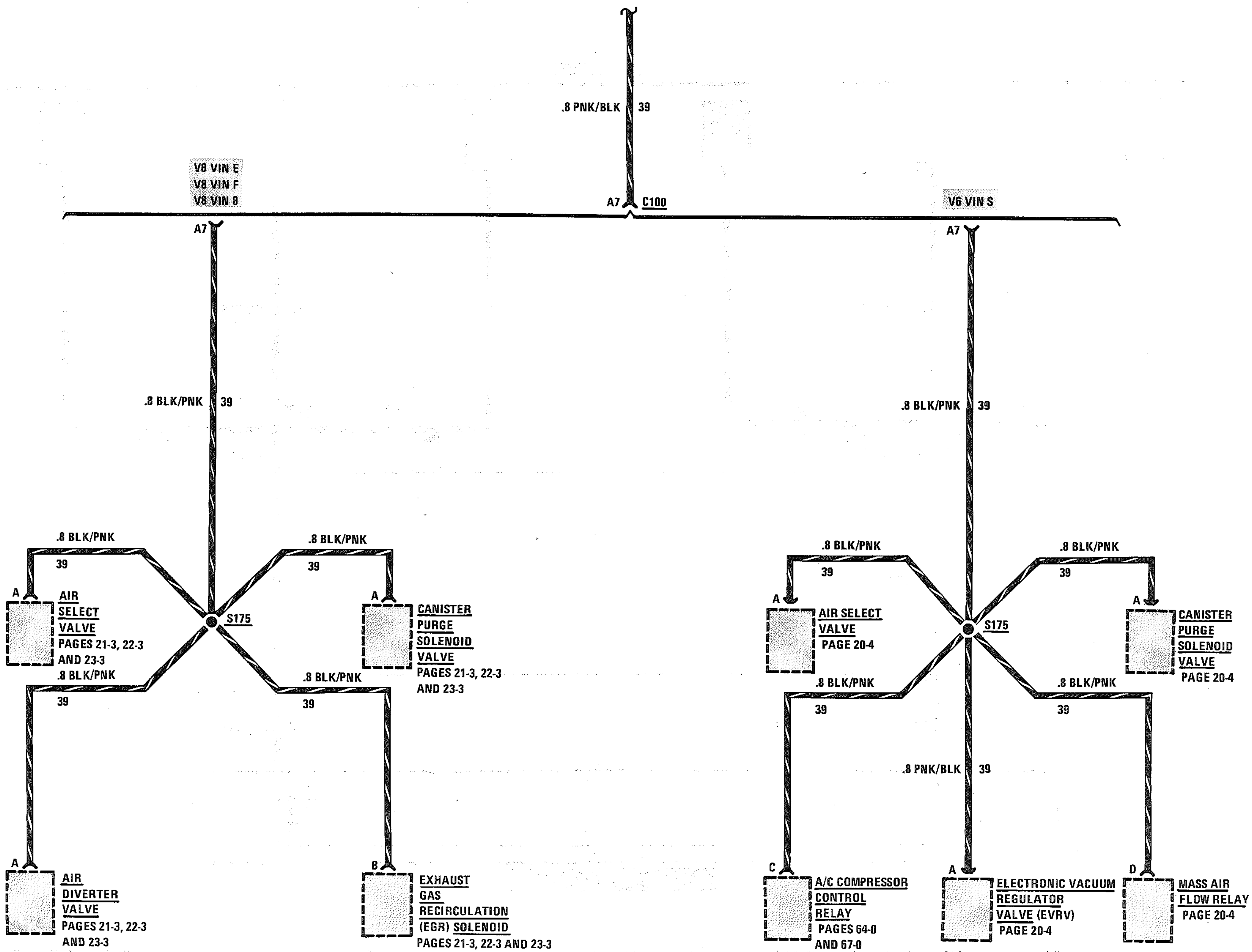


FUSE BLOCK DETAILS: ECM-IGN FUSE



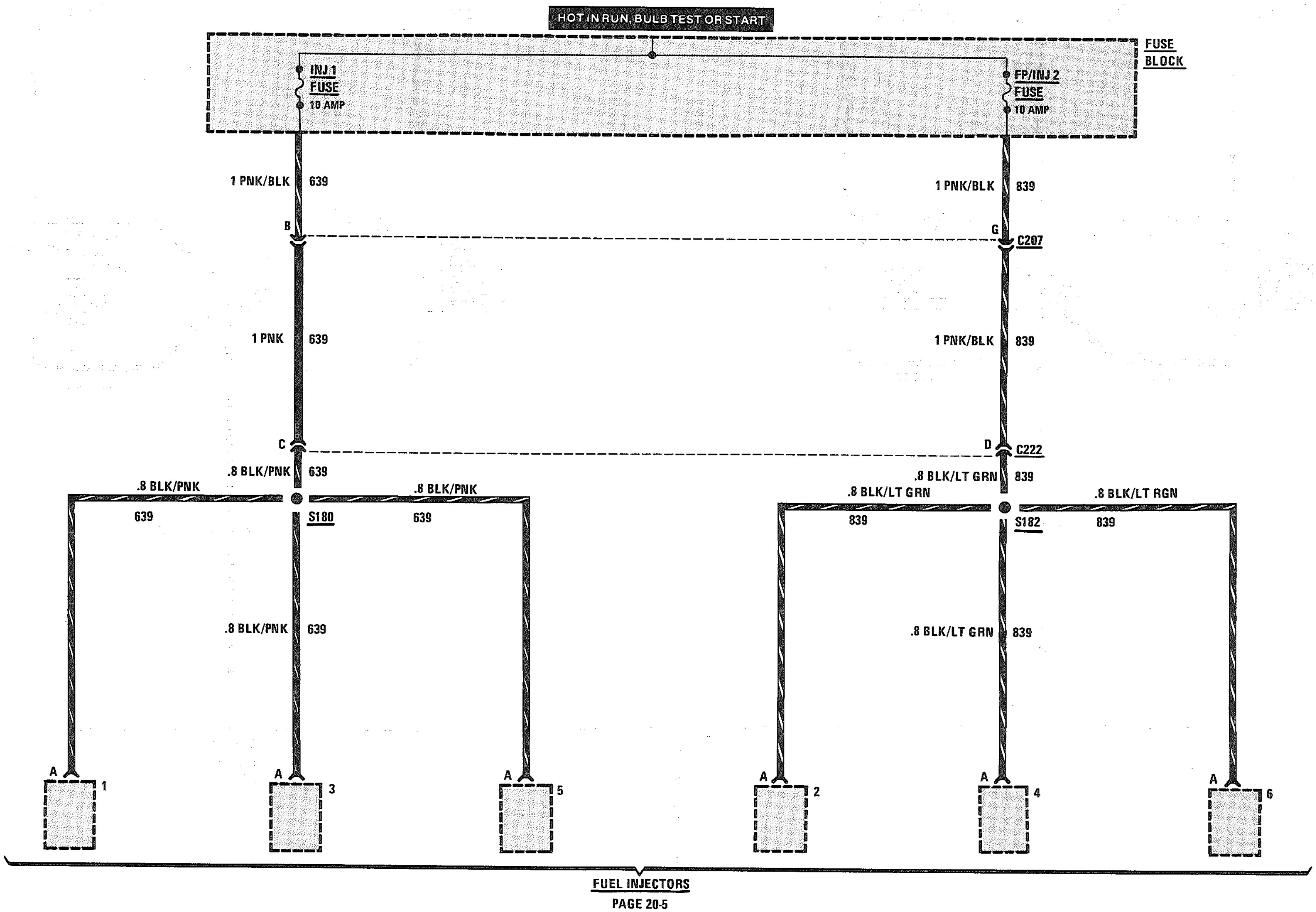
FUSE BLOCK DETAILS: GAGES FUSE




.8 PNK/BLK 39
A7 C100
V8 VIN E
V8 VIN F
V8 VIN 8
V6 VIN S
A7
.8 BLK/PNK 39
.8 BLK/PNK 39
S175
A
AIR SELECT VALVE
PAGES 21-3, 22-3 AND 23-3
A
CANISTER PURGE SOLENOID VALVE
PAGES 21-3, 22-3 AND 23-3
A
AIR DIVERTER VALVE
PAGES 21-3, 22-3 AND 23-3
B
EXHAUST GAS RECIRCULATION (EGR) SOLENOID
PAGES 21-3, 22-3 AND 23-3
A
AIR SELECT VALVE
PAGE 20-4
A
CANISTER PURGE SOLENOID VALVE
PAGE 20-4
.8 PNK/BLK 39
C
A/C COMPRESSOR CONTROL RELAY
PAGES 64-0 AND 67-0
A
ELECTRONIC VACUUM REGULATOR VALVE (EVRV)
PAGE 20-4
D
MASS AIR FLOW RELAY
PAGE 20-4

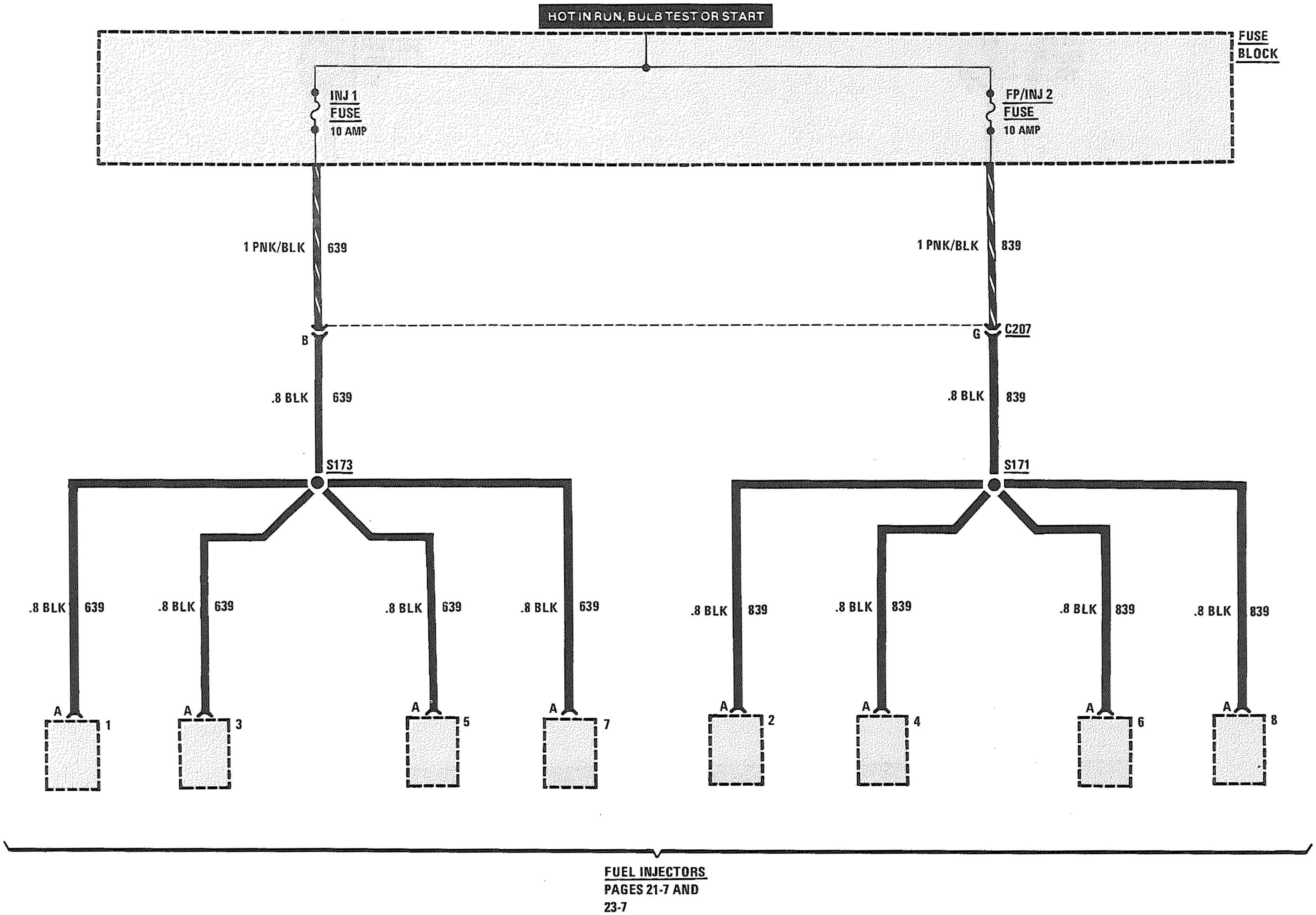
FUSE BLOCK DETAILS: INJ 1 FUSE AND FP/INJ 2 FUSE

V6 VIN S



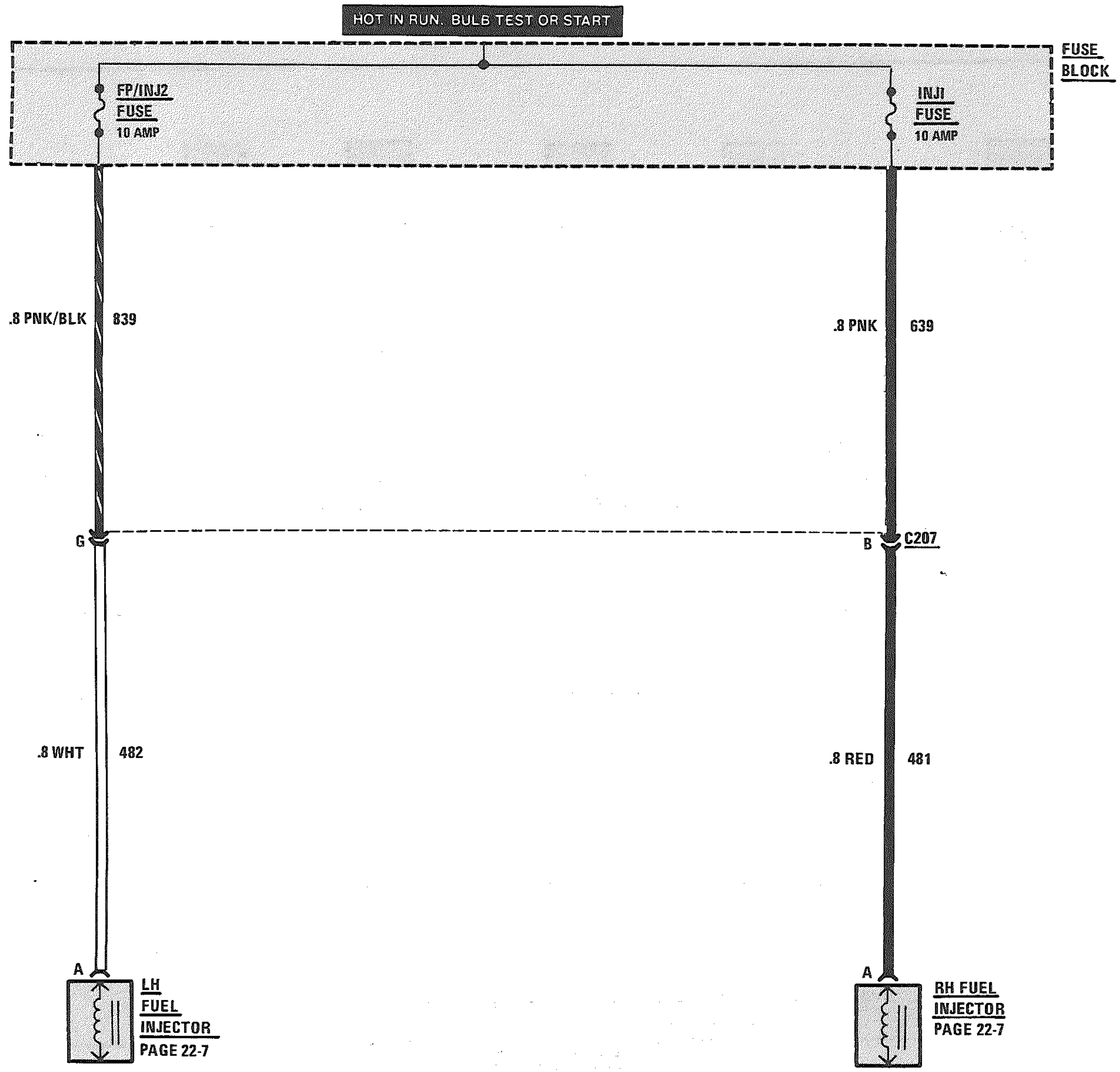
FUSE BLOCK DETAILS: INJ 1 FUSE AND FP/INJ 2 FUSE

V8 VIN F AND V8 VIN 8

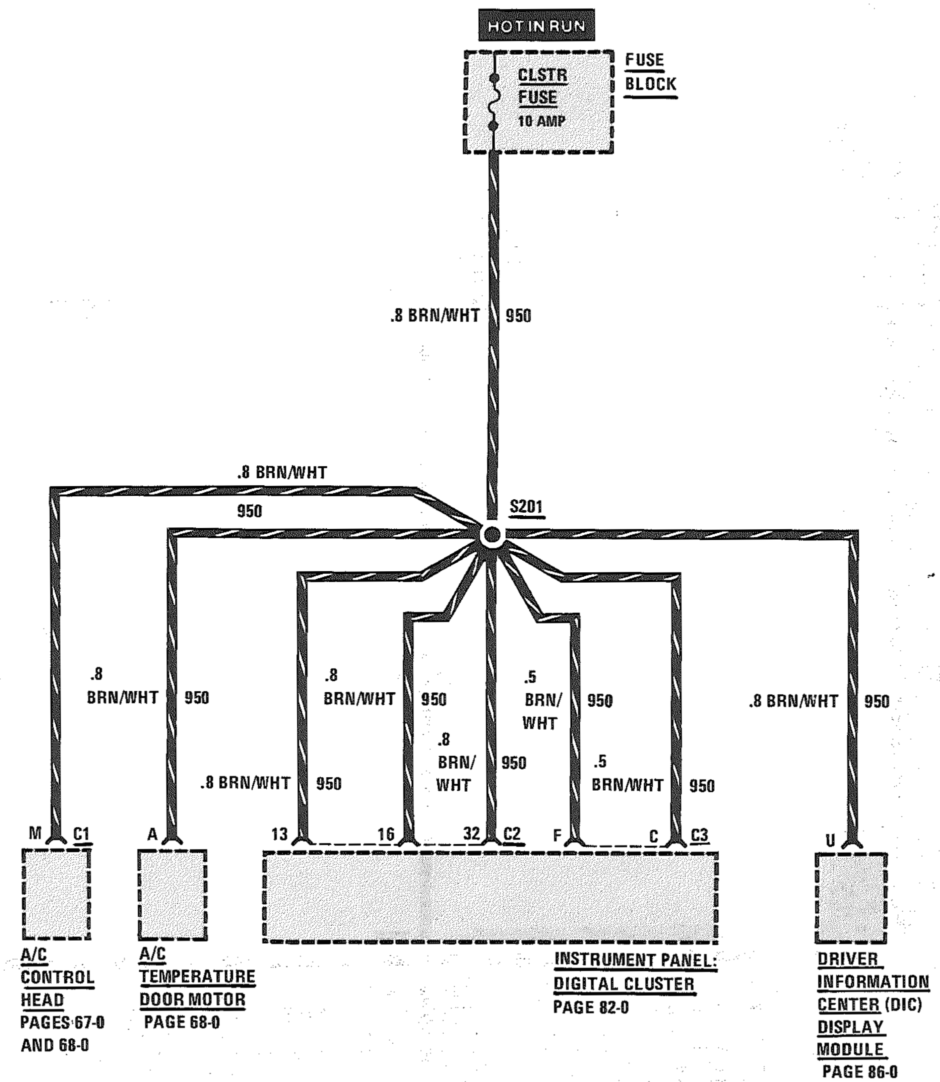


FUSE BLOCK DETAILS: INJ 1 FUSE AND FP/INJ 2 FUSE

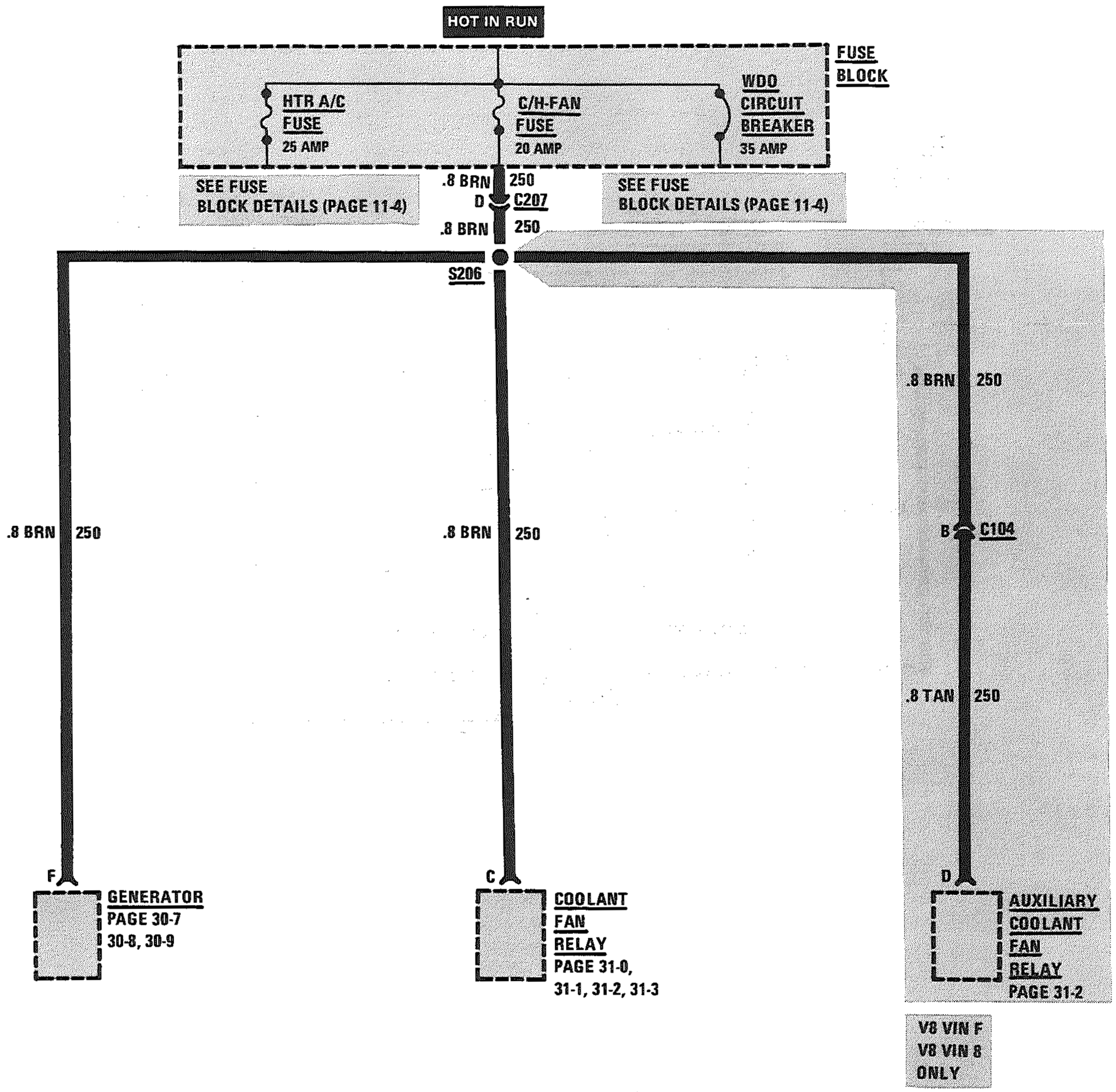
V8 VIN E



FUSE BLOCK DETAILS: CLSTR FUSE



FUSE BLOCK DETAILS: C/H FAN FUSE



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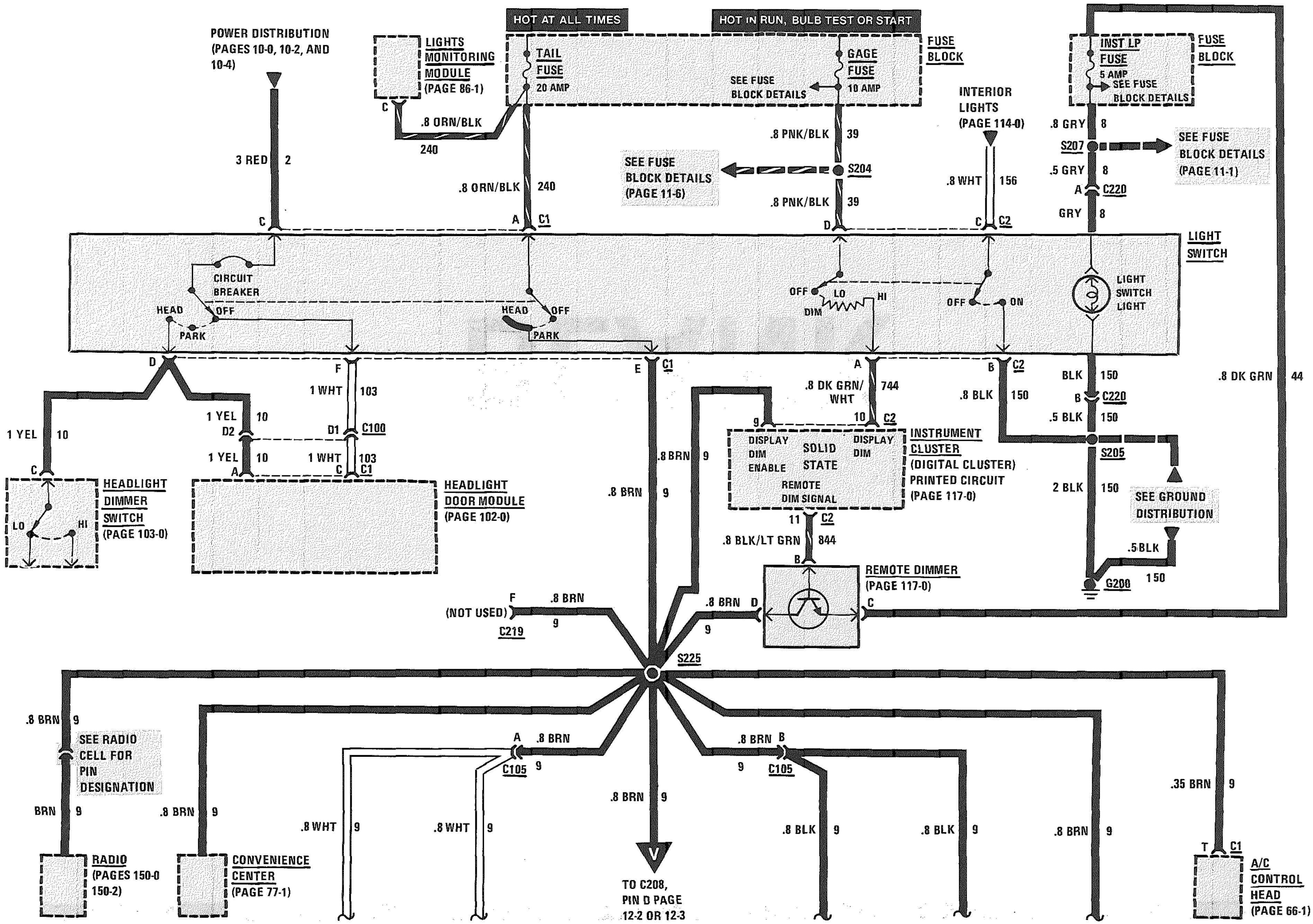
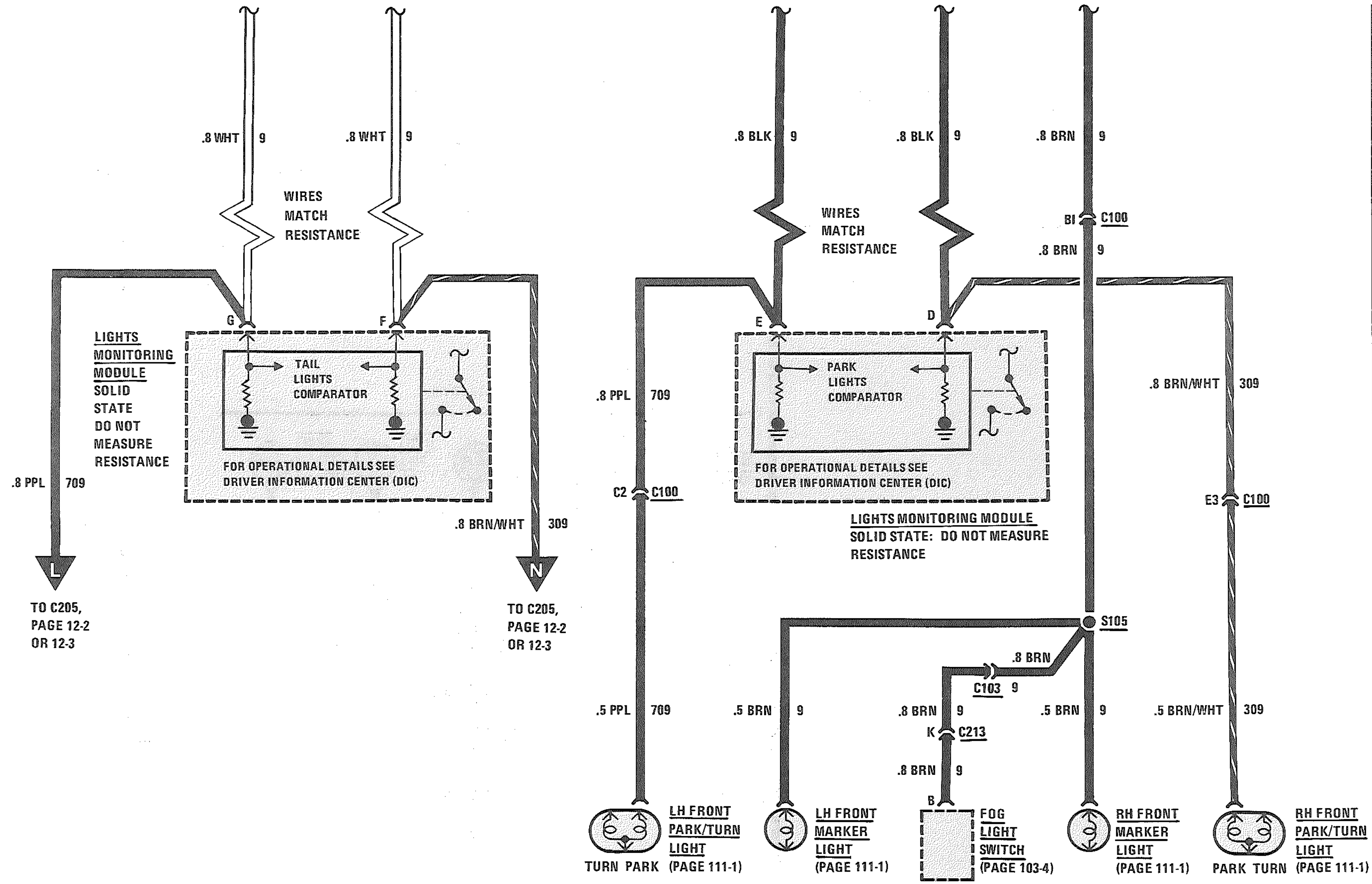
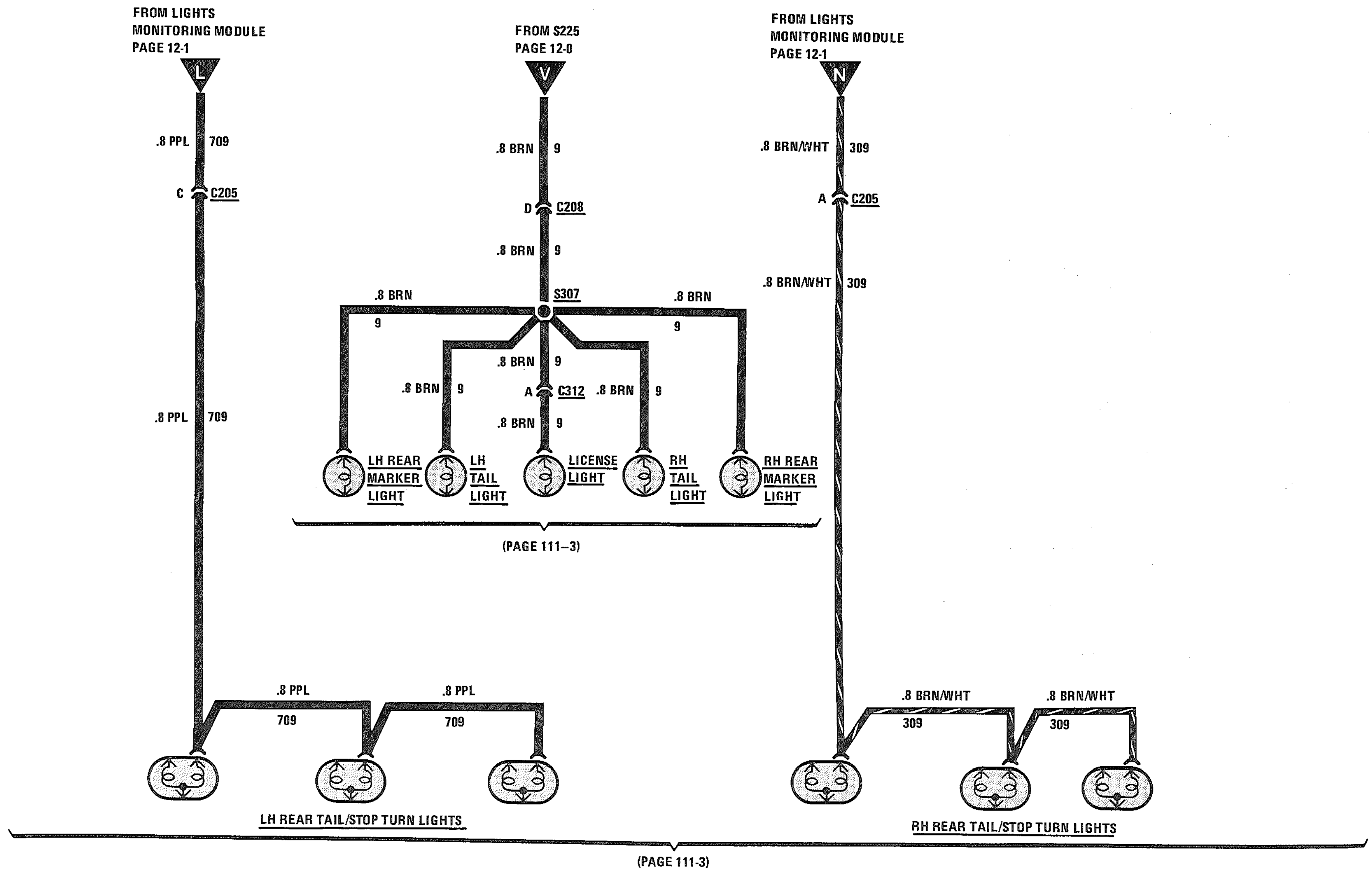
LIGHT SWITCH DETAILS: WITH DIGITAL CLUSTER

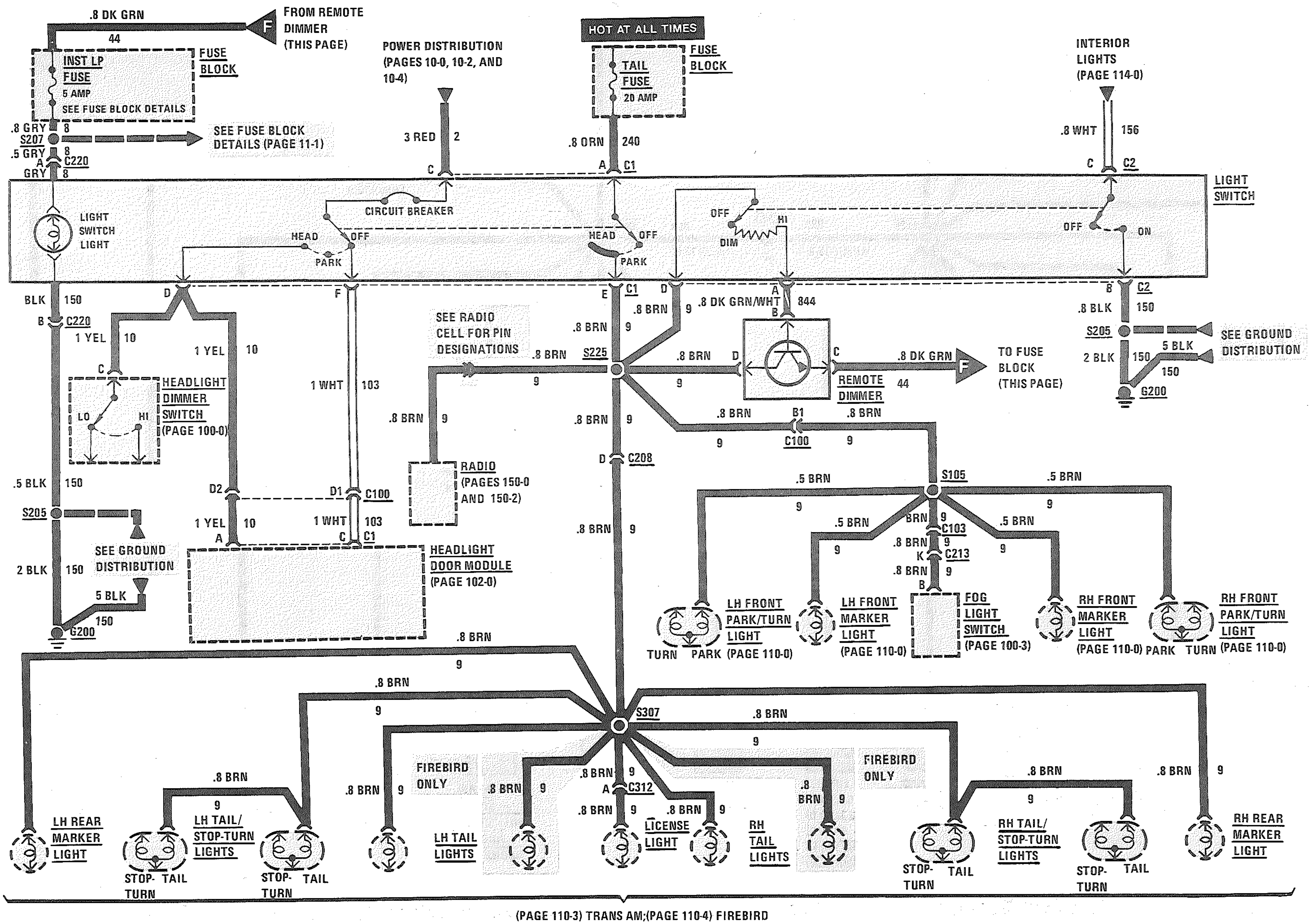



.8 WHT 9
.8 WHT 9
WIRES MATCH RESISTANCE
G
F
LIGHTS MONITORING MODULE
SOLID STATE
DO NOT MEASURE RESISTANCE
TAIL LIGHTS COMPARATOR
FOR OPERATIONAL DETAILS SEE DRIVER INFORMATION CENTER (DIC)
.8 PPL 709
.8 BRN/WHT 309
L
N
TO C205, PAGE 12-2 OR 12-3
TO C205, PAGE 12-2 OR 12-3
.8 BLK 9
.8 BLK 9
.8 BRN 9
WIRES MATCH RESISTANCE
BI C100
.8 BRN 9
E
D
PARK LIGHTS COMPARATOR
FOR OPERATIONAL DETAILS SEE DRIVER INFORMATION CENTER (DIC)
LIGHTS MONITORING MODULE
SOLID STATE: DO NOT MEASURE RESISTANCE
.8 PPL 709
.8 BRN/WHT 309
C2 C100
E3 C100
S105
.8 BRN
C103 9
.5 PPL 709
.5 BRN 9
.8 BRN 9
K C213
.8 BRN 9
.5 BRN 9
.5 BRN/WHT 309
B
TURN PARK
LH FRONT PARK/TURN LIGHT (PAGE 111-1)
LH FRONT MARKER LIGHT (PAGE 111-1)
FOG LIGHT SWITCH (PAGE 103-4)
RH FRONT MARKER LIGHT (PAGE 111-1)
PARK TURN
RH FRONT PARK/TURN LIGHT (PAGE 111-1)

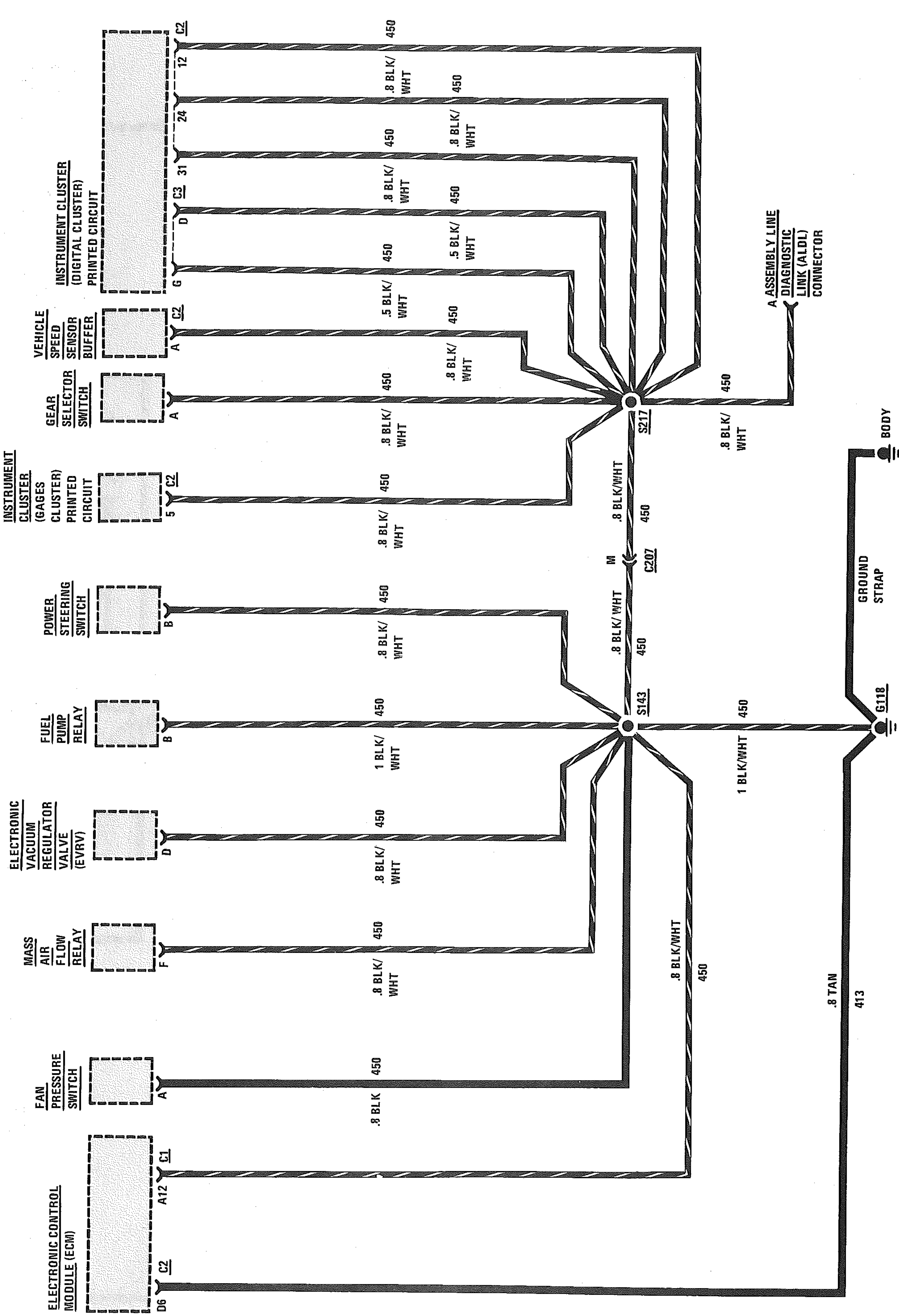
LIGHT SWITCH DETAILS: WITH DIGITAL CLUSTER



LIGHT SWITCH DETAILS: WITHOUT DIGITAL CLUSTER



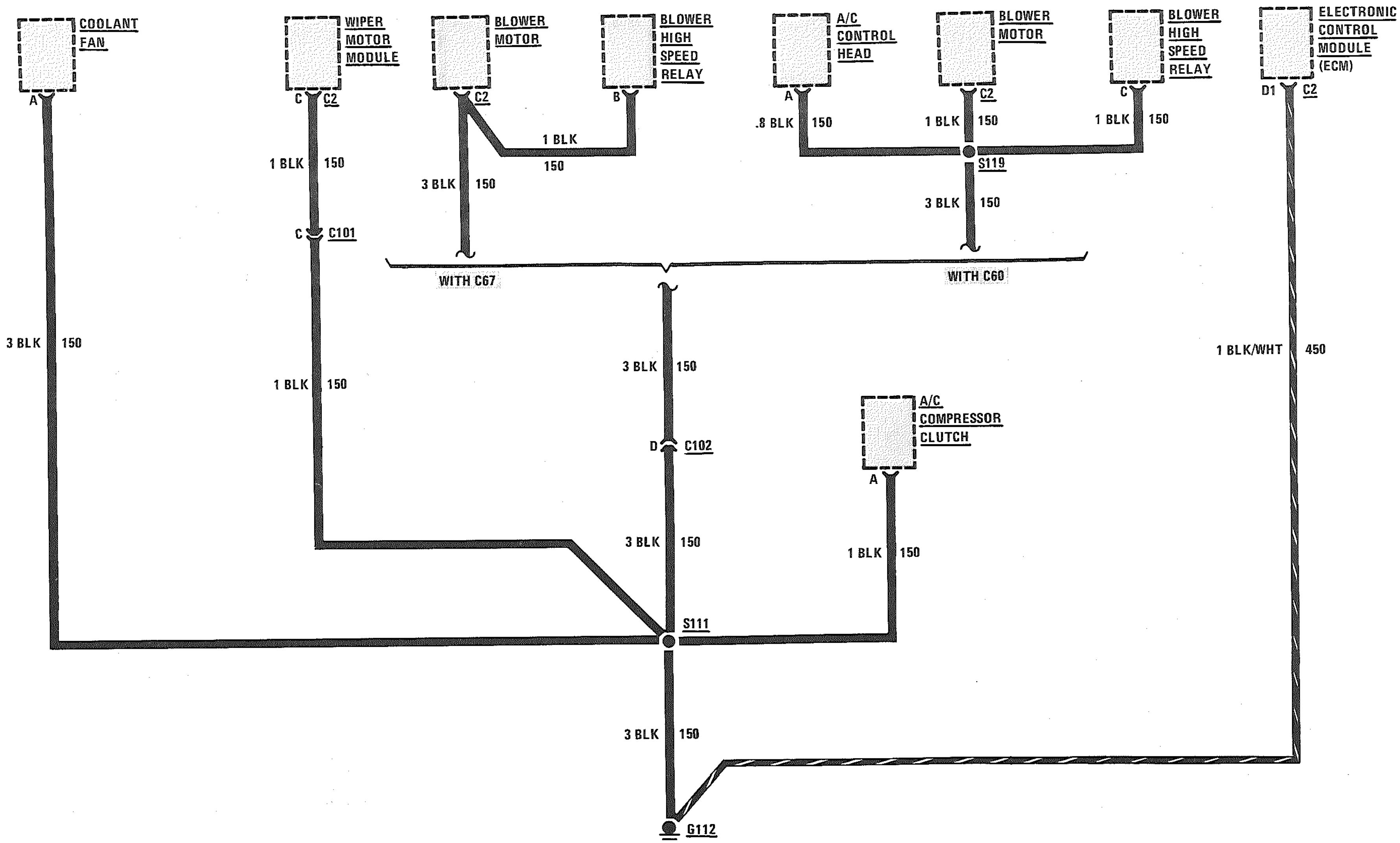
GROUND DISTRIBUTION: G118
ENGINE GROUND, V6 VIN S



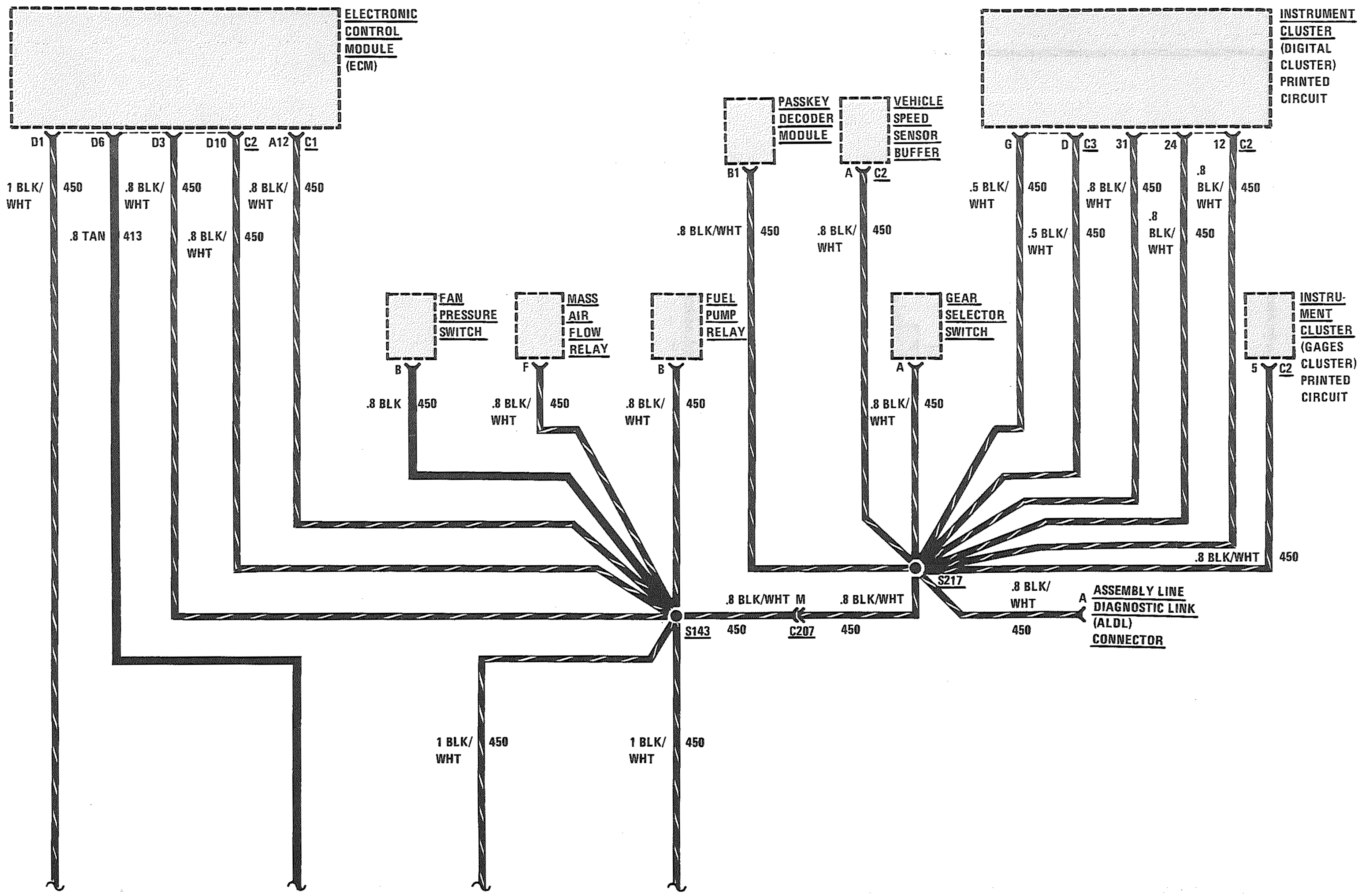
P

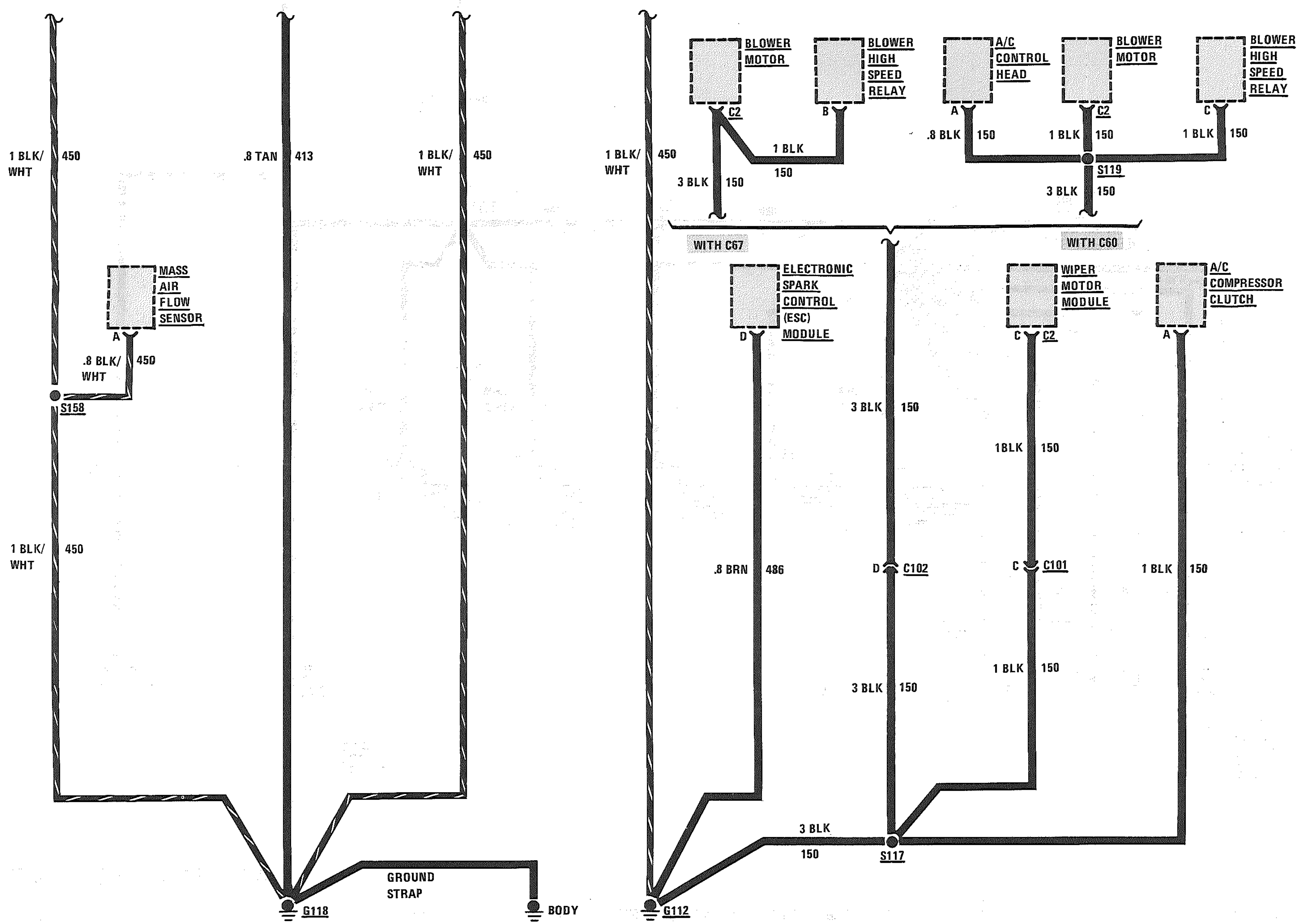
GROUND DISTRIBUTION: G112

ENGINE GROUND, V6 VIN S



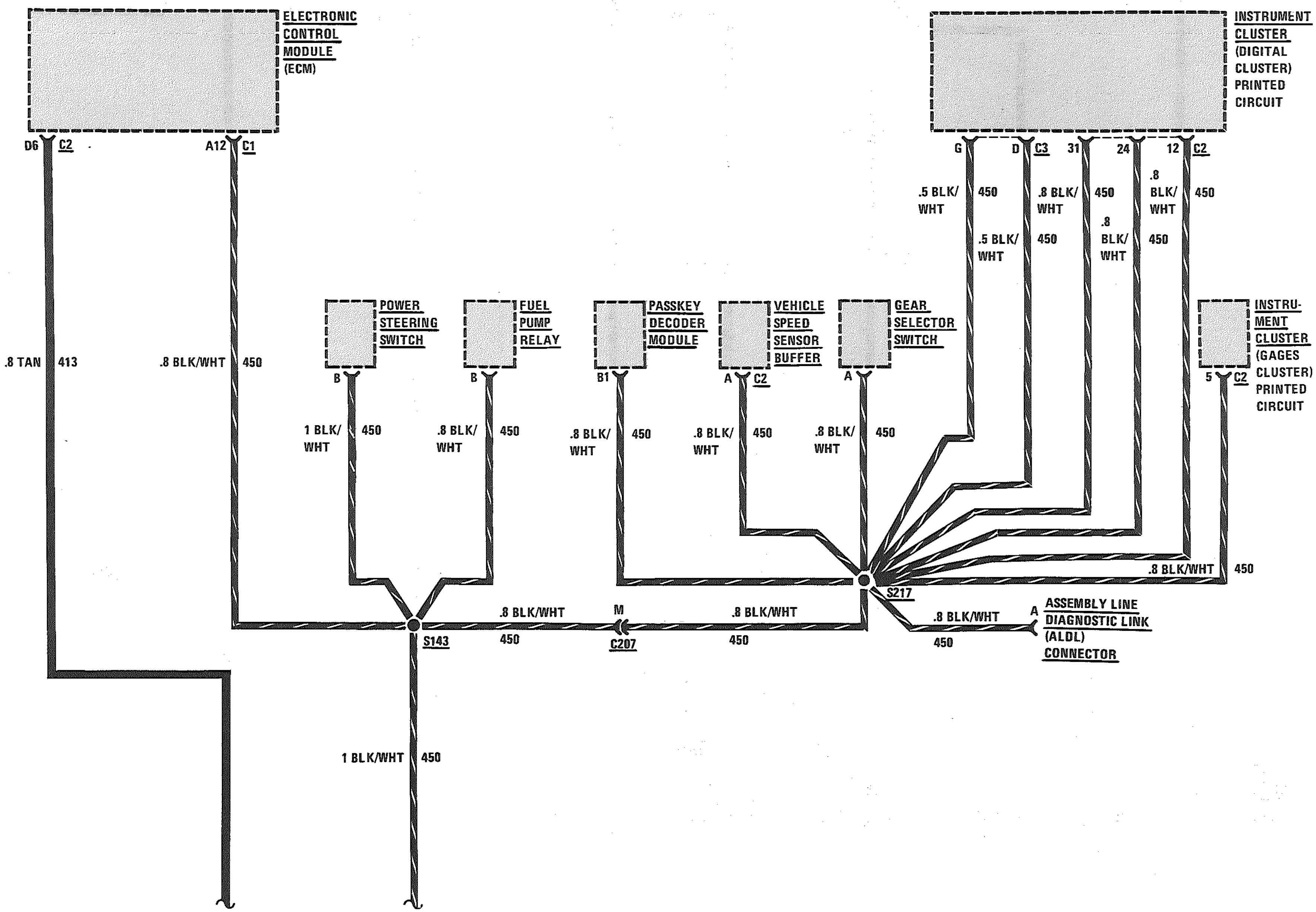
GROUND DISTRIBUTION: G112 AND G118
ENGINE GROUNDS, V8 VIN F AND V8 VIN 8

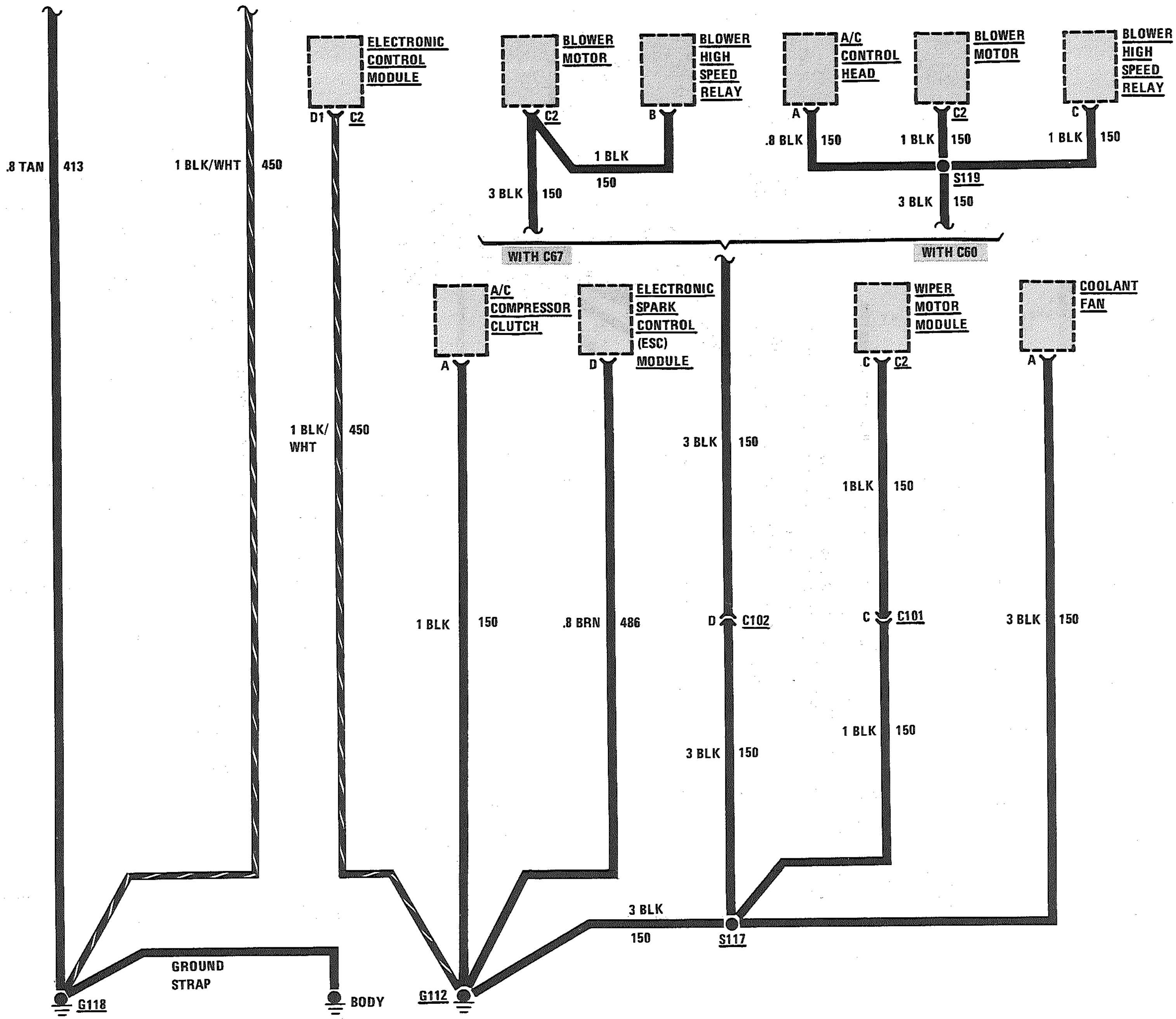



1 BLK/ WHT 450
.8 TAN 413
1 BLK/ WHT 450
1 BLK/ WHT 450
MASS AIR FLOW SENSOR
A
.8 BLK/ WHT 450
S158
1 BLK/ WHT 450
GROUND STRAP
G118
BODY
BLOWER MOTOR
C2
BLOWER HIGH SPEED RELAY
B
1 BLK 150
3 BLK 150
A/C CONTROL HEAD
A
.8 BLK 150
BLOWER MOTOR
C2
1 BLK 150
BLOWER HIGH SPEED RELAY
C
1 BLK 150
S119
3 BLK 150
WITH C67
WITH C60
ELECTRONIC SPARK CONTROL (ESC) MODULE
D
.8 BRN 486
3 BLK 150
D C102
3 BLK 150
WIPER MOTOR MODULE
C C2
1BLK 150
C C101
1 BLK 150
A/C COMPRESSOR CLUTCH
A
1 BLK 150
3 BLK 150
S117
G112

GROUND DISTRIBUTION: G112 AND G118

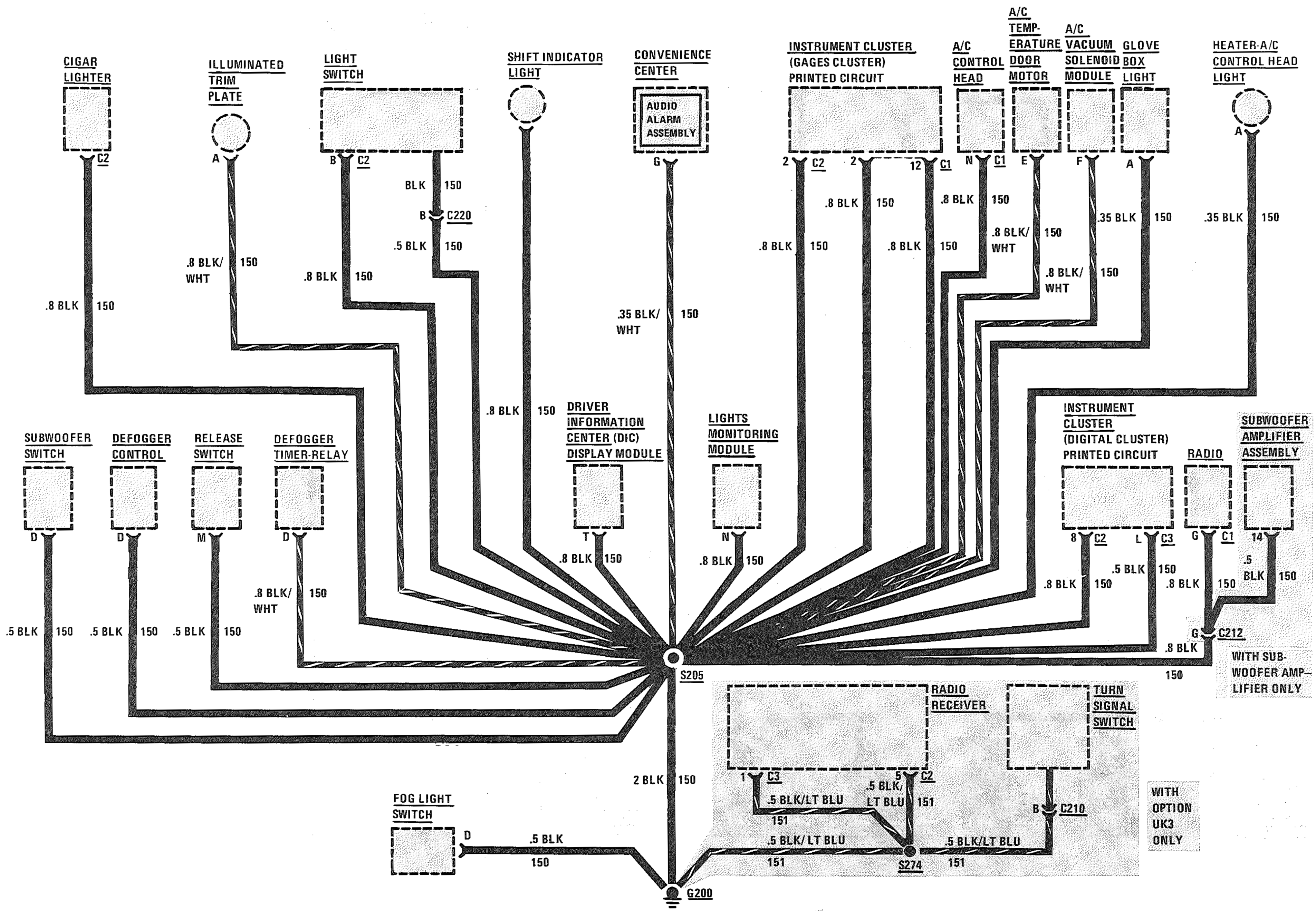
ENGINE GROUNDS, V8 VIN E



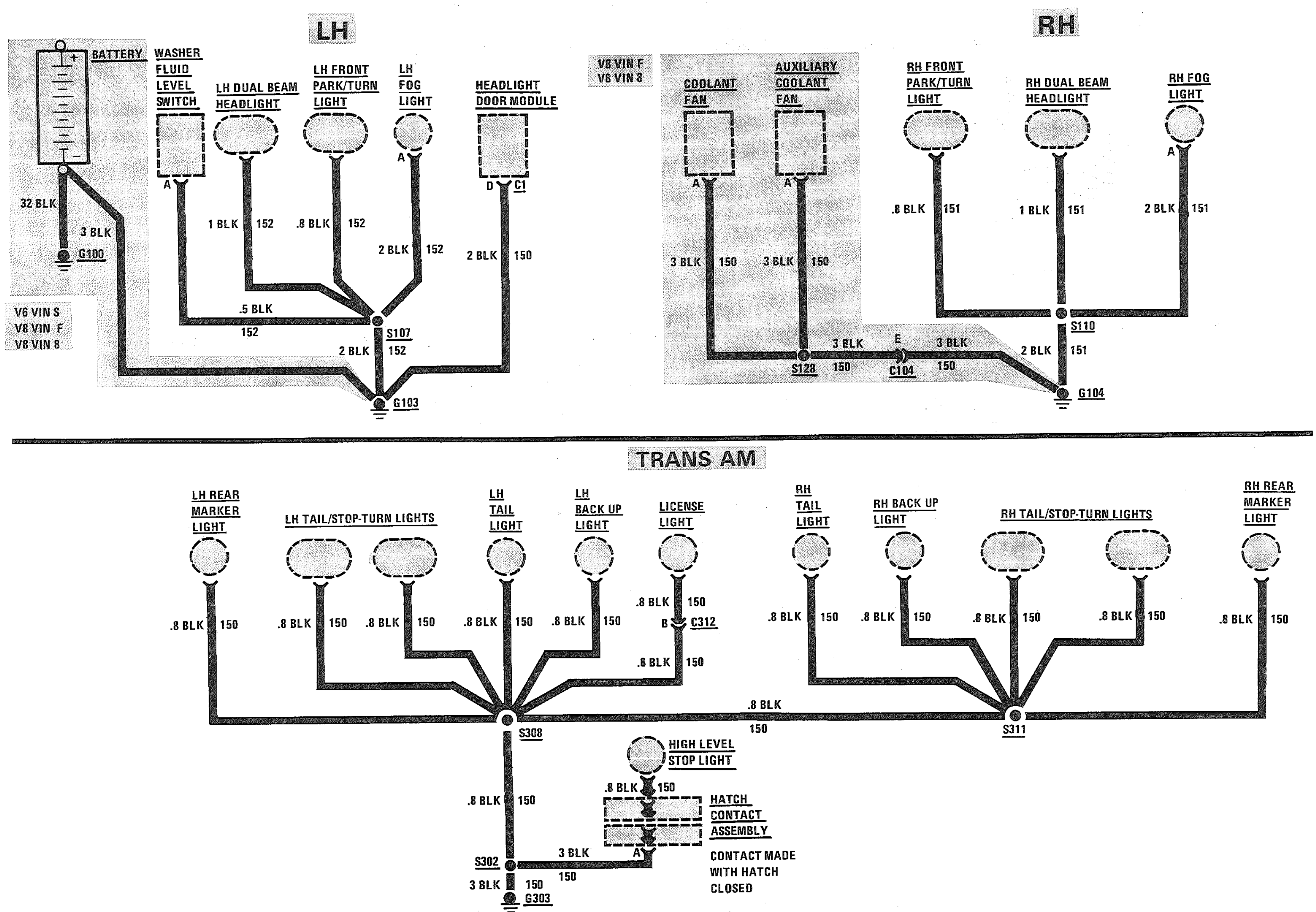

ELECTRONIC CONTROL MODULE
BLOWER MOTOR
BLOWER HIGH SPEED RELAY
A/C CONTROL HEAD
BLOWER MOTOR
BLOWER HIGH SPEED RELAY
D1 C2
C2
B
A
C2
C
.8 TAN 413
1 BLK/WHT 450
1 BLK 150
3 BLK 150
.8 BLK 150
1 BLK 150
1 BLK 150
S119
3 BLK 150
WITH C67
WITH C60
A/C COMPRESSOR CLUTCH
ELECTRONIC SPARK CONTROL (ESC) MODULE
WIPER MOTOR MODULE
COOLANT FAN
A
D
C C2
A
1 BLK/ WHT 450
3 BLK 150
1BLK 150
1 BLK 150
.8 BRN 486
D C102
C C101
3 BLK 150
1 BLK 150
3 BLK 150
3 BLK 150
S117
GROUND STRAP
G118
BODY
G112

GROUND DISTRIBUTION: G200

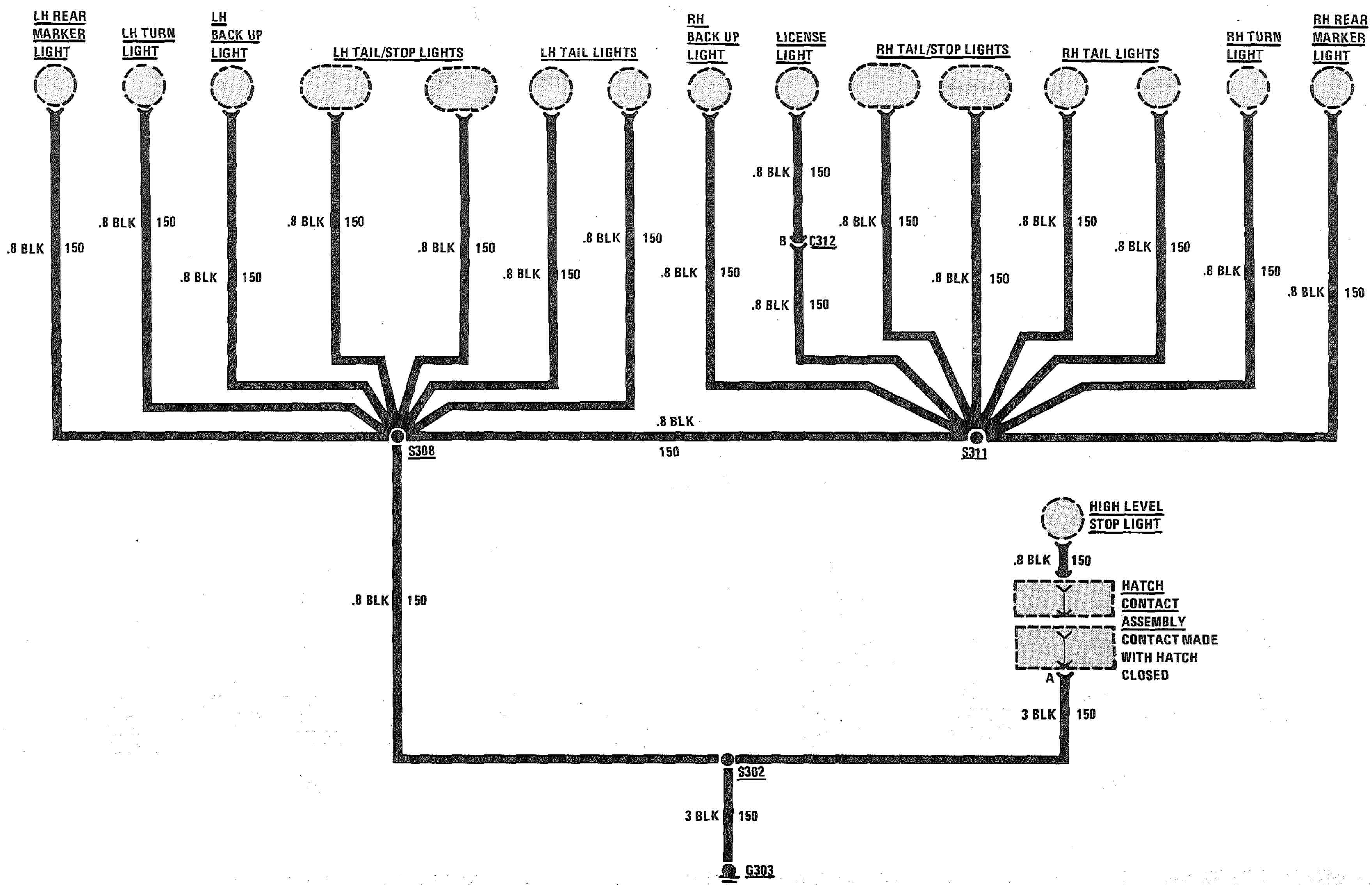
INSTRUMENT CLUSTER



GROUND DISTRIBUTION: G103, G104, G303



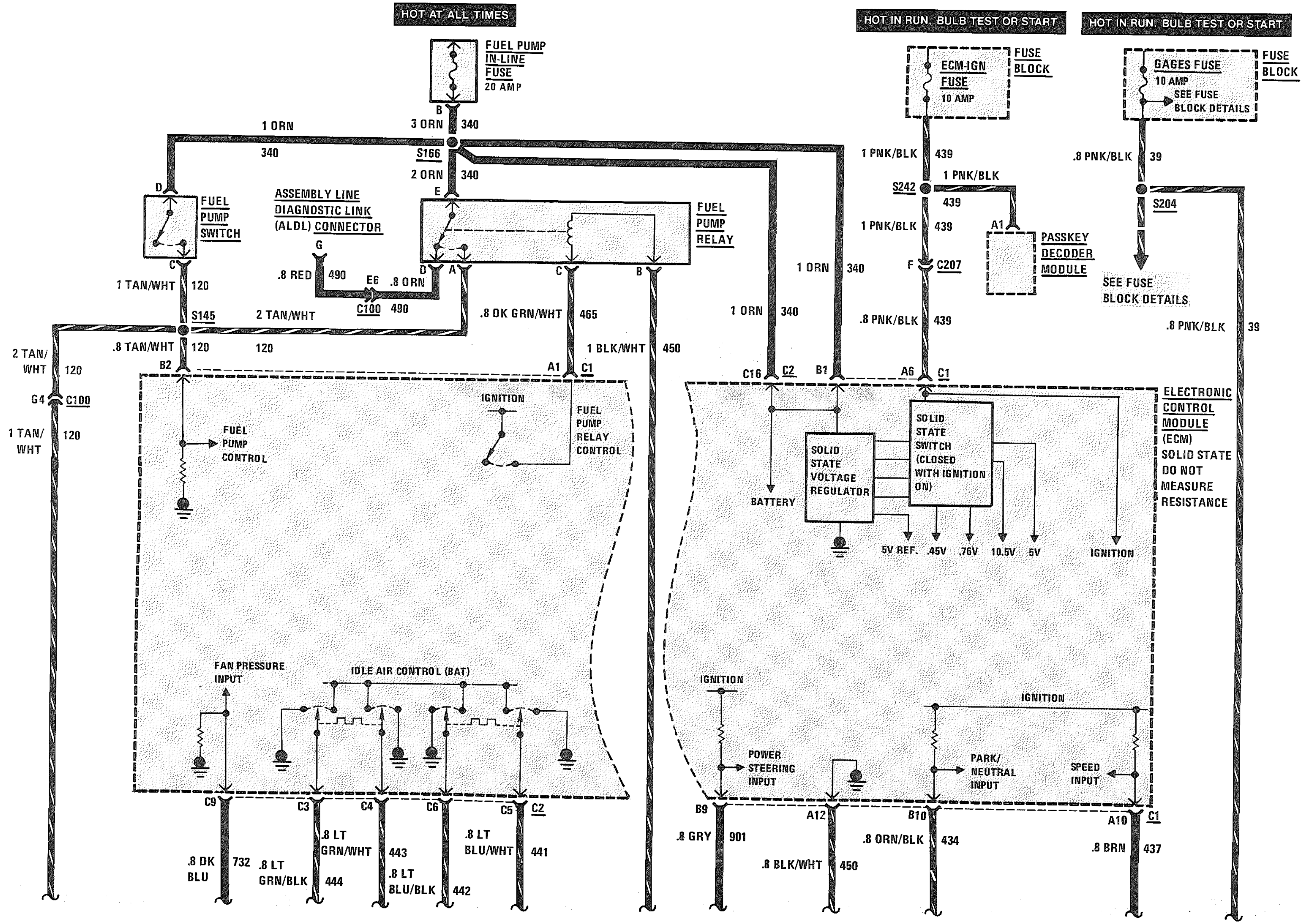
FIREBIRD

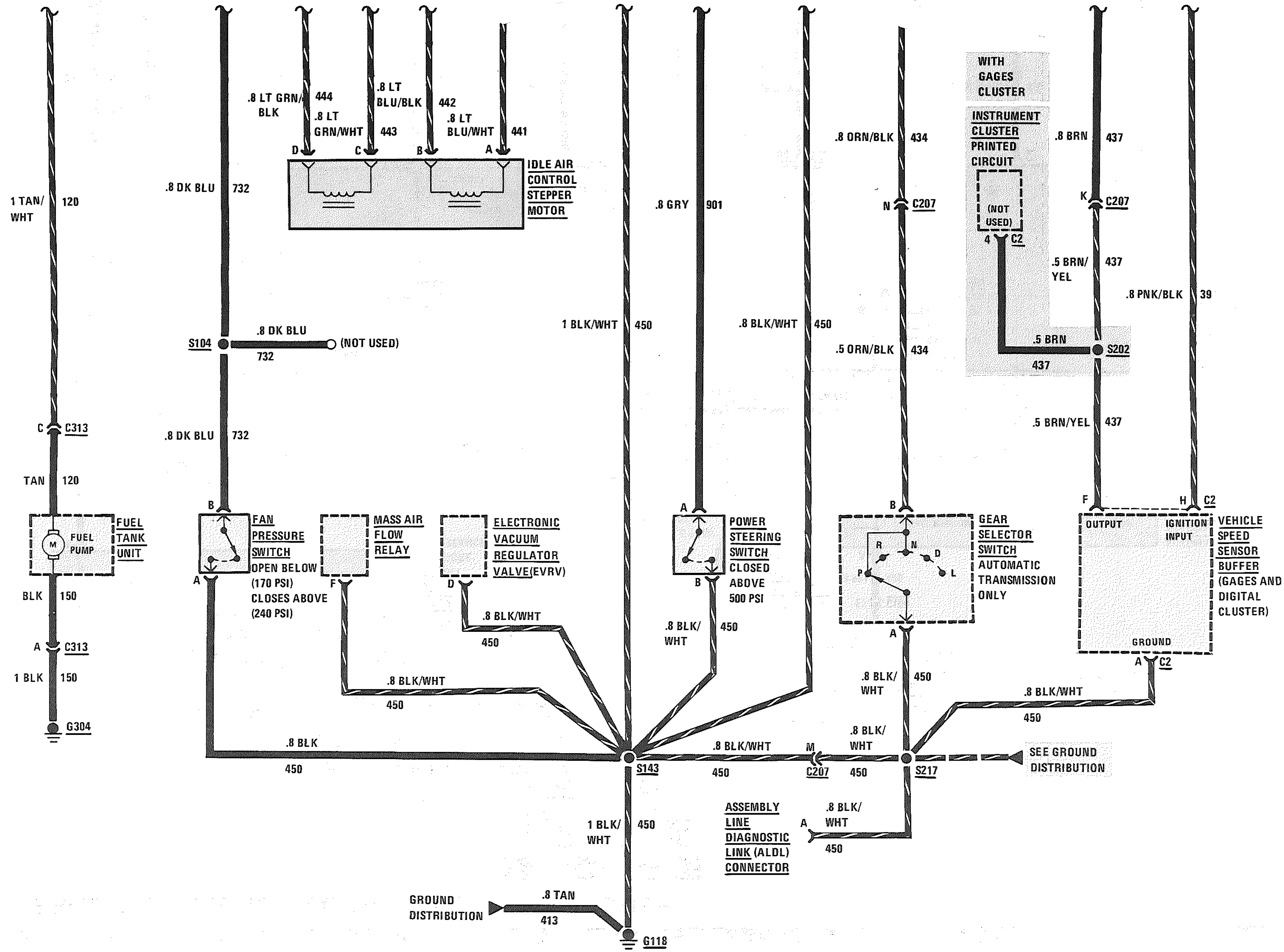

LH REAR MARKER LIGHT
LH TURN LIGHT
LH BACK UP LIGHT
LH TAIL/STOP LIGHTS
LH TAIL LIGHTS
RH BACK UP LIGHT
LICENSE LIGHT
RH TAIL/STOP LIGHTS
RH TAIL LIGHTS
RH TURN LIGHT
RH REAR MARKER LIGHT
.8 BLK 150
B C312
S308
S311
HIGH LEVEL STOP LIGHT
HATCH CONTACT ASSEMBLY
CONTACT MADE WITH HATCH CLOSED
A
3 BLK 150
S302
G303

BLANK

MULTI-PORT FUEL INJECTION: V6 VIN S

IDLE SPEED CONTROL, FUEL CONTROL, AND VEHICLE DATA SENSORS

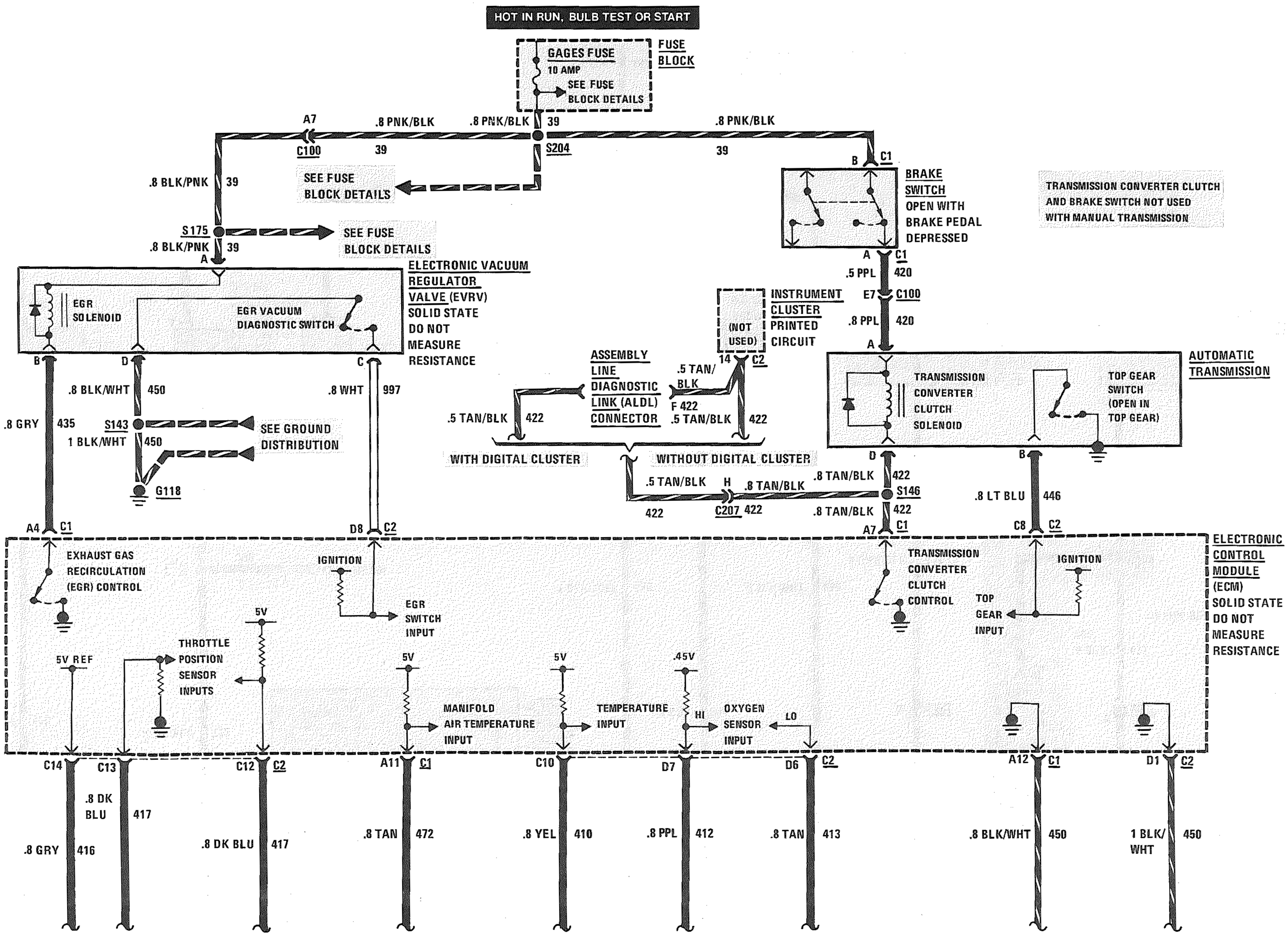


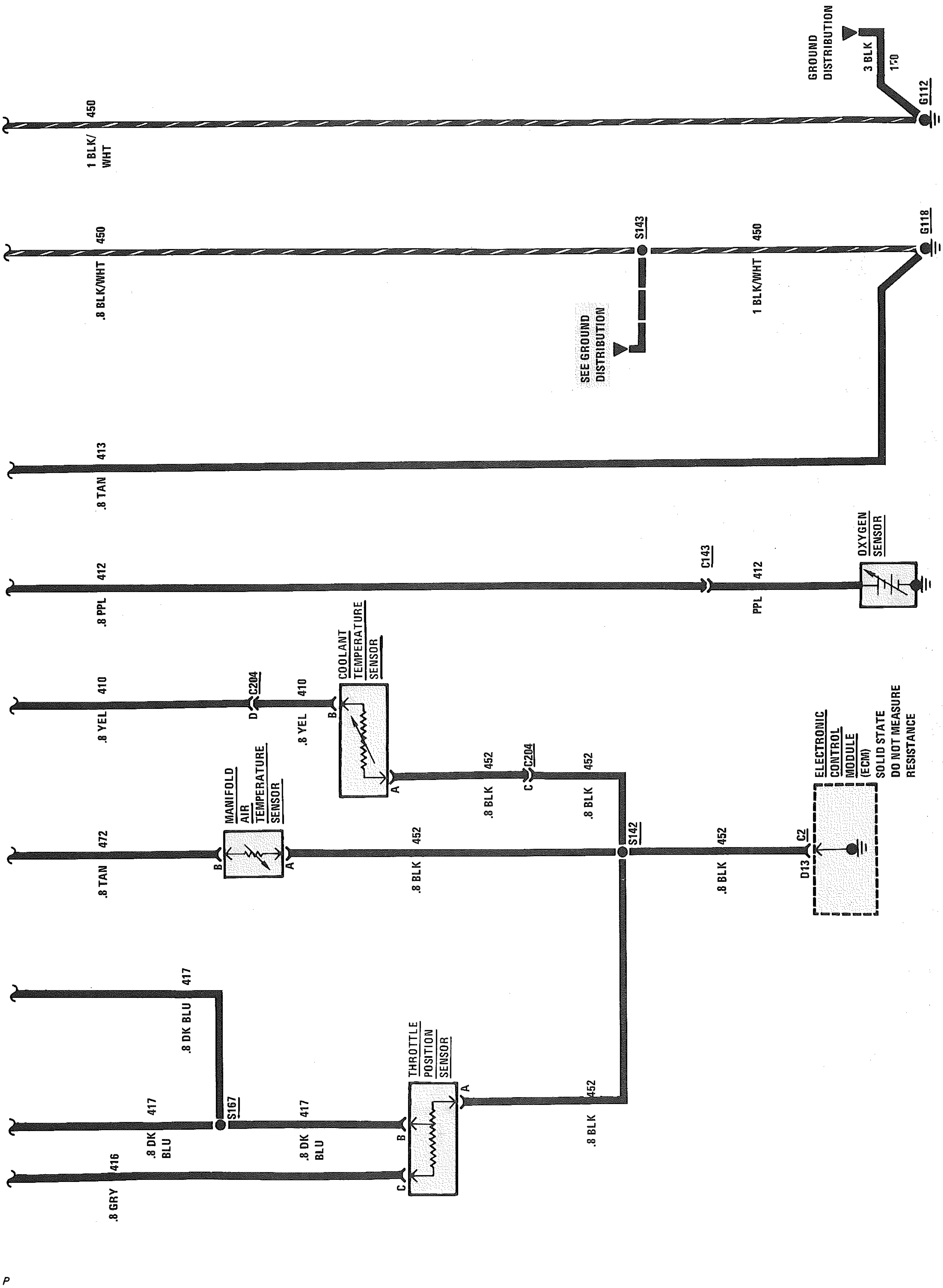


1 TAN/ WHT 120
C C313
TAN 120
FUEL PUMP
FUEL TANK UNIT
BLK 150
A C313
1 BLK 150
G304
.8 DK BLU 732
S104
.8 DK BLU
732
(NOT USED)
.8 DK BLU 732
B
FAN PRESSURE SWITCH
OPEN BELOW (170 PSI)
CLOSES ABOVE (240 PSI)
A
.8 LT GRN/ BLK 444
.8 LT GRN/WHT 443
.8 LT BLU/BLK 442
.8 LT BLU/WHT 441
D C B A
IDLE AIR CONTROL STEPPER MOTOR
MASS AIR FLOW RELAY
F
ELECTRONIC VACUUM REGULATOR VALVE(EVRV)
D
.8 BLK/WHT
450
.8 BLK/WHT
450
.8 BLK
450
.8 GRY 901
1 BLK/WHT 450
A
POWER STEERING SWITCH
CLOSED ABOVE 500 PSI
B
.8 BLK/ WHT 450
.8 BLK/WHT 450
S143
.8 BLK/WHT
450
M
C207
1 BLK/ WHT 450
GROUND DISTRIBUTION
.8 TAN
413
G118
.8 ORN/BLK 434
N C207
.5 ORN/BLK 434
B
GEAR SELECTOR SWITCH
AUTOMATIC TRANSMISSION ONLY
R N D P L
A
.8 BLK/ WHT 450
.8 BLK/ WHT
450
S217
SEE GROUND DISTRIBUTION
ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR
A
.8 BLK/ WHT
450
WITH GAGES CLUSTER
INSTRUMENT CLUSTER PRINTED CIRCUIT
(NOT USED)
4 C2
.8 BRN 437
K C207
.5 BRN/ YEL 437
.5 BRN
437
S202
.5 BRN/YEL 437
.8 PNK/BLK 39
F
H C2
OUTPUT
IGNITION INPUT
GROUND
VEHICLE SPEED SENSOR BUFFER (GAGES AND DIGITAL CLUSTER)
A C2
.8 BLK/WHT
450

MULTI-PORT FUEL INJECTION: V6 VIN S

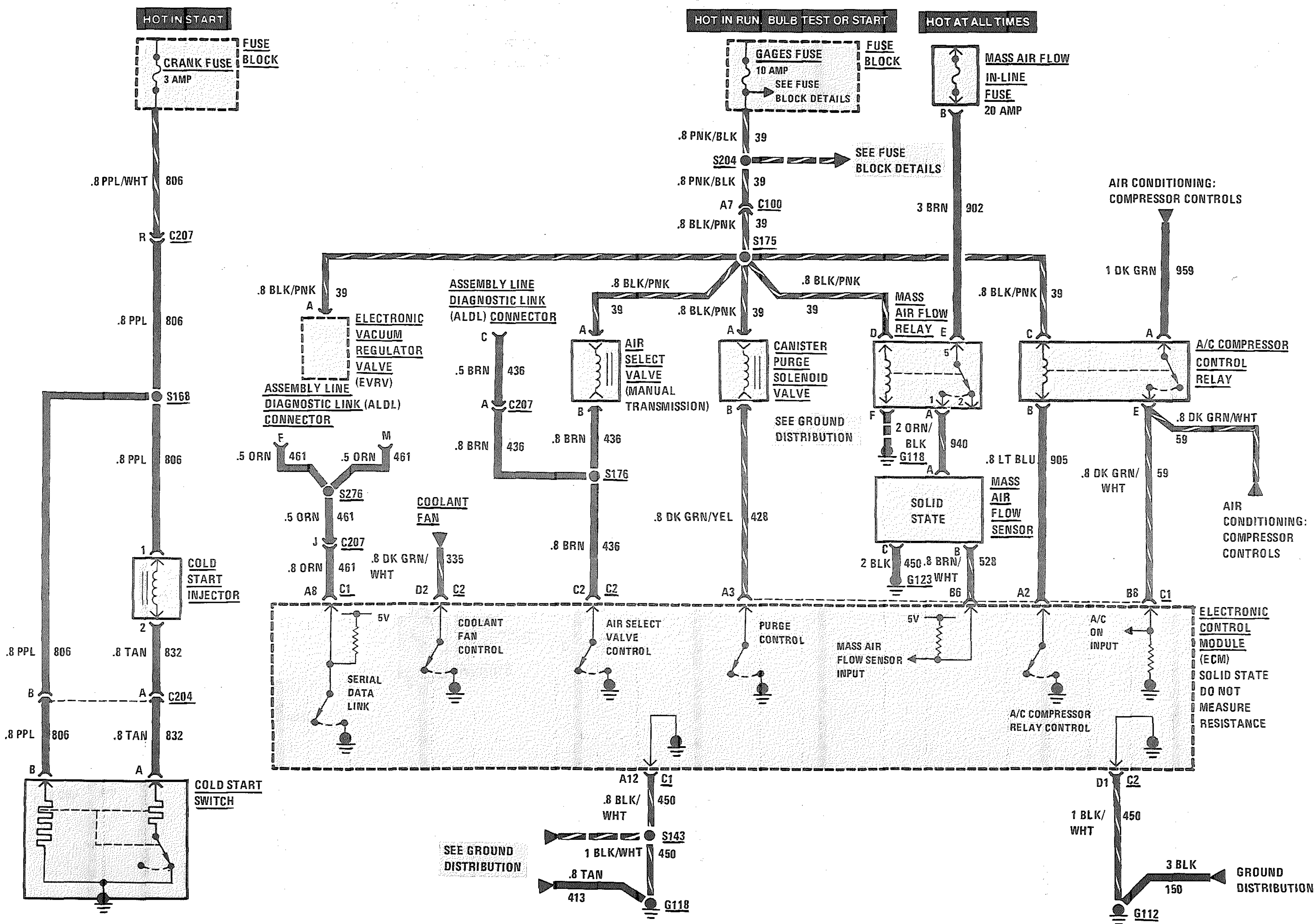
ENGINE DATA SENSORS, TRANSMISSION CONVERTER CLUTCH




GROUND DISTRIBUTION
3 BLK
150
G112
450
1 BLK/ WHT
450
.8 BLK/WHT
S143
450
1 BLK/WHT
G118
SEE GROUND DISTRIBUTION
413
.8 TAN
412
.8 PPL
C143
412
PPL
OXYGEN SENSOR
410
.8 YEL
C204
D
410
.8 YEL
COOLANT TEMPERATURE SENSOR
B
A
452
.8 BLK
C204
C
452
.8 BLK
ELECTRONIC CONTROL MODULE (ECM) SOLID STATE DO NOT MEASURE RESISTANCE
472
.8 TAN
MANIFOLD AIR TEMPERATURE SENSOR
B
A
452
.8 BLK
S142
452
.8 BLK
C2
D13
417
.8 DK BLU
S167
417
.8 DK BLU
417
.8 DK BLU
THROTTLE POSITION SENSOR
A
B
C
452
.8 BLK
416
.8 GRY

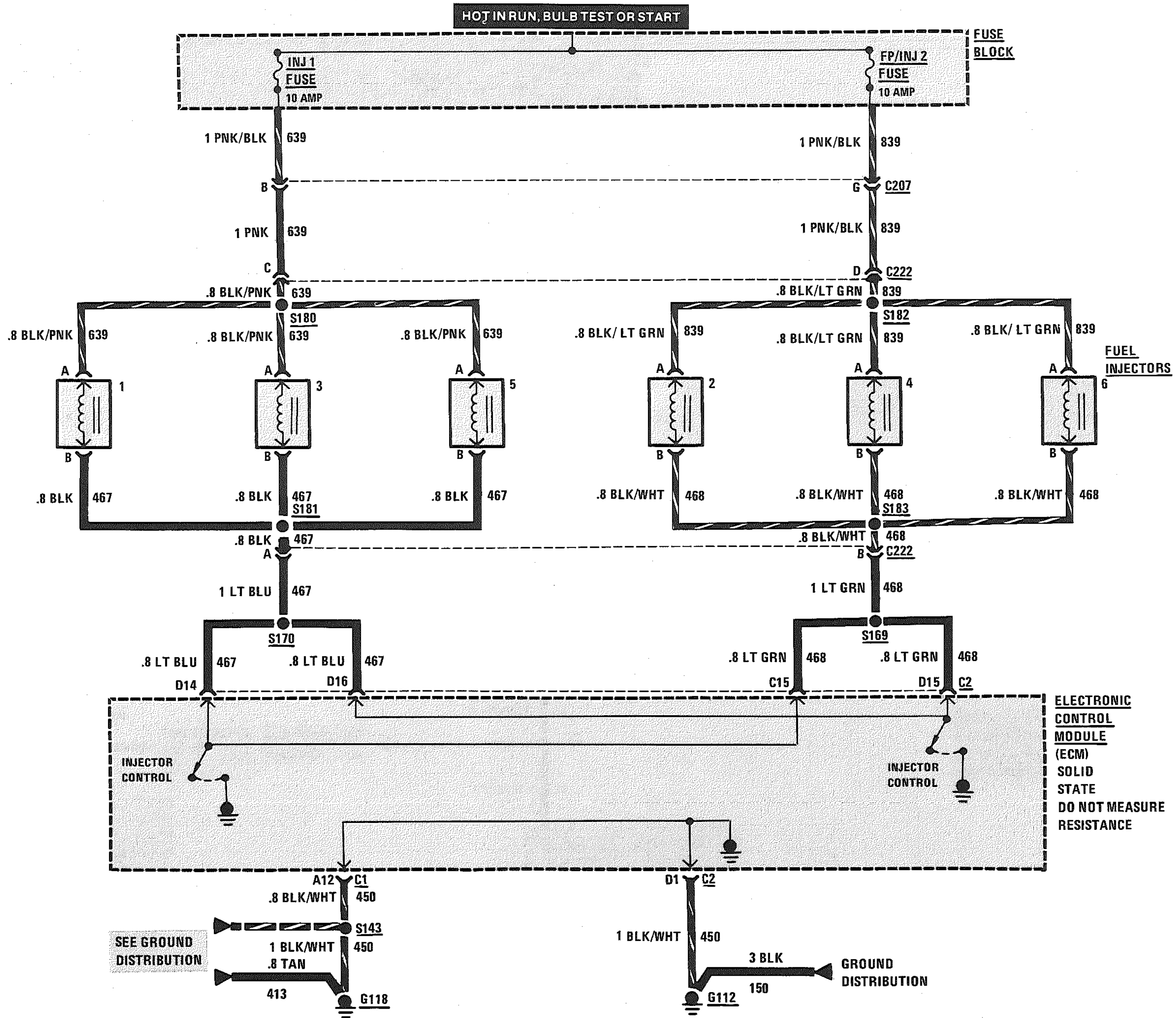
MULTI-PORT FUEL INJECTION: V6 VIN S

COLD START, EMISSION CONTROL, AND MASS AIR FLOW SENSOR



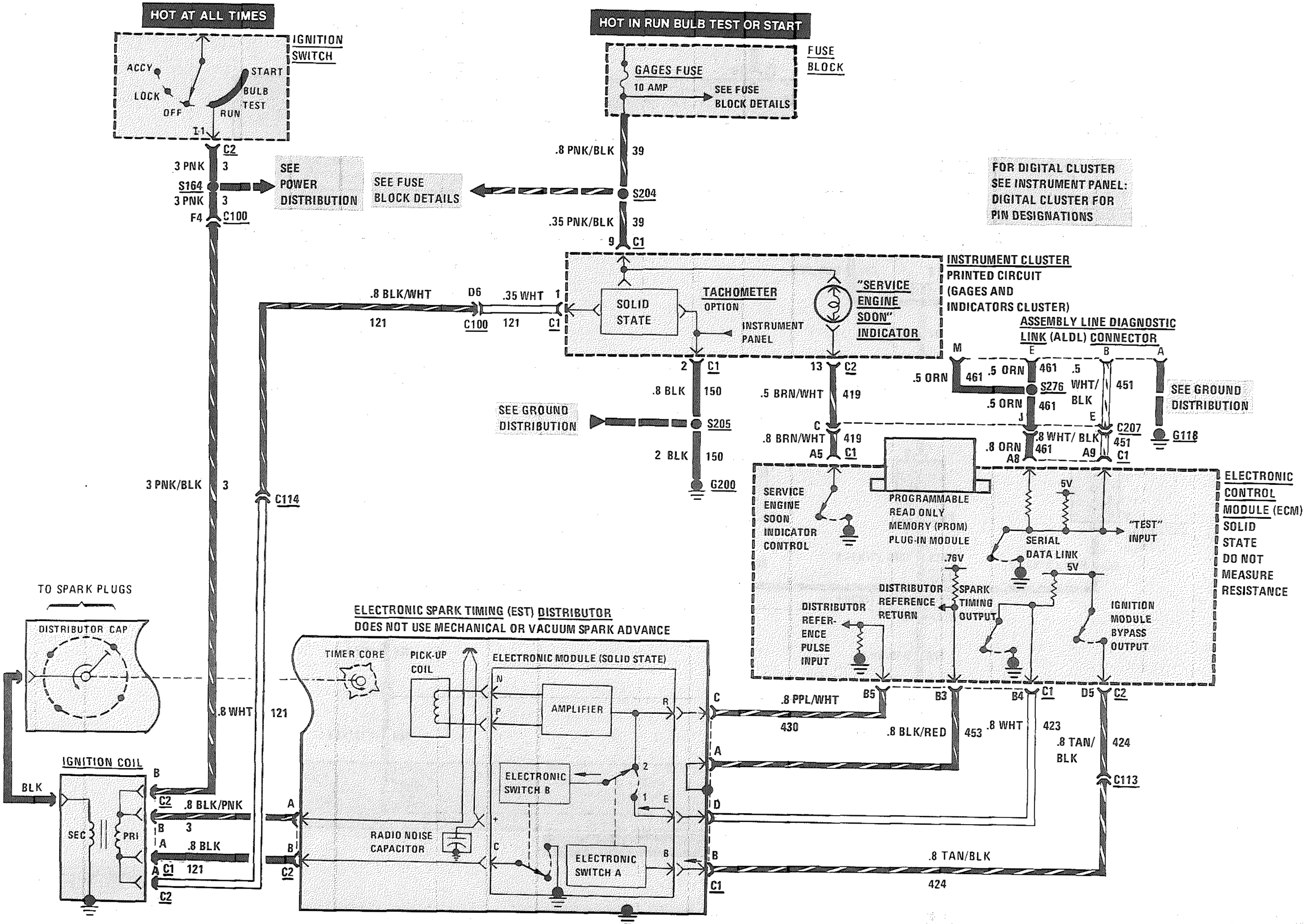
MULTI-PORT FUEL INJECTION: V6 VIN S

FUEL INJECTORS



MULTI-PORT FUEL INJECTION: V6 VIN S

IGNITION, SERVICE ENGINE SOON INDICATOR, AND TACHOMETER



COMPONENT LOCATION

Component	Location	Page-Figure
A/C Compressor Control Relay	LH rear corner of engine compartment, on relay bracket	201- 0-A
AIR Select Valve (VIN S)	Lower RH side of engine, behind AIR pump	
Assembly Line Diagnostic Link (ALDL) Connector	On bottom of I/P hush panel, to right of steering column	
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Canister Purge Solenoid Valve (VIN S)	Lower RH front corner of engine compartment	201- 1-A
Cold Start Injector (VIN S)	Top LH rear of engine	201- 0-C
Cold Start Switch (VIN S)	Top of engine	
Coolant Temperature Sensor (VIN S)	Top LH front of intake manifold	201- 0-A
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Electronic Spark Timing (EST) Distributor (VIN S)	Top rear of engine	201- 1-C
Electronic Vacuum Regulator Valve (EVRV)	Top RH rear of engine	201- 1-A
Fan Pressure Switch (VIN S)	Lower RH front of engine compartment, on A/C line	201- 1-A
Fuel Injectors	Top of engine, at each intake cylinder	
Fuel Pump In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Fuel Pump Relay (VIN S)	LH rear corner of engine compartment, on relay bracket	201- 0-A
Fuel Pump Switch (VIN S)	Lower LH side of engine	201- 0-A
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Idle Air Control Stepper Motor (VIN S)	Top center of engine	201- 1-A
Ignition Coil (VIN S)	Rear RH side of engine	201- 1-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Manifold Air Temperature (MAT) Sensor (VIN S)	RH front of engine compartment, on air cleaner assembly	201- 1-A

COMPONENT LOCATION

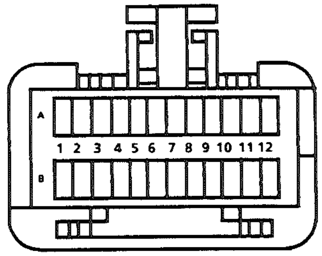
Component	Location	Page-Figure
Mass Air Flow (MAF) Relay (VIN S)	Front of engine compartment, on RH side of radiator bracket	201- 1-A
Mass Air Flow (MAF) Sensor (VIN S)	Front of engine compartment, on rear of air cleaner	201- 1-A
Mass Air Flow In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Oxygen Sensor (VIN S)	Lower RH rear of engine, on exhaust manifold	201- 1-A
Power Steering Switch	Lower LH front corner of engine compartment, on steering unit	201- 0-A
Throttle Position Sensor (VIN S)	Top center of engine	201- 1-A
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C113 (1 cavity) (VIN S)	Taped to engine harness, RH front of dash	201- 1-A
C114 (1 cavity) (VIN S)	Taped to engine harness, above rear of engine	201- 1-A
C143 (1 cavity) (VIN S)	Lower rear RH side of engine	201- 1-A
C204 (4 cavities)	Above LH rear corner of engine	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C222 (4 cavities)	Top front of engine	201- 0-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
G123	RH front corner of engine compartment, on inner fender panel	201- 1-A
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S104 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S142 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S145 (VIN S)	Engine harness, above rear of engine	201- 1-A
S146 (VIN S)	Engine harness, behind RH side of I/P	
S164	I/P harness, above Fuse Block	201-10-A
S166 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S167	Engine harness, behind RH side of I/P	
S168 (VIN S)	Engine harness, top rear of engine	201- 1-C
S169	Engine harness, behind RH side of I/P	
S170	Engine harness, behind RH side of I/P	

COMPONENT LOCATION

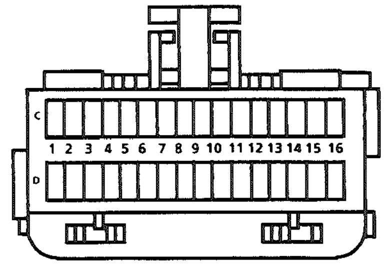
Component	Location	Page-Figure
S175 (VIN S)	Engine harness, lower LH front of dash	201- 0-A
S176 (VIN S)	Engine harness, behind RH side of I/P	
S180 (VIN S)	Injector harness, top of engine	
S181	Injector harness, top of engine	
S182	Injector harness, top of engine	
S183	Injector harness, top of engine	
S202	I/P harness, behind RH side of I/P	201-13-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S242	I/P harness, behind RH side of I/P	201-13-A
S276	I/P harness, behind RH side of I/P	201-13-A
S346	Speaker harness, behind RH side of rear seat	201- 9-B

MULTI-PORT FUEL INJECTION: V6 VIN S

ELECTRONIC CONTROL MODULE CONNECTORS



C1 BLK



C2 BLK

ELECTRONIC CONTROL MODULE (ECM)

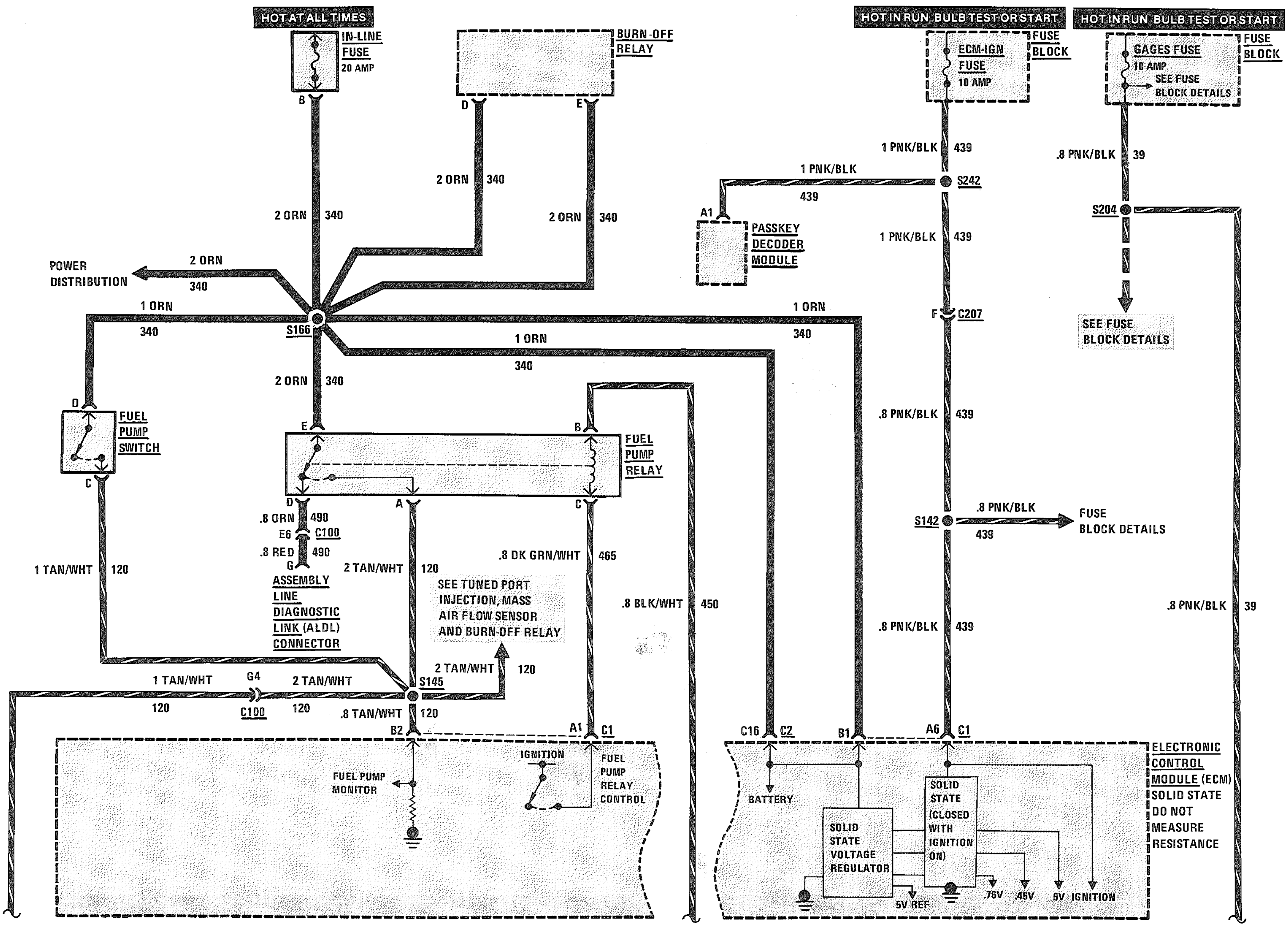
Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
A1	DK GRN/WHT	465	Fuel Pump Relay Control
A2	LT BLU	905	A/C Compressor Relay Control
A3	DK GRN/YEL	428	Canister Purge Solenoid Valve Control
A4	GRY	435	Exhaust Gas Recirculation Solenoid Control
A5	BRN/WHT	419	"Service Engine Soon" Indicator Control
A6	PNK/BLK	439	Ignition
A7	TAN/BLK	422(Auto) 456(Man)	TCC Control (Auto) Shift Indicator Control (Man)
A8	ORN	461	Serial Data Link
A9	WHT/BLK	451	Diagnostic "Test" Input
A10	BRN	437	Speed Input
A11	TAN	472	Manifold Air Temperature Sensor Input
A12	BLK/WHT	450	Ground
B1	ORN	340	Battery
B2	TAN/WHT	120	Fuel Pump Control
B3	BLK/RED	453	Distributor Reference Pulse: LO
B4	WHT	423	Spark Timing Output
B5	PPL/WHT	430	Distributor Reference Pulse Input: HI
B6	BRN/WHT	528	Mass Air Flow Sensor Input
B7	–	–	Not Used
B8	DK GRN/WHT	59	A/C On Input
B9	GRY	901	Power Steering Input
B10	ORN/BLK	434	Park/Neutral Input
B11	–	–	Not Used
B12	–	–	Not Used
C1	–	–	Not Used
C2	BRN	436	Air Select Valve Control

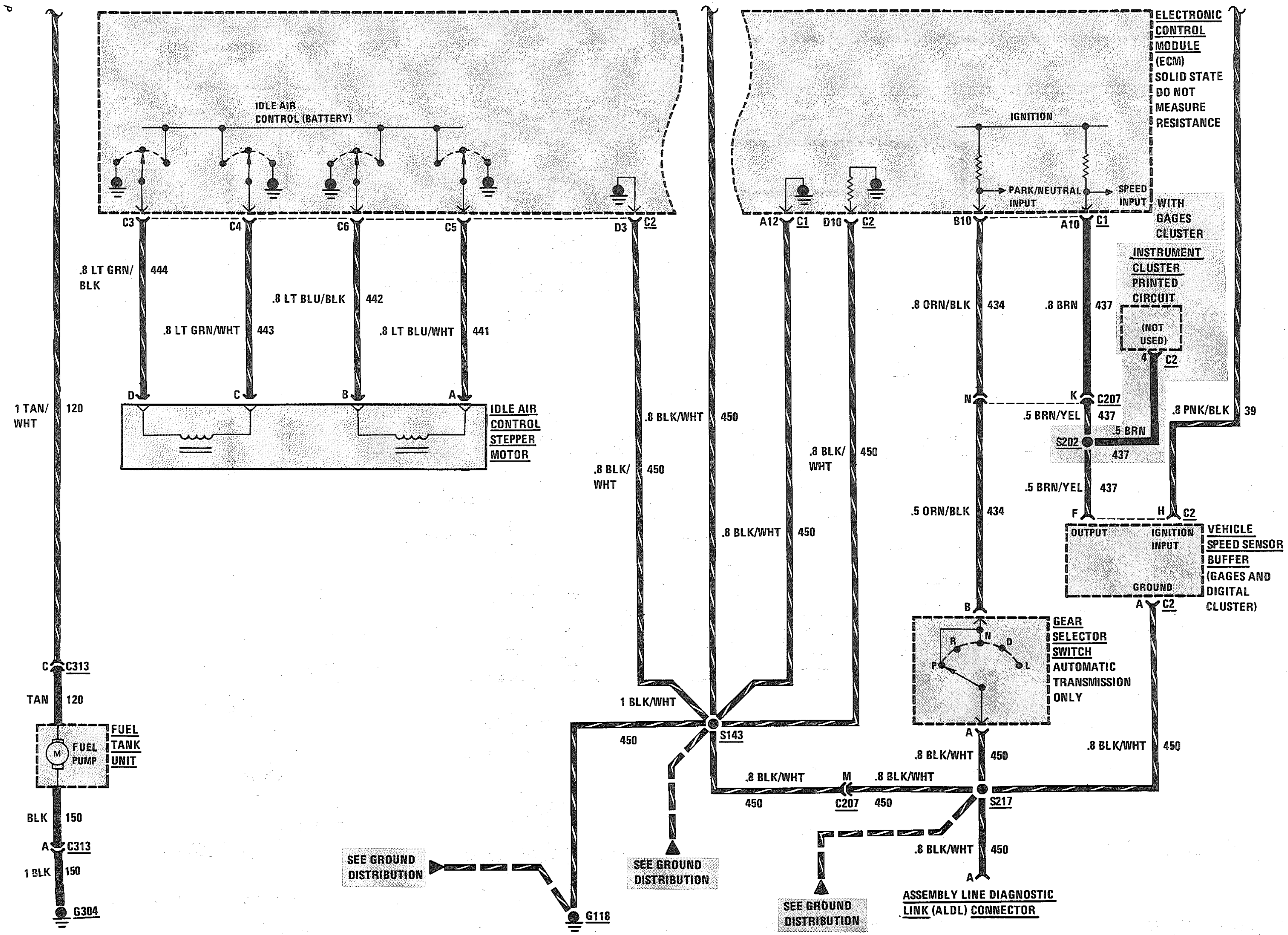
Cavity	Wire Color Socket Half	Circuit Number	Circuit Function
C5	LT BLU/WHT	441	Idle Air Control A HI
C6	LT BLU/BLK	442	Idle Air Control A LO
C7	–	–	Not Used
C8	LT BLU	446	Top Gear Input
C9	DK BLU	732	Fan Pressure Switch Input
C10	YEL	410	Coolant Temperature Sensor Input
C11	–	–	Not Used
C12	DK BLU	417	Throttle Position Sensor Input
C13	DK BLU	417	Throttle Position Sensor Input
C14	GRY	416	5 Volt Reference
C15	LT GRN	468	Connected to D14
C16	ORN	340	Battery
D1	BLK/WHT	450	Ground
D2	DK GRN/WHT	335	Fan Control Output
D3	–	–	Not Used
D4	–	–	Not Used
D5	TAN/BLK	424	Ignition Module Bypass Output
D6	TAN	413	Oxygen Sensor Input: LO
D7	PPL	412	Oxygen Sensor Input: HI
D8	WHT	397	Evrv Control
D9	–	–	Not Used
D10	–	–	Not Used
D11	–	–	Not Used
D12	–	–	Not Used
D13	BLK	452	Ground
D14	LT BLU	467	Fuel Injector Control
D15	LT GRN	468	Fuel Injector Control
D16	LT BLU	467	Connected to D15

BLANK

TUNED PORT INJECTION: V8 VIN F

IDLE SPEED CONTROL, FUEL CONTROL, AND VEHICLE DATA SENSORS

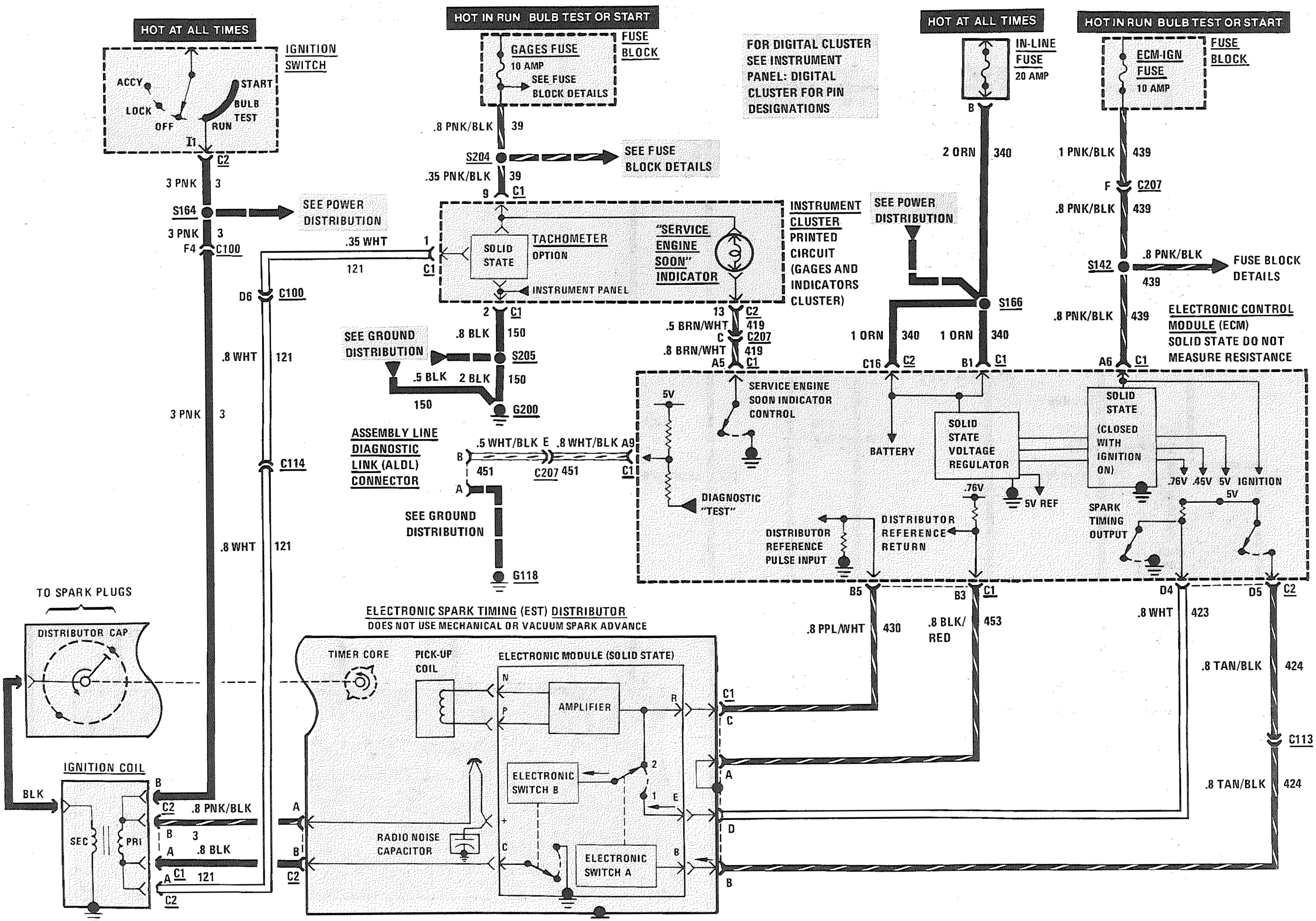




ELECTRONIC CONTROL MODULE (ECM) SOLID STATE DO NOT MEASURE RESISTANCE
IDLE AIR CONTROL (BATTERY)
IGNITION
PARK/NEUTRAL INPUT
SPEED INPUT
WITH GAGES CLUSTER
C3
C4
C6
C5
D3 C2
A12 C1
D10 C2
B10
A10 C1
.8 LT GRN/BLK 444
.8 LT GRN/WHT 443
.8 LT BLU/BLK 442
.8 LT BLU/WHT 441
D
C
B
A
IDLE AIR CONTROL STEPPER MOTOR
1 TAN/WHT 120
C C313
TAN 120
FUEL TANK UNIT
M
FUEL PUMP
BLK 150
A C313
1 BLK 150
G304
.8 BLK/WHT 450
.8 BLK/WHT 450
.8 BLK/WHT 450
.8 BLK/WHT 450
1 BLK/WHT
450
S143
SEE GROUND DISTRIBUTION
G118
SEE GROUND DISTRIBUTION
.8 ORN/BLK 434
.8 BRN 437
INSTRUMENT CLUSTER PRINTED CIRCUIT
(NOT USED)
4 C2
N
K C207
.5 BRN/YEL 437
.5 BRN
S202
437
.8 PNK/BLK 39
.5 BRN/YEL 437
.5 ORN/BLK 434
F
H C2
OUTPUT
IGNITION INPUT
GROUND
VEHICLE SPEED SENSOR BUFFER (GAGES AND DIGITAL CLUSTER)
A C2
B
GEAR SELECTOR SWITCH AUTOMATIC TRANSMISSION ONLY
R
N
D
P
L
A
.8 BLK/WHT 450
.8 BLK/WHT 450
.8 BLK/WHT
M
.8 BLK/WHT
450
C207
450
S217
SEE GROUND DISTRIBUTION
.8 BLK/WHT 450
A
ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR

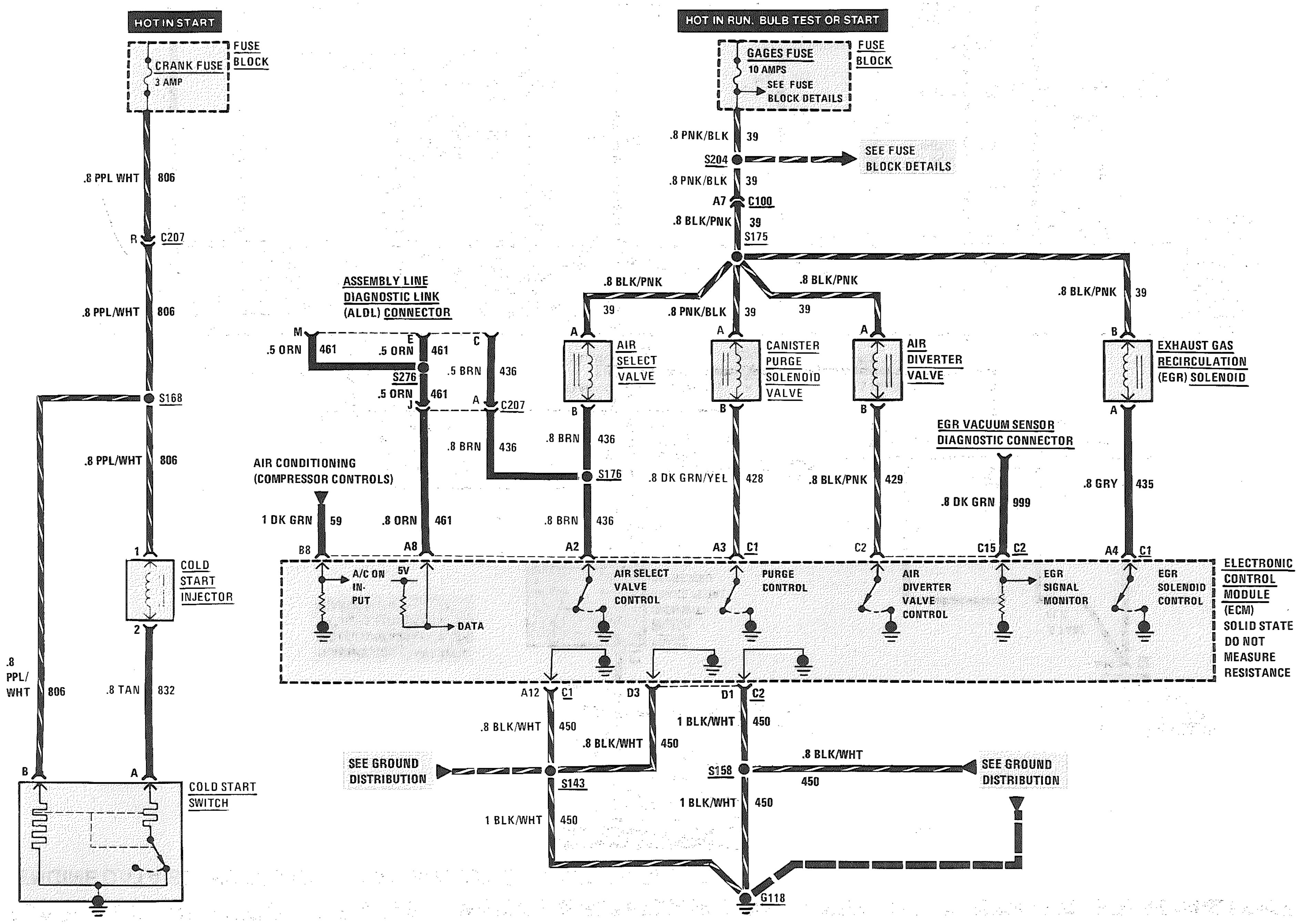
TUNED PORT INJECTION: V8 VIN F

IGNITION, SERVICE ENGINE SOON INDICATOR AND TACHOMETER



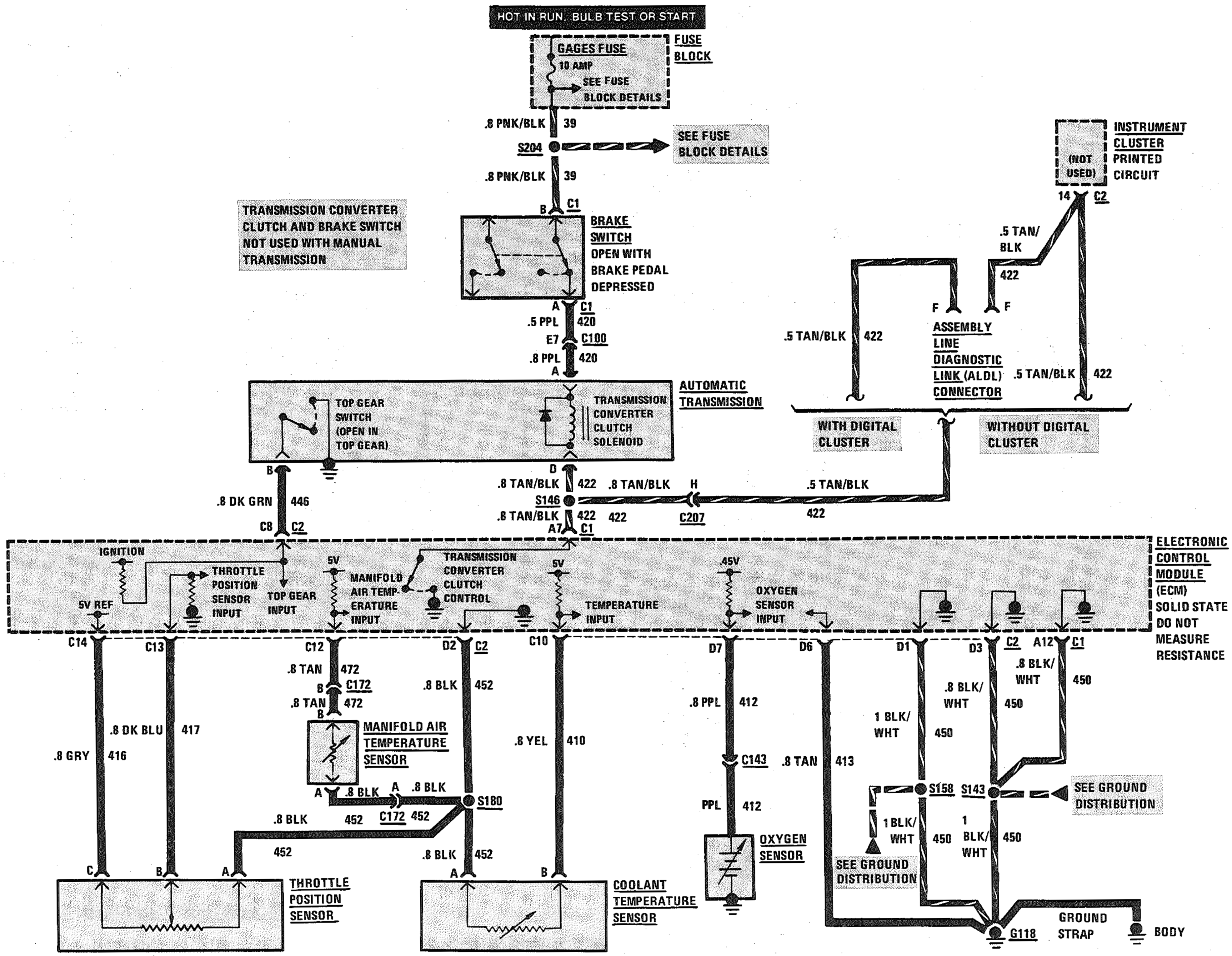
TUNED PORT INJECTION: V8 VIN F

COLD START AND EMISSION CONTROL

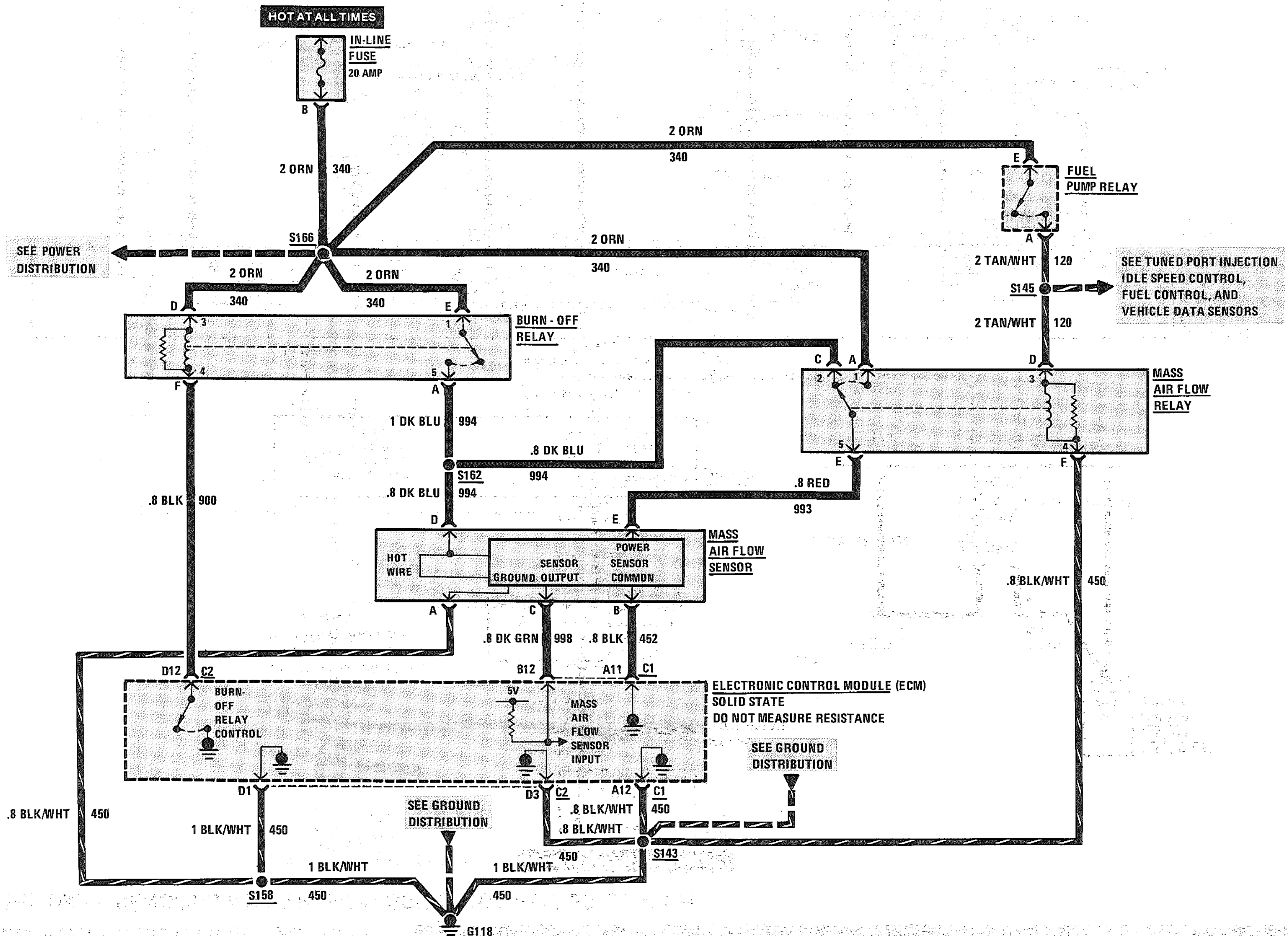


TUNED PORT INJECTION: V8 VIN F

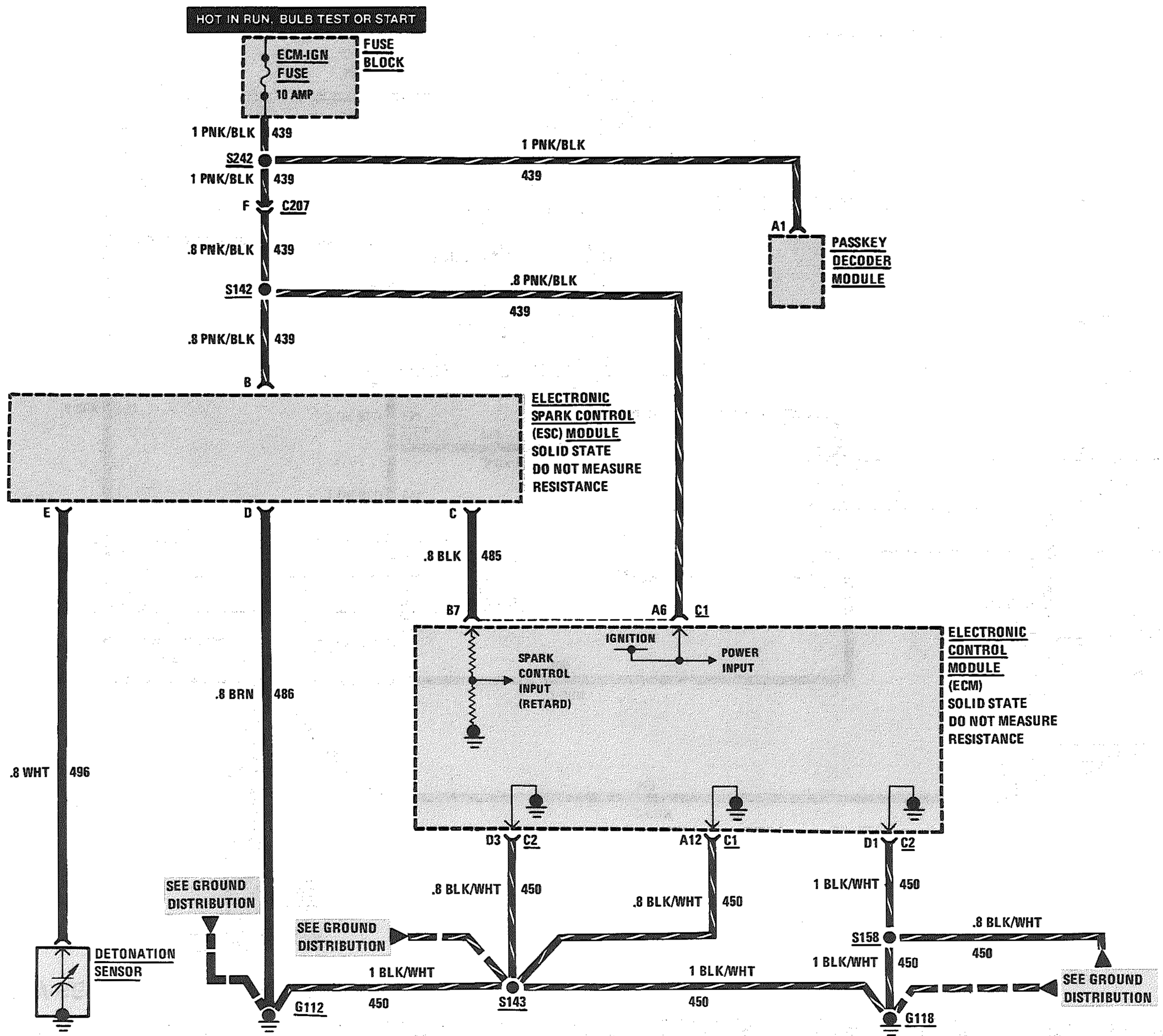
ENGINE DATA SENSORS AND TRANSMISSION CONVERTER CLUTCH



MASS AIR FLOW SENSOR AND BURN-OFF RELAY

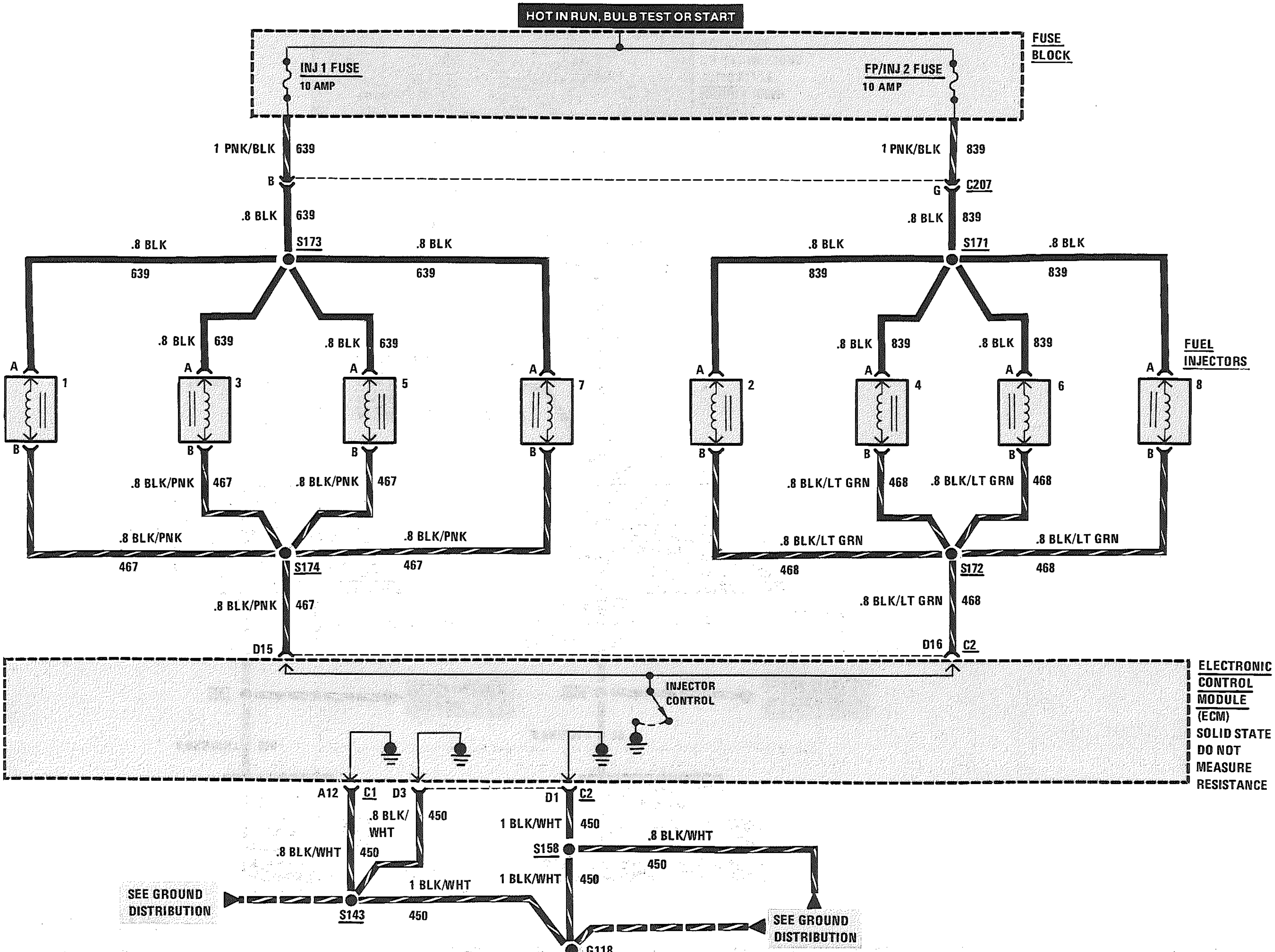


TUNED PORT INJECTION: V8 VIN F
SPARK CONTROL

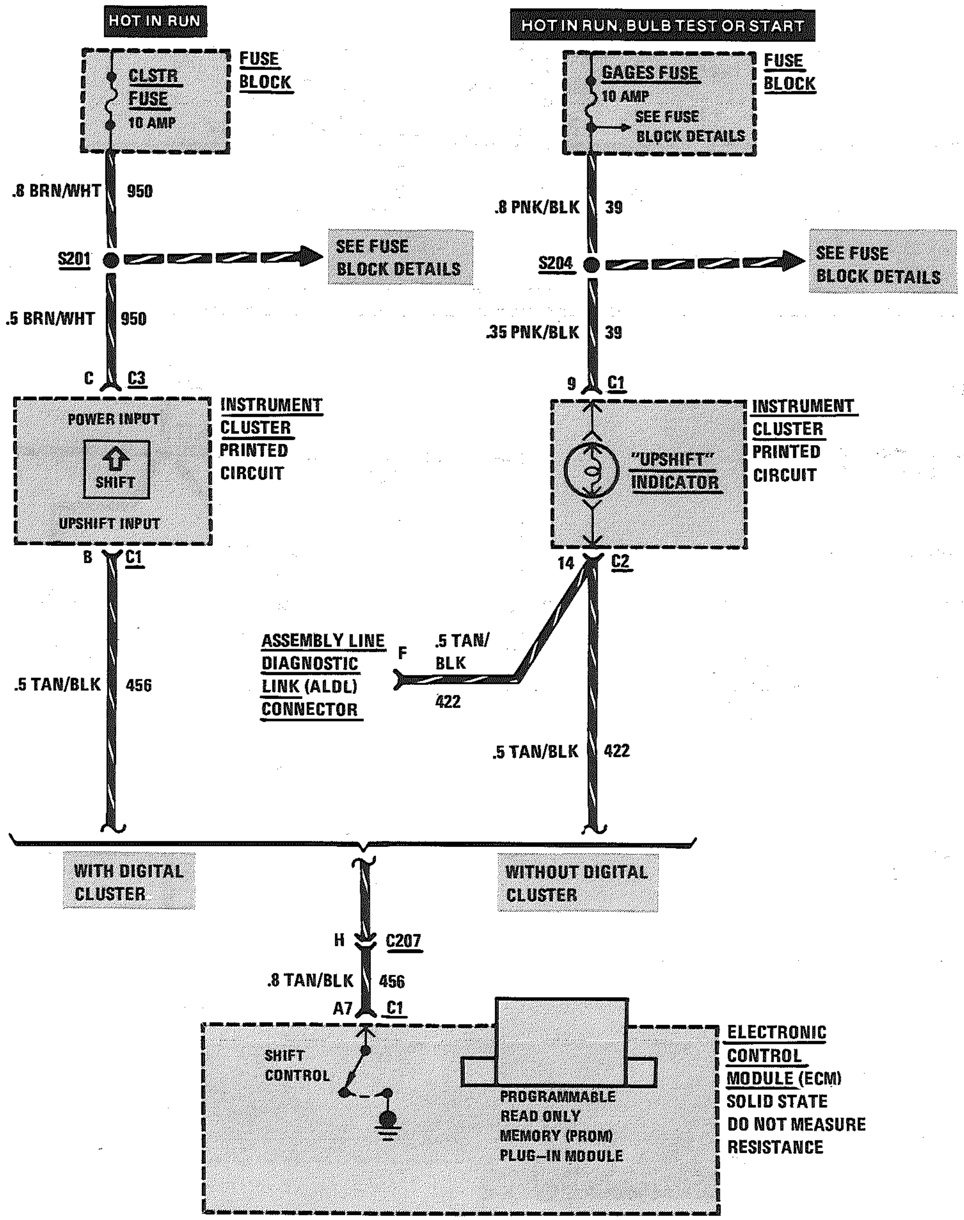


TUNED PORT INJECTION: V8 VIN F

FUEL INJECTORS



TUNED PORT INJECTION: V8 VIN F
UPSHIFT INDICATOR



COMPONENT LOCATION

Component	Location	Page-Figure
AIR Diverter Valve (VIN F) (VIN 8)	RH front of engine, on valve cover	201- 6-A
AIR Select Valve (VIN F) (VIN 8)	RH front of engine, on valve cover	201- 6-A
Assembly Line Diagnostic Link (ALDL) Connector	On bottom of I/P hush panel, to right of steering column	
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Burn-Off Relay	LH rear corner of engine compartment, on relay bracket	201- 7-A
Canister Purge Solenoid Valve (VIN F) (VIN 8)	Lower RH front corner of engine compartment	201- 5-A
Cold Start Injector (VIN F) (VIN 8)	Top LH side of engine	201- 7-A
Cold Start Switch (VIN F) (VIN 8)	Top center of engine	201- 8-C
Coolant Temperature Sensor (VIN F) (VIN 8)	Top LH front of engine	201- 8-C
Detonation Sensor (VIN F) (VIN 8)	Lower RH side of engine, above Starter Solenoid	201- 5-A
EGR Vacuum Sensor Diagnostic Connector	Top rear of engine	201- 4-E
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Electronic Spark Control (ESC) Module (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Electronic Spark Timing (EST) Distributor (VIN F) (VIN 8)	Top rear of engine	201- 5-A
Exhaust Gas Recirculation (EGR) Solenoid (VIN F) (VIN 8)	Top RH rear of intake manifold	201- 5-A
Fuel Injectors	Top of engine, at each intake cylinder	
Fuel Pump Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Fuel Pump Switch (VIN F) (VIN 8)	Lower LH side of engine	201- 8-A
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Idle Air Control Stepper Motor (VIN F) (VIN 8)	Top LH front of engine	201- 8-C
Ignition Coil (VIN F)(VIN 8)	RH rear side of engine	201- 7-B
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A

COMPONENT LOCATION

Component	Location	Page-Figure
In-Line Fuse (VIN F)(VIN 8)	On LH side of radiator support, forward of battery	201- 5-C
Manifold Air Temperature (MAT) Sensor (VIN F) (VIN 8)	Top of intake manifold	
Mass Air Flow (MAF) Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Mass Air Flow (MAF) Sensor (VIN F) (VIN 8)	Front of engine compartment, on rear of air cleaner	201- 5-A
Oxygen Sensor (VIN F) (VIN 8)	Lower LH side of engine, on exhaust manifold	
Throttle Position Sensor (VIN F) (VIN 8)	Top center of engine	201- 8-C
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C113 (1 cavity) (VIN F) (VIN 8)	Taped to engine harness, RH front of dash	201- 5-A
C114 (1 cavity) (VIN F) (VIN 8)	Taped to engine harness, above rear of engine	201- 7-B
C143 (1 cavity) (VIN F) (VIN 8)	Lower LH side of engine, below exhaust manifold	201- 8-A
C172 (2 cavities)	Top rear of engine	201- 4-E
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S142 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S145 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S146 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S158	Engine harness, behind RH side of I/P	
S162	Engine harness, LH rear corner of engine compartment	201- 7-A
S164	I/P harness, above Fuse Block	201-10-A
S166 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S168 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S171	Engine harness, RH front of dash	201- 6-A

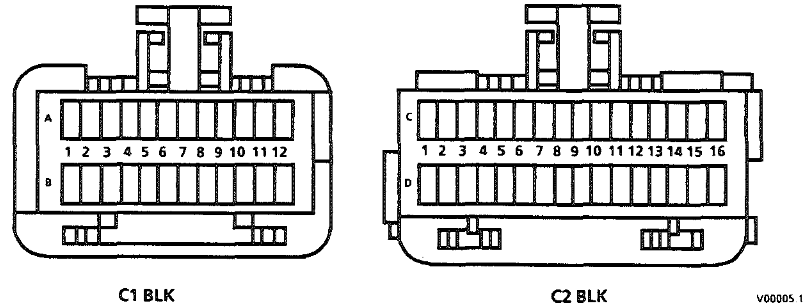
COMPONENT LOCATION

		Page-Figure
S172 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S173	Engine harness, top center rear of engine	201- 7-A
S174 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A
S175 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S176 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S180 (VIN F) (VIN 8)	Engine harness, above RH rear of engine	201- 7-B
S201	I/P harness, behind instrument cluster	201-10-A
S202	I/P harness, behind RH side of I/P	201-13-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S242	I/P harness, behind RH side of I/P	201-13-A
S276	I/P harness, behind RH side of I/P	201-13-A

TUNED PORT INJECTION: V8 VIN F

ELECTRONIC CONTROL MODULE CONNECTORS

ELECTRONIC CONTROL MODULE (ECM)



CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
A1	DK GRN/WHT	465	Fuel Pump Relay Control
A2	BRN	436	Air Select Valve Control
A3	DK GRN/YEL	428	Canister Purge Solenold Valve Control
A4	GRY	435	Exhaust Gas Recirculation Solenold Control
A5	BRN/WHT	419	"Service Engine Soon" Indicator Control
A6	PNK/BLK	439	Ignition
A7	TAN/BLK	422(Auto) 456 (Manual)	TCC Control (auto) Shift Indicator Control (manual)
A8	ORN	461	Data
A9	WHT/BLK	451	Diagnostic "Test" Input
A10	BRN	437	Speed Input
A11	BLK	452	Ground
A12	BLK/WHT	450	Ground
B1	ORN	340	Battery
B2	TAN/WHT	120	Fuel Pump Control
B3	BLK/RED	453	Distributor Reference Pulse Input:LO
B4	—	—	Not Used
B5	PPL/WHT	430	Distributor Reference Pulse Input:HI
B6	PPL	963	Theft Deterrent
B7	BLK	485	Electronic Spark Control Input (Retard)
B8	DK GRN	59	A/C On Input
B9			Not Used
B10	ORN/BLK	434	Park/Neutral Input
B11	—	—	Not Used
B12	DK GRN	998	Mass Air Flow Sensor Input
C1	DK GRN/WHT	335	Fan Control Output
C2	BLK/PNK	429	Air Diverter Valve Control
C3	LT GRN/BLK	444	Idle Air Control B LO
C4	LT GRN/WHT	443	Idle Air Control B HI

CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
C5	LT BLU/WHT	441	Idle Air Control A HI
C6	LT BLU/BLK	442	Idle Air Control A LO
C7	—	—	Not Used
C8	DK GRN	446	Top Gear Input
C9	—	—	Not Used
C10	YEL	410	Coolant Temperature Sensor Input
C11	—	—	Not Used
C12	TAN	472	Manifold Air Temperature Sensor Input
C13	DK BLU	417	Throttle Position Sensor Input
C14	GRY	416	5 Volt Reference
C15	DK GRN	999	EGR Vacuum Sensor Signal
C16	ORN	340	Battery
D1	BLK/WHT	450	Ground
D2	BLK	452	Ground
D3	BLK/WHT	450	Ground
D4	WHT	423	Spark Timing Output
D5	TAN/BLK	424	Ignition Module Bypass Output
D6	TAN	413	Oxygen Sensor Ground
D7	PPL	412	Oxygen Sensor Input
D8	—	—	Not Used
D9	—	—	Not Used
D10	BLK/WHT	450	Ground
D11	GRY	731	Fan Pressure Switch Input
D12	BLK	900	Burn-Off Relay Control
D13	—	—	Not Used
D14	—	—	Not Used
D15	BLK/PNK	467	Fuel Injector Control
D16	BLK/LT GRN	467	Fuel Injector Control

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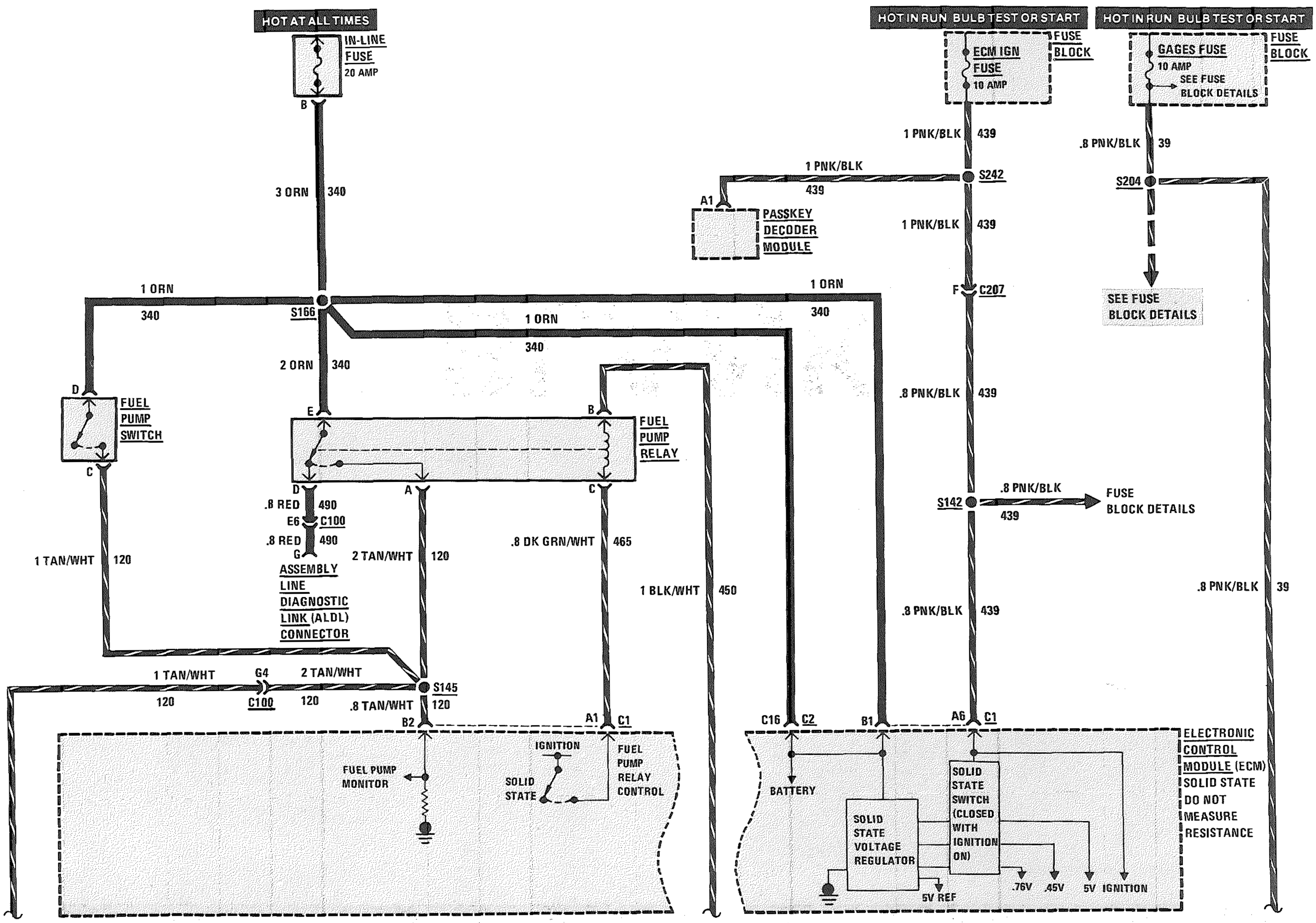
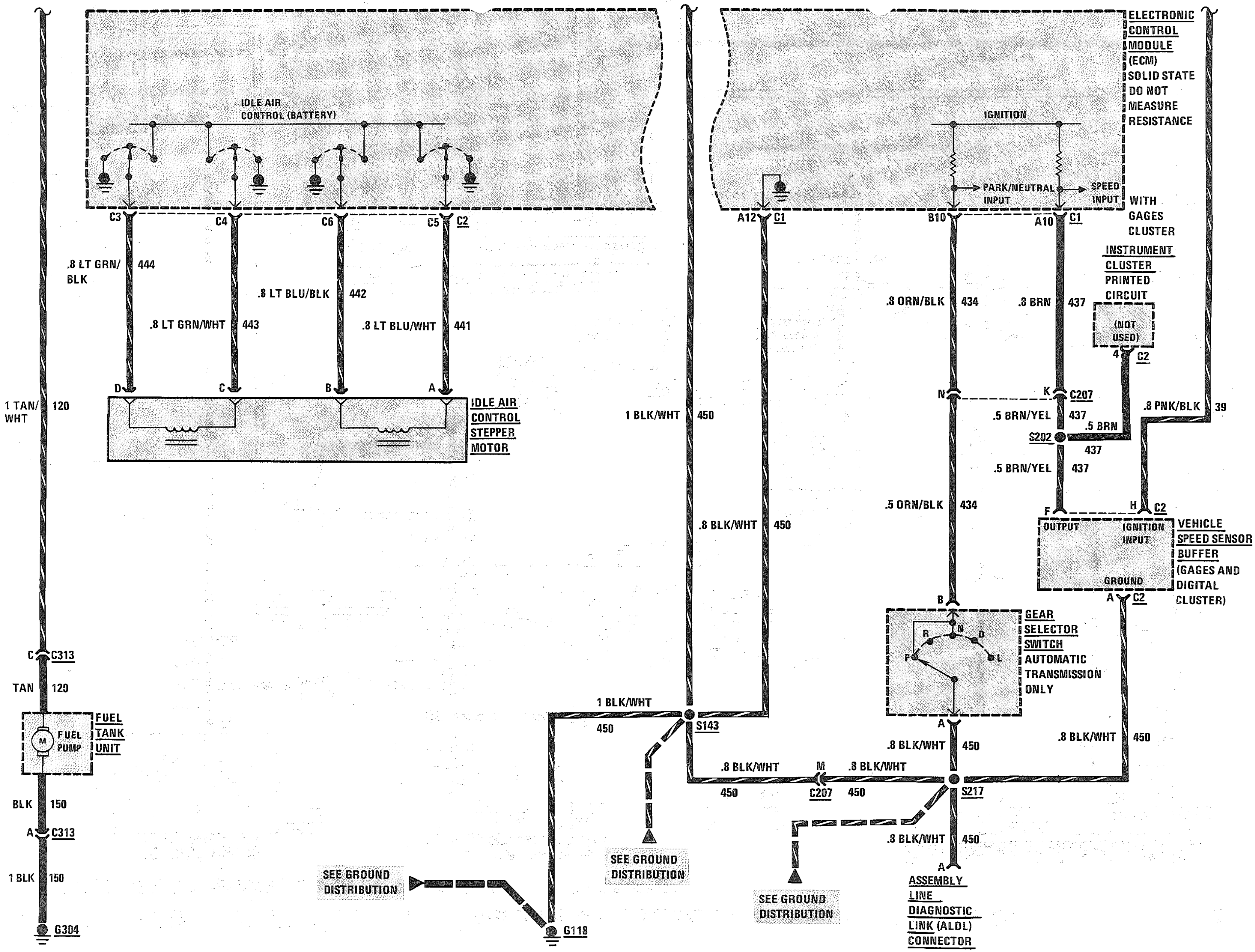
THROTTLE BODY INJECTION: V8 VIN E

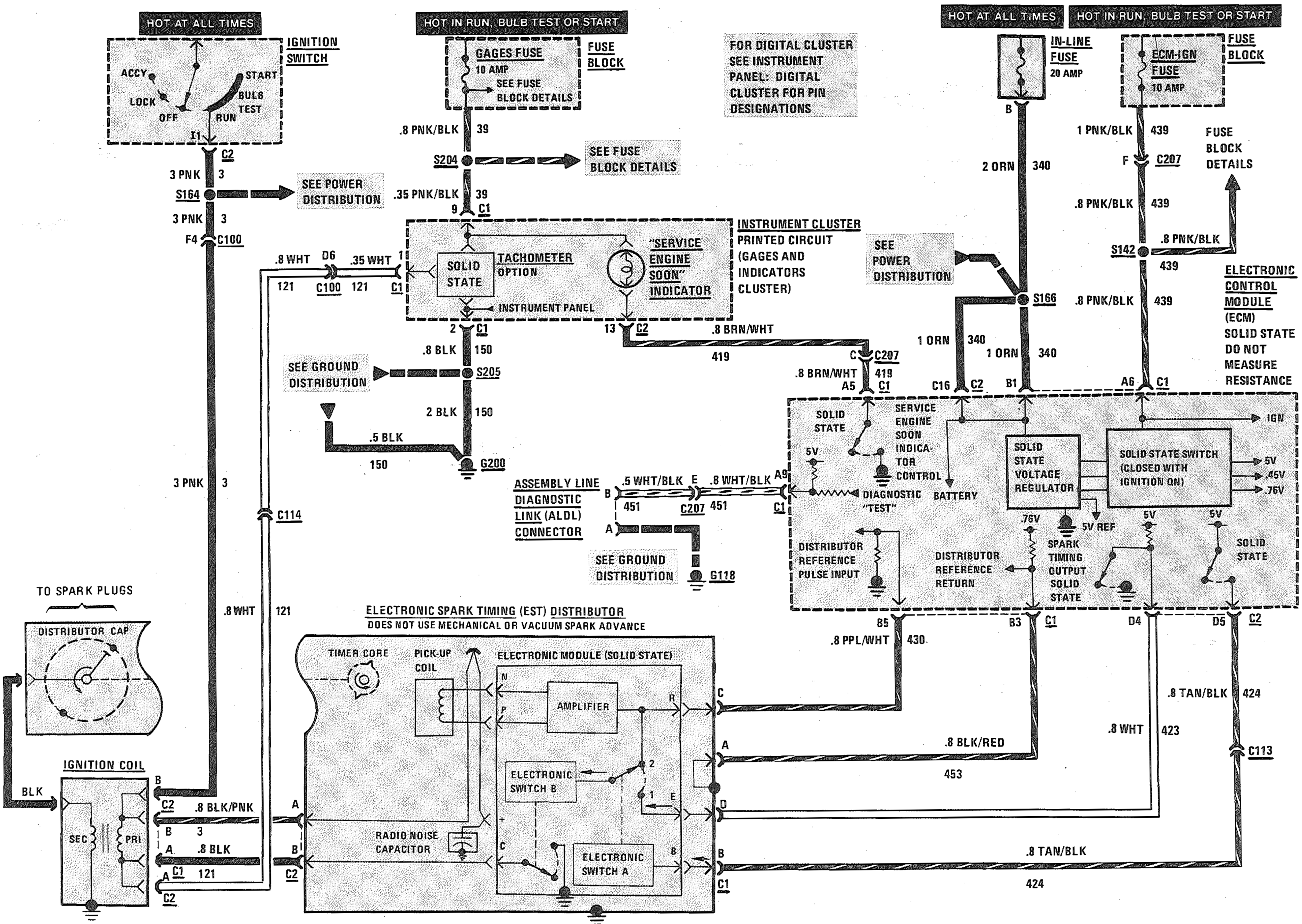
IDLE SPEED CONTROL, FUEL CONTROL, AND VEHICLE DATA SENSORS




ELECTRONIC CONTROL MODULE (ECM) SOLID STATE DO NOT MEASURE RESISTANCE
IDLE AIR CONTROL (BATTERY)
IGNITION
PARK/NEUTRAL INPUT
SPEED INPUT
WITH GAGES CLUSTER
C3
C4
C6
C5
C2
A12
C1
B10
A10
.8 LT GRN/BLK 444
.8 LT GRN/WHT 443
.8 LT BLU/BLK 442
.8 LT BLU/WHT 441
D C B A
IDLE AIR CONTROL STEPPER MOTOR
1 TAN/WHT 120
C313
TAN 120
FUEL TANK UNIT
FUEL PUMP
BLK 150
1 BLK 150
G304
1 BLK/WHT 450
.8 BLK/WHT 450
S143
G118
SEE GROUND DISTRIBUTION
SEE GROUND DISTRIBUTION
SEE GROUND DISTRIBUTION
.8 ORN/BLK 434
.8 BRN 437
INSTRUMENT CLUSTER PRINTED CIRCUIT
(NOT USED)
4 C2
N
K C207
.5 BRN/YEL 437
.5 BRN
S202
437
.8 PNK/BLK 39
.5 ORN/BLK 434
F
H C2
OUTPUT
IGNITION INPUT
GROUND
VEHICLE SPEED SENSOR BUFFER (GAGES AND DIGITAL CLUSTER)
A C2
B
GEAR SELECTOR SWITCH AUTOMATIC TRANSMISSION ONLY
R N D P L
A
.8 BLK/WHT 450
M C207
S217
ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR

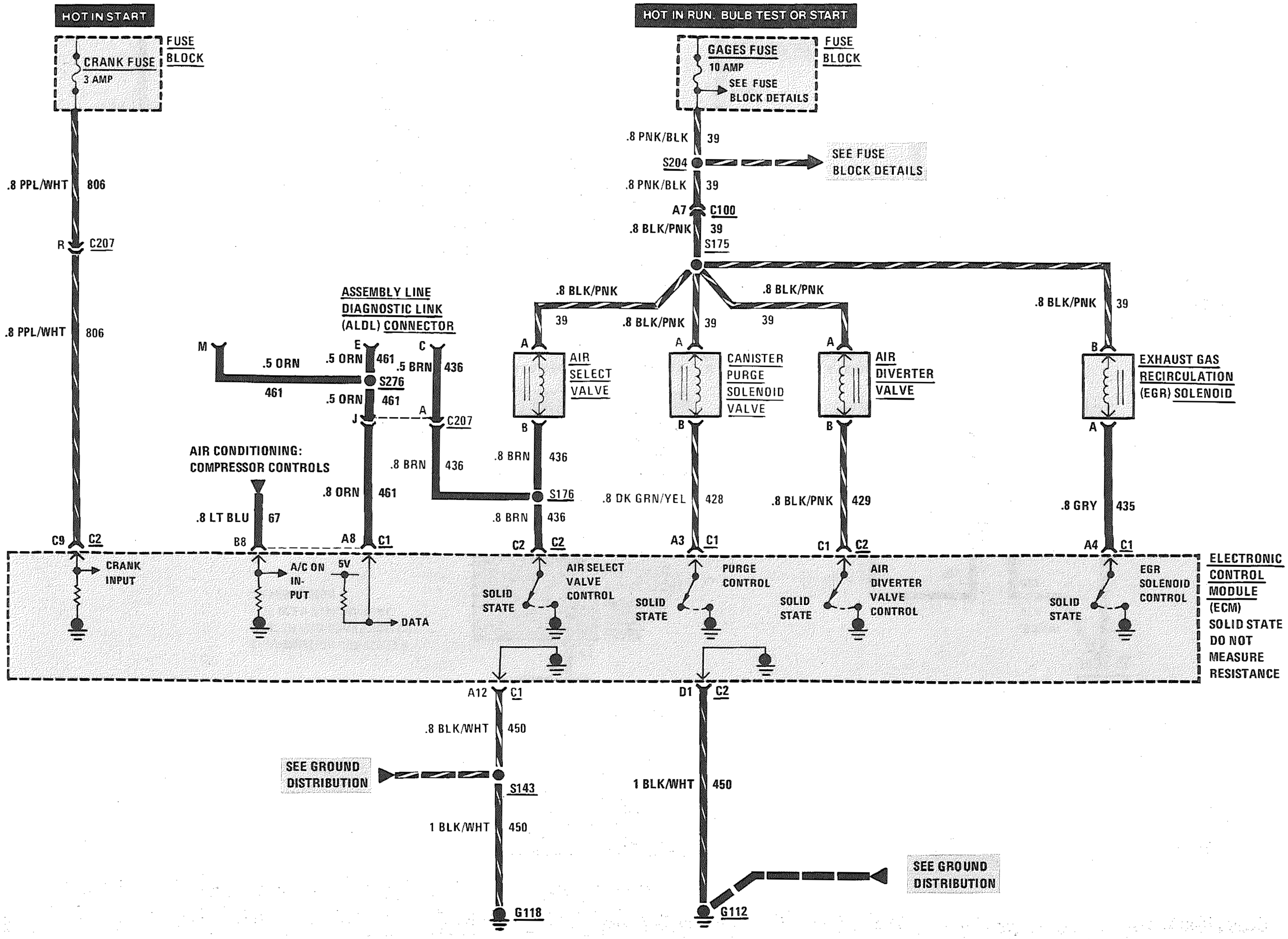
THROTTLE BODY INJECTION: V8 VIN E

IGNITION, SERVICE ENGINE SOON INDICATOR, AND TACHOMETER



THROTTLE BODY INJECTION: V8 VIN E

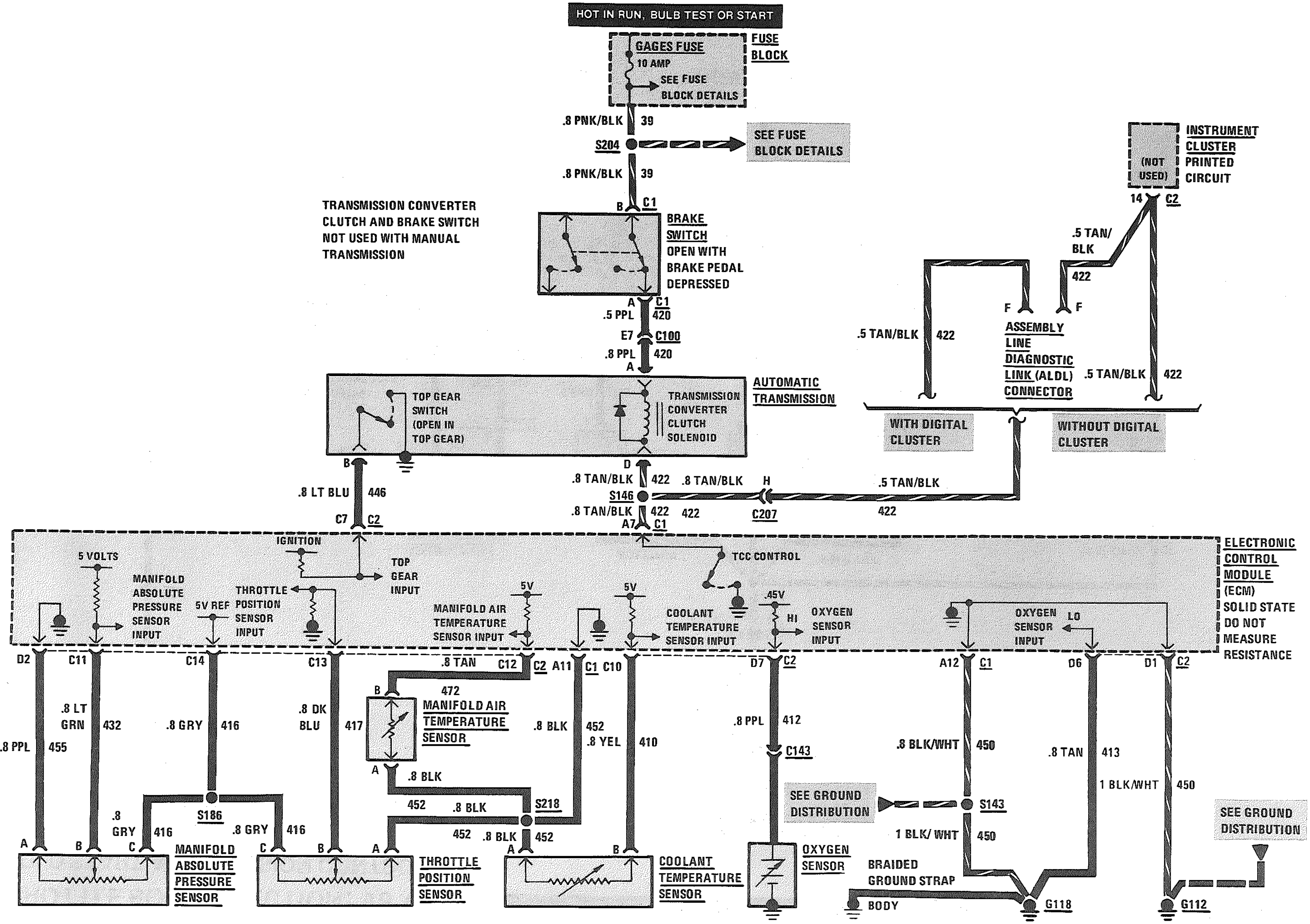
COLD START AND EMISSION CONTROL



FIREBIRD

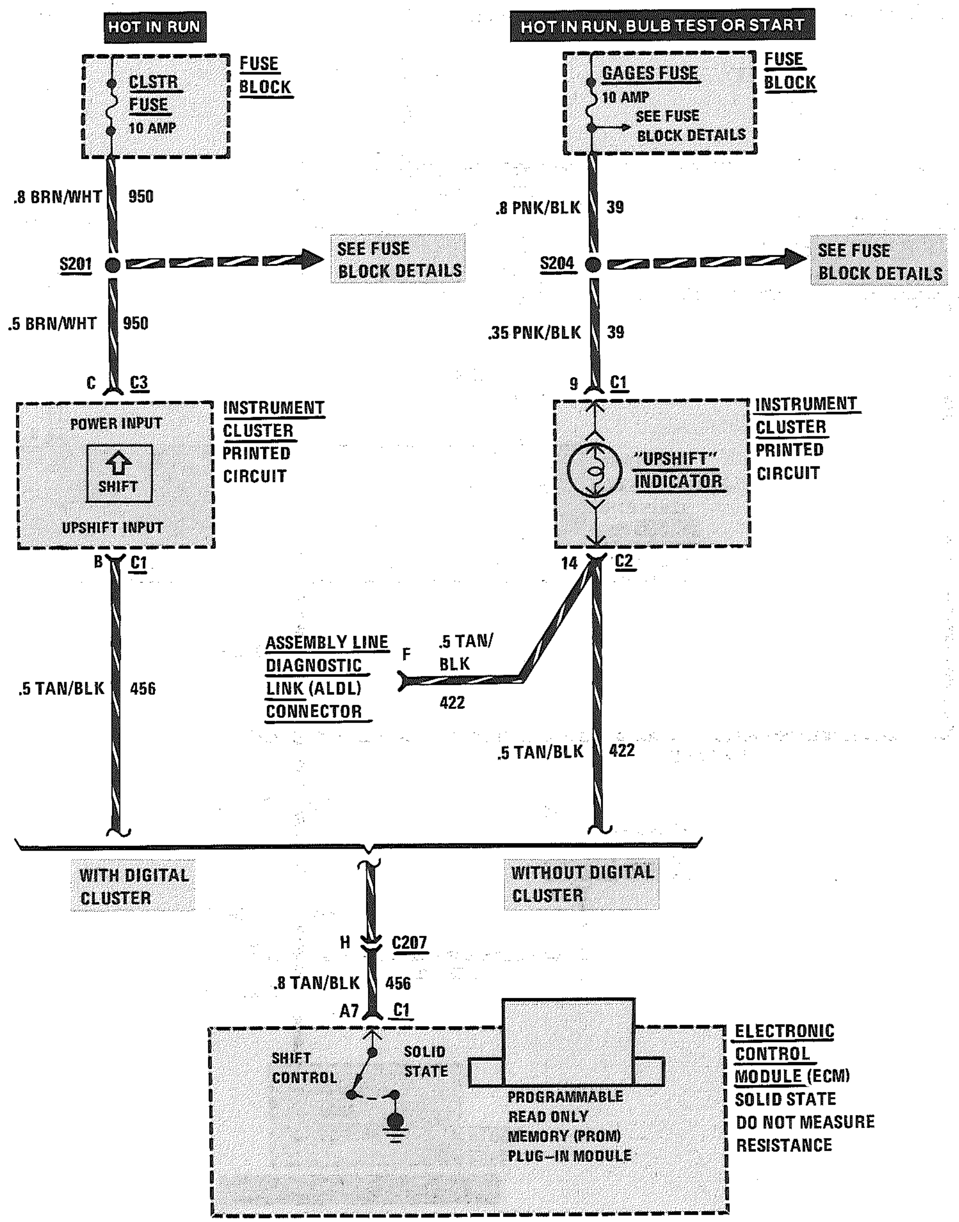
THROTTLE BODY INJECTION: V8 VIN E

ENGINE DATA SENSORS AND TRANSMISSION CONVERTER CLUTCH

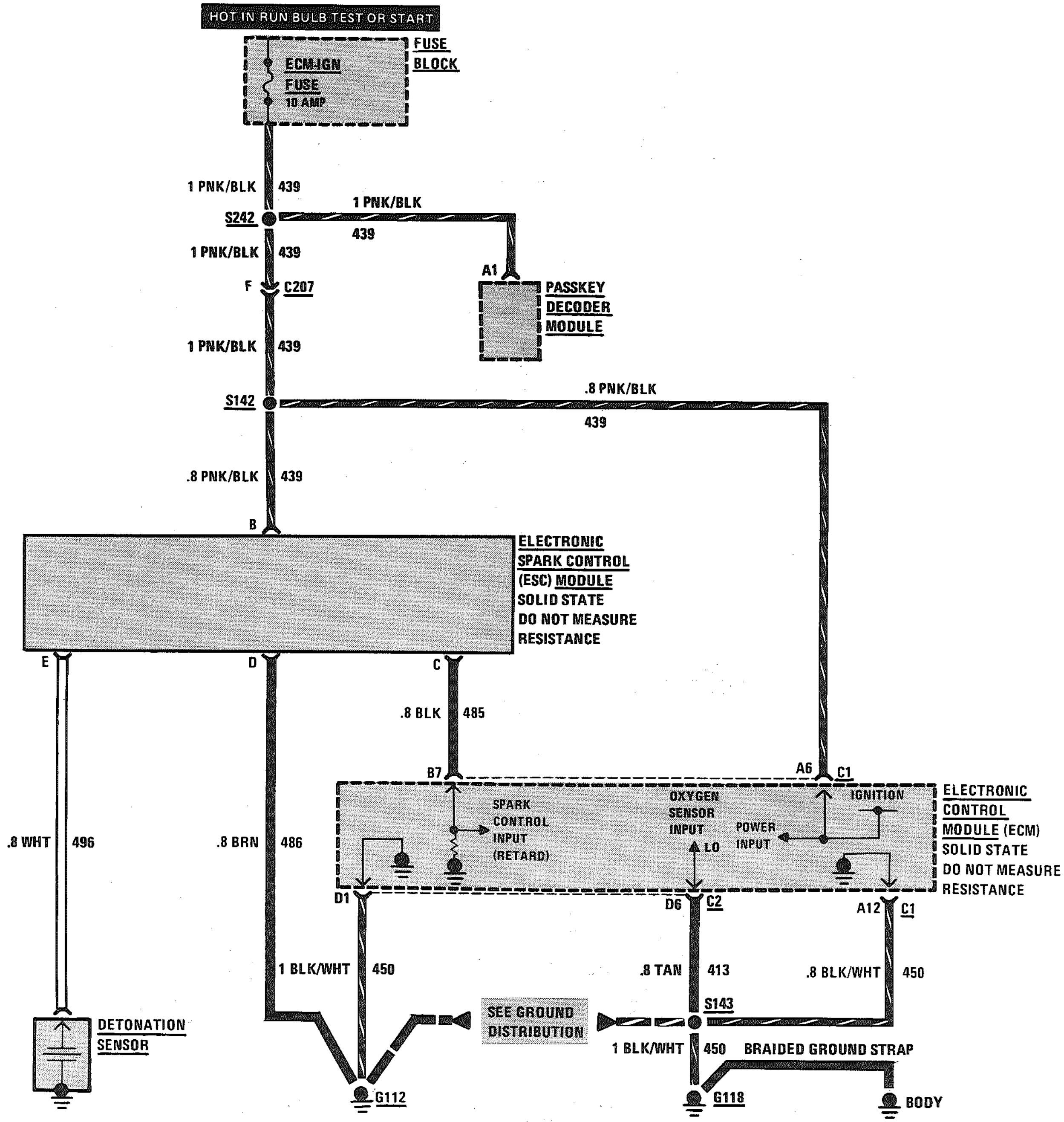


THROTTLE BODY INJECTION: V8 VIN E

UPSHIFT INDICATOR

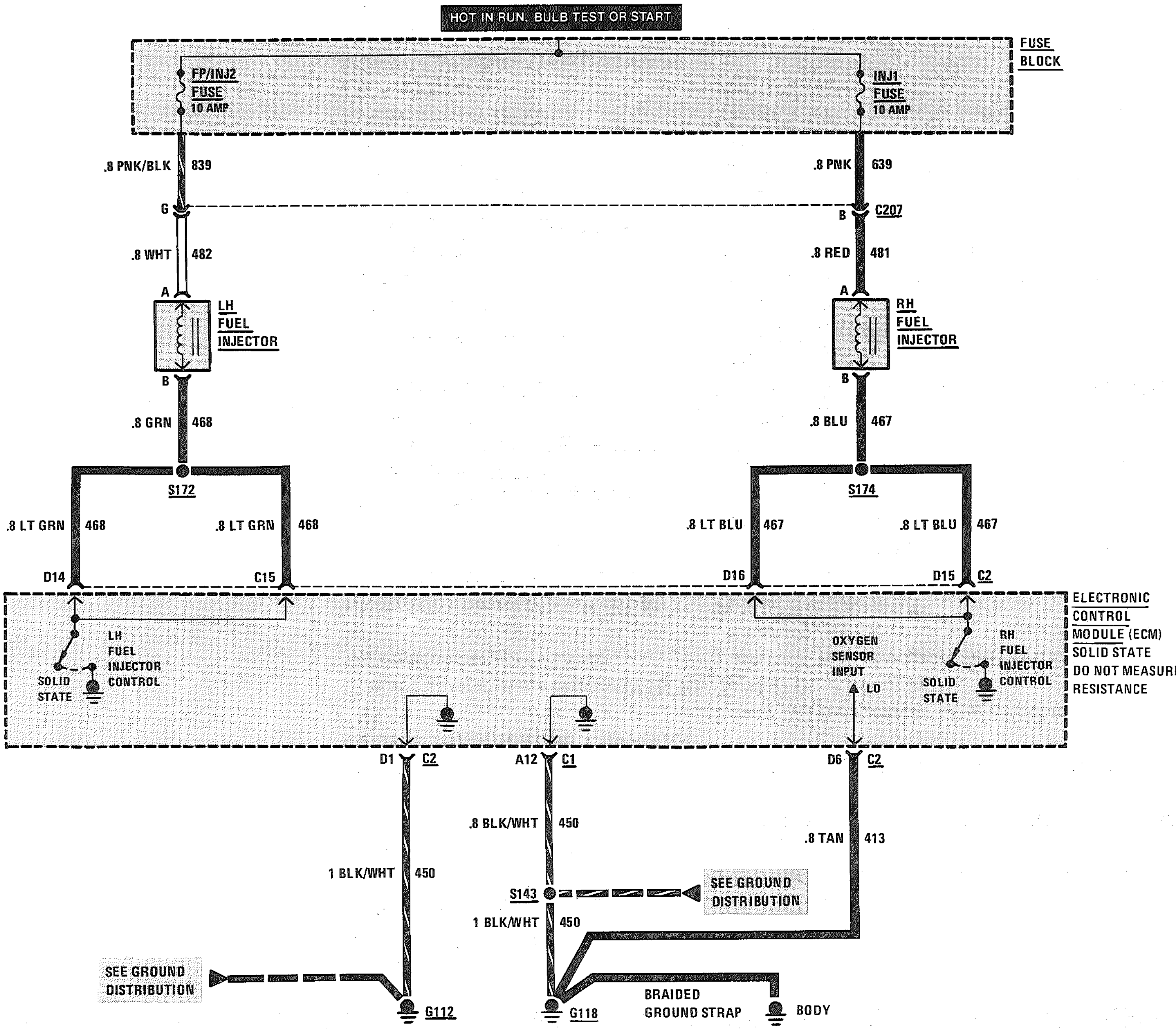


SPARK CONTROL



THROTTLE BODY INJECTION: V8 VIN E

FUEL INJECTORS



COMPONENT LOCATION

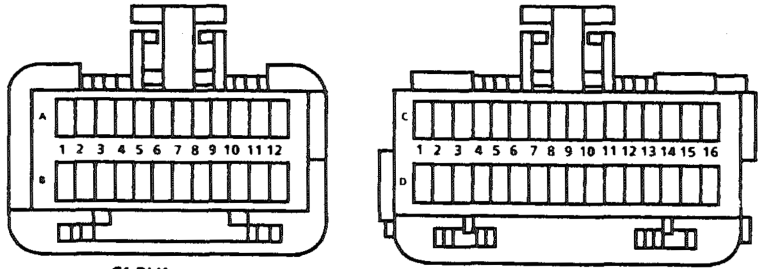
		Page-Figure
AIR Diverter Valve (VIN E)	RH front of engine	201- 2-A
AIR Select Valve (VIN E)	RH front of engine	201- 2-A
Assembly Line Diagnostic Link (ALDL) Connector	On bottom of I/P hush panel, to right of steering column	
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Canister Purge Solenoid Valve (VIN E)	Lower LH front corner of engine compartment	201- 2-A
Coolant Temperature Sensor (VIN E)	Top LH front of engine	201- 4-D
Detonation Sensor (VIN E)	Lower RH side of engine, ahead of Starter Solenoid	201- 4-C
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Electronic Spark Control (ESC) Module (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 2-A
Electronic Spark Timing (EST) Distributor (VIN E)	Top rear of engine	201- 3-A
Exhaust Gas Recirculation (EGR) Solenoid (VIN E)	Top RH rear of intake manifold	201- 4-A
Fuel Pump Relay (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 3-A
Fuel Pump Switch (VIN E)	Lower LH rear of engine	201- 3-A
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Idle Air Control Stepper Motor (VIN E)	Top center of engine	201- 2-A
Ignition Coil (VIN E)	Top center rear of engine	201- 4-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
In-Line Fuse (VIN E)	RH inner fender panel by battery	201- 3-B
LH Fuel Injector	Top of throttle body	201- 4-A
Manifold Absolute Pressure (MAP) Sensor	RH front of dash	201- 2-A
Manifold Air Temperature (MAT) Sensor (VIN E)	Top RH rear of engine	201- 4-A
Oxygen Sensor (VIN E)	Lower LH side of engine, on exhaust manifold	
RH Fuel Injector	Top of throttle body	201- 4-A

COMPONENT LOCATION

Component	Location	Page-Figure
Throttle Position Sensor (VIN E)	Top center of engine	201- 4-A
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C113 (1 cavity) (VIN E)	Taped to engine harness, RH front of dash	201- 2-A
C114 (1 cavity) (VIN E)	Taped to engine harness, above rear of engine	
C143 (1 cavity) (VIN E)	Lower LH side of engine	201- 3-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G118 (VIN E)	Rear of RH cylinder head	201- 5-B
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S142 (VIN E)	Engine harness, behind RH side of I/P	
S143 (VIN E)	Engine harness, RH front of dash	201- 2-A
S145 (VIN E)	Engine harness, above rear of engine	201- 3-C
S146 (VIN E)	Engine harness, behind RH side of I/P	
S164	I/P harness, above Fuse Block	201-10-A
S166 (VIN E)	Engine harness, above rear of engine	201- 3-C
S172 (VIN E)	Engine harness, RH front of dash	201- 2-A
S174 (VIN E)	Engine harness, RH front of dash	201- 2-A
S175 (VIN E)	Engine harness, above LH rear of engine	201- 3-A
S176 (VIN E)	Engine harness, behind RH side of I/P	
S186	Engine harness, RH front of dash	201- 2-A
S201	I/P harness, behind instrument cluster	201-10-A
S202	I/P harness, behind RH side of I/P	201-13-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S218	Engine harness, lower RH corner of engine compartment	201- 2-A
S242	I/P harness, behind RH side of I/P	201-13-A
S276	I/P harness, behind RH side of I/P	201-13-A

THROTTLE BODY INJECTION: V8 VIN E

ELECTRONIC CONTROL MODULE CONNECTORS



C1 BLK

C2 BLK

ELECTRONIC CONTROL MODULE (ECM)

CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
A1	DK GRN/WHT	465	FUEL PUMP RELAY CONTROL
A2	–	–	NOT USED
A3	DK GRN/YEL	428	CANISTER PURGE SOLENOID VALVE CONTROL
A4	GRY	435	EXHAUST GAS RECIRCULATION SOLENOID CONTROL
A5	BRN/WHT	419	"SERVICE ENGINE SOON" INDICATOR CONTROL
A6	PNK/BLK	439	IGNITION
A7	TAN/BLK	422 (AUTO) 456 (MAN)	TCC CONTROL (AUTO) SHIFT INDICATOR CONTROL (MAN)
A8	ORN	461	SERIAL DATA LINK
A9	WHT/BLK	451	DIAGNOSTIC "TEST" INPUT
A10	BRN	437	SPEED INPUT
A11	BLK	452	GROUND
A12	BLK/WHT	450	GROUND
B1	ORN	340	BATTERY
B2	TAN/WHT	120	FUEL PUMP CONTROL
B3	BLK/RED	453	DISTRIBUTOR REFERENCE PULSE INPUT: LO
B4	–	–	NOT USED
B5	PPL/WHT	430	DISTRIBUTOR REFERENCE PULSE INPUT: HI
B6	–	–	NOT USED
B7	BLK	485	ELECTRONIC SPARK CONTROL INPUT (RETARD)
B8	LT BLU	67	A/C ON INPUT
B9	–	–	NOT USED
B10	ORN/BLK	434	PARK/NEUTRAL INPUT
B11	–	–	NOT USED
B12	–	–	NOT USED
C1	BLK/PNK	429	AIR DIVERTER VALVE CONTROL
C2	BRN	436	AIR SELECT VALVE CONTROL
C3	LT GRN/BLK	444	IDLE AIR CONTROL B LO
C4	LT GRN/WHT	443	IDLE AIR CONTROL B HI

CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
C5	LT BLU/WHT	441	IDLE AIR CONTROL A HI
C6	LT BLU/BLK	442	IDLE AIR CONTROL A LO
C7	LT BLU	446	TOP GEAR INPUT
C8	LT BLU	901	POWER STEERING INPUT
C9	PPL/WHT	806	CRANK INPUT
C10	YEL	410	COOLANT TEMPERATURE SENSOR INPUT
C11	LT GRN	432	MANIFOLD ABSOLUTE PRESSURE SENSOR INPUT
C12	TAN	472	MANIFOLD AIR TEMPERATURE SENSOR INPUT
C13	DK BLU	417	THROTTLE POSITION SENSOR INPUT
C14	GRY	416	5 VOLT REFERENCE
C15	LT GRN	468	CONNECTED TO D14
C16	ORN	340	BATTERY
D1	BLK/WHT	450	GROUND
D2	PPL	455	GROUND
D3	–	–	NOT USED
D4	WHT	423	SPARK TIMING OUTPUT
D5	TAN/BLK	424	IGNITION MODULE BYPASS OUTPUT
D6	TAN	413	OXYGEN SENSOR INPUT: LO
D7	PPL	412	OXYGEN SENSOR INPUT
D8	–	–	NOT USED
D9	–	–	NOT USED
D10	–	–	NOT USED
D11	–	–	NOT USED
D12	–	–	NOT USED
D13	–	–	NOT USED
D14	LT GRN	468	LH FUEL INJECTOR CONTROL
D15	LT BLU	467	RH FUEL INJECTOR CONTROL
D16	LT BLU	467	CONNECTED TO D15

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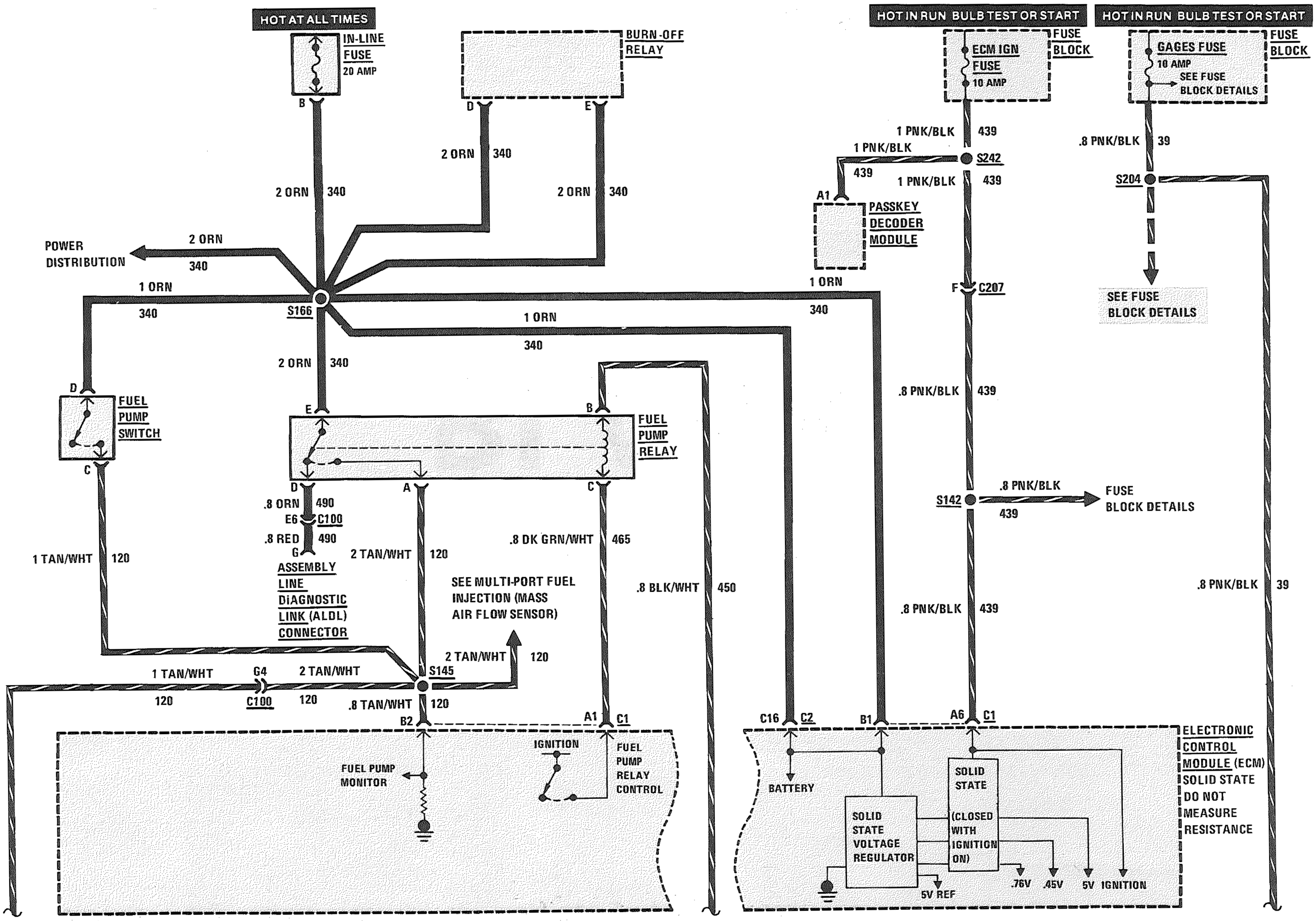
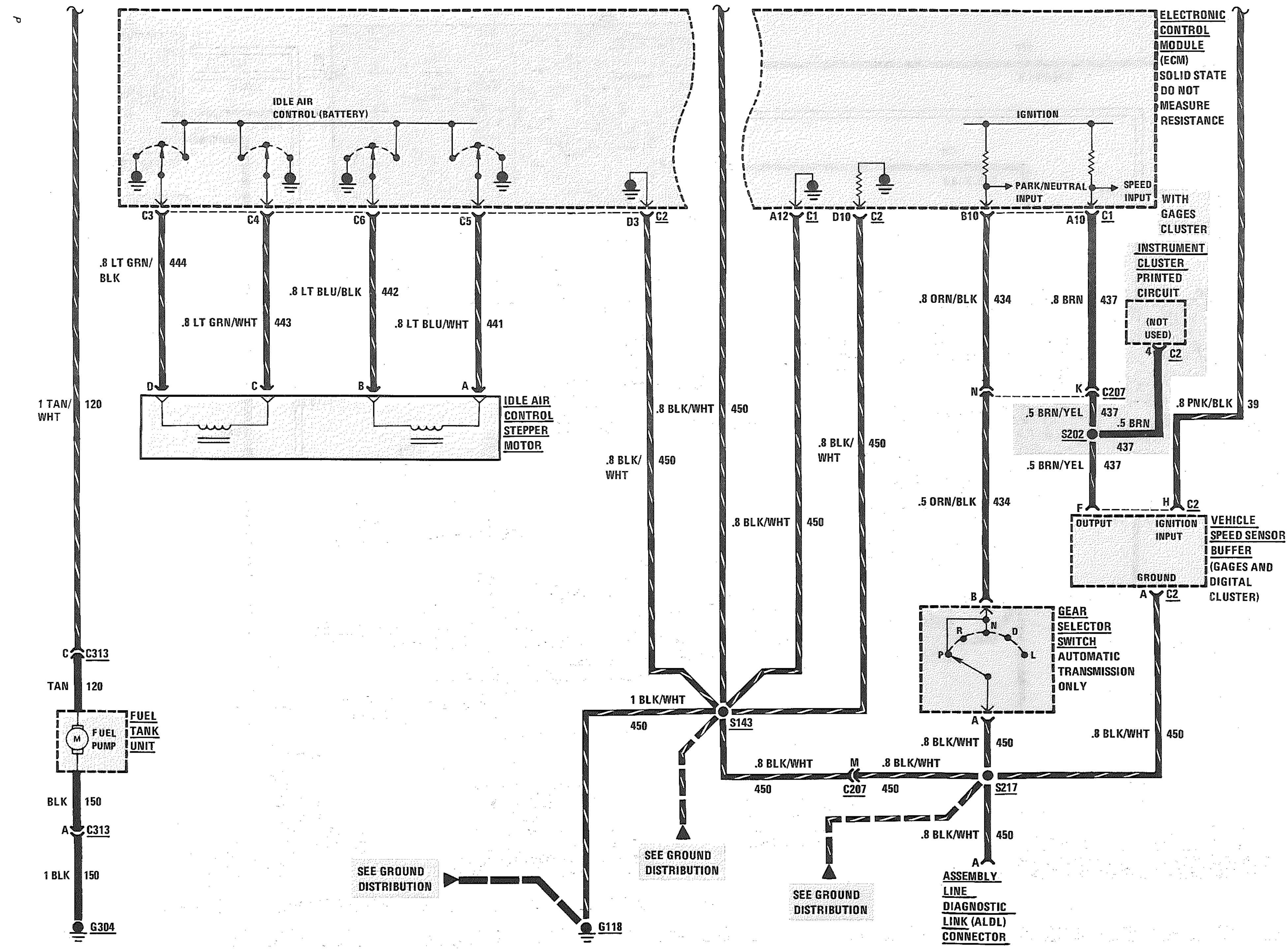
MULTI-PORT FUEL INJECTION: V8 VIN 8

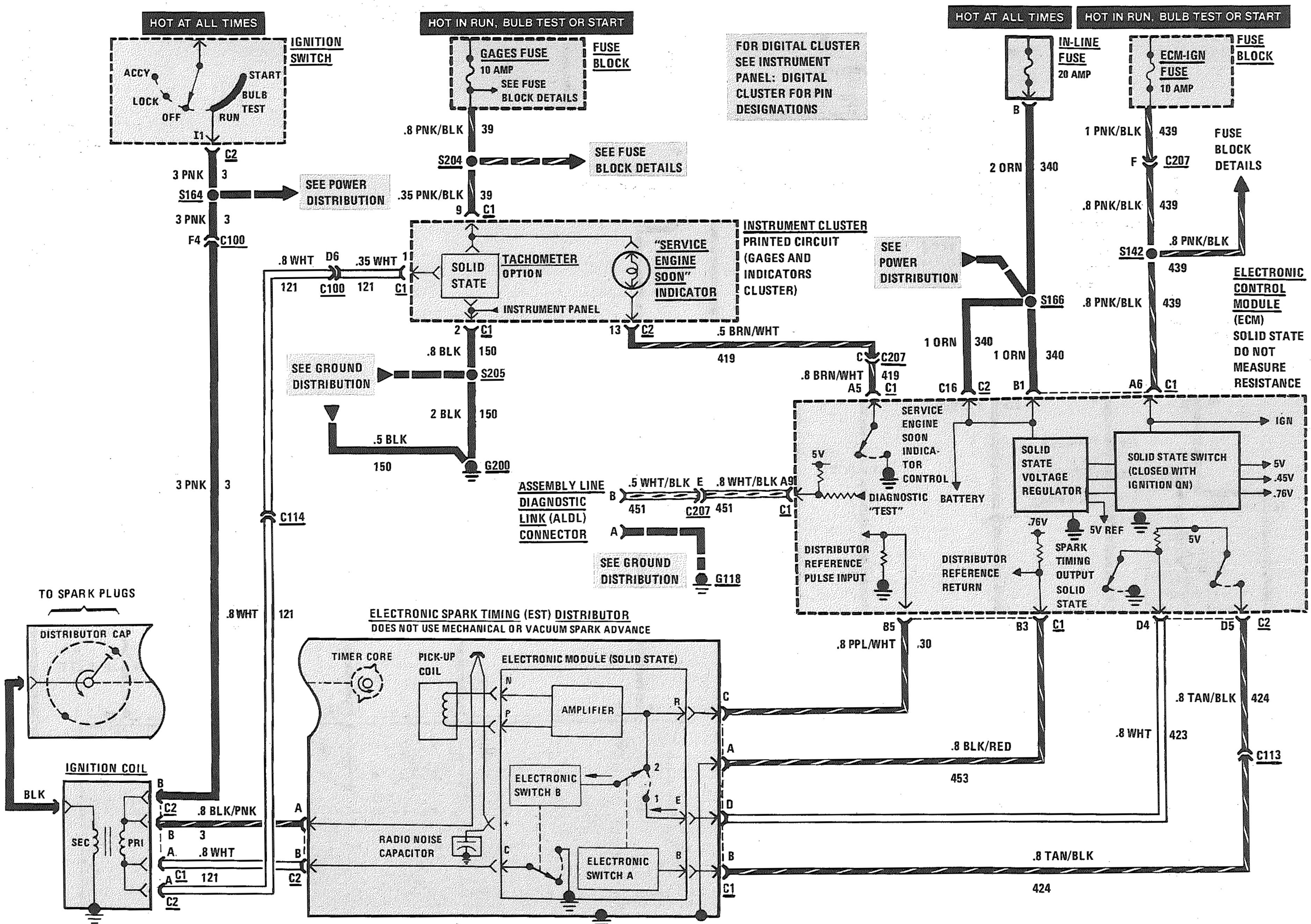
IDLE SPEED CONTROL, FUEL CONTROL, AND VEHICLE DATA SENSORS




ELECTRONIC CONTROL MODULE (ECM) SOLID STATE DO NOT MEASURE RESISTANCE
IDLE AIR CONTROL (BATTERY)
IGNITION
PARK/NEUTRAL INPUT
SPEED INPUT
WITH GAGES CLUSTER
C3
C4
C6
C5
D3 C2
A12 C1
D10 C2
B10
A10 C1
.8 LT GRN/BLK 444
.8 LT GRN/WHT 443
.8 LT BLU/BLK 442
.8 LT BLU/WHT 441
IDLE AIR CONTROL STEPPER MOTOR
.8 BLK/WHT 450
.8 BLK/WHT 450
.8 BLK/WHT 450
.8 ORN/BLK 434
.8 BRN 437
INSTRUMENT CLUSTER PRINTED CIRCUIT
(NOT USED)
4 C2
N
K C207
.5 BRN/YEL 437
S202
.5 BRN
437
.5 BRN/YEL 437
.8 PNK/BLK 39
.5 ORN/BLK 434
F
H C2
OUTPUT
IGNITION INPUT
GROUND
VEHICLE SPEED SENSOR BUFFER (GAGES AND DIGITAL CLUSTER)
A C2
GEAR SELECTOR SWITCH AUTOMATIC TRANSMISSION ONLY
R N D P L
B
A
1 TAN/WHT 120
C C313
TAN 120
FUEL PUMP
FUEL TANK UNIT
BLK 150
A C313
1 BLK 150
G304
1 BLK/WHT
450
S143
SEE GROUND DISTRIBUTION
G118
SEE GROUND DISTRIBUTION
.8 BLK/WHT 450
M C207
.8 BLK/WHT 450
.8 BLK/WHT 450
S217
.8 BLK/WHT 450
.8 BLK/WHT 450
SEE GROUND DISTRIBUTION
A
ASSEMBLY LINE DIAGNOSTIC LINK (ALDL) CONNECTOR

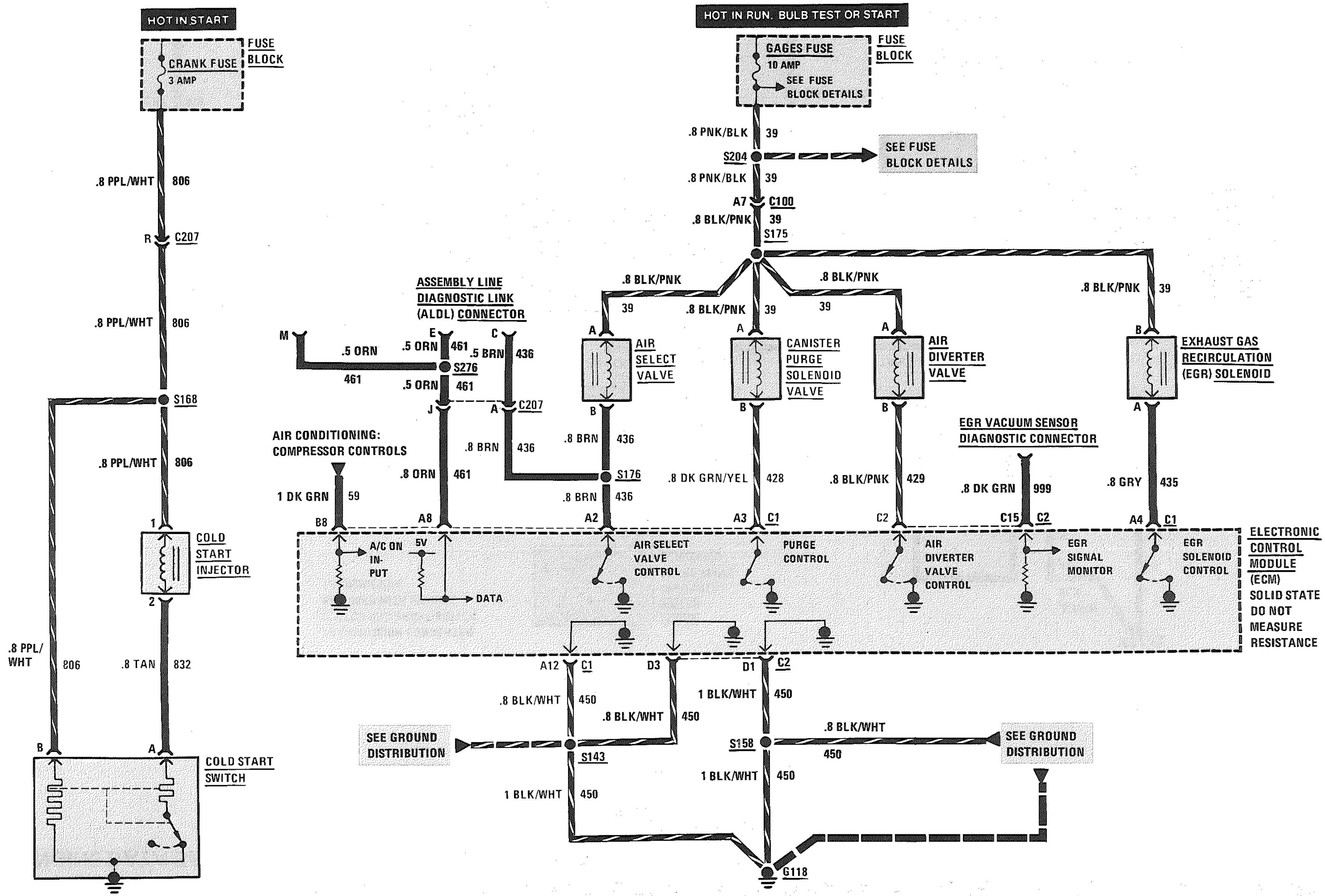
MULTI-PORT FUEL INJECTION: V8 VIN 8

IGNITION, SERVICE ENGINE SOON INDICATOR, AND TACHOMETER



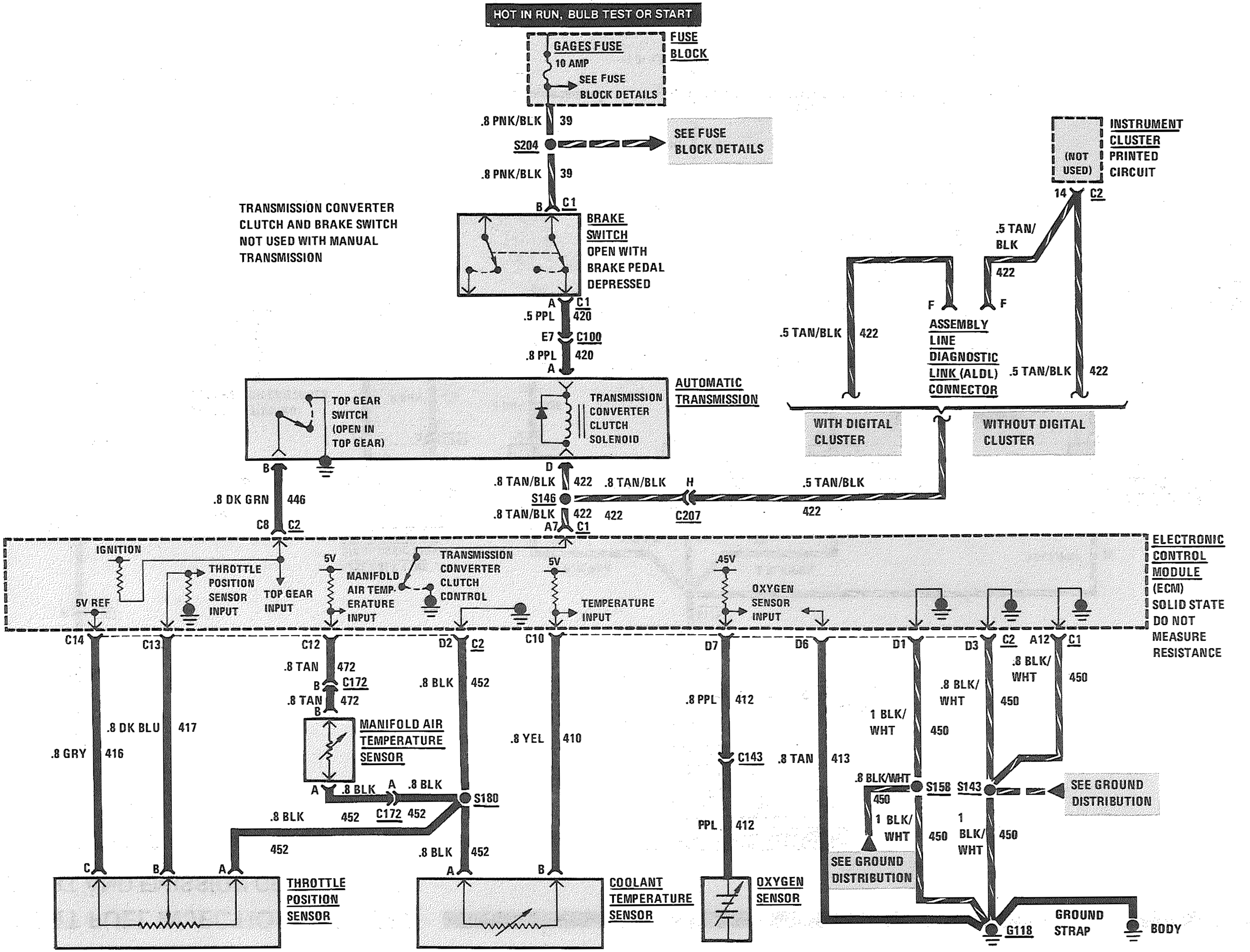
MULTI-PORT FUEL INJECTION: V8 VIN 8

COLD START AND EMISSION CONTROL



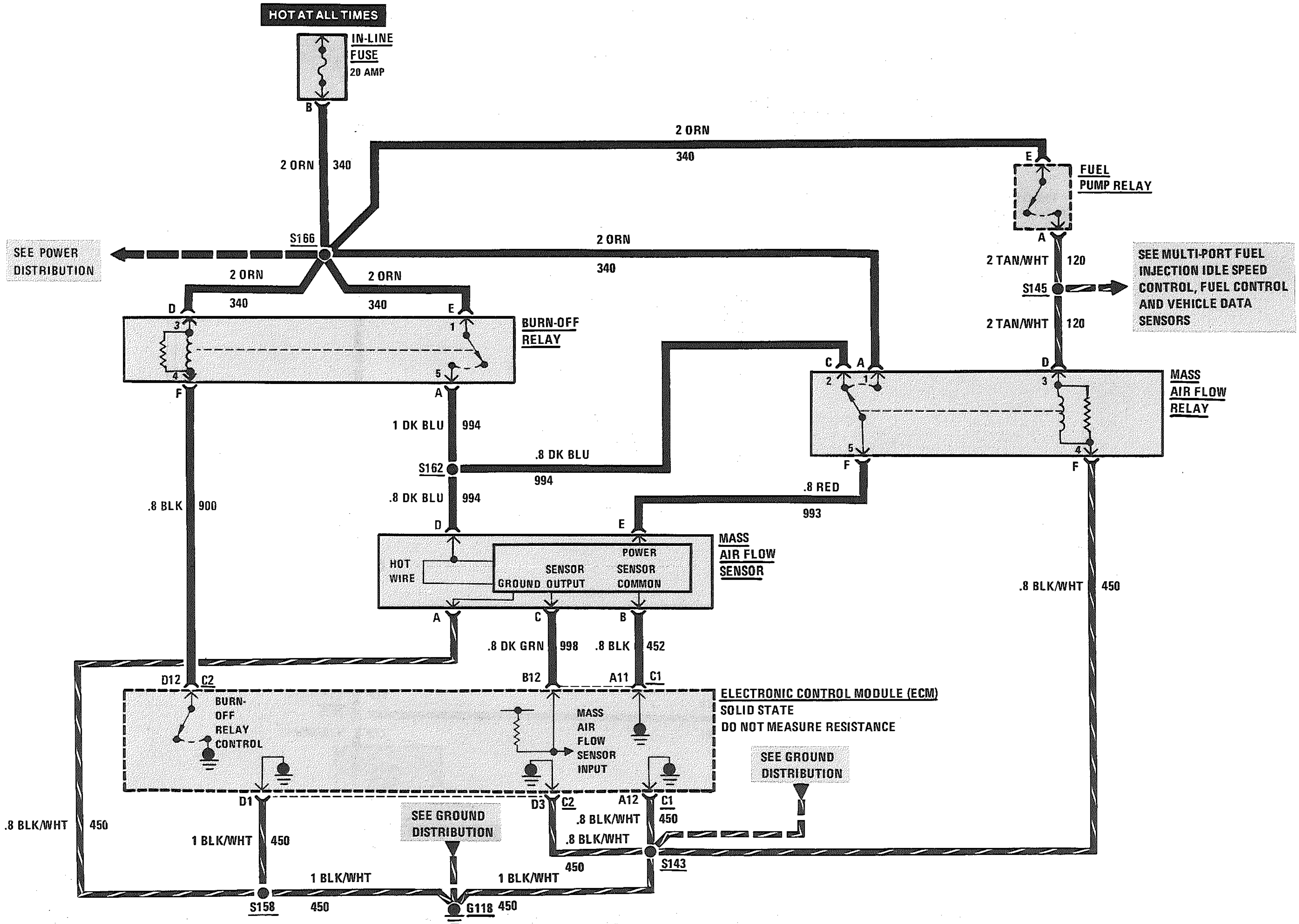
MULTI-PORT FUEL INJECTION: V8 VIN 8

ENGINE DATA SENSORS AND TRANSMISSION CONVERTER CLUTCH



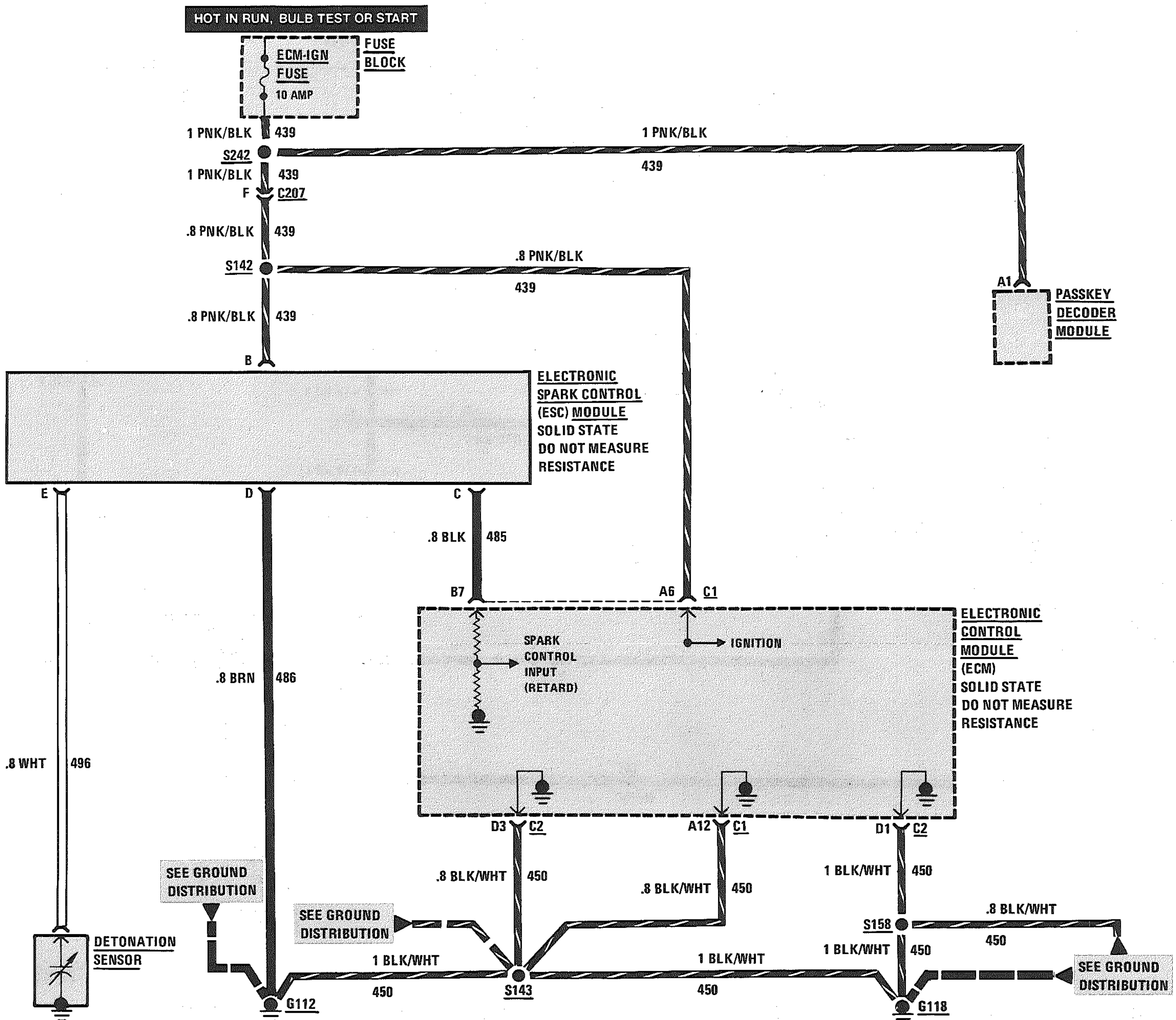
MULTI-PORT FUEL INJECTION: V8 VIN 8

MASS AIR FLOW SENSOR AND BURN-OFF RELAY



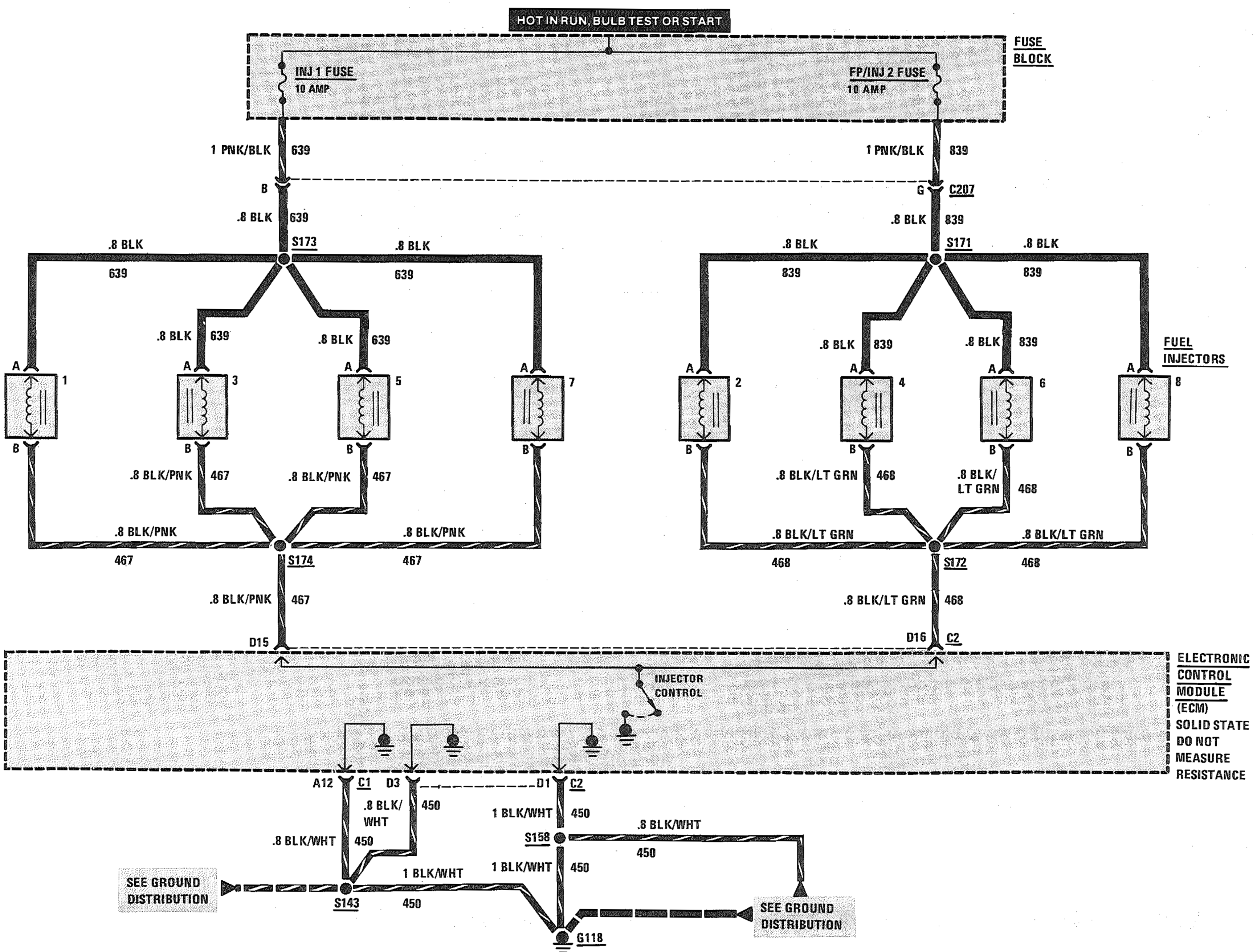
MULTI-PORT FUEL INJECTION: V8 VIN 8

SPARK CONTROL



MULTI-PORT FUEL INJECTION: V8 VIN 8

FUEL INJECTORS



COMPONENT LOCATION

Component	Location	Page-Figure
AIR Diverter Valve (VIN F) (VIN 8)	RH front of engine, on valve cover	201- 6-A
AIR Select Valve (VIN F) (VIN 8)	RH front of engine, on valve cover	201- 6-A
Assembly Line Diagnostic Link (ALDL) Connector	On bottom of I/P hush panel, to right of steering column	
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Burn-Off Relay	LH rear corner of engine compartment, on relay bracket	201- 7-A
Canister Purge Solenoid Valve (VIN F) (VIN 8)	Lower RH front corner of engine compartment	201- 5-A
Cold Start Injector (VIN F) (VIN 8)	Top LH side of engine	201- 7-A
Cold Start Switch (VIN F) (VIN 8)	Top center of engine	201- 8-C
Coolant Temperature Sensor (VIN F) (VIN 8)	Top LH front of engine	201- 8-C
Detonation Sensor (VIN F) (VIN 8)	Lower RH side of engine, above Starter Solenoid	201- 5-A
EGR Vacuum Sensor Diagnostic Connector	Top rear of engine	201- 4-E
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Electronic Spark Control (ESC) Module (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Electronic Spark Timing (EST) Distributor (VIN F) (VIN 8)	Top rear of engine	201- 5-A
Exhaust Gas Recirculation (EGR) Solenoid (VIN F) (VIN 8)	Top RH rear of intake manifold	201- 5-A
Fuel Injectors	Top of engine, at each intake cylinder	
Fuel Pump Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Fuel Pump Switch (VIN F) (VIN 8)	Lower LH side of engine	201- 8-A
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Idle Air Control Stepper Motor (VIN F) (VIN 8)	Top LH front of engine	201- 8-C
Ignition Coil (VIN F)(VIN 8)	RH rear side of engine	201- 7-B
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
In-Line Fuse (VIN F)(VIN 8)	On LH side of radiator support, forward of battery	201- 5-C

COMPONENT LOCATION

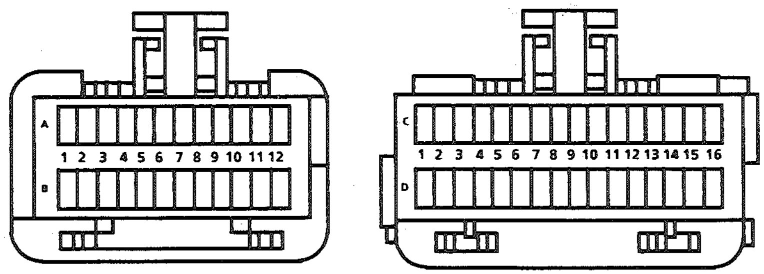
Component	Location	Page-Figure
Manifold Air Temperature (MAT) Sensor (VIN F) (VIN 8)	Top of intake manifold	
Mass Air Flow (MAF) Relay (VIN F) (VIN 8)	LH rear corner of engine compartment, on relay bracket	201- 7-A
Mass Air Flow (MAF) Sensor (VIN F) (VIN 8)	Front of engine compartment, on rear of air cleaner	201- 5-A
Oxygen Sensor (VIN F) (VIN 8)	Lower LH side of engine, on exhaust manifold	
Throttle Position Sensor (VIN F) (VIN 8)	Top center of engine	201- 8-C
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C113 (1 cavity) (VIN F) (VIN 8)	Taped to engine harness, RH front of dash	201- 5-A
C114 (1 cavity) (VIN F) (VIN 8)	Taped to engine harness, above rear of engine	201- 7-B
C143 (1 cavity) (VIN F) (VIN 8)	Lower LH side of engine, below exhaust manifold	201- 8-A
C172 (2 cavities)	Top rear of engine	201- 4-E
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S142 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S145 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S146 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S158	Engine harness, behind RH side of I/P	
S162	Engine harness, LH rear corner of engine compartment	201- 7-A
S164	I/P harness, above Fuse Block	201-10-A
S166 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S168 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S171	Engine harness, RH front of dash	201- 6-A
S172 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A

COMPONENT LOCATION

		Page-Figure
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S242	I/P harness, behind RH side of I/P	201-13-A
S276	I/P harness, behind RH side of I/P	201-13-A
S173	Engine harness, top center rear of engine	201- 7-A
S174 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A
S175 (VIN F) (VIN 8)	Engine harness, above LH rear of engine	201- 7-A
S176 (VIN F) (VIN 8)	Engine harness, behind RH side of I/P	
S180 (VIN F) (VIN 8)	Engine harness, above RH rear of engine	201- 7-B
S202	I/P harness, behind RH side of I/P	201-13-A
S204	I/P harness, behind instrument cluster	201-10-A

MULTI-PORT FUEL INJECTION: V8 VIN 8

ELECTRONIC CONTROL MODULE CONNECTORS



C1 BLK ELECTRONIC CONTROL MODULE (ECM) C2 BLK

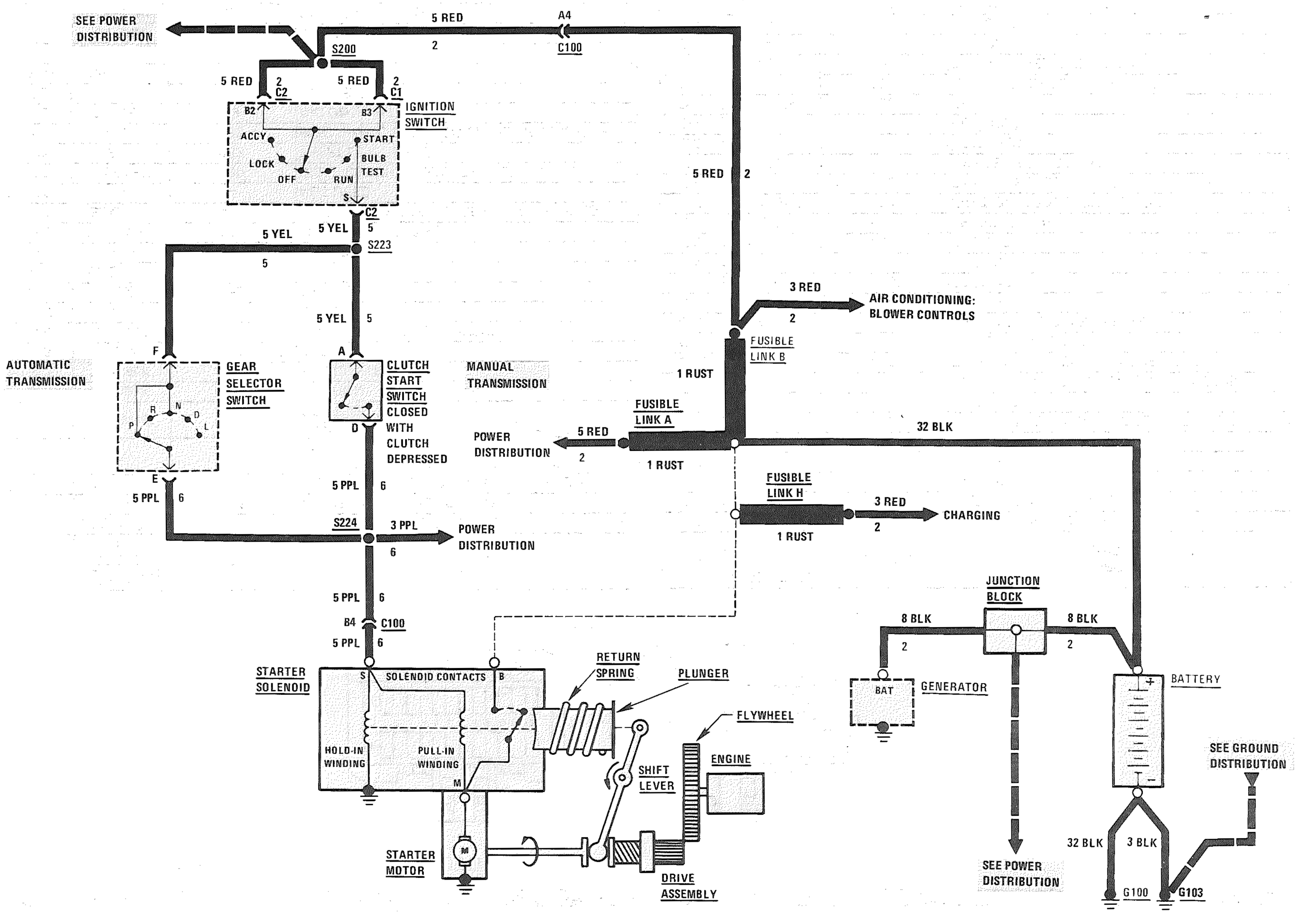
V00005.1

CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
A1	DK GRN/WHT	465	FUEL PUMP RELAY CONTROL
A2	BRN	436	AIR SELECT VALVE CONTROL
A3	DK GRN/YEL	428	CANISTER PURGE SOLENOID VALVE CONTROL
A4	GRY	435	EXHAUST GAS RECIRCULATION SOLENOID CONTROL
A5	BRN/WHT	419	"SERVICE ENGINE SOON" INDICATOR CONTROL
A6	PNK/BLK	439	IGNITION
A7	TAN/BLK	422	TCC CONTROL
A8	ORN	461	DATA
A9	WHT/BLK	451	DIAGNOSTIC "TEST" INPUT
A10	BRN	437	SPEED INPUT
A11	BLK	452	GROUND
A12	BLK/WHT	450	GROUND
B1	ORN	340	BATTERY
B2	TAN/WHT	120	FUEL PUMP CONTROL
B3	BLK/RED	453	DISTRIBUTOR REFERENCE PULSE INPUT: LO
B4	—	—	NOT USED
B5	PPL/WHT	430	DISTRIBUTOR REFERENCE PULSE INPUT: HI
B6	PPL	963	THEFT DETERRENT
B7	BLK	485	ELECTRONIC SPARK CONTROL INPUT (RETARD)
B8	DK GRN	59	A/C ON INPUT
B9	—	—	NOT USED
B10	ORN/BLK	434	PARK/NEUTRAL INPUT
B11	—	—	NOT USED
B12	DK GRN	998	MASS AIR FLOW SENSOR INPUT
C1	DK GRN/WHT	335	FAN CONTROL OUTPUT
C2	BLK/PNK	429	AIR DIVERTER VALVE CONTROL
C3	LT GRN/BLK	444	IDLE AIR CONTROL B LO
C4	LT GRN/WHT	443	IDLE AIR CONTROL B HI

CAVITY	WIRE COLOR SOCKET HALF	CIRCUIT NUMBER	CIRCUIT FUNCTION
C5	LT BLU/WHT	441	IDLE AIR CONTROL A HI
C6	LT BLU/BLK	442	IDLE AIR CONTROL A LO
C7	—	—	NOT USED
C8	DK GRN	446	TOP GEAR INPUT
C9	—	—	NOT USED
C10	YEL	410	COOLANT TEMPERATURE SENSOR INPUT
C11	—	—	NOT USED
C12	TAN	472	MANIFOLD AIR TEMPERATURE SENSOR INPUT
C13	DK BLU	417	THROTTLE POSITION SENSOR INPUT
C14	GRY	416	5 VOLT REFERENCE
C15	DK GRN	999	EGR VACUUM SENSOR SIGNAL
C16	ORN	340	BATTERY
D1	BLK/WHT	450	GROUND
D2	BLK	452	GROUND
D3	BLK/WHT	450	GROUND
D4	WHT	423	SPARK TIMING OUTPUT
D5	TAN/BLK	424	IGNITION MODULE BYPASS OUTPUT
D6	TAN	413	OXYGEN SENSOR GROUND
D7	PPL	412	OXYGEN SENSOR INPUT
D8	—	—	NOT USED
D9	—	—	NOT USED
D10	BLK/WHT	450	GROUND
D11	GRY	731	FAN PRESSURE SWITCH INPUT
D12	BLK	900	BURN-OFF RELAY CONTROL
D13	—	—	NOT USED
D14	—	—	NOT USED
D15	BLK/PNK	467	FUEL INJECTOR CONTROL
D16	BLK/LT GRN	468	FUEL INJECTOR CONTROL

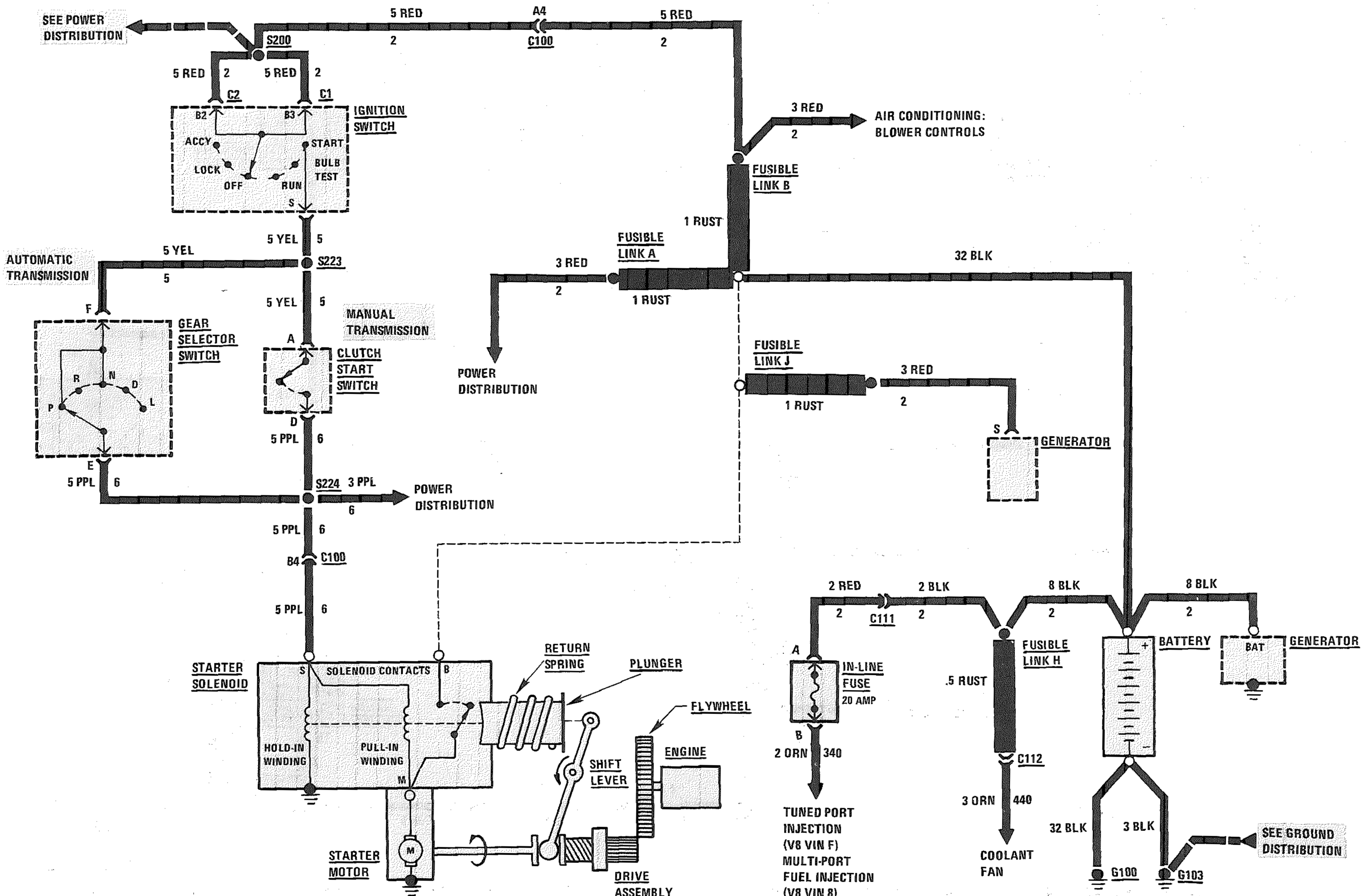
STARTER AND CHARGING SYSTEM: V6 VIN S

STARTER



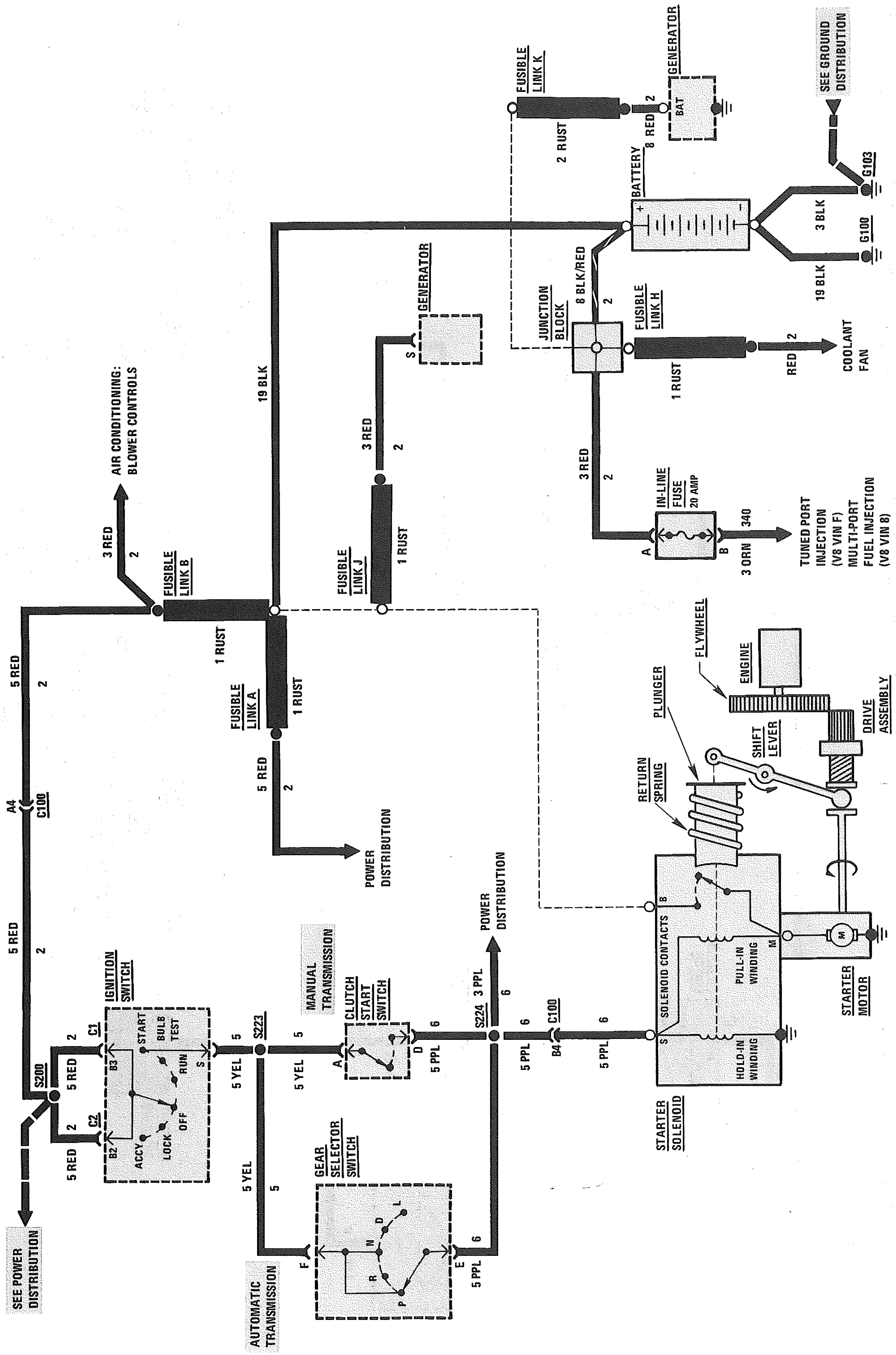
STARTER AND CHARGING SYSTEM: V8 VIN F, V8 VIN 8

STARTER



STARTER AND CHARGING SYSTEM: V8 VIN E

STARTER



TROUBLESHOOTING HINTS

STARTER

- **Try the following checks before doing the System Diagnosis.**

1. Check the hydrometer eye that is built into the vehicle Battery before troubleshooting the Starter System.
   — Green eye - Battery is charged.
   — Dark eye - Battery is discharged. Recharge Battery.
   — Clear or yellow eye - Battery fluid is low. Replace Battery.
2. Check that the Starter Solenoid terminals S and B and battery connections are clean and tight.
3. Check that grounds G100 and G103 are clean and tight.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

STARTER

NOTE: The following tests are designed for engines and batteries at normal operating temperatures and assumes that there are no engine symptoms which could cause a no start condition. To use the tests under other conditions could result in misdiagnosis.

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

COMPONENT LOCATION

Component	Location	Page-Figure
Clutch Start Switch	Above clutch pedal, on clutch pedal support	
Fusible Link A (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link A (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link A (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link B (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link B (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link B (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link H (VIN E)	RH front of engine compartment, at Junction Block	201- 3-B
Fusible Link H (VIN F) (VIN 8)	LH front of engine compartment, behind battery	201- 5-C
Fusible Link H (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link J (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link J (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link K	RH front of engine compartment, at Junction Block	201- 3-B
Gear Selector Switch	In console, at base of gear selector	201-11-E
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
In-Line Fuse (VIN E)	RH inner fender panel by battery	201- 3-B
In-Line Fuse (VIN F)(VIN 8)	On LH side of radiator support, forward of battery	201- 5-C
Junction Block	RH front of engine compartment, behind headlight	201- 1-A
Starter Solenoid (VIN E)	Lower RH side of engine	201- 2-A
Starter Solenoid (VIN F) (VIN 8)	Lower RH side of engine	201- 6-B
Starter Solenoid (VIN S)	Lower RH side of engine	201- 1-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C111 (1 cavity)	Behind battery, near positive battery cable	201- 7-A
C112 (1 cavity)	Behind battery, near positive battery cable	201- 7-A
G100 (VIN E)	RH front of engine	201- 4-B
G100 (VIN F) (VIN 8)	Lower LH front of engine.	201- 8-B
G100 (VIN S)	Lower LH front of engine.	201- 1-B
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G103 (VIN E)	RH inner fender panel, near battery	201- 3-B
S200	I/P harness, behind LH side of I/P	201-10-A

SYMPTOM TABLE

A: Engine does not crank and Starter Solenoid does not click
B: Starter Solenoid clicks, but engine does not crank or cranks slowly

COMPONENT LOCATION

		Page-Figure
S223	I/P harness, above Fuse Block	201- 9-A
S224	I/P harness, near LH shroud	

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 1)

Measure: VOLTAGE
At: STARTER SOLENOID
Conditions:
- Ignition Switch: START
- Gear Selector: PARK (Automatic Transmission)
- Clutch: DEPRESSED (Manual Transmission)

Measure Between	Correct Voltage	For Diagnosis
S (PPL) & Ground	Battery	See 1
S (PPL) & Starter Motor mounting bolts	Battery	See 2

- If all the voltages are correct, replace the Starter Solenoid. Refer to Section 6D for replacement procedures.

1. Go to Table 2 (Automatic Transmission) or Table 3 (Manual Tranmission).
2. Clean the Starter Motor mounting bolts and Starter Motor. Scrape off any excess paint, rust or dirt.

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 2—AUTOMATIC TRANSMISSION)

Measure: VOLTAGE
At: GEAR SELECTOR SWITCH CONNECTOR (Disconnected)
Condition:
- Ignition Switch: START

Measure Between	Correct Voltage	For Diagnosis
F (YEL) & Ground	Battery	See 1

- If voltage is correct, go to Table 4.

1. Go to Table 6.

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 3—MANUAL TRANSMISSION)

Measure: VOLTAGE
At: CLUTCH START SWITCH CONNECTOR (Disconnected)
Condition:
- Ignition Switch: START

Measure Between	Correct Result	For Diagnosis
A (YEL) & Ground	Battery	See 1

- If voltage is correct, go to Table 5.

1. Go to Table 6.

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 4—AUTOMATIC TRANSMISSION)

Connect: FUSED JUMPER
At: GEAR SELECTOR SWITCH CONNECTOR (Disconnected)
Condition:
- Ignition Switch: START

Jumper Between	Correct Result	For Diagnosis
F (YEL) & E (PPL)	Engine cranks	See 1

- If engine cranks, replace Gear Selector Switch. Check Gear Selector Switch adjustment before replacing with new switch.

1. Check/repair PPL (6) wire for an open.

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 5—MANUAL TRANSMISSION)

Connect: FUSED JUMPER
At: CLUTCH SWITCH CONNECTOR (Disconnected)
Condition:
- Ignition Switch: START

Jumper Between	Correct Result	For Diagnosis
A (YEL) & D (PPL) wires	Engine cranks	See 1

- If the engine cranks, check/replace the Clutch Start Switch.

1. Check/repair PPL (6) wire for an open.

A: ENGINE DOES NOT CRANK AND STARTER SOLENOID DOES NOT CLICK (TABLE 6)

Measure: VOLTAGE
At: IGNITION SWITCH CONNECTORS C1 & C2 (Connected)

Measure Between	Correct Result	For Diagnosis
B2 (RED) & Ground	Battery	See 1
B3 (RED) & Ground	Battery	See 1
• Turn the Ignition Switch to START		
S (YEL) & Ground	Battery	See 2

- If all the voltages are correct, check/repair YEL (5) wire for an open (see schematic).

1. Check RED (2) wire and Fusible Link B (see schematic).
2. Replace Ignition Switch.

B: STARTER SOLENOID CLICKS BUT ENGINE DOES NOT CRANK OR CRANKS SLOWLY (TABLE 1)

Measure: VOLTAGE
At: BATTERY TERMINALS
Conditions:
- Battery fully charged
- Fuses INJ1 and FP/INJ 2: REMOVED
- Ignition Switch: START
- Engine being cranked

Measure Between	Correct Voltage	For Diagnosis
Positive & Negative Battery Terminals	Greater than 9.5 volts	See 1

- If the voltage is correct, go to Table 2.

1. Refer to Section 6D for Battery Load Test. Remove Starter Assembly for repairs if the Battery is OK.

B: STARTER SOLENOID CLICKS BUT ENGINE DOES NOT CRANK OR CRANKS SLOWLY (TABLE 2)

Measure: VOLTAGE
At: BATTERY CABLES
Conditions:
- Battery fully charged
- Fuses INJ1 and FP/INJ 2: REMOVED
- Ignition Switch: START
- Engine being cranked

Measure Between	Correct Voltage	For Diagnosis
Negative Battery Terminal & Engine Block	Less than .5 volts	See 1
Positive Battery Terminal & Starter Solenoid Terminal B	Less than .5 volts	See 2

- If both voltages are correct, remove the Starter Assembly for repairs. Refer to Section 6D.

1. Replace negative battery cable.
2. Replace positive battery cable.

CIRCUIT OPERATION

STARTER

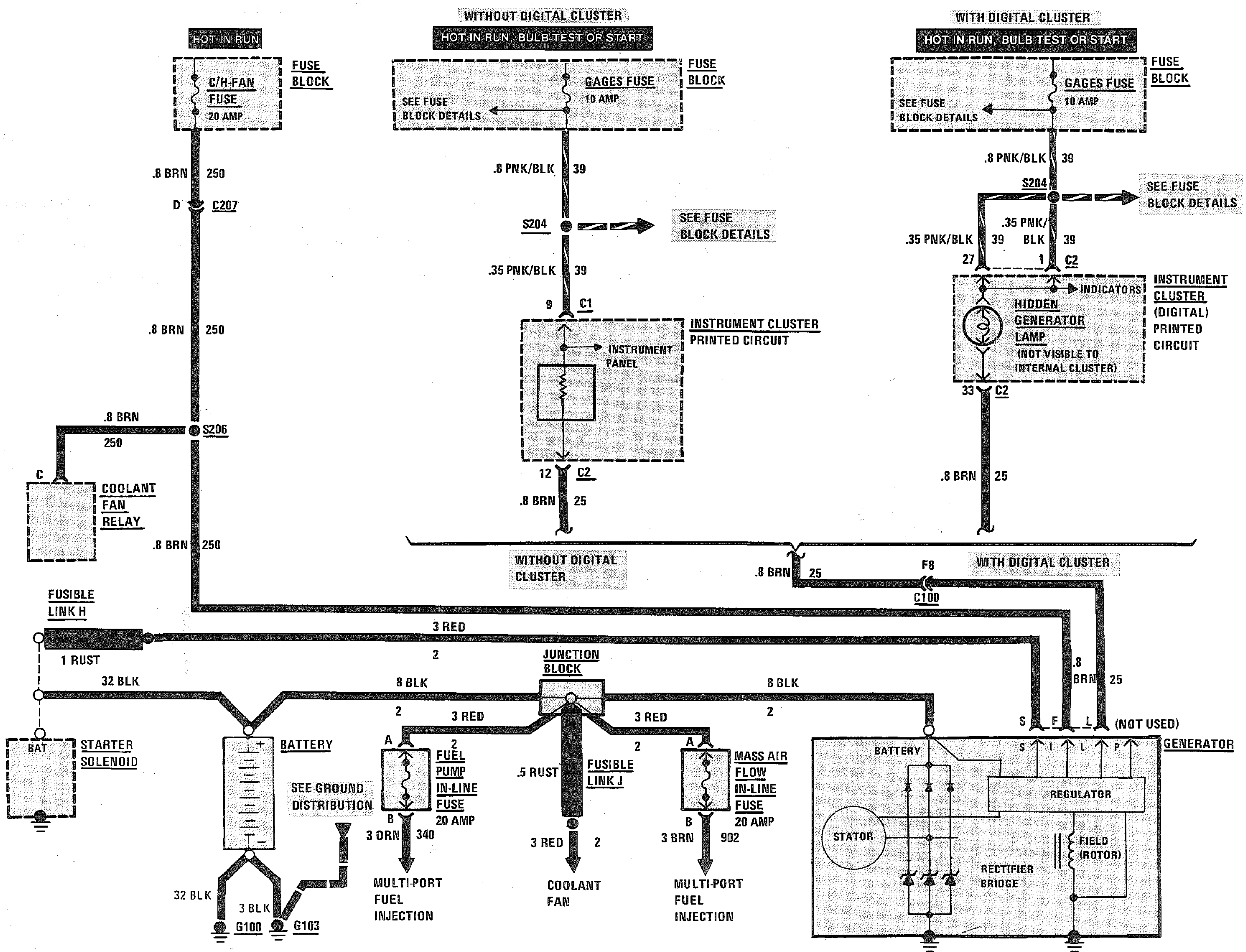
When the Ignition Switch is moved to the START position with the Gear Selector Switch in PARK or NEUTRAL (automatic transmission) or the Clutch Start Switch closed (manual transmission), battery voltage is applied to the Starter Solenoid. Both solenoid windings are energized. The circuit through the Pull-In Winding is completed to ground through the Starter Motor. The windings work together magnetically to pull in and hold in the Plunger. The Plunger moves the Shift Lever. This action causes the Drive Assembly to rotate as it engages the Flywheel Gear on the engine. At the same time, the Plunger also closes the Solenoid Switch contacts in the Starter Solenoid. Full battery voltage is applied directly to the Starter Motor and it cranks the engine.

As soon as the Solenoid Switch contacts close, current no longer flows through the Pull-In Winding since battery voltage is applied to both ends of the winding. The Hold-In Winding remains energized and its magnetic field is strong enough to hold the Plunger, Shift Lever, Drive Assembly, and Solenoid Switch contacts in place to continue cranking the engine.

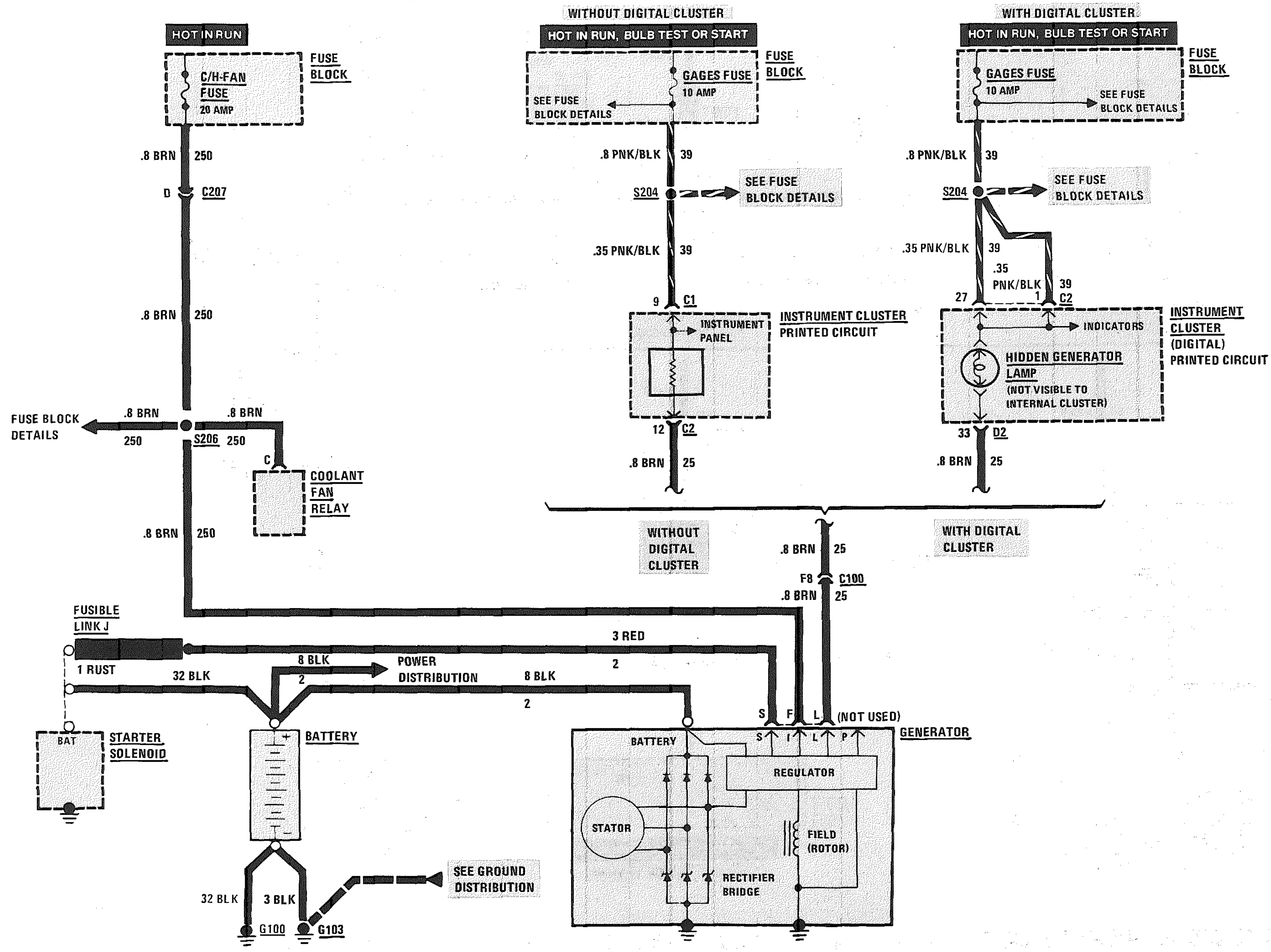
When the Ignition Switch is released from the START position, battery voltage is removed from the PPL wire and the junction of the two windings. Current flows from the motor contacts, through both windings, to ground at the end of the Hold-In Winding. However, the direction of current flow through the Pull-In Winding is now opposite to the direction of current flow when the winding was first energized. The magnetic fields of the Pull-In and Hold-In Windings now oppose one another. This action of the windings, with the help of the Return Spring, causes the starter Drive Assembly to disengage and Solenoid Switch contacts open, the Starter Circuit is turned off.

STARTER AND CHARGING SYSTEM: V6 VIN S

CHARGING

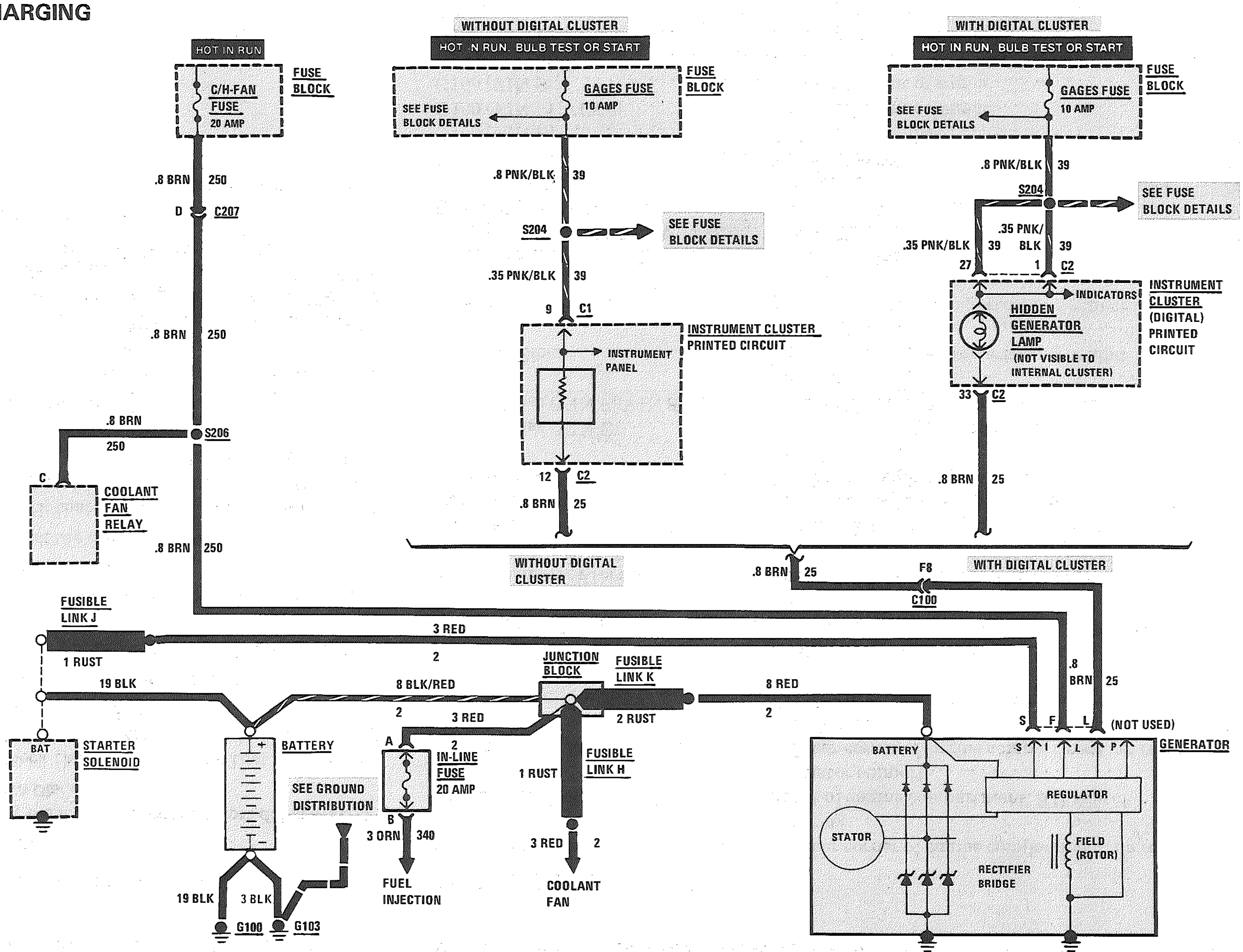


STARTER AND CHARGING SYSTEM: V8 VIN F, V8 VIN 8
CHARGING



STARTER AND CHARGING SYSTEM: V8 VIN E

CHARGING



TROUBLESHOOTING HINTS

CHARGING

- **Try the following checks before doing the System Diagnosis.**

1. Check the hydrometer eye that is built into the vehicle Battery before troubleshooting the Charging System.
   - Green eye - Battery is charged.
   - Dark eye - Battery is discharged. Recharge Battery.
   - Clear or yellow eye - Battery fluid is low. Replace Battery.
2. Check the Generator Belt.
3. Check that the Starter Solenoid terminal B and battery connections are clean and tight.
4. Check that the Generator connector is tight and that the Generator battery terminal is clean and tight.
5. Check the vehicle voltmeter (if equipped) to assure accurate voltage readings.
6. Check the GAGES Fuse. This check can be done by observing the BRAKE Warning Indicator with the Ignition Switch in RUN and the Park Brake applied.
7. Check the C/H-FAN Fuse.

- **Go to System Diagnosis for diagnostic tests.**

COMPONENT LOCATION

Component	Location	Page-Figure
Coolant Fan Relay (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 3-A
Coolant Fan Relay (VIN F) (VIN 8)	Front of engine compartment, RH side of radiator support	201- 5-A
Coolant Fan Relay (VIN S)	LH rear corner of engine compartment, on relay bracket	201- 0-A
Fuel Pump In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link H (VIN E)	RH front of engine compartment, at Junction Block	201- 3-B
Fusible Link H (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link J (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link J (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link J (VIN S)	RH side of radiator support, at Junction Block	201- 1-A
Fusible Link K	RH front of engine compartment, at Junction Block	201- 3-B
In-Line Fuse (VIN E)	RH inner fender panel by battery	201- 3-B
In-Line Fuse (VIN F)(VIN 8)	On LH side of radiator support, forward of battery	201- 5-C
Junction Block	RH front of engine compartment, behind headlight	201- 1-A
Mass Air Flow In-Line Fuse	RH side of engine compartment, on inner fender panel	201- 1-A
Starter Solenoid (VIN E)	Lower RH side of engine	201- 2-A
Starter Solenoid (VIN F) (VIN 8)	Lower RH side of engine	201- 6-B
Starter Solenoid (VIN S)	Lower RH side of engine	201- 1-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
G100 (VIN E)	RH front of engine	201- 4-B
G100 (VIN F) (VIN 8)	Lower LH front of engine	201- 8-B
G100 (VIN S)	Lower LH front of engine	201- 1-B
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G103 (VIN E)	RH inner fender panel, near battery	201- 3-B
S204	I/P harness, behind instrument cluster	201-10-A
S206 (VIN E)	Engine harness, RH front of dash	201- 2-A

(Continued on facing page)

SYSTEM DIAGNOSIS

CHARGING

- **Do the tests below if the Battery is undercharged or overcharged or if the vehicle voltmeter shows less than 12 volts or more than 16 volts with the engine running at fast idle.**

GENERATOR TEST (TABLE 1)

Measure: VOLTAGE
At: GENERATOR BATTERY TERMINAL AND GENERATOR CONNECTOR (Disconnected)
Conditions
- **Ignition Switch: RUN**

Measure Between	Correct Result	For Diagnosis
L (BRN) & Ground	Battery	See 1
F (BRN) & Ground (see schematic)	Battery	See 2
S (RED) & Ground	Battery	See 3
Battery Terminal & Ground	Battery	See 4

(Continued in next column)

(Continued from previous column)

- If all voltages are correct, reconnect the connector and go to Table 2.

1. Check GAGES Fuse, BRN (25) wire, PNK/BLK (39) wire and the Instrument Cluster Printed Circuit for an open or short to ground.
2. Check C/H-FAN FUSE and the BRN (250) wire for an open or short to ground (see schematic).
3. Check RED (2) wire and Fusible Link (see schematic) for an open or short to ground.
4. Check wiring from the battery positive terminal of the Generator (see schematic).

GENERATOR TEST (TABLE 2)

Measure: VOLTAGE
At: GENERATOR
Conditions:
- **Generator Connector: CONNECTED**
- **All accessories: OFF**
- **Engine running at fast idle**

Measure Between	Correct Result	For Diagnosis
Battery terminal & Ground	Less than 16 volts	See 1

- If the voltage is correct, perform a Generator Load Test. Refer to Section 6D. Perform a Battery Load Test if the Generator is good. Refer to Section 6D.

1. Repair/replace Generator. Refer to Section 6D.

COMPONENT LOCATION

		Page-Figure
S206 (VIN F)(VIN 8)	Engine harness, top center rear of engine	201- 7-A
S206 (VIN S)	Engine harness, above rear of engine	201- 1-A

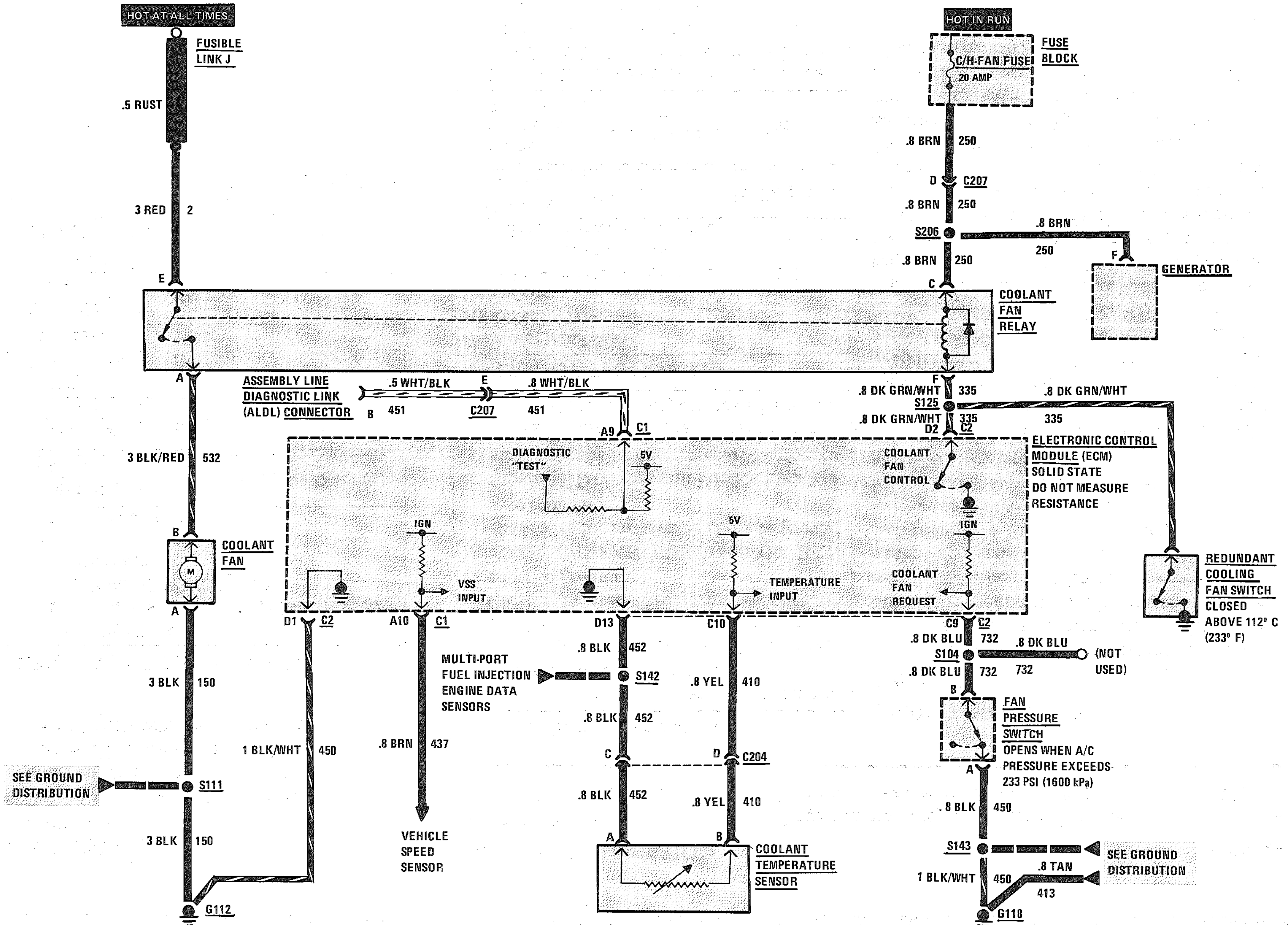
CIRCUIT OPERATION

CHARGING

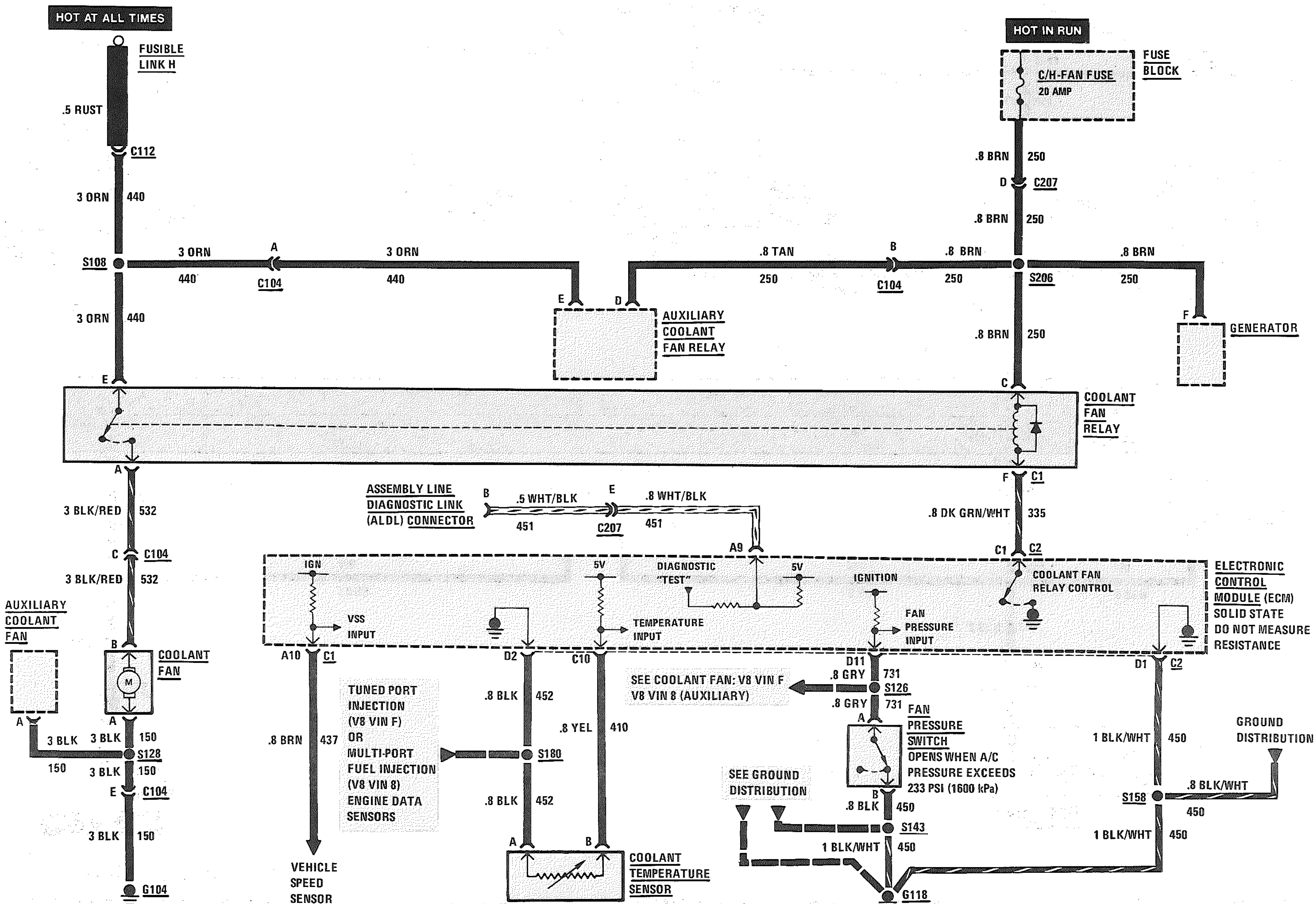
The Generator provides voltage to operate the car's electrical system and to charge its battery. A magnetic field is created when current flows through the Rotor. This field rotates as the Rotor is driven by the engine, creating an AC voltage in the Stator windings. The AC voltage is converted to DC by the rectifier bridge and is supplied to the electrical system at the Battery terminal.

The Generator's Regulator uses digital techniques to supply the Rotor current and thereby control the output voltage. The Rotor current is proportional to the width of the electrical pulses supplied by the Regulator. When the Ignition Switch is placed in RUN, voltage is supplied to terminals L and F, turning on the Regulator. Narrow width pulses are supplied to the Rotor, creating a weak magnetic field. When the engine is started, the Regulator senses Generator rotation by detecting AC voltage at the stator through an internal wire. Once the engine is running, the Regulator varies the field current by controlling the pulse width. This regulates the Generator output voltage for proper battery charging and electrical system operation.

COOLANT FAN: V6 VIN S

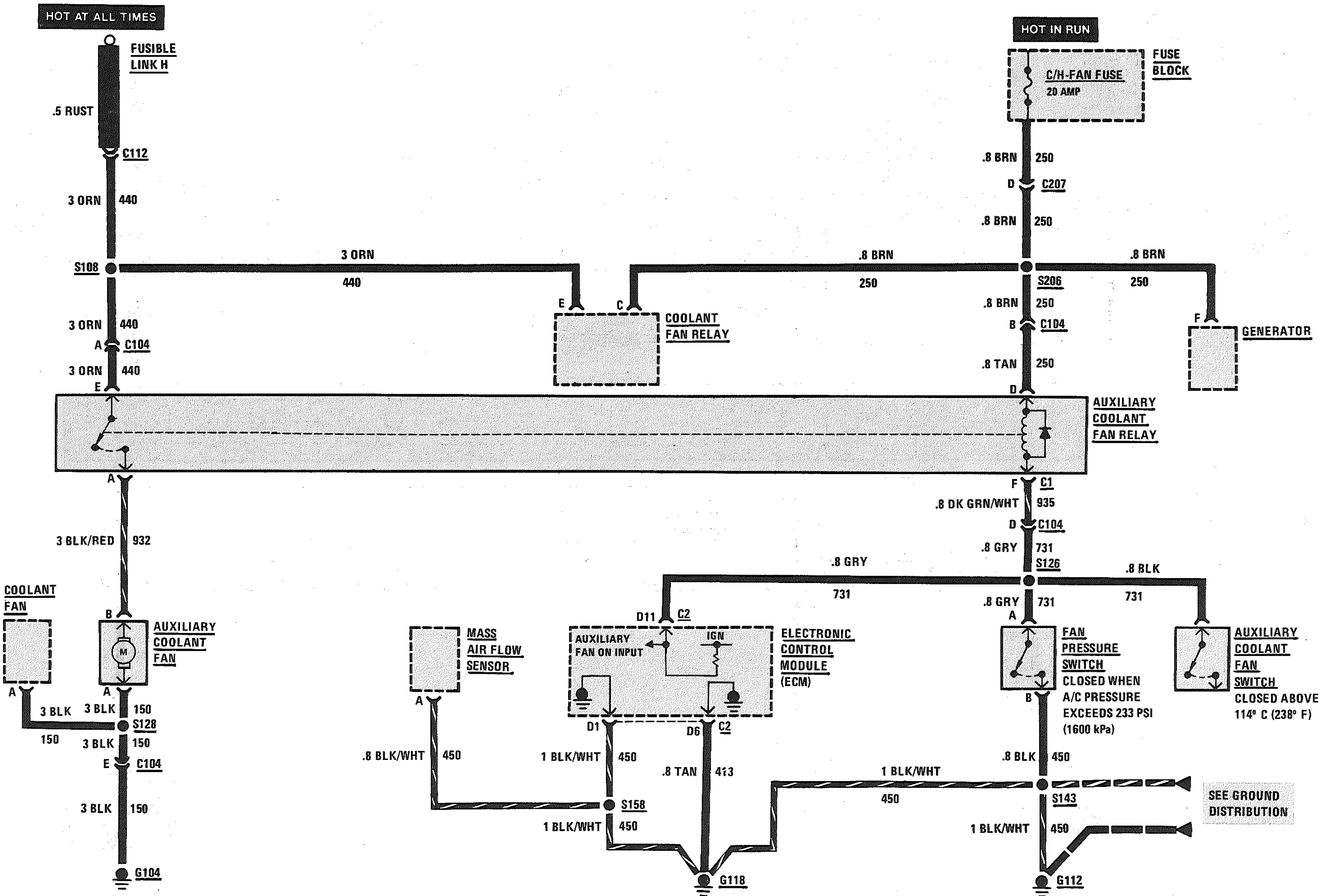


COOLANT FAN: V8 VIN F, V8 VIN 8

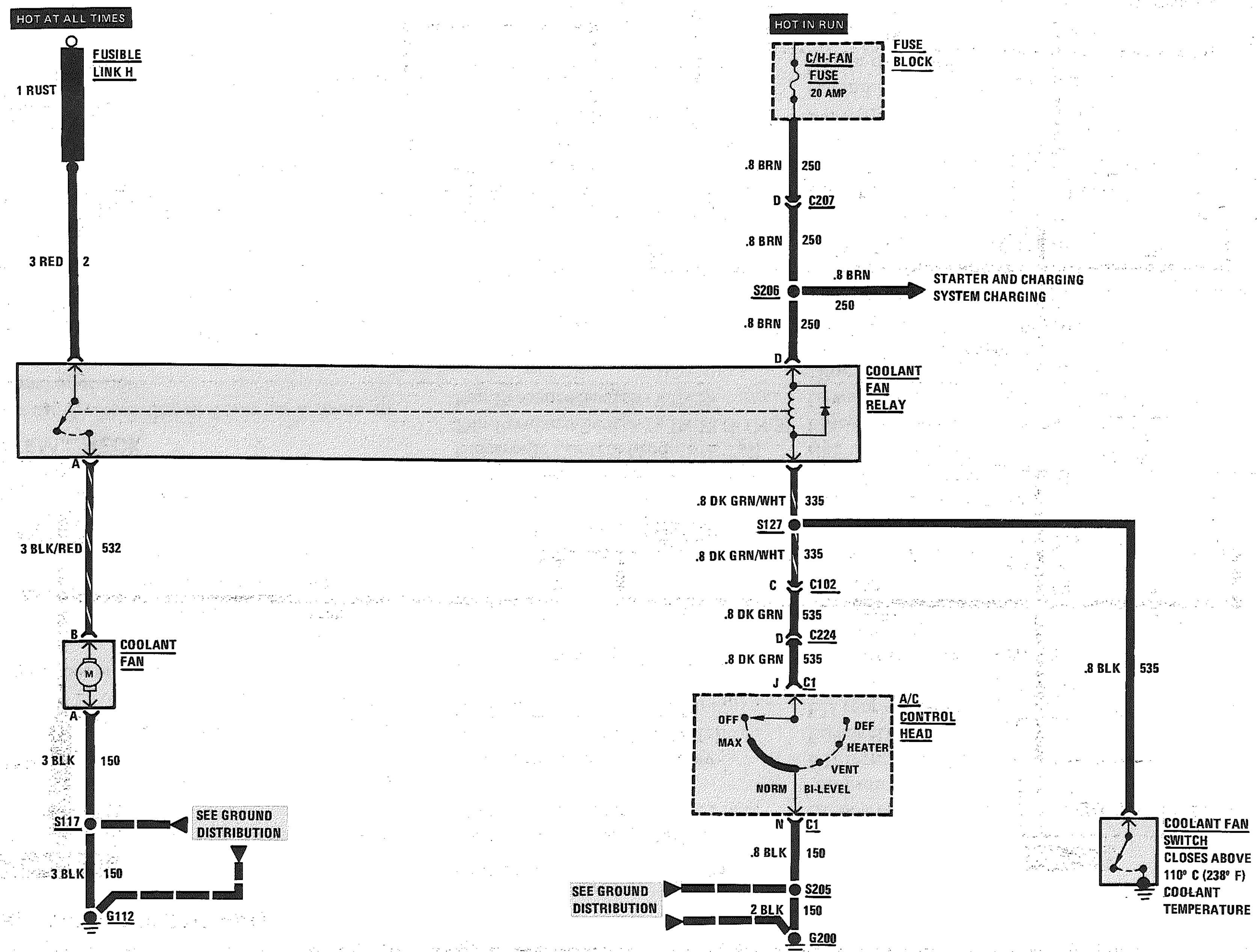


COOLANT FAN: V8 VIN F, V8 VIN 8

AUXILIARY COOLANT FAN



COOLANT FAN: V8 VIN E



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the C/H-FAN Fuse if the Coolant Fan does not run.
2. Check that ground G112 (V6 VIN S), G117 (V8 VIN E) or G104 (V8 VIN F and V8 VIN 8) is clean and tight.
3. Check the Fusible Link (see schematic).
4. If the Coolant Fan runs with the Ignition Switch OFF, replace the Coolant Fan Relay.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the engine cold and idling, turn the A/C Selector to NORM (if equipped with A/C)	VIN E: Coolant Fan turns on VIN S, VIN F & VIN 8: Coolant Fan (and Auxiliary Coolant Fan-if equipped) turns on when A/C Control Head Pressure exceeds 233 psi (1600 kPa)

(Continued on next page)

COMPONENT LOCATION

Component	Location	Page-Figure
Assembly Line Diagnostic Link (ALDL) Connector	On bottom of I/P hush panel, to right of steering column	
Auxiliary Coolant Fan Relay	RH front side of engine compartment	201- 5-A
Auxiliary Coolant Fan Switch	Lower RH rear of engine	201- 6-A
Coolant Fan Relay (VIN E)	LH rear corner of engine compartment, on relay bracket	201- 3-A
Coolant Fan Relay (VIN F) (VIN 8)	Front of engine compartment, RH side of radiator support	201- 5-A
Coolant Fan Relay (VIN S)	LH rear corner of engine compartment, on relay bracket	201- 0-A
Coolant Fan Switch	Lower RH rear of engine, above starter solenoid	201- 4-A
Coolant Temperature Sensor (VIN F) (VIN 8)	Top LH front of engine	201- 8-C
Coolant Temperature Sensor (VIN S)	Top LH front of intake manifold	201- 0-A
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Fan Pressure Switch (VIN F) (VIN 8)	Lower RH side of engine, on A/C line	201- 5-A
Fan Pressure Switch (VIN S)	Lower RH front of engine compartment, on A/C line	201- 1-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link H (VIN E)	RH front of engine compartment, at Junction Block	201- 3-B
Fusible Link H (VIN F) (VIN 8)	LH front of engine compartment, behind battery	201- 5-C
Fusible Link J (VIN S)	RH side of radiator support, at Junction Block	201- 1-A
Redundant Cooling Fan Switch	Top RH rear of engine	201- 1-C
C102 (4 cavities)	Center front of dash	201-14-A
C104 (6 cavities)	Front of engine compartment, RH side of radiator	201- 5-A
C204 (4 cavities)	Above LH rear corner of engine	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C224 (6 cavities)	Center of I/P, behind A/C control	201-14-B
G104	On radiator support, behind RH headlights	201-16-A
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G118 (VIN S)	Rear of RH cylinder head	201- 1-C

(Continued on next page)

COOLANT FAN

(Continued from previous page)

With the engine coolant below operating temperature, move the A/C Selector to OFF	VIN E: Coolant Fan turns off VIN S, VIN F & VIN 8: Coolant Fan (and Auxiliary Coolant Fan-if equipped) turns off when A/C Control Head Pressure falls below 233 psi (1600 kPa)
With the engine warm, run the engine at a fast idle for several minutes	Coolant Fan (and Auxiliary Coolant Fan-if equipped) turns on before the Coolant Temperature Indicator in the Instrument Panel lights or before the Coolant Temperature Gage needle indicates hot
Turn the Ignition Switch to off	Coolant Fan (and Auxiliary Coolant Fan-if equipped) turns off

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

V6 VIN S

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

COMPONENT LOCATION

		Page-Figure
G200	Behind I/P, left of steering column	201-10-A
S104 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S108	Engine harness, lower RH side of engine	201- 5-A
S111	Engine harness, RH rear of engine compartment	201- 1-A
S126	Engine harness, RH rear corner of engine compartment	201- 5-A
S127	Engine harness, RH front of dash	201- 2-A
S128	Cooling Fan harness, RH front corner of engine compartment	201- 6-A
S142 (VIN S)	Engine harness, lower RH side of engine	201- 1-A
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S158	Engine harness, behind RH side of I/P	
S205	I/P harness, behind instrument cluster	201-10-A
S206 (VIN E)	Engine harness, RH front of dash	201- 2-A
S206 (VIN F)(VIN 8)	Engine harness, top center rear of engine	201- 7-A
S206 (VIN S)	Engine harness, above rear of engine	201- 1-A

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Coolant Fan does not run at all	Do Test A
Coolant Fan does not run with engine hot but does run with the A/C on	Do Test B
Coolant Fan runs at all times with the engine cool and the A/C off	Do Test C

(Continued on next page)

COOLANT FAN

A: COOLANT FAN OPEN TEST (TABLE 1)

Connect: FUSED JUMPER
At: ALDL CONNECTOR
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
B & Ground	Coolant Fan runs	See 1

- If the result is correct, go to section 6E for ECM diagnosis.

1. Go to Table 2

A: COOLANT FAN OPEN TEST (TABLE 2)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
F (DK GRN/ WHT) & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs, check the DK GRN/WHT (335) wire for an open. If the wire is OK, go to section 6E for ECM diagnosis.

1. Go to Table 3.

A: COOLANT FAN OPEN TEST (TABLE 3)

Connect: TEST LAMP
At: COOLANT FAN RELAY CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
C (BRN) & Ground	Test Lamp lights	See 1
E (RED) & Ground	Test Lamp lights	See 2

- If the results are correct, go to Table 4.

1. Check C/H-FAN Fuse and BRN (250) wire for open.
2. Check Fusible Link J and RED (2) wire for opens.

A: COOLANT FAN OPEN TEST (TABLE 4)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
E (RED) & A (BLK/RED)	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 5.

A: COOLANT FAN OPEN TEST (TABLE 5)

Connect: TEST LAMP
At: COOLANT FAN CONNECTOR (Disconnected)
Condition:
- **Fused jumper from Table 4 connected**

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Coolant Fan.

1. Check BLK/RED (532) wire for an open.
2. Check BLK (150) wire for an open.

B: COOLANT FAN SWITCH TEST

Connect: FUSED JUMPER
At; REDUNDANT COOLING FAN SWITCH CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
DK GRN/ WHT & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Redundant Cooling Fan Switch, then refer to Section 6E for ECM diagnosis.

1. Check the DK GRN/WHT (335) wire for an open (see schematic).

C: COOLANT FAN SHORT TEST

1. With the Ignition Switch in RUN, remove the Redundant Cooling Fan Switch connector.

- If the Coolant Fan does not turn off, go to Step 2.
- If the Coolant Fan turns off, replace the Redundant Cooling Fan Switch.

2. Remove the C/H-FAN Fuse.

- If the Coolant Fan turns off, check the DK GRN/WHT (335) wires for a short to ground. Refer to Section 6E for ECM diagnosis if the wires are OK.
- If the Coolant Fan does not turn off, replace the Coolant Fan Relay.

SYSTEM DIAGNOSIS

V8 VIN F AND V8 VIN 8

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Coolant Fan does not run at all	Do Test A
Coolant Fan runs at all times with the A/C off and engine cool	Do Test B
Auxiliary Coolant Fan does not run at all	Do Test C
Auxiliary Coolant Fan runs at all times with A/C off and the engine cool	Do Test D

(Continued in next column)

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A: COOLANT FAN OPEN TEST (TABLE 1)

Connect: FUSED JUMPER
At: ALDL CONNECTOR
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
B & Ground	Coolant Fan runs	See 1

- If the result is correct, go to Section 6E for ECM diagnosis.

1. Go to Table 2.

A: COOLANT FAN OPEN TEST (TABLE 2)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
F (DK GRN/ WHT) & Ground	Coolant Fan runs	See 1

(Continued in next column)

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- If the Coolant Fan runs, check the DK GRN/WHT (335) wire for an open. If wire is OK, go to Section 6E for ECM diagnosis.

1. Go to Table 3.

A: COOLANT FAN OPEN TEST (TABLE 3)

Connect: TEST LAMP
At: COOLANT FAN RELAY CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
C (BRN) & Ground	Test Lamp lights	See 1
E (ORN) & Ground	Test Lamp lights	See 2

- If the results are correct, go to Table 4.

1. Check C/H-FAN Fuse and BRN (250) wire for opens.
2. Check Fusible Link H and ORN (440) wire for opens.

(Continued on next page)

COOLANT FAN

A: COOLANT FAN OPEN TEST (TABLE 4)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
E (ORN) & A (BLK/RED)	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 5.

A: COOLANT FAN OPEN TEST (TABLE 5)

Connect: TEST LAMP
At: COOLANT FAN CONNECTOR (Disconnected)
Condition:
- Fused jumper in place from Table 4

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Coolant Fan.

1. Check BLK/RED (532) wire for an open.
2. Check BLK (150) wire for an open.

B: COOLANT FAN SHORT TEST

With the Ignition Switch in RUN, remove the C/H-FAN Fuse.

- If the Coolant Fan turns off, check the DK GRN/WHT (335) wire for a short to ground. If the wire is OK, refer to Section 6E for ECM diagnosis.
- If the Coolant Fan does not turn off, replace the Coolant Fan Relay.

C: AUXILIARY COOLANT FAN OPEN TEST (TABLE 1)

Connect: FUSED JUMPER
At: AUXILIARY COOLANT FAN RELAY CONNECTOR (Connected)
Condition:
- Ignition Switch: RUN

Jumper Between	Correct Result	For Diagnosis
F (DK GRN/ WHT) & Ground	Auxiliary Coolant Fan runs	See 1

- If the Auxiliary Coolant Fan runs, check the DK GRN/WHT (935) and GRY (731) wires for opens. If wires are good, check switches.

1. Go to Table 2.

C: AUXILIARY COOLANT FAN OPEN TEST (TABLE 2)

Connect: TEST LAMP
At: AUXILIARY COOLANT FAN RELAY CONNECTOR (Disconnected)
Condition:
- Ignition Switch: RUN

Connect Between	Correct Result	For Diagnosis
D (ORN) & Ground	Test Lamp lights	See 1
E (ORN) & Ground	Test Lamp lights	See 2

- If the results are correct, go to Table 3.

1. Check ORN (440) and BRN (250) wires for opens.
2. Check ORN (440) wires for opens.

C: AUXILIARY COOLANT FAN OPEN TEST (TABLE 3)

Connect: FUSED JUMPER
At: AUXILIARY COOLANT FAN RELAY CONNECTOR (Disconnected)

Jumper Between	Correct Result	For Diagnosis
E (ORN) & A (BLK/RED)	Auxiliary Coolant Fan runs	See 1

- If the Auxiliary Coolant Fan runs, replace the Auxiliary Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 5.

C: AUXILIARY COOLANT FAN OPEN TEST (TABLE 4)

Connect: TEST LAMP
At: AUXILIARY COOLANT FAN CONNECTOR (Disconnected)
Condition:
- Fused jumper in place from Table 4

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Auxiliary Coolant Fan.

1. Check BLK/RED (932) wire for an open.
2. Check BLK (150) wire for an open.

D: AUXILIARY COOLANT FAN SHORT TEST

1. With the Ignition Switch in RUN, disconnect the Auxiliary Coolant Fan Switch.
- If the Auxiliary Coolant Fan does not turn off, go to Step 2.
- If the Auxiliary Coolant Fan turns off, replace the Auxiliary Coolant Fan Switch.
2. Disconnect the Fan Pressure Switch.
- If the Auxiliary Coolant Fan does not turn off, go to Step 3.
- If the Auxiliary Coolant Fan turns off, replace the Fan Pressure Switch.
3. Remove the C/H-FAN Fuse.
- If the Auxiliary Coolant Fan does not turn off, replace the Auxiliary Coolant Fan Relay.
- If the Auxiliary Coolant Fan turns off, check the DK GRN/WHT (935) and GRY (731) wires for a short to ground.

SYSTEM DIAGNOSIS

V8 VIN E

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Coolant Fan does not run with engine hot and the A/C on	Do Test A
Coolant Fan does not run with engine hot but does run with the A/C on	Do Test B
Coolant Fan does not run with the A/C on but does run with the engine hot	Do Test C
Coolant Fan runs at all times with A/C off and engine cool	Do Test D

A: COOLANT FAN OPEN TEST (TABLE 1)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR (Connected)
Condition:
- Ignition Switch: RUN

Jumper Between	Correct Result	For Diagnosis
F (DK GRN) & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs, check the DK GRN (335) wire for an open.

1. Go to Table 2.

A: COOLANT FAN OPEN TEST (TABLE 2)

Connect: TEST LAMP
At: COOLANT FAN RELAY CONNECTOR (Disconnected)
Condition:
- Ignition Switch: RUN

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
E (RED) & Ground	Test Lamp lights	See 2

- If the results are correct, go to Table 3.

1. Check C/H-FAN Fuse and BRN (250) wire for opens.
2. Check Fusible Link H and RED (2) wire for opens.

(Continued on next page)

A: COOLANT FAN OPEN TEST (TABLE 3)

Connect: FUSED JUMPER
At: COOLANT FAN RELAY CONNECTOR
(Disconnected)

Jumper Between	Correct Result	For Diagnosis
E (RED) & A (BLK/RED)	Coolant Fan runs	See 1

- If the Coolant Fan runs, replace the Coolant Fan Relay.

1. Leave fused jumper in place and go to Table 4.

A: COOLANT FAN OPEN TEST (TABLE 4)

Connect: TEST LAMP
At: COOLANT FAN CONNECTOR
(Disconnected)
Condition:
- Fused jumper in place from Table 3.

Connect Between	Correct Result	For Diagnosis
B (BLK/RED) & Ground	Test Lamp lights	See 1
B (BLK/RED) & A (BLK)	Test Lamp lights	See 2

- If the results are correct, replace the Coolant Fan.

1. Check BLK/RED (532) wire for an open.
2. Check BLK (150) wire for an open.

B: COOLANT FAN SWITCH TEST

Connect: FUSED JUMPER
At: COOLANT FAN SWITCH CONNECTOR
(Disconnected)
Condition:
- Ignition Switch: RUN

Jumper Between	Correct Result	For Diagnosis
BLK & Ground	Coolant Fan runs	See 1

- If the Coolant Fan runs replace the Coolant Fan switch.

1. Check BLK (335) wire for an open (see schematic).

C: A/C CONTROL HEAD TEST

Connect: FUSED JUMPER
At: A/C CONTROL HEAD CONNECTOR C1
(Disconnected)
Condition:
- Ignition Switch: RUN

Jumper Between	Correct Result	For Diagnosis
J (DK GRN) & Ground	Coolant Fan runs	See 1
J (DK GRN) & N (BLK)	Coolant Fan runs	See 2

- If the results are correct, replace the A/C Control Head.

1. Check DK GRN/WHT (335) and DK GRN (535) wires for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).

D: COOLANT FAN SHORT TEST

1. With the Ignition Switch in RUN, remove the Coolant Fan Switch.

- If the fan continues to run, go to step 2.
- If the fan turns off, replace the Coolant Fan Switch.

2. Remove the C/H-FAN Fuse.

- If the fan turns off, go to step 3.
- If the fan continues to run, replace the Coolant Fan Relay.

3. Disconnect the A/C Control Head and reconnect C/H-FAN Fuse.

- If the fan continues to run, check the DK GRN/WHT (335) and BLK (335) wires for a short to ground.
- If the fan turns off, replace the A/C Control Head.

CIRCUIT OPERATION

V6 VIN S, V8 VIN F and V8 VIN 8

The Coolant Fan is controlled by the Electronic Control Module (ECM). In the V6 VIN S, the Coolant Fan is also controlled by the Redundant Cooling Fan Switch. When the ECM grounds the 335 circuit, the Coolant Fan Relay is energized and battery voltage is applied to the Coolant Fan. If the ECM fails (V6 VIN S), the Redundant Cooling Fan Switch will ground the 335 circuit and energize the Coolant Fan Relay. The ECM will ground the Coolant Fan Relay when the Coolant Temperature Sensor indicates the coolant temperature is greater than 106 °C (222 °F) or when the A/C Control Head pressure is greater than 233 psi (1600 kPa) and the vehicle speed is less than 40 mph.

COOLANT FAN

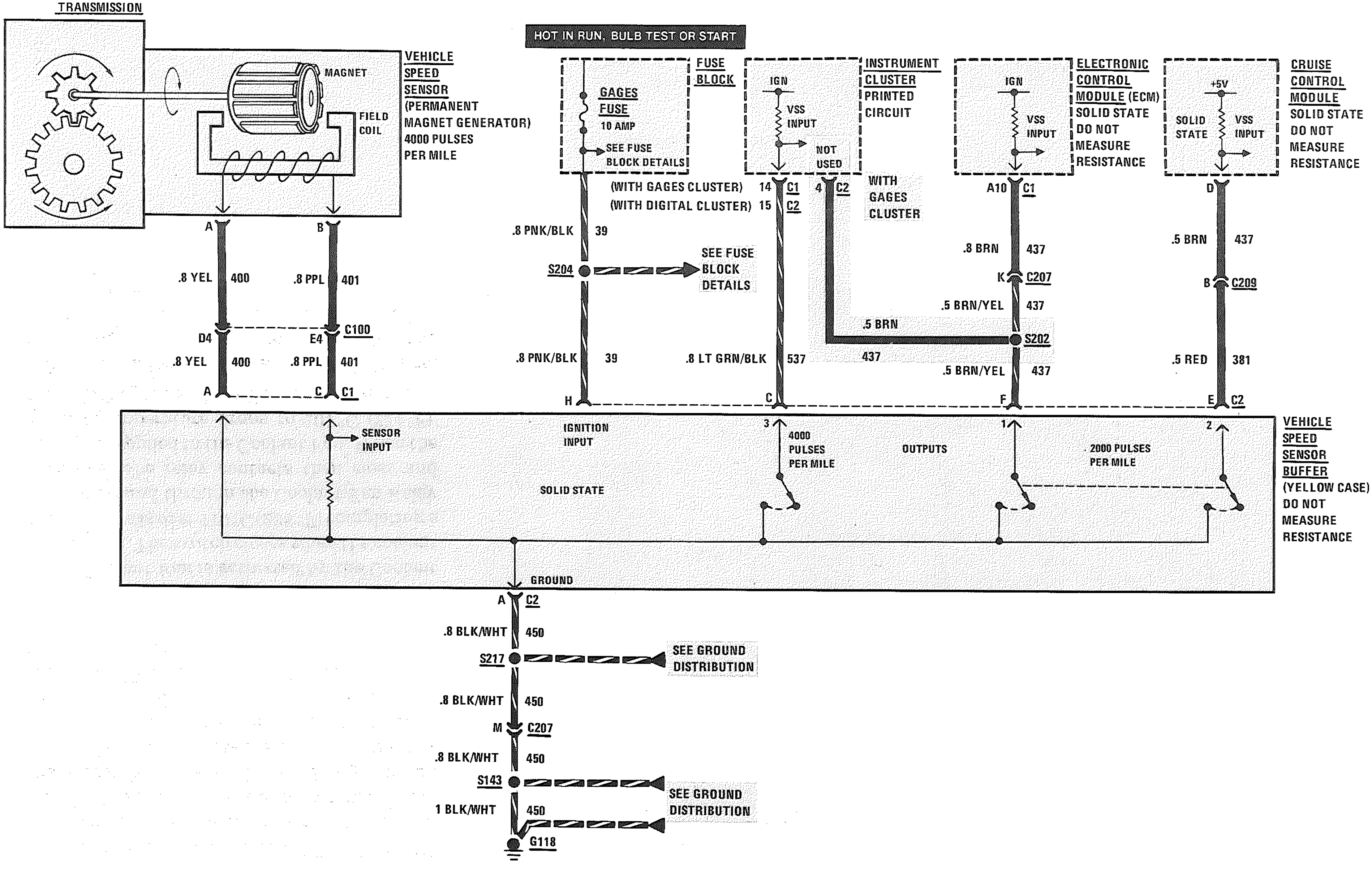
The Auxiliary Coolant Fan (V8 VIN F and V8 VIN 8) is controlled by the Fan Pressure Switch and the Auxiliary Coolant Fan Switch. If one of these switches closes, the Auxiliary Coolant Fan Relay is energized and the Auxiliary Coolant Fan is turned on. When a switch is closed, terminal D11 of ECM connector C2 is grounded. This tells the ECM that the Auxiliary Coolant Fan should be on.

V8 VIN E

The Coolant Fan is activated by the Coolant Fan Switch. The switch closes when the coolant temperature is over 110 °C (238 °F) completing a path to ground through the Coolant Fan Relay windings. The relay contacts then close and voltage is applied to the Coolant Fan. When the coolant temperature drops to 101 °C (214 °F), the switch opens and the Coolant Fan stops.

In A/C equipped vehicles, the A/C Control Head completes a path to ground for the Coolant Fan Relay. Voltage is then applied to the Coolant Fan.

VEHICLE SPEED SENSOR: PERMANENT MAGNET GENERATOR



VEHICLE SPEED SENSOR

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the Gages Fuse by observing the Brake Indicator when applying the Parking Brake with the Ignition Switch in RUN (engine not running).
2. Check ground G118.
3. If only the Speedometer or only the Odometer does not work, replace the suspect item.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

COMPONENT LOCATION

		Page-Figure
Cruise Control Module	Behind RH side of I/P	201-11-A
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Vehicle Speed Sensor	Lower LH rear of transmission	201- 8-D
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C209 (2 cavities)	Behind RH side of I/P, left of Cruise Control Module	201-11-A
G118 (VIN E)	Rear of RH cylinder head	201- 5-B
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
S143 (VIN E)	Engine harness, RH front of dash	201- 2-A
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S202	I/P harness, behind RH side of I/P	201-13-A
S204	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Speedometer does not operate properly, ECM Code 24 is not set	Do Test B
ECM Code 24 is set, Speedometer is good	Do Test C See Section 6E of Service Manual
Speedometer does not operate properly, and ECM Code 24 is set	Do Test A
Cruise Control does not operate properly, ECM Code 24 is not set	Do Test D

- **If your symptom is not listed in the Symptom Table, perform all the tests.**

VEHICLE SPEED SENSOR

A: VEHICLE SPEED SENSOR BUFFER TEST (TABLE 1)

Measure: VOLTAGE
At: VEHICLE SPEED SENSOR BUFFER CONNECTOR C2 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
H (PNK/BLK) & Ground	Battery	See 1
H (PNK/BLK) & A (BLK/WHT)	Battery	See 2

- If both voltages are correct, go to Table 2.

1. Check/repair PNK/BLK (39) wire for an open (see schematic).
2. Check/repair BLK/WHT (450) wire for an open (see schematic). Check that ground G118 is clean and tight.

A: VEHICLE SPEED SENSOR BUFFER TEST (TABLE 2)

Measure: AC VOLTAGE
At: VEHICLE SPEED SENSOR BUFFER CONNECTOR C1 (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Gear Selector: NEUTRAL**
- **Turn drive wheels by hand while making measurement**

Measure Between	Correct AC Voltage	For Diagnosis
A (YEL) & C (PPL)	1 volt AC to 5 volts AC	See 1

- If the voltage is correct, replace the Vehicle Speed Sensor Buffer.

1. Check/repair the YEL (400) and PPL (401) wires (see schematic). Replace Vehicle Speed Sensor if both wires are OK, and connector C100 is correctly mated.

B: INSTRUMENT CLUSTER INPUT TEST

Measure: VOLTAGE
At: VEHICLE SPEED SENSOR BUFFER CONNECTOR C2 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
C (LT GRN/BLK) & Ground	Battery	See 1
• Vehicle Speed Sensor Buffer: CONNECTED • Gear Selector: NEUTRAL • Turn drive wheels by hand while making measurement		
C (LT GRN/BLK) & Ground	Varying from less than 1 volt to more than 4 volts	See 2

- If voltages are correct, repair/replace Speedometer/Instrument Cluster.

1. Check LT GRN/BLK (537) wire for open or short to ground. If OK, repair/replace Instrument Cluster after verifying power inputs to Cluster (see Section 8A-81 or 82).
2. Replace Vehicle Speed Sensor Buffer.

C: ECM INPUT TEST

Measure: VOLTAGE
At: VEHICLE SPEED SENSOR BUFFER CONNECTOR C2 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
F (BRN/YEL) & Ground	Battery	See 1

- Vehicle Speed Sensor Buffer: CONNECTED
- Gear Selector: NEUTRAL
- Turn drive wheels by hand while making measurement

Measure Between	Correct Voltage	For Diagnosis
F (BRN/YEL) & Ground	Varying from less than 1 volt to more than 4 volts	See 2

- If voltages are correct, refer to Section 6E for further diagnosis.

1. Check BRN and BRN/YEL (437) wires for an open or short to ground. Also check that connections are good. If OK, replace ECM.
2. Replace Vehicle Speed Sensor Buffer.

D: CRUISE CONTROL INPUT TEST

Measure: VOLTAGE
At: VEHICLE SPEED SENSOR BUFFER CONNECTOR C2 (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Cruise Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
E (RED) & Ground	5 volts	See 1

- Vehicle Speed Sensor Buffer: CONNECTED
- Gear Selector: NEUTRAL
- Turn drive wheels by hand while making measurement

Measure Between	Correct Voltage	For Diagnosis
E (RED) & Ground	Varying from less than 1 volt to more than 2.5 volts	See 2

- If voltages are correct, refer to Cruise Control, Section 8A-34 for further diagnosis. If Section 8A-34 refers you back to this section (Vehicle Speed Sensor, 8A-33), replace Cruise Control Module.

1. Check RED (381) wire for open or short to ground. If wire is good, replace Cruise Control Module.
2. Replace Vehicle Speed Sensor Buffer.

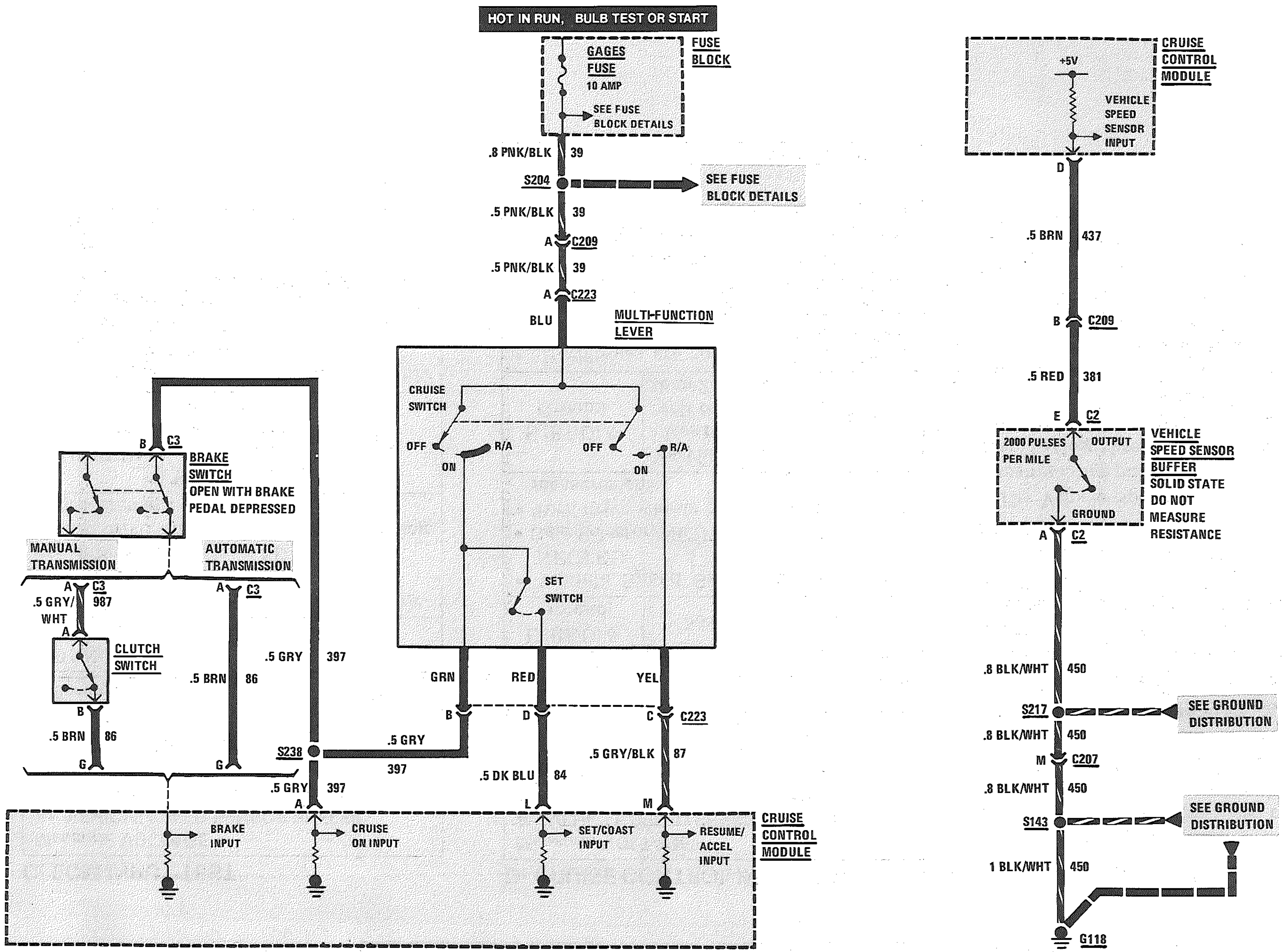
CIRCUIT OPERATION

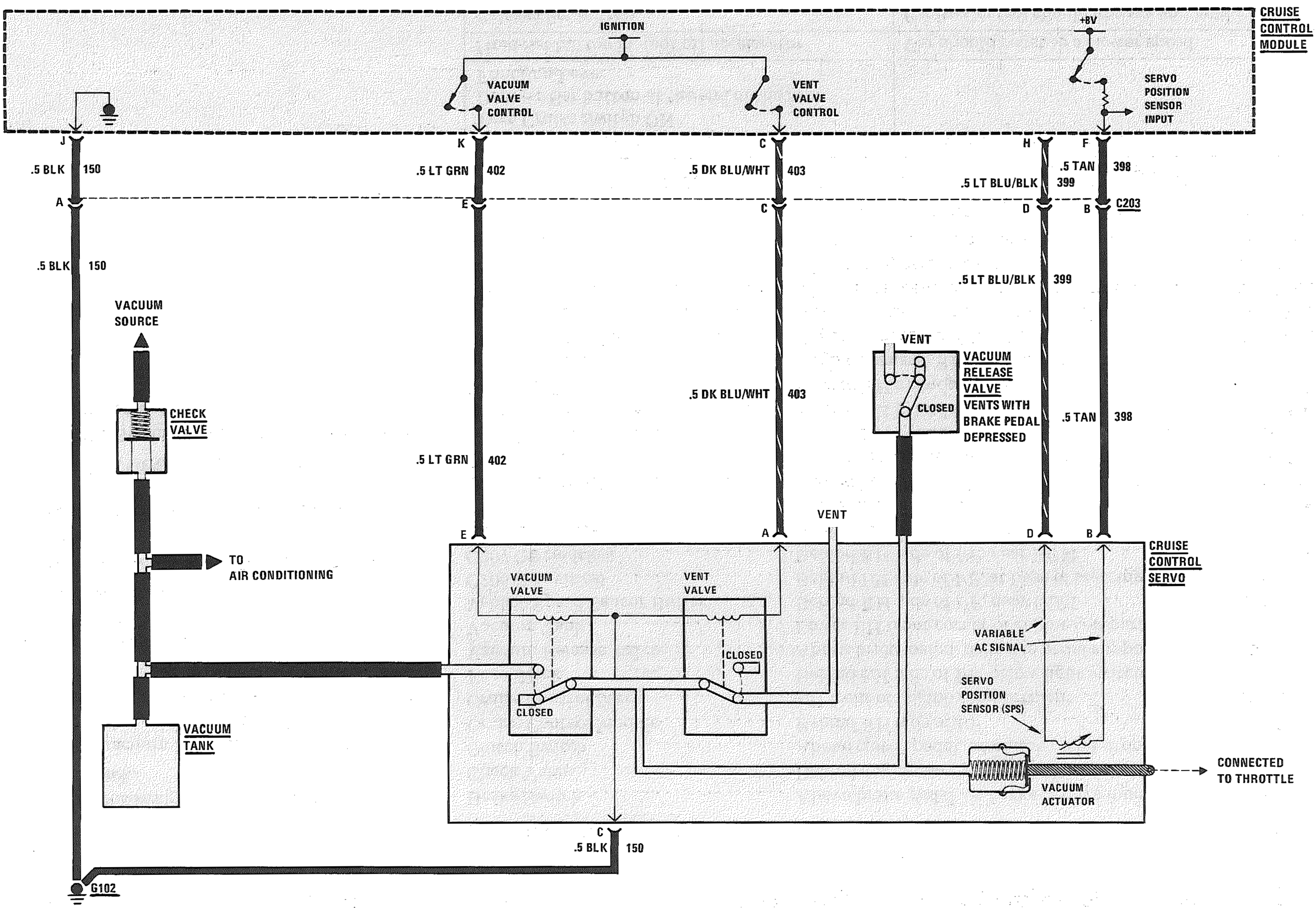
The Vehicle Speed Sensor (VSS) generates a signal that indicates the speed of the vehicle. This signal is processed by the solid state Vehicle Speed Sensor Buffer to supply inputs to the Electronic Control Module (ECM), the Cruise Control Module and the Speedometer.

The Vehicle Speed Sensor is mounted in the Transmission. A magnet rotates near a coil, producing voltage pulses in the coil. The frequency of the AC voltage coming from this coil depends on the vehicle speed. As the speed increases, so does the number of voltage pulses per second.

The Vehicle Speed Sensor Buffer takes the sensor/voltage pulses from the sensor and uses them to close three solid state output switches. Each output terminal is switched to ground at a rate that is proportional to the speed of the car. The sensor generates 4000 pulses per mile (ppm). The Speedometer is switched at a frequency of 4000 ppm. The ECM and the Cruise Control use a lower frequency, 2000 pulses per mile. Their output pulses are operated by a circuit after it has divided the sensor frequency by two.

CRUISE CONTROL




CRUISE CONTROL MODULE
IGNITION
+8V
VACUUM VALVE CONTROL
VENT VALVE CONTROL
SERVO POSITION SENSOR INPUT
J
K
C
H
F
.5 BLK 150
.5 LT GRN 402
.5 DK BLU/WHT 403
.5 LT BLU/BLK 399
.5 TAN 398
A
E
C
D
B
C203
.5 BLK 150
.5 LT BLU/BLK 399
VACUUM SOURCE
CHECK VALVE
VENT
VACUUM RELEASE VALVE VENTS WITH BRAKE PEDAL DEPRESSED
CLOSED
.5 DK BLU/WHT 403
.5 TAN 398
.5 LT GRN 402
VENT
E
A
D
B
TO AIR CONDITIONING
CRUISE CONTROL SERVO
VACUUM VALVE
VENT VALVE
CLOSED
CLOSED
VARIABLE AC SIGNAL
SERVO POSITION SENSOR (SPS)
VACUUM TANK
CONNECTED TO THROTTLE
VACUUM ACTUATOR
C
.5 BLK 150
G102

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check vacuum hose for leaks, kinks, and/or restrictions. Also check Cruise Control Servo linkage. Refer to Section 9 for vacuum hose routing and servo linkage adjustments.
2. If the system works except for the Tap-Up and Tap-Down functions, replace the Cruise Control Module.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK (ROAD TEST)

- **Use the System Check Table as a guide to normal operation.**

COMPONENT LOCATION

Component	Location	Page-Figure
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Check Valve	Behind engine, to right of master brake cylinder	201-15-A
Clutch Switch	Above clutch pedal, on clutch pedal support	201-10-B
Cruise Control Module	Behind RH side of I/P	201-11-A
Cruise Control Servo	LH front of engine compartment	201-15-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Vacuum Release Valve	Above brake pedal, on brake pedal support	201-10-B
Vacuum Tank	Lower LH front corner of engine compartment	201-15-A
Vehicle Speed Sensor Buffer	Behind RH side of I/P, near ECM	201-13-A
C203 (6 cavities)	Behind LH side of I/P, at base of steering column	201-11-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C209 (2 cavities)	Behind RH side of I/P, left of Cruise Control Module	201-11-A
C223 (4 cavities)	Behind LH side of I/P, at base of steering column	201-11-A
G102	LH rear corner of engine compartment	201-15-A
G118 (VIN E)	Rear of RH cylinder head	201- 5-B
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
S143 (VIN E)	Engine harness, RH front of dash	201- 2-A
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S204	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S238	Cruise control harness, near Brake Switch	201-11-A

SYSTEM CHECK TABLE

ACTION	CORRECT RESULT
Drive car faster that 25 mph Turn Cruise Switch ON Depress Set button at the end of the Multi-Function Lever	Car should maintain speed
Hold Set button in, foot off accelerator	Car should coast to a slower speed
Release Set button	Cruise Control should engage and hold a slower speed, if the new speed remains above 25 mph
Slide Cruise Switch to R/A and hold it there	Car should accelerate

(Continued on facing page)

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Release Cruise Switch back to ON	Car should hold new faster speed
Tap brake pedal	Car should coast slower (Cruise disengages)
Slide Cruise Control Switch momentarily to R/A	Car should accelerate to former set speed
While cruising, accelerate, then remove foot from accelerator	Car should coast back to set speed
While cruising, tap Cruise Switch to R/A	Car should increase 1 mph for each tap, up to ten taps, then system must be reset to a new speed
While cruising, tap Set button	Car speed should decrease by 1 mph for each tap until 25 mph is reached when Cruise Control will not operate
Slide Cruise Switch to OFF	Cruise Control turns off

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Use the Isolation Test below to choose the proper diagnostic tests.**
- **Tests follow the Isolation Test.**
- **Note: Do not press both the SET and R/A Switches at the same time while the engine is running. If the Quick Checker displays a short light, release the switches immediately. Shorts can damage the Quick Checker.**

ISOLATION TEST

Connect: QUICK CHECKER (J-34185, SPECMO QC-3 OR EQUIVALENT) or VOLT-OHMMETER
At: CRUISE CONTROL MODULE CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Test with Quick Checker (J-34185 or equivalent) or Digital Meter**

Test	Condition	With Quick Checker, Correct Response	Without Quick Checker, Using a Digital Meter			For Different Response, Do Test:
			Meter Range	Connector Terminals	Correct Response	
1	Cruise Switch OFF	—	200 ohms	J & Ground	0 ohms	B
		All Lights Off	20 VDC	A & J	0 volts	A
			20 VDC	M & J	0 volts	

(ISOLATION TEST continued on next page)

(ISOLATION TEST continued from previous page)

Test	Condition	With Quick Checker, Correct Response	Without Quick Checker, Using a Digital Meter			For Different Response, Do Test
			Meter Range	Connector Terminals	Correct Response	
2	Cruise Switch ON	ON/OFF Light On	20 VDC	A & J	Battery voltage	B
		BRK Light On	20 VDC	G & J	Battery voltage	C
		VENT Light On	200 ohms	C & J	30 to 55 ohms	D
		VAC Light On	200 ohms	K & J	30 to 55 ohms	E
		SPS Light On	200 ohms	F & H	15 to 25 ohms	F
		RA Light Off	20 VDC	M & J	0 volts	A
		SC Light Off	20 VDC	L & J	0 volts	A
3	Cruise Switch ON, Set Switch pressed	SC Light On	20 VDC	L & J	Battery voltage	G
		VAC & SHORT Lights Off	200 ohms	K & J	30 to 55 ohms	H
4	Cruise Switch in R/A	ON/OFF Light On	20 VDC	A & J	Battery voltage	A
		RA Light On	20 VDC	M & J	Battery voltage	I
		VENT & SHORT Lights Off	200 ohms	C & J	30 to 55 ohms	J
5	Cruise Switch ON, drive wheels turned by hand	VSS Light flashes On and Off	20 VDC	A & D	Pulses between approximately battery voltage and less than 7 volts	K, L
6	Run engine for one minute, then turn it off. With Ignition Switch in RUN, and holding Cruise Switch in R/A, press Set Switch, wait for Servo to pull in and release Set Switch	Vacuum holds the servo all the way in	Connect fused jumper from C to M and from K to L before operating switches		Vacuum holds the servo all the way in	M
7	Quick Checker not connected	—	200 ohms	F & J	Over range	N

• If all the responses were correct, replace Cruise Control Module and check for proper operation.

TEST A: CRUISE SWITCH SHORT

Check for shorts to voltage in the wires to terminals G (BRN), A (GRY), M (GRY/BLK), L (DK BLU) of the Module (see schematic).

- If the wires are good, replace the Multi-Function Lever.

TEST B: POWER CIRCUIT OPEN

1. Check the GAGES Fuse.
2. Check that terminal J (BLK) is grounded.
3. Disconnect connector C235 and check for battery voltage at terminal A of the socket half with Ignition in RUN.

- If battery voltage is missing, check/repair PNK/BLK (239) wire.

4. Check continuity between terminals A (BLU) and B (GRN) of the pin half of connector C223 with the Cruise Switch ON.

- If the Switch is open, replace the Multi-Function Lever.

5. Check for an open in GRY (397) wire between terminal B of connector C223 and terminal A of the module connector.

TEST C: BRK CIRCUIT OPEN

1. Check for an open Brake Switch or Clutch Switch (see schematic)
2. Check for an open in the GRY (397) wire, BRN (86) wire or GRY/WHT (987) wire.

TEST D: VENT CIRCUIT OPEN

If you measured less than 30 ohms, perform Test J. Otherwise, remove the connector from the Cruise Control Servo. Measure the resistance between terminals A and C of the Servo.

- If it is greater than 55 ohms, replace the Servo.
- If it is less than 55 ohms, check for an open DK BLU/WHT (403) wire between terminal C of the Module and terminal A of the Servo. Check that terminal C (BLK) of the Servo connector is grounded (see schematic).

TEST E: VAC CIRCUIT OPEN

If you measured less than 30 ohms, perform Test H. Otherwise, remove the connector from the Cruise Control Servo. Measure the resistance between terminals E and C of the Servo.

- If it is more than 55 ohms, replace the Servo.
- If it is less than 55 ohms, check for an open in the LT GRN (402) wire between terminal K of the Module and terminal E of the Servo. Check that terminal C (BLK) of the Servo Connector is grounded (see schematic).

TEST F: SPS CIRCUIT OPEN

If you measured less than 15 ohms, perform Test N. Otherwise, remove the connector from the Cruise Control Servo. Measure the resistance between terminals B and D of the Servo.

- If it is more than 25 ohms, replace the Servo.
- If it is less than 25 ohms, check for an open in the LT BLU/BLK (399) wire between terminals H of the Module and terminal D of the Servo. Check for an open in the TAN (398) wire between terminal F of the Module and terminal B of the Servo.

TEST G: SC CIRCUIT OPEN

Disconnect C223 and check the switch continuity between terminals B (GRN) and D (RED) of the pin half with the Set Switch pressed.

- If the Switch is open, replace the Multi-Function Lever.
- If the switch is not open, check for an open in the DK BLU (84) wire between terminal D of connector C223 and terminal L of the Module.

TEST H: VAC CIRCUIT SHORT

Remove the connector from the Servo and measure resistance between terminals C and E of the Servo.

- If it is less than 30 ohms, replace the Servo.
- If it is 30 ohms or more, check for a short to ground in the LT GRN wire from terminal K of the Module to terminal E of the Servo.

(Continued on next page)

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TEST I: R/A CIRCUIT OPEN

Disconnect C223 and check switch continuity between terminals A (BLU) and C (YEL) of the pin half of the Cruise Switch in R/A.

- If the switch is open, replace the Multi-Function Lever.
- If the switch is not open, check for an open in the GRY/BLK (87) wire between terminal C of connector C223 at terminal M of the Module.

TEST J: VENT CIRCUIT SHORT

Remove the connector from the Servo and measure resistance between terminals A and C of the Servo.

- If it is less than 30 ohms, replace the Servo.
- If it is 30 ohms or more, check for a short to ground in the DK BLU/WHT wire from terminal C of the Module to terminal A of the Servo.

TEST K: VSS CIRCUIT OPEN

If the VSS light does not come on, or the voltage between terminals A (GRY) and D (BRN) remains less than 7 volts, check for an open in the BRN (437) wire or the RED (381) wire from the Vehicle Speed Sensor Buffer. Refer to page 33-0 for diagnosis of Vehicle Speed Sensor.

TEST L: VSS CIRCUIT SHORT

If the VSS lights does not go off or Battery voltage remains between terminals A (GRY) and D (BRN), check for a short to ground on the BRN (437) wire or the RED (381) wire from the Vehicle Speed Sensor Buffer. Refer to page 33-0 for diagnosis of Vehicle Speed Sensor.

TEST M: VACUUM SYSTEM

1. Check for a blocked or leaking vacuum source.
2. If the vacuum source is good, plug the Vacuum Release Port and repeat Test 6 of the Isolation Test.

- If the vacuum now holds the throttle open, replace or repair the Vacuum Release Valve or the hose to it.
- If the test still fails, replace the Cruise Control Servo.

TEST N: SPS CIRCUIT SHORT

Disconnect the Cruise Control Servo connector and repeat Test 7 of the Isolation Test.

- If the resistance is now over range, replace the Cruise Control Servo.
- If the resistance is still low, find and repair the short in the TAN wire from terminal F of the Cruise Control Module to terminal B of the Cruise Control Servo.

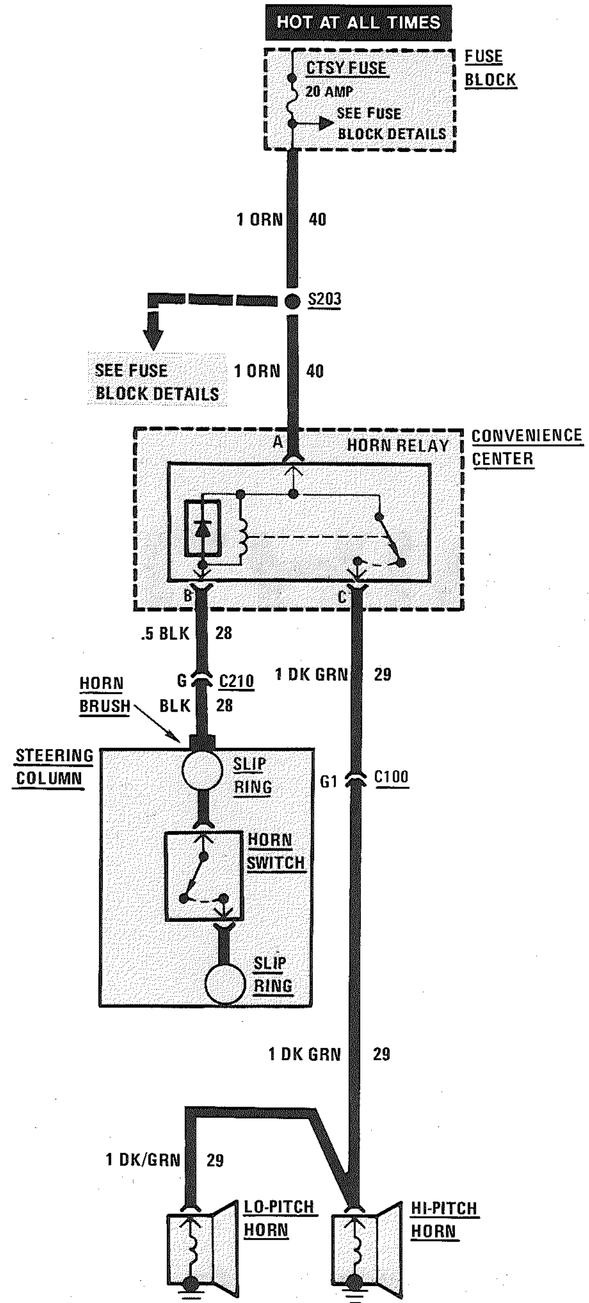
CIRCUIT OPERATION

The Cruise Control System operates a mechanical linkage to the throttle by means of a Vacuum Motor. This is a diaphragm moved by a vacuum applied to one side. A solenoid operated valve connects the Vacuum Motor to a Vacuum Tank. Another solenoid valve vents the vacuum to reduce the suction. The Cruise Control Module controls the Vacuum Motor and the throttle by pulsing these solenoid valves on and off.

One input to the Module is the vehicle speed. This input comes from the Vehicle Speed Sensor. If the actual speed signal is different from the speed that was set into and remembered by the Module, the Module generates pulses to change the vacuum and return the vehicle to the set speed. The Vehicle Speed Sensor is mounted on the Transmission. Other inputs to the Module are from the Cruise Switch and the Set Switch. A disengage input to the Module comes from a switch on the brake pedal. A seperate vacuum shut down of the Cruise Control comes from the Vacuum Release Valve on the brake pedal.

The two outputs of the Cruise Control Module operate the coils of the Vacuum Valve and the Vent Valve. Both valves are located in the Cruise Control Servo. These valves move the throttle be means of the Vacuum Motor. The Servo Position Sensor (SPS) coil senses the position and motion of the Vacuum Motor. It feeds this information back to the Module to provide smooth acceleration while the vehicle is in Cruise Control.

BLANK


HOT AT ALL TIMES
CTSY FUSE
20 AMP
SEE FUSE BLOCK DETAILS
FUSE BLOCK
1 ORN 40
S203
SEE FUSE BLOCK DETAILS
1 ORN 40
A
HORN RELAY
CONVENIENCE CENTER
B
C
.5 BLK 28
HORN BRUSH
G
C210
BLK 28
1 DK GRN 29
STEERING COLUMN
SLIP RING
G1
C100
HORN SWITCH
SLIP RING
1 DK GRN 29
1 DK/GRN 29
LO-PITCH HORN
HI-PITCH HORN

HORNS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. If the Horns do not sound at all, check the CTSY Fuse by operating the Cigar Lighter.
2. If only one Horn sounds, check the DK GRN (29) wire and the suspect Horn.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: The Horns sound continuously
B: None of the Horns sound

A: THE HORNS SOUND CONTINUOUSLY

Connect: TEST LAMP
At: CONVENIENCE CENTER
Condition:
- **Horn Relay disconnected**

Connect Between	Correct Result	For Diagnosis
A (ORN) & B (BLK)	Test Lamp off	See 1

- If the result is correct, replace the Horn Relay.

1. Check the BLK (28) wire and the Horn Switch for shorts (see schematic).

COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind I/P, to right of steering column	201-10-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Horn Switch	Below steering wheel hub	
Slip Ring	Below steering wheel hub	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C210 (11 cavities)	Behind I/P, on RH lower side of steering column	201- 9-A
S203	I/P harness, behind instrument cluster	201-10-A

B: NONE OF THE HORNS SOUND (TABLE 1)

Connect: TEST LAMP
At: CONVENIENCE CENTER
Condition:
- **Horn Relay disconnected**

Connect Between	Correct Result	For Diagnosis
A (ORN) & Ground	Test Lamp lights	See 1
• Horn Switch: ON		
A (ORN) & B (BLK)	Test Lamp lights	See 2

- If all the results are correct, go to Table 2.

1. Check the ORN (40) wire for an open (see schematic).
2. Check the BLK (28) wire and the Horn Switch for an open (see schematic).

B: NONE OF THE HORNS SOUND (TABLE 2)

Connect: FUSED JUMPER
At: CONVENIENCE CENTER
Condition:
- **Horn Relay disconnected**

Jumper Between	Correct Result	For Diagnosis
A (ORN) & C (DK GRN)	Both Horns Sound	See 1

- If the result is correct, replace the Horn Relay.

1. Leave fused jumper connected and go to Table 3.

(Continued on next page)

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B: NONE OF THE HORNS SOUND (TABLE 3)

Connect TEST LAMP
At: HORN CONNECTORS (Disconnected)
Condition:
- **Fused Jumper from Table 2 Connected**

Connect Between	Correct Result	For Diagnosis
Hi-Pitch Horn Connector & Ground	Test Lamp lights	See 1
Lo-Pitch Horn Connector & Ground	Test Lamp lights	See 1

- If all the results are correct, check/replace the suspect Horn(s).

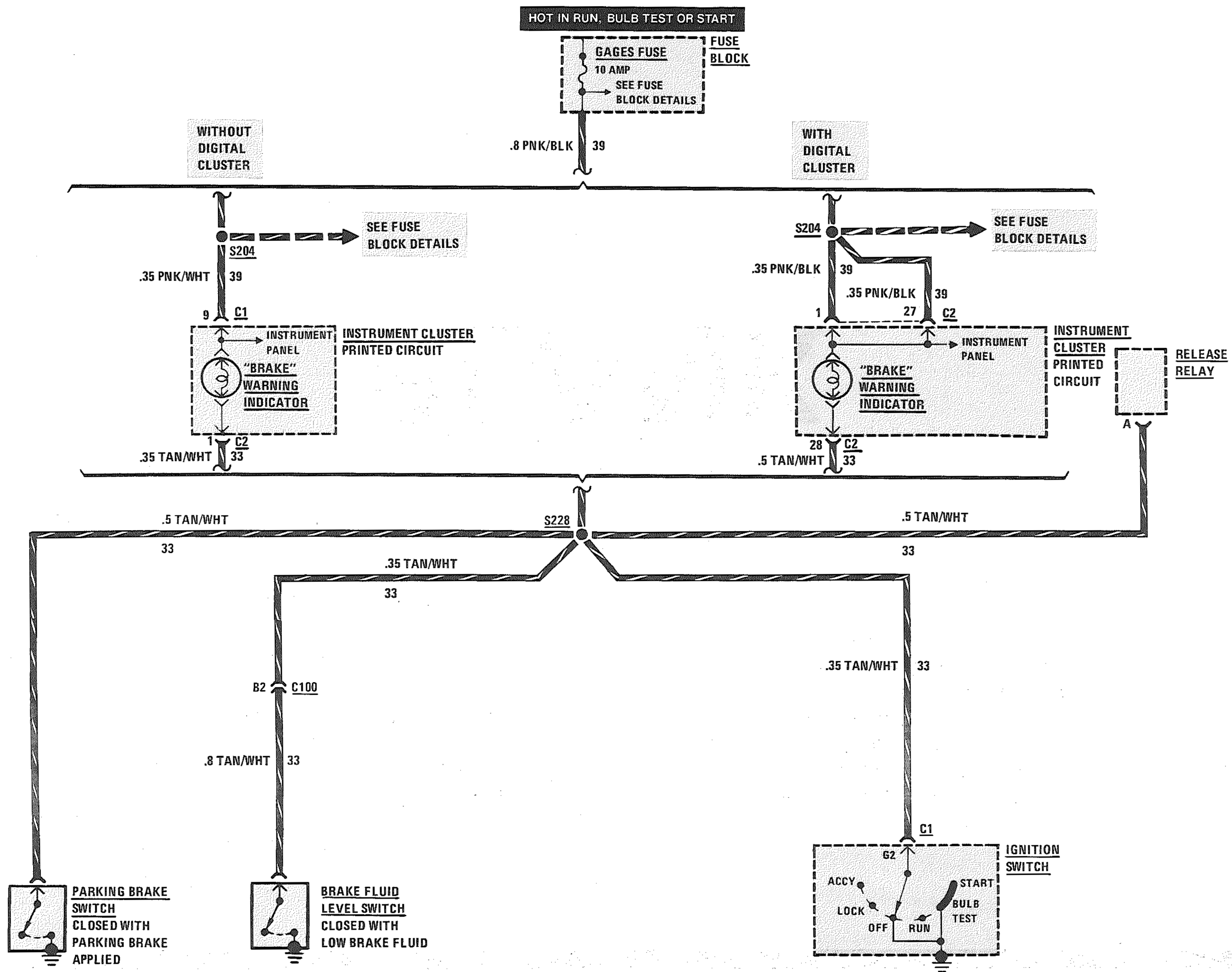
1. Check DK GRN (29) wire for an open (see schematic).

CIRCUIT OPERATION

Voltage is applied to the Horn Relay at all times. When the Horn Switch is depressed, the relay coil is grounded and the relay contacts close. Voltage is then applied to both Horns. The Horns sound.

BLANK

BRAKE WARNING SYSTEM



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

  Check the GAGES Fuse and PNK/BLK (39) wire by observing the VOLTS or SERVICE ENGINE SOON Indicator with the Ignition Switch in RUN and the engine OFF.
- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the park brake released, turn the Ignition Switch slowly past the RUN position to BULB TEST	BRAKE Warning Indicator lights
Release the Ignition Switch to the RUN position	BRAKE Warning Indicator does not light
With the Ignition Switch in RUN, apply the park brake	Brake Warning Indicator lights
Release the park brake	Brake Indicator does not light

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Brake Fluid Level Switch	Below brake fluid reservoir	201-16-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Parking Brake Switch	In console, at base of parking brake	201-12-D
Release Relay	Taped to I/P harness, behind RH side of I/P	201-13-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
S204	I/P harness, behind instrument cluster	201-10-A
S228	I/P harness, above Fuse Block	201-10-A

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A	BRAKE Indicator remains on with the Ignition Switch in RUN and the park brake off
B	BRAKE Indicator lights with the park brake applied, but does not light when brake fluid level is low
C	BRAKE Indicator does not light at all
D	BRAKE Indicator lights with the Ignition Switch in BULB TEST, but does not light when the park brake is applied
E	BRAKE Indicator lights with the park brake applied, but does not light when the Ignition Switch is in BULB TEST

A: BRAKE INDICATOR REMAINS ON WITH THE IGNITION SWITCH IN RUN AND THE PARK BRAKE OFF (TABLE 1)

Disconnect: CONNECTOR
At: BRAKE FLUID LEVEL SWITCH
Conditions:
- **Ignition Switch: RUN**
- **Park Brake: OFF**

Disconnect	Correct Result	For Diagnosis
Brake Pressure Switch connector	Brake Warning Indicator does not light	See 1

- If the result is correct, refer to Section 5 to test the Brake Hydraulic System. Replace the Brake Fluid Level Switch if the Brake Hydraulic System is OK.

1. Go to Table 2.

A: BRAKE INDICATOR REMAINS ON WITH THE IGNITION SWITCH IN RUN AND THE PARK BRAKE OFF (TABLE 2)

Disconnect: CONNECTOR
At: PARKING BRAKE SWITCH
Conditions:
- Ignition Switch: RUN
- Park Brake: OFF

Disconnect	Correct Result	For Diagnosis
Parking Brake Switch connector	Brake Warning Indicator does not light	See 1

- If the result is correct, check/replace the Parking Brake Switch

1. Check the Ignition Switch for a short to ground in the RUN position. If Ignition Switch is good, check TAN/WHT (33) wires for a short to ground.

B: BRAKE INDICATOR LIGHTS WITH THE PARK BRAKE APPLIED, BUT DOES NOT LIGHT WHEN BRAKE FLUID LEVEL IS LOW

Connect: FUSED JUMPER
At: BRAKE FLUID LEVEL SWITCH CONNECTOR
Conditions:
- Ignition Switch: RUN
- Park Brake: OFF

Connect Between	Correct Result	For Diagnosis
Brake Fluid Level Switch Connector & Ground	Brake Warning Indicator lights	See 1

- If the result is correct, check/replace the Brake Fluid Level Switch.

1. Check TAN/WHT (33) wire for an open.

C: BRAKE INDICATOR DOES NOT LIGHT AT ALL

Connect: FUSED JUMPER
At: CONNECTOR C100 (Connected)
Condition:
- Ignition Switch: RUN

Connect Between	Correct Result	For Diagnosis
B2 (TAN/ WHT) & Ground	Brake Warning Indicator lights	See 1

- If the result is correct, go to Tables C and D.

1. Check Indicator bulb, TAN/WHT (33) wire(s) and the Instrument Cluster Printed Circuit for an open.

D: BRAKE INDICATOR LIGHTS WITH THE IGNITION SWITCH IN BULB TEST, BUT DOES NOT LIGHT WHEN THE PARK BRAKE IS APPLIED

Connect: FUSED JUMPER
At: PARKING BRAKE SWITCH CONNECTOR
Conditions:
- Ignition Switch: RUN

Connect Between	Correct Result	For Diagnosis
Park Brake Switch connector & Ground	Brake Warning Indicator lights	See 1

- If the result is correct check/replace the Parking Brake Switch.

1. Check/repair TAN/WHT (33) wire for an open.

E: BRAKE INDICATOR LIGHTS WITH THE PARK BRAKE APPLIED, BUT DOES NOT LIGHT WHEN THE IGNITION SWITCH IS IN BULB TEST

Connect: FUSED JUMPER
At: IGNITION SWITCH CONNECTOR C1 (Connected)
Conditions:
- Ignition Switch: RUN
- Park Brake: OFF

Connect Between	Correct Result	For Diagnosis
G2 (TAN/WHT) & Ground	Brake Warning Indicator lights	See 1

- If the result is correct, check/replace the Ignition Switch.

1. Check/repair TAN/WHT (33) wire for an open.

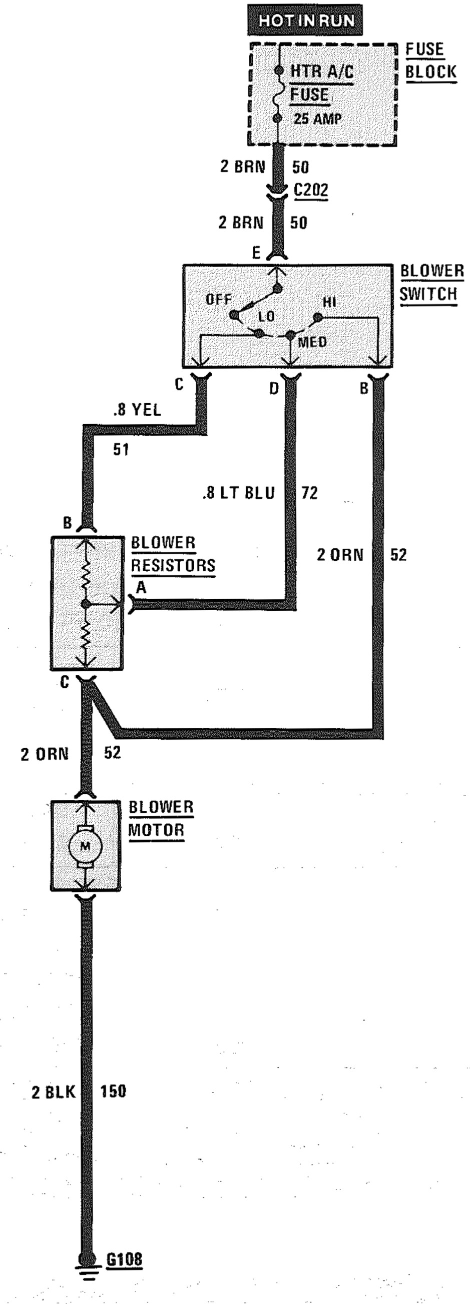
CIRCUIT OPERATION

Battery voltage is applied to the BRAKE Warning Indicator when the Ignition Switch is in RUN, BULB TEST, or START. Three switches are connected to the BRAKE Warning Indicator. When any one of these switches closes, ground is provided and the Indicator lights.

The Ignition Switch provides a ground when it is in the BULB TEST and START positions. The BRAKE Warning Indicator lights.

The Parking Brake Switch provides a ground when the park brake is applied. The BRAKE Warning Indicator lights to alert the driver.

The Brake Fluid Level Switch closes to light the BRAKE Warning Indicator when there is low brake fluid in one of the two hydraulic brake systems. This could be caused by a leak in one of the brake lines. The switch can be reset to an open condition by refilling the reservoir. This can only be accomplished after the faulty system has been repaired.


HOT IN RUN
FUSE BLOCK
HTR A/C FUSE
25 AMP
2 BRN 50
C202
2 BRN 50
E
BLOWER SWITCH
OFF
LO
HI
MED
C
D
B
.8 YEL
51
.8 LT BLU 72
2 ORN 52
B
BLOWER RESISTORS
A
C
2 ORN 52
BLOWER MOTOR
M
2 BLK 150
G108

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. If the Blower Motor does not operate at all, check the HTR A/C Fuse.
2. If the Blower Motor does not operate at all, check that G108 is clean and tight.
3. If the Blower Motor does not turn off, install a new Blower Switch.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the Ignition Switch in RUN, set the Blower Switch to OFF	Blower Motor does not operate
Set the Blower Switch to LO	Blower Motor operates at low speed
Set the Blower Switch to MED	Blower Motor operates at Medium speed
Set the Blower Switch to HI	Blower Motor operates at High speed

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Blower Motor (Without A/C)	RH front of dash, behind strut tower	201-14-D
Blower Resistors (Without A/C)	RH front side of heater housing	201-14-D
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C202 (1 cavity)	Behind center of I/P, near control head	201-14-C
G108	RH front of dash, above center of Blower Motor	201-14-D

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Blower Motor operates with the Blower Switch in OFF	Replace Blower Switch
Blower Motor does not operate at all	Do Test C
Blower Motor does not operate in HI but operates in LO and/ or MED	Do Test A Check ORN (52) wire for an open if Blower Switch is OK
Blower Motor does not operate in LO and/or MED but operates in HI	Do Test A Do Test B

- **If your symptom does not appear in the Sympton Table perform all of the Tests.**

A: BLOWER SWITCH TEST

Measure: VOLTAGE
At: BLOWER SWITCH CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
• Blower Switch: LO		
C (YEL) & Ground	Battery	See 2
• Blower Switch: MED		
D (LT BLU) & Ground	Battery	See 2
• Blower Switch: HI		
B (ORN) & Ground	Battery	See 2

(A: BLOWER SWITCH TEST continued on next page)

(A: BLOWER SWITCH TEST continued from previous page)

- If all results are correct, go to the Symptom Table.

1. Check/repair BRN (50) wire for an open (see schematic).
2. Replace the Blower Switch.

B: BLOWER RESISTORS TEST

Measure: VOLTAGE
At: BLOWER RESISTORS CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Blower Switch: LO**

Measure Between	Correct Voltage	For Diagnosis
B (YEL) & Ground	Battery	See 1
• Blower Switch: MED		
A (LT BLU) & Ground	Battery	See 2

- If all results are correct, replace the Blower Resistors.

1. Check/repair YEL (51) wire for an open (see schematic).
2. Check/repair LT BLU (72) wire for an open (see schematic).

C: BLOWER MOTOR TEST

Measure: VOLTAGE
At: BLOWER MOTOR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Blower Switch: HI**

Measure Between	Correct Voltage	For Diagnosis
ORN wire & Ground	Battery	See 1
ORN wire & BLK wire	Battery	See 2

- If all results are correct, replace the Blower Motor.

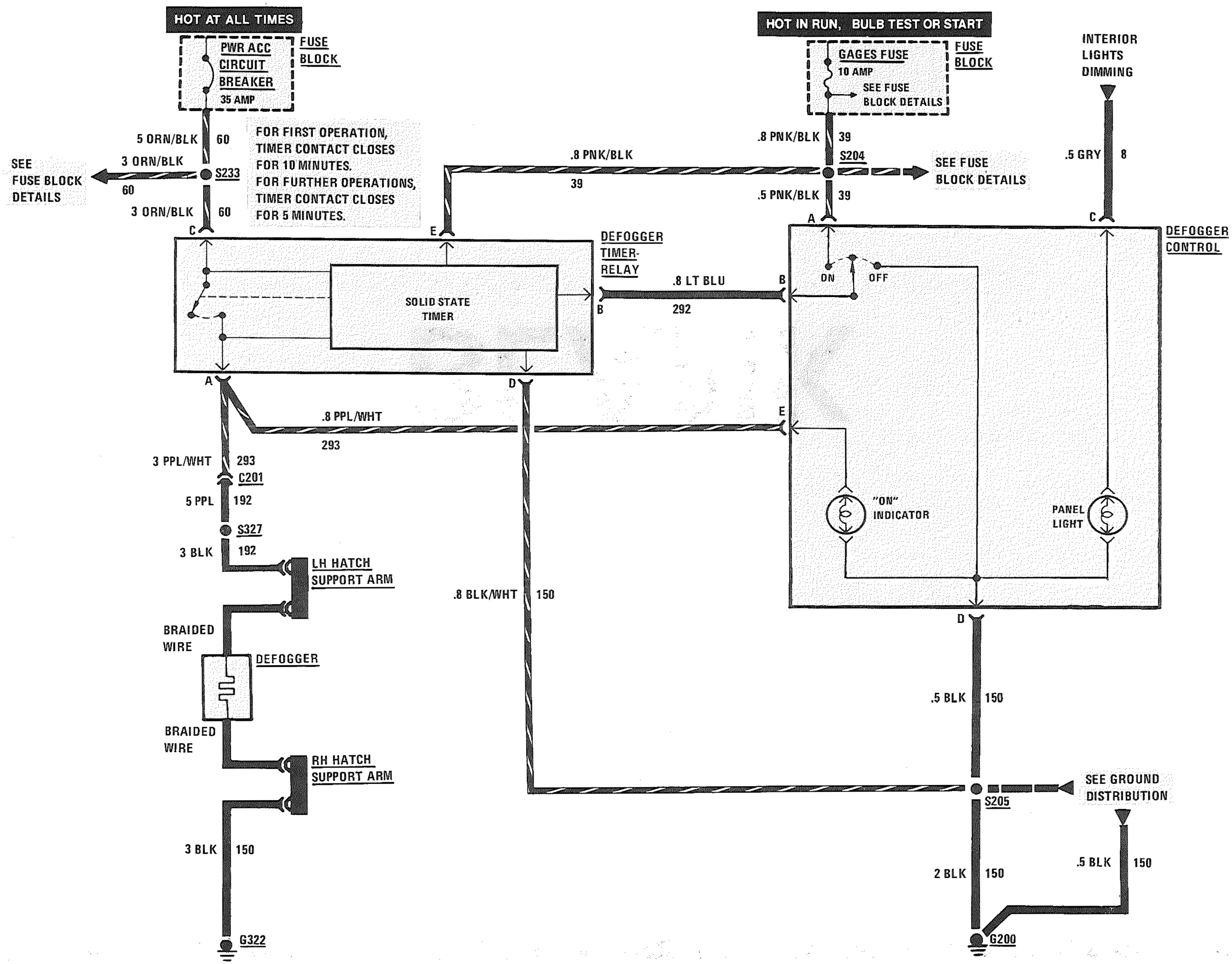
1. Perform Blower Switch Test. If Blower Switch is OK, check/repair ORN (52) wire for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).

CIRCUIT OPERATION

The Blower Motor delivers air to the interior of the vehicle. Its speed is controlled by the Blower Switch and the Blower Resistors. When the Ignition Switch is in RUN, battery voltage is applied to the Blower Switch. With the Blower Switch in LO, voltage is applied across both Blower Resistors and the Blower Motor. The Blower Motor runs at its slowest speed. With the Blower Switch in MED, one of the Blower Resistors is bypassed and the Blower Motor runs faster. When the Blower Switch is set to HI, battery voltage is applied directly to the Blower Motor and the Blower Motor runs at its fastest speed.

BLANK

DEFOGGER


HOT AT ALL TIMES
FUSE BLOCK
PWR ACC CIRCUIT BREAKER
35 AMP
5 ORN/BLK 60
SEE FUSE BLOCK DETAILS
3 ORN/BLK
S233
60
3 ORN/BLK 60
FOR FIRST OPERATION, TIMER CONTACT CLOSES FOR 10 MINUTES. FOR FURTHER OPERATIONS, TIMER CONTACT CLOSES FOR 5 MINUTES.
HOT IN RUN, BULB TEST OR START
GAGES FUSE
10 AMP
SEE FUSE BLOCK DETAILS
FUSE BLOCK
INTERIOR LIGHTS DIMMING
.8 PNK/BLK 39
.8 PNK/BLK
39
S204
SEE FUSE BLOCK DETAILS
.5 GRY 8
.5 PNK/BLK 39
DEFOGGER TIMER-RELAY
SOLID STATE TIMER
.8 LT BLU
292
DEFOGGER CONTROL
ON
OFF
.8 PPL/WHT
293
3 PPL/WHT 293
C201
5 PPL 192
S327
3 BLK 192
LH HATCH SUPPORT ARM
"ON" INDICATOR
PANEL LIGHT
.8 BLK/WHT 150
BRAIDED WIRE
DEFOGGER
BRAIDED WIRE
RH HATCH SUPPORT ARM
.5 BLK 150
SEE GROUND DISTRIBUTION
S205
3 BLK 150
.5 BLK 150
2 BLK 150
G322
G200

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the PWR ACC Circuit Breaker by operating the Power Door Locks or Power Seats (if equipped).
2. Check the Gages Fuse by observing that the Instrument Cluster Lights.
3. Check ground G200 by observing that the Cigar Lighter operates normally.
4. Check that the connectors on the Defogger and the Defogger Timer-Relay are properly mated.
5. If one or more of the grid lines do not heat, refer to the Body Service Manual (Section 2) for repair procedures.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

COMPONENT LOCATION

		Page-Figure
Defogger Timer-Relay	Behind RH side of I/P, near ECM	201-11-D
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C201 (1 cavity)	LH shroud, near center access hole	
G200	Behind I/P, left of steering column	201-10-A
G322	Rear of car, near RH hatch support bracket	201-15-D
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S233	I/P harness, above Fuse Block	201-10-A
S327	Defogger harness, behind LH side of rear seat	

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur. The actions must be performed in the order shown.**
- **Tests follow in System Diagnosis.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT	FOR DIAGNOSIS OF OTHER RESULTS
1. Turn the Ignition Switch to RUN, and depress the Defogger Control Switch.	A. The switch button returns to the rest position, and the ON Indicator in the center of the Defogger Control lights B. The Defogger grid removes fog from the rear window C. The ON Indicator and the Defogger turn off after approximately 10 minutes	Do Test A Do Test B Do Test D
2. Depress the Defogger Control Switch again	The ON Indicator and the Defogger turn on After approximately 5 minutes, they turn off again	Replace the Defogger Timer-Relay
3. With the Defogger ON, depress the Defogger Control OFF Switch	The ON Indicator and the Defogger turn OFF	Do Test B Do Test C

(Continued on next page)

SYSTEM DIAGNOSIS

- Do the tests below when directed by the System Check.

A. DEFOGGER TIMER-RELAY INPUT VOLTAGE TEST

Measure: VOLTAGE
At: DEFOGGER TIMER-RELAY CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN

Measure Between	Correct Voltage	For Diagnosis
C (ORN/BLK) & Ground	Battery	See 1
E (PNK/BLK) & Ground	Battery	See 2

- If all the voltages are correct, go to Test B.

1. Check the ORN/BLK (60) wire for an open (see schematic). If the wire is OK, check the PWR ACC Circuit Breaker.
2. Check the PNK/BLK (39) wire for an open (see schematic). If the wire is OK, check the Gages Fuse.

B: DEFOGGER TIMER-RELAY TEST

Connect: TEST LAMP
At: DEFOGGER TIMER-RELAY CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN
- Defogger Switch: ON (HOLD)

Connect Between	Correct Result	For Diagnosis
B (LT BLU) & Ground	Test Lamp lights	See 3
D (BLK/WHT) & B (LT BLU)	Test Lamp lights	See 2
A (PPL/WHT) & Ground	Test Lamp lights	See 1
• Defogger Switch: OFF (HOLD)		
B (LT BLU) & E (PNK/BLK)	Test Lamp lights	See 4
A (PPL/WHT) & Ground	Test Lamp does not light	See 1

- If all the results are correct, do Test D.

1. Replace the Defogger Timer-Relay.
2. Check the BLK/WHT (150) wire for an open (see schematic). Check that ground G200 is clean and tight.
3. Check the LT BLU (292) wire for an open (see schematic). If the wire is OK, do Test C.
4. Do Test C.

C: DEFOGGER CONTROL VOLTAGE TEST

Measure: VOLTAGE
At: DEFOGGER CONTROL CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN
- Defogger Switch: ON (HOLD)
- Headlight Switch: PARK (Maximum Brightness)

Connect Between	Correct Voltage	For Diagnosis
A (PNK/BLK) & Ground	Battery	See 1
B (LT BLU) & Ground	Battery	See 2
E (PPL/WHT) & Ground	Battery	See 3
C (GRY) & Ground	Battery	See 4
C (GRY) & D (BLK)	Battery	See 5

- If all the voltages are correct, and the Defogger still does not operate properly, do Test D.

1. Check the PNK/BLK (39) wire for an open (see schematic). If the wire is OK, check the Gages Fuse.
2. Replace the Defogger Control.
3. Check the PPL/WHT (293) wire for an open (see schematic). If the wire is OK, do Test B.
4. Check the INST LP Fuse. Check the GRY (8) wire for an open (see schematic).
5. Check the BLK (150) wire for an open (see schematic). Check that ground G200 is clean and tight. Replace Panel Light if wire and ground are OK.

D: DEFOGGER TEST

With the Ignition Switch in RUN, and the Defogger Switch pressed ON, connect one lead of a test lamp to ground. From inside the car, lightly touch the other lead to each grid line, and slowly move it along the length of the grid. The brilliance of the test lamp bulb should increase as the test lamp is moved from left (Passenger's side) to right (Driver's side).

- **If the test lamp does not light along any one of the grid lines, check PPL/WHT (293), PPL (192) and BLK (192) wires to the Defogger Control for an open (see schematic). If OK, do Test E.**
- **If the test lamp bulb shows full brilliance at both ends of the grid, check the BLK (150) wire for an open to ground (see schematic).**
- **If the test lamp suddenly lights as it is moved along the grid, a break in the continuity of the grid line exists. Refer to the GM Body Service Manual for grid line repair procedure.**

E: DEFOGGER LAMP TEST

Connect: TEST LAMP
At: LH & RH HATCH SUPPORT ARM (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Defogger Switch: ON**

Connect Between	Correct Voltage	For Diagnosis
LH Hatch Support Arm (Braided Wire) & Ground (see schematic)	Test Lamp lights	See 1
LH Hatch Support Arm (Braided Wire) & RH Hatch Support Arm (Braided Wire) (see schematic)	Test Lamp lights	See 2

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- If all the results are correct, refer to the GM Body Service Manual Section 2 for grid line repair.

1. Do Test B.
2. Check the BLK (150) wire for an open (see schematic). Check that Ground G322 is clean and tight (see schematic).

CIRCUIT OPERATION

With the Ignition Switch in RUN, voltage is applied to the Defogger Control. When the Defogger Control Switch is pressed ON, voltage is then applied to the Defogger Timer-Relay. The contact closes which provides voltage to the ON Indicator and the Defogger. The rear window will become warm to remove the fog from the surface of the window.

The contact in the Defogger Timer-Relay will stay closed until the Defogger OFF Switch is pushed, or the timer cycle is complete.

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The first time the Rear Defogger Switch is pushed in, the Defogger Timer-Relay will allow the Defogger to operate for approximately 10 minutes. Each time after the rear Defogger Switch is pushed in, the Defogger Timer-Relay will reset to operate for approximately 5 minutes. The Defogger Timer-Relay will reset to 10 minutes when the Ignition Switch is turned OFF and then back to the RUN position.

The timer also shuts off at any time when the Defogger Control OFF Switch is depressed. In order to reset the Defogger Timer-Relay for the initial 10 minute time interval, the Ignition Switch must be turned OFF and then back to the RUN position before activating the Defogger.

BLANK

SYSTEM CHECK

- Use the System Check Table as a guide to normal operation. All of the checks can be performed without the use of tools or disassembly of components.
- Even though one or more checks may not give a normal result, complete the entire System Check to reveal all symptoms which may exist.

SYSTEM CHECK TABLE

Air Conditioning C60 Manual and C67 Electronic
Conditions:
- Engine warm and running at idle
- Temperature outside car at 60 °F (16 °C) or higher

SET A/C CONTROLS	EXPECTED RESULT	FOR DIAGNOSIS OF OTHER RESULTS
1. OFF Fan LO	• Blower is not running	8A-63, 66 Blower Controls
2. Move Temperature Selector rapidly back and forth (Manual)	• Temperature Valve hits stop in each direction	8A-65 Air Delivery
3. Move Temperature Selector from COLD to HOT (Electronic)	• Temperature Valve motor moves valve from one position to the other	8A-68 Air Delivery
4. HEATER Temperature Level at COLD	• Blower runs at low speed • Air at outside Temperature flows from floor outlets • Slight air flow at windshield outlets	8A-63, 66 Blower Controls 8A-65, 68 Air Delivery
5. Move Fan Switch through M1, M2 to HI	• Increased air flow at each step	8A-63, 66 Blower Controls
6. Move Temperature Selector to HOT	• Air flow becomes warm	8A-65, 68 Air Delivery
7. VENT	• Warm air flows from Instrument Panel outlets	8A-65, 68 Air Delivery
8. DEF	• Warm air flows from windshield outlets • Compressor turns on • Engine idle speed may increase	8A-65, 68 Air Delivery 8A-64, 67 Compressor Controls 6E Driveability and Emissions

(SYSTEM CHECK TABLE continued on facing page)

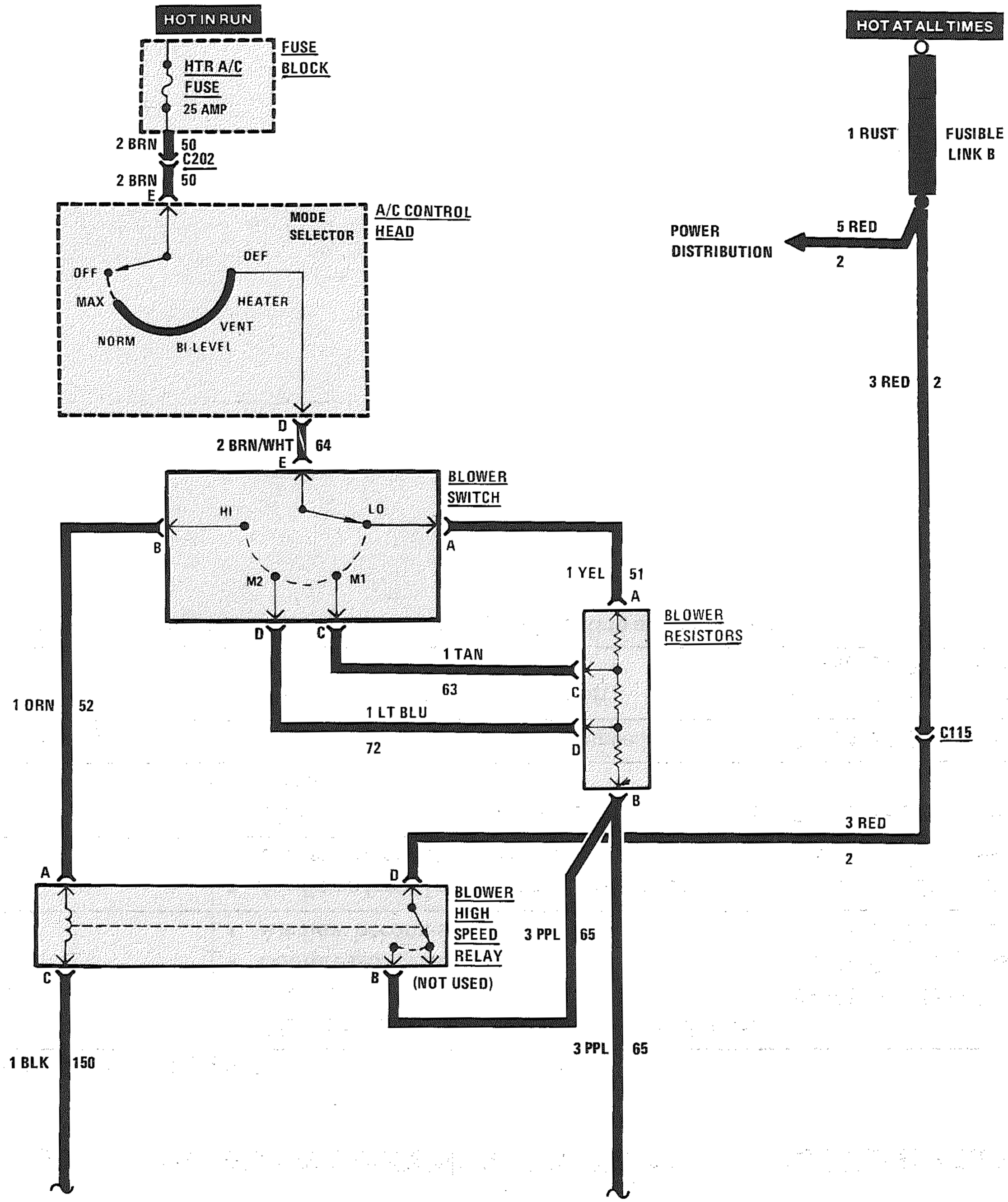
(SYSTEM CHECK TABLE continued from facing page)

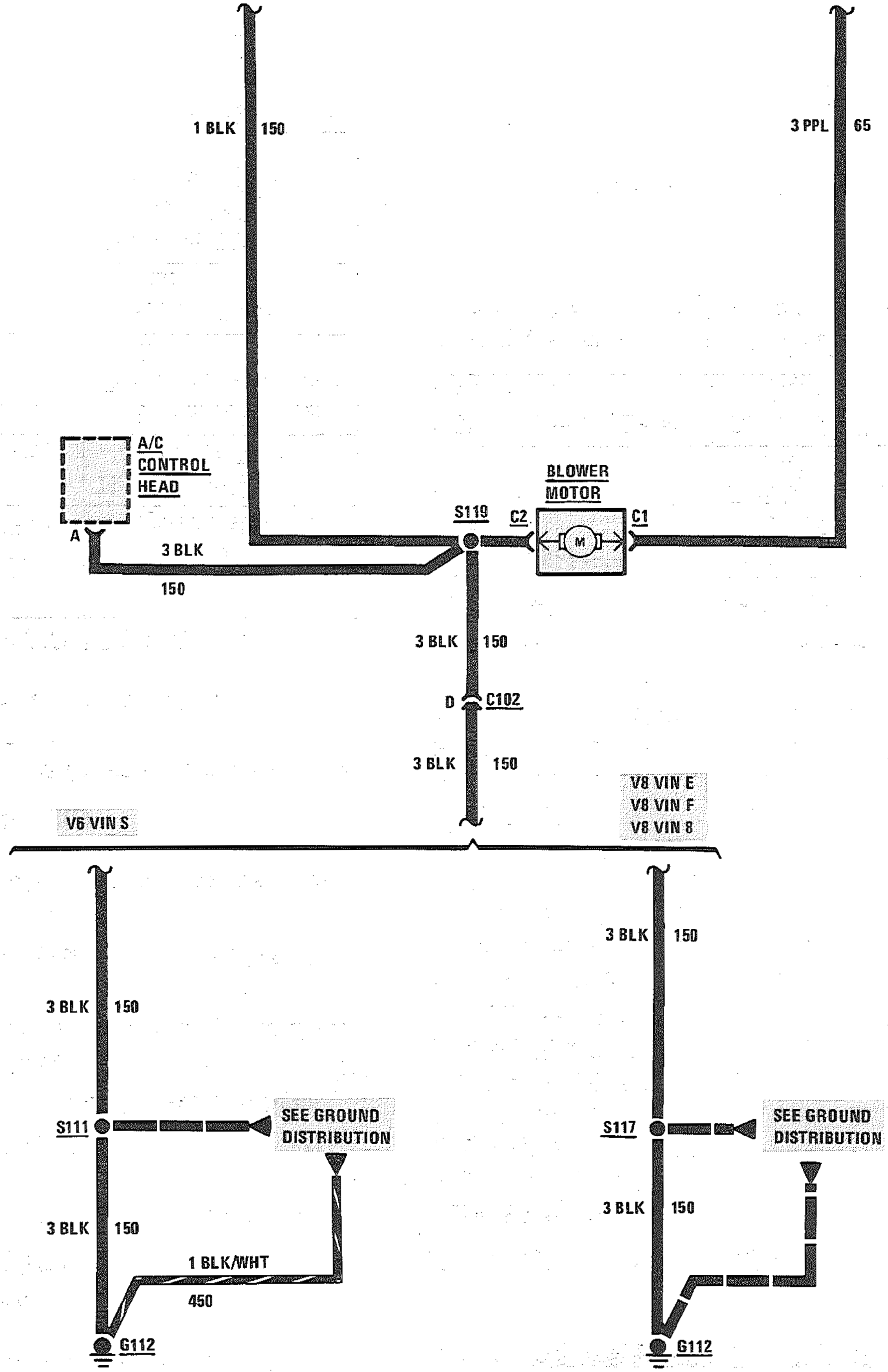
9. BI-LEVEL Set Temperature lever to COLD	• Air flows from Instrument Panel and floor outlets • Compressor turns on • Air flow becomes cold	8A-65, 68 Air Delivery 8A-64, 67 Compressor Controls 8A-64, 67 Compressor Controls
10. NORMAL	• Air flows from Instrument Panel outlets • Compressor continues to run	8A-65, 68 Air Delivery 8A-64, 67 Compressor Controls
11. MAX	• Blower noise increases as outside air door closes	8A-65, 68 Air Delivery
12. Quickly rotate steering wheel to stop	• Engine maintains normal idle speed	8A-64, 67 Compressor Controls
13. OFF	• Blower and Compressor turn off	8A-63, 64 Blower and Compressor Controls 8A-66, 67 Blower and Compressor Controls

- **If all of the above steps can be completed as described, the Air Conditioning and Heating system is operating normally.**

AIR CONDITIONING: BLOWER CONTROLS

C60, MANUAL




1 BLK
150
3 PPL
65
A/C
CONTROL
HEAD
A
3 BLK
150
S119
C2
BLOWER
MOTOR
M
C1
3 BLK
150
D
C102
3 BLK
150
V6 VIN S
V8 VIN E
V8 VIN F
V8 VIN 8
3 BLK
150
S111
SEE GROUND
DISTRIBUTION
3 BLK
150
1 BLK/WHT
450
G112
3 BLK
150
S117
SEE GROUND
DISTRIBUTION
3 BLK
150
G112

AIR CONDITIONING: BLOWER CONTROLS

C60, MANUAL

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the HTR A/C Fuse by visual inspection.
2. Check that ground G112 is clean and tight.
3. Check that Blower Motor connectors and Blower Relay are mated correctly and firmly seated.

- **Go to the A/C System Check in 8A-62 for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Blower runs all the time (Ignition OFF)	B: Blower High Speed Relay Test
Blower run all the time (Ignition OFF)	E: A/C Mode Selector Test
Blower will not run in any mode	A: Blower Motor Test E: A/C Mode Selector Test
No Lo speed operation	C: Blower Resistors Test
No Hi speed operation	B: Blower High Speed Relay Test D: Blower Switch Test

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SYMPTOM	DO TEST
Hi speed only	B: Blower High Speed Relay Test D: Blower Switch Test
Blower runs in Lo at M1 or M2	D: Blower Switch Test

- **If your symptom does not appear in the Symptom Table, perform all of the tests.**

COMPONENT LOCATION

		Page-Figure
Blower High Speed Relay	RH front of dash, near Blower Motor	201-14-A
Blower Motor (With A/C)	RH front of dash.	201-14-A
Blower Resistors (With A/C)	RH front of dash, behind strut tower	201-14-A
Fuse Block.	Behind LH side of I/P, below light switch.	201-10-A
Fusible Link B (VIN E).	Lower RH side of engine, at Starter Solenoid.	201- 2-A
Fusible Link B (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid.	201- 6-B
Fusible Link B (VIN S).	Lower RH side of engine, at Starter Solenoid.	201- 1-A
C102 (4 cavities)	Center front of dash	201-14-A
C115 (1 cavity).	Center front of dash	201-14-A
C202 (1 cavity)	Behind center of I/P, near control head.	201-14-C
G112 (VIN E)	Rear of LH cylinder head.	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head.	201- 7-C
G112 (VIN S).	Rear of LH cylinder head.	201- 0-C
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN E).	Engine harness, RH front of dash.	201- 2-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine.	201- 7-A
S119	A/C harness, RH rear of engine compartment	201-13-C

A: BLOWER MOTOR TEST

Measure: VOLTAGE
At: BLOWER MOTOR CONNECTORS (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: HI**

(A: BLOWER MOTOR TEST continued on facing page)

C60, MANUAL

(A: BLOWER MOTOR TEST continued from facing page)

Measure Between	Correct Voltage	For Diagnosis
C1 (PPL) & Ground	Battery	See 1
C1 (PPL) & C2 (BLK)	Battery	See 2

- If the voltages are correct but the blower does not run, install a new Blower Motor.

1. Check the PPL (65) wire for an open. If the wire is good, go to Test B and Test D.
2. Check the BLK (150) wire for an open and that ground G112 is clean and tight (see schematic).

B: BLOWER HIGH SPEED RELAY TEST (TABLE 1)

Measure: VOLTAGE
At: BLOWER RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: HI**

Measure Between	Correct Voltage	For Diagnosis
D (RED) & Ground	Battery	See 1
A (ORN) & Ground	Battery	See 2
• Blower Switch: LO		
B (PPL) & Ground	Battery	See 3

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- If all voltages are correct, go to Table 2.

1. Check RED (2) wire for an open back to Fusible Link B.
2. Check ORN (52) wire for an open. If wire is good, go to Test D.
3. Check PPL (65) wire for an open between the Blower High Speed Relay Terminal B and the Blower Resistors Terminal B. If wire is good, go to Test C.

B: BLOWER HIGH SPEED RELAY TEST (TABLE 2)

Measure: RESISTANCE
At: BLOWER HIGH SPEED RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: OFF**
- **Negative Battery Terminal: DISCONNECTED**

Measure Between	Correct Resistance	For Diagnosis
C (BLK) & Ground	0 ohms	See 1
B (PPL) & Ground	Less than 3 ohms	See 2

- If all results in Table 1 and Table 2 are correct, but Blower Relay does not operate or Blower runs all the time, replace the Blower Relay.

1. Check the BLK (150) wire for an open.
2. Check the PPL (65) wire for an open. If wire is good, go to Test A.

C: BLOWER RESISTORS TEST

Measure: RESISTANCE
At: BLOWER RESISTORS (Disconnected)
Condition:
- **Ignition Switch: OFF**

Measure Between	Correct Result	For Diagnosis
A & C	1.5±1 ohm	See 1
C & D	0.2±1 ohm	See 1
D & B	0.7±5 ohm	See 1

- If the results are correct, Blower Resistors are operating normally. Return to Symptom Table.

1. Install new Blower Resistors.

D: BLOWER SWITCH TEST (TABLE 1)

Measure: VOLTAGE
At: BLOWER RESISTORS CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: LO**

Measure Between	Correct Voltage	For Diagnosis
A (YEL) & Ground	Battery	See 1 & 6
C (TAN) & Ground	0 Volts	See 2
• Blower Switch: M1		

(D: BLOWER SWITCH TEST (TABLE 1) continued on next page)

C60, MANUAL

(D: BLOWER SWITCH TEST (TABLE 1) continued on previous page)

C (TAN) & Ground	Battery	See 3 & 6
D (LT BLU) & Ground	0 Volts	See 4
• Blower Switch: M2		
D (LT BLU) & Ground	Battery	See 5 & 6

- If all voltages are correct, go to Table 2.

1. Check YEL (51) wire for an open.
2. If voltage is present, check TAN (63) wire for a wire to wire short to voltage. If wire is good, replace the Blower Switch.
3. Check the TAN (63) wire for an open.
4. If voltage is present, check LT BLU (72) wire for a wire to wire short to voltage. If wire is good, replace the Blower Switch.
5. Check Lt BLU (72) wire for an open.
6. If battery voltage is not present at terminals A, C or D, go to Test E. If voltage is present at one or more of the terminals, replace the Blower Switch.

D: BLOWER SWITCH TEST (TABLE 2)

Measure: VOLTAGE
At: BLOWER HIGH SPEED RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: M2**

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	0 Volts	See 1
• Blower Switch: HI		
A (ORN) & ground	Battery	See 2

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- If voltages are correct, Blower Switch is operating normally. Return to Symptom Table.

1. If voltage is present, check ORN (52) wire for a wire to wire short to voltage. If wire is good, replace Blower Switch.
2. Check ORN (52) wire for an open. If wire is good, replace Blower Switch.

E: A/C MODE SELECTOR TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR (Connected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: OFF**

Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
D (BRN/WHT) & Ground	0 Volts	See 2
• A/C Mode: All positions except OFF		
D (BRN/WHT) & Ground	Battery	See 3

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- If all voltages are correct, check the BRN/WHT (64) wire for an open. If wire is good replace the Blower Switch.

1. Check BRN (50) wire for an open back to HTR A/C Fuse.
2. If voltage is present, check BRN/WHT (64) wire for a wire to wire short to voltage. If wire is good, replace A/C Control Head.
3. If battery voltage is present at terminal E but is not present at terminal D, replace the A/C Control Head.

CIRCUIT OPERATION

The Blower Motor speed is controlled by the Blower Switch in the A/C Control Head. With the switch in the LO position, all of the Blower Resistors are in the circuit with the motor so that it runs slowly. In the M1 and M2 positions, the Blower Switch bypasses some of the Resistors, increasing the Motor speed.

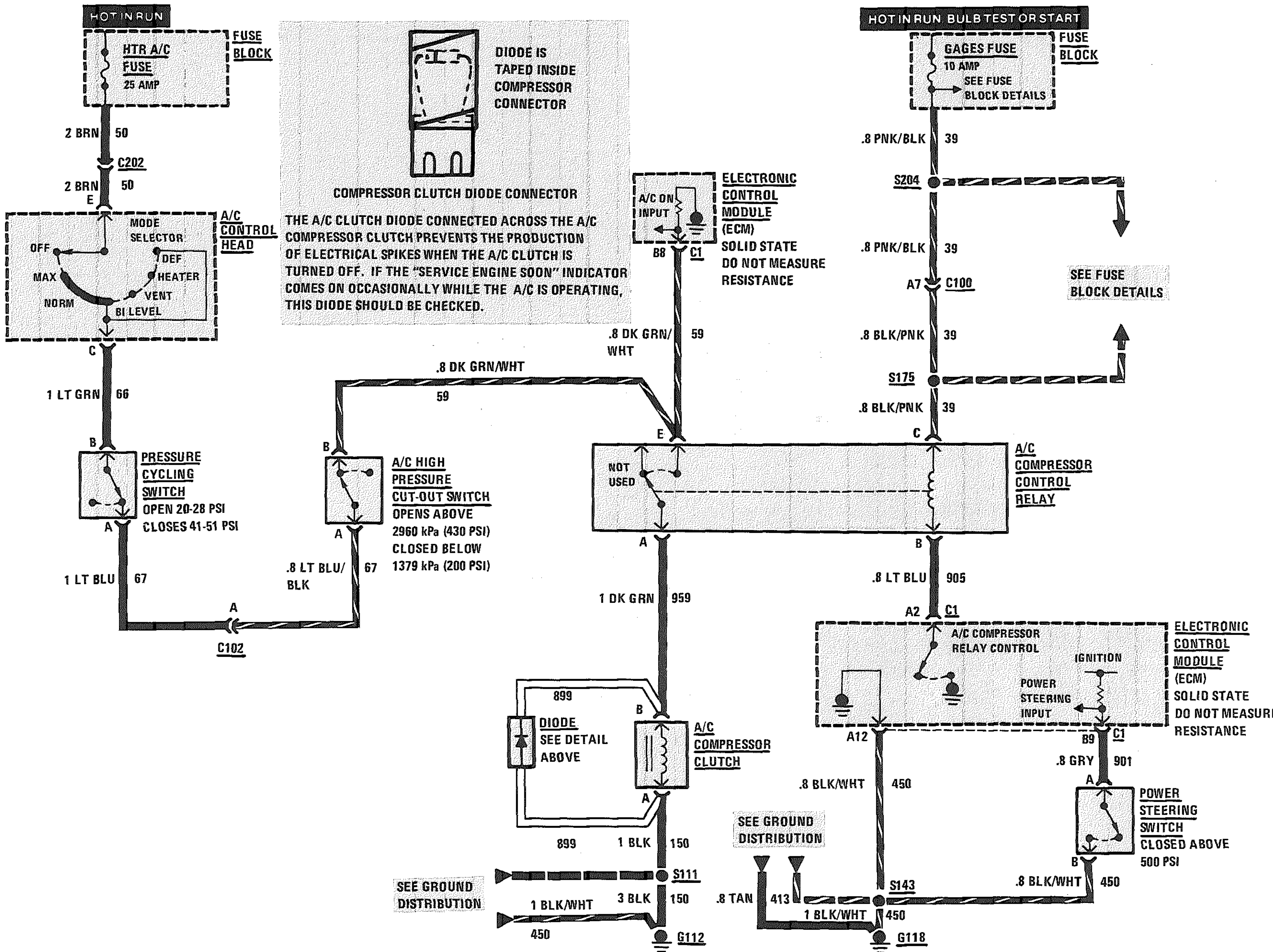
Voltage is applied to the Blower Motor through the contacts of the Blower High Speed Relay. When the Blower Switch is in the HI position, battery voltage is supplied through the ORN wire to the coil of the Blower High Speed Relay. The Relay is energized and its contacts supply battery voltage directly to the Blower Motor from Fusible Link B.

When the Mode Selector is in the OFF position, no voltage is applied to the Blower Switch and Motor so the Blower does not run. In all other positions, the Blower will operate as described.

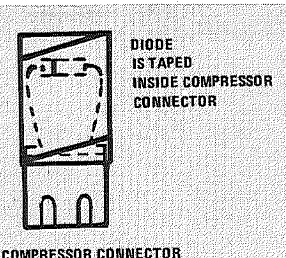
BLANK

AIR CONDITIONING: COMPRESSOR CONTROLS

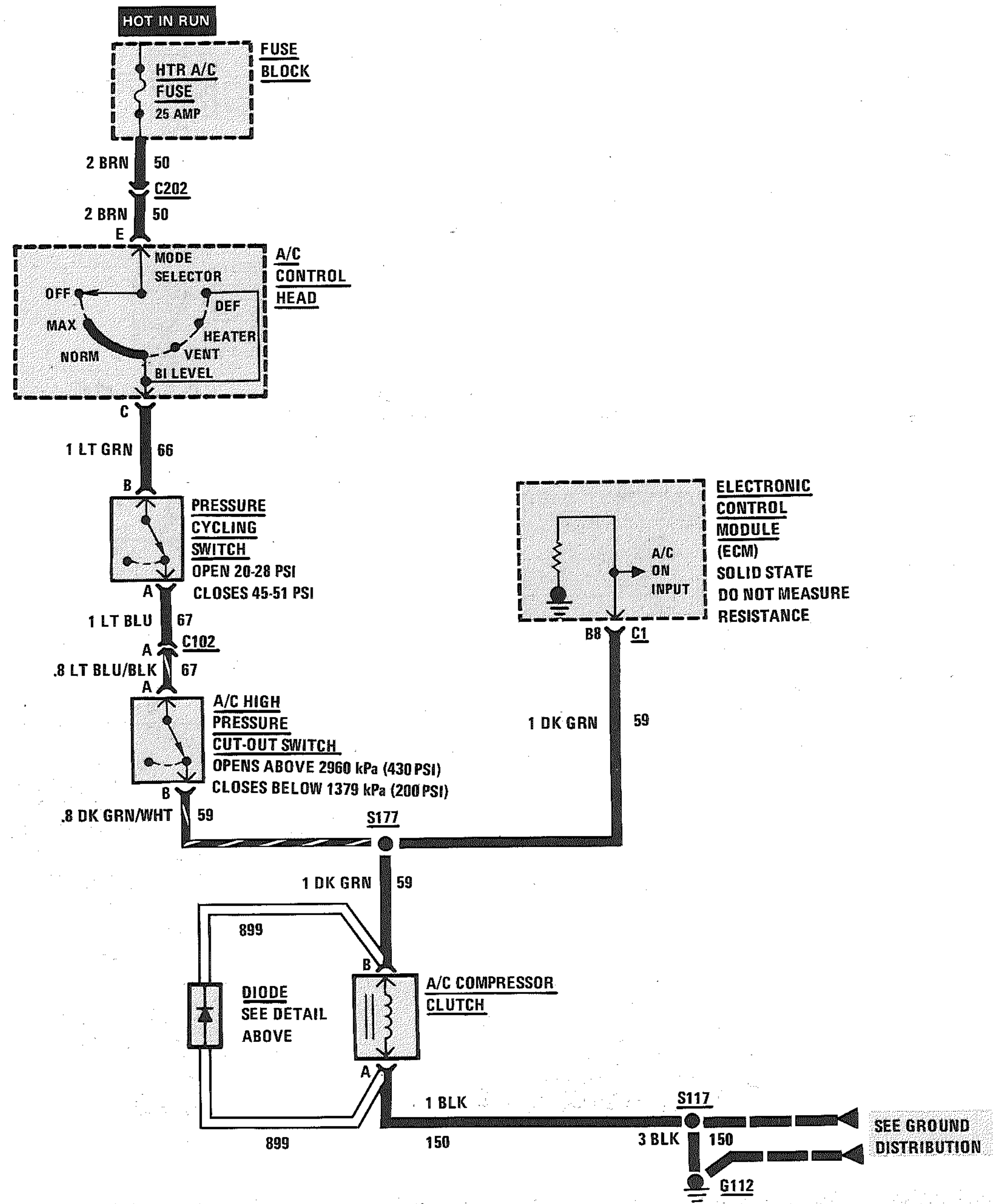
C60, MANUAL, V6 VIN S



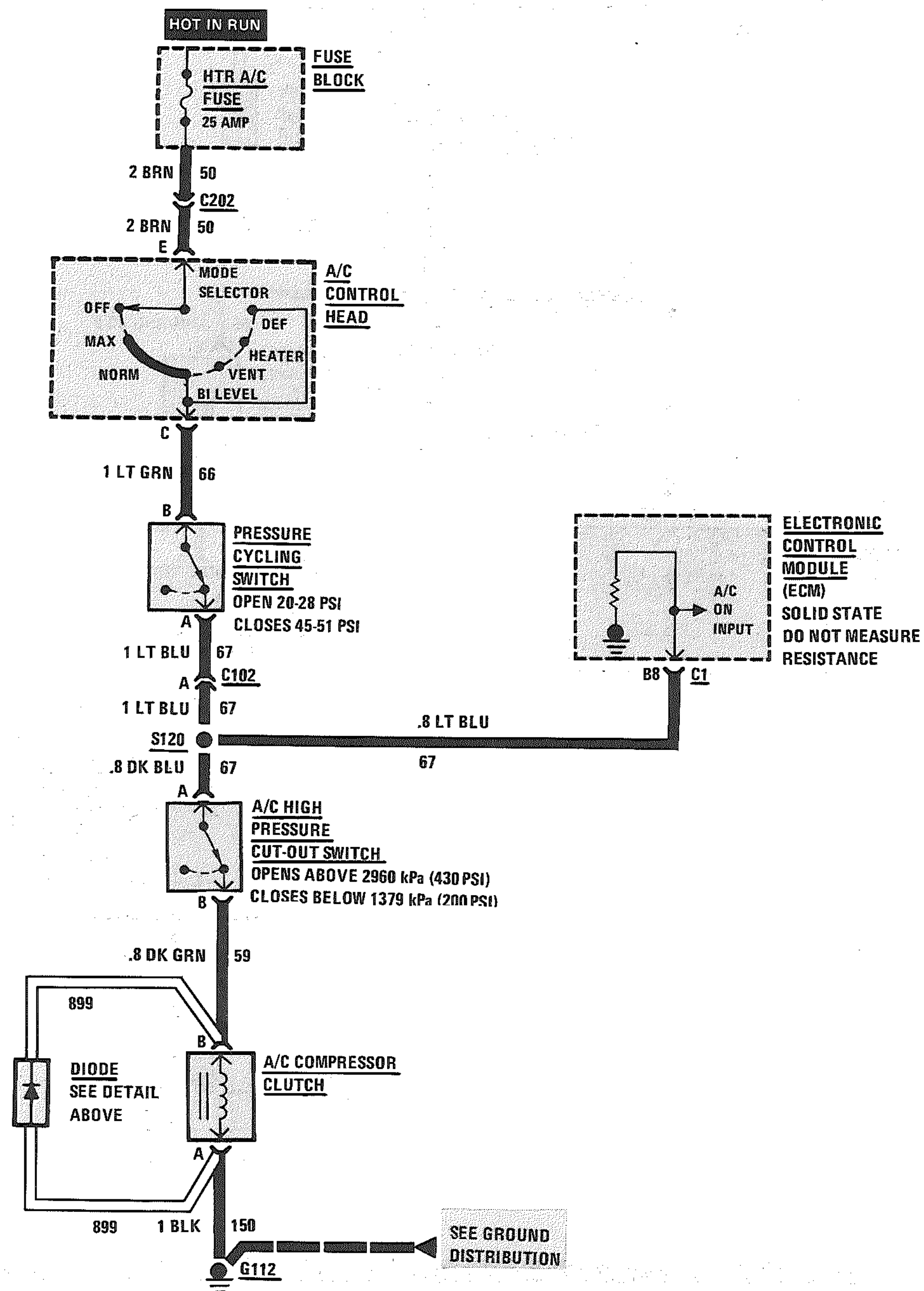
AIR CONDITIONING: COMPRESSOR CONTROLS
C60, MANUAL, V8 VIN F, V8 VIN 8

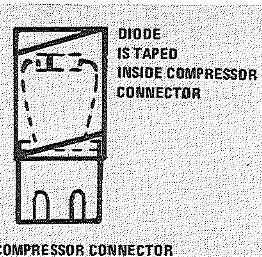


THE A/C CLUTCH DIODE CONNECTED ACROSS THE A/C COMPRESSOR CLUTCH PREVENTS THE PRODUCTION OF ELECTRICAL SPIKES WHEN THE A/C CLUTCH IS TURNED OFF. IF THE "SERVICE ENGINE SOON" INDICATOR COMES ON OCCASIONALLY WHILE THE A/C IS OPERATING, THIS DIODE SHOULD BE CHECKED.



AIR CONDITIONING: COMPRESSOR CONTROLS
C60, MANUAL, V8 VIN E





THE A/C CLUTCH DIODE CONNECTED ACROSS THE A/C COMPRESSOR CLUTCH PREVENTS THE PRODUCTION OF ELECTRICAL SPIKES WHEN THE A/C CLUTCH IS TURNED OFF. IF THE "SERVICE ENGINE SOON" INDICATOR COMES ON OCCASIONALLY WHILE THE A/C IS OPERATING, THIS DIODE SHOULD BE CHECKED.

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check HTR-A/C Fuse by visual inspection.
2. Check that the A/C Compressor Clutch connector is firmly seated.
3. Check that ground G112 is clean and tight.

- **Go to System Check for a guide to normal Compressor Control operation.**
- **Go to System Diagnosis for Compressor Control diagnostic tests.**

SYSTEM CHECK

- **Complete the A/C System Check in Section 8A-62 as a guide to normal operation of the A/C System.**
- **Use the System Check Table as a guide to normal operation of the Compressor Controls.**

COMPONENT LOCATION

Component	Location	Page-Figure
A/C Compressor Clutch (VIN E)	Top RH front of engine	201- 4-A
A/C Compressor Clutch (VIN F) (VIN 8)	Top RH front of engine	201- 6-A
A/C Compressor Clutch (VIN S)	Top LH front of engine.	201- 0-B
A/C Compressor Control Relay	LH rear corner of engine compartment, on relay bracket	201- 0-A
A/C High Pressure Cut-Out Switch (VIN E)	Top RH front of engine, on rear of A/C compressor	201- 4-D
A/C High Pressure Cut-Out Switch (VIN F) (VIN 8)	Top RH front of engine, on rear of A/C compressor	201- 6-C
A/C High Pressure Cut-Out Switch (VIN S)	Top LH front of engine, on rear of A/C compressor	201- 0-B
Diode	Inside A/C Compressor Clutch connector	201- 0-B
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Fuse Block	Behind LH side of I/P, below light switch.	201-10-A
Power Steering Switch	Lower LH front corner of engine compartment, on steering unit	201- 0-A
Pressure Cycling Switch.	On side of A/C accumulator	201-14-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C102 (4 cavities)	Center front of dash	201-14-A
C202 (1 cavity)	Behind center of I/P, near control head.	201-14-C
G112 (VIN E)	Rear of LH cylinder head.	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head.	201- 7-C
G112 (VIN S)	Rear of LH cylinder head.	201- 0-C
G118 (VIN S)	Rear of RH cylinder head.	201- 1-C
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine.	201- 7-A
S120	Engine harness, RH front of dash.	201- 2-A
S143 (VIN S)	Engine harness, center front of dash.	201- 1-A
S175 (VIN S)	Engine harness, lower LH front of dash	201- 0-A

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C60, MANUAL

(Continued from previous page)

COMPONENT LOCATION

		Page-Figure
S177	Engine harness, top RH front of engine	201- 5-A
S204	I/P harness, behind instrument cluster	201-10-A

SYSTEM CHECK TABLE

ACTION	EXPECTED RESULT
1. Turn the Ignition Switch to RUN and start the engine Move the A/C Mode Selector to OFF then to MAX	A click can be heard when the clutch engages
2. Move the Mode Selector between OFF and MAX several times	Verify that the clutch engages in the MAX position Clutch plate movement can be seen on the front of the compressor pulley If the clutch does not engage, proceed to step 4 If the clutch operates as expected, continue to step 3
3. Put the Mode Selector in MAX to engage clutch	Check that air from the coolant fan can move freely through condensor Feel the input (cool) and output (warm) pipes to the compressor If there is not a wide temperature difference after the compressor has run for several seconds, see Section 1B for refrigerant and compressor diagnostics
4. Turn off the ignition Check the refrigerant charge, according to the procedures in Section 1B	If the refrigerant charge is low, follow the procedures in Section 1B for refrigerant diagnosis If the refrigerant charge is normal, isolate the conditions using the procedures which follow in the System Diagnosis

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

SYSTEM DIAGNOSIS

V6 VIN S

- Use the Isolation Test below to choose the proper diagnostic tests.
- Tests follow the Isolation Test.

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60 °F (16 °C)

Measure Between	Correct Voltage	For Diagnosis
C (PNK/BLK) & Ground	Battery	Check GAGES Fuse and PNK/BLK (39) wire for an open
E (DK GRN/WHT) & Ground	Battery	Check DK GRN/WHT (59) wire for an open. If wire is good, do Test C

- If voltages are correct, leave A/C Compressor Control Relay connector disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: FUSED JUMPER
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60 °F (16 °C)

Jumper Between	Correct Result	For Diagnosis
E (DK GRN/WHT) & A (DK GRN)	Clutch engages	Do Test B

- If action is correct, do Test A.

A: ECM COMPRESSOR CONTROL TEST (TABLE 1)

Measure: VOLTAGE
At: ECM CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- A/C Compressor Control Relay: CONNECTED
- Temperature Outside Car: Above 60 °F (16 °C)

Measure Between	Correct Voltage	For Diagnosis
B8 on Conn C1 (DK GRN/WHT) & Ground	Battery	See 1
A2 on Conn C1 (LT BLU) & Ground	Battery	See 2

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- If the voltages are correct, proceed to Table 2.

1. Check for an open in the DK GRN/WHT (59) wire.
2. Check for an open in the LT BLU (905) wire. If the wire is good, replace the A/C Compressor Control Relay.

A: ECM COMPRESSOR CONTROL TEST (TABLE 2)

Measure: RESISTANCE
At: ECM CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: OFF
- Negative Battery Terminal Disconnected

Measure Between	Correct Resistance	For Diagnosis
B9 on Conn C1 (GRY) & Ground	0 Ohms	See 1

- If resistance is correct proceed to Table 3.

1. Check that Power Steering Switch is closed. If switch is open, replace it. Check for an open in the GRY (901) wire and BLK/WHT (450) wire.

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C60, MANUAL

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A: ECM COMPRESSOR CONTROL TEST (TABLE 3)

Connect: FUSED JUMPER
At: ECM CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Jumper Between	Correct Action	For Diagnosis
A2 on Conn C1 (LT BLU) and Ground	A/C Compressor Control Relay operates & A/C Clutch engages	See 1

- If action is correct but A/C system does not operate under normal conditions, condition is due to ECM. Refer to Section 6E for ECM diagnostics.

1. Replace A/C Compressor Control Relay.

B: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

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Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check for open in DK GRN (959) wire.
2. Check for open in BLK (150) wire.

C: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
C (LT GRN) & Ground	Battery	Replace A/C Control Head

- If voltages are correct, go to Step 2.

1. Check for open HTR-A/C Fuse or open BRN (50) wire.

C1. Remove the connectors from the Pressure Cycling Switch and the A/C High Pressure Switch. Connect a fused jumper between the terminals of the connectors. If switch is open, battery voltage will be present at terminal E of the A/C Compressor Control Relay, when the jumper is connected.

- If the Pressure Cycling Switch is open, refer to Section 1B to check for normal refrigerant charge. If refrigerant charge is low, follow procedures in Section 1B for refrigerant diagnostics. If refrigerant charge is normal, replace the Pressure Cycling Switch.
- If A/C High Pressure Cut-Out Switch is open, replace it.
- If both switches are good but battery voltage is not present at the A/C Compressor Control Relay, check the wiring between switches for an open (see schematic).

SYSTEM DIAGNOSIS

V8 VIN F, V8 VIN 8

- Use the Isolation Test below to choose the proper diagnostic tests.
- Tests follow the Isolation Test.

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60° F (16° C)

Measure Between	Correct Voltage	For Diagnosis
B (LT GRN) & Ground	Battery	Do Test B

- If voltage is correct, leave Pressure Cycling Switch disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: JUMPER
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60° F (16° C)

Jumper Between	Correct Action	For Diagnosis
B (LT GRN) & A (LT BLU)	Clutch engages	Do Test A

- If action is correct, refer to Section 1B for procedure to check refrigerant pressure.
- If refrigerant pressure is normal, replace the Pressure Cycling Switch.

A: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)
- Pressure Cycling Switch: RECONNECTED

Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check that A/C High Pressure Cut-Out Switch is closed (see schematic). If it is open, replace it. Check for an open in the LT BLU (67) and DK GRN (59) wires.
2. Check for an open in the BLK (150) wire. Check that ground G112 is clean and tight.

B: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:
- Ignition Switch: RUN
- A/C Mode: NORM
- Temperature Outside Car: Above 60° F (16° C)

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Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
C (LT GRN) & Ground	Battery	Replace A/C Control Head

- If voltages are correct, check for an open in the LT GRN (66) wire.

1. Check for open HTR-A/C Fuse or open BRN (50) wire.

SYSTEM DIAGNOSIS

V8 VIN H

- Use the Isolation Test below to choose the proper diagnostic tests.
- Tests follow the Isolation Test.

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
B (LT GRN) & Ground	Battery	Do Test B

- If voltage is correct, leave Pressure Cycling Switch disconnected and go to Table 2.

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ISOLATION TEST (TABLE 2)

Connect: JUMPER
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60 °F (16 °C)

Jumper Between	Correct Action	For Diagnosis
B (LT GRN) & A (LT BLU)	Clutch engages	Do Test A

- If action is correct but A/C Compressor Clutch does not engage under normal operating conditions, refer to Section 1B for procedure to check refrigerant pressure.
- If refrigerant pressure is normal, replace the Pressure Cycling Switch.

A: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Pressure Cycling Switch Connected
- Temperature Outside Car: Above 60 °F (16 °C)

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Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check that A/C High Pressure Cut-Out Switch is closed (see schematic). If it is open, replace it. Check for an open in the LT BLU (67) wire and the DK BLU (67) wire. Check for an open in the DK GRN (59) wire.
2. Check for an open in the BLK (150) wire.

B: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:
- Ignition Switch: RUN
- A/C Mode: NORM
- Temperature Outside Car: Above 60 °F (16 °C)

Measure Between	Correct Voltage	For Diagnosis
E (BRN) & Ground	Battery	See 1
C (LT GRN) & Ground	Battery	Replace A/C Control Head

- If voltages are correct, check for an open in the LT GRN (66) wire.

(Continued from previous column)

1. Check for open HTR-A/C Fuse or open BRN (50) wire.

CIRCUIT OPERATION

The compressor for the air conditioning system is belt driven by the engine through the Compressor Clutch. The clutch allows the compressor to be disengaged when air conditioning is not required or to remove the air conditioning load from the engine when necessary.

Operation of the compressor depends on the particular A/C mode selected by the driver. When the A/C Mode Selector Switch is in MAX, NORM, BI-LEVEL, or DEF, battery voltage is applied through the HTR-A/C Fuse and A/C Control Head Selector Switch to the remaining circuits.

V6 VIN S

For vehicles equipped with the V6 VIN S engine, the path to the A/C Compressor Control Relay is through the A/C Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch which are both normally closed. The A/C Pressure Cycling Switch opens when refrigerant pressure drops to a point near the level where the evaporator may begin to ice. It closes again when additional cooling is required. This action causes the compressor to cycle on and off. The A/C High Pressure Cut-Out Switch opens when refrigerant pressure is too high for normal operation.

AIR CONDITIONING: COMPRESSOR CONTROLS

C60, MANUAL

The A/C Compressor Control Relay is operated by the ECM. When the ECM receives the A/C ON signal at terminal B8, it grounds terminal A2 energizing the relay. When the relay is energized, voltage is applied to the A/C Compressor Clutch through the contacts of the relay.

If the ECM determines that engine load should be reduced, such as during full throttle, the A/C Compressor Control Relay is de-energized, which removes voltage from the A/C Compressor Clutch, thus removing the A/C load from the engine.

V8 VIN F, V8 VIN 8

From the A/C Control Head, voltage is applied to the A/C Compressor Clutch through the Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch. The Pressure Cycling Switch is normally closed but opens when refrigerant pressure drops below 172kPa (25 psi). It closes again when refrigerant pressure rises enough that additional cooling is required. This action causes the A/C Compressor to cycle on and off so that the evaporator temperature does not drop low enough to cause icing. The A/C High Pressure Cut-Out Switch opens if refrigerant pressure rises to a point that is too high for normal operation.

When voltage is applied to the Compressor Clutch, it is also applied to the ECM at terminal B8 on connector C1. The ECM will than increase the engine idle speed while the A/C Compressor Clutch is engaged.

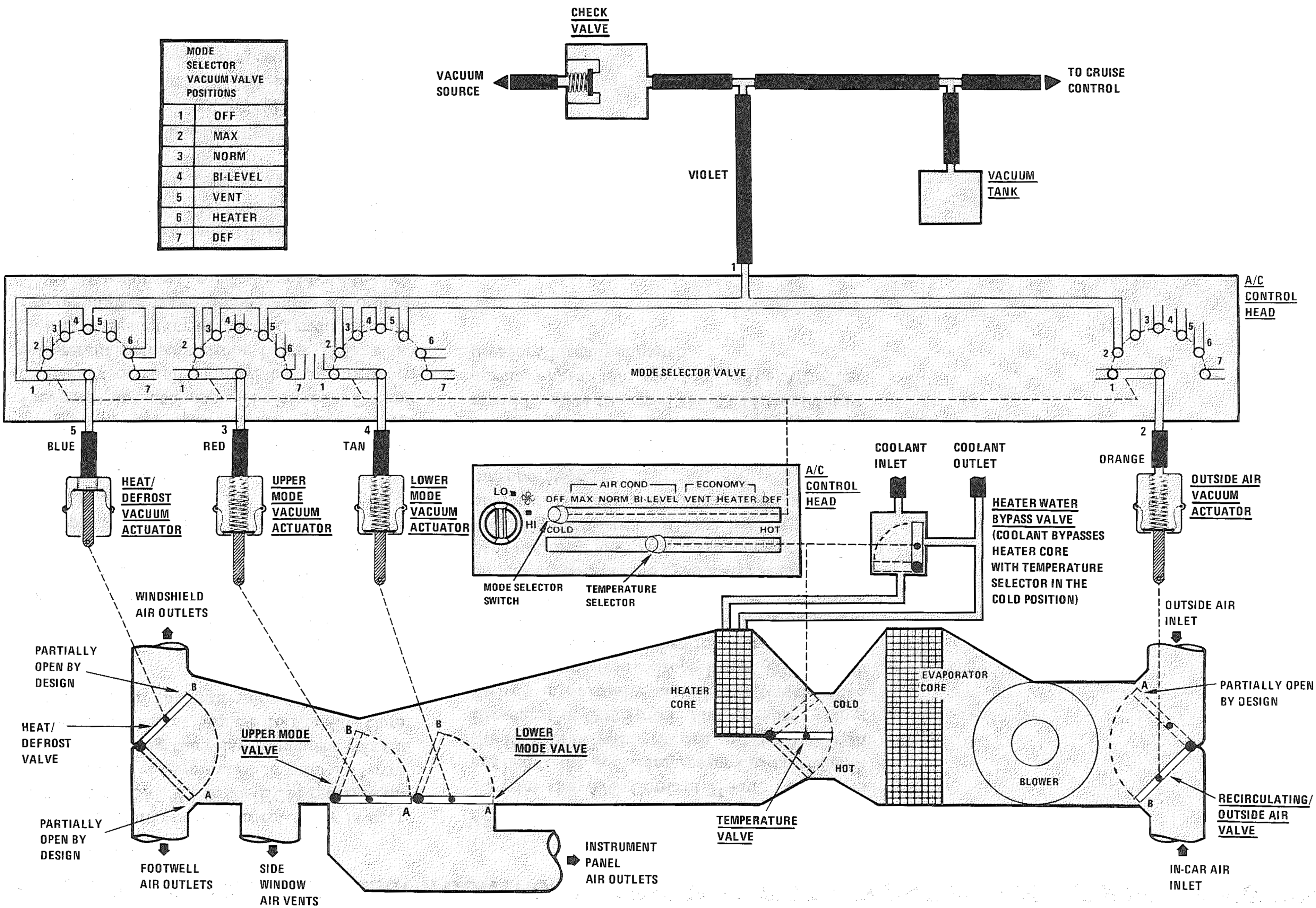
V8 VIN E

From the A/C Control Head, voltage is applied to the A/C Compressor Clutch through the Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch. The Pressure Cycling Switch is normally closed but opens when refrigerant pressure drops below 172 kPa (25 psi). It closes again when refrigerant pressure rises enough that additional cooling is required. This action causes the A/C Compressor to cycle on and off so that the evaporator temperature does not drop low enough the cause icing. The A/C High Pressure Cut-Out Switch opens if refrigerant pressure becomes too high for normal operation.

When voltage is applied to the Compressor Clutch, it is also applied to the Computer Command Control to signal the ECM to maintain normal engine idle speed while the A/C Compressor Clutch is engaged.

AIR CONDITIONING: AIR DELIVERY
C60, MANUAL

MODE SELECTOR VACUUM VALVE POSITIONS	
1	OFF
2	MAX
3	NORM
4	BI-LEVEL
5	VENT
6	HEATER
7	DEF



AIR CONDITIONING: AIR DELIVERY

C60, MANUAL

TROUBLESHOOTING HINTS

- **Try the following checks before doing System Diagnosis.**

1. Check for manifold vacuum to the vacuum tank at the BLACK hose from the engine and at the VIOLET hose to the A/C Control Head.
2. Check the operation of the Temperature Valve by moving the Temperature Selector rapidly back and forth several times. Listen for the valve to strike the stop at each end of its travel. If the sound indicates that the valve is not fully closing or opening, check the mechanical linkage between the valve and the Temperature Selector.
3. Check that Heater Water Bypass Valve operates when Temperature Selector is moved to maximum cold position.

- **Go to the A/C System Check in 8A-62 for a guide to normal operation and diagnostic references for the entire A/C System.**
- **Go to System Diagnosis to isolate air delivery conditions.**

SYSTEM DIAGNOSIS

- **Engine warm and running at idle.**
- If air flow does not come from the proper outlets under one or more operating modes, at least one of the air valves is not moving to the proper position.
- Check the operation of the air valves using the following chart. Put Blower Switch in HI to give a strong flow of air.

COMPONENT LOCATION

Component	Location	Page-Figure
Check Valve	Behind engine, to right of master brake cylinder	201-15-A
Heat/Defrost Vacuum Actuator	Behind I/P, on LH side of plenum	201-14-C
Lower Mode Vacuum Actuator	Behind I/P, on LH lower side of plenum	201-14-C
Recirculating-Outside Air Vacuum Actuator (Manual)	Behind I/P, on RH side of plenum	201-14-C
Upper Mode Vacuum Actuator	Behind I/P, on LH side of plenum	201-14-C
Vacuum Tank	Lower LH front corner of engine compartment	201-15-A

AIR VALVE POSITION TABLE

Conditions:
- **Ignition Switch: RUN (Engine Running)**
- **Blower Switch: HI**

Mode Selector Switch	Heat/ Defrost Valve	Lower Mode Valve	Upper Mode Valve	Outside Air Valve
OFF	B	A	A	B
MAX	A	B	B	A
NORM	A	B	B	B
BI-LEVEL	B	B	A	B
VENT	A	B	B	B
HEAT-ER	B	A	A	B
DEF	A	A	A	B

- **Additional tests of the A/C Vacuum System are given in Section 1B.**

CIRCUIT OPERATION

The air valves in the air conditioning system are operated by mechanical and vacuum controls. There are no electrical circuits. The functions of the air valves and A/C Evaporator Core are described below.

Temperature Valve

The Temperature Valve is mechanically linked to the temperature selector in the A/C Control Head. With the selector in Cold, the valve is in the cold position. This prevents air from blowing across the Heater Core. With the selector in any other position, some or all of the air blows across the Heater Core providing continuous temperature control.

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A/C Evaporator Core

All air passing through the A/C Module moves across the A/C evaporator Core. When the A/C Compressor is on, the core is cooled and removes moisture from the air.

Heater Water Bypass Valve

In most operating modes, engine coolant circulates through the Heater Core to heat the air passing through the core. When the Temperature Selector is moved to the maximum cold position, the Heater Water Bypass Valve is operated by mechanical linkage so that the coolant does not flow through the Heater Core. This allows maximum cooling of the air.

Heat Defrost Valve

With the Mode Selector Switch in OFF, BI-LEVEL or HEATER vacuum is applied to the Heat Defrost Vacuum Actuator. The bellows contract and the Heat/Defrost Valve moves to B position. Most of the air flows out of the Footwell Air Outlets. In all other positions of the Mode Selector Switch no vacuum is applied to the Vacuum Actuator and the Heater/Defrost Valve remains in position A forcing most of the air out of the Windshield Air Outlets.

Upper and Lower Mode Valves

The two Mode Valves determine the amount of air flow to the Instrument Panel Air Outlets. When the Mode Selector Switch is in MAX, NORMAL or VENT, vacuum is applied to both the Upper and Lower Mode Vacuum Actuators. Both valves then move to position B and all air flows out the Instrument Panel Air Outlets. In the BI-LEVEL mode, vacuum is applied only to the Lower Mode Vacuum Actuator which moves the Lower Mode Valve to position B. The Upper Mode Valve moves to position A. In these positions some air flows out of the Instrument Panel Air Outlets and the rest flows out the Footwell Air Outlet. IN HEATER, DEF and OFF no vacuum is applied to either Vacuum Actuator and both Valves move to position A. All air then flows to either the Footwell Air Outlets or the Windshield Air Outlets depending on the position of the Heat/Defrost Valve.

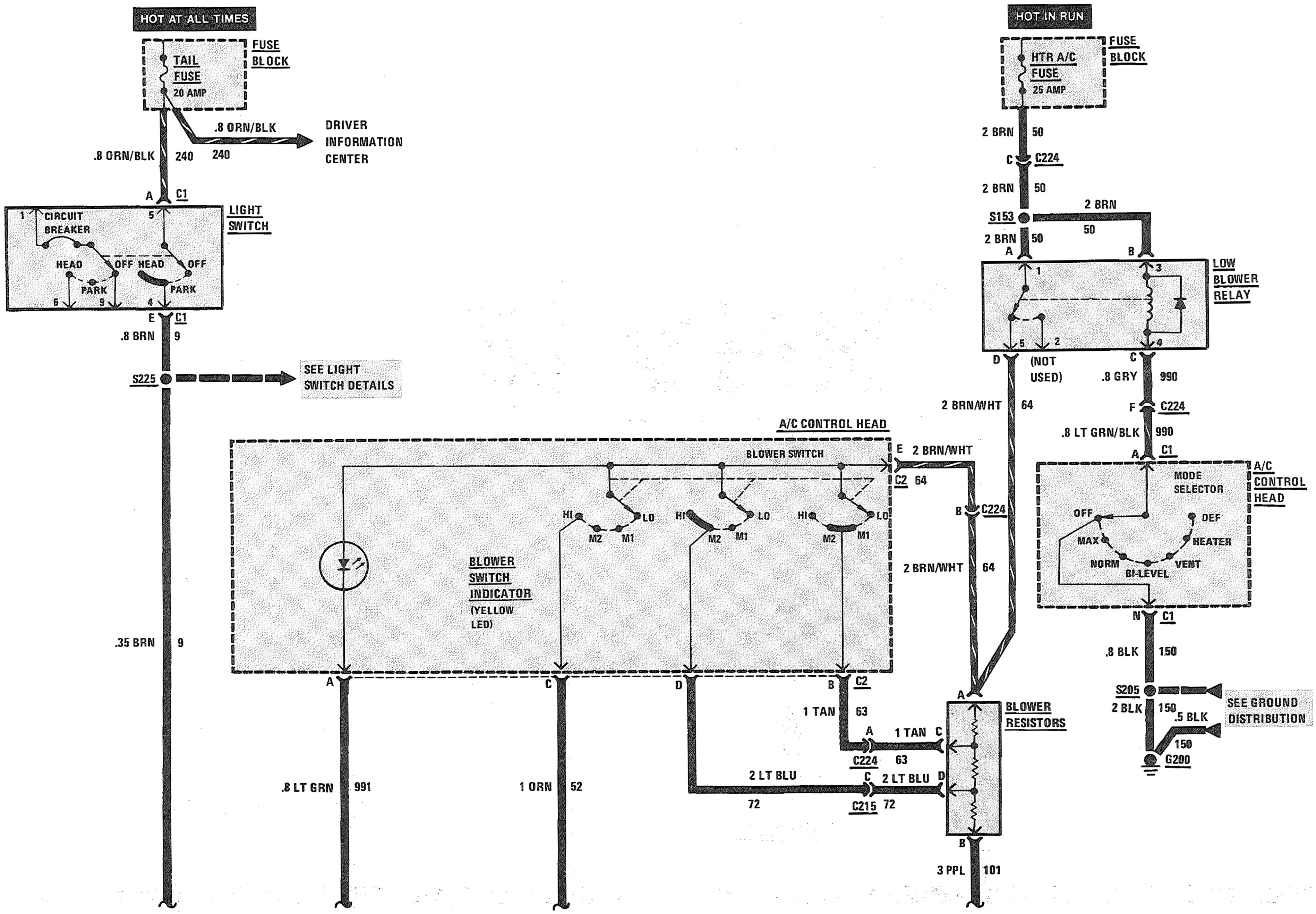
Outside Air Valve

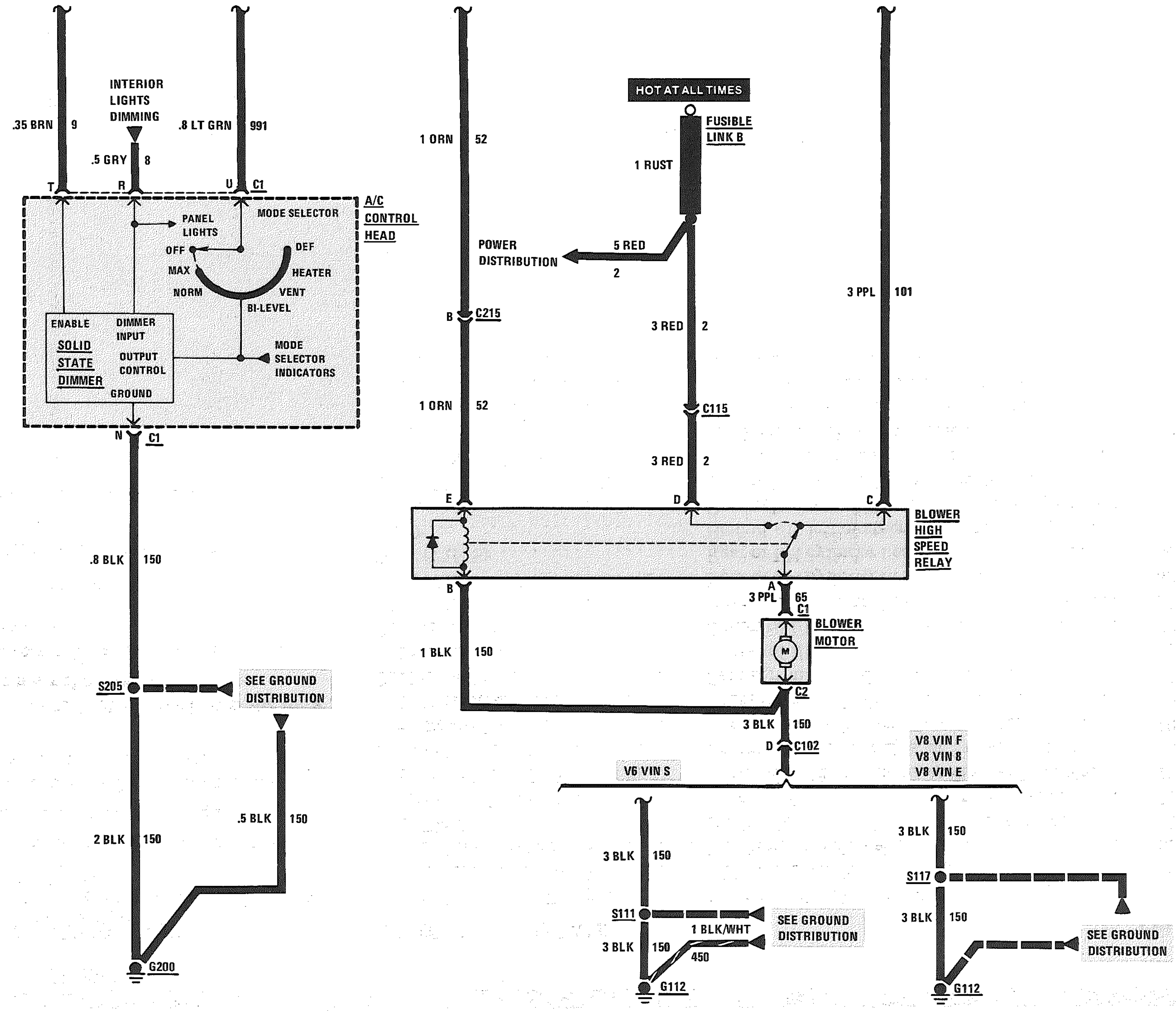
When the A/C Mode Selector is moved to MAX, vacuum is applied to the Outside Air Vacuum Actuator. The bellows are drawn in and the valve is moved to position A. Air from inside the car is pulled into the A/C Module.

In any other Mode Selector Switch position, the Motor bellows are expanded and air is drawn in from the outside.

BLANK

AIR CONDITIONING: BLOWER CONTROLS
C67, ELECTRONIC





INTERIOR LIGHTS DIMMING
.35 BRN 9
.5 GRY 8
.8 LT GRN 991
T
R
U
C1
A/C CONTROL HEAD
PANEL LIGHTS
MODE SELECTOR
OFF
DEF
MAX
HEATER
NORM
VENT
BI-LEVEL
ENABLE
DIMMER INPUT
SOLID STATE DIMMER
OUTPUT CONTROL
MODE SELECTOR INDICATORS
GROUND
N
C1
.8 BLK 150
S205
SEE GROUND DISTRIBUTION
.5 BLK 150
2 BLK 150
G200
1 ORN 52
B
C215
1 ORN 52
HOT AT ALL TIMES
FUSIBLE LINK B
1 RUST
POWER DISTRIBUTION
5 RED
2
3 RED 2
C115
3 RED 2
3 PPL 101
E
D
C
BLOWER HIGH SPEED RELAY
B
A
3 PPL 65
C1
BLOWER MOTOR
1 BLK 150
C2
3 BLK 150
D
C102
V6 VIN S
V8 VIN F
V8 VIN 8
V8 VIN E
3 BLK 150
S111
SEE GROUND DISTRIBUTION
1 BLK/WHT
450
3 BLK 150
G112
3 BLK 150
S117
3 BLK 150
SEE GROUND DISTRIBUTION
G112

AIR CONDITIONING: BLOWER CONTROLS
C67, ELECTRONIC

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the HTR A/C Fuse by visual inspection.
2. Check that G112 is clean and tight.
3. Check that Blower Motor connectors and Blower Relay are mated correctly and firmly seated.

- **Go the the A/C System Check in 8A-62 for a guide to normal operation.**
- **Go to System Diagnosis in this section for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

COMPONENT LOCATION

		Page-Figure
Blower High Speed Relay	RH front of dash, near Blower Motor	201-14-A
Blower Motor (With A/C)	RH front of dash	201-14-A
Blower Resistors (With A/C)	RH front of dash, behind strut tower	201-14-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link B (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link B (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link B (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Low Blower Relay	RH front of dash, near Blower Motor	201-14-A
C102 (4 cavities)	Center front of dash	201-14-A
C115 (1 cavity)	Center front of dash	201-14-A
C215 (3 cavities)	Center of I/P, behind A/C control	201-14-B
C224 (6 cavities)	Center of I/P, behind A/C control	201-14-B
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
G200	Behind I/P, left of steering column	201-10-A
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN E)	Engine harness, RH front of dash	201- 2-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A
S153	A/C harness, RH front of dash	201-14-A
S205	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A

SYMPTOM TABLE

SYMPTOM	DO TEST
Blower runs all the time (Ignition OFF)	B: Blower High Speed Relay Test
Blower runs all the time (Ignition ON)	E: Low Blower Relay Test
Blower will not run in any mode	A: Blower Motor Test D: Blower Switch Test F: A/C Mode Selector Blower Control Test
No Low or Medium Speed operation	C: Blower Resistors Test
No High Speed operation	B: Blower High Speed Relay Test D: Blower Switch Test
High Speed operation only	B: Blower High Speed Relay Test
None of the above	A, B, C, D, E and F
Panel lights or LED indicators do not light or dim	G: A/C Control Head LED and Panel Light Test

A: BLOWER MOTOR TEST

Measure: VOLTAGE
At: BLOWER MOTOR CONNECTORS
(Disconnected)
Conditions:
- Ignition Switch: RUN
- A/C Mode: VENT
- Blower Switch: HI

Measure Between	Correct Voltage	For Diagnosis
C1(PPL) & Ground	Battery	See 1
C1(PPL) & C2(BLK)	Battery	See 2

- If the voltages are correct, but the Blower does not run, install a new Blower Motor.

1. Check PPL (65) wire for an open. If wire is good, do Tests B and D.
2. Check BLK (150) wire for an open and ground G112 is clean and tight.

B: BLOWER HIGH SPEED RELAY TEST (TABLE 1)

Measure: VOLTAGE
AT: BLOWER HIGH SPEED RELAY CONNECTOR
(Disconnect)
Conditions:
- Ignition Switch: RUN
- A/C Mode: VENT
- Blower Switch: HI

Measure Between	Correct Voltage	For Diagnosis
D(RED) & Ground	Battery	See 1
C (PPL) & Ground	Battery	See 2
E (ORN) & Ground	Battery	See 3

- If voltages are correct, proceed to Table 2.

1. Check RED (2) wire for an open back to Fusible Link B.
2. Check PPL (101) wire for an open. If wire is good, do Test C.
3. Check ORN (52) wire for an open. If wire is good, do Test D.

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B: BLOWER HIGH SPEED RELAY TEST (TABLE 2)

Measure: RESISTANCE
AT: BLOWER HIGH SPEED RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: OFF**
- **Negative Battery Terminal: DISCONNECTED**

Measure Between	Correct Resistance	For Diagnosis
B (BLK) & Ground	0 ohms	See 1
A (PPL) & Ground	Aproximately 3 ohms	See 2

- If voltages in Table 1 and resistances in Table 2 are correct, but Blower Relay does not operate or runs all the time, replace the Blower Relay.

1. Check BLK (150) wire for an open.
2. Check PPL (65) wire for an open. If wire is good, recheck measurements made in Test A.

C: BLOWER RESISTORS TEST

Measure: RESISTANCE
At: BLOWER RESISTORS CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: OFF**

Measure Between	Correct Resistance	For Diagnosis
A & C	1.5 ± 1 ohm	See 1
C & D	0.7 ± .5 ohm	See 1
D & B	0.2 ± .1 ohm	See 1

- If resistances are correct, Blower Resistors are operating normally. Return to Symptom Table.

1. Install new Blower Resistors.

D: BLOWER SWITCH TEST (TABLE 1)

Measure: VOLTAGE
At: BLOWER RESISTOR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Blower Switch: LO**

Measure Between	Correct Voltage	For Diagnosis
A (BRN/WHT) & Ground	Battery	See 1
C (TAN) & Ground	0 volts	See 2
• Blower Switch: M1		
C (TAN) & Ground	Battery	See 3 and 5
D (LT BLU) & Ground	0 volts	See 2
• Blower Switch: M2		
D (LT BLU) & Ground	Battery	See 4 and 5

- If all voltages are correct, go to Table 2.

1. Check BRN/WHT (64) wire for an open. If wire is good, do Test E. (see schematic).
2. If battery voltage is present, check for a wire to wire short to voltage. If wire is good, replace the Blower Switch.
3. Check TAN (63) wire for an open.
4. Check LT BLU (72) wire for an open.
5. If voltage is present at terminal A but is not present at either terminals C or D, check the BRN/WHT (64) wire for an open between the Blower Resistor terminal A and the A/C Control Head terminal E.

D: BLOWER SWITCH TEST (TABLE 2)

Measure: VOLTAGE
At: BLOWER HIGH SPEED RELAY CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN
- A/C Mode: VENT
- Blower Switch: M2

Measure Between	Correct Voltage	For Diagnosis
E (ORN) & Ground	0 volts	See 1
• Blower Switch: HI		
E (ORN) & Ground	Battery	See 2

- If all voltages are correct, Blower Switch is operating normally. Return to Symptom Table.

1. If voltage is present, check ORN (52) wire for a wire to wire short to voltage. If wire is good, replace Blower Switch.
2. Check ORN (52) wire for an open. If wire is good, replace Blower Switch.

E: LOW BLOWER RELAY TEST

Measure: VOLTAGE
At: LOW BLOWER RELAY (Disconnected)
Conditions:
- Ignition Switch: RUN
- A/C Mode: OFF

Measure Between	Correct Voltage	For Diagnosis
A (BRN) & Ground	Battery	See 1 and 2
B (BRN) & Ground	Battery	See 1 and 2
A (BRN) & D (BRN/WHT)	Battery	See 3
B (BRN) & C (GRY)	Battery	See 4
• A/C Mode: All modes except OFF		
B (BRN) & C (GRY)	0 volts	See 5

- If all voltages are correct, but blower runs in A/C OFF Mode, or no voltages are present in other tests, replace the Low Blower Relay.

1. Check for an open in BRN (50) wire.
2. If voltages are incorrect at both terminals A and B, check Blower Fuse and BRN (50) wire.
3. Check for open in BRN/WHT (64) wire.
4. Check for open in GRY or LT GRN/BLK (990) wires. If wires are good, do Test F.
5. Check for short to ground in GRY or LT GRN/BLK (990) wires. If wires are good, replace the A/C Control Head.

F: A/C MODE SELECTOR BLOWER CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR C1 and C2 (Connected)
Conditions:
- Ignition Switch: RUN
- A/C Mode: OFF

Measure Between	Correct Voltage	For Diagnosis
N (BLK) C1 & Ground	0 volts	See 1
A (LT GRN/ BLK) C1 & Ground	0 volts	See 2
E (BRN/ WHT)C2 & Ground	0 volts	See 3
• A/C Mode: All positions except OFF.		
A (LT GRN/ BLK) C1 & Ground	Battery	See 4
E (BRN/WHT) C2 & Ground	Battery	See 5

- If all voltages are correct, A/C Mode Selector and Low Blower Relay are operating normally. Return to Symptom Table.

1. If voltage is present, check BLK (150) wire for an open. Check that G200 is clean and tight.
2. If voltage is present, replace A/C Control Head.
3. If voltage is present, replace Low Blower Relay.

(Continued on next page)

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4. Check for open or short to ground in LT GRN/BLK (990) wire. If wire is good, do Test E.
5. Check for open in BRN/WHT (64) wire. If wire is good, do Test E.

G: A/C CONTROL HEAD LED AND PANEL LIGHT TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTORS (Connected)
Conditions:
- **Ignition Switch: RUN**
- **A/C Mode: VENT**
- **Light Switch: PARK**
- **Light Dimmer Setting: Full Brightness**

Measure Between	Correct Voltage	For Diagnosis
T (BRN) C1 & Ground	Battery	See 1
R (GRY) & Ground	Battery	See 2

- Light Dimmer Setting: Minimum Brightness

Measure Between	Correct Voltage	For Diagnosis
R (GRY) & Ground	Minimum Panel Light Voltage	See 3

- If voltages are correct, but Panel Lights or LED Indicators do not light or dim, replace the A/C Control Head.

1. Check BRN (9) wire for an open.
2. Check GRY (8) wire for an open.
3. Go to 8A-12, Light Switch Details for diagnosis.

G1. If Blower Switch Indicator does not light, check LT GRN (991) wire for an open. If wire is good, replace A/C Control Head.

- If any individual LED Mode Indicator does not light, replace A/C Control Head.

CIRCUIT OPERATION

The Blower Motor is a variable speed motor which runs at a speed proportional to the applied voltage. The higher the voltage applied to the motor, the faster the speed.

When the Ignition Switch is in RUN, battery voltage is applied to the Low Blower Relay through the HTR-A/C Fuse.

With the Mode Selector in OFF, the Low Blower Relay coil is grounded through the GRY wire and the A/C Control Head. The relay operates, its contacts open, and the voltage to the Blower Switch is removed. No voltage is supplied to the Blower circuits. When any other mode except OFF is selected, the Low Blower Relay is deenergized and voltage is applied to the Blower Switch and Blower Resistors.

With the Blower Switch in LO, voltage is applied through all Blower Resistors to the contacts of the Blower High Speed Relay, and the Blower Motor. The blower runs at low speed.

As the Blower Switch is moved through positions M1 and M2, the switch bypasses some of the Blower Resistors allowing more voltage to be applied to the Blower Motor which will increase its speed.

When the Blower Switch is in HI, voltage is applied through the ORN (52) wire to the coil of the Blower High Speed Relay. The Blower High Speed Relay operates, removing the Blower Resistors from the circuit.

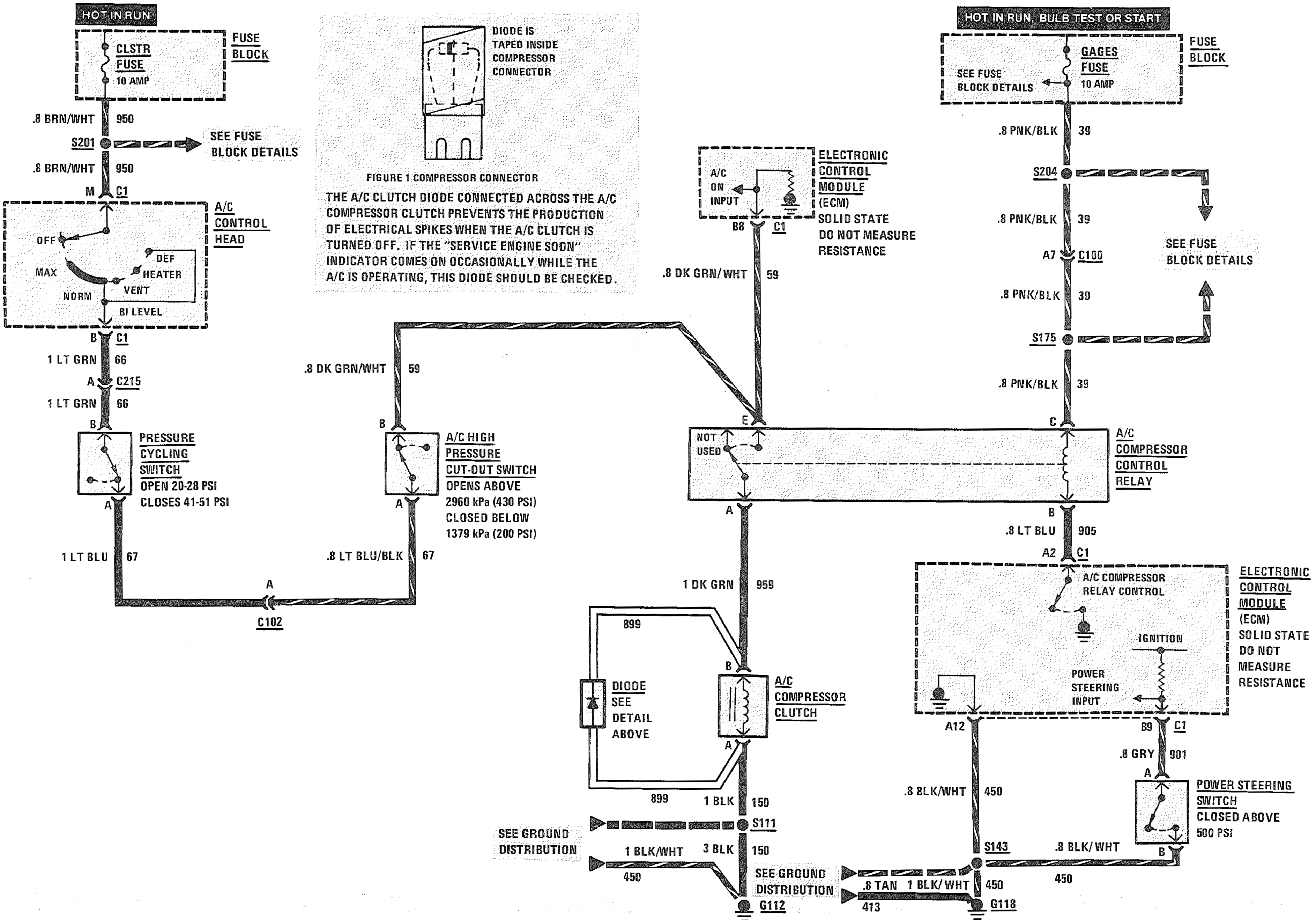
Battery voltage is then applied directly to the Blower Motor through the relay contacts and the motor runs at maximum speed.

The battery voltage at terminal E of the A/C Control Head is also applied to the Blower Switch Indicator and the Mode Selector Indicators through the LT GRN (991) wire and Mode Selector Switch. When the light switch is turned to the PARK or HEAD position, battery voltage is applied to terminal T of the A/C Control Head which enables the Solid State dimmer. The brightness of the LED Indicator will then be determined by the volage level at terminal R. The voltage at terminal R is controlled by the panel lights dimmer control and sets the brightness level of the panel lights and LED Indicators in the A/C Control Head.

BLANK

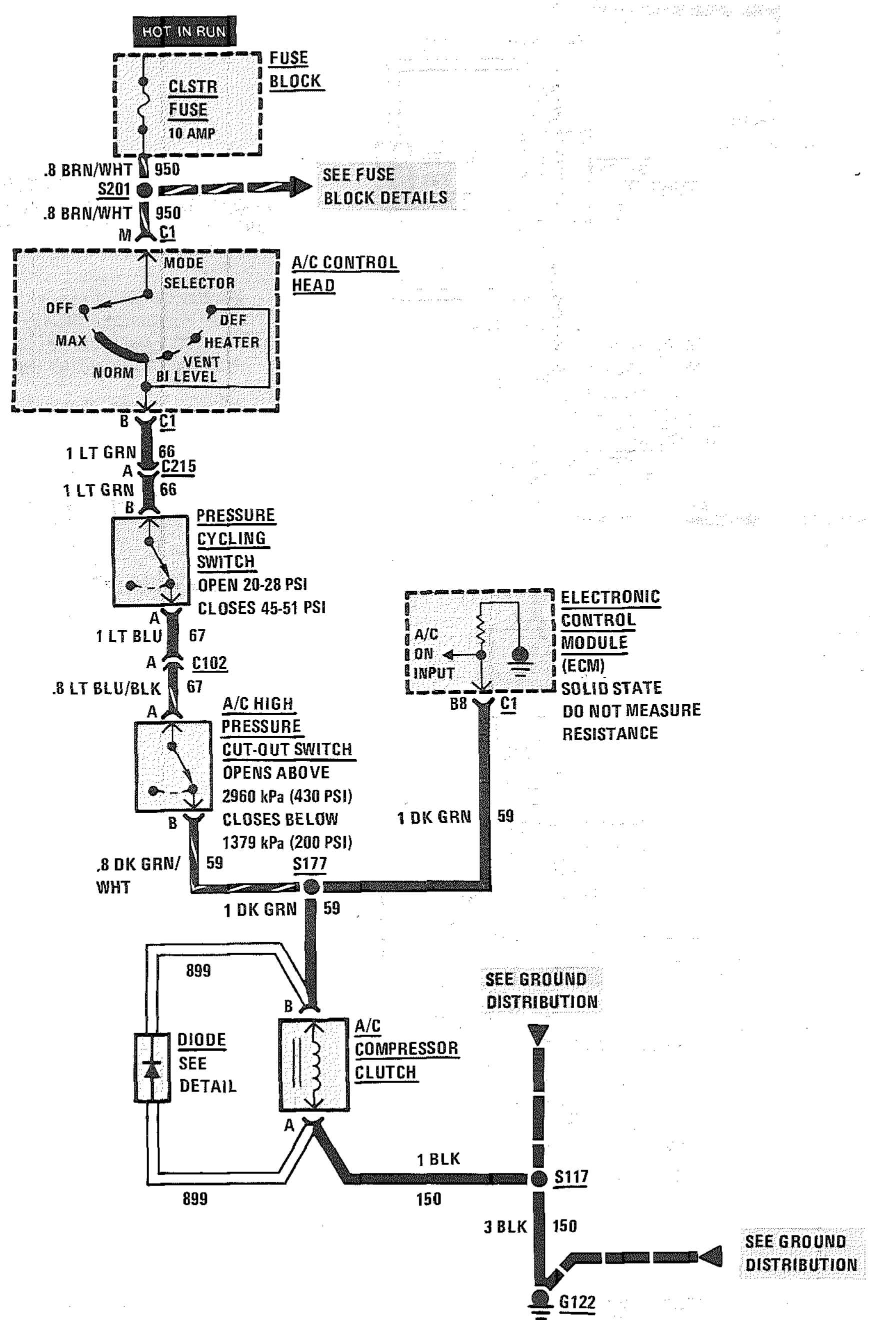
AIR CONDITIONING: COMPRESSOR CONTROLS

C67, ELECTRONIC, V6 VIN S



AIR CONDITIONING: COMPRESSOR CONTROLS

C67, ELECTRONIC, V8 VIN F, V8 VIN 8



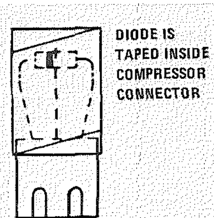


FIGURE 1 COMPRESSOR CONNECTOR

THE A/C CLUTCH DIODE CONNECTED ACROSS THE A/C COMPRESSOR CLUTCH PREVENTS THE PRODUCTION OF ELECTRICAL SPIKES WHEN THE A/C CLUTCH IS TURNED OFF. IF THE "SERVICE ENGINE SOON" INDICATOR COMES ON OCCASIONALLY WHILE THE A/C IS OPERATING, THIS DIODE SHOULD BE CHECKED.

AIR CONDITIONING: COMPRESSOR CONTROLS
C67, ELECTRONIC, V8 VIN E

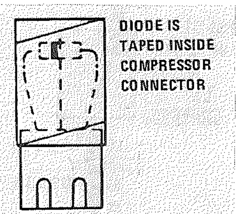


FIGURE 1 COMPRESSOR CONNECTOR

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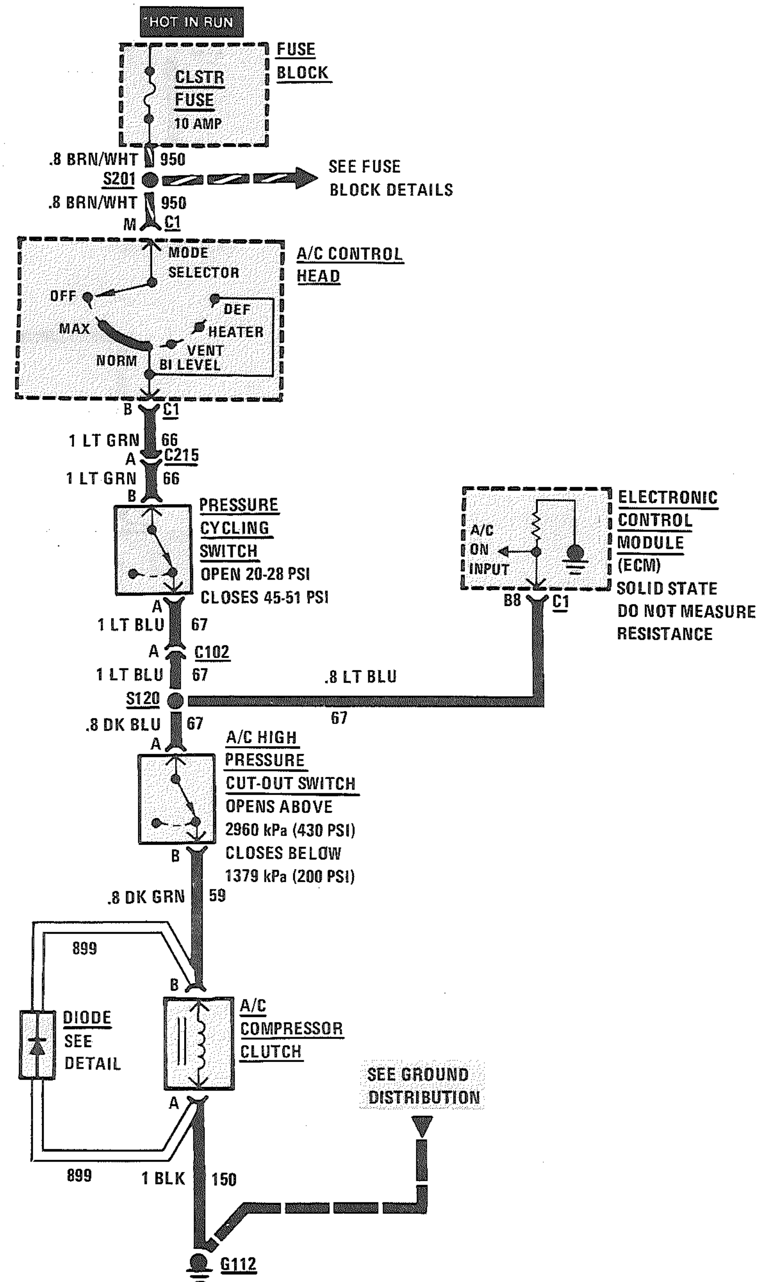

AIR CONDITIONING: COMPRESSOR CONTROLS

C67, ELECTRONIC

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check CLSTR Fuse by visual inspection.
2. Check that the A/C Compressor Clutch connector is firmly seated.
3. Check that ground G112 is clean and tight.

- **Go to System Check for a guide to normal Compressor Control operation.**
- **Go to System Diagnosis for Compressor Control diagnostic tests.**

SYSTEM CHECK

- **Complete the A/C System Check in Section 8A-62 as a guide to normal operation of the A/C System.**
- **Use the System Check Table as a guide to normal operation of the Compressor Control.**

COMPONENT LOCATION

		Page-Figure
A/C Compressor Clutch (VIN E)	Top RH front of engine	201- 4-A
A/C Compressor Clutch (VIN F) (VIN 8)	Top RH front of engine	201- 6-A
A/C Compressor Clutch (VIN S)	Top LH front of engine.	201- 0-B
A/C Compressor Control Relay	LH rear corner of engine compartment, on relay bracket	201- 0-A
A/C High Pressure Cut-Out Switch (VIN E)	Top RH front of engine, on rear of A/C compressor	201- 4-D
A/C High Pressure Cut-Out Switch (VIN F) (VIN 8)	Top RH front of engine, on rear of A/C compressor	201- 6-C
A/C High Pressure Cut-Out Switch (VIN S)	Top LH front of engine, on rear of A/C compressor	201- 0-B
Diode	Inside A/C Compressor Clutch connector	201- 0-B
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Power Steering Switch	Lower LH front corner of engine compartment, on steering unit	201- 0-A
Pressure Cycling Switch	On side of A/C accumulator	201-14-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C102 (4 cavities)	Center front of dash	201-14-A
C215 (3 cavities)	Center of I/P, behind A/C control	201-14-B
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A
S120	Engine harness, RH front of dash	201- 2-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S175 (VIN S)	Engine harness, lower LH front of dash	201- 0-A
S177	Engine harness, top RH front of engine	201- 5-A
S201	I/P harness, behind instrument cluster	201-10-A
S204	I/P harness, behind instrument cluster	201-10-A

(Continued from previous page)

SYSTEM CHECK TABLE

ACTION	EXPECTED RESULT
1. Turn the Ignition Switch to RUN and start the engine Set the A/C Mode to OFF then to MAX	A click can be heard when the clutch engages
2. Alternately select OFF and MAX several times	Verify that the clutch engages in MAX Clutch plate movement can be seen on the front of the compressor pulley If the clutch does not engage, proceed to step 4 If the clutch operates as expected, continue to Step 3
3. Select MAX mode to engage clutch	Check that air from the coolant fan can move freely through condensor Feel the input (cool) and output (warm) pipes to the compressor If there is not a wide temperature difference after the compressor has run for several seconds, see Section 1B for refrigerant and compressor diagnostics
4. Turn off the ignition Check the refrigerant charge, according to the procedures in Section 1B	If the refrigerant charge is low, follow the procedures in Section 1B for refrigerant diagnosis If the refrigerant charge is normal, isolate the conditions using the procedures which follow in the System Diagnosis

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

V6 VIN S

- **Use the Isolation Test below to choose the proper diagnostic tests.**
- **Tests follow the Isolation Test.**

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: Above 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
C (PNK/BLK) & Ground	Battery	Check GAGES Fuse and PNK/BLK (39) wire for an open

(ISOLATION TEST (TABLE 1) continued on facing page)

AIR CONDITIONING: COMPRESSOR CONTROLS

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(ISOLATION TEST (TABLE 1) continued from facing page)

E (DK GRN/ WHT) & Ground	Battery	Check DK GRN/WHT (59) wire for an open. If wire is good, do Test C

- If voltages are correct leave A/C Compressor Control Relay Connector disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: FUSED JUMPER
At: A/C COMPRESSOR CONTROL RELAY CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: Above 60°F (16°C)**

Jumper Between	Correct Action	For Diagnosis
E (DK GRN/ WHT) & A (DK GRN)	Clutch Engages	Do Test B

- If action is correct, do Test A.

A: ECM COMPRESSOR CONTROL TEST (TABLE 1)

Measure: VOLTAGE
At: ECM CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **A/C Compressor Control Relay Connected**
- **Temperature Outside Car: Above 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
B8 on Conn C1 (DK GRN/ WHT) & Ground	Battery	See 1
A2 on Conn C1 (LT BLU) & Ground	Battery	See 2

- If voltages are correct proceed to Table 2.
1. Check for open in DK GRN/WHT (59) wire.
2. Check for open in LT BLU (905) wire. If wire is good, replace A/C Compressor Control Relay.

A: ECM COMPRESSOR CONTROL TEST (TABLE 2)

Measure: RESISTANCE
At: ECM CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: OFF**
- **Negative Battery Terminal Disconnected**

Measure Between	Correct Resistance	For Diagnosis
B9 on Conn C1 (GRY) & Ground	0 ohms	See 1

- If resistance is correct proceed to Table 3.
1. Check that Power Steering Switch is closed. If switch is open, replace it. Check for an open in the GRY (901) wire and BLK/WHT (450) wire.

(Continued on next page)

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(Continued from previous page)

A: ECM COMPRESSOR CONTROL TEST (TABLE 3)

Connect: FUSED JUMPER
At: ECM CONNECTOR (Disconnected)
Conditions:

- Ignition Switch: RUN (Engine not running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Jumper Between	Correct Action	For Diagnosis
A2 on Conn C1 (LT BLU) & Ground	A/C Compressor Control Relay operates and A/C Clutch engages	See 1

- If action is correct but A/C system does not operate under normal conditions, condition is due to ECM. Refer to Section 6E for ECM diagnostics.

1. Replace A/C Compressor Control Relay.

B: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: COMPRESSOR CLUTCH CONNECTOR (Disconnected)

- Ignition Switch: RUN (Engine not running)
- A/C Mode: NORM
- A/C Compressor Control Relay disconnected
- A/C Compressor Control Relay terminals A and E jumpered
- Temperature Outside Car: Above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check for open in DK GRN (959) wire.
2. Check for open in BLK (150) wire.

C: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:

- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
M (BRN/WHT) & Ground	Battery	See 1
B (LT GRN) & Ground	Battery	Replace A/C Control Head

- If voltages are correct, go to C1.

1. Check for open CLSTR Fuse or open BRN/WHT (950) wire.

C1. Remove the connectors from the A/C Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch and connect a fused jumper between the terminals of the connectors.

- If either switch is open, battery voltage will be present at Terminal E of the A/C Compressor Control Relay when the jumper is connected.
- If the A/C Pressure Cycling Switch is open, refer to Section 1B to check for normal refrigerant charge. If refrigerant charge is normal replace the switch. If refrigerant charge is low, follow procedures in Section 1B for refrigerant diagnostics.
- If the A/C High Pressure Cut-Out Switch is open replace it.

AIR CONDITIONING: COMPRESSOR CONTROLS

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- If both switches are good but battery voltage is not present at the A/C Compressor Control Relay, check the wiring between switches for an open (see schematic).

SYSTEM DIAGNOSIS

V8 VINF, V8 VIN 8

- **Use the Isolation Test below to choose the proper diagnostic tests.**
- **Tests follow the Isolation Test.**

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: A/C PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: Above 60°F (16°C)**

Measure Between	Correct Voltage	For Diagnosis
B (LT GRN) & Ground	Battery	Do Test B

- If voltage is correct, leave Pressure Cycling Switch disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: FUSED JUMPER
At: A/C PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine need not be running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: Above 60°F (16°C)**

Jumper Between	Correct Action	For Diagnosis
B (LT GRN) & A (LT BLU)	Clutch Engages	Do Test A

- If action is correct, refer to Section 1B for procedure to check refrigerant pressure. If refrigerant pressure is normal, replace the Pressure Cycling Switch.

A: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN (Engine not running)**
- **A/C Mode: NORM**
- **Temperature Outside Car: Above 60 °F (16 °C)**

Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check that A/C High Pressure Cut-Out Switch is closed (see schematic). If it is open, replace it. Check for an open in the LT BLU (67) and DK GRN (59) wires.
2. Check for an open in the BLK (150) wire. Check that ground G112 is clean and tight.

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B: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:
- Ignition Switch: RUN
- A/C Mode: NORM
- Temperature outside car: above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
M (BRN/WHT) & Ground	Battery	See 1
B (LT GRN) & Ground	Battery	Replace A/C Control Head Assembly

- If voltages are correct, check for an open in the LT GRN (66) wire.

1. Check for an open CLSTR Fuse or open BRN/WHT (950) wire.

SYSTEM DIAGNOSIS

V8 VIN E

- Do the tests listed for your symptom in the Symptom Table below.
- Tests follow the Symptom Table.

ISOLATION TEST (TABLE 1)

Measure: VOLTAGE
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
B (LT GRN) & Ground	Battery	Do Test B

- If voltage is correct, leave Pressure Cycling Switch disconnected and go to Table 2.

ISOLATION TEST (TABLE 2)

Connect: JUMPER
At: PRESSURE CYCLING SWITCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine need not be running)
- A/C Mode: NORM
- Temperature Outside Car: Above 60°F (16°C)

Jumper Between	Correct Action	For Diagnosis
B (LT GRN) & A (LT BLU)	Clutch Engages	Do Test A

- If action is correct but A/C Compressor Clutch does not engage under normal operating conditions, refer to Section 1B for procedure to check refrigerant pressure. If refrigerant pressure is normal, replace the Pressure Cycling Switch.

A: A/C COMPRESSOR CLUTCH TEST

Measure: VOLTAGE
At: A/C COMPRESSOR CLUTCH CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN (Engine not running)
- A/C Mode: NORM
- Pressure Cycling Switch Connected
- Temperature Outside Car: Above 60 °F (16 °C)

Measure Between	Correct Voltage	For Diagnosis
B (DK GRN) & Ground	Battery	See 1
B (DK GRN) & A (BLK)	Battery	See 2

- If voltages are correct but clutch does not engage, replace the Compressor Clutch.

1. Check that A/C High Pressure Cut-Out Switch is closed (see schematic). If it is open, replace it. Check for an open in the LT BLU (67) wire, the DK BLU (67) wire and the DK GRN (59) wire.
2. Check for an open in the BLK (150) wire. Check that ground G112 is clean and tight.

C67, ELECTRONIC

B: A/C COMPRESSOR FUNCTION CONTROL TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD
Conditions:
- Ignition Switch: RUN
- A/C Mode: NORM
- Temperature outside car: above 60°F (16°C)

Measure Between	Correct Voltage	For Diagnosis
M (BRN/WHT) & Ground	Battery	See 1
B (LT GRN) & Ground	Battery	Replace A/C Control Head

- If voltages are correct, check for an open in the LT GRN (66) wire.

1. Check for an open CLSTR Fuse or open BRN (950) wire.

CIRCUIT OPERATION

The compressor for the air conditioning system is belt driven by the engine through the Compressor Clutch. The clutch allows the compressor to be disengaged when air conditioning is not required or to remove the air conditioning load from the engine when necessary.

Operation of the compressor depends on the particular A/C mode selected by the driver. When the A/C Mode is in MAX, NORM, BI-LEVEL or DEF battery voltage is applied through the CLSTR Fuse and A/C Control Head Mode Selector Switch to the remaining circuits.

V6 VIN S

For vehicles equipped with the V6 VIN S engine the path to the A/C Compressor Control Relay is through the A/C Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch which are both normally closed. The A/C Pressure Cycling Switch opens when refrigerant pressure drops to a point where the evaporator may begin to ice. It closes again when the pressure rises to the point where additional cooling is required. This action causes the compressor to cycle on and off. The A/C High Pressure Cut-Out Switch opens when refrigerant pressure is too high for normal operation.

The A/C Compressor Control Relay is operated by the ECM. When the ECM receives the A/C ON signal at Terminal B8, it grounds Terminal A2, energizing the relay. When the relay is energized, voltage is applied to the A/C Compressor Clutch through the contacts of the relay. If the ECM determines that engine load should be reduced, such as during full throttle, the A/C Compressor Control Relay is de-energized which removes voltage from the A/C Compressor Clutch thus removing the A/C load from the engine.

V8 VIN F, V8 VIN 8

From the A/C Control Head voltage is applied to the A/C Compressor Clutch through the Pressure Cycling Switch and the A/C High Pressire Cut-Out Switch. The Pressure Cycling Switch is normally closed but opens when refrigerant pressure drops below 172 kPa (25 psi). It closes again when refrigerant pressure rises enough that additional cooling is required. This action causes the A/C Compressor to cycle on and off so that the evaporator temperature does not drop low enough to cause icing. The A/C High Pressure Cut-Out Switch opens if refrigerant pressure rises to a point which is too high for normal operation.

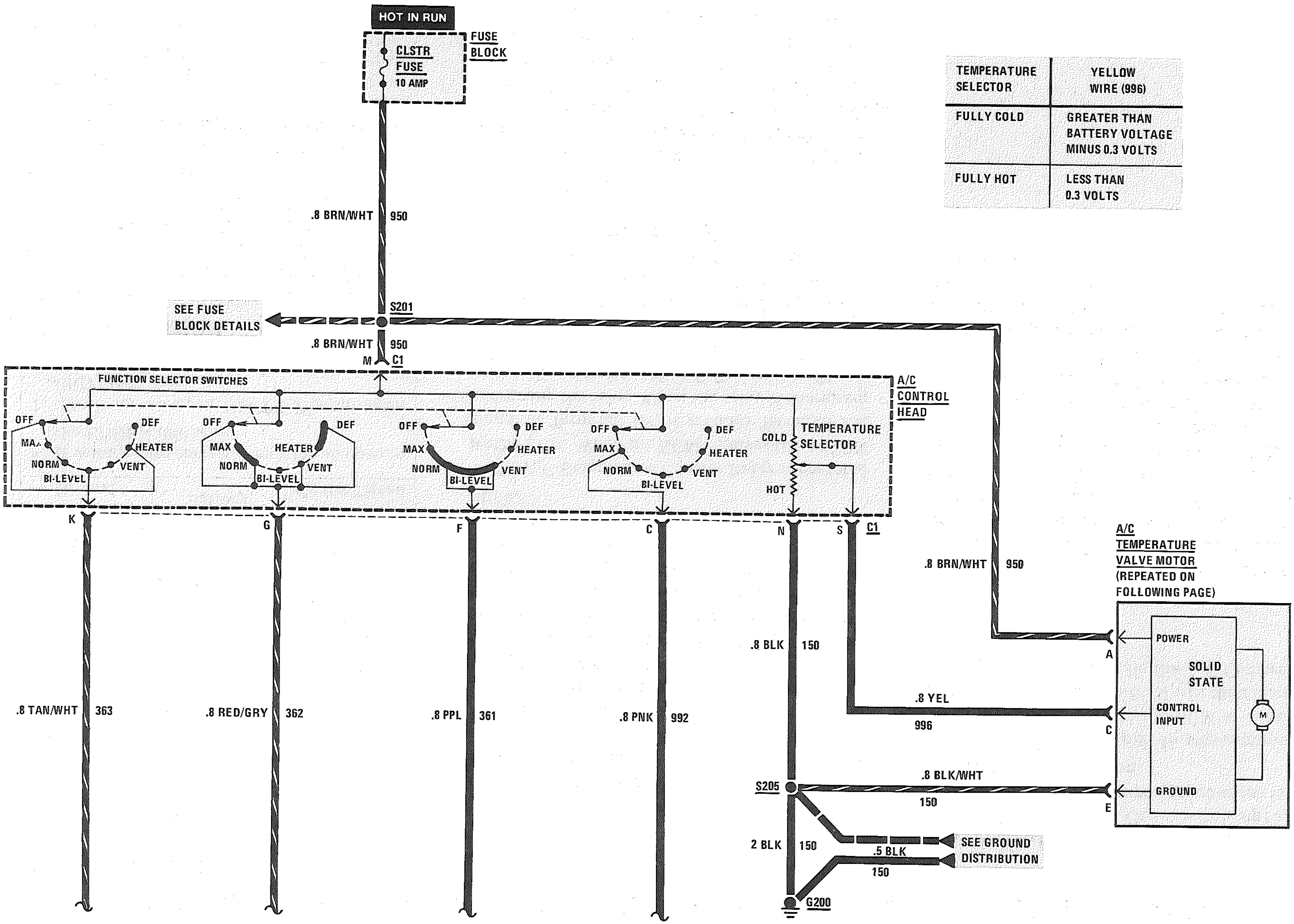
When voltage is applied to the compressor clutch it is also applied to the ECM at Terminal B8 on Connector C1. The ECM will then increase the engine idle speed while the A/C Compressor Clutch is engaged.

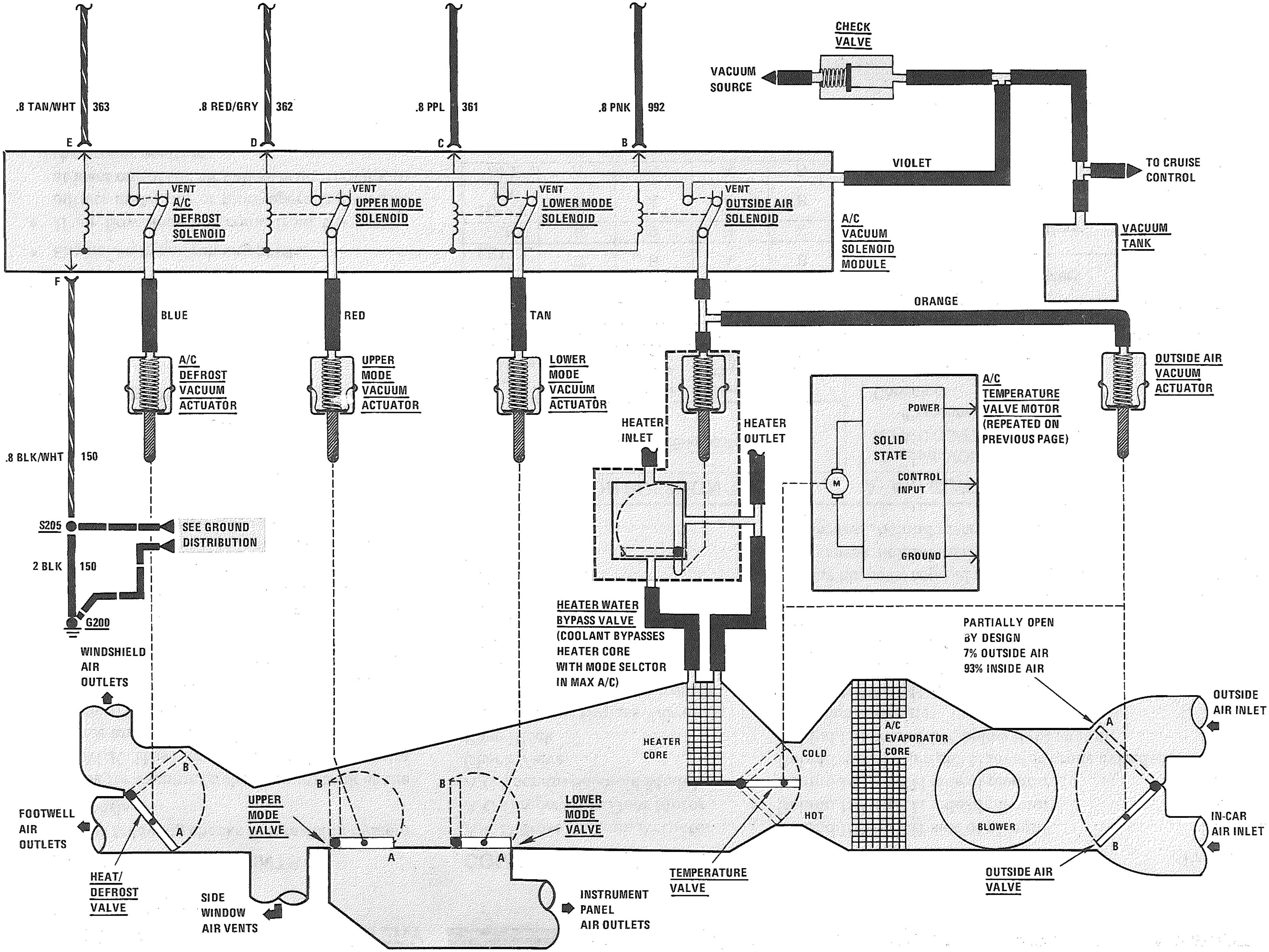
V8 VIN E

From the A/C Control Head voltage is applied to the A/C Compressor Clutch through the Pressure Cycling Switch and the A/C High Pressure Cut-Out Switch. The Pressure Cycling Switch is normally closed but opens when refrigerant pressure drops below 172 kPa (25 psi). It closes again when refrigerant pressure rises enough that additional cooling is required. This action causes the A/C Compressor to cycle on and off so that the evaporator temperature does not drop low enough to cause icing. The A/C High Pressure Cut-Out Switch opens if refrigerant pressure becomes too high for normal operation.

AIR CONDITIONING: AIR DELIVERY
C67, ELECTRONIC

TEMPERATURE SELECTOR	YELLOW WIRE (996)
FULLY COLD	GREATER THAN BATTERY VOLTAGE MINUS 0.3 VOLTS
FULLY HOT	LESS THAN 0.3 VOLTS





CHECK VALVE
VACUUM SOURCE
.8 TAN/WHT 363
.8 RED/GRY 362
.8 PPL 361
.8 PNK 992
E
D
C
B
VIOLET
TO CRUISE CONTROL
VENT
A/C DEFROST SOLENOID
VENT
UPPER MODE SOLENOID
VENT
LOWER MODE SOLENOID
VENT
OUTSIDE AIR SOLENOID
A/C VACUUM SOLENOID MODULE
VACUUM TANK
F
ORANGE
BLUE
RED
TAN
A/C DEFROST VACUUM ACTUATOR
UPPER MODE VACUUM ACTUATOR
LOWER MODE VACUUM ACTUATOR
OUTSIDE AIR VACUUM ACTUATOR
A/C TEMPERATURE VALVE MOTOR (REPEATED ON PREVIOUS PAGE)
POWER
SOLID STATE
CONTROL INPUT
GROUND
M
HEATER INLET
HEATER OUTLET
.8 BLK/WHT 150
S205
SEE GROUND DISTRIBUTION
2 BLK 150
G200
HEATER WATER BYPASS VALVE (COOLANT BYPASSES HEATER CORE WITH MODE SELCTOR IN MAX A/C)
PARTIALLY OPEN BY DESIGN 7% OUTSIDE AIR 93% INSIDE AIR
WINDSHIELD AIR OUTLETS
HEATER CORE
COLD
HOT
A/C EVAPORATOR CORE
BLOWER
OUTSIDE AIR INLET
IN-CAR AIR INLET
A
B
FOOTWELL AIR OUTLETS
UPPER MODE VALVE
LOWER MODE VALVE
HEAT/ DEFROST VALVE
SIDE WINDOW AIR VENTS
INSTRUMENT PANEL AIR OUTLETS
TEMPERATURE VALVE
OUTSIDE AIR VALVE

AIR CONDITIONING: AIR DELIVERY

C67, ELECTRONIC

TROUBLESHOOTING HINTS

- **Try the following checks before doing System Diagnosis.**

1. Check for vacuum to the vacuum tank at the BLACK Hose from the engine vacuum source and at the VIOLET Hose to the A/C Vacuum Solenoid Module.
2. Check the operation of the Temperature Valve by setting the Temperature Selector to COLD and then moving it to HOT. Observe that the valve moves through its full range each time the Temperature Selector is changed from one end of the range to the other. If the valve is not fully closing or opening, check that the valve is free to move and that none of the linkage is binding.
3. Check that Heater Water Bypass Valve operates in MAX A/C Mode.

- **Go to the A/C System Check in 8A-62 for a guide to normal operation of the Air Delivery System.**
- **Go to System Diagnosis in this section for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Engine warm and running at idle.**
- If air flow does not come from the proper outlets under one or more operating modes, at least one of the air valves is not moving to the proper position.
- Check the operation of the air valves using the following chart. Put Blower switch in HI to give a strong flow of air.

COMPONENT LOCATION

		Page-Figure
A/C Defrost Vacuum Actuator	Behind I/P, on LH side of plenum	201-14-B
A/C Temperature Door Motor	Behind I/P, on RH side of plenum	201-13-A
A/C Vacuum Solenoid Module	Behind I/P, on RH side of plenum	201-13-A
Check Valve	Behind engine, to right of master brake cylinder	201-15-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Heater Water Bypass Valve	RH front of engine	
Lower Mode Vacuum Actuator	Behind I/P, on LH side of plenum	201-14-B
Outside Air Vacuum Actuator	Behind I/P, on RH side of plenum	201-14-B
Upper Mode Vacuum Actuator	Behind I/P, on LH side of plenum	201-14-B
Vacuum Tank	Lower LH front corner of engine compartment	201-15-A
G200	Behind I/P, left of steering column	201-10-A
S125	Engine harness, top LH rear of engine	201- 0-C
S201	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A

AIR DOOR POSITION TABLE

Conditions:
- **Ignition Switch: RUN (Engine Running)**
- **Blower Switch: HI**

Operating Mode	Heat/ Defrost Valve	Lower Mode Valve	Upper Mode Valve	Outside Air Valve
OFF	B	A	A	B
MAX	B	B	B	A
NORM	B	B	B	B
BI-LEVEL	B	B	A	B
VENT	B	B	B	B
HEATER	B	A	A	B
DEF	A	A	A	B

- **Additional tests of the A/C Vacuum System are given in Section 1B.**

A: A/C CONTROL HEAD VOLTAGE TEST

Measure: VOLTAGE
At: A/C CONTROL HEAD CONNECTOR C1 (Disconnected)
Condition:
- **Ignition Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
M (BRN/WHT) & Ground	Battery	See 1
M (BRN/WHT) & N (BLK)	Battery	See 2

- If voltages are correct, go to tests B and C.

1. Check for open CLSTR Fuse or BRN/WHT (950) wire.
2. Check for open in BLK (150) wire to ground.

(Continued on facing page)

B: TEMPERATURE VALVE MOTOR VOLTAGE TEST

Measure: VOLTAGE
At: A/C TEMPERATURE VALVE MOTOR CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN
- Mode: VENT
- Temperature Selector: COLD

Measure Between	Correct Voltage	For Diagnosis
A (BRN/WHT) & Ground	Battery	See 1
A (BRN/WHT) & E (BLK/WHT)	Battery	See 2
C (YEL) & E (BLK/WHT)	Battery	See 3
• Temperature Selector: HOT		
C (YEL) & E (BLK/WHT)	Less than 0.5 volts (See Note)	See 3

- If voltages are correct, check that Temperature Valve is free to move and linkage is not binding. If valve is free to move, but does not operate correctly, replace the A/C Temperature Valve Motor.

1. Check for open in BRN/WHT (950) wire.
2. Check for open in BLK/WHT (150) wire.
3. Check for open in YEL (996) wire. If wire is good, replace A/C Control Head.

Note: Voltage at terminal C (YEL) varies continuously between Battery and approximately 0.5 volts as the Temperature Selector is moved from COLD to HOT. If voltage change is not uniform, replace the A/C Control Head.

C: VACUUM SOLENOID MODULE VOLTAGE TEST

Measure: VOLTAGE
At: A/C VACUUM SOLENOID MODULE CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: RUN
- Mode: OFF

Measure Between	Correct Voltage	For Diagnosis
E (TAN/WHT) & Ground	Battery	See 1
E (TAN/WHT) & F (BLK/WHT)	Battery	See 2
• Mode: BI-LEVEL and HEATER		
E (TAN/WHT) & Ground	Battery	See 1
• Mode: MAX, NORM and VENT		
D (RED/GRY) & Ground	Battery	See 3
• Mode: MAX, NORM, BI-LEVEL and VENT		
C (PPL) & Ground	Battery	See 4
• Mode: MAX		
B (PNK) & Ground	Battery	See 5

- If all voltages are correct, but one or more air valves do not receive vacuum, replace the A/C Vacuum Solenoid Module.

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1. Check TAN/WHT (363) wire for an open or short to ground. If wire is good, replace the A/C Control Head.
2. Check BLK/WHT (150) wire for an open.
3. Check RED/GRY (362) wire for an open or short to ground. If wire is good, replace the A/C Control Head.
4. Check PPL (361) wire for an open or short to ground. If wire is good, replace the A/C Control Head.
5. Check PNK (992) wire for an open or short to ground. If wire is good, replace the A/C Control Head.

CIRCUIT OPERATION

The air valves that control the heating and air conditioning air flow are operated by vacuum actuators. The valves that apply or vent vacuum to these actuators are solenoid operated and are located in the A/C Control Head. Circuits controlled by pushbutton switches power the solenoids.

The functions of the vacuum valves and air valves are described below.

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Temperature Valve

The Temperature Valve is positioned by the A/C Temperature Valve Motor which is controlled by the Temperature Selector. When the Temperature Selector is moved to the COLD position, battery voltage is applied to the Control Input of the A/C Temperature Valve Motor on the YEL (996) wire. The circuits in the A/C Temperature Valve Motor cause the motor to move the Temperature Valve to the COLD position which blocks all air from passing through the Heater Core.

As the Temperature Selector is moved from the COLD to HOT position, the voltage at the control input of the A/C Temperature Valve Motor drops to about 0.3 volts at the HOT position. The changing voltage level causes the motor to move the valve to the position corresponding to the setting of the Temperature Selector.

Outside Air Valve

The Outside Air Valve determines whether air will be drawn from the outside air inlet or from inside the car. The valve is in position B (see schematic) in all modes except MAX, permitting outside air to enter. In the MAX Mode, the Outside Air Solenoid is energized applying vacuum to the Outside Air Vacuum Actuator which moves the valve to position A. Air from inside the car is then recirculated to get maximum cooling from the air conditioning system.

Heater Water Bypass Valve

In all operating modes except MAX, engine coolant circulates through the heater core to heat the air from the Blower. When the MAX Mode is selected, the Heater Water Bypass valve is operated by the Outside Air Vacuum Actuator.

Heat/Defrost Valve

With the system OFF, or with the BI-LEVEL or HEATER Modes selected, vacuum is applied to the A/C Defrost Vacuum Actuator. The bellows contract and the Heat/Defrost Valve moves to B position. Most of the air flows out of the Footwell Air Outlets. In all other Modes no vacuum is applied to the Vacuum Actuator and the Heat/Defrost Valve remains in position A forcing most of the air out of the Windshield Air Outlets.

Upper and Lower Mode Valves

The two Mode Valves determine the amount of air flow to the Instrument Panel Air Outlets. When the Mode selected is MAX, NORMAL or VENT, vacuum is applied to both the Upper and Lower Mode Vacuum Actuators. Both valves then move to position B and all air flows out the Instrument Panel Air Outlets. In the BI-LEVEL mode, vacuum is applied only to the Lower Mode Vacuum Actuator which moves the Lower Mode Valve to position B. The Upper Mode Valve moves to position A. In these positions some air flows out of the Instrument Panel Air Outlets and the rest flows out the Footwell Air Outlet. In HEATER, DEF and OFF no vacuum is applied to either Vacuum Actuator and both valves move to position A. All air then flows to either the Footwell Air Outlets or the Windshield Air Outlets depending on the position of the Heat/Defrost Valve.

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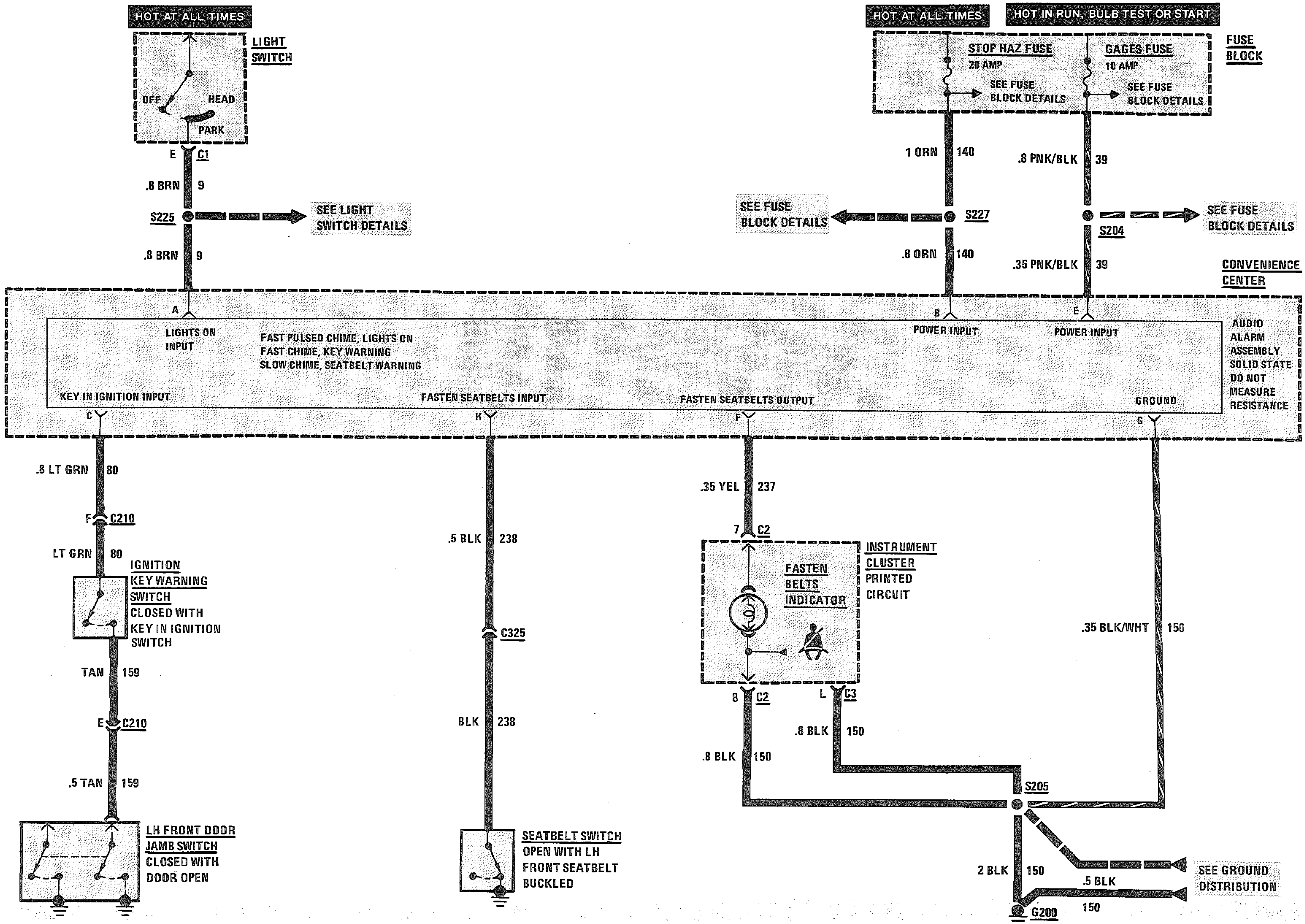
WARNINGS AND ALARMS: CHIME



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the STOP HAZ Fuse by observing the Hazard Lights Operation.
2. Check the GAGES Fuse by observing the BRAKE Warning Indicator with the Park Brake applied and the Ignition Switch in RUN.
3. Check G200 by operating the Cigar Lighter.
4. If the FASTEN BELT chime reminder and indicator operate continuously, replace Audio Alarm Assembly.
5. If the Park Lights are operating normally and only the Lights-On reminder operates incorrectly, replace the Audio Alarm Assembly.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind I/P, to right of steering column	201-10-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Ignition Key Warning Switch	Upper part of steering column	
Seatbelt Switch	In driver's seatbelt buckle	
C210 (11 cavities)	Behind I/P, on RH lower side of steering column	201- 9-A
C325 (1 cavity)	At LH door sill, base of center pillar	
G200	Behind I/P, left of steering column	201-10-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S227	I/P harness, behind instrument cluster	201-10-A

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Sit in the driver's seat and close the driver's door Turn the Ignition Switch to RUN Do not buckle the seatbelt	A slow chime alarm sounds The FASTEN BELTS Indicator lights in the Instrument Cluster The chime stops and the indicator shuts off after 4 to 8 seconds

(Continued in next column)

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ACTION	NORMAL RESULT
Repeat above, but buckle seatbelt	No chime, FASTEN BELTS Indicator lights for 4-8 Seconds
With the Ignition Switch in ACCY, LOCK, or OFF, and the key still in the ignition, open the LH front door	The fast chime alarm sounds (faster than the seatbelt chime)

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Remove the key from the Ignition	The alarm stops
With the key removed from the ignition, turn the Light Switch to PARK	The fast pulsed chime alarm sounds (faster than the key chime)
Turn the Light Switch OFF	The alarm stops

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
None of the Alarms operate	A: Audio Alarm Assembly Test
Only the Key In Ignition Warning does not operate	B: Key In Ignition Input Test
The Key In Ignition Warning operates when it should not	B: Key In Ignition Input Test
THE FASTEN BELTS chime reminder does not operate	C: Fasten Belts Input Test
The FASTEN BELTS chime reminder operates when the Seatbelt is buckled	C: Fasten Belts Input Test
The FASTEN BELTS Indicator does not operate, but the FASTEN BELTS chime operates	D: FASTEN BELTS Indicator Test
The FASTEN BELTS Indicator is always on, but chime operates properly	D: FASTEN BELTS Indicator Test
Only the Lights-On Reminder does not operate	E: Lights-On Input Test

(Continued in next column)

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A: AUDIO ALARM ASSEMBLY TEST

Connect: TEST LAMP
At: CONVENIENCE CENTER
Condition:
- **Audio Alarm Module Removed**

Connect Between	Correct Result	For Diagnosis
B (ORN) & Ground	Test Lamp lights	See 1
B (ORN) & G (BLK/WHT)	Test Lamp lights	See 2

- If all results are correct and all the chime functions were not working, replace the Audio Alarm Assembly.

1. Check the ORN (140) wire.
2. Check the BLK/WHT (150) wire for an open to ground.

B: KEY IN IGNITION INPUT TEST

Connect: SELF-POWERED TEST LAMP
At: CONVENIENCE CENTER
Conditions:
- **Ignition Switch (Key In): ACCY, LOCK, or OFF**
- **Audio Alarm Assembly removed**
- **LH Front Door: OPEN**

Connect Between	Correct Result	For Diagnosis
C (LT GRN) & Ground	Test Lamp lights	See 1
• Ignition Switch: KEY OUT • LH Front Door: OPEN		
C (LT GRN) & Ground	Test Lamp does not light	See 2
• Ignition Switch (KEY IN): ACCY, LOCK or OFF • LH Front Door: CLOSED		
C (LT GRN) & Ground	Test Lamp does not light	See 3

- If all the test lamp results are correct, replace the Audio Alarm Module.

1. Check/repair the Ignition Key Warning Switch, the LH Front Door Jamb Switch, LT GRN (80) and TAN (159) wires for an open (see schematic).
2. Check Ignition Key Warning Switch and LT GRN (80) wire for a short to ground (see schematic).
3. Check LH Front Door Jamb Switch and TAN (159) wire for a short to ground.

C: FASTEN BELTS INPUT TEST

Connect: TEST LAMP
At: CONVENIENCE CENTER
Conditions:
- **Ignition Switch: RUN**
- **Audio Alarm Assembly: Removed**
- **LH Front Seatbelt Unbuckled**

Connect Between	Correct Result	For Diagnosis
E (PNK/BLK) & Ground	Test Lamp lights	See 1
E (PNK/BLK) & H (BLK)	Test Lamp lights	See 2
• Buckle LH Front Seatbelt		
E (PNK/BLK) & H (BLK)	Test Lamp off	See 3

- If the above results are correct, replace the Audio Alarm Assembly.

1. Check PNK/BLK (39) wire for an open.
2. Check the Seatbelt Switch, and BLK (238) wire for an open (see schematic).
3. Check BLK (238) wire for a short to ground. If wire is OK, replace the Seatbelt Switch.

D: FASTEN BELTS INDICATOR TEST

Connect: FUSED JUMPER
At: CONVENIENCE CENTER
Condition:
- **Audio Alarm Assembly Removed**

Connect Between	Correct Result	For Diagnosis
B (ORN) & F (YEL)	FASTEN BELTS Indicator lights	See 1
Remove Jumper	FASTEN BELTS Indicator does not light	See 2

- If the indicator response was correct, replace the Audio Alarm Module.

1. Check/repair the bulb, the YEL (237) wire, the BLK (150) wires, and the Instrument Cluster printed circuit for opens.
2. Check the Instrument Cluster Printed Circuit for a short to Battery.

E: LIGHTS-ON INPUT TEST

Measure: VOLTAGE
At: CONVENIENCE CENTER
Conditions:
- **Audio Alarm Module Removed**
- **Light Switch: HEAD or PARK**

Measure Between	Correct Voltage	For Diagnosis
A (BRN) & Ground	Battery	See 1

- **If the voltage is correct, replace the Audio Alarm Module.**

1. Check/repair the BRN wire to splice S225 (see schematic).

CIRCUIT OPERATION

The Warnings and Alarms System sounds a chime to bring attention to one or more of several conditions. These conditions are: 1) the lights are on and the Ignition Switch is not in RUN, BULB TEST, or START; 2) the Ignition key is in the Ignition Switch when the driver's door is open; and 3) the seatbelt is unbuckled when the Ignition Switch is in RUN, BULB TEST, or START.

Voltage is applied at all times through the STOP HAZ Fuse to terminal B, to power the solid state Audio Alarm Assembly.

IGNITION KEY WARNING

Voltage is applied to the Audio Alarm Assembly by the STOP HAZ Fuse. Whenever the key is in the Ignition Switch and the Ignition Switch is in LOCK, OFF, or ACCY with the driver's door open, terminal C of the module is grounded. This sounds the alarm.

SEATBELT WARNING

With the Ignition Switch in RUN, BULB TEST, or START, voltage is applied through the Gages Fuse to the Audio Alarm Assembly. With the driver's seatbelt unbuckled, terminal H of the module is grounded through the Seatbelt Switch. The FASTEN BELTS Indicator always goes on for about 5 seconds when the Ignition Switch is set to RUN, BULB TEST, or START. The Fasten Belts Chime, however, only sounds if the seatbelt is unbuckled and the Ignition Switch is in RUN, BULB TEST or START.

LIGHTS-ON WARNING

When the Light Switch is in HEAD or PARK, voltage is applied to the Audio Alarm Assembly. When the Ignition Switch is in RUN, BULB TEST, or START, voltage is applied through the Gages Fuse to the module. These two voltages are sensed and the alarm is not sounded.

When the Ignition Switch is not in RUN, BULB TEST, or START, the Gages Fuse loses voltage. The Audio Alarm Assembly senses the change. If voltage is still available from the Light Switch, the Lights-On Warning alarm will sound. The alarm can be turned off by turning the Light Switch to the OFF setting. The module no longer senses voltage from the Light Switch, so the alarm does not sound.

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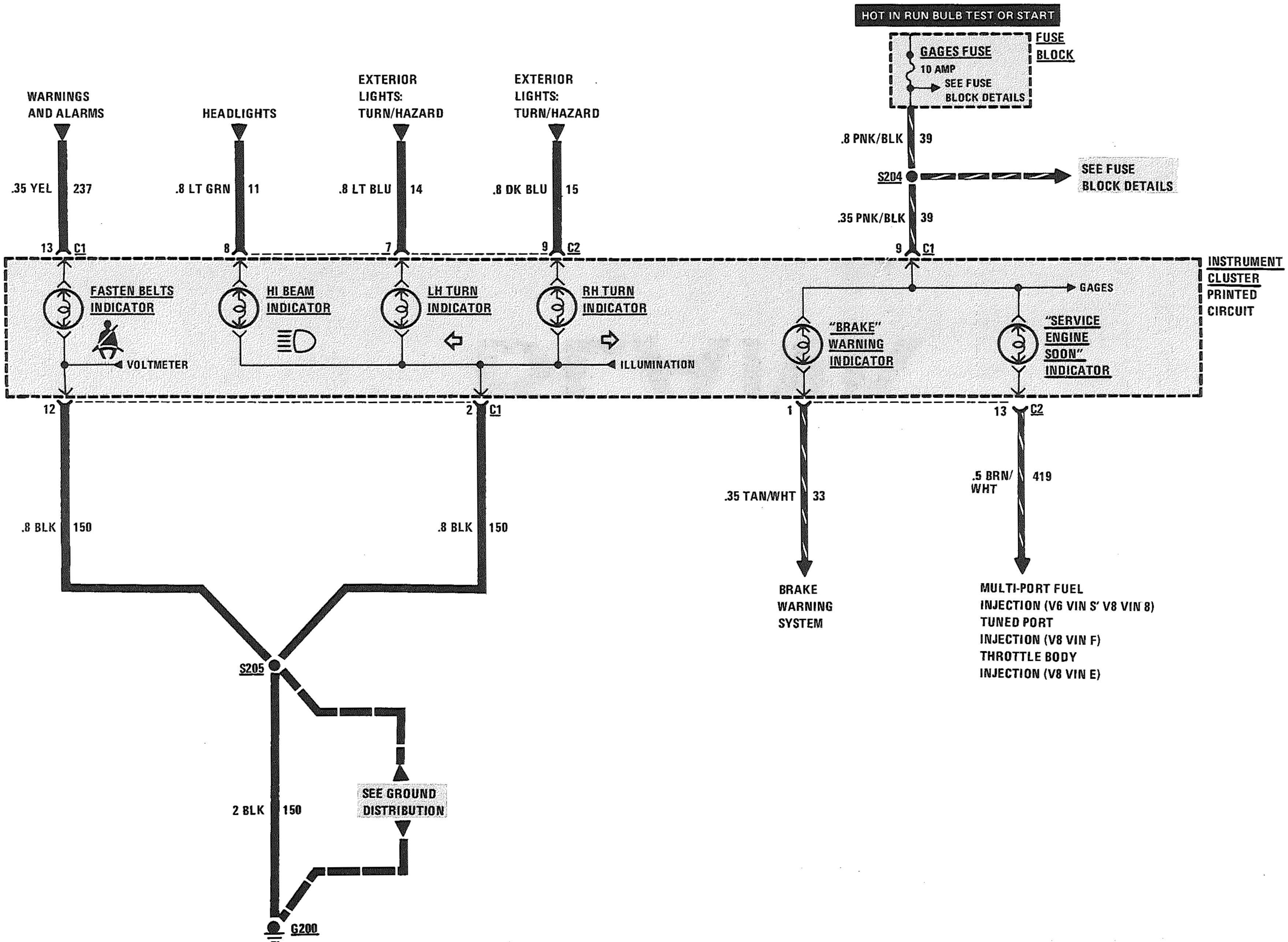
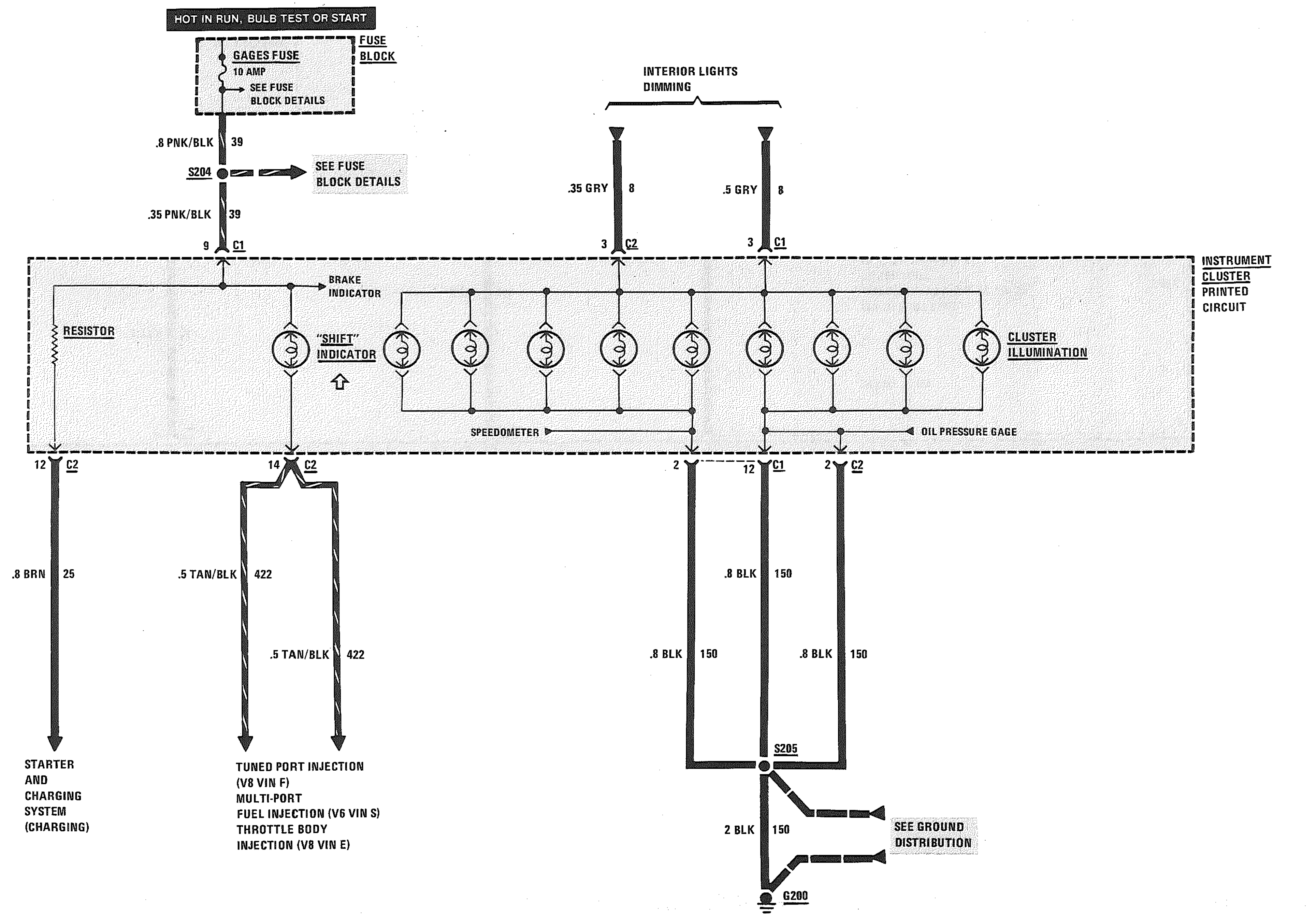
INSTRUMENT PANEL: GAGES CLUSTER
INDICATORS

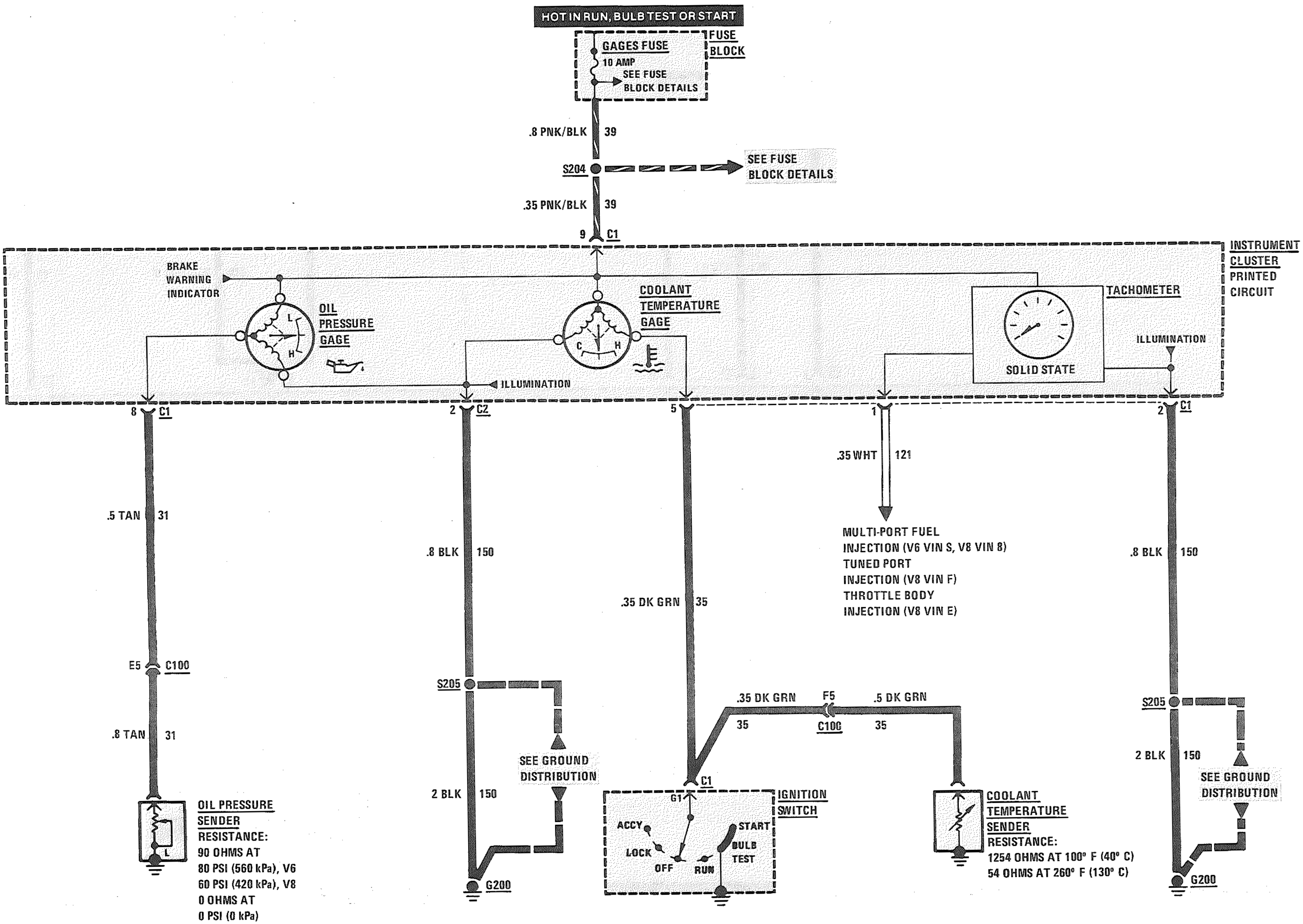


INSTRUMENT PANEL: GAGES CLUSTER
INDICATORS, ILLUMINATION



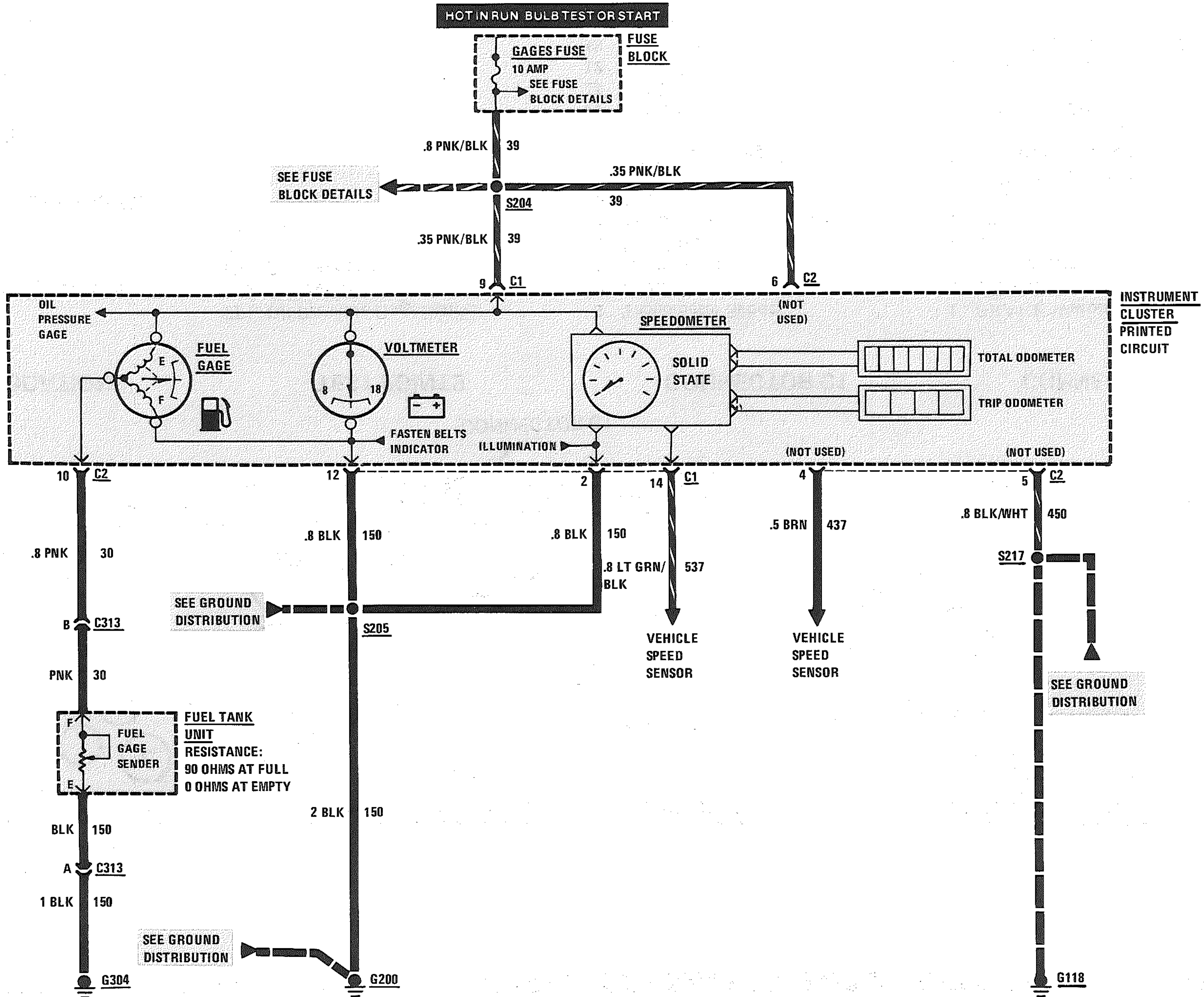
INSTRUMENT PANEL: GAGES CLUSTER

GAGES TACHOMETER



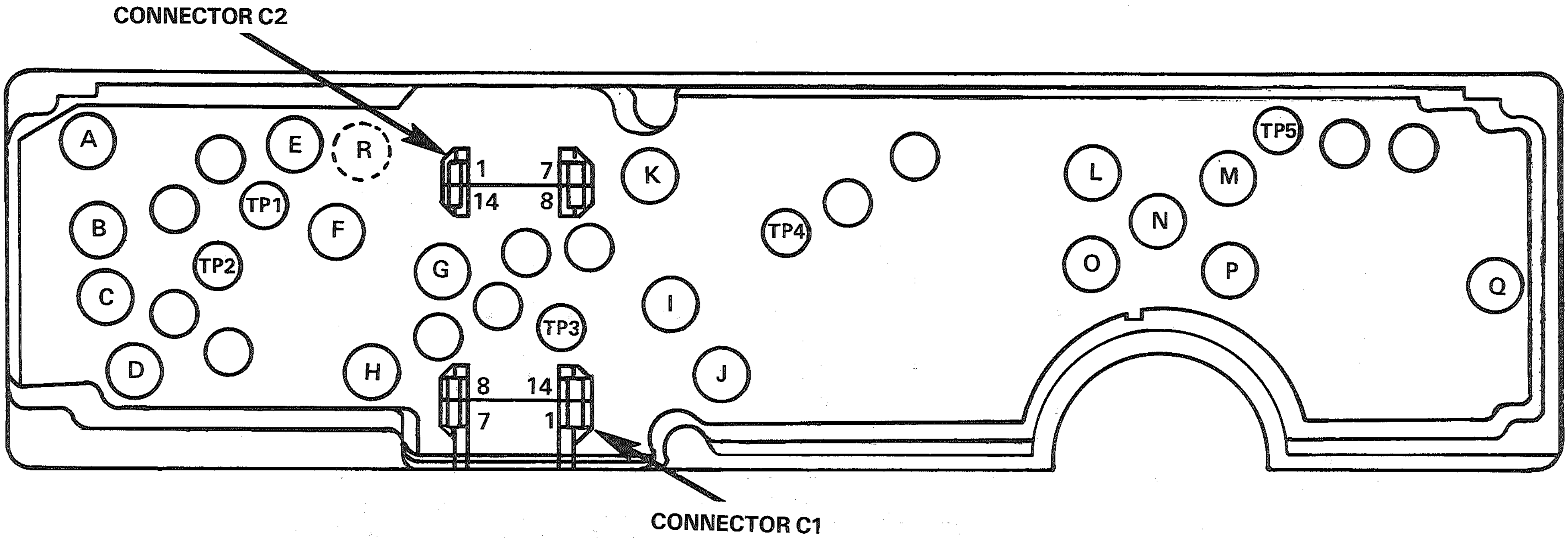
INSTRUMENT PANEL: GAGES CLUSTER

GAGES, SPEEDOMETER



INSTRUMENT PANEL: GAGES CLUSTER

CLUSTER REAR VIEW



BULB LOCATIONS

A	Illumination
B	BRAKE Warning Indicator
C	Not Used
D	Illumination
E	Illumination
F	SERVICE ENGINE SOON Indicator
G	Not Used
H	Illumination
I	Fasten Belts Indicator
J	Illumination
K	Illumination
L	RH Turn Indicator
M	LH Turn Indicator
N	Hi Beam Indicator
O	Illumination
P	Illumination
Q	Illumination
R	SHIFT Indicator

TEST POINTS

TP1	Oil Pressure Gage Sender
TP2	Temperature Gage Sender
TP3	Fuel Gage Sender
TP4	Tachometer Sender
TP5	Speed

CONNECTOR C1

1	Tachometer Sender
2	Ground
3	Illumination
4	Not Used
5	Temperature Gage Sender
6	Not Used
7	Open
8	Oil Pressure Gage Sender
9	Ignition
10	Not Used
11	Not Used
12	Ground
13	Fasten Belts
14	Speedometer

CONNECTOR C2

1	BRAKE Warning Indicator
2	Ground
3	Illumination
4	Open
5	Open
6	Open
7	LH Turn Indicator
8	Hi Beam Indicator
9	RH Turn Indicator
10	Fuel Gage Sender
11	Not Used
12	470Ω to Generator
13	SERVICE ENGINE SOON Indicator
14	SHIFT Indicator

INSTRUMENT PANEL: GAGES CLUSTER

TROUBLESHOOTING HINTS

- **For a list of possible symptoms, go to System Diangosis.**
- **For Instrument Cluster removal and replacement procedures, see Section 8C of the Service Manual.**
- **Try the following checks before doing the System Check.**

1. Check GAGES Fuse by observing the BRAKE Warning Indicator with the Ignition Switch in RUN and the Park Brake applied.
2. Check ground G200.
3. Check case ground of Coolant Temperature Sender.
4. Check case ground of Oil Pressure Sender.
5. Check Indicator bulbs.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

		Page-Figure
Coolant Temperature Sender (VIN E)	Lower LH side of engine	201- 3-A
Coolant Temperature Sender (VIN F) (VIN 8)	Lower LH side of engine	201- 8-A
Coolant Temperature Sender (VIN S)	Top LH front of engine, behind A/C Compressor	201- 0-B
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Oil Pressure Sender (VIN E)	Top rear of engine, near distributor	201- 3-C
Oil Pressure Sender (VIN F) (VIN 8)	Top rear of engine, near distributor	201- 7-C
Oil Pressure Sender (VIN S)	Lower LH side of engine	201- 0-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A

SYSTEM CHECK TABLE

ACTION	CORRECT RESULT	FOR DIAGNOSIS OF INCORRECT RESULTS
Turn the Ignition Switch to RUN	SERVICE ENGINE SOON Indicator lights	See Section 6E of Service Manual
	FASTEN BELTS Indicator lights for 6 to 8 seconds	See Warnings and Alarms (Section 8A-75)
	Fuel Gage indicates correct fuel level	See Symptom Table
	Oil Pressure Gage indicates low oil pressure	See Symptom Table
	Coolant Temperature Gage indicates engine temperature	See Symptom Table
	Voltmeter indicates Battery Voltage	Do Test L
Turn the Ignition Switch to BULB TEST	Coolant Temperature Gage indicates hot	See Symptom Table
With Ignition Switch in RUN, apply the Park Brake	BRAKE Warning Indicator lights	See Brake Warning System (Section 8A-41)
With Ignition Switch in RUN, turn the Headlights and Hi Beams on	Hi Beam Indicator lights	See Headlights (Section 8A-100)
With Ignition Switch in RUN and lights still on, adjust the Instrument Cluster dimmer control	Instrument Cluster illumination varies as control is adjusted	See Interior Lights (Section 8A-117)
With Ignition Switch in RUN, operate Turn signals	LH and RH Turn Indicators light	See Exterior Lights (Section 8A-110)
Start the Engine	Tachometer indicates engine RPM	Do Test M
	Oil Pressure Gage indicates engine oil pressure	See Symptom Table

- Go to System Diagnosis for a list of symptoms.

SYSTEM DIAGNOSIS

- Do the tests listed for your symptom in the Symptom Table below, or when directed by the System Check.
- For Instrument Cluster removal and replacement procedures, see Section 8C of the Service Manual.
- Tests follow the Symptom Table.

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
Fuel Gage indicates EMPTY when there is fuel in the tank	Do Test C: (Also see Test B terminal 10)
Fuel Gage indicates FULL or beyond at all times	Do Test D: (Also see Test B terminal 10)
Fuel Gage is inaccurate	Do Test E: (Also see Test B terminal 10)
Coolant Temperature Gage indicates HOT with engine coolant cool and Ignition Switch in RUN	Do Test F (Also see Test B terminal 2)
Coolant Temperature Gage indicates COLD at all times	Do Test G: (Also see Test B terminal 2)
Coolant Temperature Gage is inaccurate	Do Test H: (Also see Test B terminal 2)

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Coolant Temperature Gage does not indicate HOT with Ignition Switch in START or BULB TEST, but does operate accurately	Check DK GRN (35) wire and Ignition Switch for opens Repair/replace as necessary
Oil Pressure Gage indicates low pressure and oil pressure is good	Do Test I: (Also see Test A terminal B)
Oil Pressure Gage indicates high pressure at all times and oil pressure is good	Do Test J: (Also see Test A terminal 8)
Oil Pressure Gage is inaccurate	Do Test K: (also see Test A terminal 8)
Voltmeter is inaccurate	Do Test L
Tachometer does not operate	Do Test M
Speedometer/ Odometer is inaccurate	Do Test N: (with J-33431-873 harness connector available)
One or both Odometers do not operate properly, but Speedometer operates accurately	Check the Instrument Cluster Printed Circuit for cracks or flaws Replace the Speedometer/ Odometer Assembly

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Hi Beam Indicator does not operate properly	See Exterior lights Section 8A-110 (Also see Test B terminal 8)
Seatbelt Indicator and alarm do not operate properly	See Warnings and Alarms (see Index) (Also see Test A terminal 13)
BRAKE Warning Indicator does not work properly	See Brake Warning System, Section 8A-41 (Also, see Test A terminal 1)
SERVICE ENGINE SOON Indicator does not work properly	See Section 6E of Service Manual
Upshift Indicator does not work properly	Do Test O
Turn Indicators do not operate properly	See Exterior Lights, Section 8A-110 (Also, see Test B terminals 7 and 9)

INSTRUMENT PANEL: GAGES CLUSTER

A: CONNECTOR C1 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MEASURE TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C1 AS SEEN FROM THE DRIVER'S SEAT WITH THE INSTRUMENT CLUSTER REMOVED
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK WIRES, BULBS, AND PRINTED CIRCUIT. IF OK, REPLACE EITHER THE GAGE OR THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED

NOT USED
11

GROUND FROM FASTEN BELTS INDICATOR, VOLTMETER, CLUSTER ILLUMINATION BULBS TO GROUND G200. SEE SECTION 8A-14.
BLK (150) 12

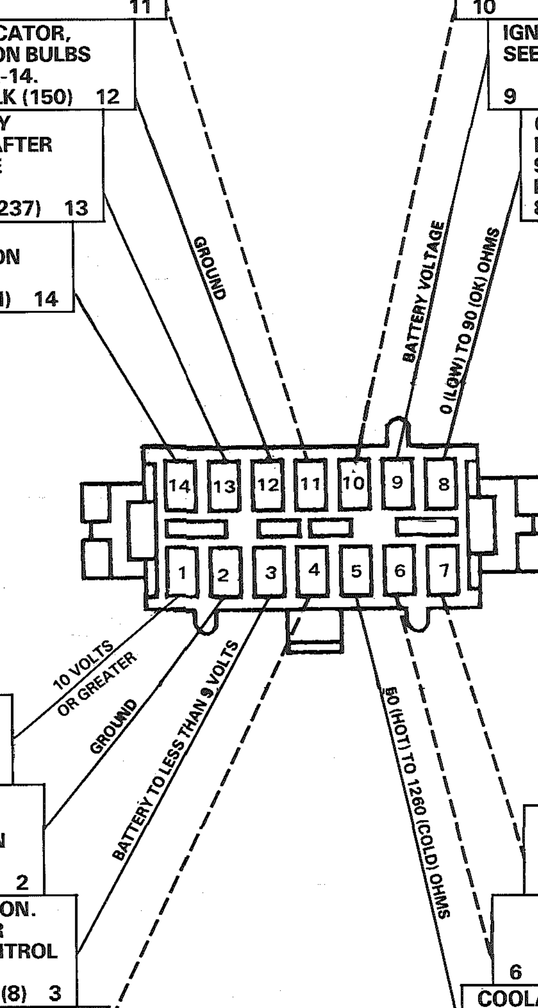
FASTEN BELTS INDICATOR. BATTERY VOLTAGE FOR ABOUT 5 SECONDS AFTER IGNITION IS SWITCHED TO RUN. SEE SECTION 8A-75.
YEL (237) 13

VEHICLE SPEED SIGNAL. SEE SECTION 8A-33.
LT GRN/BLK (531) 14

NOT USED
10

IGNITION POWER FROM THE GAGES FUSE. SEE SECTION 8A-11.
9 PNK/BLK (39)

OIL PRESSURE GAGE INPUT FROM OIL PRESSURE SENDER. 0 OHMS 0 PSI (0 kPa) TO 90 OHMS 80 PSI (560 kPa), V6 60 PSI (420 kPa), V8 DO TESTS I, J AND K
8 TAN (31)



TACHOMETER INPUT FROM IGNITION SYSTEM. DO TEST M.
WHT (121) 1

GROUND FROM HI BEAM, LH TURN, RH TURN AND CLUSTER ILLUMINATION BULBS. SEE SECTION 8A-14.
BLK (150) 2

INSTRUMENT CLUSTER ILLUMINATION. VARIABLE VOLTAGE WITH HEAD OR PARK LIGHTS ON AND DIMMER CONTROL ADJUSTED. SEE SECTION 8A-117.
GRY (8) 3

NOT USED
4

NOT USED
7

NOT USED
6

COOLANT TEMPERATURE GAGE INPUT FROM THE COOLANT TEMPERATURE SENDER. 50 OHMS AT 260°F (130°C) TO 1260 OHMS AT 100°F (40°C). DO TESTS F, G AND H.
5 DK GRN (35)

INSTRUMENT PANEL: GAGES CLUSTER

B: CONNECTOR C2 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MEASURE TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C2 AS SEEN FROM THE DRIVER'S SEAT WITH THE INSTRUMENT CLUSTER REMOVED
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINAL, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK WIRES, BULBS, AND PRINTED CIRCUIT. IF OK, REPLACE EITHER THE GAGE OR THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED

VEHICLE SPEED SIGNAL
NOT USED
BRN (4387) 4

GROUND
NOT USED
BLK/WHT (450) 5

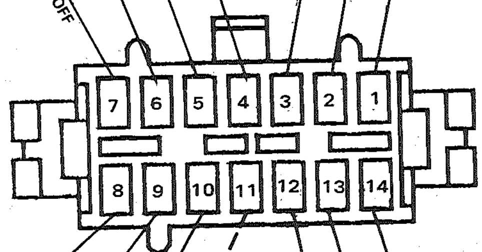
IGNITION POWER TO CLUSTER
NOT USED
PNK/BLK (39) 6

LH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH THE LEFT TURN SIGNAL ON. SEE SECTION 8A-110.
LT BLU (14) 7

INSTRUMENT CLUSTER ILLUMINATION. VARIABLE VOLTAGE WITH HEAD OR PARK LIGHTS ON AND DIMMER CONTROL ADJUSTED. SEE SECTION 8A-117
3 GRY (8)

GROUND FOR CLUSTER ILLUMINATION OIL PRESSURE AND COOLANT TEMPERATURE GAGES TO GROUND G200. SEE SECTION 8A-14
2 BLK (150)

BRAKE WARNING INDICATOR. GROUNDED WITH PARK BRAKE SET OR LOW BRAKE FLUID. SEE SECTION 8A-41.
1 TAN/WHT (33)



HI BEAM INDICATOR. BATTERY VOLTAGE WITH HI BEAMS ON. SEE SECTION 8A-100
LT GRN (11) 8

RH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH THE RIGHT TURN SIGNAL ON. SEE SECTION 8A-110
DK BLU (15) 9

FUEL GAGE INPUT FROM THE FUEL GAGE SENDER. 90 OHMS (FULL) TO 0 OHMS (EMPTY). DO TESTS A, B AND C
PNK (30) 10

NOT USED
11

SHIFT INDICATOR TO TUNED PORT INJECTION (V8 VIN F) MULTI-PORT FUEL INJECTION (V6 VIN S) OR THROTTLE BODY INJECTION (V8 VIN E) DO TEST O.
14 TAN/BLK (422)

SERVICE ENGINE SOON INDICATOR TO THROTTLE BODY INJECTION (V8 VIN E), MULTI-PORT FUEL INJECTION (V6 VIN S AND V8 VIN 8) OR TUNED PORT INJECTION (V8 VIN F). SEE SECTION 6E
13 BRN/WHT (419)

470Ω GENERATOR RESISTOR. LOCATED IN CLUSTER.
SEE SECTION 8A-30.
12 BRN (25)

C: FUEL GAGE ALWAYS INDICATES FULL

Disconnect the Fuel Tank Sender Unit connector. Turn Ignition Switch to RUN.

- If the Fuel Gage now indicates FULL, repair/replace Fuel Gage Sender.
- If the Fuel Gage still indicates EMPTY, check PNK (30) wire (see schematic) for a short to ground. Check the Instrument Cluster Printed Circuit for flaws and the gage connections. Replace Fuel Gage if the PNK (30) wire, Printed Circuit, and gage connections are OK, (see Section 8C).

D: FUEL GAGE ALWAYS INDICATES EMPTY

Connect: FUSED JUMPER
At: FUEL TANK SENDER UNIT CONNECTOR (HARNESS HALF) (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
B (PNK) & Ground	Fuel Gage reads EMPTY	See 1
B (PNK) & A (BLK)	Fuel Gage reads EMPTY	See 2

- If results are correct, replace Fuel Gage Sender and its wires.

1. Check/repair PNK (30) wire (see schematic) for an open. Check Instrument Cluster Printed Circuit for flaws and for clean and tight Fuel Gage connections. Replace Fuel Gage if the above checks are OK (see Section 8C).
2. Check BLK (150) wire for an open to ground.

E: FUEL GAGE ACCURACY TEST

Disconnect the Fuel Tank Sender Unit connector and connect one red lead of J-33431 tester to terminal B (PNK) and the other to terminal A (BLK) of the harness half of the connector. Set the resistance dials of the tester to 0 ohms, 44 ohms and then to 90 ohms. The Fuel Gage should read E, 1/2 and then F.

- If Fuel Gage responds correctly, replace Fuel Gage Sender and its wires.
- If Fuel Gage does not respond correctly, check PNK (30) wire to the Instrument Cluster Printed Circuit and BLK (150) wire for high resistance. Also, inspect the Printed Circuit for proper mating of connectors. Replace the Fuel Gage if the wires and Printed Circuit are good.

F: COOLANT TEMPERATURE GAGE ALWAYS INDICATES HOT

Disconnect the Coolant Temperature Sender connector and place Ignition Switch in RUN.

- If Coolant Temperature Gage reads cold, replace the Coolant Temperature Sender.
- If the Coolant Temperature Gage does not read cold check DK GRN (35) wires and Ignition Switch, terminal G1 of connector C1 for a short to ground (see schematic). Replace the Coolant Temperature Gage if all are good (see section 8C).

G: COOLANT TEMPERATURE GAGE ALWAYS INDICATES COLD

Disconnect the Coolant Temperature Sender connector and jumper the DK GRN (35) wire to ground. Put the Ignition Switch in RUN.

- If the Coolant Temperature Gage reads hot, replace the Coolant Temperature Sender.
- If the Coolant Temperature Gage does not read hot, check DK GRN (35) wire for an open. Replace the Coolant Temperature Gage if the wire is good (see Section 8C).

H: COOLANT TEMPERATURE GAGE ACCURACY TEST

Disconnect the Coolant Temperature Sender connector. Connect one red clip lead of the J-33431 tester to the harness connector DK GRN (35) wire and the other red clip lead to ground. Adjust the resistance dials of the tester to 1254 ohms, 697 ohms and then to 54 ohms. The Coolant Temperature Gage should show 100°F (40°C), 220°F (100°C) and then 260°F (130°C).

- If the gage reads correctly, the wiring and gage are good. Replace the Coolant Temperature Sender.
- If the gage is not correct check DK GRN (35) wire and Printed Circuit. If they are good, replace the Coolant Temperature Gage (see Section 8C).

I: OIL PRESSURE GAGE ALWAYS INDICATES ZERO

Disconnect: CONNECTOR
At: OIL PRESSURE SENDER
Condition:
- **Ignition Switch: RUN**

Action	Correct Result	For Diagnosis
Disconnect Oil Pressure Sender connector	Oil Pressure Gage shows high pressure	See 1

- If the result is correct, replace the Oil Pressure Sender.

1. Check TAN (31) wire to Instrument Cluster for a short to ground. Check Instrument Cluster Printed Circuit for cracks or flaws. Repair/replace the Oil Pressure Gage if the wire and Printed Circuit are OK (see Section 8C).

J: OIL PRESSURE GAGE ALWAYS INDICATES HIGH PRESSURE

Connect: FUSED JUMPER
At: OIL PRESSURE SENDER CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
TAN & Ground	Oil Pressure Gage shows low pressure	See 1

- If the result is correct, replace the Oil Pressure Sender.

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1. Check TAN (31) wire and Instrument Cluster Printed Circut for an open. If wire and Printed Circuit are OK, repair/replace the Oil Pressure Gage (see Section 8C).

K: OIL PRESSURE GAGE ACCURACY TEST

Disconnect the Oil Pressure Sender. Connect one red clip of the J-33431 tester to the harness connector, TAN (31) wire, and connect the other red clip lead to ground. Set the resistance dials of the sender to 0 ohms, 43 ohms and then to 90 ohms. The Oil Pressure Gage should read 0 psi (0 kPa), 40 psi (280 kPa) and 80 psi (660 kPa) with the V6 or 0 psi (0 kPa), 30 psi (210 kPa) and 60 psi (420 kPa) with the V8.

- If the gage reads correctly, replace the Oil Pressure Sender.
- If the gage does not read correctly, check the TAN (31) wire and Printed Circuit. If they are good, replace the Oil Pressure Gage (see Section 8C).

L: VOLTMETER TEST

With the Ignition Switch in RUN, connect a Voltmeter between the positive and negative terminals of the Battery.

- If the voltage reading on the test voltmeter is approximately the same as the car's Voltmeter, the car's Voltmeter is OK.
- If the voltage reading on the test voltmeter is different from the car's Voltmeter, check the Instrument Cluster Printed Circuit for cracks or flaws. Repair/replace the Voltmeter if all wires and Printed Circuit are OK (see Section 8C).

M: TACHOMETER TEST

Measure: VOLTAGE
At: INSTRUMENT CLUSTER PRINTED CIRCUIT CONNECTOR C1 (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis Of Incorrect Results
1 (WHT) & Ground	Greater than 10 volts	See 1

- If above voltage is correct, replace the Tachometer.

1. Check WHT (121) wire and Tachometer Filter to Ignition Coil (see schematic). If wire is OK, see Section 6D for further diagnosis.

N: SPEEDOMETER TEST

1. Disconnect connector C207. Connect the J-33431 tester to the harness half of the connector, terminal C (LT GRN) and to ground, using the J-33431-873 harness connector or equivalent. With the tester set to ON, 54 mph, 60 Hz and the Ignition Switch in RUN, the speedometer should read 54 mph + 2 mph.

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- If the Speedometer reads correctly, refer to Vehicle Speed Sensor, Section 8A-33 for further diagnosis.
- If the Speedometer reads incorrectly, check LT GRN (537) wire and the Instrument Cluster Printed Circuit for opens. Replace the Speedometer Assembly if the wire and Printed Circuit are good (see Section 8C).

O: UPSHIFT INDICATOR WIRE TEST

Disconnect ECM connector C207. Put the Ignition Switch in RUN and measure the voltage at terminal H (see section 8A-21 or 22).

- If battery voltage is present, see section 6E for ECM diagnosis.
- If battery voltage is not present, check the TAN/BLK (422) wire for an open or short to Ground.

CIRCUIT OPERATION

The operation of an indicator is explained in the operation of the circuit it is a part of. See the circuit referred to for a complete description of that indicator and the other components that work with it. Only the gages and indicators that do not appear in other schematics are described in this section.

Tachometer

The Tachometer displays engine speed in rpm. Voltage pulses are taken from the Ignition System and sent to the Tachometer. Solid State circuits process these pulses into a signal that drives the pointer of the meter. The Tachometer responds to the frequency of the voltage pulses. These pulses increase with engine speed.

Fuel Gage

The pointer of the Fuel Gage is moved by the magnetic field of two coils. The coils are at right angles to each other. Battery voltage is applied to the E coil and the circuit divides at the opposite end of this coil. One path continues to ground through the F coil. Another goes to ground through the variable resistor of the Fuel Gage Sender Unit.

When the tank is low, the resistance of the Fuel Gage Sender is low. A large flow of current passes through the E coil and the Fuel Gage Sender resistor. This moves the pointer towards E on the scale. When the tank is full, the sender resistance is high. More current flows through the F coil, moving the pointer toward F on the scale.

With two coils operating the pointer, the Fuel Gage is not affected by changes in the voltage of the system.

Oil Pressure Gage

The engine oil pressure is displayed by the Oil Pressure Gage. The pointer of the gage is moved by two coils, and its operation is similar to that of the Fuel Gage.

The Oil Pressure Sender is connected to the junction of the two coils. It has low resistance when the oil pressure is low, and 90 ohms resistance when the oil pressure is high. This changing resistance changes the current flow through the coils. The magnetic fields of the coils move the pointer to indicate high or low coolant temperature.

Voltmeter

The Voltmeter measures the electrical system voltage with the Ignition Switch in RUN, BULB TEST, or START. With the engine stopped, the Voltmeter indicates battery condition. With the engine running, the Voltmeter indicates Charging System operation.

Coolant Temperature Gage

The Coolant Temperature Gage is also operated by two coils. Battery voltage is applied to both coils. One is grounded directly and the other is grounded through the Coolant Temperature Sender. This has 54 ohms resistance at 260 °F, 130 °C (hot coolant) and its resistance becomes greater at lower temperatures. It is approximately 1284 ohms at 100 °F (40 °C). This causes the current through the sender and one coil to vary as the coolant temperature charges and this moves the pointer.

(Continued on next page)

Speedometer and Odometers

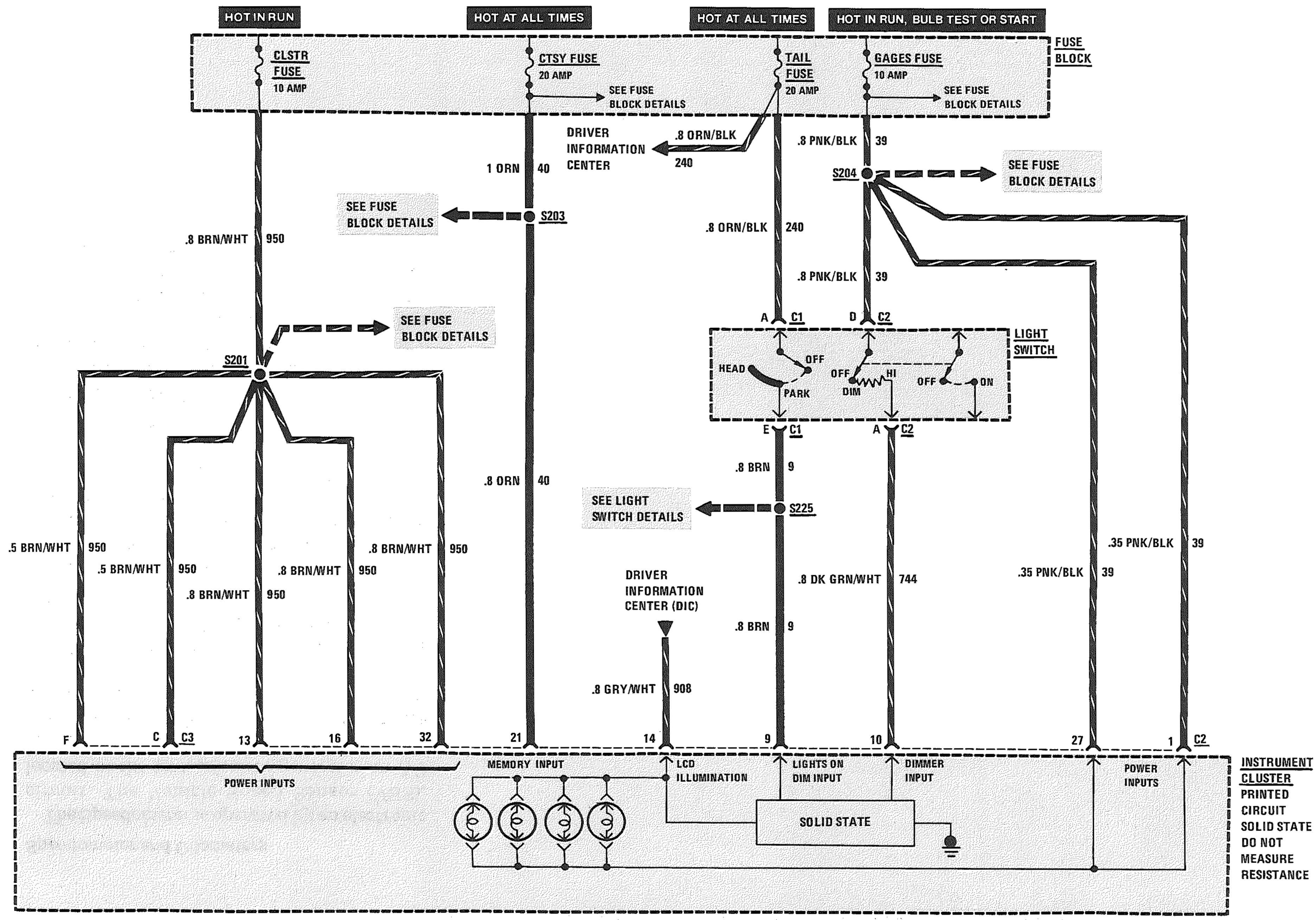
The Speedometer is operated by an electronic circuit. The Vehicle Speed Sensor (VSS), located in the transmission, generates an AC voltage whose frequency is proportional to the speed of the vehicle. This goes to the Vehicle Speed Sensor Buffer and then to the Speedometer circuit board in the Instrument Cluster. The Solid State circuit drives the pointer of the Speedometer. There is no speedometer cable in the vehicle.

The same speed signal from the Vehicle Speed Buffer is processed by the Speedometer circuit board to drive the Odometers. They are operated by a motor that responds to pulses from the Speedometer circuit.

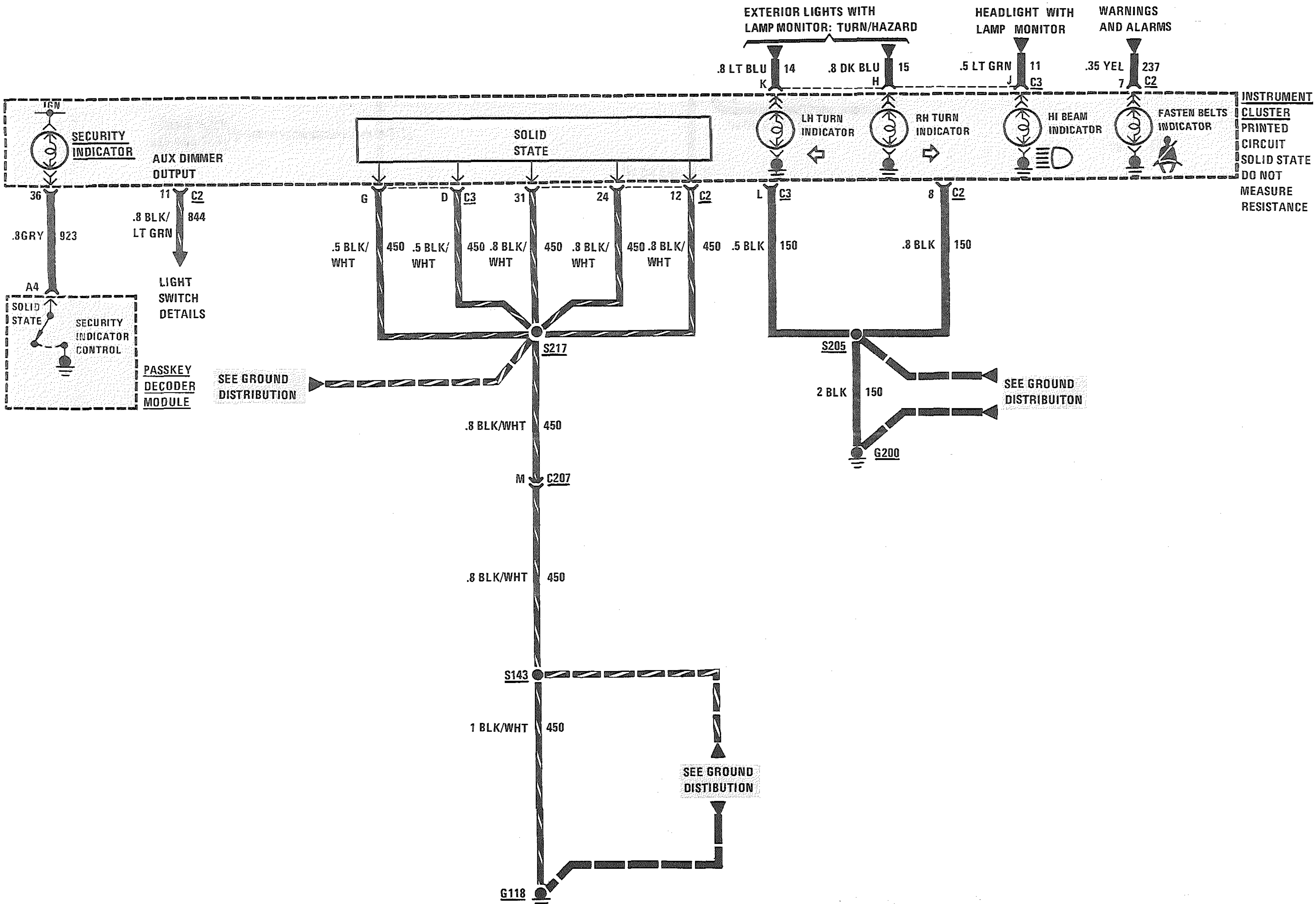
Upshift Indicator

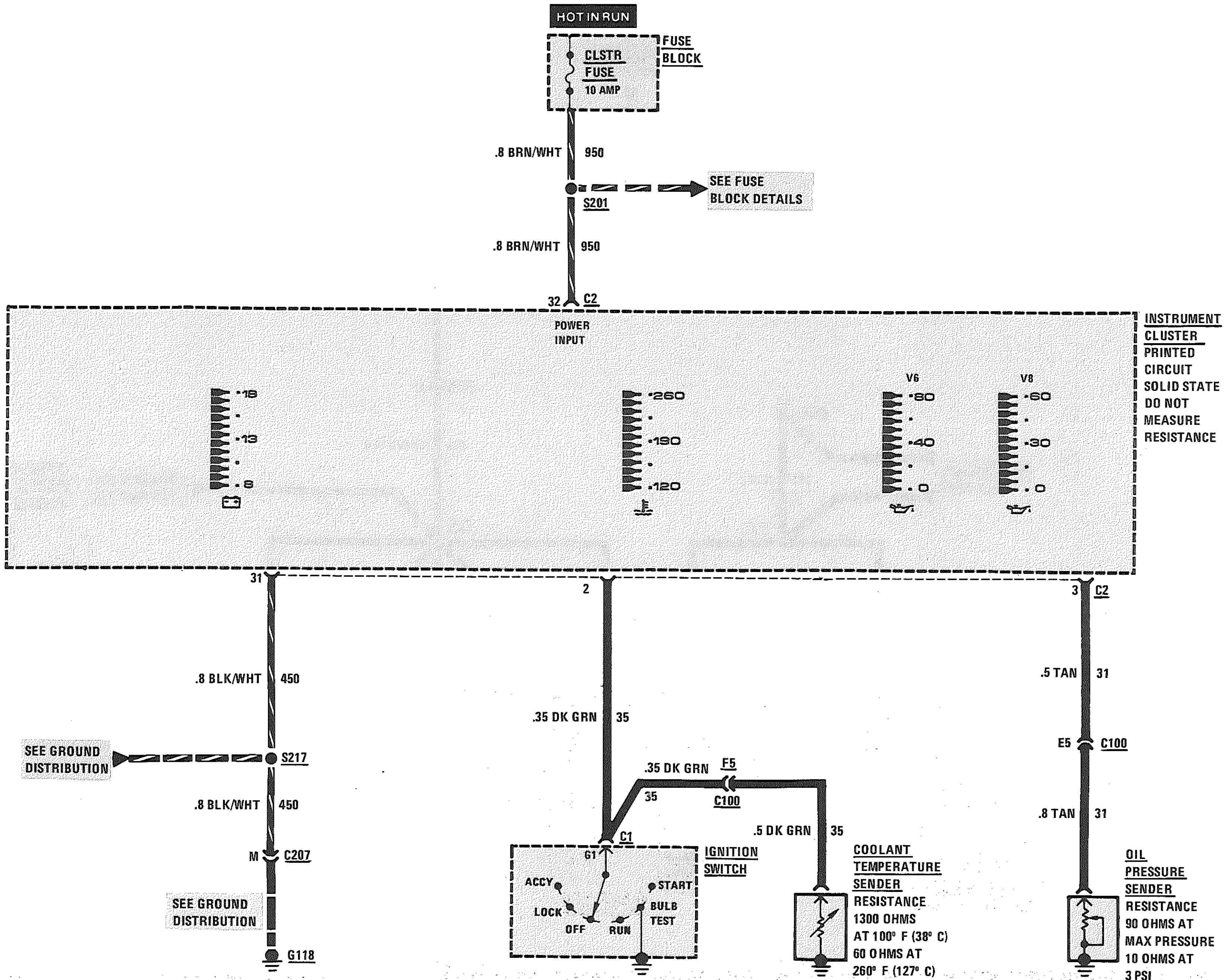
With Manual Transmission, the indicator lights when the car should be shifted to the next higher gear for better fuel economy. Battery voltage is applied to one side of the bulb. The other side of the bulb is switched to ground by the ECM which uses engine data to compute an efficient shift point.

INSTRUMENT PANEL: DIGITAL CLUSTER

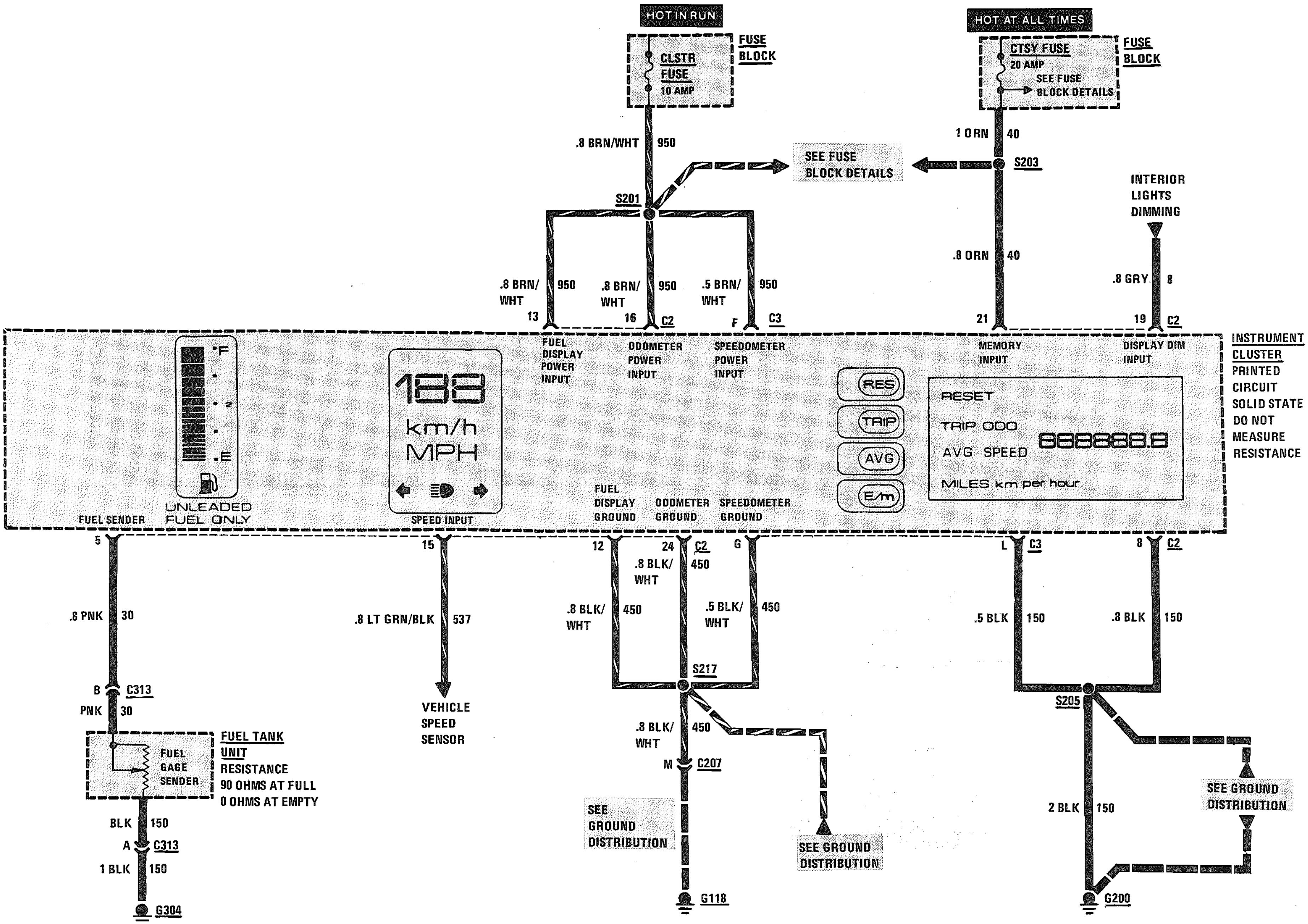


INSTRUMENT PANEL: DIGITAL CLUSTER

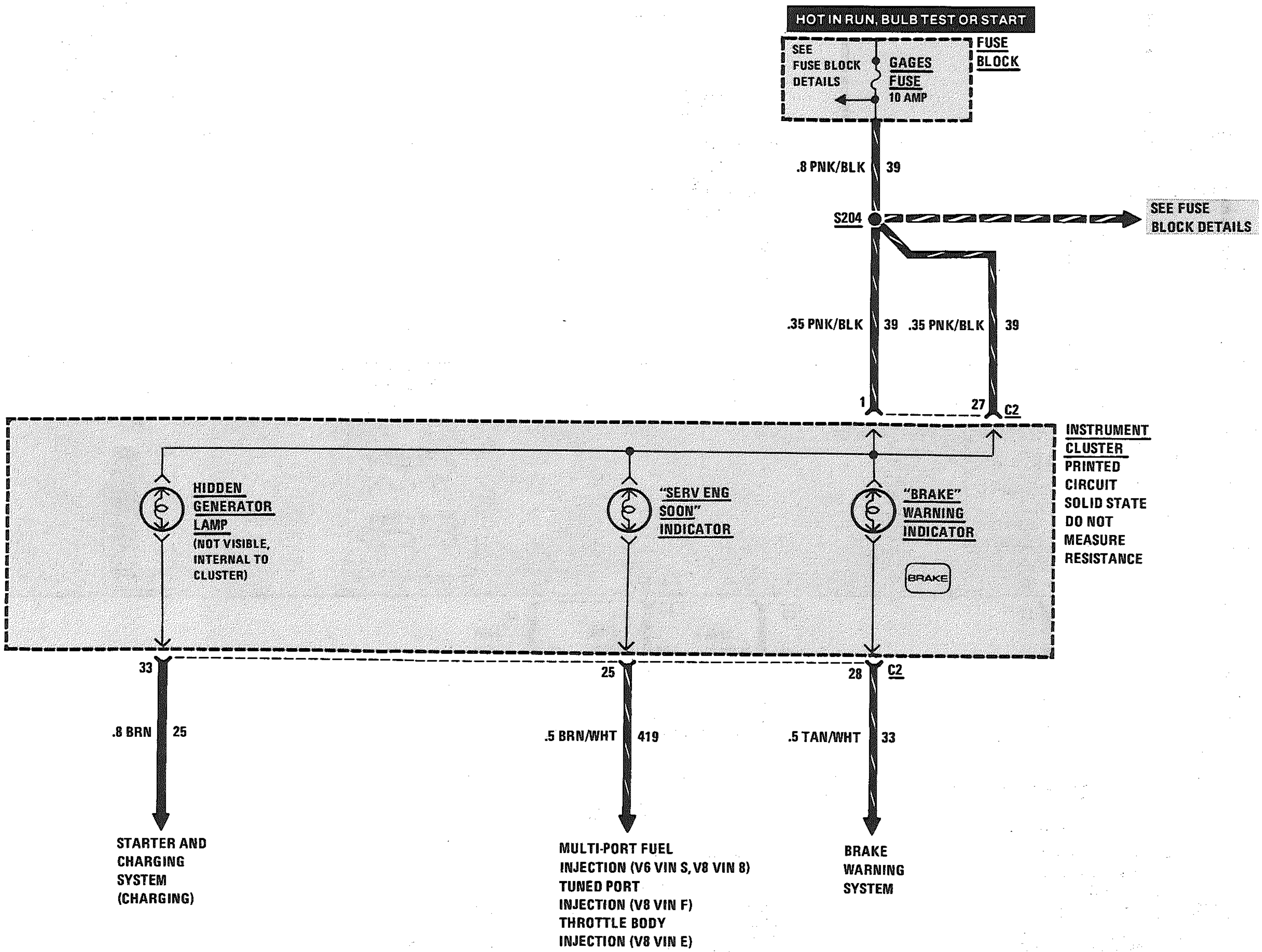



HOT IN RUN
CLSTR FUSE 10 AMP
FUSE BLOCK
.8 BRN/WHT 950
S201
SEE FUSE BLOCK DETAILS
.8 BRN/WHT 950
32 C2
POWER INPUT
INSTRUMENT CLUSTER
PRINTED CIRCUIT
SOLID STATE
DO NOT MEASURE RESISTANCE
18
13
8
260
190
120
V6
80
40
0
V8
60
30
0
31
2
3 C2
.8 BLK/WHT 450
SEE GROUND DISTRIBUTION
S217
.8 BLK/WHT 450
M C207
SEE GROUND DISTRIBUTION
G118
.35 DK GRN 35
.35 DK GRN F5
35
C100
C1
G1
IGNITION SWITCH
ACCY
LOCK
OFF
RUN
START
BULB TEST
.5 DK GRN 35
COOLANT TEMPERATURE SENDER
RESISTANCE 1300 OHMS AT 100° F (38° C) 60 OHMS AT 260° F (127° C)
.5 TAN 31
E5 C100
.8 TAN 31
OIL PRESSURE SENDER
RESISTANCE 90 OHMS AT MAX PRESSURE 10 OHMS AT 3 PSI

INSTRUMENT PANEL: DIGITAL CLUSTER

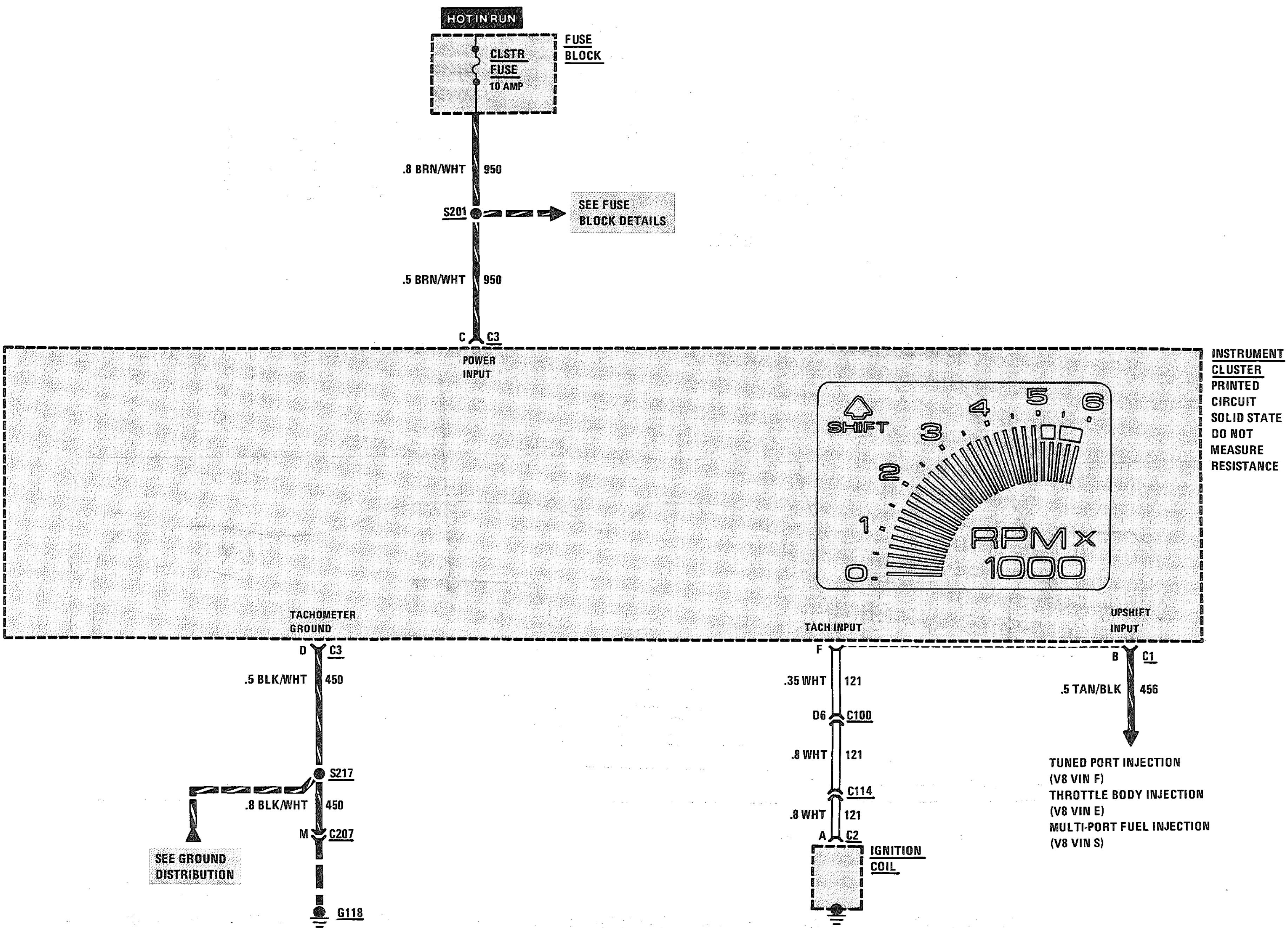


INSTRUMENT PANEL: DIGITAL CLUSTER
INDICATORS

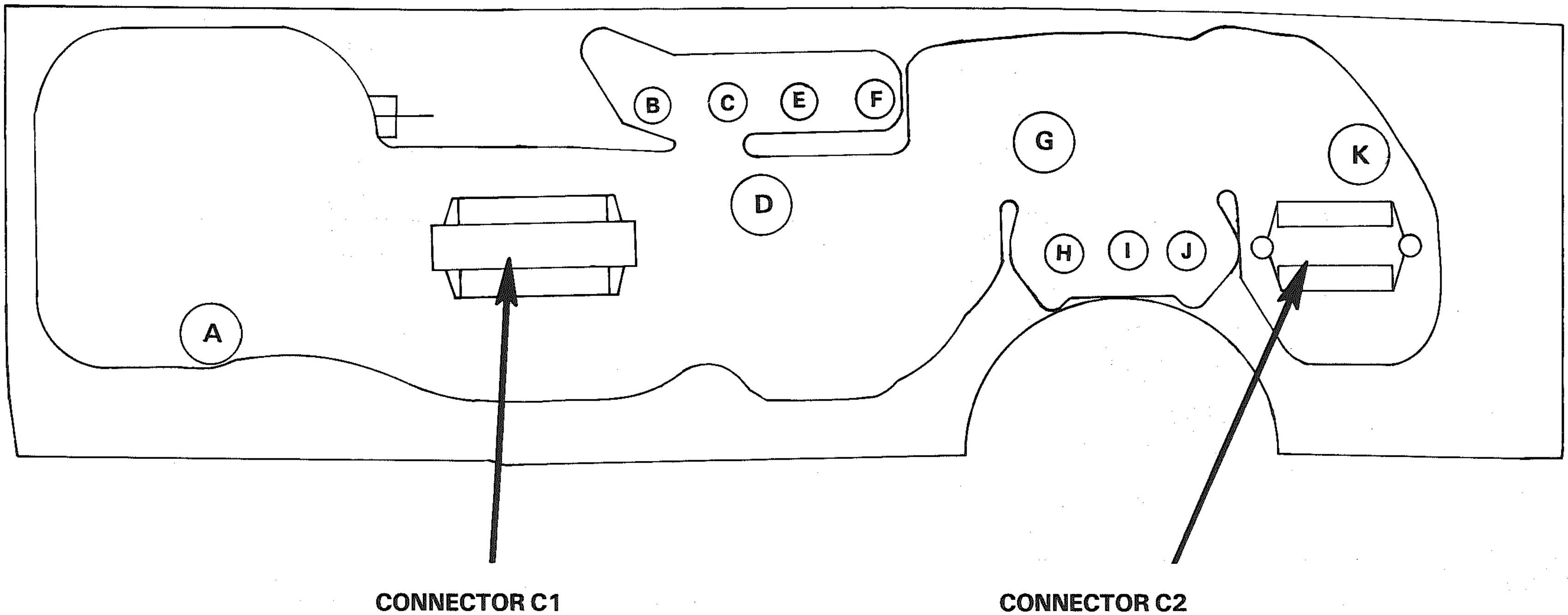


INSTRUMENT PANEL: DIGITAL CLUSTER

TACHOMETER



CLUSTER REAR VIEW



BULB LOCATIONS

A LCD Illumination
B Not Used
C FASTEN BELTS Indicator
D LCD Illumination
E BRAKE Warning Indicator
F SERV ENG SOON Indicator
G LCD Illumination
H RH Turn Indicator
I Hi Beam Indicator
J LH Turn Indicator
K LCD Illumination

INSTRUMENT PANEL: DIGITAL CLUSTER

TROUBLESHOOTING HINTS

- **For a list of symptoms and their diagnosis, go to System Diagnosis.**
- **For Instrument Cluster removal and replacement procedures see Section 8C of the Service Manual.**
- **Try the following checks before doing the System Check.**

1. Check the CLSTR Fuse.
2. Check the CTSY Fuse.
3. Check the TAIL Fuse.
4. Check the GAGES Fuse.
5. If more than one indicator is out, check the battery voltage inputs.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

Component	Location	Page-Figure
Coolant Temperature Sender (VIN E)	Lower LH side of engine	201- 3-A
Coolant Temperature Sender (VIN F) (VIN 8)	Lower LH side of engine	201- 8-A
Fuel Tank Unit	Top center of fuel tank	201- 9-C
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Ignition Coil (VIN E)	Top center rear of engine	201- 4-A
Ignition Coil (VIN F)(VIN 8)	RH rear side of engine	201- 7-B
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Oil Pressure Sender (VIN E)	Top rear of engine, near distributor	201- 3-C
Oil Pressure Sender (VIN F) (VIN 8)	Top rear of engine, near distributor	201- 7-C
Oil Pressure Sender (VIN S)	Lower LH side of engine	201- 0-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C114 (1 cavity) (VIN E)	Taped to engine harness, above rear of engine	
C114 (1 cavity) (VIN F) (VIN 8)	Taped to engine harness, above rear of engine	201- 7-B
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C313 (3 cavities)	Below center of back seat	201- 9-C
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G200	Behind I/P, left of steering column	201-10-A
G304	Under rear seat, on support bracket	
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S201	I/P harness, behind instrument cluster	201-10-A
S203	I/P harness, behind instrument cluster	201-10-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S217	I/P harness, behind center of I/P	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A

(Continued on next page)

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT	FOR DIAGNOSIS
Turn the Ignition Switch to RUN	All displays light up at full intensity for 2 seconds including Speedometer, Tachometer, Fuel, Oil Pressure, Coolant Temperature, and Battery voltage	Do Tests A and B Check all Ignition Power Inputs and grounds
	Bar graphs (Tachometer, Fuel) run up to the maximum and back again and then display their present readings All other displays use a segment pointer that runs from bottom to top and back again and then displays their present readings Segments of the bar graphs that are not fully illuminated, are lit up faintly and are visible	Replace the Instrument Cluster (See Section 8C)
Press the E/M button on the Digital Instrument Cluster Observe and press it again	Readouts change between English and Metric units This affects the Speedometer and Odometer displays	Replace the Instrument Cluster (See Section 8C)
Press the TRIP button on the Digital Instrument Cluster	The Trip Odometer is displayed	Replace the Instrument Cluster (See Section 8C)
Press the RES button	The Trip Odometer resets to zero	Replace the Instrument Cluster (See Section 8C)
Press the AVG button	The average speed (since last reset) is displayed	Replace the Instrument Cluster (See Section 8C)
Turn the Headlights to Hi Beam	Blue Hi Beam Indicator comes on	Do Test A Check Terminal J (C3)
Turn the Park Lights on and rotate the Dimmer Control	Panel and Switch illumination is varied Digital Cluster brightness is varied	Do Test B Check Terminals 9 and 10
Operate the Turn Lights, first for a right turn and then for a left turn	Green Turn Indicator arrow flashes on and off with the turn signals	Do Test A Check Terminals H and K (C3)
Operate the Hazard Switch	Both Turn Indicators flash simultaneously	Do Test A Check Terminals H and K (C3)
Start the engine	The Tachometer displays the correct engine RPM The Speedometer indicates the correct vehicle speed The Fuel, Oil pressure, Coolant Temperature and Volt displays indicate the correct values	See Symptom Table

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below, or when directed by the System Check.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM		FOR DIAGNOSIS
ENTIRE CLUSTER	• Is Not Illuminated	Do Test B, Check Terminals 1, 27, and All Grounds
	• LCD Displays Do Not Operate	Do Test B, Check Terminals 13, 16, 32, and All Grounds Do Test A, Check C3 Terminals C, F, and All Grounds
	• Has Missing Display Segments	Replace Cluster (See Section 8C)
	• Does Not Dim When Park Lights Go On	Do Test B, Check Terminals 9 and 10
	• Does Not Dim When I/P Light Dimmer Is Adjusted	Do Test B, Check Terminal 10
	• Does Not Change Between English And Metric Or The Audio Alarm Does Not Work	Replace Cluster (See Section 8C)
SPEEDOMETER/ ODOMETERS TACHOMETER	• Odometer Flashes 9999.9	Replace Memory Chip In Cluster (See Section 8C)
	• Tachometer Does Not Operate	Do Test C
	• Speedometer Does Not Operate, Odometers OK	Replace Cluster (See Section 8C)
	• Odometers Do Not Operate, Speedometer OK	Replace Cluster (See Section 8C)
	• Speedometer And Both Odometers Do Not Operate	See Vehicle Speed Sensor (8A-33)
	• Speedometer And Odometer Are Inaccurate	Do Test M
	• Trip Odometer Does Not Reset To Zero	Replace Cluster (See Section 8C)
COOLANT TEMPERATURE DISPLAY	• Always Reads Hot	Do Test D
	• Is Not Accurate	Do Test F
	• Always Reads Cold	Do Test E
VOLTAGE DISPLAY	• Does Not Operate	Replace Cluster (See Section 8C)
FUEL DISPLAY	• Always Reads Empty	Do Test G
	• Always Reads Full	Do Test H
	• Reading Is Not Accurate	Do Test I
OIL PRESSURE DISPLAY	• Always Reads Maximum Pressure	Do Test K
	• Always Reads Zero Pressure	Do Test J
	• Is Not Accurate	Do Test L

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SYMPTOM TABLE

SYMPTOM		FOR DIAGNOSIS
INDICATORS	• Up Shift Indicator Does Not Operate	Do Test N
	• Turn Signal Arrow Indicators Do Not Operate	Do Test A, Check C3 Terminals H and K
	• Hi Beam Indicator Does Not Operate	Do Test A, Check C3 Terminal J
	• Fasten Belts Indicator Does Not Operate	Do Test B, Check Terminal 7
	• SERV ENG SOON Indicator Does Not Work Properly	See Section 6E
	• Brake Warning Indicator Does Not Work Properly	See Brake Warning System (8A-41)

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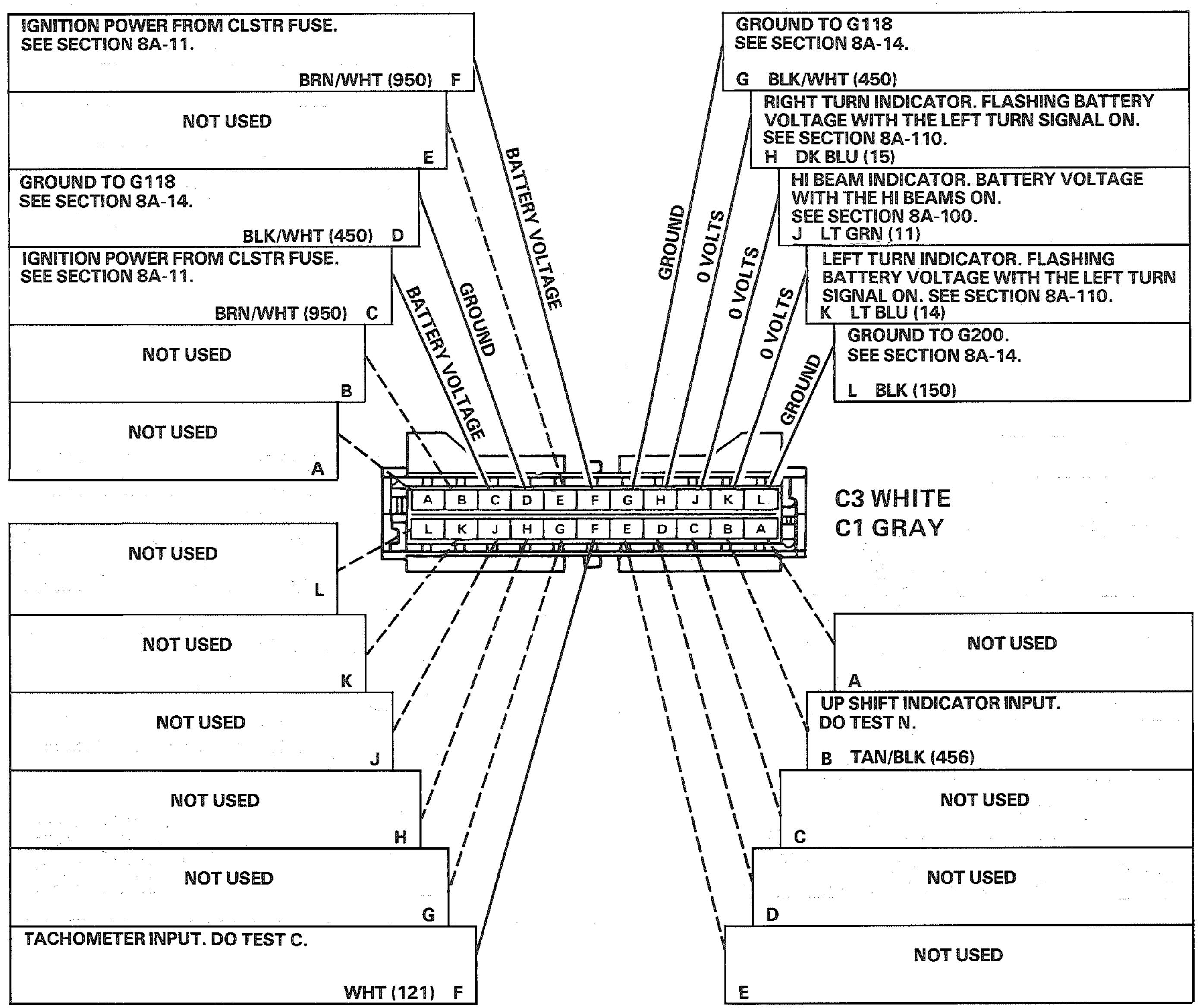
A: CONNECTOR C1/C3 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MAKE ALL RESISTANCE MEASUREMENTS WITH THE NEGATIVE BATTERY CABLE DISCONNECTED
- MEASURE TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C1/C3 AS SEEN FROM THE DRIVER'S SEAT WITH THE INSTRUMENT CLUSTER REMOVED
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK WIRES AND BULBS. IF OK, REPLACE THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED



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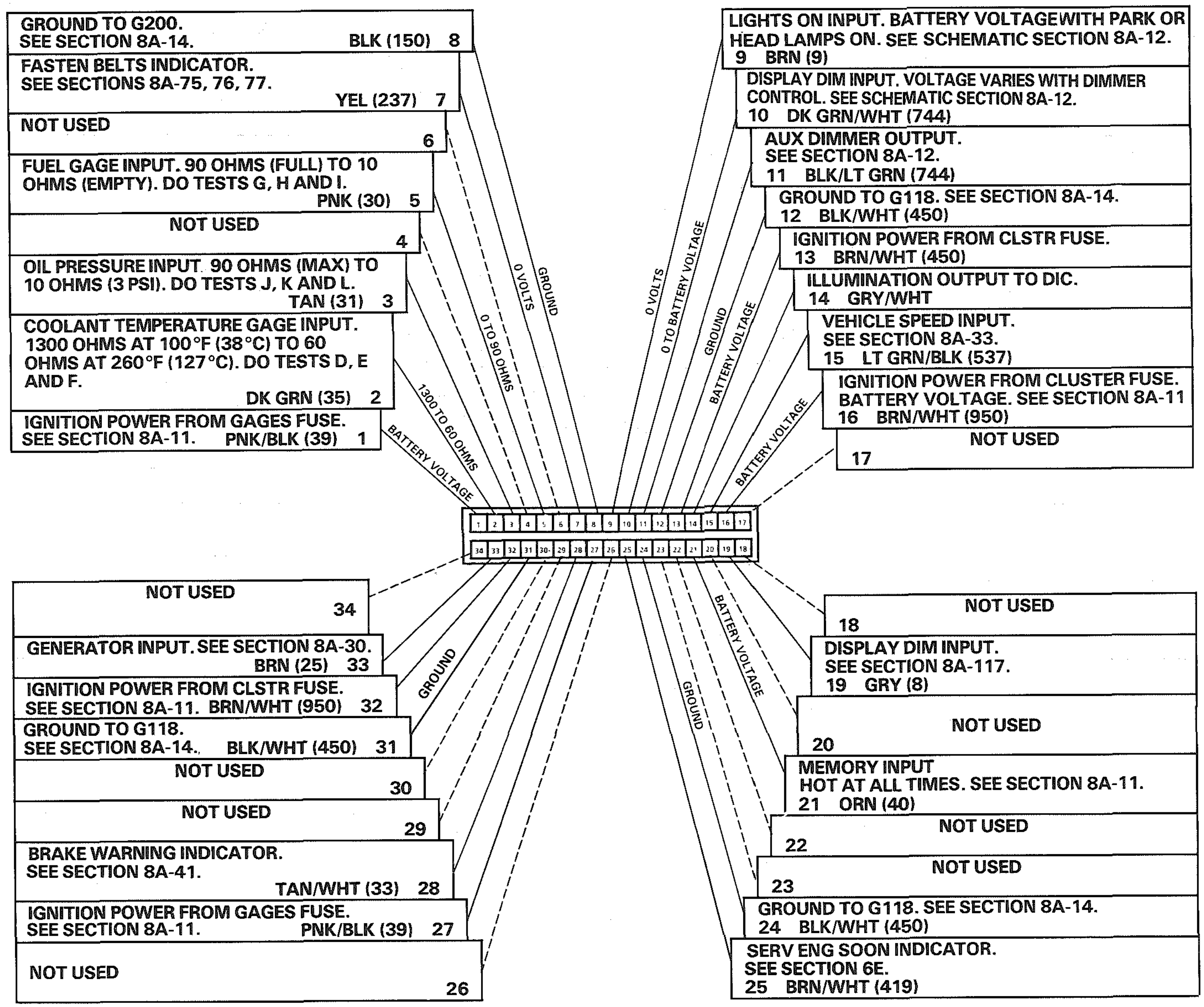
B: CONNECTOR C2 PINOUT TEST

- IGNITION SWITCH IN RUN EXCEPT FOR RESISTANCE MEASUREMENTS
- MAKE ALL RESISTANCE MEASUREMENTS WITH THE NEGATIVE BATTERY CABLE DISCONNECTED
- MEASURE TO GROUND UNLESS ANOTHER TERMINAL IS GIVEN
- CLUSTER CONNECTOR C2 AS SEEN FROM THE DRIVER'S SEAT WITH THE INSTRUMENT CLUSTER REMOVED
- IF THE CORRECT VOLTAGE OR RESISTANCE IS FOUND AT THE TERMINALS, AND THE CLUSTER FUNCTION THAT USES THOSE TERMINALS DOES NOT OPERATE, CHECK WIRES AND BULBS. IF OK, REPLACE THE INSTRUMENT CLUSTER (SEE SECTION 8C)
- IF THE CORRECT VOLTAGE OR RESISTANCE IS NOT FOUND AT A TERMINAL, DO THE TEST GIVEN OR GO TO THE PAGE REFERRED



C: TACHOMETER DOES NOT OPERATE

Disconnect the Ignition coil connector and connect the mating cable from tester J-33431 to the connector. Plug in the tester and set the switches to ON and 54 mph. Switch the Ignition to RUN and observe the Tachometer.

- If the Tachometer reads 900 rpm (V8), or 1350 rpm (V6), check the EST Distributor or Ignition Coil for an open.
- If the Tachometer does not read correctly, check the WHT (121) wire for an open. If OK, replace the Instrument Cluster (See Section 8C).

D: TEMPERATURE DISPLAY ALWAYS SHOWS HOT

Disconnect the Coolant Temperature Sender. Turn the Ignition Switch to RUN and observe the Temperature Gage.

- If the Display now reads cold, replace the Coolant Temperature Sender.
- If the display still reads hot, check the DK GRN/WHT (35) wire for a short to ground (see schematic). If OK, replace the Instrument Cluster (See Section 8C).

E: TEMPERATURE DISPLAY ALWAYS SHOWS COLD

Connect: FUSED JUMPER
At: COOLANT TEMPERATURE SENDER CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis
DK GRN (35) & Ground	TEMP Display now reads hot	See 1

- If the test gave the correct result, replace the Coolant Temperature Sender.

1. Check the DK GRN (35) wire for an open (see schematic). If OK, replace the Instrument Cluster (see Section 8C).

F: TEMPERATURE DISPLAY IS NOT ACCURATE

Remove the connector from the Coolant Temperature Sender. Connect one red clip lead of tester J-33431 to the DK GRN (35) wire (see schematic) and the other red clip lead to ground. Adjust the resistance dials of the tester to 1254 ohms, 97 ohms and then to 54 ohms. The Temperature display should show low temperature, approximately 100 °F (40 °C), 220 °F (100 °C), 260 °F (130 °C).

- If the display reads correctly, install a new Coolant Temperature Sender.
- If the display is not correct, check the DK GRN (35) wire between the sender and the Instrument Cluster for high resistance. If this wire is OK, replace the Instrument Cluster (See Section 8C).

G: FUEL GAGE INDICATES EMPTY WHEN THERE IS FUEL IN THE TANK

Disconnect the Fuel Tank Unit connector (C313). Turn the Ignition Switch to RUN.

- If the Fuel Gage now indicates full, replace the Fuel Gage Sender.
- If the Fuel Gage still indicates empty, check/repair the PNK (30) wire for a short to ground (see schematic). If the wire is OK, replace the Instrument Cluster (see Section 8C).

H: FUEL GAGE ALWAYS INDICATES FULL

Connect: FUSED JUMPER
At: FUEL TANK UNIT CONNECTOR (C313, Socket Half) (Disconnected)
Conditions:
- **Ignition Switch: RUN**

Jumper Between	Correct Indication	For Diagnosis
B (PNK) & Ground	Fuel Gage Reads Empty	See 1
B (PNK) & A (BLK)	Fuel Gage Reads Empty	See 2

- If the Fuel Gage indicates correctly both times, replace the Fuel Gage Sender.

1. Check the PNK (30) wire for an open (see schematic). If OK, replace the Instrument Cluster (see Section 8C).
2. Check/repair BLK (150) wire to ground G304 for an open (see schematic).

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I: FUEL GAGE IS INACCURATE

Disconnect the fuel tank unit connector C313 and connect the two red clip leads of tester J-33431 to terminals A (BLK) and B (PNK) of the harness half of that connector C313. Set the resistance dials of the tester to 0 ohms, 44 ohms and then to 90 ohms. The Fuel display should read "E", 1½ and Full. Cycle the Ignition after each resistance change.

- If the display responds correctly, install a new Fuel Gage Sender.
- If the display does not respond correctly, check the PNK (30) wire between the fuel tank and the Instrument Cluster for high resistance. If this wire is OK, replace the Instrument Cluster (see Section 8C).

J: OIL PRESSURE DISPLAY READS ZERO

Check the oil pressure with a manual gage. If the pressure is correct, continue with the electrical diagnosis.

Remove the connector from the Oil Pressure Sender.

- If the display now shows high pressure, the wiring is good. Install a new Oil Pressure Sender.
- If the display remains low, check for a short in the TAN (31) wire between the sender and the Instrument Cluster. If that wire is not shorted to ground, replace the Instrument Cluster (see Section 8C).

K: OIL PRESSURE DISPLAY READS MAXIMUM PRESSURE

Disconnect the connector from the Oil Pressure Sender and jumper the TAN (31) wire to ground. Put the Ignition Switch in RUN.

- If the display now reads low, the wiring is good. Install a new Oil Pressure Sender.
- If the display remains high, check for an open in the TAN (31) wire back to the Instrument Cluster. If that wire is good, replace the Instrument Cluster (see Section 8C).

L: OIL PRESSURE DISPLAY IS INACCURATE

Disconnect the connector from the Oil Pressure Sender and connect one red clip lead from tester J-33431 to the TAN (31) wire terminal. Connect the other red clip lead to ground. Set the resistance dials of the testor to 0 ohms, 43 ohms and then to 90 ohms. The display should read 0 PSI (0 kPa), 40 PSI (280 kPa) and 80 PSI (660 kPa) with the V6 or 0 PSI (0 kPa) 130 PSI (210 kPa) and 60 PSI (420 kPa) with the V8.

- If the display is correct, install a new Oil Pressure Sender.
- If the display is not correct, check the TAN (31) wire for high resistance (no more than 1 ohm). If is is good, replace the Instrument Cluster (see Section 8C).

M: SPEEDOMETER TEST

(J33431-873 connector available)

1. Disconnect connector C207. Connect the J-33431 tester to the harness half of the connector, terminal C (LT GRN and ground using the J33431-873 harness connector or equivalent). With the tester set to ON, 54 mph, 60 Hz and the Ignition Switch in RUN, the Speedometer should read 54 mph ± 2 mph.

- If the Speedometer reads correctly, refer to Vehicle Speed Sensor, Section 8A-33 for further diagnosis.
- If the Speedometer reads incorrectly, check DK GRN (389) wire and the Instrument Cluster Printed Circuit for opens. Replace the Instrument Cluster if the wire and Printed Circuit are good (see Section 8C).

N: UPSHIFT INDICATOR WIRE TEST

Disconnect ECM connector C207. Put the Ignition Switch in RUN and measure the voltage at terminal H (see Section 8A-21, 22).

- If battery voltage is present, see Section 6E for ECM diagnosis.
- If battery voltage is not present, check the TAN/BLK (456) wire for an open or short to ground.

CIRCUIT OPERATION

The Instrument Cluster uses a microprocessor to develop data for fuel supply, coolant temperature, oil pressure, voltage, engine rpm, and vehicle speed. The Digital Cluster also contains an Odometer, Warning Indicators, and an Audible Alarm. The Audible Alarm signals low oil pressure, high temperature, low or high voltage, and low fuel.

With the Ignition Switch in RUN, voltage is applied through the GAGES Fuse to the Battery Power inputs of the Instrument Cluster. With the Light Switch in PARK or HEAD, voltage is applied at all times to the Lights On Dim Input. The car's speed is displayed in mph or kmh by selecting either English or Metric with the English/Metric selector switch.

Gages and Audible Alarm

With the Ignition Switch in RUN, voltage is applied through the GAGES Fuse to the Battery Power Input terminal. With the Light Switch in PARK or HEAD, voltage is applied at all times to the Lights On Dim Input.

Fuel Display

The Fuel Display Sender provides a signal to the cluster that is related to fuel level. With a full tank the resistance is 90 ohms, and with an empty tank the resistance is less than 1 ohm. The microprocessor converts this signal and activates a 12 segment bar graph which displays the fuel level. When the bar graph fuel gage display changes from two segments to one, the Audible Alarm beeps briefly.

Oil Pressure Display

The Oil Pressure Sender, with a resistance of 0 to 90 ohms, sends a signal to the cluster that is related to oil pressure. At zero pressure (0 PSI), resistance is 0 ohms, and at maximum pressure (80 PSI), resistance is approximately 90 ohms. The microprocessor converts the signal and activates a 12 segment bar graph which displays the oil pressure. When the bar graph changes from two segments to one segment (approximately 4 PSI), the Audible Alarm beeps briefly.

Temperature Display

The Coolant Temperature Sender sends a signal to the Instrument Cluster that is related to coolant temperature. Coolant Temperature Sender resistance drops from 1,365 ohms at 100°F (38°C), to 55 ohms at 260°F (127°C). The temperature display is a bar graph display with 12 segments. When the bar graph changes to all segments activated (hot coolant temperature), the Audible Alarm beeps.

Volts Display

The microprocessor in the gages module receives a signal from the Battery Power Input terminal. This signal activates the 12 segment bar graph volts display. The volts gage ranges from 8 volts (1 segment lit) to 18 volts (all segments lit). Under idling and normal driving conditions, 7 or 8 segments are lit. When the volts gage displays less than 4 segments or more than 12 segments, the Audible Alarm beeps.

Tachometer

The Tachometer displays engine speed in rpm. Voltage pulses are taken from the Ignition System and sent to the Tachometer. Solid state circuits process these pulses into a signal that controls the Tachometer display. The Tachometer responds to the frequency of the voltage pulses, the number of pulses in a second. This increases with engine speed. The Tachometer Filter in the circuit rounds off the pulses and removes voltage spikes.

Speedometer

The digital Speedometer is operated by an electronic circuit. The Vehicle Speed Sensor, located in the Transmission, generates an AC voltage whose frequency is proportional to the speed of the vehicle. This goes to the Vehicle Speed Sensor Buffer and then to the Speedometer circuit board in the Instrument Cluster. The solid state circuit processes this signal into a control signal for the Speedometer display.

Odometer

The digital Odometer display is operated by an electronic circuit. The Vehicle Speed Sensor, located in the Transmission, generates an AC voltage whose frequency is proportional to miles (kilometers) traveled. This goes to the Buffer and then to the Odometer circuit board in the Instrument Cluster. The solid state circuit processes this signal into a control signal for the Odometer display. Distance Data is stored in NV RAM Chip.

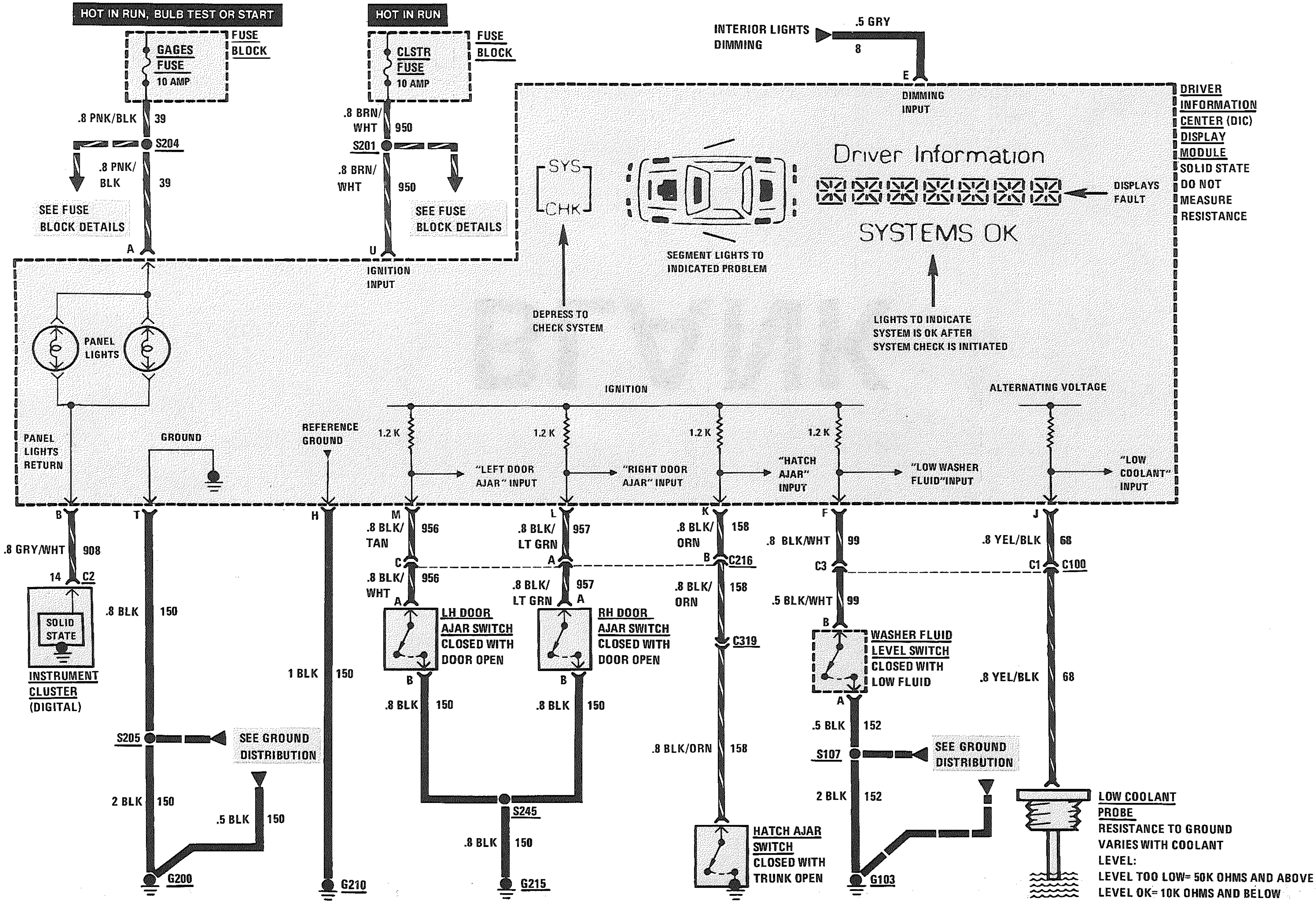
Indicators

See the circuit referred to for the complete operation of an indicator and the other components that work with it.

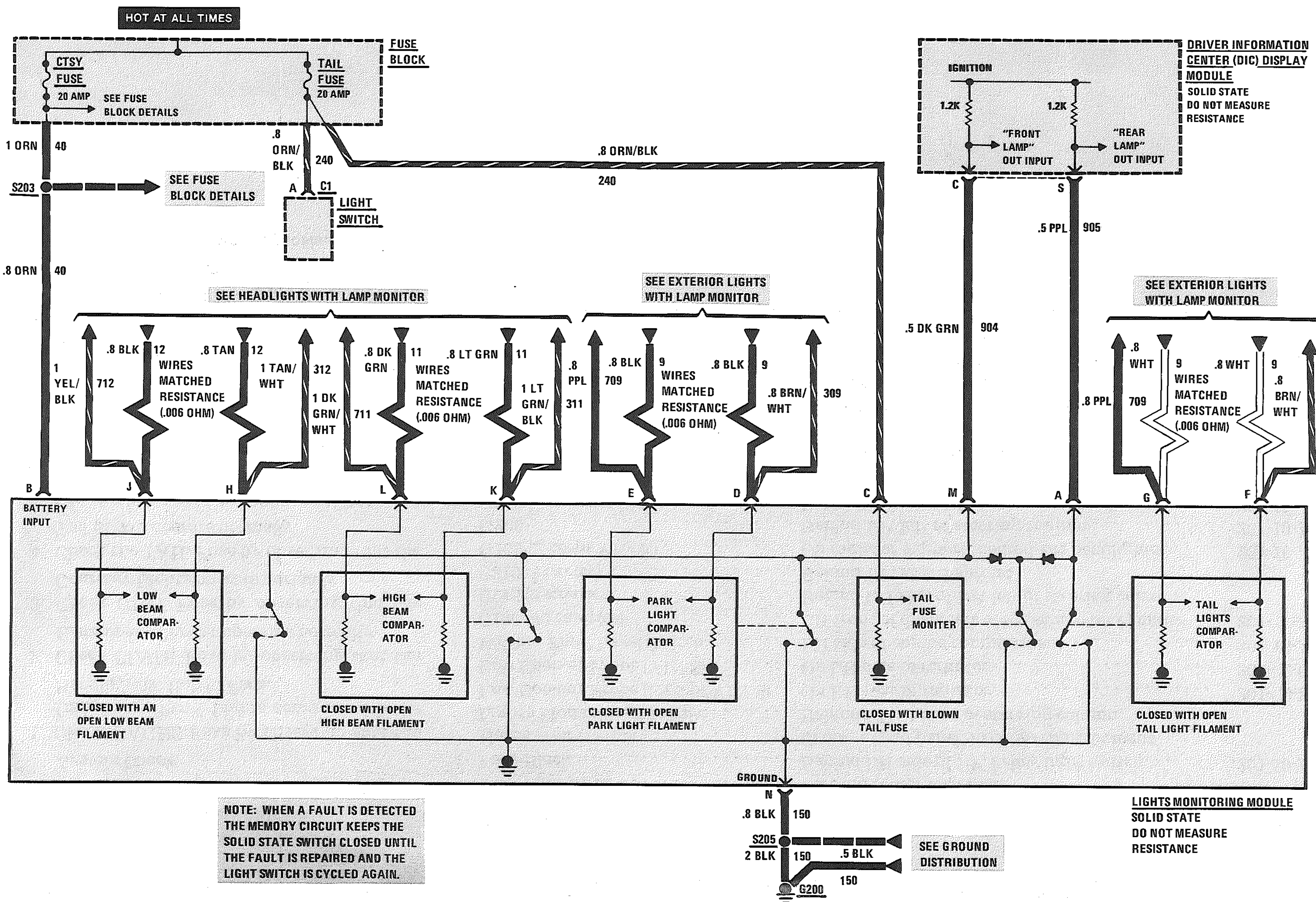
Upshift Indicator

With Manual Transmission, the indicator lights when the car should be shifted to the next higher gear for better fuel economy. Battery voltage is applied to one side of the bulb. The other side of the bulb is switched to ground by the ECM which uses engine data to compute an efficient shift point.

BLANK


HOT IN RUN, BULB TEST OR START
GAGES FUSE 10 AMP
FUSE BLOCK
HOT IN RUN
CLSTR FUSE 10 AMP
FUSE BLOCK
.8 PNK/BLK 39
S204
.8 PNK/BLK 39
SEE FUSE BLOCK DETAILS
.8 BRN/WHT 950
S201
.8 BRN/WHT 950
SEE FUSE BLOCK DETAILS
INTERIOR LIGHTS DIMMING
.5 GRY
8
E
DIMMING INPUT
DRIVER INFORMATION CENTER (DIC) DISPLAY MODULE
SOLID STATE DO NOT MEASURE RESISTANCE
SYS
CHK
Driver Information
DISPLAYS FAULT
SYSTEMS OK
SEGMENT LIGHTS TO INDICATED PROBLEM
DEPRESS TO CHECK SYSTEM
LIGHTS TO INDICATE SYSTEM IS OK AFTER SYSTEM CHECK IS INITIATED
A
U
IGNITION INPUT
PANEL LIGHTS
IGNITION
ALTERNATING VOLTAGE
PANEL LIGHTS RETURN
GROUND
REFERENCE GROUND
1.2 K
"LEFT DOOR AJAR" INPUT
"RIGHT DOOR AJAR" INPUT
"HATCH AJAR" INPUT
"LOW WASHER FLUID" INPUT
"LOW COOLANT" INPUT
B T H M L K F J
.8 GRY/WHT 908
14 C2
SOLID STATE
INSTRUMENT CLUSTER (DIGITAL)
.8 BLK 150
S205
SEE GROUND DISTRIBUTION
2 BLK 150
.5 BLK 150
G200
1 BLK 150
G210
.8 BLK/TAN 956
C
.8 BLK/WHT 956
A
LH DOOR AJAR SWITCH CLOSED WITH DOOR OPEN
B
.8 BLK 150
.8 BLK/LT GRN 957
A
.8 BLK/LT GRN 957
A
RH DOOR AJAR SWITCH CLOSED WITH DOOR OPEN
B
.8 BLK 150
S245
.8 BLK 150
G215
.8 BLK/ORN 158
B C216
.8 BLK/ORN 158
C319
.8 BLK/ORN 158
HATCH AJAR SWITCH CLOSED WITH TRUNK OPEN
.8 BLK/WHT 99
C3
.5 BLK/WHT 99
B
WASHER FLUID LEVEL SWITCH CLOSED WITH LOW FLUID
A
.5 BLK 152
S107
SEE GROUND DISTRIBUTION
2 BLK 152
G103
.8 YEL/BLK 68
C1 C100
.8 YEL/BLK 68
LOW COOLANT PROBE
RESISTANCE TO GROUND VARIES WITH COOLANT LEVEL:
LEVEL TOO LOW= 50K OHMS AND ABOVE
LEVEL OK= 10K OHMS AND BELOW

DRIVER INFORMATION CENTER (DIC)



NOTE: WHEN A FAULT IS DETECTED THE MEMORY CIRCUIT KEEPS THE SOLID STATE SWITCH CLOSED UNTIL THE FAULT IS REPAIRED AND THE LIGHT SWITCH IS CYCLED AGAIN.

DRIVER INFORMATION CENTER (DIC)

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check GAGES Fuse by observing that the Instrument Panel Lights come on with the Headlight Switch in Park.
2. Check CLSTR Fuse by observing that the Instrument Cluster operates normally.
3. Check CTSY Fuse by observing that the Courtesy Lights operate normally.
4. Check the TAIL Fuse by observing that the Tail Lights operate normally.
5. Check that grounds G200 and G210 are clean and tight.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation. Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

		Page-Figure
Door Ajar Switch	On each center lock pillar	
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Hatch Ajar Switch	Center of end panel, in cargo compartment	
Lights Monitoring Module	Behind I/P, at base of steering column	
Low Coolant Probe (Except VIN S)	On RH rear of radiator	201- 2-B
Low Coolant Probe (VIN S)	On LH side of radiator	201- 2-C
Washer Fluid Level Switch	LH side of engine compartment	201-16-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C216 (3 cavities)	Behind LH side of I/P, left of steering column	
C319 (1 cavity)	Behind I/P, at LH shroud	
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
G210	Behind center of I/P, on support bracket	201-10-A
G215	Behind LH side of I/P, left of steering column	
S107	Front lights harness, behind LH headlights	201-16-A
S201	I/P harness, behind instrument cluster	201-10-A
S203	I/P harness, behind instrument cluster	201-10-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S245	Ajar harness, behind LH side of I/P	

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SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Turn the Igntion Switch to RUN	Driver Information Center (DIC) Display comes on Parts of the vehicle symbols (LCD) light up in sequence The following messages are scrolled, or spelled out as they move across the Display: RIGHT DOOR AJAR FRONT LAMP LEFT DOOR AJAR REAR LAMP LOW COOLANT LOW WASHER FLUID HATCH AJAR PONTIAC SYSTEMS OK Audible Warning will sound twice when the PONTIAC SYSTEMS OK displays at the end of the routine
Press the SYS CHK button on the DIC display	The start-up routine is repeated as described when the Ignition Switch is turned to RUN in Step 1
With all the doors closed, open the LH door	LH door of vehicle symbol lights LEFT DOOR AJAR is displayed
Leave the LH door open, and open the RH door	LH and RH doors of vehicle symbol are lit RIGHT DOOR AJAR is displayed
Leave both doors open, and open the trunk	LH and RH doors and trunk of vehicle symbol are lit TRUNK AJAR is displayed for 2 seconds RIGHT DOOR AJAR is then displayed

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below or when directed by the System Check.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
None of the DIC Indicator segments light or messages are displayed	Do Test A
Low Washer Fluid Indicator segment lights and message is displayed when the reservoir is not low	Do Test C
Low Washer Fluid Indicator segment does not light and message is not displayed with the washer fluid reservoir low	Do Test B
Low Coolant Indicator segment does not light and message is not displayed when the coolant is low	Do Test D
Low Coolant Indicator segment lights and message is displayed when the coolant is not low	Do Test E

(SYMPTOM TABLE continued on next page)

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SYMPTOM TABLE

Hatch Ajar Indicator segment lights and message is displayed when the trunk is closed	Do Test F
Hatch Ajar Indicator segment does not light and message is not displayed with the trunk open	Do Test G
Headlamp Outage Indicator segment lights and message is displayed when all lamps are OK	Check the DK GRN (904) wire for a short to ground (see schematic) If OK, replace the Lights Monitor Module
Taillamp Outage Indicator segment lights and message is displayed when all lamps are OK	Check the PPL (905) wire for a short to ground (see schematic) If OK, replace the Lights Monitor Module
Headlamp Outage Indicator Segment does not light and message is not displayed when a lamp is out	Check the DK GRN (904) wire and printed circuit for an open If OK, replace the Lights Monitor Module
Taillamp Outage Indicator segment does not light and message is not displayed when a lamp is out	Check the PPL (905) wire and printed circuit for an open If OK, replace the Lights Monitor Module
One of the Door Ajar segments lights and message is displayed when that door is closed	Do Test H
One of the Door Ajar segments does not light and message is not displayed with that door open	Do Test I

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A: POWER INPUT TEST

Measure: VOLTAGE
At: DIC CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis of Incorrect Results
A (PNK/BLK) & Ground	Battery	See 1
U (BRN/WHT) & Ground	Battery	See 2
A (PNK/BLK) & T (BLK)	Battery	See 3
A (PNK/BLK) & H (BLK)	Battery	See 4
A (PNK/BLK) & B (GRY/WHT)	Battery	See 5

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- If all results are correct, replace the DIC.

1. Check the PNK/BLK (39) wire for an open (see schematic).
2. Check the BRN/WHT (950) wire for an open (see schematic).
3. Check the BLK (150) wire for an open (see schematic). Check ground G200.
4. Check the BLK (150) wire. Check ground G210.
5. Check the GRY/WHT (908) wire for an open (see schematic).

B: WASHER FLUID LEVEL OPEN SWITCH TEST

Connect: JUMPER
At: WASHER FLUID LEVEL SWITCH CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis of Incorrect Result
B (BLK/WHT) & Ground	Windshield Indicator/Low Washer Fluid lights after 11 seconds	See 1
B (BLK/WHT) & A (BLK)	Windshield Indicator/Low Washer Fluid lights after 11 seconds	See 2

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- If both tests are good, replace the Washer Fluid Level Switch.

1. Check the BLK/WHT (99) wire for an open (see schematic).
2. Check the BLK (152) wire for an open (see schematic).

C: WASHER FLUID LEVEL SHORTED SWITCH TEST

Disconnect the Washer Fluid Level Switch Connector terminal A. Switch the Ignition to RUN and observe the Low Washer Fluid Indicator segment on windshield of the vehicle symbol on the DIC.

- If the Low Washer Fluid segment is now off, and Low Washer Fluid is not displayed, replace the Washer Fluid Level Switch.
- If the Low Washer Fluid segment lights, and LOW WASHER FLUID is displayed, check the BLK/WHT (99) wire for a short to ground.

D: LOW COOLANT PROBE CONNECTOR TEST

If the Low Coolant message does not come on and the indicator segment on the vehicle symbol does not light with the coolant low, remove the connector to the Low Coolant Probe. With the Ignition in RUN the indicator should operate after approximately 11 seconds.

- If it does, install a new Low Coolant Probe.
- If it does not, check YEL/BLK wire to the DIC Display for a short to ground. Install a new DIC display if the wire is good.

E: LOW COOLANT PROBE RESISTANCE TEST

If the LOW COOLANT message comes on and the indicator segment on the vehicle symbol lights with the engine coolant full, check the resistance of the Low Coolant Probe and its wire. Remove the connector from the probe and measure the resistance to ground of the probe.

- If the resistance is higher than 30,000 ohms, install a new Low Coolant Probe.
- If the probe and its wiring are good, and the display does not indicate properly, install a new DIC.

F: HATCH AJAR SHORTED SWITCH TEST

Disconnect the Hatch Ajar Switch Connector. Switch the Ignition to RUN and observe the Hatch Ajar Indicator segment on the trunk of the vehicle symbol on the DIC.

- If the Hatch Ajar segment is now off and HATCH AJAR is not displayed, replace the Hatch Ajar Switch.
- If the Hatch Ajar segment is still on, and HATCH AJAR is displayed, check the BLK/ORN (158) wire for a short to ground (see schematic).

G: HATCH AJAR OPEN SWITCH TEST

Connect: JUMPER
At: HATCH AJAR SWITCH CONNECTOR (Disconnected)
Condition:
- Ignition Switch: RUN

Jumper Between	Correct Result	For Diagnosis of Incorrect Results
BLK/ORN (158) & Ground	Trunk Indicator/ HATCH AJAR Displayed	See 1

- If the test is correct, replace the Hatch Ajar Switch.

1. Check the BLK/ORN (158) wires for an open (see schematic).

H: DOOR AJAR SHORTED SWITCH TEST

Disconnect the suspect Door Ajar Switch terminal A Connector. Switch the Ignition to RUN and observe the Door Ajar Indicator segment of the vehicle symbol on the DIC.

- If the Door Ajar segment is now off and the suspect DOOR AJAR message is not displayed, replace the Door Ajar Switch.
- If the Door Ajar segment lights and the suspect DOOR AJAR message is displayed, check the wire at terminal A for a short to ground (see schematic).

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I: DOOR AJAR OPEN SWITCH TEST

Connect: JUMPER
At: SUSPECT DOOR AJAR SWITCH CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Jumper Between	Correct Result	For Diagnosis of Incorrect Results
A & Ground (see schematic)	Door Indicator/ DOOR AJAR Displayed	See 1
A & B (see schematic)	Door Indicator/ DOOR AJAR Displayed	See 2

- If both results are good, replace the Door Ajar Switch.

1. Check the wire at terminal A for an open (see schematic).
2. Check the wire at terminal B for an open (see schematic).

CIRCUIT OPERATION

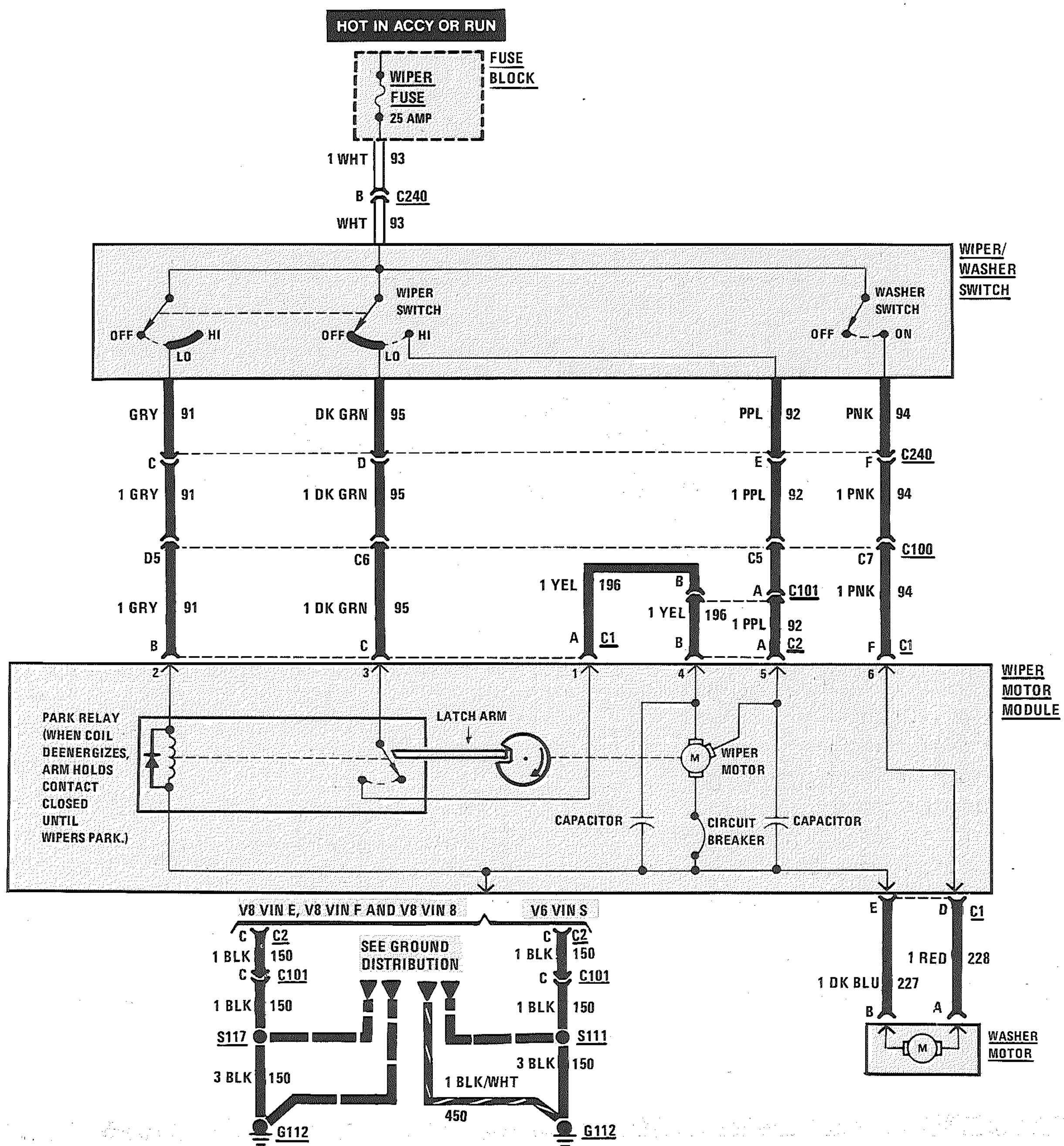
The Driver Information Center (DIC) displays warnings about saftey conditions in the vehicle. The location of the condition is indicated in a car symbol, where segments of the symbol are lit. Seven displays that form letters light up to spell out the condition, such as LOW COOLANT. The car symbol and the letters are made by Liquid Crystal Displays (LCD) that are turned on by a solid state microprocessor.

Door and trunk switches that are closed with the door open (like interior light switches) are connected to the DIC Display. These ground the DIC inputs if the door or trunk is not closed tightly, and then the display illuminates the warning. The Washer Fluid Level Switch works in the same way. It closes when the windshield washer fluid is low.

The Low Coolant Probe is not a switch that opens and closes. It has a very high resistance to ground, more than 50,000 ohms, when the engine coolant level is low. This causes the DIC Display to light the LOW COOLANT warning. With more of the probe covered by coolant, its resistance decreases. When the fluid level is good, the resistance will be less than 10,000 ohms. With the probe resistance between 10,000 and 50,000 ohms, the probe is partly covered and the fluid is not low enough to cause the warning to be displayed.

Burned out light bulbs in the vehicle are detected by the Lights Monitor. The power feed from a switch to a bulb circuit contains resistance wire. This is connected between the switch and the Lights Monitor Module. If the bulb is on properly, the current through the resistance wire causes a small voltage drop, less than one volt. When a bulb burns out, there is no current through it and the voltage drop at the module is missing. The Lights Monitor Module detects this battery voltage at one of its inputs (instead of slightly lower voltage) and closes a solid state switch in the Module to cause the warning to appear in the DIC Display.

BLANK


HOT IN ACCY OR RUN
FUSE BLOCK
WIPER FUSE 25 AMP
1 WHT 93
B C240
WHT 93
WIPER/ WASHER SWITCH
WIPER SWITCH
WASHER SWITCH
OFF HI LO
OFF ON
GRY 91
DK GRN 95
PPL 92
PNK 94
C240
1 GRY 91
1 DK GRN 95
1 PPL 92
1 PNK 94
C100
1 YEL 196
C101
1 PPL 92
C1
C2
WIPER MOTOR MODULE
PARK RELAY (WHEN COIL DEENERGIZES, ARM HOLDS CONTACT CLOSED UNTIL WIPERS PARK.)
LATCH ARM
WIPER MOTOR
CAPACITOR
CIRCUIT BREAKER
V8 VIN E, V8 VIN F AND V8 VIN 8
V6 VIN S
SEE GROUND DISTRIBUTION
1 BLK 150
3 BLK 150
S117
S111
1 BLK/WHT
450
G112
1 RED 228
1 DK BLU 227
WASHER MOTOR

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the WIPER Fuse by visual inspection.
2. Check that the three Wiper Motor mounting bolts are clean and tight.
3. Check that the Wiper/Washer Switch connector C240 is correctly mated.
4. If the Washer does not operate, check that:
   — Washer reservoir is filled.
   — Hoses are not pinched or kinked.
   — Hoses are correctly attached.
   — Nozzles are not clogged.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Washer Motor	LH side of engine compartment, in washer fluid reservoir	201- 2-A
Wiper Motor Module	LH front of dash	201- 0-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C101 (3 cavities)	LH front of dash	201- 8-E
C240 (7 cavities)	Behind I/P, near base of steering column	201- 9-A
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN E)	Engine harness, RH front of dash	201- 2-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Hold the Washer Switch ON for one or two seconds	Washer sprays the windshield as long as washer switch is held ON Wipers run at low speed and continue to run in LO after washer cycle is completed
Turn the Wiper Switch to LO	Wipers run continuously at low speed
Turn the Wiper Switch to HI	Wipers run continuously at a faster speed
Turn the Wiper Switch to OFF	Wipers complete sweep at low speed and park

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

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SYMPTOM TABLE

SYMPTOM	DO TEST
Wipers do not operate in any mode	A. Wiper/Washer Switch Battery Voltage Test B. Wiper Motor Module Input Test
Wipers run in low speed only (High speed inoperative)	B. Wiper Motor Module Input Test
Wipers will not shut off	B. Wiper Motor Module Input Test
Wipers run in high speed only (Low speed inoperative)	B. Wiper Motor Module Input Test
Washer will not operate	C. Washer Motor Module Voltage Test
Washer runs continuously	B. Wiper Motor Module Input Test

A: WIPER/WASHER SWITCH BATTERY VOLTAGE TEST

Measure: VOLTAGE
At: WIPER/WASHER SWITCH CONNECTOR C240 (Connected)
Condition:
- **Ignition Switch: ACCY**

Measure Between	Correct Voltage	For Diagnosis
B (WHT) & Ground	Battery	See 1

- If voltage is correct, do Test B.

1. Check Wiper Fuse and WHT (93) wire for an open (see schematic).

B: WIPER MOTOR MODULE INPUT TEST

Measure: VOLTAGE
At: WIPER MOTOR MODULE CONNECTORS C1 & C2 (Connected)
Conditions:
- ***Ignition Switch:* ACCY**
- **Wiper Switch: OFF or LO**

Measure Between	Correct Voltage	For Diagnosis
C1C (DK GRN) & Ground	Battery	See 1
• Wiper Switch: LO or HI		
C1B (GRY) & Ground	Battery	See 2
• Wiper Switch: HI		
C2A (PPL) & Ground	Battery	See 3
• Washer Switch: OFF		
C1F (PNK) & Ground	0 Volts	See 4
• Wiper Switch: LO		
C1A (YEL) & Ground	Battery	See 5
C2B (YEL) & Ground	Battery	See 6

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- If all the voltages are correct, but the Wiper Motor Module does not operate, remove the Wiper Motor Module for repair (See Section 8E for diagnostic procedures).

1. Check the DK GRN (95) wire for an open. Check that the Wiper/Washer Switch connector C240 is correctly mated. If OK, replace the Wiper/Washer Switch.
2. Check the GRY (91) wire for an open. Check that the Wiper/Washer Switch connector C240 is correctly mated. If OK, replace the Wiper/Washer Switch.
3. Check the PPL (92) wire for an open. Check that the Wiper/Washer Switch connector C240 is correctly mated. If OK, replace the Wiper/Washer Switch.
4. Replace the Wiper/Washer Switch.
5. Remove the Wiper Motor for repair (See Section 8E for diagnostic procedures).
6. Check the YEL (196) wire for an open.

C: WASHER MOTOR MODULE VOLTAGE TEST (TABLE 1)

Measure: VOLTAGE
At: WIPER MOTOR MODULE CONNECTOR C1 (Connected)
Conditions:
- Ignition Switch: ACCY
- Washer Switch: ON

Measure Between	Correct Voltage	For Diagnosis
F (PNK) & Ground	Battery	See 1

- If voltage is correct, go to Table 2.

1. Check PNK (94) wire for an open. Check that Wiper/Washer Switch connector C240 is correctly mated. If wire and connector are good, replace the Wiper/Washer Switch.

C: WASHER MOTOR MODULE VOLTAGE TEST (TABLE 2)

Measure: VOLTAGE
At: WASHER MOTOR CONNECTOR (Disconnected)
Conditions:
- Ignition Switch: ACCY
- Washer Switch: ON

Measure Between	Correct Voltage	For Diagnosis
A (RED) & Ground	Battery	See 1
A (RED) & B (DK BLU)	Battery	See 2

- If both voltages are correct, but Washer Motor does not run, replace Washer Motor.

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1. Check RED (228) wire for an open. If wire is good, check for open in internal wiring of Wiper Motor Module. (between terminals F and D).
2. Check DK BLU (227) wire for an open.

CIRCUIT OPERATION

LO SPEED

When the Wiper/Washer Switch is in the LO position, battery voltage is applied to the Park Relay through the GRY wire. This closes the relay contacts and supplies battery voltage to the Wiper Motor through the DK GRN and YEL wires. The wiper blades run continuously. When the Wiper/Washer Switch is turned to the OFF position, the Park Relay is deenergized. However, a mechanical arm riding on a cam attached to the Wiper Motor keeps the relay contacts closed until the wipers park or complete the last sweep. After this last sweep the mechanical arm falls into a detent permitting the relay contacts to open. This stops the Wiper Motor, and the Wiper blades remain in park.

HI SPEED

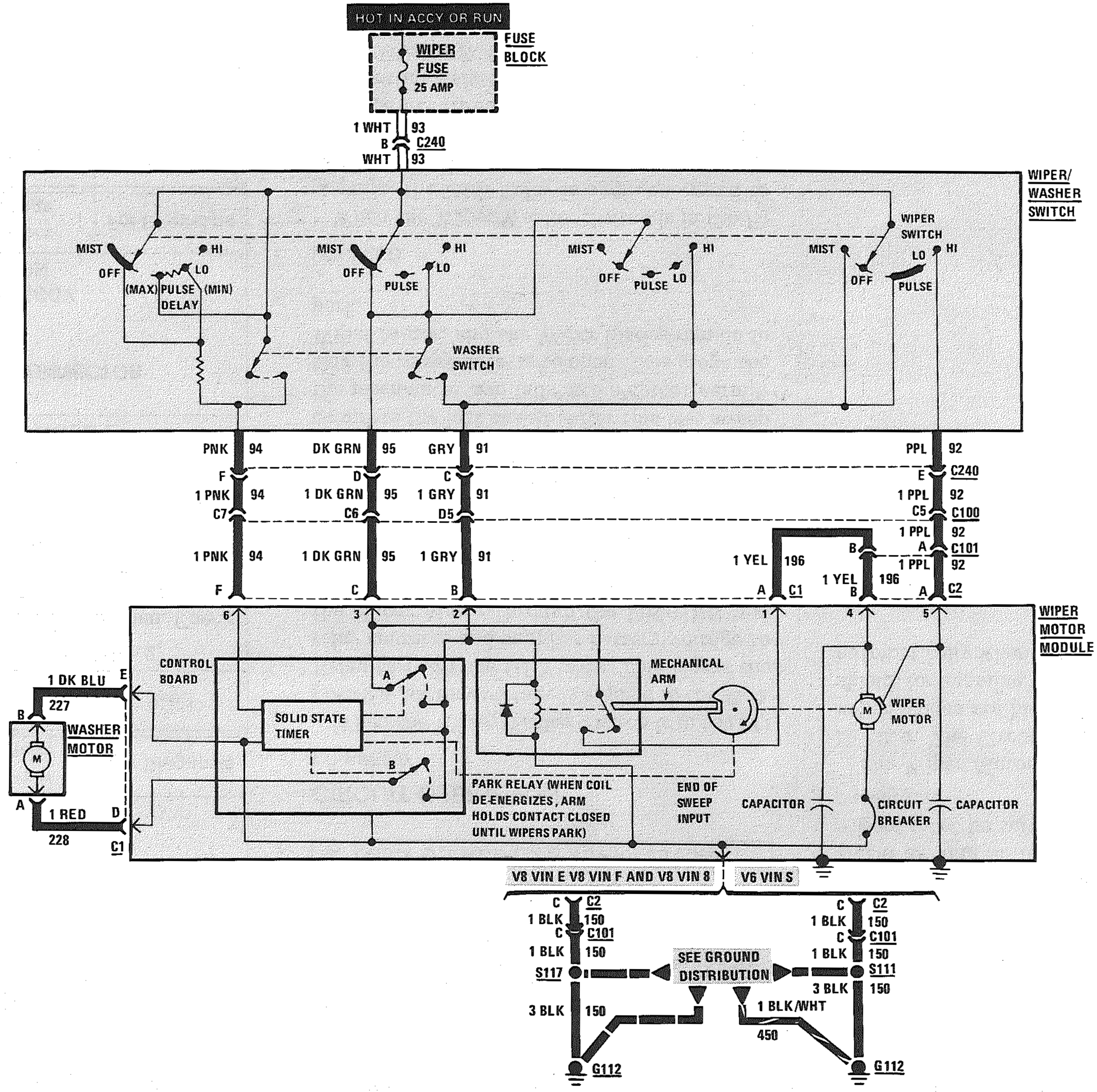
When the Wiper/Washer Switch is in the Hi position, the Park Relay is again energized to relase the latch arm. However, battery voltage is applied to the high speed brushes of the Wiper Motor through the PPL wire. The wipers run continuously at a higher speed. When the Wiper/Washer Switch is turned OFF, the wiper blades will move at low speed for the final sweep and then park.

WASHER OPERATION

When the Washer Switch is pressed ON, battery voltage is applied to the Washer Motor as well as mechanically advancing the Wiper Switch to LO. The Washer sprays the windshield as long as its switch is held ON. The wipers must be turned off manually after the wash cycle.

The Wiper Motor is protected by a Circuit Breaker. The Circuit Breaker will open if the wiper blades are blocked, by ice on the windshield, for example. The Circuit Breaker resets automatically when it cools.

WIPER/WASHER: PULSE, CD4



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the Wiper Fuse by visual inspection.
2. Check that the three Wiper Motor mounting bolts are clean and tight.
3. Check that Wiper/Washer Switch connector C240 and Wiper/Washer Motor Module Connectors are mated correctly.
4. If the Washer does not operate, check that:
   — The Washer reservoir is filled.
   — The hoses are not pinched or kinked.
   — The hoses are correctly attached.
   — The nozzles are not clogged.

- **Go to System Check for a guide to normal operation.**
- **Go to System diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System diagnosis for a list of symptoms and diagnostic steps.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Washer Motor	LH side of engine compartment, in washer fluid reservoir	201- 2-A
Wiper Motor Module	LH front of dash	201- 0-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C101 (3 cavities)	LH front of dash	201- 8-E
C240 (7 cavities)	Behind I/P, near base of steering column	201- 9-A
G112 (VIN E)	Rear of LH cylinder head	201- 3-C
G112 (VIN F) (VIN 8)	Rear of LH cylinder head	201- 7-C
G112 (VIN S)	Rear of LH cylinder head	201- 0-C
S111	Engine harness, RH rear of engine compartment	201- 1-A
S117 (VIN E)	Engine harness, RH front of dash	201- 2-A
S117 (VIN F) (VIN 8)	Engine harness, top center rear of engine	201- 7-A

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
1. Press Washer Switch ON for less than one second.	Washer sprays windshield for approximately 2½ seconds Wipers run at low speed and continue to run at low speed until the Washer Button is released After button is released, Wipers run for approximately six seconds and then return to park
2. Turn Wiper Switch to PULSE (Delay Mode)	Wipers make one complete stroke, then pause for 0 to 25 seconds before making the next stroke The wait time is adjusted by turning the Wiper Switch through the delay range
3. With the Wiper Switch in PULSE, hold the Washer Switch on for one or two seconds	Washer sprays windshield as long as Washer Button is held ON Pulse function is overridden and the Wipers run at low speed during spray period After the Washer stops, the Wipers continue to run for six seconds Wipers return to Pulse operation

(SYSTEM CHECK TABLE continued on next page)

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4. With the Wiper Switch in HI, hold Washer Switch for one or two seconds	Same operation as low speed wash except that the Wipers run at high speed
5. Turn Wiper Switch to LO	Wipers run continuously at low speed
6. Turn Wiper Switch to HI	Wipers run continuously at high speed
7. Turn Wiper Switch to OFF	Wipers return to park position at low speed
8. Move Wiper Switch to MIST	Wipers make one complete stroke and then park

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Wipers do not operate in any mode	A: Wiper/Washer Voltage Test B: Wiper Motor Voltage Test
Wipers run at low speed only	B: Wiper Motor Voltage Test
Wipers run at high speed only	B: Wiper Motor Voltage Test
Wipers will not shut off	B: Wiper Motor Voltage Test
No delay in the Pulse (Delay) Mode	C: Wiper/Washer Pulse Control Resistance Test
Washer will not operate	D: Washer Pump Voltage Test

A: WIPER/WASHER VOLTAGE TEST

Measure: VOLTAGE
At: WIPER/WASHER SWITCH CONNECTOR C240 (Disconnected)
Condition:
- **Ignition Switch: ACCY**

Measure Between	Correct Voltage	For Diagnosis
B (WHT) & Ground	Battery	See 1

- If the voltage is correct, return to Symptom Table.

1. Check Wiper Fuse and WHT (93) wire for an open.

B: WIPER MOTOR VOLTAGE TEST

Measure: VOLTAGE
At: WIPER MOTOR MODULE CONNECTORS (Disconnected)
Conditions:
- **Ignition Switch: ACCY**
- **Wiper Switch: MIST, PULSE, and LO**

Measure Between	Correct Voltage	For Diagnosis
B (GRY) C1 & Ground	Battery	See 1
B (GRY) C1 & C (BLK) C2	Battery	See 4

• Wiper Switch: HI		
A (PPL) C2 & Ground	Battery	See 2
• Wiper Switch: MIST, OFF, and LO		
C (DK GRN) C1 & Ground	Battery	See 3

- If all voltages are correct, but the Wiper/Washer Module does not operate normally, remove the Wiper Motor Module for repair. See Section 8E for diagnostic procedures.

1. Check the GRY (91) wire for an open. Check that connectors C240 and C100 are properly mated. If the wire and connectors are good, replace the Wiper/Washer Switch.
2. Check the PPL (92) wire for an open. Check that connectors C240 and C100 are properly mated. If the wire and connectors are good, replace the Wiper/Washer Switch.
3. Check the DK GRN (95) wire for an open. Check that connectors C240 and C100 are properly mated. If wire and connectors are good, replace the Wiper/Washer Switch.
4. Check the BLK (150) wire for an open.

C: WIPER/WASHER PULSE CONTROL RESISTANCE TEST

Measure: RESISTANCE
At: WIPER MOTOR MODULE CONNECTOR C1 (Disconnected)
Conditions:
- **Ignition Switch: ACCY**
- **Negative Battery Terminal: DISCONNECTED**
- **Wiper Switch: LO**

Measure Between	Correct Resistance	For Diagnosis
B (GRY) & F (PNK)	Approximately 24K ohms	See 1
• Move Wiper Switch through delay range to maximum delay position		
B (GRY) & F (PNK)	Approximately 1.2 Megohms	See 1

- If resistances are correct, but Pulse Mode does not operate, remove the Wiper Motor Module for repair. See Section 8E for diagnostic instructions.

1. Check the GRY (91) and PNK (94) wires for opens. If wires are OK, replace the Wiper/Washer Switch.

D: WASHER PUMP VOLTAGE TEST

Measure: VOLTAGE
At: WIPER MOTOR MODULE CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: ACCY**
- **Wiper/Washer Switch: OFF**
- **Washer Switch: OFF**

Measure Between	Correct Voltage	For Diagnosis
B (GRY) & Ground	0 Volts	See 1
• Washer Switch: ON		
B (GRY) & Ground	Battery	See 1
• Wiper/Washer Switch: HI • Washer Switch: OFF		
F (PNK) & Ground	0 Volts	See 1
• Washer Switch: ON		
F (PNK) & Ground	Battery	See 1
D (RED) C1 & E (DK BLU) C1	Battery	See 2

- If voltages are correct, but Washer Pump does not run check the RED (228) wire and DK BLU (227) wire for an open. If wires are good, replace the Washer Motor.

1. Check GRY (91) wire or PNK (94) wire for an open. If wire is good, replace Wiper/Washer Switch.
2. Remove Wiper Motor Module for repair. See Section 8E for diagnostic procedures.

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CIRCUIT OPERATION

In addition to the features of a conventional (Non-pulse) wiper system (MIST, LO and HI speed), the pulse-type windshield wiper/washer system includes an operating mode in which the wipers make single strokes with an adjustable time interval between strokes. The time interval is controlled by a Solid State Pulse Timer Relay in the Wiper/Washer Assembly. The duration of the delay interval is determined by the Delay Rheostat in the Wiper/Washer Control Switch.

Pulse Operation

With the Wiper/Washer Switch in Pulse, battery voltage is applied to the Wiper/Washer Motor Module at terminal B through the GRY wire. Voltage is also applied to terminal F through the PNK wire and the pulse delay resistance in the Wiper/Washer Switch. The battery voltage at terminal B energizes the Park Relay which closes its contacts. In response to the voltage at terminal F, the Solid State Timer momentarily closes contact A on the control board which applies the battery voltage at terminal B to the contacts of the Park Relay, starting the Wiper Motor.

A second mechanical arm (end of sweep input) operates contacts on the Control Board which cause the contacts at A to open when the wipers have completed their sweep. Since the Park Relay remains energized, the wipers do not park but remain just above the parked position until the Control Board closes the contacts at A again to start another sweep.

The length of delay time between sweeps is controlled by the variable Pulse Delay resistor. The delay is adjustable from zero to 25 seconds.

Low Speed

In the LO position of the Wiper/Washer Switch, battery voltage is applied at terminal C of the Wiper Motor Module as well as terminal B, through the DK GRN and GRY wires. The Park Relay is again energized and battery voltage is applied to the Park Relay contacts from terminal C and the Wiper Motor which runs continuously.

High Speed

With the Wiper Switch in the HI position, battery voltage is supplied directly to the Wiper Motor, without passing through the Park Relay contacts. The input (PPL wire) is connected to a separate armature brush for high speed operation.

When turned off from HI, the wipers complete the last sweep at low speed and park. To do this, the Wiper Motor receives battery voltage in the OFF position of the Wiper Switch which is applied through the DK GRN wire to terminal C of C1. The Park relay is deenergized when the Wiper/Washer Switch is moved to OFF, but the contacts remain closed until the wipers reach the parked position.

The Wiper Motor is protected by a Circuit Breaker. If the wipers are obstructed, by snow or ice for example, the circuit breaker will open the circuit. The Circuit Breaker resets automatically when it cools.

Washer

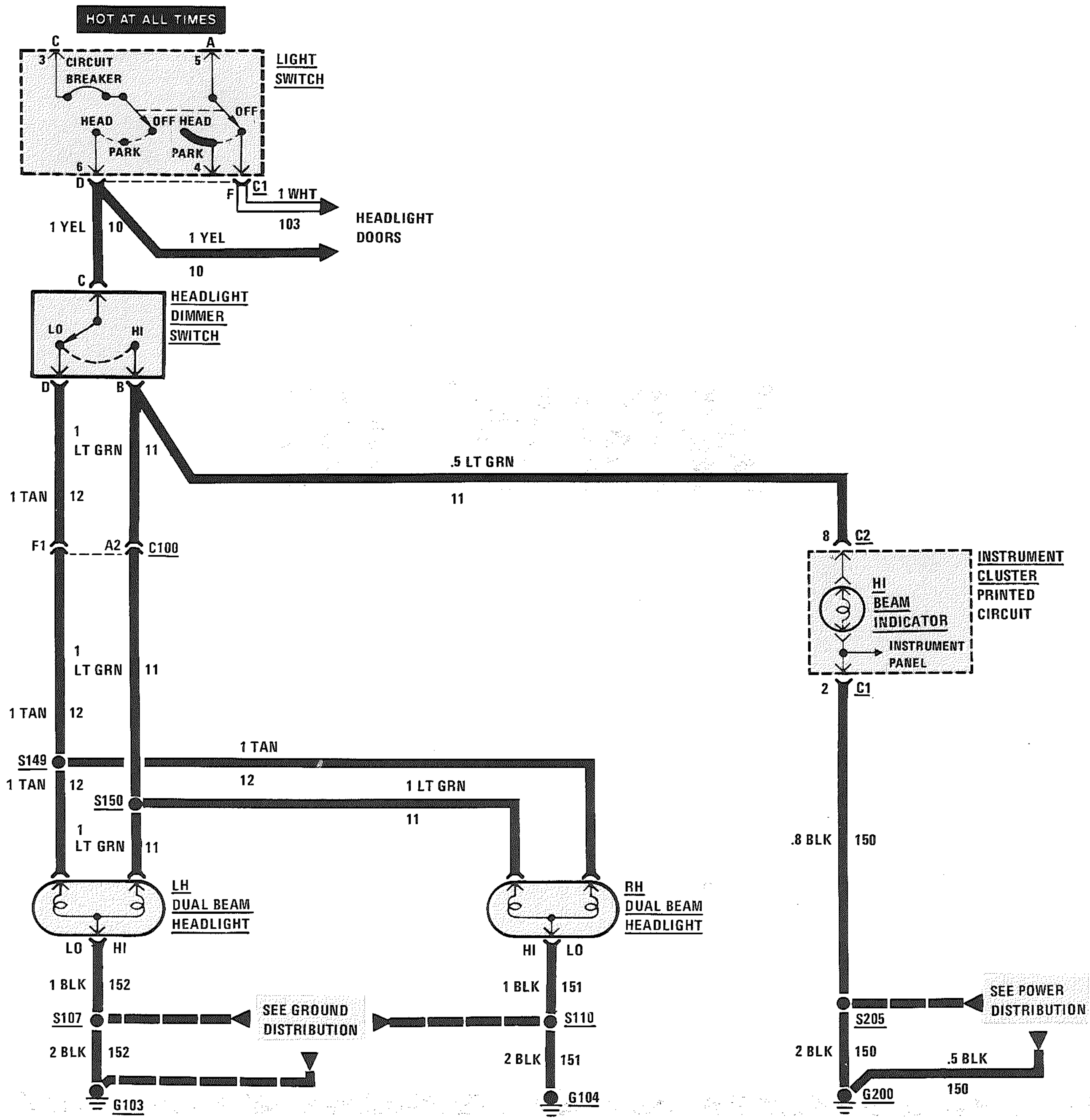
When the Washer Switch is held ON, battery voltage is applied to the Control Board through the PNK and GRY wires. The Park Relay is energized by the battery voltage at terminal B. The Control Board turns on the Washer and Wiper Motors by closing contacts A and B. The Control Board turns the Wiper Motor OFF approximately 6 seconds after it interrupts power to the Washer Motor. If the Wipers had been in Pulse, LO, or HI, they would return to that operation after the wash cycle.

Mist

When the control is moved to MIST and released, the wipers make one sweep at low speed and return to park. The circuit operation is the same as that of LO.

BLANK

HEADLIGHTS



HOT AT ALL TIMES
LIGHT SWITCH
CIRCUIT BREAKER
HEAD
OFF HEAD
OFF
PARK
PARK
1 WHT
103
HEADLIGHT DOORS
1 YEL
10
HEADLIGHT DIMMER SWITCH
LO
HI
1 LT GRN
11
1 TAN
12
.5 LT GRN
C100
C2
INSTRUMENT CLUSTER PRINTED CIRCUIT
HI BEAM INDICATOR
INSTRUMENT PANEL
C1
S149
S150
LH DUAL BEAM HEADLIGHT
RH DUAL BEAM HEADLIGHT
.8 BLK
150
1 BLK
152
151
S107
S110
S205
SEE GROUND DISTRIBUTION
SEE POWER DISTRIBUTION
2 BLK
.5 BLK
G103
G104
G200

HEADLIGHTS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. If Headlights on one side are on dimly, check the ground on that side.
2. If Hi Beams do not light, but the Hi Beam Indicator lights, check LT GRN (11) wire for an open (see schematic).
3. If one Headlight doesn't work, check the Headlight, connections, and wires to the Headlight.
4. If the Headlights do not turn off, replace the Light Switch.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: All Headlights are inoperative or intermittent
B: Lo Beams on both sides are inoperative or Hi Beams and Hi Beam Indicator are inoperative

COMPONENT LOCATION

Component	Location	Page-Figure
Headlight Dimmer Switch	Behind I/P, on LH upper side of steering column	201- 9-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G103 (VIN E)	RH inner fender panel, near battery	201- 3-B
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
S107	Front lights harness, behind LH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S149	Front lights harness, behind LH headlights	201-16-A
S150	Front lights harness, behind LH headlights	201-16-A
S205	I/P harness, behind instrument cluster	201-10-A

A: ALL HEADLIGHTS ARE INOPERATIVE OR INTERMITTENT (TABLE 1)

Connect: TEST LAMP
At: LIGHT SWITCH CONNECTOR C1 (Connected)
Condition:
- **Light Switch: HEAD**

Connect Between	Correct Result	For Diagnosis
C (RED) & Ground	Test Lamp lights	See 1
D (YEL) & Ground	Test Lamp lights	Go to Table 2

- If both results are correct, go to Test B.

1. Check Fusible Link A and RED (2) wire for an open (see Power Distribution).

A: ALL HEADLIGHTS ARE INOPERATIVE OR INTERMITTENT (TABLE 2)

Connect: FUSED JUMPER
At: LIGHT SWITCH CONNECTOR C1 (Disconnected)
Conditions:
- **Put a 15 amp fuse in the fused jumper**
- **Headlight Dimmer Switch: LO**

Connect Between	Correct Indication	For Diagnosis
C (RED) & D (YEL)	Headlights light	See 1
• Headlight Dimmer Switch: HI		
C (RED) & D (YEL)	Hi Beams light	See 1

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• If results are correct, replace Light Switch.
1. Check for short to ground in wiring to Headlights.

B: LO BEAMS ON BOTH SIDES ARE INOPERATIVE OR HI BEAMS AND HI BEAM INDICATOR ARE INOPERATIVE

Connect: TEST LAMP
At: HEADLIGHT DIMMER SWITCH CONNECTOR (Connected)
Conditions:
- **Light Switch: HEAD**
- **Headlight Dimmer Switch: LO**

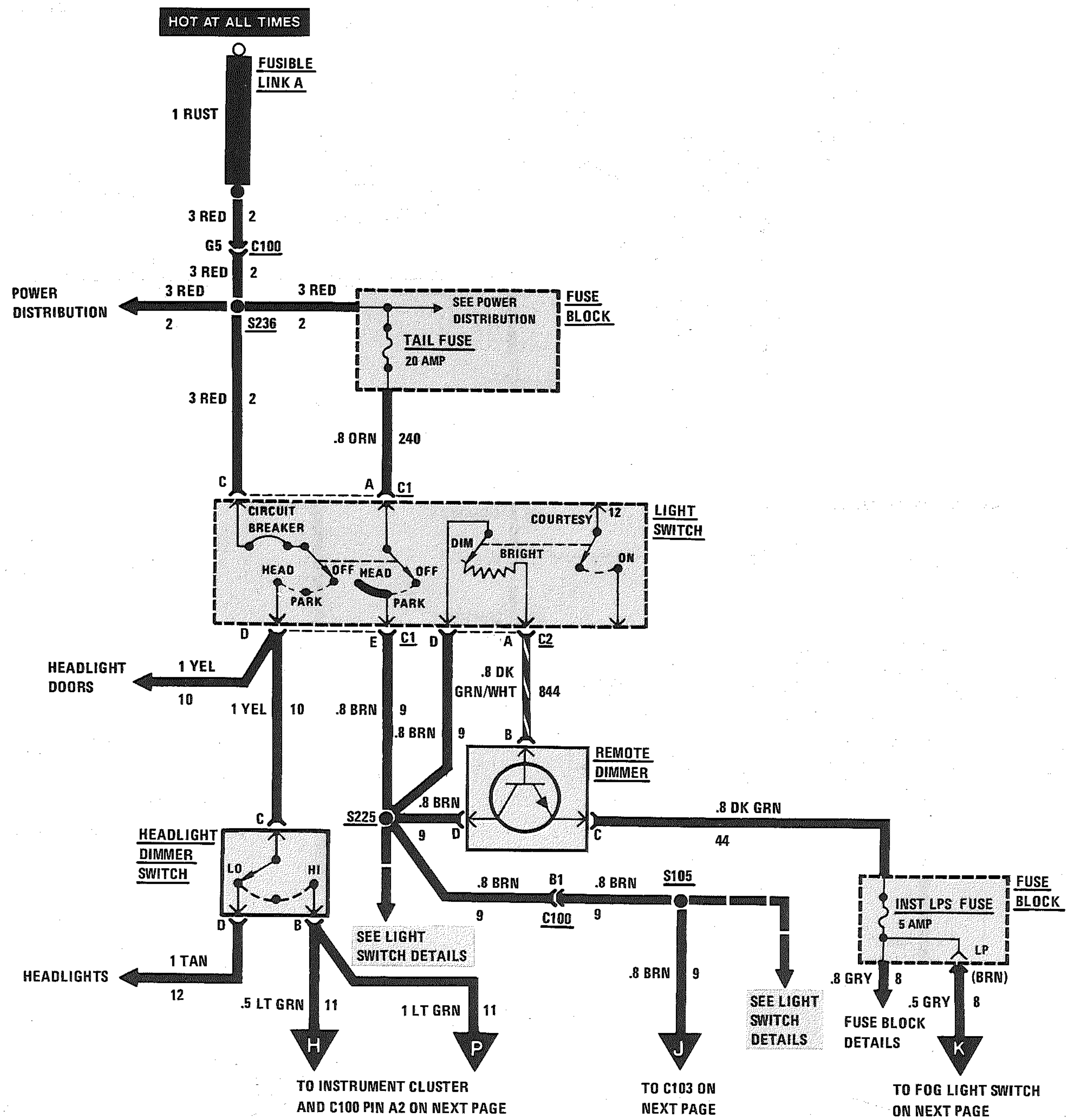
Connect Between	Correct Result	For Diagnosis
C (YEL) & Ground	Test Lamp lights	See 1
D (TAN) & Ground	Test Lamp lights	See 2
• Headlight Dimmer Switch: HI		
B (LT GRN) & Ground	Test Lamp lights	See 2

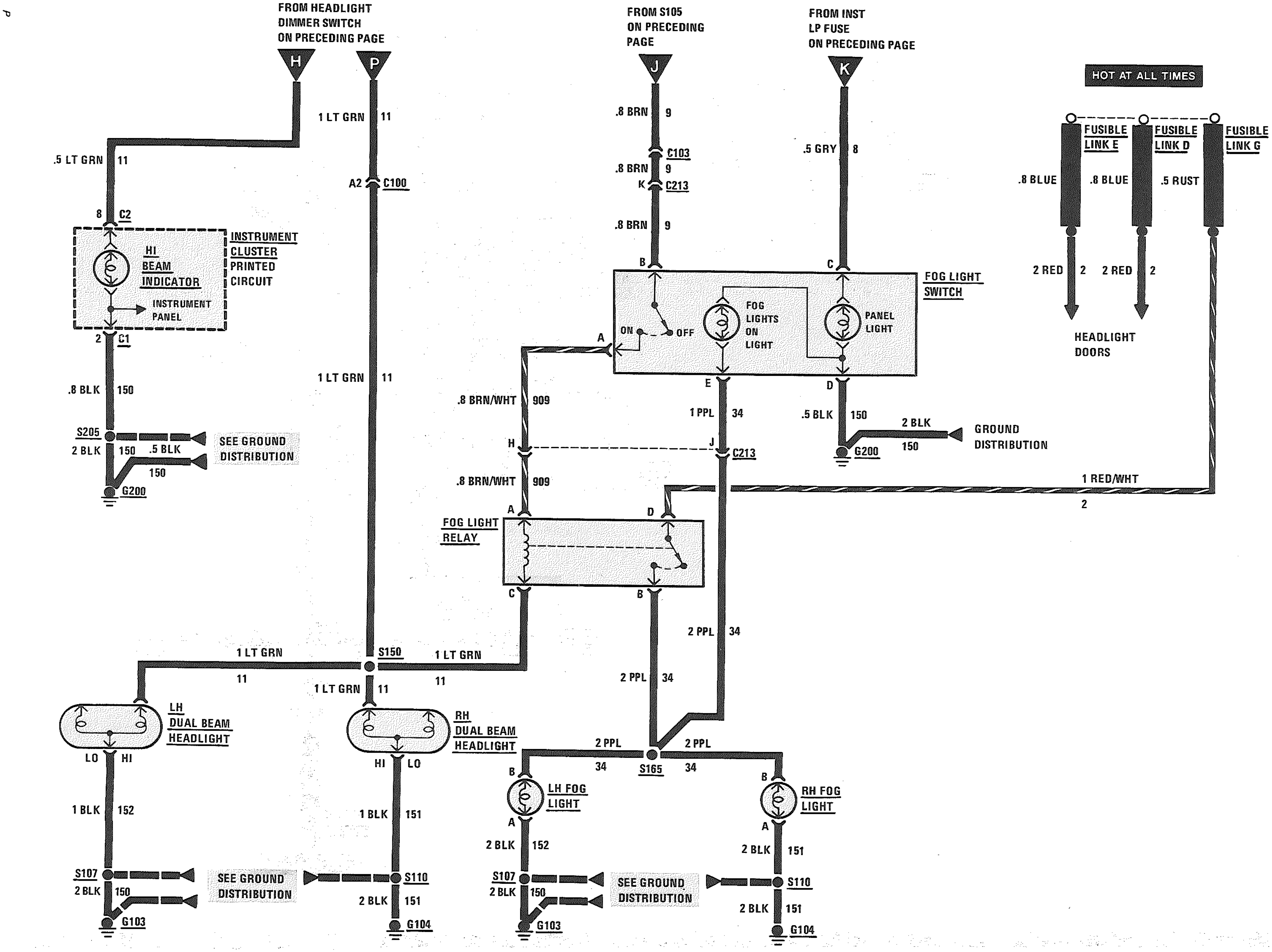
- If all results are correct, check wiring to lights for an open.
1. Check YEL (10) wire for an open.
2. Replace Headlight Dimmer Switch.

CIRCUIT OPERATION

Voltage is applied to the Light Switch at all times. The Light Switch includes a Self-Resetting Circuit Breaker. The Circuit Breaker opens when the Headlight circuit draws too much current. When the Circuit Breaker opens, it interrupts the current flow. With no current flow, the Circuit Breaker cools off and resets automatically. When the Light Switch is in HEAD, the Headlight Dimmer Switch directs voltage to either the Lo Beams or Hi Beams. The Hi Beam Indicator also receives voltage along with the Hi Beams.

HEADLIGHTS: FOG LIGHTS




FROM HEADLIGHT DIMMER SWITCH ON PRECEDING PAGE
H
P
FROM S105 ON PRECEDING PAGE
J
FROM INST LP FUSE ON PRECEDING PAGE
K
HOT AT ALL TIMES
.5 LT GRN 11
1 LT GRN 11
A2 C100
8 C2
INSTRUMENT CLUSTER PRINTED CIRCUIT
HI BEAM INDICATOR
INSTRUMENT PANEL
2 C1
.8 BLK 150
S205
2 BLK 150
.5 BLK
150
SEE GROUND DISTRIBUTION
G200
.8 BRN 9
C103
.8 BRN 9
K C213
.8 BRN 9
.5 GRY 8
FUSIBLE LINK E
FUSIBLE LINK D
FUSIBLE LINK G
.8 BLUE
.8 BLUE
.5 RUST
2 RED 2
2 RED 2
HEADLIGHT DOORS
B
C
FOG LIGHT SWITCH
ON
OFF
FOG LIGHTS ON LIGHT
PANEL LIGHT
A
E
D
.8 BRN/WHT 909
1 PPL 34
.5 BLK 150
2 BLK
150
GROUND DISTRIBUTION
G200
H
J
C213
.8 BRN/WHT 909
1 RED/WHT
2
A
D
FOG LIGHT RELAY
C
B
2 PPL 34
2 PPL 34
1 LT GRN
11
S150
1 LT GRN
11
1 LT GRN 11
LH DUAL BEAM HEADLIGHT
RH DUAL BEAM HEADLIGHT
LO HI
HI LO
2 PPL
34
S165
2 PPL
34
B
LH FOG LIGHT
A
B
RH FOG LIGHT
A
1 BLK 152
1 BLK 151
2 BLK 152
2 BLK 151
S107
2 BLK 150
G103
SEE GROUND DISTRIBUTION
S110
2 BLK 151
G104
S107
2 BLK 150
G103
SEE GROUND DISTRIBUTION
S110
2 BLK 151
G104

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check that the Headlights and Park Lights work properly before troubleshooting the Fog Lights.
2. If one Fog Light doesn't work, check the Fog Light, connections, and wires to the Fog Light.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the following test if the Fog Lights do not operate.**

COMPONENT LOCATION

		Page-Figure
Fog Light Relay	LH front of engine compartment, on fender	201-16-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link A (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link A (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link A (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link D	Front lights harness, near LH side of dash	201-16-A
Fusible Link E	Front lights harness, near LH side of dash	201-16-A
Fusible Link G	Front lights harness, near LH side of dash	201-16-A
Headlight Dimmer Switch	Behind I/P, on LH upper side of steering column	201- 9-A
Remote Dimmer	RH side of steering column, on I/P retainer	201-10-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C103 (1 cavity)	In front lights harness, LH rear corner of engine compartment	201-15-C
C213 (3 cavities)	Behind LH side of I/P, near light switch	201-10-C
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
S105	Front lights harness, behind LH headlights	201-16-A
S107	Front lights harness, behind LH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S150	Front lights harness, behind LH headlights	201-16-A
S165	Forward lights harness, LH front corner of engine compartment	201-15-B
S205	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S236	I/P harness, below light switch	201-10-A

FOG LIGHTS DO NOT OPERATE

Measure: VOLTAGE
At: FOG LIGHT RELAY CONNECTOR (Disconnected)
Conditions:
- **Light Switch: PARK**
- **Fog Light Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
A (BRN/WHT) & Ground	Battery	See 1
A (BRN/WHT) & C (LT GRN)	Battery	See 2
D (RED/WHT) & Ground	Battery	See 3
D (RED/WHT) & B (PPL)	Battery	See 4

- If all voltages are correct, replace the Fog Light Relay.

1. Check the Fog Light Switch and BRN (9) and BRN/WHT (909) wires for an open (see schematic).
2. Check LT GRN (11) wire for an open.
3. Check Fusible Link G and RED/WHT (2) wire for an open.
4. Check PPL (34) wire for an open.

CIRCUIT OPERATION

The Fog Lights are controlled by the Light Switch. They can be turned on with the Park or Headlights on. With the Hi Beams on, the Fog Lights go out.

The Fog Light Relay controls battery voltage to the Fog Lights. The Fog Light Switch applies voltage to the relay coil. The relay coil is grounded through the Hi Beam filaments. When the Hi Beams come on, battery voltage is at both sides of the relay coil. The relay and the Fog Lights turn off.

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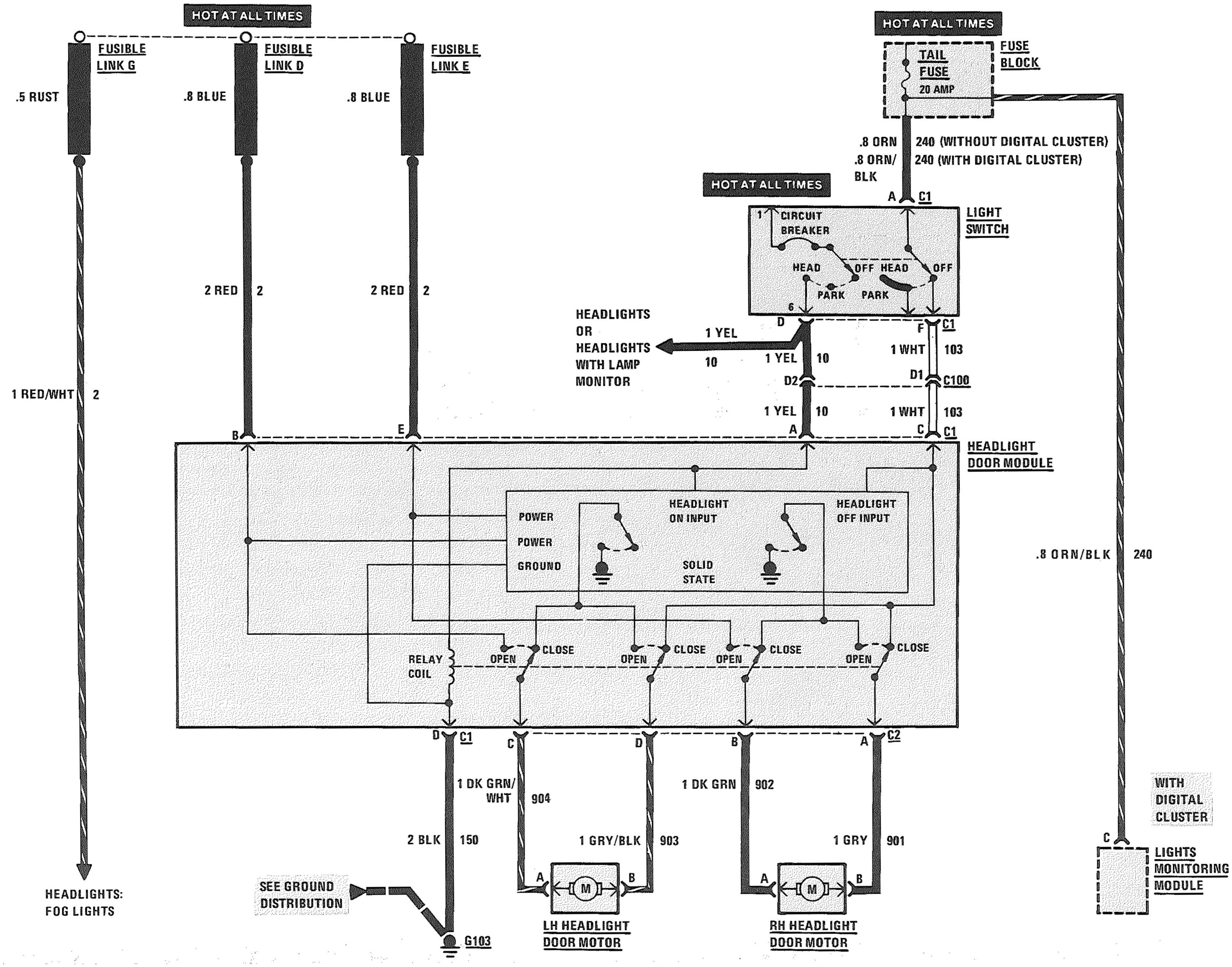
HEADLIGHT DOORS



HEADLIGHT DOORS

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Put Light Switch in HEAD	Headlight Doors open and Headlights light
Put Light Switch in PARK	Headlights go out, Headlight Doors stay open
Put Light Switch in OFF	Headlight Doors close

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

A: Neither Headlight Door operates properly
B: Left Headlight Door does not operate properly
C: Right Headlight Door does not operate properly

COMPONENT LOCATION

Component	Location	Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link D	Front lights harness, near LH side of dash	201-16-A
Fusible Link E	Front lights harness, near LH side of dash	201-16-A
Fusible Link G	Front lights harness, near LH side of dash	201-16-A
Headlight Door Module	LH front of dash	201-16-A
LH Headlight Door Motor	To right of LH headlight	201-16-A
Lights Monitoring Module	Behind I/P, at base of steering column	
RH Headlight Door Motor	To left of RH headlight	201-16-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A

A: NEITHER HEADLIGHT DOOR OPERATES PROPERLY

Connect: TEST LAMP
At: HEADLIGHT DOOR MODULE CONNECTOR C1 (Disconnected)
Condition:
- **Light Switch: OFF**

Connect Between	Correct Result	For Diagnosis Of Incorrect Results
B (RED) & Ground	Test Lamp lights	See 1
E (RED) & Ground	Test Lamp lights	See 1
C (WHT) & Ground	Test Lamp lights	See 2
C (WHT) & D (BLK)	Test Lamp lights	See 3
• Light Switch: HEAD		
A (YEL) & Ground	Test Lamp lights	See 4

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- If all results are correct, replace Headlight Door Module.

1. Check RED (2) wire and Fusible Link D or E for an open (see schematic).
2. Check TAIL Fuse, Light Switch, and WHT (103) wire for an open (see schematic).
3. Check BLK (150) wire for an open.
4. Check YEL (10) wire for an open. Refer to Headlights (8A-100) for diagnosis if wire is OK.

B: LEFT HEADLIGHT DOOR DOES NOT OPERATE PROPERLY

1. Check for mechanical binding.
2. Remove connector C2 from the Headlight Door Module. (Leave C1 connected.) Connect fused jumpers from terminal D (GRY/BLK) of the connector to terminal A of the Module, and from terminal C (DK GRN/WHT) of the connector to terminal B of the Module. Operate the Headlights.

- If LH Headlight Door works, replace Headlight Door Module.
- If no Headlight Door works, check wiring to the motor. Replace the motor as necessary.

C: RIGHT HEADLIGHT DOOR DOES NOT OPERATE PROPERLY

1. Check for mechanical binding.
2. Remove connector C2 from the Headlight Door Module. (Leave C1 connected.) Connect fused jumpers from terminal B (DK GRN) of the connector to terminal C of the Module, and from terminal A (GRY) of the connector to terminal D of the module. Operate the Headlights.

- If RH Headlight Door works, replace Headlight Door Module.
- If no Headlight Door works, check wiring to the motor. Replace the motor as necessary.

CIRCUIT OPERATION

Voltage to open the Headlight Doors and to power the solid state circuitry is applied to the Headlight Door Module at all times at terminals B and E of connector C1. With the Light Switch in OFF, voltage to close the Headlight Doors is applied to terminal C of connector C1. With the Light Switch in HEAD, voltage is applied to terminal A of connector C1 to allow the Headlight Doors to open.

When the Light Switch is moved to HEAD, voltage is applied to the Headlight Door Motors. Ground is provided for the motors through the solid state circuitry until the Headlight doors are open.

When the Light Switch is moved to OFF, voltage is reversed across the Headlight Door Motors. The motors run in the opposite direction to close the Headlight Doors. When the doors are closed, the solid state circuitry senses the motors are not operating and ground is removed.

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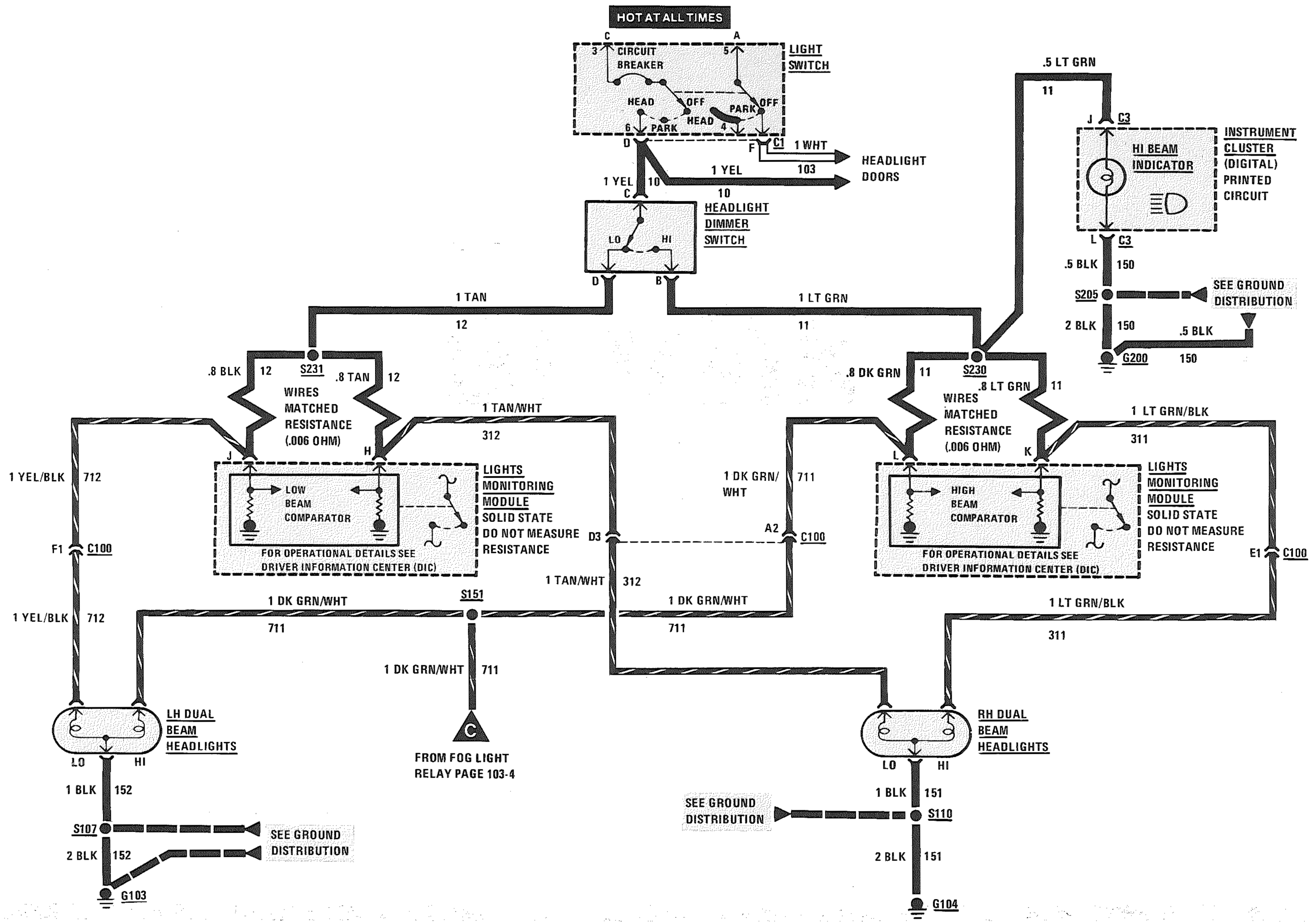
HEADLIGHTS WITH LAMP MONITOR



HEADLIGHTS WITH LAMP MONITOR

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. If the Headlight on one side is dimly lit, check the ground on that side.
2. If the Hi Beam Indicator does not light, but the High Beams operate, check the LT GRN (11) wire for an open (see schematic).
3. If one Headlight doesn't work, check the connections, the Headlight, and the wires to the Headlight.
4. If the Headlights do not turn off, replace the Light Switch.

- **Go to the System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the Tests listed for your Symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
All Headlights inoperative or intermittent	Do Test A
Low beams on both sides are inoperative	Do Test B
High Beams and Hi Beam Indicator are inoperative	Do Test B
A Headlight is out, but no warning message is displayed on the Instrument Panel	Refer to Driver Information Center (DIC), page 86-0
A Headlight out warning message is displayed but all Headlights are functioning properly	Refer to Driver Information Center (DIC), page 86-0

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COMPONENT LOCATION

Component	Location	Page-Figure
Headlight Dimmer Switch	Behind I/P, on LH upper side of steering column	201- 9-A
Lights Monitoring Module	Behind I/P, at base of steering column	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
S107	Front lights harness, behind LH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S151	Front lights harness, lower LH side of engine compartment	201-16-A
S205	I/P harness, behind instrument cluster	201-10-A
S230	I/P harness, behind LH side of I/P	201-10-A
S231	I/P harness, above Fuse Block	201-10-A

A: LIGHT SWITCH TEST (TABLE 1)

Connect: TEST LAMP
At: LIGHT SWITCH CONNECTOR (Connected)
Condition:
- **Light Switch: HEAD**

Connect Between	Correct Result	For Diagnosis Of Incorrect Results
C (RED) & Ground	Test Lamp lights	See 1
D (YEL) & Ground	Test Lamp lights	Go to Table 2

- If both results are correct, go to Test B.

1. Check Fusible Link A and RED (2) wire for an open.

A: LIGHT SWITCH TEST (TABLE 2)

Connect: FUSED JUMPER
At: LIGHT SWITCH CONNECTOR (Disconnected)
Conditions:
- **Put a 15 amp fuse in the fused jumper**
- **Dimmer Switch: LO**

Jumper Between	Correct Result	For Diagnosis Of Incorrect Results
C (RED) & D (YEL)	Headlights light	See 1
• Put Dimmer Switch in HI		
C (RED) & D (YEL)	High Beams light	See 1
• If results are correct, replace Light Switch.		
1. Check for short to ground in wiring to Headlights.		

B: DIMMER SWITCH TEST

Connect: TEST LAMP
At: HEADLIGHT DIMMER SWITCH CONNECTOR (Connected)
Conditions:
- **Light Switch: HEAD**
- **Dimmer Switch: LO**

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Connect Between	Correct Result	For Diagnosis Of Incorrect Results
C (YEL) & Ground	Test Lamp lights	See 1
D (TAN) & Ground	Test Lamp lights	See 2
• Put Dimmer Switch in HI		
B (LT GRN) & Ground	Test Lamp lights	See 2
• If all results are correct, check wiring to lights for an open.		
1. Check YEL (10) wire for an open.		
2. Replace Headlight Dimmer Switch.		

CIRCUIT OPERATION

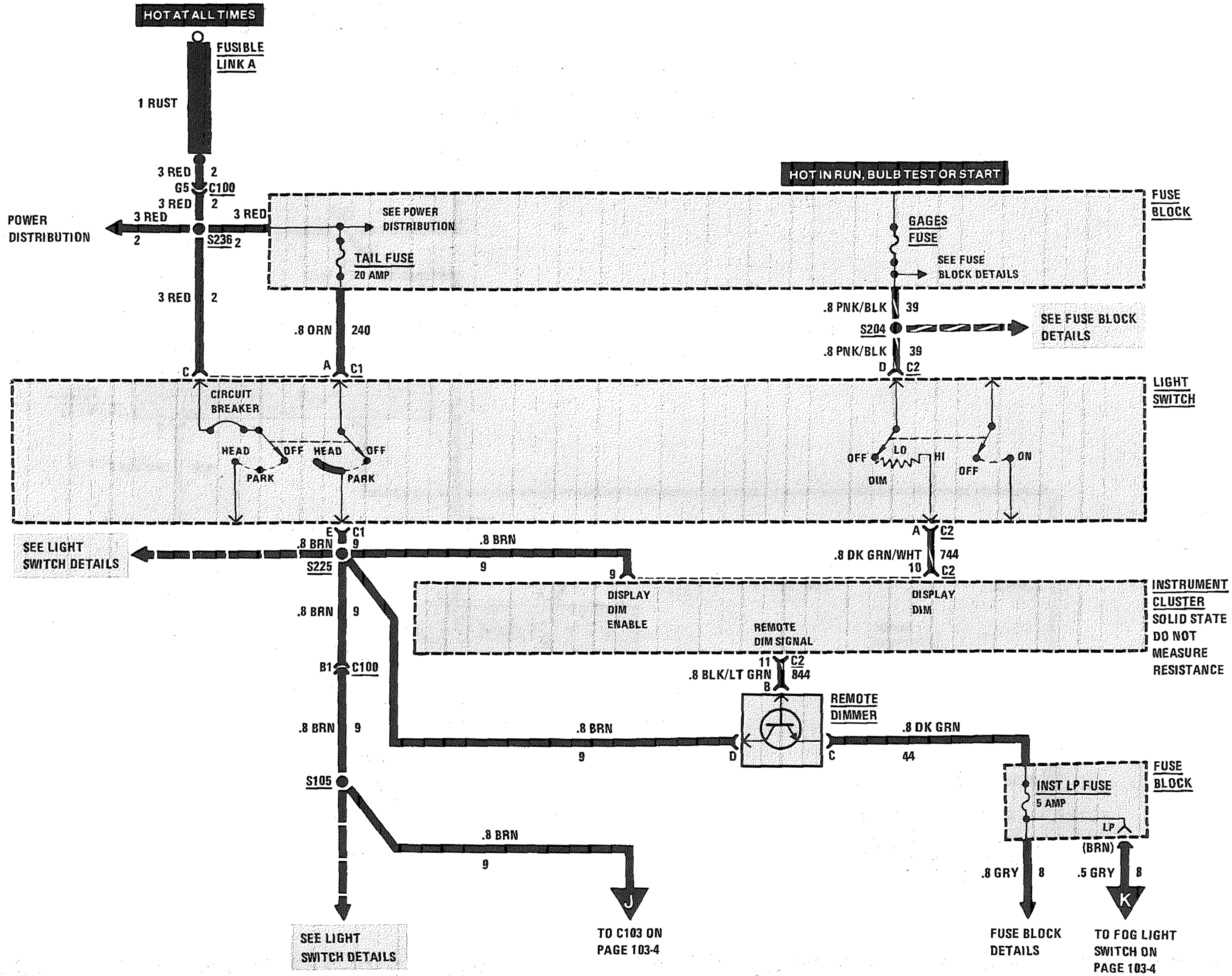
Voltage is applied to the Light Switch through the Headlights Circuit Breaker. When the switch is closed in HEAD, voltage is applied through the YEL wire to the Headlight Dimmer Switch. With the Dimmer Switch in LO, voltage is applied through the TAN and BLK matched resistance wires to the Lights Monitoring Module and to the LH and RH Low Beam Headlights. The Lo Beam Headlights turn on.

If either of the Lo Beam Headlights is burned out, the Lo Beam Comparator detects the open low beam filament, and the Driver Information Center (DIC) displays the fault.

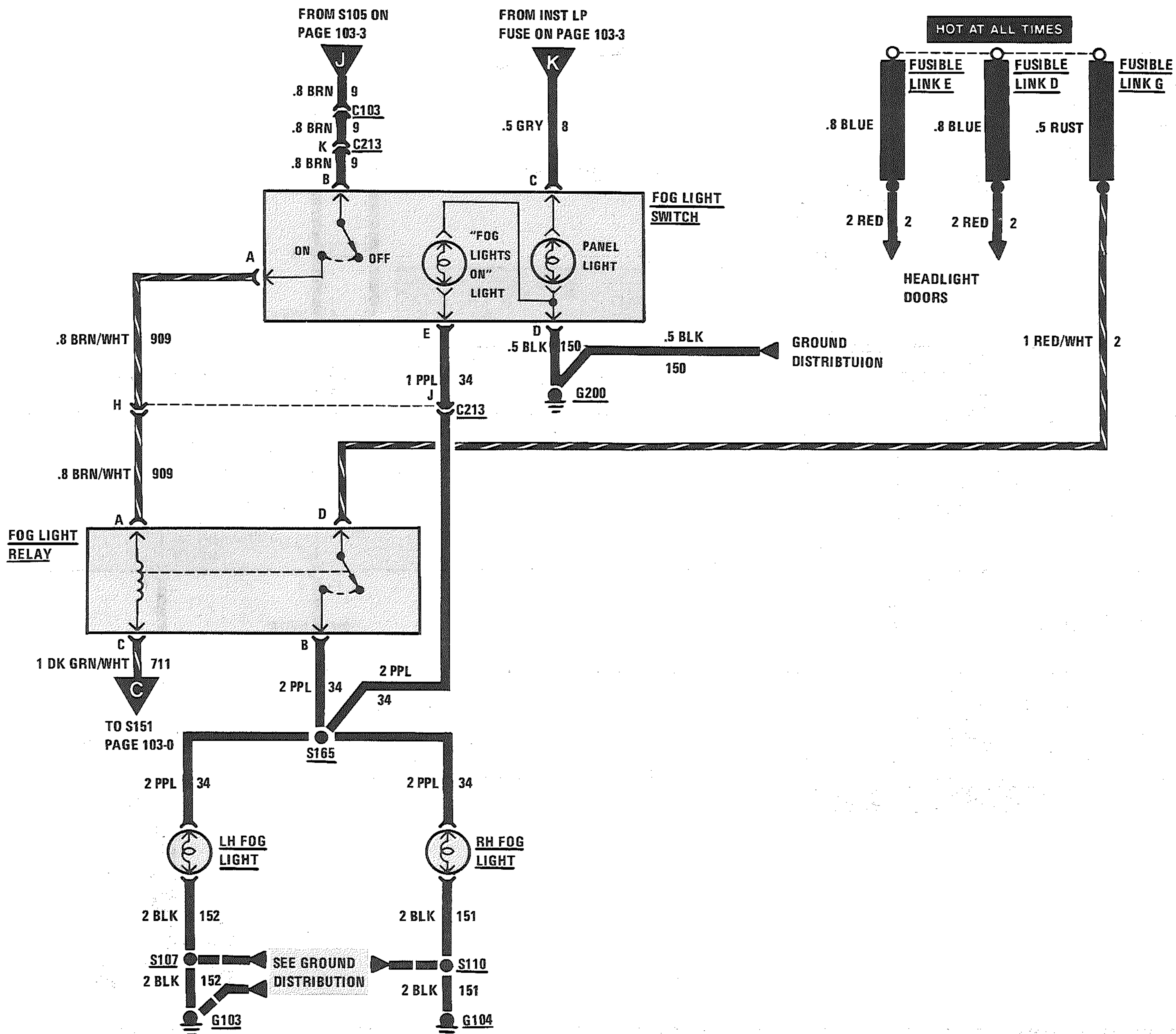
With the Headlight Dimmer Switch in HI, voltage is applied through the LT GRN wire and the matched resistance wires to the Lights Monitoring Module and to the LH and RH Hi Beam Headlights. The Hi Beam Headlights turn on. Voltage is also applied through the LT GRN wire to the Hi Beam Indicator. The Indicator lights whenever voltage is applied to the high beams.

If either of the Hi Beam Headlights is burned out, the Hi Beam Comparator detects the open high beam filament and the Driver Information Center (DIC) displays the fault.

HEADLIGHTS WITH LAMP MONITOR: FOGLIGHTS



HEADLIGHTS WITH LAMP MONITOR: FOGLIGHTS



HEADLIGHTS WITH LAMP MONITOR: FOG LIGHTS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check that the Headlights and Park Lights work properly before troubleshooting the Fog Lights.
2. If one Fog Light doesn't work, check the Fog Light, connections, and wires to the Fog Light.
3. If the Fog Light Switch is not illuminated when the Park Lights are on, check the GRY (8) wire.
4. If the FOG LIGHTS ON Light and the Panel Light do not operate, check the BLK (150) wire for an open.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the test below if the Fog Lights do not operate.**

FOG LIGHTS DO NOT OPERATE

Measure: VOLTAGE
At: FOG LIGHT RELAY CONNECTOR (Disconnected)
Conditions:
- **Light Switch: PARK**
- **Fog Light Switch: ON**

Measure Between	Correct Voltage	For Diagnosis
A (BRN/WHT) & Ground	Battery	See 1

(FOG LIGHTS DO NOT OPERATE continued on next page)

COMPONENT LOCATION

Component	Location	Page-Figure
Fog Light Relay	LH front of engine compartment, on fender	201-16-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Fusible Link A (VIN E)	Lower RH side of engine, at Starter Solenoid	201- 2-A
Fusible Link A (VIN F) (VIN 8)	Lower RH side of engine, at Starter Solenoid	201- 6-B
Fusible Link A (VIN S)	Lower RH side of engine, at Starter Solenoid	201- 1-A
Fusible Link D	Front lights harness, near LH side of dash	201-16-A
Fusible Link E	Front lights harness, near LH side of dash	201-16-A
Fusible Link G	Front lights harness, near LH side of dash	201-16-A
Remote Dimmer	RH side of steering column, on I/P retainer	201-10-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C103 (1 cavity)	In front lights harness, LH rear corner of engine compartment	201-15-C
C213 (3 cavities)	Behind LH side of I/P, near light switch	201-10-C
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
S105	Front lights harness, behind LH headlights	201-16-A
S107	Front lights harness, behind LH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S165	Forward lights harness, LH front corner of engine compartment	201-15-B
S204	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S236	I/P harness, below light switch	201-10-A

(FOG LIGHTS DO NOT OPERATE continued from previous page)

A (BRN/WHT) & C (DK GRN/WHT)	Battery	See 2
D (RED/WHT) & Ground	Battery	See 3
D (RED/WHT) & B (PPL)	Battery	See 4

- If all voltages are correct, replace the Fog Light Relay.

1. Check the Fog Light Switch and BRN (9) and BRN/WHT (909) wire for an open (see schematic).
2. Check DK GRN/WHT (711) wire for an open.
3. Check Fusible Link G and RED/WHT (2) wire for an open.
4. Check PPL (34) wire for an open.

CIRCUIT OPERATION

The Fog Lights are controlled by the Light Switch. They can be turned on with the Park or Headlights on. With the Hi Beams on, the Fog Lights go out.

The Fog Light Relay controls battery voltage to the Fog Lights. The Fog Light Switch applies voltage to the relay coil. The relay coil is grounded through the Hi Beam filaments. When the Hi Beams come on, battery voltage is at both sides of the relay coil. The relay and the Fog Lights turn off.

When the Fog Light Relay is energized, voltage is also applied to the FOG LIGHTS ON Light in the Fog Light Switch. The FOG LIGHTS ON Light is illuminated.

If the Park Lights are on, voltage is applied to the Panel Light in the Fog Light Switch. The light turns on.

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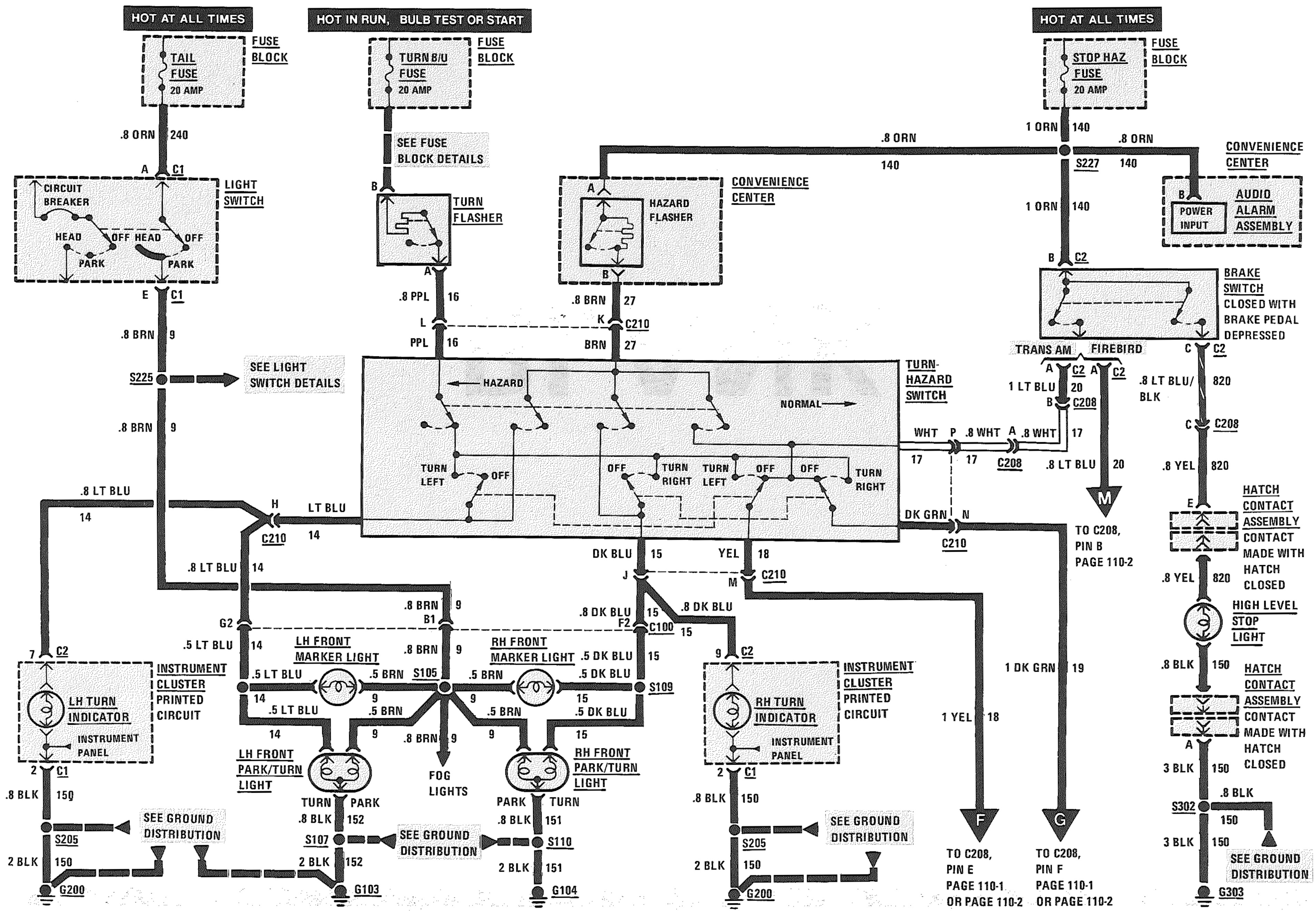
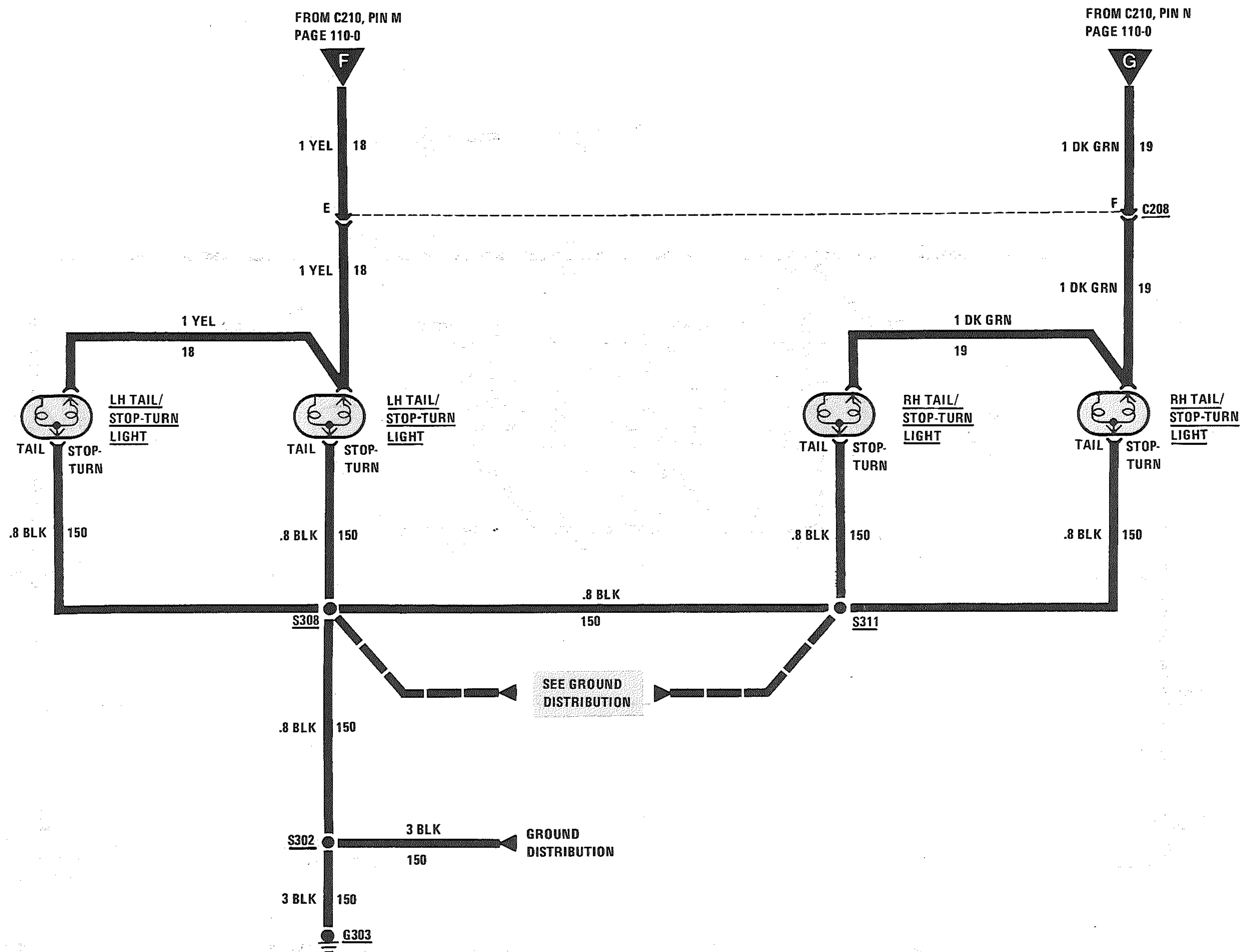
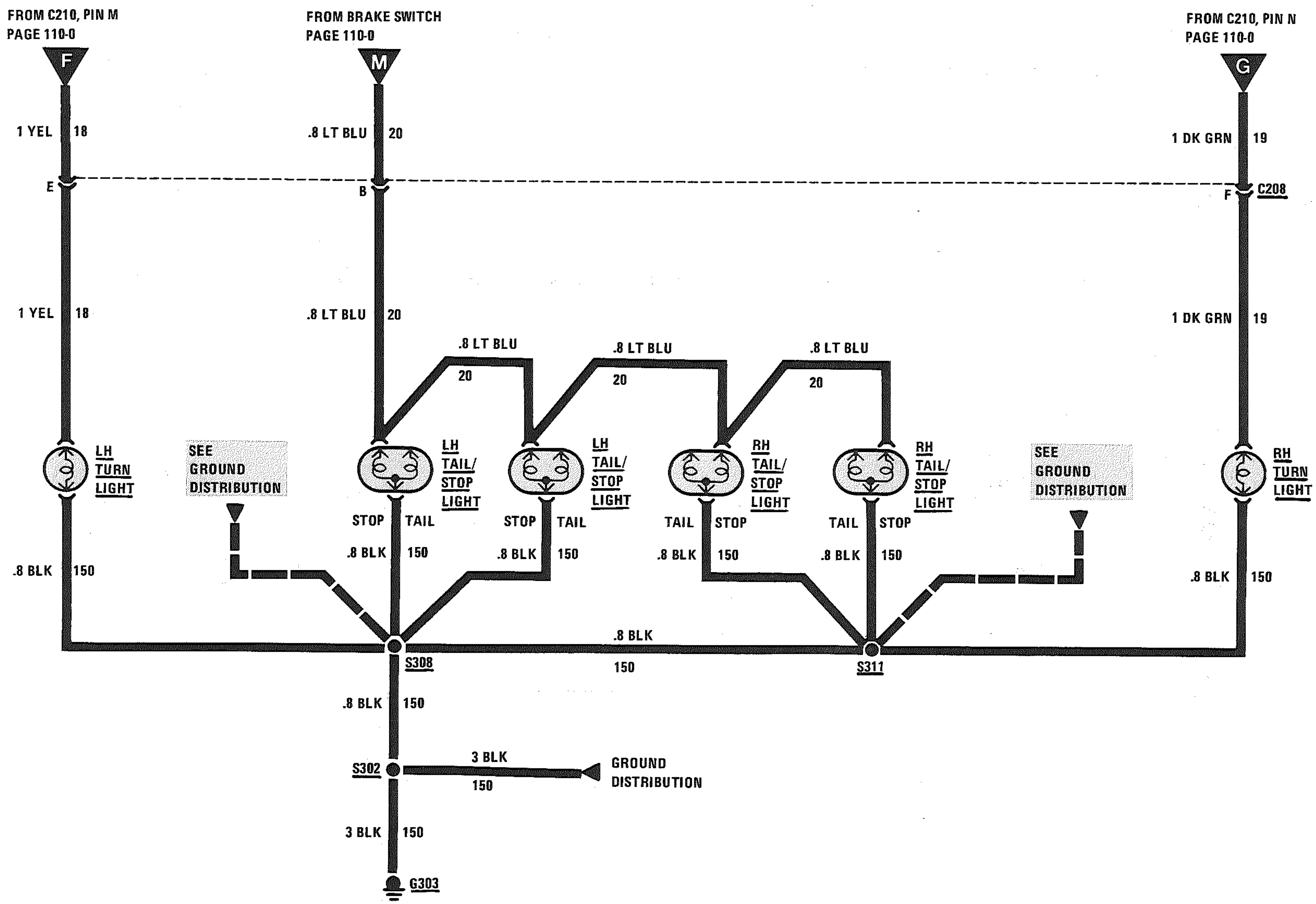
EXTERIOR LIGHTS: TURN/HAZARD/FRONT PARK/FRONT MARKER/STOP/HIGH LEVEL STOP LIGHT



EXTERIOR LIGHTS: TURN/HAZARD/STOP
TRANS AM

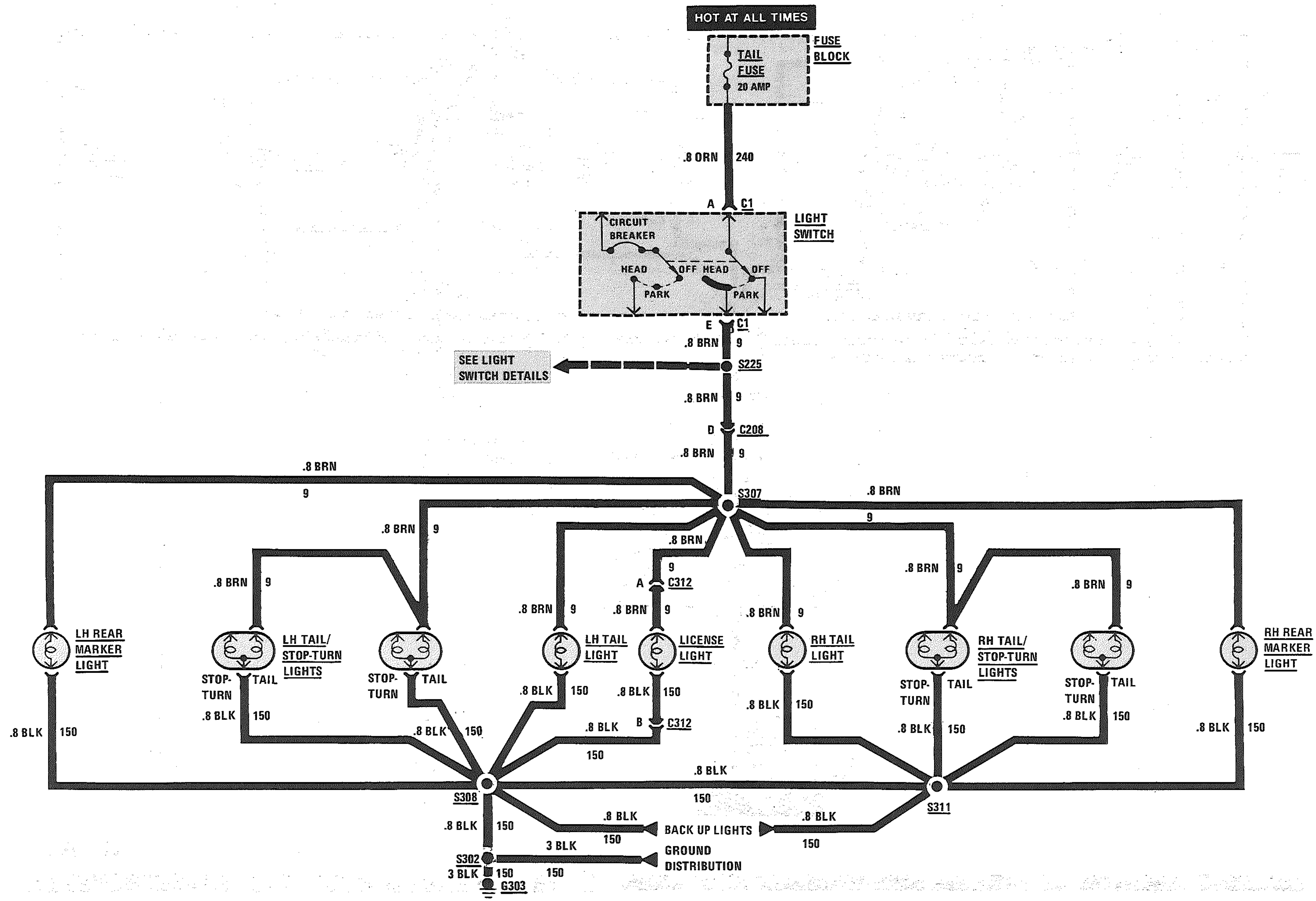


EXTERIOR LIGHTS: TURN/HAZARD/STOP
FIREBIRD

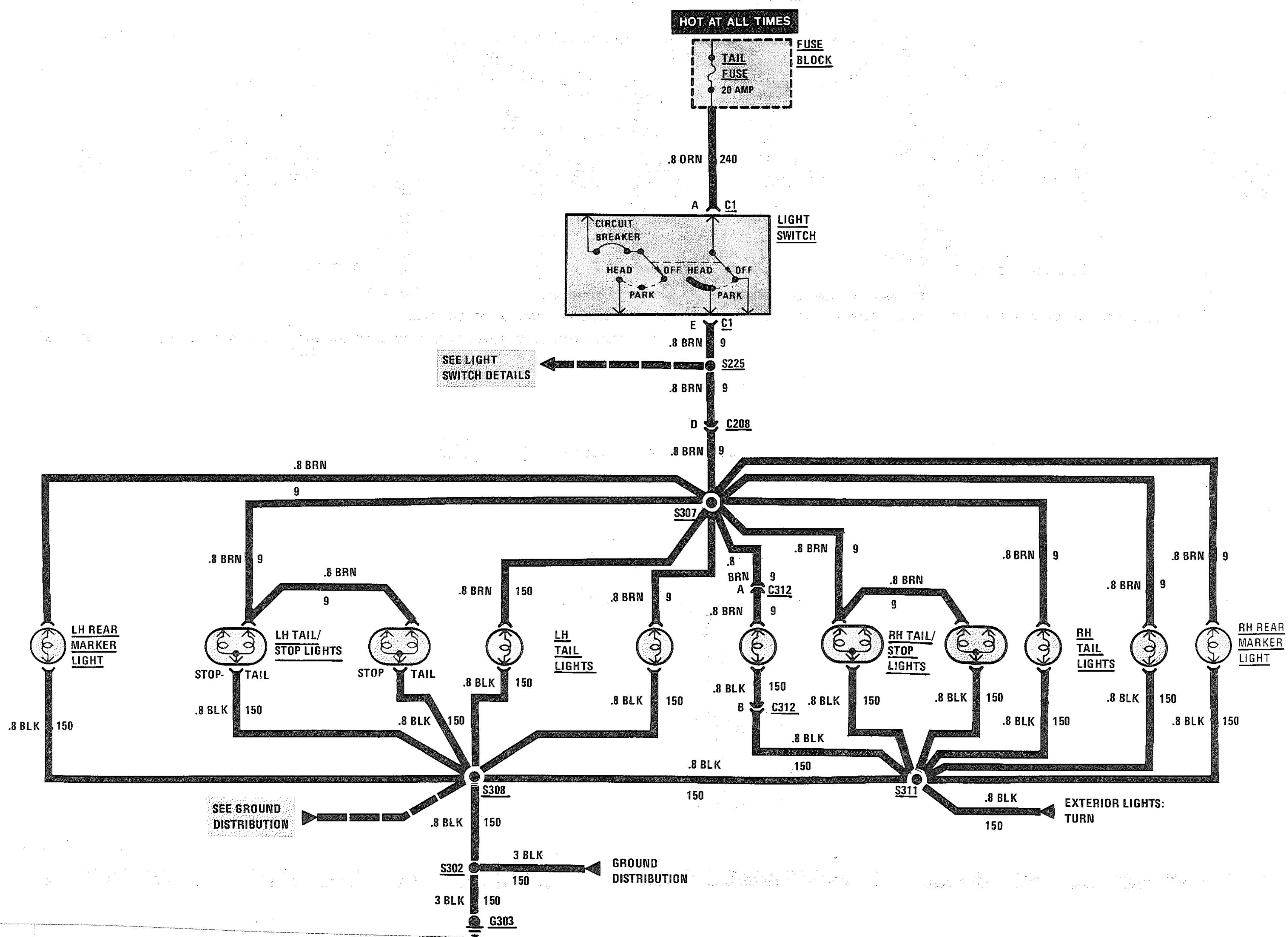


EXTERIOR LIGHTS: TAIL/REAR MARKER/LICENSE

TRANS AM



EXTERIOR LIGHTS: TAIL/REAR MARKER/LICENSE
FIREBIRD



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

Turn Lights

1. Check the TURN B/U Fuse by operating the Back Up Lights.
2. If the Turn Indicator and Front Turn Light on one side are inoperative, check the connection at C210. Replace the Turn-Hazard Switch as necessary.
3. If only some of the Turn Lights work but all of the Hazard Lights work, replace the Turn-Hazard Switch.
4. If the Turn Lights stay on (do not flash) in both Turn Left and Turn Right, replace the Turn Flasher.
5. If only one light does not light, check the bulb, socket, and related wiring (see schematic).

Stop Lights

1. Check the STOP-HAZ Fuse by operating the Hazard Lights.
2. If no Stop Lights work, check the Brake Switch and ORN (140) wire for continuity (see schematic).
3. If the Stop Lights do not turn off, adjust/replace the Brake Switch as necessary.
4. If only one light does not light, check the bulb, socket, and related wiring (see schematic).

Hazard Lights

1. Check the STOP-HAZ Fuse by operating the Stop Lights.
2. If only some of the Hazard Lights work but all of the Turn Lights work, replace the Turn-Hazard Switch.
3. If the Hazard Lights do not turn off, replace the Turn-Hazard Switch.
4. If the Hazard Lights stay on (do not flash), replace the Hazard Flasher.

COMPONENT LOCATION

Component	Location	Page-Figure
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Convenience Center	Behind I/P, to right of steering column	201-10-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Turn Flasher	Behind I/P, to right of steering column	201- 9-A
Turn/Hazard Switch	Top of steering column	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C208 (8 cavities)	Behind LH side of rear seat	201-17-C
C210 (11 cavities)	Behind I/P, on RH lower side of steering column	201- 9-A
C312 (2 cavities)	Behind rear license plate	201-17-A
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
G303	Center of end panel	201-17-B
S105	Front lights harness, behind LH headlights	201-16-A
S106	Front lights harness, LH front corner of engine compartment	201-15-B
S107	Front lights harness, behind LH headlights	201-16-A
S109	Front lights harness, left of RH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S205	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S226	I/P harness, at head of console	201-10-A
S227	I/P harness, behind instrument cluster	201-10-A
S302	Rear lights harness, LH side of end panel	201-17-B
S307	Rear lights harness, LH rear corner of cargo compartment	201-17-B
S308	Rear lights harness, behind LH rear lights	201-17-A
S311	Rear lights harness, left of RH back up lights	201-17-A

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Park/Marker/Tail/License Lights

1. If the Park, Marker and Tail Lights do not work, check the Tail Fuse, Light Switch, and BRN (9) wires for continuity (see schematic).
2. If the Front Marker and the Park Lights do not work, check the connection at C100 and related wiring (see schematic).
3. If the Park Lights do not turn off, replace the Light Switch.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Turn Lights do not work, but Hazard Lights work	A: Turn Lights Test
Hazard Lights do not work, but Stop Lights work	B: Hazard Lights Test
Stop Lights do not work, but Turn Signals work	C: Stop Lights Test
Stop-Turn Lights on one or both sides do not work	C: Stop Lights Test

A: TURN LIGHTS TEST

Connect: TEST LAMP
At: CONNECTOR C210 (Connected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
L (PPL) & Ground	Test Lamp lights	See 1

- If test lamp lights, replace the Turn-Hazard Switch.

1. Check Turn Flasher and PPL (16) wire for an open.

B: HAZARD LIGHTS TEST (TABLE 1)

Connect: FUSED JUMPER
At: CONVENIENCE CENTER
Conditions:
- **Hazard Flasher: REMOVED**
- **Hazard Switch: HAZARD**

Jumper Between	Correct Result	For Diagnosis
A (ORN) & B (BRN)	All Turn Lights turn on	See 1

- If the result is correct, replace the Hazard Flasher.

1. Go to Table 2.

B: HAZARD LIGHTS TEST (TABLE 2)

Measure: VOLTAGE
At: CONNECTOR C210 (Disconnected)
Condition:
- **Hazard Flasher: CONNECTED**

Measure Between	Correct Voltage	For Diagnosis
K (BRN) & Ground	Battery	See 1

- If the voltage is correct, replace the Turn-Hazard Switch.

1. Check ORN (140) and BRN (27) wires for an open.

C: STOP LIGHTS TEST

Connect: TEST LAMP
At: C208 (Female Half) (Disconnected)
Condition:
- **Brake Pedal: DEPRESSED and HELD**

Connect Between	Correct Result	For Diagnosis
B (LT BLU) & Ground	Test Lamp lights	See 1
C (LT BLU/BLK) & Ground	Test Lamp lights	See 2

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- If the results are correct for the Trans AM, check WHT (17) wire to the Turn-Hazard Switch. Replace the Turn-Hazard Switch if the wiring is OK and the Rear Turn Lights light; for the Firebird, check the bulb, socket, and related wiring (see schematic).

1. **Check the Brake Switch, LT BLU (20) and ORN (140) wires for continuity. Repair/replace as necessary.**
2. Check the Brake Switch, ORN (140) and LT BLU (820) wires for continuity. Repair/replace as necessary.

CIRCUIT OPERATION

Turn Lights

With the Ignition Switch in RUN, BULB TEST, or START, voltage is applied through the TURN B/U Fuse and Turn Flasher to the normally closed pole of the Hazard Switch in the Turn-Hazard Switch.

With the Turn Switch in TURN LEFT position, voltage is applied from the Turn Switch through the LT BLU wires to the LH Turn Indicator and the LH Front Park/Turn Light. Voltage is applied through the YEL wires to the LH Rear Turn Lights. The lights go on immediately. They begin to flash when the current flow heats up the timing element in the flasher and it repeatedly opens and closes the circuit.

When voltage is applied to the LH Front Park/Turn Light, voltage will also be applied to the LH Front Marker Light. If the Light Switch is OFF, current will flow to ground through S105 and the many lights connected in parallel to ground. These lights provide low resistance paths to ground. The Marker Light will flash with the Turn Lights. The lights used for the ground path will not flash, however, since the voltage drop across the Marker Light is much higher than that across the other lights.

When the Light Switch is in either PARK or HEAD, voltage is applied through the Tail Fuse, Light Switch, and S105 to the Marker and Park Lights. If the Turn-Hazard Switch is in TURN LEFT, the LH Front Marker Light has battery voltage at both terminals and goes out. When the flasher stops supplying voltage to the Turn Light, the Marker Light is grounded through the Turn Light and goes on. In this way, the LH Front Marker flashes on when the LH Front Park/Turn Light goes off, and off when the Turn Light goes on.

With the Turn-Hazard Switch in TURN RIGHT, the circuit operation is similar.

Hazard Lights

Voltage is applied at all times through the STOP-HAZ Fuse and the Hazard Flasher to the normally open poles of the Hazard Switch in the Turn-Hazard Switch. With the Hazard Switch in HAZARD, current flows through the assembly using all four paths used by both Front and Rear Turn Lights. All of the Turn Lights and both Turn Indicators flash on and off.

The Front Marker Lights flash in HAZARD, just as they did in TURN RIGHT and TURN LEFT. If the Light Switch is in OFF, they flash on when the Hazard Lights are on. If the Light Switch is in either PARK or HEAD, they flash on when the Hazard Lights are off, and off when the Hazard Lights are on.

In HAZARD, the turn circuit is always open, and the Hazard Flasher controls the lights.

Stop Lights

Voltage is applied at all times through the STOP HAZ Fuse to the Brake Switch. When the brake pedal is depressed, the contacts in the Brake Switch close.

The Trans Am Stop Lights receive voltage through the WHT wires that feed the Turn-Hazard Switch. With the switches in the positions shown in the schematic, the Stop Lights are connected to the WHT wire through the YEL and DK GRN wires and the turn switches. They will come on when the Brake Switch is closed. The Firebird Stop Lights are connected directly to the Brake Switch.

For the High Level Stop Light, voltage is applied directly from the Brake Switch to the High Level Stop Light.

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Front Park Lights

The Front Park Lights can be lit by putting the Light Switch either in PARK or in HEAD.

With the Park Lights or Headlights on, battery voltage is provided through the BRN wires to both Park Lights. The path to ground for the Park Lights is G103 (LH) or G104 (RH).

The Park Lights will not flash when the turn signal is on, they will have a steady glow.

Front Marker Lights

The Front Marker Lights can be lit by the Park Lights or the Turn Lights. Neither of the two wires to each of the marker bulbs is a ground wire.

With the Park Lights on, battery voltage is supplied through the BRN wires to both Marker Lights. The path to ground for the marker bulbs is through the Turn Lights. The small Marker Light bulbs light up, but not the larger turn bulbs.

When the Turn Lights are on, but not the Park Lights, battery voltage is applied through the BLU wires to the Marker Lights. They glow since they are grounded through the entire Park Light system. As before, the small marker bulbs light up, but not all the parking bulbs.

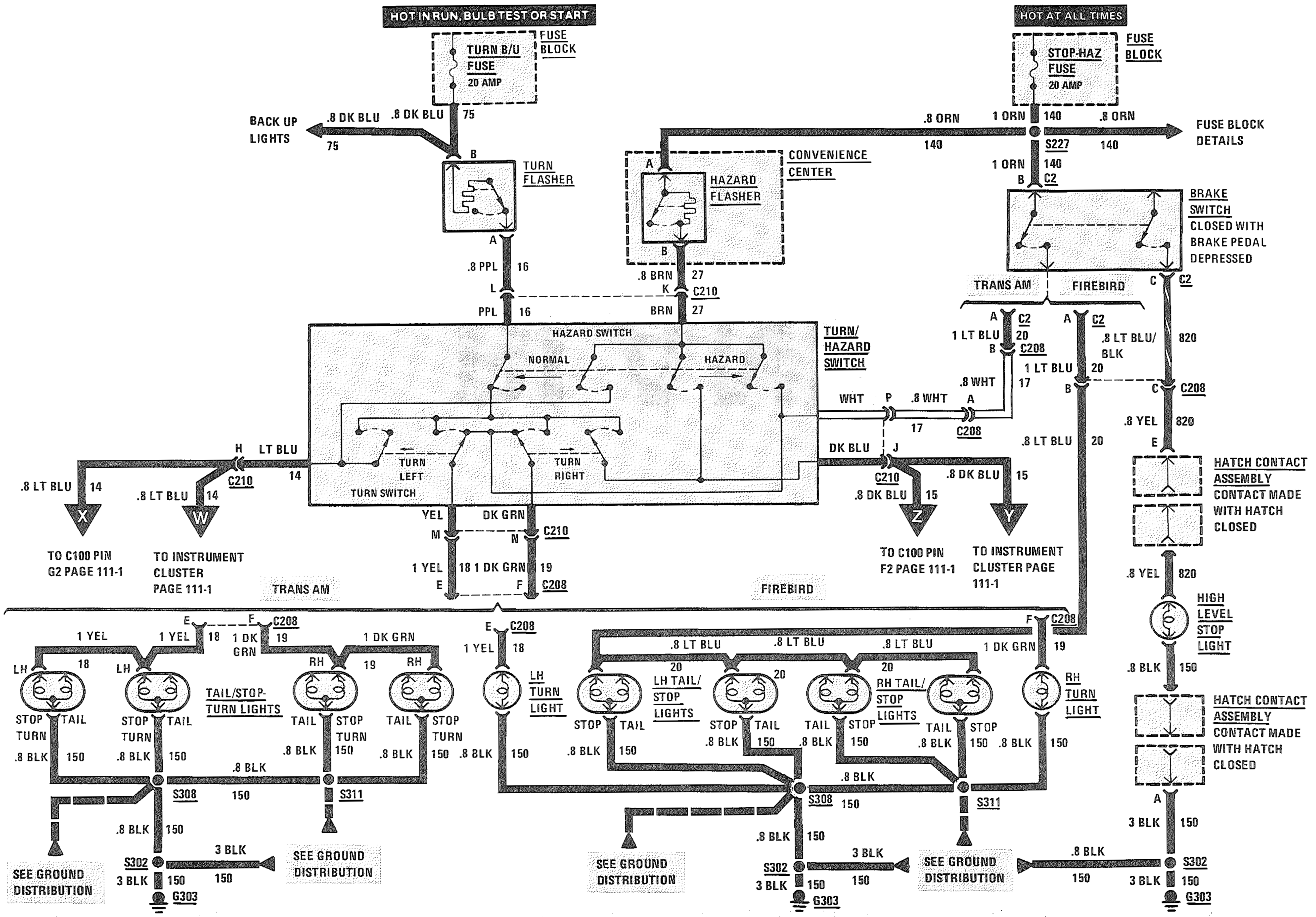
If both the Park Lights and a set of Turn lights are on at the same time, the marker bulb for that side will not light up. With battery voltage on both sides of a bulb, it will not glow. When the Turn Lights flash off, however, the marker bulb on that side will come on since it is now grounded through the Turn Lights. This circuit makes the turn and marker bulbs flash out of step with each other when the Park Lights are on.

License, Tail, or Rear Marker Lights

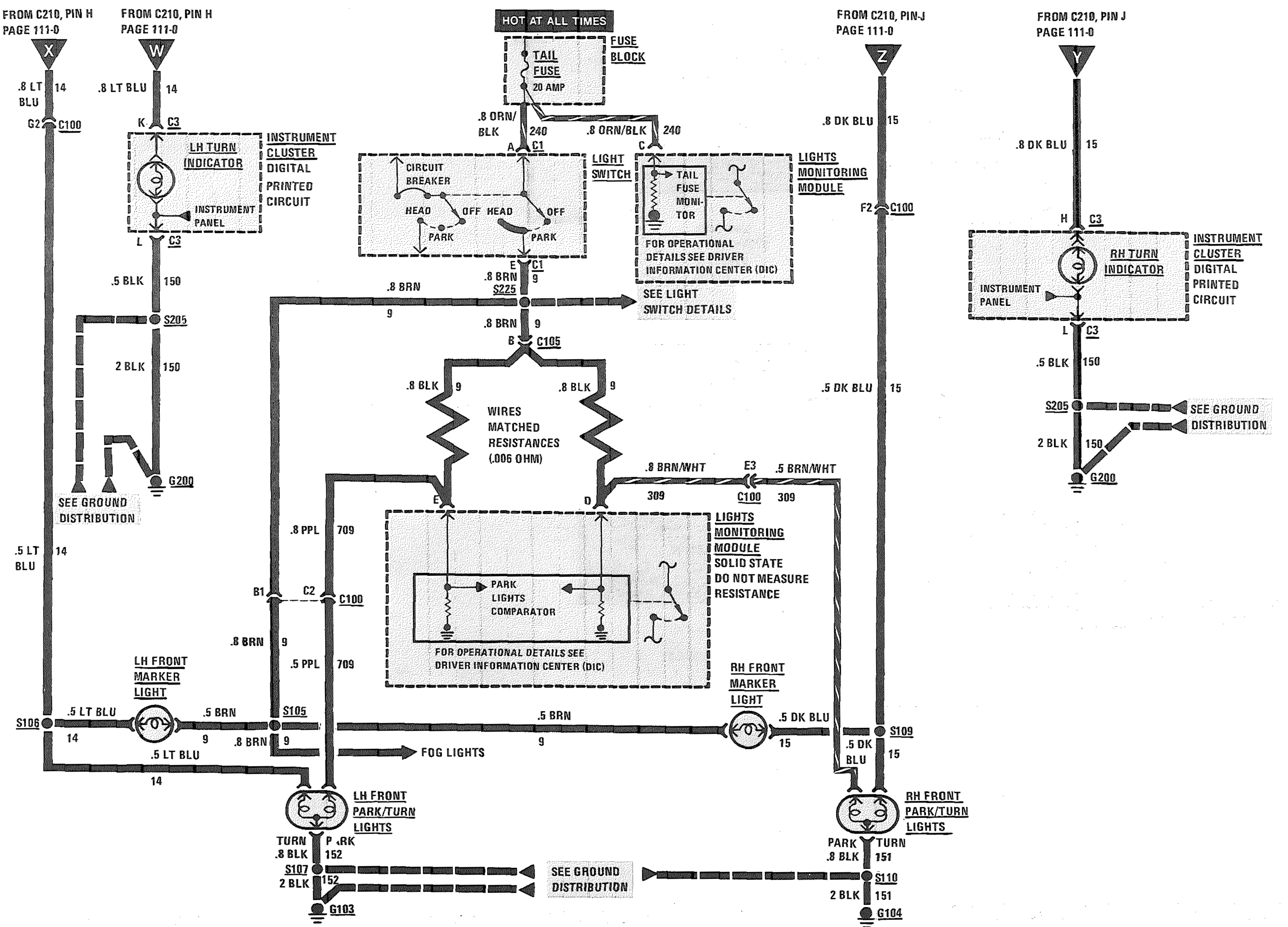
Voltage is applied through the Tail Fuse to the Light Switch at all times. With the Light Switch in PARK or HEAD, voltage is applied through the fuse and the Light Switch to all of the lights in this circuit.

BLANK

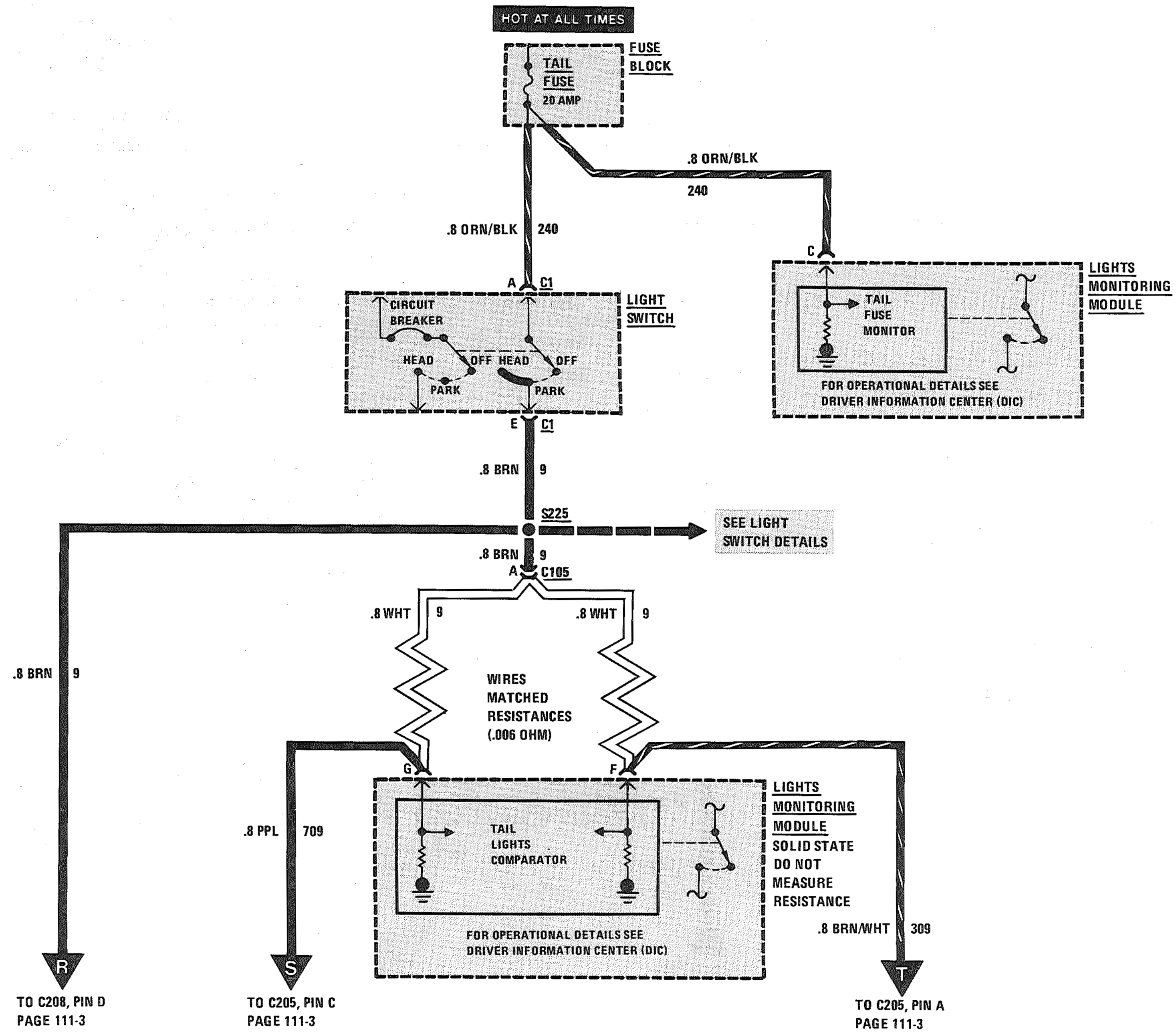
EXTERIOR LIGHTS WITH LAMP MONITOR: TURN/HAZARD/STOP/FRONT PARK/FRONT MARKER/ HIGH LEVEL STOP LIGHT



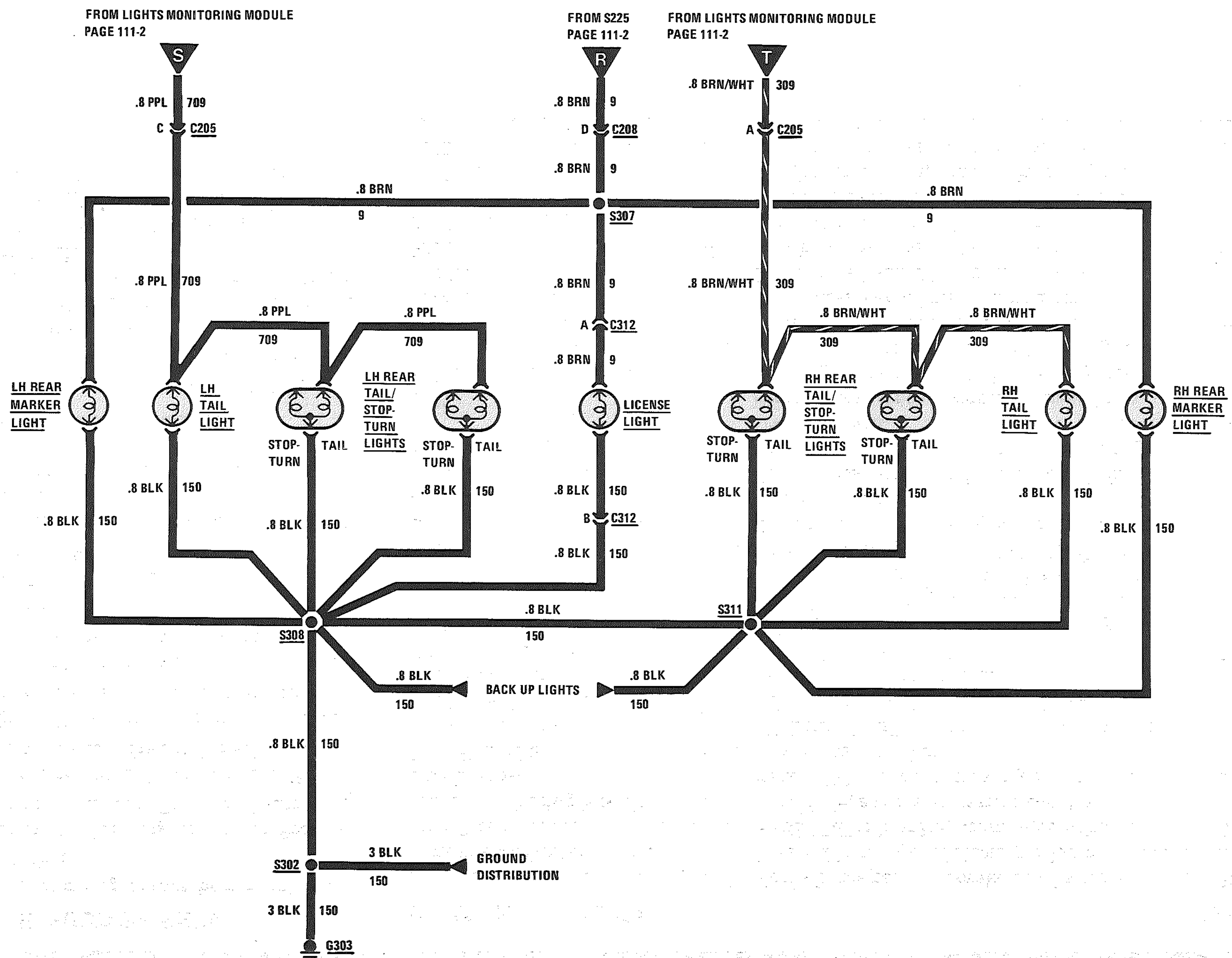
EXTERIOR LIGHTS WITH LAMP MONITOR: TURN/HAZARD/FRONT PARK/FRONT MARKER



EXTERIOR LIGHTS WITH LAMP MONITOR: TAIL/REAR MARKER/LICENSE



EXTERIOR LIGHTS WITH LAMP MONITOR: TAIL/REAR MARKER/LICENSE



EXTERIOR LIGHTS WITH LAMP MONITOR

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. If neither the Turn Lights nor the Back Up Lights work, check the TURN B/U Fuse.
2. If neither the Stop Lights nor the Hazard Lights work, check the STOP-HAZ Fuse.
3. If only one light does not operate, check bulb, socket, and related wiring (see schematic).
4. If one of the Turn Indicators goes on when the Park Lights are turned on, check the Front Turn Light on that side.
5. For any of the following symptoms, replace the Turn-Hazard Switch:

- Some Turn Lights work and all Hazard Lights work.
- Some Hazard Lights work and all Turn Lights work.
- Hazard Lights do not turn off.

6. If the Turn Lights stay on (do not flash) in both TURN LEFT and TURN RIGHT, replace the Turn Flasher.
7. If the Hazard Lights stay on (do not flash) in HAZARD, but the Stop Lights go off normally, replace the Hazard Flasher.
8. If no Park, Tail, or License Lights work, check the Light Switch, and the ORN/BLK (240) and BRN (9) wires for an open (see schematic).

COMPONENT LOCATION

		Page-Figure
Brake Switch	Above brake pedal, on brake pedal support	201- 9-A
Convenience Center	Behind I/P, to right of steering column	201-10-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Lights Monitoring Module	Behind I/P, at base of steering column	
Turn Flasher	Behind I/P, to right of steering column	201- 9-A
Turn/Hazard Switch	Top of steering column	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C105 (2 cavities)	Behind LH side of I/P, near fuse block	
C205 (3 cavities)	Behind LH side of rear seat	201-17-C
C208 (8 cavities)	Behind LH side of rear seat	201-17-C
C210 (11 cavities)	Behind I/P, on RH lower side of steering column	201- 9-A
C312 (2 cavities)	Behind rear license plate	201-17-A
G103 (Except VIN E)	On radiator support, behind LH headlights	201-16-A
G104	On radiator support, behind RH headlights	201-16-A
G200	Behind I/P, left of steering column	201-10-A
G303	Center of end panel	201-17-B
S105	Front lights harness, behind LH headlights	201-16-A
S106	Front lights harness, LH front corner of engine compartment	201-15-B
S107	Front lights harness, behind LH headlights	201-16-A
S109	Front lights harness, left of RH headlights	201-16-A
S110	Front lights harness, behind RH headlights	201-16-A
S205	I/P harness, behind instrument cluster	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S227	I/P harness, behind instrument cluster	201-10-A
S302	Rear lights harness, LH side of end panel	201-17-B
S307	Rear lights harness, LH rear corner of cargo compartment	201-17-B
S308	Rear lights harness, behind LH rear lights	201-17-A
S311	Rear lights harness, left of RH back up lights	201-17-A

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9. If the Stop Lights stay on without the brake pedal pressed, adjust/replace the Brake Switch.
10. If the Park Lights do not turn off, replace the Light Switch.
11. If only the High Level Stop Light does not work, check the Brake Switch, High Level Stop Light, the LT BLU/BLK and YEL (820) wires, and the BLK (150) wires for an open.
12. If a Turn Indicator lights steadily (does not flash) when the Turn Signal is on, check the Turn Lights on that side.

- **Go to System Diagnosis for diagnostic tests.**

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: The Turn Lights do not work, but the Hazard Lights work
B: The Hazard Lights do not work, but the Stop Lights and Turn Lights work
C: The Stop Lights do not work, but the Turn Signals work
D: The Rear Turn Lights on one or both sides do not work
E: The Front Turn Light and Turn Indicator on one or both sides do not light

A: THE TURN LIGHTS DO NOT WORK, BUT THE HAZARD LIGHTS WORK

Connect: TEST LAMP
At: CONNECTOR C210 (Connected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis of Incorrect Results
L (PPL) & Ground	Test Lamp lights	See 1

- If the test lamp lights, replace the Turn-Hazard Switch.

1. Check the Turn Flasher, Turn B/U Fuse, and the DK BLU (75) and PPL (16) wires for an open (see schematic).

B: THE HAZARD LIGHTS DO NOT WORK, BUT THE STOP LIGHTS AND TURN LIGHTS WORK (TABLE 1)

Connect: FUSED JUMPER
At: CONVENIENCE CENTER (Disconnected)
Conditions:
- **Hazard Flasher: REMOVED**
- **Hazard Switch: HAZARD**

Jumper Between	Correct Result	For Diagnosis of Incorrect Results
B (BRN) & A (ORN)	All the Turn Lights light	See 1

- If the result is correct, replace the Hazard Flasher.

1. Go to Table 2.

B: THE HAZARD LIGHTS DO NOT WORK, BUT THE STOP LIGHTS AND TURN LIGHTS WORK (TABLE 2)

Connect: TEST LAMP
At: CONNECTOR C210 (Connected)

Connect Between	Correct Result	For Diagnosis of Incorrect Results
K (BRN) & Ground	Test Lamp lights	See 1

- If the result is correct, replace the Turn-Hazard Switch.

1. Check the ORN (140) and BRN (27) wires for an open (see schematic).

C: THE STOP LIGHTS DO NOT WORK, BUT THE TURN SIGNALS WORK

Connect: TEST LAMP
At: CONNECTOR C208 (Connected)
Condition:
- **Brake Pedal: DEPRESSED**

Connect Between	Correct Result	For Diagnosis of Incorrect Results
B (LT BLU) & Ground	Test Lamp lights	See 1

- If the test lamp lights, with Trans Am, check WHT (17) wire for an open, then replace Turn/Hazard Switch if WHT wire is good. With Firebird, check LT BLU (20) wire for an open (See schematic).

1. Check/adjust the Brake Switch, and check the WHT (17) and ORN (140) wires for an open (see schematic).

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D: THE REAR TURN LIGHTS ON ONE OR BOTH SIDES DO NOT WORK

Connect: TEST LAMP
At: CONNECTOR C210 (Connected)
Condition:
- **Brake Pedal: DEPRESSED**

Connect Between	Correct Result	For Diagnosis of Incorrect Results
M (YEL) & Ground	Test Lamp lights	See 1
N (DK GRN) & Ground	Test Lamp lights	See 1

- If both results are correct, check the YEL (18) or DK GRN (19) wire for an open.

1. Replace the Turn-Hazard Switch.

E: THE FRONT TURN LIGHT AND TURN INDICATOR ON ONE OR BOTH SIDES DO NOT LIGHT

Connect: TEST LAMP
At: CONNECTOR C210 (Connected)
Conditions:
- **Hazard Switch: HAZARD**
- **Brake Pedal: DEPRESSED**

Connect Between	Correct Result	For Diagnosis of Incorrect Results
H (LT BLU) & Ground	Test Lamp lights	See 1
J (DK BLU) & Ground	Test Lamp lights	See 1

- If both results are correct,check the LT BLU (14) or DK BLU (15) wire for an open (see schematic).

1. Replace the Turn-Hazard Switch.

CIRCUIT OPERATION

Turn Lights

With the Ignition Switch in RUN, BULB TEST, or START, voltage is applied through the TURN B/U Fuse and the Turn Flasher to the Turn/Hazard Switch. With the switch in TURN LEFT, voltage is applied to the LH Turn Lights and Turn Indicator. The current through the bulbs heats the Turn Flasher. It opens and closes to flash the left turn lights.

The right turn lights operate in a similar way when the turn light switches are closed to the right.

Stop Lights

Voltage is applied directly from the Brake Switch to the High Level Stop Light when the Brake pedal is depressed.

The lower Stop Lights receive voltage through the WHT wire that feeds the Turn/Hazard Switch. With the switches in the positions shown in the schematic, the WHT wire is connected through the Turn Switch and the YEL and DK GRN wires to the Stop Lights. They come on when the Brake Switch is closed.

Front Marker Lights

The Front Marker Lights can be lit by either the Park Lights or the Turn Lights. Neither of the two wires to each of the marker bulbs is a ground wire.

With the Park Lights on, battery voltage is supplied through the BRN wires to both Marker Lights. The path to the ground for the marker bulbs is through the Turn Lights. The small Marker Light bulbs light up, but not the larger turn bulbs.

When the Turn Lights are on, but not the Park Lights, battery voltage is applied through the BLU wires to the Marker Lights. They glow since they are grounded through the entire Park Light system. As before, the small marker bulbs light up, but not all the parking bulbs.

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If both the Park Lights and a set of Turn Lights are on at the same time, the marker bulb for that side will not light up. With battery voltage on both sides of a bulb, it will not glow. When the Turn Lights flash off, however, the marker bulb on that side will come on since it is now grounded through the Turn Lights. This circuit makes the turn and marker bulbs flash out of step with each other when the Park Lights are on.

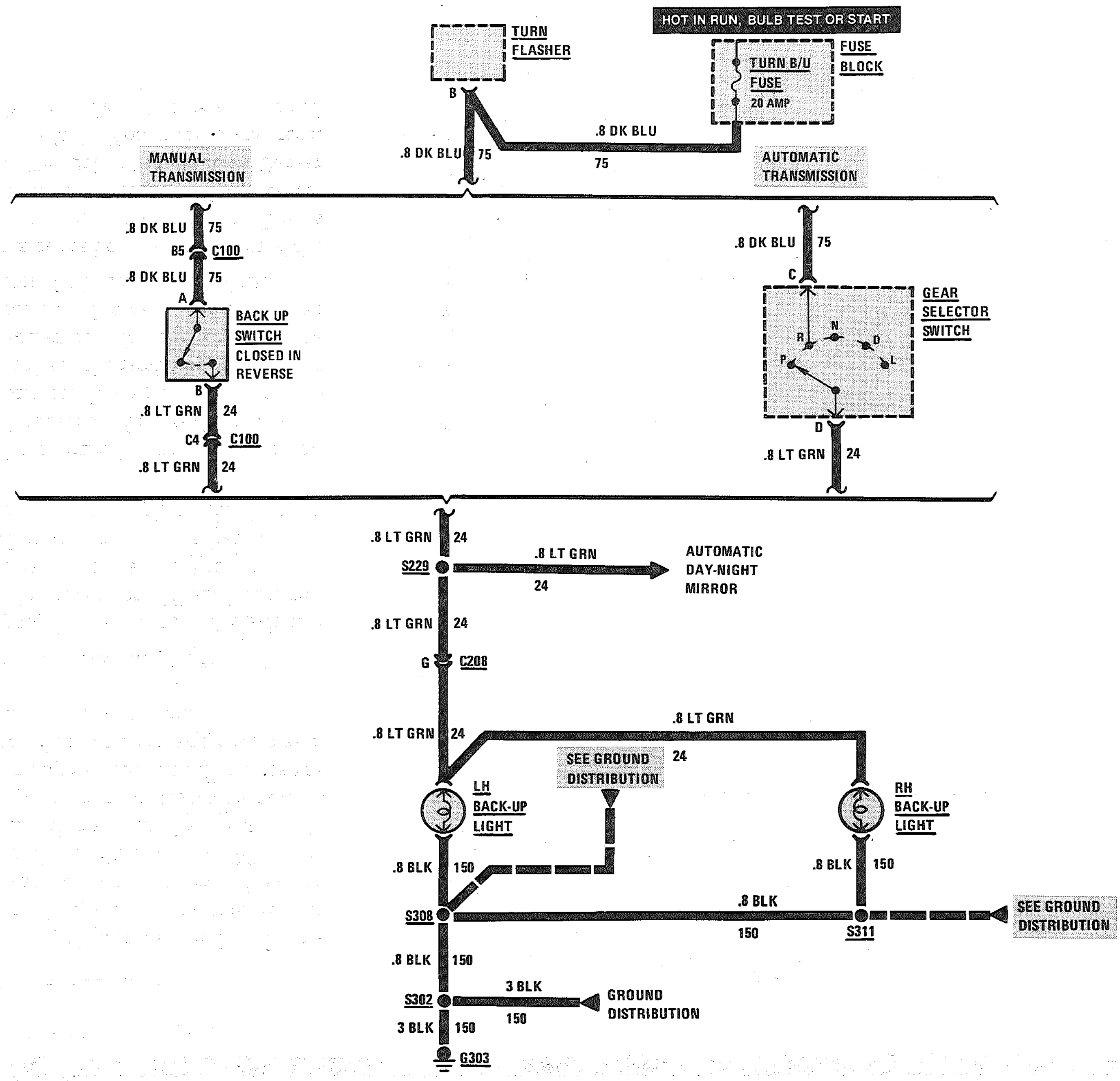
Park, Tail, Marker, and License Lights

Voltage is applied at all times through the Tail Fuse to the Light Switch. When the switch is closed, voltage is applied to the Exterior Lights. All the Front Park and Marker Lights, Rear Marker Lights, Tail Lights, and License Lights light.

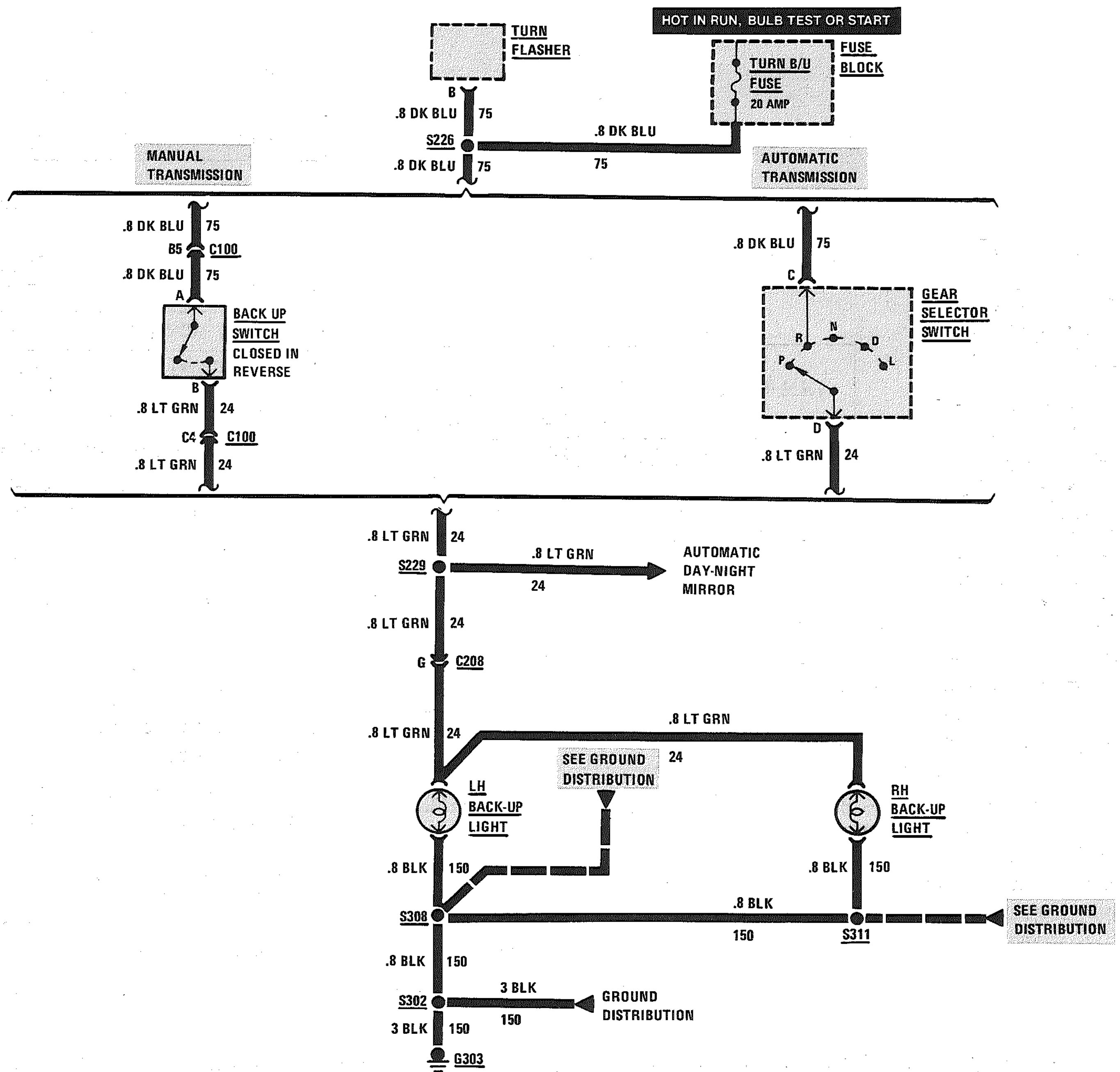
If one of the Front Park Lights is burned out, the Park Light Comparator detects the open park light filament, and the Driver Information Center (DIC) displays the fault. Similarly, if one of the Tail Lights is burned out, the Tail Lights Comparator detects the open filament, and the Driver Information Center (DIC) displays the fault.

If a Tail Light is burned out on both sides of the vehicle for the same comparator in the Lights Monitoring Module, the module will not detect the malfunction. The Driver Information Center will not display the fault. The module will react the same if both Front Park Lights are burned out.

BACK UP LIGHTS
WITH DIGITAL CLUSTER



BACK UP LIGHTS
WITHOUT DIGITAL CLUSTER



BACK UP LIGHTS

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the TURN B/U Fuse by operating the Turn Flasher.
2. If only one Back Up Light does not operate, check bulb, socket, and related wiring.
3. If the Back Up Lights go on or off in the wrong gear, adjust the Gear Selector (Automatic) or Back Up (Manual) Switch.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Turn the Ignition Switch to RUN, and move the Gear Shift to any gear except REVERSE	Back Up Lights are off
Move the Gear Shift to REVERSE	Back Up Lights come on
Move the Gear Shift to any gear except REVERSE	Back Up Lights go off

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Back Up Switch	On LH side of transmission	201- 8-F
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Turn Flasher	Behind I/P, to right of steering column	201- 9-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C208 (8 cavities)	Behind LH side of rear seat	201-17-C
G303	Center of end panel	201-17-B
S229	I/P harness, behind LH side of I/P	201-10-A
S302	Rear lights harness, LH side of end panel	201-17-B
S308	Rear lights harness, behind LH rear lights	201-17-A
S311	Rear lights harness, left of RH back up lights	201-17-A

SYSTEM DIAGNOSIS

- **Diagnostic steps for the symptoms listed in the following table are listed after the table.**

SYMPTOM TABLE

A: Back Up Lights do not operate
B: Back Up Lights light in PARK or NEUTRAL

A: BACK UP LIGHTS DO NOT OPERATE

Measure: VOLTAGE
At: GEAR SELECTOR SWITCH (Automatic) or BACK UP SWITCH (Manual) (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Gear Shift: REVERSE**

Measure Between	Correct Voltage	For Diagnosis
DK BLU & Ground	Battery	See 1

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BACK UP LIGHTS

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DK BLU & LT GRN	Battery	See 2

- If the above voltages are correct, adjust/replace the switch as necessary.

1. Check DK BLU (75) wire and the TURN B/U Fuse.
2. Check LT GRN (24) wire and sockets for an open.

B: BACK UP LIGHTS LIGHT IN PARK OR NEUTRAL

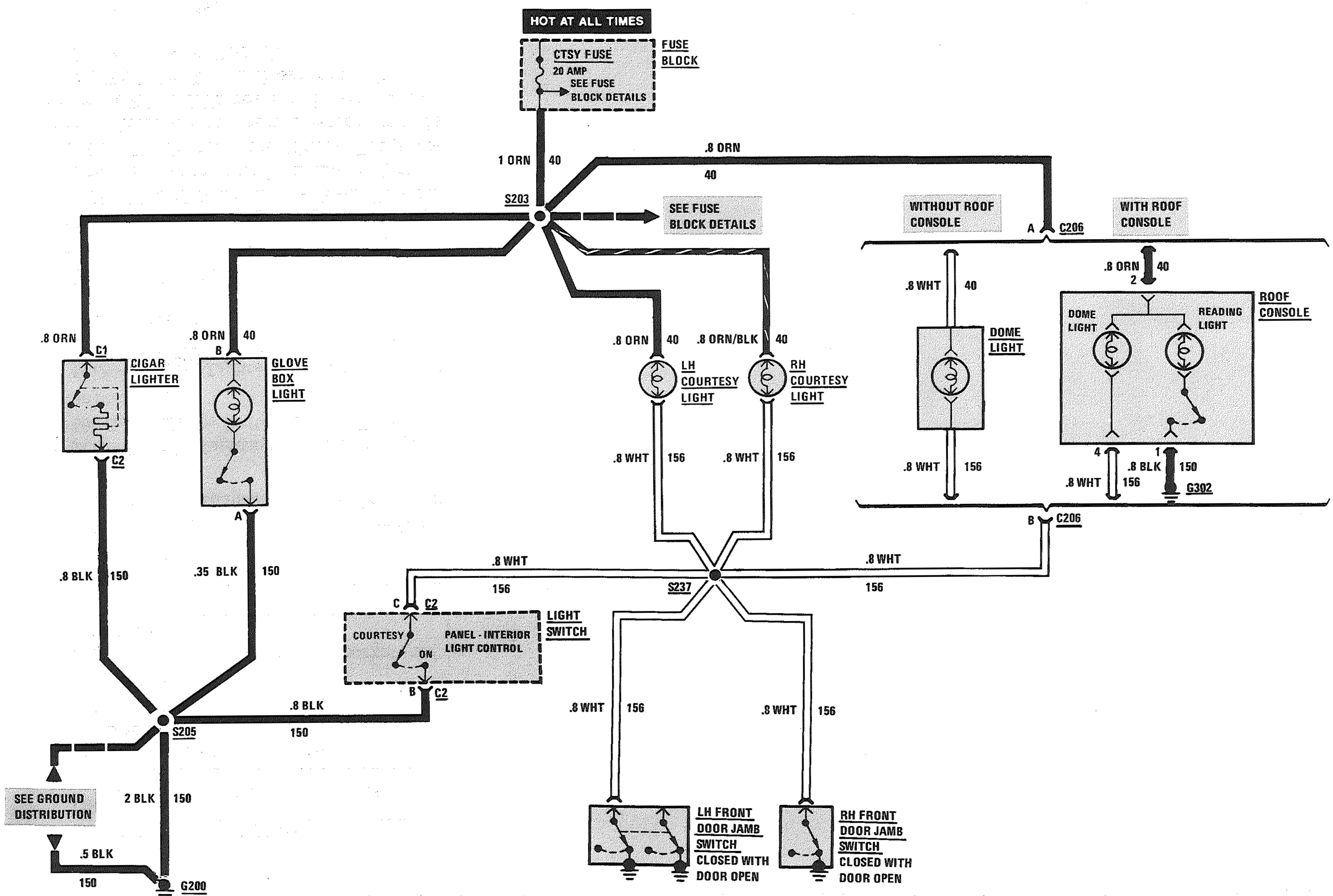
Remove the connector from the Gear Selector Switch (Automatic) or Back Up Switch (Manual).

- If the Back Up Lights go out, adjust/replace the Gear Selector Switch or Back Up Switch as necessary.
- If the Back Up Lights do not go out, check LT GRN (24) wires and sockets for a short to battery voltage.

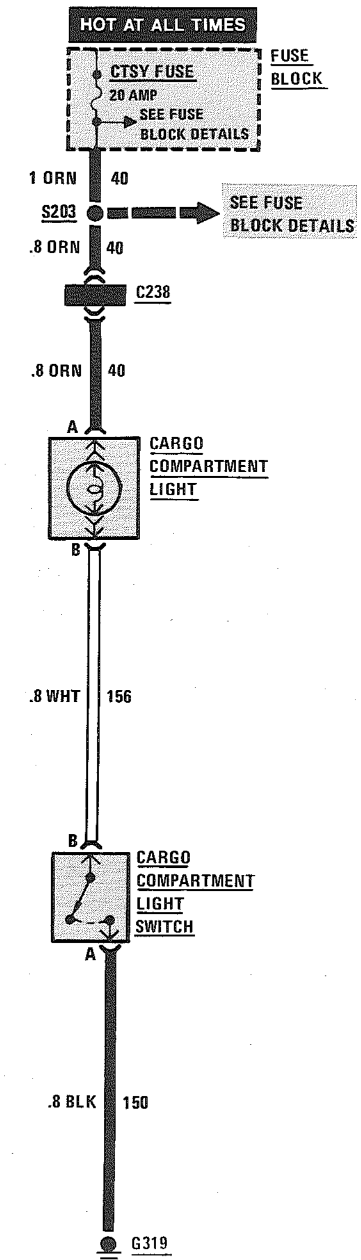
CIRCUIT OPERATION

With the Ignition Switch in RUN, BULB TEST or START, voltage is applied through the TURN B/U Fuse to the Gear Selector Switch (with Automatic Transmission), or to the Back Up Switch (with Manual Transmission). Whenever the gear selector lever is shifted to REVERSE, the Gear Selector Switch or the Back Up Switch closes, and voltage is applied to the Back Up Lights.

INTERIOR LIGHTS: DOME/READING/COURTESY/GLOVE BOX AND CIGAR LIGHTER



INTERIOR LIGHTS: CARGO COMPARTMENT LIGHT



TROUBLESHOOTING HINTS

- **Try the following checks.**
- **Check CTSY Fuse if none of the Interior Lights operate.**

Dome/Reading/Courtesy Lights

1. If the Panel/Interior Light Control does not operate the Interior lights but the lights turn on with any door open, check the Light Switch, WHT (156) and BLK (150) wires for continuity (see schematic).
2. If the Interior Lights do not come on with only one door open, check the WHT (156) wire and suspect Door Jamb Switch for continuity. Repair/replace as necessary.
3. If the Dome Light comes on but the Reading Light(s) do not, repair/replace the Reading Light(s) as necessary.
4. If the Dome and Reading Lights do not light but the RH and LH Courtesy Lights do, check connection at C206 and related wiring (see schematic).
5. If the Dome Lights do not light when the Panel Interior Light Control is turned to ON but do light with any door open, check connection at C206 and related wiring for continuity (see schematic).
6. If the RH and LH Courtesy Lights do not light with any door open but do light when the Panel Interior Light Control is turned ON, check related wiring for continuity (see schematic).
7. If only one light does not operate, check bulb, socket and related wiring (see schematic).
8. If the Courtesy Lights do not turn off, check the Panel Interior Light Control, Door Jamb Switches and WHT (156) wires for a short to ground.

Glove Box Light Console/Cigar Lighter

1. If the Glove Box Light does not light but the Cigar Lighter works, check the connector, ORN (40) wire, BLK (150) wires, and switch for continuity.
2. If only the Cigar Lighter does not operate, check the element for corrosion or damage. Also check the ORN (40) and BLK (150) wires to their connector and connector for continuity. Replace the Cigar Lighter Assembly if the element, the wires, and connector are good.

Cargo Compartment Light

If only the Cargo Compartment Light does not operate, check the Cargo Compartment Light Switch, connector C238, ORN (40) wire, WHT (156) wire and BLK (150) wires for continuity (see schematic). Repair/replace as necessary.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C206 (2 cavities)	Behind I/P, at LH shroud	
C238 (12 cavities)	LH shroud, ahead of center access hole	201-11-C
G200	Behind I/P, left of steering column	201-10-A
G302	Center of windshield header	201-15-E
G319	In cargo compartment, behind center of end panel	201-17-D
S203	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S237	I/P harness, behind LH side of I/P	201-10-A

INTERIOR LIGHTS

CIRCUIT OPERATION

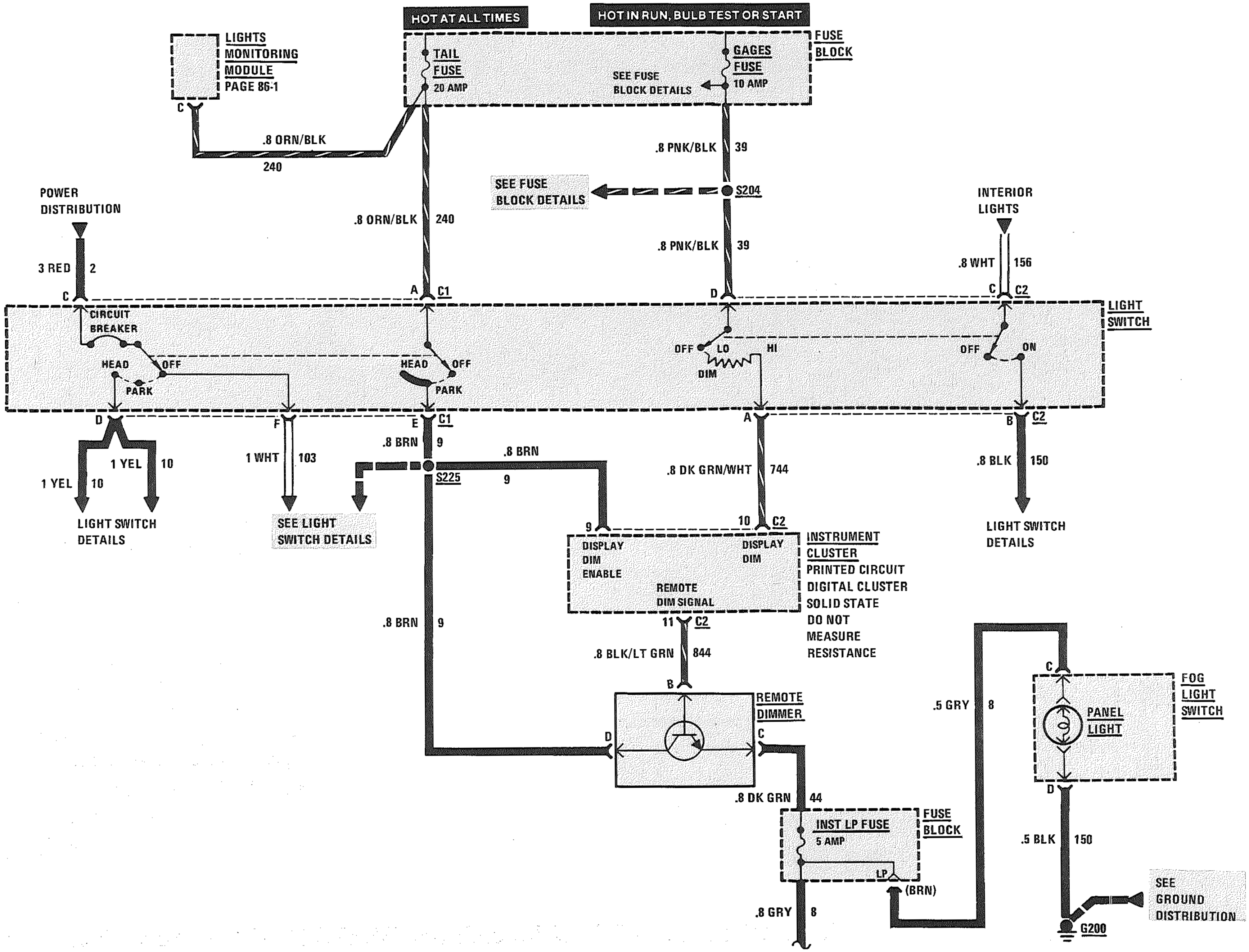
Interior Lights and Cigar Lighter

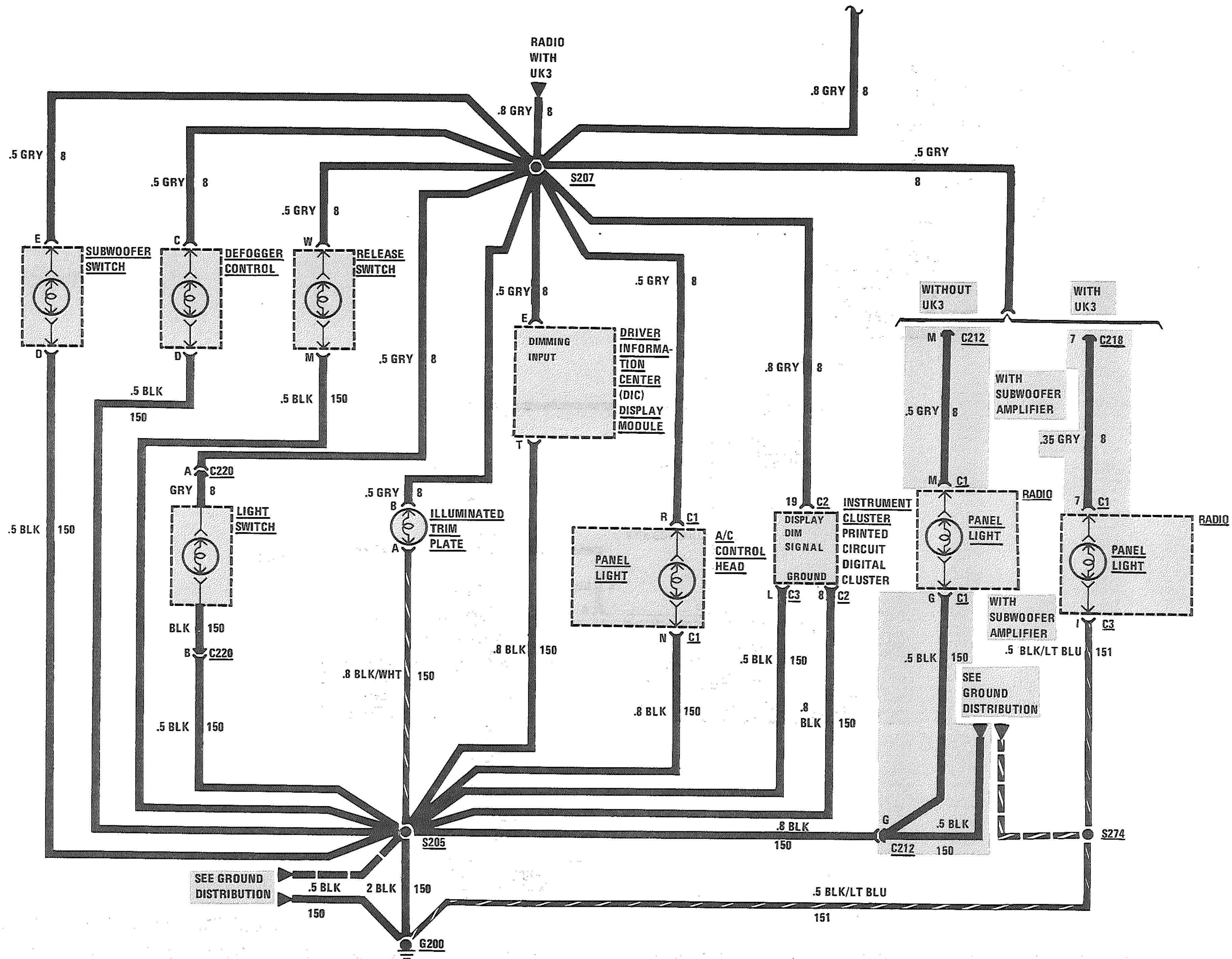
Voltage is applied at all times through the CTSY Fuse to the components in the circuit. The Glove Box Light, Dome Reading Lights, and Cigar Lighter each use separate switches. The LH and RH Courtesy Lights and the Dome Light can be turned on by closing the Panel Interior Light Control, or by opening a door.

Cargo Compartment Light

Voltage is applied to the CTSY Fuse at all times. With the Cargo Compartment Light Switch closed, voltage is applied to the Cargo Compartment Light.

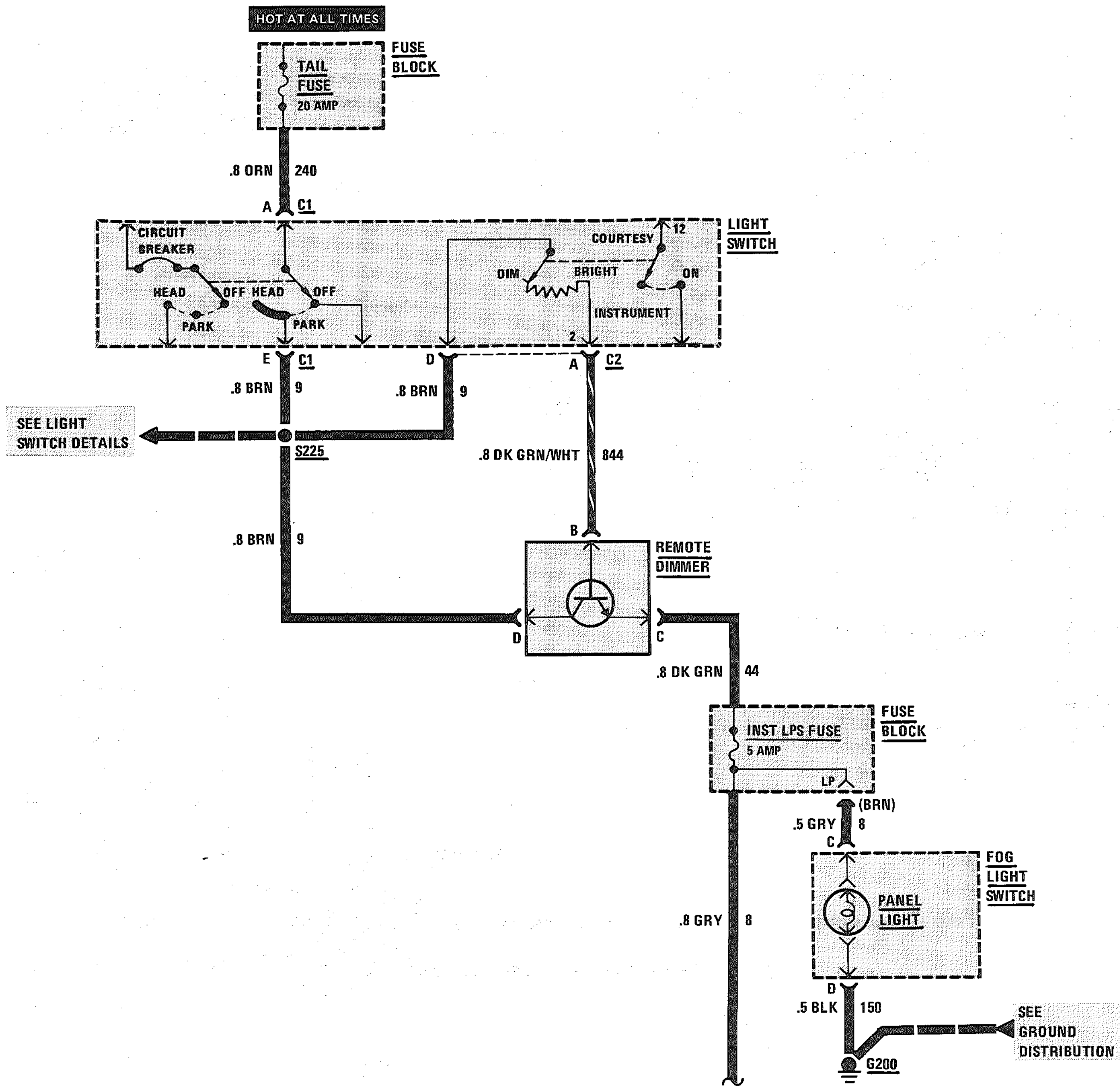
INTERIOR LIGHTS DIMMING
WITH DIGITAL CLUSTER

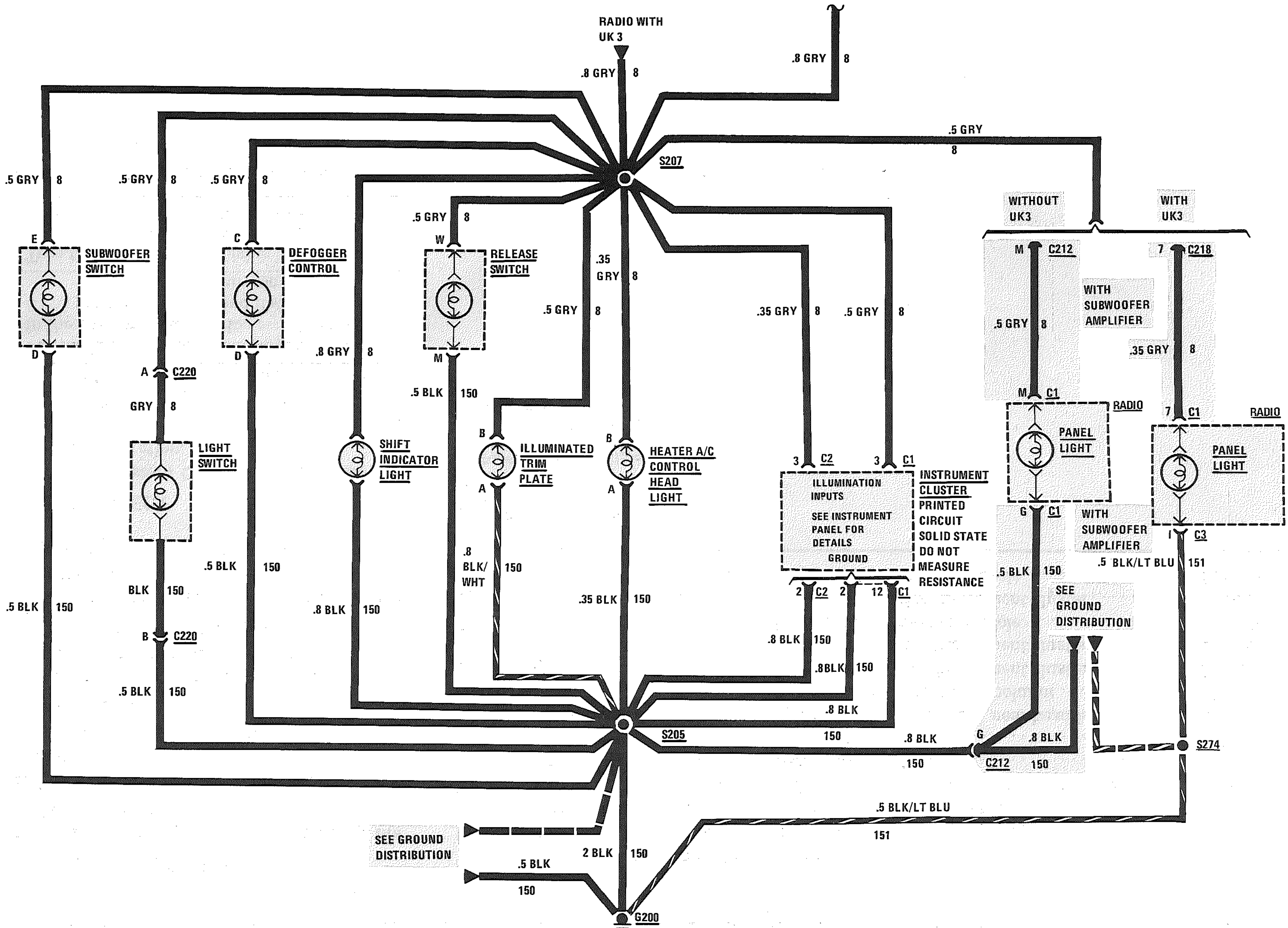




RADIO WITH UK3
.8 GRY 8
.8 GRY 8
.5 GRY 8
.5 GRY 8
.5 GRY 8
.5 GRY
8
S207
E
SUBWOOFER SWITCH
D
C
DEFOGGER CONTROL
D
W
RELEASE SWITCH
M
.5 GRY 8
.5 GRY 8
E
DIMMING INPUT
DRIVER INFORMATION CENTER (DIC) DISPLAY MODULE
T
WITHOUT UK3
WITH UK3
M C212
7 C218
WITH SUBWOOFER AMPLIFIER
.5 GRY 8
.35 GRY 8
.5 BLK 150
.5 BLK 150
.5 GRY 8
.8 GRY 8
A C220
GRY 8
LIGHT SWITCH
BLK 150
B C220
.5 GRY 8
B
ILLUMINATED TRIM PLATE
A
R C1
PANEL LIGHT
A/C CONTROL HEAD
N C1
19 C2
DISPLAY DIM SIGNAL
GROUND
INSTRUMENT CLUSTER PRINTED CIRCUIT DIGITAL CLUSTER
L C3
8 C2
M C1
RADIO
PANEL LIGHT
G C1
7 C1
RADIO
PANEL LIGHT
I C3
WITH SUBWOOFER AMPLIFIER
.5 BLK 150
.5 BLK/LT BLU 151
SEE GROUND DISTRIBUTION
.5 BLK 150
.5 BLK 150
.8 BLK/WHT 150
.8 BLK 150
.5 BLK 150
.8 BLK 150
.8 BLK 150
G
.5 BLK
C212 150
S274
.8 BLK
150
S205
SEE GROUND DISTRIBUTION
.5 BLK
150
2 BLK 150
.5 BLK/LT BLU
151
G200

INTERIOR LIGHTS DIMMING
WITHOUT DIGITAL CLUSTER




RADIO WITH
UK 3
.8 GRY 8
.8 GRY 8
.5 GRY 8
S207
.5 GRY 8
.5 GRY 8
.5 GRY 8
.5 GRY 8
WITHOUT
UK3
WITH
UK3
E
SUBWOOFER
SWITCH
C
DEFOGGER
CONTROL
W
RELEASE
SWITCH
.35
GRY 8
M
C212
7
C218
WITH
SUBWOOFER
AMPLIFIER
.5 GRY 8
.35 GRY 8
.5 GRY 8
.35 GRY 8
.5 GRY 8
.5 GRY 8
D
D
.8 GRY 8
M
A
C220
.5 BLK 150
M
C1
RADIO
7
C1
RADIO
PANEL
LIGHT
PANEL
LIGHT
GRY 8
B
B
LIGHT
SWITCH
SHIFT
INDICATOR
LIGHT
ILLUMINATED
TRIM
PLATE
HEATER A/C
CONTROL
HEAD
LIGHT
3
C2
3
C1
ILLUMINATION
INPUTS
SEE INSTRUMENT
PANEL FOR
DETAILS
GROUND
INSTRUMENT
CLUSTER
PRINTED
CIRCUIT
SOLID STATE
DO NOT
MEASURE
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A
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G
C1
WITH
SUBWOOFER
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I
C3
.5 BLK/LT BLU 151
.5 BLK 150
.5 BLK 150
.8
BLK/
WHT
150
.5 BLK 150
SEE
GROUND
DISTRIBUTION
BLK 150
.5 BLK 150
.8 BLK 150
.35 BLK 150
2
C2
2
12
C1
B
C220
.8 BLK 150
.8BLK 150
.5 BLK 150
.8 BLK
S205
150
.8 BLK
G
.8 BLK
S274
150
C212
150
.5 BLK/LT BLU
151
SEE GROUND
DISTRIBUTION
2 BLK 150
.5 BLK
150
G200

INTERIOR LIGHTS DIMMING

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the Light Switch by operating the Park Lights.
2. If none of the Instrument Panel Lights work, check the INST LP Fuse.
3. If a single light does not work, check the bulb and the associated wires to the bulb.
4. Check that G200 is clean and tight.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Put the Light Switch in the Park or Head Lamp position	Instrument Panel, Heater-A/C Panel, and Radio Lights turn on
Turn the Dimmer Control through its range	Lights brighten in one direction and dim in the other

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Lights Monitoring Module	Behind I/P, at base of steering column	
Remote Dimmer	RH side of steering column, on I/P retainer	201-10-A
C212 (12 cavities)	Behind center of I/P	201-13-B
C218	Behind center of I/P	201-12-A
C220 (2 cavities)	Behind top LH side of I/P, near headlight switch.	201-10-A
G200	Behind I/P, left of steering column	201-10-A
S204	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S207	I/P harness, at head of console	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S274	I/P harness, at head of console	201-12-C

SYSTEM DIAGNOSIS

WITH DIGITAL CLUSTER

- **Perform the following tests if the Interior Lights dimming functions do not operate properly.**

(Continued on facing page)

(Continued from facing page)

A: INTERIOR LIGHTS DIMMING TEST

Connect: TEST LAMP
At: FUSE BLOCK-HOT SIDE OF INST LP FUSE
Conditions:

- **Ignition Switch: RUN**
- **INST LP Fuse: REMOVED**
- **Light Switch: PARK**
- **Dimmer Control: HI**

Connect Between	Correct Result	For Diagnosis
INST LP Fuse cavity (DK GRN) & Ground	Test Lamp lights	See 1
• Slowly turn Dimmer Control to LO		
INST LP Fuse cavity (DK GRN) & Ground	Test Lamp dims	See 1

- If all results are correct but Interior Lights do not work, check the GRY (8) wire for an open (see schematic).

1. Check DK GRN (44) wire for an open. If wire is good, do Test B.

B: REMOTE DIMMER TEST

Connect: TEST LAMP
At: REMOTE DIMMER CONNECTOR (Connected)
Conditions:

- **Light Switch: PARK**
- **Dimmer Control: HI**

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
B (BLK/LT GRN) & Ground	Test Lamp lights	See 2
C (DK GRN) & Ground	Test Lamp lights	See 3
• Slowly turn Dimmer Control to LO		
C (DK GRN) & Ground	Test Lamp dims	See 3

- If all results are correct, check the DK GRN (44) wire for an open (see schematic).

1. Check BRN (9) wire for an open (see schematic).
2. Check BLK/LT GRN (844) wire for an open (see schematic). If wire is good, do Test C.
3. Replace Remote Dimmer.

C: LIGHT SWITCH TEST

Connect: TEST LAMP
At: LIGHT SWITCH CONNECTOR C2 (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Light Switch: PARK**
- **Dimmer Control: HI**

Connect Between	Correct Result	For Diagnosis
D (PNK/BLK) & Ground	Test Lamp lights	See 1
A (DK GRN/ WHT) & Ground	Test Lamp lights	See 2
• Slowly turn Dimmer Control to LO		
A (DK GRN/ WHT) & Ground	Test Lamp dims	See 2

- If all results are correct but Interior Lights do not dim, check the DK GRN/WHT (744) wire for an open. If wire is good, replace Instrument Cluster.

1. Check the PNK/BLK (39) wire for an open.
2. Repair/replace the Light Switch.

(Continued on next page)

INTERIOR LIGHTS DIMMING

(Continued from previous page)

WITHOUT DIGITAL CLUSTER

A: INTERIOR LIGHTS DIMMING TEST

Connect: TEST LAMP
At: FUSE BLOCK-HOT SIDE OF INST LP FUSE
Conditions:

- **Ignition Switch: RUN**
- **INST LP Fuse: REMOVED**
- **Light Switch: PARK**
- **Dimmer Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
INST LP Fuse cavity (DK GRN) & Ground	Test Lamp lights	See 1
• Slowly turn Dimmer Control to DIM		
INST LP Fuse cavity (DK GRN) & Ground	Test Lamp dims	See 1

- If all results are correct but Interior Lights do not work, check the GRY (8) wire for an open (see schematic).

1. Check DK GRN (44) wire for an open. If wire is good, do Test B.

B: REMOTE DIMMER TEST

Connect: TEST LAMP
At: REMOTE DIMMER CONNECTOR (Connected)
Conditions:

- **Light Switch: PARK**
- **Dimmer Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
B (DK GRN/ WHT) & Ground	Test Lamp lights	See 2
C (DK GRN) & Ground	Test Lamp lights	See 3
• Slowly turn Dimmer Control to DIM		
C (DK GRN) & Ground	Test Lamp dims	See 3

- If all results are correct, check the DK GRN (44) wire for an open (see schematic).

1. Check BRN (9) wire for an open (see schematic).
2. Check DK GRN/WHT (844) wire for an open (see schematic). If wire is good, do Test C.
3. Replace Remote Dimmer.

C: LIGHT SWITCH TEST

Connect: TEST LAMP
At: LIGHT SWITCH CONNECTOR C2 (Connected)
Conditions:

- **Light Switch: PARK**
- **Dimmer Control: BRIGHT**

Connect Between	Correct Result	For Diagnosis
D (BRN) & Ground	Test Lamp lights	See 1
A (DK GRN/ WHT) & Ground	Test Lamp lights	See 2
• Slowly turn Dimmer Control to DIM		
A (DK GRN/ WHT) & Ground	Test Lamp dims	See 2

- If all results are correct but Interior Lights do not dim, check the DK GRN/WHT (844) wire for an open.

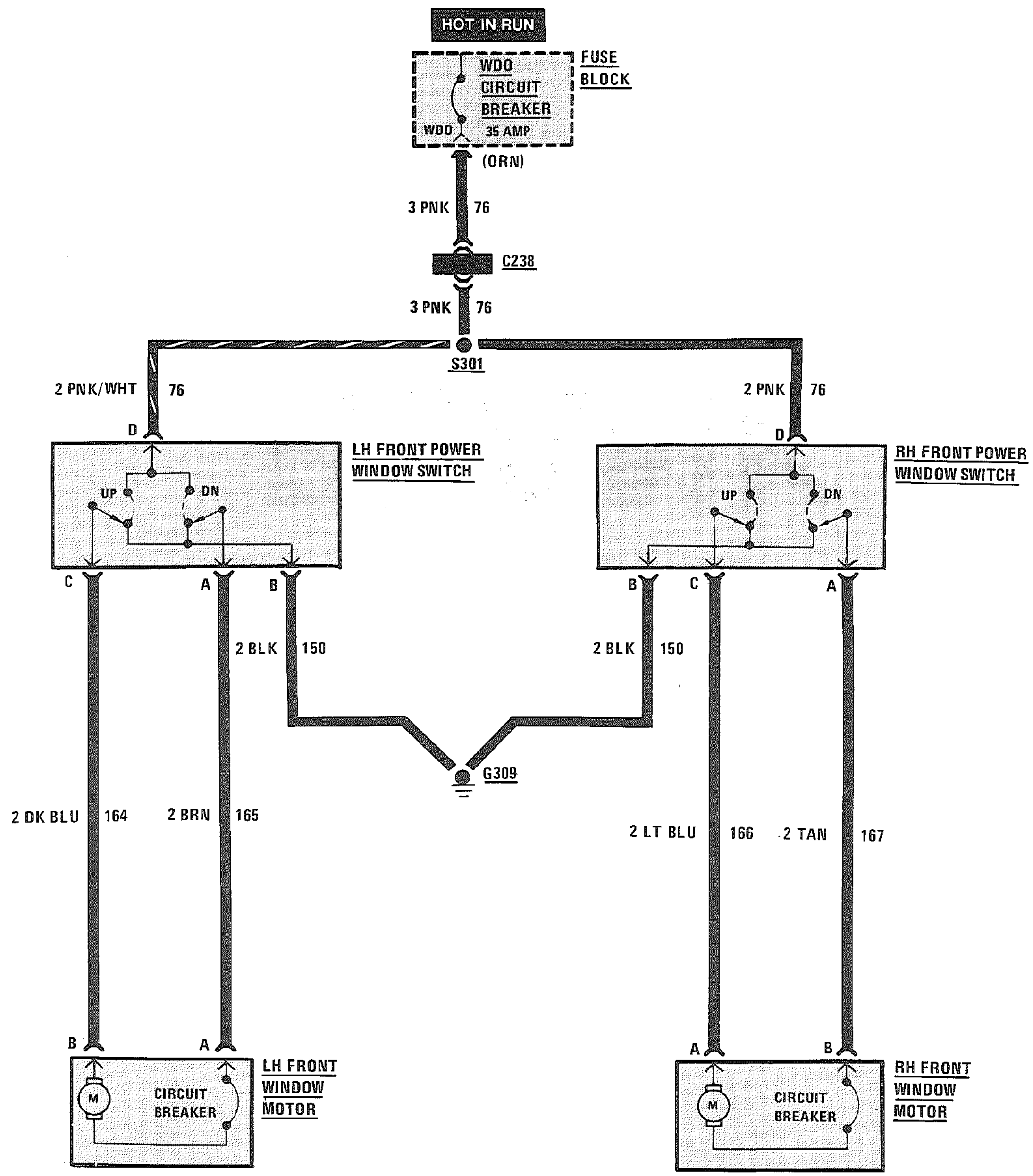
1. Check the BRN (9) wire for an open.
2. Repair/replace the Light Switch.

CIRCUIT OPERATION

Voltage is applied at all times to the Light Switch through the Tail Fuse. With the Light Switch in HEAD or PARK, voltage is applied through the Light Switch, Remote Dimmer, and INST LP Fuse to the various Instrument Panel and Console Lights. The lights can be dimmed using the rheostat in the Light Switch.

BLANK

POWER WINDOWS



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. If no windows operate, check the WDO Circuit Breaker by visual inspection.
2. If no windows operate, check that ground G309 is clean and tight.

- Go to System Check for a guide to normal operation.
- Go to System Diagnosis for diagnostic tests.

SYSTEM CHECK

- Use the System Check Table as a guide to normal operation.
- Refer to System Diagnosis for a list of symptoms and diagnostic steps.

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Operate the LH Front Window UP and DN from the LH Front Power Window Switch	LH Front Window operates quietly and smoothly, with no sticking
Operate the RH Front Window UP and DN from the RH Front Power Window Switch	RH Front Window operates quietly and smoothly, with no sticking

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Window Motors	In lower front corner of each door	201-18-A
C238 (12 cavities)	LH shroud, ahead of center access hole	201-11-C
G309	Below rear of console	
S301	Crosscar harness, below LH front seat	

SYSTEM DIAGNOSIS

- Do the tests listed for your symptom in the Symptom Table below.
- Tests follow the Symptom Table.

SYMPTOM TABLE

SYMPTOM	FOR DIAGNOSIS
No Power Windows operate	Check PNK (76) wire to splice S301 for an open. If wire is OK, perform tests A and B
LH Front Power Window does not operate	A: LH Front Power Window Switch Test C: Window Motor Test
RH Front Power Window does not operate	B: RH Front Power Window Switch Test C: Window Motor Test

A: LH FRONT POWER WINDOW SWITCH TEST

Connect: TEST LAMP
At: LH FRONT POWER WINDOW SWITCH CONNECTOR (Connected)
Condition:
- Ignition Switch: RUN

Connect Between	Correct Result	For Diagnosis
D (PNK/WHT) & Ground	Test Lamp Lights	See 1
D (PNK/WHT) & B (BLK)	Test Lamp Lights	See 2

- Operate LH Front Power Window Switch UP and DN

(A: LH FRONT POWER WINDOW SWITCH TEST continued on next page)

POWER WINDOWS

(A: LH FRONT POWER WINDOW SWITCH TEST continued from previous page)

C (DK BLU) & A (BRN)	Test Lamp Lights	See 3

- If all the results are correct, go to Test C.

1. Check PNK/WHT (76) wire for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).
3. Replace LH Front Power Window Switch

B: RH FRONT POWER WINDOW SWITCH TEST

Connect: TEST LAMP
At: RH FRONT POWER WINDOW SWITCH CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Connect Between	Correct Result	For Diagnosis
D (PNK) & Ground	Test Lamp Lights	See 1
D (PNK) & B (BLK)	Test Lamp Lights	See 2
• Operate RH Front Power Window Switch UP and DN		
C (LT BLU) & A (TAN)	Test Lamp lights	See 3

- If all the results are correct, go to Test C.

1. Check PNK (76) wire for an open (see schematic).
2. Check BLK (150) wires for an open (see schematic).
3. Replace RH Front Power Window Switch.

C: WINDOW MOTOR TEST

Connect: TEST LAMP
At: SUSPECT WINDOW MOTOR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Operate associated Power Window Switch UP and DN**

Connect Between	Correct Result	For Diagnosis
A (BRN) or (LT BLU) & B (DK BLU) or (TAN)	Test Lamp Lights	See 1

- If the result is correct, replace the Window Motor. Refer to the Body Section 5 for replacement procedures.

1. Check the wiring to the Window Motor for an open (see schematic).

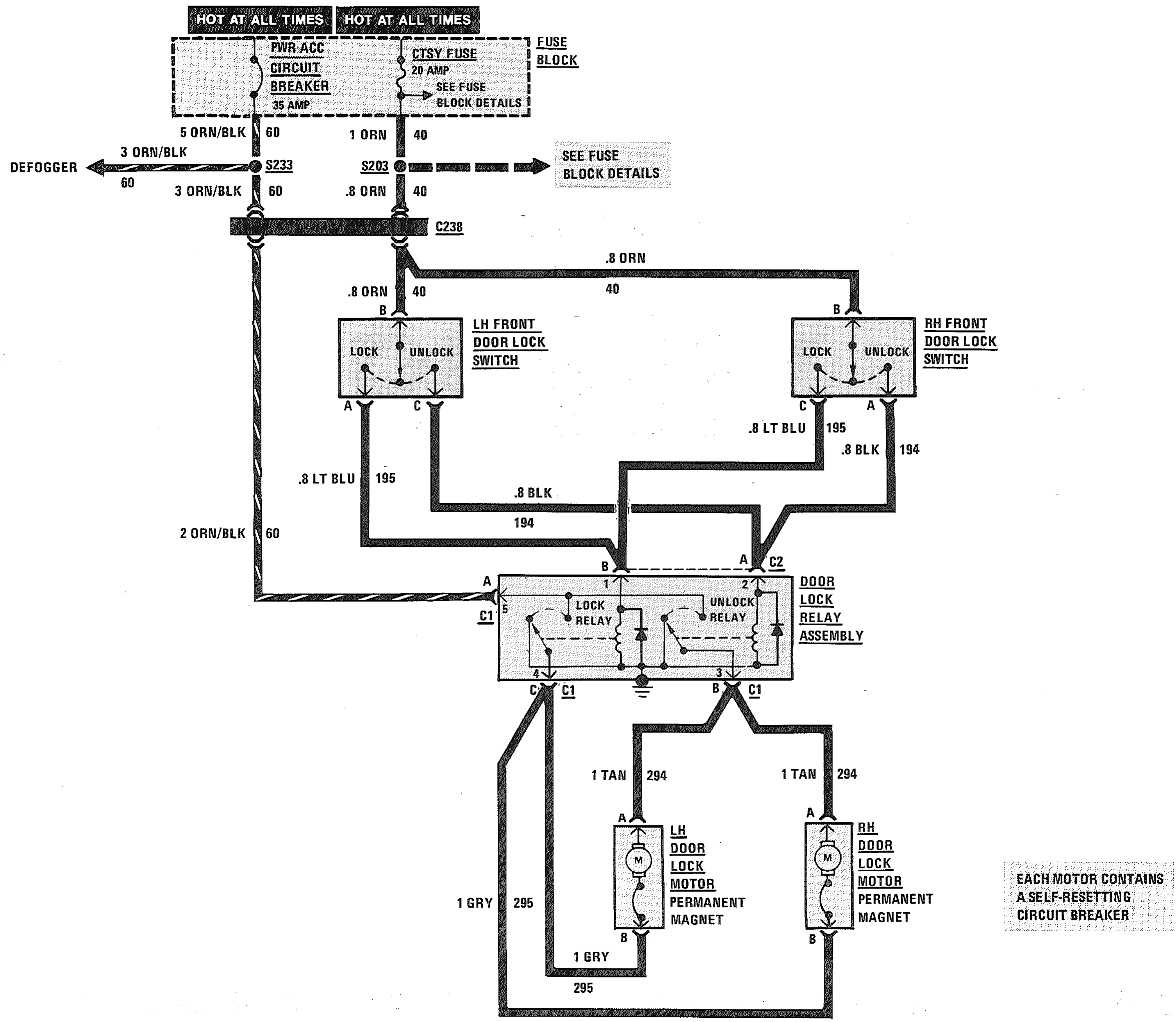
CIRCUIT OPERATION

With the Ignition Switch in RUN, voltage is applied through the WDO Circuit Breaker and the PNK and PNK/WHT wires to the Power Window Switches. With the LH Front Power Window Switch in UP, voltage is applied through the WDO Circuit Breaker, the LH Front Power Window Switch, and the DK BLU wire to the LH Front Window Motor. The Motor is grounded through the BRN wire and the DN contacts of the LH Front Window Switch to G309. The motor runs and the window goes up. Voltage is similarly applied with the RH Front Power Window Switch in UP.

In DN, voltage is applied to each motor in the opposite direction and the window goes down.

BLANK

POWER DOOR LOCKS



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the PWR ACC Circuit Breaker by operating the Defogger.
2. Check the CTSY Fuse by operating the Horn.
3. Check that the Door Lock Relay Assembly case ground is making good contact.
4. If one or more of the door lock motors do not operate properly, but the other door locks function normally, check the wiring to the motors. If the wiring is correct, replace that motor.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL OPERATION
Operate the LH Door Lock Switch	All the doors lock and unlock
Operate the RH Door Lock Switch	All the doors lock and unlock
Unlock one door using the vehicle key	That door unlocks, but the other doors remain unlocked
With all the doors closed and locked, operate the inside door handle to try to open each door	The doors will not open
Open the LH door and move the LH Door Lock Switch to the LOCK position, close the door, and try to open each door from the outside	The doors will not open

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- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Door Lock Motors	In each door, near lower rear corner	201-18-A
Door Lock Relay Assembly	LH shroud, near lower access hole	201-11-B
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C238 (12 cavities)	LH shroud, ahead of center access hole	201-11-C
S203	I/P harness, behind instrument cluster	201-10-A
S233	I/P harness, above Fuse Block	201-10-A

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table below.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Only one door does not lock or unlock	A: Door Lock Motor Test on suspect Door Lock Motor
The Power Door Locks do not operate from one Door Lock Switch	B: Door Lock Switch Test on suspect Door Lock Switch
The Power Door Locks do not operate from any Door Lock Switch	C: Door Lock Relay Test B: Door Lock Switch Test

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A: DOOR LOCK MOTOR TEST

Measure: VOLTAGE
At: SUSPECT DOOR LOCK MOTOR CONNECTOR (Disconnected)
Condition:
- **LH Door Lock Switch: UNLOCK and hold**

Measure Between	Correct Voltage	For Diagnosis
A (TAN) & Ground	Battery	See 1
A (TAN) & B (GRY)	Battery	See 2

- If all the voltages are correct, replace the suspect Door Lock Motor.

1. Check the TAN (294) wire for an open (see schematic).
2. Check the GRY (295) wire for an open (see schematic).

B: DOOR LOCK SWITCH TEST

Measure: VOLTAGE
At: SUSPECT DOOR LOCK SWITCH CONNECTOR (Connected)

Measure Between	Correct Voltage	For Diagnosis
B (ORN) & Ground	Battery	See 1
• Move the Door Lock Switch to LOCK and hold		
LT BLU (195) & Ground	Battery	See 2
• Move the Door Lock Switch to UNLOCK and hold		
BLK (194) & Ground	Battery	See 2

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- If all the voltages are correct, check the LT BLU (195) wire and BLK (194) wires for an open (see schematic).

1. Check the CTSY Fuse. Check the ORN (40) wire for an open (see schematic).
2. Replace the suspect Door Lock Switch.

C: DOOR LOCK RELAY TEST (TABLE 1)

Connect: TEST LAMP
At: DOOR LOCK RELAY CONNECTOR C1 (Disconnected)

Connect Between	Correct Result	For Diagnosis
A (ORN/BLK) & Ground	Test Lamp lights	See 1

- If the result is correct, proceed to Table 2.

1. Check the PWR/ACC Circuit Breaker and the ORN/BLK (60) wire for an open (see schematic).

C: DOOR LOCK RELAY TEST (TABLE 2)

Connect: TEST LAMP
At: DOOR LOCK RELAY CONNECTORS C1 & C2 (Connected)
Condition:
- **Door Lock Switch: LOCK and hold**

Connect Between	Correct Result	For Diagnosis
C2: B (LT BLU) & Ground	Test Lamp lights	See 1
C1: C (GRY) & Ground	Test Lamp lights	See 3
C1: C (GRY) & C1: B (TAN)	Test Lamp lights	See 3
• Move the Door Lock Switch to UNLOCK and hold		
C2: A (BLK) & Ground	Test Lamp lights	See 2
C1: B (TAN) & Ground	Test Lamp lights	See 3
C1: C (GRY) & C1: B (TAN)	Test Lamp lights	See 3

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- If all the results are correct, check the TAN (294) and GRY (295) wires for opens (see schematic). If the wires are OK, do Test A.

1. Check the LT BLU (195) wire for an open (see schematic). If the wire is good, do Test B.
2. Check the BLK (194) wire for an open (see schematic). If the wire is good, do Test B.
3. Replace the Door Lock Relay.

CIRCUIT OPERATION

When a Door Lock Switch is activated in the Power Door Lock system, all of the doors will lock or unlock in unison. Each lock can also be operated manually from the locking post. The locks are operated by reversible Motors that receive voltage from two relays in the Door Lock Relay Assembly. These relays operate to turn the Motors on by applying a voltage to one of the terminals and a ground to the other terminal.

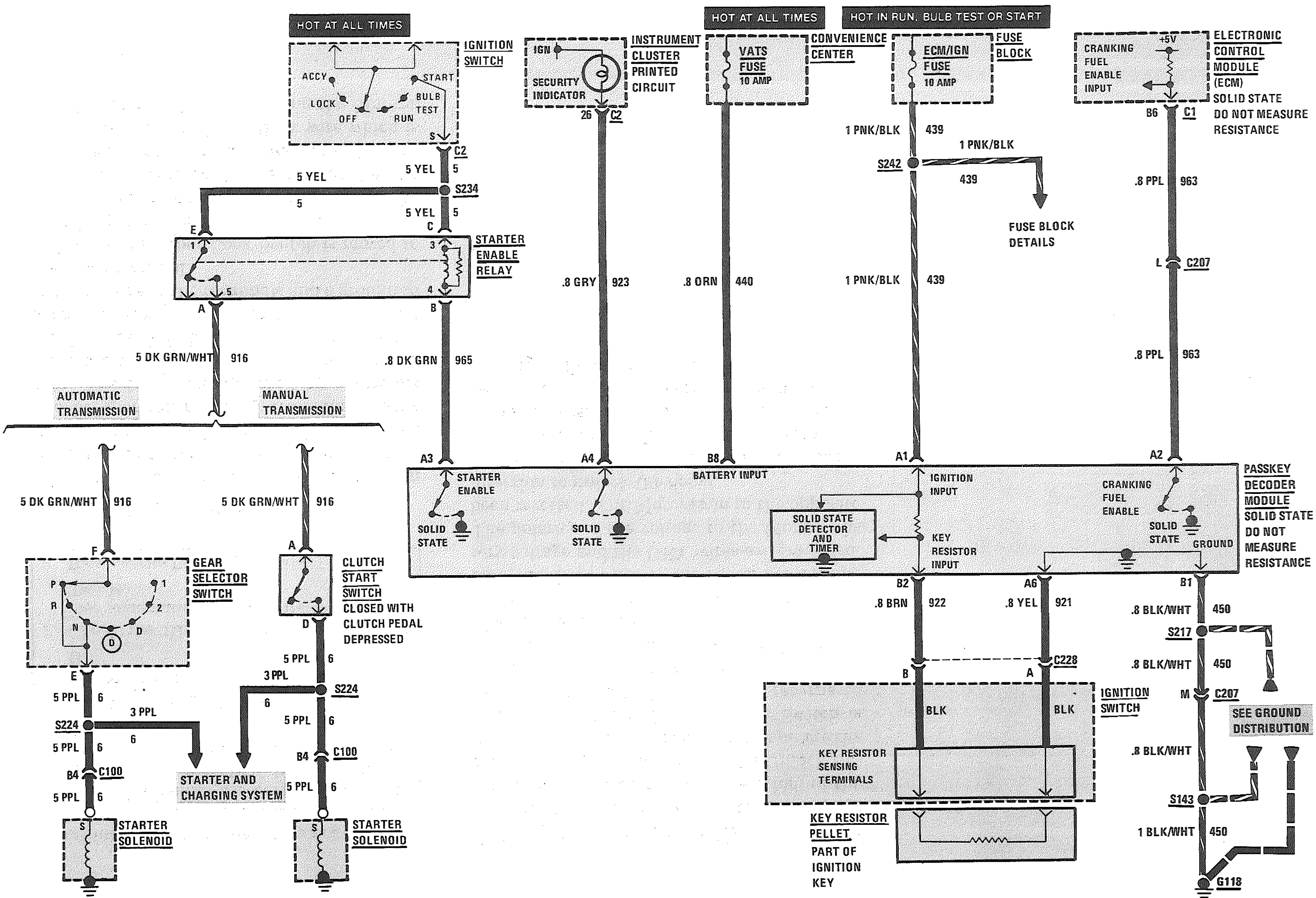
When either Door Lock Switch is moved to the LOCK position, it completes the circuit to the coil of the Door Lock Relay Assembly. The lock relay is energized. The contact for the Lock Relay closes, and is connected to battery voltage through the ORN/BLK wire which is the high current feed for driving the Motors.

Voltage is then applied to the GRY wire and the Door Lock Motors, which are grounded by the TAN wire from the other terminal of the Motor through the contact for the Unlock Relay. The Motor in each door runs to operate the Door Locks. When the Door Lock Switch is released, the Lock Relay contact returns to ground and the Motors turn off.

A similar action occurs with the unlock relay when it is energized by either of the Door Lock Switches closing to the UNLOCK position. Now the TAN wires to the Motors carry battery voltage and the GRY wires are grounded. The polarity of the voltage to the Motors has been reversed. The Motors run in the opposite direction to unlock the doors.

The Door Lock Switches are usually closed for just a moment. If they are held closed, a circuit breaker in each motor will open to protect against damage. The circuit breakers close automatically when they cool off.

THEFT DETERRENT SYSTEM: PASSKEY



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the key pellet sensing contacts in the Ignition Lock Cylinder by looking into the key opening. If the contacts are damaged, replace the Lock Cylinder.
2. Check the VATS Fuse by visual inspection.
3. Check owner's ignition key using the J35628 VATS Interrogator or equivalent. If the Key Code window shows "E", replace the owner's key.
4. Check the Security Indicator Bulb.
5. Check the C/H Fuse by visual inspection.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for a list of symptoms and diagnostic steps.**

SYSTEM CHECK TABLE

Put the Ignition Switch in RUN	Security Indicator lights for approximately 2 seconds If Indicator does not light do Test E

(Continued on next page)

COMPONENT LOCATION

Component	Location	Page-Figure
Clutch Start Switch	Above clutch pedal, on clutch pedal support	
Convenience Center	Behind I/P, to right of steering column	201-10-A
Electronic Control Module (ECM)	Behind RH side of I/P	201-12-B
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Starter Enable Relay	Behind LH side of I/P, left of steering column	
Starter Solenoid (VIN E)	Lower RH side of engine	201- 2-A
Starter Solenoid (VIN F) (VIN 8)	Lower RH side of engine	201- 6-B
Starter Solenoid (VIN S)	Lower RH side of engine	201- 1-A
VATS Decoder Module	Behind LH side of I/P, above steering column	
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C207 (15 cavities)	Behind RH side of I/P, near ECM	201-13-A
C228	Behind I/P, on upper RH side of steering column	
G118 (VIN E)	Rear of RH cylinder head	201- 5-B
G118 (VIN F) (VIN 8)	Rear of RH cylinder head	201- 5-A
G118 (VIN S)	Rear of RH cylinder head	201- 1-C
S143 (VIN E)	Engine harness, RH front of dash	201- 2-A
S143 (VIN F) (VIN 8)	Engine harness, RH front of dash	201- 6-A
S143 (VIN S)	Engine harness, center front of dash	201- 1-A
S217	I/P harness, behind center of I/P	201-10-A
S224	I/P harness, near LH shroud	
S234	I/P harness, above Fuse Block	201- 9-A
S242	I/P harness, behind RH side of I/P	201-13-A

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Insert ignition key into ignition key lock and turn Ignition Switch to START	If engine starts, proceed to next step If engine does not start, proceed to System Diagnosis
Do the following to check that PASSKEY will detect the use of an incorrect key Shut off engine Remove hush panel under steering column and disconnect C228 (Two-cavity connector at base of steering column)	
Attempt to start engine	Engine should not crank If engine cranks, do Starter Enable Relay Test in System Diagnosis
Reconnect C228 and attempt to start engine again (must be done within two minutes of first attempt)	Engine should not crank If engine cranks, replace PASSKEY Decoder Module
Turn Ignition Switch to OFF Wait four minutes and turn Ignition Switch to START	Engine starts normally
Replace hush panel	

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

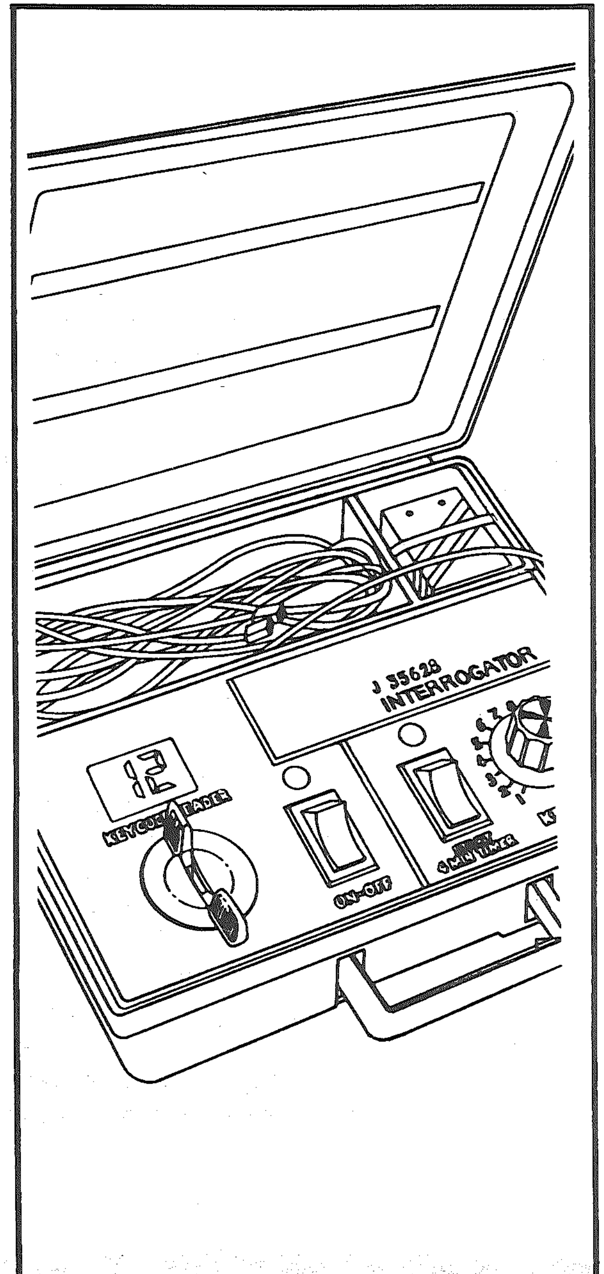
Use the following table to determine the procedure to use. If engine won't crank, or cranks but won't start, enter ECM Diagnostic Mode and check for display of code 46.

There are four "No Start" conditions that can occur on a vehicle equipped with PASSKEY that may appear to be caused by PASSKEY. The four conditions are given in the following table. The first of these is almost certain to be a PASSKEY problem. The second and third can be caused by other systems on the vehicle. The fourth symptom is definitely not related to PASSKEY.

SYMPTOM TABLE

No Crank ECM Code 46 Present	A: Lock Cylinder and Harness Test B: Decoder Module Test
Crank but no Start ECM Code 46 Present	D: ECM Enable Test
No Crank No ECM Code 46	C: Starter Enable Relay Test
Crank but no Start No ECM Code 46	Refer to Section 6E
Security Indicator does not work properly	E: Security Indicator open test

- **If your symptom is not one of the symptoms listed, do all the following tests.**



A: LOCK CYLINDER AND HARNESS TEST

1. Remove the hush panel under the steering column. Disconnect the two-cavity connector in the wire leading into the steering column. Connect the male and female parts to the mating connectors on the pigtails from the J35628 Interrogator or equivalent.
2. Insert the customer's ignition key into the Ignition Switch Lock Cylinder.
3. Press the On-Off switch on the J35628 Interrogator to the ON position.
   - The window above the Key Code Reader indicates the electrical code for the key (1 to 15) or "E" error.
   - Rotate the ignition lock cylinder while the key is inserted to insure that the correct code is read in all positions.
   — If the code is correct in all positions, proceed to step 5.
   — If code is not correct in all positions, replace the Lock Cylinder.
   - If the window shows "E", proceed to step 4.
4. Check the customer's ignition key by inserting it in the Key Code Reader on the J35628 Interrogator.
   - If the Interrogator indicates "E", replace the key with a spare or follow the procedures under Key Replacement.
   - If Interrogator shows the electrical code (1 to 15), replace the Lock Cylinder. (See procedure following Key Duplication Procedure).
5. Set the Key Code Selector on the J35628 Interrogator to the same electrical code determined in step 3. Turn the Ignition Switch to START.
   - If engine starts, reconnect vehicle wiring and check that the two-cavity connector at the base of the steering column mates correctly.
   - If engine does not start, go to Test B, Decoder Module Test.

B: PASS KEY DECODER MODULE TEST (TABLE 1)

Measure: VOLTAGE
At: PASSKEY DECODER MODULE CONNECTOR (Disconnected)
Condition:
- Ignition Switch: RUN

Measure Between	Correct Voltage	For Diagnosis
A1 (PNK/ BLK) & Ground	Battery	See 1
B8 (ORN) & Ground	Battery	See 2
A1 (PNK/ BLK) & B1 (BLK/WHT)	Battery	See 3
A2 (PPL) & B1 (BLK/ WHT)	5 Volts	See 4
• Ignition Switch: START		
A3 (DK GRN) & Ground	Battery	See 5

- If voltages are correct, go to Table 2.

(Continued in next column)

(Continued from previous column)

1. Check the PNK/BLK (439) wire and C/H Fuse for an open.
2. Check the ORN (440) wire and VATS Fuse for an open.
3. Check the BLK/WHT (450) wire for an open.
4. Check the PPL (963) wire for an open. If wire is good, replace ECM.
5. Check DK GRN (965) wire for an open. If wire is good, do Test C.

B: PASSKEY DECODER MODULE TEST (TABLE 2)

Measure: RESISTANCE
At: PASSKEY DECODER MODULE CONNECTOR (Disconnected)
Conditions:
- Negative Battery Terminal Disconnected
- No Key In Ignition Switch

Measure Between	Correct Resistance	For Diagnosis
A6 (YEL) & UB2 (BRN)	Open circuit	See 1
• Key in Ignition		
A6T (YEL) & UB2 (BRN)	380 to 12.3K ohms	See 2

- If resistance is correct but engine will not crank, replace the PASSKEY Decoder Module.

(Continued in next column)

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Note: When the PASSKEY Decoder Module is replaced, the new key code may not match the code in the owner's existing keys. If it does not match, then new keys must be made. Use the key duplication procedure.

1. Check YEL (921) and BRN (922) wires for shorts to ground or between the two wires.
2. Check YEL (921) and BRN (922) wires for an open.

C: STARTER ENABLE RELAY TEST

Measure: VOLTAGE
At: STARTER ENABLE RELAY CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: START**

Measure Between	Correct Voltage	For Diagnosis
E (YEL) & Ground	Battery	See 1
C (YEL) & Ground	Battery	See 1

- If voltages are correct, go to C2.

1. Check YEL (5) wire for an open. If wire is good but voltage is not present, go to 8A-30 for diagnosis of Starter and Charging Circuits.

C2. Connect a fused jumper between terminals E (YEL) wire and A (DK GRN/WHT) wire of the Starter Enable Relay Connector. Turn Ignition Switch to START.

- If engine cranks proceed to C3.
- If engine does not crank, go to page 30-0 for diagnosis of Starter and Charging Circuits.

C3. Reconnect the Starter Enable Relay and connect a fused jumper from terminal A3 (DK GRN) wire of the PASSKEY Decoder Module to ground. Turn Ignition Switch to START.

- If engine cranks, replace the PASSKEY Decoder Module.
- If engine does not crank, check the DK GRN (965) wire for an open. If wire is OK, replace the Starter Enable Relay.

D: ECM ENABLE SIGNAL TEST

Measure: VOLTAGE
At: PASSKEY DECODER MODULE CONNECTOR (Connected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
A2 (PPL) & Ground	5 Volts	See 1

- Ignition Switch: START
- Wait four minutes from last time Ignition Switch was turned to OFF to allow PASSKEY Internal timer to reset.

Measure Between	Correct Voltage	For Diagnosis
A2 (PPL) & Ground	2 to 3 Volts	See 2

- If voltages are correct, cranking Fuel Enable signal is operating normally, return to Symptom Table.

1. Check PPL (963) wire for an open.

(Continued in next column)

(Continued from previous column)

2. Replace PASSKEY Decoder Module.

Note: When the PASSKEY Decoder Module is replaced, the key code it is set for may not match the code in the owner's keys. If it does not, then new keys must be made. Use the procedure under Duplication of Keys.

E: SECURITY INDICATOR OPEN TEST

Measure: VOLTAGE
At: PASSKEY DECODER MODULE CONNECTOR (Disconnected)
Condition:
- **Ignition Switch: RUN**

Measure Between	Correct Voltage	For Diagnosis
A4 (GRY) & Ground	Battery	See 1

- If voltage is correct do Test B.

1. Check the GRY (923) wire for an open or short to ground. If OK replace the Instrument Cluster (see section 8C).

KEY DUPLICATION PROCEDURE

Key Replacement (Spare Key Available)

The J35628 Interrogator or equivalent must be used to determine the proper electrical code of the key.

1. Insert the customer's spare ignition key into the Key Code Reader on the J35628 Interrogator.
2. Press the On-Off rocker switch to the ON position.

3. A number from 1 to 15 will appear in the window designating the electrical code of the key.
4. Cut a new key having the electrical code determined from the J35628 Interrogator.
5. Start the engine using the new key to insure that the key is correct both mechanically and electrically.

Key Replacement (No Spare Key Available)

1. If the Ignition Key is lost and there is no spare key, determine the mechanical code from the code on the Ignition Key Lock Cylinder. The code may also be determined from the dealer invoice for the car, or from the Chevrolet Zone Office.
2. Cut a new key to this mechanical code. Use a blank PASSKEY test key which has no resistance pellet. This key will be used to operate the Ignition Switch for the remaining steps.
3. Remove the hush panel under the steering column and disconnect C281 (two-cavity connector leading into the steering column).
4. Insert the male half of the connector into the female pigtail connector from the J35628 Interrogator.
5. Set the Key Code Selector on the Interrogator (J35628 or equivalent) to "1".
6. Attempt to start engine using the key made in step 2.

- If engine starts, the Key Code Selector is set to the correct electrical code. Cut a new key having this electrical code. The new key will be customer's replacement key.
- If engine does not start, turn Ignition Switch to OFF, then turn the Key Code Selector to the next higher position. Wait four minutes and attempt to start the engine using the new electrical code. Use the 4-minute Timer on the J35628 Interrogator to indicate the 4-minute interval. Start the Timer by depressing the "Start" rocker switch. The red indicator will turn off at the end of a four minute interval.

CIRCUIT OPERATION

Resistor sensing contacts are located in the Ignition Key Lock Cylinder. These contact the Key Resistor Pellet on the key when it is inserted. When the lock is rotated, battery is applied through the C/H Fuse to the PASSKEY Decoder Module. The Pellet resistance is then compared against a fixed resistance in the Module.

If the Key Pellet is the proper resistance, terminal A3 is grounded, energizing the Starter Enable Relay. At the same time, a signal is applied at terminal A2 to enable the Electronic Control Module (ECM). When this signal is received by the Electronic Control Module (ECM), it allows fuel injector pulses to begin.

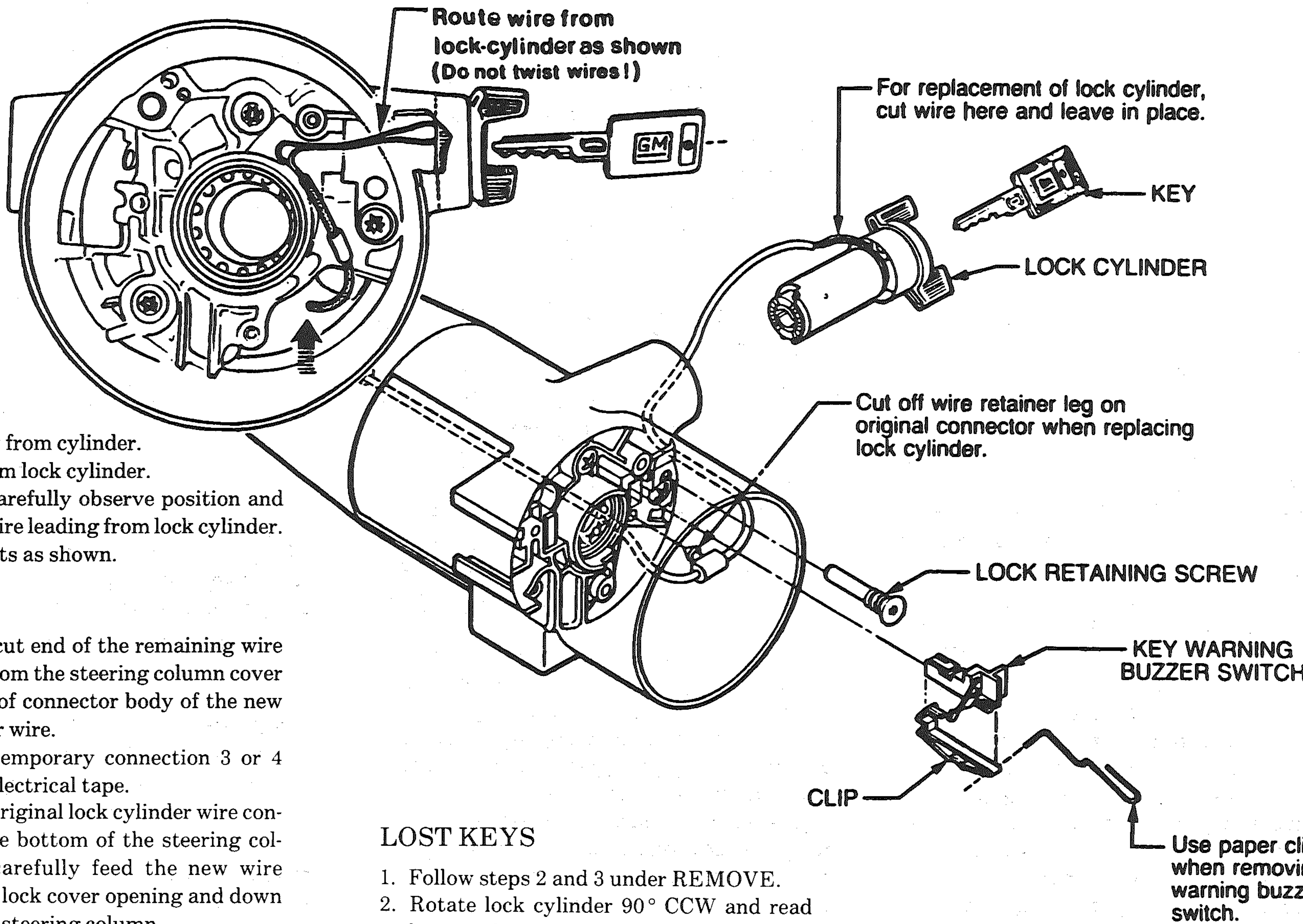
If the Key Resistor Pellet is the wrong value, the PASSKEY Decoder Module will shut down for 2 to 4 minutes. During this interval there will be no output at terminals A3 or A2.

If the Ignition Switch is turned on again during this interval, the Timer will begin over again and the PASSKEY Decoder Module will remain shut down for another 2 to 4 minutes. The PASSKEY Decoder Module will continue this process even if a key with the correct pellet is used to turn the ignition back on. The Timer is restarted by the ignition voltage at terminal A1 when Ignition Switch is turned to RUN.

Once the Timer has completed its 2 to 4 minute cycle with the ignition off, the PASSKEY Decoder Module and Timer are reset. A key having the correct code can then be used to start the engine.

The Security Indicator is controlled directly by the PASSKEY Decoder Module. If there is a PASSKEY Failure this indicator will be grounded by the PASSKEY Decoder Module with the ignition in RUN, BULB TEST or START. When the Ignition Switch is first placed in RUN, BULB TEST or START the Indicator lights for about 2 seconds as a bulb check.

REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER



REMOVE

1. Remove key from cylinder.
2. Cut wire from lock cylinder.
3. NOTE — Carefully observe position and routing of wire leading from lock cylinder.
4. Remove parts as shown.

INSTALL

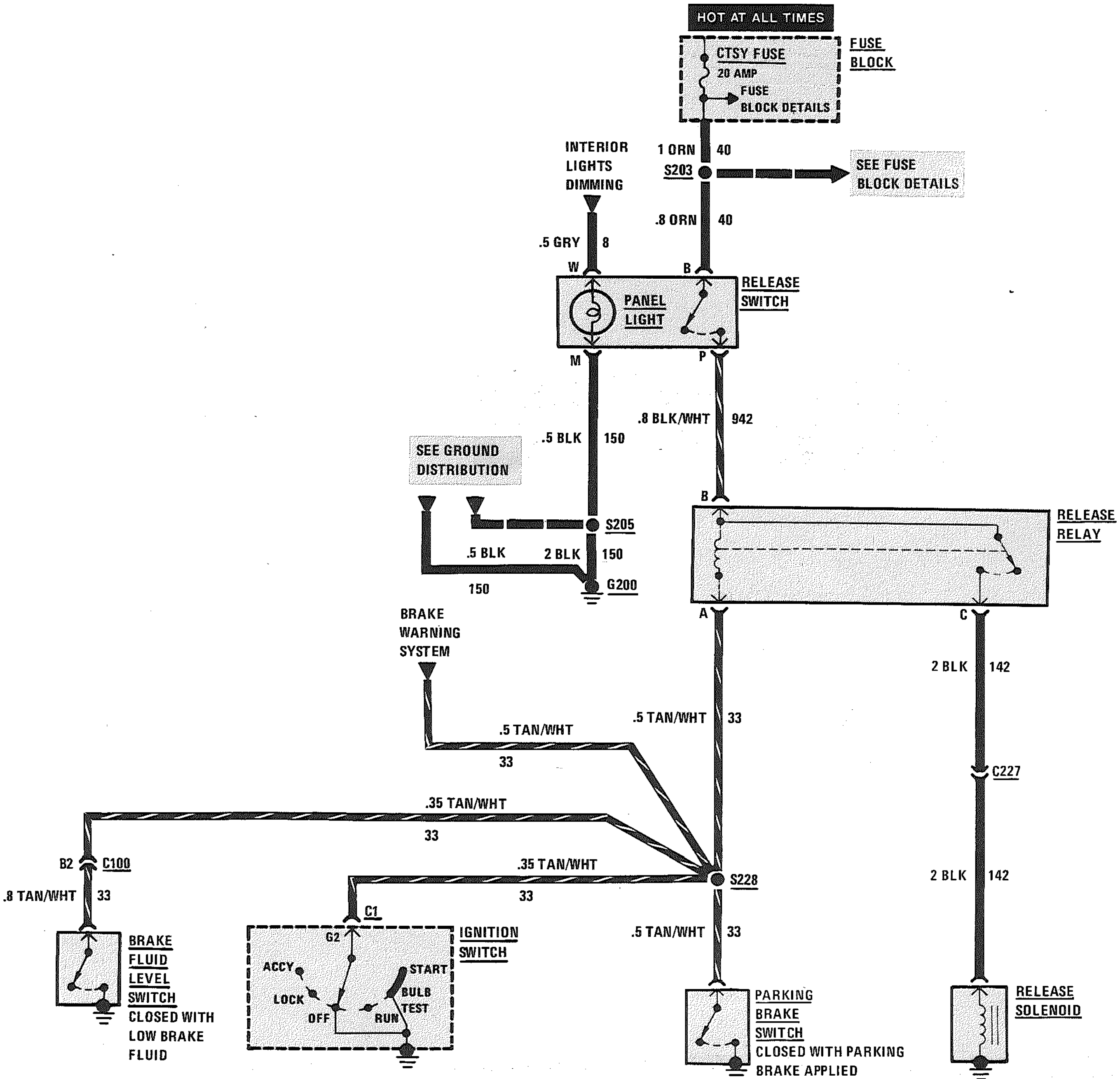
1. Attach the cut end of the remaining wire extending from the steering column cover to the back of connector body of the new lock cylinder wire.
2. Wrap this temporary connection 3 or 4 times with electrical tape.
3. Pull on the original lock cylinder wire connector at the bottom of the steering column, and carefully feed the new wire through the lock cover opening and down through the steering column.
4. Route wire as it originally was and insert wire retaining grommet.

LOST KEYS

1. Follow steps 2 and 3 under REMOVE.
2. Rotate lock cylinder 90° CCW and read key number.
3. Reinstall lock cylinder and route attached wire as shown.

BLANK

HATCH RELEASE



HATCH RELEASE

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Diagnosis.**

1. Check the CTSY Fuse by operating the Radio.
2. Check that the Hatch Release Solenoid case ground is clean and tight.
3. Check the Parking Brake Switch by applying Parking Brake with Ignition Switch in RUN and observing the BRAKE Indicator.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Press Hatch Release button with the Park Brake Applied	Hatch Lid Unlatches

SYSTEM DIAGNOSIS

- **Do the tests below if the Hatch Release does not operate properly.**

COMPONENT LOCATION

Component	Location	Page-Figure
Brake Fluid Level Switch	Below brake fluid reservoir	201-16-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Ignition Switch	Behind I/P, on top side of steering column	201- 9-A
Parking Brake Switch	In console, at base of parking brake	201-12-D
Release Relay	Taped to I/P harness, behind RH side of I/P	201-13-A
Release Solenoid	On center of end panel	201-16-C
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C227 (1 cavity)	Behind LH side of I/P, at shroud	
G200	Behind I/P, left of steering column	201-10-A
S203	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S228	I/P harness, above Fuse Block	201-10-A

HATCH RELEASE TEST (TABLE 1)

Measure: VOLTAGE
At: RELEASE SOLENOID CONNECTOR (Disconnected)
Condition:
- **Parking Brake: APPLIED**

Measure Between	Correct Voltage	For Diagnosis
BLK & Ground	0 Volts	See 1

- Hatch Release button pressed

(Continued in next column)

(Continued from previous column)

Measure Between	Correct Voltage	For Diagnosis
BLK & Ground	Battery	See 1

- If both voltages are correct, repair/replace Hatch Release Solenoid.

1. Reconnect Solenoid and go to Table 2.

(Continued on next page)

HATCH RELEASE

(Continued from previous page)

HATCH RELEASE TEST (TABLE 2)

Measure: VOLTAGE
At: HATCH RELEASE SWITCH CONNECTOR (Connected)

Measure Between	Correct Voltage	For Diagnosis
B (ORN) & Ground	Battery	See 1
• Release Switch Depressed		
P (BLK/WHT) & Ground	Battery	See 2

- If both voltages are correct, go to Table 3.

1. Check/Repair ORN (40) wire.
2. Replace the Hatch Release Switch.

HATCH RELEASE TEST (TABLE 3)

Measure: VOLTAGE
At: RELEASE RELAY CONNECTOR (Disconnected)
Conditions:
- **Release Switch: DEPRESSED (hold)**
- **Parking Brake: APPLIED**
- **Ignition Switch: LOCK**

Measure Between	Correct Voltage	For Diagnosis
B (BLK/WHT) & Ground	Battery	See 1
B (BLK/WHT) & A (TAN/WHT)	Battery	See 2
• Parking Brake: RELEASED • Ignition Switch: OFF		
B (BLK/WHT) & A (TAN/WHT)	Battery	See 3

(Continued in next column)

(Continued from previous column)

- If all voltages are correct, go to Table 4.

1. Check/repair BLK/WHT (40) wire.
2. Check/repair TAN/WHT (33) wire and Parking Brake Switch (see schematic).
3. Check/repair TAN/WHT (33) wire and Ignition Switch (see schematic).

HATCH RELEASE TEST (TABLE 4)

Connect: FUSED JUMPER
At: RELEASE RELAY (Disconnected)
Condition:
- **Hatch Release Switch: DEPRESSED**

Jumper Between	Correct Result	For Diagnosis
B (BLK/WHT) & C (BLK)	Hatch opens	See 1

- If the result is correct, replace the Hatch Release Relay.

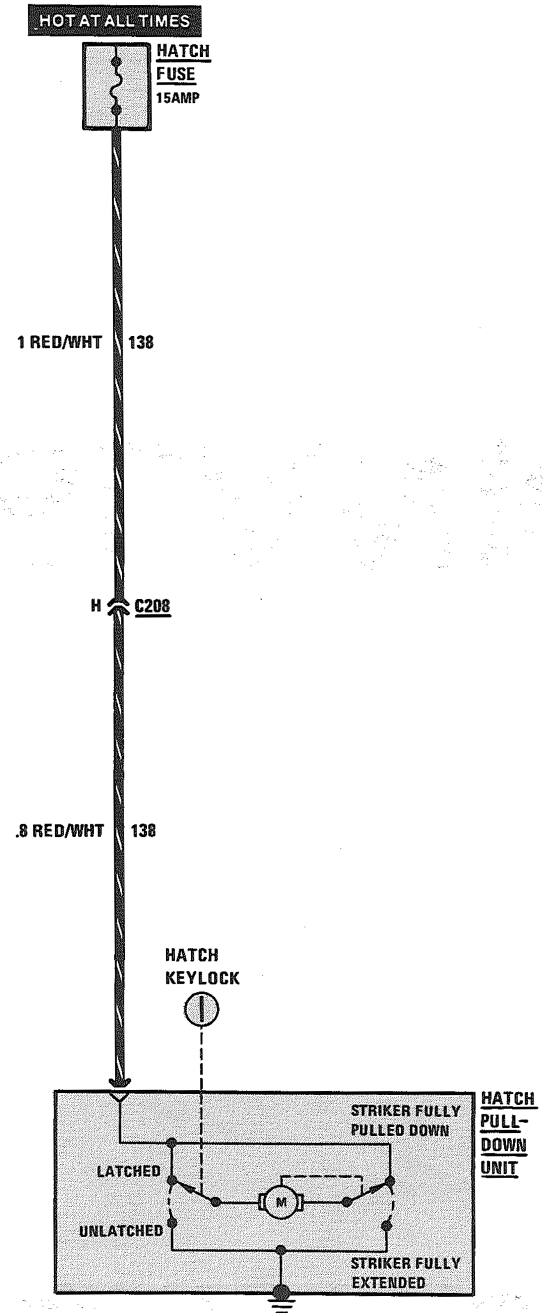
1. Check/repair BLK (142) wire.

CIRCUIT OPERATION

Voltage is applied at all times through the CTSY Fuse to the Release Switch. With the Parking Brake applied, or with the Ignition Switch in OFF, depressing the Release Switch will cause current to flow through the Release Relay coil. The relay operates and voltage is applied to the Release Solenoid. The Solenoid operates and the Hatch opens.

BLANK

HATCH PULL-DOWN



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check that connector on Hatch Pull-Down Unit is firmly seated.
2. Check Hatch Fuse by visual inspection.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to System Diagnosis for diagnostic steps.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Open the Hatch with the vehicle key and raise the lid	Striker rises to maximum height
Lower the Hatch slowly until lock hook on Hatch latches the striker	Striker retracts pulling Hatch closed Caution: to avoid injury keep fingers and clothing away from edge of Hatch while it is closing

COMPONENT LOCATION

		Page-Figure
Hatch Fuse	Attached to side of Fuse Block	
Hatch Pull-Down Unit	Center of end panel, in cargo compartment	201-17-B
C208 (8 cavities)	Behind LH side of rear seat	201-17-C

SYSTEM DIAGNOSIS

- **Do the test below if the Hatch Pull-Down Unit does not operate**

Measure: VOLTAGE
At: HATCH PULL-DOWN UNIT (Connected)
Condition:
- Hatch: OPEN

Measure Between	Correct Voltage	For Diagnosis
RED/WHT & Ground	Battery	See 1

- If voltages are correct but Hatch Pull-Down Unit does not operate, replace Pull-Down Unit. (See Body Section 7 for disassembly procedures).

1. Check RED/WHT (138) wire and Hatch Fuse for an open.

CIRCUIT OPERATION

Opening

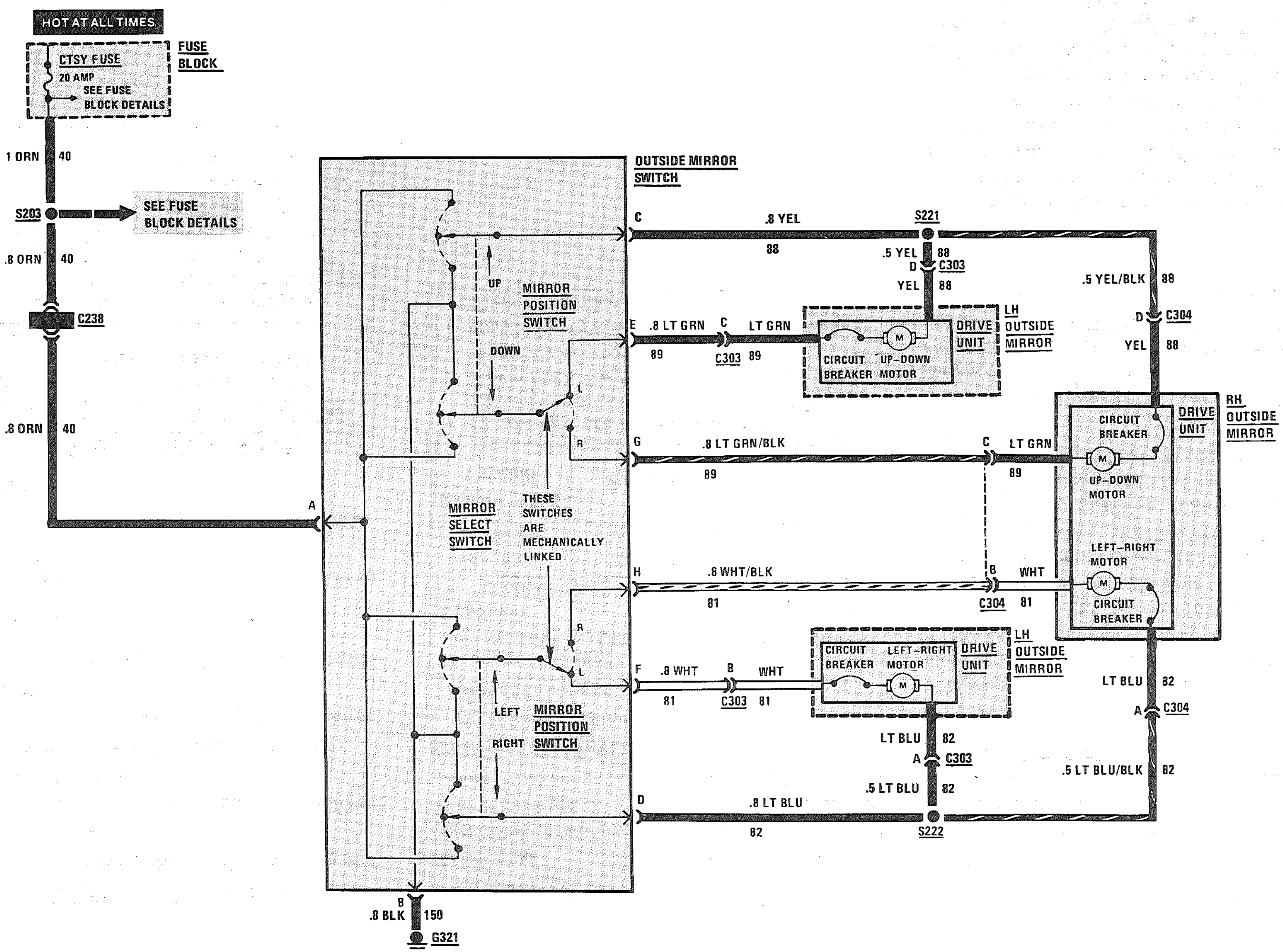
When the Hatch is closed, the Latch contacts and Striker contacts are in the position shown on the schematic. Voltage is applied at all times to the Hatch Pull-Down Unit through the Hatch Fuse and the RED/WHT (138) wire. When the Hatch is opened, the Latch contacts are moved from the LATCHED to the UNLATCHED position. The motor in the Hatch Pull-Down Unit is then grounded through the UNLATCHED path of the Latch contacts.

The motor drives the Striker upward to prepare for closing. When the Striker reaches the fully extended position, the Striker contacts move to the STRIKER FULLY EXTENDED position removing battery voltage from the motor.

Closing

When the Hatch is lowered, the lock hook latches the Striker, moving the Pull-Down Unit Latch contacts to the LATCHED position. Voltage is then applied to the motor in the reverse direction. The motor moves the Striker down, pulling the Hatch closed. Once the Hatch is closed, the Pull-Down Unit Striker contacts move to the STRIKER FULLY PULLED DOWN position removing the ground from the motor.

POWER MIRRORS



POWER MIRRORS

TROUBLESHOOTING HINTS

- Try the following check before doing the System Check.

  Check the CTSY Fuse by checking for operation of the LH courtesy light.
- Go to System Check for a guide to normal operation.
- Go to System Diagnosis for diagnostic tests.

SYSTEM CHECK

- Use the System Check Table as a guide to normal operation.
- Refer to System Diagnosis for a list of symptoms and diagnostic steps.

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
Put the mirror Select Switch in the L position, operate the Mirror Control Switch in the UP and DOWN position	LH Outside Mirror moves smoothly upward and downward
Operate the Mirror Position Switch in the left and right positions	LH Outside Mirror moves smoothly to the left and right
Put the Mirror Select Switch in the R position and operate the Mirror Control Switch in the UP and DOWN positions	RH Outside Mirror moves smoothly upward and downward
Operate the Mirror Position Switch in the LEFT and RIGHT positions	RH Outside Mirror moves smoothly to the left and right

- Refer to System Diagnosis when a result is not normal.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C238 (12 cavities)	LH shroud, ahead of center access hole	201-11-C
C303 (4 cavities)	LH shroud, near center access hole	
C304 (4 cavities)	RH shroud, near center access hole	
G321	In center console, below switches	
S203	I/P harness, behind instrument cluster	201-10-A
S221	Mirror harness, LH shroud at center access hole	
S222	Mirror harness, LH shroud at center access hole	

SYSTEM DIAGNOSIS

- Diagnostic steps for the symptoms listed in the following table are listed after the table.

SYMPTOM TABLE

A: Both mirrors do not operate in any mode
B: LH mirror does not operate in one or more mode
C: RH mirror does not operate in one or more mode

A: BOTH MIRRORS DO NOT OPERATE IN ANY MODE

Measure: VOLTAGE
At: OUTSIDE MIRROR SWITCH CONNECTOR (Disconnected)

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Battery	See 1

(A: BOTH MIRRORS DO NOT OPERATE IN ANY MODE continued on next page)

(A: BOTH MIRRORS DO NOT OPERATE IN ANY MODE continued from previous page)

A (ORN) & B (BLK)	Battery	See 2

- If both voltages are correct, replace the Outside Mirror Switch.

1. Check ORN (40) wire.
2. Check BLK (150) wire

B: LH MIRROR DOES NOT OPERATE IN ONE OR MORE MODE

Measure: VOLTAGE
At: OUTSIDE MIRROR SWTICH CONNECTOR (Connected)
Conditions:
- **Mirror Select Switch: L**
- **Hold Mirror Position Switch in UP or DOWN position**

Measure Between	Correct Voltage	For Diagnosis
C (YEL) & E (LT GRN)	Battery	See 1

- Hold Mirror Position Switch in the Left or Right position.

D (LT BLU) & F (WHT)	Battery	See 1

- If both voltages are correct, replace the LH Outside Mirror Drive Unit, after checking connector C303, the YEL (88), LT GRN (89), LT BLU (82) and WHT (81) wires.

1. Replace Outside Mirror Switch.

C: RH MIRROR DOES NOT OPERATE IN ONE OR MORE MODE

Measure: VOLTAGE
At: OUTSIDE MIRROR SWITCH CONNECTOR (Connected)
Conditions:
- **Mirror Select Switch: R**
- **Hold Mirror Position Switch in UP or DOWN position**

Measure Between	Correct Voltage	For Diagnosis
C (YEL) & G (LT GRN/ BLK)	Battery	See 1

- Hold Mirror Position Switch in the Left or Right position.

H (WHT/ BLK) & D (LT BLU)	Battery	See 1

- If both voltages are correct, replace the RH Outside Mirror Drive Unit, after checking connector C304 and the YEL (88), LT GRN/BLK (89), and LT BLU (82) wires.

1. Replace Outside Mirror Switch.

CIRCUIT OPERATION

Each Outside Mirror has two reversible Motors: one to adjust the mirror view up and down, the other to adjust the mirror view Right and Left. The driver operates four Switches that control the polarity of the voltage to the Motors. The Mirror Select Switch directs these control voltages to either the RH or LH Outside Mirror.

With the Switches in the positions shown in the schematic, the LH Outside Mirror is moved. When the Mirror Position Switch is moved to the UP position, battery voltage from the ORN wire is applied to the YEL or YEL/BLK wire and the Up-Down Motor in each Outside Mirror. The LH Outside Mirror Up-Down Motor, has a path to ground through the LT GRN wire, the Up contacts of the Mirror Position Switch, and the BLK wire. The LH Up-Down Motor runs and turns the mirror up.

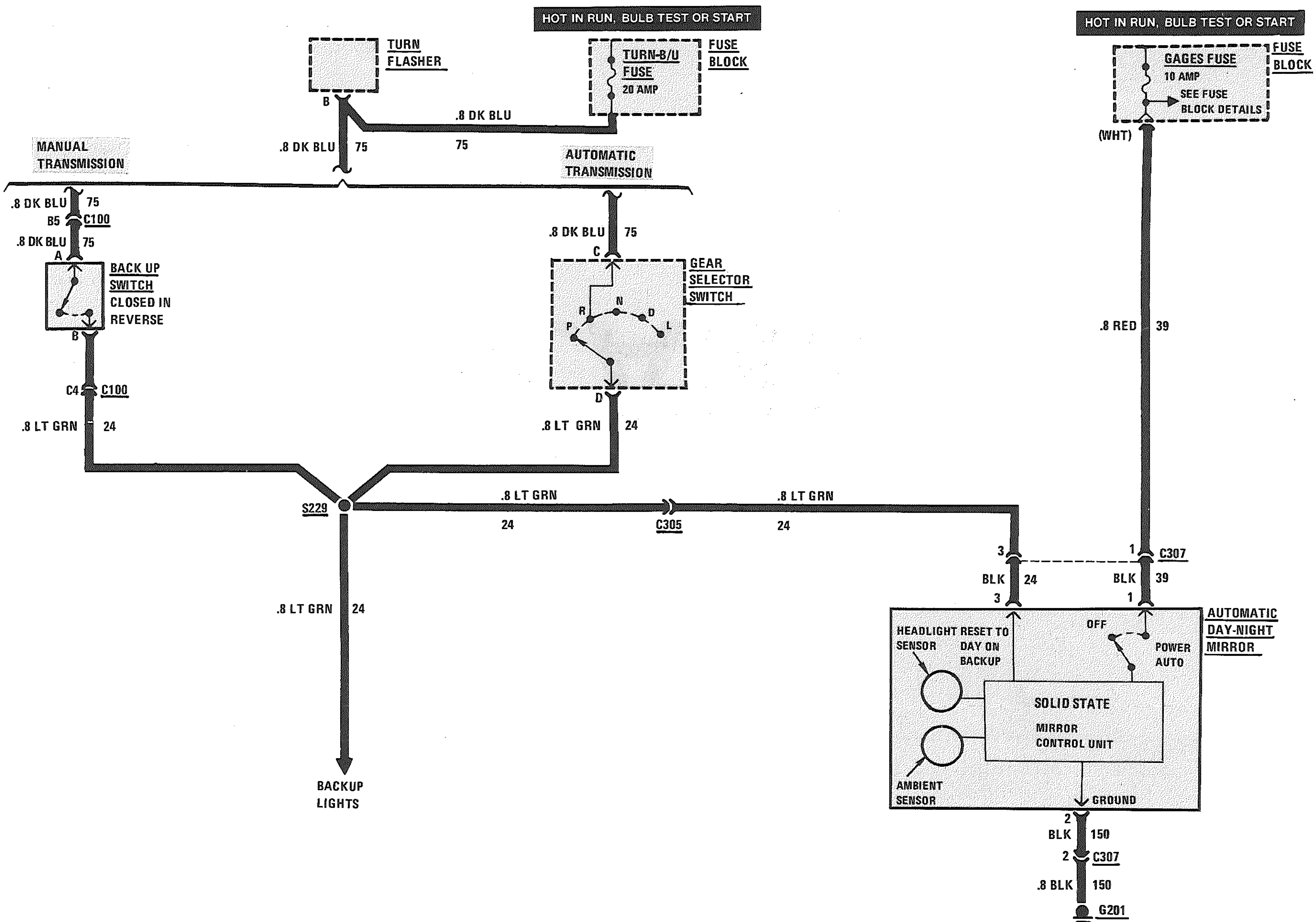
If the Mirror Switch Position is pushed to the DOWN position, the same Motor receives voltage. Now the polarity is reversed, with the YEL or YEL/BLK wires grounded. The Motor runs in the opposite direction.

The RH Left-Right Motor operates in a similar manner when the Mirror Position Switch is moved to the LEFT position. The WHT wire gets battery voltage and the LT BLU wire is grounded through the Mirror Position Switch. If the Mirror Position Switch is pushed to the RIGHT position, the polarity is reversed and the motor will run in the opposite direction.

The RH Outside Mirror works in the same way as the LH Outside Mirror when the Mirror Select Switch is moved to the R position and the Mirror Position Switch is operated.

BLANK

AUTOMATIC DAY-NIGHT MIRROR



AUTOMATIC DAY-NIGHT MIRROR

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check TURN B/U Fuse and the Gear Selector Switch (Automatic Transmission) or Back Up Switch (Manual Transmission) by checking operation of the Back Up Lights.
2. Check GAGES Fuse by observing the BRAKE Indicator with the Park Brake applied and Ignition Switch in RUN.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With Ignition Switch in RUN, cover the front side of the mirror with cardboard Put the Automatic Day-Night Switch in AUTO Shine a light on the mirror	Mirror will shift to the low reflectance (nighttime) position
Turn off light	Mirror will shift to the high reflectance (daytime) position

(Continued in next column)

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Shine light on mirror	Mirror will shift to the low reflectance (nighttime) position
Put Gear Selector in R (Reverse) position Keep light shining on mirror	Mirror will shift to the high reflectance (daytime) position
Put Gear Selector in P (Park) position Keep light shining on mirror	Mirror will shift to the low reflectance (nighttime) position

(Continued in next column)

(Continued from previous column)

Put Automatic Day-Night Mirror switch in the OFF position	Mirror will shift to the high reflectance (daytime) position

- **Refer to System Diagnosis when a result is not normal.**

COMPONENT LOCATION

		Page-Figure
Back Up Switch	On LH side of transmission	201- 8-F
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Gear Selector Switch	In console, at base of gear selector	201-11-E
Turn Flasher	Behind I/P, to right of steering column	201- 9-A
C100 (42 cavities)	LH front of dash, left of brake master cylinder	201- 0-A
C305 (1 cavity)	Under LH side of I/P	
C307 (3 cavities)	Center of windshield header	
G201	Top center of windshield header	
S229	I/P harness, behind LH side of I/P	201-10-A

(Continued on next page)

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SYSTEM DIAGNOSIS

- **Do the tests below if the Automatic Day-Night Mirror does not operate correctly.**

AUTOMATIC DAY-NIGHT MIRROR VOLTAGE TEST

Measure: VOLTAGE
At: AUTOMATIC DAY-NIGHT MIRROR CONNECTOR (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Gear Selector: REVERSE**

Measure Between	Correct Voltage	For Diagnosis
3 (BLK) & Ground	Battery	See 1
• Gear Selector: NEUTRAL		
3 (BLK) & Ground	0 volts	See 2
1 (BLK) & Ground	Battery	See 3
1 (BLK) & 2 (BLK)	Battery	See 4

- If all voltages are correct, replace Automatic Day-Night Mirror.

1. Check BLK and LT GRN (24) wires for an open. If Back Up lights do not operate, check Gear Selector Switch adjustment (automatic) or Back Up Switch adjustment (manual). If adjustment does not correct the problem, refer to 8A-112 for diagnosis.

(Continued from previous column)

2. Check Gear Selector Switch adjustment (automatic) or Back Up Switch adjustment (manual). Replace suspect switch if adjustment does not correct the problem.
3. Check BLK and RED (39) wire for an open.
4. Check BLK (150) wire for an open.

CIRCUIT OPERATION

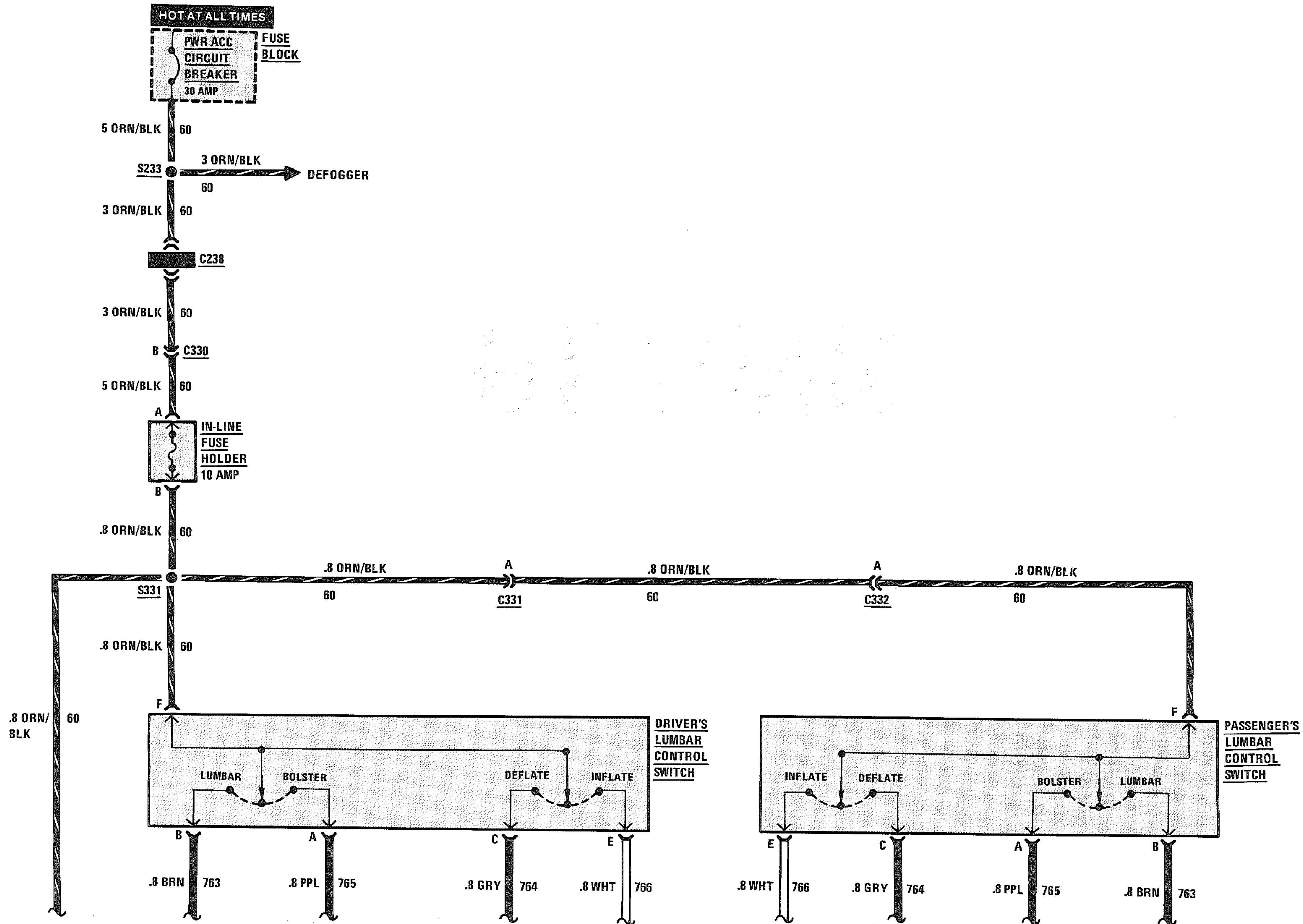
The Automatic Day-Night Mirror is automatically moved to the DAY and NIGHT positions as light conditions change. The Headlight and Ambient Sensors read the light conditions and feed this information to the solid state mirror control unit. The control unit activates the Motor that drives the mirror.

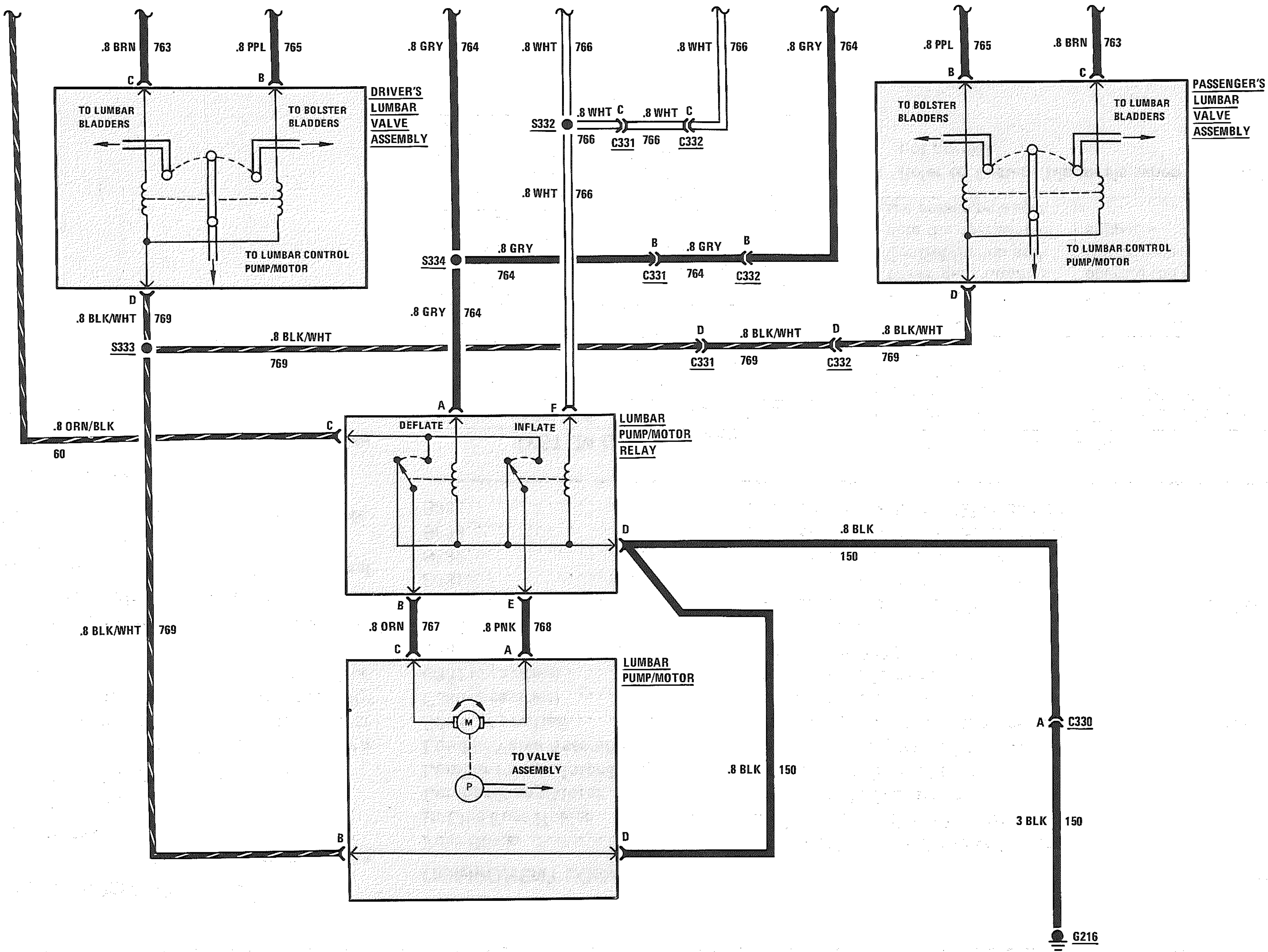
With the Gear Selector in Reverse, battery voltage is applied through the Gear Selector Switch or Back Up Switch to the reset input of the mirror. If the mirror is in the NIGHT position, it changes to the DAY position. This provides a clear view for backing the car.

A distance or sensitivity control changes the brightness required from the headlights of the car behind to cause the mirror to shift to the NIGHT position.

BLANK

LUMBAR AND BOLSTER SUPPORT





.8 BRN 763
.8 PPL 765
.8 GRY 764
.8 WHT 766
DRIVER'S LUMBAR VALVE ASSEMBLY
TO LUMBAR BLADDERS
TO BOLSTER BLADDERS
TO LUMBAR CONTROL PUMP/MOTOR
PASSENGER'S LUMBAR VALVE ASSEMBLY
S332
S334
S333
C331
C332
.8 BLK/WHT 769
.8 ORN/BLK 60
LUMBAR PUMP/MOTOR RELAY
DEFLATE
INFLATE
.8 BLK 150
.8 ORN 767
.8 PNK 768
LUMBAR PUMP/MOTOR
TO VALVE ASSEMBLY
M
P
C330
3 BLK 150
G216

LUMBAR AND BOLSTER SUPPORT

TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the In-Line Fuse.
2. Check the PWR ACC Circuit Breaker.
3. If the Lumbar Pump/Motor runs, but both driver's and passenger's Lumbar and Bolster Supports do not operate, check the continuity to ground of BLK/WHT (769) wire (see schematic).
4. Check the hose between the Valve Assemblies and the Pump/Motor for leaks or cracks.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

COMPONENT LOCATION

Component	Location	Page-Figure
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
In-Line Fuse Holder	Taped to C331, below LH front seat	
Lumbar Pump/Motor	Underside of LH front side	
Lumbar Pump/Motor Relay	Underside of LH front seat	
Lumbar Valve Assembly	Underside of respective front seat	
C238 (12 cavities)	LH shroud, ahead of center access hole	201-11-C
C330 (2 cavities)	Underside of LH front seat	
C331 (4 cavities)	Underside of LH front seat	
C332 (4 cavities)	Underside of RH front seat	
G216	At LH shroud	
S233	I/P harness, above Fuse Block	201-10-A
S331	Lumbar harness, below LH front seat	
S332	Lumbar harness, below LH front seat	
S333	Lumbar harness, below LH front seat	
S334	Lumbar harness, below LH front seat	

SYSTEM CHECK TABLE

SET CONTROLS	NORMAL OPERATION
Driver's Lumbar Control Switch: BOLSTER and INFLATE	The Bolster Support on the driver's seat inflates
Driver's Lumbar Control Switch: LUMBAR and INFLATE	The Lumbar Support on the driver's seat inflates
Driver's Lumbar Control Switch: BOLSTER and DEFLATE	The Bolster Support on the driver's seat deflates
Driver's Lumbar Control Switch: LUMBAR and DEFLATE	The Lumbar Support on the driver's seat deflates
Repeat the above settings using the Passenger's Lumbar Control Switch and note the operation of the passenger's seat	The supports in the passenger's seat operate the same as the driver's seat supports

(Continued in next column)

(Continued from previous column)

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- **Do the tests listed for your symptom in the Symptom Table.**
- **Tests follow the Symptom Table.**

SYMPTOM TABLE

SYMPTOM	DO TEST
Neither Lumbar Control causes the supports to inflate or deflate	A: Lumbar Control Pump/Motor Relay Test
Lumbar and/or Bolster Supports do not operate in the driver's seat only	B: Lumbar Control Switch Test
Lumbar and/or Bolster Supports do not operate in the passenger's seat only	B: Lumbar Control Switch Test

A: LUMBAR CONTROL PUMP/MOTOR RELAY TEST (TABLE 1)

Measure: VOLTAGE
At: LUMBAR PUMP/MOTOR RELAY CONNECTOR (Disconnected)
Condition:
- **Driver's Lumbar Control Switch: DEFLATE**

Measure Between	Correct Voltage	For Diagnosis
C (ORN/ BLK) & Ground	Battery	See 1
C (ORN/ BLK) & D (BLK)	Battery	See 2
A (GRY) &Ground	Battery	See 3
• Driver's Lumbar Control Switch: INFLATE		
F (WHT) & Ground	Battery	See 4

- If voltages are correct, go to Table 2.

1. Check ORN/BLK (60) wire for an open (see schematic).
2. Check BLK (150) wire for an open (see schematic).
3. Check GRY (764) wire for an open (see schematic).
4. Check WHT (766) wire for an open (see schematic).

A: LUMBAR CONTROL PUMP/MOTOR RELAY TEST (TABLE 2)

Connect: FUSED JUMPER
At: LUMBAR PUMP/MOTOR RELAY CONNECTOR (Disconnected)
Condition:
- **Driver's Lumbar Control Switch: LUMBAR**

Jumper Between	Correct Result	For Diagnosis
C (ORN/ BLK)& E (PNK) and B (ORN) & D (BLK)	Driver's Lumbar Support inflates	See 1
C (ORN/BLK) & B (ORN) and E (PNK) & D (BLK)	Driver's Lumbar Support deflates	See 1

- If results are correct, replace the Lumbar Pump/Motor Relay.

1. Check ORN (767) and PNK (768) wires and connectors for continuity. If the connections and wires are good, replace the Lumbar Pump/Motor.

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B: LUMBAR CONTROL SWITCH TEST

Measure: VOLTAGE
At: DRIVER'S OR PASSENGER'S LUMBAR CONTROL SWITCH (Connected)
Condition:
- **Lumbar Control Switch: LUMBAR & INFLATE**

Measure Between	Correct Voltage	For Diagnosis
F (ORN/BLK) & Ground	Battery	See 1
B (BRN) & Ground	Battery	See 2
E (WHT) & Ground	Battery	See 2
• Lumbar Control Switch: BOLSTER & DEFLATE		
A (PPL) & Ground	Battery	See 2
C (GRY) & Ground	Battery	See 2

- If voltages are correct, do Test C.

1. Check In-Line Fuse and ORN/BLK (60) wire for an open.
2. Check In-Line Fuse. If blown, check attached wire for a short to ground. Otherwise, replace Lumbar Control Switch.

C: LUMBAR VALVE ASSEMBLY TEST

Measure: VOLTAGE
At: DRIVER'S OR PASSENGER'S LUMBAR VALVE ASSEMBLY CONNECTOR (Disconnected)
Condition:
- **Lumbar Control Switch: LUMBAR**

Measure Between	Correct Voltage	For Diagnosis
C (BRN) & Ground	Battery	See 1
C (BRN) & D (BRN/WHT)	Battery	See 2
• Lumbar Control Switch: BOLSTER		
B (PPL) & Ground	Battery	See 3

- If voltages are correct, replace the suspect Lumbar Valve Assembly.

1. Check BRN (763) wire for an open.
2. Check BLK/WHT (769) wire for continuity to ground.
3. Check PPL (765) wire for an open.

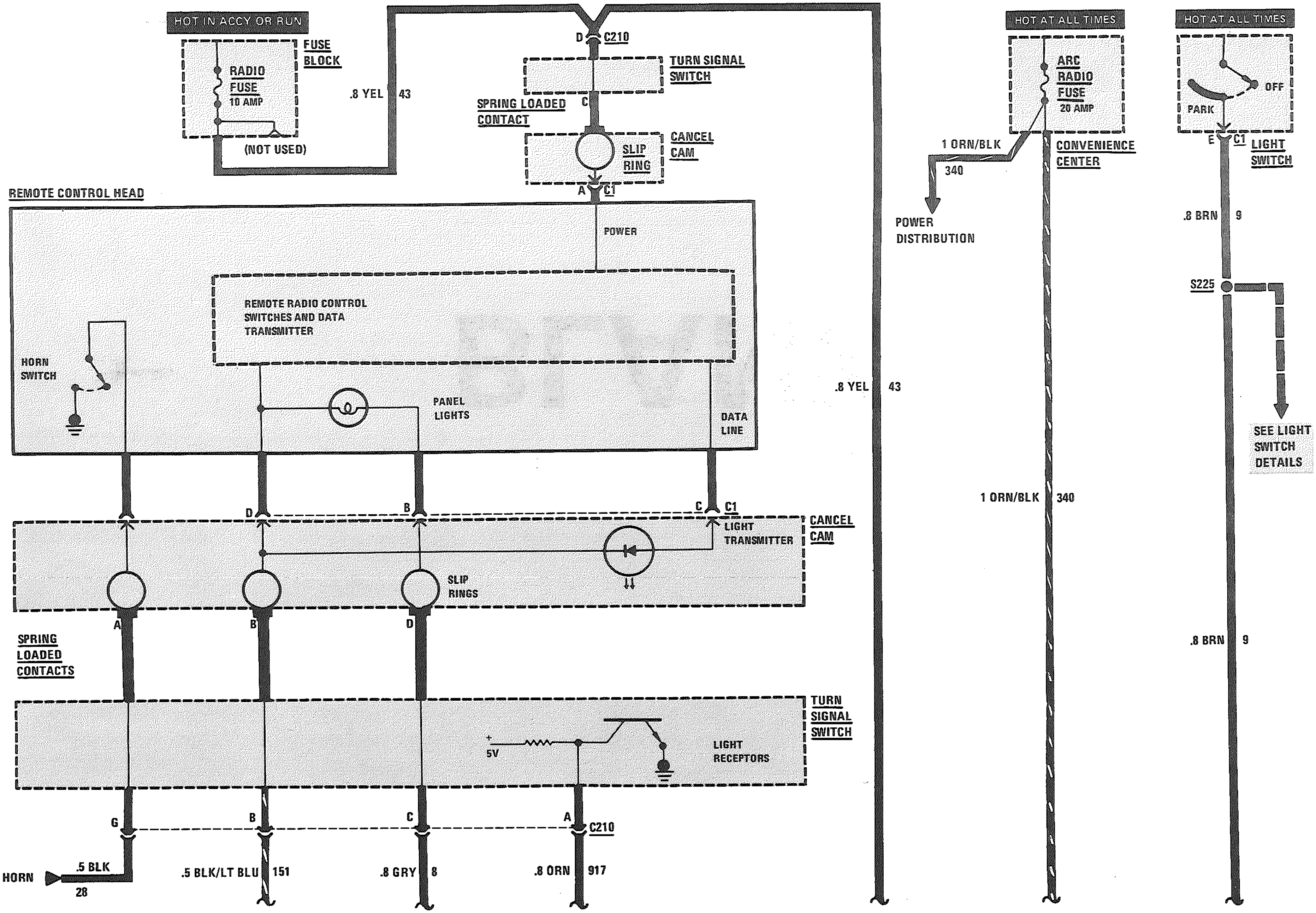
CIRCUIT OPERATION

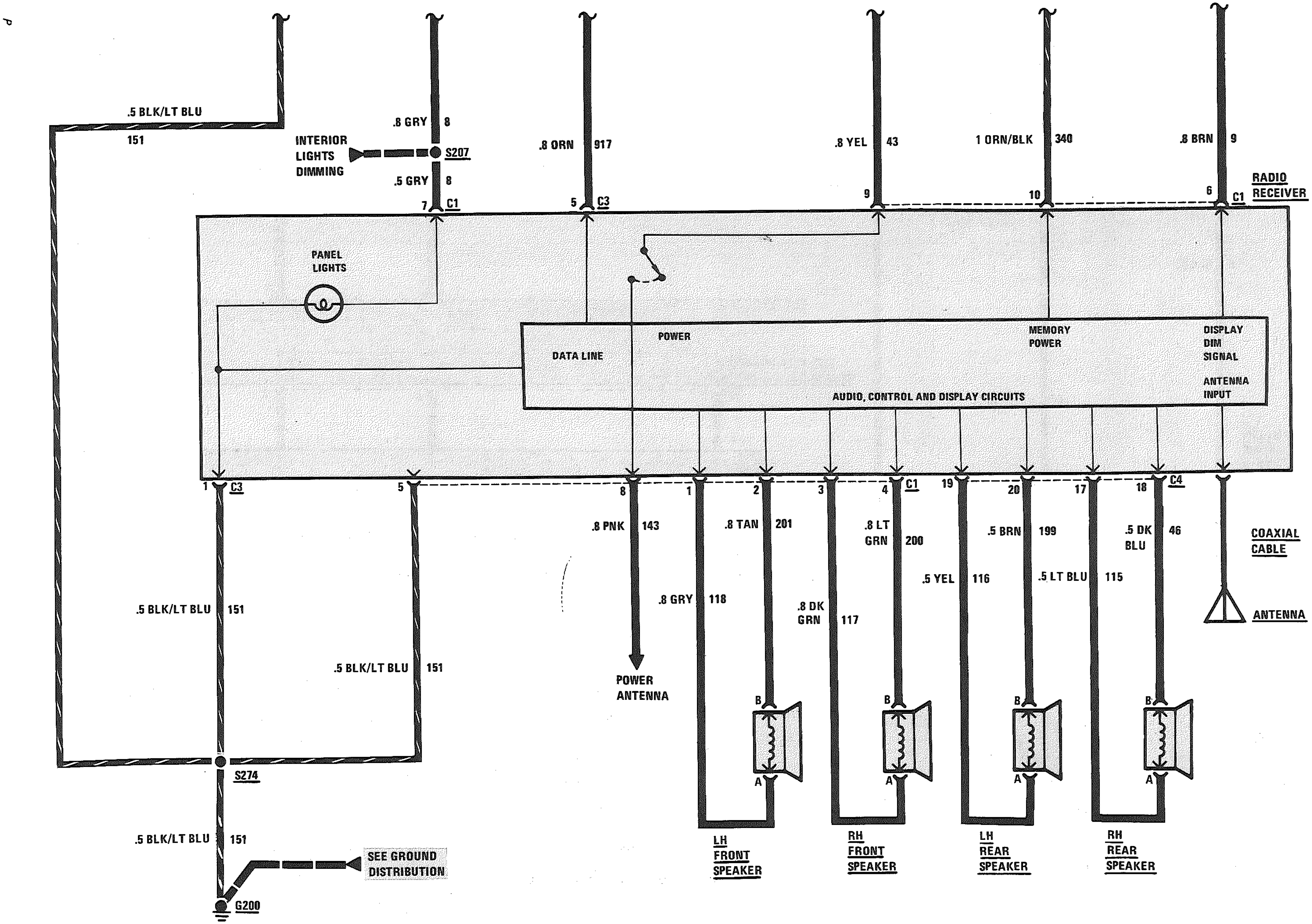
Voltage is applied at all times through the PWR ACC Circuit Breaker. When the Lumbar Control Switch is moved to LUMBAR and INFLATE, the Lumbar Pump/Motor starts to operate to pump up the Lumbar Support. When the Lumbar Control Switch is moved to DEFLATE, the Lumbar Pump Motor reverses to pull the air from the Lumbar Support.

Bolster Support operates in the same manner.

BLANK

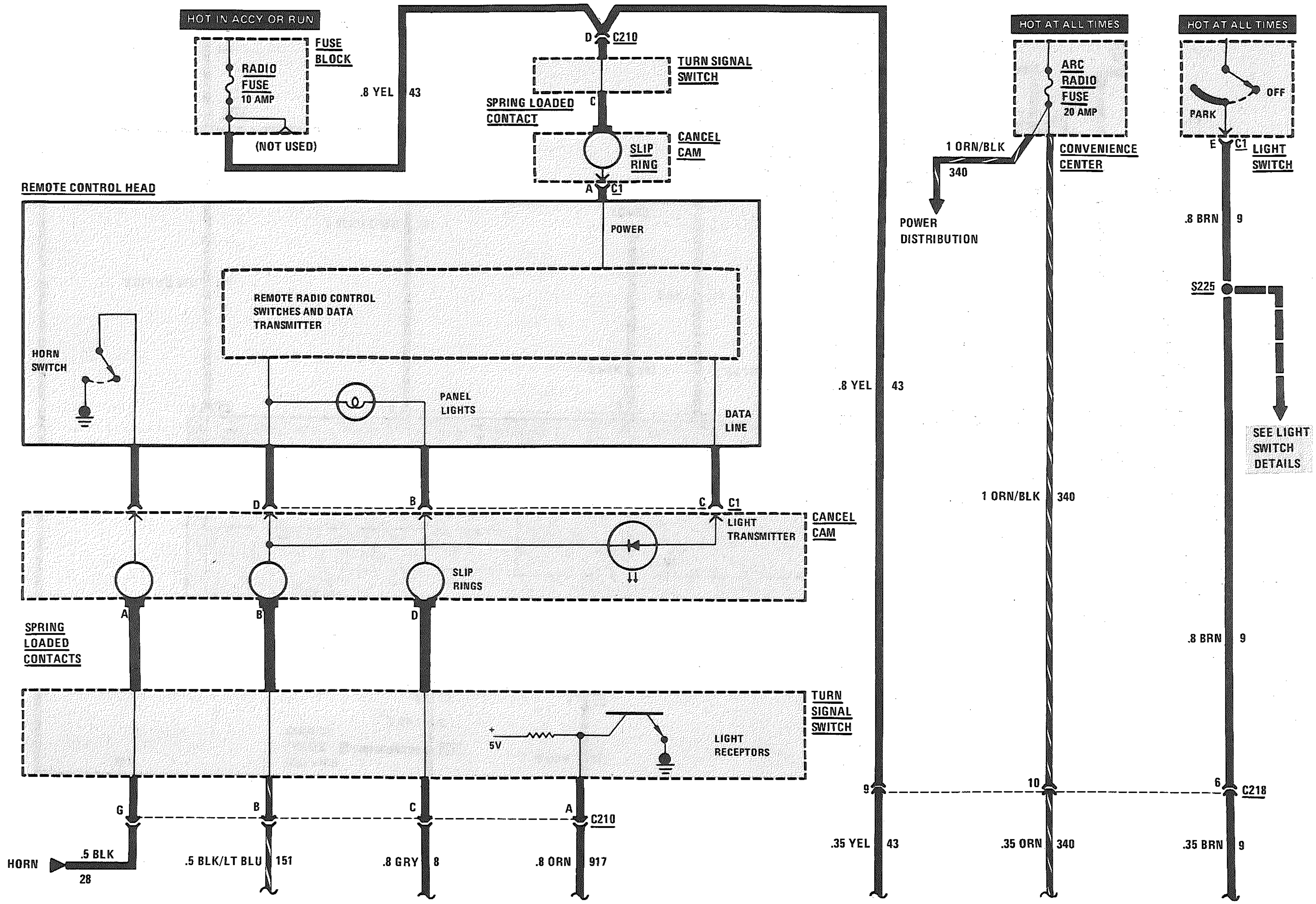
RADIO
WITH UK3

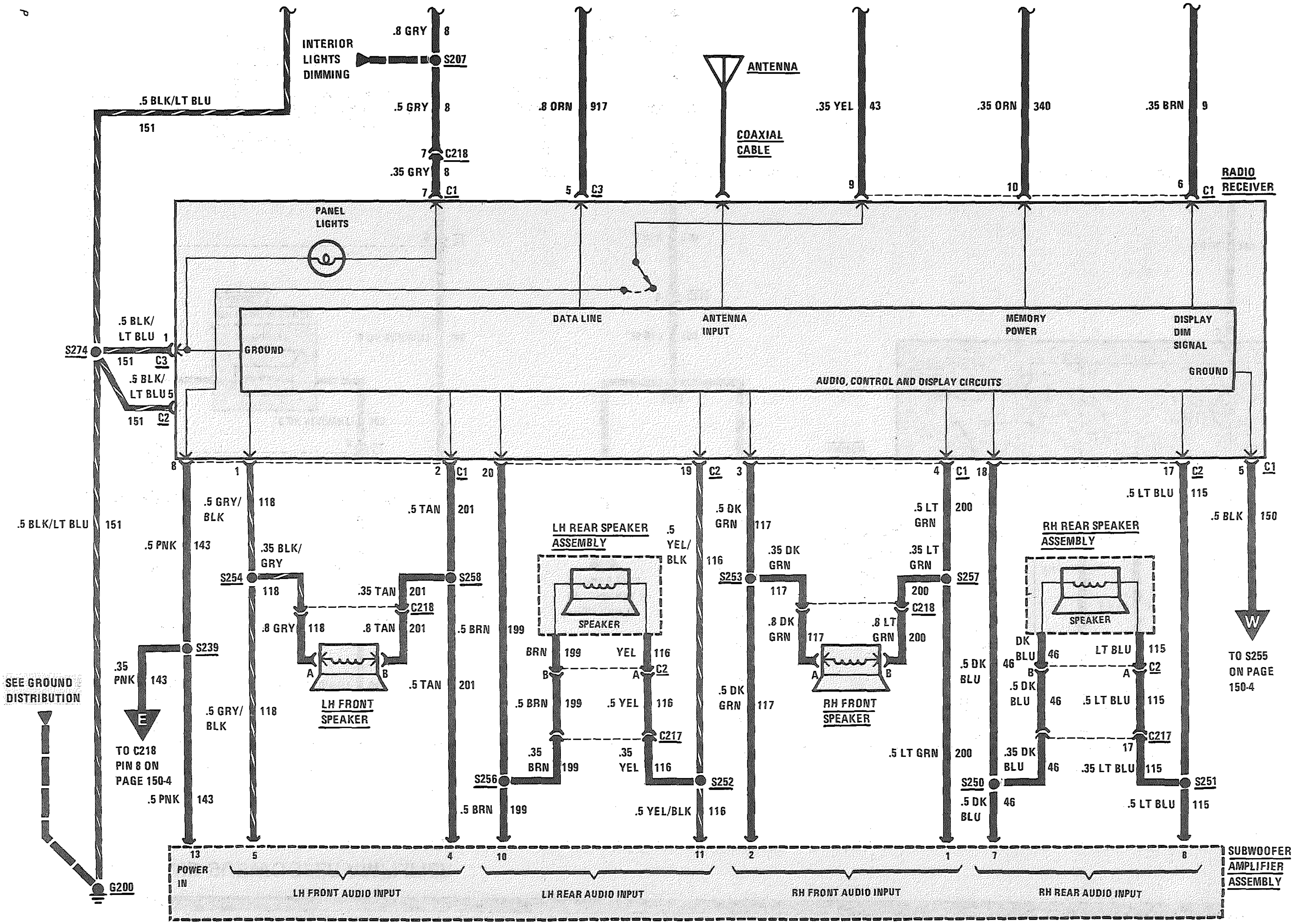



.5 BLK/LT BLU
151
.8 GRY 8
INTERIOR LIGHTS DIMMING
S207
.5 GRY 8
7 C1
.8 ORN 917
5 C3
.8 YEL 43
9
1 ORN/BLK 340
10
.8 BRN 9
6 C1
RADIO RECEIVER
PANEL LIGHTS
DATA LINE
POWER
MEMORY POWER
DISPLAY DIM SIGNAL
ANTENNA INPUT
AUDIO, CONTROL AND DISPLAY CIRCUITS
1 C3
5
8
1
2
3
4 C1
19
20
17
18 C4
.8 PNK 143
.8 TAN 201
.8 LT GRN 200
.5 BRN 199
.5 DK BLU 46
COAXIAL CABLE
.8 GRY 118
.8 DK GRN 117
.5 YEL 116
.5 LT BLU 115
ANTENNA
.5 BLK/LT BLU 151
.5 BLK/LT BLU 151
POWER ANTENNA
B
A
S274
LH FRONT SPEAKER
RH FRONT SPEAKER
LH REAR SPEAKER
RH REAR SPEAKER
.5 BLK/LT BLU 151
SEE GROUND DISTRIBUTION
G200

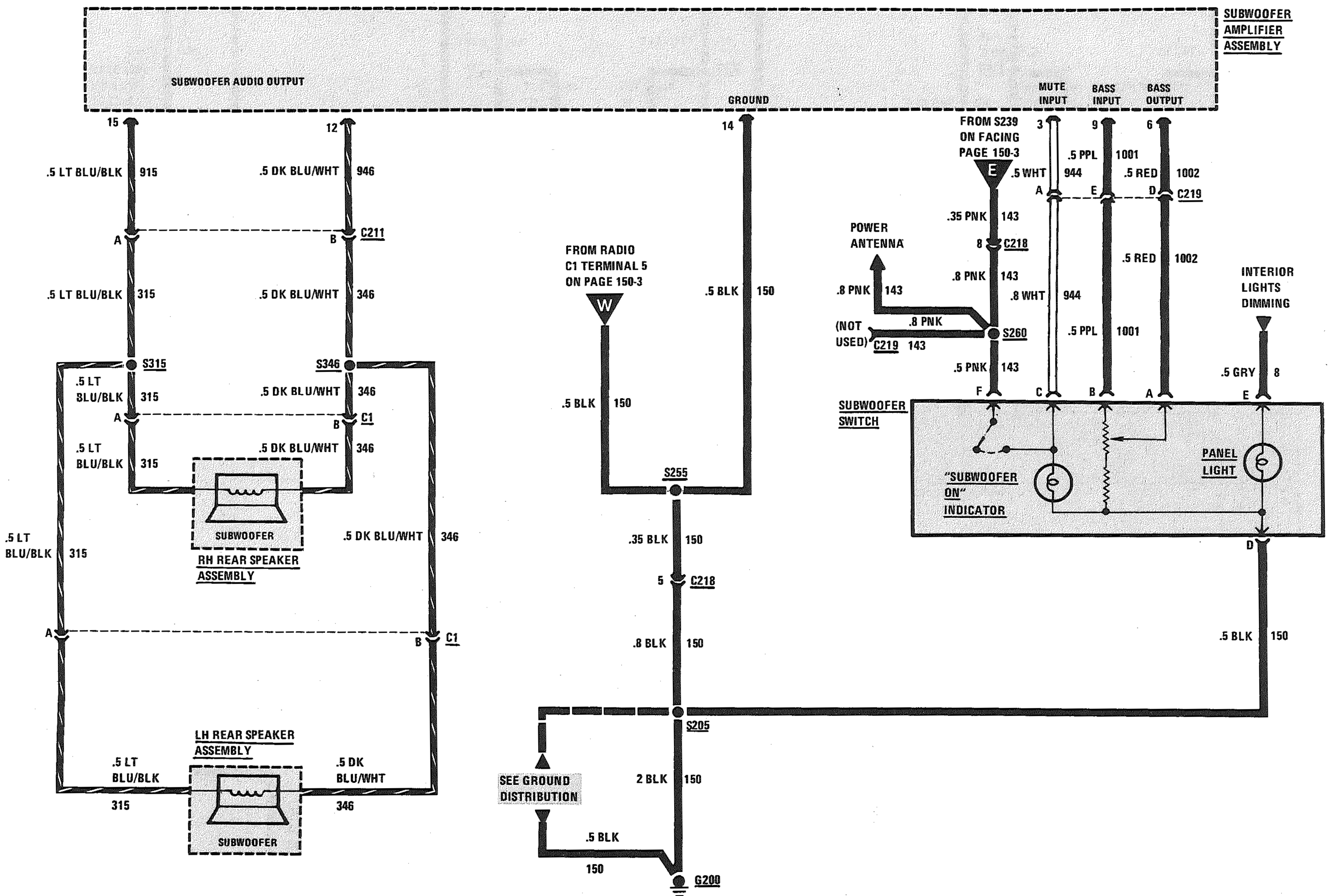
RADIO

WITH UK3 AND SUBWOOFER AMPLIFIER



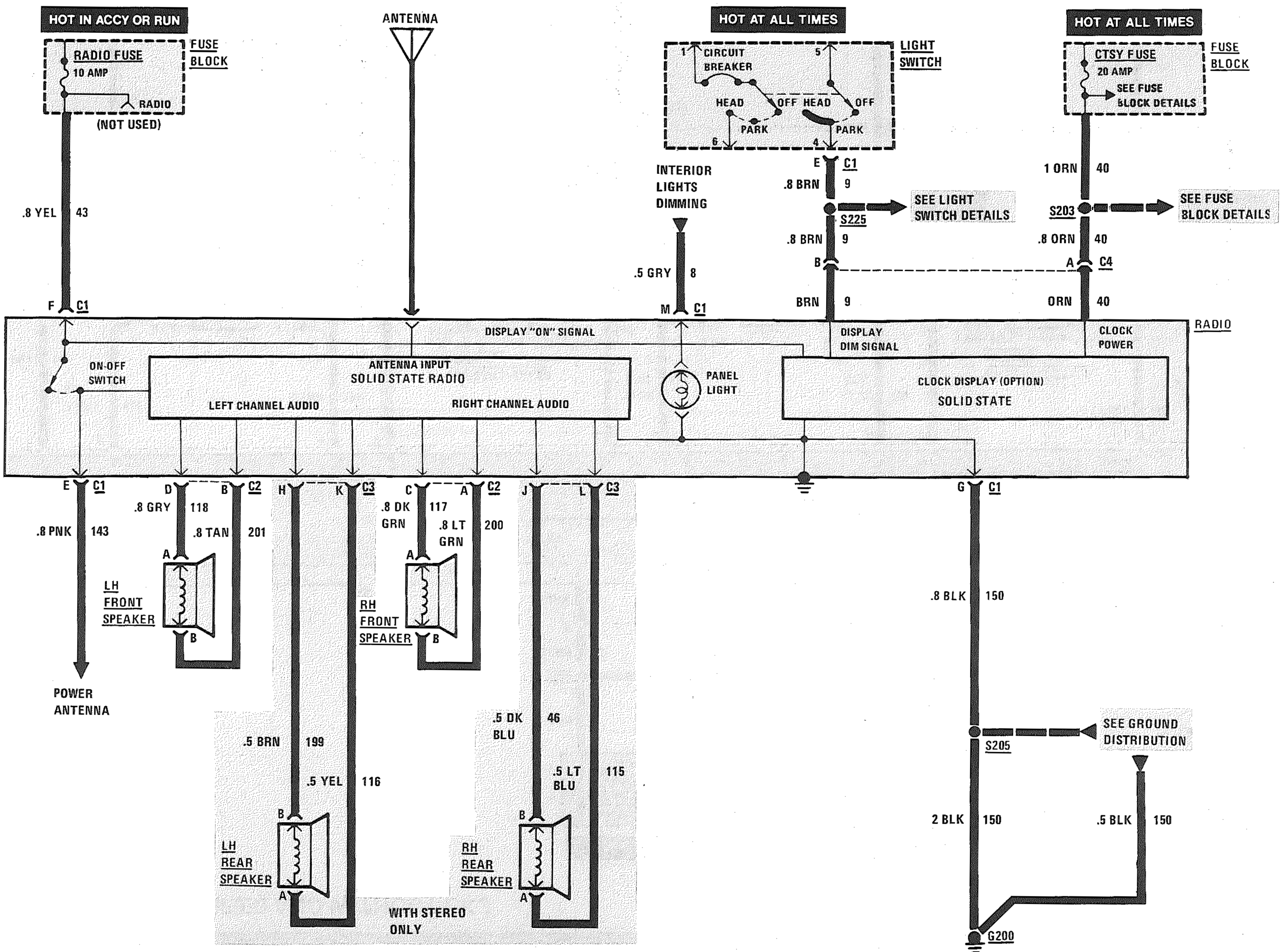

INTERIOR LIGHTS DIMMING
.8 GRY 8
S207
.5 GRY 8
7 C218
.35 GRY 8
7 C1
.5 BLK/LT BLU
151
.8 ORN 917
5 C3
ANTENNA
COAXIAL CABLE
.35 YEL 43
9
.35 ORN 340
10
.35 BRN 9
6 C1
RADIO RECEIVER
PANEL LIGHTS
DATA LINE
ANTENNA INPUT
MEMORY POWER
DISPLAY DIM SIGNAL
GROUND
GROUND
AUDIO, CONTROL AND DISPLAY CIRCUITS
.5 BLK/ LT BLU 1
S274
151 C3
.5 BLK/ LT BLU 5
151 C2
8
1
2 C1
20
19 C2
3
4 C1
18
17 C2
5 C1
.5 BLK/LT BLU 151
.5 PNK 143
.5 GRY/ BLK 118
.35 BLK/ GRY
S254
118
.5 TAN 201
S258
.35 TAN 201
C218
.8 GRY 118
.8 TAN 201
.5 BRN
A
B
LH FRONT SPEAKER
.5 TAN 201
LH REAR SPEAKER ASSEMBLY
.5 YEL/ BLK 116
SPEAKER
199
BRN 199
YEL 116
B
A
C2
.5 BRN 199
.5 YEL 116
C217
.35 BRN 199
.35 YEL 116
S256
S252
.5 BRN 199
.5 YEL/BLK 116
.5 DK GRN 117
.35 DK GRN
S253
117
.5 LT GRN 200
.35 LT GRN
S257
200
C218
.8 DK GRN 117
.8 LT GRN 200
RH FRONT SPEAKER
.5 DK GRN 117
.5 LT GRN 200
RH REAR SPEAKER ASSEMBLY
SPEAKER
.5 LT BLU 115
DK BLU 46
LT BLU 115
.5 DK BLU 46
C2
.5 DK BLU 46
.5 LT BLU 115
C217
17
.35 DK BLU 46
.35 LT BLU 115
S250
S251
.5 DK BLU 46
.5 LT BLU 115
.5 BLK 150
W
TO S255 ON PAGE 150-4
S239
.35 PNK 143
E
TO C218 PIN 8 ON PAGE 150-4
.5 GRY/ BLK 118
.5 PNK 143
SEE GROUND DISTRIBUTION
G200
13
5
4
10
11
2
1
7
8
POWER IN
LH FRONT AUDIO INPUT
LH REAR AUDIO INPUT
RH FRONT AUDIO INPUT
RH REAR AUDIO INPUT
SUBWOOFER AMPLIFIER ASSEMBLY

WITH UK3 AND SUBWOOFER AMPLIFIER



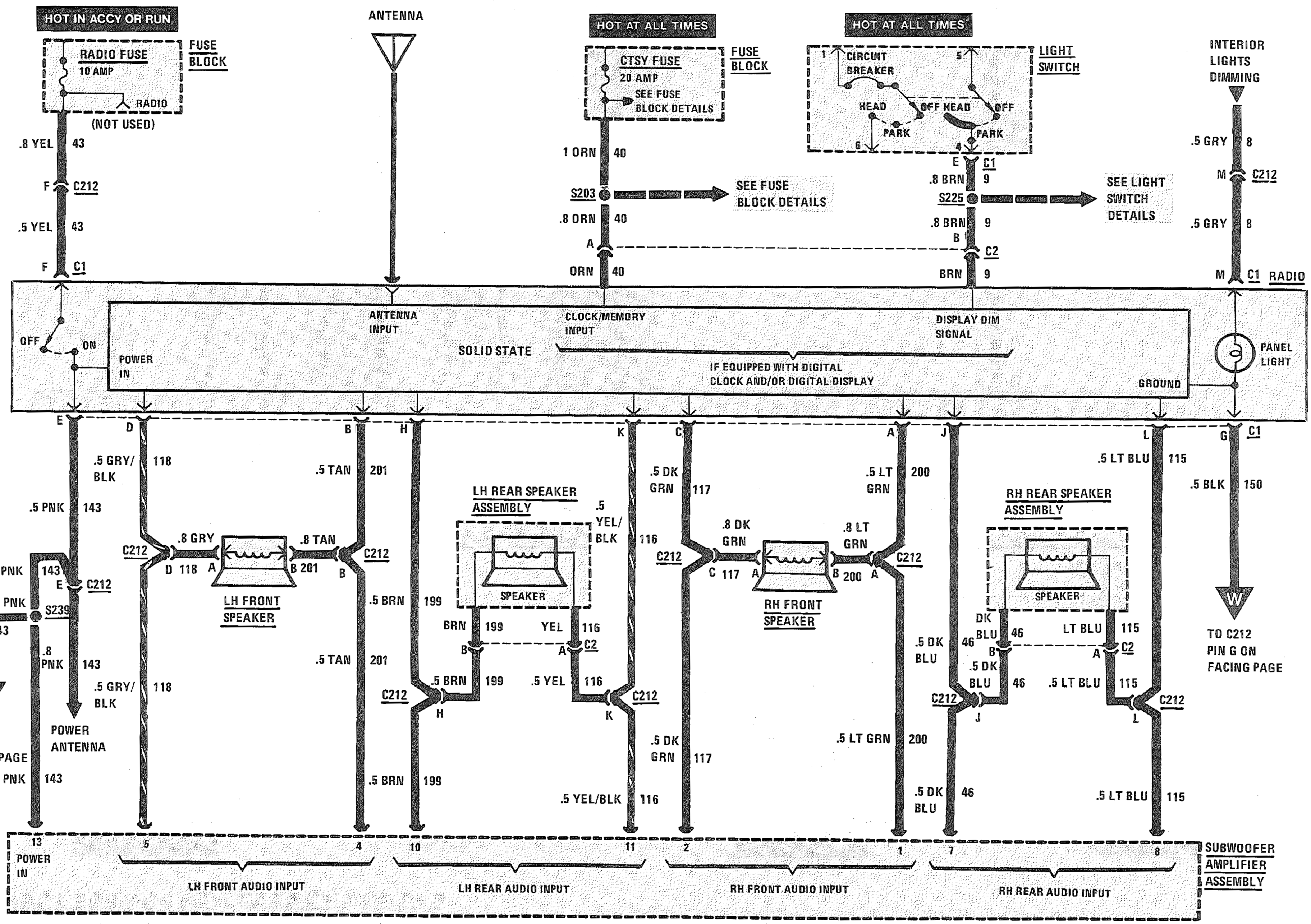
RADIO

WITHOUT SUBWOOFER AMPLIFIER AND UK3



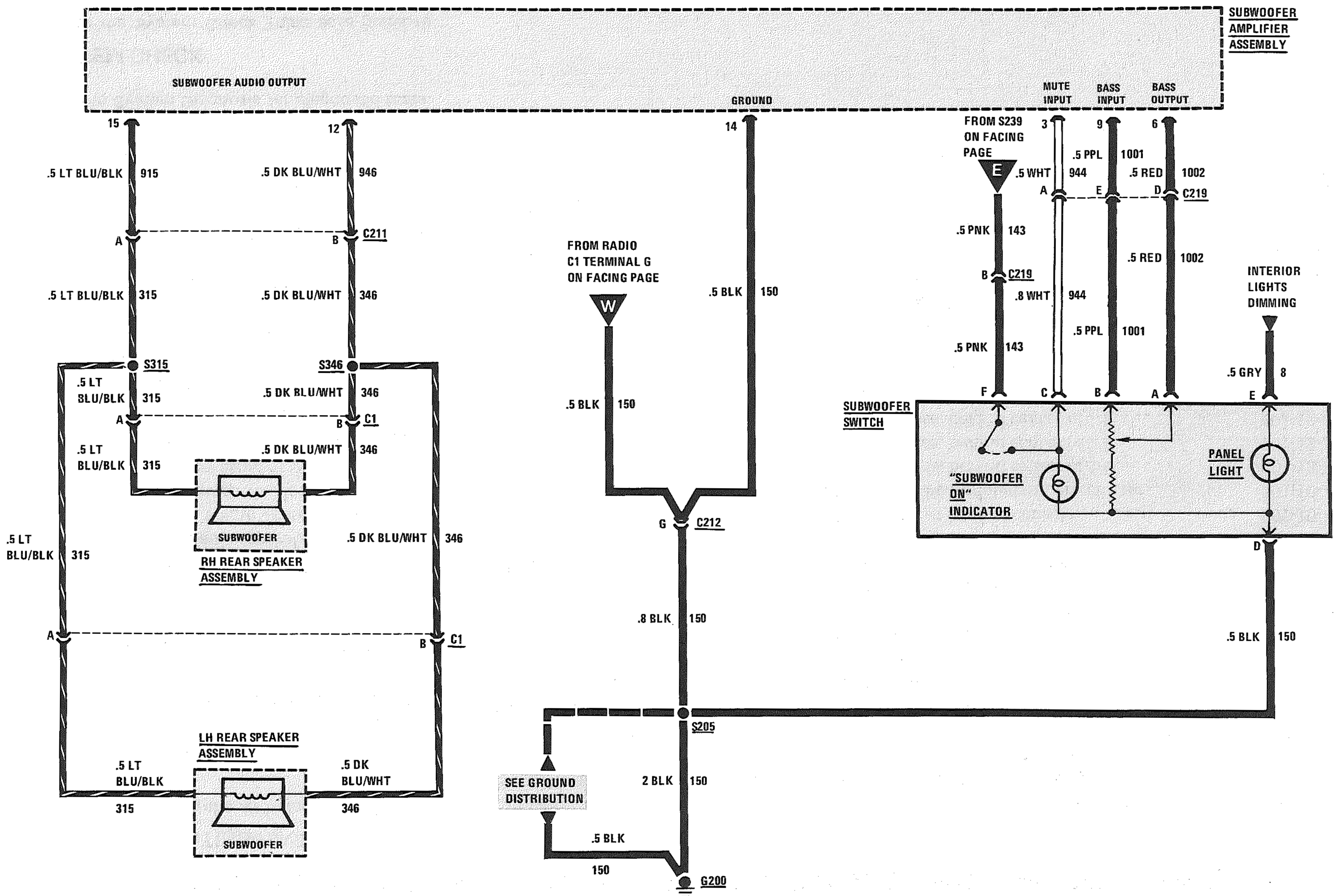
RADIO

WITH SUBWOOFER AMPLIFIER AND WITHOUT UK3



RADIO

WITH SUBWOOFER AMPLIFIER AND WITHOUT UK3



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check RADIO Fuse.
2. Check CTSY Fuse or check ARC RADIO Fuse (if equipped with Remote Control Head).
3. Check ground G200 by operating the Cigar Lighter.
4. Check that the Antenna connector and coaxial cable are properly connected.
5. Adjusting the Radio controls will change the operation of the sound system. Consult the Delco Sound Service Guide for information regarding the operating of these controls.
6. Before troubleshooting a suspect Speaker, check all connections to that Speaker.
7. For proper noise diagnosis, take the car outside where signals are strong. Close the hood, and keep away from metal buildings or sources of radio interference.
8. Ignition noise on FM may indicate a defective Ignition System.
9. Coasted screws or bolts can cause a poor ground condition. Scrape ground screw clean of any paint or varnish.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**
- **Refer to the diagnosis given if other results occur.**
- **Tests follow in System Diagnosis.**

COMPONENT LOCATION

Component	Location	Page-Figure
Convenience Center	Behind I/P, to right of steering column	201-10-A
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
Subwoofer Amplifier Assembly	Behind I/P, to right of center air vent	201-13-B
C210 (11 cavities)	Behind I/P, on RH lower side of steering column	201- 9-A
C211 (2 cavities)	Behind center of I/P	
C212 (12 cavities)	Behind center of I/P	201-13-B
C217	Behind center of I/P	
C218	Behind center of I/P	201-12-A
C219 (6 cavities)	Behind RH side of I/P, near Subwoofer Amplifier	201-13-B
G200	Behind I/P, left of steering column	201-10-A
S203	I/P harness, behind instrument cluster	201-10-A
S205	I/P harness, behind instrument cluster	201-10-A
S207	I/P harness, at head of console	201-10-A
S225	I/P harness, behind instrument cluster	201-10-A
S239	Radio harness, behind center of I/P	201-13-B
S250	Radio harness, behind center of I/P	201-12-A
S251	Radio harness, behind center of I/P	201-12-A
S252	Radio harness, behind center of I/P	201-12-A
S253	Radio harness, behind center of I/P	201-12-A
S254	Radio harness, behind center of I/P	201-12-A
S255	Radio harness, behind center of I/P	201-12-A
S256	Radio harness, behind center of I/P	201-12-A
S257	Radio harness, behind center of I/P	201-12-A
S258	Radio harness, behind center of I/P	201-12-A
S260	I/P harness, at head of console	201-10-A
S274	I/P harness, at head of console	201-12-C
S315	Speaker harness, behind RH side of rear seat	201- 9-B
S346	Speaker harness, behind RH side of rear seat	201- 9-B

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT	FOR DIAGNOSIS OF OTHER RESULTS
Turn Ignition Switch to RUN or ACCY	Time display appears	Do Test L, or if equipped with Remote Control do Test A
Turn Radio on and tune in a local station Center Balance and Fade Controls	Power Antenna extends Program is heard from all speakers without noise or engine whine	See Power Antenna (Section 8A-151) If no sound comes from any Speaker, do Test G If one or more Speakers do not operate, do Test D on suspect Speaker(s) If excesssive noise is present, do Test H
Turn on Headlights or Park Lights and set Instrument Panel Lights to maximum brightness	Radio digital display dims Radio Panel Lamp lights Steering wheel Remote Control Head Panel Lamps light (if equipped)	Do test N, or if equipped with Remote Control Head, do test B Do Test M, or if equipped with Remote Control Head, do Test C Check bulbs If all four bulbs are out, do Test E
Turn on Subwoofer	Program is heard from subwoofer speakers	If subwoofer does not operate, do Test I If only one subwoofer speaker does not operate, do Test K If excessive noise is present, do Test H
Turn steering wheel from lock to lock (engine running to assist in steering) (if equipped with Remote Control Head)	Remote Control Head Panel Lamps remain lit with no flickering as wheel is turned	Do Test F
Operate the Tune-Up and Tune-Dn controls on the Remote control Head while turning the steering wheel from lock to lock (if equipped with Remote Control Head)	Radio responds to all controls at all wheel positions	If controls operate at some steering wheel positions, do Test F If controls do not operate at all, do Test E
Operate all Remote Control Head Radio controls (if equipped with Remote Control Head)	Radio responds to all controls All buttons have a similar feel	If inoperative button does not have a feel similar to the others, replace Control Head If all buttons feel the same, but some control functions do not operate, do Test F

- If all results are normal, the system is OK.

SYSTEM DIAGNOSIS

- Do the tests below when directed by the System Check.

A: RADIO POWER INPUT TEST FOR REMOTE CONTROL HEAD (TABLE 1)

Measure: VOLTAGE
At: RADIO RECEIVER CONNECTOR C1 (Disconnected)

Measure Between	Correct Voltage	For Diagnosis
10 (ORN/BLK) & Ground (Without Subwoofer Amplifier) 10 (ORN) & Ground (With Subwoofer Amplifier)	Battery	See 1

- If the voltage is correct, go to Table 2.

1. Check ORN/BLK (340) or ORN (340)wire for an open.

A: RADIO POWER INPUT TEST FOR REMOTE CONTROL HEAD (TABLE 2)

Measure: VOLTAGE
At: RADIO RECEIVER CONNECTORS C1 & C3 (Disconnected)
Condition:
- Ignition Switch: RUN

Measure Between	Correct Voltage	For Diagnosis
C1/9 (YEL) & Ground	Battery	See 1
C1/9 (YEL) & C3/1 (BLK/LT BLU)	Battery	See 2
C1/9 (YEL) & C1/5 (BLK/LT BLU) (Without Subwoofer Amplifier) C1/9 (YEL) & C1/5 (BLK) (With Subwoofer Amplifier)	Battery	See 2

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- If all voltages are correct, send Radio to an authorized AC-Delco repair station.

1. Check YEL (43) wire.
2. Check BLK/LT BLU (151) or BLK (150) wire for an open to ground (see schematic).

B: DISPLAY DIMMING TEST FOR REMOTE CONTROL HEAD

Measure: VOLTAGE
At: RADIO RECEIVER CONNECTOR C1 (Disconnected)
Condition:
- Light Switch: HEAD or PARK

Measure Between	Correct Voltage	For Diagnosis
6 (BRN) & Ground	Battery	See 1

- If the voltage is correct, send Radio to an authorized AC-Delco repair station.

1. Check BRN (9) wire.

C: PANEL LAMPS TEST FOR REMOTE CONTROL HEAD

Measure: VOLTAGE
At: RADIO RECEIVER CONNECTOR C1 (Disconnected)
Conditions:
- Light Switch: HEAD or PARK
- Instrument Panel Lights at maximum brightness

Measure Between	Correct Voltage	For Diagnosis
7 (GRY) & Ground	Battery	See 1

- If the voltage is correct, send Radio to an authorized AC-Delco repair station.

1. Check GRY (8) wire.

D: SPEAKER TEST

1. Disconnect suspect speaker connector and connect a known good 1.5 volt battery across speaker terminals.

Caution: Do not leave 1.5 volt battery connected for more than one second. Prolonged connection could damage speaker.

- If speaker pops, go to Speaker Test Table.
- If speaker does not pop, replace defective speaker.

D: SPEAKER TEST

Measure: AC VOLTAGE
At: RADIO OUTPUT FOR SUSPECT SPEAKER
Conditions:
- **Ignition Switch: RUN**
- **Radio: ON (High Volume)**

Action	Correct Voltage	For Diagnosis
Connect voltmeter across outputs for suspect Speaker with Radio tuned to a strong signal	Varying around 1 volt AC	See 1

- If the voltage is correct, repair the wires between the Radio and the suspect Speaker.

1. Send Radio to an authorized AC-Delco repair station.

E: REMOTE CONTROL SYSTEM TEST (TABLE 1)

Measure: VOLTAGE
At: CONNECTOR C210 (Connected)
Conditions:
- **Ignition Switch: RUN**
- **Headlights: ON**
- **Instrument Panel at maximum brightness**

Measure Between	Correct Voltage	For Diagnosis
D (YEL) & Ground	Battery	See 1
D (YEL) & B (BLK/LT BLU)	Battery	See 2
C (GRY) & Ground	Battery	See 3

(Continued in next column)

(Continued from previous column)

- If all voltages correct, go to Table 2.

1. Check YEL (43) wire.
2. Check BLK/LT BLU (151) wire for an open to ground (see schematic).
3. Check GRY (8) wire.

E: REMOTE CONTROL SYSTEM TEST (TABLE 2)

Measure: VOLTAGE
At: CONNECTOR C210 (Connected)
Condition:
- **Engine Running**

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Between 4.5 and 5.5 volts	See 1

- Press the Preset, Mute, and RCL buttons on the Remote Control Head simultaneously
- Turn the steering wheel slowly while measuring

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Between 2.0 and 3.0 volts at all positions	See 2

- If all voltages are correct, check ORN (917) wire to the Radio. Send Radio to an authorized AC-Delco repair station if wiring and connections are OK. Refer to Section 9A for removal and replacement procedures.

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1. Inspect/replace the Turn Signal Switch. Refer to Section 3B5 for replacement procedures.
2. Do Test F.

F: OPTICAL SLIPRING TEST (TABLE 1)

- Remove the Remote Control Head. Refer to Section 3B5 for removal procedures.
- Install tool J-353630 between the Control Head and connector C1 (see section 3B5).
- Make the following measurements.

Measure: VOLTAGE
At: TOOL J-35630 (Connected)
Conditions:
- **Engine running**
- **Light Switch: HEAD or PARK**
- **Instrument Panel Lights at maximum brightness**
- **Turn steering wheel slowly while measuring**

Measure Between	Correct Voltage	For Diagnosis
Terminal A & Ground	Battery at all wheel positions	See 1
Terminal A & Terminal D	Battery at all wheel positions	See 1
Terminal B & Terminal D	Battery at all wheel positions	See 1

- If all voltages are correct, go to Table 2.

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1. Remove the Cancel Cam. Inspect the Slip Rings on the Cancel Cam and the spring loaded contacts on the Turn Signal Switch. Replace as necessary. Incorrect or missing lubricant on the Cam can cause premature failure. Take care to keep lubricant or any foreign material away from the LED's and receptors as it will hinder or prevent proper operation. The correct lubricant is part no. 26002312.

F: OPTICAL SLIPRING TEST (TABLE 2)

Measure: VOLTAGE
At: TOOL J-35630 (Connected)
Conditions:

- **Engine running**
- **Press the Preset, Mute and RCL buttons or the Seek, Scan, and AM/FM buttons on the Remote Control Head simultaneoulsy**
- **Turn the steering wheel slowly while measuring**

Measure Between	Correct Voltage	For Diagnosis
Terminal C & Ground	Between 3.0 and 4.5 volts at all wheel positions	See 1

- If the voltage is correct, go to Table 3.

1. Replace the Remote Control Head. Refer to Section 3B5 for replacement procedures.

F: OPTICAL SLIPRING TEST (TABLE 3)

- Remove the Cancel Cam. Refer to Section 3B5 for removal procedures.
- Make the following measurements.

Measure: VOLTAGE
At: CONNECTOR C210 (Connected)
Conditions:

- **Ignition Switch: RUN**
- **Shield the Turn Signal Switch Light Receptors from outside light with a dark cloth**

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Between 4.5 and 5.5 volts	See 1
Direct a flashlight beam at the Turn Signal Switch Light Receptors		
A (ORN) & Ground	Battery	See 1

- If voltages are correct, replace the Cancel Cam.

1. Replace the Turn Signal Switch. Refer to Section 3B5 for replacement procedures.

G: ANTENNA TEST

Check connectors Radio and Antenna ends of Antenna Coaxial Cable. Connect a known good test Antenna to the Radio. The test Antenna must be designed for use with ARC Radios, as ARC Radios use a different size Antenna connector than conventional Radios.

- If Radio plays, replace the Antenna.
- If Radio still does not operate, send Radio to an authorized AC-Delco repair station.
- Refer to section 9A for removal and replacement procedures.

H: NOISE DIAGNOSIS

Unplug the Antenna at the back of the Radio.

- If noise disappears, it was being picked up by the Antenna. Consult the Delco Sound Service Guide for Antenna noise diagnosis.
- If the noise persists, it is coming in the Radio wiring. Refer to the following chart for a possible cause and corrective action.

NOISE DIAGNOSIS TEST

SYMPTOM	POSSIBLE CAUSE	REPAIR ACTION
Harsh popping noise that changes with engine rpm.	Ignition noise	Perform the steps found on the following page under Ignition Noise.
High whine (like a siren) that changes with engine rpm.	Generator noise	Add filter package 1224205 to power and/or memory lead to the Radio see Fig. 2 on the following page. By-pass the generator output with 250 MFD 100v capacitor. See Fig. 3. Install a braided ground strap on the Radio. See Fig. 1 on the following page. Run a direct wire from battery (+) to generator. Exchange the defective Radio with a good Radio. If noise disappears, send the defective Radio for repair. Replace generator.
Noise occurs only when an accessory is on.	Condition in that accessory	Install filter package 1224205 in the power lead(s) to that accessory. See Fig. 2 on the following page. Install a .5MFD by-pass capacitor at the power lead to that accessory. Consult Delco Sound Service Guide.
All stations weak, noisy, both AM and FM.	Defective antenna or lead-in wire	Temporarily replace the antenna with another one. Repair/replace the defective one if the Radio reception improves. Check at the Antenna Coax Lead-In, and the connector.
AM only, weak, noisy.	AM alignment	Remove Radio for repair.
FM only, weak, noisy.	FM alignment	Remove Radio for repair.
Noise present with engine not running.	ECM	Install filter package 1224205 in the power leads to the Electronic Control Module (ECM).

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Noise that stops when Antenna is unplugged from back of Radio	Antenna noise	Replace defective antenna with a good antenna. If noise disappears repair or replace the defective antenna. Check antenna ground, Coaxial Cable Braid, and ground at connectors. If noise persists with replacement antenna, the problem must be repaired at the source of noise (generator, ignition system, accessory, etc.). See Delco Manual for noise "Sniffing" procedures.

Ignition Noise

Try the following fixes in the given order:

1. Check for loose or defective spark plug wire.
2. Check for defective spark plug.
3. Move all wiring away from Ignition System and spark plug wires.
4. Reroute spark plug wires laying against anything that could possibly transmit noise to the Radio (car wiring or sensor leads that travel into the passenger compartment).
5. Inspect Ignition system for the following and replace if necessary:
   - Distributor cap carbon ball eroded away, cracked or loose cap.
   - A rotor with burned black spot on wiper or pits in wiper surface.
   - A defective coil.
   - An oily film on some of the lead terminals or inside the cap.
   - Defective HEI module; can cause ignition noise on FM only.
6. Replace distributor cap and rotor.
7. Check the ground from engine to firewall; install a braided ground strap if necessary.
8. Install a braided ground strap on the hood.
9. Check Heater Core ground; clean or install a braided ground strap if necessary.
10. Check air conditioner accumulator ground; clean or install a braided ground strap if necessary.

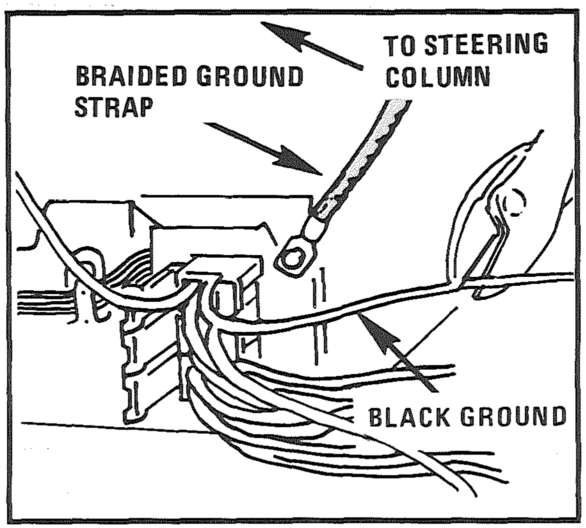


Figure 1 - Cut the BLACK (ground) wire from the black plug at the back of the Radio and run a braided ground strap from the case of the Radio to good, unpainted body ground.

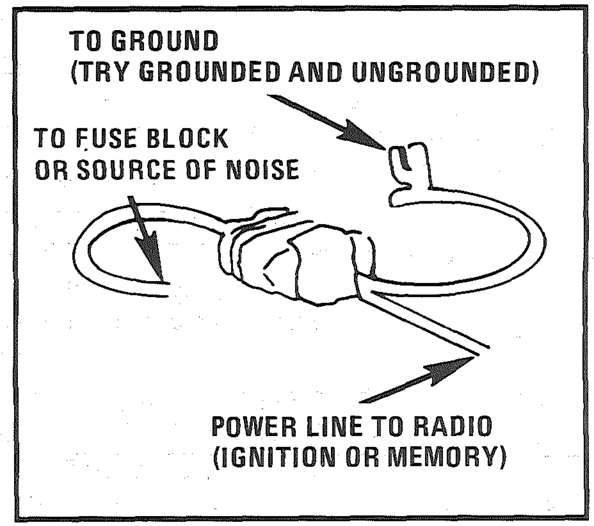


Figure 2 - Install a 1224205 filter package.

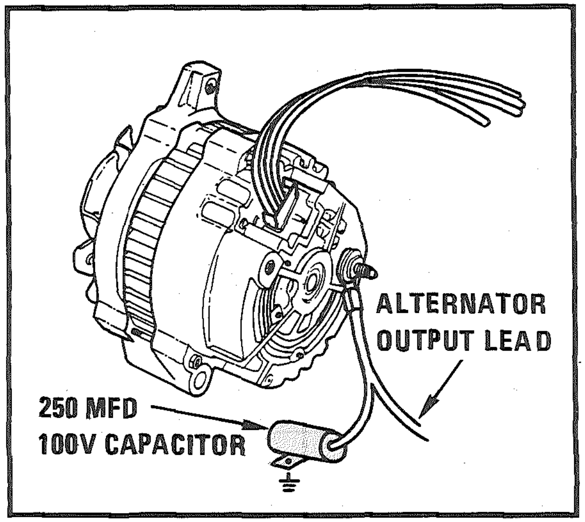


Figure 3. Install a 250 MFD, 100V capacitor on the alternator output lead to ground.

I: SUBWOOFER AMPLIFIER TEST (TABLE 1)

Measure: VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN
- Radio: ON

Measure Between	Correct Voltage	For Diagnosis
13 (PNK) & Ground	Battery	See 1
13 (PNK) & 14 (BLK)	Battery	See 2
• Subwoofer switch: ON		
3 (WHT) & Ground	Battery	See 3

- If all voltages are correct, go to Table 2.

1. Check/repair PNK (143) wire for an open.
2. Check/repair BLK (150) wire for an open.
3. Check/repair WHT (944) wire for an open. If OK, go to Test J Subwoofer Switch Test.

I: SUBWOOFER AMPLIFIER TEST (TABLE 2)

Measure: VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN
- Radio: ON
- Subwoofer Switch: ON

Measure Between	Correct Voltage	For Diagnosis
6 (RED) & Ground	Approximately 8 volts	See 1
• Gain Switch at Minimum		
9 (PPL) & Ground	3.5 to 4.5 volts	See 2
• Gain Switch at Mid Scale		
9 (PPL) & Ground	5.5 to 6.5 volts	See 2
• Gain Switch at Maximum		
9 (PPL) & Ground	Approximately 8 volts	See 2

- If all voltages are correct, go to Test K Subwoofer Speaker Test.

1. Replace Subwoofer Amplifier Assembly.
2. Check/repair PPL (1001) wire for an open. If OK, go to Test J: Subwoofer Switch Test.

J: SUBWOOFER SWITCH TEST

Measure: VOLTAGE
At: SUBWOOFER SWITCH CONNECTOR (Connected)
Conditions:
- Ignition Switch: RUN
- Radio: ON
- Subwoofer Switch: ON

Measure Between	Correct Voltage	For Diagnosis
F (PNK) & Ground	Battery	See 1
C(WHT) & Ground	Battery	See 2
A(RED) & Ground	Approximately 8 volts	See 3
F (PNK) & D (BLK)	Battery	See 4
• Gain Switch at Minimum		
B (PPL)& Ground	3.5 to 4.5 volts	See 2
• Gain Switch at Mid Scale		
B (PPL) & Ground	5.5 to 6.5 volts	See 2
• Gain Switch at Maximum		
B (PPL) & Ground	Approximately 8 volts	See 2

- If all voltages are correct, go to Test K Subwoofer Speaker Test.

1. Check PNK (143) wire for an open.
2. Replace Subwoofer Switch.
3. Check RED (1002) wire for an open.
4. Check BLK (150) wire for an open.

K: SUBWOOFER SPEAKER TEST

1. Disconnect suspect Subwoofer speaker connector and connect a known good 1.5 volt battery across speaker terminals.

Caution: Do not leave 1.5 volt battery connected for more than one second prolonged connection could damage speaker.

- If speaker pops, go to Subwoofer Speaker Test Table.
- If speaker does not pop, replace defective speaker.

K: SUBWOOFER SPEAKER TEST

Measure: AC VOLTAGE
At: SUBWOOFER AMPLIFIER CONNECTOR (Connected)
Conditions:
- Speaker Wires: RECONNECTED
- Ignition Switch: RUN
- Radio: ON (High Volume)
- Subwoofer Switch: ON (Gain Switch at Maximum

Measure Between	Correct Voltage	For Diagnosis
15 (LT BLU/ BLK) & 12 (DK BLU/ WHT)	Varying around 1 volt AC	See 1

- If the voltage is correct, check/repair wires between the Subwoofer Amplifier and the Subwoofer Speakers.

1. Remove Subwoofer Amplifier for service.

L: RADIO POWER INPUT TEST (TABLE 1)

Measure: VOLTAGE
At: RADIO CONNECTOR C1 (Disconnected)
Condition:
- Ignition Switch: RUN

Measure Between	Correct Voltage	For Diagnosis
F (YEL) & Ground	Battery	See 1
F (YEL) & G (BLK)	Battery	See 2

- If the voltages are correct, go to Table 2.

1. Check YEL (43) wire for an open (see schematic).
2. Check BLK (150) wire for an open to ground (see schematic).

L: RADIO POWER INPUT TEST (TABLE 2)

Measure: VOLTAGE
At: RADIO CONNECTOR C2 (with Subwoofer Amplifier) or C4 (without Subwoofer Amplifier)(Disconnected)

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Battery	See 1

- If the voltage is correct, remove Radio for service.

1. Check ORN (40) wire for an open (see schematic).

M: PANEL LIGHT TEST

Measure: VOLTAGE
At: RADIO CONNECTOR C1 (Disconnected)
Conditions:
- Light Switch: PARK
- Dimmer Switch: BRIGHT

Measure Between	Correct Voltage	For Diagnosis
M (GRY) & Ground	Battery	See 1

- If the voltage is correct, remove Radio for service.

1. Check GRY (8) wire for an open (see schematic).

N: DISPLAY DIMMING TEST

Measure: VOLTAGE
At: RADIO CONNECTOR C2 (with Subwoofer Amplifier) or C4 (without Subwoofer Amplifier)(Disconnected)
Condition:
- Light Switch: PARK

Measure Between	Correct Voltage	For Diagnosis
B (BRN) & Ground	Battery	See 1

- If the voltage is correct, remove Radio for service.

1. Check BRN (9) wire for an open (see schematic).

CIRCUIT OPERATION

The Radio Fuse provides power to the Radio and to the Power Antenna. With the Ignition Switch in ACCY or RUN, voltage is applied through the Radio Fuse and the YEL wire to the On-Off Switch in the Radio. The circuit is grounded at G200. With the On-Off Switch closed, voltage is applied from the Radio Fuse to the Radio Switch (Power Antenna), and the solid state Radio Circuits to ground. Two wires connect each speaker to the Radio.

The ETR Radio has two inputs that other models do not have; Display Dim Signal and Clock/Memory.

The ETR model is an AM/FM Radio that changes stations electronically. The frequency of pre-selected stations can be stored in the electronic memory. The ETR model also provides a digital display of time or station frequency. As in other models, the Light Switch controls Panel Light dimming. In the ETR model, dimming is also controlled by the Radio itself by means of the Dim Display Input Signal.

The ETR model's clock memory and Radio memory functions are powered at all times through the CTSY Fuse or through the ARC RADIO Fuse if equipped with the Remote Control Head. If power to the ETR model is cut off by disconnecting the Battery, for example, the operator must reset the memory functions when power is restored.

Subwoofer Speaker System

The Subpower Speaker System consists of a Subwoofer Amplifier Assembly and two Subwoofers. The Amplifier receives power from the Radio PNK (143) wire and is grounded at G200. The Amplifier Switch is located in the Subwoofer Switch which, when put in the ON position, causes the Subwoofer Amplifier to operate. The eight audio inputs from the I/P Speakers and Rear Speakers are sent to the Subwoofer Amplifier which then outputs an audio signal to the Subwoofers.

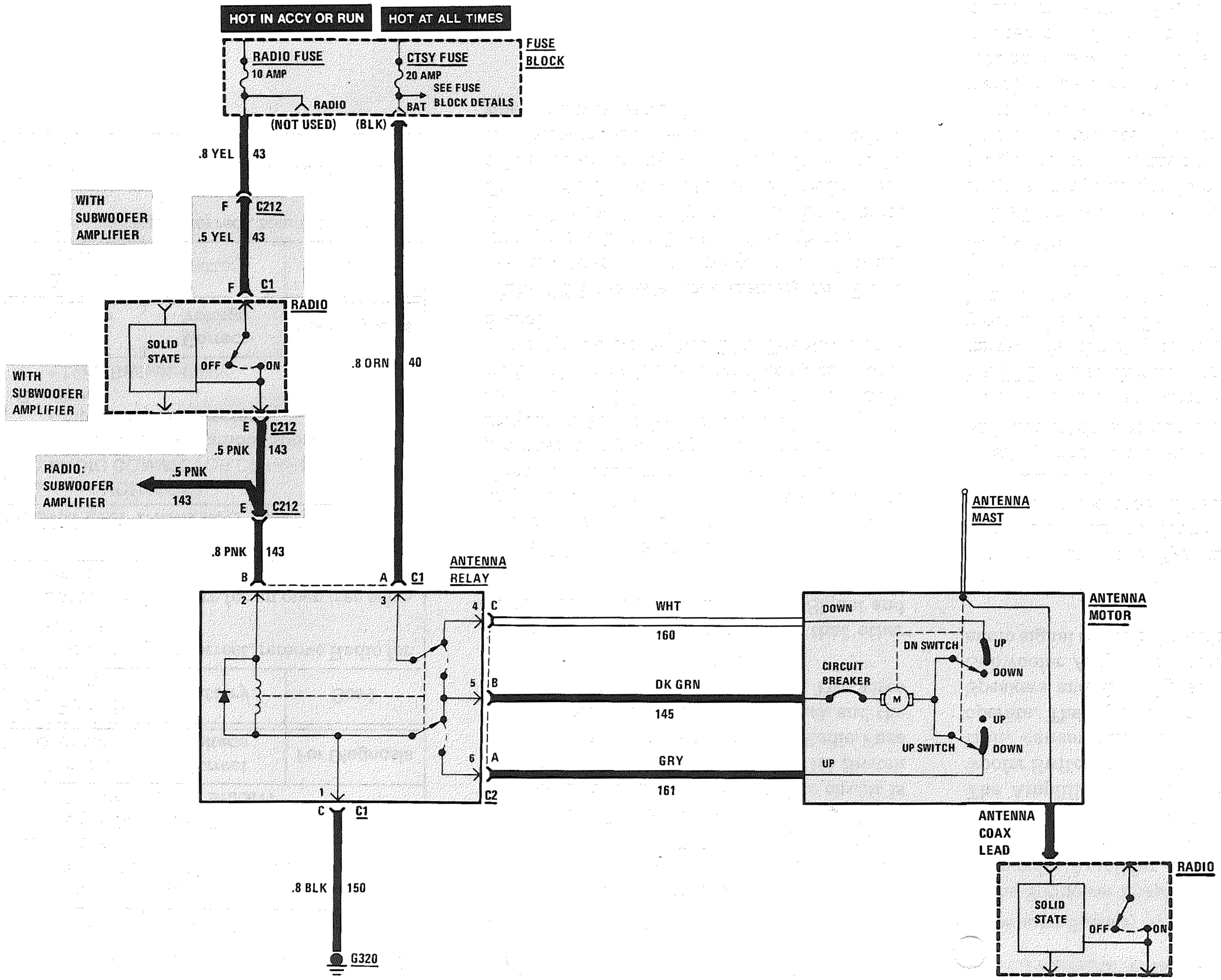
Remote Radio System

The Remote Radio System consists of a multifunction Remote Control Head and Data Transmitter located in the steering wheel, a Slip Ring and a rotating optical data link in the steering column, and an ARC Radio equipped with a serial data port for remote control.

Power for the electronics is supplied from the RADIO Fuse, through the YEL (43) wire, through the slip ring to the Control Head. The ground (the BLK/LT BLU (151) wire) and Panel Lamps Power (the GRY (8) wire) are likewise supplied to the Control Head through the Slip Ring assembly.

The Remote Control Head controls the Radio by generating a unique data word for each operating function when the button controlling that function is pressed. The data words are converted from an electronic signal to an optical signal by the Light Transmitter in the steering column Cancel Cam. The light signal then crosses the air gap to the Light Receptor located in the Turn Signal Switch where it is reconverted to an electronic signal. This signal is then routed via wire to the Radio, which responds to the Control signal.

POWER ANTENNA



TROUBLESHOOTING HINTS

- **Try the following checks before doing the System Check.**

1. Check the Radio Fuse by turning the Radio ON and noting that the display lights come on.
2. Check the CTSY Fuse by operating the Cigar Lighter.
3. Power Antenna goes up or down part way.

— Check Power Antenna mast for bent condition or dirt. If mast is dirty and/or bent, straighten the mast and clean off the dirt. Lube with light oil and check operation. If the mast is straight and clean, replace the Antenna Motor.

- **Go to System Check for a guide to normal operation.**
- **Go to System Diagnosis for diagnostic tests.**

SYSTEM CHECK

- **Use the System Check Table as a guide to normal operation.**

SYSTEM CHECK TABLE

ACTION	NORMAL RESULT
With the Ignition Switch in RUN, turn Radio ON	Antenna mast extends to full height Radio receives strong broadcast signals
Turn Radio OFF	Antenna retracts into fender

COMPONENT LOCATION

		Page-Figure
Antenna Motor	In RH front fender, behind wheel well	201-16-B
Antenna Relay	Behind RH side of I/P, to left of ECM	201-12-B
Fuse Block	Behind LH side of I/P, below light switch	201-10-A
C212 (12 cavities)	Behind center of I/P	201-13-B
G320	Behind RH side of I/P	201-12-B

- **Refer to System Diagnosis when a result is not normal.**

SYSTEM DIAGNOSIS

- ***Make the measurements given in the following tables if the Antenna does not operate.***

A: ANTENNA DOES NOT OPERATE (TABLE 1)

Measure: VOLTAGE
At: ANTENNA RELAY CONNECTOR C1 (Disconnected)
Conditions:
- **Ignition Switch: RUN**
- **Radio: ON**

Measure Between	Correct Voltage	For Diagnosis
A (ORN) & Ground	Battery	See 1
A (ORN) & C (BLK)	Battery	See 2
B (PNK) & Ground	Battery	See 3

(Continued in next column)

(Continued from previous column)

- If all voltages are correct, go to Table 2.

1. Check ORN (40) wire for an open.
2. Check BLK (150) wire for an open to ground.
3. Check PNK (143) wire for an open to the Radio. Remove the radio for repair if wire is OK (see schematic).

(Continued on next page)

(Continued from previous page)

A: ANTENNA DOES NOT OPERATE (TABLE 2)

Connect: FUSED JUMPERS
At: ANTENNA RELAY CONNECTORS C1 & C2 (Disconnected)

Jumper Between	Correct Result	For Diagnosis
C1/A (ORN) to C2/B (DK GRN) and C2/A (GRY) to C1/C (BLK)	Antenna Mast Extends	See 1
C1/A (ORN) to C2/C (WHT) and C2/B (DK GRN) to C1/C (BLK)	Antenna Mast Retracts	See 1

- If all results are correct, replace the Antenna Relay.

1. Replace the Antenna motor.

CIRCUIT OPERATION

When the Radio is turned on, voltage is applied from the PNK wire to the Antenna Relay coil. The Antenna Relay contacts close, and battery voltage is supplied to the DK GRN wire and then to the Antenna Motor. The other motor terminal is grounded through the UP Switch, the GRY wire, and the relay contacts. The motor drives the Antenna up. At the end of its travel, the Up Switch opens and the motor stops.

When the Radio or ignition is turned off, the circuit through the Antenna Relay coil opens. The contacts open to the position shown in the schematic, applying battery voltage to the WHT wire. The DK GRN wire is now grounded. Since the DN Switch at the Antenna is now making contact to the WHT wire, the voltage to the motor has reversed polarity. It runs in the opposite direction and drives the antenna down. At the end of the travel, the DN Switch opens the circuit. Both sets of switches are now in the positions shown in the schematic with the Radio off and the Antenna down.

The Antenna is connected to the Radio by a coaxial cable.

BLANK

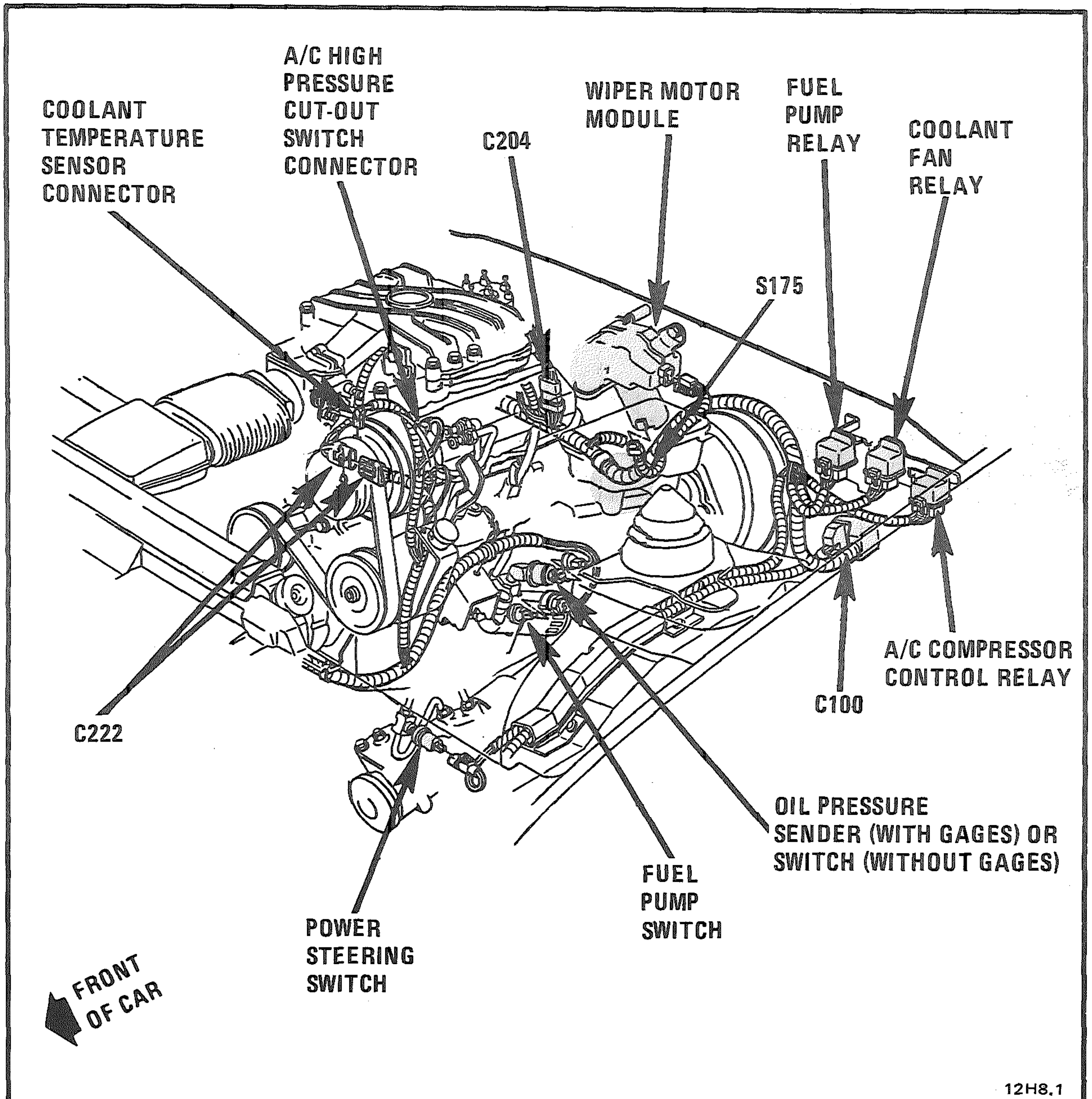


Figure A - LH Side Of VIN S Engine Compartment

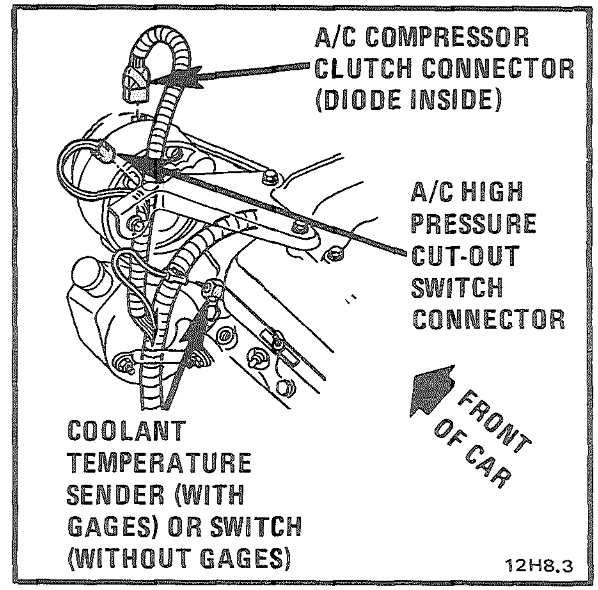


Figure B - Top LH Front Of VIN S Engine

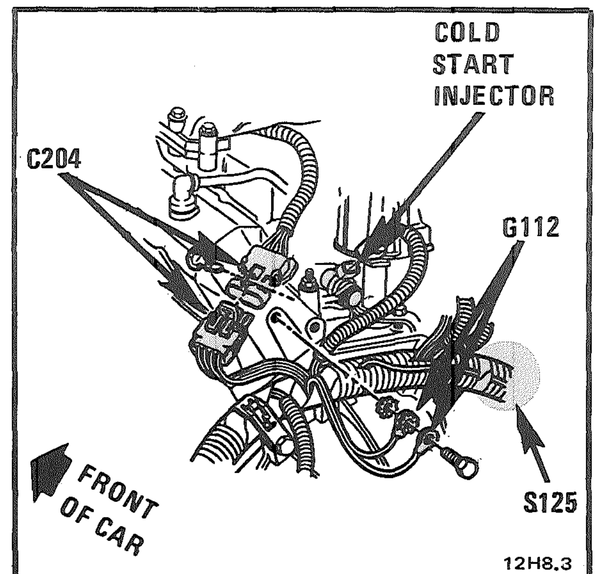


Figure C - Top LH Rear Of VIN S Engine

COMPONENT LOCATION VIEWS

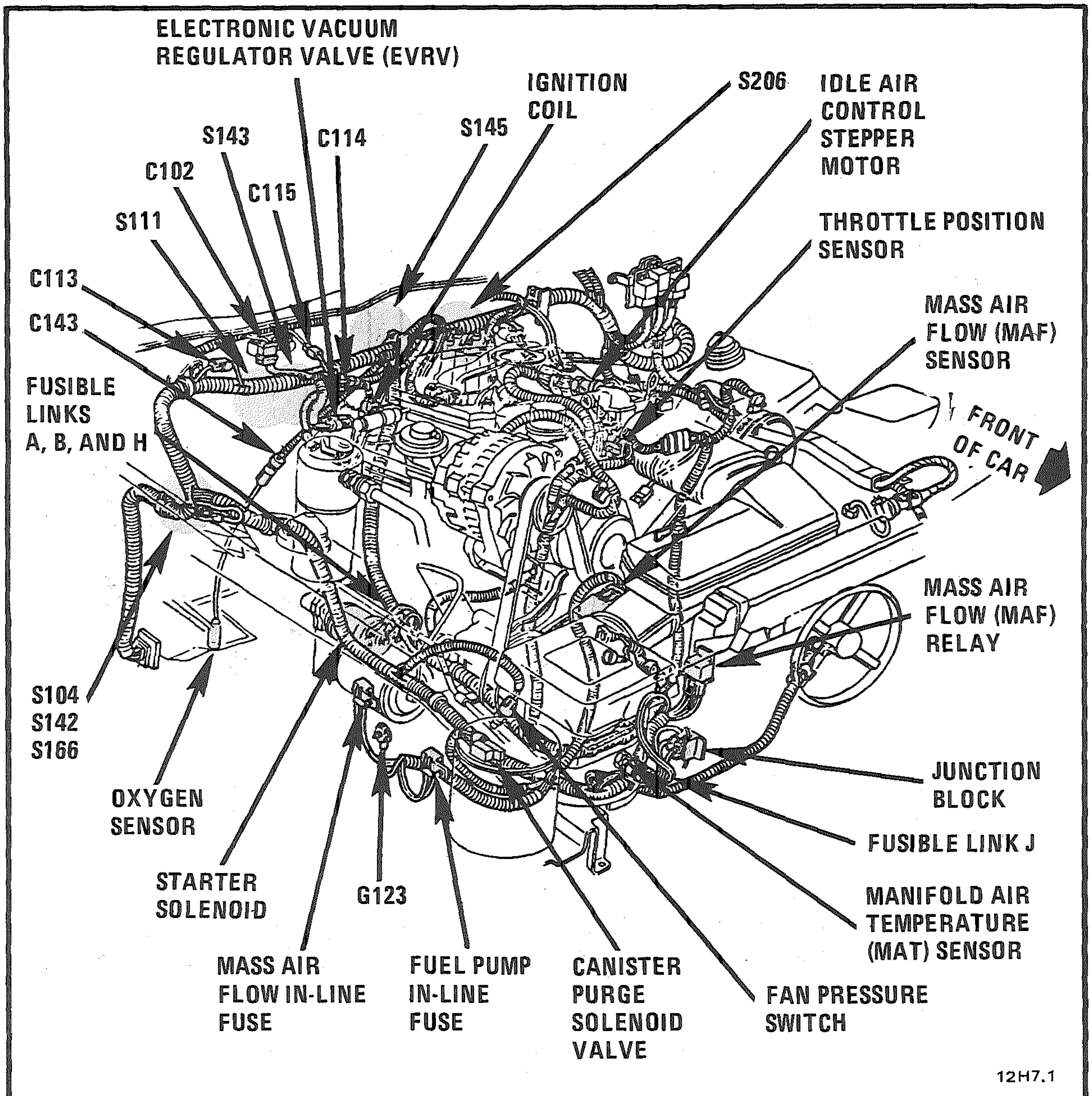


Figure A - VIN S Engine Compartment

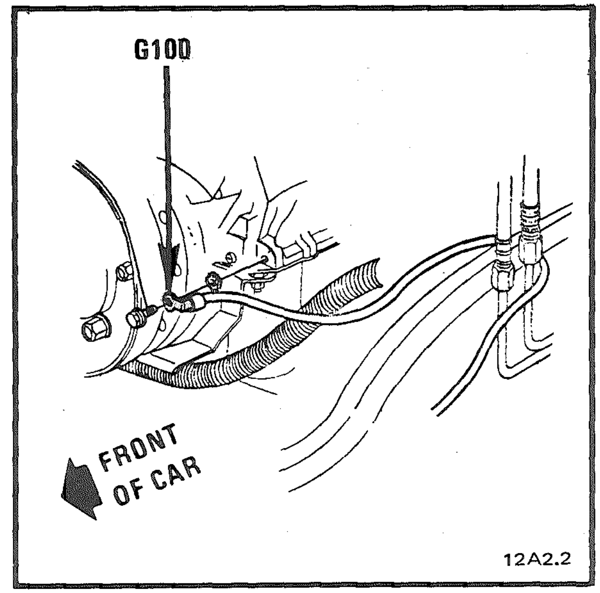


Figure B - Lower LH Front Of VIN S Engine

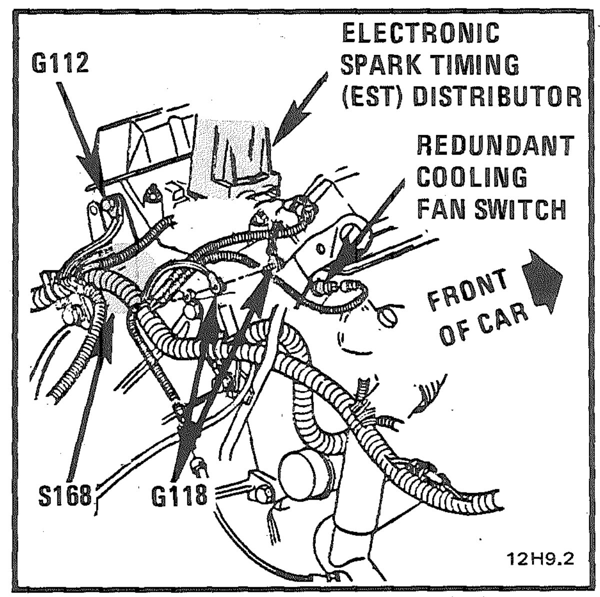


Figure C - Top LH Rear Of VIN S Engine

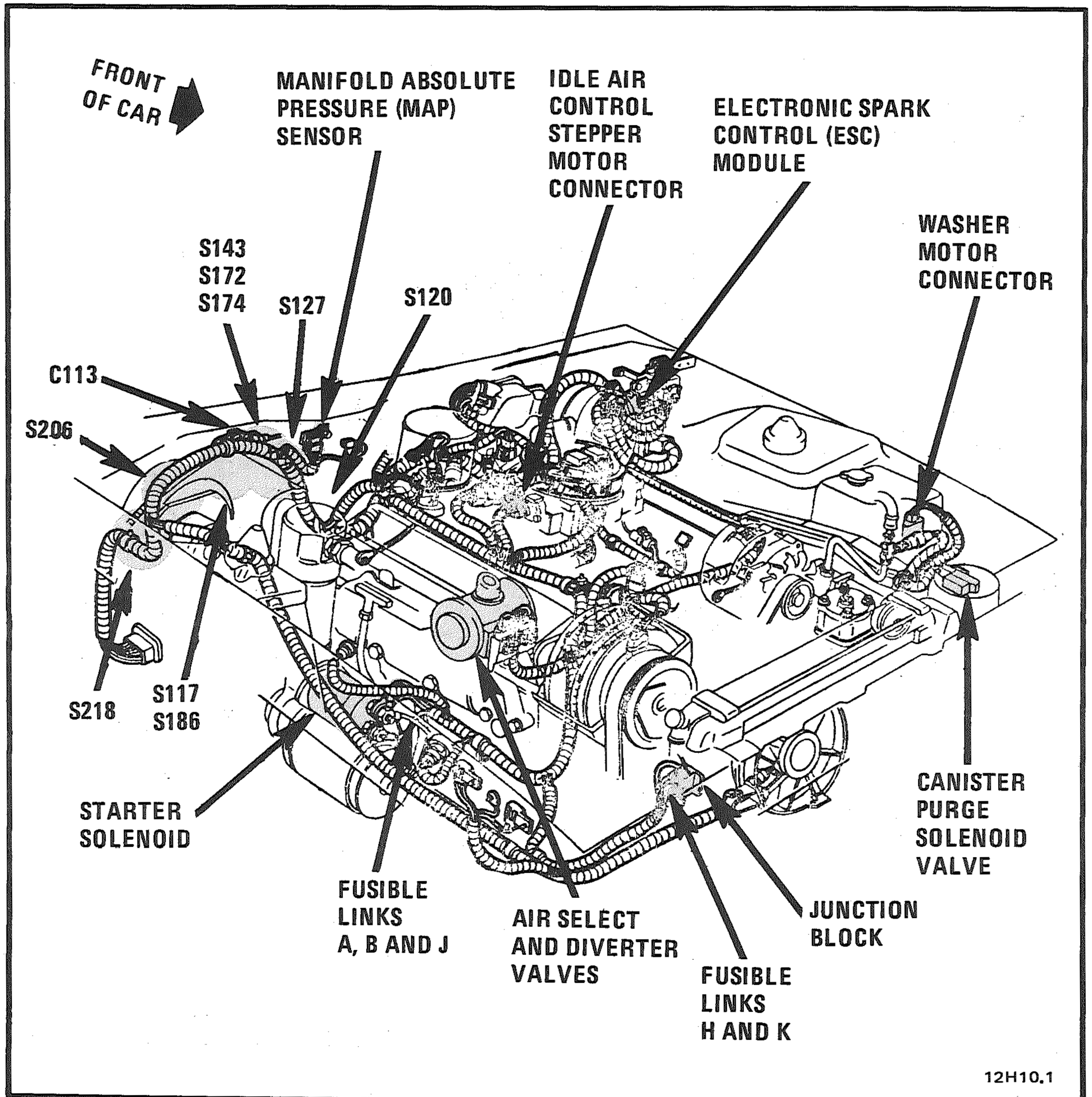


Figure A - VIN E Engine Compartment

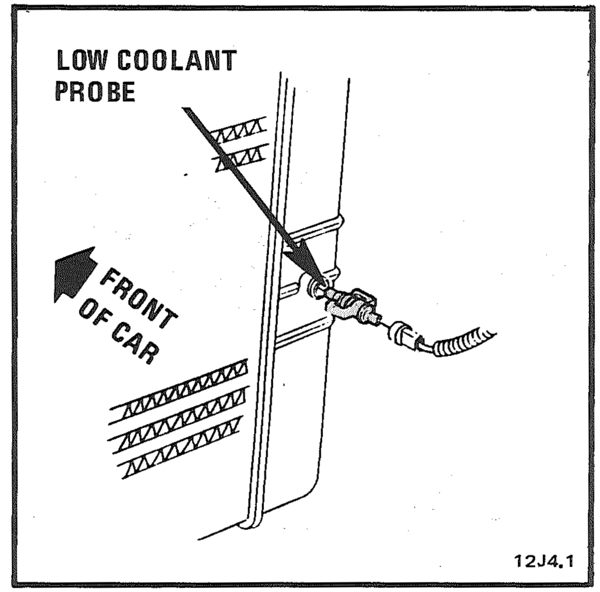


Figure B - RH Front Of Radiator (Except VIN S)

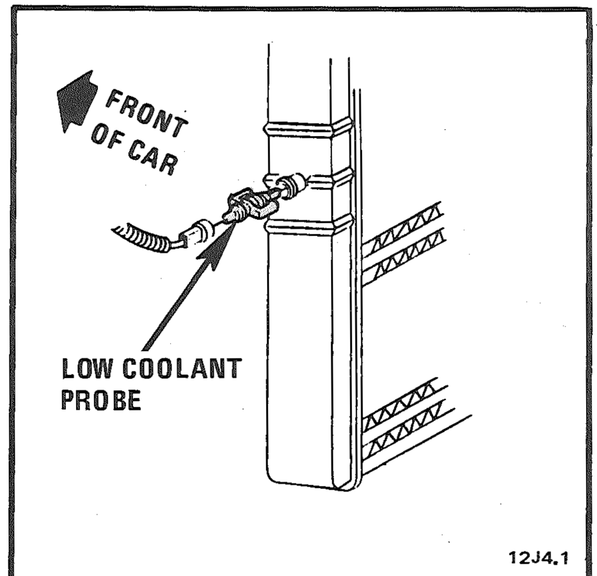


Figure C - LH Side Of Radiator (VIN S)

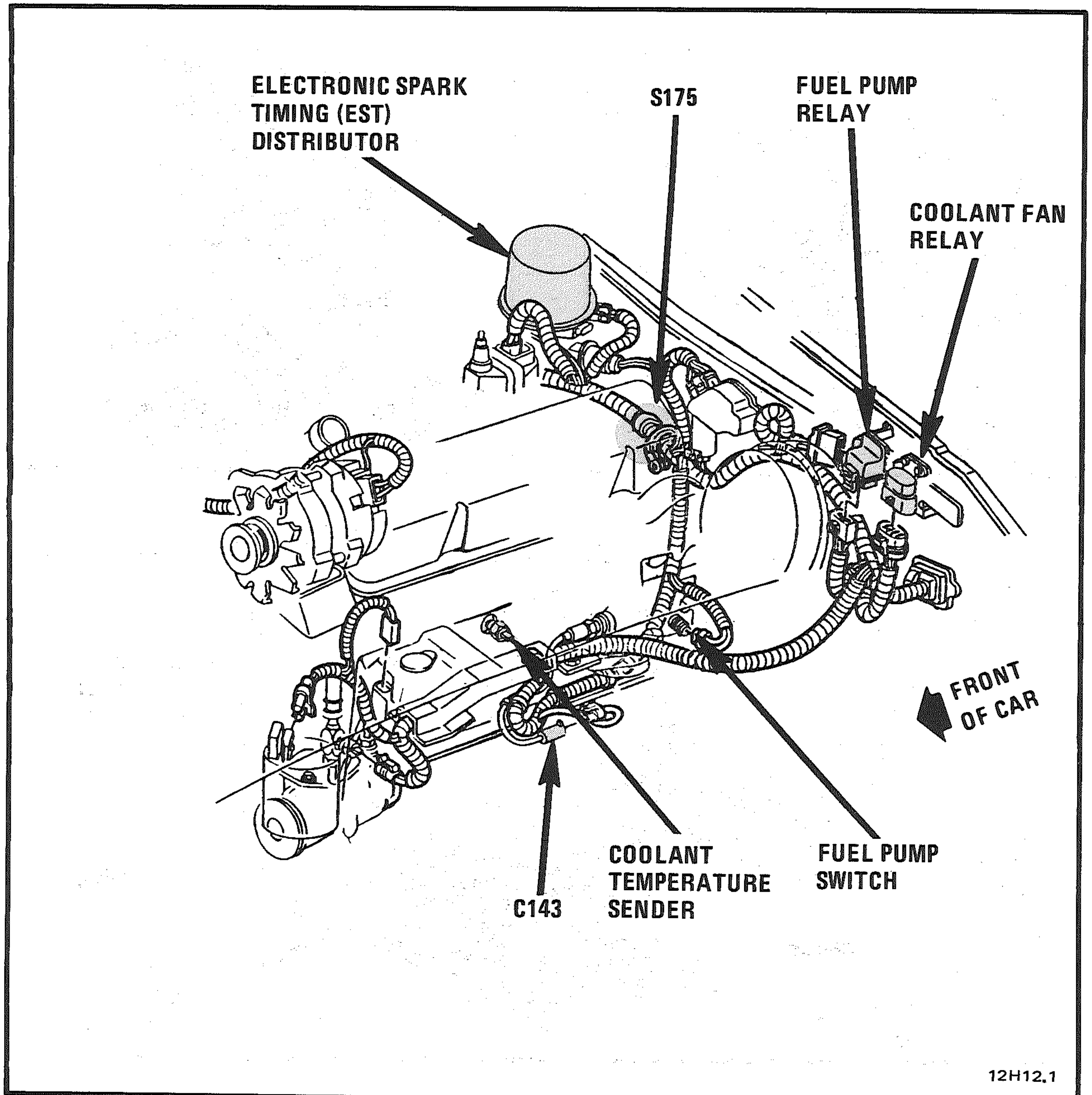


Figure A - LH Side Of VIN E Engine Compartment

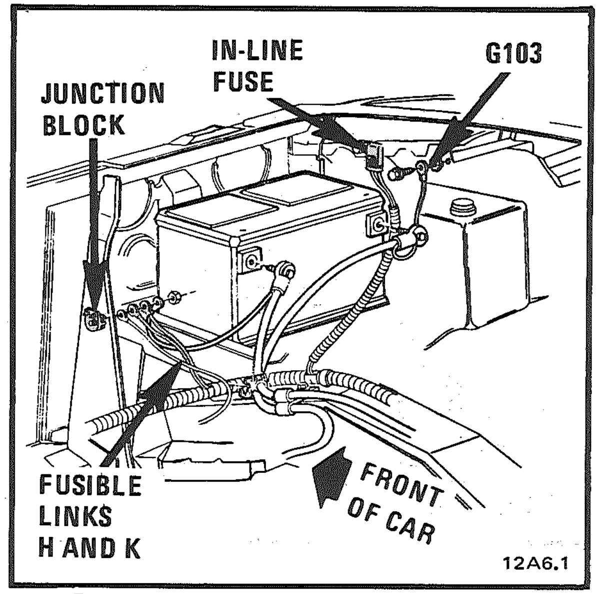


Figure B - RH Front Corner Of VIN E Engine Compartment

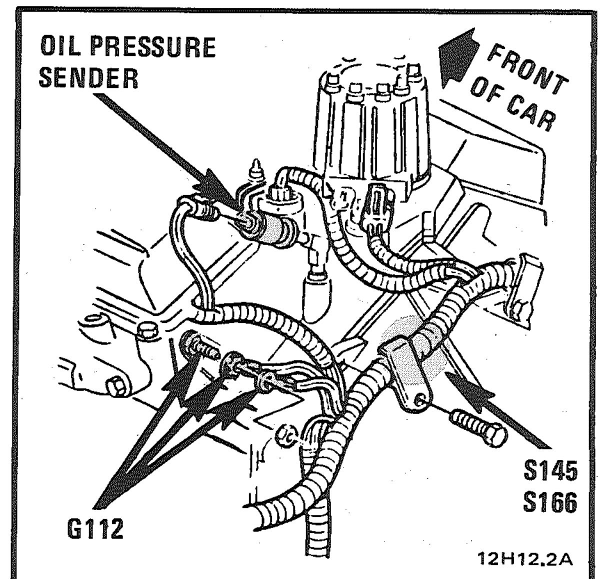


Figure C - LH Rear Of VIN E Engine

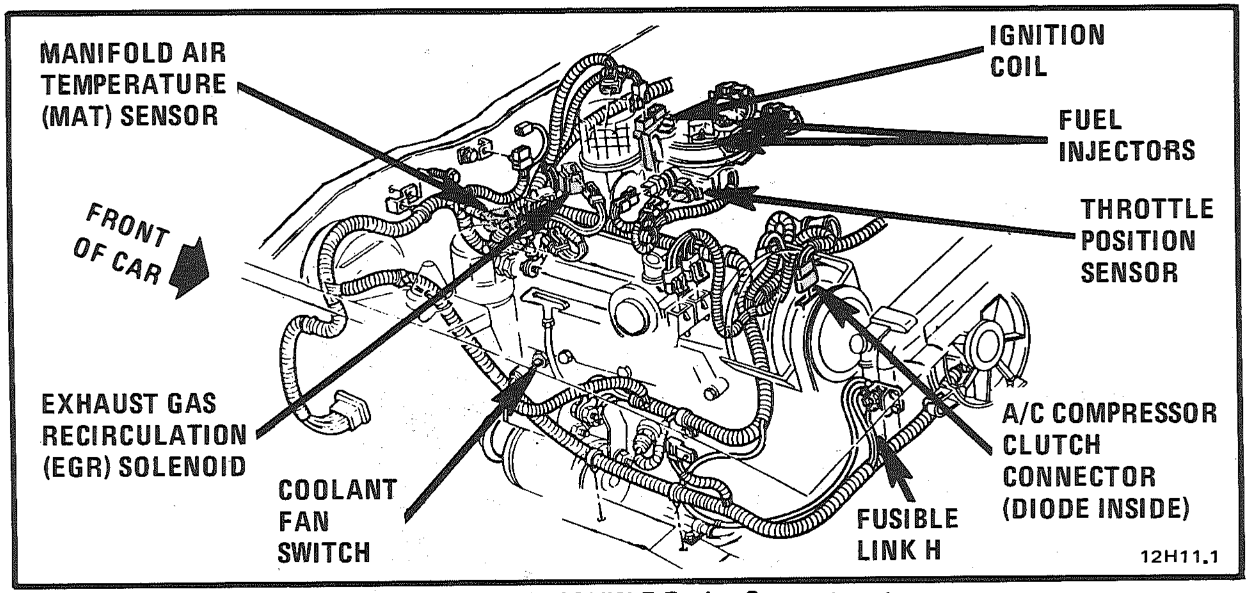


Figure A - RH Side Of VIN E Engine Compartment

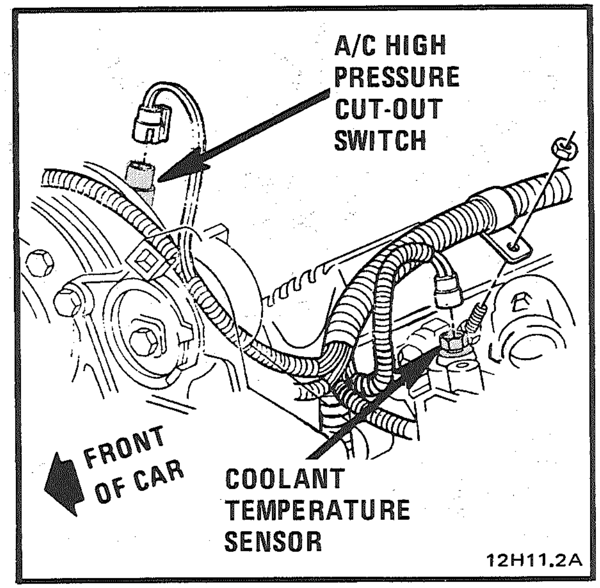


Figure D - Top LH Front Of VIN E Engine

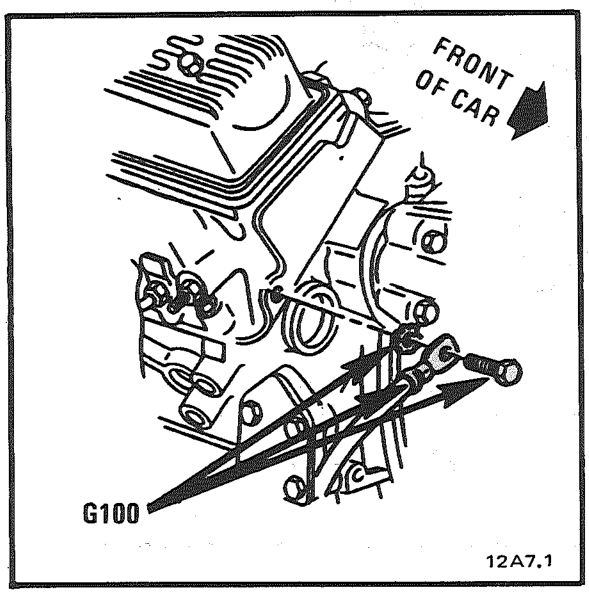


Figure B - RH Front Of VIN E Engine

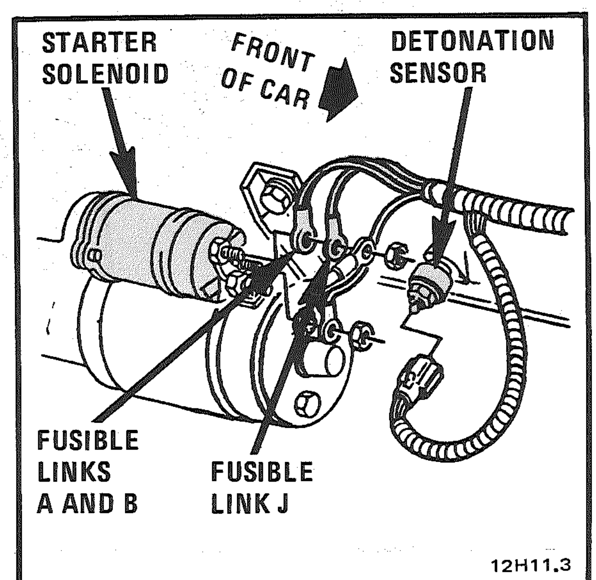


Figure C - Lower RH Side Of VIN E Engine

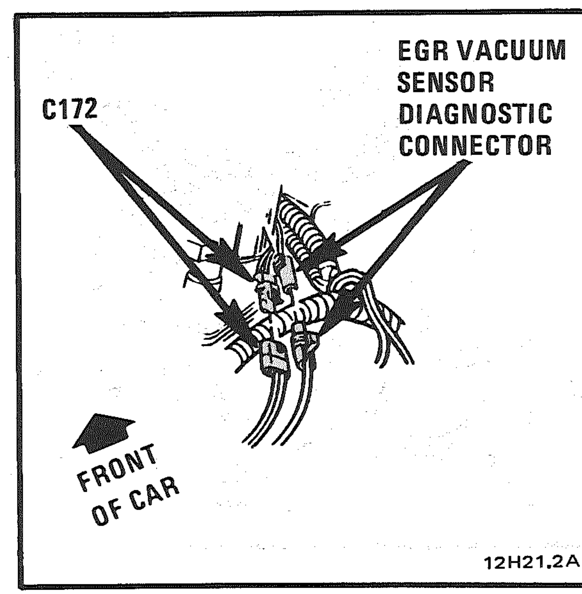


Figure E - Top Rear Of VIN F Engine
(VIN 8 Similar)

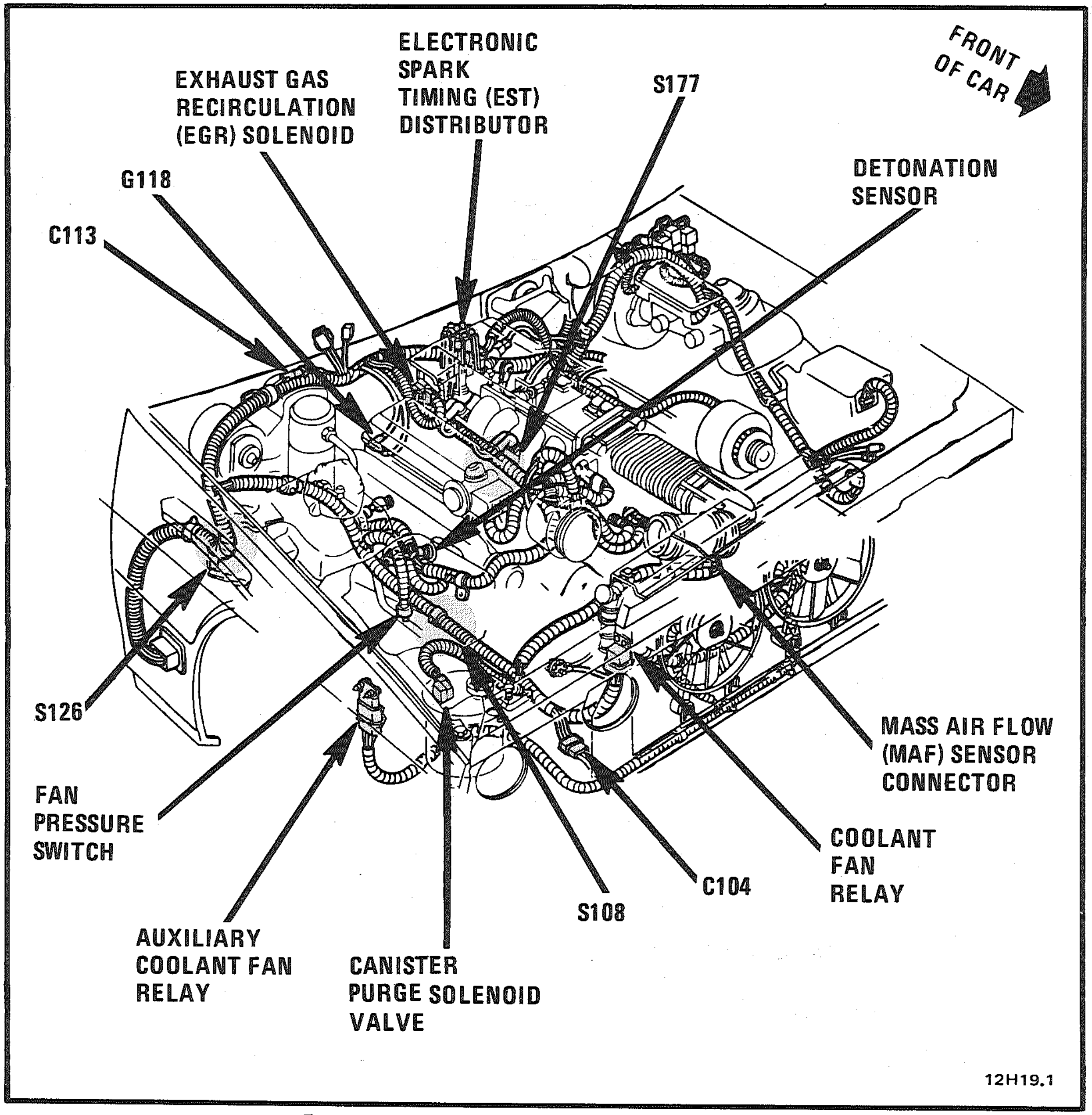


Figure A - VIN F Engine Compartment (VIN 8 Similar)

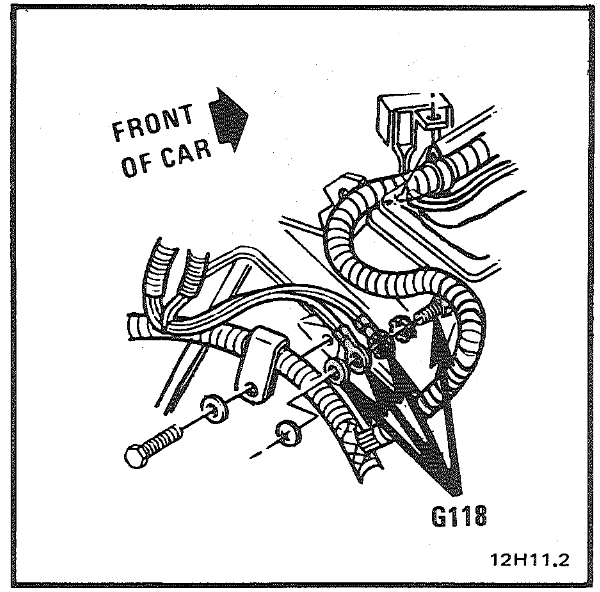


Figure B - Rear Of RH Cylinder Head (VIN E)

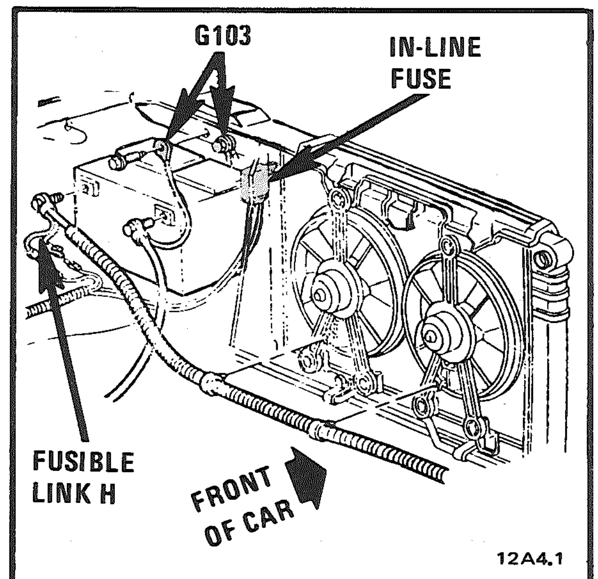


Figure C - LH Front Corner Of VIN F Engine Compartment (VIN 8 Similar)

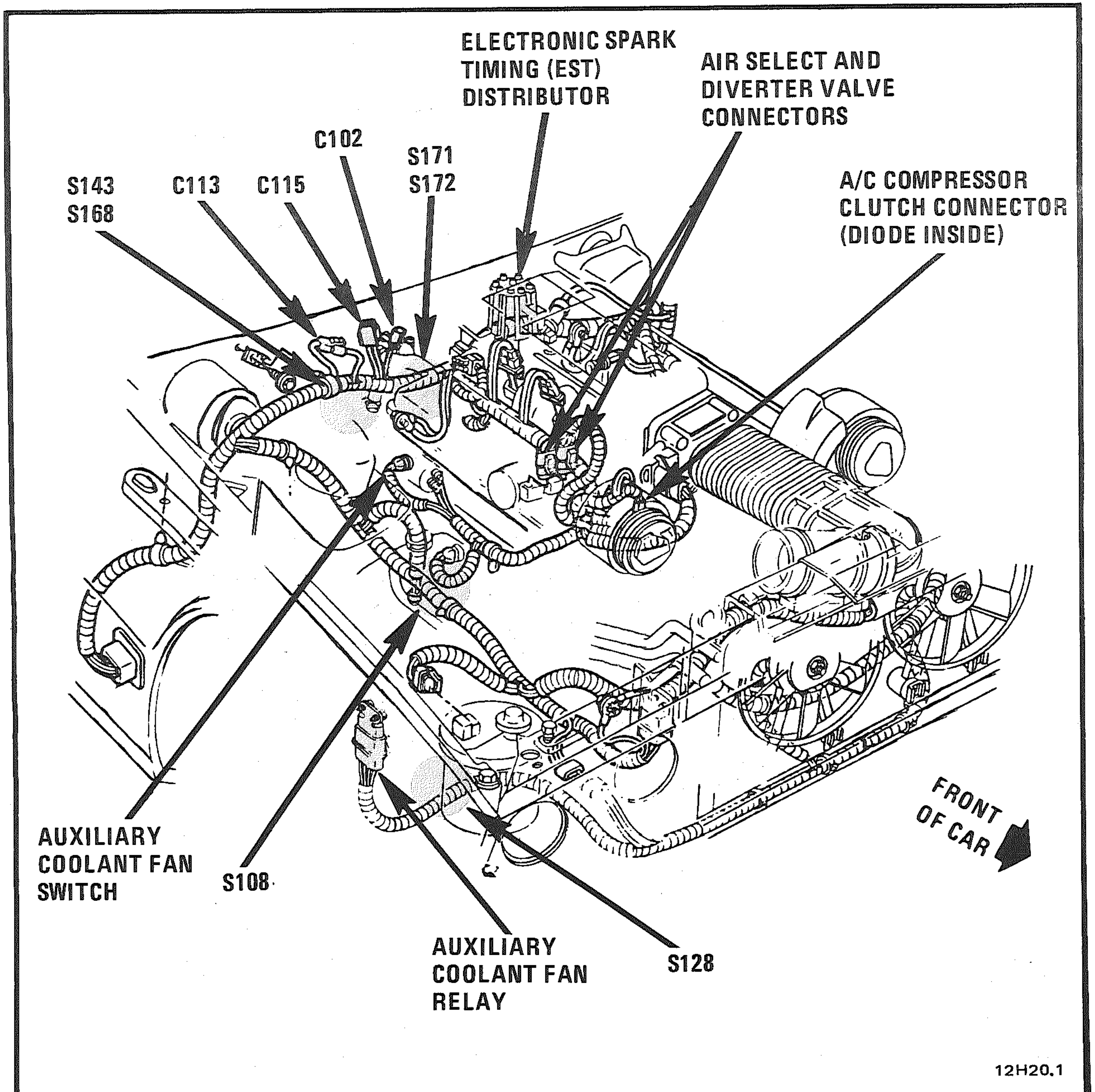


Figure A - RH Side Of VIN F Engine Compartment (VIN 8 Similar)

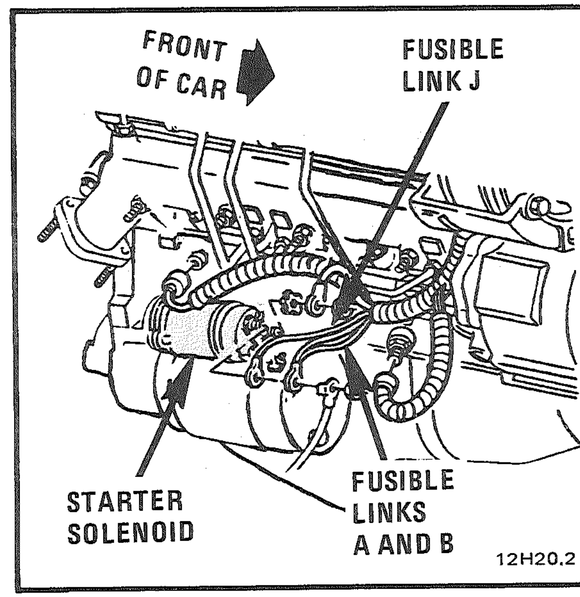


Figure B - Lower RH Side Of VIN F Engine
(VIN 8 Similar)

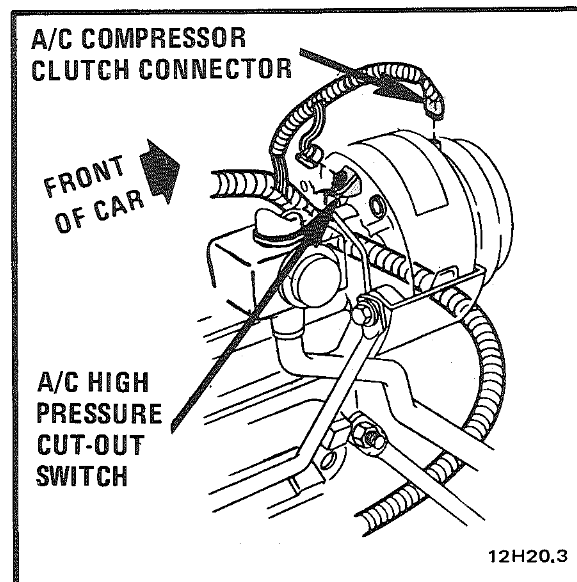


Figure C - Top Front RH Side Of VIN F Engine
(VIN 8 Similar)

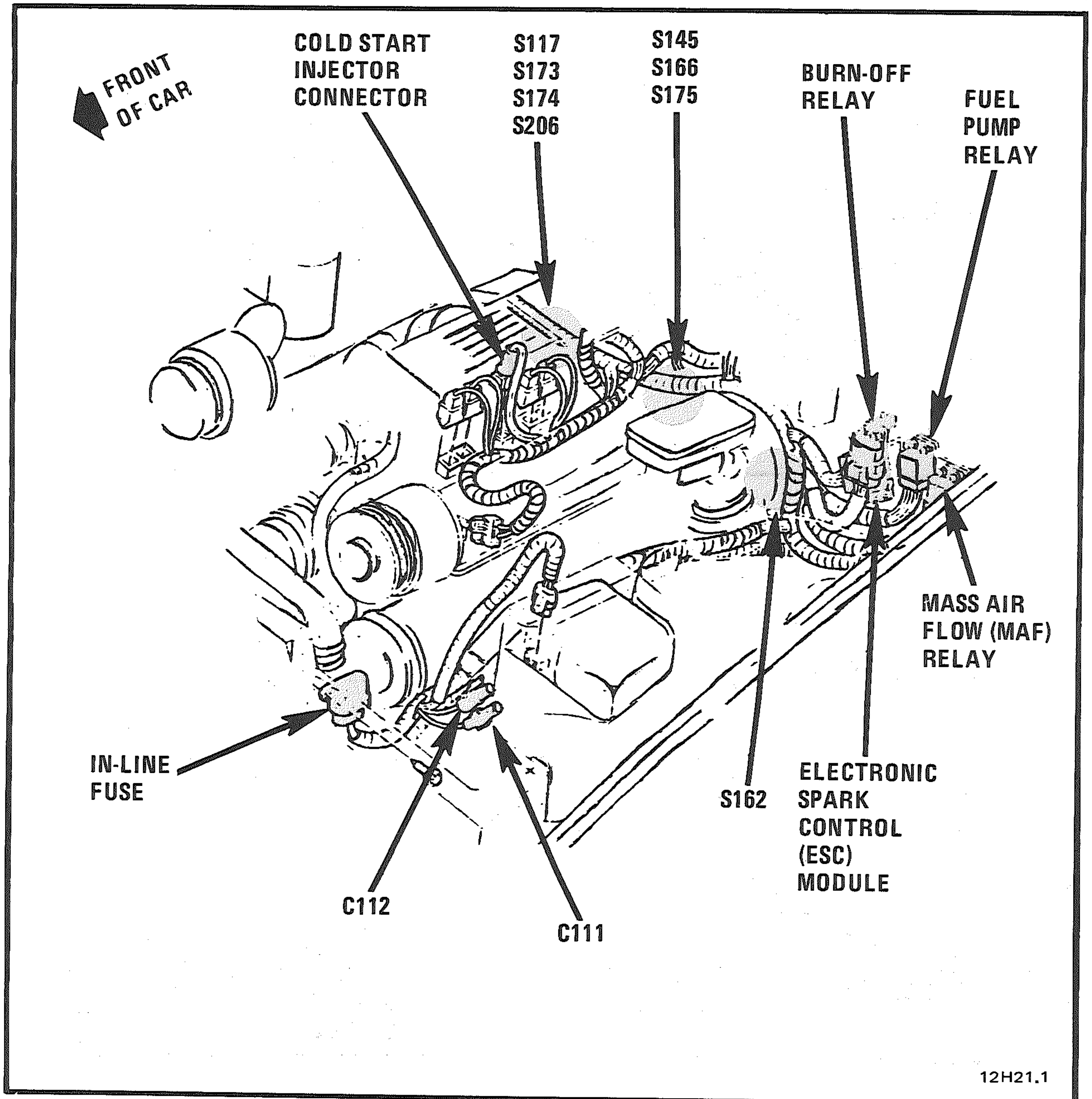


Figure A - LH Side Of VIN F Engine Compartment (VIN 8 Similar)

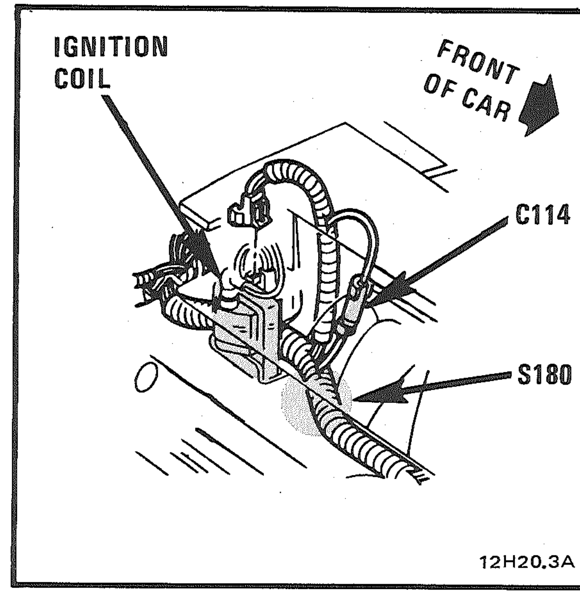


Figure B - RH Rear Side Of VIN F Engine (VIN 8 Similar)

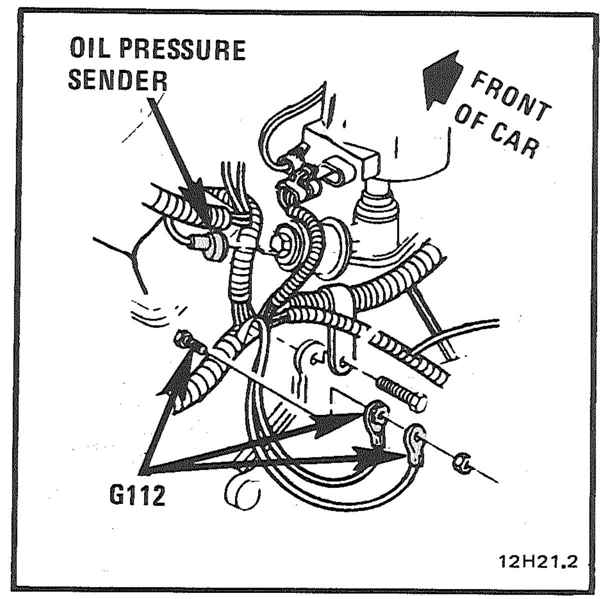


Figure C - Top LH Rear Of VIN F Engine (VIN 8 Similar)

COMPONENT LOCATION VIEWS

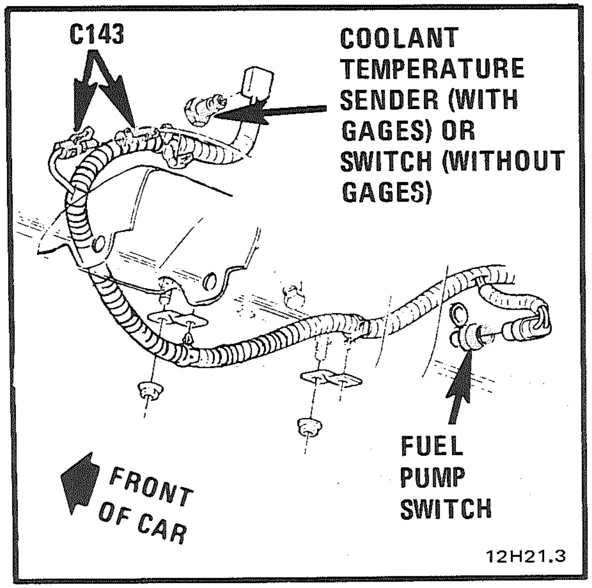


Figure A - Lower LH Side Of VIN F Engine (VIN 8 Similar)

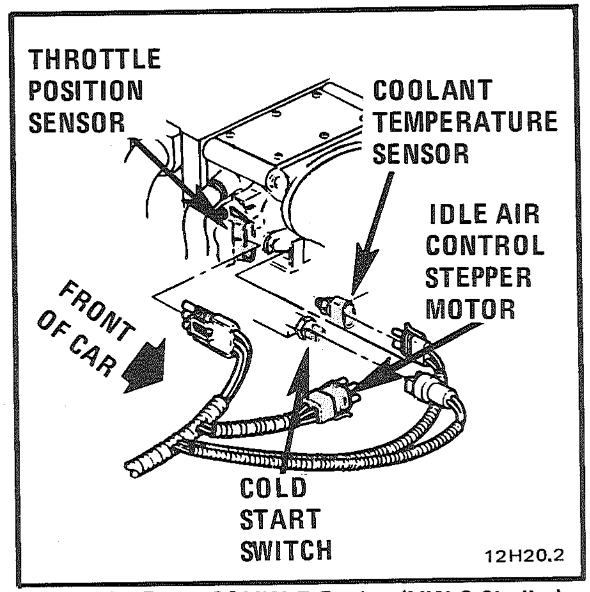


Figure C - Front Of VIN F Engine (VIN 8 Similar)

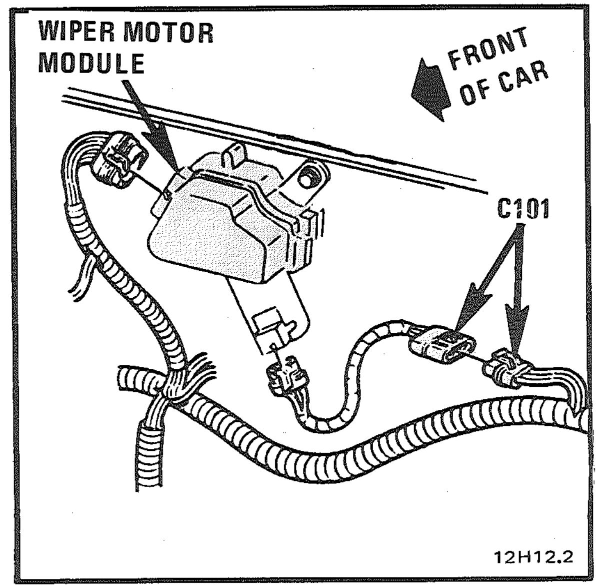


Figure E - Center Front Of Dash

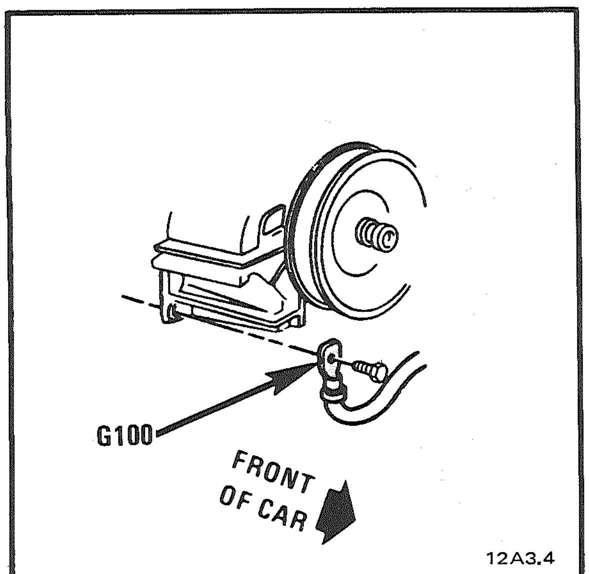


Figure B - Lower LH Front Of VIN F Engine (VIN 8 Similar)

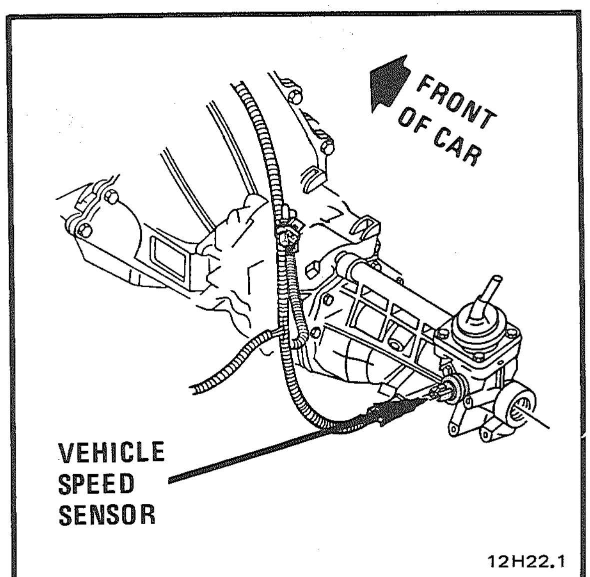


Figure D - LH Side Of Transmission (Manual Shown, Automatic Similar)

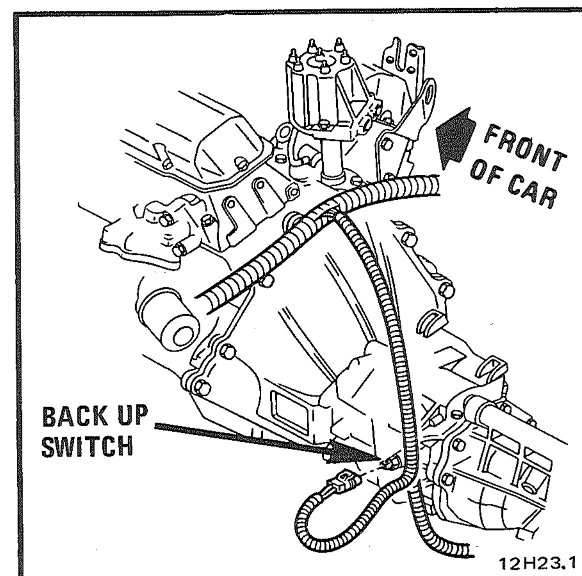


Figure F - LH Side Of Manual Transmission

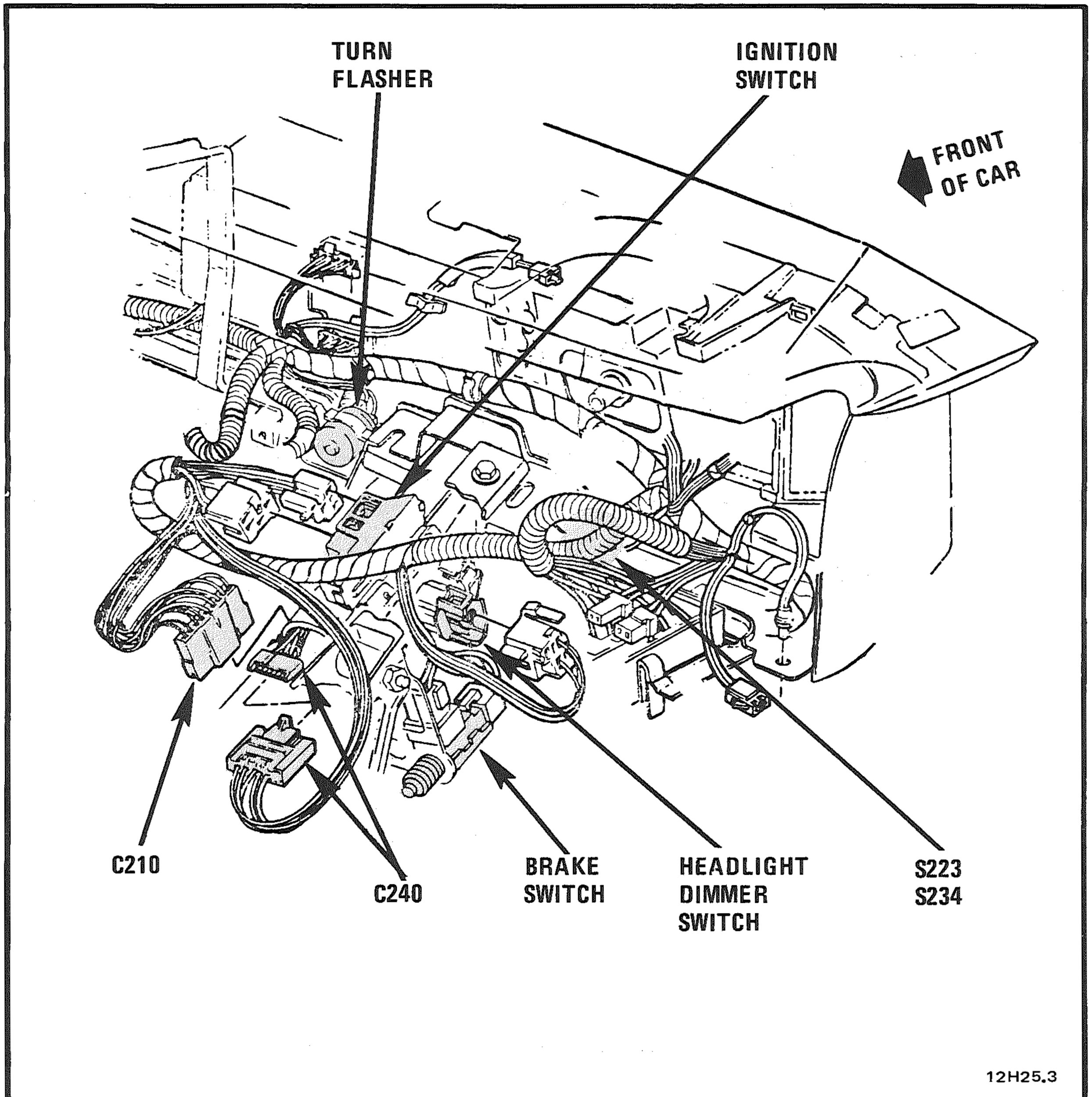


Figure A - Behind LH Side Of I/P

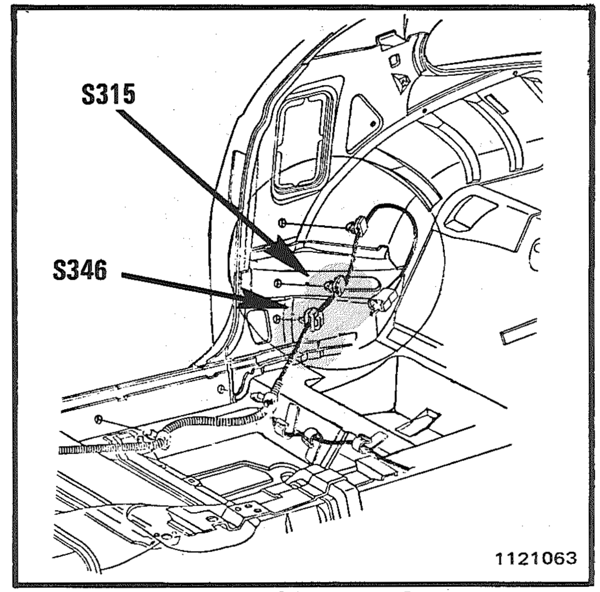


Figure B - RH Rear Of Passenger Compartment

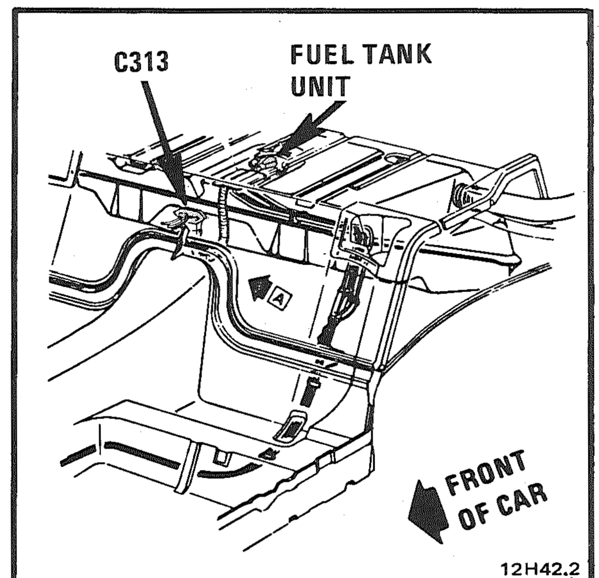


Figure C - Below Rear Of Car

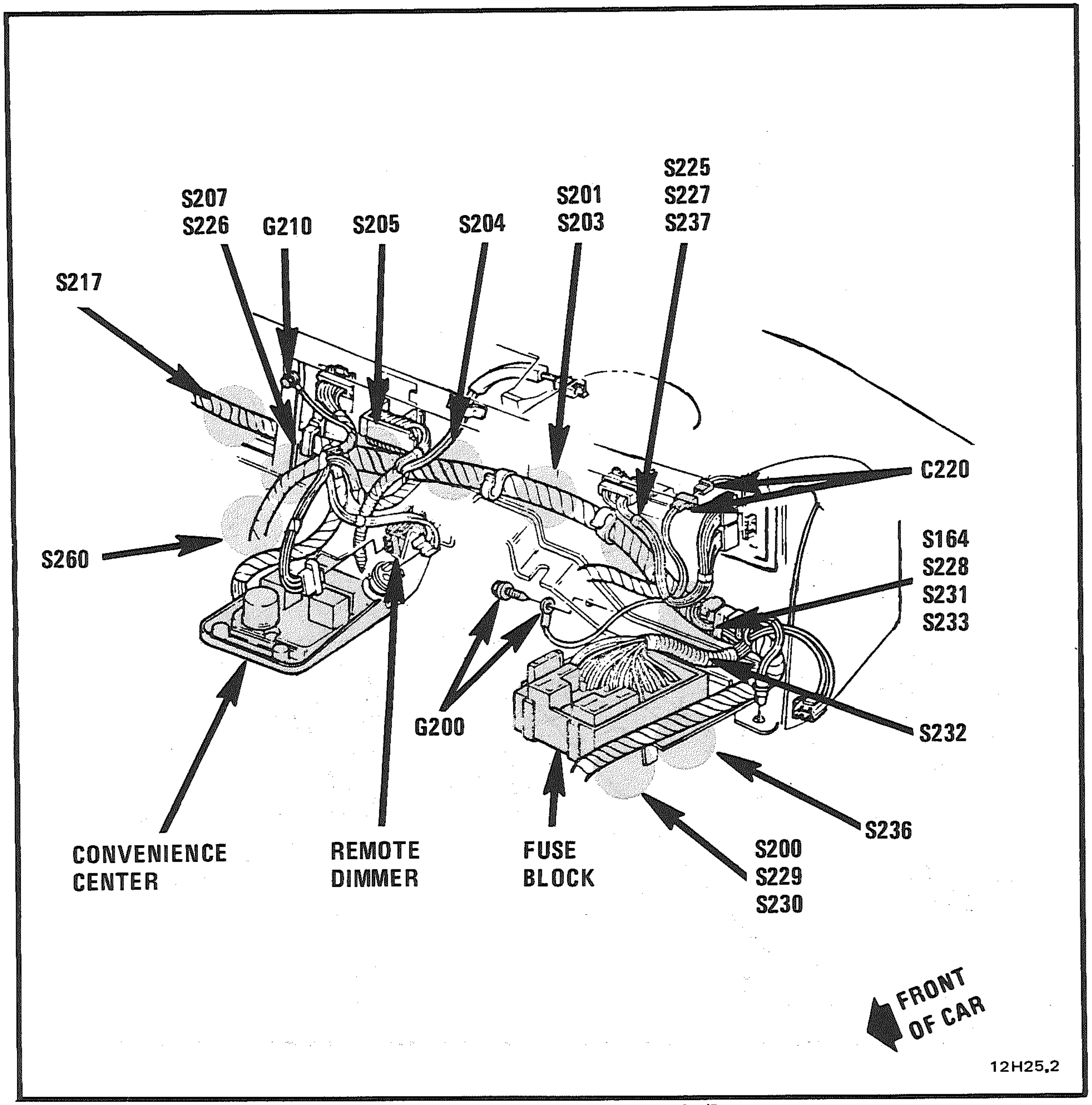


Figure A - Behind LH Side Of I/P

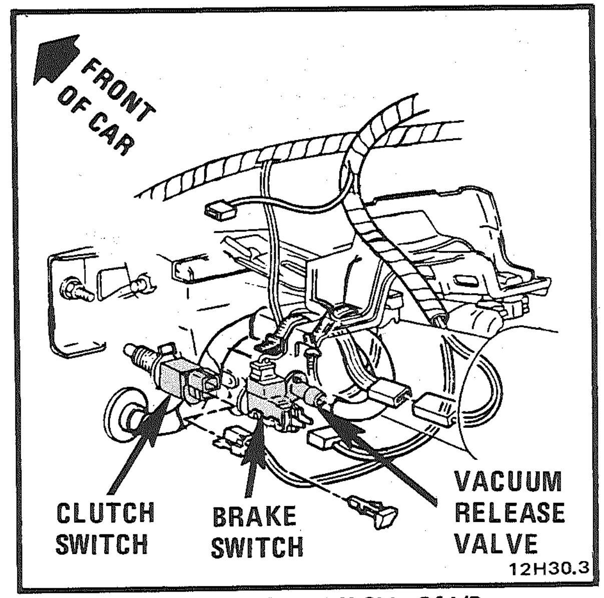


Figure B - Behind LH Side Of I/P

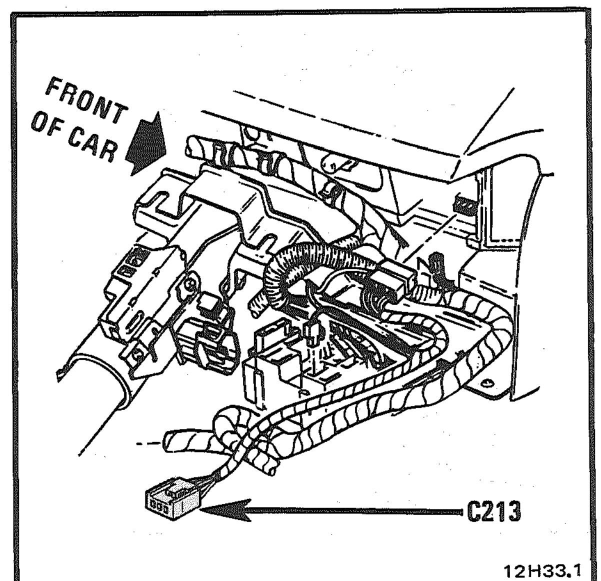


Figure C - Behind LH Side Of I/P

COMPONENT LOCATION VIEWS

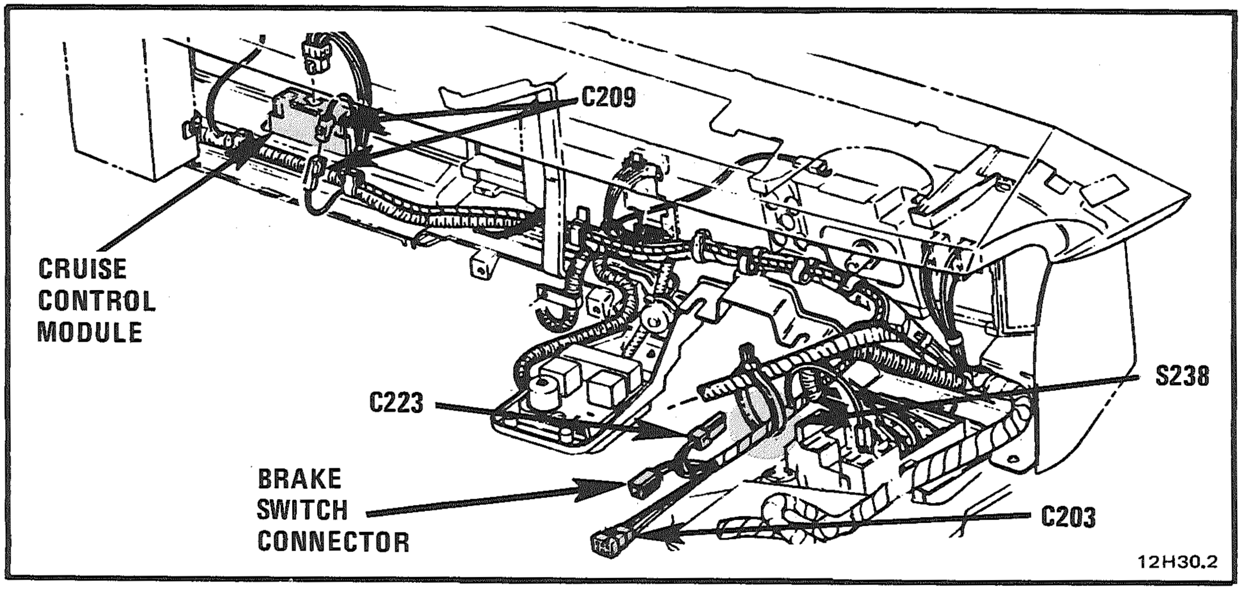


Figure A - Behind I/P

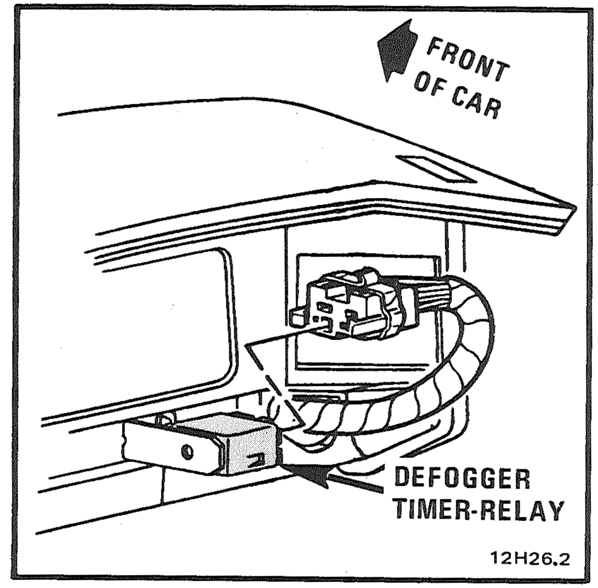


Figure D - Behind RH Side Of I/P

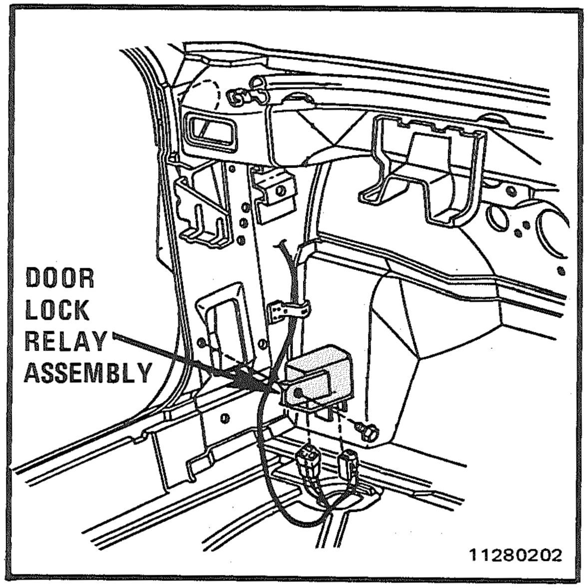


Figure B - LH Shroud

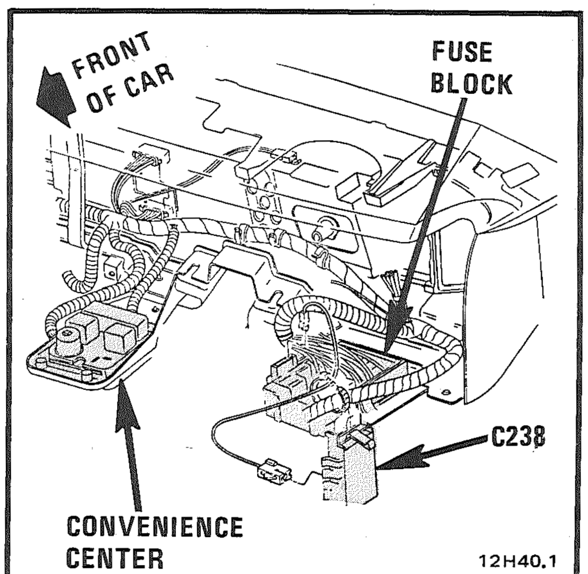


Figure C - Behind LH Side Of I/P

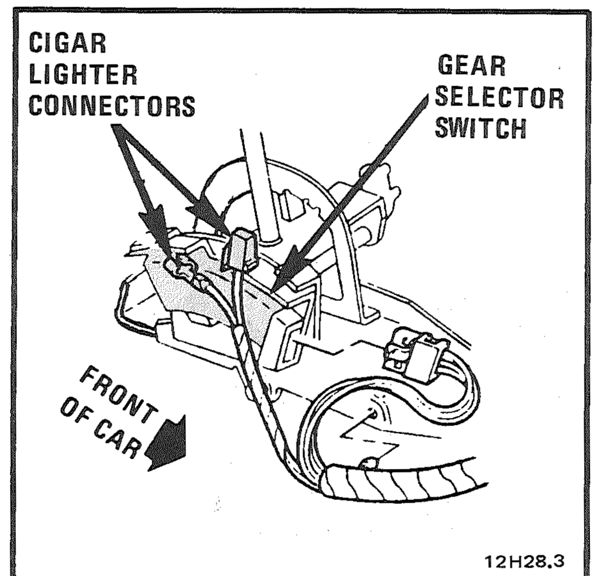


Figure E - Below Front Of Console

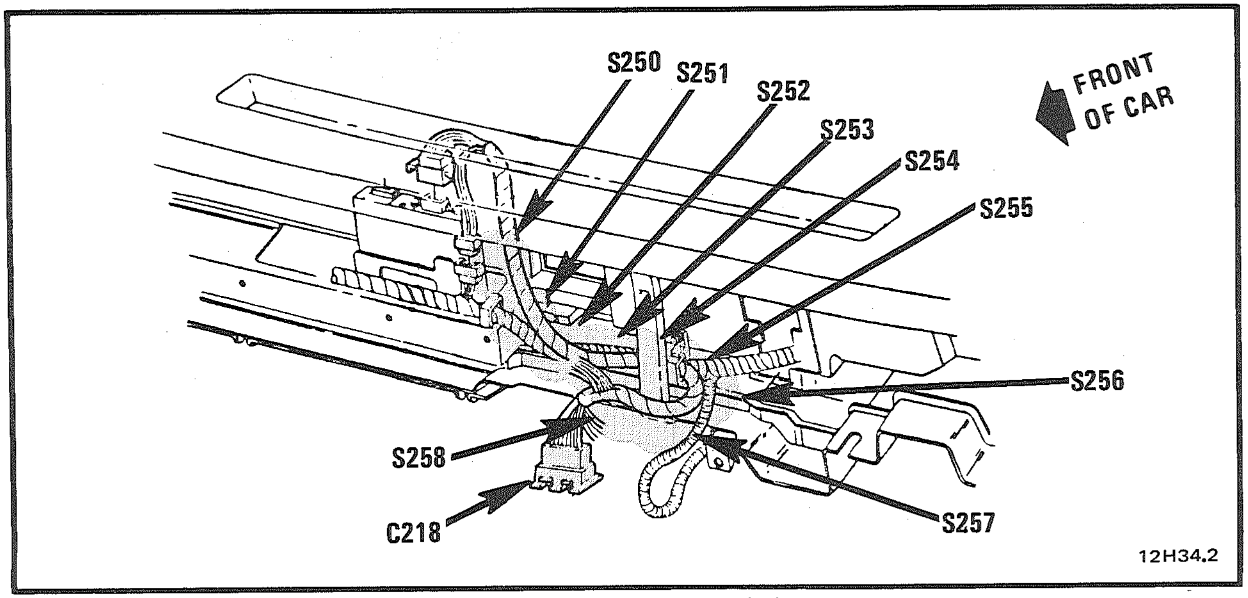


Figure A - Behind Center Of I/P

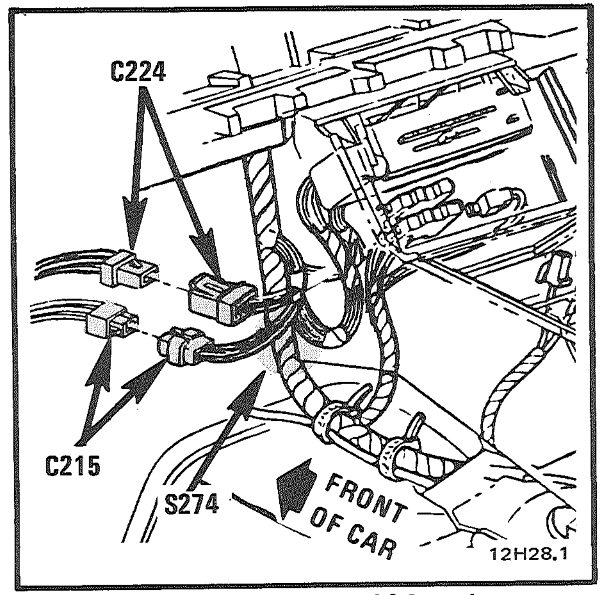


Figure C - Behind Head Of Console

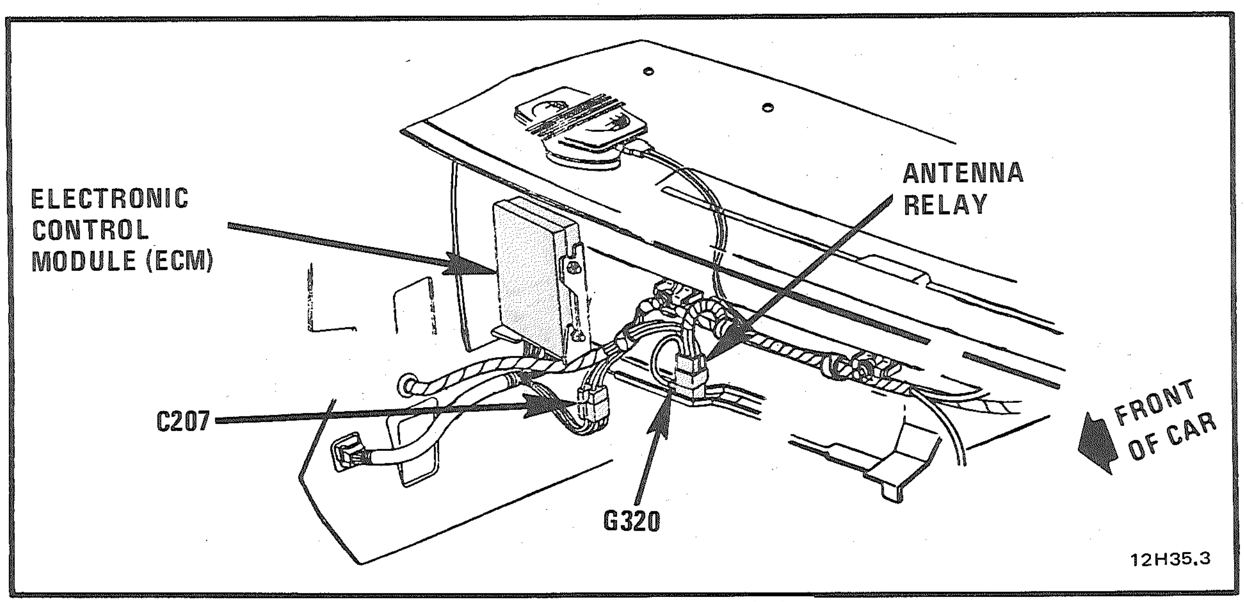


Figure B - Behind RH Side Of I/P

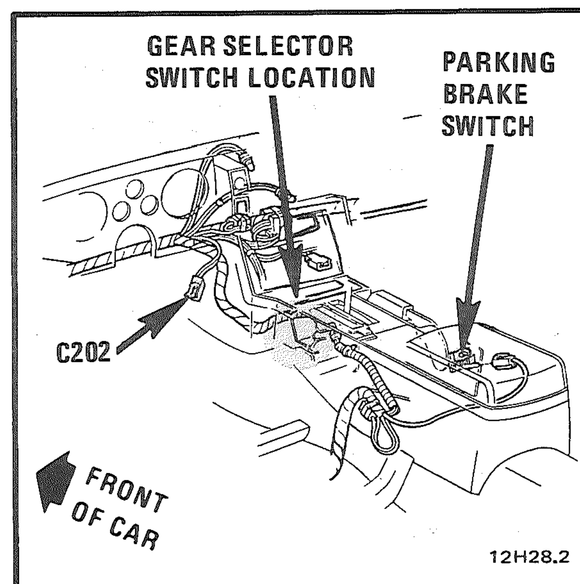


Figure D - Console

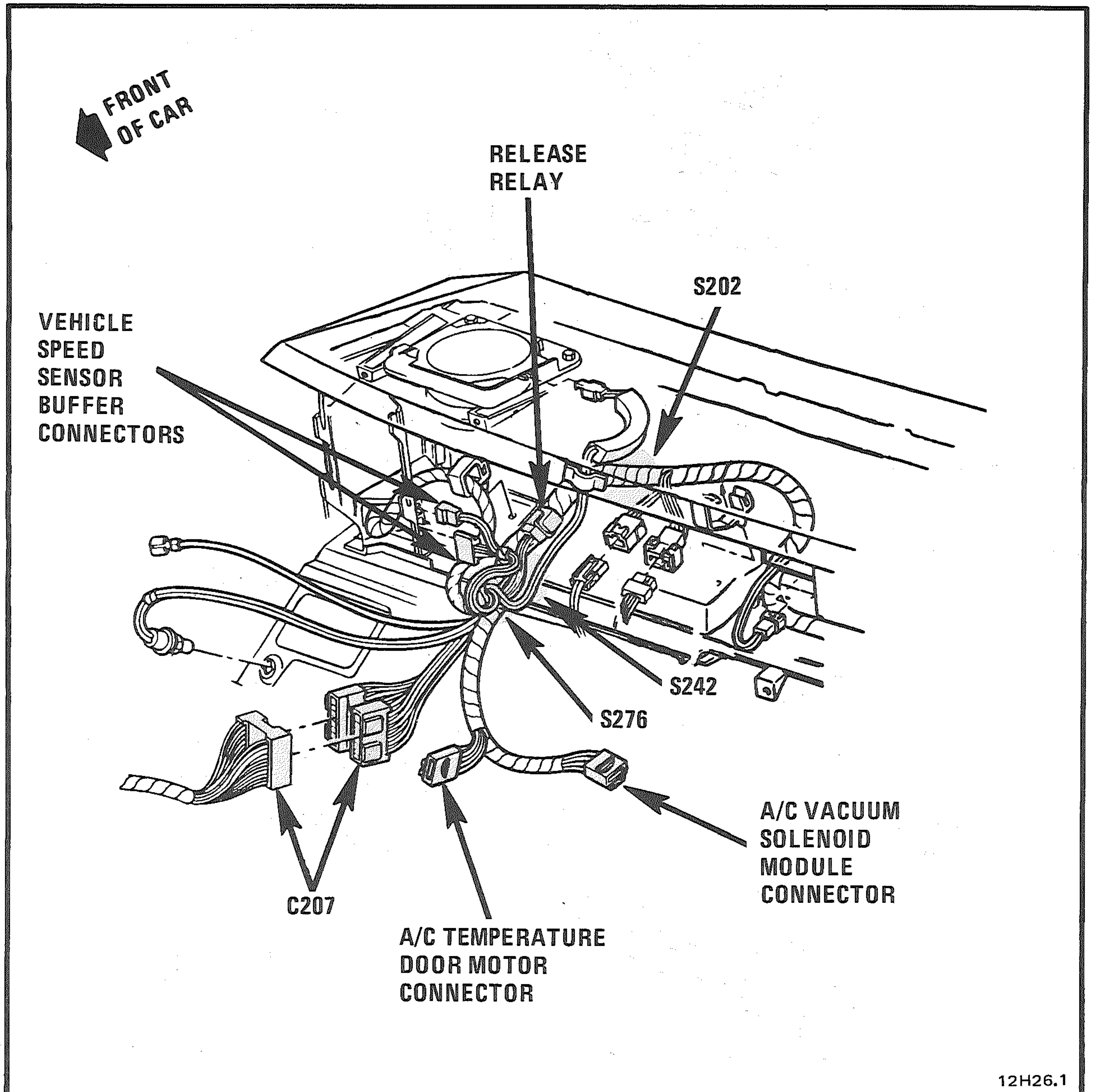


Figure A - Behind RH Side Of I/P

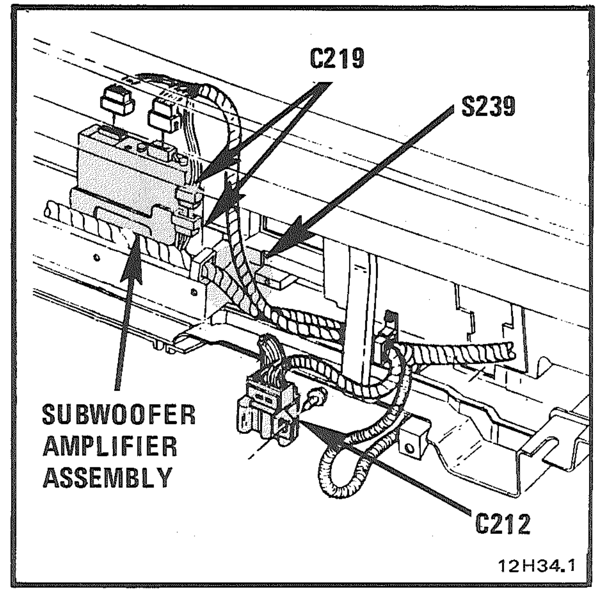


Figure B - Behind Center Of I/P

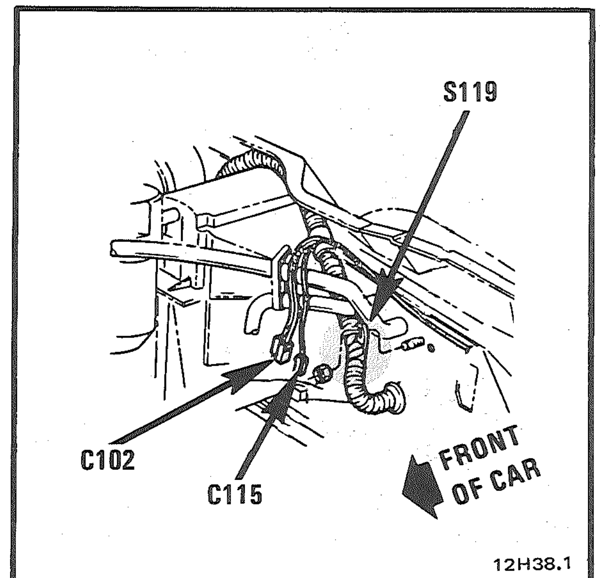


Figure C - RH Rear Corner Of Engine Compartment

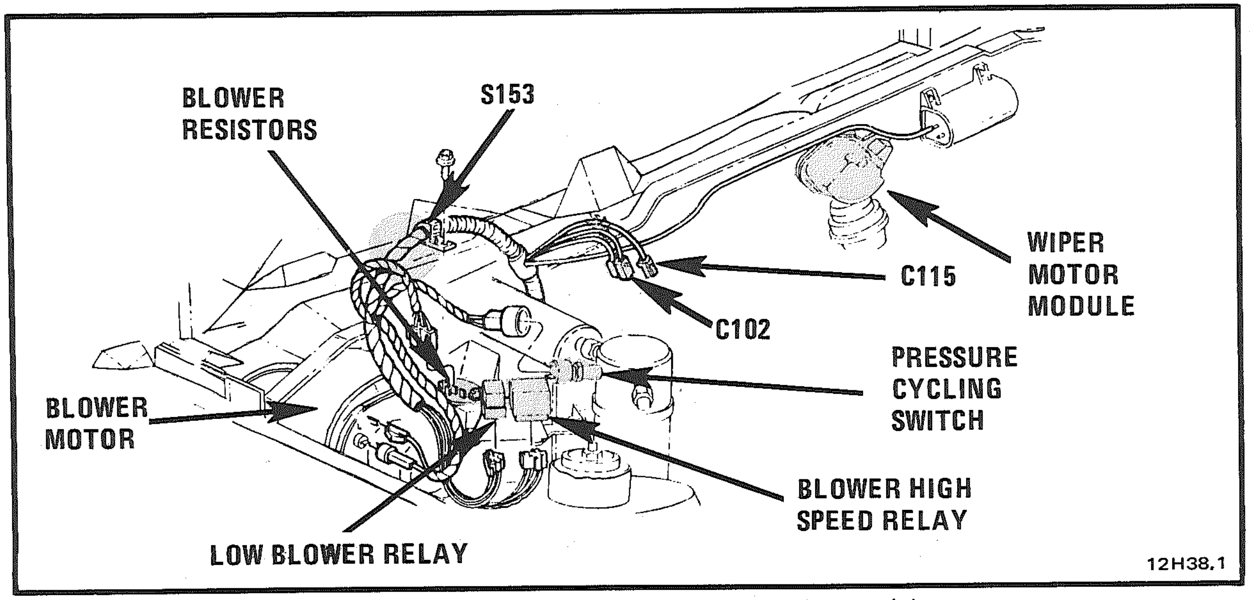


Figure A - RH Front And Center Of Dash (With A/C)

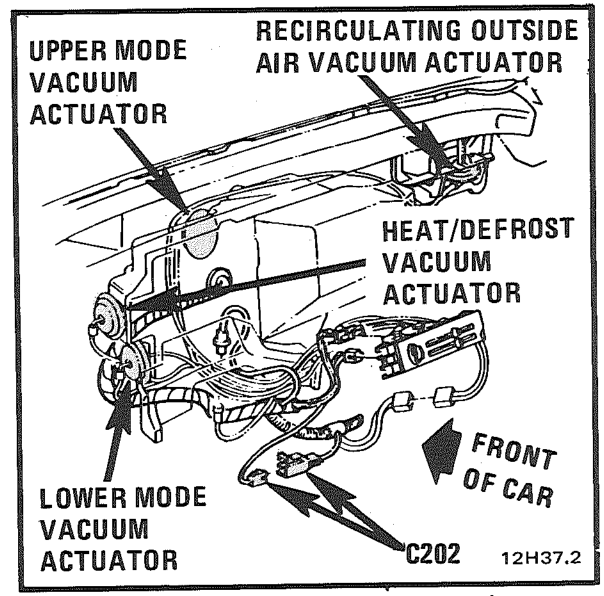


Figure C - Behind I/P (C60 Manual)

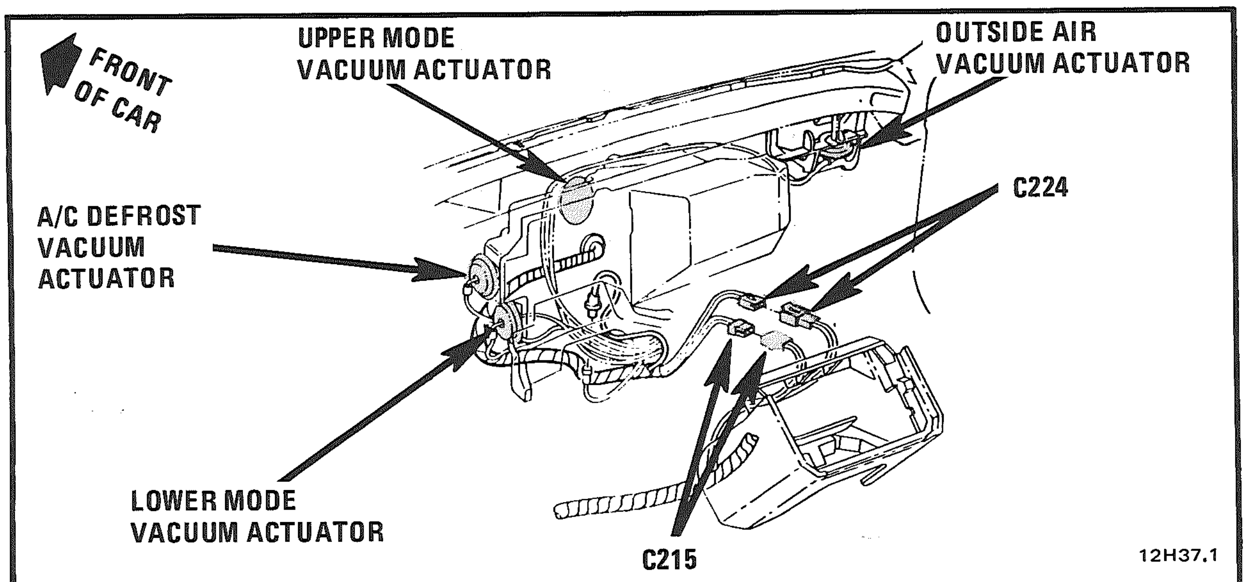


Figure B - Behind I/P (C67 Electronic)

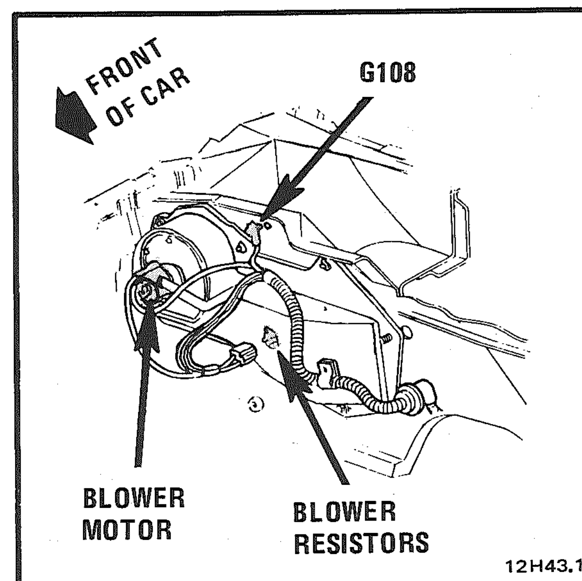


Figure D - RH Front Of Dash (Without A/C)

COMPONENT LOCATION VIEWS

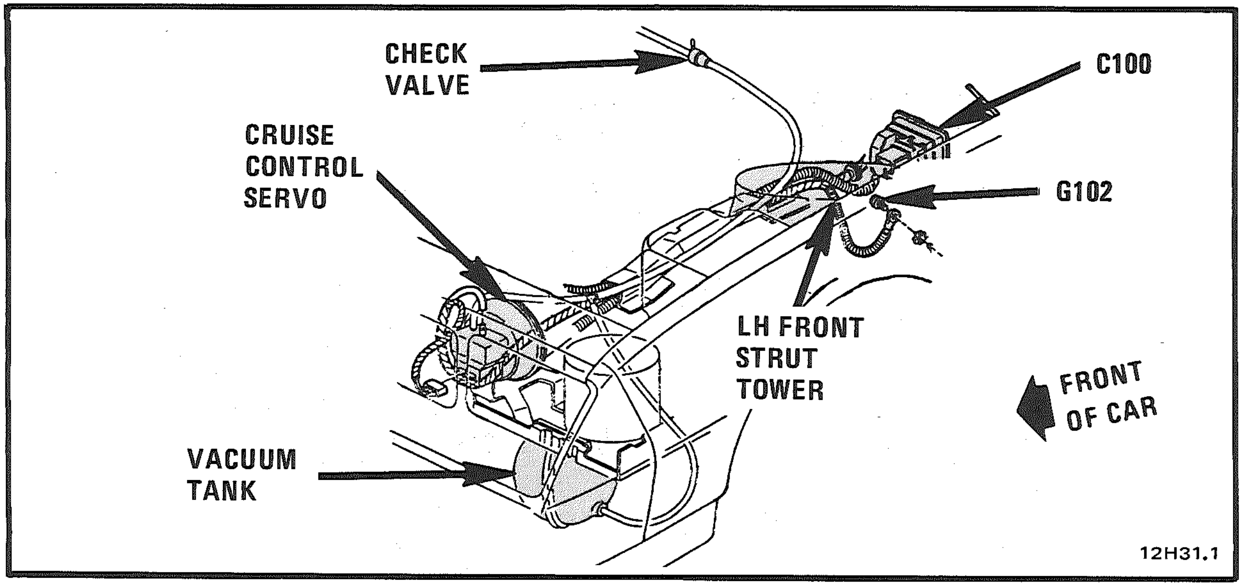


Figure A - LH Side Of Engine Compartment

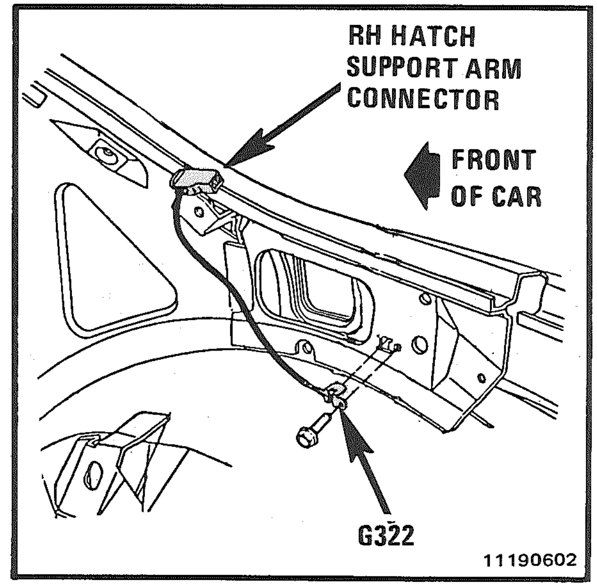


Figure D - RH Side Of Cargo Compartment

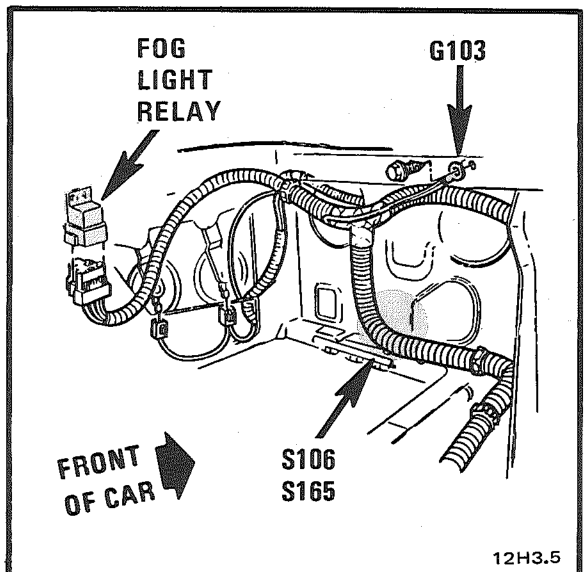


Figure B - LH Front Corner Of Engine Compartment

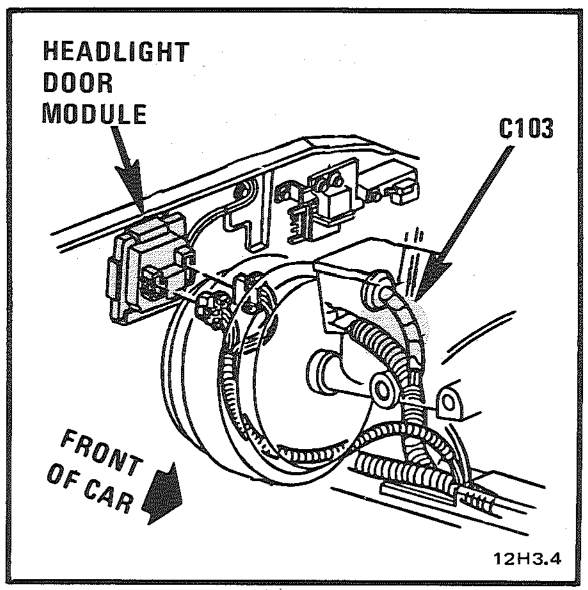


Figure C - LH Rear Corner Of Engine Compartment

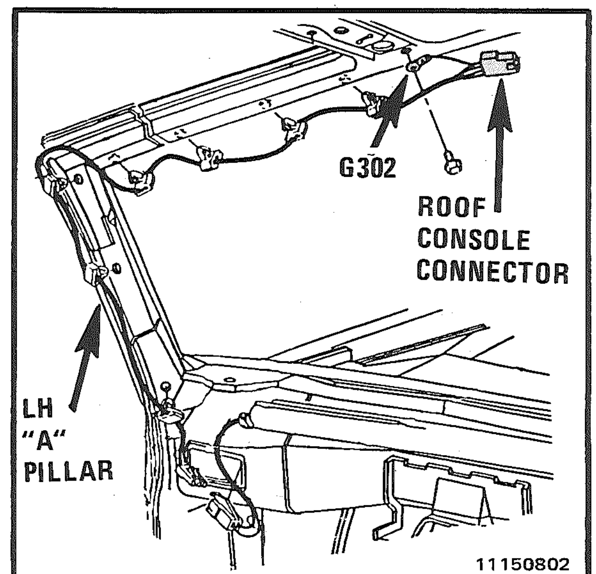


Figure E - LH Side Of Windshield Header

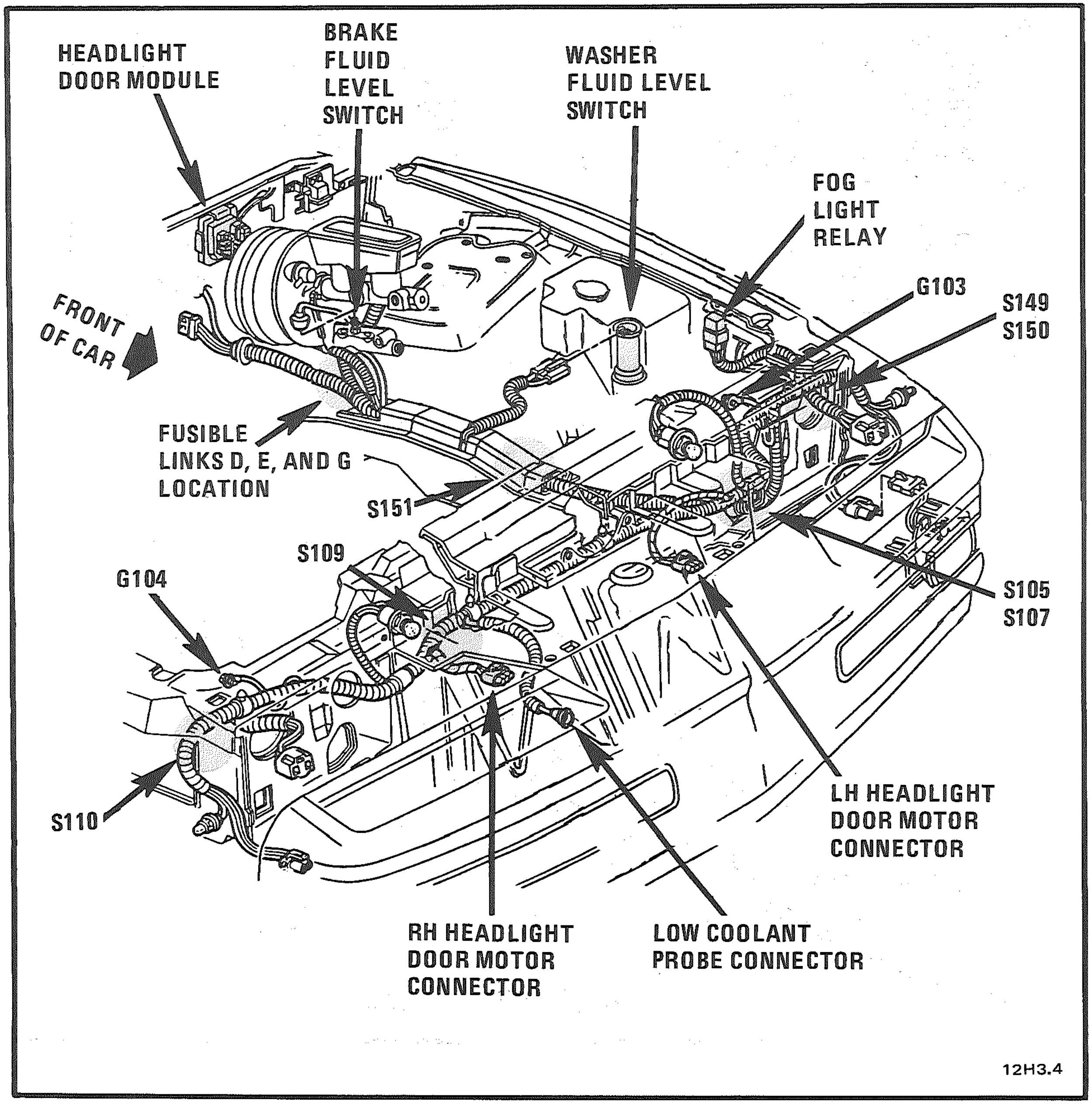


Figure A - Engine Compartment

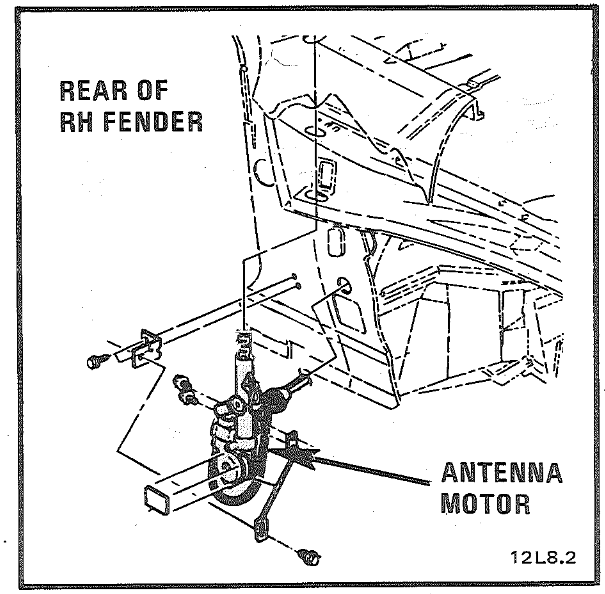


Figure B - Behind RH Front Wheel Well

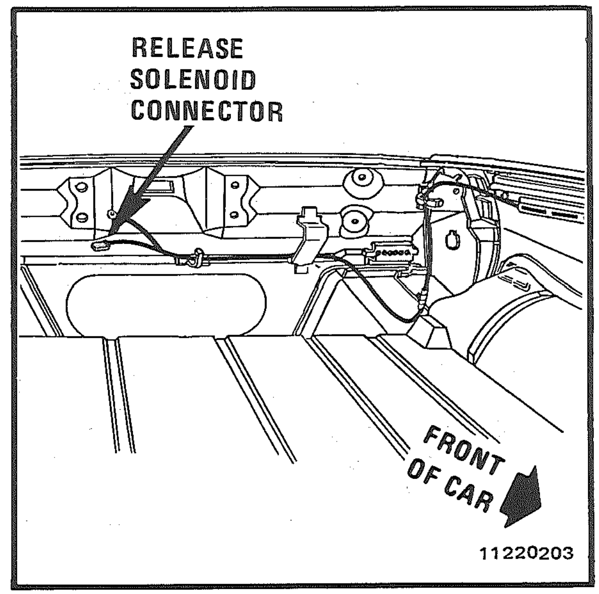


Figure C - LH Rear Corner Of Cargo Compartment

COMPONENT LOCATION VIEWS

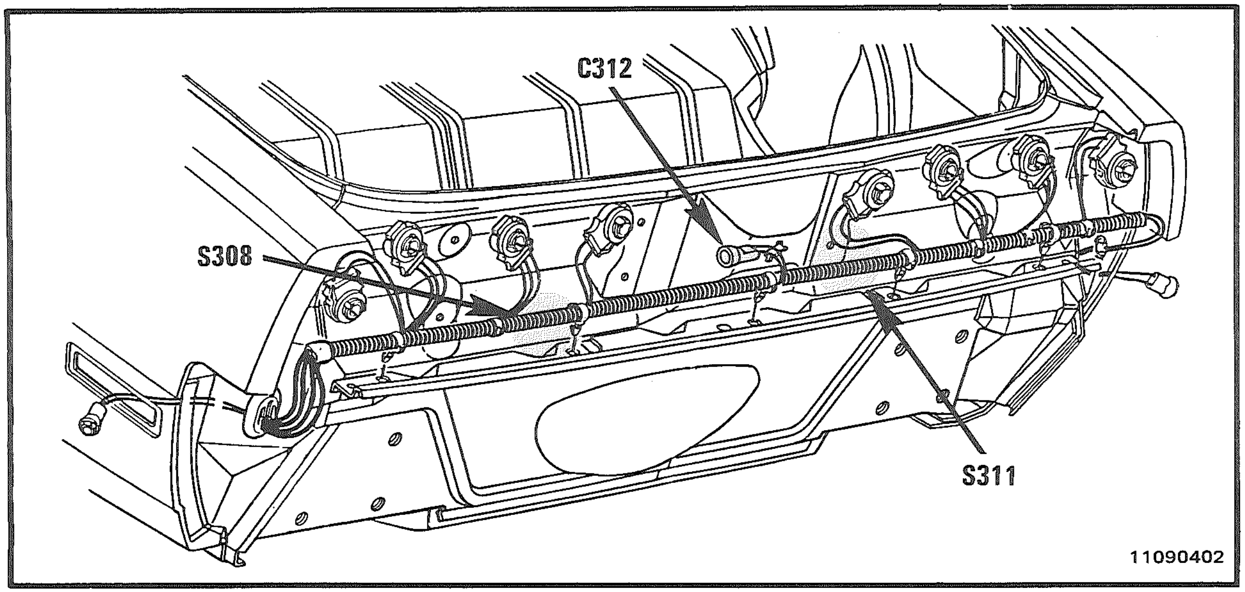


Figure A - Rear Of Car

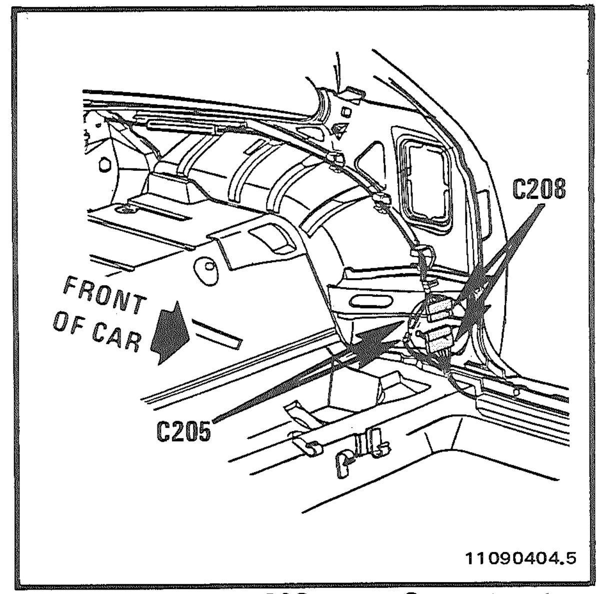


Figure C - LH Rear Of Passenger Compartment

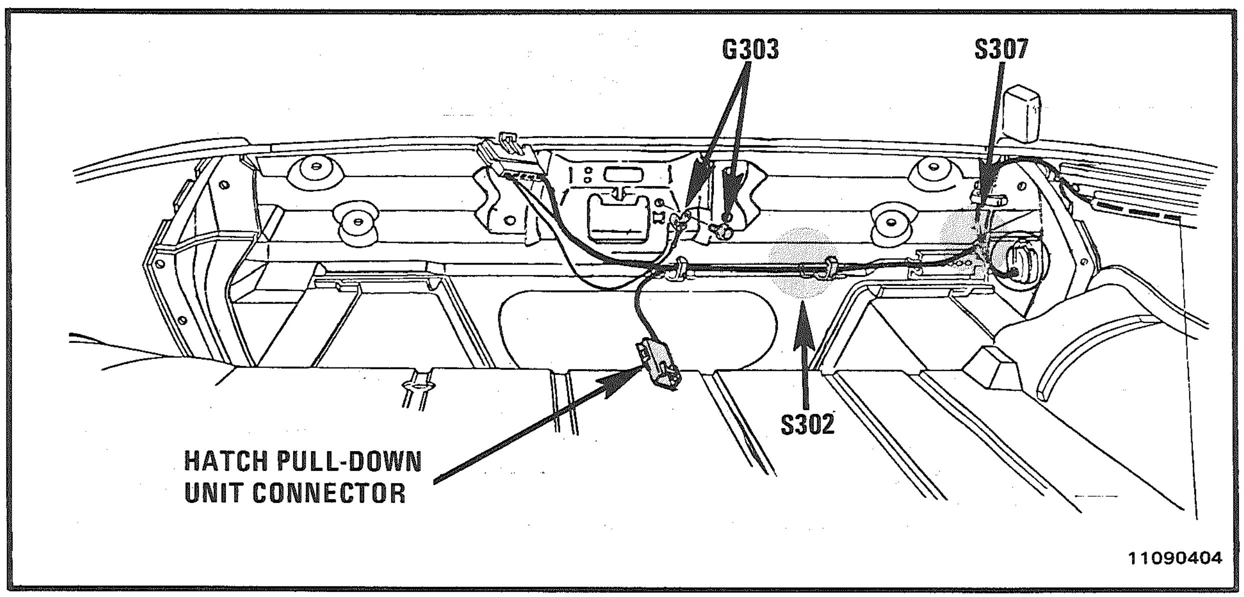


Figure B - Rear Of Cargo Compartment

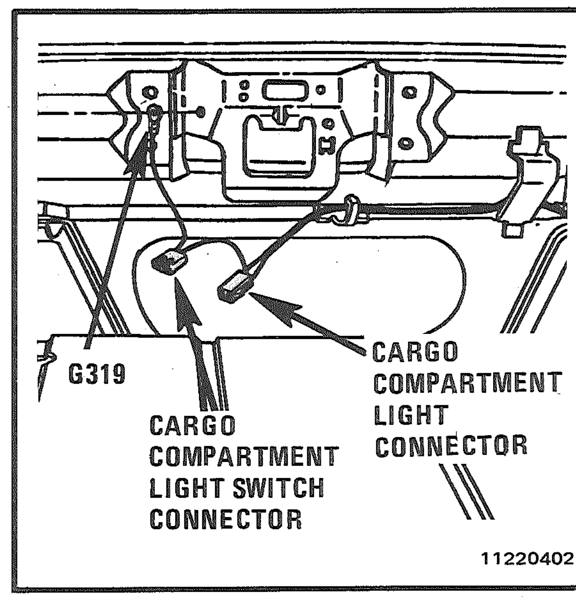


Figure D - Center Of End Panel, In Trunk

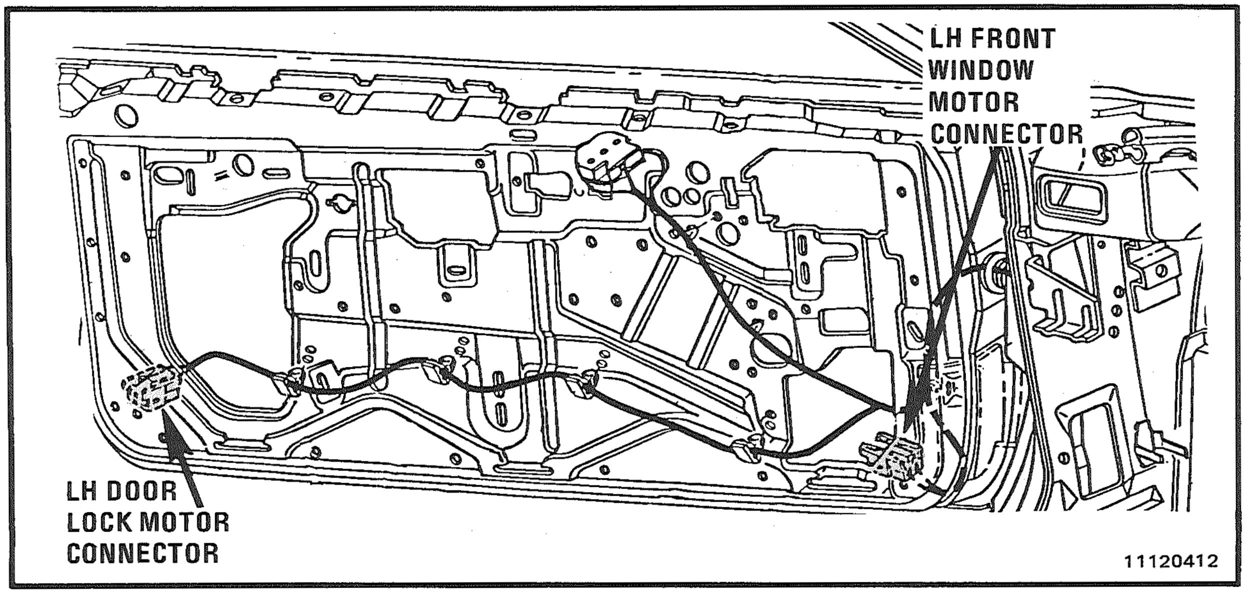
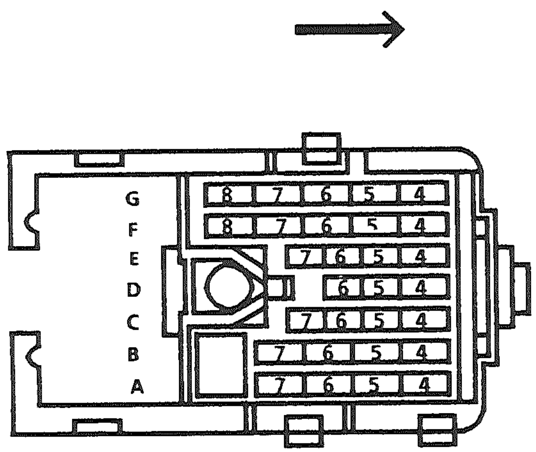


Figure A - LH Door (RH Similar)

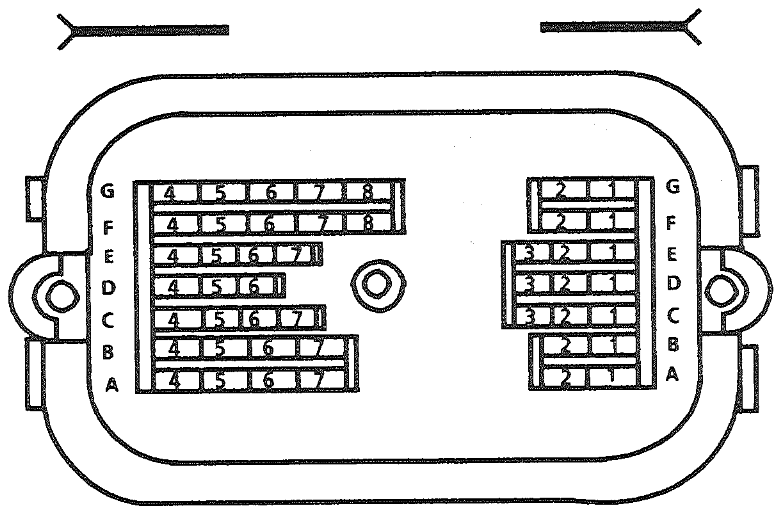
BLANK

HARNESS CONNECTOR FACES

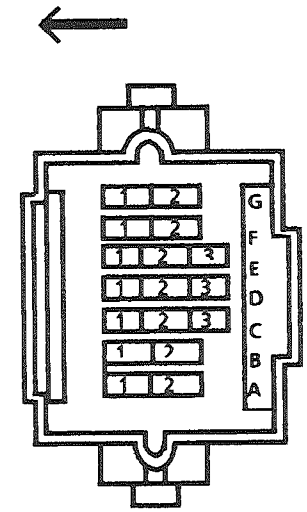
BULKHEAD CONNECTOR, C100



ENGINE HARNESS CONNECTOR
(REMOVED FROM C100)



C100 TERMINAL VIEW
(AS MOUNTED ON COWL)



FRONT LIGHT HARNESS CONNECTOR
(REMOVED FROM C100)

V42000.0

HARNESS CONNECTOR FACES

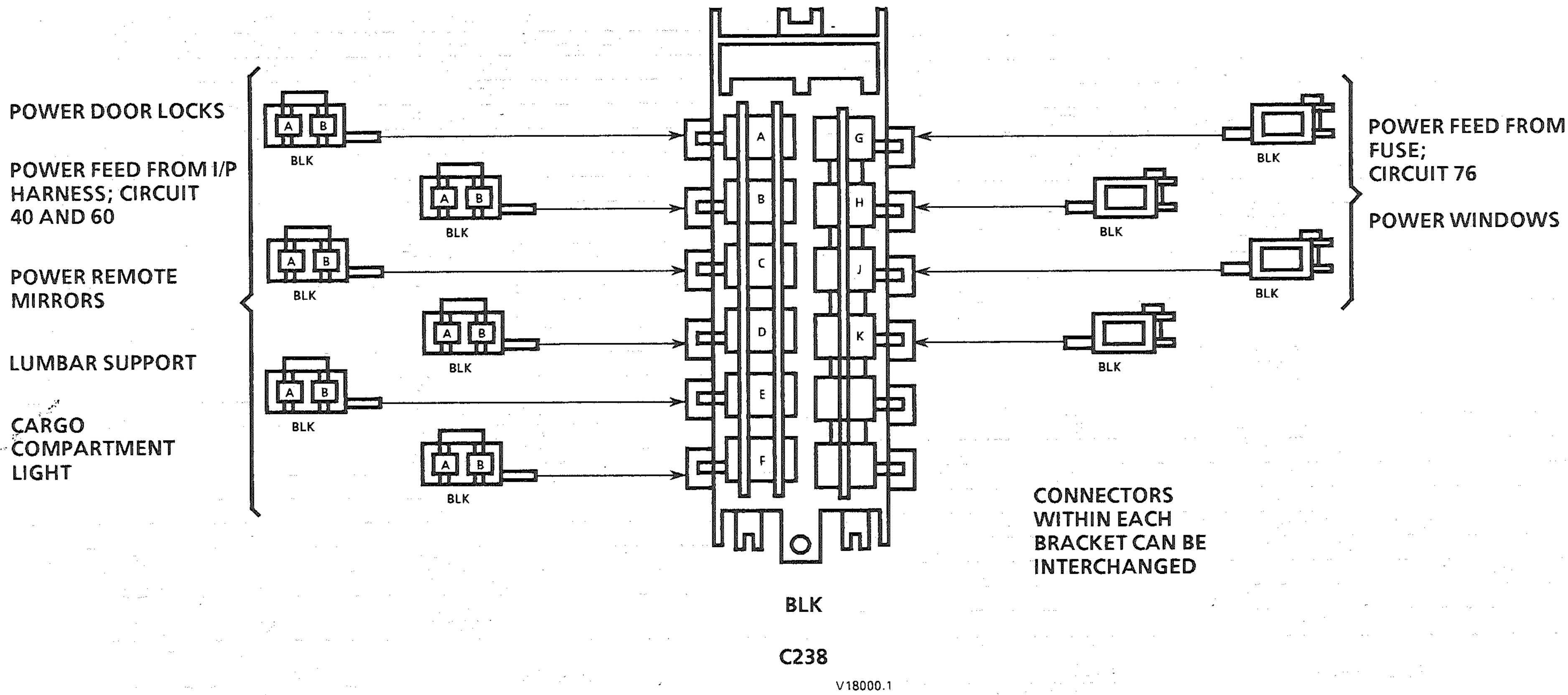
BULKHEAD CONNECTOR, C100

CAVITY	WIRE COLOR		SCHEMATIC
	PIN HALF	SOCKET HALF	
A1	RED	RED	Power Distribution (Headlight Door/Fog Lights)
A2	DK GRN/WHT	DK GRN/WHT	Headlights (Hi Beams)
A4	RED	RED	Power Distribution (Ignition Switch)
A5	—	—	Not Used
A6	—	—	Not Used
A7	PNK/BLK	PNK/BLK	Idle Speed Control (V8 VIN E)
B1	BRN	BRN	Lights: Park/Front Marker
B2	TAN/WHT	TAN/WHT	Brake Warning System
B4	PPL	PPL	Starting System (Starter Interlock)
B5	DK BLU	DK BLU	Back Up Lights
B6	—	—	Not Used
B7	—	—	Not Used
C1	YEL/BLK	YEL/BLK	Low Coolant Probe (Driver Information Center [DIC])
C2	PPL	PPL	Lights: Park/Turn (LH Front with Lamp Monitor
C3	BLK/WHT	BLK/WHT	Washer Fluid Level (Driver Information Center [DIC])
C4	LT GRN	LT GRN	Back Up Lights
C5	PPL	PPL	Wiper/Washer
C6	DK GRN	DK GRN	Wiper/Washer
C7	PNK	PNK	Wiper/Washer
D1	WHT	WHT	Headlight Doors
D2	YEL	YEL	Headlight Doors
D3	TAN/WHT	TAN/WHT	Headlights (LO Beam, with Lamp Monitor)
D4	YEL (V6 VIN S), PNK/BLK (V8 VIN E) (V8 VIN F) (V8 VIN 8)	YEL	Vehicle Speed Sensor
D5	GRY	GRY	Wiper/Washer
D6	WHT (V8 VIN E) (V8 VIN F) (V8 VIN 8), BLK/WHT (V6 VIN S)	WHT	Tachometer

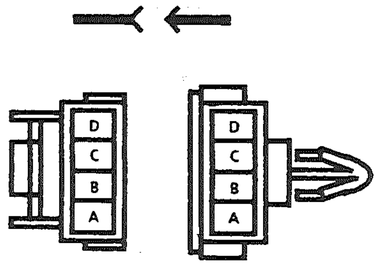
CAVITY	WIRE COLOR		SCHEMATICS
	PIN HALF	SOCKET HALF	
E1	LT GRN/BLK	LT GRN/BLK	Headlights (Hi Beams)
E2	—	—	Not Used
E3	BRN/WHT	BRN/WHT	Lights: Park/Turn (RH Front, with Lamp Monitor)
E4	PPL (V6 VIN S)	PPL	Vehicle Speed Sensor
E5	TAN	TAN	Engine Oil Pressure (Instrument Panel)
E6	RED	RED	Fuel Pump Relay
E7	PPL	PPL	Automatic Transmission
F1	YEL/BLK	YEL/BLK	Headlights (LO Beams, with Lamp Monitor)
F2	DK BLU	DK BLU	Lights: Turn (RH Front)
F4	PNK/BLK (V6 VIN S), PNK (V8 VIN E) (V8 VIN F) (V8 VIN 8)	PNK	Power Distribution (Multi-Port Fuel Injection, Throttle Body Injection, Tuned Port Injection)
F5	DK GRN	DK GRN	Coolant Temperature (Instrument Panel)
F6	—	—	Not Used
F7	—	—	Not Used
F8	BRN	BRN	Charging System
G1	DK GRN	DK GRN	Horn
G2	LT BLU	LT BLU	Lights: Turn (LH Front)
G4	TAN/WHT	TAN/WHT	Fuel Tank Unit
G5	RED	RED	Power Distribution (Light Switch, Fuse Block)
G6	—	—	Not Used
G7	—	—	Not Used
G8	—	—	Not Used

HARNESS CONNECTOR FACES

JUNCTION BLOCK, C238

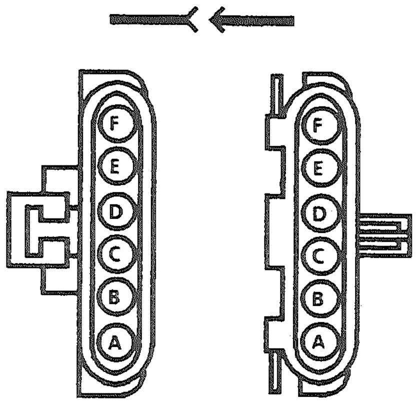


HARNESS CONNECTOR FACES



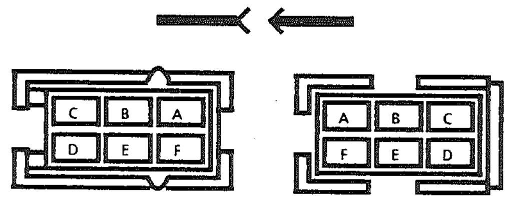
BLK BLK

C102



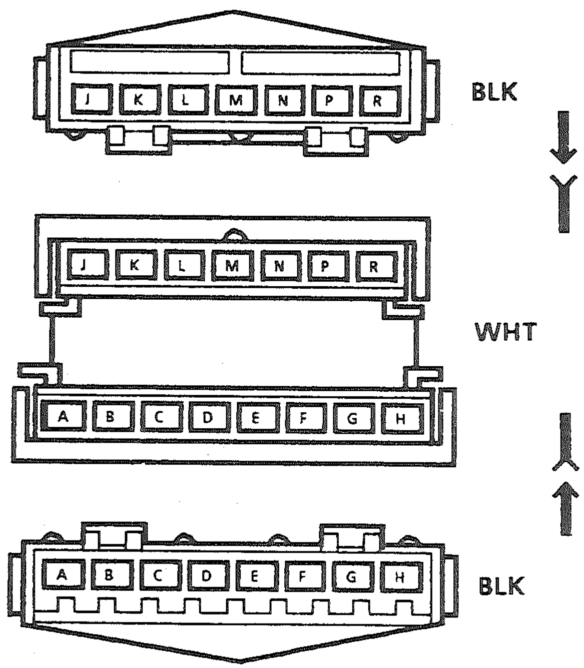
BLK BLK

C104



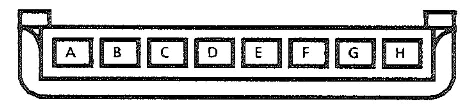
BLK BLK

C203



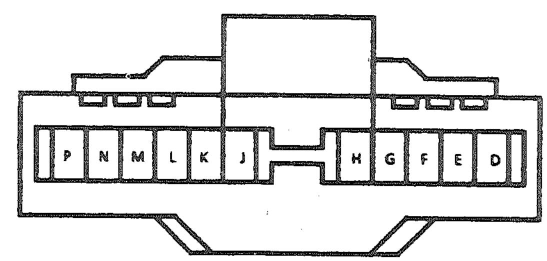
C207

C204, SEE C222



WHT

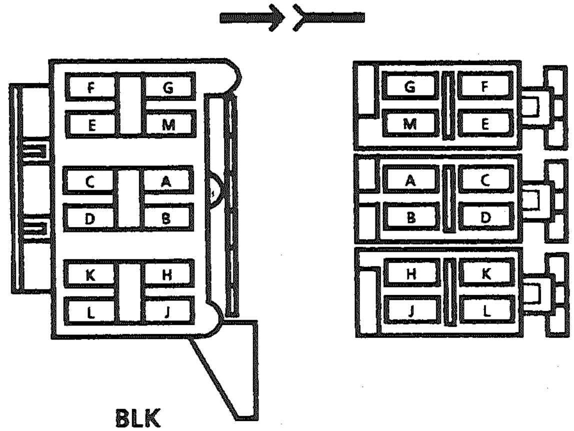
C208



BLK

C210

HARNESS CONNECTOR FACES



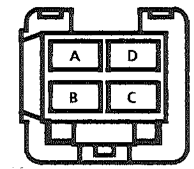
BLK

WHT

BLU

BLK

C212



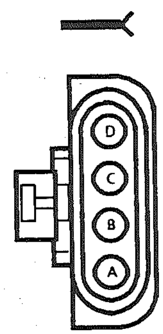
BLK

C223

C217, SEE C4 OF RADIO (WITH UK3)

C218, SEE C2 OF RADIO (WITH UK3)

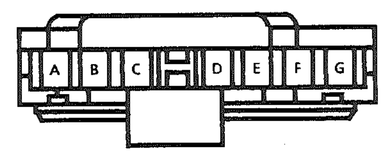
C219, SEE C203



BLK

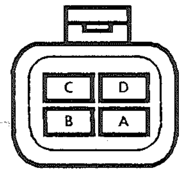
C222

C224, SEE C203



GRY

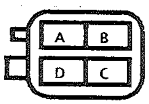
C240



BLK

C303

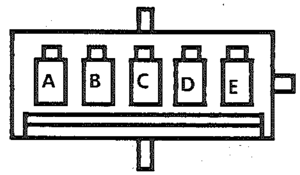
C304, SEE C303



BLK

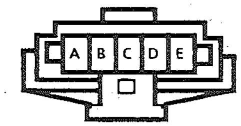
C331

C332, SEE C331



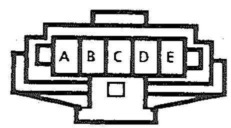
BLK

A/C COMPRESSOR CONTROL RELAY

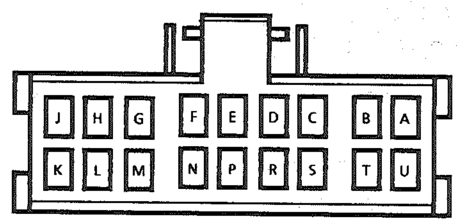


BLK

A/C CONTROL HEAD (WITH C60)



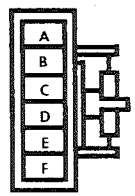
C1 BLK



C2 BLK

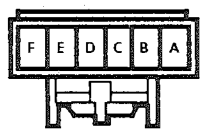
A/C CONTROL HEAD (WITH C67)

HARNESS CONNECTOR FACES



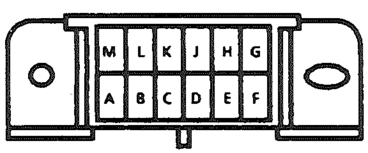
WHT

A/C TEMPERATURE
DOOR MOTOR



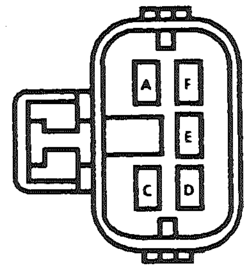
BLK

A/C VACUUM SOLENOID MODULE



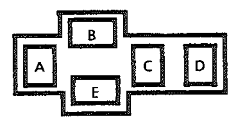
BLK

ASSEMBLY LINE DIAGNOSTIC
LINK (ALDL) CONNECTOR



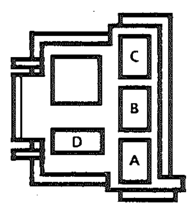
GRY

AUXILIARY COOLANT
FAN RELAY



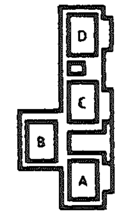
BLK

BLOWER HIGH SPEED
RELAY (WITH C67)



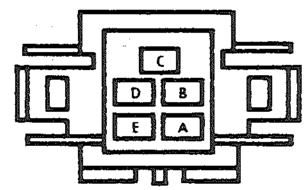
BLK

BLOWER HIGH SPEED
RELAY (MANUAL A/C)



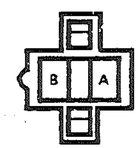
GRY

BLOWER RESISTORS

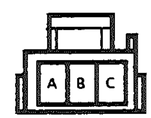


BLK

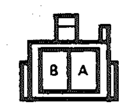
BLOWER SWITCH



C1 WHT



C2 BLK

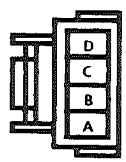


C3 BLU

V00240.0

Brake Switch

BURN-OFF RELAY, SEE AUXILIARY COOLANT FAN RELAY

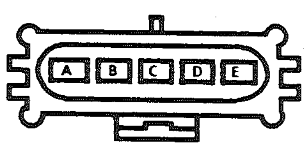


BLK

CLUTCH START SWITCH

V00491.1

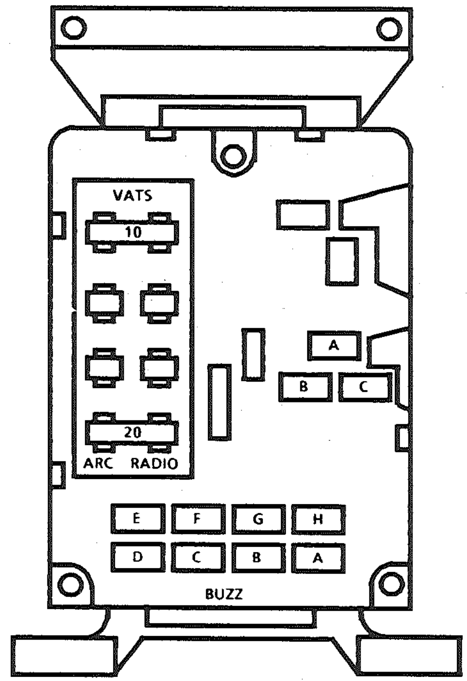
COOLANT FAN RELAY, SEE AUXILIARY COOLANT FAN RELAY



GRY

CRUISE CONTROL SERVO

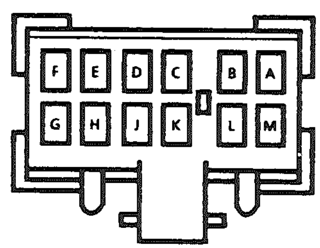
V00459 0



BLK

CONVENIENCE CENTER

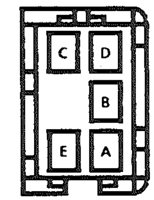
V00275.1



WHT

CRUISE CONTROL MODULE

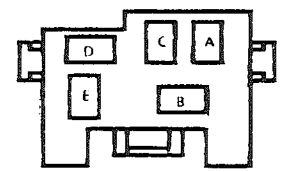
V00286.0



WHT

DEFOGGER CONTROL

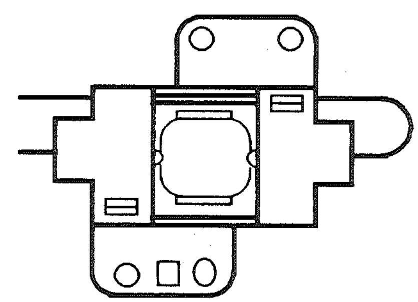
V00569.0



BLK

DEFOGGER TIMER RELAY

V00561 0

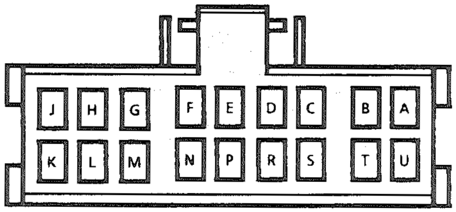


WHT

DOME LIGHT

V00570.0

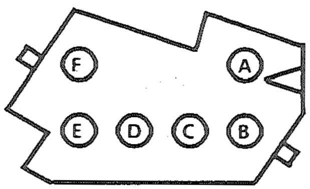
HARNESS CONNECTOR FACES



BLK

DRIVER INFORMATION CENTER (DIC)

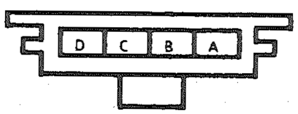
V00297.4



BLK

DRIVER'S LUMBAR CONTROL SWITCH

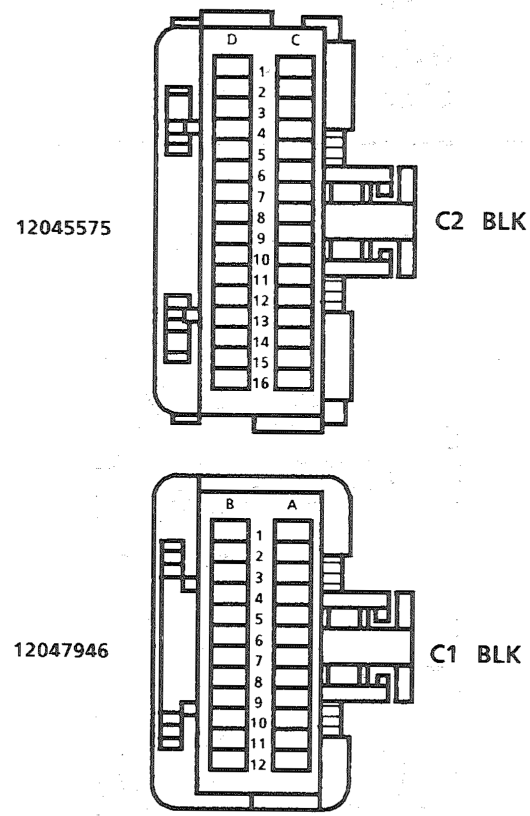
V00545.1



WHT

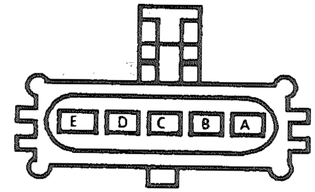
DRIVER'S LUMBAR VALVE ASSEMBLY

V00123.0



ELECTRONIC CONTROL MODULE (ECM)

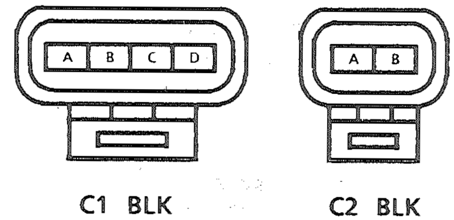
V00005.0



BLK

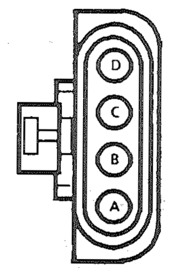
ELECTRONIC SPARK CONTROL (ESC) MODULE

V00456.0



ELECTRONIC SPARK TIMING (EST) DISTRIBUTOR

V00328.0

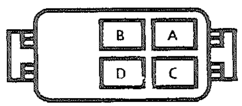


BLK

ELECTRONIC VACUUM REGULATOR VALVE (EVRV) (V6 VIN S)

V04016.2

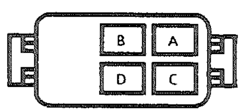
FOG LIGHT SWITCH,
SEE DEFOGGER CONTROL



WHT

FRONT POWER WINDOW SWITCH (LH)

V00487.1

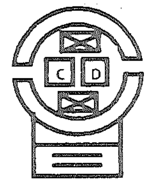


BLU

FRONT POWER WINDOW SWITCH (RH)

V00571.0

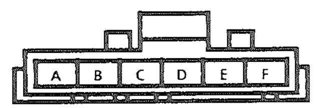
FUEL PUMP RELAY, SEE A/C COMPRESSOR CONTROL RELAY



BRN

FUEL PUMP SWITCH
(V8 VIN F) (V8 VIN 8)

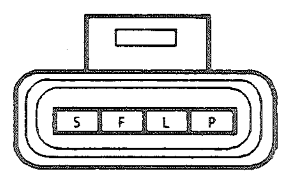
V00249.0



BLK

GEAR SELECTOR SWITCH

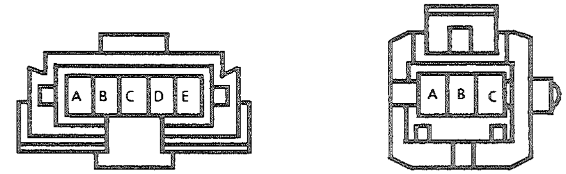
V00541.1



BLK

GENERATOR

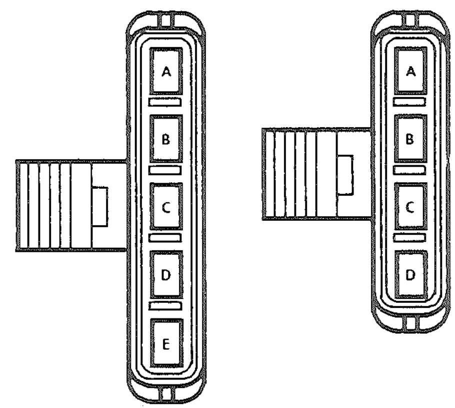
V00176.0



C1 BLK   C2 BLK

HATCH CONTACT ASSEMBLY

V00235.0

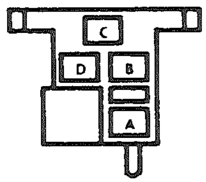


C1 BLK   C2 BLK

HEADLIGHT DOOR MODULE

V00512.0

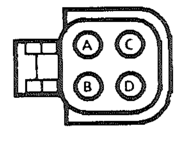
HARNESS CONNECTOR FACES



BLK

HEADLIGHT DIMMER SWITCH

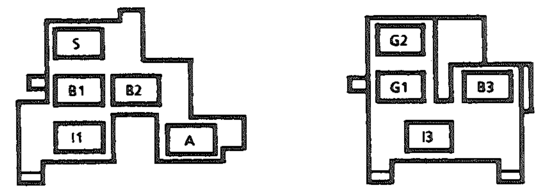
V00285.0



BLK

IDLE AIR CONTROL
STEPPER MOTOR

V00083.3

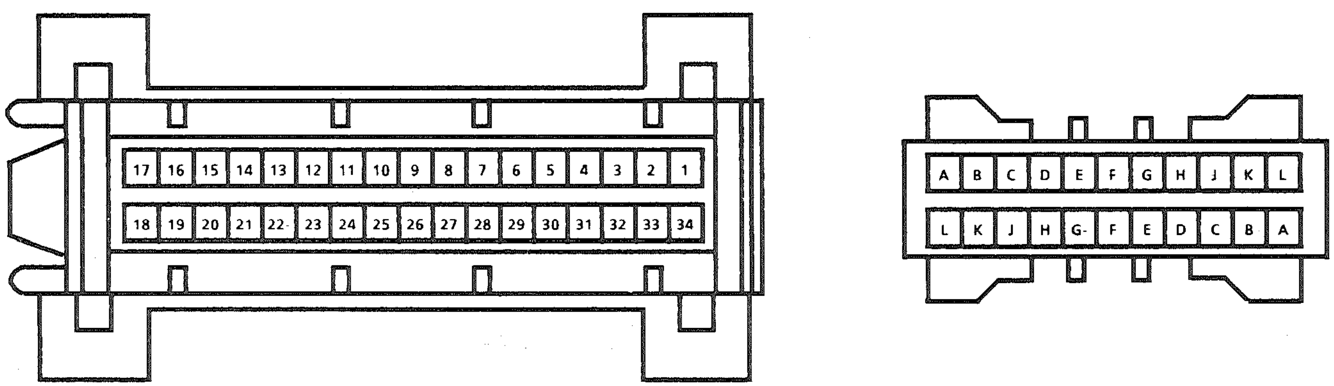


C2 BLU

C1 BLK

IGNITION SWITCH

V00032.0



C3 WHT

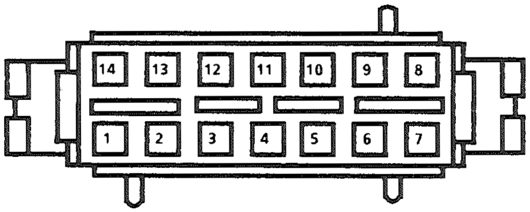
C1 WHT

C2 BLK

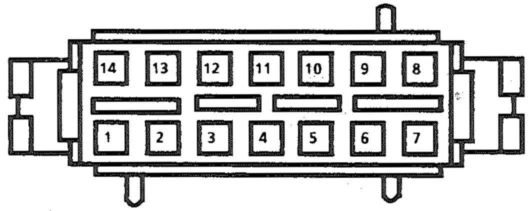
INSTRUMENT PANEL (DIGITAL CLUSTER)

V00319.0

HARNESS CONNECTOR FACES



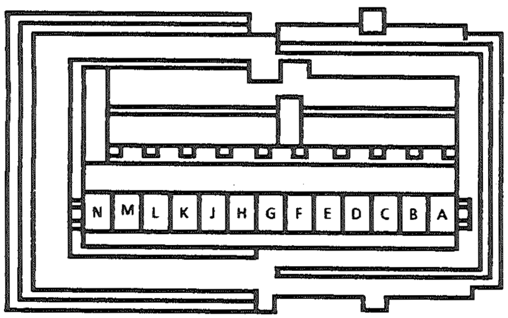
C1 BRN



C2 GRY

INSTRUMENT PANEL
(WITHOUT DIGITAL CLUSTER)

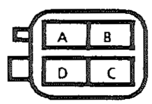
V00324.1



BLK

LIGHTS MONITORING MODULE

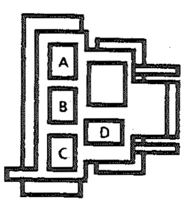
V00572.0



BLK

LUMBAR PUMP/MOTOR

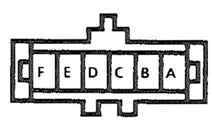
V00122.0



BLK

LOW BLOWER RELAY

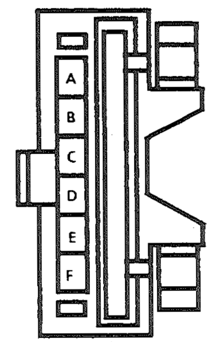
V00573.0



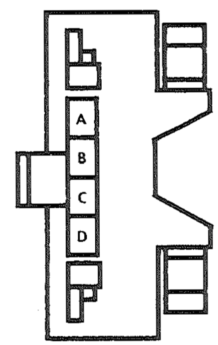
BLK

LUMBAR PUMP/MOTOR
RELAY

V00137.2



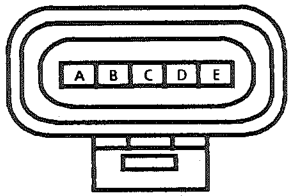
C1 WHT



C2 WHT

LIGHT SWITCH

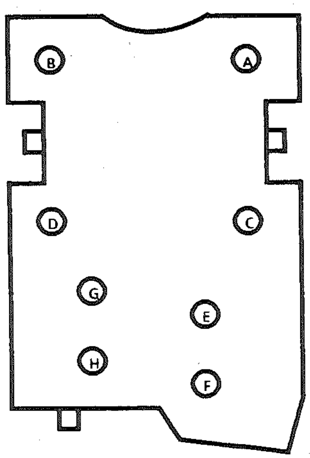
V00326.0



BLK

MASS AIR FLOW SENSOR
(V8 VIN F) (V8 VIN 8)

V00526.2



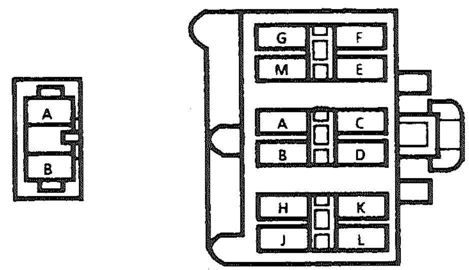
WHT

OUTSIDE MIRROR SWITCH

V00184.2

PASSENGER'S LUMBAR CONTROL SWITCH,
SEE DRIVER'S LUMBAR CONTROL SWITCH

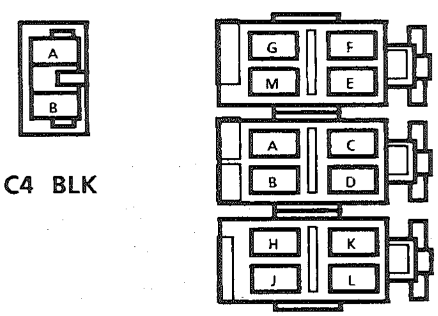
PASSENGER'S LUMBAR VALVE ASSEMBLY,
SEE DRIVER'S LUMBAR VALVE ASSEMBLY



C2 BLK C1 GRY

RADIO (WITH SUBWOOFER)

V00320.0



C4 BLK

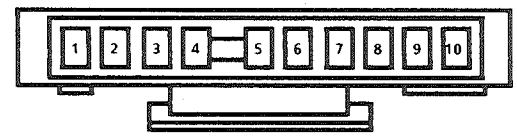
C1 BLK

C2 WHT

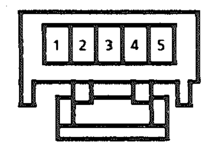
C3 BLU

RADIO (WITHOUT SUBWOOFER AND UK3)

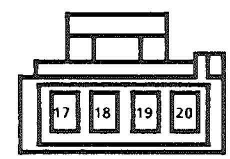
V00236.1



C2 BLK
(C218 WITH UK3 AND SUBWOOFER)



C3 GRY

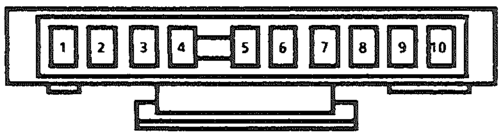


C4 BLU
(C217 WITH UK3 AND SUBWOOFER)

RADIO
(WITH UK3)

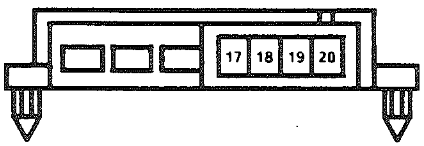
V00578.0

HARNESS CONNECTOR FACES



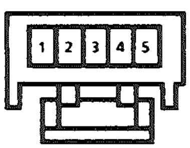
C1 BLK

12047530



C2 BLU

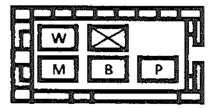
12066172



C3 GRY

RADIO
(WITH UK3 AND SUBWOOFER)

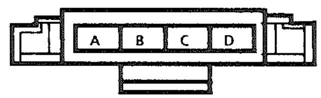
V00579.0



GRY

RELEASE SWITCH

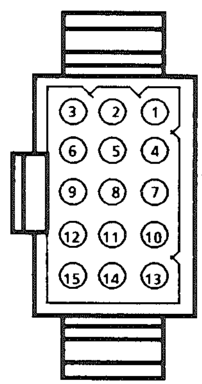
V00574.0



WHT

REMOTE DIMMER

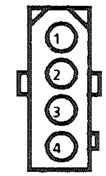
V00472.1



WHT

SUBWOOFER AMPLIFIER
ASSEMBLY

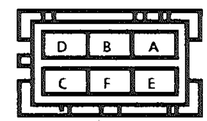
V00576.0



WHT

ROOF CONSOLE

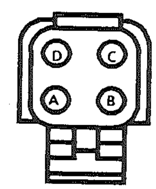
V00575.0



BLK

SUBWOOFER SWITCH

V00577.0

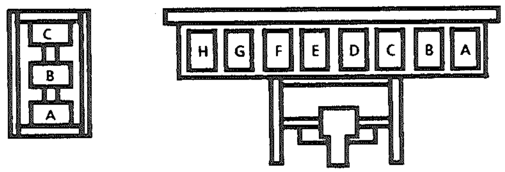


WHT

TRANSMISSION
CONVERTER CLUTCH

V04017.2

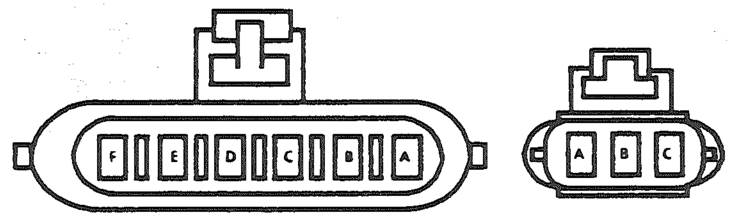
HARNESS CONNECTOR FACES



C1 BLK C2 BLK

VEHICLE SPEED SENSOR BUFFER

V00325.0



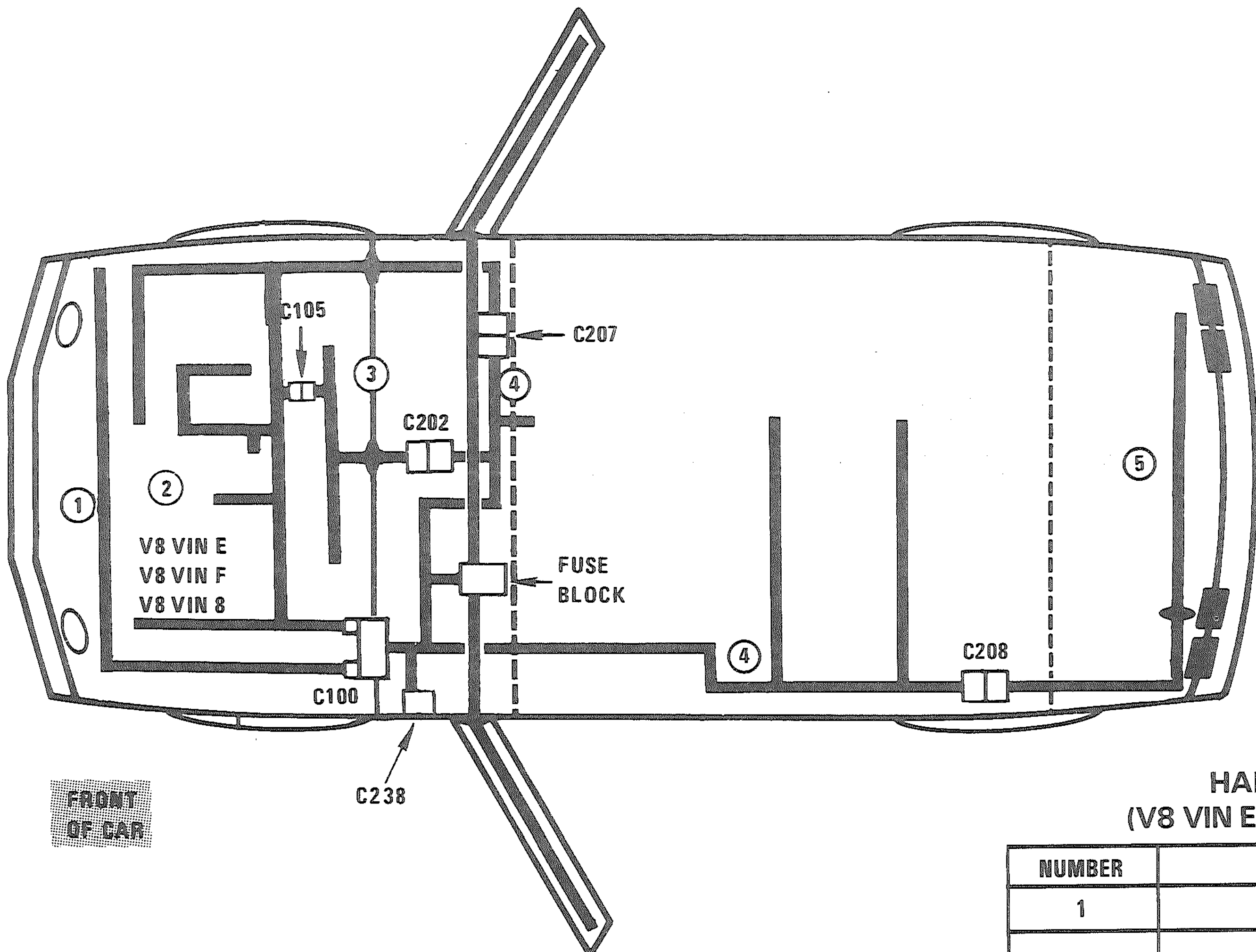
C1 BLK C2 BLK

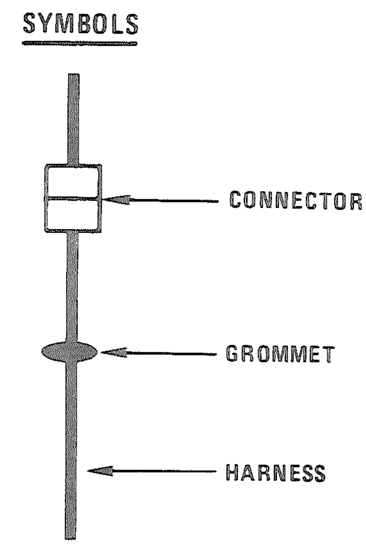
WIPER MOTOR MODULE

V00409.1

BLANK

HARNESS ROUTING VIEWS: V8 VIN E, V8 VIN F, V8 VIN 8

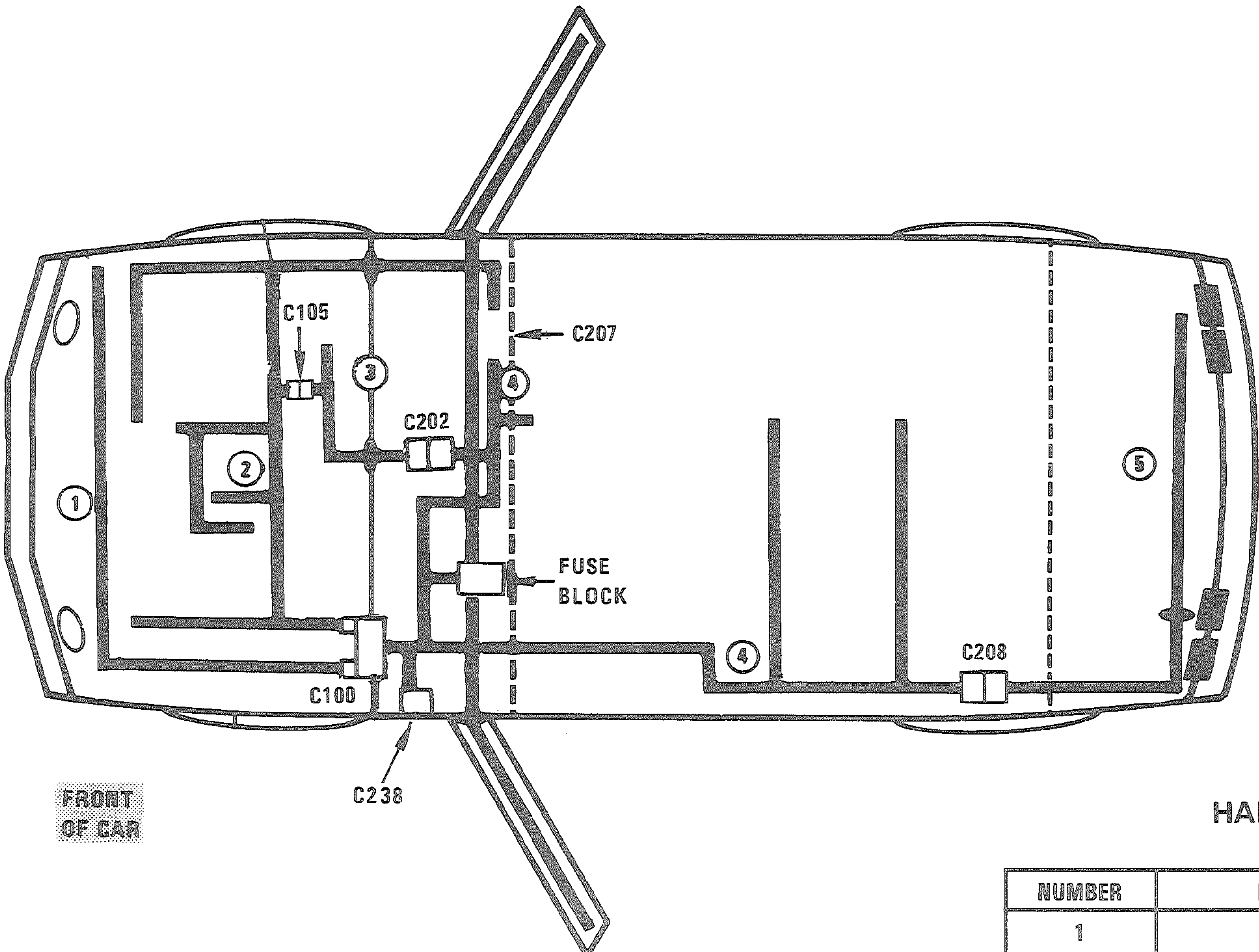


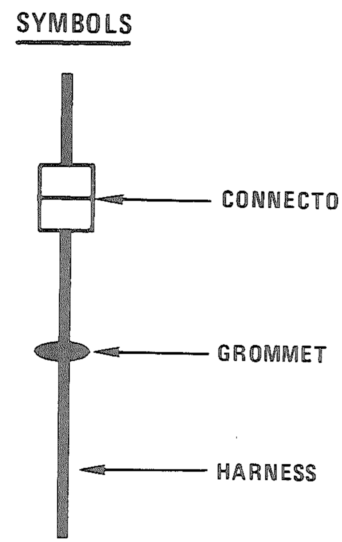


HARNESS CHART (V8 VIN E, V8 VIN F, V8 VIN 8)

NUMBER	HARNESS NAME	PAGE-FIGURE
1	FRONT LIGHTS	201-16-A
2	ENGINE	(VIN E) 201-2-A (VIN F) (VIN 8) 201-5-A
3	AIR CONDITIONING	201-14-A
4	INSTRUMENT PANEL	201-11-A
5	REAR LIGHTS	201-17-A

HARNESS ROUTING VIEWS: V6 VIN S





HARNESS CHART
(V6 VIN S)

NUMBER	HARNESS NAME	PAGE-FIGURE
1	FRONT LIGHTS	201-16-A
2	ENGINE	201-0-A 201-1-A
3	AIR CONDITIONING	201-14-A
4	INSTRUMENT PANEL	201-11-A
5	REAR LIGHTS	201-17-A

SECTION 8B

LIGHTING SYSTEMS AND HORNS

CONTENTS

The following information, previously shown in this section, has been moved to the sections shown.

GENERAL DESCRIPTION

EXTERIOR LIGHTS

The exterior lighting system includes the headlights (and headlight motors to raise or lower the headlights), front parking/turn signal lights, front cornering lights, fog lights, rear tail/stop/turn signal lights, back-up lights, license plate lights, center high-mounted stoplight, and the underhood light; it also includes all associated wiring, controls and related hardware for these lights.

BACK-UP LIGHTS – The back-up lights are next to the rear license plate. They will come on when the transmission is shifted to Reverse. On cars with an automatic transmission, the back-up lights are activated by the neutral start switch. On cars with a manual transmission, they are activated by a separate back-up light switch on the transmission. For more information, see Section 7.

CENTER HIGH-MOUNTED STOPLIGHT – The center high-mounted stoplight, in the center of the rear spoiler, will come on whenever the brake pedal is pushed down. The light is powered separately from the rear tail/stop/turn signal lights through a separate circuit in the stoplight switch (see Section 8A).

EXTERIOR LIGHT MONITOR – The Driver Information Center, on cars so equipped, also monitors certain front and rear lights. When a bulb burns out, the message **"FRONT LAMP"** or **"REAR LAMP"** will appear in the DIC display, and a light will come on to indicate which bulb has burned out. For more information, see Section 8A.

FOG LIGHTS – The fog light switches are to the left of the steering column on the edge of the instrument panel. To use the fog lights, first turn on the headlights or parking lights. Then, push the middle switch (with the fog light symbol) to turn on the fog lights. Push the left **("OFF")** switch to turn off the fog lights.

The fog lights should not be used as a substitute for the headlights.

Switching to high-beam headlights will turn off the fog lights; switching back to low-beams will turn the fog lights on again.

The fog lights must be aimed for proper illumination of the road. Fog light aim should be checked: at least once a year; when a new light housing is installed; or if service or repairs in the front end area have (or may have) disturbed the fog light mountings.

FRONT PARKING/TURN SIGNAL LIGHTS – Pushing either side of the instrument panel switch will turn on the front parking lights. (Pushing the left side of the switch will also turn on the headlights.) When the ignition is on and the turn signal lever is moved, the appropriate front parking light flashes to signal a turn. Both lights will flash when the hazard flashers are on.

If the driver's door is opened when the parking lights are on, a warning tone will sound. For more information, see Section 8A-77.

HAZARD FLASHERS – The hazard warning flasher is part of the turn signal circuit. Pushing in the button (on the right side of the steering column) will cause the front and rear turn signal lights, and the front sidemarker lights, to flash. Pull out the collar around the button to turn off the hazard flashers.

The hazard flashers will work with the ignition either off or on. When the hazard flashers are on, the turn signals do not work.

The hazard flashers will stop flashing and stay on brightly if the brake pedal is pushed down.

HEADLIGHTS – The headlights are controlled by the switch on the instrument panel (to the left of the speedometer). They will come on whether or not the ignition is turned on. Pushing the upper left side of the switch turns on the headlights and causes the headlight motors to raise the headlights. Pushing the bottom part of the switch turns off the headlights, and they should lower.

If the driver's door is opened when the ignition is off and the headlights are on, a warning tone will sound. For more information, see Section 8A-77.

Headlight low-beam and high-beam are controlled by the turn signal/multifunction lever on the left side of the steering column. When the headlights are on, pull the lever toward the steering wheel until the switch clicks; the lights will change from low-beam to high-beam, or from high-beam to low-beam. An indicator light on the center instrument cluster will come on when the high-beam headlights are on.

The headlights must be aimed for proper illumination of the road. Headlight aim should be checked: at least once a year; when a new headlight bulb is installed; or if service or repairs in the front end area have (or may have) disturbed the headlights or their mountings. The headlight bezels do not need to be removed to aim the headlights.

Headlight focus is set when the sealed-beam unit is made; no adjustment for focus is necessary or possible.

Some state and local laws specify requirements for headlight aim; these laws must be followed.

LICENSE PLATE LIGHTS – A light above the rear license plate will come on when the headlights or parking lights are on.

LIGHT SWITCH – Most exterior lights are controlled by the switch on the instrument panel, to the left of the speedometer. Pushing the upper right part of the switch turns on the front parking lights, the taillights and the sidemarker lights. (It also turns on the instrument panel lights.) Pushing the upper left part of the switch turns on all these lights plus the headlights. Pushing the bottom part of the switch turns off all lights.

In some cases (such as going through a car wash), it may be desirable to raise the headlights without leaving the headlights on. To do so, push the upper right part of the switch to turn on the parking lights. Then, lightly push the upper right part of the switch; the headlights will raise but will not turn on. (Remember that the parking lights and taillights will stay on.)

For more information on this switch (including on-car service), see Section 8C. Also see Section 8C for information on interior lights.

REAR TAIL/STOP/TURN SIGNAL LIGHTS – The rear tail/stop/turn signal lights are part of the same light assembly. Pushing either side of the instrument panel switch turns on the taillights. When the brake pedal is pushed down, the lights glow brighter to serve as stoplights.

Moving the turn signal lever when the ignition is on causes the appropriate rear lights to flash. (If the brake pedal is held down and a turn is signalled, one side will flash and the other will stay on brightly.)

All lights will flash when the hazard flashers are on. However, if the brake pedal is pushed while the hazard flashers are on, the lights will stop flashing and stay on brightly.

SIDEMARKER LIGHTS – The front and rear sidemarker lights will come on when the headlights or parking lights are on. Both front and rear sidemarker lights also have reflectors; they will shine when struck by light, whether or not the car's lights are on.

If the headlights or parking lights are *off* when a turn is signalled, the front sidemarker light will flash in unison with the front turn signal light on the same side. If the lights are *on* when a turn is signalled, the front sidemarker light and front turn signal light flash alternately.

TURN SIGNALS – The front turn signals are combined with the front parking lights. The rear turn signals are part of the rear tail/stop/turn signal lights. The turn signals work only when the ignition is on, and the hazard flashers are turned off.

The turn signals are controlled by the turn signal/multifunction lever on the left side of the steering column. Moving the lever all the way up or down (past the detent) will turn on the turn signals. When the turn is completed, the lever will return to neutral and the turn signals will stop flashing.

For changing lanes or shallow turns where the steering wheel does not move far enough to cancel the signal, move the turn signal lever only to the first detent. When the lever is released, it will return to neutral and the turn signals will cancel.

UNDERHOOD LIGHT – The underhood light will come on when the hood is raised.

HORNS

The horn(s) are mounted behind the front fascia on the driver's side. Pushing the pad in the center of the steering wheel sounds the horn by closing the horn relay (in the convenience center behind the instrument panel, to the right of the steering column). The horns use a solenoid-operated diaphragm to generate sound. See Section 8A-40 for wiring and circuit information.

ON-CAR SERVICE

Wiring diagrams and other diagnosis information is given in Section 8A. Information on properly repairing wiring harnesses, connectors, etc., is on 8A-5.

Most lighting problems are caused by loose connectors, open or shorted wiring, burned-out bulbs, bad switches, inadequate ground or blown fuses. Many of these require only replacement of a defective part. When replacing a part that requires a special procedure (such as a lens and housing assembly sealed together), follow the instructions normally included in the replacement parts package.

When removing a part that requires special sealing items (such as sealing washers), be sure to reinstall those items when replacing the part. Also, if any body sealing items (grommets, etc.) are disturbed, be sure to repair them so the passenger compartment remains properly sealed.

EXTERIOR LIGHTS

BACK-UP LIGHTS

Fig. 8B-8

Replacement Bulb: Trade No. 1156, 32 Candlepower

To replace a back-up light bulb, see "Rear Tail/Stop/Turn Signal Lights" in this section. For information on the back-up light switch on the transmission, see Section 7.

CENTER HIGH-MOUNTED STOPLIGHT

Fig. 8B-1

Assembly Replacement

Remove or Disconnect

1. Spoiler (see Body Service Manual, Section 7H)
2. Four nuts from assembly
3. Stoplight assembly

Install or Connect

1. Stoplight assembly
2. Four nuts
3. Spoiler

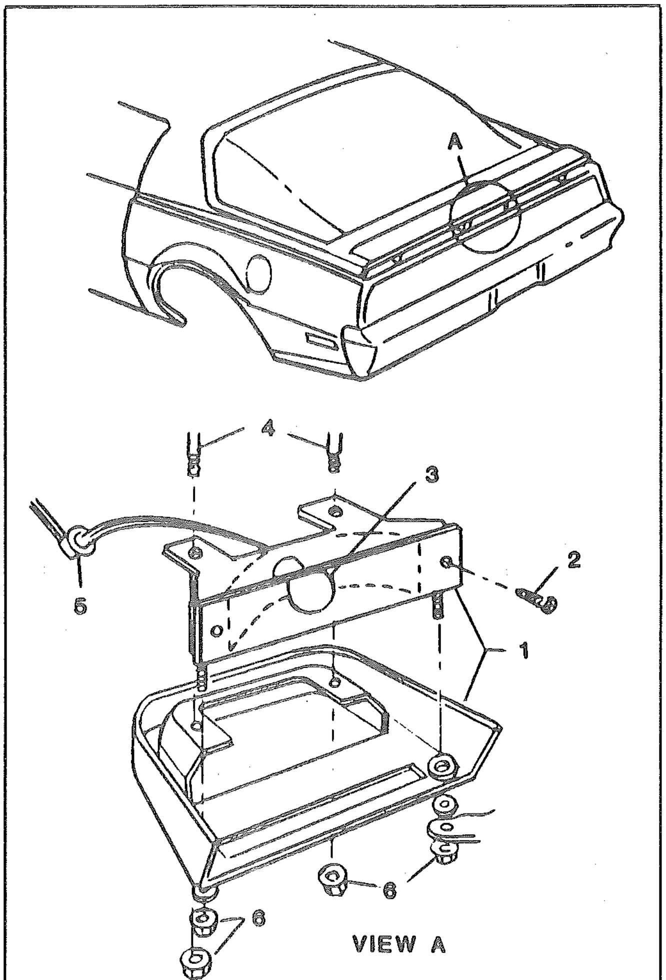


Fig. 8B-1 Center High-Mounted Stoplight

Bulb Replacement

Replacement Bulb: Trade No. 577, 21 Candlepower

Remove or Disconnect

1. Two screws from lens
2. Lens
3. Bulb from socket

Install or Connect

1. Bulb into socket
2. Lens
3. Two screws

FOG LIGHTS

Figs. 8B-2 and 8B-3

Assembly or Bulb Replacement

Replacement Bulb: Trade No. H-3

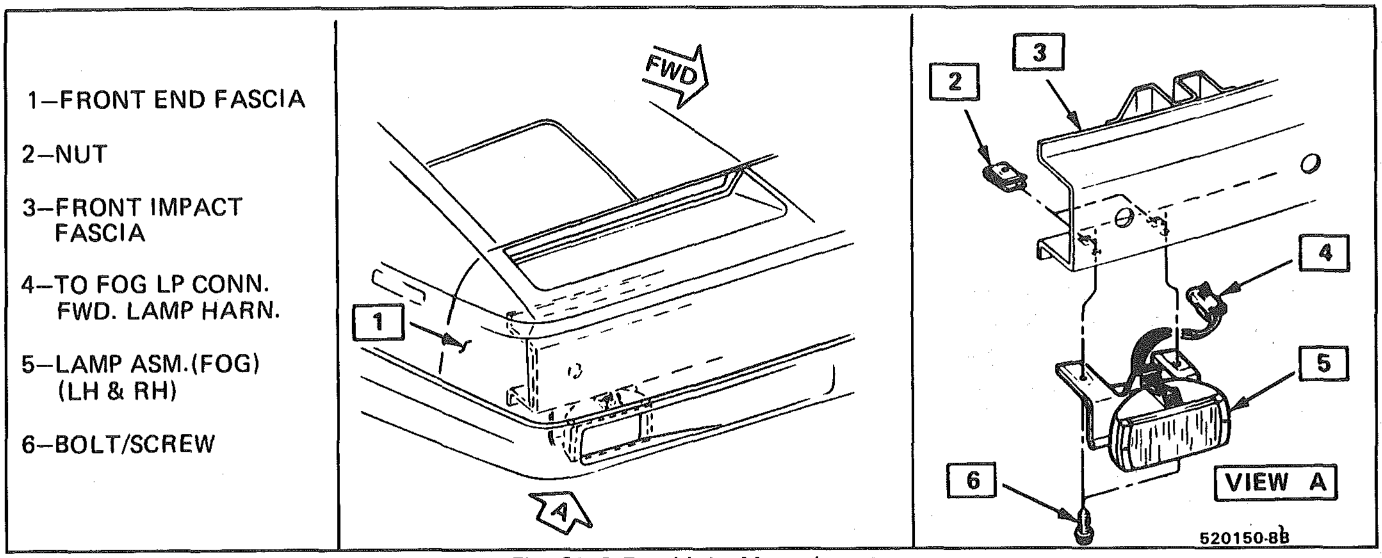


Fig. 8B-2 Fog Light Mounting

Remove or Disconnect

1. Six screws holding filler panel under front fascia
2. Filler panel
3. Electrical connector
4. Two bolts holding light
5. Fog light assembly by lowering through filler panel opening
6. To replace bulb, remove two screws at front of assembly

Install or Connect

1. Fog light assembly (including new bulb, if necessary)
2. Two bolts
3. Electrical connector
4. Filler panel
5. Six screws

Adjust

- Fog light aim

FRONT PARKING/TURN SIGNAL LIGHTS

Fig. 8B-4

Assembly Replacement

Remove or Disconnect

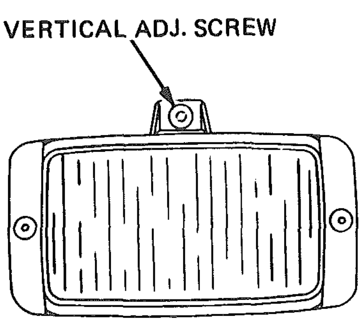
1. Open hood
2. Socket from assembly
3. Two bolts/screws
4. Assembly

Install or Connect

1. Assembly
2. Two bolts/screws
3. Socket
4. Close hood

Bulb Replacement

Replacement Bulb: Trade No. 2057, 32/2 Candlepower



FOG LAMP AIM SPECIFICATIONS

1. FOG LAMP TO BE VISUALLY AIMED AND CHECKED IN ACCORD WITH SECTIONS SIX AND SEVEN OF S.A.E. STANDARD J599.
2. PREPARE VEHICLE FOR CHECKING OF SETTING AIM AS FOLLOWS:
   A. COMPLETELY ASSEMBLE ALL COMPONENTS ON VEHICLE.
   B. PLACE VEHICLE ON LEVEL PAD.
   C. STOP ALL OTHER OPERATIONS OF WORK ON VEHICLE
   D. CLOSE DOORS.
   E. ROCK VEHICLE SIDEWAYS.
3. TO CHECK OF SET AIM PER J599, USE THE FOLLOWING LIMITS:
   A. VERTICAL AIM. TOP EDGE OF HIGH INTENSITY ZONE TO BE 100mm BELOW CENTERLINE OF FOG LAMP +51mm/-64mm ON A SCREEN 7.6m AWAY

FUEL LOAD TO BE ½ TANK OR LESS

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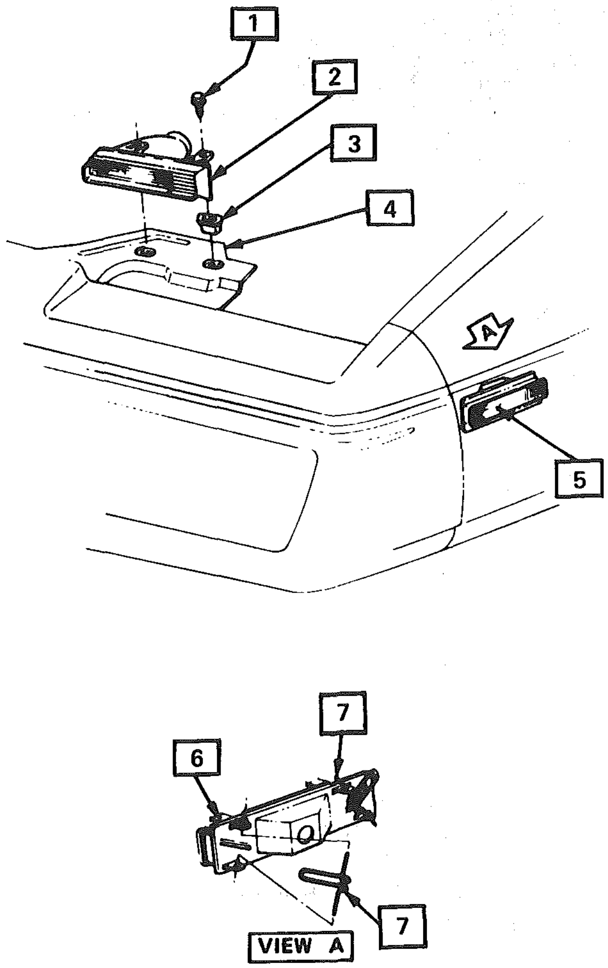
Fig. 8B-3 Fog Light Aiming



MAIN VIEW

1 – BOLT/SCREW (2)
2 – PARKING/TURN LIGHT ASSEMBLY
3 – NUT (2)
4 – FRONT END PANEL ASSEMBLY
5 – SIDEMARKER LIGHT ASSEMBLY

VIEW A

6 – FENDER TABS (4)
7 – RETAINER (2)

JP0003-8B-F

Fig. 8B-4 Front Parking/Turn Signals and Sidemarker Lights

Remove or Disconnect

1. Open hood
2. Socket from assembly
3. Bulb from socket

Install or Connect

1. Bulb into socket
2. Socket
3. Close hood

HAZARD FLASHER

The hazard flasher is in the convenience center, behind the instrument panel to the right of the steering column. To remove the flasher, lift it up and out.

HEADLIGHTS

Actuator Replacement

Fig. 8B-5

Remove or Disconnect

1. Headlight assembly (see following procedure)
2. Nut from actuator arm
3. Three bolts attaching actuator to assembly
4. Actuator

Install or Connect

1. Actuator
2. Three bolts
3. Nut
4. Headlight assembly (see following procedure)

Assembly Replacement

Fig. 8B-5

Remove or Disconnect

1. Open hood
2. Raise headlight by turning the knob on the headlight motor counterclockwise
3. Four screws, two at each side of bezel
4. Bezel
5. Retaining spring, by using a hooked tool (such as a cotter pin remover) to pull it to the side
6. Four screws from retainer
7. Retainer
8. Headlight by rotating toward center of car
9. Electrical connector
10. Turn the knob to lower the headlight assembly about halfway
11. Two lower headlight assembly bolts by reaching through opening
12. Two upper headlight assembly bolts
13. Electrical connector at motor
14. Headlight assembly

Install or Connect

1. Headlight assembly

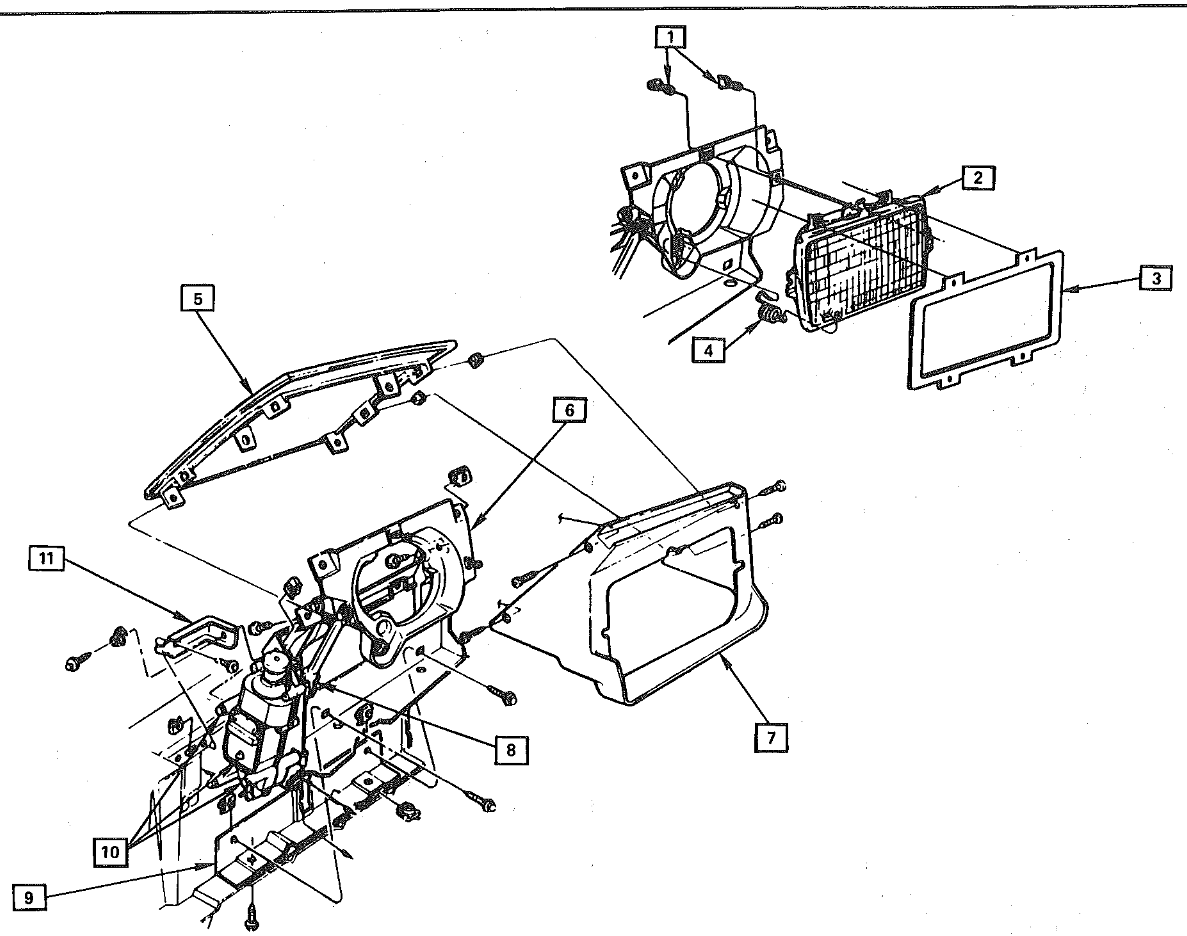


Fig. 8B-5 Headlight Assembly

2. Electrical connector at motor
3. Two upper bolts
4. Two lower bolts
5. Raise headlight assembly
6. Electrical connector
7. Headlight
8. Retainer
9. Four retainer screws
10. Bezel
11. Four screws at bezel
12. Retaining spring
13. Lower headlight
14. Close hood

Adjust

- Headlight aim

Aiming Headlights

Fig. 8B-6

Horizontal and vertical aiming of each sealed-beam headlight is done by two (2) adjusting screws which move the mounting ring in the body against the tension of a coil spring. When using mechanical aimers, follow the manufacturer's instructions.

Bulb Replacement

Replacement Bulb: Trade No. H6054, 35 Watt/65 Watt

Remove or Disconnect

1. Open hood
2. Raise headlight by turning knob on top of headlight motor
3. Four screws, two at each side of bezel
4. Bezel
5. Retaining spring, by using a hooked tool (such as a cotter pin remover) to move it to the side
6. Headlight by rotating toward center of car
7. Electrical connector
8. Retaining ring

HEADLAMP AIM SPECIFICATIONS

I. CALIBRATE MECHANICAL AIMERS CONFORMING TO SAE J602 AS FOLLOWS:
1. SET MASTER FIXTURE TO "0" U/D AND "0" R/L
2. CALIBRATE AIMERS ON MASTER FIXTURE TO READ "0" U/D AND R/L.

II. PREPARE VEHICLE FOR CHECKING OR SETTING AIM AS FOLLOWS:
1. COMPLETELY ASSEMBLE ALL COMPONENTS ON VEHICLE.
2. PLACE VEHICLE ON LEVEL PAD.
3. STOP ALL OTHER OPERATIONS OR WORK ON VEHICLE.
4. CLOSE DOORS.
5. ATTACH AIMERS TO HEADLAMPS.
6. ROCK VEHICLE SIDEWAYS.

III. TO CHECK OR SET AIM PER SAE J599 USE THE FOLLOWING LIMITS:

VERTICAL AIM	HORIZONTAL AIM
2 UP TO 2.5 DOWN	4"R TO 4"L

FUEL LOAD TO BE 1/2 TANK OR LESS

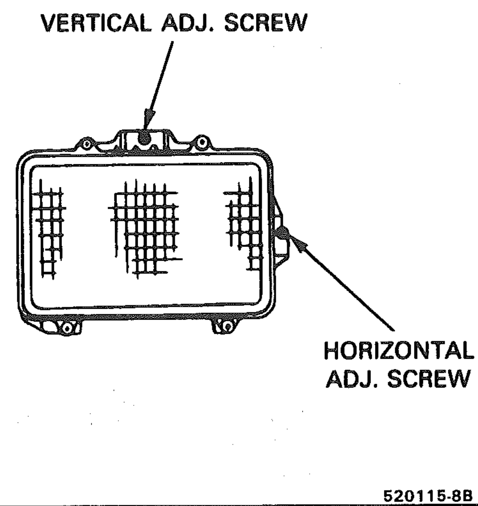


Fig. 8B-6 Headlight Aiming

Install or Connect

1. Retaining ring
2. Electrical connector
3. Headlight
4. Retaining spring
5. Bezel
6. Four screws into bezel
7. Lower headlight
8. Close hood

Adjust

- Headlight aim

LICENSE PLATE LIGHT

Fig. 8B-7

Assembly or Bulb Replacement

Remove or Disconnect

1. License plate

1 – TAILLIGHT LENS
2 – LICENSE PLATE LIGHT ASSEMBLY
3 – SCREWS (2)
4 – REAR FASCIA
5 – CONNECTOR

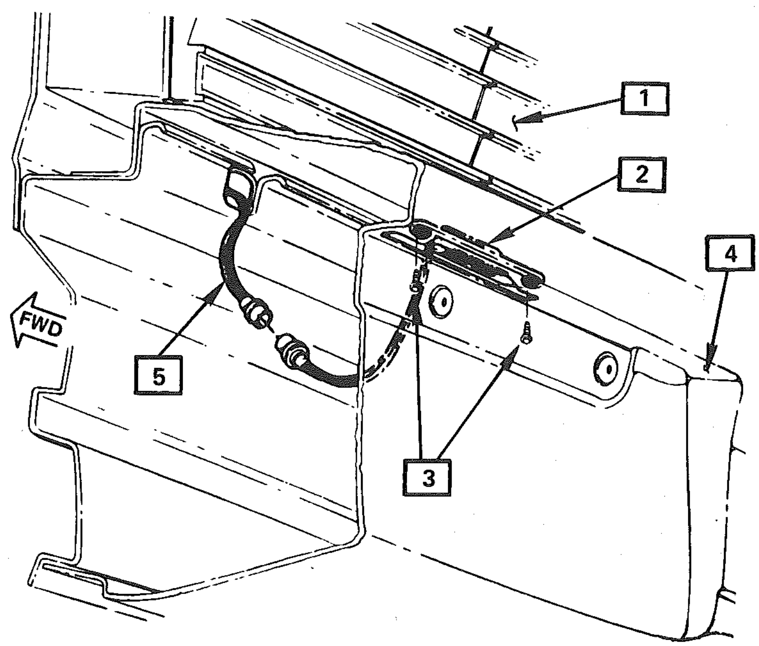


Fig. 8B-7 License Plate Light

2. Two screws
3. Light assembly
4. Socket from assembly
5. Bulb from socket

Install or Connect

1. Bulb into socket
2. Socket into assembly
3. Assembly
4. Two screws
5. License plate

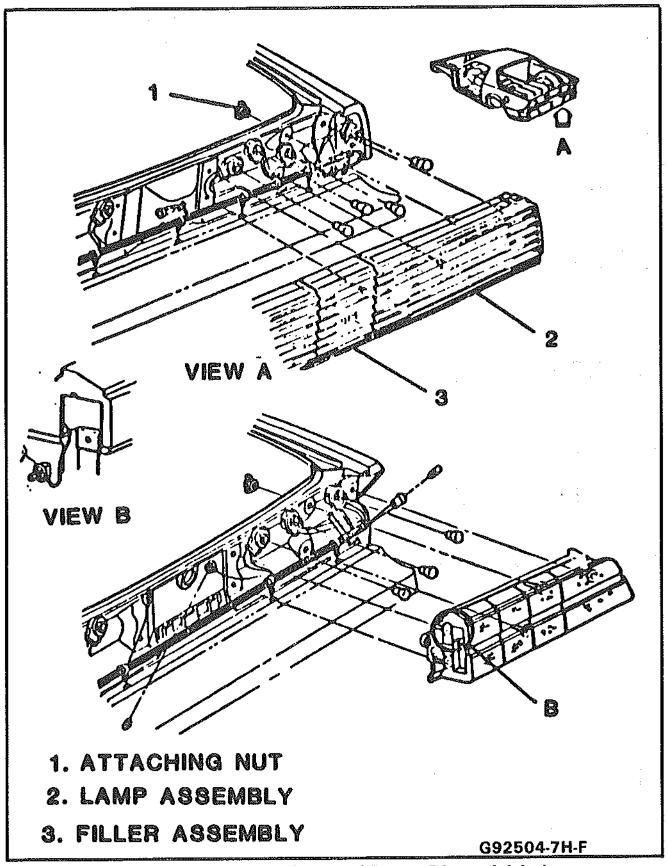


Fig. 8B-8 Rear Tail/Stop/Turn Signal Lights

REAR TAIL/STOP/TURN SIGNAL LIGHTS

Fig. 8B-8

Replacement Bulb: Trade No. 2057, 32/2 Candlepower

Remove or Disconnect

1. Open hatch
2. Fasteners at trim panel
3. Trim panel
4. Wing nuts holding taillight lens
5. Taillight lens
6. Bulb from socket

Install or Connect

1. Bulb into socket
2. Taillight lens
3. Wing nuts

Adjust

- Taillight lens for proper appearance before tightening wing nuts

4. Trim panel
5. Fasteners
6. Close hatch

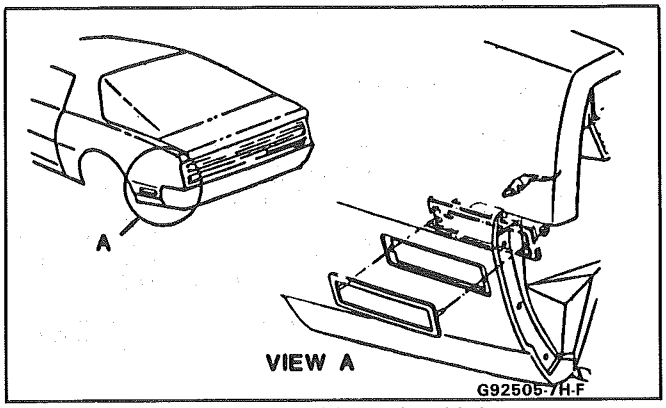


Fig. 8B-9 Rear Sidemarker Lights

SIDEMARKER LIGHTS

Figs. 8B-4 (Front) and 8B-9 (Rear)

Assembly Replacement - Front

Remove or Disconnect

1. Six screws from filler panel under front fascia
2. Filler panel
3. Socket from assembly
4. Two retainers
5. Assembly

Install or Connect

1. Assembly
2. Two retainers
3. Socket
4. Filler panel
5. Six screws

Assembly Replacement - Rear

Remove or Disconnect

1. Open hatch
2. Fasteners at trim panel
3. Trim panel
4. Socket from assembly
5. Two nuts
6. Assembly

Install or Connect

1. Assembly
2. Two nuts
3. Socket
4. Trim panel
5. Fasteners
6. Close hatch

Bulb Replacement – Front

Replacement Bulb: Trade No. 194, 2 Candlepower

Remove or Disconnect

1. Six screws from filler panel under front fascia
2. Filler panel
3. Socket from assembly
4. Bulb from socket

Install or Connect

1. Bulb into socket
2. Socket into assembly
3. Filler panel
4. Six screws

Bulb Replacement – Rear

Replacement Bulb: Trade No. 194, 2 Candlepower

Remove or Disconnect

1. Open hatch
2. Fasteners at trim panel
3. Trim panel
4. Socket from assembly
5. Bulb from socket

Install or Connect

1. Bulb into socket
2. Socket into assembly
3. Trim panel
4. Fasteners
5. Close hatch

TURN SIGNAL FLASHER

The turn signal flasher is in the convenience center, behind the instrument panel to the right of the steering column. To remove the flasher, lift it up and out.

UNDERHOOD LIGHT

Replacement Bulb: Trade No. 93, 15 Candlepower

Remove or Disconnect

1. Open hood
2. Bulb from socket

Install or Connect

1. Bulb into socket
2. Close hood

HORNS

If the horns do not blow, or blow constantly, follow the diagnostic procedures in Section 8A.

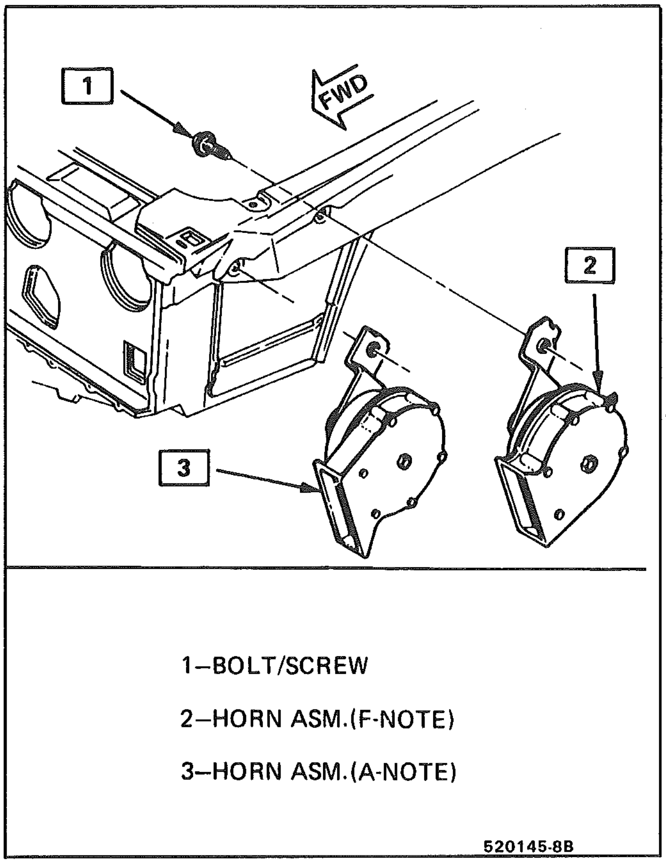


Fig. 8B-10 Horns

Horn Tone Poor

1. **Horn Tone Poor** – Tighten bolts in mounting area, or correct poor connections or ground.
2. **Low-Pitched Moan** – Sounds like "mooing." Caused by current too high. Adjust current (see the following).
3. **Weak Tone** – Current too low. Correct poor connections or ground, or adjust current (see the following).
4. **Weak, Strained Tone** – Remove foreign object in horn.
5. **Harsh Vibration** – Bend bracket so horn is not touching sheet metal.

Current Adjustment

Current draw for a horn while operating should be 4.5 to 5.5 amperes at 11.5 to 12.5 volts. High current (more than 20 amperes) indicates an overheated winding or shorted horn; replace the horn. A current reading of about 18 amperes means the contact points are not opening; adjust the horn current (see the following).

No current reading indicates a broken connection, or an open circuit due to a broken lead or overheated horn. An overheated horn must be replaced. No current reading may also mean the contact points are open; adjust the horn (see the following).

Adjust

1. Increase Current – Turn adjusting screw clockwise
2. Decrease Current – Turn adjusting screw counterclockwise
3. Current adjustments should be made 1/4 turn (90°) at a time

Horn Assembly

Fig. 8B-11

Remove or Disconnect

1. Six screws from filler panel behind front fascia on driver's side
2. Filler panel
3. Electrical connector
4. Bolt/screw
5. Horn

Install or Connect

1. Horn
2. Bolt/screw
3. Electrical connector
4. Filler panel
5. Six screws

Horn Relay

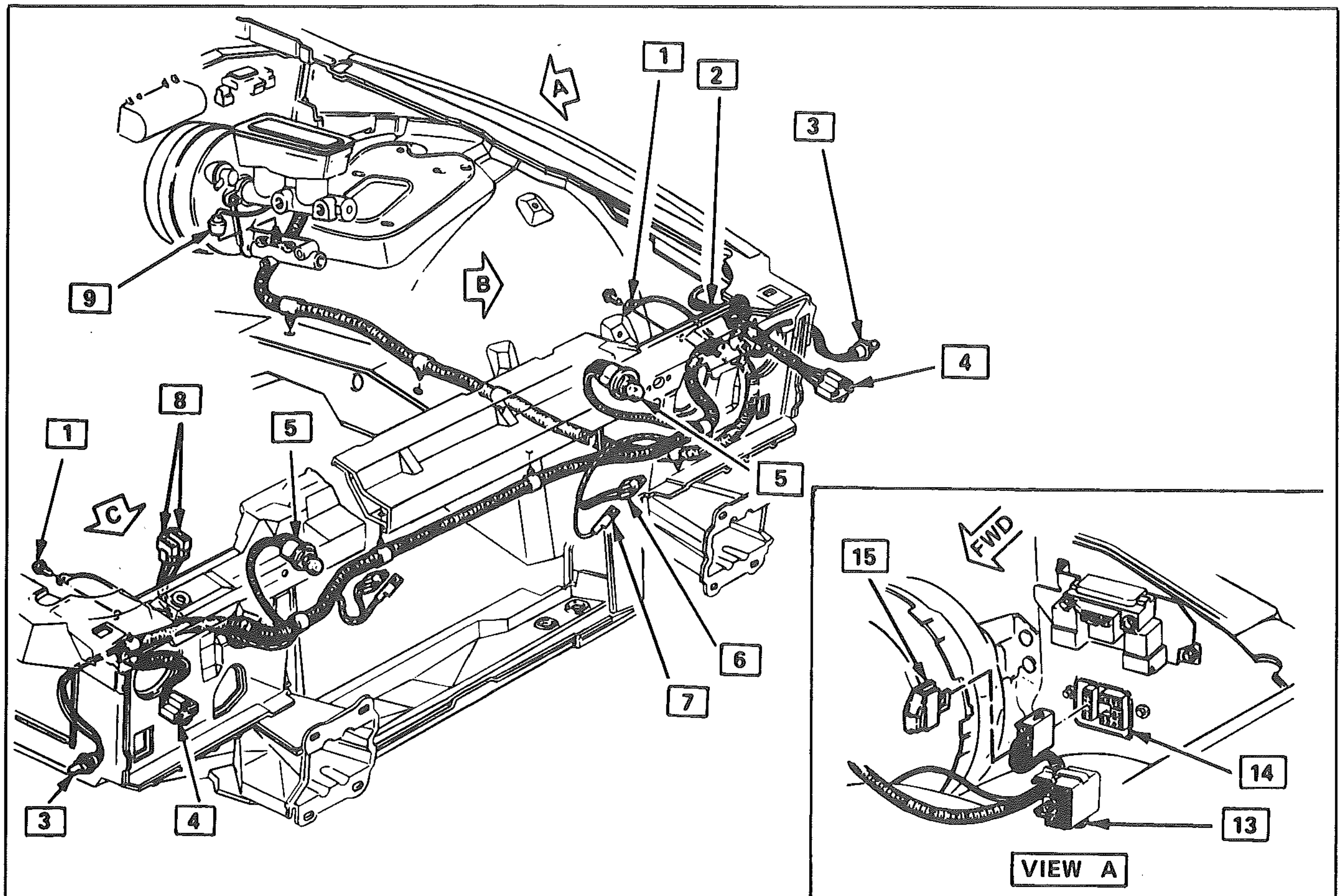
The horn relay is in the convenience center, behind the instrument panel to the right of the steering column. To remove the relay, pull it straight out.

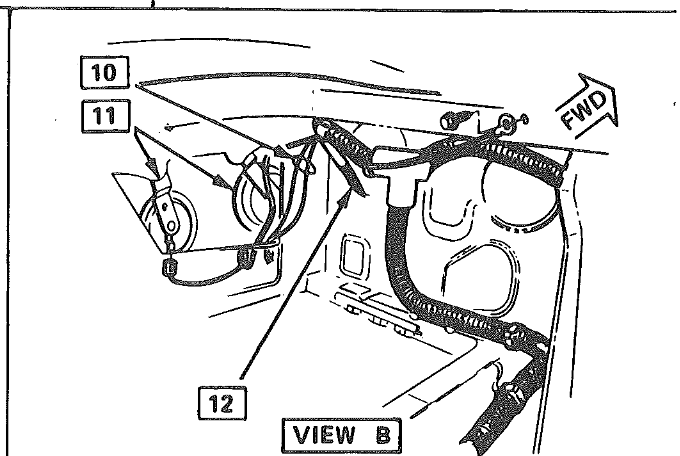
REPLACEMENT LIGHT BULBS

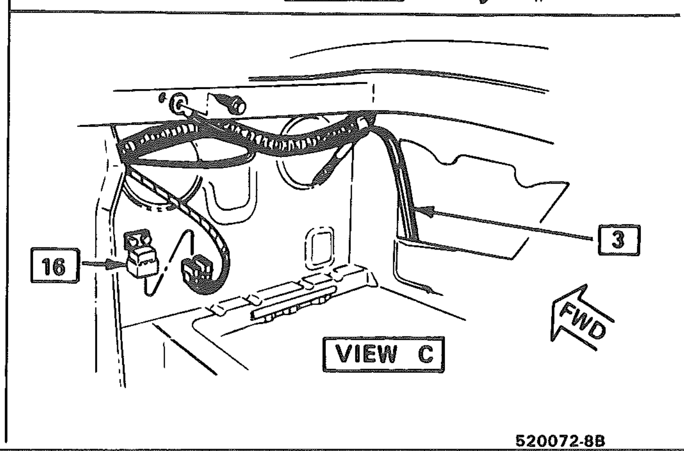
For exterior light replacement procedures, see the rest of this section. For interior light replacement procedures, see Section 8A and Section 8C.

EXTERIOR LIGHTS	Trade No.
Back-up Lights	1156
Center High-Mounted Stoplight	577
Front Parking/Turn Signal Lights	2057
Fog Lights	H-3
Headlights	H6054
License Plate Lights	194
Rear Tail/Stop/Turn Signal Lights	2057
Sidemarker Lights (Front and Rear)	194
Underhood Light	211

INTERIOR LIGHTS	Trade No.
Air Conditioner/Heater Controls	194
Ashtray & Lighter	194
Cargo Compartment	561
Cluster & Speedometer (Tach)	194
Console Ashtray	194
Console Compartment	194
Courtesy Lights	194
Dome Light	561
Gear Selector Indicator	74
Headlight High-Beam Indicator	194
Indicator Lights	
Brake System Warning	194
With Gages	74
Charging System Warning (except Rally Gages)	194
Choke Warning	194
With Gages	74
Oil Pressure Warning (except Rally Gages)	194
Seat Belt Reminder	194
With Gages	74
Service Engine Soon Warning	194
With Gages	74
Temperature Gage Warning (except Rally Gages)	194
Reading Light	906
Turn Signal Indicators	194







1–HEADLAMP GROUND
2–HORN LEADS
3–SIDE MARKER
4–HEADLAMP
5–TURN SIGNAL PARK LAMP
6–HEADLAMP MOTOR RELAY
7–HEADLAMP MOTOR JUMPER
8 – HEADLAMP ISOLATION RELAY
9– BRAKE PRESS. WARNING SW.
10–TO SIDE MARKER
11–HORNS
12–TO HEADLAMP
13–ENGINE HARNESS CONNECTOR
14–BULKHEAD CONNECTOR
15–CONNECTOR END CAP
16–HEADLAMP MOTOR ISOLATION RELAY

Fig. 8B-11 Forward Light Wiring

SECTION 8C

INSTRUMENT PANEL, GAGES & CONSOLE

CONTENTS

GENERAL DESCRIPTION

INSTRUMENT PANEL AND GAGES

The instrument panel on most cars is a single unit design and all parts attach to the main instrument panel with clips and screws. To service the instrument panel and components see On-Car Service information.

PRINTED CIRCUIT

All models are equipped with printed circuits which supply current to most instrument panel lights and instruments. These circuits are made of copper foil which is die cut and bonded to a polyester base film (usually mylar). The printed circuit electrical power is supplied by a connector containing several wires, as shown in the instrument panel wiring harness installation instructions. The connector also helps retain the printed circuit to the speedo cluster. The rest of the circuit is retained by additional connectors (if used) and snap-in bulbs/sockets. For individual printed circuit diagrams, see Section 8A-80/81/82/83, 'Instrument Panel'.

INSTRUMENTS

Instruments consist of fuel gage, temperature indicator light, generator light, oil pressure indicator light, and speedometer. See Section 9F for optional Rally Gages and tachometer. Service on instruments can be obtained through authorized repair stations. However, knowledge of instrument circuit checks will help in determining if operating difficulties lie in the instrument itself or its related circuit.

Instruments have been designed for easy removal by elimination of separate wiring. With the wiring provisions integrated with the instrument panel wiring, the instruments can be removed after removing the trim and lens.

SPEED SENSORS

There are three speed sensors currently in use:

1. PINION GEAR; used in mechanical systems
2. PHOTO SPEED SENSORS; used in mechanical systems
3. PM GENERATOR; used in electronic systems

Pinion Gear

The PINION GEAR is attached to the transmission/transaxle output shaft and rotates in proportion to the speed of the car. This rotation is transferred from the pinion gear to the speedometer head by the speedometer cable.

Photo Speed Sensor

On vehicles that use a mechanical drag-cup speedometer, the PHOTO SPEED SENSOR is inserted into the frame of the mechanical speedometer to provide an electrical feedback to the ECM that represents vehicle speed. The ECM needs to know how fast the car is traveling in order to control and operate the cruise control, cooling fan, and transmission and evaporative systems.

The photo speed sensor is made up of two special electronic devices: a Light-Emitting Diode (LED) and a photo transistor (a light-sensitive amplifying device). In the mechanical speedometer, there is a reflective blade attached to the rotating magnet that is polished to reflect light from the LED back to the photo transistor. Whenever the light strikes the photo transistor, it conducts electricity. The rate that the transistor conducts and does not conduct is proportional to the speed of the magnet, which reflects the speed of the vehicle. This voltage signal from the photo transistor is sent to a buffer amplifier (part of the speed sensor) to be conditioned to a signal the ECM can understand and use.

PM Generator

The PM (Permanent Magnet) GENERATOR is a small AC generator used to sense vehicle speed. The shaft of the generator fits into a pinion gear in the transmission/transaxle output shaft (as does the cable in a mechanical system).

When the output shaft rotates, the magnet rotates and generates a voltage. Except for the permanent magnet, the PM Generator is exactly like a miniature alternator. The PM generator is constructed to provide a voltage whose frequency is about 1.1 cycles per second for every mile per hour of vehicle speed. This signal is sent to a buffer amplifier, and then to the speedometer and the ECM.

SPEEDOMETER

The speedometer is a road speed indicator with an odometer to record total mileage, and, on some cars, a resettable trip odometer.

The major types of speedometers in use are mechanical instruments and electronic instruments. Mechanical speedometers use a dial needle to indicate road speed. Electronic speedometers include instruments that use a dial indicator and those using bar-graph LCD's (Liquid Crystal Displays) or VTF (Vacuum Tube Fluorescent) displays.

Mechanical Speedometers

A mechanical speedometer uses a cable driven (through a pinion gear) by the transmission output shaft. The cable connects to a magnetic drag-cup inside the speedometer, which rotates the speedometer needle. The end of the rotating cable causes a small bar magnet to rotate within a metal cup. As the magnet rotates within the cup, it magnetically attracts (drags) the metal cup along behind it. Two things work to prevent the cup from rotating as quickly as the magnet.

1. The distance of the magnet from the cup reduces its effect on the cup.
2. A counterspring is wound around the shaft of the cup in such a way as to oppose the normal rotation of the cup. The counterspring loads the drag-cup to give correct indication of the speed, prevent needle overshoot, and also to return the drag cup to a zero point.

Mechanical speedometers require a photo speed sensor to provide road speed information for the ECM and other systems, such as Cruise Control and the TCC (Torque Converter Clutch).

The odometer on these instruments consists of numbered wheels that are rotated by the speedometer cable through worm gears.

Quartz Speedometer

The quartz speedometer is an electrically driven instrument. The indicator needle is driven by a precision DC motor, and is countersprung to provide a mechanical load, prevent overshoot of the needle, and return the indicator to zero when the road speed is zero.

The source of speed information for a quartz speedometer is the PM generator. From the PM generator, speed information goes to the buffer amplifier to be converted to digital voltage, and then to the cluster circuitry, which interprets the speed of the vehicle and produces small voltage to apply to the speedometer motor.

The odometer on this instrument consists of numbered wheels that are electrically driven by a special precision DC motor called a stepper motor.

Digital Speedometer

Digital clusters utilize two types of displays: LCD (Liquid Crystal Display) and VTF (Vacuum Tube Fluorescent). They are used in digital speedometers and bar-graph tachometers, fuel gages, etc.

Speed information entering the cluster from the buffer amplifier is interpreted by a microcomputer which controls the speed indication, the tachometer display and the odometer reading.

The odometers associated with these instruments utilize either numbered wheels driven by a small motor or electronic displays. With an electronic display, the mileage reading is stored in a computer chip (called a non-volatile RAM chip; NVRAM) that does not become 'erased' when the vehicle is turned off, as the display does not retain the information.

FUEL GAGE

An electrical fuel gage is used on all models, consisting of an instrument panel gage and a fuel tank pick-up. The fuel gage indicates the quantity of fuel in tank only when ignition switch is turned to "ON" or "ACCESSORY" positions.

When ignition is turned to "OFF" or "START" positions, the pointer may come to rest at any position. The letters "E" and "F" on the fuel gage are used to point out direction of indicator travel only.

TEMPERATURE WARNING LIGHT

The engine temperature warning light is controlled by a thermal switch which senses engine coolant temperatures.

When the ignition switch is turned to "START" position, a test circuit is closed and the light will come on to indicate whether the light is functioning properly.

It is important to note that with low boiling-point coolants (such as plain water) the temperature light may not come on even though the coolant is boiling.

GENERATOR WARNING LIGHT

The generator warning light, located in the instrument cluster, should come on when the ignition switch is turned "ON" and engine is **not** running. If not, either the bulb is burned out or wiring to generator has an open circuit.

When the generator voltage output becomes greater than the battery voltage, the "GEN" light should go out. This does not, however, indicate whether the battery is being charged or if the voltage regulator is functioning properly.

Checks of the charging system are covered in Section 6D, 'Engine Electrical'.

ENGINE OIL PRESSURE LIGHT

The engine oil pressure warning light is mounted in the instrument cluster and controlled by a pressure operated switch located on the engine block. When the ignition switch is in the "run" or "start" position, the oil pressure light should come on. If not, the bulb is burned out, there is an open circuit between the bulb and the oil pressure switch, or there is an open circuit between the oil pressure switch and the choke heater. After the engine is running, the oil pressure light should go out when the oil pressure reaches the correct specification. If not an oil pressure problem, a faulty oil pressure switch or an open circuit from the choke heater fuse to the oil pressure switch is indicated.

"SERVICE ENGINE SOON" LIGHT

All cars have a "SERVICE ENGINE SOON" light mounted in the instrument cluster. The "SERVICE ENGINE SOON" light should come on during engine starting. The light may stay on a short time after the engine starts. If the light comes on while driving, service to the emission control system may be required. See Section 6E and Section 8A-80, 'Instrument Cluster', for complete diagnosis and wiring diagrams of the "SERVICE ENGINE SOON" light circuit.

UPSHIFT INDICATOR LIGHT

If your vehicle has a manual transmission, there may be an "Upshift" light on the instrument panel. This light is illuminated to indicate optimum shift points throughout the range from optimum fuel economy to optimum performance. When this light is on, shift your transmission to the next higher gear range if conditions permit. For fuel economy, accelerate slowly and shift when the light goes on. For performance, accelerate as desired and shift when the light goes on.

Safe operation of the vehicle may require shifting differently than indicated by the "Upshift" light to adapt to weather, road or traffic conditions.

Downshifting one or more gears may be required to keep the engine running smoothly or to maintain satisfactory performance.

DIAGNOSIS

Diagnostic information for all instrument panel electrical systems is found in Section 8A-80, 'Instrument Panel'.

CAUTION: When removing or installing any electrical units, disconnect the negative battery cable to prevent possible short circuits which could lead to personal injury and/or property damage.

SPEEDOMETER

When replacing a speedometer or odometer assembly, the law requires the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires that the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous odometer reading and the date of replacement.

GENERAL INFORMATION

INSTRUMENT PANEL AND GAGES

The instrument panel is a single unit design and all parts attach to the main instrument panel with clips and screws. To service the instrument panel and components see Figs. 601 through 610.

ON-CAR SERVICE

INSTRUMENT PANEL PAD

Figure 601

Remove or Disconnect

1. Four (4) screws in defroster ducts.
2. Screws under lip of I.P. pad.
3. I.P. pad from carrier.

Install or Connect

1. I.P. to carrier.
2. Screws under lip of I.P. pad.
3. Four (4) screws in defroster ducts.

INSTRUMENT PANEL CLUSTER

Figure 603

Remove or Disconnect

1. Right and left lower trim plates. Removal of lower I.P. covers not required.
2. Instrument cluster trim plate.
3. Six (6) cluster attachment screws, pull cluster back and disconnect speedo cable and electrical connections.
4. Trip odometer, reset knob (if so equipped) and remove cluster lens.
5. Individual gages and/or speedo head are now accessible for service or replacement. If service is intended for only gages or tachometer, skip Step 3.

Install or Connect

1. Trip odometer, reset knob (if so equipped) and remove cluster lens.
2. Six (6) cluster attachment screws, pull cluster back and disconnect speedo cable and electrical connections.
3. Instrument cluster trim plate.
4. Right and left lower trim plates. Removal of lower I.P. covers not required.

INSTRUMENT PANEL CARRIER

Figure 602

Remove or Disconnect

1. Negative battery cable.
2. Console.
3. Instrument panel pad and lower hush panels.
4. Right and left lower I.P. covers and trim plates.
5. Instrument panel cluster and headlight switch.
6. Lower steering column.
7. Five (5) upper and six (6) lower I.P. carrier to cowl screws.
8. Instrument panel electrical harness at cowl (bulkhead) connector, and under dash.
9. I.P. carrier from car.
10. I.P. mounted components (A/C, defroster ducts, wiring harness, etc.) are now accessible for service or replacement.
11. Any seals or sealant damaged during disassembly.

Install or Connect

1. I.P. carrier to car.
2. Instrument panel electrical harness at cowl (bulkhead) connector, and under dash.
3. Five (5) upper and six (6) lower I.P. carrier to cowl screws.
4. Steering column.
5. Instrument panel cluster and headlight switch.
6. Right and left lower I.P. covers and trim plates.
7. Instrument panel pad and lower hush panels.
8. Console.
9. Negative battery cable.

HEADLIGHT SWITCH

Figure 620

Remove or Disconnect

1. Right and left lower trim plates. Removal of lower I.P. cover(s) not required.
2. I.P. cluster trim plate.
3. Two (2) switch assembly retaining screws.
4. Depress side tangs and pull switch assembly from I.P.
5. Individual switches of assembly are now accessible for service or replacement.

Install or Connect

1. Depress side tangs and replace switch assembly to I.P.
2. Two (2) switch assembly retaining screws.
3. I.P. cluster trim plate.
4. Right and left lower trim plates. Removal of lower I.P. cover(s) not required.

DASH MOUNTED ACCESSORY SWITCHES

Figure 621

Installation for various dash mounted accessory switches is shown in Fig. 621.

CONSOLE MOUNTED SWITCHES AND ACCESSORIES

Figure 617

Installation of various console mounted switches, lights and accessories is shown in Figure 617.

CONSOLE

Remove or Disconnect

1. Negative battery cable.
2. Shift gate trim plate. Requires removal of shift handle and seven (7) screws.
3. Radio/A/C-heater controller trim plate.

4. A/C-heater controller (see Section 1B).
5. Radio (see Section 9A).
6. Electrical connectors (cigar lighter, ash tray light, etc.) and pull harness forward out of console.
7. Six (6) console hold-down and two (2) console to I.P. screws and remove console.

Install or Connect

1. Six (6) console hold-down and two (2) console to I.P. screws and replace console.
2. Electrical connectors (cigar lighter, ash tray light, etc.) and pull harness forward out of console.
3. Radio (see Section 9A).
4. A/C-heater controller (see Section 1B).
5. Radio/A/C-heater controller trim plate.
6. Shift gate trim plate.
7. Negative battery cable.

SPEEDOMETER

Figures 603

Remove or Disconnect

1. Right and left lower trim plates. Removal of lower I.P. cover(s) not required.
2. Instrument cluster trim plate.
3. Six (6) cluster attachment screws, pull cluster back and disconnect speedo cable.
4. Cluster lens.
5. Two (2) screws retaining speedo head in cluster from rear.
6. Electrical (VSS) connectors and remove speedo head.

Install or Connect

1. Electrical (VSS) connectors and replace speedo head.
2. Two (2) screws retaining speedo head in cluster from rear.
3. Cluster lens.
4. Six (6) cluster attachment screws, reconnect speedo cable, replace cluster.
5. Instrument cluster trim plate.
6. Right and left lower trim plates.

1–NUT

2–BOLT/SCREW

3–PAD ASM.

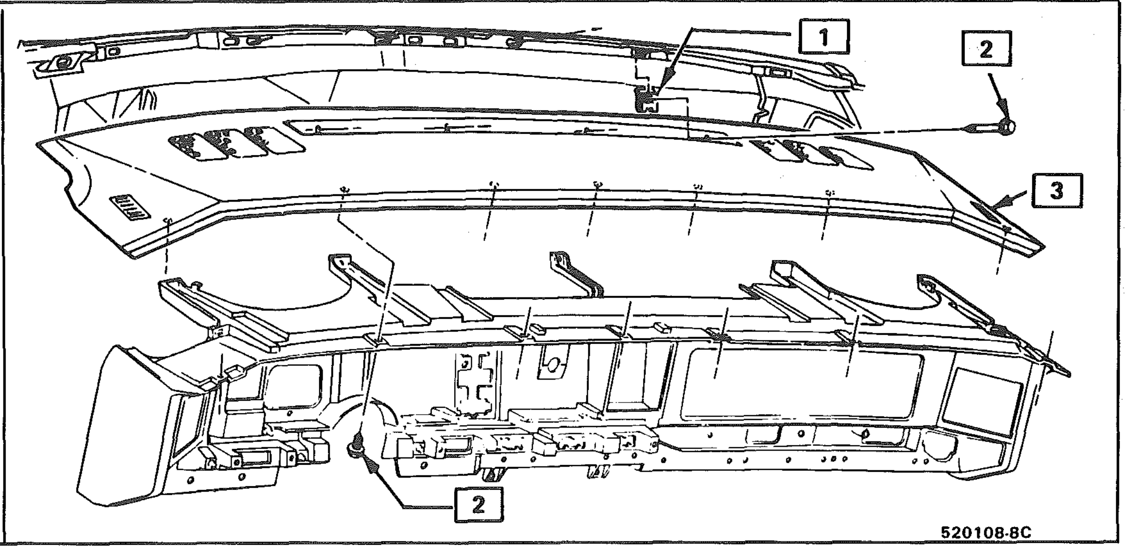


Fig. 601 IP Pad

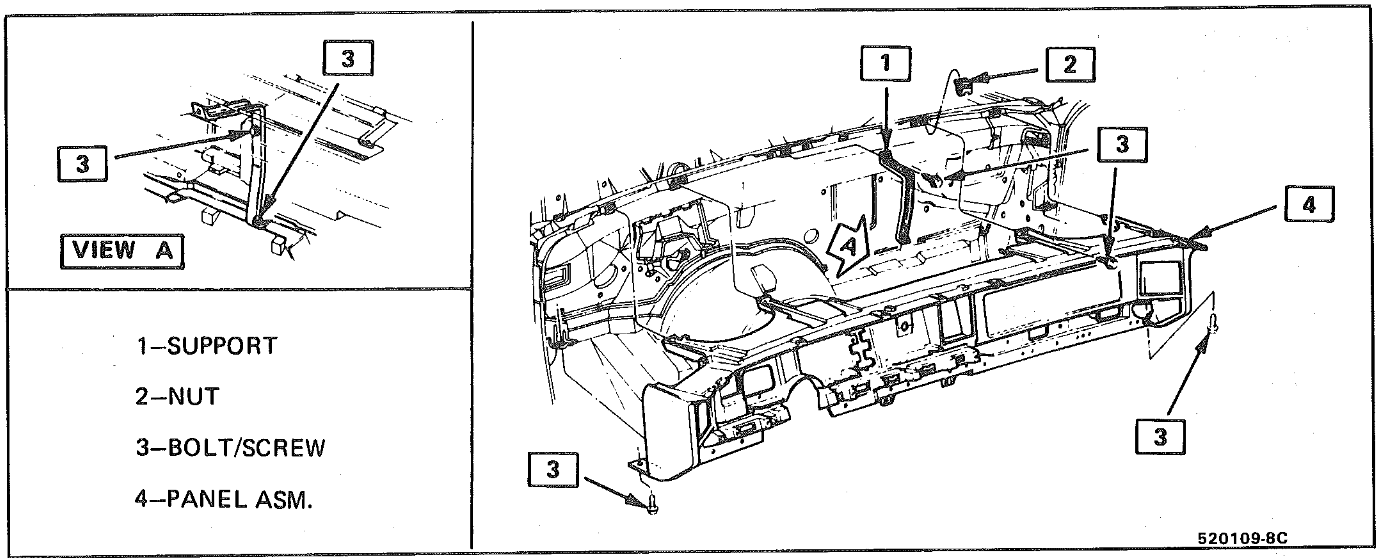


Fig. 602 IP Carrier

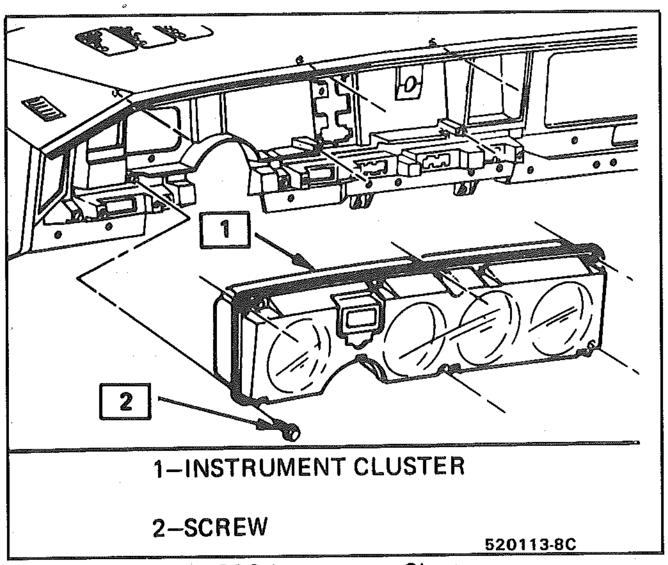
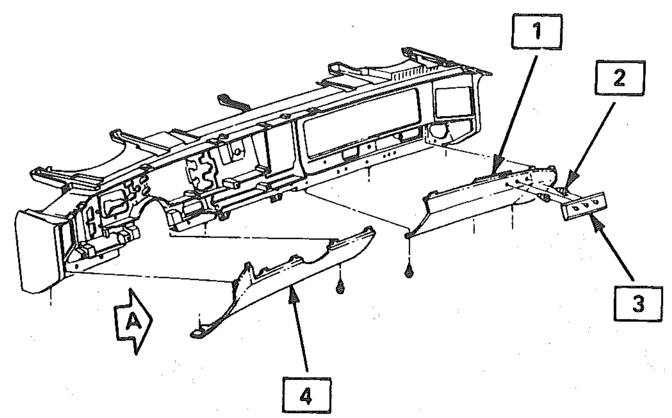
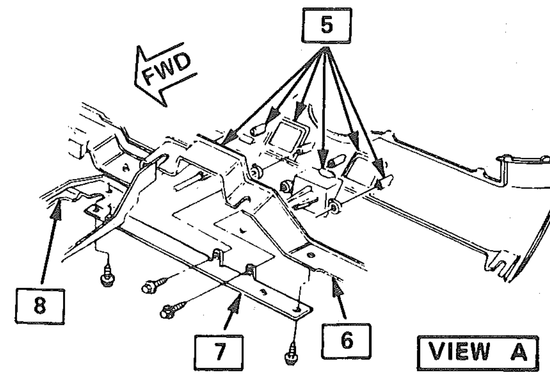


Fig. 603 Instrument Cluster





1-RH COVER
2-RETAINER
3-PLATE
4-STEERING COLUMN FILLER PANEL
5-W/O A/C
6-IP LOWER REINFORCEMENT
7-BRACKET
8-CONVENIENCE CENTER MOUNTING BRACKET

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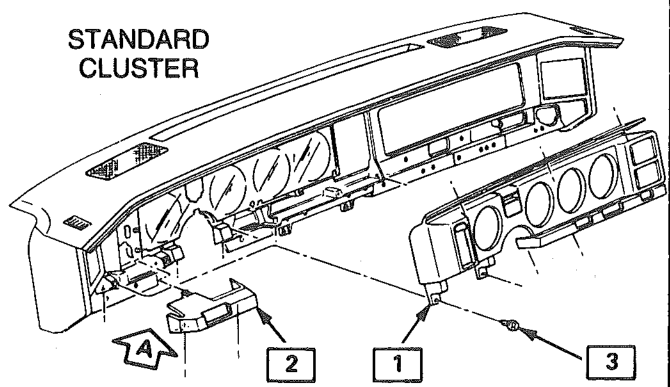
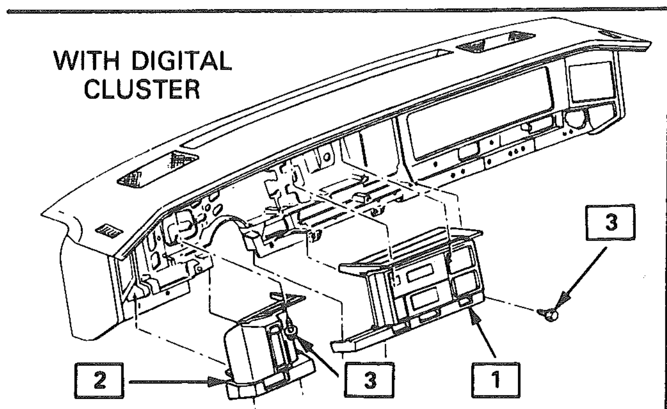
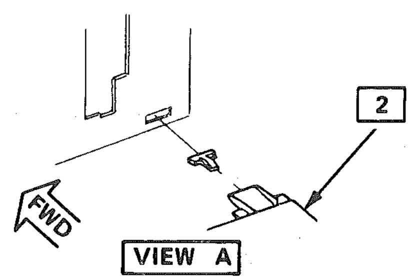
Fig. 604 Lower IP Covers







*** WITH DIGITAL CLUSTER ***

INSTALLATION PROCEDURE FOR LEFT & RIGHT HAND PLATE ASSEMBLIES

1-POSITION BOSS ON PLATE ASSEMBLY OVER LOCATING PIN.

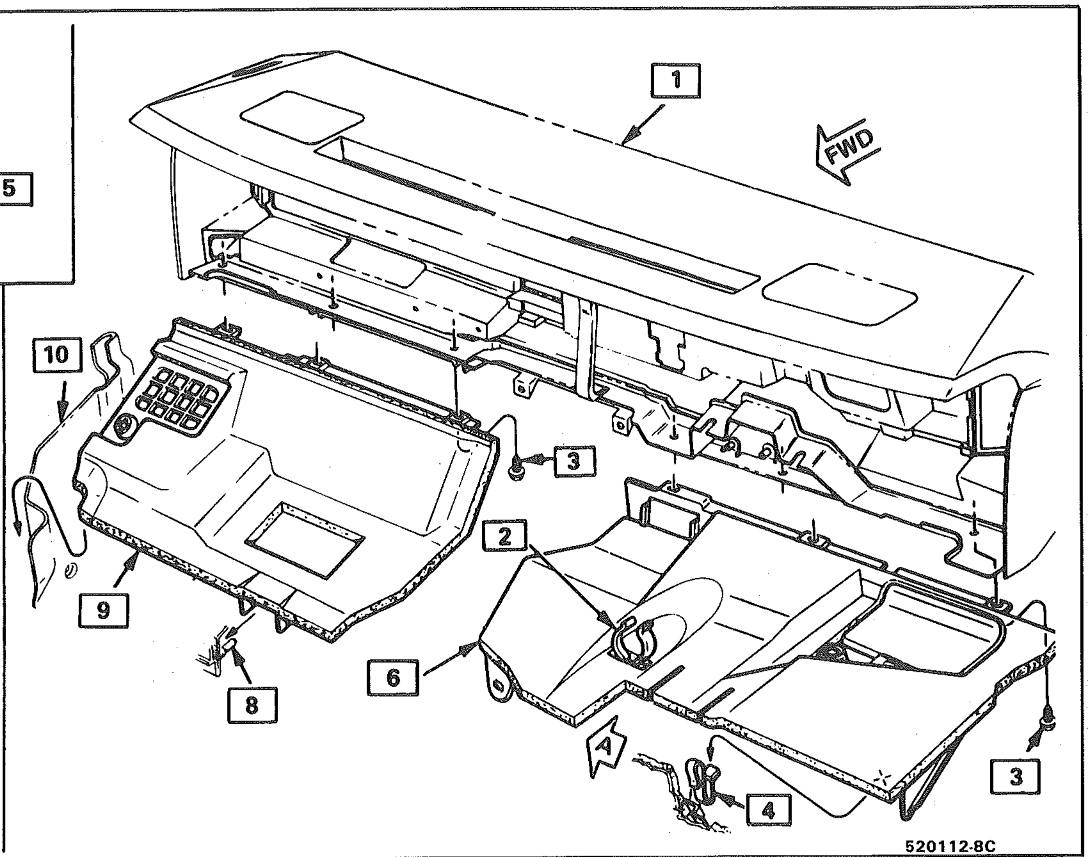
2-ALIGN SCREW HOLES.

3-INSTALL SCREWS, BEGINNING WITH SCREW LOCATIONS ALONG THE LOWER EDGE OF EACH PLATE. SECURE SCREWS ALONG TOP EDGE OF EACH PLATE LAST.

1-TRIM PLATE (RH)
2-TRIM PLATE (LH)
3-1.5 N•m (13 LB. IN.)

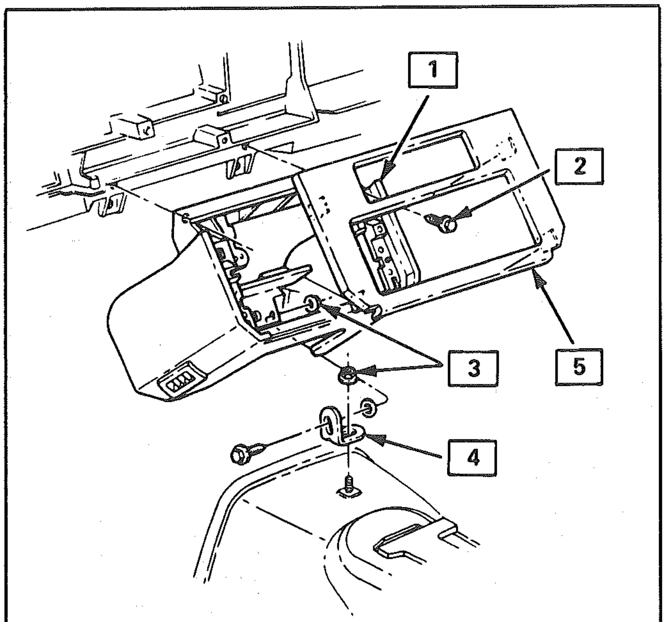
H20041-8C

Fig. 605 IP Trimplates



1–INSTRUMENT PANEL
2–CLIP, STRG. COLUMN
3–BOLT/SCREW
4–CLIP
5–NUT
6–LH INSULATOR ASM.
7–ACCL. PEDAL BRK'T.
8–REST ON EXISTING DASH STUD
9–RH INSULATOR ASM.
10–KICK PANEL TRIM

Fig. 606 IP Hush Panels; with A/C



1 – PAD ASM.
2 – 4 N•m (36 LB. IN.)
3 – 6 N•m (54 LB. IN.)
4 – BRACKET
5 – TRIM PLATE

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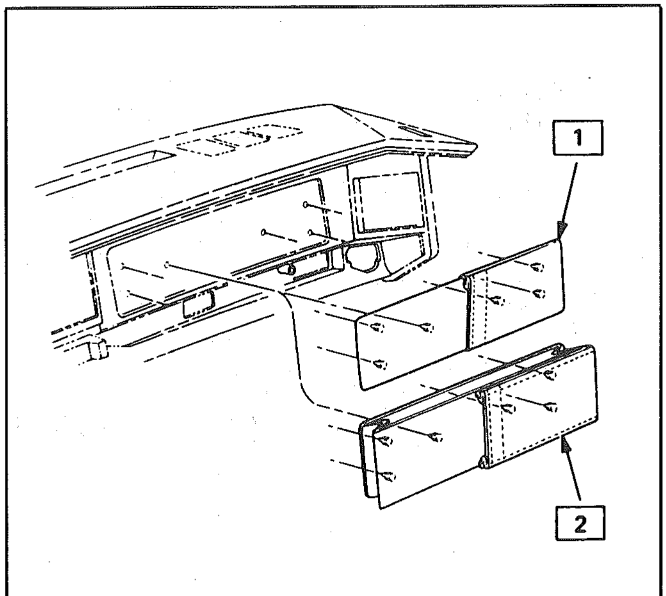
Fig. 607 IP Lower Trim Pad (Console)



1 – MAP HOLDER
2 – MAP POCKET

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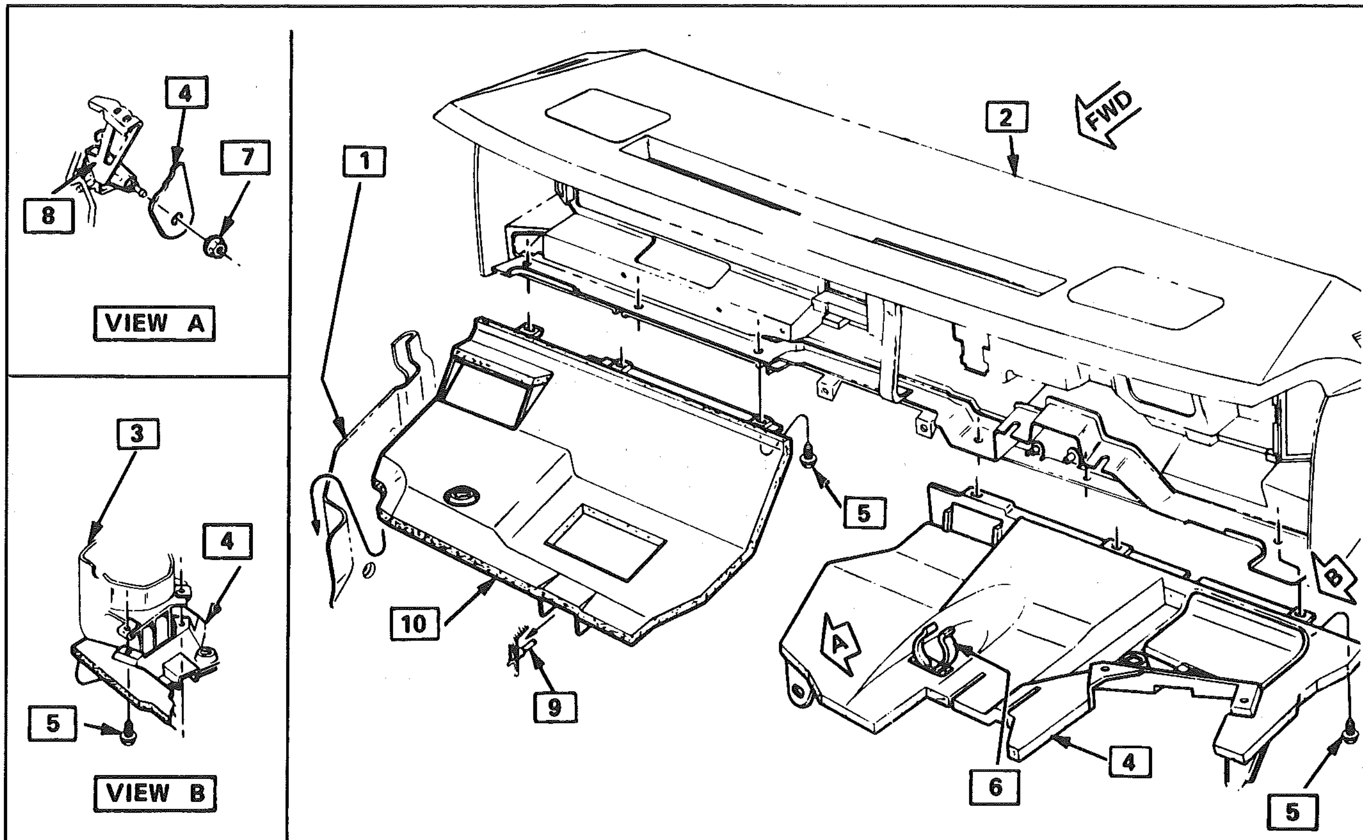
Fig. 608 Map Holder or Map Pocket



1–KICK PANEL TRIM
2–INSTRUMENT PANEL
3–LH VENT DUCT EXTENSION
4–LH INSULATOR ASM.
5–BOLT/SCREW
6–CLIP INTO STEERING COLUMN
7–NUT
8 –ACCEL. PEDAL BRK'T.
9–REST ON EXISTING DASH STUD
10–RH INSULATOR ASM.

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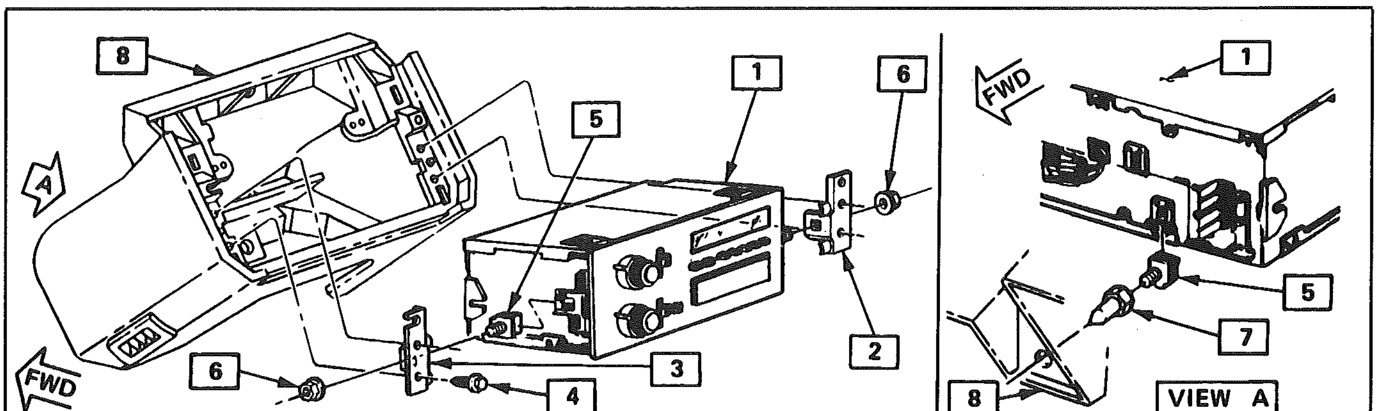
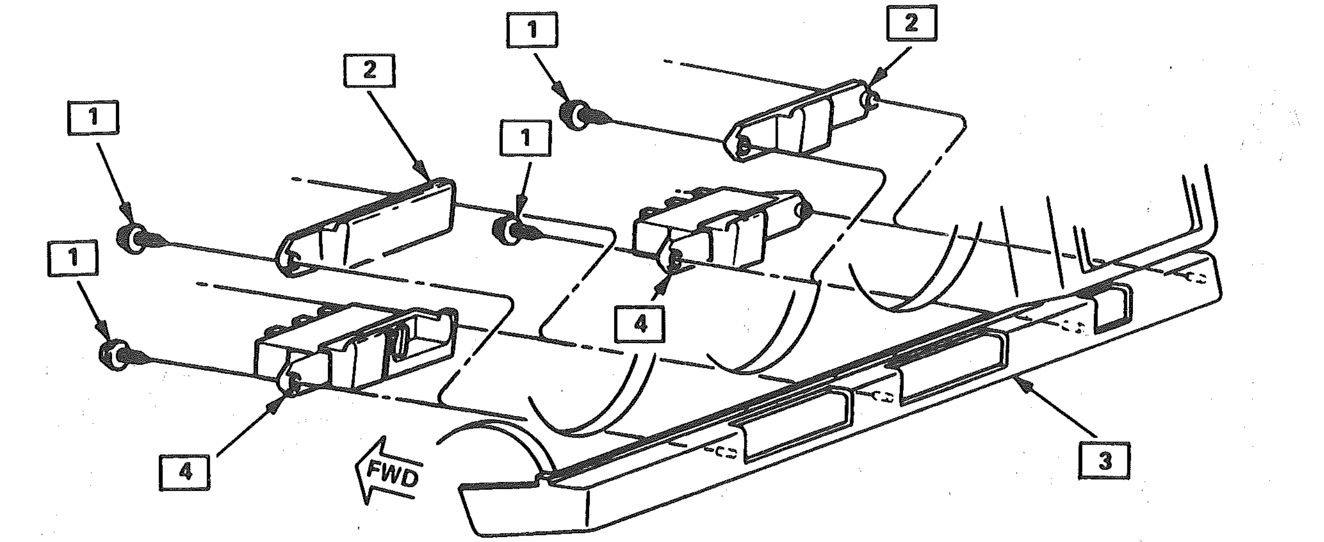
Fig. 609 IP Hush Panels; w/o A/C



1—RADIO ASM.
2—BRACKET
3—BRACKET
4—BOLT/SCREW (4)
5—BOLT/SCREW (3)
6—NUT
7—BUMPER
8—I/P LOWER TRIM PAD

520208-8C

Fig. 610 Radio Mounting



1–BOLT/SCREW–USING TORQUE, CONTROL TOOL, 800 RPM MAX.

2–COVER

3–TRIM PLATE I.P.

4–SWITCH ASM.

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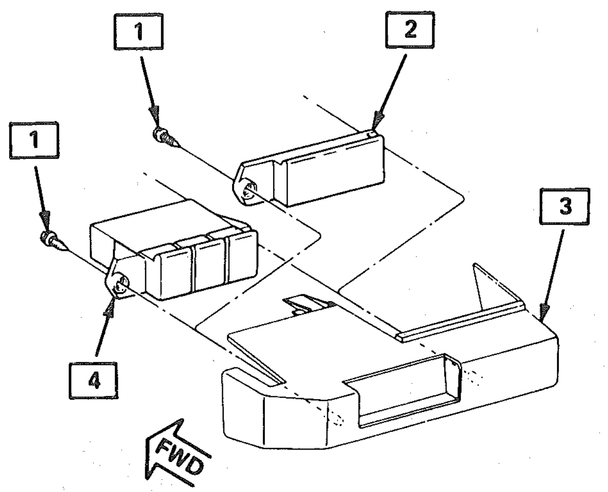
Fig. 611 Subwoofer & Hatch Release Switches/Covers



1 – 1.5 N•m (13 LB. IN.)

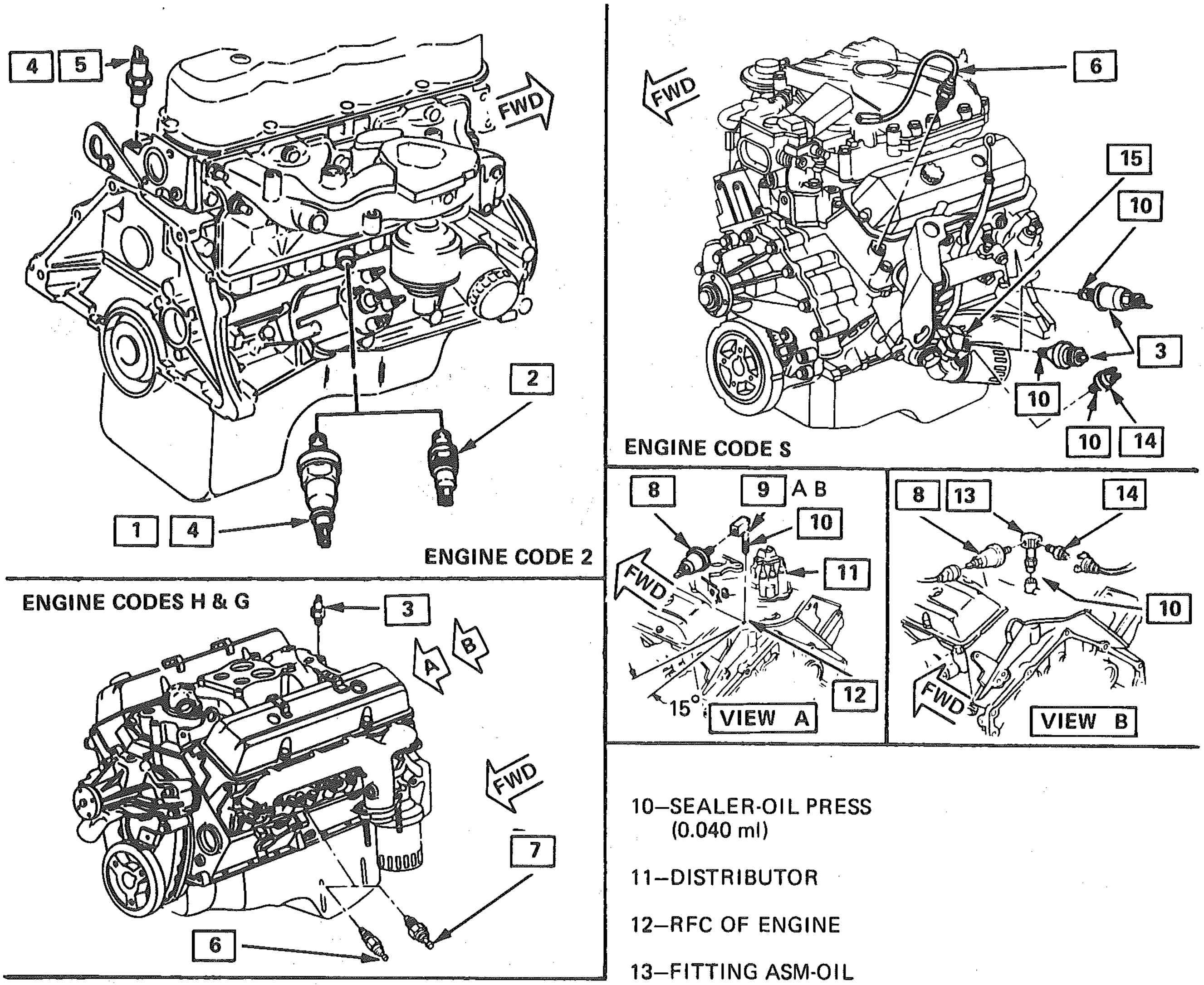
2 – COVER (W/O FOG LAMPS)

3 – IP TRIMPLATE (LH)

4 – SWITCH

H20042-8C

Fig. 612 Foglamp Switch/Cover



10–SEALER-OIL PRESS (0.040 ml)

11–DISTRIBUTOR

12–RFC OF ENGINE

13–FITTING ASM-OIL

14–SWITCH ASM-FUEL PUMP

15–FITTING (ENGINE)

1–SENDER ASM OIL, W/GAGES

2–SWITCH ASM-OIL, W/O GAGES

3–SWITCH ASM OIL

4–SENSOR ASM-WATER, W/GAGES

5–SWITCH ASM-WATER, W/O GAGES

6–SWITCH ASM, WATER

7–SENSOR ASM,WATER

8–SENSOR ASM-OIL PRESS

9–FITTING OIL– CODE H

A–INSTALL ITEM 9 15°±° off OFF RFC OF ENGINE AS SHOWN.

B–REMOVE EXISTING PLUG FROM ENGINE ASM.

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Fig. 613 Oil Pressure and Temperature Switches

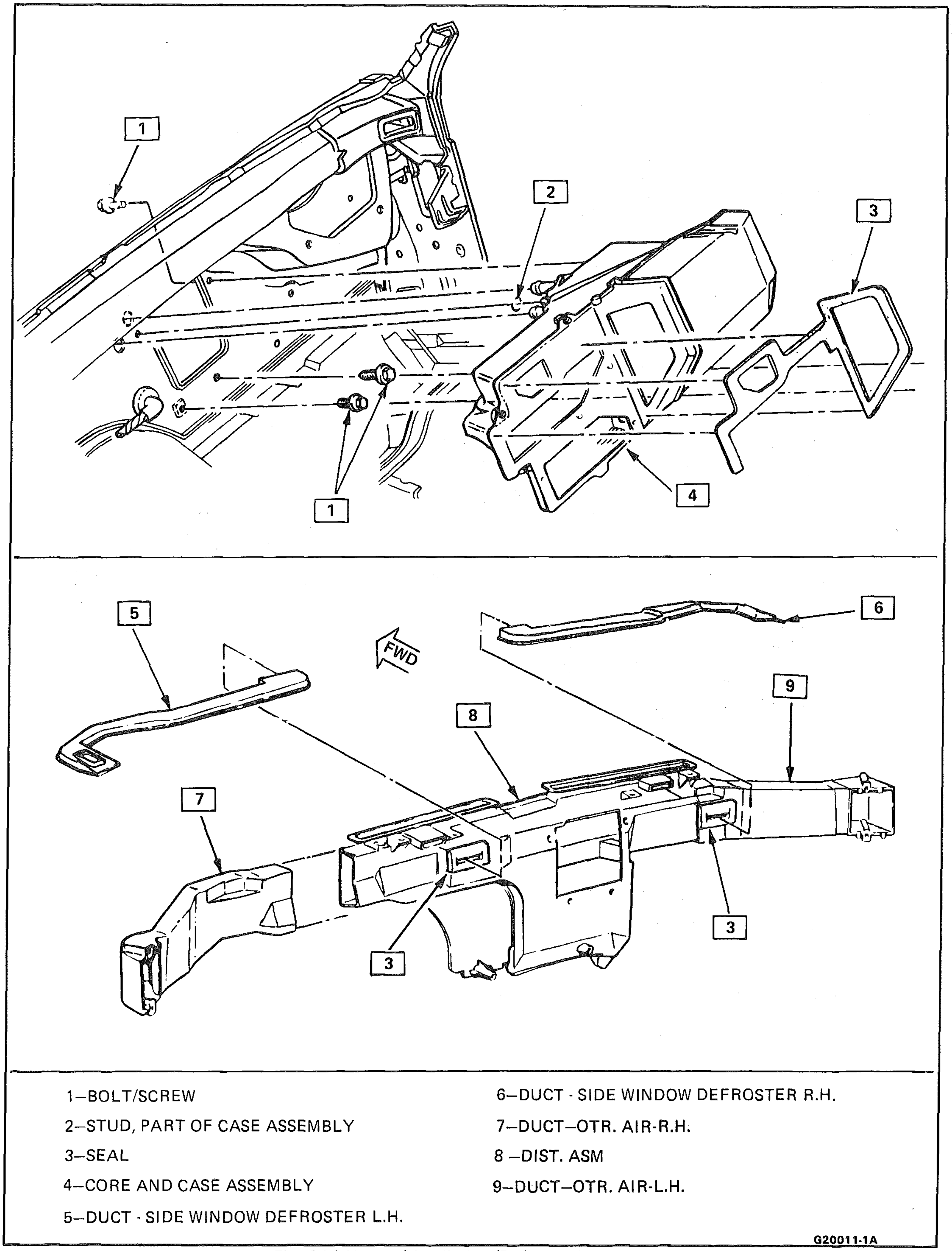
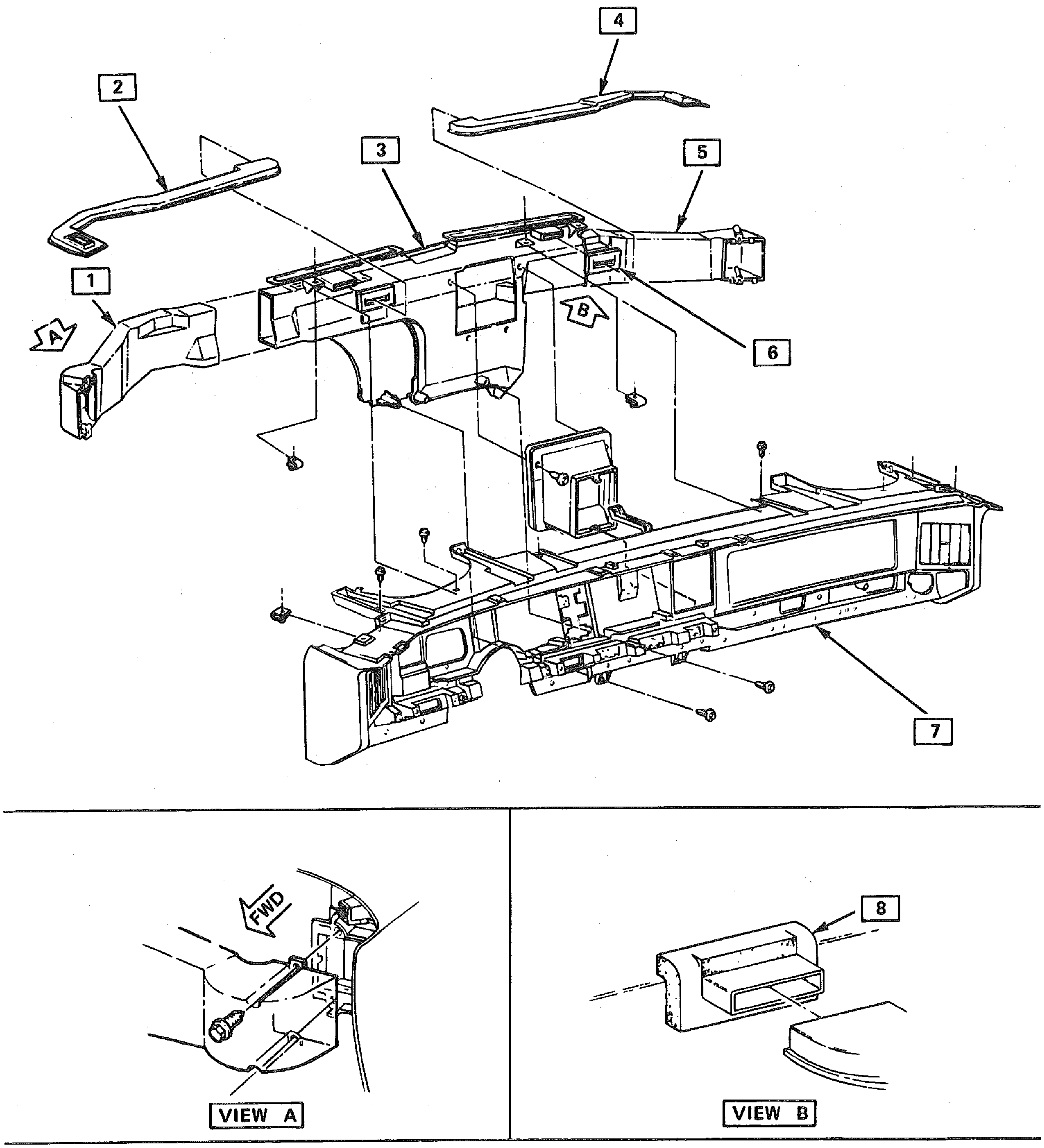


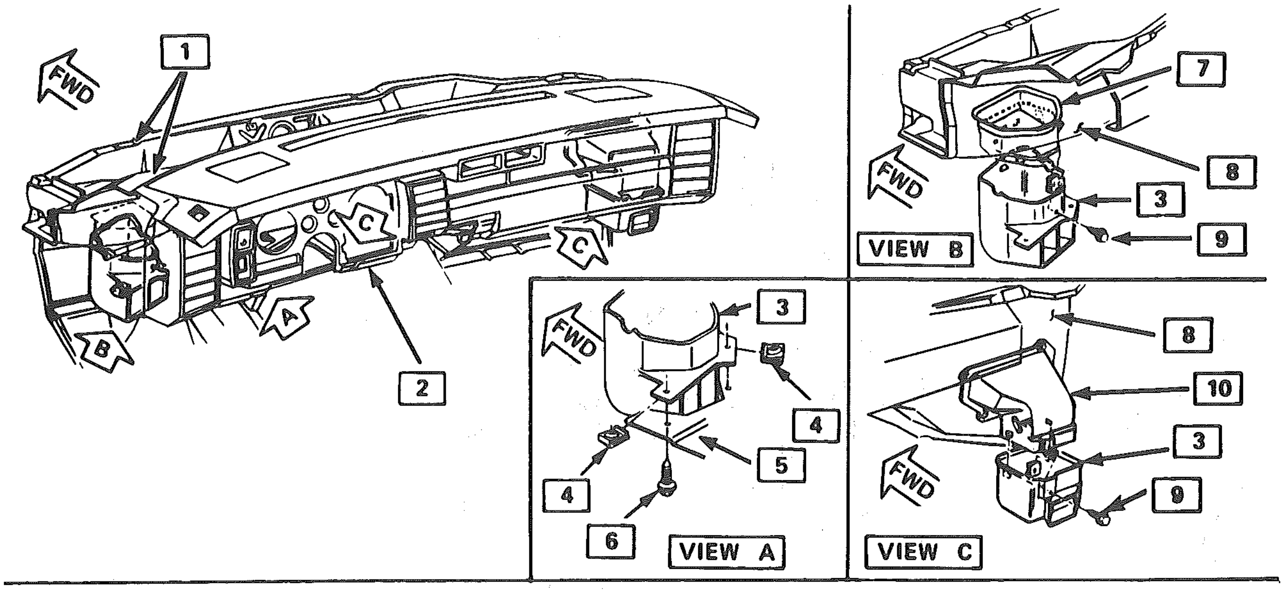
Fig. 614 Heater/Ventilation/Defroster Ductwork



1–DUCT-A/C LEFT
2–DUCT-SIDE WIND. DEF., LH
3–DUCT-CENTER/DEFROST
4–DUCT-SIDE WIND. DEF., RH
5–DUCT-A/C RIGHT
6–DUCT-CENTER DISTRIBUTION
7–INSTRUMENT CARRIER
8–GASKET

520132-1B

Fig. 615 A/C and Defroster Ductwork

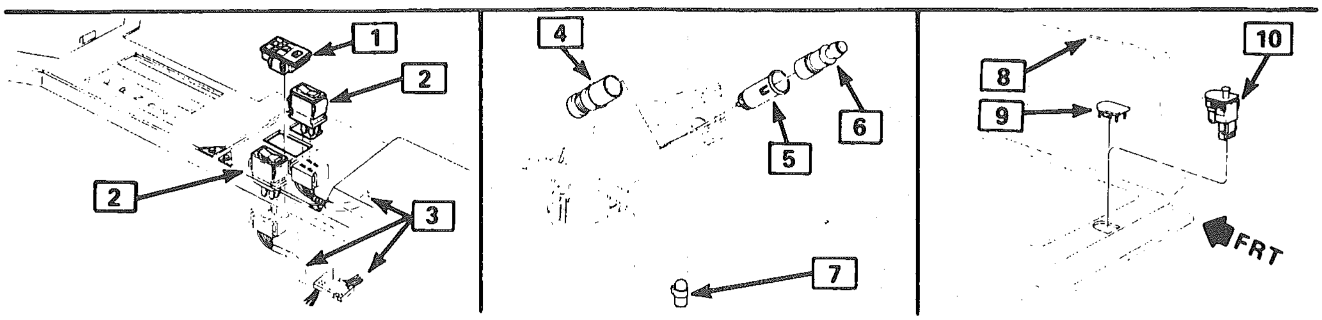


1–UPPER DASH PANEL AND PLENUM CHAMBER
2–INSTRUMENT PANEL ASSEMBLY
3–EXTENSION - SIDE VENT DUCT
4–"U" NUT
5–INSULATOR ASSEMBLY
6–BOLT/SCREW
7–DUCT AND VALVE ASSEMBLY
8–PLENUM CHAMBER
9–FASTENER
10–DUCT AND BAFFLE ASSEMBLY

520052-1A

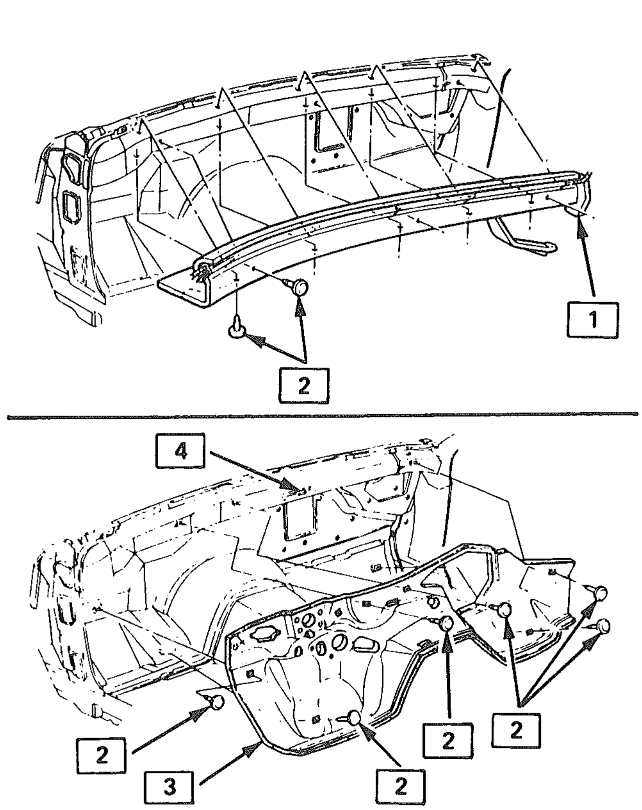
Fig. 616 Ram Vent System Ductwork

1 SWITCH, POWER MIRRORS
2 SWITCH, POWER WINDOWS
3 I.P. HARNESS
4 RETAINER
5 HOUSING
6 KNOB, SHIELD, ELEMENT
7 LIGHT HOOD, ASH TRAY
8 CONSOLE COMPARTMENT DOOR
9 COVER, W/O LAMP GROUP
10 SWITCH, W/LAMP GROUP



520146-9

Fig. 617 Console Mounted Switches & Accessories



1 – INSULATOR (UPPER); UPPER RETENTION IS PROVIDED BY CROSS CAR WIRE HARNESS CONDUIT FASTENERS.
2 – RETAINER
3 – INSULATOR (LOWER)
4 – BEND TAB TO RETAIN MAT

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Fig. 618 Dash Insulators

1 SWITCH, HATCH RELEASE
2 SCREW
3 SWITCH, REAR WIPER
4 SWITCH, REAR DEFOG

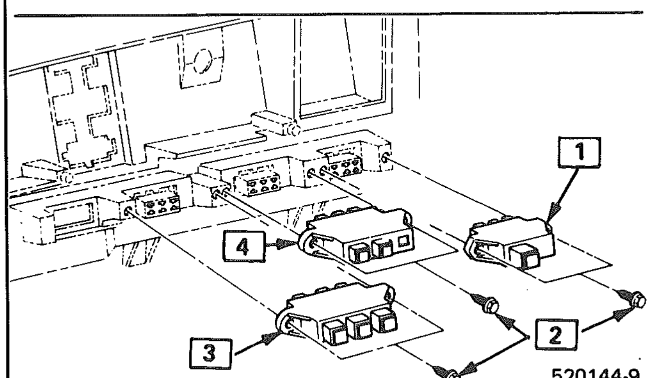
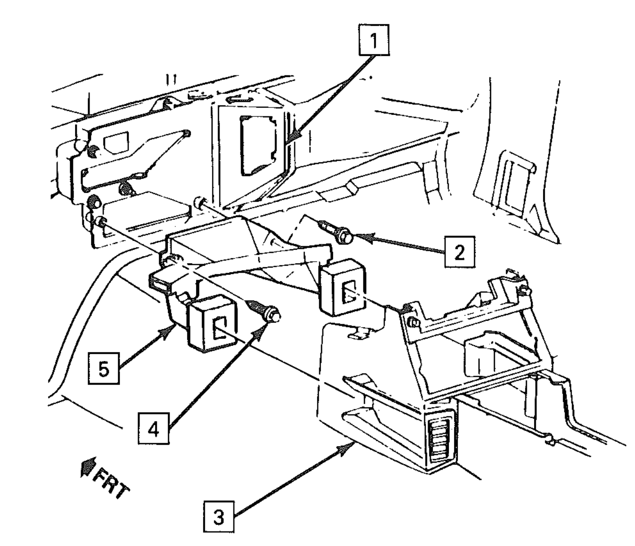


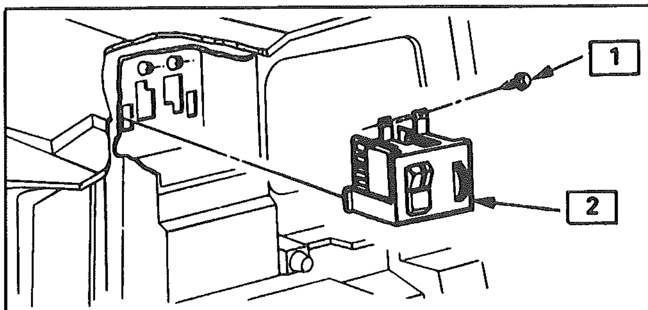
Fig. 621 Dash Mounted Accessory Switches



1. HEATER AND DEFROSTER ASSEMBLY
2. 1.4 N·m (12 LBS. IN.) INSTALL FIRST
3. CONSOLE ASSEMBLY
4. 1.4 N·m (12 LBS. IN.)
5. FLOOR OUTLET ASSEMBLY

J10003-1A-F

Fig. 619 Heater Floor Outlet



1–BOLT/SCREW 2–HEADLAMP SWITCH ASM.

520114-8C

Fig. 620 Headlamp/Parking Lamp Switch

SECTION 8E

F CARLINE WINDSHIELD WIPER-WASHER SYSTEM (PULSE & STANDARD)

CONTENTS

GENERAL DESCRIPTION

Figs. 1 and 2

The Permanent Magnet (PM) Depressed Park windshield (w/s) wiper with remote washer pump system consists of a depressed park wiper motor and a remote washer pump mounted on the washer fluid container.

Based on the type of control switch used and whether an optional electronic printed circuit board is attached in the wiper cover, the system can serve as either a pulse type wiper-washer system or a standard type windshield wiper. Pulse timing and "demand" wash functions are controlled electronically on pulse windshield wipers.

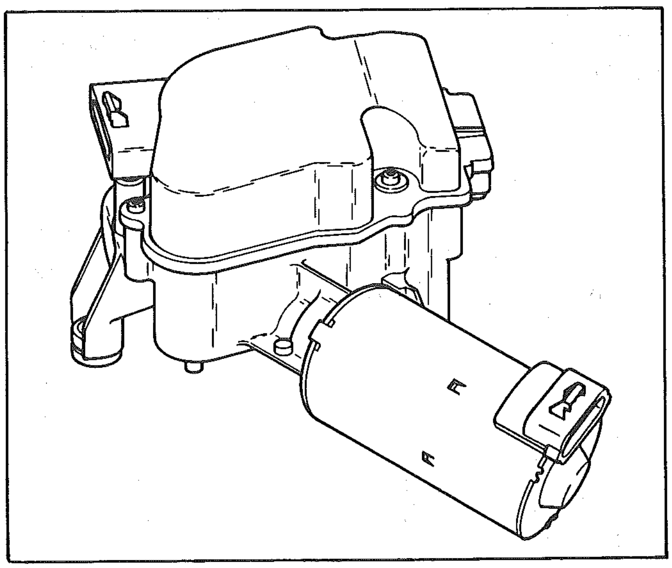


Fig. 1 Wiper Motor

WIPER AND WASHER OPERATION

Pulse Windshield Wiper System

Electronic logic circuits on a pulse wiper system's printed circuit board establish all timing and washer commands. When the WASH switch is pressed, the washer sprays only during the wiper arm outwipe and pulsates operation for 2-1/2 seconds. Then the wiper dry wipes for nearly 6 seconds before shutting off. See Pulse Wiper Operation Chart, Fig. 3, for a brief description of pulse wiper system operation.

If the WASH switch is pressed for more than one second, a (demand) wash is performed for as long as the switch is depressed. This wash action is followed by 6 seconds of dry wipes before shut-off. With the control switch in the LO or HI speed position, the respective

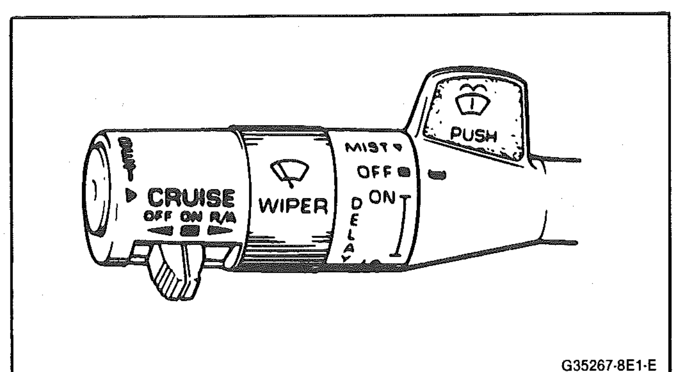


Fig. 2 Wiper-Washer Control Switch

brush circuit (Fig. 12) is completed to the (+) 12 volts DC source and the wiper motor runs at that particular speed setting.

Moving the switch to the PULSE mode operates the wiper motor intermittently and the delay can be varied by moving the switch back and forth in the Delay Mode. An instantaneous wipe can be obtained by moving the switch to the MIST position. If the switch is pressed continually, a continuous wiping action will be performed. See Figs. 14, 15, and 16.

DIAGNOSIS

DIAGNOSTIC PROCEDURES

The following procedures assume that the service technician has checked:

- the continuity of circuit harness wiring,
- that the wiper-motor assembly-to-dash mounting hardware is tight,
- circuit fuses, and
- that the washer hoses are clear, not kinked, disconnected or broken.

See Fig. 12 for wiper circuit diagrams.

WIPER MOTOR

Check motor operation before removing wiper assembly from the car. Disconnect wiring harness from wiper assembly before performing the following checks:

1. Apply a (+) 12 volt DC (source) voltage to wiper connector pins as shown in Fig. 13. If the motor runs in all operating modes (LO, HI; PARK & PULSE), perform the voltage and continuity wiper switch tests as shown on Figs. 14, 15 and 16.
2. If the wiper motor does not run in any one or all of the operating modes, refer to the Wiper-Washer Motor Diagnostic Procedures Reference (Fig. 4).

WASHER PUMP

Check washer pump operation before removing washer pump from the car. Disconnect (cover) wiring harness connection to wiper cover connector. Then apply a (+) 12 volt DC (source) voltage to wiper terminals as shown on Fig. 17.

1. If washer pump motor does not run or does not pump water, replace washer pump. See On-Car Service procedures for "Washer Pump Replacement."
2. If washer pump motor runs and pumps water, the problem is in the wiper switch. See Fig. 16 for switch test procedures.

WIPER SWITCH POSITION	WASH BUTTON POSITION: OFF	WASH BUTTON POSITION: BUTTON HELD LESS THAN ONE SECOND	WASH BUTTON POSITION: BUTTON HELD MORE THAN ONE SECOND
OFF	Wiper and washer are off—blades are at park position.	Wiper starts, runs and washes in low speed. Fluid pulses approx. 2½ seconds, followed by approx. six seconds of drying wipes. Wiper then returns to park and shuts off.	Wiper starts, runs and washes in low speed. Fluid flows as long as button is held, then approx. six seconds of drying wipes and wiper returns to park position and shuts off.
DELAY	Wiper runs one low speed wipe. Blades stop at inner wipe position, next wipe is delayed for period of time of 0-25 seconds (depending upon rheostat setting), then cycle repeats.	Delay function is overridden and followed by wash and dry cycle above. Blades then return to inner wipe position and delay function resumes.	Delay function is overridden and followed by wash and dry cycle above. Blades then return to inner wipe position and delay function resumes.
LOW	Wiper runs in continuous low speed.	Wiper continues to run in low during wash cycle above, and remains in low speed after wash.	Wiper continues to run in low during wash cycle above, and remains in low speed after wash.
HIGH	Wiper runs in continuous high speed.	Same as low speed wash above except motor running in high speed.	Same as low speed wash above except motor running in high speed.

Fig. 3 Pulse Wiper Operation Chart

WIPER-WASHER MOTOR DIAGNOSTIC CHART

PROBLEM	PROCEDURE
Pump inoperative	1
Washer pumps continuously	2
Wiper motor inoperative	3
Intermittent wiper operation in "Pulse", "Lo" or "Hi" modes	4
Wiper will not park	5
No delay, or continuous in delay (motor operates in "Lo" and "Hi" modes)	6
Wiper stays in "Delay" during wash cycle started in "Delay" mode	7
No "Lo" mode	8
No "Hi" mode or blades cycle in and out of park with switch in "Hi"	9
Blades cycle in and out of park position when wiper is shut off	10

Fig. 4 Wiper-Washer Diagnostic Chart

ON-CAR SERVICE

WASHER PUMP REPLACEMENT

Fig. 21

Remove or Disconnect

1. Washer solvent
2. Brace
3. Container screws (2)
4. Electrical connectors and washer hose
5. Washer pump motor from container

Install or Connect

1. Washer pump motor to container
2. Electrical connectors and washer hose
3. Container screws (2)
4. Brace
5. Washer solvent

Important

- Make sure new washer pump is pushed all the way into the container gasket.

WIPER COVER REPLACEMENT

Fig. 18

Remove or Disconnect

1. Cover screws
2. Wiper cover

Install or Connect

1. New wiper cover
2. Cover screws

Important

- Always install cover assembly with wiper in park position and drive pin in the open area of the cam.

PARK SWITCH REPLACEMENT

Remove or Disconnect

1. Wiper cover

Important

- If motor is in park position (Fig. 18), operate motor as required to remove pawl from relay slot.

2. Park switch assembly

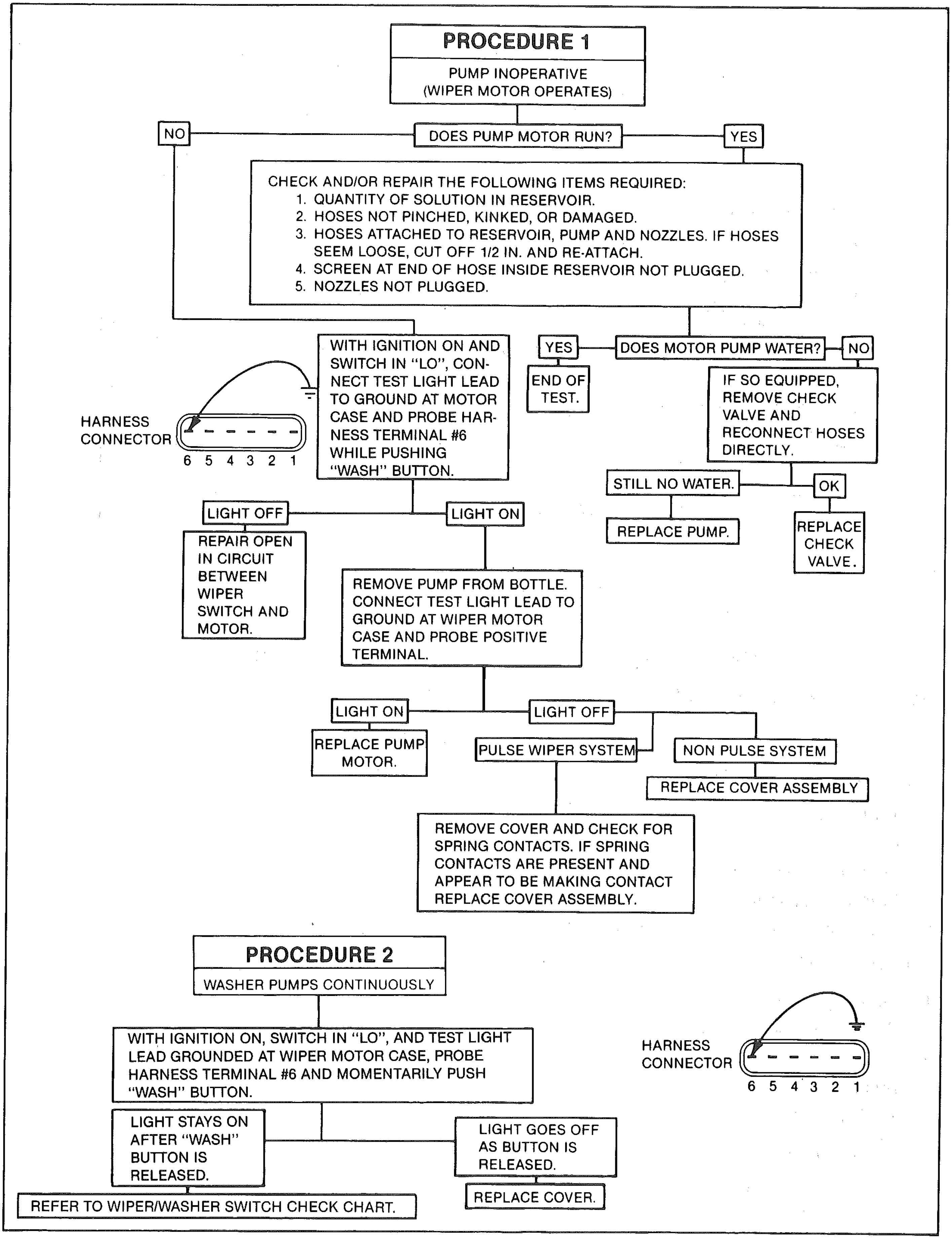


Fig. 5 Diagnostic Procedures 1 & 2

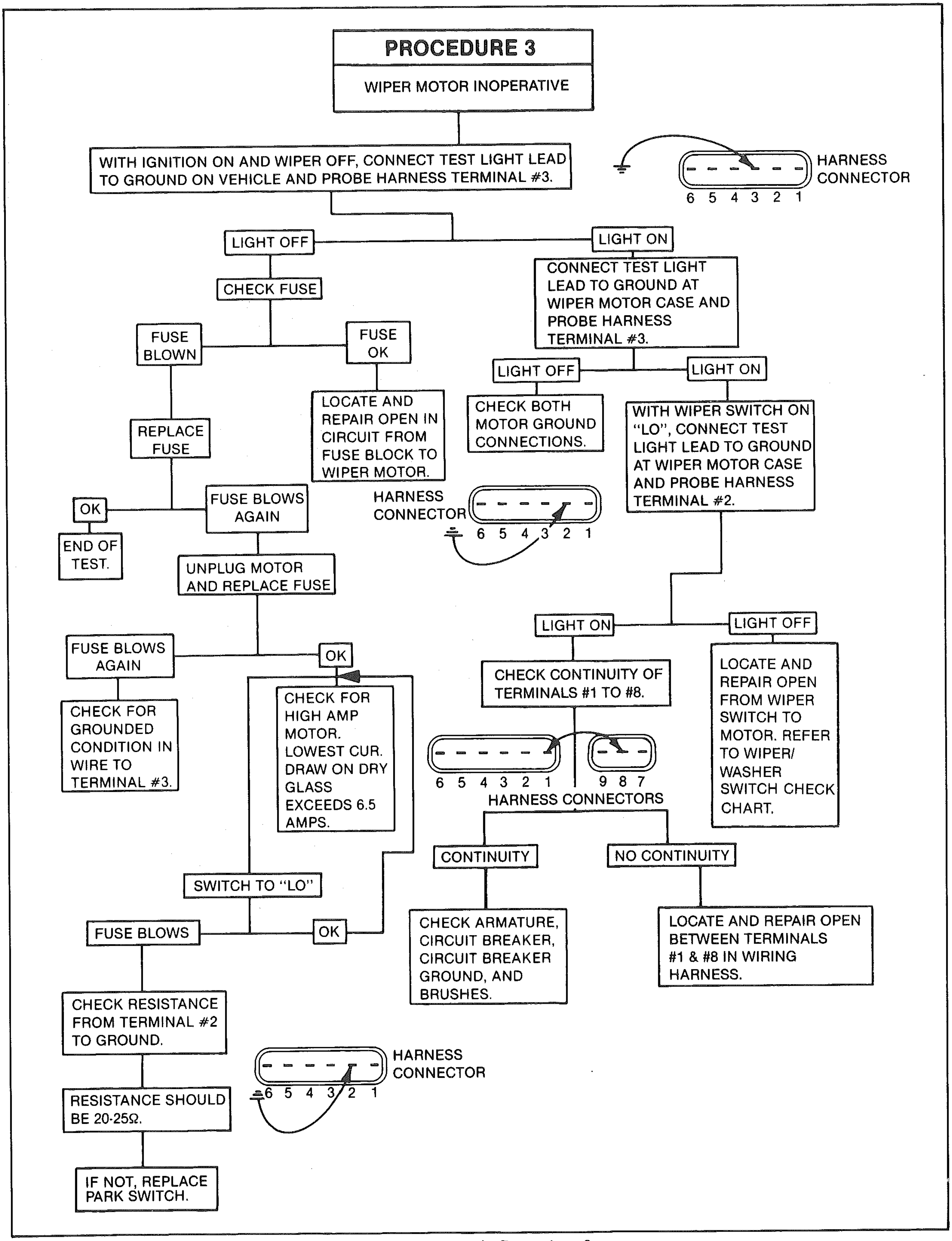


Fig. 6 Diagnostic Procedure 3

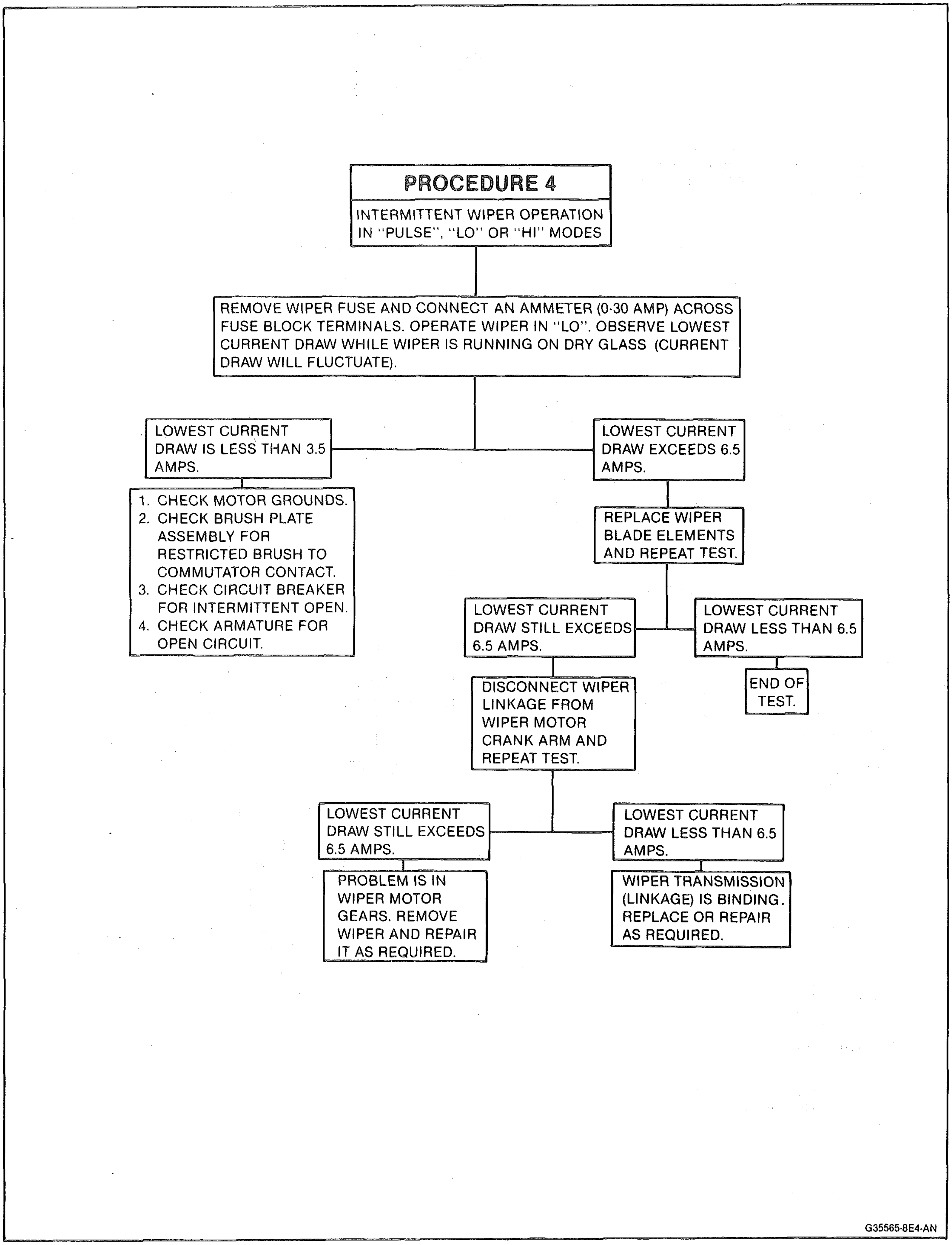
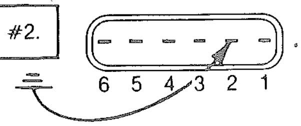


Fig. 7 Diagnostic Procedure 4

PROCEDURE 5

WIPER WILL NOT PARK

WITH IGNITION ON AND WIPER SWITCH OFF, PROBE HARNESS TERMINAL #2.



- LIGHT OFF
  - REMOVE WIPER COVER. RECONNECT MOTOR WITHOUT COVER. WHEN MOTOR IS SWITCHED FROM "LO" TO "OFF" IS PARK SWITCH LATCH ARM IN POSITION TO CATCH DRIVE PAWL ?
    - YES
      - IS DRIVE PAWL BENT?
        - NO
          - CHECK SHAFT ENDPLAY. IF DRIVE PAWL OVERRIDES LATCH, REPLACE SHAFT ASSEMBLY.
        - YES
          - REPLACE DRIVE PAWL.
    - NO
      - REPLACE PARK SWITCH OR COVER ASSEMBLY (PULSE ONLY).
- LIGHT ON
  - REFER TO WIPER/WASHER SWITCH CHECK CHART.

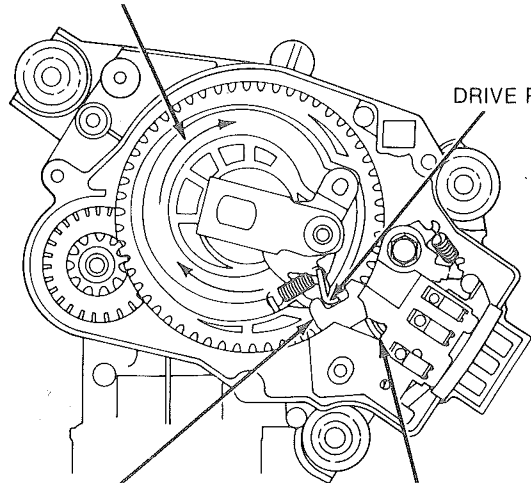


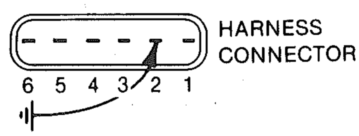
Fig. 8 Diagnostic Procedure 5

PROCEDURE 6

NO DELAY OR CONTINUOUS IN DELAY (MOTOR OPERATES IN "LO" AND "HI")

WITH VOLTMETER CONNECTED TO TERMINAL #6, AND GROUNDED AT MOTOR CASE, VARY DELAY MODE FROM MINIMUM DELAY TIME TO MAXIMUM DELAY TIME. VOLTAGE SHOULD VARY FROM A MAXIMUM TO MINIMUM.

- VOLTAGE VARIES
  - WITH IGNITION ON AND WIPER SWITCH ON MINIMUM DELAY, CONNECT TEST LIGHT LEAD TO GROUND AT WIPER MOTOR CASE AND PROBE HARNESS TERMINAL #2.
    - LIGHT ON
      - REMOVE COVER: ARE PARK SWITCH PULSE TERMINALS TOUCHING PADS ON CIRCUIT BOARD?
        - NO
          - REPLACE SPRING CONTACTS.
        - YES
          - REPLACE COVER.
    - LIGHT OFF
      - REFER TO WIPER/WASHER SWITCH CHECK CHART.
- VOLTAGE DOES NOT VARY
  - REFER TO WIPER/WASHER SWITCH CHECK CHART.



PROCEDURE 7

WIPER STAYS IN DELAY DURING WASH CYCLE STARTED IN DELAY

CIRCUIT BOARD IS DEFECTIVE, REPLACE WIPER COVER.

Fig. 9 Diagnostic Procedures 6 & 7

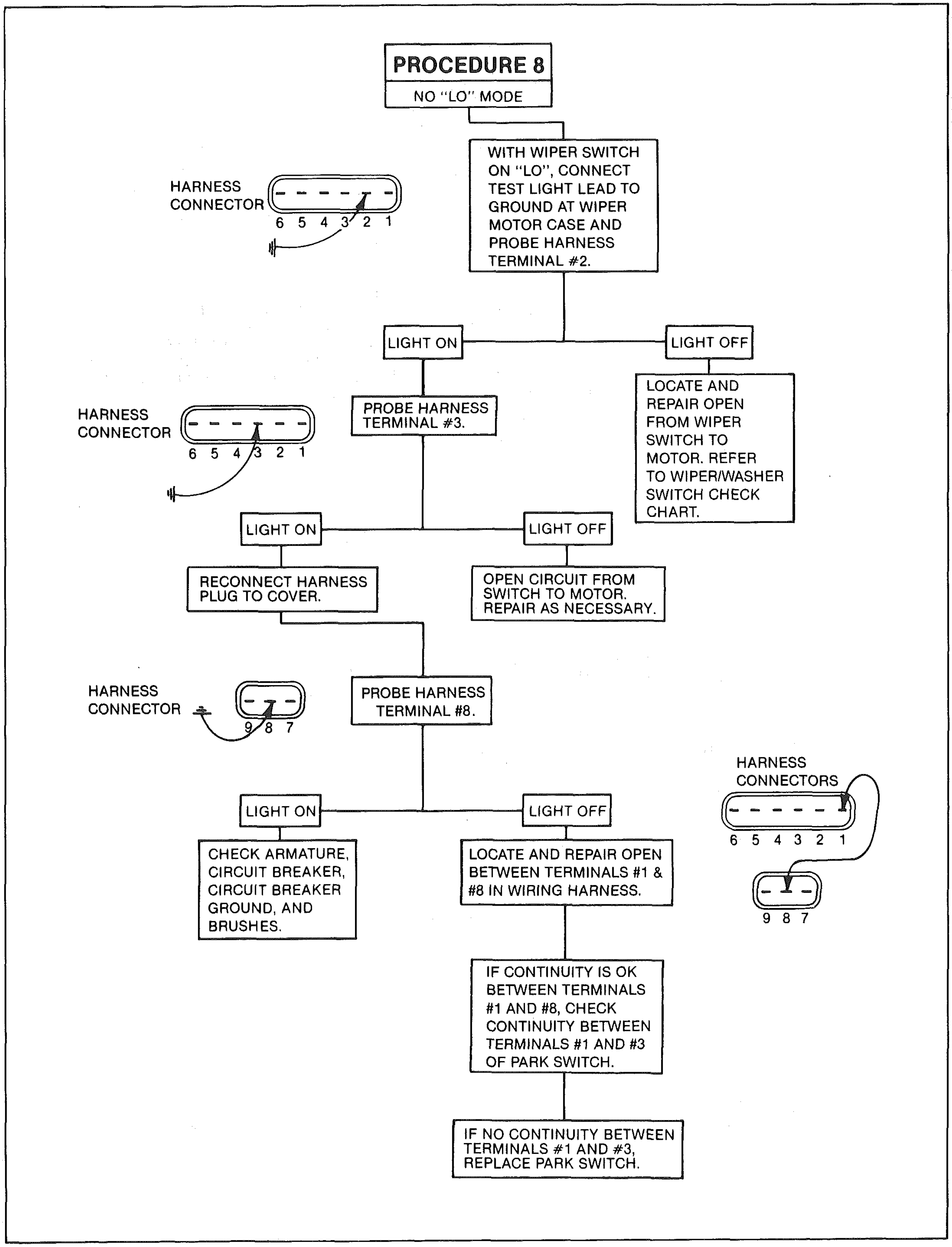


Fig. 10 Diagnostic Procedure 8

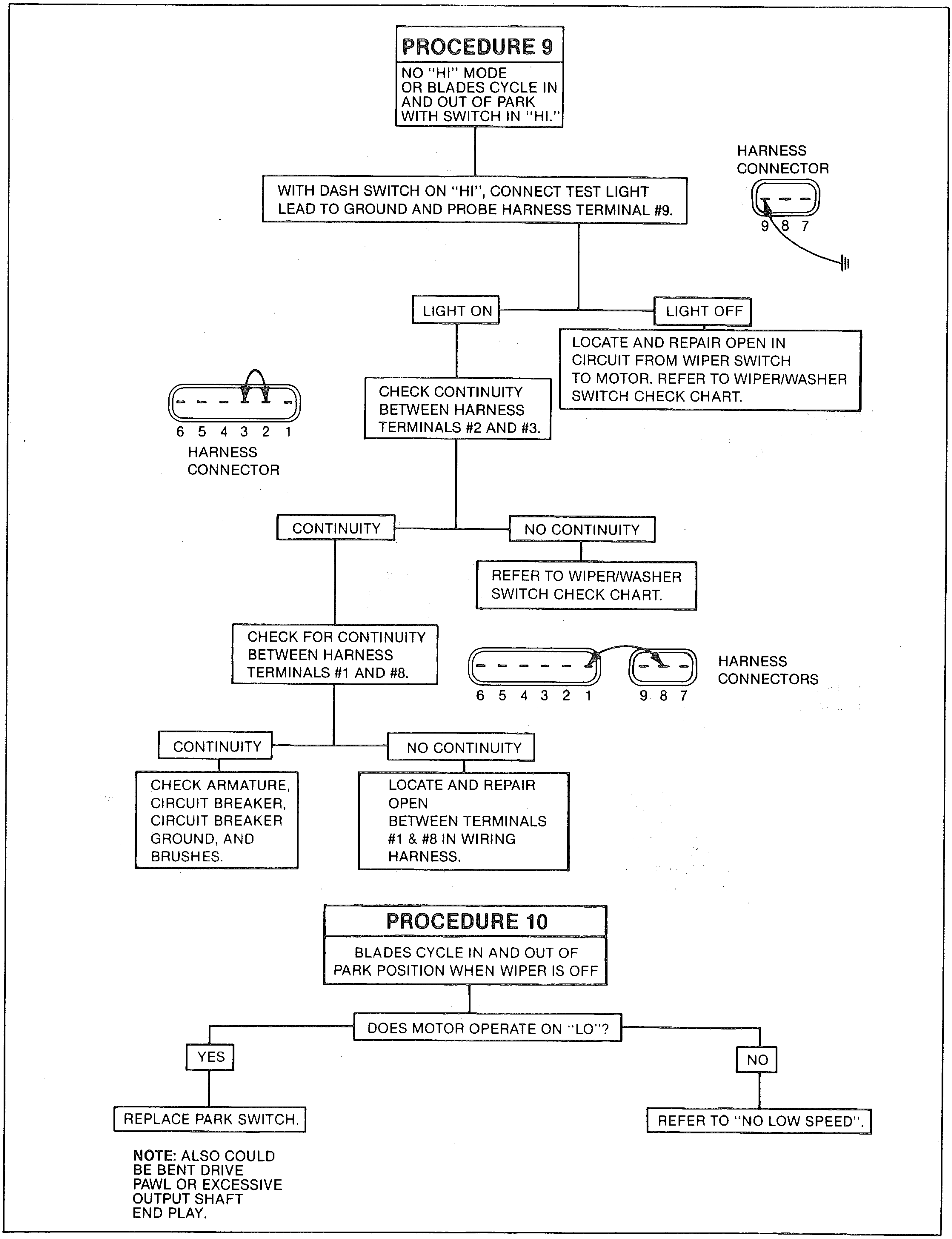


Fig. 11 Diagnostic Procedures 9 & 10

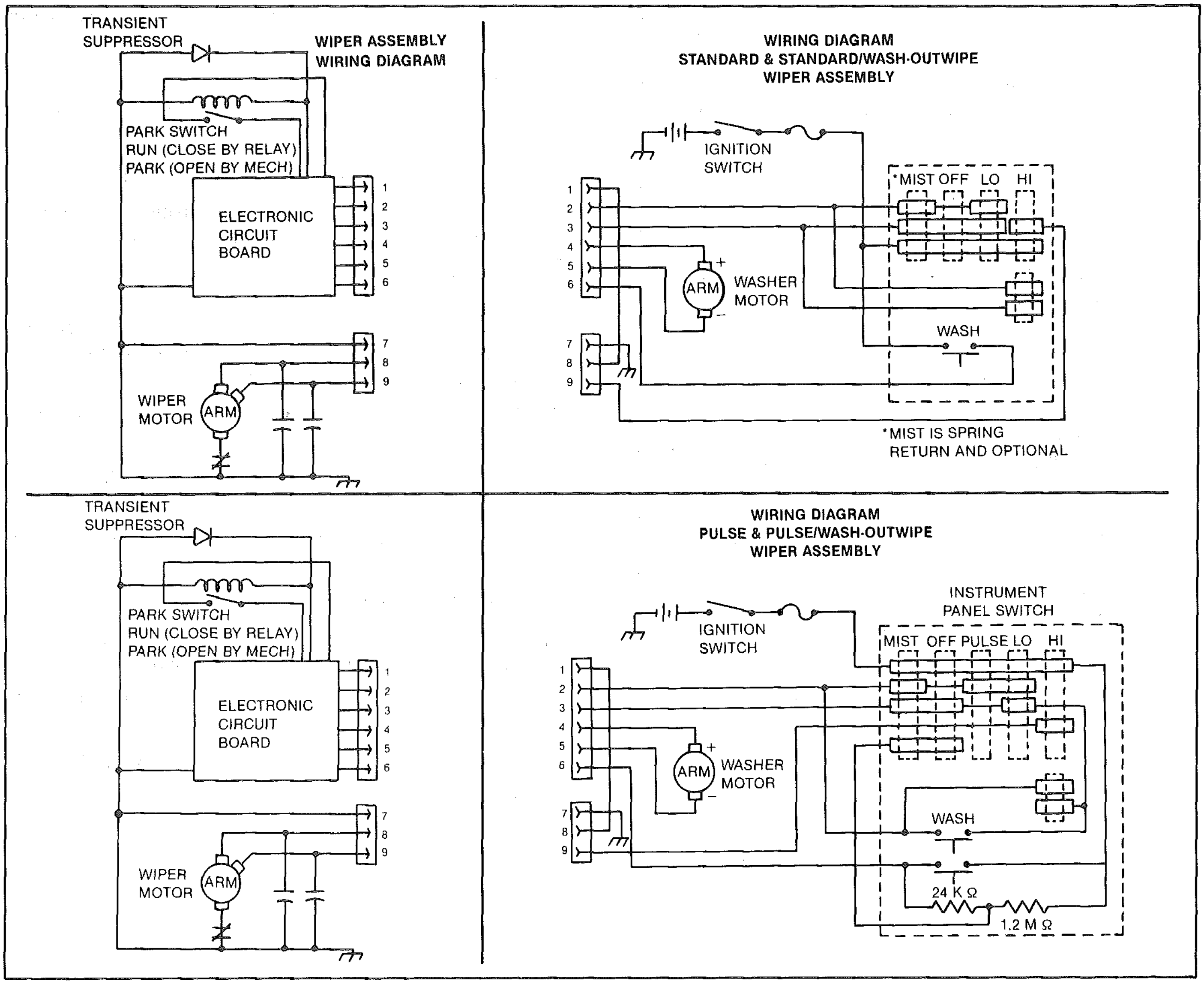


Fig. 12 W/S Wiper-Washer Circuit Diagrams

Install or Connect

1. New park switch assembly (standard switch has no extra terminals. Pulse switch requires them).
2. Follow "Wiper Cover Replacement" procedure carefully.

WIPER MOTOR REPLACEMENT

Remove or Disconnect

1. L.H. and R.H. wiper arms
2. Cowl cover
3. Wiper arm drive link from crank arm
4. Electrical connectors
5. Wiper motor attaching bolts
6. Wiper motor guiding crank arm through hole

Install or Connect

1. Wiper motor guiding crank arm through hole
2. Wiper motor attaching bolts
3. Electrical connectors
4. Wiper arm drive link to crank arm
5. Cowl cover
6. L.H. and R.H. wiper arms

WIPER TRANSMISSION

Fig. 19

Remove or Disconnect

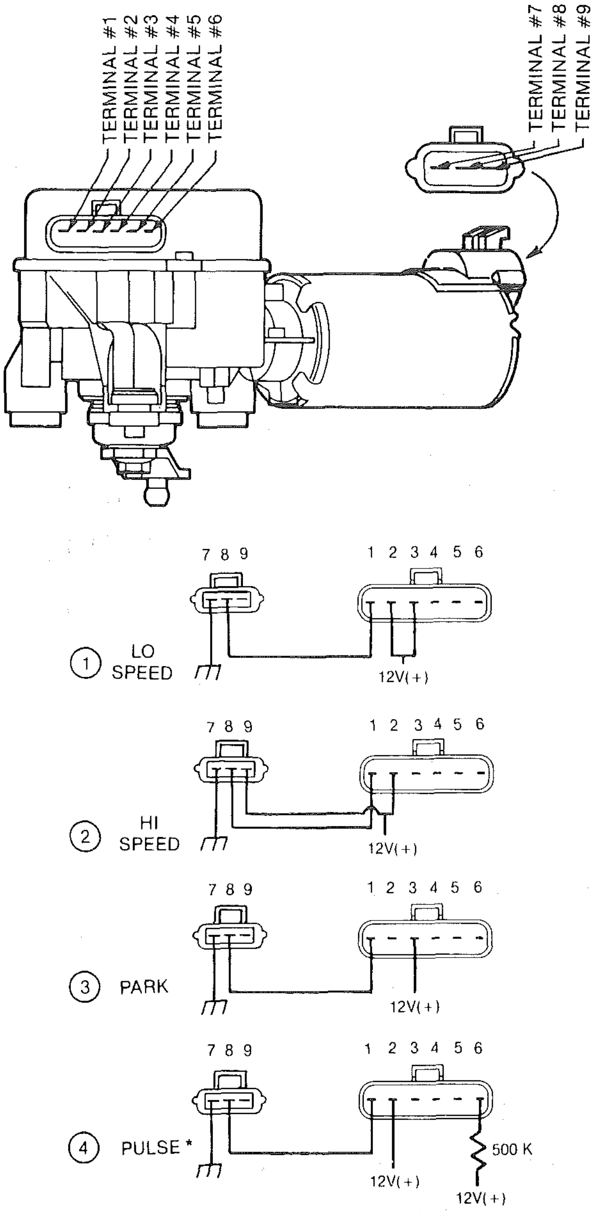
1. Raise hood.
2. Right and left wiper arm and blade assemblies

NOTE: THE FOLLOWING PROCEDURES ASSUME THAT THE TECHNICIAN HAS CHECKED THE FOLLOWING:

1. CONTINUITY OF ALL HARNESS WIRES
2. WIPER MOTOR TO DASH MOUNTING SCREWS TIGHT
3. FUSES

WIPER MOTOR

CHECK FOR MOTOR OPERATION BEFORE REMOVING FROM VEHICLE. DISCONNECT ALL WIRING FROM WIPER AND PERFORM THE FOLLOWING CHECKS IN THIS ORDER:



IF WIPER MOTOR FUNCTIONS IN ALL MODES, GO TO WIPER/WASHER SWITCH CHECK CHART.

*IF A STANDARD TYPE MOTOR IS WIRED FOR THE PULSE CHECK, THE PARK RELAY WILL CLICK SHUT BUT THERE WILL BE NO OBSERVABLE MOTOR ACTION.

Fig. 13 Wiper On-Car Check

3. Loosen (do not remove) attaching nuts securing transmission drive link(s) to motor crank arm
4. Air inlet screw/panel
5. Transmission drive link(s) from the motor crank arm
6. Transmission-to-body attaching screws
7. Transmission and linkage assembly by guiding it through access hole in shroud upper panel

Install or Connect

1. To install transmission and linkage assembly, position assembly in plenum chamber through the shroud upper panel openings.
2. Loosely install transmission to body attaching screws.
3. Transmission drive link to motor crank arm and tighten attaching nuts to 7 N·m (64 lbs. in.)
4. Align transmission and tighten attaching screws to body.
5. Air inlet screen/panel
6. Wiper arm and blade assemblies and adjust as described under "Wiper Arm Adjustment"
7. Check wiper operation, wipe pattern and park position.
8. Cowl vent screen or cowl upper panel and screen
9. Check washer nozzle alignment.

WIPER ARM

Fig. 20

Remove or Disconnect

1. With wipers "On", turn ignition "Off" when wiper arm is at the mid-wipe position.
2. Lift wiper arm from windshield and pull retaining latch.
3. Arm from transmission shaft

Install or Connect

1. Arm on transmission shaft
2. Push retaining latch in and return arm to windshield.
3. Park wipers

WIPER ARM ADJUSTMENT

Adjust

Adjustment should not be required. However, if adjustment is required, it can be performed as follows:

1. Remove the right arm and blade assembly.
2. Loosen, do not remove, the transmission drive link-to-motor crank arm attaching nuts.

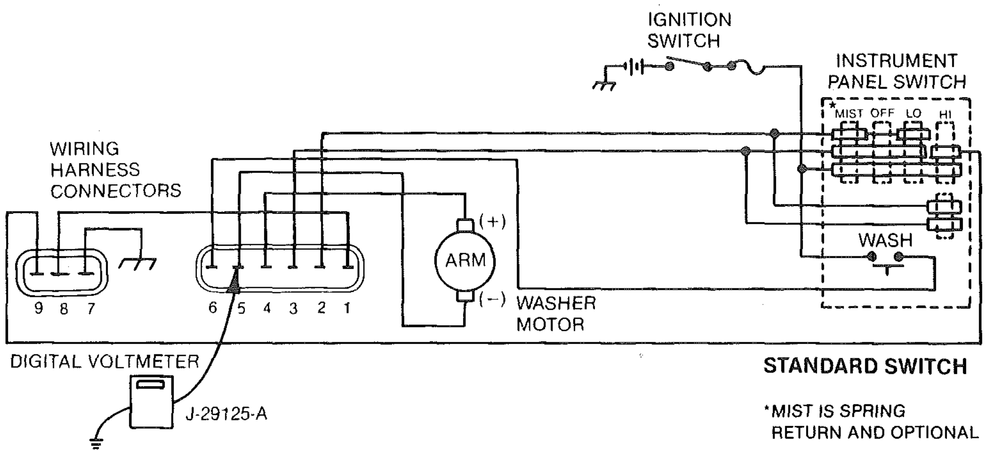


Fig. 14 Testing Standard W/S Wiper-Washer Switch

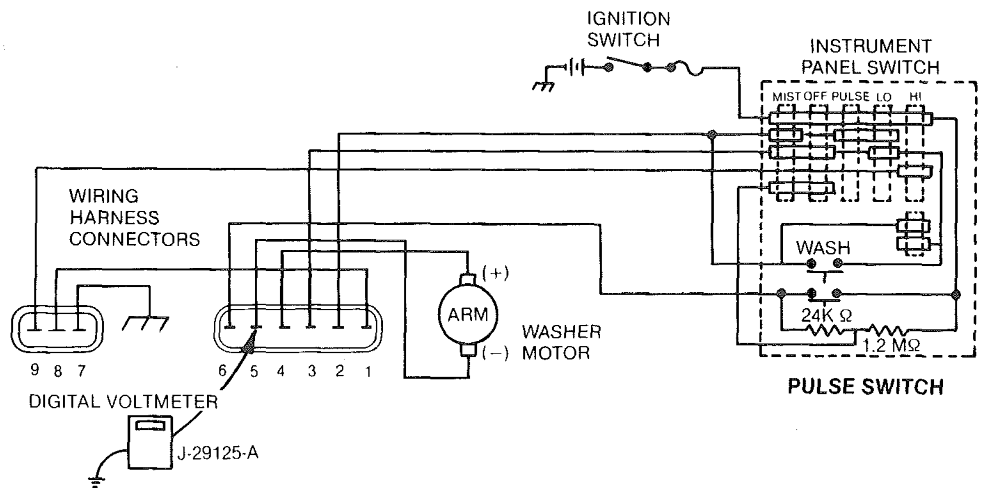


Fig. 15 Testing Pulse W/S Wiper-Washer Switch

3. Rotate the left arm assembly to a position slightly below the blade stops.
4. Tighten the attaching nuts on the transmission drive link(s) to motor crank arm 7.5 N·m (66 lbs. in.).
5. Position the right arm and blade assembly slightly below the blade stop and install arm assembly to transmission shaft.
6. Lift the right and left arm and blade assemblies over the stops.
7. Check wipe pattern and park position. Dimension A is 18 mm (11/16") from top of driver's blade on outwipe to paint line and 6 mm (15/64") from edge of glass in park position.

The correct park position and outwipe dimensions are determined with the wipers operating at low speed on a wet glass.

WIPER BLADE

Fig. 20

Remove or Disconnect

Anco®

1. Place wiper arm at the mid-wipe position, see "Wiper Arm"
2. Lift blade retainer.
3. Wiper blade

Trico®

1. Place wiper arm at the mid-wipe position, see "Wiper Arm".
2. Disengage blade retainer with a small screwdriver.
3. Wiper blade

SWITCH MODE / TERMINAL #		MIST	OFF	PULSE	LO	HI †	WASH
PULSE	1	C	C	C	C	C	C
	2	B(+)	—	B(+)	B(+)	—	*B(+)
	3	B(+)	B(+)	—	B(+)	—	*B(+)
	4	—	—	—	—	—	—
	5	—	—	—	—	—	—
	6	10-12V	10-12V	10-12V	10-12V	10-12V	B(+)
	7	GROUND	GROUND	GROUND	GROUND	GROUND	GROUND
	8	C	C	C	C	C	C
	9	—	—	—	—	B(+)	—
STANDARD	1		C		C	C	C
	2		—		B(+)	—	*B(+)
	3		B(+)		B(+)	—	*B(+)
	4		—		—	—	—
	5		—		—	—	—
	6		—		—	—	B(+)
	7		GROUND		GROUND	GROUND	GROUND
	8		C		C	C	C
	9		—		—	B(+)	—

C = CONTINUITY † TERMINALS #2 & #3 CONNECTED TOGETHER. *EXCEPT ON HI.

Fig. 16 Wiper-Washer Switch Check Chart

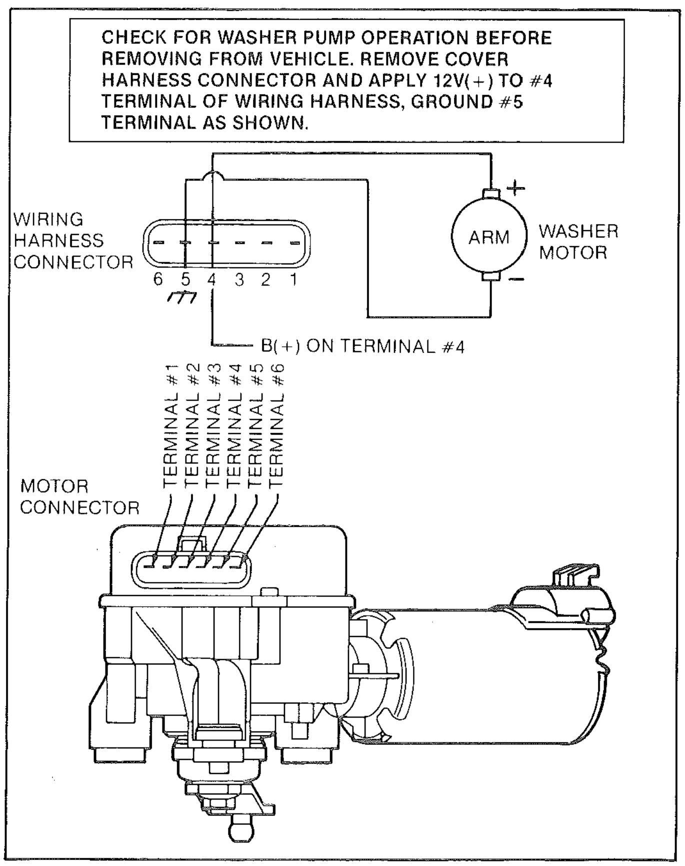


Fig. 17 Washer Pump On-Car Check

Install or Connect

Anco® and Trico®

1. Wiper blade onto wiper arm
2. Park wipers.

WIPER BLADE INSERT

Fig. 20

Remove or Disconnect

Anco®

1. Place wiper arm at the mid-wipe position, see "Wiper Arm".
2. Push down on insert retainer.
3. Insert with retainer

Trico®

1. Place wiper arm at the mid-wipe position, see "Wiper Arm".
2. Squeeze insert retainer together.
3. Insert

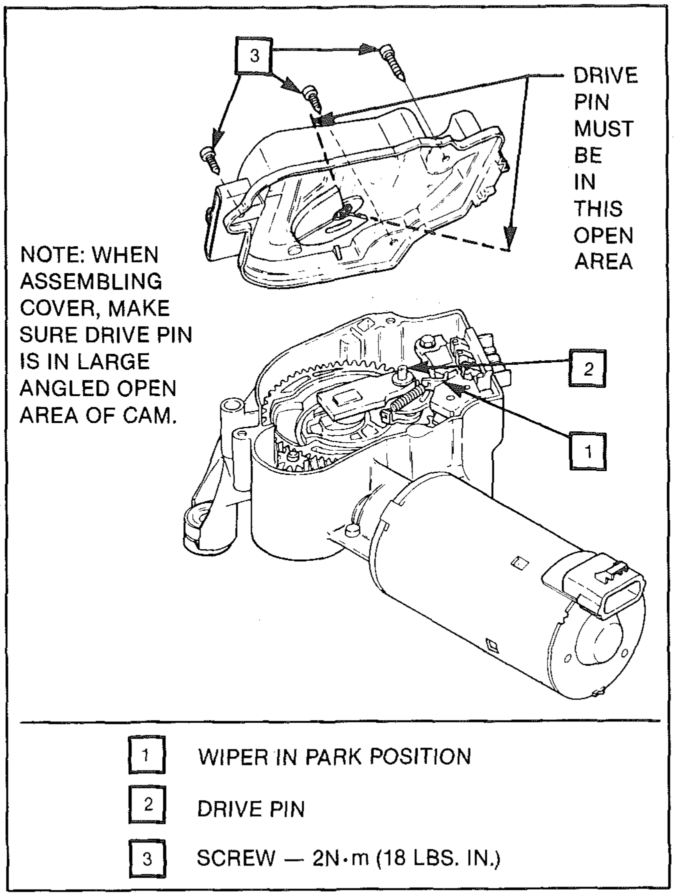


Fig. 18 Pulse Wiper (Cover Removed)

Install or Connect

Anco® and Trico®

1. Insert with retainer
2. Engage retainer.
3. Park wiper arms.

WINDSHIELD WASHER

Fig. 21

A correctly operating windshield wiper-washer system has a spray pattern that cleans 75% of the wipe pattern (Fig. 21) within ten wiper cycles.

If the nozzles become plugged, apply air pressure. If nozzle remains plugged, the nozzle must be replaced. If the spray pattern is too low or too high on the windshield, wedge-type adjustment shims can be used. Placement of a shim under the nozzle mounting bracket will raise the pattern three degrees. Reverse installation of the same shim will lower the pattern three degrees.

UNIT REPAIR

Figs. 22 through 25

GEAR REPLACEMENT

Important

- Clamp crank arm in vise.

Remove or Disconnect

1. Crank arm retaining nut
2. Crank arm
3. Rubber seal cap
4. Thrust collar or retaining ring. (Thrust collar is on original motor. Retaining ring to be used on service motor.)
5. Shim washers
6. Shield
7. Spacer washers
8. Park switch assembly
9. Large gear
10. Inner spacer washer
11. Intermediate gear retainer
12. Intermediate gear

Disassemble

1. Drive plate and shaft assembly

Assemble

1. Drive plate and shaft assembly into new large gear

   Important

   - Move drive and lock pawls as required to allow their respective pins to fit in the gear pockets. Make sure drive plate is firmly against gear.

2. Intermediate gear
3. New intermediate gear retainer
4. Inner spacer washer onto large gear tube
5. Large gear (See wiper-washer mechanism lube note)
6. Spacer washer
7. Shield
8. Shim washers as required to obtain 0.03 to 0.25mm (0.001 to 0.010 in.) end play.
9. Retaining ring (in place of thrust collar on original motor)
10. Rubber seal cap
11. Crank arm

Tighten

1. Crank arm nut (in vise) to 42 N·m (31 lbs. ft.)

Inspect

1. Check for proper motor operation (See "Wiper On-Car Check").

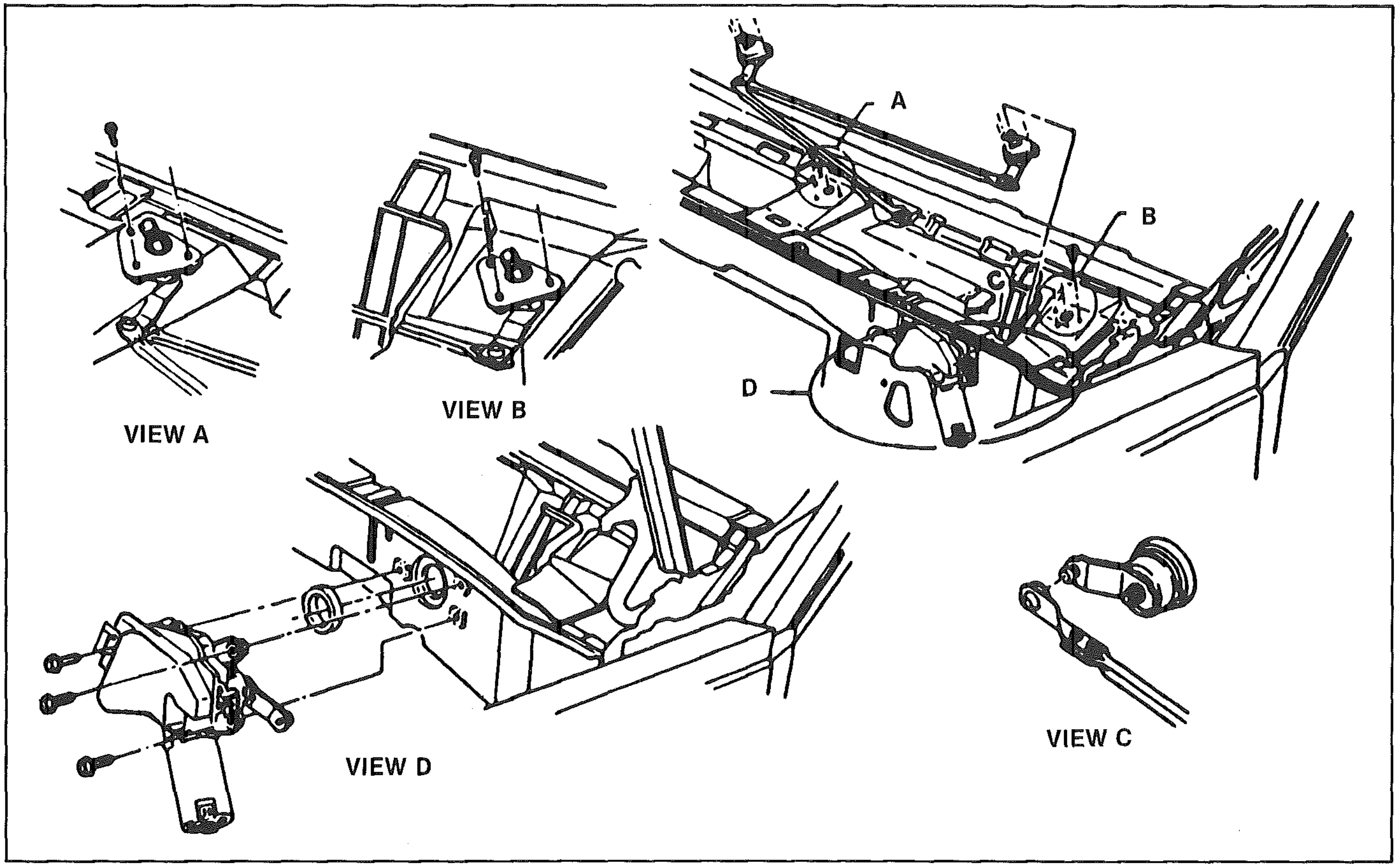


Fig. 19 Wiper Transmission (Typical)

1. WIPER ARM
2. TRANSMISSION SHAFT
3. WIPER ARM RETAINING LATCH
4. WIPER BLADE REMOVAL
5. WIPER INSERT REMOVAL
6. WIPER BLADE ASSEMBLY
7. WIPER INSERT
8. SCREWDRIVER
9. BLADE RETAINER
10. INSERT RETAINER

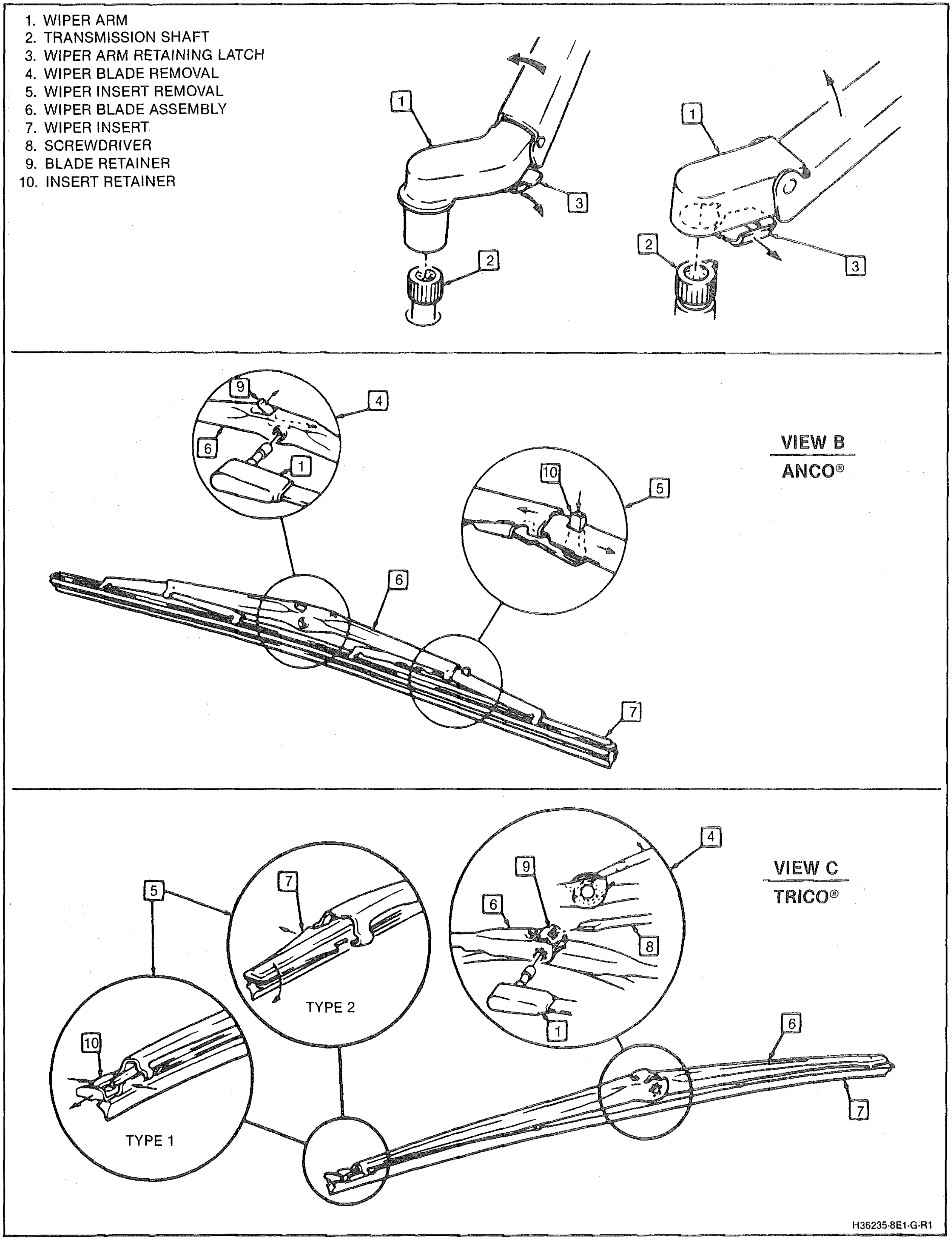


Fig. 20 Wiper Arm, Blade and Insert

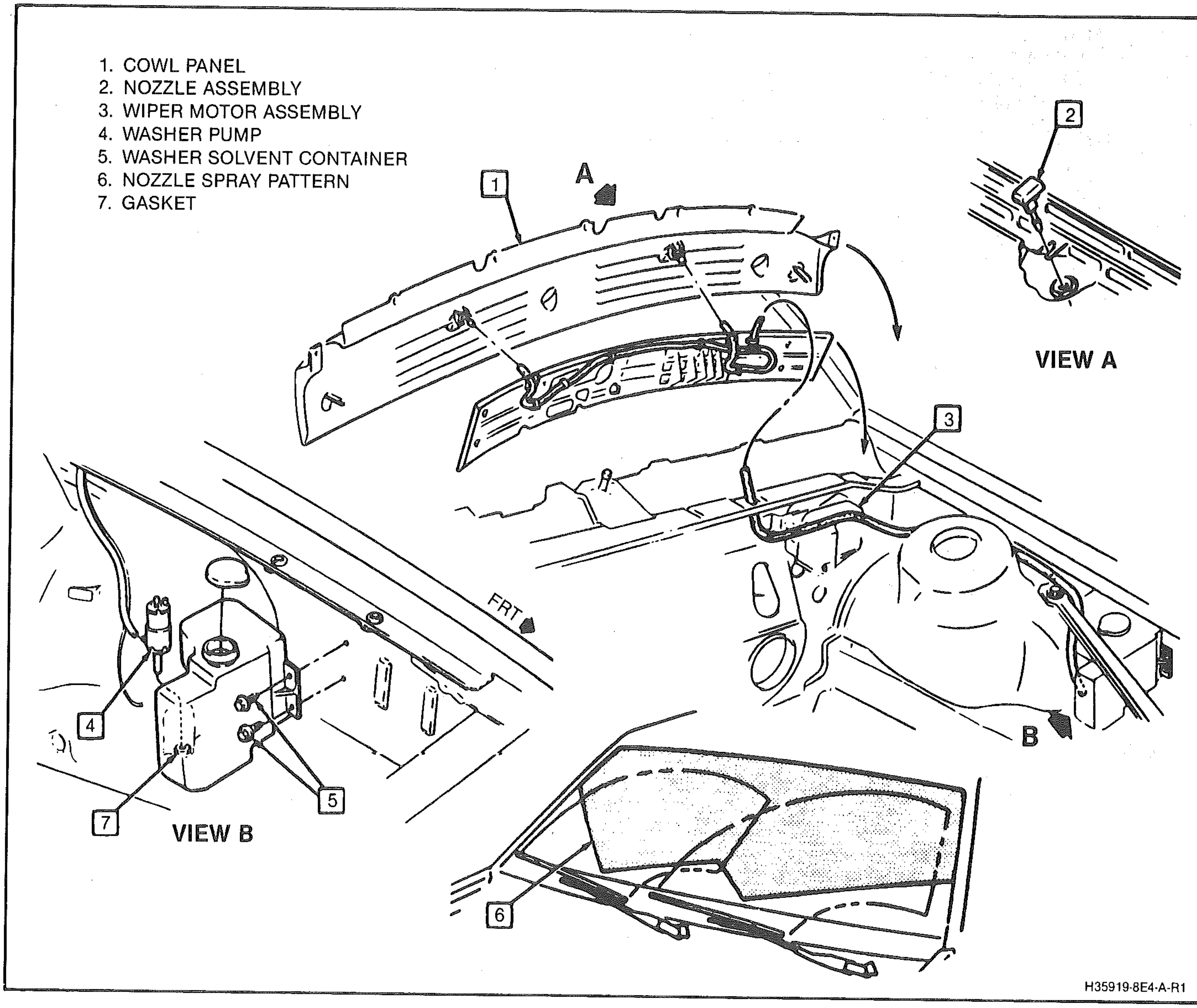


Fig. 21 Washer Nozzle and Container Mounting

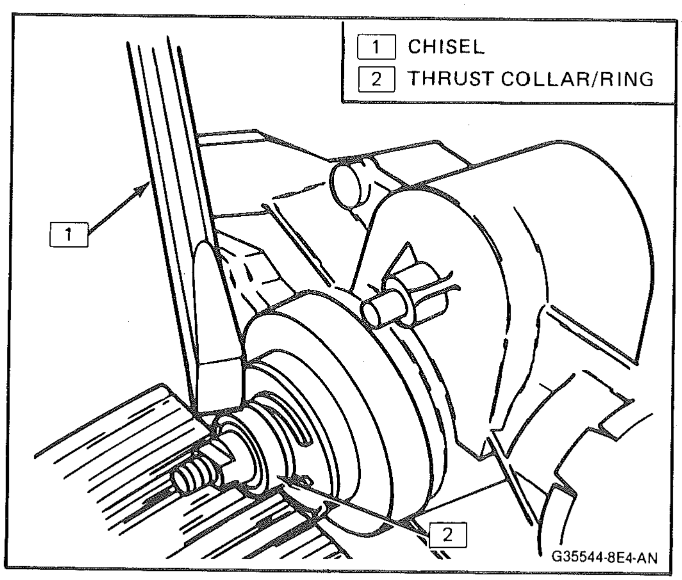


Fig. 22 Thrust Collar — Ring Removal

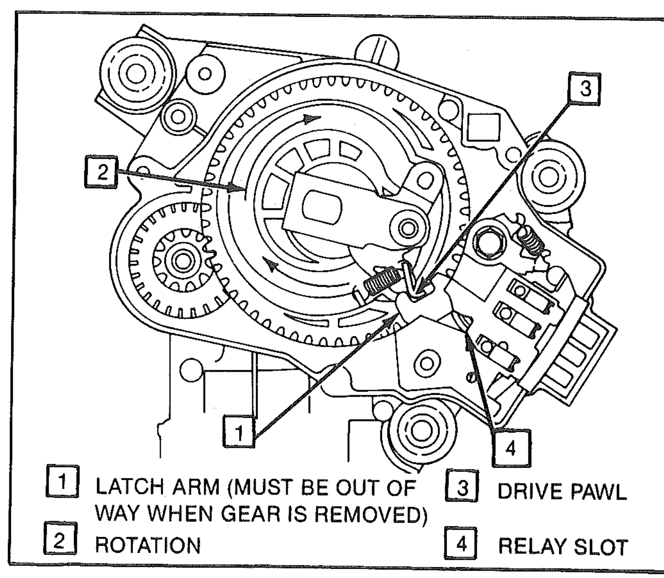


Fig. 23 Large Gear Removal

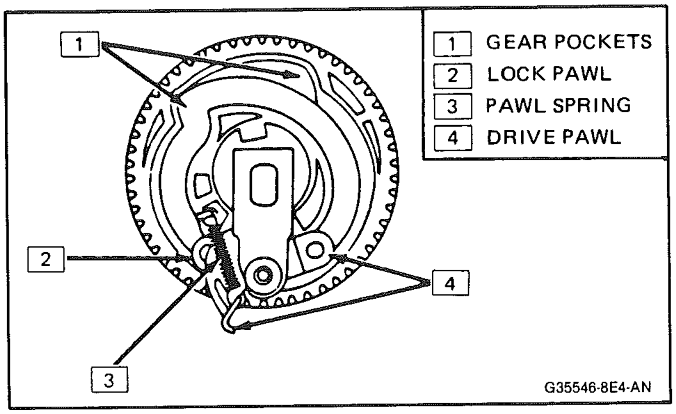
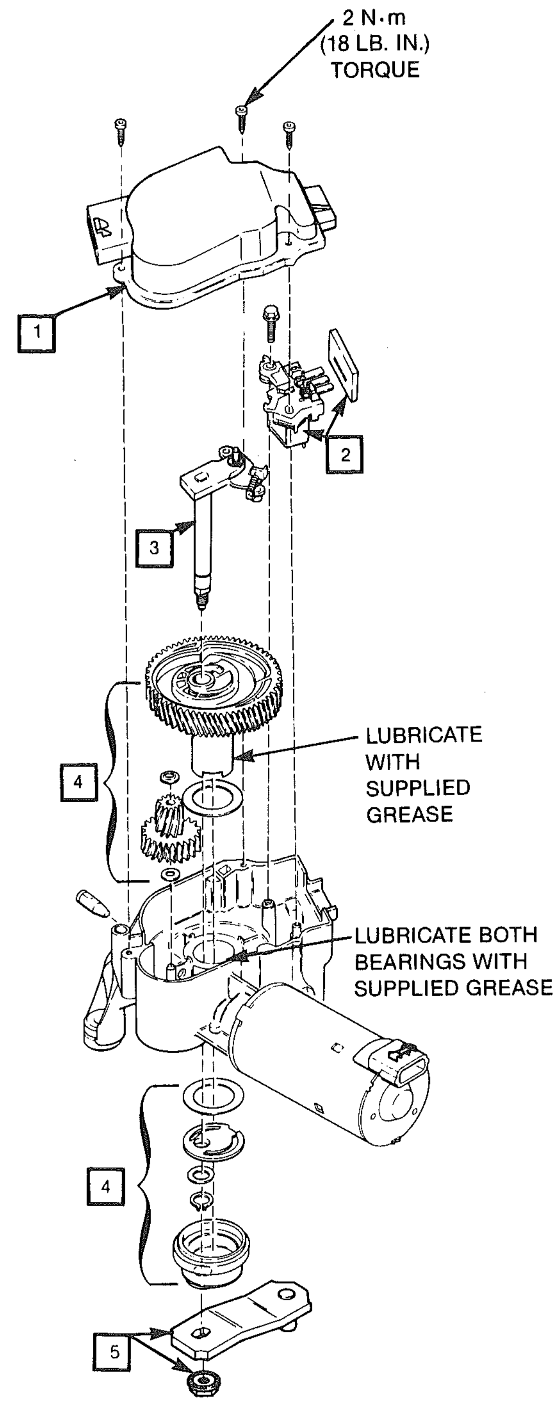


Fig. 24 Gear-Pawl Alignment



SERVICE PACKAGES

1 COVER

2 PARK SWITCH

3 DRIVE SHAFT PACKAGE

4 GEAR PACKAGE

5 CRANK ARM

Fig. 25 Wiper-Washer Mechanism

SECTION 9
ACCESSORIES
CONTENTS

SECTION 9A

RADIO SYSTEMS AND ANTENNAS

CONTENTS

GENERAL DESCRIPTION

RADIO

For radios and radio use see the "Radio Operation" section. ETR means 'Electronically Tuned Receiver'.

ANTENNAS

Fixed Antenna

The fixed antenna on the right front fender cannot be adjusted up or down. It may provide improved reception in rural areas.

The fixed antenna is designed to withstand most car washes without damage. If the antenna becomes slightly bent, you can straighten it by hand. The antenna can be replaced if severely bent (by vandalism, etc.). Antennas must be kept clean for good performance.

DIAGNOSIS

RADIO

Because radio problems are normally repaired at authorized warranty repair stations, the tendency is to remove the set when a problem is reported, without any preliminary diagnosis. This results in a large number of radios being "No Trouble Found" units when received by the warranty repair stations. Often the trouble can be corrected without radio removal.

ETR radios require clock and button reset if the battery is disconnected.

Static and Noise

Ground strap connections must be clean and tight, spark plug cables must be TVRS type and in good condition and resistance-type spark plugs used. Capacitors are used in the generator, heating/air conditioning system, and fuse panel to reduce noise entering the radio through the feed wires. If the car has a heater only, the capacitor is in the blower motor feed wire. If equipped with A/C, the blower motor has a built-in capacitor. Extra electrical equipment added to the static if not properly grounded or wiring was improperly routed.

Weak FM station reception will be affected by nearby buildings, car speed and direction. These "flutter" and "fading" conditions are characteristic of weak FM signals.

Popping Noise

Operating devices such as turn signals, pushing in cigarette lighter, operating stop lights, etc., may cause a popping noise on distant (weak) AM signals.

Preliminary Diagnostics

The inconvenience of driving without a radio while the set is being serviced can often be avoided if the following quick checks are used to eliminate external radio system problems before removing the radio for repair:

1. Turn ignition to the accessory position and turn radio on.
2. On AM-FM radios, if the radio is dead on FM but the AM plays normally, the radio should be removed for repair. (The reverse of this condition does not necessarily call for radio removal).
3. On combination radio/tape units, if the radio operates properly but the tape player does not, the unit should be removed for repair. (The reverse of this condition does not necessarily call for radio/tape removal.)

Always determine the exact nature of the radio problem as an aid to diagnosis. Knowing whether the condition is intermittent or constant, whether it occurs with engine offor running, and whether it occurs with car parked or moving will help to pinpoint the problem.

Radio diagnostic information is in Section 8A.

FIXED ANTENNA

Testing For Good Ground of Antenna Mounting and Connections

Poor grounding of the power antenna, either at the antenna mounting or at any other connection in the antenna/lead-in system, can result in seriously reduced radio performance. A poor ground can be a reason for excess ignition noise in AM reception, or erratic audio.

To check for a poor ground of the antenna, perform the following:

1. Fully lower antenna.
2. Disconnect antenna motor electrical connector.
3. Remove escutcheon from fender.
4. Attach alligator clip to upper end of antenna to act as antenna. Leave other end of clip unattached.
5. Tune radio for weak AM station or signal which is dependent on clip, i.e., clip attached, station is present; clip removed, no station.
6. Remove clip.
7. Ground upper end of antenna to fender (preferably with knife blade, very short jumper wire, etc.).
8. If radio station is not received, then the antenna grounds are good. If the station is still present or stronger, a poor ground or no ground connection is present in the system.

Possible ground loss points are:

- Antenna upper mounting (screws loose, paint overspray, etc.)
- Coaxial connector at antenna not tight or corroded. (Remove to inspect inside the connector for corrosion.)
- Coaxial connector at radio not tight or corroded.
- Quick connect connector corroded.

Checking Antennas

Unplug antenna lead-in at back of radio and plug a test antenna into radio. Make sure test antenna base is grounded to the car chassis and keep hands off of the

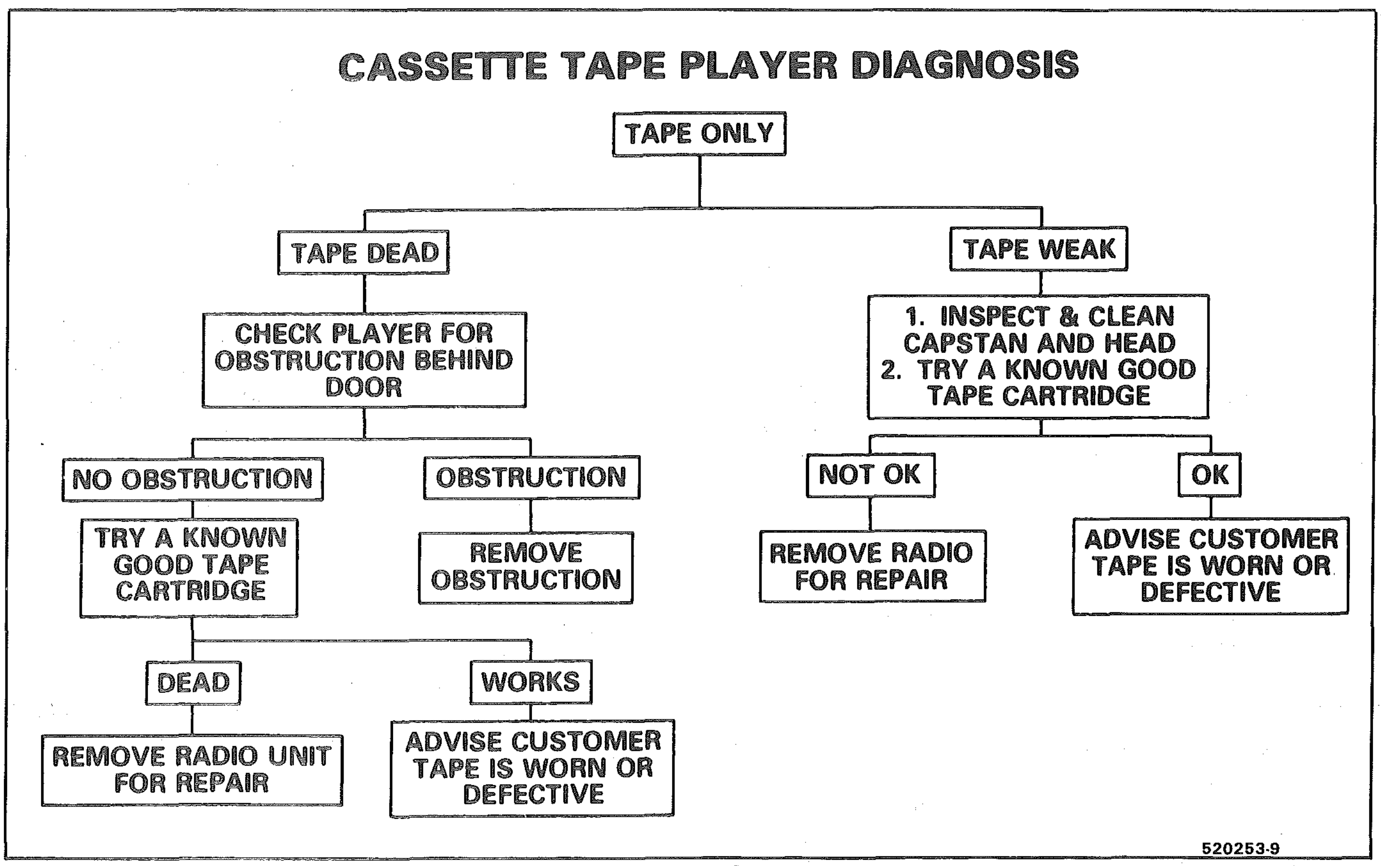


Fig. 1 Tape Player Diagnosis

antenna. Check radio reception in an area away from electrical interferences. These include tall buildings, metal structures, power lines, fluorescent lighting, and power tools. Tune to high and low ends of the dial on both AM and FM checking weak and strong station reception. If reception is OK, problem exists with antenna and/or its lead-in cable. If reception is still poor, refer to Section 8A.

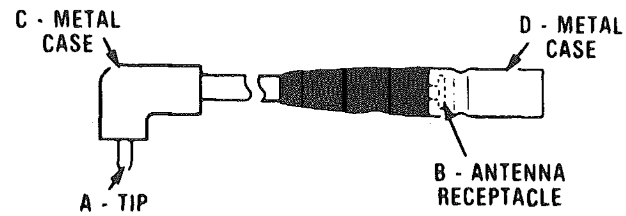
Checking Lead-In Cables

Figure 2

Usually symptons of broken center conductor of the lead-in cable will result in no AM and weak FM. In case of continued reception or noise complaints, always check the lead-in with an ohmmeter. The chart and diagram shown in Figure 2 show readings which should be obtained. When checking resistance, cautiously wiggle the lead-in tip and cable. If the readings shown in Figure 2 are not obtained, some portion of the lead-in is intermittent and the lead-in should be replaced.

CHECKING FIXED ANTENNAS

Unplug antenna lead-in at back of radio and plug a test antenna into radio. Make sure test antenna base is grounded to the car chassis and keep hands off of the antenna (see "Testing for Good Grounds"). Check radio reception in an area away from electrical interferences. These include tall buildings, metal structures, power lines, fluorescent lighting, and power tools. Tune to high and low ends of the dial on both AM and FM checking weak and strong station reception. If reception is OK, problem exists with antenna and/or its lead-in cable. If reception is still poor, refer to Section 8A.



Ohmmeter probes at points;	Resistance measured in ohms
A and B	less than 0.5*
C and D	less than 0.5
A and D	infinite
C and B	infinite
A and C	infinite
B and D	infinite

*On some long lengths of lead-ins, such as power antennas, capacitance is added in the tip. This results in a resistance reading of approximately 100,000 ohms.

G35209-9-E

Fig. 2 Lead-In Cable Diagnosis

SERVICE PROCEDURES

RADIO AND SPEAKERS

NOTICE: All radios are the bridge audio type, using two wires to each speaker. It is very important when changing speakers or performing any radio work to avoid pinching the wires. A short circuit to ground from either wire will cause damage to the output circuit in the radio.

Also, all Delco sound systems have ungrounded speakers. Installing add-on tape players, CB radios or other units which use the car speakers may damage your Delco sound system. Please consult your dealer in advance if you are considering additions.

See On-Car Service for radio or front speaker replacement. See Body Service Manual at end of this manual for door or rear speaker replacement.

RADIO NOISE SUPPRESSION EQUIPMENT

Figure 3

When installing a new radio, or when noise is a problem, ensure that radio suppression equipment is present and properly installed.

STEREO CASSETTE TAPE PLAYER

Figure 4

Tape and Tape Player Care

Optimum performance can be maintained by cleaning the internal tape head, capstan, and pinch roller periodically (approx. each 100 hours of operation). This can be done by inserting a nonabrasive cleaning cassette in place of the music tape.

DO NOT USE silicone spray lubricants for switch, plunger or tape head lubrication.

NO LUBRICANTS should be used since they cause the player to operate improperly, especially at extreme temperatures.

Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cassette played will be degraded.

Store cassettes away from extreme heat or direct sunlight. Protect the open ends from dirt or damage; store them in their original cases or other protective cases. For best results, 120 minute tapes are not recommended.

When leaving the car, cassettes may be left in the tape player (tapes are either automatically ejected or internally protected).

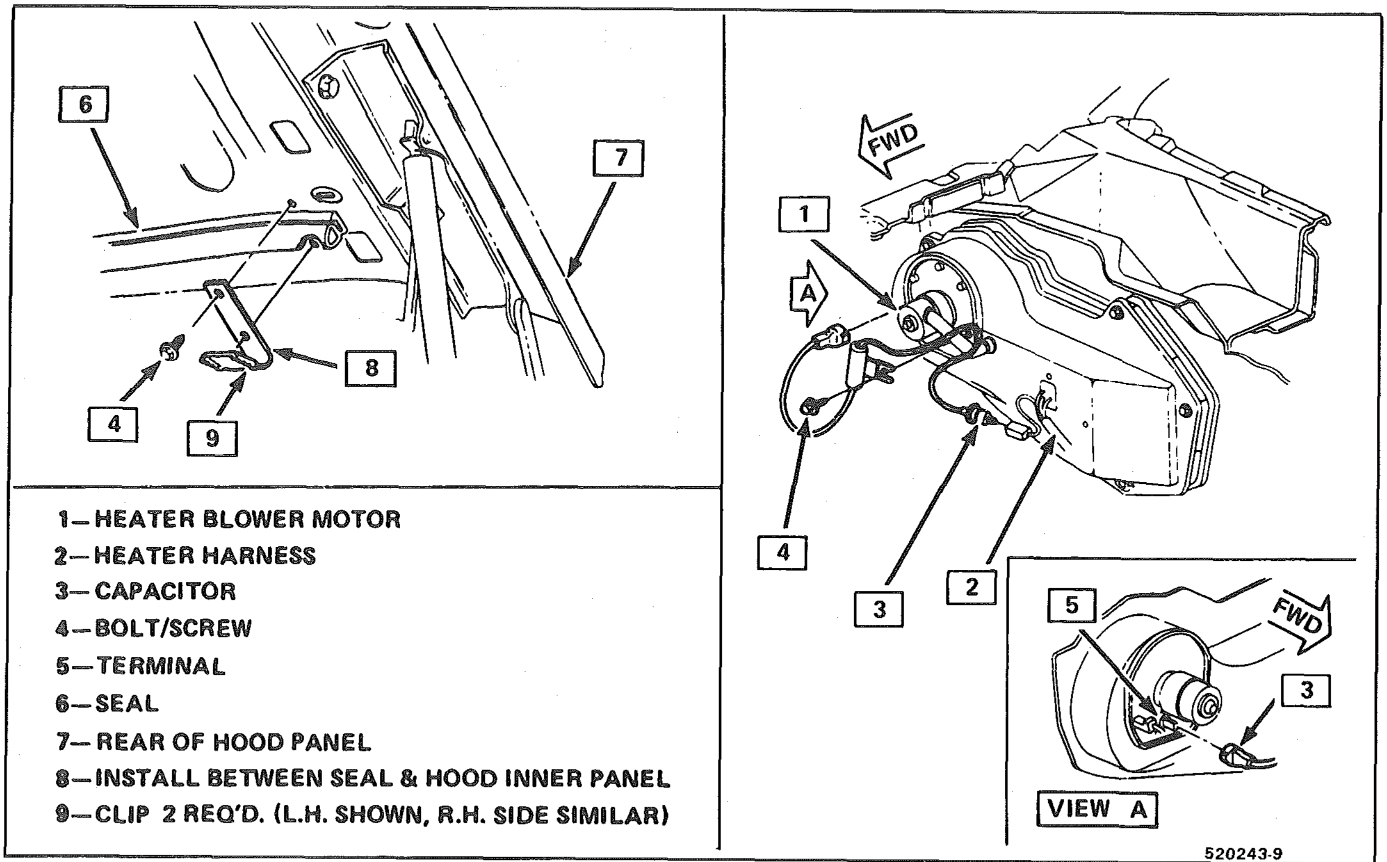


Fig. 3 Radio Suppression Equipment - Typical

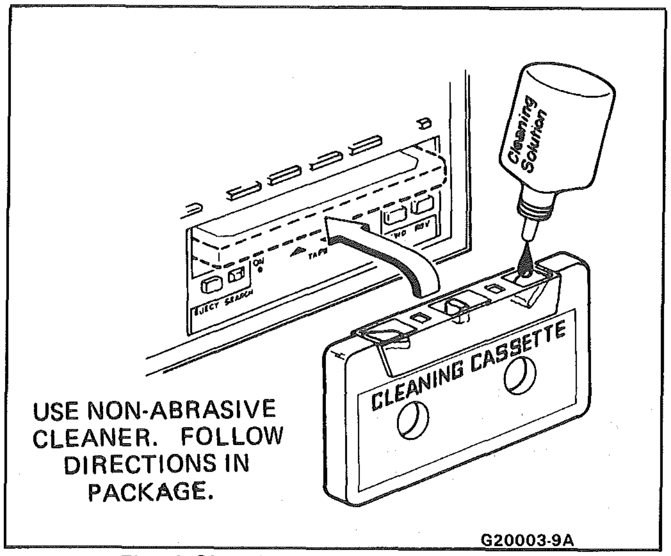


Fig. 4 Cleaning the Cassette Player

RADIO OPERATION

ETR AM-FM STEREO (UM-7)

Figure 801

ETR AM-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on. Press again to turn radio off.
- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with ignition on or to display time of day with ignition off.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.

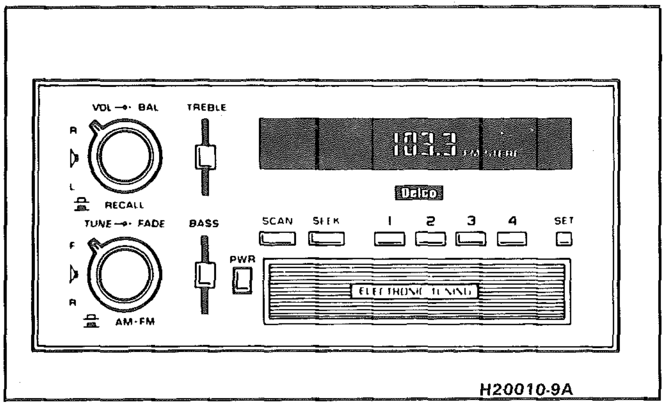


Fig. 801 UM7 Radio

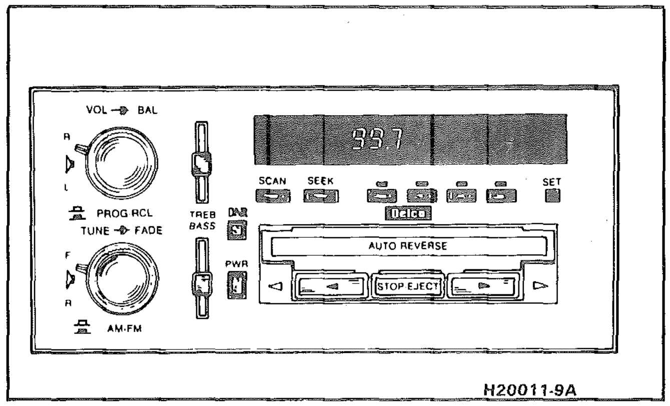


Fig. 802 UM6 Radio

- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** - slide treble control up to increase treble or down to decrease treble. Slide bass control up to increase bass or down to decrease bass.
- **Station Preset Buttons**

  The radio has four pushbuttons for presetting favorite stations:

  1. Select the desired band (AM or FM), and tune to the desired station.
  2. Press SET button. Within five seconds press one of the four station buttons.

     The radio will tune in the selected station whenever you press that station button.
- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning. Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again. The SCAN indicator light on the frequency dial will be lit during SCAN operation. Press the SEEK button to locate and retain the next listenable station on the band automatically.

  The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (dual channel) sound is more realistic.
- **Time Set**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the radio frequency will be displayed. Then press the SCAN button, holding SCAN button in until correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up and the radio frequency will be displayed. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

ETR STEREO/CASSETTE (UM-6)

Figure 802

ETR AM-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on. Press again to turn radio off.
- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time of day with ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **Bass and Treble Controls** - slide treble control up to increase treble or down to decrease treble. Slide bass control up to increase bass or down to decrease bass.
- **Station Preset Buttons**

  The radio has four pushbuttons for presetting favorite stations:

  1. Select the desired band (AM or FM) and tune to the desired station.
  2. Press SET button. Within five seconds, press one of the four station set buttons.

  The radio will tune in the selected station whenever you push that station button.

  Note: Up to three additional stations on each band may be preset by "pairing" the pushbuttons:

  1. Tune in the desired station;

  2. press SET, and within five seconds press any two adjacent push buttons at the same time. (The station will return when the two buttons are pressed again.)
- **Seek and Scan**

  Use the SEEK and SCAN buttons for automatic station tuning.

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

  The SCAN indicator light on the frequency dial will be lit during SCAN operation.

Press the SEEK button to locate and retain the next listenable station on the band automatically. The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (dual stereo) sound is more realistic.

- **Time Set**

  To set hour, press SET button. The SET indicator light on the dial will then light up and the radio frequency will be displayed. Then press SCAN button, holding SCAN button in until the correct hour appears.

  To set minutes, press SET button. The SET indicator light will then light up and the radio frequency will be displayed. Then press SEEK button, holding SEEK button in until correct minute appears.

  NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

- **To Operate Tape Player**

  Insert the cassette squarely into tape door, with exposed edge entering first. Tape will snap into position when fully inserted. This automatically switches the unit from radio to tape operation. After the cassette has snapped into position, adjust the volume and fader controls to your preference.

  To advance tape rapidly, press the button next to the lighted arrow (arrow on button points in the same direction as lighted arrow). To reverse tape and located an earlier selection, press the button which has an arrow pointing in the opposite direction. To stop fast motion and return to playing speed, press STOP-EJECT lightly; press again, but more firmly to eject the tape. **Reversing Sides - Press the upper left knob (volume control) to play the other side of the tape. When the end of tape is reached, it automatically reverses and plays the other side. Tape Indicator Light**

  When the left indicator light is lit, the top side of the tape is playing. When the right indicator light is lit, the bottom side of the tape is playing.

  NOTE: When end-of-tape is reached in one direction, the unit will automatically play the other side of the tape.

  To remove the tape or listen to the radio, push the STOP-EJECT button.

  Press the Dynamic Noise Reduction (DNR®) button to reduce high frequency background hiss on AM, FM, FM stereo, and tape.

  For best results, 120 minute tapes are not recommended.

ETR STEREO/CASSETTE/EQUALIZER (UX-1)

Figure 803

ETR AM Stereo-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio on. Press again to turn radio off.

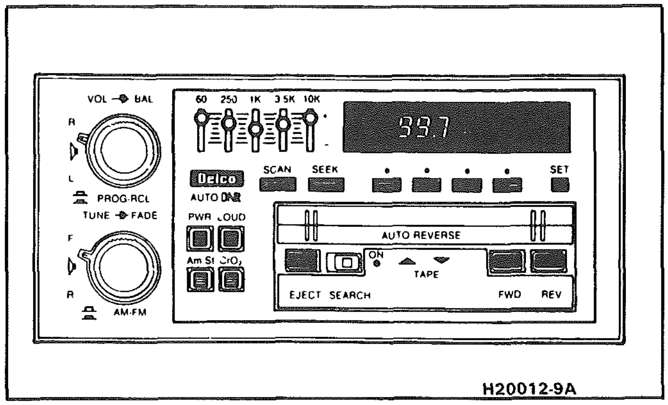


Fig. 803 UX1 Radio

- **Upper Knob** - rotate knob to control volume. Press knob to recall station frequency when listening to the radio with the ignition on, or to display time of day with ignition off. Press knob to select the other side of the tape when the cassette is playing.
- **Loudness Button** ("LOUD") - Press to boost bass frequencies when the system is playing at low volume.
- **Balance Control** (located behind upper knob) - turn to adjust left/right speaker balance.
- **Lower Knob** - rotate knob to tune radio stations manually. Frequency will be displayed during tuning. Press knob to select AM or FM band alternately.
- **Front/Rear Speaker Control** (located behind lower knob) - rotate control to adjust the sound between the front and rear speakers.
- **AM Stereo** ("AM-ST") - press to receive AM stereo. " Stereo" indicator light will be displayed when tuned to a station broadcasting C-QUAM® AM stereo, provided it is being received with adequate signal strength in your locality. When the button is "out", all AM stations will be received in monaural, "single-channel" sound.

  C-Quam® is a registered trademark of Motorola, Inc.

- **FM Stereo**

  The stereo indicator light will be displayed whenever tuned to an FM station broadcasting in stereo. Stereo (dual channel) sound is more realistic.

  "Stereo" operation means the radio is separating a stereo broadcast back into the original two channel, called "left" and "right."Stereo sound is noticably realistic to the ear.

- **5-Band Graphic Equalizer** - allows you to adjust bass, midrange, and treble to suit personal taste. Move control up to increase frequency range or down to decrease frequency range.

  NOTE: 60 and 250 denote bass; 1K denotes midrange; 3.5K and 10K denote treble.

  Generally, the 1k control is placed in the center (detent) position, while the bass and treble controls are adjusted upwards to varying degrees Since the 10K control has the most influence on treble, it may produce high frequency hiss when fully up. If this occurs, move it down until the hiss disappears.

This radio has automatic Dynamic Noise Reduction (DNR®) to reduce high frequency background hiss on AM, FM, AM Stereo, FM Stereo, and tape.

- **Station Preset Buttons**

The radio has four pushbuttons for presetting favorite stations:

1. Select the desired band (AM or FM), and tune to the desired station.
2. Press SET button. Within five seconds press one of the four station buttons.

   The radio will tune in the selected station whenever you press that station button.

   NOTE: Up to three additional stations on each band may be preset by "pairing" the pushbuttons:

   1. Tune in the desired station;

   2. press SET, and within five seconds press any two adjacent pushbuttons at the same time. (The station will return when the two buttons are pressed again.)

- **Seek and Scan**

Use the SEEK and SCAN buttons for automatic station tuning.

Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button again.

The SCAN indicator light on the frequency dial will be lit during SCAN operation.

Press the SEEK button to locate and retain the next listenable station on the band automatically.

The FM stereo indicator will light when tuned to an FM station broadcasting in stereo. Stereo (dual channel) sound is more realistic.

- **Time Set**

To set hour, press SET button. The SET indicator light on the dial will then light up. Then press SCAN button, holding SCAN button in until correct hour appears.

To set minutes, press SET button. The SET indicator light will then light up. Then press SEEK button, holding SEEK button in until correct minute appears.

NOTE: After you press the SET button, the radio frequency will be displayed. The time of day will be displayed when you press the SCAN or SEEK button.

- **To Operate Tape Player:**

Insert the cassette squarely through the door. This automatically switches the unit from radio to tape operation. If the sound is garbled (or there is no sound), eject the tape and reinsert it squarely.

To advance the tape, press the forward ("FWD") button. To listen to the earlier portion of the tape, press the reverse ("REV") button. To stop forward or reverse movement, press the opposite button lightly.

To listen to the next selection, slide the "SEARCH" button to the right and press the forward ("FWD") button. The radio will seek the next selection.

To listen to the previous selection again, slide the "SEARCH" button to the right and press the reverse ("REV") button. The radio will repeat the previous selection.

The "ON" light, to the right of the search switch, will be on while the search function is engaged.

When the left triangle indicator light is lit, the top side of the tape is playing. When the right triangle indicator light is lit, the bottom side of the tape is playing.

To play the other side of the tape before the present side has ended, press the upper left knob. This will automatically play the opposite side of the tape.

NOTE: When end-of-tape is reached in one direction, the unit will automatically play the other side of the tape. To remove the tape or listen to the radio, push the EJECT button.

When the ignition is turned off, the tape is automatically ejected.

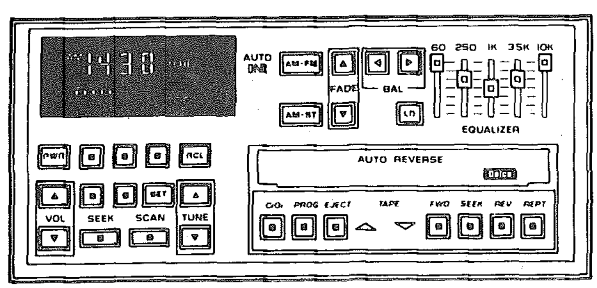
The equalization setting which is desired will vary according to the type of tape being used. Chrome (CrO_2) and metal tapes usually have 70 usec equalization, while standard (iron) tapes have 120 usec equalization. The tape bias is often indicated on the cassette label or case.

Select the setting for proper tape equalization as follows:

1. Select 70 usec (push button in).
2. Select 120 usec (button is out).

ADVANCED ETR TOUCH CONTROL STEREO/CASSETTE/EQUALIZER (UT-4)

Figure 804 and 805



H20014-9A

Fig. 804 Advanced UT-4 Radio

NOTE: This innovative radio has remote controls conveniently mounted in the center of the steering wheel. Major functions of station selection, volume, and front/rear speaker control can be made at the radio receiver (located in the instrument panel), or at the steering wheel controls.

- **Graphic Display and Lighting**

This advance ETR has many conveniences. The graphic display (upper left corner) provides useful information about time, station frequency,

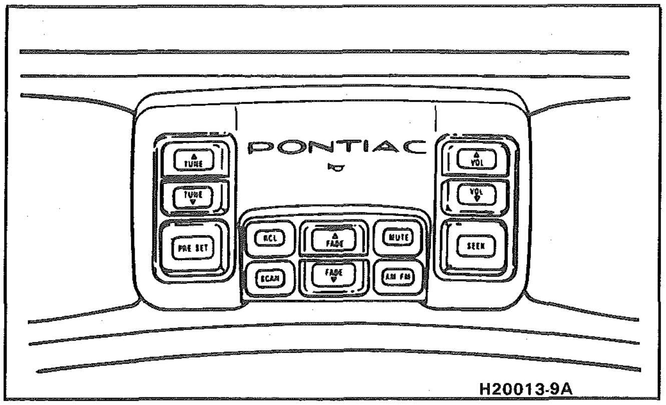


Fig. 805 Steering Wheel Controls

band (AM or FM), stereo, scan, volume and speaker balance. Lighting dims with other instrument lighting to prevent glare at night.

- **To Operate Radio:**

  Turn Radio On (at Receiver) - press power **PWR** button; press again to turn radio off.

  NOTE: Ignition must be in the "Accessory" or ON position. If radio does not come on, press MUTE button on steering wheel. (See anti-theft feature).

  Adjust Volume (at Receiver or Steering Wheel) - press VOL arrow pointing up to increase volume; press VOL arrow pointing down to decrease volume.

  (at Receiver Only) - pressing VOL arrow pointing up and VOL arrow pointing down simultaneously will return volume to a factory preset level.

  NOTE: When the radio is turned off, the last volume setting is stored in memory. When turned back on, it will slowly return to that level.

- **Select AM or FM (at Receiver or Steering Wheel):**

  Press AM FM to select desired band.

- **Select Stations (at Receiver or Steering Wheel):**

  Seek

  Press SEEK button to automatically search for the next station.

  Scan

  Press SCAN button to sample each station for a few seconds; press again to stop scan.

  Tune Manually

  Press and hold TUNE button with arrow pointing up or down.

  Favorite Stations

  The PRESET button on the steering wheel control (if available can be used to cycle through a list of favorite stations, but they must first be set up at the receiver.

- **Setting Favorite Stations (at Receiver):**

  Locate a favorite station by using the seek, scan, or up-down tuning buttons. Then press the SET button, and within five seconds, press one of the five station buttons.

  The radio will now return to that station whenever the station button is depressed.

  NOTE: A total of 10 stations can be preset (five AM and five FM).

- **Setting Time of Day:**

  To Set Hours, press SET button; within five seconds press and hold SEEK button until correct hour appears.

  To Set Minutes, press SET button; within five seconds press and hold SCAN button until correct minute appears.

- **To Display Time with Ignition Off (on Receiver):**

  Press recall button (RCL).

- **To Display Frequency (Receiver or Steering Wheel):**

  When the radio is on and time is being displayed, press recall button (RCL) to display frequency.

- **To Receive Stereo:**

  The radio will automatically switch to stereo when tuned to an AM* or FM Station broadcasting in stereo.

  If AM stereo is not desired, press the AM-ST button; press again to return to stereo. (Note: Nonstereo may be desired in areas of high noise level.

- **Loudness Control (on Receiver):**

  Press LD button to boost bass; press again to release.

- **Graphic Equalizer (on Receiver):**

  NOTE: 60 and 250 control bass; 1k controls midrange, 3.5k and 10k control treble.

  Generally, the 1k control is placed in the center (detent) position, while the bass and treble controls are adjusted upward to varying degrees. Since the 10k control has the most influence on treble, it may produce high frequency hiss when fully up. If this occurs, move it down until the hiss disappears.

- **Speaker Balance (on Receiver):**

  To increase volume in the right speakers, press the BAL button with arrow pointing right; to increase volume in the left speakers, press BAL button with arrow pointing left.

  NOTE: Pressing both buttons at the same time puts balance in the center (see graphic display on receiver).

- **Speaker Front-Rear Volume (on Receiver or Steering Wheel):**

  To increase front speaker volume, press FADE button with arrow pointing up to increase rear speaker volume, press FADE button with arrow pointing down.

  NOTE: On receiver only, pressing both buttons at the same time put equal volume in front and rear speakers (see graphic display on receiver).

- **To Deaden Sound (on Steering Wheel Only):**

  Press MUTE to stop all sound; press again to bring sound back. MUTE button is also used to reactivate radio if battery or radio is removed and reinstalled. (See anti-theft feature).

- **Anti-Theft Feature:**

This radio cannot be used on cars without steering wheel controls. When removed from the car and reinstalled, the radio will be dead and LOC will appear on the graphic display. Press MUTE on the steering wheel to reactivate the radio.

- **To Operate the Tape Player:**

(NOTE: The following controls are located on the receiver.)

Inserting Tape

Insert cassette into door marked AUTO REVERSE, so exposed edge of tape enters first. This turns tape player on and disables the radio.

Tape Bias

When the "CrO" button is lighted, it is set for chrome or metal tapes; press and the light will go out (for normal bias tapes).

Reversing Sides

Press program button PROG to play other side of tape. When end of tape is reached, it automatically reverses direction and plays the other side.

NOTE: When lighted arrow located below tape door points "up," selections listed on the top side of the tape are being played; when arrow points "down,"the bottom side is being heard.

Fast Forward

Press FWD button to activate; press PROG to return to playing speed.

Fast Reverse

Press REV button to activate; press PROG to return to playing speed.

Music Search

Press SEEK to automatically find the next selection. Press REPT to repeat the selection being played.

To Eject Tape

Press EJECT.

NOTE: Power button must be "on." Tape ejects and radio becomes operative. (It is not nesessary to eject tapes when leaving car, since internal pressure is automatically released when ignition is turned "off.")

For best results, 120 minute tapes are not recommended.

*Receives C-QUAM® AM stereo broadcasts. Most AM stereo stations across the country broadcast in C-QUAM®, but some do not. Check with your local station for compatibility in your area.

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ON-CAR SERVICE

RADIO RECEIVER

Figures 606 and 607

Remove or Disconnect

1. Negative battery cable.
2. Radio/AC-Heater console trimplate.
3. Four (4) radio retaining screws.
4. Pull radio straight out.
5. Power, speaker and antenna connectors. Remove radio.
6. Transfer attaching parts (clips, brackets, etc.) to new radio if unit is to be replaced.

Install or Connect

To replace, reverse removal procedure.

RADIO STEERING WHEEL CONTROLS

Refer to Section 3B4 for removal procedure.

AUDIO AMPLIFIER

Figure 610

Remove or Disconnect

1. Negative battery cable.
2. Right side instrument close out panel.
3. Two (2) amplifier bracket to instrument panel screws.
4. Lower audio amplifier and bracket out of instrument panel.
5. Two (2) harness connectors.
6. Three (3) attaching screws and remove bracket from amplifier.

Install or Connect

Reverse removal procedure to reinstall.

RADIO SUPPRESSION EQUIPMENT

When installing a new radio, or when noise is a problem, insure that radio suppression equipment is present and properly installed.

FRONT SPEAKER

Figure 606

Remove or Disconnect

1. Instrument panel pad (see Section 8C).
2. Four (4) screws holding speaker in instrument panel carrier.
3. Lift speaker out of instrument panel. Disconnect wiring.

Install or Connect

Reverse removal procedure to install.

REAR SPEAKER; SUB-WOOFER SPEAKER

Rear speakers are mounted in the rear quarter trim panel. See Section 2H in the body portion of this manual for complete details of replacement.

ANTENNA

Figure 609

Diagnosis is covered in the general description at the front of this section.

Remove or Disconnect

1. Negative battery cable.
2. Right side lower instrument close out panel.
3. Antenna connection at radio.
4. Power antenna: Disconnect instrument panel harness from radio and, using tool J 28742 or equivalent, remove power antenna wire from connector. Remove right lower instrument close out panel and disconnect power antenna relay.
5. Raise car and remove fender wheelhouse panel (see Section 2C).
6. Mast escution.
7. Mast or motor assembly bracket screws.
8. Grommet from kick-panel bulkhead and carefully pull harness from car interior.
9. Lower antenna assembly from fender well.

Install or Connect

Reverse removal procedure to install.

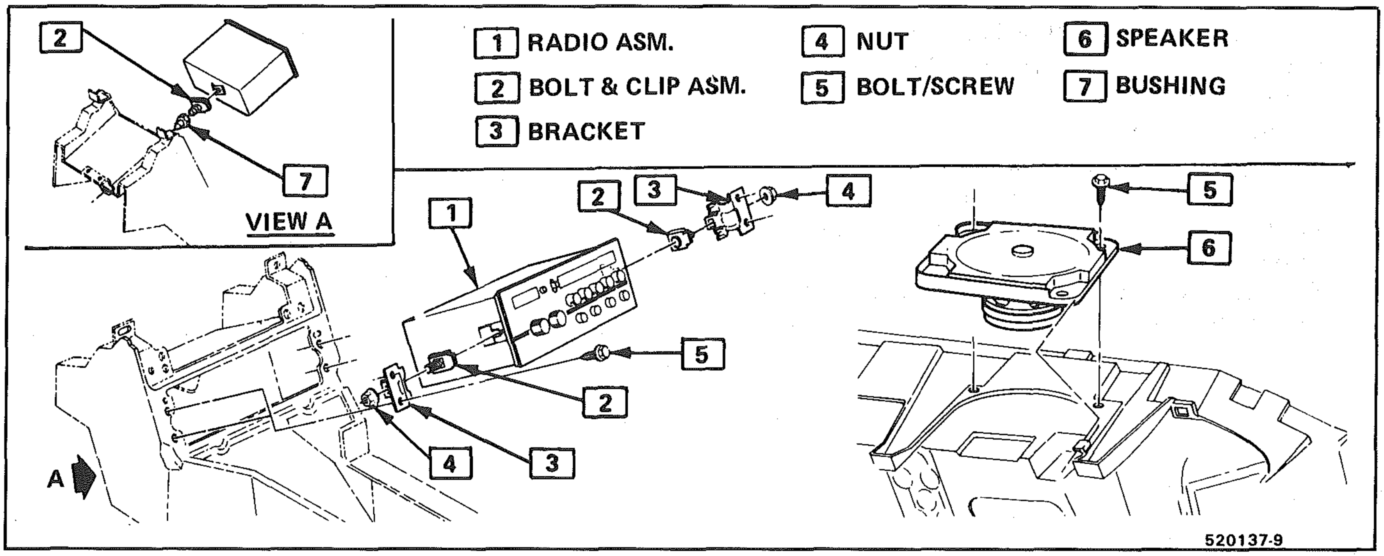


Fig. 606 Radio and Speaker Installation

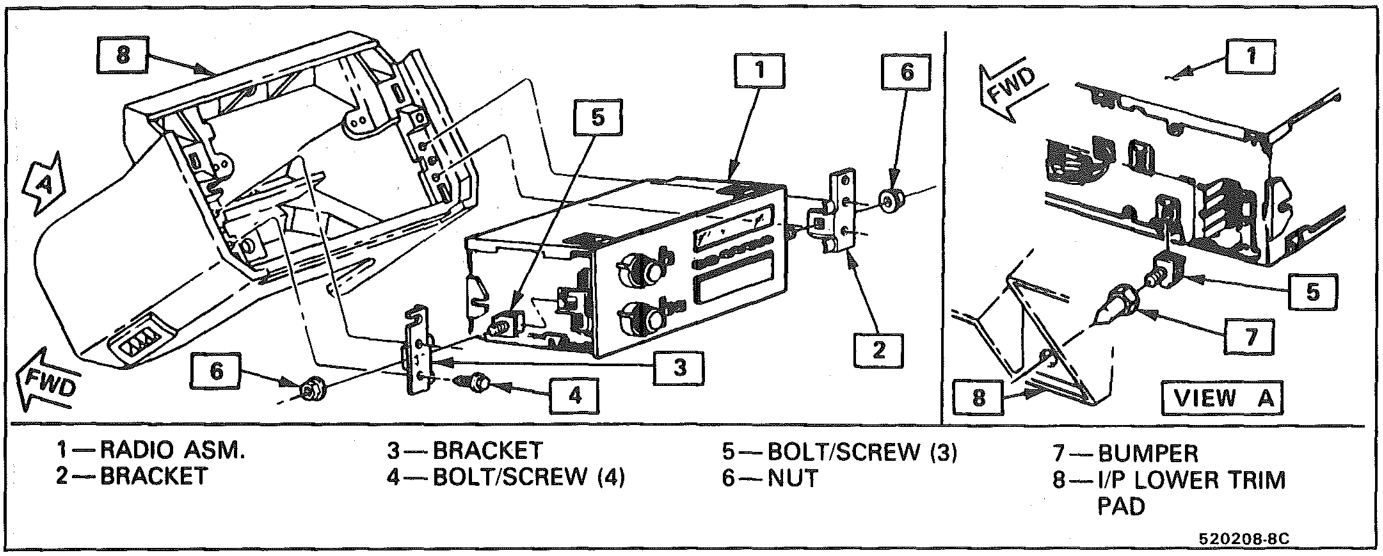


Fig. 607 Radio Installation

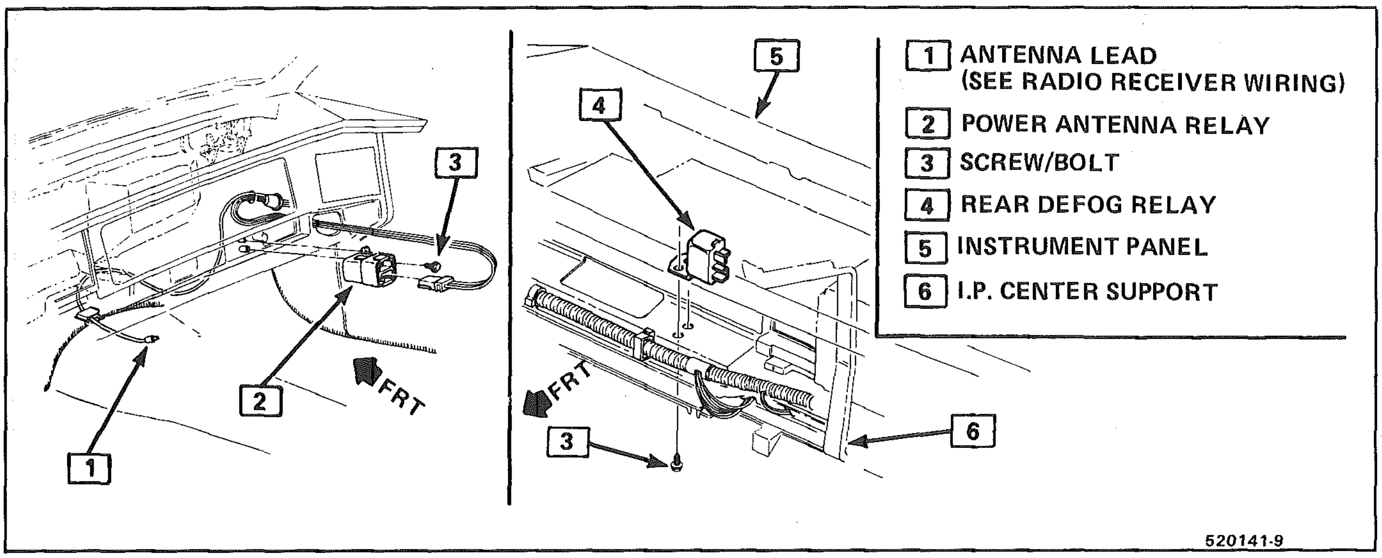


Fig. 608 Power Antenna and Rear Defog. Relay

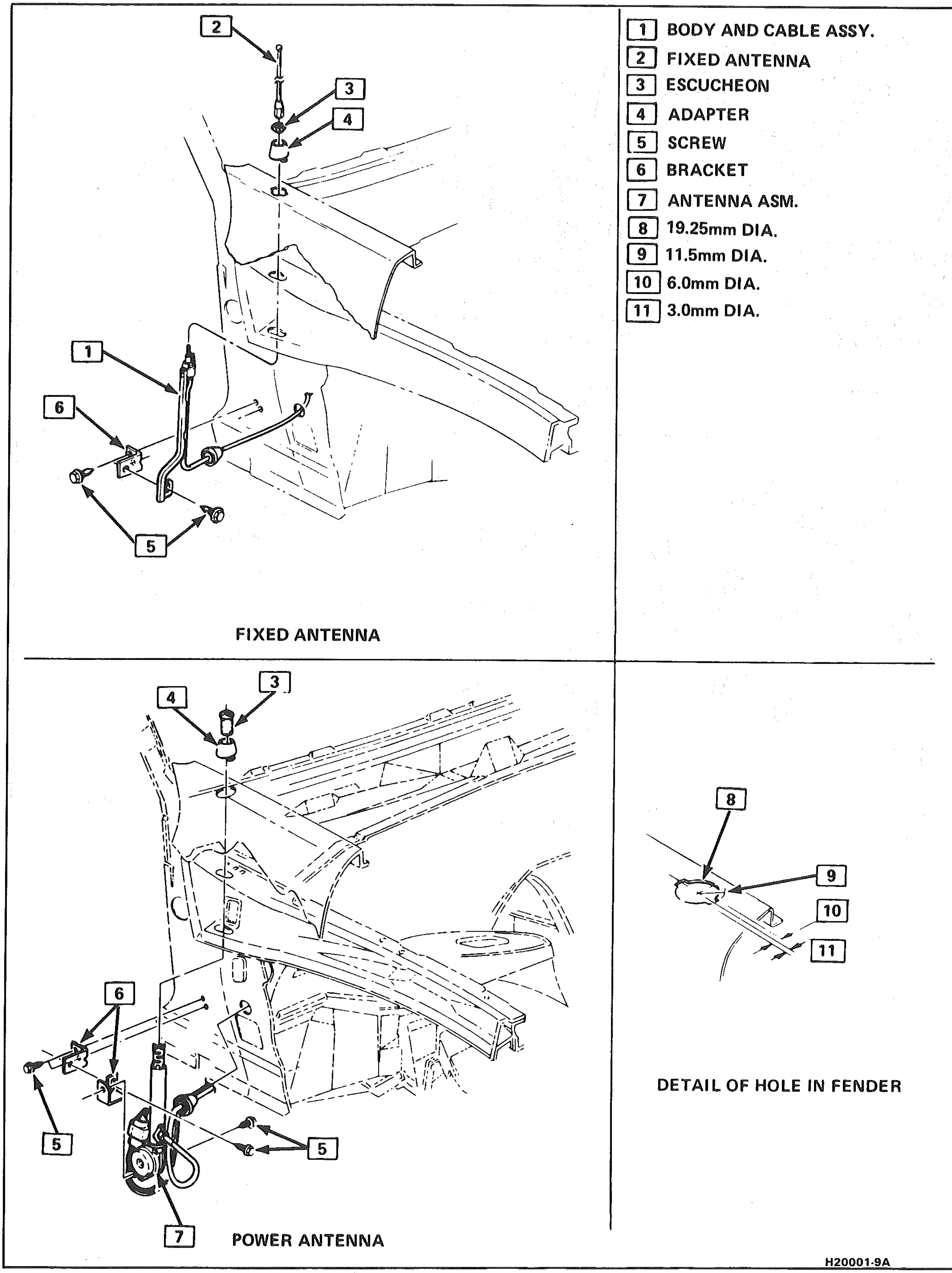
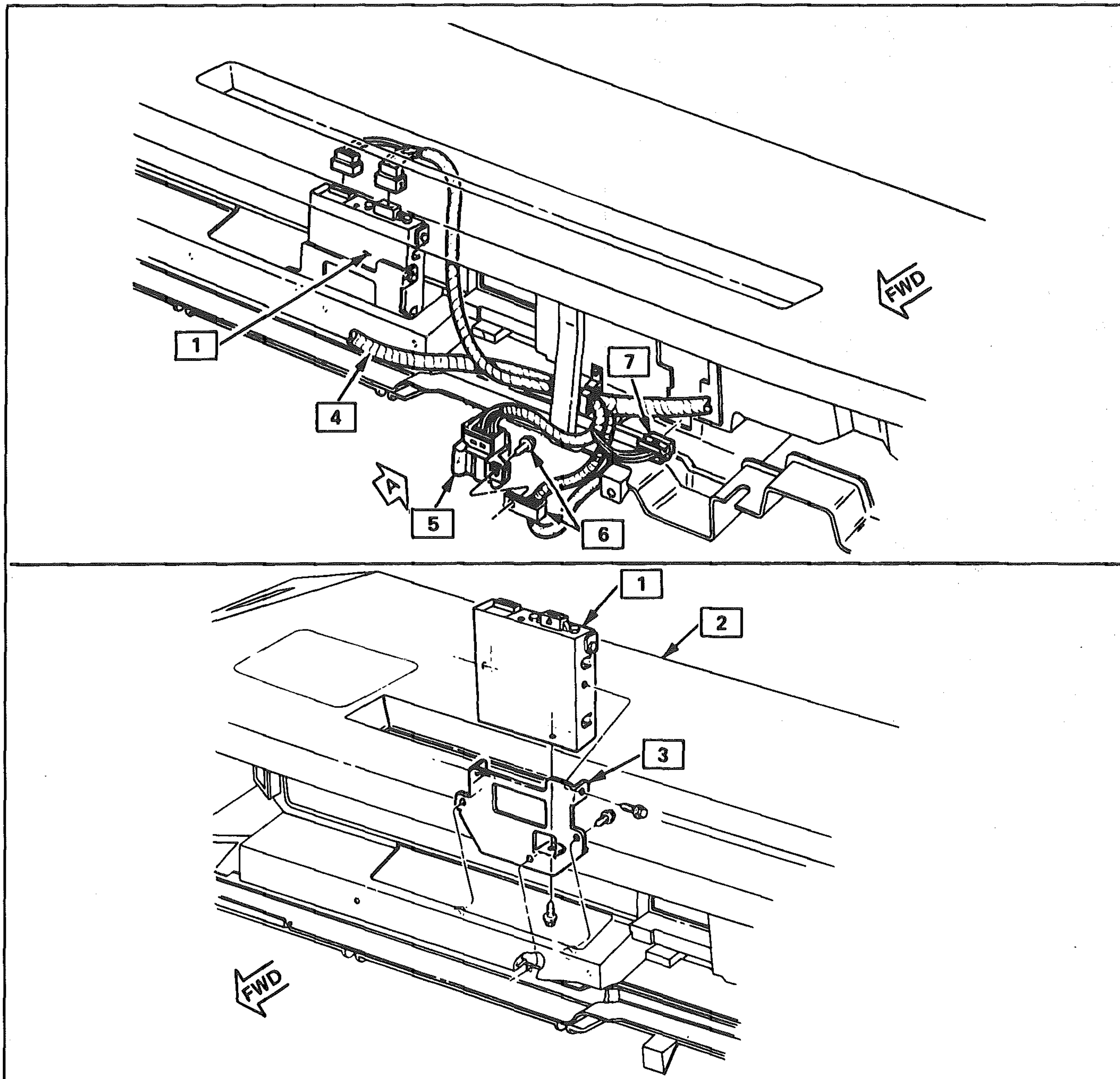


Fig. 609 Antenna Mounting



1—AMPLIFIER ASSEMBLY
2—I.P. PAD AND RETAINER
3—BRACKET
4—I.P. HARNESS
5—HARNESS ASSEMBLY
6—BOLT/SCREW AND CUP
7—TO SWITCH ASSEMBLY
8—TO FISHER HARNESS
9—FISHER CONNECTOR - REAR SPEAKER (BLUE)
10—RADIO CONNECTOR - I.P. HARNESS (BLACK AND NATURAL)

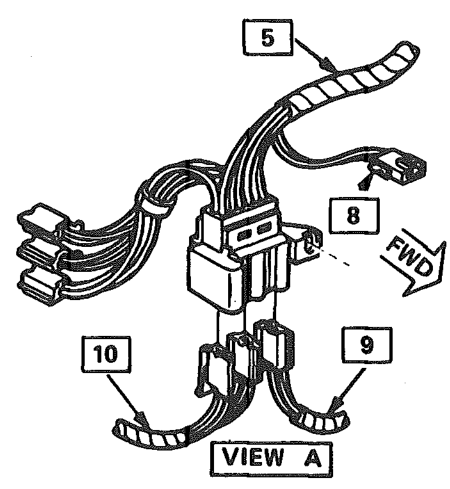


Fig. 610 Audio Amplifier

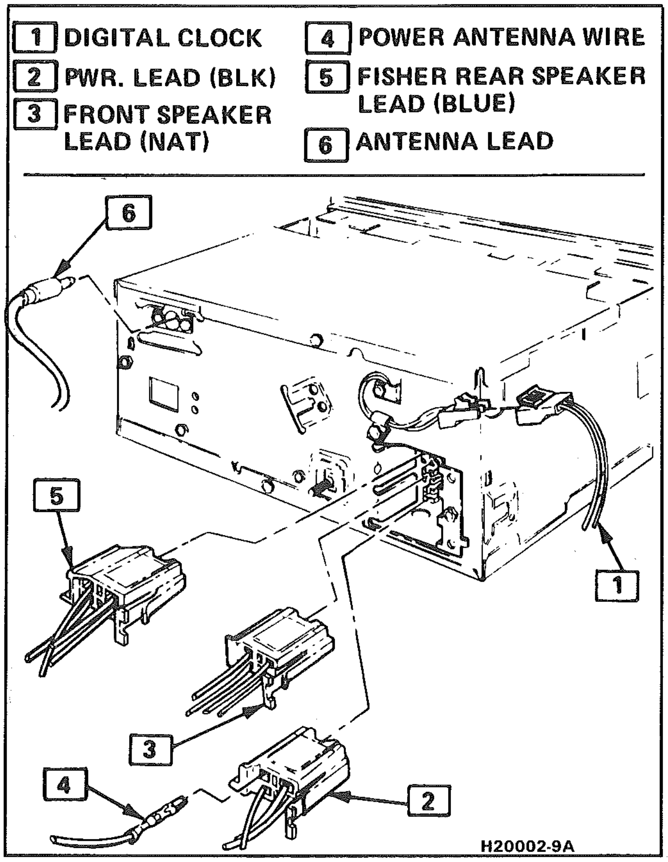


Fig. 611 Radio Electrical and Antenna Connections

SECTION 9B

CRUISE CONTROL

CONTENTS

GENERAL DESCRIPTION

Cruise control is a speed control system which maintains a desired car speed under normal driving conditions. However, steep grades up or down may cause variations in the selected speeds. The electronic cruise control system has the capability to cruise, coast, resume speed, accelerate, and "tap-up" and "tap-down".

The main parts of the cruise control system are the mode control switches, controller (module), servo unit, speed sensor, vacuum supply, electrical and vacuum release switches, and electrical harness.

The cruise control system uses vacuum to operate a throttle servo unit. The servo unit maintains a desired car speed by trapping vacuum in the servo unit at the proper servo position. The controller monitors vehicle speed and servo position and operates the vacuum and vent valves in the servo to maintain desired speed. The controller contains a low speed limit which will prevent system engagement below a minimum speed of about 25 mph. The operation of the controller is controlled by mode control switches located in the end of the directional signal lever. To disengage the system, two release switches are provided. An electrical release switch mounted on the brake pedal bracket (brake and clutch pedal bracket on cars equipped with manual transmission) disengages the system electrically when the brake pedal (or clutch pedal) is depressed. A vacuum release valve, mounted on the brake pedal bracket, vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to quickly return the throttle to idle position.

OFF/ON/RESUME/ACCEL SWITCH (OPERATION)

Figure 1

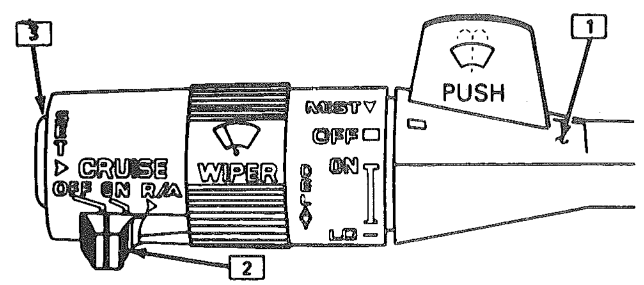
The Off/On/Resume/Accel Switch has three positions. This switch turns the cruise control system ON and OFF and also returns cruise control operation to the last speed setting when MOMENTARILY moved towards the R/A position after braking. (Do not hold the slider in the R/A position ... release it immediately.) If the slider is held in the R/A position for more than one second, the system goes into the Accel mode. To accelerate the car, move the slider switch to the R/A position and hold it there until the car reaches the desired speed. When the slider switch is released, the system will maintain the new cruise speed. In order to use the Accel mode, the cruise OFF/ON/Resume/Accel switch must be in the "ON" position and the car must be above the low speed limit of 25 mph.

The slide switch can also be used to "tap-up" car speed. In order to do this the cruise must be engaged and operating. "Tapping-up" is done by quickly pressing the slide switch toward the R/A position and quickly releasing it, or "tapping" the lever. Do not hold the lever in the R/A position or the system will go into the Accel mode. "Tap-up" is a function in which cruise speed can be increased by 1 mph increments (one tap = 1 mph increase).

SET/COAST BUTTON SWITCH

Figure 1

The cruise control Set/Coast Switch (located in the end of the turn signal lever) has two positions - "Normal" and "Depressed".



1—DIRECTIONAL SIGNAL LEVER
2—OFF/ON/RESUME/ACCEL SWITCH
3—SET/COAST SWITCH

520161-9

Fig. 1 Multi-Function Lever

- **The Set Position** - With the button switch depressed and then released (car speed must exceed the low speed limit point, and the Off/On/Resume/Accel Switch must be in the ON position) the cruise speed will be set at the speed the car was at when the button was released. Car cruise speed will be within ± 1 mph of the actual speed at engaged speed. The system will cruise until either the Off/On/Resume/Accel Switch is moved to OFF, the ignition switch is turned off, and/or the Set/Coast Button is pushed in fully and held. Pushing the brake pedal (or clutch pedal) releases the cruise but not the resume capability.
- **The Coast Position** - With the button switch fully depressed, the driver can raise or lower his speed. To increase speed, the driver can accelerate to a new speed, fully depress the switch and release the button. The controller "forgets" the previously set speed. An increased control speed can also be more easily set by the Off/On/Resume/Accel Switch as previously described. To decrease cruise speed, the button switch is held in, disengaging the cruise system, which allows the throttle to return to the idle position. When the car has slowed to the desired cruise speed, releasing the switch will re-engage the system.
- **The "Tap-Down" Position** - In order to do this the cruise must be engaged and operating. "Tapping-down" is done by quickly pressing and releasing the Set/Coast Button, or "tapping" the button. Do not hold the button in the depressed position or the system will go into the "coast" mode. "Tap-down" is a function in which cruise speed can be decreased by 1 mph increments (one tap = 1 mph decrease).

  The accelerator may be depressed at any time to override the cruise system. Release of the accelerator will return the car to the previous set cruise speed.

NOTICE: To keep the vehicle under control, and to prevent possible vehicle damage, it is not advisable to use the cruise control on slippery roads. It is not recommended to use the cruise control in conditions such as on winding roads or in traffic of heavy or varying volume. When traveling down a steeply graded hill, the cruise control should be disengaged by depressing the brake pedal lightly. The transmission can then be shifted into a lower gear range to help control vehicle speed.

ELECTRONIC CONTROLLER (MODULE)

Figure 2

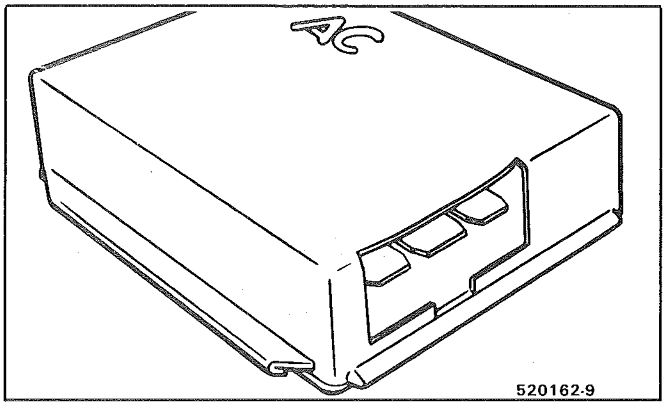


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Fig. 2 Controller (Module)

The controller interprets the position of the servo, the position of the control switches and the output of the speed sensor. In response to these inputs, the controller electrically signals the opening or closing of the vent and vacuum solenoid valves in the servo.

The controller is usually mounted on the pedal bracket, but is integral with the ECM on some models with certain engines. For specific location, see the On-Car Service portion of this section.

SERVO UNIT

Figure 3

The servo consists of a vacuum operated diaphragm, a normally open solenoid valve to vent the diaphragm chamber to atmosphere, a normally closed solenoid valve to connect the diaphragm chamber to the vacuum source, and a variable inductance position sensor.

The servo incorporates a steel core which moves within a coil. Its resulting variable inductance provides a continuous (voltage) servo position signal to the controller. This voltage signal is constantly compared to the vehicle speed signal. This comparison determines if the cruise system has corrected the speed error or if additional changes are required.

The servo operates the throttle in response to signals from the electronic controller as follows:

- **Steady Cruise State** (system engaged and operating) - Both vacuum and vent valves are closed or sealed. The servo has a constant vacuum on the diaphragm and places no requirements on the vacuum source, as vacuum is trapped in the diaphragm chamber.
- **Vehicle Losing Speed** (due to steep grades or driver wishes to increase speed by using the Accel or 'tap-up' feature) - The controller energizes the vacuum solenoid to open the vacuum valve to the vacuum source. This increases the vacuum level

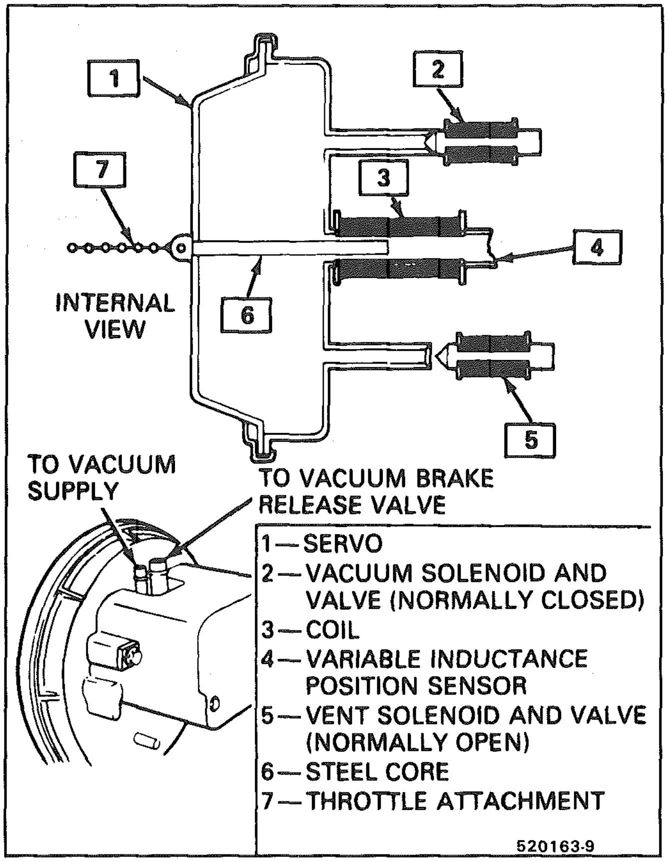


Fig. 3 Servo Unit

in the servo to increase the throttle opening. The vent remains closed.

- **Vehicle Gaining Speed** (due to steep grades or driver wishes to decrease speed by using the Coast or 'tap-down' feature) - The controller de-energizes the vent solenoid to open the vent valve to the atmosphere. This reduces vacuum in the servo and allows the throttle return spring to decrease the throttle opening. The vacuum valve remains closed.

When the cruise system is engaged and operating (without any interference from the driver via the mode control switches), no speed correction will be made until the car varies approximately $\pm 1/2$ mph from set speed.

When the controller senses an over or underspeed condition it will pulse the opening of the vent or vacuum valve. The pulse will be repeated as required until the speed correction necessary brings the car to the set speed. From any set speed, under normal road load conditions, the vacuum valve will remain in a completely open position when vehicle speed has dropped 5 mph below set speed. Likewise, when vehicle speed has exceeded 3 mph over the set speed, such as down a steep grade, the vent will go into constant open position.

The servo will go into an open vent valve position under the following conditions:

- When the brake (or clutch) pedal is depressed.
- An open variable inductance position sensor coil in the servo.
- A loss of electrical power to the system.
- The ignition is turned off.

SPEED SENSORS

VSS Buffer Amplifier

Figure 4

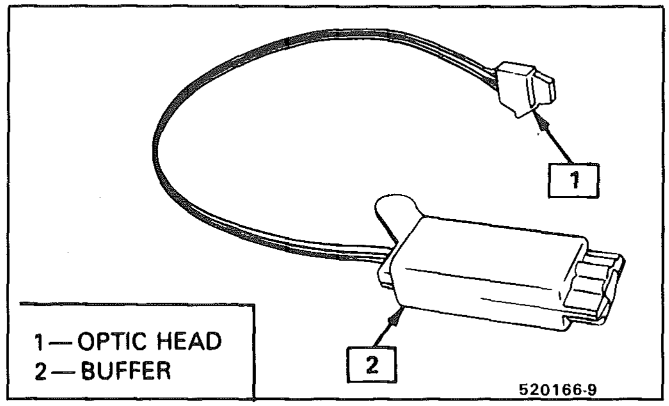


Fig. 4 VSS (Vehicle Speed Sensor)

This device supplies the vehicle speed input to the controller on some cars. The optic head portion of the VSS is located in the speedometer frame. A reflective blade is attached to the speedometer cable/head assembly. The blade spins like a propeller, with its blades passing through a light beam from a L.E.D. in the optic head. As each blade enters the L.E.D. light beam, light is reflected back to a photocell in the optic head, causing a low power speed signal to be sent to the buffer for amplification and signal conditioning. This amplified signal is then sent to the cruise controller.

P. M. Generator

Figure 5

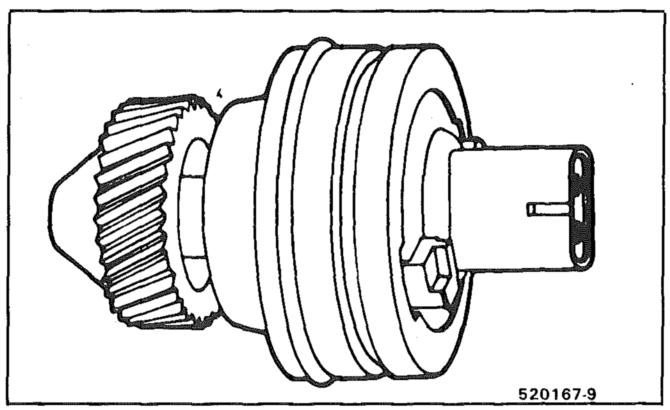


Fig. 5 P. M. Generator

This device supplies the vehicle speed input to the controller on some cars. Vehicle speed information is provided to the controller by a P. M. (permanent magnet) generator driven by the transmission. The output frequency of the P. M. generator is sent to the buffer, which amplifies and conditions the signal to the controller.

VACUUM SUPPLY

The vacuum to operate the Cruise Control servo can come from: manifold vacuum connected straight to the servo, from manifold through a vacuum storage tank, or straight from a vacuum pump. For specific vacuum routing, see On-Car Service.

ELECTRICAL AND VACUUM RELEASE SWITCHES

These switches are used to disengage the cruise control system. An electrical release switch mounted on the brake pedal bracket (and clutch pedal bracket on cars equipped with manual transaxle) disengages the system electrically when the brake (or clutch) pedal is depressed. This is done by interrupting the flow of current to the controller. A vacuum release valve mounted on the brake pedal bracket vents the trapped vacuum in the servo to atmosphere when the brake pedal is depressed, allowing the servo unit to more quickly return the throttle to idle position. This is done by routing a separate hose directly to the servo from the normally closed vacuum switch. These two types of switches will also sometimes be combined with stop light switch, TCC switch, or other switches. For specific usage and adjustment of these switches, see On-Car Service.

ELECTRICAL HARNESS

For specific wiring and connector locations, see Section 8A-34, 'Cruise Control'.

DIAGNOSIS

Improper operation can be caused by one or a combination of mechanical, electrical and vacuum problems. In resolving any cruise system operating problem, first make a visual inspection. Check the system to ensure there are no bare, broken, or disconnected wires or any pinched, damaged, or disconnected vacuum hoses. The servo and throttle linkage should operate freely and smoothly. The servo linkage should be adjusted as described in the On-Car Service portion of this section.

Since any problem in this system is either vacuum, mechanical, or electrical, the technician should perform a few initial checks before turning to Section 8A. This can be done by first eliminating a vacuum or mechanical problem by starting the engine and using finger to feel for source vacuum at the servo, and by visual inspection of vacuum release valve, throttle linkage, vacuum hoses, etc. If preliminary inspection reveals no solution and the system is inoperative, use the diagnostic information in Section 8A-34, 'Cruise Control'.

Several versions of a quick check instrument similar to tool J-34185 are available. This quick check instrument is installed in place of the controller and determines which part of the system has a problem. Instructions on the operation of the instrument will be provided with the unit.

CRUISE SYSTEM SURGES

- The servo and throttle linkages should operate freely and smoothly. This linkage should be adjusted as described in the On-Car Service portion of this section.
- Check hose routing for pinches, leaks or restrictions. (See vacuum schematics in the On-Car Service portion of this section).
- See Section 8A-34, 'Cruise Control'.

CRUISE SET SPEED HIGH OR LOW

- Check vacuum hoses for proper routing, restrictions or leaks. Adjust or replace as required. (See vacuum schematics in the On-Car Service portion of this section.)
- Check servo linkage for excess slack and adjust as described in the On-Car Service portion of this section.
- If no system problem is noted, replace the electronic controller (module).

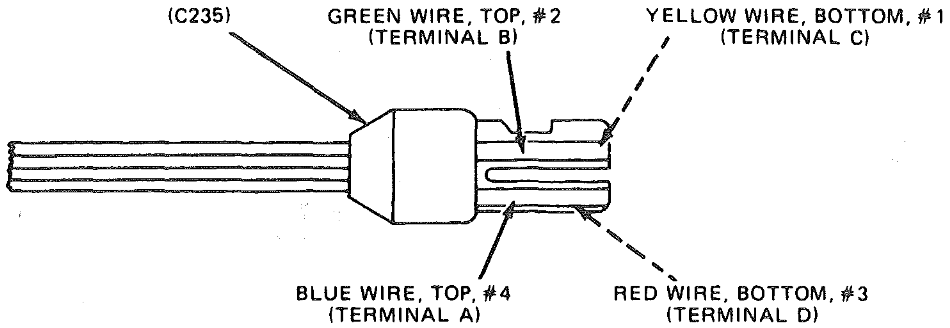
EXCESSIVE CRUISE SPEED LOSS ON HILLS

- Check hoses for vacuum leaks. (See vacuum schematics in the On-Car Service portion of this section).
- Determine if check valve is functional (where applicable).

CRUISE TAP-UP & TAP-DOWN

If all other functions of cruise control are working except "tap-up" and "tap-down" the controller (module) is at fault.

CONTROL SWITCH
CONTINUITY CHECK



C – CLOSED
O – OPEN

SET/COAST (S/C) SW	POSITION SLIDER	1-2	1-3	1-4	2-3	2-4	3-4
NORMAL	OFF	O	O	O	O	O	O
NORMAL	ON	O	O	O	O	C	O
NORMAL	R/A	C	O	C	O	C	O
DEPRESSED	OFF	O	O	O	C	O	O
DEPRESSED	ON	O	O	O	C	C	C
DEPRESSED	R/A	C	C	C	C	C	C

CRUISE CONTROLLER (MODULE) CHECKS AT CONNECTOR

- IGNITION ON
- CONTROLLER DISCONNECTED

PIN	FUNCTION	VOLTAGE TO GND	RESISTANCE	CONDITIONS
G	BRAKE INPUT	12 V 0 V	– –	BRAKE (AND CLUTCH) NOT DEPRESSED BRAKE (AND/OR CLUTCH) DEPRESSED
L	SET/COAST INPUT	12 V 0 V 0 V	– – –	SLIDER SWITCH "ON" – SET/COAST DEPRESSED SLIDER SWITCH "ON" – SET/COAST NORMAL SLIDER SWITCH "OFF" – SET/COAST NORMAL
M	RESUME/ ACCEL. INPUT	12 V 0 V 0 V	– – –	SLIDER SWITCH "R/A" POSITION SLIDER SWITCH "ON" – SET/COAST DEPRESSED OR NORMAL SLIDER SWITCH "OFF" – SET/COAST DEPRESSED OR NORMAL
J	GROUND	–	0 Ω	MEASURED TO VEHICLE GROUND
A	ON/OFF INPUT	12 V 0 V	– –	SLIDER SWITCH "ON" SLIDER SWITCH "OFF" – SET/COAST DEPRESSED OR NORMAL
B	INDICATOR LAMP	12 V	–	CRUISE ARMED
F H	SPS HIGH SPS LOW	– –	20-30 Ω 0 Ω	MEASURED BETWEEN PINS F & H – SERVO CONNECTED MEASURED BETWEEN PINS F & H – SERVO DISCONNECTED
D	SPEED SIGNAL	→	→	SEE CHART (DIAGNOSTIC) ON SPEED SENDER TEST
K	VACUUM VALVE CONTROL	– –	30-50 Ω ∞ Ω	MEASURED TO GROUND – SERVO CONNECTED MEASURED TO GROUND – SERVO NOT CONNECTED
C	VENT VALVE CONTROL	– –	30-50 Ω ∞ Ω	MEASURED TO GROUND – SERVO CONNECTED MEASURED TO GROUND – SERVO NOT CONNECTED

SERVO CHECKS

- SERVO CONNECTOR DISCONNECTED
- MEASURE AT SERVO PINS

PIN	FUNCTION	RESISTANCE	CONDITIONS
D B	SPS HIGH SPS LOW	20-30 Ω	MEASURED BETWEEN PINS D AND B (IF MEASURED RESISTANCE IS NOT STATED VALUE REPLACE SERVO)
A	VENT VALVE	30-50 Ω	MEASURED BETWEEN PINS A AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE REPLACE SERVO)
E	VACUUM VALVE	30-50 Ω	MEASURED BETWEEN PINS E AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE REPLACE SERVO)

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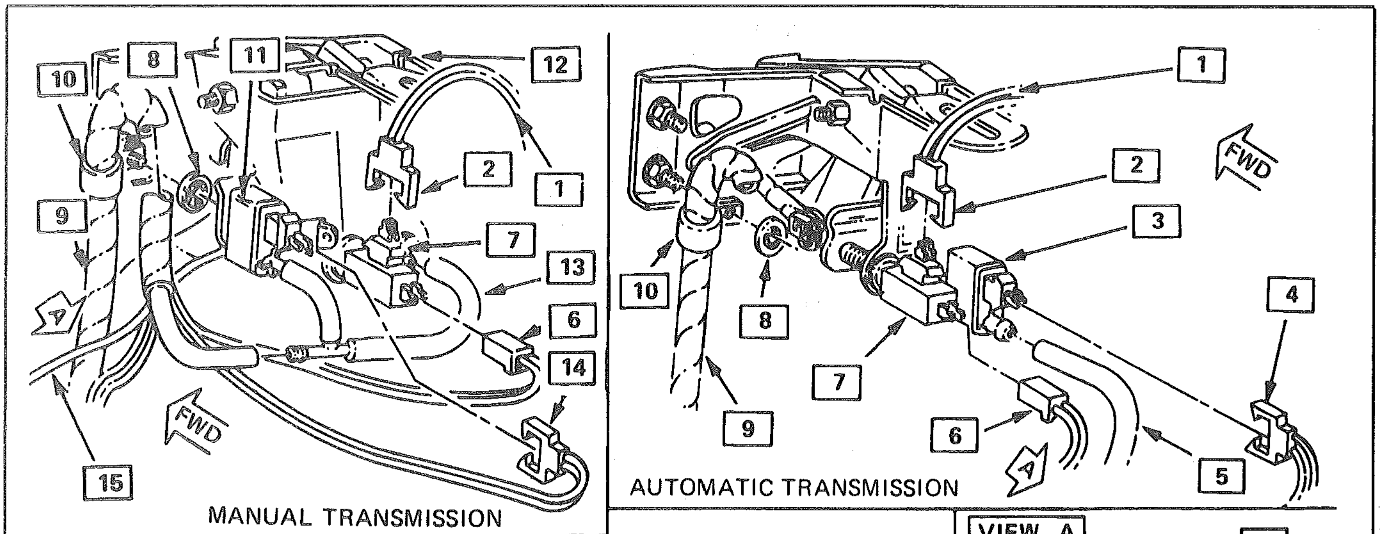
Fig. 6 Controller, Servo & Control Switch Check

ON-CAR SERVICE (ILLUSTRATED)



1–I/P HARNESS
2–STOP LAMP CONNECTOR
3–TCC SWITCH
4–TCC CONNECTOR
5–HOSE - CRUISE CONTROL WIRING
6–CRUISE CONTROL CONNECTOR
7–STOP LAMP AND CRUISE CONTROL
8–NUT - PUSH-ON
9–CRUISE CONTROL WIRING
10–CLAMP
11–CLUTCH CRUISE CONTROL SWITCH
12–BRAKE PEDAL BRACKET
13–VACUUM
14–CLUTCH SWITCH CONNECTOR
15–TO FUSE PANEL
16–FUSE PANEL
17–IGNITION

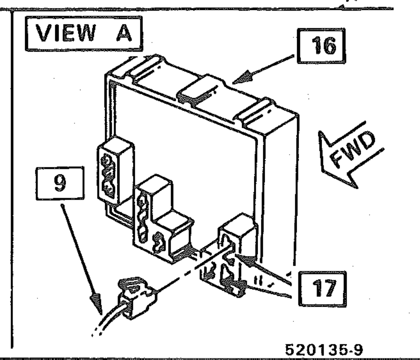
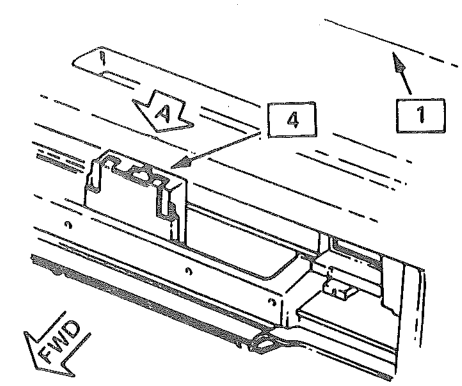
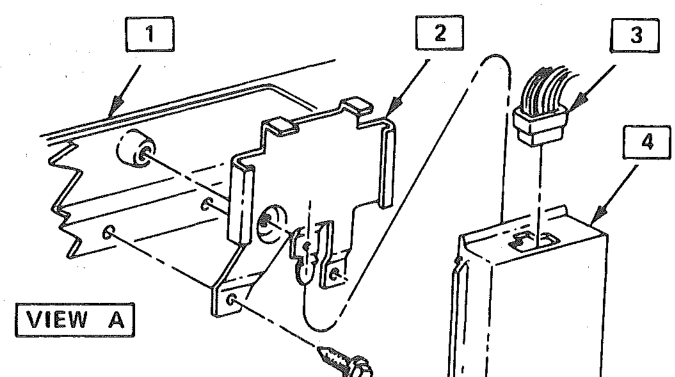
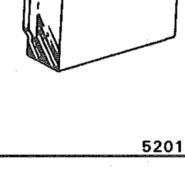


Fig. 601 Cruise Release Switches







1–INSTRUMENT PANEL
2–BRACKET ASSEMBLY
3–INSTRUMENT PANEL CRUISE HARNESS
4–MODULE ASSEMBLY

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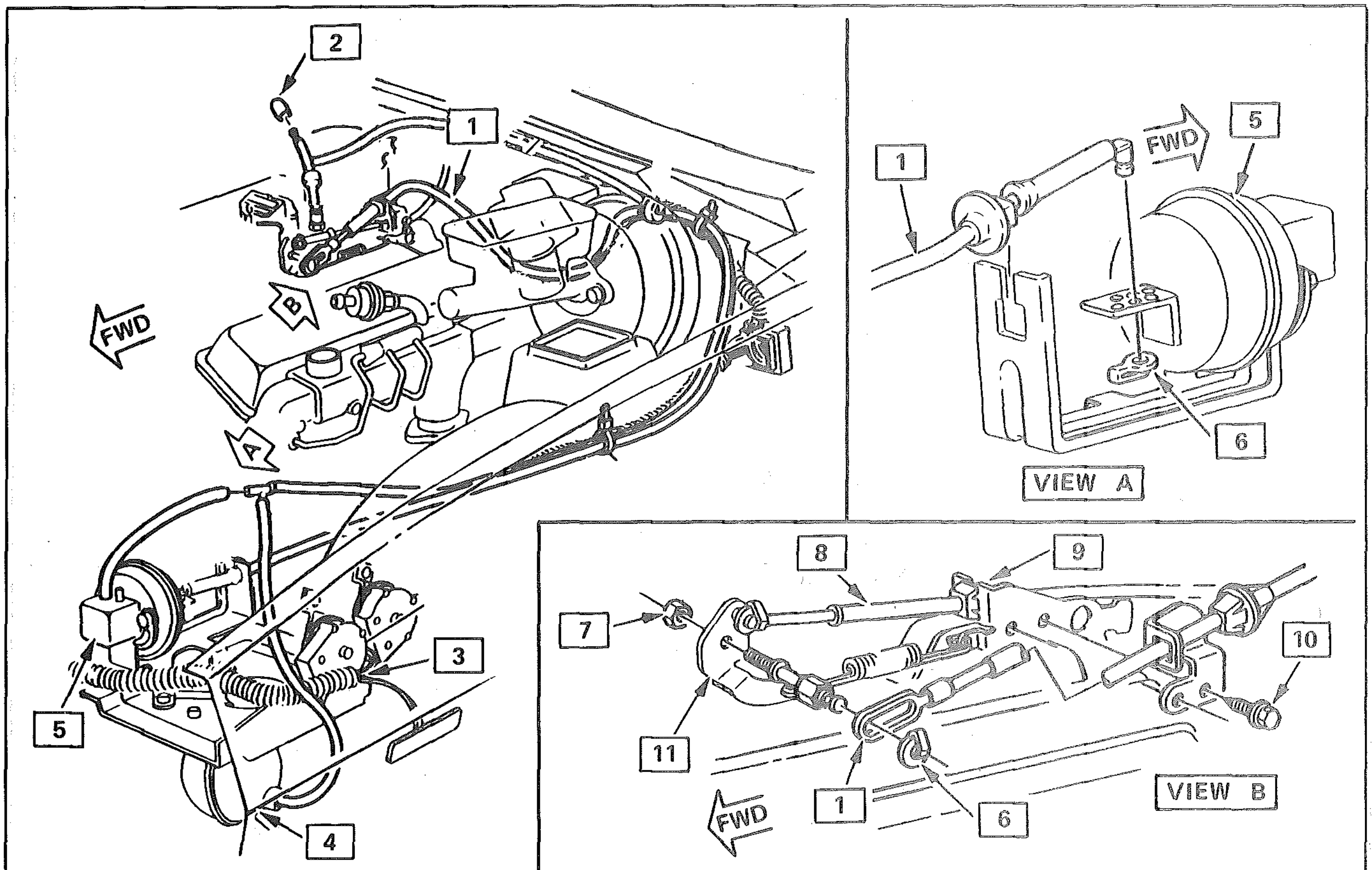
Fig. 602 Cruise Processor Module



1–CABLE

2–CAP (W/O A/C)

3–FORWARD LAMP HARNESS

4–VACUUM TANK

5–SERVO

6–RETAINER

7–24 N•m (18 LBS. FT.)

8–ACCELERATOR CABLE

9–ENGINE BRACKET

10– 6 N•m (54 LB. IN.)

11–CARB. LEVER

CABLE ADJUSTMENT PROCEDURE

1–WITH CABLE 1 INSTALLED IN ENGINE BRACKET AND SERVO BRACKET, INSTALL CABLE OVER STUD ON LEVER SO STUD ENGAGES SLOT IN CABLE END. ASSEMBLE CABLE TO CARBURETOR LEVER STUD WITH RETAINER 6 AND RELEASE CARBURETOR LEVER.

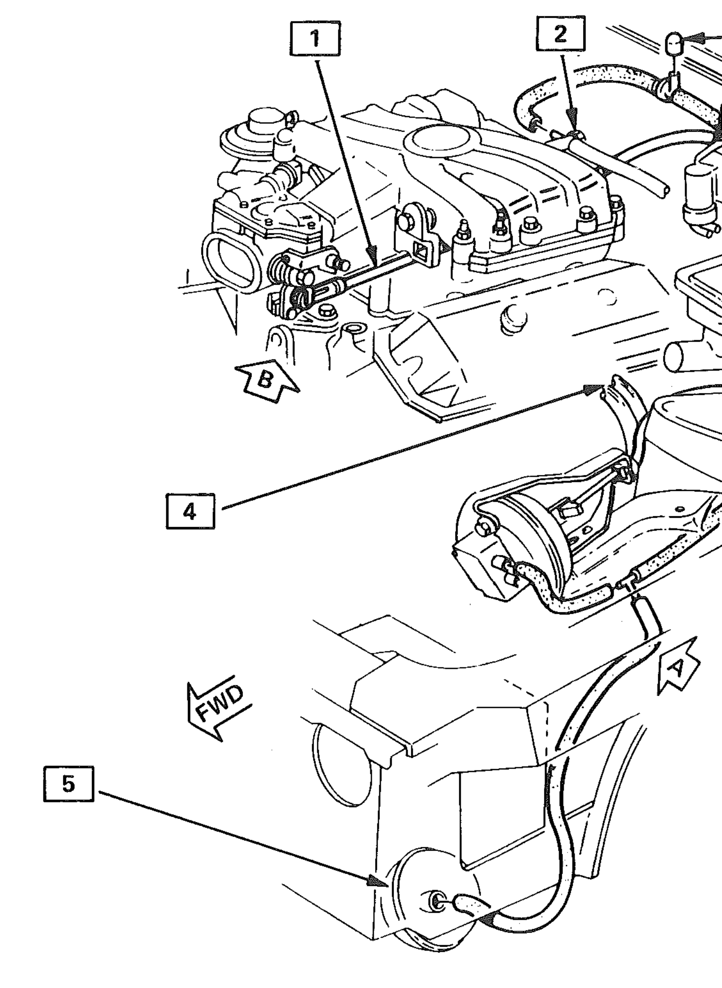
2– **CAUTION** THROTTLE MUST BE COMPLETELY CLOSED. (IGNITION OFF-FAST IDLE CAM OFF)

3–PULL SERVO ASM. END OF CABLE TOWARD SERVO WITHOUT MOVING CARBURETOR LEVER.

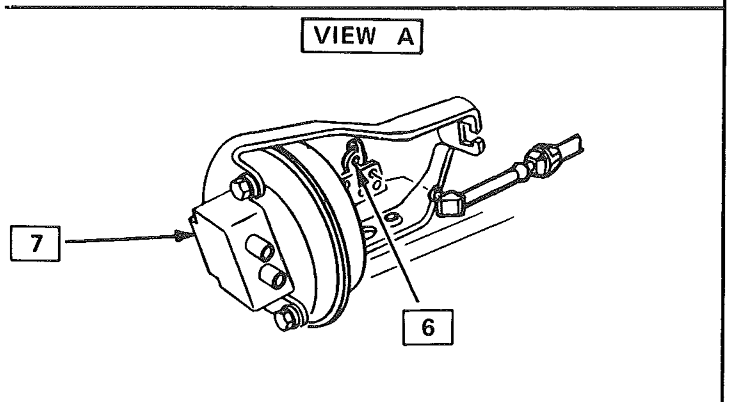
4–IF ONE OF THE SIX HOLES IN THE SERVO ASM. TAB LINES UP WITH CABLE PIN, CONNECT PIN TO TAB WITH RETAINER 6 .

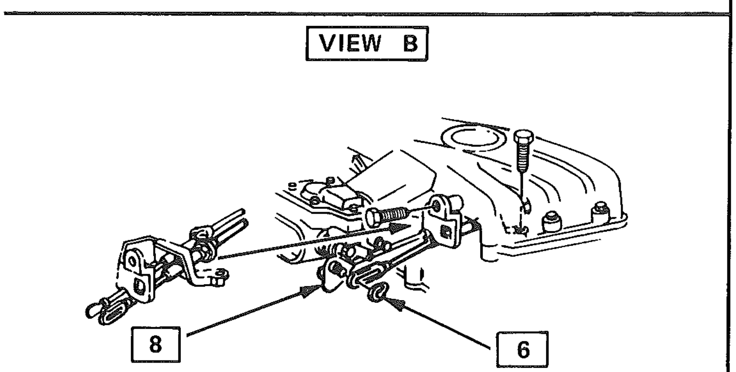
5–IF A TAB HOLE DOES NOT LINE UP WITH THE PIN, MOVE THE CABLE AWAY FROM THE SERVO ASM. UNTIL THE NEXT CLOSEST TAB HOLE LINES UP AND CONNECT PIN TO TAB WITH RETAINER 6 .

Fig. 603 Vacuum Harness and Cable Routing - VIN E



1–CABLE
2–VACUUM FITTING
3–CAP (W/O A/C)
4–FUEL LINES
5–VACUUM TANK
6–RETAINER
7–SERVO
8–THROTTLE LEVER





CABLE ADJUSTMENT PROCEDURE

1–WITH CABLE ASM. INSTALLED IN SERVO BRACKET. INSTALL CABLE ASM. END ONTO STUD OF LEVER ASM. AND SECURE WITH RETAINER.

2–PULL SERVO ASM. END OF CABLE ASM. TOWARD SERVO ASM. WITHOUT MOVING LEVER ASM.

3–IF ONE OF THE SIX HOLES IN THE SERVO ASM. TAB LINES UP WITH THE CABLE ASM. PIN, CONNECT PIN TO TAB WITH RETAINER.

4–IF A TAB HOLE DOES NOT LINE UP WITH THE PIN, MOVE CABLE ASM. AWAY FROM SERVO ASM. UNTIL THE NEXT CLOSEST HOLE LINES UP AND SECURE WITH RETAINER.

CAUTION DO NOT STRETCH CABLE ASM. SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO PIN. THIS WILL PREVENT ENGINE FROM RETURNING TO IDLE

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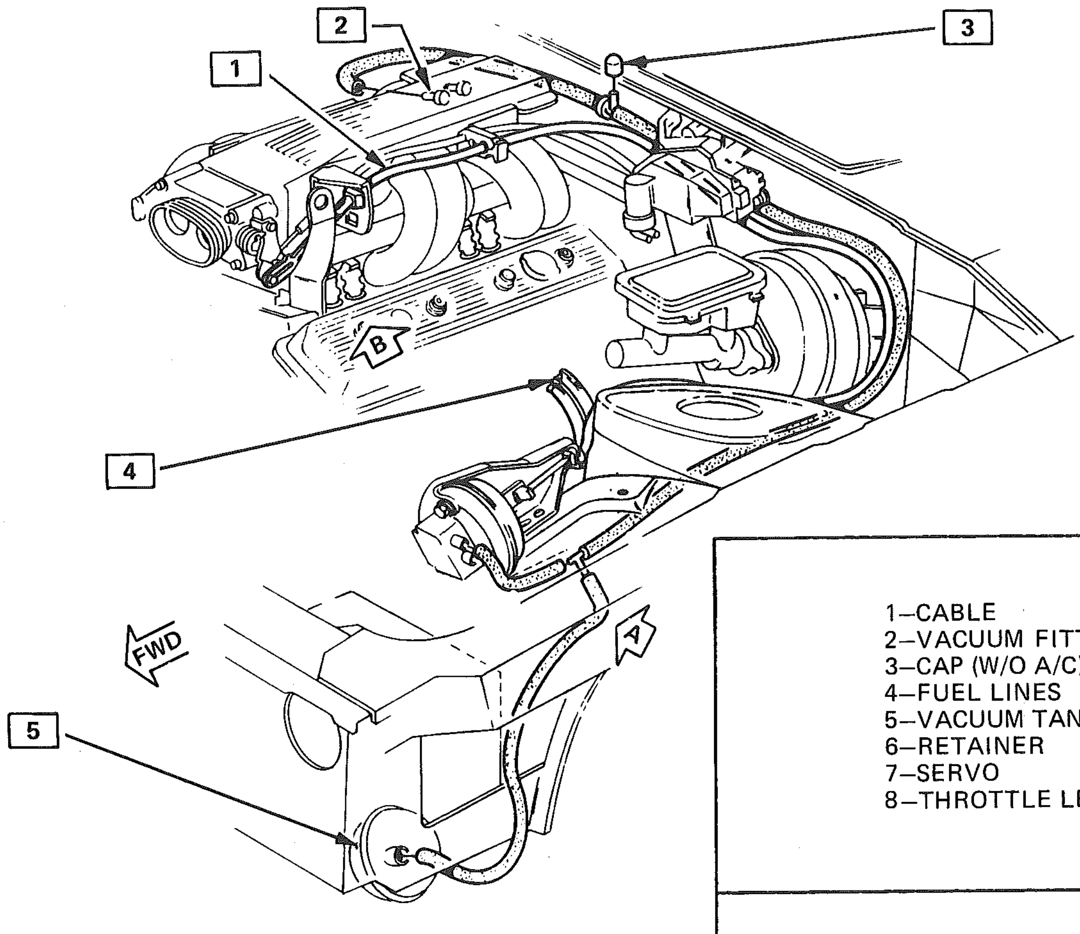
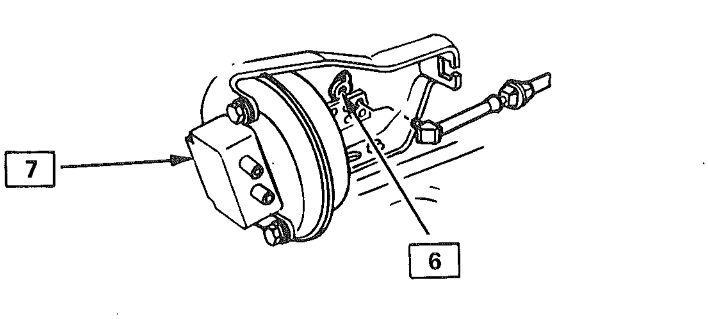
Fig. 604 Vacuum Harness and Cable Routing - VIN S

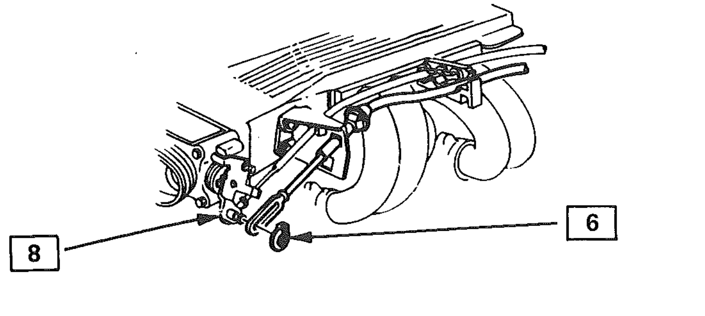


1–CABLE
2–VACUUM FITTING
3–CAP (W/O A/C)
4–FUEL LINES
5–VACUUM TANK
6–RETAINER
7–SERVO
8–THROTTLE LEVER

VIEW A



VIEW B



CABLE ADJUSTMENT PROCEDURE

1–WITH CABLE ASM. INSTALLED IN SERVO BRACKET. INSTALL CABLE ASM. END ONTO STUD OF LEVER ASM. AND SECURE WITH RETAINER.

2–PULL SERVO ASM. END OF CABLE ASM. TOWARD SERVO ASM. WITHOUT MOVING LEVER ASM.

3–IF ONE OF THE SIX HOLES IN THE SERVO ASM. TAB LINES UP WITH THE CABLE ASM. PIN, CONNECT PIN TO TAB WITH RETAINER.

4–IF A TAB HOLE DOES NOT LINE UP WITH THE PIN, MOVE CABLE ASM. AWAY FROM SERVO ASM. UNTIL THE NEXT CLOSEST HOLE LINES UP AND SECURE WITH RETAINER.

CAUTION DO NOT STRETCH CABLE ASM. SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO PIN. THIS WILL PREVENT ENGINE FROM RETURNING TO IDLE

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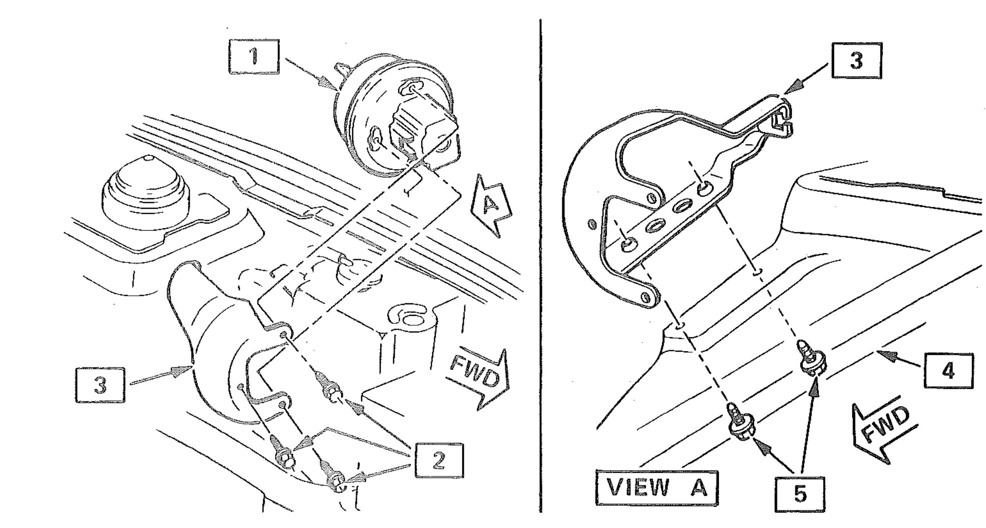
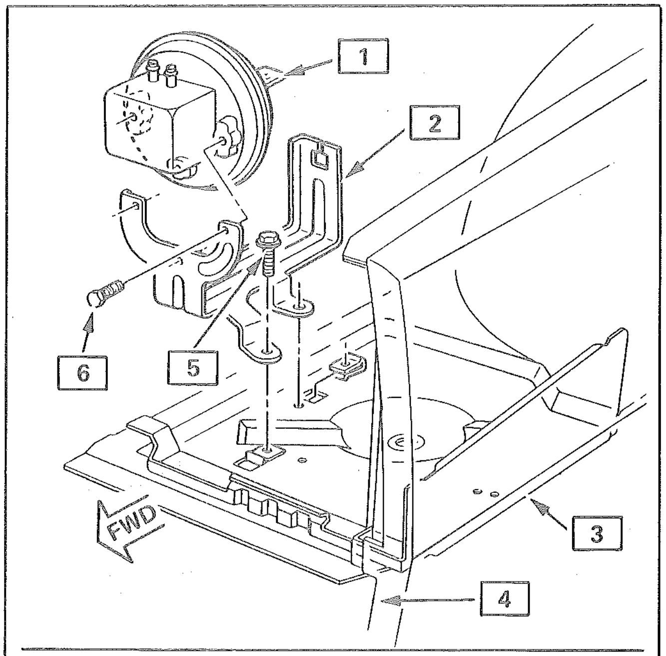
Fig. 605 Vacuum Harness and Cable Routing - VIN F,8



1–SERVO
2–1.6 N•m (14 LBS. IN.)
3–BRACKET
4–LH FRONT FENDER
5–24 N•m (18 LBS. FT.)

Fig. 606 Servo Mounting - VIN S,F



1–SERVO
2–BRACKET
3–CANISTER TRAY
4–LH FRONT FENDER
5–24 N•m (18 LBS. FT.)
6–1.6 N•m (14 LB. IN.)

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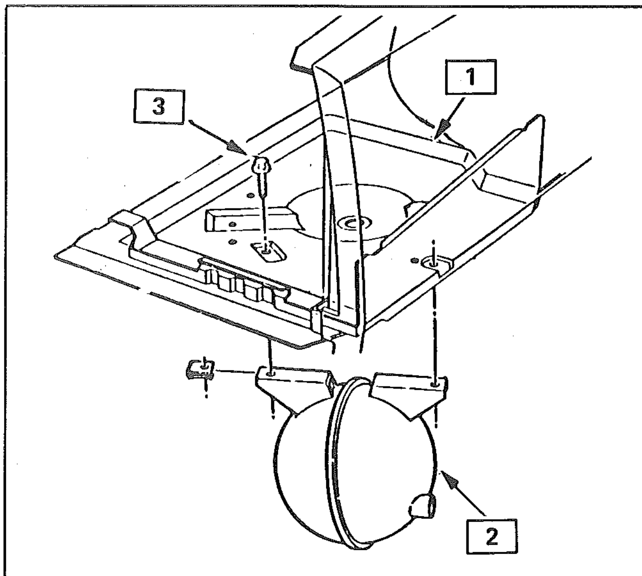
Fig. 607 Servo & Bracket - VIN E



1–BATTERY TRAY
2–VACUUM TANK
3–5 N•m (45 LBS. IN.)

Fig. 608 Vacuum Tank - VIN S,F,E

SECTION 9G

MISCELLANEOUS ACCESSORIES

CONTENTS

GENERAL DESCRIPTION

RALLY GAGES

Figure 1

The Rally Gage option, available on most models, consists of an engine water temperature gage, an oil pressure gage and a voltmeter.

These gages are incorporated into the instrument cluster and replace the standard warning lamps. The water temperature and oil pressure gages are electrically operated from sending units mounted in the cylinder head and oil filter base respectively. The voltmeter registers regulated voltage, providing an indication of the charging system's ability to keep the battery charged. Continuous readings in either the high or low voltage red bands can indicate improper voltage regulation, broken or slipping alternator belt, a shorted alternator diode or a defective battery. Readings in the yellow band are normal with the engine idling or for short periods after long engine cranking. However, continuous readings in the yellow band can indicate faulty operation. See Section 8A for diagnosis.

TACHOMETER

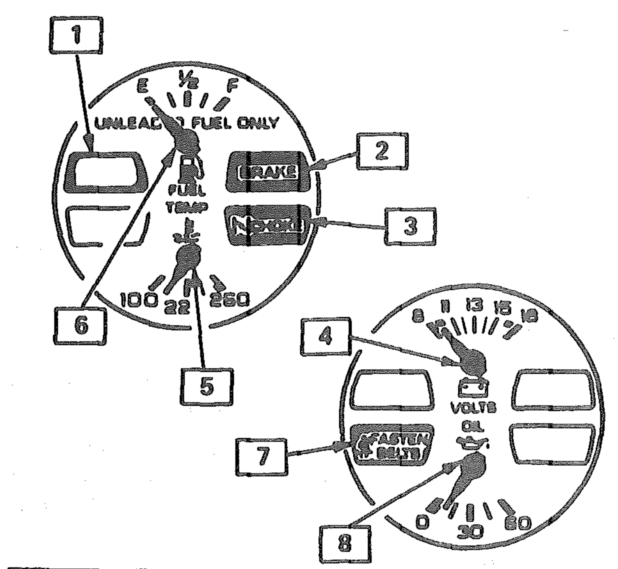
Figure 2

The tachometer indicates speed of the engine in revolutions per minute (RPM). The engine can safely be operated up to a maximum RPM as indicated by the start of the red bar. Engine operation with tachometer readings in the red area can lead to serious engine damage.

Due to its dual-coil design, the tachometer may not return to zero when the ignition is turned off. This is a normal condition and should not be diagnosed as a problem in the tachometer.

TRIP ODOMETER

The trip odometer can be reset by **twice** fully depressing the push button located on the right side of the speedometer cluster. The first depression shows all zeroes, and the second locks them in position. Both depressions must be done to avoid possible half cycling



1—SERVICE ENGINE SOON
2—BRAKE WARNING LIGHT
3—CHOKE WARNING LIGHT
4—VOLTMETER
5—COOLANT TEMP. GAGE
6—FUEL GAGE
7—SEAT BELT LIGHT
8—OIL PRESSURE GAGE

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Fig. 1 Rally Gages - Typical

of the trip odometer. A slow, steady push should be used to avoid damage to the internal mechanism.

Do not reset the odometer with the vehicle in motion. Damage to the odometer may occur.

The trip odometer does not affect service procedures for speedometers listed in Section 8C.

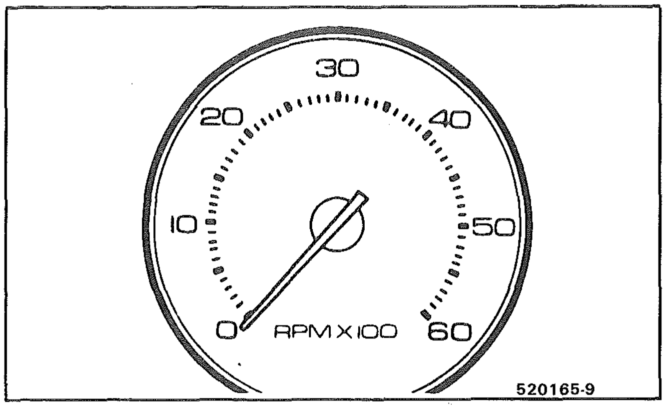


Fig. 2 Tachometer - Typical

ELECTRIC REAR WINDOW DEFOGGER

The electric rear window defogger system incorporates an electrical grid fused to the inside surface of the rear glass. Current is applied to this grid through a control switch on the instrument panel to warm and defog the glass. A defogger timer, which is also activated when the switch is depressed, allows current flow through the rear window grid for approximately 10 minutes on first application (approximately 5 minutes on subsequent applications) and automatically shuts off the system. The system can be turned off at any time by pushing the control switch to the "OFF" position. The system is designed to operate only when the ignition is on and must be reactivated whenever the ignition has been turned off and turned on again. Care should be exercised when cleaning the inside rear glass so as not to scratch or remove any of the grid material. Damage to the grid could cause an open circuit. A monitor lamp in the control switch indicates power being fed to the rear window grids so the operator can determine when the system is operating.

POWER REMOTE CONTROL REARVIEW MIRROR

Electric powered remote control mirrors are available with a control that allows the mirrors to be adjusted from the driver's seat.

DIAGNOSIS

RALLY GAGES

Diagnosis of individual rally gages is found in Section 8A

TACHOMETER

1. Insure that the in-line or fuseblock fuse is not blown. (See Section 8A for wiring information.)
2. With ignition off, remove the tachometer from the cluster to gain access to the connectors. Turn ignition on and check for 12 volts at the power input connector (pink/black) and no voltage at ground (black). Connect a test light to the brown wire which connects to the "TACH" terminal of the distributor. With the engine idling, a test light should light with approximately the same intensity as when attached to 12 volts. As the engine speed increases, the test light intensity should decrease.
3. If proper signals are present at the connector, replace the gage. If not, the problem is in the wiring to the gage.
   - Some tachometers use a circuit shorting bar to accommodate usage on several engine models. If tachometer readings are significantly wrong (for example, tach reads 2900 RPM with engine at 2000 RPM), check for a shorting bar on the back of the tach and insure proper position (Figure 3). If position is correct, tach must be repaired. (Not all tachometers use a shorting bar).

   Due to its dual-coil design, the tachometer may not return to zero when the ignition is turned off. This is a normal condition and should not be diagnosed as a problem in the tachometer.

ELECTRIC REAR WINDOW DEFOGGER

Figure 4

To check for proper operation of the rear window grid, start the engine and actuate the system by depressing the control switch to the "ON" position. Contact one probe of a test lamp to one of the left side rear window garnish molding screws. With the other test lamp probe tip removed (so as not to damage the grid), contact the bare wire to the grid adjacent to the garnish molding. The test lamp should glow at full brilliance. Contact the same grid line midway across the window. The lamp should glow at half brilliance. Repeat the procedure for each grid line. If an open circuit exists in a grid line between the left side and the center, the test lamp will not glow. If there is an open circuit between the center and the right side, the test lamp will glow more brilliantly at the center than if the line were unbroken.

Rear window grid repairs may be made by following the procedure published in Section 2H of the Body Service Manual.

The electric defogger system, wiring and troubleshooting, is covered in Section 8A, "Electrical Diagnosis". A quick-check troubleshooting guide is shown.

POWER REMOTE CONTROL REARVIEW MIRROR

The repair and mounting of the mirror assemblies is covered in the Body Service Manual.

1—V-8 POSITION (SHOWN)
2—L-4 NOT INSTALLED
3—V-6 POSITION
4—SHORTING BAR
5—SHORTING BAR CARRIER

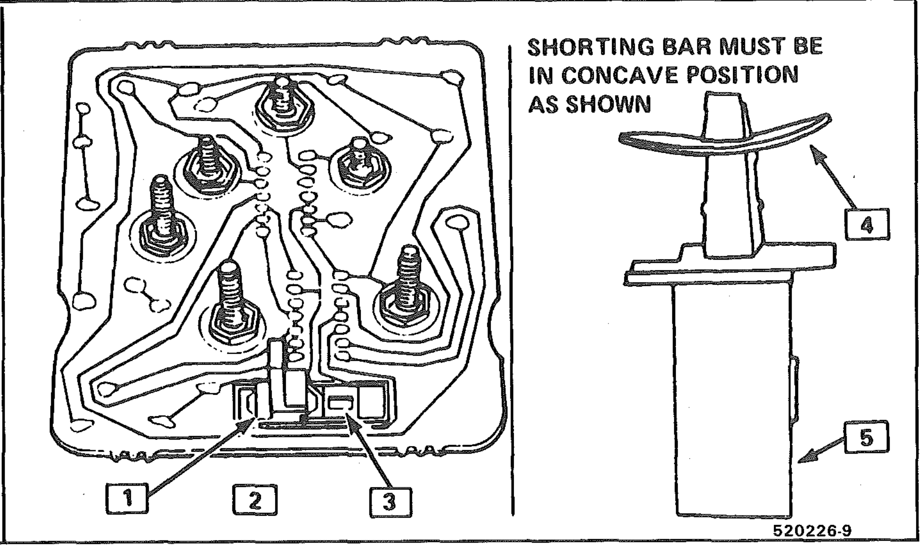


Fig. 3 Tachometer Shorting Bar

CONDITION	CAUSE	CORRECTION
System is inoperative (monitor lamp will not light)	Circuit breaker open from an electrical short in the power feed circuit	Check for electrical short in power feed circuit of body harness. Circuit breaker will reset itself when short circuit is corrected.
	Burned fusible link	Check for short circuit between starter solenoid and circuit breaker.
	Burned out or missing monitor lamp	Check lamp mounted in switch.
	Open circuit in either of the wiring harnesses	Check affected wiring for open circuit and check wiring connectors.
	Inoperative or dis-connected control timer assembly	Check harness connection to timer assembly.
		Check for proper ground.
		Check for relay "pull in" (click) when 12 volts is applied to the light blue wire terminal of timer assembly. If no pull in, replace timer assembly.
	Defective control switch	With switch held in "ON" position and connector installed on switch, connect a test light to the light blue wire terminal with connector on rear of switch to ground. Test light should glow brightly; if not, replace switch.
System operates but will not turn off auto-matically in 10-15 minutes	Defective control switch	With test light connected to center terminal as described in step above, test light should glow brightly in "ON" position and dim when switch is released. If not, switch is defective.
	Defective control timer assembly	Replace timer assembly.
System operates but won't stay on for full time cycle	Defective control timer assembly	Replace timer assembly.

520228-9

Fig. 4 Electric Rear Window Defogger Diagnosis

DASH AND CONSOLE MOUNTED ACCESSORY SWITCHES

Installation for various dash and console mounted accessory switches is shown in Section 8C.

GENERAL DESCRIPTION

ELECTRONIC GLARE CONTROL MIRROR

Service procedures regarding this mirror are found in the Body Section of this manual.

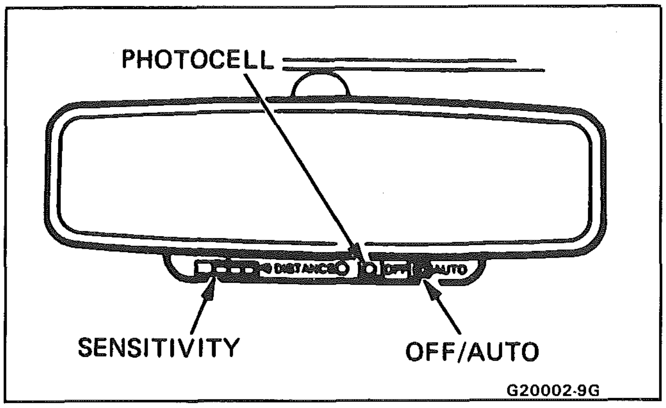


Fig. 601 EGC Mirror

The EGC mirror has light sensors which monitor activity in front and back of the mirror and compensate for brightly lit or extremely dark driving conditions. After glare is no longer detected in the night mode, a short time delay is automatically activated, preventing unnecessary changing as traffic moves in and out behind the car.

As an added feature, the Automatic Day/Night Mirror will hold in the normal viewing mode whenever the shift selector is placed in reverse. This assures you of a bright, clear view while backing up.

The Automatic Mirror with EGC (Electornic Glare Control) is a technological breakthrough using advanced computer circuitry. It is powered by the vehicle electrical system and requires no batteries or scheduled maintenance. Power is drawn only when the ignition is on.

Illuminated Distance Dial provides a full range of adjustments to match your eye sensitivity.

Night Mode Indicator illuminates green when mirror switches to the non-glare position.

Light Sensors monitor ambient lighting conditions and headlamp glare, then adjust the mirror accordingly.

Auto-Off Switch allows fully automatic operation or manual selection.

ON-CAR SERVICE

RALLY GAGES, TACH

Remove and Replace

Removal of the entire gage cluster assembly is not required to service the individual rally gages and/or tachometer.

To replace the rally gages, remove the lower and upper trimplates. Remove the trip odometer reset knob (if so equipped) and gage cluster lens from the front (see Section 8C).

To replace the tachometer by itself, remove the lower trimplates, the trip odometer reset knob (if so equipped) and the instrument cluster lens. Remove the gage from the cluster. Refer to Section 8C for instrument panel cluster removal.

REAR WINDOW DEFOGGER

The electric defogger system, available on all models, is covered in Section 8A. Electrical diagnosis and grid repair is covered in Body Service Manual.

POWER REMOTE CONTROL REARVIEW MIRROR

Electric powered remote control mirrors are available with a console mounted control that allows the mirrors to be adjusted from the driver's seat. The repair and mounting of the mirror assemblies are covered in the Body Service Manual. Location and installation of the control switch is shown in Figure 603.

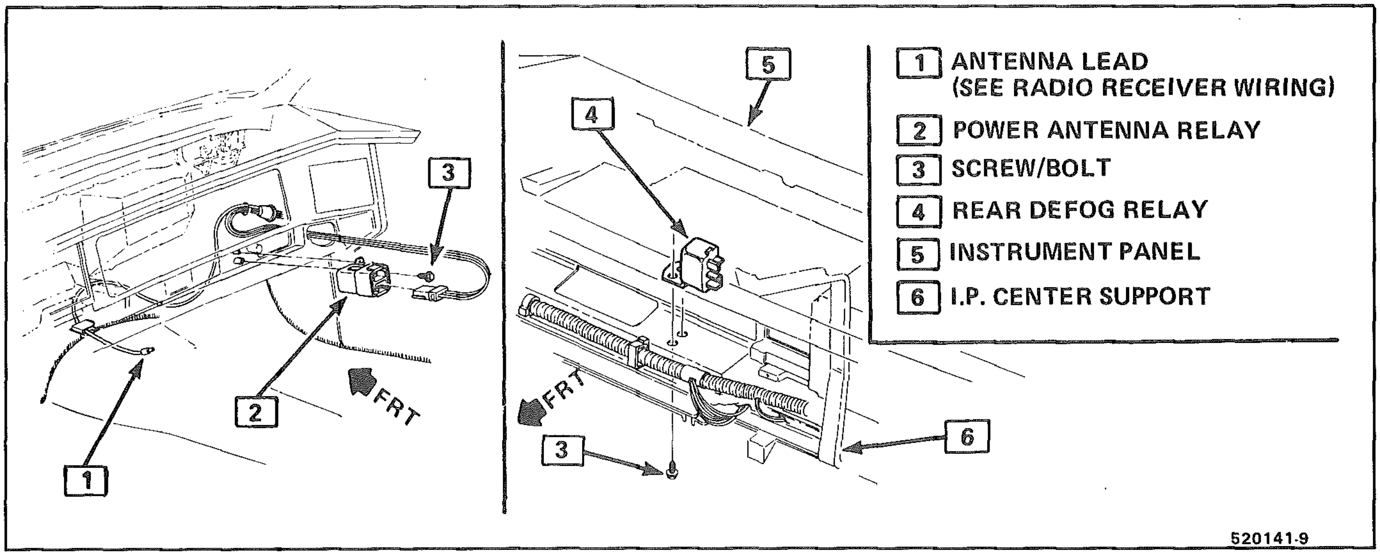


Fig. 602 Power Antenna and Rear Defogger Relays

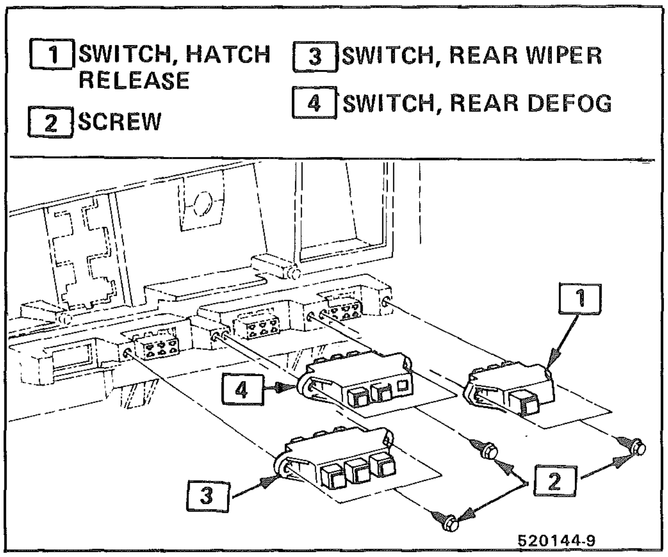


Fig. 603 Dash Mounted Accessory Switches.

F CARLINE

BODY SERVICE

This section contains essential removal, installation, adjustment and maintenance procedures for servicing the F body style. This information is current at time of publication approval.

TABLE OF CONTENTS

SECTION 1H

GENERAL INFORMATION

NOTICE: The anti-theft label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask **must** be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

LOCK CYLINDER CODING

KEY IDENTIFICATION AND USAGE

The lock cylinder keyway is designed so that other model keys will not enter a current model lock cylinder. Two noninterchangeable keys are used.

- Square headed key is used in the ignition lock cylinder.
- Oval headed key is used in all other lock cylinders.

Key identification is obtained from the four character key code stamped on the knockout portion of the key head and an identification letter stamped on the key shank. After the code number has been recorded by the owner, the plugs should be knocked out of the key head. From these numbers, the lock combination can be determined by use of a code list (available to owners of key cutting equipment from equipment suppliers). If key code numbers are not available from records or from the knockout plug, the lock combination (tumbler numbers and position) can be determined by laying key on diagram in Figure 1.

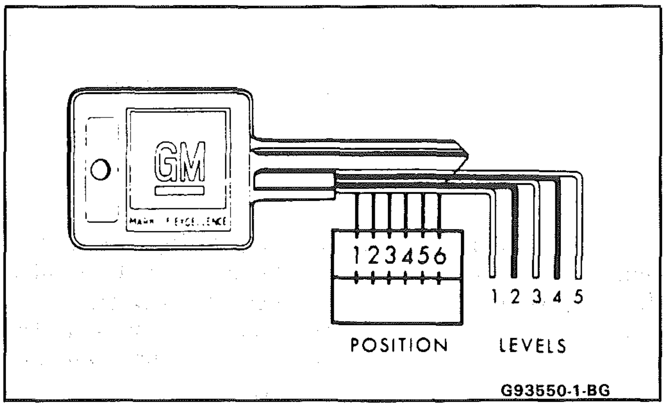


Fig. 1 - Key Code Diagram

CUTTING KEYS

- Determine special code from the code list or the key code diagram (Fig. 1).
- Cut a blank key to the proper level for each of six tumbler positions.
- Check key operation in the lock cylinder.

REPLACEMENT LOCK CYLINDERS

Lock cylinders are available from service parts warehouses. The new cylinder has a locking bar staked in place. Tumblers are also available and must be assembled into the cylinder.

ASSEMBLING AND CODING LOCK CYLINDERS

All Lock Cylinders Except Rear Stowage Compartment

Tumblers for all locks are shaped exactly alike with the exception of the notch position on one side. As the key is inserted in the lock cylinder, tumblers are lowered to the correct height so that notches on each tumbler are at the same level. When the notches on all six tumblers line up, the side bar is pushed into the notches by two small springs. This allows the cylinder to turn in its bore. Five types of tumblers are used to make the various lock combinations. Each tumbler is coded according to a number, 1 through 5, stamped on its side.

Assemble (Figs. 2 and 3)

1. Determine tumbler numbers and arrangement.
   a. With numerical key code, use code list provided by key cutting equipment supplier.
   b. Without numerical key code or without code list, refer to Figure 1.
      - Lay key on key code diagram. Be sure key is outlined by diagram.
      - Start with position number one. Find and record lowest level (tumbler number) that is visible. Repeat for each of the remaining five positions.
2. Starting with position one (open end or head of cylinder), insert tumblers in their proper slots in the order called for by the code (Fig. 2).
3. Pull side bar out with fingers so that tumblers will drop completely into place.
4. Insert one tumbler spring above each tumbler.

5. Insert spring retainer so that end prongs slide into the slots at each end of cylinder. Press retainer down.

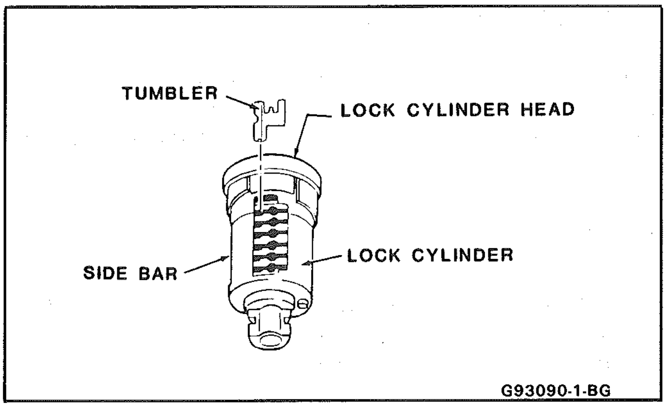


Fig. 2 - Installing Tumblers

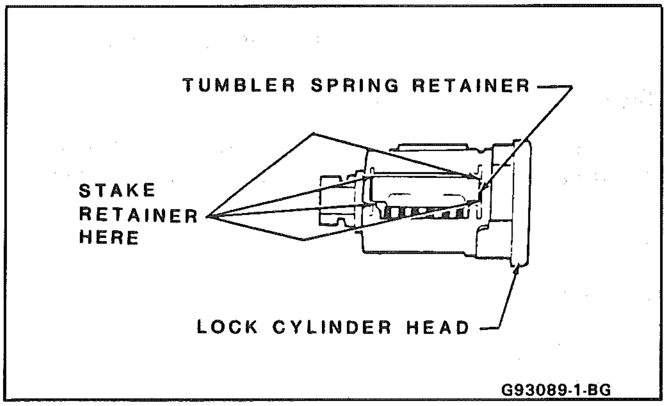


Fig. 3 - Installing Spring Retainer

6. Insert key into lock cylinder to check for proper installation.

Inspect

Side bar will drop down if tumblers are installed properly, If incorrectly assembled, disassemble and reassemble correctly.

NOTICE: Use leather or wood at each vise jaw to prevent damage to cylinder.

7. Remove key and secure cylinder in a vise with spring retainer exposed.
8. Stake spring retainer securely in place at each end. Use suitable staking tool and stake cylinder metal over retainer.
9. Black lock cylinders should be lubricated with a light oil. All other lock cylinders should be lubricated with a general purpose silicone lubricant, part no. 1052277 or equivalent.

Rear Stowage Compartment Lock Cylinder

A lock cylinder with snap-in tumblers is used for the rear stowage compartment lock. The lock cylinder has four or five tumbler positions. The number 1 or 2 position (closest to cylinder head) is a brass retainer tumbler. The 2 through 5 positions or 3 through 5 positions are standard tumbler positions depending upon cylinder type. Therefore only the last 4 or 5 tumbler combinations are required.

Assemble (Figs. 4 and 5)

Determine tumbler numbers and arrangement as previously described and install tumblers.

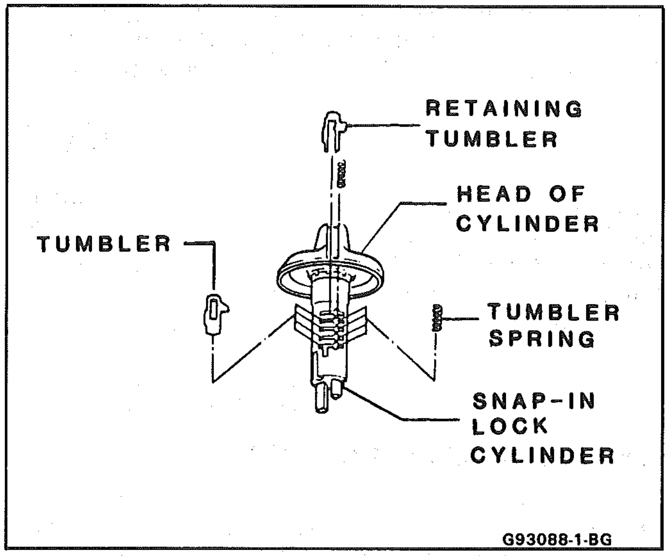


Fig. 4 - Installing Tumblers

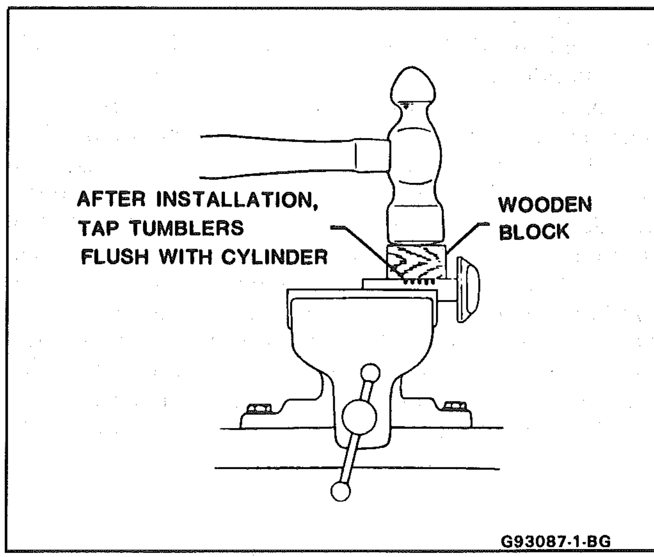


Fig. 5 - Locking Tumblers in Place

LUBRICATION

Mechanical parts having contacting surfaces in relative motion with other body parts are lubricated during assembly. To maintain ease of operation, it is recommended that these parts be lubricated at the basic service intervals shown in the Maintenance Schedule with the following lubricants:

- Door hinges – oil (30 weight preferred). Apply lubricant to roller and hinge pin bushings.

Important

Do not apply to hold-open link and roller contacting surfaces as this could cause improper roller operation.

- Compartment lid hinges – part no. 1052196, Lubriplate Auto Lube A; part no. 1052349, Lubriplate Spray Lube A, part no. 8915, 3M Lithium Spray Lube or equivalent.
- Black lock cylinders – light oil.
- All other lock cylinders – a general purpose silicone lubricant, part no. 1052277 or equivalent.
- Seat mechanism and door hardware are covered in the specific body area sections in this manual.
- All weatherstrips should be periodically lubricated with a silicone paste lubricant, part no. 1052363, or equivalent. A thin film of lubricant should be applied using a clean cloth.

ADHESIVE BODY SIDE MOLDING

The body side moldings are attached to the body panels with adhesive tape. To insure a good molding replacement (new or old moldings), the panel surface should be warm (21°C to 32°C or 70°F to 90°F), clean and free of any wax or oily film. Two methods are listed to attach loose molding ends and completely removed moldings.

Molding End Loose

1. Wash affected area with soap and water and wipe dry. Wipe panel and adhesive side of molding with a clean rag using oil-free naphtha or alcohol.

   If molding has pulled loose from adhesive backing (tape remains on body panel), do not remove tape from body. Clean back of molding and tape on body with oil-free naphtha or alcohol and proceed with step 3.
2. If needed, apply a length of masking tape as a molding guide. A straightedge may also be used in most cases.
3. Apply adhesive to back of molding and press in place. If Loctite 414 adhesive (part no. 1052283) or equivalent is used, apply constant pressure to molding for 30 seconds or until a firm bond has been made.

Molding Completely Removed

1. Wash affected panel area with soap and water and wipe dry. Remove all traces of adhesive from body panel and back of molding using oil-free naphtha or alcohol.
2. Mark proper position of molding with a length of masking tape. Use adjacent moldings as a guide, if applicable (Fig. 6).
3. If body is below 21°C (70°F) due to shop temperature or outside temperature, warm body panel with heat lamp or heat gun while proceeding with step 4.
4. Apply a double-coated acrylic foam tape such as 3M Super Automotive Attachment Tape (part no. 06380 which has a white backing or part no. 06379 which has a black backing) or equivalent to the molding.
5. Align molding to tape guideline and press firmly in place.

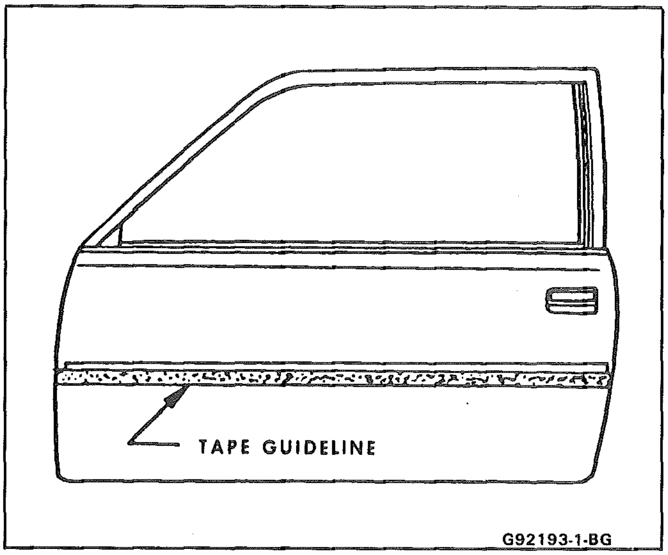


Fig. 6 - Adhesive Body Side Molding Repair

WATERLEAK DIAGNOSIS AND REPAIR

GM vehicles are designed to operate under normal environmental conditions. The design criteria for sealing materials and components takes into consideration the sealing forces required to withstand the natural elements. These specifications do not, and cannot, take into consideration all artificial conditions such as may be encountered in some high pressure car washes.

The watertest procedure has been correlated to the natural elements and will determine the ability of a car to perform under normal operating conditions.

Repairing body waterleaks is a problem of proper testing, diagnosis and repair through adjustment of misaligned components and/or application of proven repair materials. The first step in waterleak diagnosis is finding the conditions under which the leak occurs. For example, leak noticed only when parked on an inclined drive or water in spare tire compartment.

If the general leak area can be found, the exact entry point can be quickly isolated by use of a localized test such as a water hose or air hose. If the leak source is not obvious, the generalized testing method using watertest equipment such as the watertest stands shown in Figures 7 and 8 should be used. It may be necessary to remove some interior trim panels or components to locate and confirm repairs.

GENERALIZED TESTING

Specifications for construction of the watertest stand are shown in Figure 9.

If the specified water pressure of 155 kPa (22 psi) cannot be obtained because of a local situation, both test stands may be moved toward body until water spray overlap can be obtained.

LOCALIZED TESTING (SPOT TEST)

Localized testing may be made with either water or air. Begin test at the base of the suspected area and continue up slowly until the leak is located.

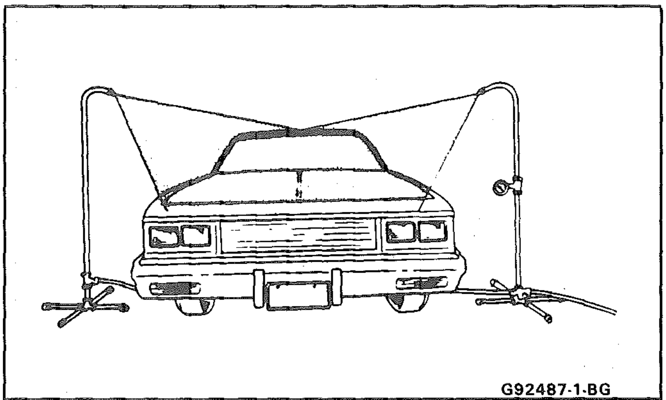


Fig. 7-Watertest Stands Positioned for Front End Watertest

Important

Pinpoint the leak area before any repair is made. Random repair may only temporarily restrict water entry and make future diagnosis and repair more difficult.

Continue localized testing in the same general area to confirm that all leaks have been located.

WATER HOSE TEST

- Have a helper inside the car to detect the actual leak point (Figs. 10 and 11).
- Use unrestricted water flow (no nozzle).
- Begin at base of suspected leak area and move upward slowly.

AIR HOSE TEST

- Apply bubble solution (liquid soap) to suspected area (Figs. 12 and 13).
- Apply air pressure with an air hose from inside the car. Do not exceed 205 kPa (30 psi).
- Observe for bubbles on outside at suspected leak area.

WATERLEAK REPAIR

To locate the exact leak point or to repair the leak (Fig. 14), it may be necessary to remove some interior trim panels or components. For waterleak repair procedure on stationary glass, see Section 2H.

After completion of any waterleak repair, the general area should be retested using the watertest stand. Do not use air hose or water hose to test repaired areas as the repair material may dislodge under abnormal pressure.

ANTICORROSION TREATMENT

To provide for rust resistance, special anticorrosion materials are used on interior and exterior surfaces of metal panels. These materials include special metals such as one-sided and two-sided galvanized zincrometal and zinc-iron alloy steels, These specially treated metals are used on components such as fenders, doors, quarter panels, rocker panels, lids, floor pans, wheelhousings and other critical parts.

Special metal conditioners and primers are used on interior and exterior surfaces along with protective waxes on interior surfaces in areas where moisture

WATERTEST STAND SPECIFICATIONS

TYPE OF NOZZLE — FULL CONE SPRAY WITH 60° INCLUDED ANGLE — "FULL JET" SPRAY NOZZLE NO. 1/2 GG-25 OR EQUIVALENT.

NOZZLE HEIGHT — APPROXIMATELY 1 600 mm (63") FROM FLOOR

VOLUME OF FLOW — 14 LITERS (3.7 GALLONS) PER MINUTE

PRESSURE — 155 kPa (22 PSI) MEASURED AT NOZZLE

WINDSHIELD AND FRONT BODY PILLAR — APPROXIMATELY 30 DEGREES DOWN, 45 DEGREES TOWARDS REAR AND AIMED AT CORNER OF WINDSHIELD

SIDE — APROXIMATELY 30 DEGREES DOWN, 45 DEGREES TOWARDS REAR AND AIMED AT CENTER OF REAR DOOR OR REAR QUARTER.

BACK WINDOW AND REAR COMPARTMENT LID — APPROXIMATELY 30 DEGREES DOWN, 30 DEGREES TOWARDS FRONT AND AIMED APPROXIMATELY 600 mm (24") FROM CORNER OF BACK WINDOW.

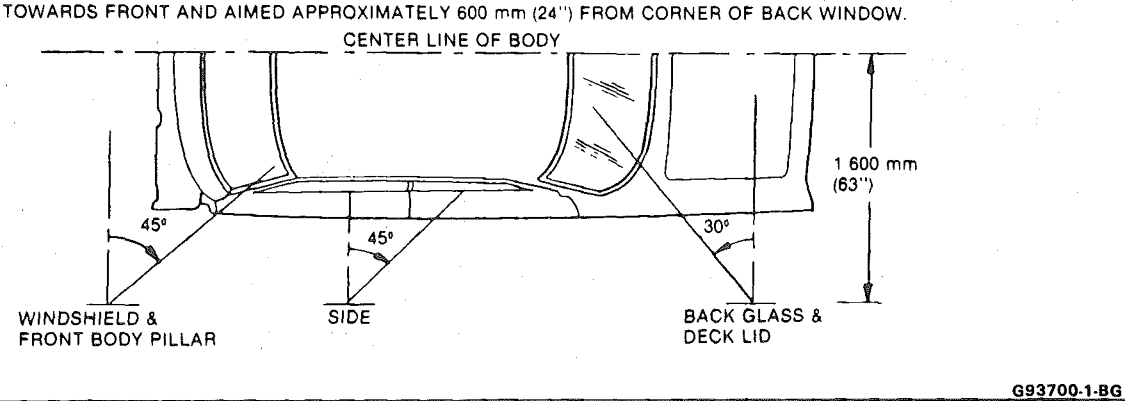
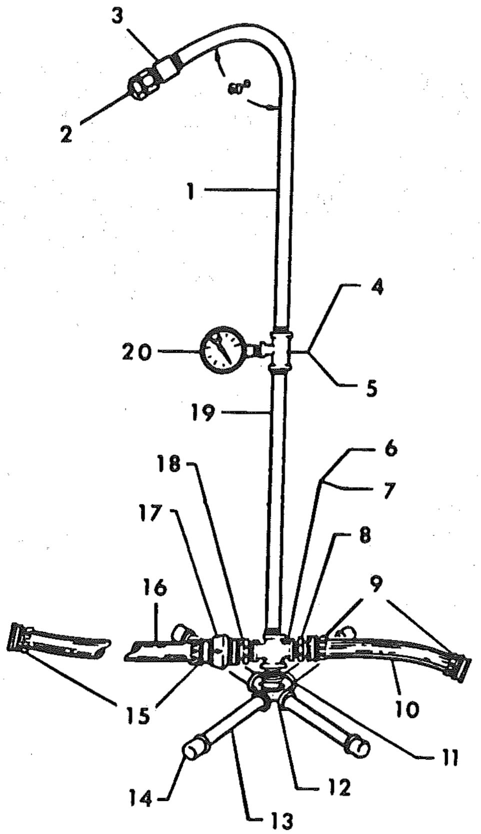


Fig. 8-Watertest Stand Specifications



1. 1/2" x 36" Pipe
2. Full-Jet Spray Nozzle #1/2GG-25 or Equivalent Nozzle Height - 64" to Floor
3. 1/2" Coupling
4. 1/2" x 1/2" x 1/4" Reducing Tee (Right Only)
5. 1/2" Coupling (Left Only)
6. 1/2" Cross (Right Only)
7. 1/2" Tee (Left Only)
8. 1/2" Pipe to Hose Nipple (Right Only)
9. 5/8" Female Hose Coupling
10. 2' Input Hose (5/8" Dia.) Right Only
11. 1/2" Close Nipple
12. 1/2" Cross with Weld-On 1/2" Cap
13. 1/2" x 12" Nipple
14. 1/2" Cap
15. 5/8" Female Hose Coupling
16. 12' Cross Hose (5/8" Dia.)
17. Hose Quick Connect
18. 1/2" Pipe to Hose Nipple
19. 1/2" x 30" Pipe (Straight)
20. Water Pressure Gage (Right Side)

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Fig. 9-Watertest Stand

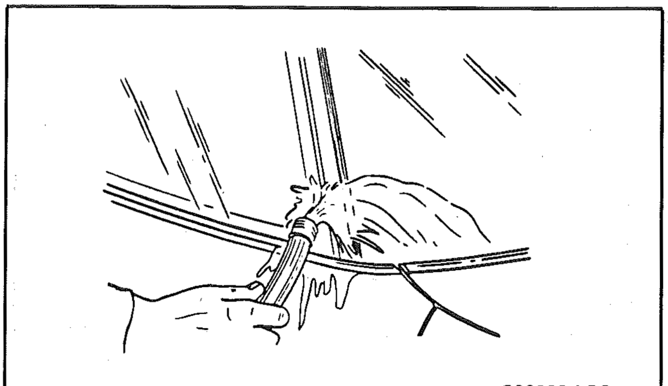

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Fig. 10-Water Hose Test of Windshield Pillar

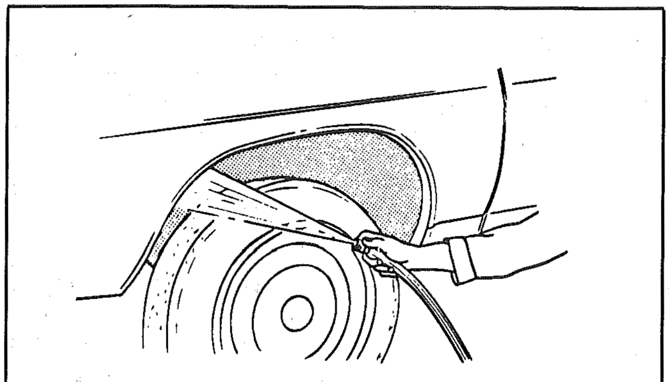

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Fig. 11-Pressure Test of Wheelhouse

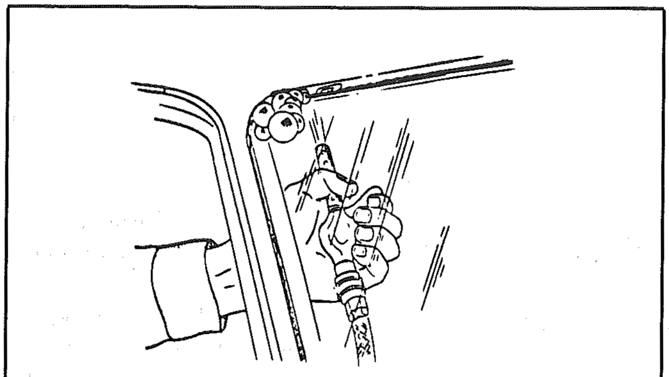

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Fig. 12-Air Hose and Bubble Solution Test of Windshield Glass Sealant

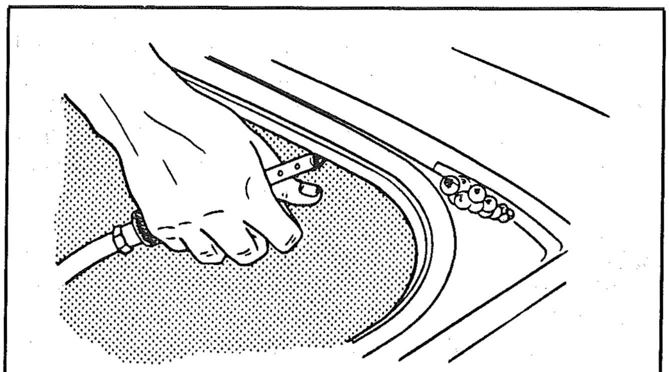

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Fig. 13-Air Gun and Bubble Solution Test of Panel Joints

LEAK AREAS	REPAIR MATERIALS
WINDSHIELD, BACK WINDOW AND QUARTER GLASS	URETHANE ADHESIVE CAULKING KIT No. 9636067 OR EQUIVALENT
METAL JOINTS	BRUSHABLE SEAM SEALER WHICH CAN BE PAINTED
VENTILATION DUCTS AND DRIP MOLDINGS	3M AUTO BEDDING AND GLAZING COMPOUND OR EQUIVALENT
SMALL CRACKS AND PIN HOLES	3M DRIP-CHEK SEALER OR EQUIVALENT
LARGE HOLES	3M ALL AROUND AUTOBODY SEALANT No. 8500 OR EQUIVALENT
WEATHERSTRIPS	3M 08011 WEATHERSTRIP ADHESIVE OR EQUIVALENT
BOLTS, STUDS AND SCREWS	STRIP CAULK

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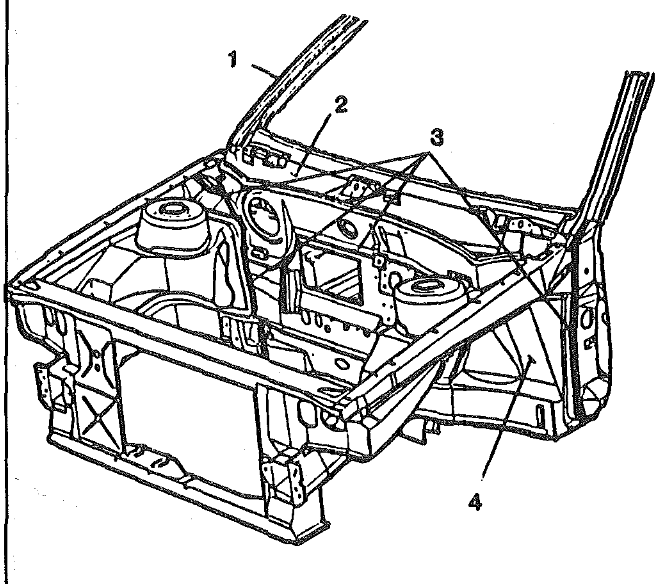
Fig. 14-Recommended Materials for Waterleak Repair

might accumulate. Sealers are applied along exposed joints and moisture-repelling asphaltic sound deadeners are applied inside wheel wells and doors and on some underbody components. Figures 15 through 23 illustrate typical production and field usage of these materials.

Any procedure that disturbs these special treatments, such as panel replacement or collision damage repair operations, may leave the metal unprotected and result in corrosion. Therefore, proper recoating of these surfaces with service-type anticorrosion material is essential.

Metal conditioners and primer coatings are applied to all metal panels at the time of vehicle manufacture. After repair and/or replacement parts are installed, all accessible bare metal surfaces must be treated with metal conditioner and reprimed using an acrylic chromate material. This operation is to be performed prior to the application of sealers, waxes, deadeners and antirust compounds.

Sealers are applied to specific joints during manufacture. These sealers are intended to prevent water and dust from entering the car and also perform



1. WINDSHIELD PILLAR
2. PLENUM
3. APPLY A BRUSHABLE SEAM SEALER OR MEDIUM-BODIED SEALER
4. SHROUD SIDE PANEL

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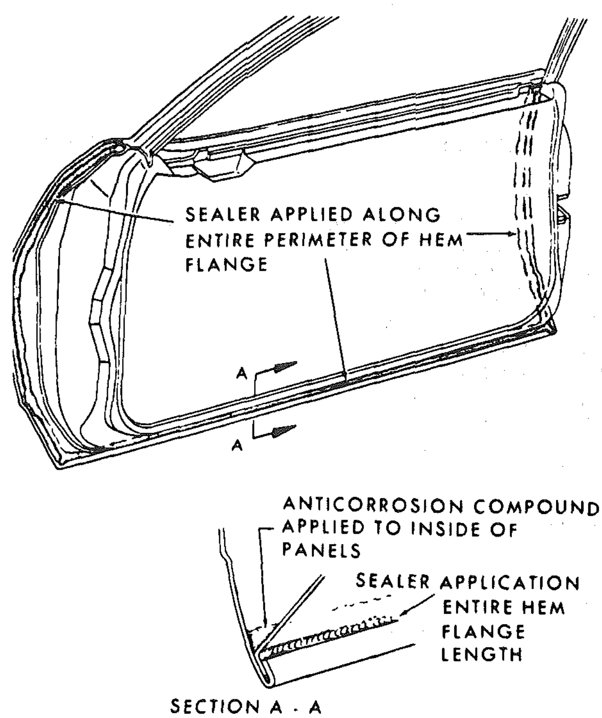
Fig. 15 - Sealing Front End



TO BE EFFECTIVE, SEALER MUST PENETRATE BETWEEN INNER AND OUTER PANELS

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Fig. 16-Typical Hem Flange and Anticorrosion Treatment

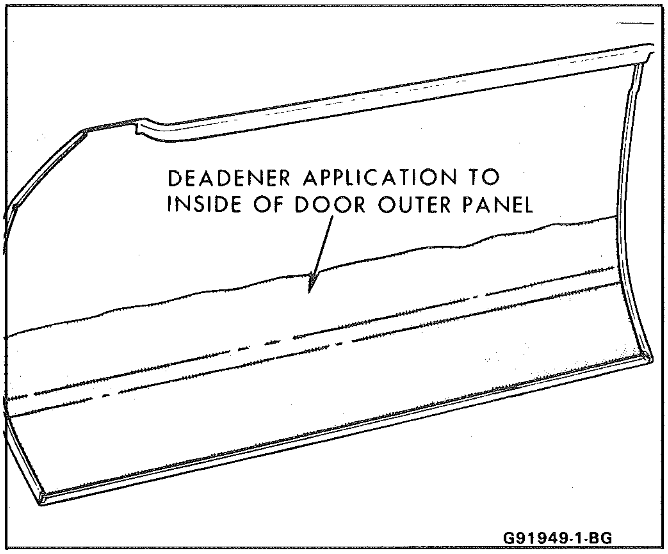

Fig. 17-Typical Application of Deadener Material

as anticorrosion barriers. Sealers are applied to such areas as door and rear compartment lid hem flanges, wheelhouse, quarter outer, floor, cowl, roof and various other panel-to-panel attaching points. The originally sealed joints are obvious and any damage to these sealed locations should be corrected by resealing. Attaching points of new replacement panels should be resealed. Replacement lids and doors will also require sealing in the hem flange areas.

Flanged joints, overlap joints and seams should be sealed using a quality sealer of medium-bodied consistency. Sealer used must retain its flexible characteristics after curing and be paintable.

Open joints which require bridging of sealer to close a gap should be sealed using a heavy-bodied caulking material. Follow label directions for material selected.

Color application may be required to restore repaired areas such as hood, fenders, doors, quarters, lid, roof, engine compartment, underbody and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat build-up and color application techniques should be followed.

Deadener materials (spray-on type) are used on various metal panels to provide corrosion resistance, joint sealing and control the general noise level inside the passenger area of the car. When deadeners are disturbed because of damage, removed during repair operations, or a new replacement panel is installed, the deadener material must be replaced by a service equivalent material. The application pattern and location of deadener materials can be determined by observing the original production installation.

Anticorrosion compounds are light-bodied materials designed to penetrate between metal-to-metal surfaces, such as pinch-weld joints, hem flanges, and integral panel attaching points where metal surfaces are difficult to coat with conventional undercoating materials, and are inaccessible for painting. Materials suited for this type application are 3M Rust Fighter-1 (part no. 08892) or equivalent.

Conventional undercoating is recommended to coat large areas such as replacement door and quarter outer panels, floor pan sections, lids, hoods, fenders, etc.

During undercoating operations, care should be taken to prevent the material from being sprayed into door and quarter hardware mechanisms such as door locks, glass run channels, window regulators and seat belt retractors. On the underbody, the material should not be applied to any moving or rotating part, energy absorbing bumper components or shock absorbers. After undercoating, make sure that all body drain holes are open.

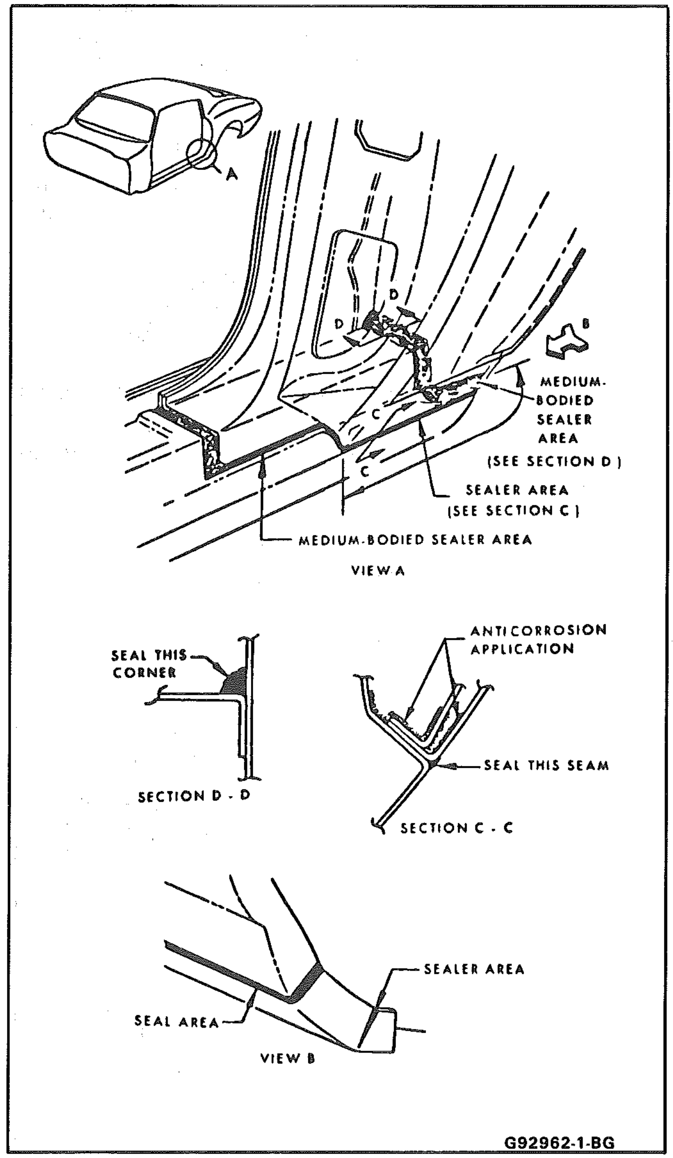

Fig. 18-Typical Sealer and Anticorrosion Compound Treatment

Sequence of application steps for anticorrosion materials is as follows:

1. Clean and prepare metal.
2. Apply primer (acrylic chromate).
3. Apply sealers (at all previously sealed joints).
4. Apply color in areas where color is required, such as hem flanges, exposed joints and underbody components.

5. Apply deadeners (as indicated by original application pattern).
6. Apply anticorrosion compounds.
7. Apply underbody rustproofing material.

Cleaning of interior and underbody panel surfaces is necessary when original galvanized or other anticorrosion materials have been burned off during welding or heating operations. Removal of the residue left from burning will require additional care in such areas as interior surfaces of box-type construction and when configurations of the metal panels limit access to interior surfaces. One or more of the following methods will remove the residue.

CAUTION: Standard shop practices, particularly eye protection, should be followed during these operations to avoid personal injury.

- Where access is possible, scraping can be used. If a standard putty knife or scraper will not fit into the affected area, consider fabricating a small, flexible scraper from a narrow piece of sheet metal.
- A jet of compressed air will remove most residue and could be most effective in limited-access areas. Eye protection is absolutely necessary in an operation of this type.
- Sandblasting is most effective and should be used when the equipment is available and access to the area is good. Sandblasting is an excellent method for cleanup and preparation of open joints, underbody components and hem flange areas.
- Wire brushing (power and by hand).
- When access is good, sandpaper and steel wool can be used.

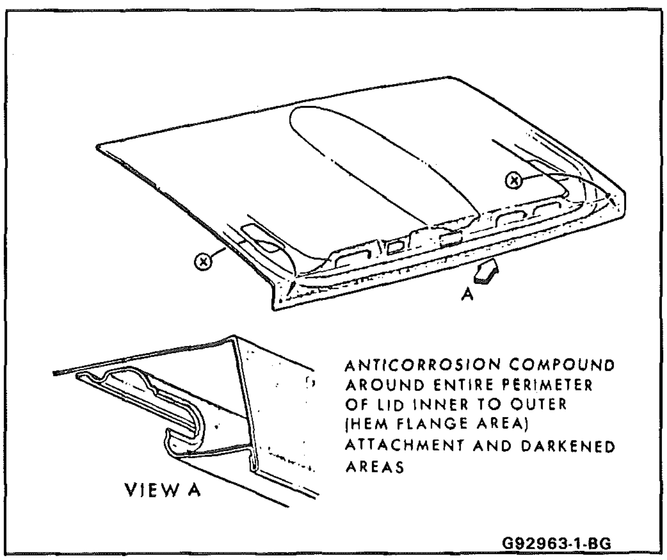

Fig. 19-Typical Anticorrosion Treatment to Interior of Rear Compartment

CHIP RESISTANT PLASTISOL MATERIAL

A chip resistant plastisol material is applied to specific lower areas of the body prior to color coat application on some cars. The presence of the applied material can be detected through visual inspection. If the production-applied, chip resistant plastisol

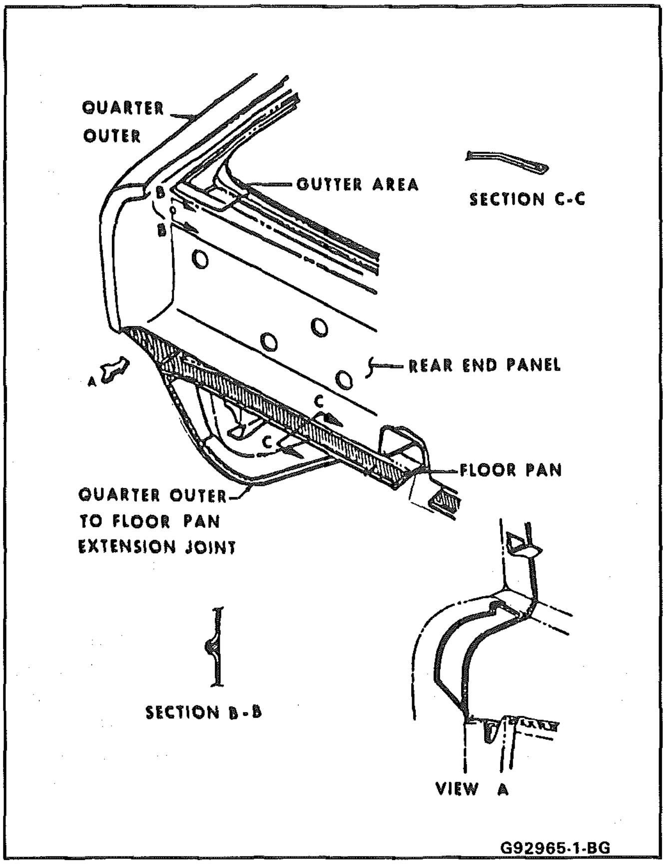

Fig. 20-Typical Joint Sealing, Rear End Area(s)

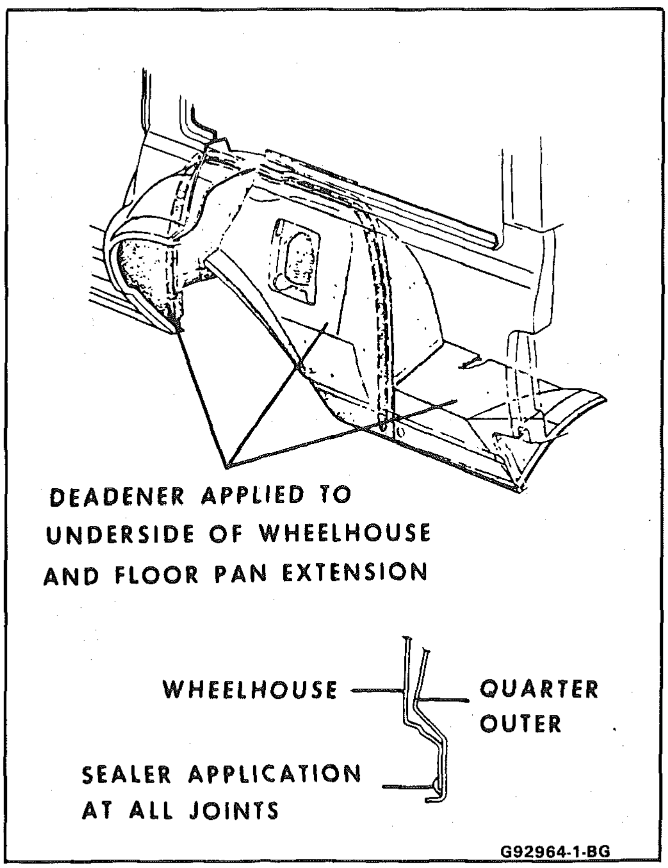

Fig. 21-Typical Deadener and Sealer Application, Wheelhouse Area

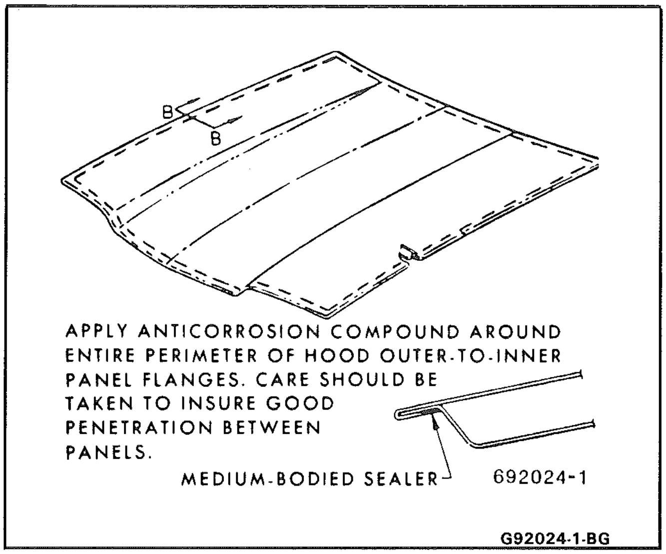

Fig. 22-Typical Hood Panel Sealer Application

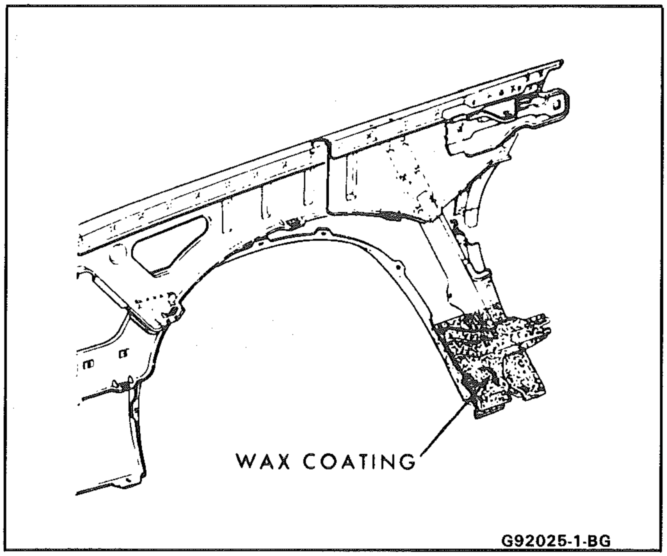

Fig. 23-Typical Fender Anticorrosion Compound Application

material requires replacement, a chip resistant air dry vinyl plastisol that is solvent borne and sprayable is available for field use.

The following materials can be used for refinish operations. Follow material manufacturer's label directions for application.

- Acme Gravel Guard #559 or equivalent - 1 quart container
- Rodgers Vinyl Gravel Guard #4559 or equivalent - 1 quart container
- Sherwin-Williams Vinyl Gravel Guard #G1W295 or equivalent - 1 quart container
- Tuff-Kote #1077 or equivalent - 1 quart container

Equipment necessary for repair in addition to the above materials:

- Sandpaper - #80 Grit
- Portable heat lamp or heat gun
- Extension cord
- Clean shop towel
- Conventional hand spray gun with pressure feed cup attached (DeVilbiss, J.G.A., Binks or equivalent)
- Putty knife

FLEXIBLE EXTERIOR PLASTIC PARTS REPAIR AND REFINISHING (EXCEPT E/P OR TPO)

Soft plastic parts used for exterior or cosmetic application are compounded of resins that have flexible characteristics in order to absorb minor impact without sustaining damage. Typical examples include bumpers, front end fascia or side panels such as fenders. These parts are generally fabricated of thermosetting plastics which, when cured, cannot be melted with application of heat such as through hot air welding. However, if the impact force is great enough to create damage, thermoset plastics can be successfully repaired with structural adhesives.

Briefly, the repair system amounts to a filling and, where necessary, a reinforcing operation. After curing, the patch is dressed to conform to the surrounding contour.

Following are typical damage conditions and respective repair procedures:

1. Gouge or puncture repair
   a. Clean the repair area with a wax, grease and silicone-removing solvent applied with a water-dampened cloth. Wipe dry. With a random orbit sander fitted with a #180 grit disc, remove the paint film in and surrounding the area to be filled. The repair material should **not** overlap the painted surface (Fig. 24).

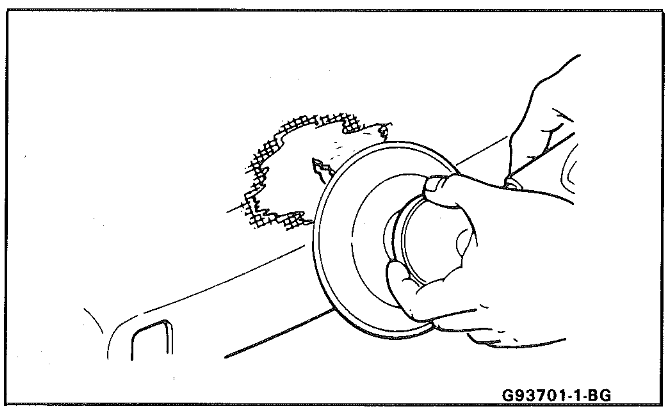

Fig. 24-Removing Paint Surrounding Damage

   b. Use a clean 2″ or 3″ #50 grit disc to enlarge the gouge or puncture in order to ensure removal of grease, oil or dirt from the area to be contacted by the repair material. This action should also create at least a 25 mm (1″) taper around the damage for extended contact between the repair material and substrate. Remove all dust and loose particles from the repair area (Fig. 25).

   Aluminum Autobody Repair Tape (3M #06935, #06936 or equivalent) can be used on the back side of a puncture to support the repair material (Fig. 26).

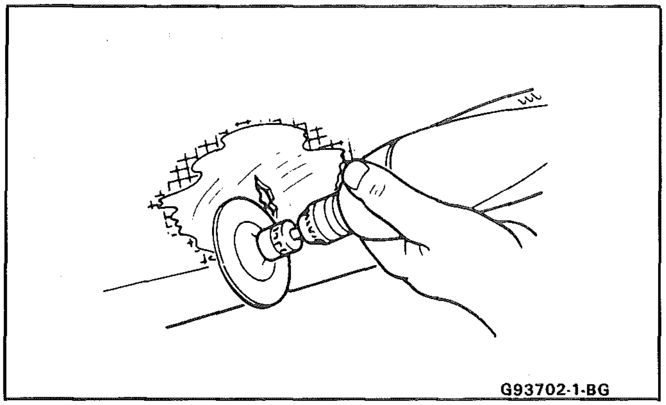

Fig. 25-Tapering Substrate Surrounding Damage

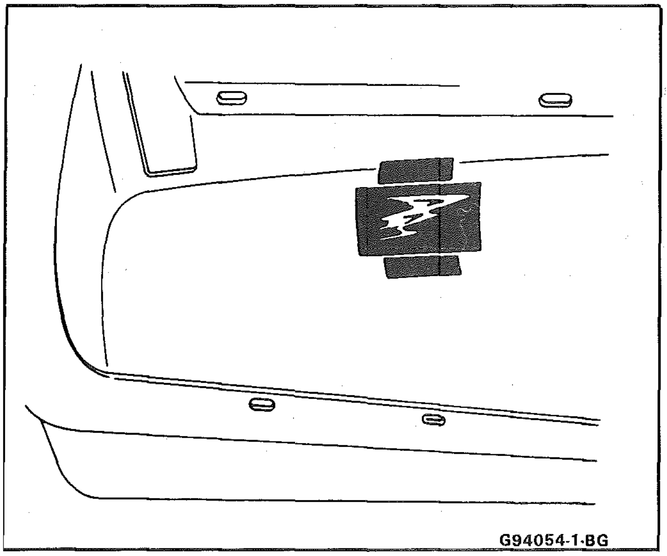

Fig. 26-Tape Support for Repair Material

c. On a clean, flat surface of nonporous material such as metal, glass or plastic, deposit equal length beads of each component (3M Flexible Parts Repair Material #05900 or 3M Brand Structural Adhesive #08101 or equivalent). With a paddling motion, mix the two components until a uniform color and consistency is achieved (Fig. 27).

d. Apply the mixed repair material with a squeegee or plastic spreader. Apply a light coat over the entire area; then continue application to a level slightly above the surrounding contour. Allow the mixture to cure 20 to 30 minutes at 16°C to 27°C (60°F to 80°F). If low areas or pits remain, mix and spread additional adhesive or use 3M Flexible Parts Putty #05903 or equivalent (Fig. 28).

e. Establish rough contour where possible with a curved tooth body file. Follow by block sanding using #220 sandpaper to establish accurate level and contour with the surrounding surface (Figs. 29 and 30). For final feathering, use a random orbit sander with a #320 disc.

2. Structural type repair

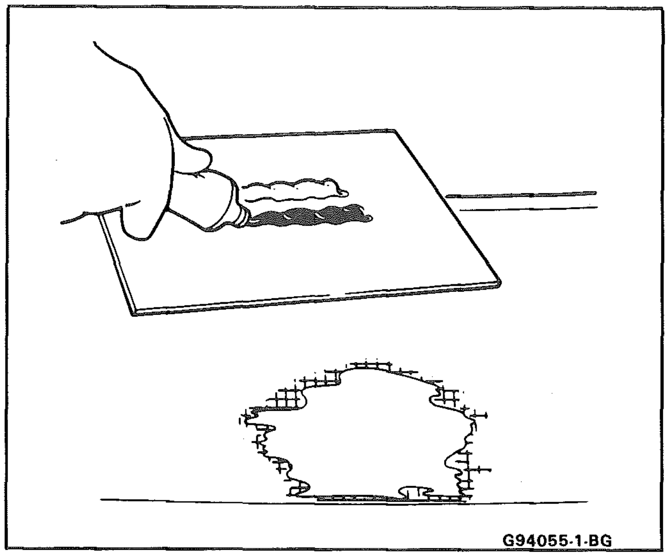

Fig. 27-Measuring Two-Component Repair Material

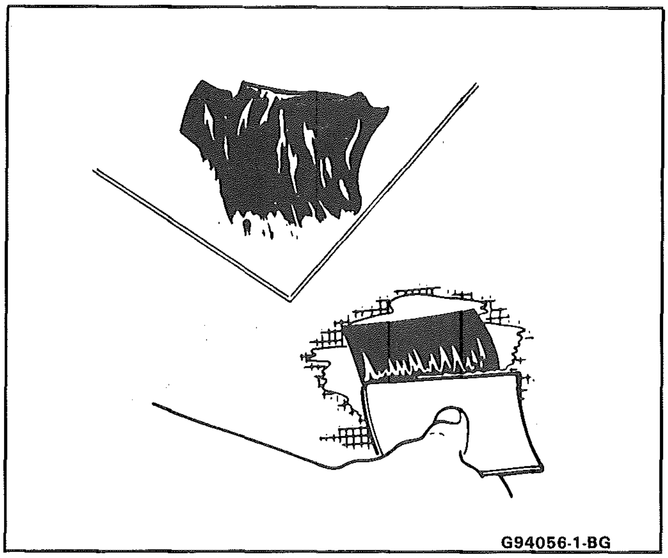

Fig. 28-Applying Mixed Repair Material

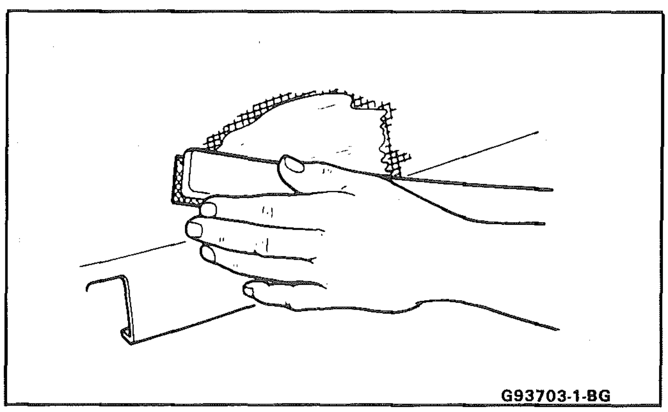

Fig. 29-Establishing Rough Contour with Body File

When a piece of attaching surface of a part is cracked or broken away as in Figure 31, structural strength may be restored as follows:

a. Align and secure the piece on the face side with body tape and clamp (Fig. 32).

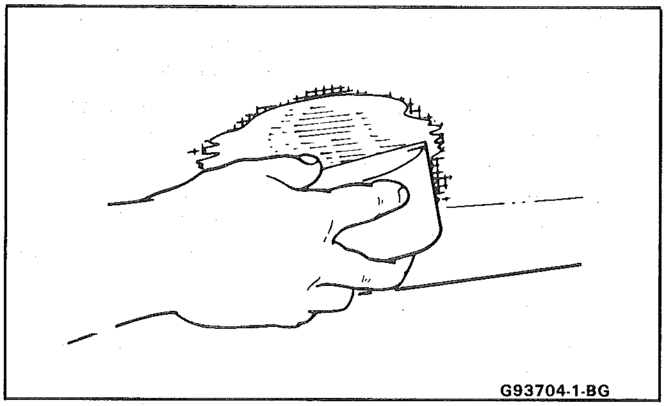

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Fig. 30-Block Sanding for Accurate Contour

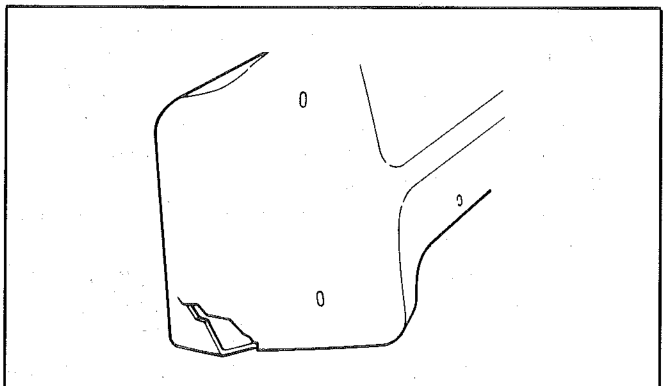

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Fig. 31-Damaged Attaching Surface

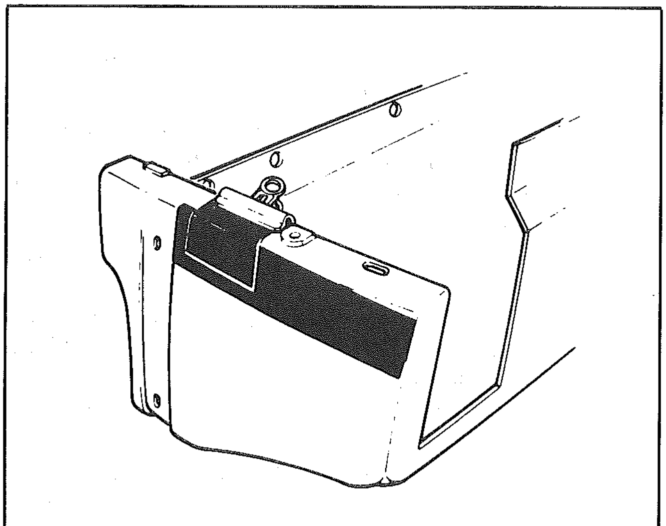

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Fig. 32-Aligning Damage with Tape and Clamp

b. Clean the underside of the repair area as in step 1a. Sand each side of the break with a #50 grit disc (Fig. 33).

c. Cut a piece of fiberglass cloth large enough to overlap the break 38 mm (1-1/2") (Fig. 34).

d. As in step 1c, thoroughly mix a quantity of adhesive and apply a layer of the mixture approximately 3 mm (1/8") thick on the back side of the part overlapping the break at least 38 mm (1-1/2") as in Figure 35.

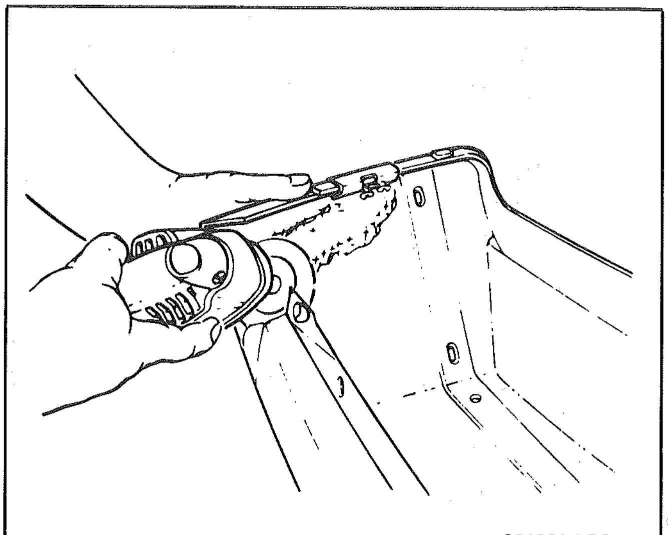

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Fig. 33-Discing Back Side of Damage

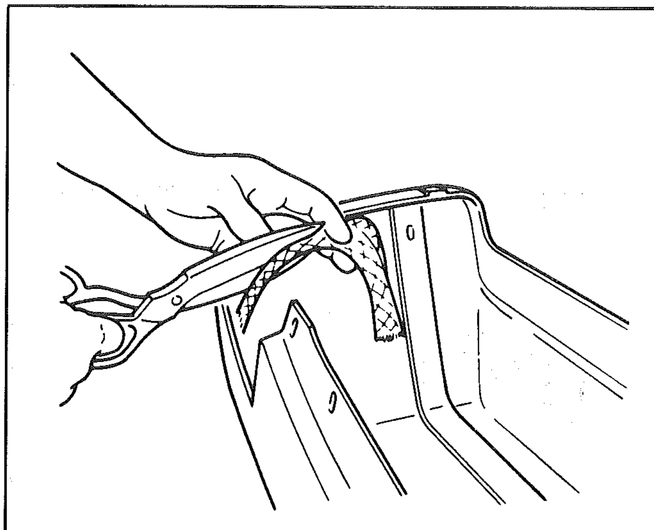

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Fig. 34-Cutting Fiberglass Cloth to Size

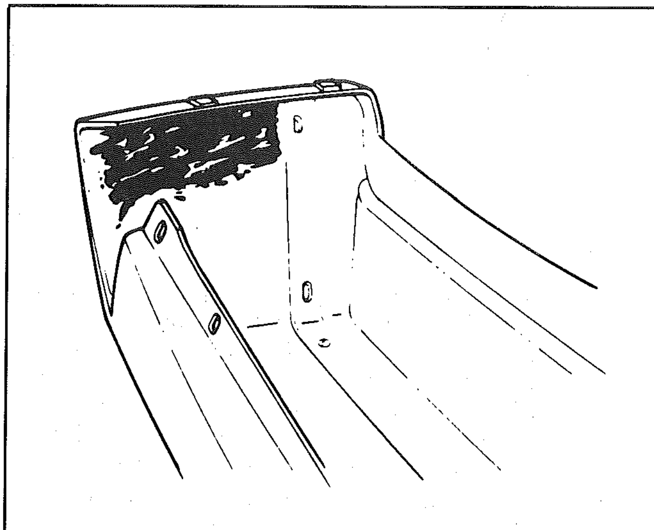

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Fig. 35-Applying Repair Material - Back Side of Damage

e. Apply the precut fiberglass cloth to the adhesive and immediately cover the cloth with additional adhesive in sufficient quantity to fill the weave (Figs. 36 and 37).

f. Allow 20-30 minutes cure time at 16°C to 27°C (60°F to 80°F). Trim excess repair material at edge if necessary.

g. Repair the face side of the area following steps 1a through 1e.

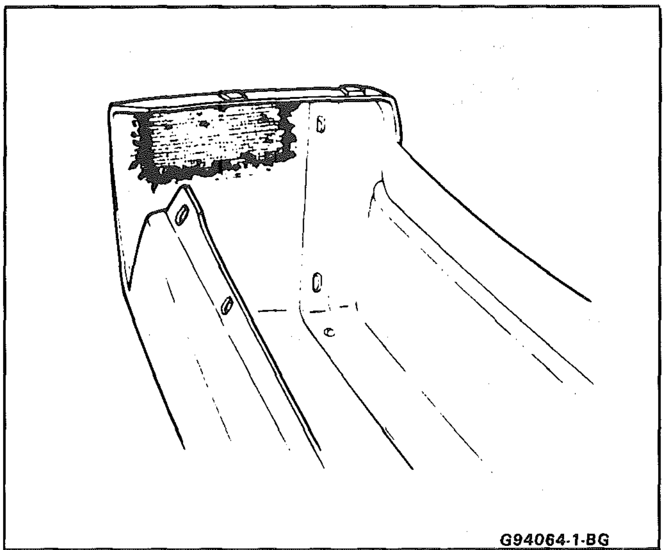


Fig. 36-Applying Fiberglass Cloth to Repair Material

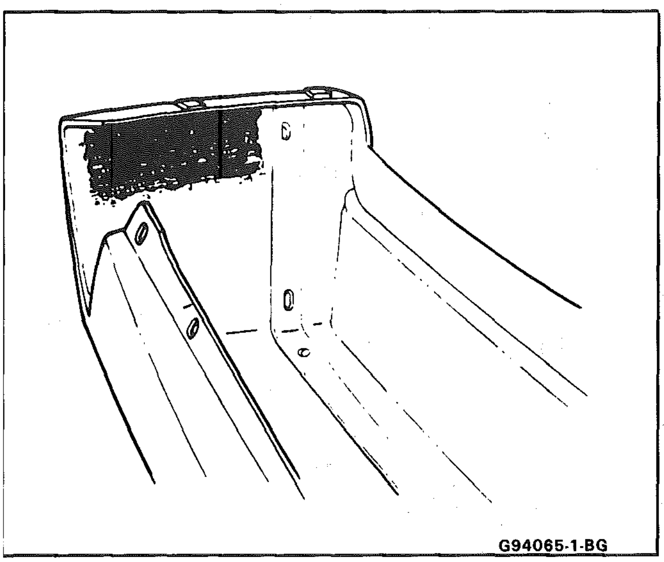


Fig. 37-Filling Fiberglass Cloth

3. Paint repair

The original factory applied paint finish on flexible exterior plastic parts is in most cases baked elastomeric enamel. However, for repair, either a lacquer or enamel system may be used; but **both** primer, when required, and color coats **must** have elastomeric or flexible properties.

There is a wide choice of flexible paint systems available for service use; however, many require additives containing isocyanates. Be certain to follow all recommendations and warnings listed on the container labels for materials selected.

Following is a list of some of the products available for painting flexible plastic parts: DuPont Dexlar Flexible Finish (Lucite "B" color suffix plus Dexlar 365 B plus 792-S Hardener), Rinshed-Mason Flex Agent 891 (additive for R-M acrylic lacquer and primer surfacer), Ditzler Flexative DX-369 (additive for Ditzler acrylic lacquer and enamel), Ditzler Elastomeric Primer DPX 844 (requires DTX 895 Thinner), Sherwin-Williams Acrylic Flex Additive V2V297 (additive for S-W acrylic lacquer), 3M Flexible Parts Coating #05905 or other equivalent products.

CAUTION: If the paint system selected specifies an additive containing isocyanates, it is mandatory that adequate respiratory protection be worn. An example of such protection is an air line respirator with a full hood or half mask. If not available, use a vapor/particulate respirator that the respirator supplier recommends as effective for isocyanate vapors and mists (unless local regulations prevail).

Color coat the entire component. Spot repair is not recommended.

a. Clean the entire part with a wax, grease and silicone-removing solvent applied with a water-dampened cloth. Wipe dry.

b. Featheredge the repair with #320 sandpaper, blow off dust and tack.

c. Mix and apply four medium coats of flexible primer surfacer (R-M or equivalent). Allow each coat to flash.
   - 2 parts APS Primer-Surfacer or equivalent
   - 1 part 891 Flex Agent or equivalent
   - 3 parts PNT 62 or equivalent

   Allow to dry at least one hour and block sand with #400 sandpaper.

   For color coat only operations, omit steps b and c.

d. **Thoroughly** sand the entire part with #400 sandpaper to remove **all** gloss. Reclean as in step a.

e. Mix the color, flexible additive and solvent (R-M or equivalent) as follows:
   - 1 part Alpha-Cryl or equivalent
   - 1 part 891 Flex Agent or equivalent
   - 1/2 part PNT 88 or PNT 90 or equivalent

f. Apply a sufficient number of coats to achieve complete hiding and color match. The topcoat mixture will dry to the touch in about one hour.

E/P OR TPO REPAIR

1. Clean repair area with wax, grease and silicone removing solvent. Wipe dry.
2. Use a 2" or 3" #50 grit disc to enlarge the damaged area.
3. With a random orbit sander fitted with a #180 grit disc, sand the damaged area and remove the paint film from the surrounding area to be filled.

4. Prime entire area with 3M Polyolefin Adhesion Promoter Part #05907 or equivalent before filling with 3M Flexible Parts Repair Material #05900 or equivalent.
5. Shape repair material with curved body tooth file. Then block sand with #220 grit disc and final featheredge with #320 grit disc.
6. If low areas or pits remain, first reapply 3M Polyolefin Adhesion Promoter or equivalent, then mix and spread additional repair material.

Painting Flexible Parts - E/P or TPO

When painting flexible plastic exterior parts identified as E/P or TPO, a polypropylene primer **must be used.** Follow manufacturer's label instructions.

METAL REPLACEMENT PARTS FINISHING

Metal service replacement parts (or assemblies) are painted with a high-bake factory primer. For proper adhesion of color coats in service, the following refinish steps are necessary.

1. Clean part with a wax and grease-removing solvent such as Prep-sol, Pre-Kleano, Sher-Will-Clean, Acryli-Clean or equivalent.
2. Scuff-sand panel lightly with wet or dry no. 400 sandpaper and water. Avoid cut-throughs. Reclean part. Apply sealer to entire part.
3. If factory primer coat was cut through, apply metal conditioner to exposed bare metal. Follow label directions.
4. Apply primer-surfacer to entire part; allow to dry thoroughly before sanding. Follow label directions for drying time.
5. Sand primer-surfacer using wet or dry no. 400 sandpaper and water. Do not sand sealer.
6. Reclean part.
7. Apply color coats to parts.
8. Follow label directions for drying time before compounding.
9. Compound part by hand or with power equipment.
10. Nonsealing polish may be applied after rub-out if desired. Waxes, however, should **not** be applied until the paint finish has aged at least two months.

Prior to replacing exterior body parts or assemblies, check condition of paint on all covered or hidden interior surfaces. If rust scale is found in these areas, proceed as follows:

1. Remove rust with suitable wire brush, abrasive or liquid rust removing agent. Follow label directions.
2. If necessary, wash with detergent, rinse and dry.
3. Apply a heavy coating of anticorrosion compound to all cleaned hidden surfaces before installing exterior body parts. Also, apply anticorrosion compound to all inner surfaces of exterior body parts being installed.

INTERIOR PLASTIC TRIM PARTS FINISHING

Paintable plastic interior trim components can be divided into three general types:

- Polypropylene Plastic
- ABS Plastic
- Vinyl Plastic

It is important for a painter to be able to identify each plastic in order to paint it satisfactorily. Painting of complete soft seat cushion and seatback trim cover assemblies of vinyl construction is not approved by the factory. Excluding the soft seat cushion and seat back trim cover assemblies, the plastic used most widely on the interior of bodies is polypropylene.

The purpose of the following tests is to determine the identity of a given plastic so that proper paint procedures and materials can be used.

Test for Polypropylene and ABS Plastic

To determine if a service part to be painted is polypropylene or ABS plastic, perform the following burn test:

1. From a hidden backside portion of the part, remove a sliver of plastic with a sharp blade.
2. While holding the sliver of plastic with tweezers or laying it on a clean noncombustible surface, ignite the plastic.
3. Observe the burning plastic closely:
   a. Polypropylene burns with no readily visible smoke.
   b. ABS plastic burns with a readily visible black smoke residue which hangs temporarily in the air.

Test for Vinyl Plastic

To determine if a part to be painted is vinyl plastic (polyvinyl chloride), a copper wire test should be performed as follows:

1. Heat a copper wire in a suitable flame such as provided by a propane or equivalent torch until the wire glows (turns red).
2. Touch the heated wire to the backside or hidden surface of the part being tested in a manner so as to retain some of the plastic on the wire.
3. Return the wire (and retained plastic) to the flame and observe for a green, turquoise blue flame. A flame in this color range indicates that the plastic being tested is vinyl.
4. If black smoke residue, which hangs temporarily in the air, is readily visible when wire (with retained plastic residue) is returned to the flame, the part is made of flexible (soft) ABS plastic material.

PAINTING POLYPROPYLENE PLASTIC PARTS

The system for painting polypropylene parts involves the use of a special primer. Since polypropylene plastic is hard, it can be color coated after prime with conventional interior acrylic lacquer.

NOTICE: Service part must be primed with a coating of special polypropylene primer according to factory recommendations. Failure to use the required primer as directed will result in color coat lifting and/or peeling problems. Use Polypropylene Primer, part no. 1052364, or equivalent.

1. Wash part with a solvent such as Acryli-Clean, Pre-Kleano, Prep-Sol or equivalent. Follow label directions.
2. Apply a thin, wet coat of polypropylene primer according to label directions. Wetness of primer is determined by observing gloss reflection of spray application in adequate lighting. Be sure primer application includes all edges. Allow primer to flash dry one minute minimum and ten minutes maximum.
3. During the above flash time period (1 to 10 minutes), apply conventional interior acrylic lacquer color as required and allow to dry before installing part. Application of color during above flash time range promotes best adhesion of color coats.

PAINTING RIGID OR HARD ABS PLASTIC PARTS

Rigid or hard ABS plastic requires no primer. Conventional interior acrylic lacquers adhere satisfactorily to hard ABS plastics.

1. Wash part with a solvent such as Acryli-Clean, Pre-Kleano, Prep-Sol or equivalent.
2. Apply conventional interior acrylic lacquer color according to trim combination (see paint supplier color chart for trim and color code). Apply only enough color for proper hiding to avoid washout of "grain" effect.
3. Allow to dry following label directions and then install part.

PAINTING VINYL AND FLEXIBLE (SOFT) ABS PLASTIC PARTS

The outer cover material of flexible instrument panel cover assemblies is made mostly of ABS plastic modified with PVC or vinyl. The same is true of many padded door trim assemblies. The soft cushion padding under ABS covers is urethane foam plastic.

The most widely used flexible vinyls (polyvinyl chloride) are coated fabrics as used in seat trim, some door trim assemblies, headlinings and sunshades. Most head restraints are covered with flexible vinyls. Examples of hard vinyls are door and front seatback assist handles, coat hooks and exterior molding inserts.

The paint system for vinyl and flexible ABS plastic involves the use of interior vinyl color and a clear vinyl top coat. No primer or primer-sealer is required.

1. Wash part with a vinyl cleaning and preparation solvent, such as Vinyl Prep, Vinyl Prep Conditioner or equivalent. Wipe off cleaner while still wet with clean, lint-free cloth.
2. As soon as the surface has been wiped dry, apply interior vinyl color in wet coats. Allow flash time between coats. Follow label directions. Use proper vinyl color as shown by interior trim code combination. Apply only enough color for proper hiding to avoid washout of grain effect.
3. Before color flashes completely, apply one wet double coat of vinyl clear top coat. Use top coat with appropriate gloss level to match adjacent similar components. The clear coat is necessary to control the gloss requirement and to prevent crocking (rubbing-off) of the color coat after drying.
4. Allow to dry according to label directions before installing part.

AVAILABILITY OF COLORS FOR PAINTING INTERIOR PLASTIC PARTS

Interior colors are color keyed to trim code combination numbers located on the body number plate or service parts identification label.

Conventional interior acrylic lacquer colors are designed for use only on hard trim parts, such as:

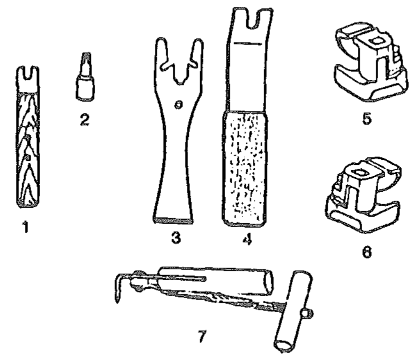
1. Steel parts (primer and/or sealer required on new service parts)
2. Hard ABS plastic (no primer necessary)
3. Hard polypropylene plastic (special primer required)

Each major paint supplier provides an interior color chart which identifies the stock number, color name, gloss factor and trim code combination number for each conventional interior color.

Vinyl interior colors are designed for soft trim parts such as instrument panel cover assemblies, door trim assemblies and head restraints. These colors require a final top coat of clear vinyl. Instrument panel covers require a nonglare final top coat. Other trim parts require a degree of gloss to match similar adjacent parts. Use interior vinyl colors and clear vinyl finishes such as Ditzler Vinyl Spray Colors, American Jetway UR-1 Vynicolor or equivalents.

SPECIAL BODY TOOLS

Figure 38 shows the special body tools that are recommended as aids in servicing the various body components. Equivalent tools may be substituted.



1. J-21104 WEATHERSTRIP REMOVING TOOL
2. J-23457 OR BT-7107 DOOR LOCK STRIKER, SEAT BELT ANCHOR BOLT REMOVING TOOL
3. J-9886 DOOR HANDLE CLIP REMOVING TOOL
4. J-24595B OR BT-7323A TRIM PAD REMOVER
5. J-28625-1 RIGHT FRONT DOOR HINGE SPRING TOOL
6. J-28625-2 LEFT FRONT DOOR HINGE SPRING TOOL
7. J-244402-A STATIONARY GLASS REMOVER

H93691-1H-F

Fig. 38 - Special Body Tools

SECTION 2H

STATIONARY GLASS

CONTENTS

REMOVAL OF MINOR SCRATCHES AND ABRASIONS

Minor glass scratches and abrasions on the outside surface of the glass can be removed or reduced by using the methods described in this section.

There are two basic types of auto glass: laminated safety plate (used in all windshields) and solid tempered safety plate (used in side and back windows).

A major concern in glass polishing is the chance of causing double vision in areas of occupant vision. For this reason, removal of scratches or abrasions on a windshield in the occupant's line of vision is more limited than in other areas. Distortion is most apt to result when trying to remove deep scratches. Scratch removal must be performed with care.

Tools Required:

- Low speed (600-1300 RPM) rotary polisher (Skil Model No. 570 or equivalent).
- Wool felt rotary-type polishing pad, about 75 mm (3") in diameter and 50 mm (2") thick.
- Powdered cerium oxide (No. 14 Rareox or equivalent) mixed with water as the abrasive compound. Follow manufacturer's directions when using any type of polishing compound.
- Wide mouth container to hold the polish.

NOTICE: Glass polishing must not be performed on inside surface of rear window glass which has heating elements in the glass because the heating elements will be damaged.

1. Mix two parts of polishing compound (No. 14 Rareox or equivalent) with one part water to obtain a creamy mixture.
2. Stir mixture now and then to maintain a creamy texture. Powdered cerium oxide is hard to mix with water and tends to separate.
3. Draw a circle around scratches on opposite side of glass with a wax marking pencil or crayon. Draw other lines directly behind scratches to serve as guides in locating scratch during polishing (Fig. 1).
4. Use masking paper where needed to catch drippings or spattered polish.
5. Dip felt pad attached to polisher into mixture several times to insure that pad is well saturated.

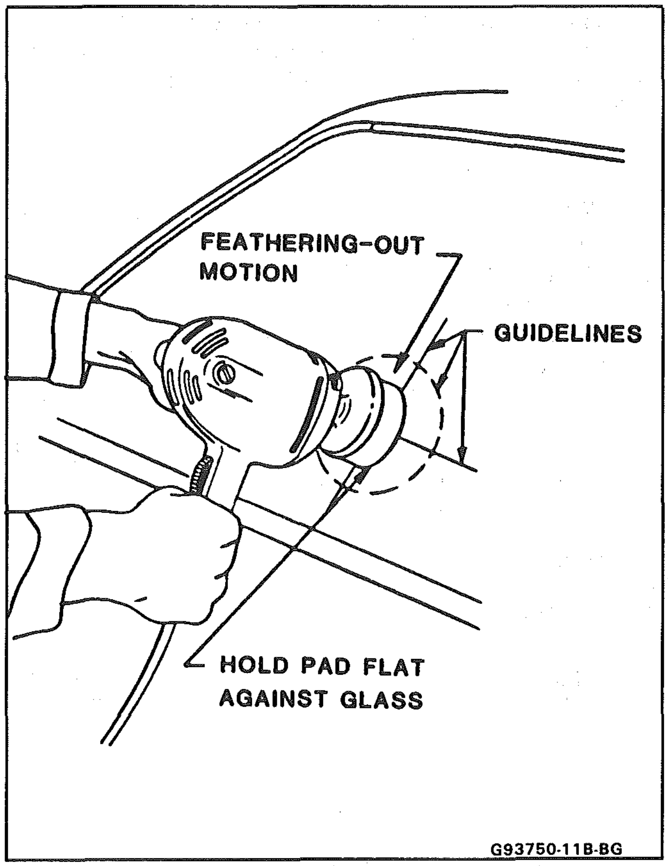


Fig. 1-Minor Glass Scratch Removal

Do not submerge or allow pad to stay in mixture as it may loosen bond between pad and metal plate.

6. Using moderate, but steady, pressure, hold pad flat against scratched area of glass, and with a feathering-out motion, polish affected area as shown in Figure 1. Avoid heavy pressure. It does not speed up operation and may cause overheating of glass.
7. Cover enough area around scratch with a feathering-out motion to eliminate any chance of a bull's-eye.

Do not hold tool in one spot or operate tool on the glass any longer than 30 to 45 seconds at a time. If glass becomes hot to touch, let it air cool before proceeding further. Cooling with cold water may crack heated glass.

8. Dip pad into mixture frequently to insure that wheel and glass are always wet during polishing operation. A dry pad causes too much heat to build up.
9. After removing scratch or abrasion, wash glass with water and wipe body clean of any polish.
10. Clean polishing pad.

Care should be taken during polishing and storage to keep pad free of foreign material such as dirt, metal filings, etc.

WINDSHIELD VINYL REVEAL MOLDINGS

Vinyl Reveal Moldings

The reveal molding is a vinyl trim that fills the cavity between the body and glass edge. The reveal molding is hand pressed into place and is retained by urethane adhesive (Fig. 3).

Remove or Disconnect

1. With a flat-bladed tool, carefully pry end of molding out about 75 mm (3").
2. Grasp with hand and slowly pull molding away from body.

   If original molding cannot be reused (due to damage, cut short, etc.), discard molding and replace with a new service molding. The service molding has a shorter shank and will not bottom-out when installed. Be sure to prefit service molding by locating on body prior to actual installation.

Install or Connect

1. To reuse original reveal molding, trim off barb and prefit in cavity (Fig. 2).
2. Apply clear primer from urethane kit (part no. 9636067 or equivalent) to lower surface of molding.

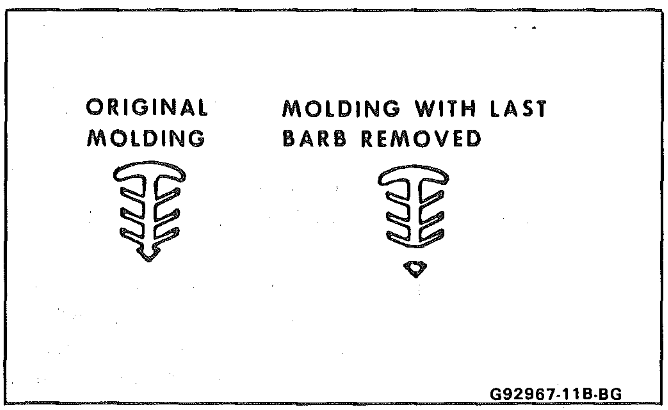


Fig. 2 - Reveal Molding Barb Removal

3. Apply urethane in cavity between body and glass.
4. Start from center and hand press molding into place. Tape can be applied to keep reveal molding flush with body.
5. Flood molding with warm water to speed set-up of adhesive.

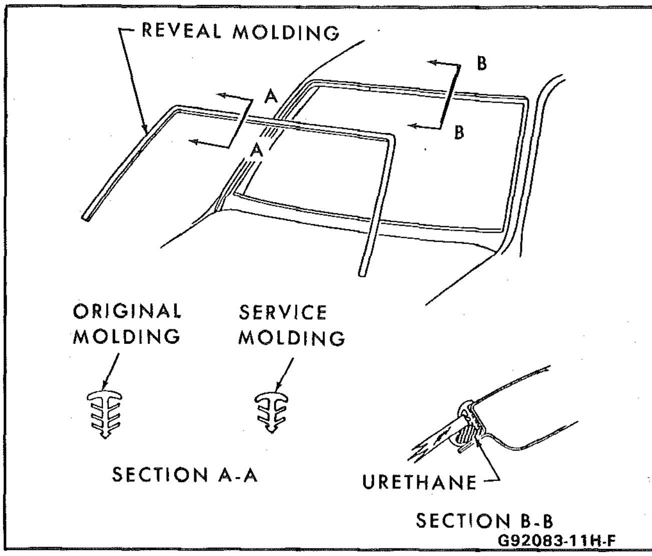


Fig. 3 - Typical Windshield Reveal Molding Installation

STATIONARY GLASS

The windshield is installed from outside the body using self-curing urethane. When replacing the windshield, urethane adhesive (part no. 9636067 or equivalent) **must** be used to maintain original installation integrity.

To replace a window installed with urethane adhesive requires either partial or complete replacement of the adhesive. Partial replacement of material is referred to as short method. Complete material replacement is known as extended method.

The short method can be used where original adhesive left on window opening pinchweld flanges after glass removal can serve as a base for the new glass. This method would apply in cases of cracked windshields or removal of windows that are still intact. The amount of adhesive left in window opening can be controlled during glass removal.

The extended method is to be used when the original adhesive left in window opening after glass removal cannot serve as a base for new glass. This method would be used in cases needing metal work or paint repair in the opening. In these cases, original material is removed and replaced with new material during window installation.

ADHESIVE SERVICE KIT

Adhesive Kit No. 9636067 (urethane adhesive) or equivalent contains some of the items needed to replace a urethane adhesive installed glass using the short method or any adhesive installed glass using the extended method.

Additional items required:

- Solvent for cleaning edge of glass (preferably alcohol)
- Household cartridge type caulking gun
- Commercial type razor knife (for cutting around edge of glass)
- Spacers (see service parts manual)
- Cold knife No. J-24402-A or equivalent

Window Removal

The window removal method is the same for both the short and extended installation methods with one exception. If the short method is to be used, more care must be used during cutout to make certain that an even bead of adhesive remains on window opening to serve as a base for new glass.

These methods are to be used when removing urethane installed windshield glass.

Remove or Disconnect

1. Place protective coverings around area where glass is being removed.
2. Remove windshield wiper arm assemblies, lower glass stops and shroud top vent grille (see Section 4H).
3. Remove reveal molding.
4. Using a razor or utility knife, make a preliminary cut into urethane adhesive around entire perimeter of glass. Make cut as close to edge of windshield glass as possible.
5. Mask area around window opening. This procedure will reduce cleanup after glass is installed.
6. Using tool J-24402-A or equivalent, cut out windshield glass keeping blade as close to edge of glass as possible.

Clean

Glass opening of any loose material. If glass is to be reinstalled, all urethane must be removed from glass.

Short Method

Install or Connect

1. Replace glass supports. Position glass in opening, apply a piece of masking tape over each edge of glass and adjacent body pillars. Slit tape vertically at edge of glass. During installation, tape on glass can be aligned with tape on body to guide glass into desired position. Remove glass.

   Clean

   Surface of glass to which adhesive will be applied (around edge of inside surface) by wiping with a clean, alcohol dampened cloth. Allow to air dry.
2. Two primers are provided in urethane adhesive kit no. 9636067 or equivalent. The clear primer is used on the glass prior to the black primer. Apply primer around entire perimeter of glass edge and 6 mm (1/4") inboard on inner surface. Allow primer to dry five minutes.
3. Apply a smooth continuous bead of adhesive around edge of glass where primed in step 2 (Fig. 4).
4. With aid of helper, lift glass into window opening. Windshield glass can be positioned without aid of carrying devices. As shown in Figure 5, carry glass with one hand on inside of glass and one hand on outside. At window opening, put glass in horizontal position. While one man holds glass in this position, second man can reach on arm around body pillar and support glass while other man assumes same position.

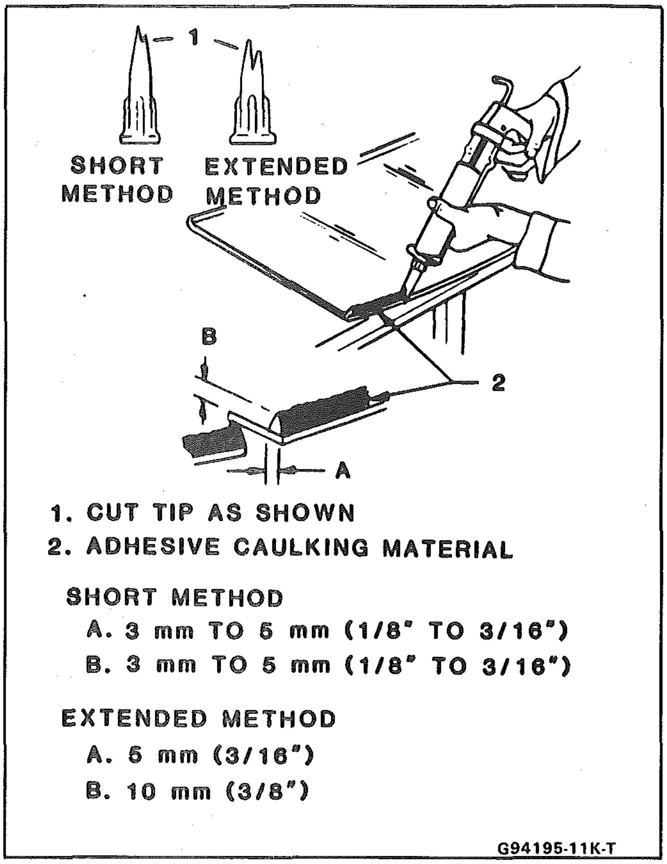


Fig. 4 - Applying Adhesive Material

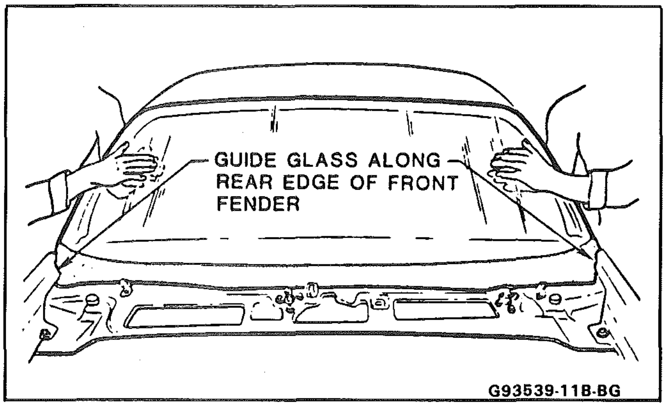


Fig. 5 - Installing Glass

5. With glass centered at opening, place glass on lower supports and use tape guides previously applied to place glass in proper position. It is important that glass is located properly within the window opening so that enough space is left between the glass and body opening to install the one-piece vinyl reveal molding.
6. Press glass firmly to wet-out and set adhesive. Use care to avoid excessive squeezeout which would cause an appearance problem. Using small disposable brush or flat-bladed tool, paddle material around edge of glass to ensure watertight seal. If necessary, paddle additional material to fill voids in seal.

7. Watertest car at once using soft spray. Use warm or hot water if available. Do not direct hard stream of water at fresh adhesive material. If any leaks are found, paddle in extra adhesive at leak point using a small disposable brush or flat-bladed tool. Water applied on top of urethane adhesive, either during watertest or as a separate operation, will speed up the cure of the urethane.
8. Install windshield reveal molding.
9. Install all other previously removed parts and clean up.
10. On windshield installations, car must remain at normal room temperature for six hours to complete proper cure of adhesive.

Extended Method

It will be necessary to use extended installation method if prior service installation was made with butyl tape or if urethane material remaining in window opening after window removal is damaged, or must be removed to permit refinishing of window opening.

Spacers are used to maintain the dimensions of the windshield stand off from the pinchweld flange. The spacers are specific to certain styles and can be found in the service parts manual. Spacers should be reused or replaced before reinstallation of windshield (Fig. 6).

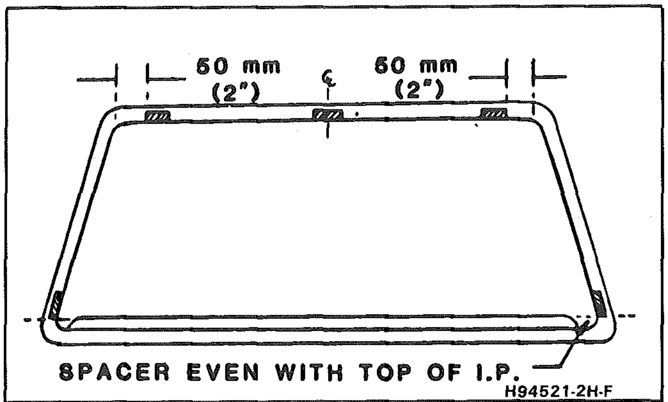


Fig. 6 - Glass Spacer Location

Clean

Using a sharp scraper or chisel, remove the old adhesive material from window opening. On butyl tape installations or installations of unknown material, it will be necessary to remove all traces of the material. On urethane installations, it is not necessary that all traces of material be removed, but there should not be any mounds or loose pieces left.

If refinishing or painting operations are required, or painted surface is exposed during removal of material, black primer should be applied to exposed area.

Install or Connect

1. Locate glass stops in their original positions.
2. With aid of helper, lift glass into window opening. The windshield glass can be positioned without aid of carrying devices as shown in Figure 5.
3. Place window in vertical position and support it on lower glass supports. While one man holds glass in position, second man can reach one arm around body pillar and support glass while other man assumes the same position.
4. With glass positioned in opening, check relationship of glass to pinchweld flange around entire perimeter. The opening between glass and pinchweld flange should be equal for installation of the vinyl reveal molding. The opening at the top of windshield may be corrected by repositioning lower glass supports.
5. After final adjustments have been made and glass is in proper position, apply pieces of masking tape over edges of glass and body, slit tape at edge of glass. Tape on glass can be aligned with tape on body to guide glass into opening during installation. Remove glass from opening.
6. For extended method, enlarge nozzle opening by removing material as indicated in Figure 4.

Clean

Surface of glass to which bead of adhesive material will be applied (around edge of inside surface of glass) by wiping with a clean, alcohol dampened cloth. Allow to air dry.

7. Two primers are provided in Urethane Adhesive Kit No. 9636067 or equivalent. The clear primer is used on the glass prior to the black primer and is applied to the entire perimeter of glass edge and 6 mm (1/4") inboard on inner surface. Allow primer to dry for five minutes. Apply black primer to any portion of glass opening that required refinishing and painting operations, or any portion that was cleaned of former adhesive enough to expose the painted surface. Allow primer to dry for five minutes.
8. With caulking gun and nozzle positioned as illustrated in Figure 4, carefully apply smooth continuous bead of adhesive 10 mm (3/8") high by 5 mm (3/16") wide at base completely around inside edge of glass. Make sure bead of adhesive is tipped slightly inboard.
9. With glass centered at opening, place glass on lower supports. Use tape guides previously applied to place glass in proper position. On windshield installation, guide lower outer surface of glass along rear edge of front fenders to avoid smearing fresh adhesive on instrument panel (Fig. 5). Make certain glass is aligned properly to tape guides on pillars, and positioned on lower metal supports. Apply light hand pressure to wet-out adhesive and obtain bond to body opening. Using small, disposable brush or flat-bladed tool, paddle material around edge of glass to ensure watertight seal. If necessary, paddle additional material to fill voids in seal.
10. Watertest at once using soft spray. Use warm or hot water if available. Do not direct stream of water at fresh adhesive. Allow water to spill over edges of glass. If waterleak is encountered, use flat-bladed tool to work in additional adhesive material at leak point.

11. Install windshield reveal molding.
12. Install all other previously removed parts and clean up.
13. On windshield installations, car must remain at normal room temperature for six hours to complete proper cure of adhesive material.

WATERLEAK CORRECTION

Urethane glass installation waterleaks can be corrected without removing and reinstalling glass where accessible. This method applies only with use of adhesive furnished in kit no. 9636067 or equivalent.

1. Remove reveal moldings in area of leak. In some cases, it may become necessary to remove garnish moldings or finishing lace to locate source of leak.
2. Mark location of leak(s). Carefully push outward on glass in area of leak to determine extent of leak. This operation should be performed while water is being applied to leak area. Mark extent of leak area.

Clean

From outside body, clean any dirt or foreign material from leak area with water; then dry area with air hose.

3. Using a sharp knife, trim off uneven edge of adhesive material (operation A, Fig. 7) at leak point and 75 mm (3") to 100 mm (4") on both sides of leak point or beyond limits of leak area.
4. Prime affected area, as shown in operation B, Figure 7, with black primer supplied in kit. Agitate primer prior to use. Allow primer to dry five minutes.
5. Apply adhesive material, as shown in operation C, Figure 7, at leak point and 75 mm (3") to 100 mm (4") on both sides of leak point or beyond limits of leak area.
6. Right after performing step 5, use a flat stick or other suitable flat-bladed tool to work adhesive material well into leak point and into joint of original material and body to effect watertight seal along entire length of material application (operation D, Fig. 7).
7. Using warm or hot water, spray test to assure that leak has been corrected. **Do not** run heavy stream of water directly on freshly applied adhesive.
8. Replace all previously removed parts.

BONDED REARVIEW MIRROR SUPPORT

The rearview mirror is attached to a support which is secured to the windshield glass. This support is installed by the glass supplier using a plastic-polyvinyl butyral adhesive.

Service replacement windshield glass has the mirror support bonded to the glass assembly. To install a detached mirror support or install a new part, the following items are needed.

1. Part No. 1052369, Loctite Minute-Bond Adhesive 312 two component pack or equivalent

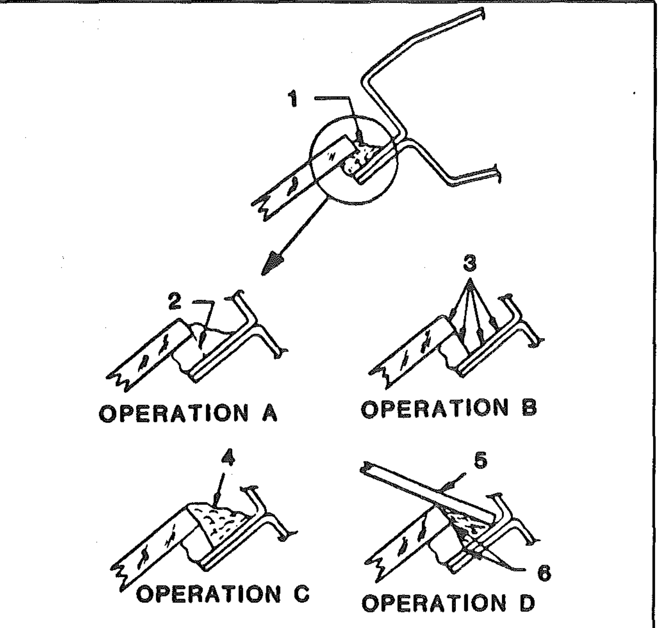


Fig. 7 - Adhesive Glass Waterleak Correction

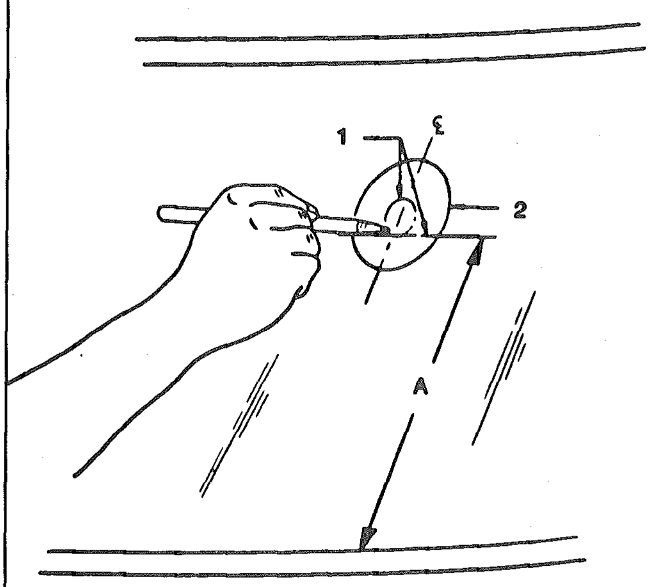
2. Original mirror support (prepared per steps 4 and 5 of installation procedure) or replacement rearview mirror support.
3. Wax marking pencil or crayon
4. Rubbing alcohol
5. Clean paper towels
6. Fine grit emery cloth or sandpaper (no. 320 or no. 360)
7. Clean toothpick
8. Six-lobed socket bit

Install or Connect

1. Determine rearview mirror support position on windshield. Support is to be located at center of glass 689 mm (27-1/8") from base of glass to base of support (dimension A, Fig. 8).
2. Mark location on outside of glass with wax pencil or crayon. Also make larger diameter circle around the mirror support circle on the outside glass surface (Fig. 8).
3. On inside glass surface, clean large circle with paper towel and domestic scouring cleanser, glass cleaning solution or polishing compound. Rub until area is completely clean and dry. When dry, clean area with an alcohol saturated paper towel to remove any traces of scouring powder or cleaning solution from this area.
4. With piece of fine grit (no. 320 or no. 360) emery cloth or sandpaper, sand bonding surface of new rearview mirror support or factory installed support. If original rearview mirror support is to be reused,

all traces of factory installed adhesive must be removed prior to reinstallation.

5. Wipe sanded mirror support with clean paper towel saturated with alcohol and allow to dry.
6. Follow directions on manufacturer's kit to prepare rearview mirror support prior to installation on glass.
7. Properly position support to its premarked location, with rounded end pointed upward; press support against glass for 30 to 60 seconds, exerting steady pressure against glass. After five minutes, any excess adhesive may be removed with an alcohol moistened paper towel or glass cleaning solution.
8. Reinstall mirror



1. LOCATING CIRCLE AND BASE OF SUPPORT LINE ON OUTSIDE GLASS SURFACE
2. CIRCLE ON OUTSIDE GLASS SURFACE INDICATES AREA TO BE CLEANED

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Fig. 8-Locating Bonded Rearview Mirror Support on Glass

REAR WINDOW DEFOGGER

The optional rear window defogger system consists of a tinted glass that has a number of horizontal ceramic silver compound element lines and two vertical bus bars baked into the inside surface during the glass forming operation. The feed wire or terminal is soldered to the bus bar on the side. The ground wire or terminal is soldered to the bus bar on the right side.

The system operates on 12 volts. Under some conditions, heat from the glass may not be detected by finger touch. The length of time required to remove interior fog from the back glass will vary with such conditions as vehicle speed, outside glass temperature and atmospheric pressure and number of passengers.

This system uses an instrument panel mounted switch with an integral indicator lamp; and will operate for five to ten minutes and automatically turn off through the use of an automatic timer. The system can be turned off during this operating period by turning either the instrument panel mounted switch or ignition switch to off.

Testing Grid Lines

To locate inoperative grid lines, start engine and turn on the rear window defogger system. Ground one test lamp lead and lightly touch the other prod to each grid line. Figure 9 illustrates the pattern of test lamp brilliance to be expected with a properly functioning grid.

If test lamp bulb shows full brilliance at both ends of grid lines, check for loose ground wire contact to body metal.

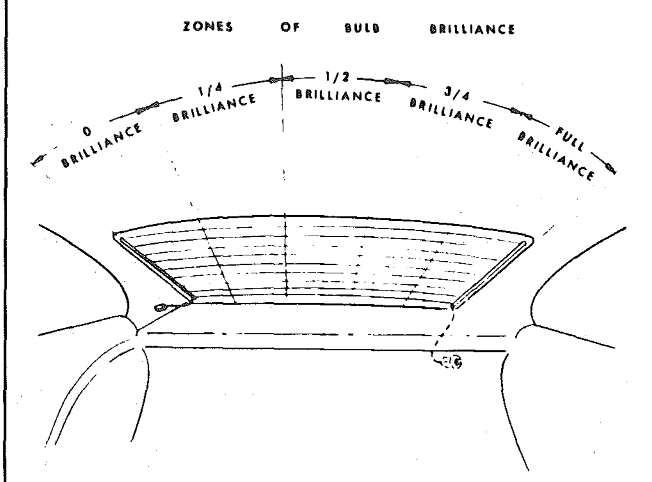

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Fig. 9-Test Lamp Bulb Brilliance Zones - Normal Operating Rear Window Defogger

The range of zones in Figure 9 may vary slightly from one glass to another; however, the bulb brilliance will decrease proportionately to the increased resistance in the grid line as the prod is moved from the left bus bar to the right.

All grid lines must be tested in at least two places to eliminate the possibility of bridging a break. For best results, contact each grid line a few millimeters (inches) either side of the glass centerline. If an abnormal light reading is apparent on a specific grid line, place test lamp prod on that grid at the left bus bar and move prod toward the right bus bar until light goes out. This will indicate a break in the continuity of the grid line (Fig. 10).

Grid Line Repair

Tools Required:

- Part No. 1052858 (or equivalent) - Rear Window Defogger Repair Kit
- Heat gun - capable of 260°C (500°F)

Remove or Disconnect

Battery feed - rear window defogger system

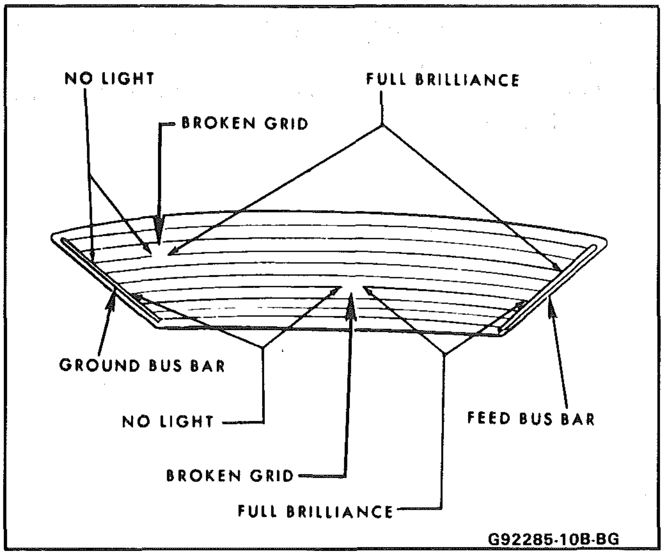

Fig. 10-Test Lamp Bulb Brilliance with Broken Grid Lines

Inspect

- Rear window defogger grid lines.
- Mark grid line breaks on outside of glass with a grease pencil.

Clean

Grid line area to be repaired. Buff with steel wool and wipe clean using cloth dampened with alcohol. Buff and clean about 6 mm (1/4") beyond each side of break in guide line.

Install or Connect (Figs. 11 and 12)

1. Grid line repair decal or two strips of tape positioned above and below repair area.
   - Repair decal or tape **must** be used to control width of repair area.
   - If decal is used, be sure the die-cut metering slot is the same width as the grid line.
2. Remove the clamp (separator) from the container of grid repair material.
   - Mix hardener and silver plastic thoroughly.
   - If hardener has crystalized, immerse packet in hot water until the hardener reliquifies.
3. At room temperature, apply grid repair material to repair area using a small wood stick or spatula.
4. Carefully remove the decal or tape.

NOTICE: The grid line repair material must be cured with heat. To avoid heat damage to interior trim, protect the trim near the repair area where heat is to be applied.

5. Apply heat to repair area for one to two minutes.
   - Hold heat gun nozzle 25 mm (1") from surface.
   - A minimum temperature of 149°C (300°F) is required.

Inspect

Grid line repair area. If repair appears discolored, apply a coating of tincture of iodine to repair area using a pipe cleaner or fine brush. Allow iodine to dry for about 30 seconds and carefully wipe off excess with lint free cloth.

6. Test rear defogger operation to verify grid line repair.

NOTICE: At least 24 hours are required for complete curing of repair materials. The unit should not be physically disturbed until after that time.

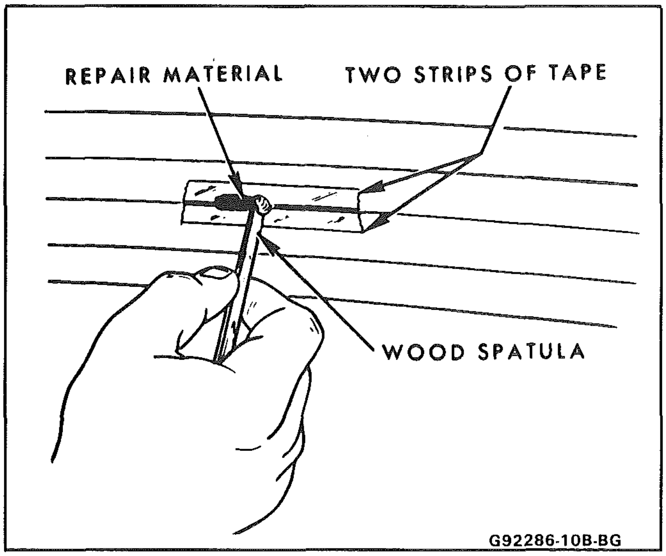

Fig. 11-Applying Repair Material to Broken Grid Line

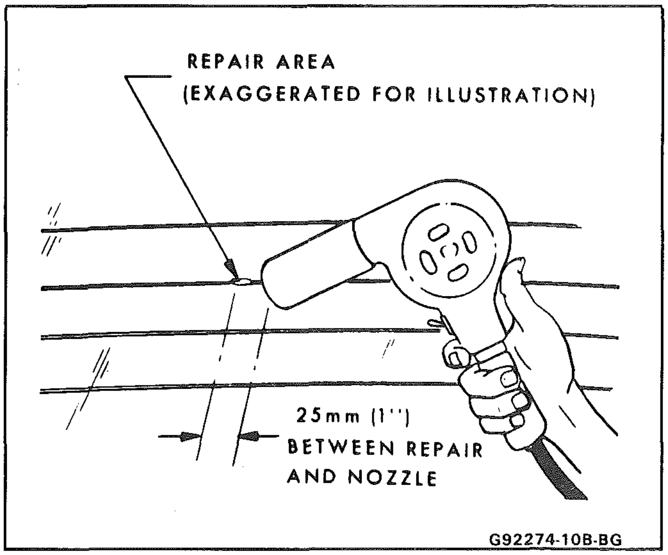

Fig. 12-Applying Heat to Grid Line Repair

Braided Lead Wire Repair

The rear defogger bus bar lead wire or terminal can be reattached by resoldering using a solder containing 3% silver and a rosin flux paste.

- Before soldering the bus bar, repair area should be buffed with fine steel wool. This removes the oxide coating formed during glass manufacture.
- Apply the paste-type rosin flux in small quantities to the wire lead and bus bar repair area using a brush.

- The soldering iron tip should be coated with solder beforehand. Use only enough heat to melt the solder and only enough solder to ensure a complete repair.
- Do not overheat the wire when resoldering it to the bus bar.

SECTION 3H

UNDERBODY

CONTENTS

GENERAL BODY CONSTRUCTION

Information in this section pertains to unitized body construction which incorporates integral front and rear frame side rails.

Consideration must be given when checking underbody dimensions. The engine front suspension lower control arms are supported by a cross member. The cross member, in turn, is bolted to the body at six locations -- three on each side of the engine front compartment lower rails. Mounting provisions for the front suspension system are shared by chassis components (suspension lower control arms and cross member) and body components (engine compartment side panels). The suspension strut towers must be dimensionally correct in relation to the remainder of the underbody in order to maintain specified suspension strut and caster/camber angles.

Since the individual underbody components also contribute directly to the overall strength of the body, it is essential that proper welding techniques be observed during service repair operations. The underbody components should be properly sealed and rustproofed whenever body repair operations destroy or damage the original sealing and rustproofing. When rustproofing critical underbody components, it is essential that a good quality type of air dry primer be used (such as corrosion resistant chromate or equivalent material). It is not advisable to use combination type primer-surfacers.

ALIGNMENT CHECKING

An accurate method of determining the alignment of the underbody utilizes a measuring tram gage. The tram gage set required to perform the recommended measuring checks must include a vertical pointer capable of reaching 914 mm (36").

Two types of measurements can be made with a tram gage: direct point-to-point measurements and measurements calculated on a horizontal plane (datum line) parallel to the underbody. In the latter case, the vertical pointers must be set as specified for each point to be measured (Fig. 3-1).

Point-to-point measurements are generally taken only on engine compartment components (Fig. 3-2) and simply require the vertical pointers to be equally set.

Figure #3-3 describes the alphabetically identified points of measurement. Figure 3-4 provides metric-to-English dimensional conversion data. Dimensions to gage holes are measured to dead center of the holes and flush to adjacent surface metal unless otherwise specified.

FLOOR PAN INSULATORS

Floor pan insulators have been designed for the higher floor pan temperatures that result from the use of the catalytic converter in the exhaust system. Therefore, when servicing a vehicle in the field, it is essential that any insulators that may have been disturbed or removed be reinstalled in the original sequence and location. Also, if it becomes necessary to replace an insulator, the material specified for that particular location on the floor pan must be used. The types of materials are listed below. Items 1 and 2 are rolled stock and are ordered by linear foot and cut to fit.

1. Insulator floor pan (cerra blanket thermal) - consists of 10 mm (3/8") thick aluminum silica (type 1).
2. Insulator floor pan (amberlite) - consists of 10 mm (3/8") thick resinated fibers (type 2).
3. Insulator floor pan sheet (phenolic bonded fiber glass) 305 mm x 457 mm (12" x 18") cut to size, (type 3).

All of the above materials must meet Motor Vehicle Safety Standard No. 302 for flammability.

When servicing or replacing interior insulators, the following instructions must be observed:

1. Insulators must be installed in the original position and sequence. Pieces should be butted together in order to avoid gapping or overlapping.
2. If it is necessary to replace an insulator, the specified material must be used.
3. Use original part to determine the amount of replacement material required and as a template for cutting and fitting the new piece to the floor pan.
4. When installing insulator, do not enlarge cutouts or holes that are used for the attachment of interior components such as seats or seat belts.
5. Cross body harnesses for interior components such as power seats, lap belt warning light and buzzer or rear speakers must be routed over the floor pan insulators in the original location and clipped in place.

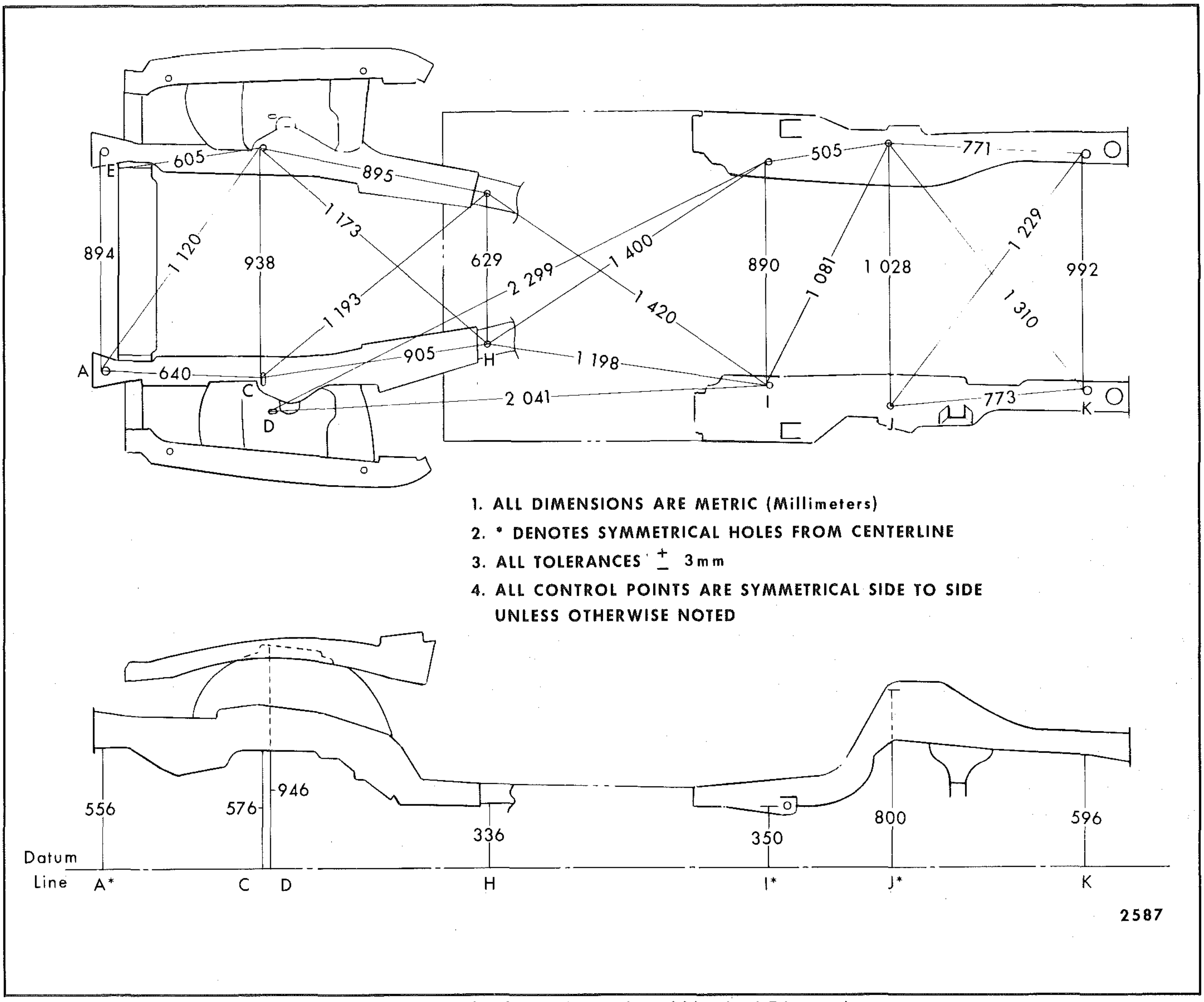

Fig. 3-1 - Underbody Horizontal and Vertical Dimensions

6. Spray-on deadeners and trim adhesives should not be applied to the top of the floor pan at area directly over the catalytic converter or muffler(s).

Any insulator service repair or replacement should be the same thickness, size and location as original installation in car.

FLOOR CARPETS

All floor carpets consist of a molded one-piece carpet over both front and rear floor pan. The following items must be removed to take out the carpet:

1. Front seats
2. Front seat belts
3. Rear seat cushion
4. Left and right shroud side trim finishing panels
5. Left and right shoulder harness floor attachments
6. Center pillar trim finishing panels
7. Console assembly (if applicable)
8. Carpet retainers

To install, reverse removal operations.

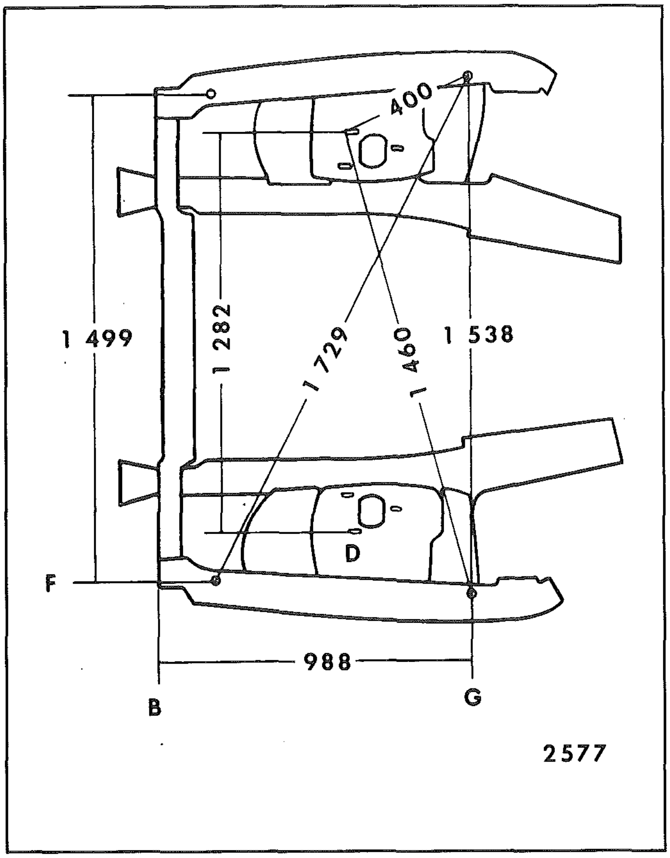

Fig. 3-2 - Suspension Strut and Upper Rail Dimensions

REF	HORIZONTAL	VERTICAL	LOCATION
A	Front edge of 24 mm (15/16") hole	Lower surface of engine compartment rail	Engine compartment rail forward of lower tie bar
B	Leading edge of upper tie bar	None	Engine compartment bar, upper rail
C	Front edge of 16 mm (5/8") gage hole (front edge center of slot on right side)	Lower surface of engine compartment rail at hole (slot on right side)	Engine compartment rail, forward of suspension pocket
D	Front edge of outboard strut mounting slot	Lower surfaces of strut tower at slot	Shock-strut tower
E	Leading edge of lower tie bar at corner	None	Engine compartment bar lower rail
F	Center of 9 mm (23/64") hole in rail depression	None	Engine compartment upper side rail
G	Center of 9 mm (23/64") hole in rail depression	None	Engine compartment upper side rail
H	Center of 16 mm (5/8") gage hole	Lower surface of reinforcement rear of rail at hole	Floor pan reinforcement behind engine compartment rail
I	Front edge of 18 mm (11/16") gage hole	Lower surface of rail at hole	Rear longitudinal rail
J	Center of 16 mm (5/8") hole	Lower surface of rail at hole	Shock mounting hole rear longitudinal rail
K	Front edge of 18 mm (11/16") hole	Lower surface of rail at hole	Rear longitudinal rail, forward of 25 mm (1") hole

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Fig. 3-3 - Underbody Horizontal and Vertical Locations

DIMENSION	METRIC (Millimeters)	ENGLISH (Inches)
	HORIZONTAL	
A to A	894	35 3/16
A to C	640	25 3/16
B to G	988	38 15/16
C to C	938	36 15/16
C to A	1 120	44 1/8
C to E	605	23 13/16
C to H Right	905	35 5/8
C to H Left	895	35 1/4
D to D	1 282	50 1/2
D to G	400	15 3/4
D to I	2 041	80 5/16
F to F	1 499	59
F to G	1 729	68 1/16
G to G	1 538	60 1/2
G to D	1 460	57 1/2
H to H	629	24 3/4
H Right to C Left	1 173	46 3/16
H Left to C Right	1 193	46 15/16
H to I	1 198	47 3/16
I to I	890	35 1/16
I to D	2 299	90 9/16
I Right to H Left	1 420	55 7/8
I Left to H Right	1 400	55 1/8
I to J	505	19 7/8
J to J	1 028	40 1/2
J to I	1 081	42 9/16
J to K Right	773	30 7/16
J to K Left	771	30 3/8
K to K	992	39 1/16
K Right to J Left	1 310	51 9/16
K Left to J Right	1 229	48 3/8
	VERTICAL	
A	556	21 7/8
C	576	22 11/16
D	946	37 1/4
H	336	13 1/4
I	350	13 3/4
J	800	31 1/2
K	596	23 1/2

2616

Fig. 3-4 - Metric-to-English Dimension Conversion Chart

SECTION 4H

FRONT END

NOTICE: The anti-theft label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The **mask** must be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

BODY VENTILATION

The body ventilation system on styles without air conditioning consists of a fresh air intake located at the front plenum chamber. Air enters the front plenum chamber through an air intake grille screen (Fig. 1). Air passes through the plenum chamber to air outlet doors. When ventilation controls are operated, air enters past the doors and into the body from outlets in the dash panel. The air then passes through the body, around the rear seat, into the rear compartment to the rear quarters and leaves the body passing through the pressure relief valves on the rear body lock pillars (Fig. 4). For complete instructions on operation of the body ventilation system, refer to the owner's manual.

Water entering the plenum chamber is drained through openings provided for that purpose.

FRONT END SEALING

All potential waterleak locations are sealed in production with high quality durable sealers. Should it be necessary to reseal specific areas, a high quality medium-bodied sealer which will remain flexible after curing and can be painted should be used.

SHROUD SIDE TRIM FINISHING PANEL

The shroud side finishing panels are designed with an integral hinge pillar pinchweld finishing lace. The left side has a cutout slot for the hood release cable handle. There is no need to remove the cable assembly when removing the trim finishing panel. The trim finishing panel is secured to the side shroud with self-tapping attaching screws.

Removal and Installation

1. Remove shroud side trim finishing panel screws (Fig. 2).
2. Pull down and rearward on trim finishing panel to release hood cable handle from slot on left side. On right side, pull rearward to remove panel from windshield lower side garnish (Figs. 2 and 3).
3. To install, reverse removal procedures.

PRESSURE RELIEF VALVE

The pressure relief valves are attached to rear lock pillars (in door opening below belt) with screws. Figure 4 shows pressure relief valve installations.

Removal and Installation

1. Remove louver-to-lock pillar screw located in the door opening (Fig. 4).
2. Slide louver up to disengage hook-type attaching clip to complete removal.
3. To install, reverse removal procedure.

HOOD LATCH RELEASE CABLE

The one-piece hood latch release cable includes pull handle, control cable and housing. The control cable is installed through the left shroud side trim panel. A sealing grommet attached to the dash panel completes the assembly (Figs. 2 and 5).

Removal and Installation

1. Raise hood and disengage cable from hood latch assembly. Block latch to prevent hood locking until cable has been reinstalled.
2. Remove left shroud side trim panel.
3. Disengage control assembly housing from cutout of trim panel and remove cable assembly from panel.
4. To install, reverse the removal procedure.

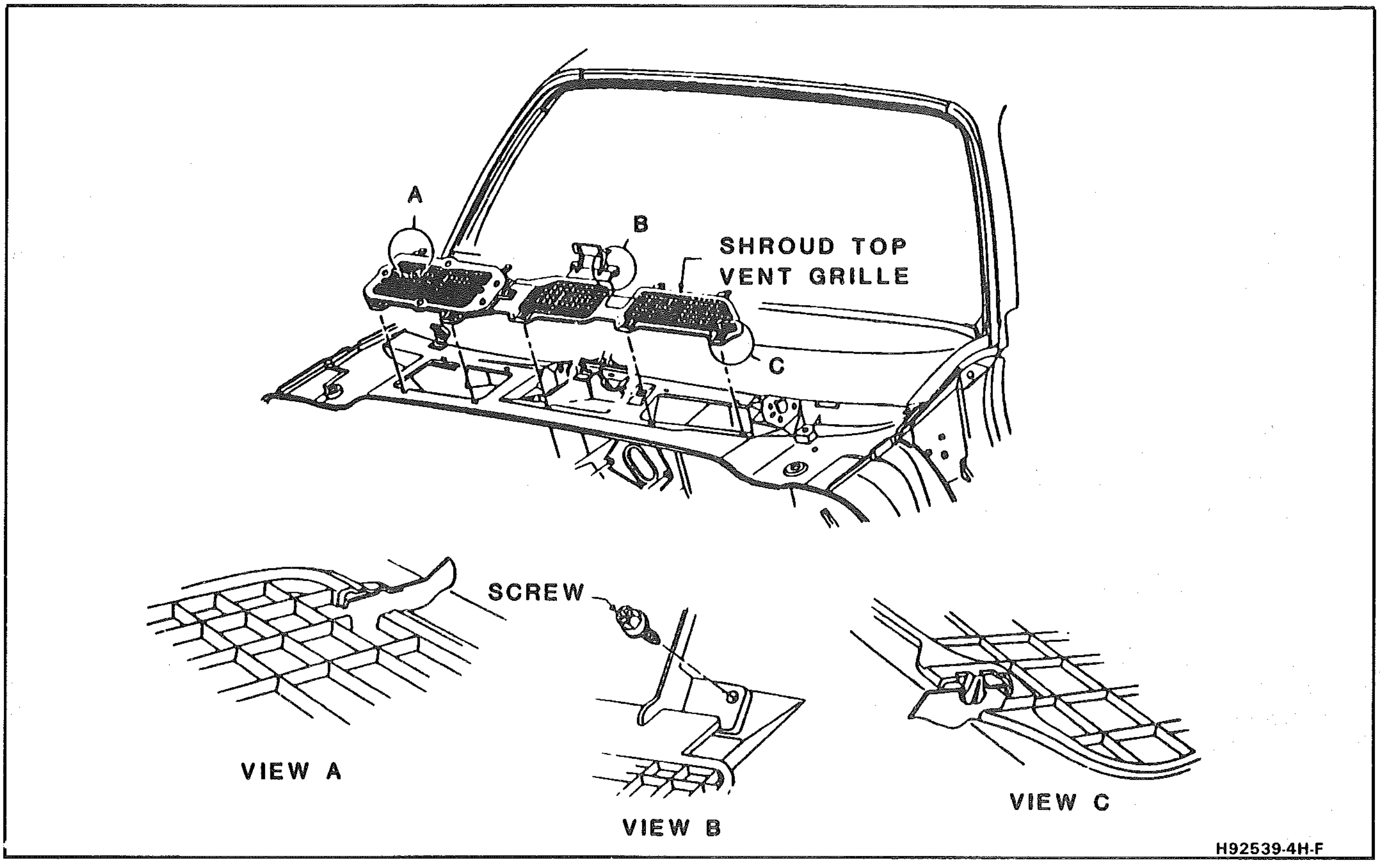


Fig. 1-Air Entrance into Plenum Chamber

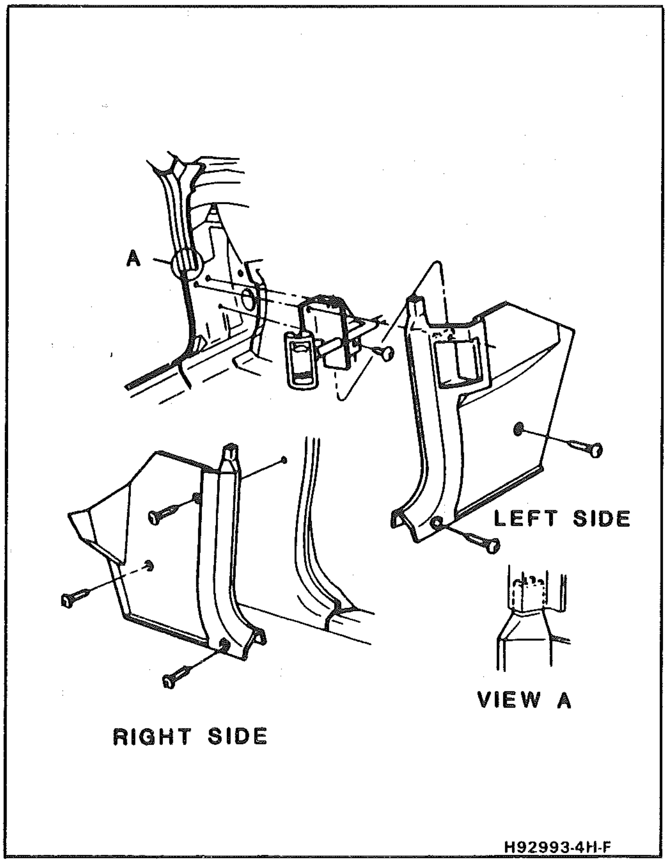


Fig. 2-Shroud Side Trim Finishing Panel

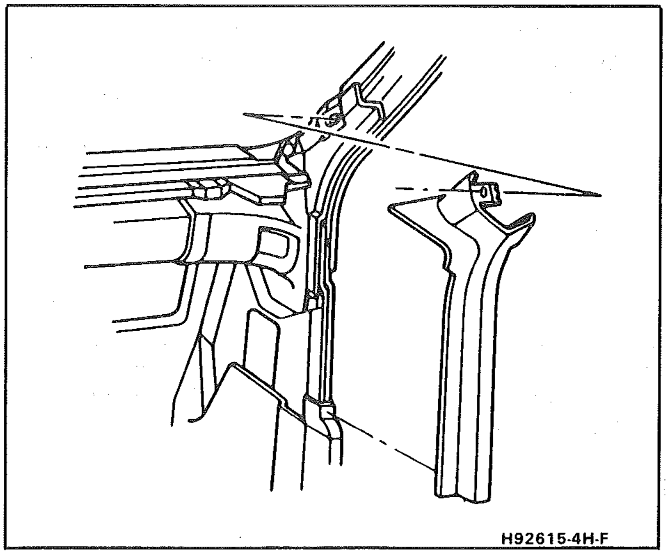


Fig. 3-Windshield Lower Side Garnish Molding

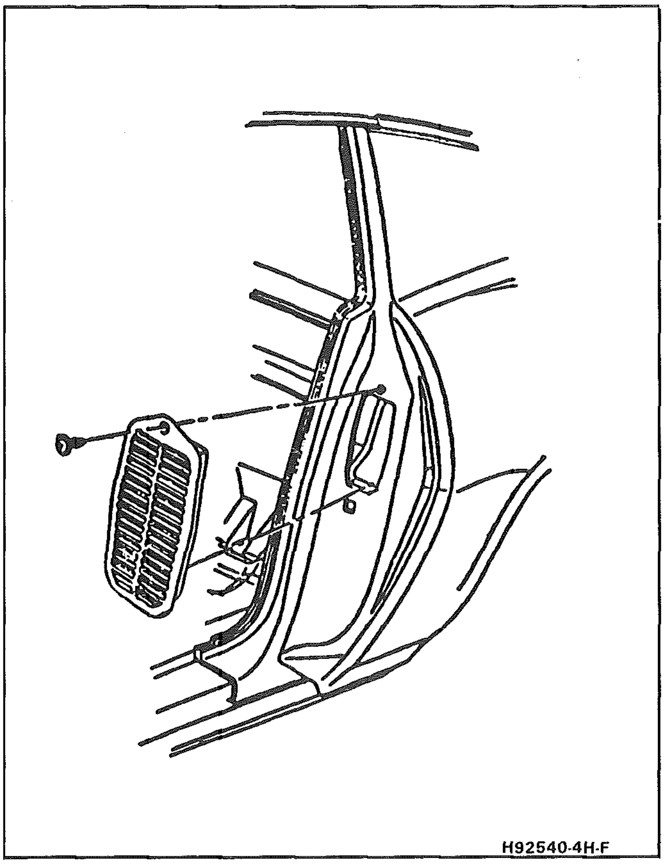


Fig. 4-Pressure Relief Valve

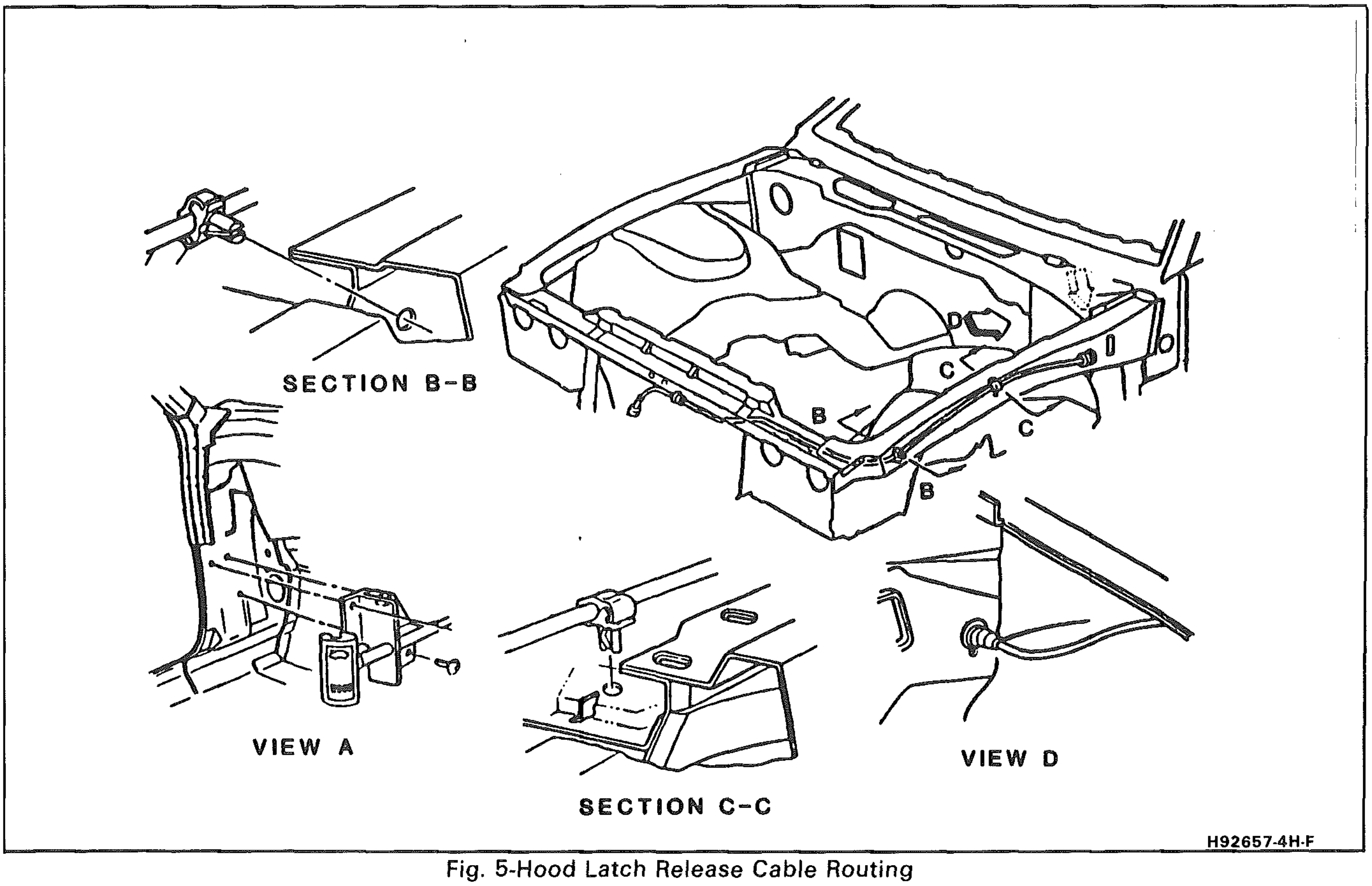


Fig. 5-Hood Latch Release Cable Routing

SECTION 5H

DOORS

NOTICE: The anit-theft label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask **must** be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

DOOR SECTIONS

This section of the manual contains the service operations necessary for the removal, installation, adjustment and sealing of door assemblies and individual hardware and trim components. It is divided into three subsections:

1. DOOR TRIM - removal and installation procedures for all door trim items.
2. DOORS - including hinges, door and side roof rail weatherstrip and all lock system components.
3. EXTERIOR MOLDINGS - removal and installation of exterior door moldings.

DOOR TRIM

DOOR ARMREST AND PULL HANDLE ASSEMBLIES

The armrest and pull handle is a one-piece assembly and is secured to the door inner panel with screws after door trim panel is installed (Fig. 1).

The removal of the door trim panel on styles with door armrest and pull handle assemblies requires removal of screws inserted through the assembly's base into the armrest hanger plate and removal of the screw at the top of the pull handle section.

DOOR OUTSIDE MIRROR REMOTE CONTROLS AND BEZEL

On styles with remote control door outside mirror, the remote control mirror cable must be disengaged from the bezel on the door trim panel to permit trim panel removal. To disengage the remote cable from the door trim panel, refer to Figure 2.

DOOR INSIDE HANDLES AND COVER PLATES

Door inside handles are retained by either rivets or spring clips (Fig. 4). On styles equipped with rivet retained handles, the rivets are covered by a screw retained cover plate that can be removed as shown in Figure 3.

Removal and Installation

1. Clips hidden by window regulator handles (Fig. 4) can be disengaged by depressing door trim assembly enough to permit inserting tool J-9886 or equivalent between handle and trim panel or plastic bearing plate (Fig. 5). Then, with tool in same plane as inside handle, push tool as indicated to disengage clip. Pull handle inboard to remove from spindle.
2. To install window regulator handles, engage retaining clip on handle. Position handle at same angle as opposite side handle and press handle outboard until clip engages regulator spindle.

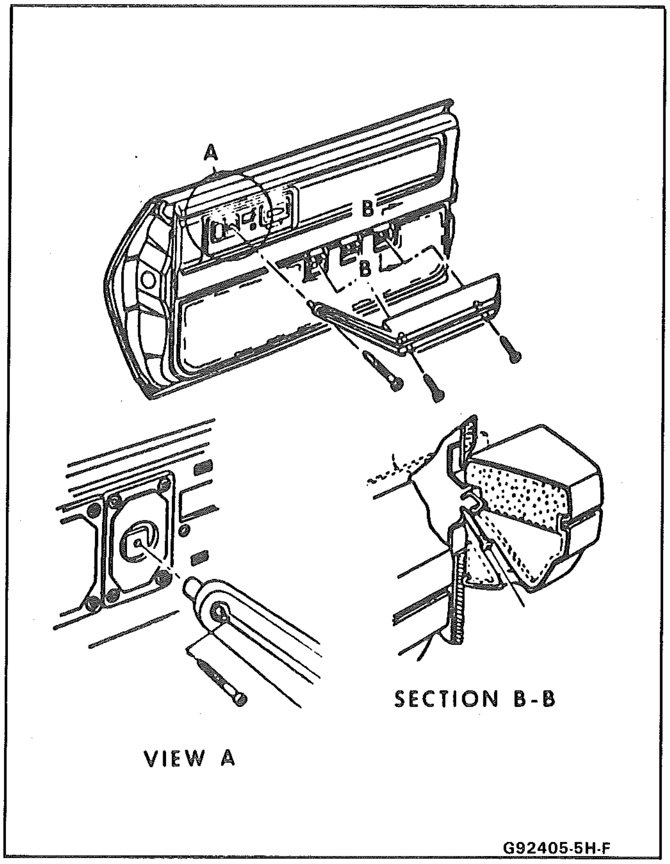


Fig. 1-Attaching Door Armrest and Pull Handle

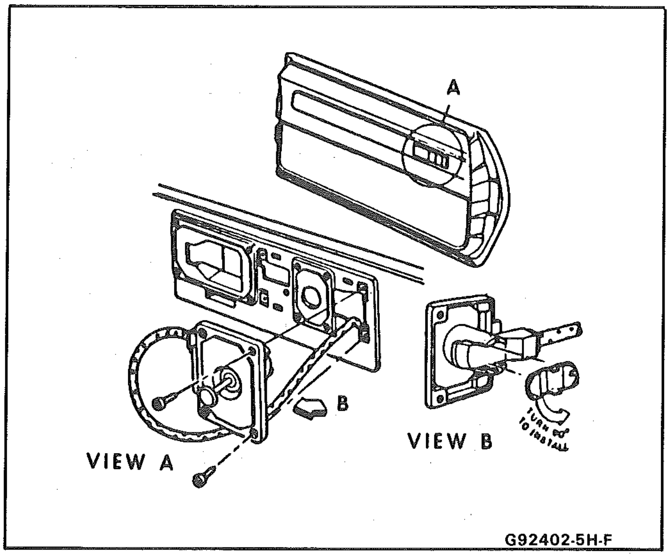


Fig. 2-Installing Remote Mirror Control

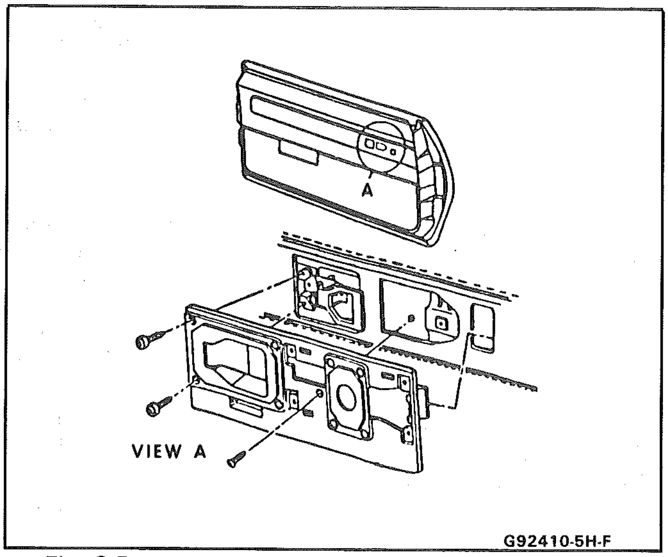


Fig. 3-Remote Handle and Lock Knob Cover Plate

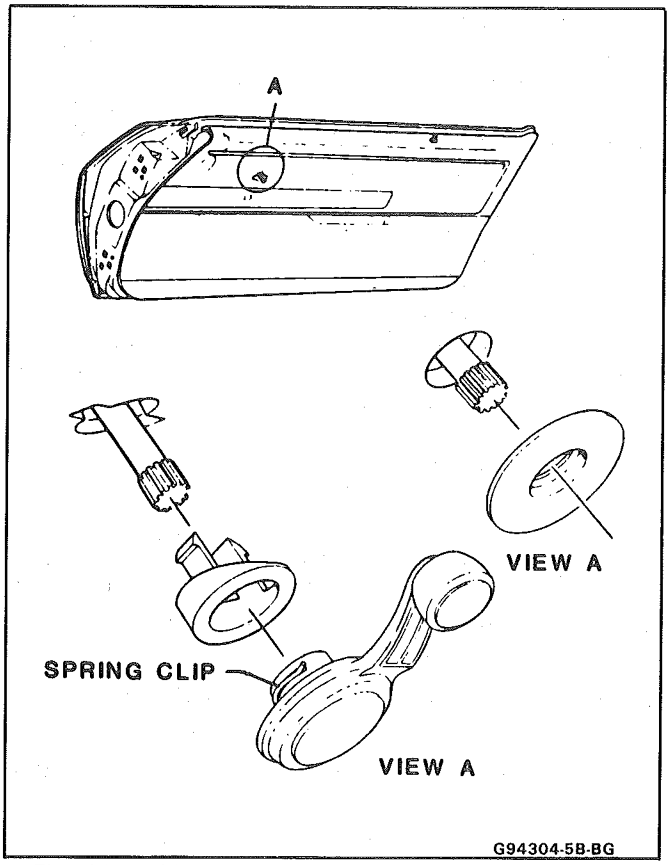


Fig. 4-Installing Window Regulator Handle (Typical)

DOOR LOCK KNOB

Removal and Installation

1. Using a small flat-bladed tool such as a screwdriver, insert blade behind end of lock knob and pry it away from rod.
2. After end of rod is free from knob, slide knob forward to remove from assembly.
3. To install, insert end of knob through hole in handle bezel.
4. Slide knob rearward until end of rod engages depression in end of knob (Fig. 6).
5. Force knob against remote control bezel until rod snaps into knob.
6. Install all previously removed items.

DOOR TRIM PANEL ASSEMBLIES

The one-piece trim hangs over the door inner panel across the top and is secured by clips down the sides and across the bottom (Fig. 8). It is retained by screws located in the areas of the armrest and pull handle assembly.

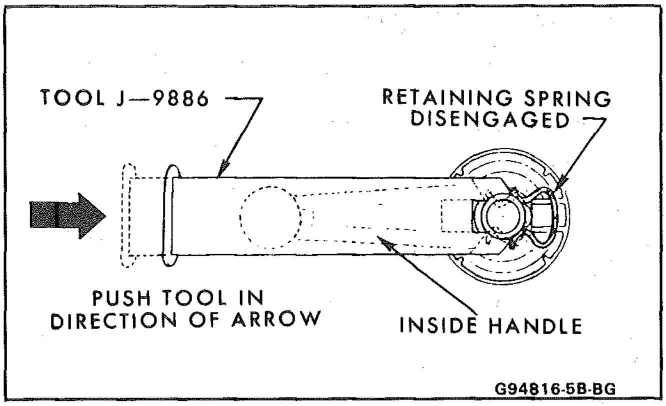


Fig. 5-Removing Clip Retained Door Inside Handle

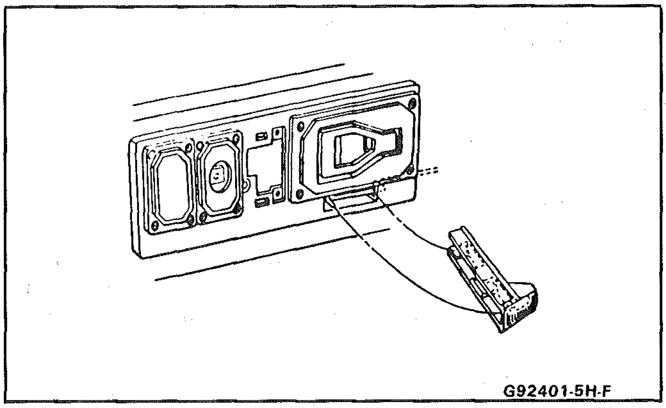


Fig. 6-Installing Door Lock Knob

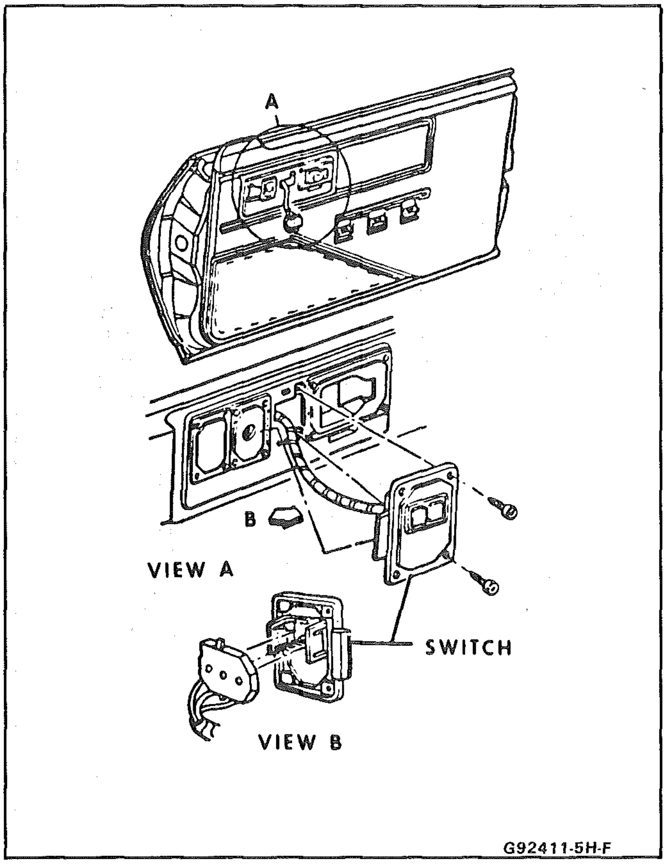


Fig. 7-Installing Power Door Lock Switch

Removal

1. Remove all door inside handles.
2. Remove door inside locking rod knob.
3. Remove screws inserted through door armrest and pull handle assembly into door inner panel or armrest hanger support bracket.
4. On styles with remote control mirror assemblies, remove control plate from bezel on trim pad and remove control from plate.
5. On styles with power door lock controls located in door trim panel, disconnect wire harnesses at switch assemblies (Fig. 7).
6. Remove remote control handle bezel screws (Fig. 3)
7. Remove screws used to hold armrest to inner panel (Fig. 1).
8. Remove screws and plastic retainers from perimeter of door trim panel using tool BT-7323A or equivalent and a screwdriver (Fig. 8).
   To remove trim panel, push trim upward and outboard to disengage from door inner panel at the beltline.
9. On styles with water deflector held in place by fasteners, use tool BT-7323A or equivalent to remove fasteners and water deflector.

Installation

1. To install water deflector, locate fasteners in holes in door inner panel and press in place. Replace all tape which may have been applied to assist in holding water deflector in place.
2. Before installing door trim panel, make certain that all trim retainers are installed securely to the panel and are not damaged. Where required, replace damaged retainers. Start retainer flange into 6.3 mm (1/4") cutout attachment hole in trim panel, rotate retainer until flange is engaged fully.
3. Connect electrical components where present.
4. To install door trim panel, locate top of assembly over upper flange of door inner panel, inserting door handle through handle slot in panel and press down on trim panel to engage upper retaining clips.
5. Position trim panel to door inner panel so trim retainers are aligned with attaching holes in panel and tap retainers into holes with palm of hand or a clean rubber mallet.
6. Install all previously removed items.

DOORS

DOOR SEALING

The following section contains service operations necessary to remove the components which seal doors against air and water entry into the passenger compartment. Items included are window belt sealing strips, insulator pads, inner panel water deflector and door opening weatherstrips.

Figure 9 shows exploded views of the door sealing components. Most parts shown are available through the service parts system.

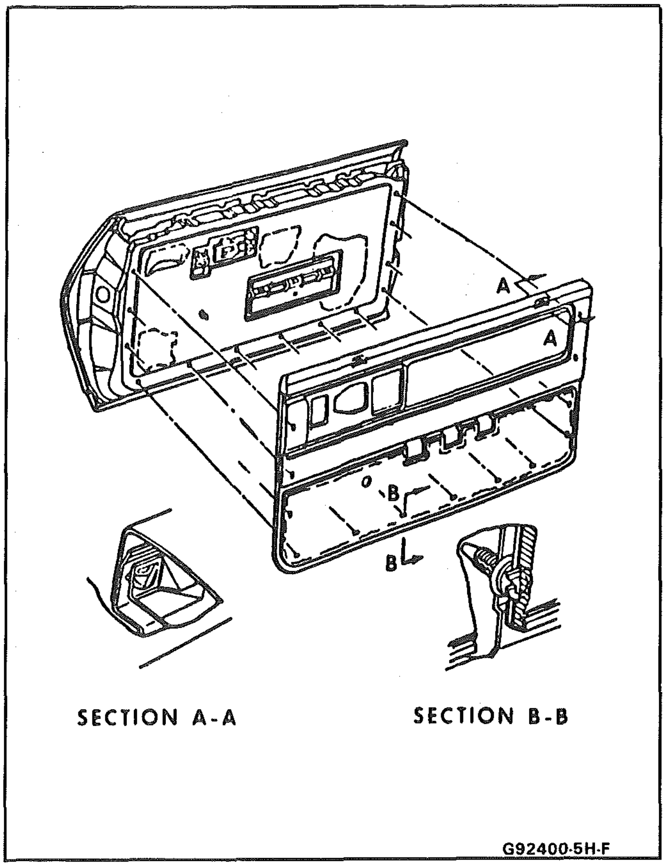


Fig. 8-Door Trim Panel Retention

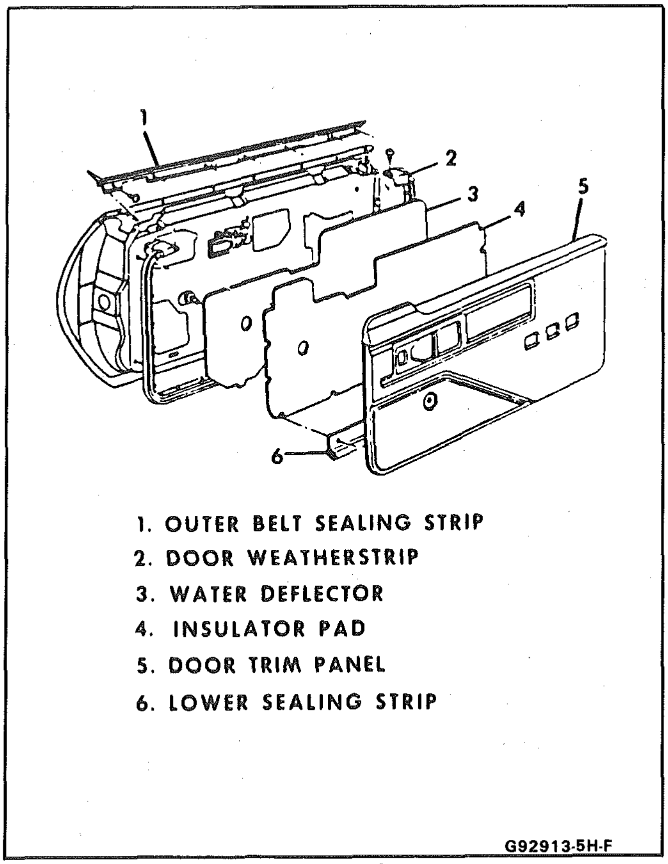


Fig. 9-Door Sealing Components

DOOR WEATHERSTRIPS

The doors use nylon fasteners to retain the door weatherstrips. The fasteners are a component part of the weatherstrip and secure the weatherstrip to the door by engaging piercings in the door panels. The serrations on the fastener also seal the openings from water entry (Fig. 10). In addition to the fastener, weatherstrip adhesive is used at the beltline and down the door hinge pillar.

To disengage nylon fasteners from door panel piercings use tool J-21104 or equivalent (Fig. 10). This tool permits removal of the weatherstrip without damaging the serrations on the fasteners so that the weatherstrip can be reinstalled if desired. Although a replacement door weatherstrip will include nylon fasteners, individual fasteners are also available as service parts.

Removal

1. Remove door trim panel to gain access to weatherstrip fasteners hidden under trim panel and remove fasteners.

NOTICE: Due to weatherstrip bond, it is recommended an application of weatherstrip release agents such as 3M Improved Release Agent No. 08971, Kent Special Release Agent No. SR-A or equivalent be applied prior to step 2 to aid in breaking the adhesive bond. The following operation must be performed carefully to prevent damaging the side roof rail weatherstrip.

2. Use a flat-bladed tool to break cement bond between door and weatherstrip. Weatherstrip adhesive is used for a distance of 229 mm (9") on door lock pillar and the entire length of the door hinge pillar (Fig. 11).
3. Use tool J-21104 or equivalent to disengage weatherstrip nylon fasteners.

Installation

1. If weatherstrip is to be reinstalled, inspect nylon fasteners and replace any that are damaged.
2. Clean off old weatherstrip adhesive from door.
3. Position weatherstrip to door and install plastic fasteners at front and rear ends of weatherstrip.
4. Tap nylon fasteners into door piercing using a hammer and blunt caulking tool.

Although weatherstrip adhesive is specified only at specific locations, it can be used at any point where additional retention or sealing is required.

If weatherstrip becomes damaged at fastener location and will not retain fastener, remove fastener and secure weatherstrip to door with weatherstrip adhesive. If more than two consecutive fastener locations become damaged, replace weatherstrip.

SIDE ROOF RAIL WEATHERSTRIP AND RETAINER

The side roof rail weatherstrip is sealed to a weatherstrip retainer which is sealed to the body by a nitrile foam material bonded to the retainer. Additional pumpable sealer is applied in corner areas

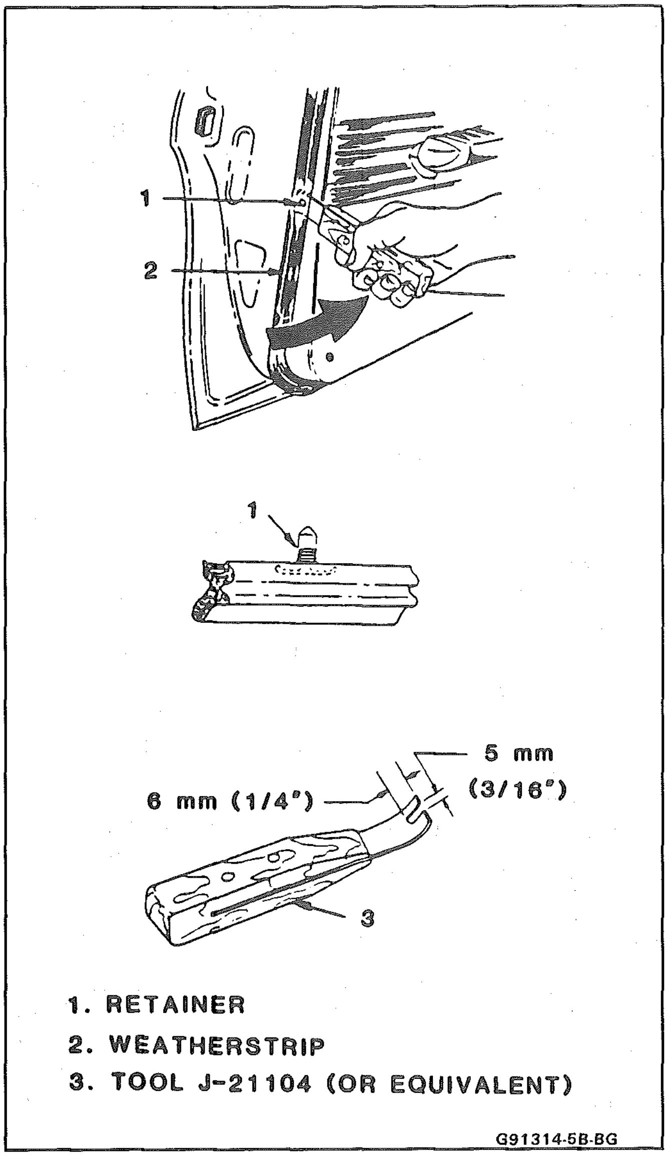


Fig. 10-Removing Door Weatherstrip

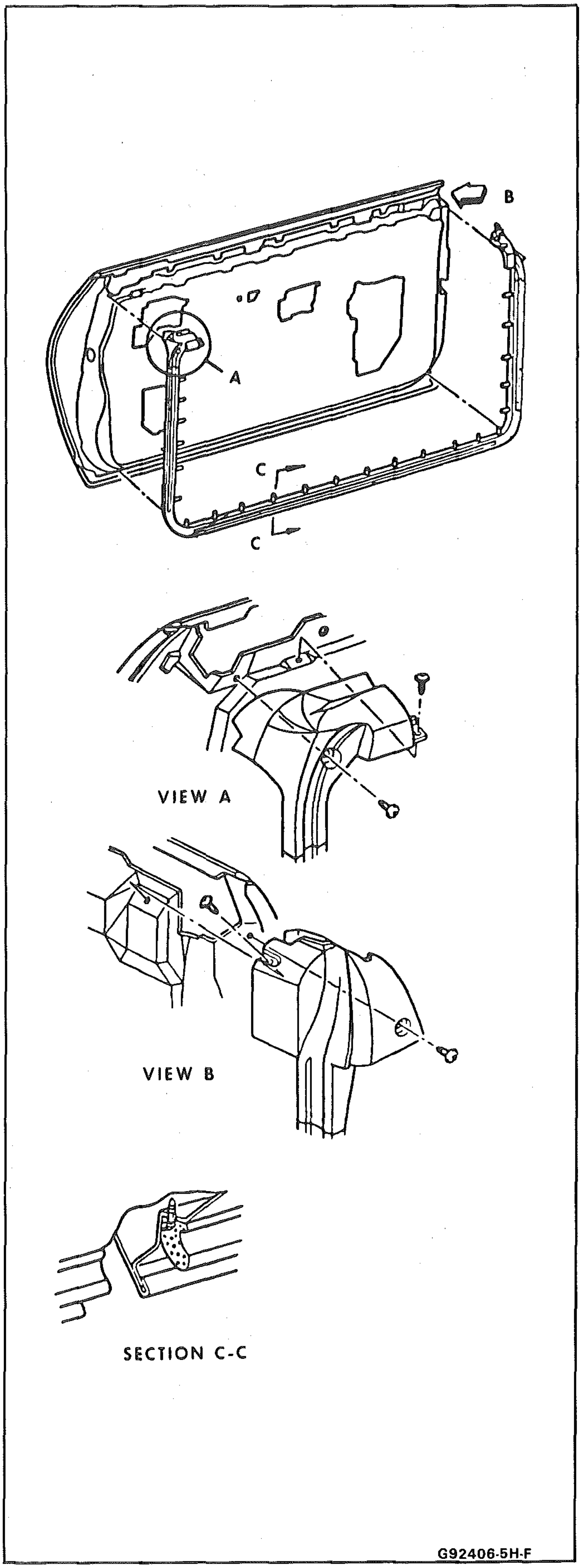


Fig. 11-Installing Door Weatherstrip

to assure a good seal against air and water. Plastic fasteners retain the ends of the weatherstrip to the body (Fig. 12).

Removal

1. Remove plastic fasteners at front and rear of side roof rail weatherstrip (Fig. 12) with tool J-21104 or equivalent.

   NOTICE: Due to weatherstrip bond, it is recommended an application of weatherstrip release agent such as 3M Improved Release Agent No. 08971, Kent Special Release Agent No. SR-A or equivalent be applied prior to step 2 to aid in breaking adhesive bond. The following operation must be performed carefully to prevent damaging side roof rail weatherstrip.

2. Beginning at the front body hinge pillar, carefully pull weatherstrip out of retainer while breaking sealer bond between weatherstrip and retainer with a flat-bladed tool.

3. With weatherstrip removed, screws securing weatherstrip retainer to side roof rail are exposed. Mark position of retainer on rail or pillar and remove screws from retainer.

Installation (Fig. 12)

1. Scrape excess sealer from weatherstrip retainer.
2. Apply a continuous bead of a pumpable type body caulking compound 100 mm (4") rearward and 100 mm (4") down from front and rear upper corner of retainer that mates with side roof rail, and along full length of body lock pillar retainer. Apply bead outboard of attaching screw holes.
3. Position retainer to body and install attaching screws.
4. Apply a continuous bead of black weatherstrip adhesive to outboard flange and outboard surface of weatherstrip retainers. Then apply black weatherstrip adhesive to the front and rear end details of the side roof rail weatherstrip.
5. Position front end of weatherstrip to body and install plastic nail fasteners. Using a flat-bladed tool, engage weatherstrip with retainer, outboard lip first, then inboard lip.
   Replacement plastic nail fasteners are available as a service part.
6. After weatherstrip has been installed along length of retainer, install plastic nail fastener at rear end of weatherstrip.

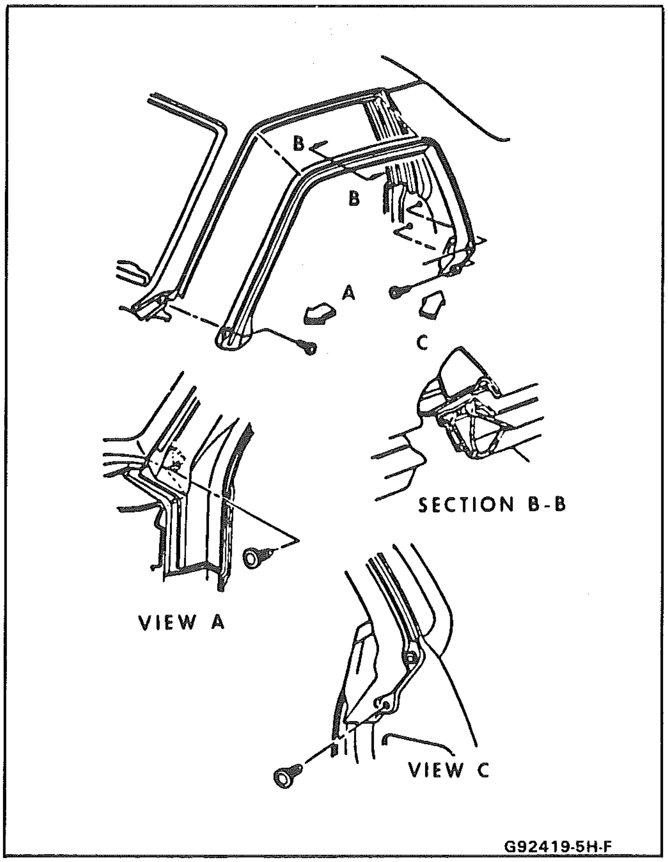


Fig. 12-Installing Roof Rail Weatherstrip

DOOR WINDOW BELT SEALING STRIPS

Door window belt sealing strips are used to form a seal between the door inner and outer panels and the window at the beltline. This sealing strip is attached to the door outer panel return flange by screws. The inner belt sealing strip is stapled to the door trim panel and its removal is not recommended.

DOOR OUTER BELT SEALING STRIP

Removal and Installation

1. Apply cloth-backed tape as a protective cover over the painted surface of the door next to the sealing strip.
2. Remove door trim panel and water deflector.
3. Remove filler assembly at belt.
4. Remove door glass as outlined later in this section.
5. Remove screws holding sealing strip to door from inboard side of door.
6. Carefully pull up on sealing strip to remove.
7. To install, reverse the removal procedure.

DOOR INSULATOR PADS - OPTIONAL

Insulator pads may be installed between the door trim panel and inner panel water deflector. The purpose of the insulator pad is to absorb sound. The pad is glued to the door trim panel.

DOOR INNER PANEL WATER DEFLECTORS

Waterproof deflectors are used to seal the door inner panel and prevent entry of water into the body. The deflector is secured by an adhesive sealer material along the front edges, rear edges and bottom, and by the application of waterproof sealing tape. Whenever work is performed where the water deflector has been disturbed, the deflector must be properly sealed and taped to the inner panel to prevent waterleaks (Fig. 13). For service sealing, strip caulking is recommended if additional sealing material is required.

When access to the inner panel is required to perform service operations, the deflector may be completely or partially detached from the inner panel. If the existing water deflector is damaged so that it will not properly seal the door, replace the deflector. The water deflector is available as a service part.

The following procedure covers complete removal and installation of the water deflector. If only partial removal of the deflector is required, perform only those steps which are necessary to expose the required area of the door inner panel.

Removal

1. Remove door trim panel. (Refer to the Door Trim portion of this section.
2. If plastic nails were used to assist in holding water deflector in place, use tool J-21104 or equivalent and remove plastic nails.
3. Carefully break sealer bond between water deflector and door inner panel down both sides of deflector.

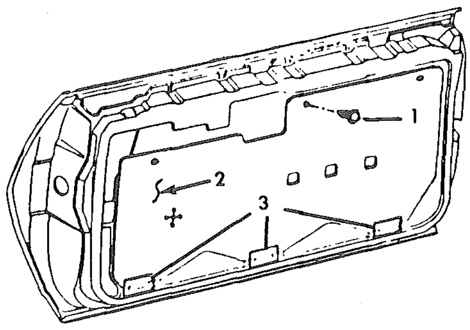


Fig. 13-Installing Door Water Deflector

4. When seal has been broken down both sides of deflector, carefully remove tape from inner panel. Disengage water deflector from inner panel drain slot and remove deflector.

Installation

1. Inspect water deflector and, where necessary, repair any tears or holes with waterproof body tape applied to both sides of deflector.
2. If a new deflector is to be installed, service parts are available.
3. Position water deflector to door inner panel and insert deflector tabs in retaining slots in inner panel. Firmly roll or press edges of deflector to obtain a good bond between deflector sealer and inner panel. If old sealer cannot make a satisfactory seal, apply additional strip caulking to inner panel at unsealed areas.
4. Apply waterproof body tape to lower edge of water deflector as shown in Figure 13.
5. If plastic nails were used to assist in holding deflector in place, locate drive nails over holes in inner panel and tap nails into inner panel.

DOOR HINGE SYSTEM

NOTICE: The door hinge components are important attaching parts in that they could affect the performance of vital components and systems, and/or could result in major repair expense. Each part must be replaced with one of the same part number or with an equivalent part if replacement is necessary. Do not use replacement parts of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

This portion of the manual contains the service operations necessary to remove the doors, the door side hinge straps and the body side hinge straps.

The door hinges are made of steel and are welded to the door and bolted to the body hinge pillars. No adjustment provisions are used in this type system. The upper hinge is a one-piece type while the lower hinge is made up of a door side and body side strap with a removable hinge pin. The removable hinge pin has a barrel type retaining clip and a serrated shank near the head which provides a friction fit with the mating surface on the hinge. All service hinge straps have holes to permit bolt-on installation. Tapped anchor plates must be used instead of nuts and washers to insure structural integrity when replacing a door side hinge strap assembly. No service welding is required when replacing door hinge straps. The door lower hinge has an integral two stage hold-open feature. Door side and body side hinge straps, hinge pins, tapped anchor plates, hinge bolts and bushings are available as separate service parts. Figure 14 identifies the various parts of the door hinge system.

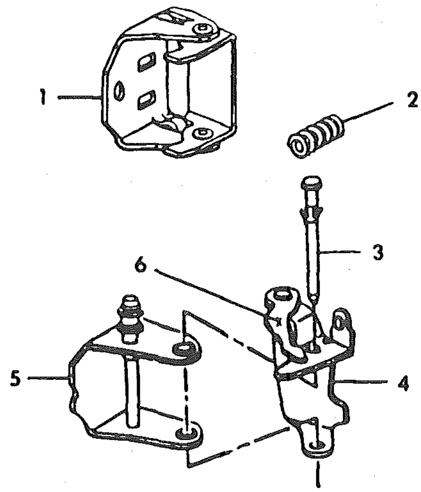


Fig. 14-Door Hinge System

Door Removal

1. On doors equipped with power-operated components, proceed as follows:
   a. Remove door trim panel and inner panel water deflector.
   b. Disconnect wire harness from all components in door.
   c. Remove rubber conduit from door, then remove wire harness from door through conduit access hole.
2. Tape area (on door pillar and body pillar) above lower hinge with cloth backed body tape.

CAUTION: Before performing the following step, cover spring with a shop cloth to prevent spring from "flying" and possibly causing personal injury or damage.

3. Insert long, flat-bladed screwdriver under pivot point of hold-open link and over top of spring. Screwdriver should be positioned so as not to apply pressure to hold-open link.
   Cover spring with shop cloth and lift screwdriver to disengage spring. Spring can also be removed using tool J-28625 (or equivalent) door hinge spring compressor tool (Fig. 15). The tool is stamped right side and left side. The tool stamped left side is used to service the right-hand hinge spring. The tool stamped right side is used to service the left-hand hinge spring.
   a. Install two jaws of tool over spring. Jaw with slot slides over spring at hold-open link. Jaw with hole fits over spring at bubble on door hinge pillar.
   b. Install bolt to jaws of tool and tighten to compress spring.
   c. Remove tool and spring from door hinge assembly. Do not remove spring from tool.
4. If replacement hinge pin barrel clips are not available, save the clip as follows:
   a. Using two small screwdrivers, spread clip enough to move clip above recess toward pointed end of pin.
   b. As pin is removed, clip will ride shank of pin and fall free.
   c. Reinstall clip onto pin before installing door.
5. With aid of helper to support door, remove lower hinge pin using soft-headed hammer and locking type pliers. Helper can aid hinge pin removal by raising and lowering rear of door.
6. Insert bolt into hole of lower hinge to maintain door attachment during upper hinge removal.
7. Using a 13 mm socket, remove upper hinge bolts from pillar. Remove bolt from lower hinge and remove door from body.

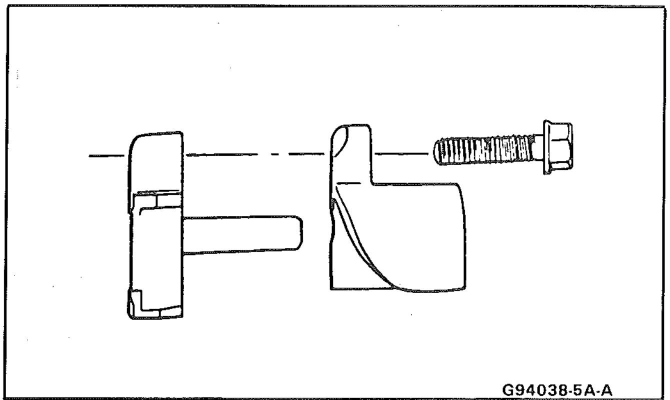


Fig. 15-Door Hinge Spring Compressor Tool

Door Installation

Before installing door, replace hinge pin clip or reuse old clip as outlined in removal procedure.

1. With aid of helper, position door and insert bolt in hole of lower hinge.
2. Upper hinge is bolted to body. Lower hinge pin is installed with pointed end down.
3. Remove screw from lower hinge and install lower hinge pin. The use of tool J-28625 or equivalent (Fig. 15) is recommended for installing hinge spring.

NOTICE: If spring is installed before installing lower hinge pin, damage to hinge bushings may result.

4. If spring was removed using screwdriver, install spring as follows:
   a. Place spring in tool J-28625 or equivalent (Fig. 16).
   b. Place tool and spring in bench vise (Fig. 17).
   c. Compress tool in vise and install bolt until spring is fully compressed (Fig. 18).
   d. Remove tool (with compressed spring) from vise and install in proper position in door lower hinge. Slot in one jaw of tool fits over hold-open link. Hole on other jaw fits over bubble.
   e. Remove bolt from tool to install spring (Fig. 16).
   f. Remove tool from door hinge (tool will fall out in three pieces). Cycle door to check spring operation.

   If tool J-28625 or equivalent was used to remove spring, follow steps d, e and f above to install spring.
5. Remove tape from door and body pillars.
6. On doors with power-operated components, install all previously removed parts in reverse order.

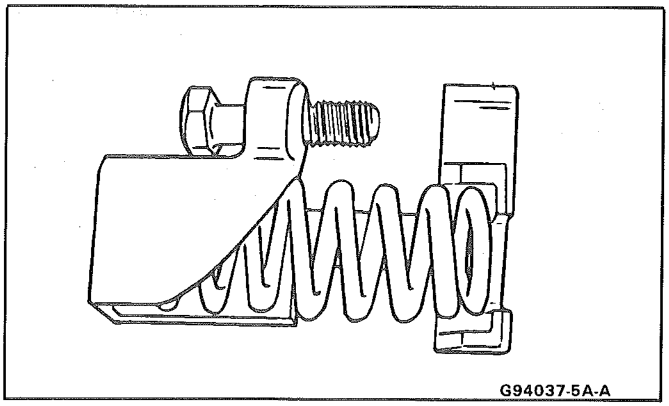


Fig. 16-Spring Installed to J-28625 (Noncompressed)

DOOR SIDE HINGE STRAP

Removal

1. Remove door trim panel and inner panel water deflector.
2. Remove door from body.
3. Center punch and scribe location of hinge strap on door hinge pillar (Fig. 19).
4. Center punch visible weld marks on hinge base. Drill a 3 mm (1/8") pilot hole completely through welds at center punch marks. When drilling out welds, drill only deep enough to penetrate hinge base to release hinge from panel as shown in Figure 20.

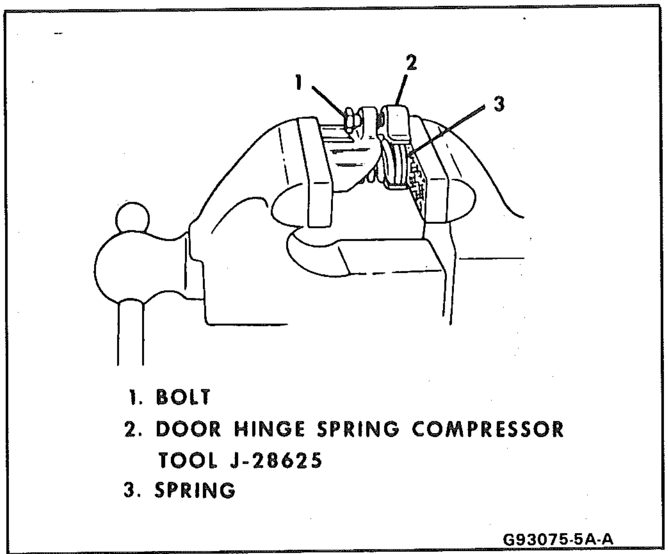


Fig. 17-Using Bench Vise to Compress Spring in J-28625

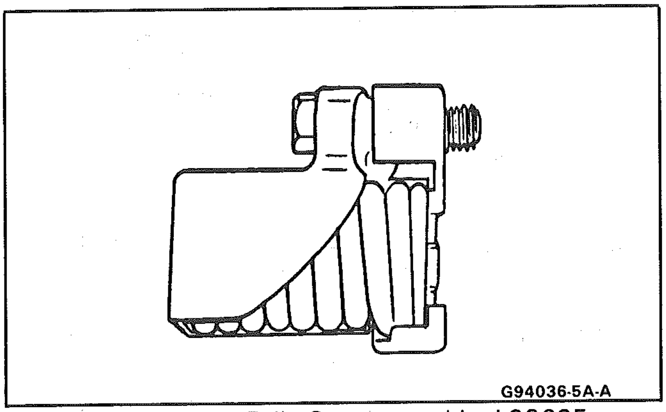


Fig. 18-Spring Fully Compressed in J-28625

5. Using 3 mm (1/8") hole as a guide, drill out welds with a 13 mm (1/2") drill bit.
6. A slight amount of weld may still retain hinge base to panel. Drive a chisel between panel and hinge base to separate hinge from panel.

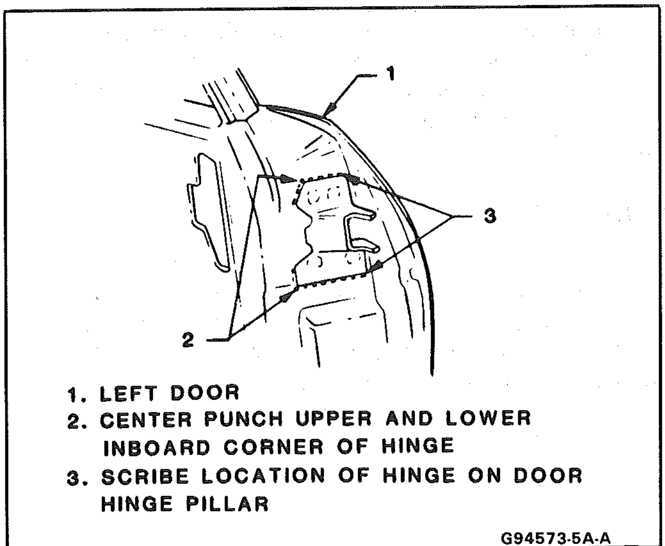


Fig. 19-Locating Hinge on Door Hinge Pillar (Typical)

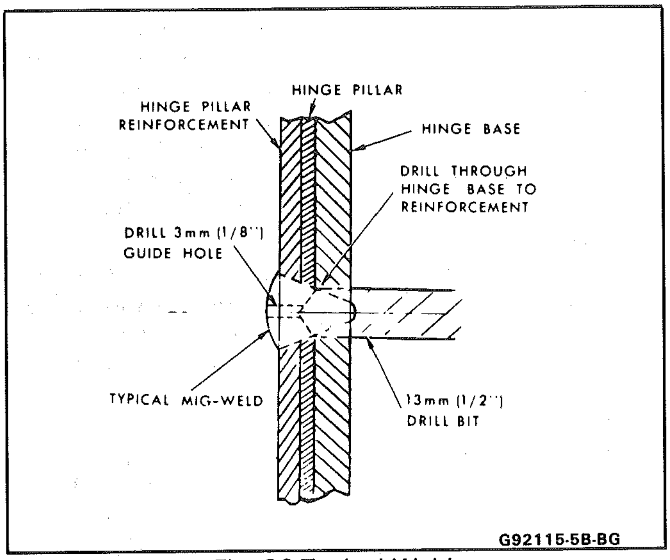


Fig. 20-Typical Weld

Installation

Figure 21 shows the service installation for the door side hinge straps on a typical door hinge pillar.

Tapped anchor plates (available as service parts) must be used to maintain structural integrity of door hinge system. Do not substitute with nuts and bolts.

1. Prepare door hinge pillar facing as required for replacement of hinge strap and anchor plate.

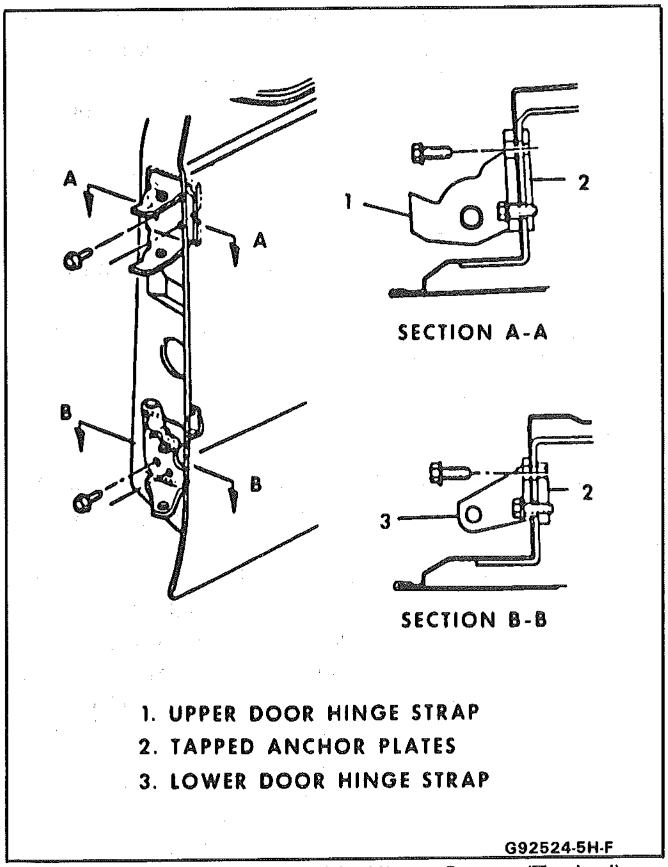


Fig. 21-Installing Door Side Hinge Straps (Typical)

2. Position the replacement bolt-on hinge within scribe marks on the hinge pillar facing and center punch bolt hole locations in hinge pillar.
3. Using a 13 mm (1/2") drill bit, drill hinge attaching holes. The 13 mm (1/2") holes in the door hinge pillar will provide for some in and out door adjustment when reinstalling the door assembly.
4. Coat surface of hinge strap that mates with hinge pillar with medium bodied sealer. Install hinge using specified service bolts and service anchor plates. Tighten hinge bolts to 20 to 28 N·m (14 to 20 ft-lb) torque.
5. Install door to body.

   Whenever hinge straps have been replaced and the door reinstalled, the door should not be closed completely until a visual check is made to determine if lock fork bolt will correctly engage with striker.
6. Install door water deflector and door trim panel.

BODY SIDE HINGE STRAP

Removal

1. Remove door assembly from body.
2. Center punch and scribe location of lower hinge strap on body hinge pillar.
3. Scribe location of hinge strap on body pillar (Fig. 19).
4. Remove one of the following trim items depending on which hinge strap is being repaired.
   - Left-hand lower hinge - remove the left-hand shroud trim panel.
   - Right-hand lower hinge - remove right-hand shroud trim panel.
5. Remove noise control adhesive patch to gain access to bolt which was installed from the inboard side of the car.
6. Using 15 mm socket, remove bolt installed from inboard side of body.
7. From outside of car, use 13 mm socket and remove remaining bolt.
8. Remove hinge strap from body.

Installation

Figure 22 shows the service installation for the body side hinge straps on a typical front body hinge pillar.

1. Prepare body hinge pillar facing as required for replacement of hinge strap and anchor plate.
2. The service body side lower hinge straps have two bolt holes. To locate the other bolt hole, use the original hinge strap to make a paper template. Outline the original hinge strap on a piece of paper. Locate the centerline of the bolt hole which is required. Push a pen or pencil through paper template at this location. Place template on service hinge and once hinge is aligned with template, center punch new hinge using hole in template as a locator.
3. Using a 8.5 mm (11/32") drill bit, drill hole in hinge strap. The holes in the body hinge pillar will provide for some movement when reinstalling the hinge strap.
4. Coat surface of hinge strap that mates with body pillar with medium bodied sealer.
5. Hand start bolt from inside of body through hinge strap.
6. Install bolt from outside of body through hinge. Torque 20 to 28 N·m (15 to 20 ft-lb).
7. Tighten inside bolt 40 to 55 N·m (20 to 40 ft-lb).
8. Install door to body. Whenever hinge straps have been replaced and the door reinstalled, the door should not be closed completely until a visual check is made to determine if lock fork bolt will correctly engage with striker.
9. Replace all trim items.

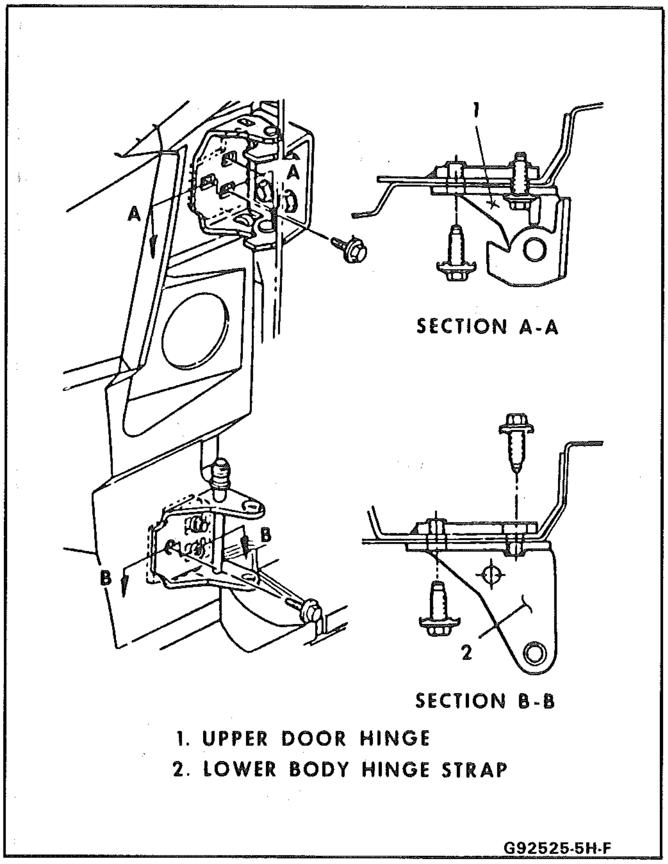


Fig. 22-Installing Body Side Hinge Straps

DOOR WINDOW SYSTEM

This portion of the manual contains the service operations necessary to remove the window glass and all hardware pertaining to the window system. Any work performed on window system hardware requires removal of the door trim panel and inner panel water deflector. These removal procedures are covered in the Door Trim and Door Sealing sections.

Adjustments

In the following steps, the numbers in parentheses refer to items in Figure 23 unless otherwise noted. Door armrest and trim panel must be removed and water deflector detached before making adjustments. After making adjustments, tighten all loosened attachments to 10 to 14 N·m (90 to 125 in-lb) torque.

1. Window Rotated - Loosen up-stops (2 and 6), adjust inner panel cam (8) as required and tighten attaching screws. Adjust up-stops as required and tighten attaching screws.
2. Window Upper Edge Inboard or Outboard - Loosen the following attachments.
   a. Filler at belt (1 and 10)
   b. Rear guide upper support lower bolts (Fig. 31, item 5)

   Adjust rear guide as needed and tighten bolts. Adjust and tighten filler assembly.
3. Window Too Far Forward or Rearward - Loosen filler assembly bolts (3 and 10). With glass in half-down position, loosen bolts on rear guide channel (7). Position glass to opening as needed and tighten bolts. Position filler to glass and opening as needed and tighten bolts.
4. Window Too High or Low in Up Position - Adjust front and rear up-travel stops (2 and 6) as required.
5. Window Binds - Ease of window operation and stability depend to a great extent on the glass stabilizers (5) at the beltline. Contact should be enough to stabilize glass but not restrict window operation.

The door window assembly consists of a frameless piece of solid tempered safety plate glass. The glass is riveted to the window regulator sash. Figure 24 illustrates a typical door with the trim panel and water deflector removed. This figure identifies the hardware parts of the door.

Removal

1. Remove door trim panel and inner panel water deflector.
2. Raise window to half-up position.
3. Punch out center pins of glass to sash channel attaching rivets.
4. Remove rear guide channel through rear access hole.
5. Remove up stop.
6. Using a 6.3 mm (1/4") drill bit, drill out attaching rivets on sash channel (Fig. 25).
7. Raise glass to remove from sash channel and remove glass from door.

Installation

1. Remove drilled out rivets and shavings from door.
2. Check rivet bushings and retainers on glass for damage. If necessary, remove bushings using a flat-bladed tool covered with cloth body tape. Install by snapping rivet retainer into bushing.
3. Lower glass into door and position on sash channel so holes in sash line up with holes in bushings and retainers.
4. Using rivet tool J-29022 or equivalent, install 1/4" peel type rivet (part no. 20184399 or equivalent) to retain glass to sash channel (Fig. 25).
5. Install rear guide channel.
6. Install front up stop to support on inner panel.
7. Before installing trim parts, check window operation for performance and fit to roof rail weatherstrip.
8. Install all remaining parts.

WINDOW SASH CHANNEL

Removal and Installation

1. Remove door trim panel and water deflector.
2. Remove door glass as outlined in the window removal portion of this section.
3. Slide sash channel off regulator rollers and remove channel from door through rear access hole.
4. To install, reverse removal procedure.

WINDOW REGULATOR AND REGULATOR MOTOR

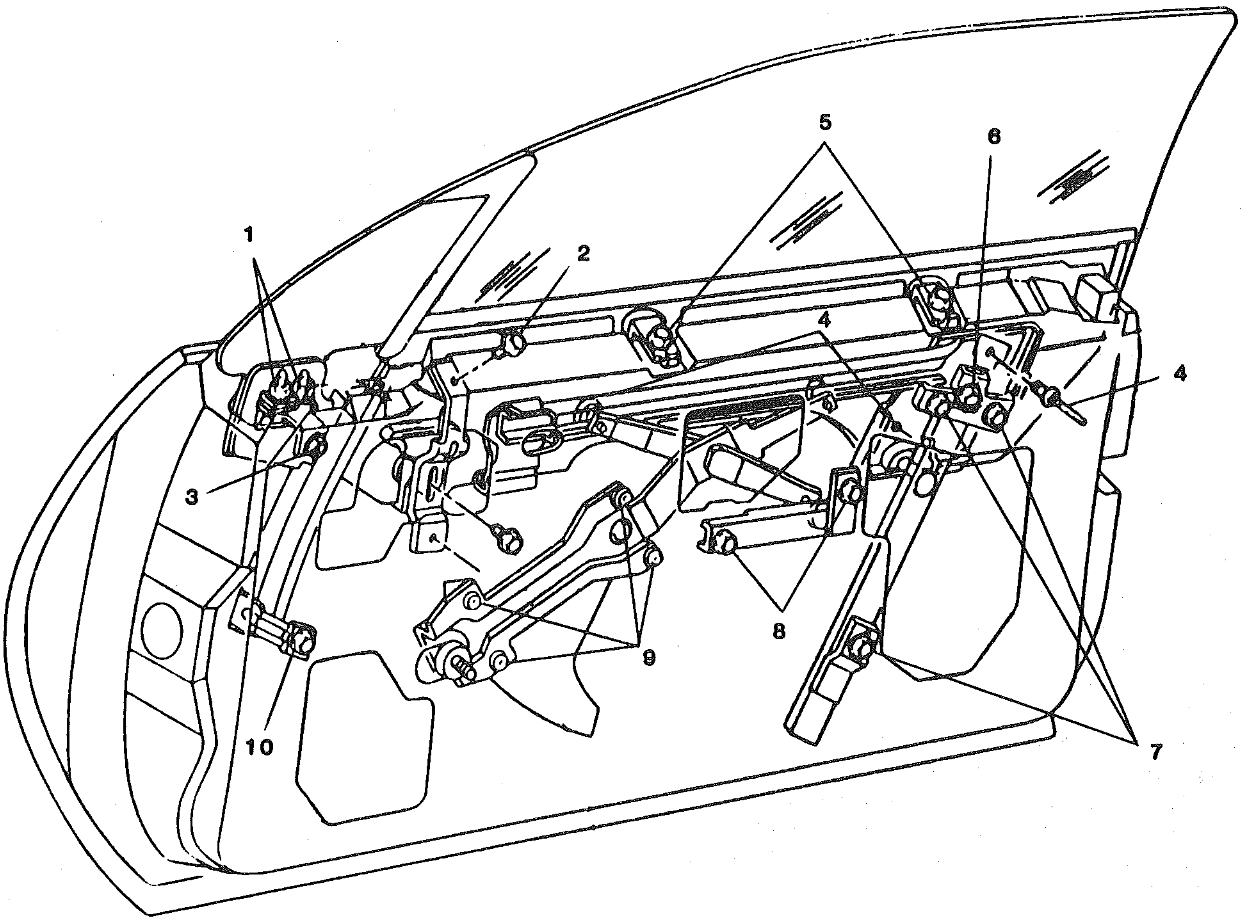
Removal

1. Remove door trim panel and inner panel water deflector.
2. Raise window to half-up position and hold in place by inserting rubber wedge door stops at front and rear of window between window and inner panel (Fig. 27).
3. Remove rear guide channel and inner panel cam channel.
4. Punch out center pins of regulator rivets; then drill out rivets using 6.3 mm (1/4") drill bit.
5. Move regulator rearward and disconnect wire harness from motor (if present). Disengage roller on regulator lift arm from glass sash channel.
6. Remove regulator through rear access hole.

   CAUTION: If electric motor removal from the regulator is required, the sector gear must be locked in position. The regulator lift arm is under tension from the counterbalance spring and could cause personal injury if the sector gear is not locked in position.
7. Drill a hole through the regulator sector gear and backplate and install a bolt and nut to lock sector gear in position (Fig. 28).
8. Using a 4.8 mm (3/16") drill bit, drill out motor attaching rivets and remove motor from regulator.

Installation

1. To install motor to regulator, use rivet tool J-29022 or equivalent, and install 4.8 mm (3/16") rivets or 4.8 mm (3/16") nuts and bolts. Remove bolt and nut used to secure sector gear in position.
2. Place regulator through rear access hole into door inner panel. If electric regulator is being installed, connect wire connector to motor prior to installing regulator to inner panel.
3. Locate lift arm roller into glass sash channel.
4. Using rivet tool J-29022 or equivalent, rivet regulator to inner panel of door using 1/4"x0. 500" aluminum peel type rivets (part no. 9436175



1. NUTS - FILLER ASSEMBLY TO SUPPORT
2. SCREWS - FRONT UP STOP SUPPORT
3. BOLT - FILLER ASSEMBLY SUPPORT
4. RIVET - SASH CHANNEL TO GLASS
5. BOLTS - GLASS STABILIZER
6. BOLT - REAR UP STOP
7. BOLTS - REAR GUIDE CHANNEL
8. BOLTS - CAM CHANNEL
9. RIVET - REGULATOR
10. ADJUSTING STUD AND NUT - FILLER ASSEMBLY

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Fig. 23-Door Hardware Attachments

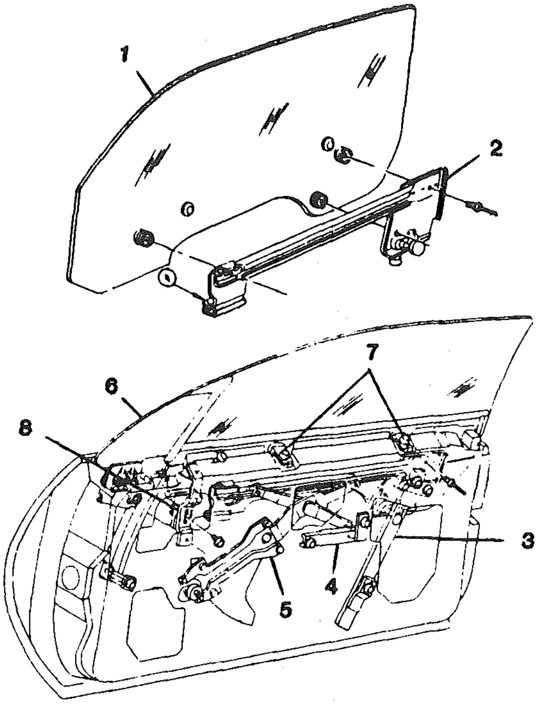


Fig. 24-Door Hardware

or equivalent). If rivet tool is not available, use the following nut and bolt method.

a. Install U clips on regulator at attaching locations. Be sure to install clips with clinch nuts on outboard side of regulator.
b. Locate regulator in door inner panel. If electric regulator is being installed, connect wire connector to regulator motor.
c. Locate lift arm roller in glass sash channel.
d. Align regulator with clinch nuts to holes in inner panel.
e. Attach regulator (and motor) to door inner panel with M6.0x1x13 (1/4-20x1/2") screws (part no. 9419723 or equivalent) into 6 mm (1/4") nuts with integral washers. Tighten screws to 10 to 14 N·m (90 to 125 in-lb) torque.

5. If electric window regulator is being installed, use rivet mentioned in step 4 to rivet window regulator and motor to door inner panel.
6. Replace all previously removed parts.

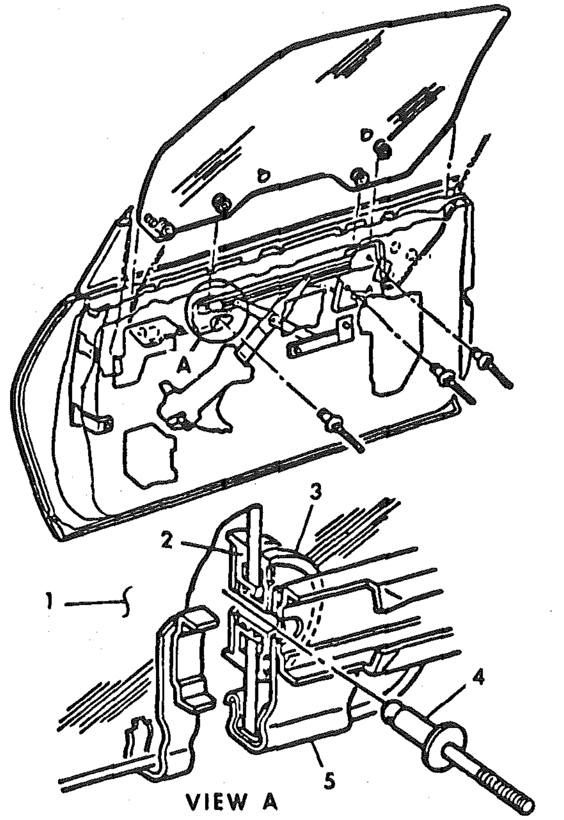


Fig. 25-Installing Glass to Sash Channel

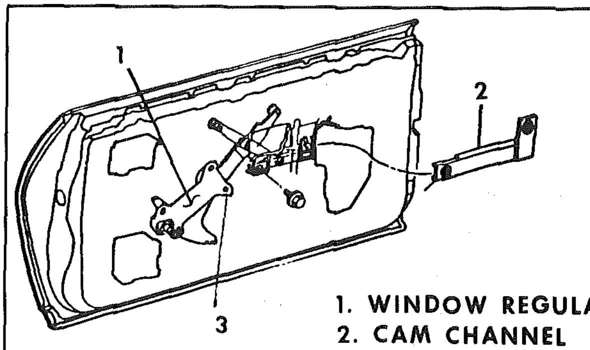


Fig. 26-Installing Regulator and Cam Channel

FILLER ASSEMBLY (AT BELT)

Removal and Installation

1. Remove door trim panel and detach water deflector.
2. Remove front attachments for door weatherstrip and position weatherstrip to provide access to filler bolts.

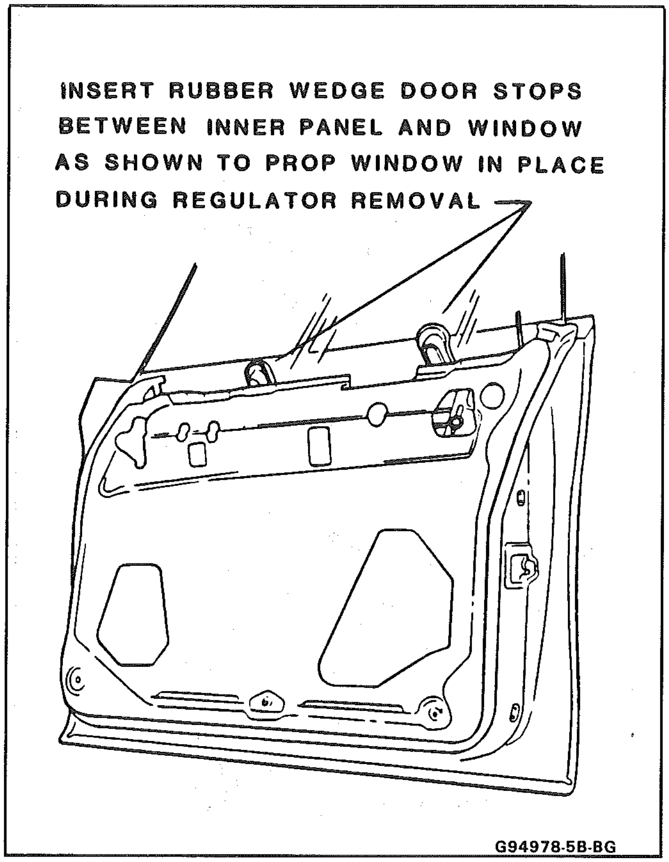


Fig. 27-Door Window Propped in Place for Regulator Removal

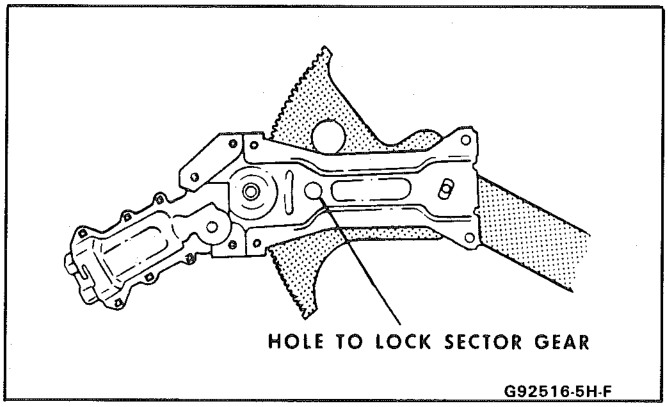


Fig. 28-Electric Motor on Window Regulator

3. Loosen two nuts on filler below beltline (Fig. 29).
4. Remove bolt holding support to inner panel.
5. Remove bolt at lower attaching point.
6. Pull filler up and rotate 90 degrees to remove through belt opening (Fig. 30).
7. To install, reverse removal procedure.

FRONT UP STOP

Removal and Installation

1. Remove door trim panel and detach water deflector.
2. Remove bolt holding up stop on inner panel and remove up stop.
3. To install, reverse removal procedure.

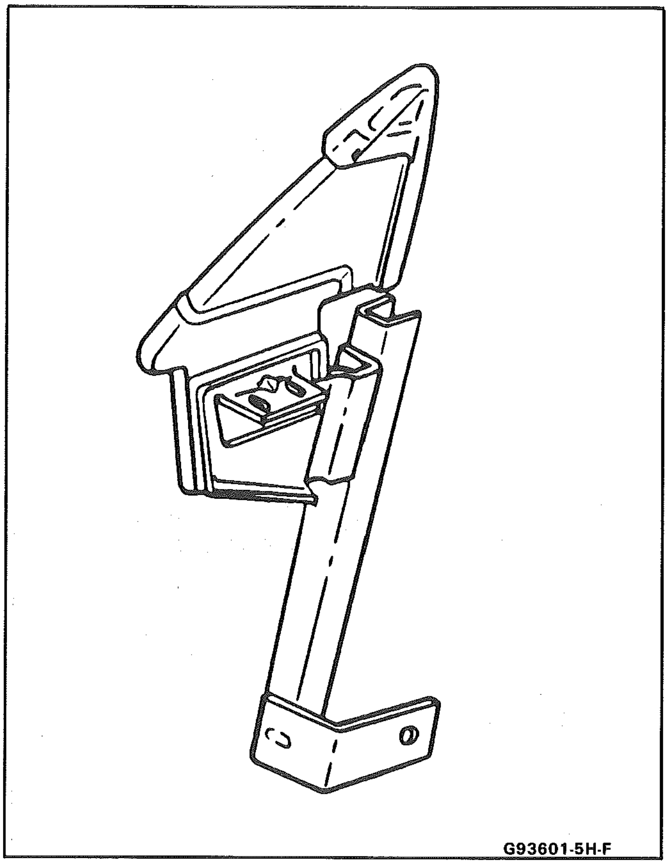


Fig. 29-Filler Assembly (at Belt)

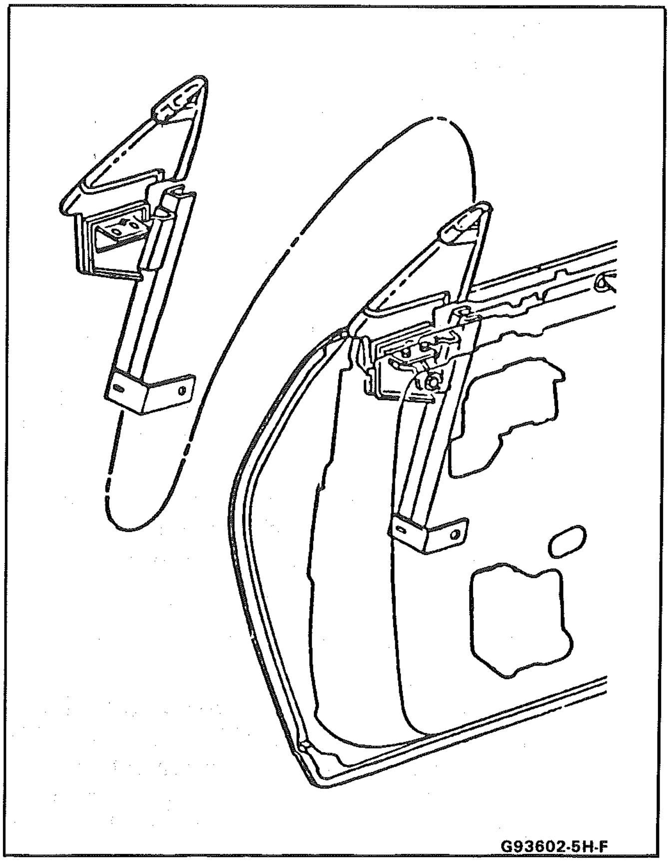
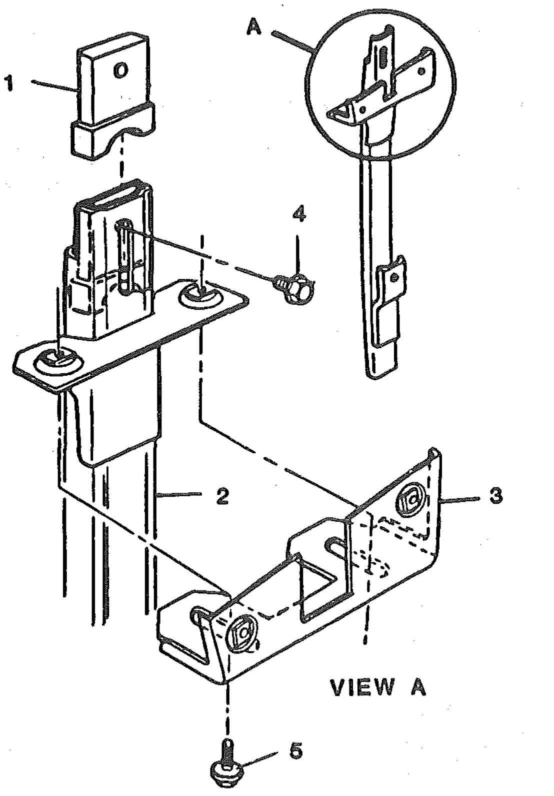


Fig. 30 - Installing Filler Assembly

REAR GUIDE CHANNEL

Removal and Installation

1. Raise glass to half-up position.
2. Remove door trim panel and water deflector.
3. Remove three attaching bolts to loosen channel from inner panel.
4. While pulling channel up and back, rotate channel 180 degrees and remove from sash roller (Fig. 32).
5. Remove rear guide channel through rear access hole.
6. To install, reverse the removal procedure.



1. REAR UP STOP
2. REAR GUIDE CHANNEL
3. REAR GUIDE CHANNEL SUPPORT
4. BOLT
5. BOLT(S)

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Fig. 31-Rear Up Stop and Guide Channel Support

OUTSIDE MIRRORS

Both the standard mirror and the optional remote control mirrors are stud mounted to the door outer panel (Fig. 33). Removal of the door trim panel and water deflector is required to gain access to the attaching nuts. Removal of these items is described in the Door Trim and Door Sealing sections. The remote control mirror face can be replaced without removing the entire mirror assembly.

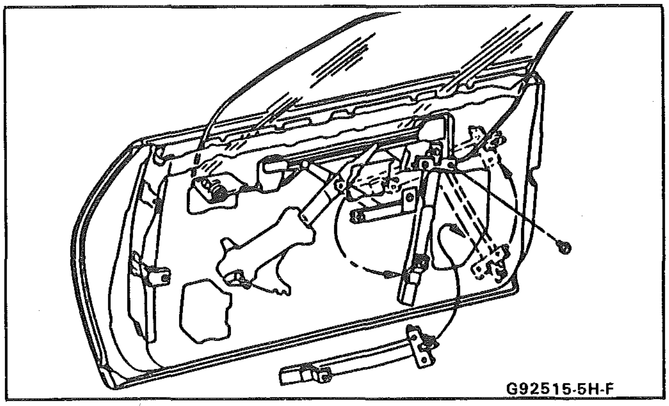
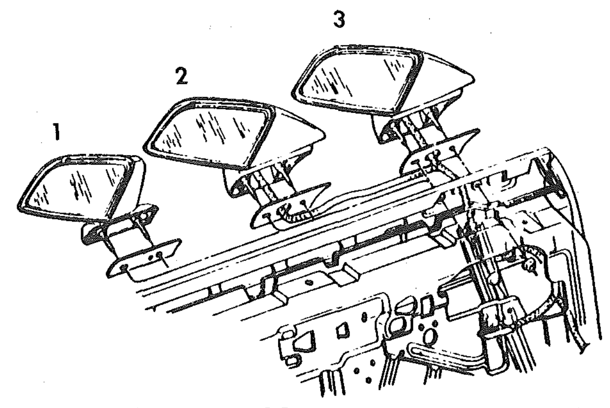


Fig. 32-Installing Rear Guide Channel



1. MANUAL MIRROR
2. REMOTE CONTROL MIRROR
3. ELECTRIC REMOTE CONTROL MIRROR

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Fig. 33-Installing Door Outside Mirror

STANDARD MIRROR

Removal and Installation

1. Remove door trim panel and detach inner panel water deflector enough to gain access to mirror retainer nuts.
2. Remove attaching nuts from mirror base studs and remove mirror assembly from door.
3. To install, reverse removal procedure. Be sure mirror gasket is aligned on door outer panel.

REMOTE CONTROL MIRRORS

The optional left side remote control mirror can be adjusted from the interior of the car by moving the control lever.

The mirror face must be replaced with the same type mirror face when serviced.

Removal and Installation

1. Remove mirror remote control bezel and door trim panel as described in Door Trim section. Detach inner panel water deflector enough to expose mirror retaining nuts.
2. Remove mirror base to door outer panel stud nuts, remove cable from clip and remove mirror and cable assembly from door.

3. To install, reverse removal procedure. Tighten nuts to 8 N·m (72 in-lb) torque.

Remote Mirror Face Replacement

CAUTION: To minimize the chance of personal injury, gloves and safety glasses should be worn when removing broken glass.

NOTICE: When breaking mirror, cover painted surface of door to avoid damage.

1. To remove a scratched, broken, stained, etc., mirror face from the frame, tape, then break the mirror glass and remove the broken glass and fiber pad from the mirror frame.
2. Wipe inside of mirror frame clean.
3. To install replacement mirror face, remove paper backing from service mirror face and center mirror in mirror frame. Press firmly to ensure adhesion of the mirror face to the mirror frame.

POWER-OPERATED OUTSIDE MIRRORS

Mirror Case and Motor Removal and Installation

Follow instructions which are included with new service part. Use electrical tape to protect electrical connections.

Mirror Housing Removal and Installation

1. From door trim panel side, remove remote control mirror bezel, release and remove door panel as described in Door Trim section and disconnect wire harness connection from remote mirror electrical switch.
2. Peel back water deflector enough to detach harness from retaining tabs in door.
3. Remove mirror base-to-door stud nuts and lift mirror housing and harness assembly from door.
4. To install, reverse removal procedure.

SPRING CLIPS

Spring clips are used to secure remote control connecting rods and inside locking rods to door lock levers and remote handles. A slot in the clip provides for disengagement of the clips, allowing easier detachment of linkage.

Removal and Installation

To disengage a spring clip, use a screwdriver or other suitable thin-bladed tool to slide clip out of engagement as shown in Figure 34. To install, reverse removal procedure.

CONNECTING RODS AND LOCKING RODS

Rods are used to connect the door lock actuating levers with the inside and outside handles and the inside lock knob. The rods are attached to the lock with spring clips.

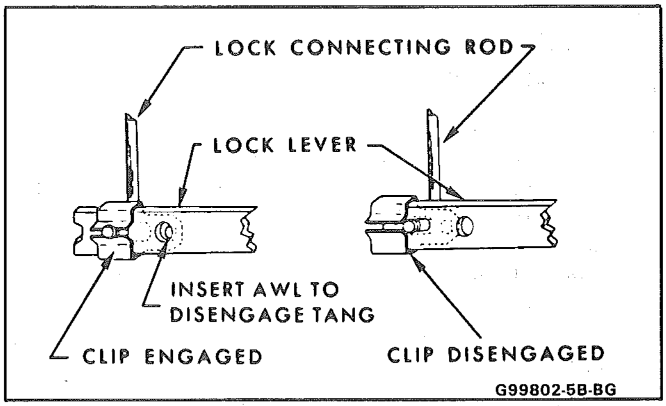


Fig. 34-Removing Spring Clip

Removal and Installation

1. Remove door trim panel and detach inner panel water deflector enough to gain access to required parts.
2. To remove any rod, disengage spring clip retaining rod to lock lever, then disengage rod. Spring clip removal is shown in Figure 34. To remove inside remote handle connecting rod, spring clip retaining rod to remote handle must also be disengaged. To remove inside lock knob to lock rod, first remove knob as described in trim portion of this section.
3. To reinstall rods, first reengage spring clips on lock levers. Align rod in installed position and engage rod in proper lock lever until held by spring clip.

INSIDE REMOTE HANDLE

Removal and Installation

1. Remove door trim panel and detach inner panel water deflector enough to gain access to remote handle (Fig. 35).
2. Disengage connecting rod clip at remote handle and disconnect rod.
3. Punch out center pin of attaching rivet (item 2, Fig. 35); then drill out rivet using 4.8 mm (3/16") drill bit.
4. Slide remote handle forward to disengage front retaining tab and remove.
5. To install, reverse removal procedure. Use steel rivet, 3/16" dia. x 5/16" length (USM Part No. SD62BS or equivalent), to attach remote handle.

OUTSIDE HANDLE

Removal and Installation

1. Raise door window to full-up position. Remove door trim panel and detach inner panel water deflector enough to expose rear access hole.
2. Remove outside handle to lock rod by disengaging clip on outside handle (Fig. 36).
3. Remove two attaching nuts on handle studs.
4. Rotate handle up to disengage from attaching holes.
5. To install, reverse removal procedure.

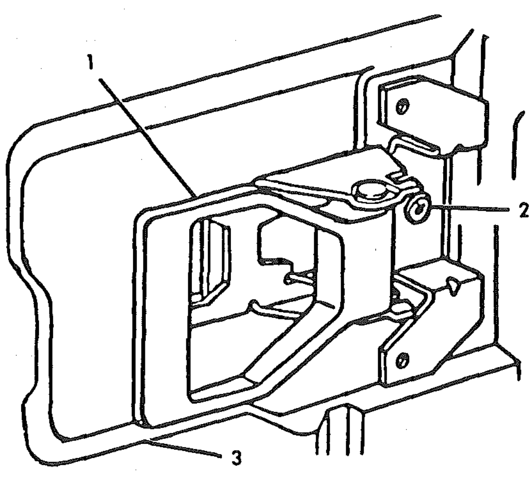


Fig. 35 - Installing Inside Remote Handle

LOCK CYLINDER ASSEMBLY

Removal and Installation

1. Raise door window. Remove door trim panel and detach inner panel water deflector enough to expose access hole.
2. Disengage lock cylinder to lock rod at cylinder (Fig. 36).

   CAUTION: If removing lock cylinder retainer by hand, wear gloves to prevent personal injury.
3. With a screwdriver or similar tool, slide lock cylinder retainer forward until disengaged. Retainer can also be removed by hand by grasping anti-theft shield at top of retainer and rotating until disengaged. Remove lock cylinder from door.
4. To install, reverse removal procedure. Be sure gasket is installed properly.
5. Black lock cylinders should be lubricated with a light oil. All other lock cylinders should be lubricated with a general purpose silicone lubricant, part no. 1052277 or equivalent.

DOOR LOCK STRIKER

The door lock striker consists of a single metal bolt and washer assembly that is threaded into a tapped, floating cage plate located in the body lock pillar. The door is secured in the closed position when the door lock fork bolt snaps over and engages the striker bolt. The striker has provisions for fore and aft adjustment only.

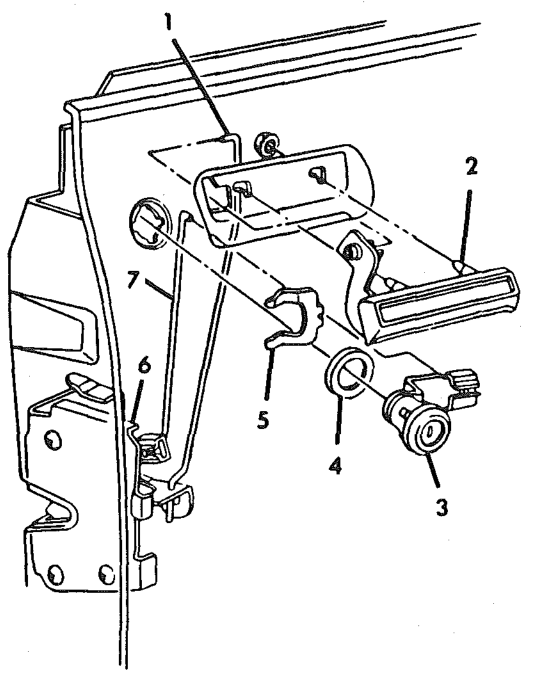


Fig. 36-Door Locking Mechanism

Adjust (Fig. 37)

To determine if striker fore or aft adjustment is required, proceed as follows:

1. Make certain door is properly aligned.
2. Apply modeling clay or body caulking compound to lock bolt opening.
3. Close door only as far as necessary for striker bolt to form an impression in clay or caulking compound. Complete door closing will make clay removal very difficult.
4. Striker impression should be centered fore and aft. The minimum allowable measurement for dimension X is 2 mm (3/32"). The maximum allowable measurement for dimension X is 4 mm (5/32").

   A 2 mm (3/32") spacer, part no. 4469196 or equivalent, can be used to achieve the desired alignment.
5. If adjustment is necessary, insert tool J23457, BT7107 or equivalent into the star-shaped recess in the head of the striker and loosen striker bolt.

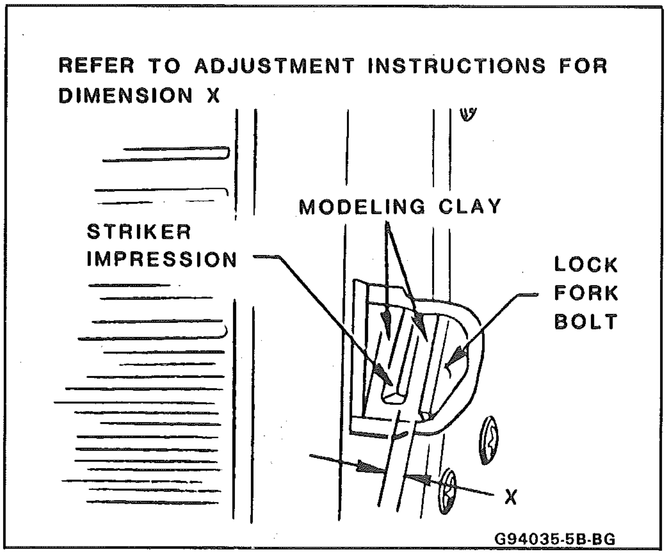


Fig. 37-Lock-to-Striker Fore and Aft Adjustment

Shift striker as required, then tighten bolt to 46 to 60 N·m (34 to 46 ft-lb).

Additional striker adjustment, up or down and in or out, can be provided by using the following procedure (Fig. 38).

1. Remove striker

NOTICE: It is important that a flat end rotary file be used so that the tapped cage plate is not damaged. The striker bolt and tapped cage plate are important attaching parts that could affect the performance of vital components and systems.

2. Using a 3/8" rotary file with a flat end and an electric drill motor, enlarge hole in the direction required (Fig. 38).
3. Reinstall striker to correct position.

Tighten

Striker bolt 46 to 60 N·m (34 to 46 ft-lb).

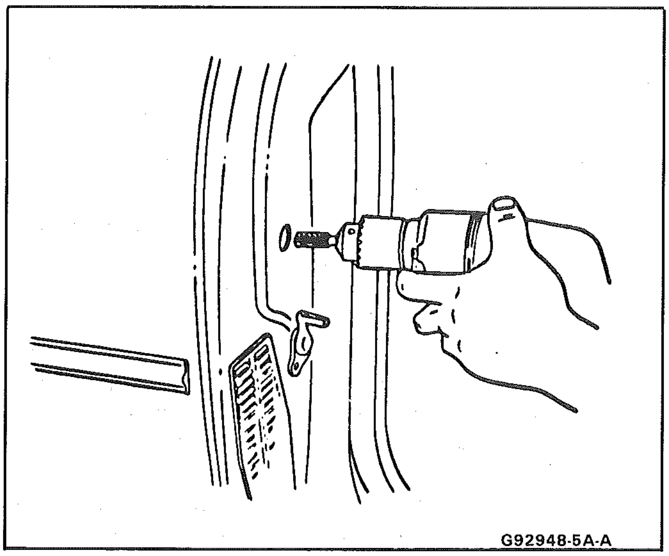


Fig. 38 - Enlarging Striker Bolt Hole

Remove or Disconnect (Fig. 39)

NOTICE: The door lock striker is an important attaching part in that it could affect the performance of vital components and systems, and/or could result in major repair expense. It must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of this part.

1. Using a pencil, mark position of striker on body lock pillar.
2. Striker, using tool J-23457, BT-7107 or equivalent.

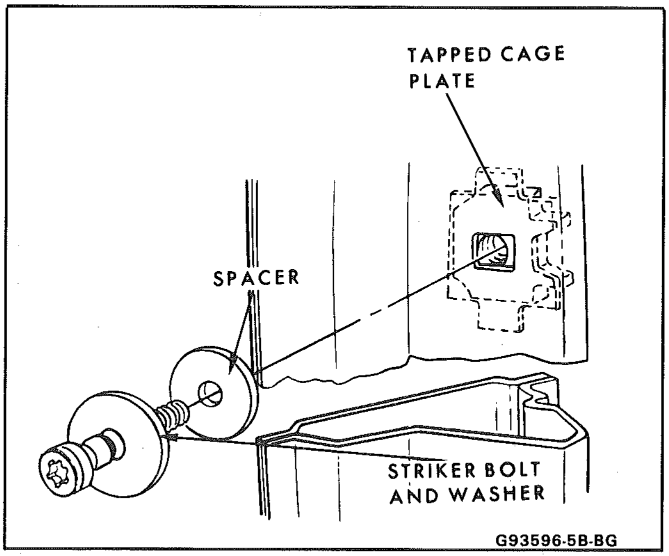


Fig. 39-Installing Door Lock Striker

Install or Connect (Fig. 39)

1. Striker to body using tool J23457, BT7107 or equivalent.

Tighten

Striker bolt to 46 to 60 N·m (34 to 46 ft-lb).

2. Touch up any exposed unpainted surface on lock pillar adjacent to striker assembly if striker is outside of pencil marks.

DOOR WEDGE PLATE (STYLES WITH HATCH ROOF)

To achieve friction fit between door and body side wedge plates, spacers can be removed or added as required to the door side wedge plate (Fig. 40). The addition of spacers may require longer screws to retain wedge plate to the door. The following spacers are available through the service parts system.

- Item 1 spacer part number 20452860 (1 mm)
- Item 2 spacer part number 20452861 (2 mm)

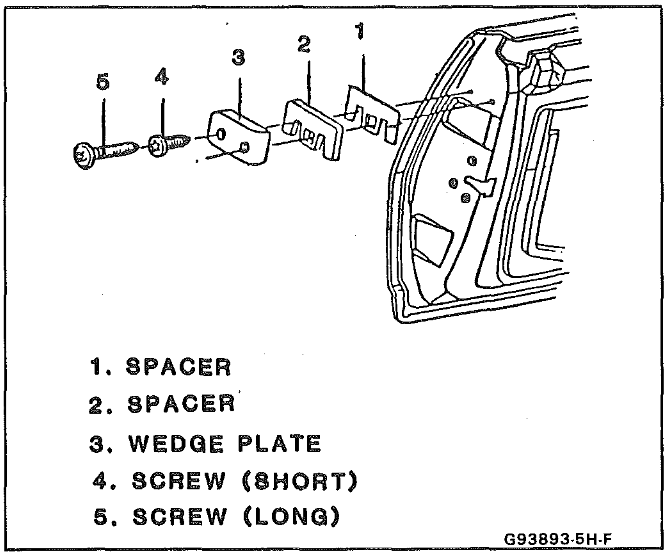


Fig. 40 - Door Wedge Plate

DOOR JAMB SWITCH

Door jamb switch assemblies consist of a plunger, plunger collar, threaded retainer and terminals. They are installed in the front and rear door hinge pillars. When the door of the vehicle is closed, the plunger is depressed which creates an open in the ground circuit. When the door is opened, the plunger is released and completes the circuit to ground (Fig. 41).

When a new jamb switch is installed and the door is closed the first time, the plunger is forced into the sleeve and automatically adjusts the jamb switch for that particular door. If a jamb switch fails, it should not be readjusted by hand. A new jamb switch should be installed.

Remove or Disconnect

1. Jamb switch
2. Electrical connector

Install or Connect

1. Electrical connector
2. Jamb switch

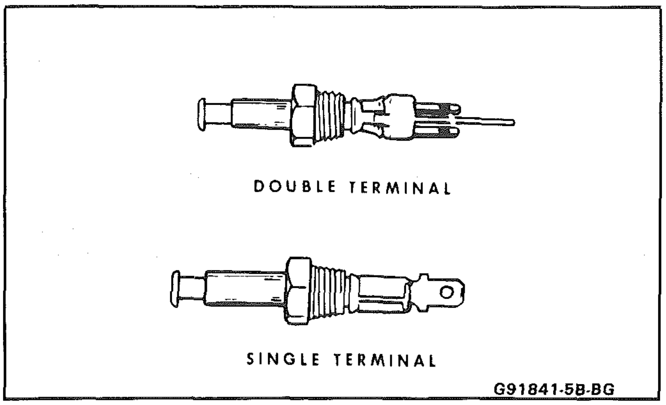


Fig. 41 - Door Jamb Switches

DOOR HARDWARE LUBRICATION

The mechanical components of the door assembly are lubricated during assembly. If additional lubrication is required, use the following lubricants. Black lock cylinders should be lubricated with a light oil. All other door lock cylinders should be lubricated with a general purpose silicone lubricant, part no. 1052277 or equivalent. Door hinge pins and rollers should be lubricated at normal service intervals with 30 weight engine oil. Do not lubricate hinge roller to hold-open link contacting surfaces as this may prevent the roller from rolling properly. The remainder of all door hardware mechanisms except lock assemblies can be lubricated with part no. 1052349, Lubriplate Spray-Lube "A", part no. 1052196, Lubriplate Auto-Lube "A" or equivalent.

HARDWARE ATTACHMENT THREAD LOCKING

All door hardware production attaching screws contain an epoxy thread-locking compound to insure that the minimum original torque setting will be maintained.

Service attaching screws may not contain a thread-locking compound. To prevent loosening of service screws or to renew thread-locking characteristics of production screws, the threads of the fastener(s) can be treated with part no. 1052279, Loctite 75 (or equivalent) which is a two-part material applied to the hardware attachment as a liquid. Upon installation and tightening, the adhesive cures to bond the attachment and prevent loosening or back out. The adhesive bond does not prevent future attachment removal if required. Loctite 75 or equivalent can be used on any threaded fastener.

DOOR LOCK SYSTEM

This portion of the manual contains the service operations necessary to remove the door lock and lock cylinder assemblies. Any work performed on lock system hardware requires the removal of the door trim panel and inner panel water deflector.

Service procedures for spring clips, connecting rods, locking rods, inside handles, outside handles and the door lock striker were described previously in this section.

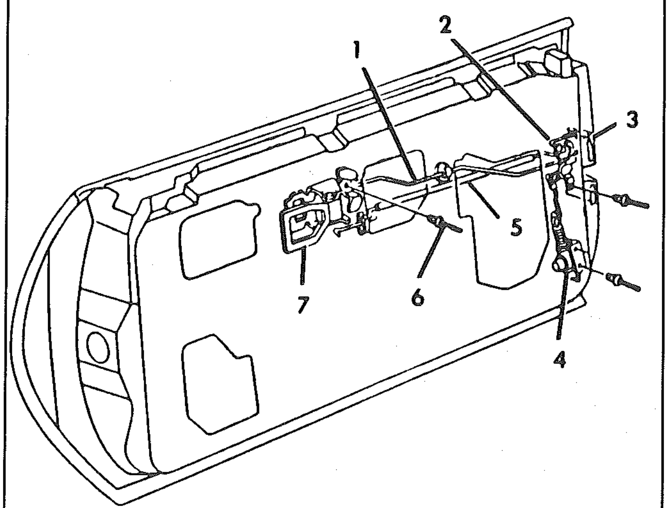
DOOR LOCK ASSEMBLIES

A fork bolt lock design is utilized which includes a safety interlock feature. The door is secured in a closed position when the door lock fork bolt snaps over the striker bolt. Doors can be locked from the inside by sliding the door inside locking knob. Both doors can be locked from the outside by simply sliding the interior door locking knob and closing the door or by using the proper key.

Do not attempt repairs to correct lock discrepancies. Make corrections through replacement of lock assembly.

Removal and Installation

1. Raise door window. Remove door trim panel and inner panel water deflector.
2. Disengage the following rods at lock assembly (Fig. 42)
   a. Inside locking rod
   b. Inside handle to lock rod
   c. Lock cylinder to lock rod
3. Remove lock screws and lower lock to disengage outside handle to lock rod. Remove lock from door.
4. To install, first install spring clips to lock assembly, then reverse removal procedure. Tighten lock screws to 9 to 11 N·m (80 to 100 in-lb) torque.



1. ROD, INSIDE HANDLE TO LOCK
2. BELL CRANK (POWER LOCKS ONLY)
3. LOCK ASSEMBLY
4. POWER LOCK ACTUATOR
5. INSIDE LOCKING ROD
6. RIVET
7. INSIDE HANDLE

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Fig. 42-Door Locking System

POWER DOOR LOCK SYSTEM

The power door lock system has a motor actuator in each door. A rod connects the actuator to the bell crank. A rod on the bell crank attaches to the lock assembly. The system is actuated by a control switch in each door trim panel. Both doors lock and unlock at the same time from either control switch. Each lock can also be operated manually by sliding the locking knob in the desired direction. The locking knob shows red when in the unlocked position. Each actuator has an internal circuit breaker which may require one to three minutes to reset.

DOOR POWER LOCK ACTUATOR

Removal

1. Remove door trim panel and inner panel water deflector. Raise door window. Locate actuator rivets on inner panel (item 4, Fig. 42).
2. Remove electrical connector.
3. Drive out rivet center pins.
4. Drill out rivets using 6.3 mm (1/4") drill bit.
5. Remove actuator from rod (actuator to bell crank rod, Fig. 42).
6. Disconnect electrical connector to actuator.
7. Remove actuator from door.

Installation

1. Install actuator to rod.
2. Connect electrical connector to actuator.
3. If hand rivet tool J-29022 or equivalent is available, install actuator to inner panel using 1/4"x0.500" aluminum peel type rivets, part no. 9436175 or equivalent.
4. If hand rivet tool is not available, attach actuator to inner panel using M6.0x1x13 (1/4-20x1/2") nuts and bolts. Tighten bolts 10 to 14 N·m (90 to 125 in-lb) torque.
5. Install water deflector and door trim panel.

DOOR BELL CRANK (POWER LOCKS ONLY)

Removal

1. Raise glass to full-up position and remove door trim panel and water deflector.
2. Punch out center pin of rivet retaining bell crank to door inner panel (item 2, Fig. 42).
3. Using a 4.8 mm (3/16") drill bit, drill out rivet.
4. Disconnect the inside lock knob to bell crank rod, bell crank to actuator rod and the bell crank to lock rod and remove bell crank.

Installation

1. Install bell crank to actuator rod.
2. Install lock to bell crank rod.
3. Install inside lock knob to bell crank rod.
4. Locate tab on bell crank in slot in inner panel.
5. Using rivet tool J-29022, install 3/16" dia. x 5/16" length rivet (USM part no. SD62BS or equivalent), through hole in bell crank and inner panel.
6. Replace all previously removed parts.

EXTERIOR MOLDINGS

The door body side moldings are attached with adhesive tape. On certain styles, a door spoiler is attached with studs and nuts while a body spoiler is attached with screws and clips.

General Precautions

When removing or installing any door outside molding, care should be exercised.

1. Adjacent finishes should be covered with masking tape to prevent damage to finish.

2. Proper tools and care should be used to guard against molding damage.
3. Holes in body panels for screws, bolts or clips that would permit water entry into the body interior must be sealed with body caulking compound or presealed screws, nuts or clips.

Molding Clip Replacement

If a weld stud on an outer panel becomes damaged or broken off, use the following procedure.

1. Drill a small hole in the panel next to original weld stud location.
2. Insert a self-sealing screw through original clip and into outer panel or replace damaged weld stud with self-sealing, screw-type weld stud.

SPOILER ON DOOR

Removal and Installation

1. Remove door trim panel and detach water deflector.
2. Remove retaining nuts at both lower corners of door and center of door (Section A-A and View B, Fig. 43).
3. Remove spoiler from door.
4. To install, reverse removal procedure.

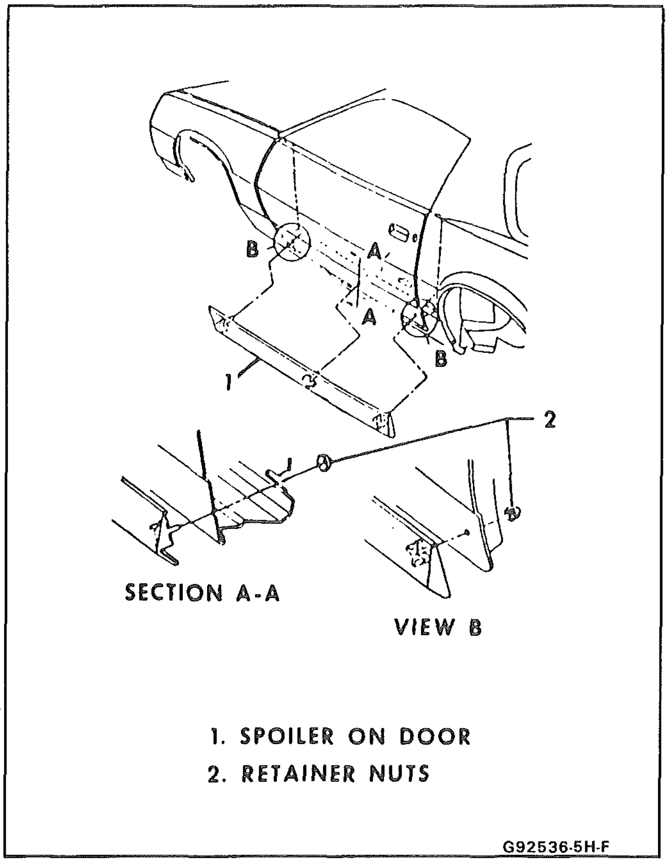


Fig. 43-Installing Spoiler on Door

SPOILER ON BODY

The spoiler on the body is retained by clips and screws. The screws thread into a support which is welded to the body.

Removal and Installation (Fig. 44)

1. Remove emblem at front of spoiler covering hidden screws.
2. Remove screws along upper and lower edge of spoiler.
3. Rotate spoiler out and up to release from clips on quarter panel.
4. To install, reverse removal procedures.

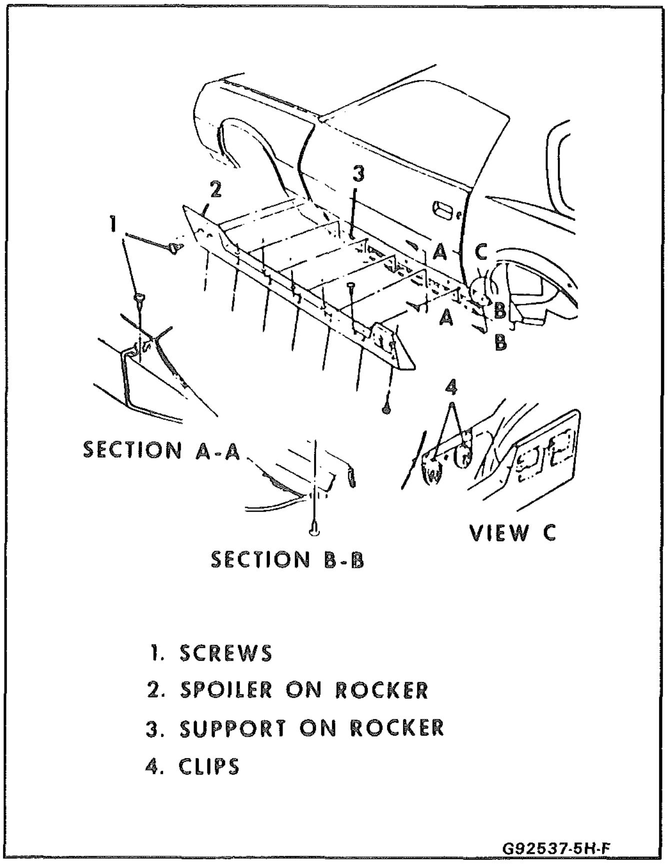


Fig. 44-Spoiler on Body Installation

Adhesive Body Side Molding

A complete procedure for attaching loose or removed adhesive attached moldings can be found in Section 1H.

SECTION 6H

REAR QUARTERS

NOTICE: The anti-theft label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask **must** be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

QUARTER TRIM

QUARTER LOWER TRIM FINISHING PANEL

Removal and Installation (Fig. 1)

1. Remove body lock pillar finishing panel (Fig. 3).
2. Remove rear seatback lock striker.
3. Remove retaining screw in rearward area of quarter lower trim panel.
4. Remove rear screws from sill plate and carpet retainer (Fig. 2).
5. Grasp quarter lower trim panel with hand; then pull forward and down to disengage from pinchweld flange at weatherstrip and quarter upper trim finishing panel.
6. Remove seat belt through slot in trim panel.
7. Remove quarter lower trim finishing panel from car by lifting up on rear portion of sill plate and carpet retainer; then pull quarter trim rearward.
8. To install, place panel retaining slots under quarter upper trim panel and apply upward pressure to secure.
9. Position panel assembly to body. Thread lap and shoulder belt through respective slots in panel.
10. Install attaching screws to secure panel to body.
11. Replace all previously removed components.

BODY LOCK PILLAR TRIM FINISHING PANEL

Removal and Installation (Fig. 3)

1. Remove trim panel attaching screws.
2. Using trim removing tool J-24595B, BT-7323A or equivalent, carefully disengage nylon fasteners that retain body lock pillar panel to quarter upper trim finishing panel.
3. To install, reverse removal procedures.

QUARTER UPPER TRIM FINISHING PANEL INSERT

Removal and Installation (Fig. 4)

1. Remove coat hook.
2. Grasp panel insert with hand and pull upward to disengage retainers from cutout slots in quarter upper trim finishing panel (Fig. 4).
3. To install, reverse removal procedures.

REAR QUARTER SPEAKERS

The rear quarter speakers are installed to a speaker retainer. The retainer and speaker are then attached to the quarter inner panel by screws.

Standard Speakers

Remove or Disconnect

1. Quarter upper trim finishing panel insert
2. Screws securing speaker retainer
3. Disconnect electrical connector from speaker
4. Speaker

Install or Connect

1. Speaker to body
2. Electrical connector
3. Screws securing speaker to retainer
4. Quarter upper trim finishing panel insert

Subwoofer Speakers (2FS/FW/FX Styles)

Remove or Disconnect (Fig. 5)

1. Quarter upper trim finishing panel insert (Fig. 4)
2. Body lock pillar trim finishing panel (Fig. 3)
3. Two rear screws from carpet retainer (Fig. 2)
4. Quarter lower trim finishing panel

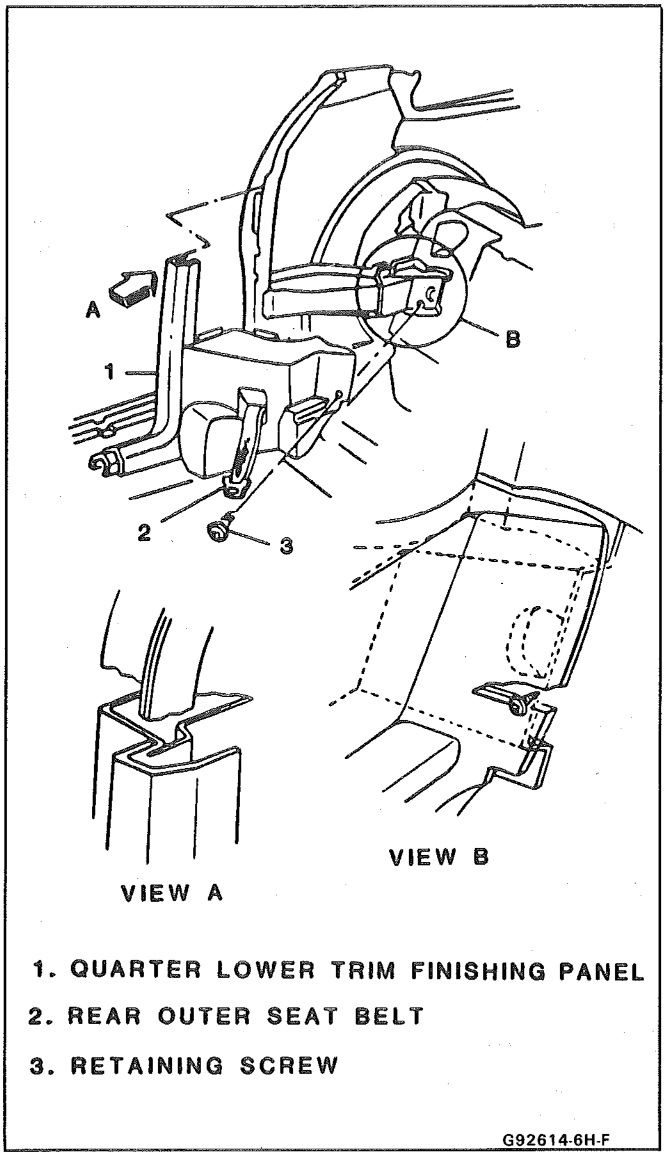


Fig. 1-Quarter Lower Trim Finishing Panel

5. Loosen quarter upper trim panel by removing the following:
   - Seatback lock striker
   - Screw at top of quarter upper trim panel (Fig. 6)
6. Two screws from back body opening garnish molding
7. Pull inboard on bottom of quarter upper trim finishing panel and disconnect subwoofer speaker wire connector (3) for lower speaker or connector (4) for upper speaker
8. Screws (2) from upper or lower speaker
9. Speaker (1 or 5)

Install or Connect

1. Speaker (1 or 5)
2. Screws (2)
3. Wire connector (3 or 4)
4. Screws removed in step 6 of removal procedure.
5. Items removed in step 5 of removal procedure.
6. Quarter lower trim finishing panel. Make sure to install seat belt through panel opening.

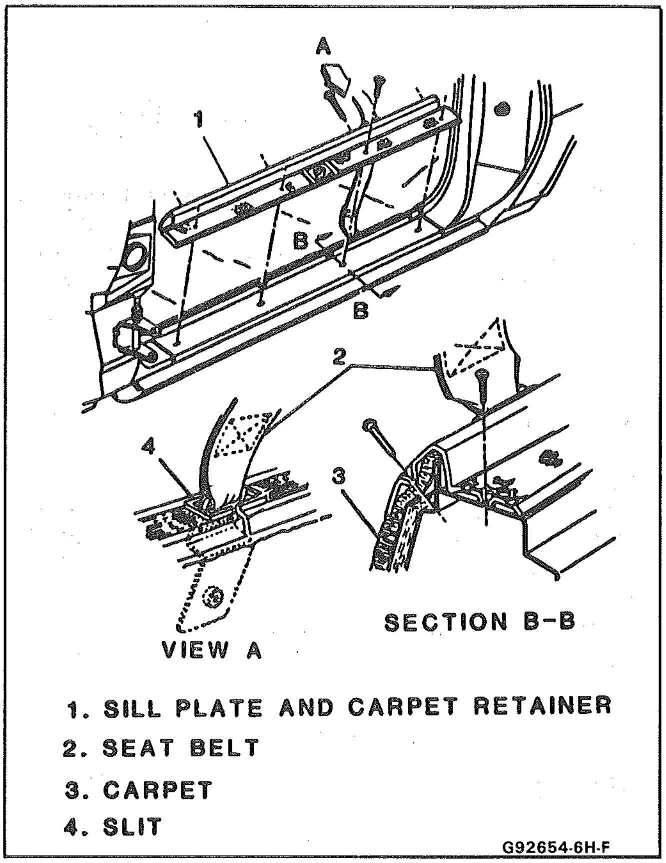


Fig. 2-Sill Plate and Carpet Trim Finishing Panel

7. Carpet retainer screws (Fig. 2).
8. Body lock pillar trim finishing panel (Fig. 3).
9. Quarter upper trim finishing panel insert (Fig. 4).

COMPARTMENT LIFT WINDOW OPENING UPPER FINISHING MOLDING

Removal and Installation

1. Open compartment lift window to gain access to upper rear finishing molding.
2. Remove attaching screws.
3. Remove rear upper finishing molding.
4. To install, position garnish molding to roof inner panel, placing ends of molding over quarter window trim finishing panel.
5. Align holes in moldings to slots in roof panel and drive screws to secure.

QUARTER UPPER TRIM FINISHING PANEL

Removal and Installation

1. Remove luggage shade cover and retainers (if present).
2. Remove lock pillar upper trim finishing panel insert (Fig. 4).
3. Lower rear folding seatback panel.
4. Remove outboard screw from upper rear finishing molding.
5. Remove gas support cover and closeout finishing trim panel to body (Fig. 8).
6. Remove spare tire cover from right quarter trim finishing panel.

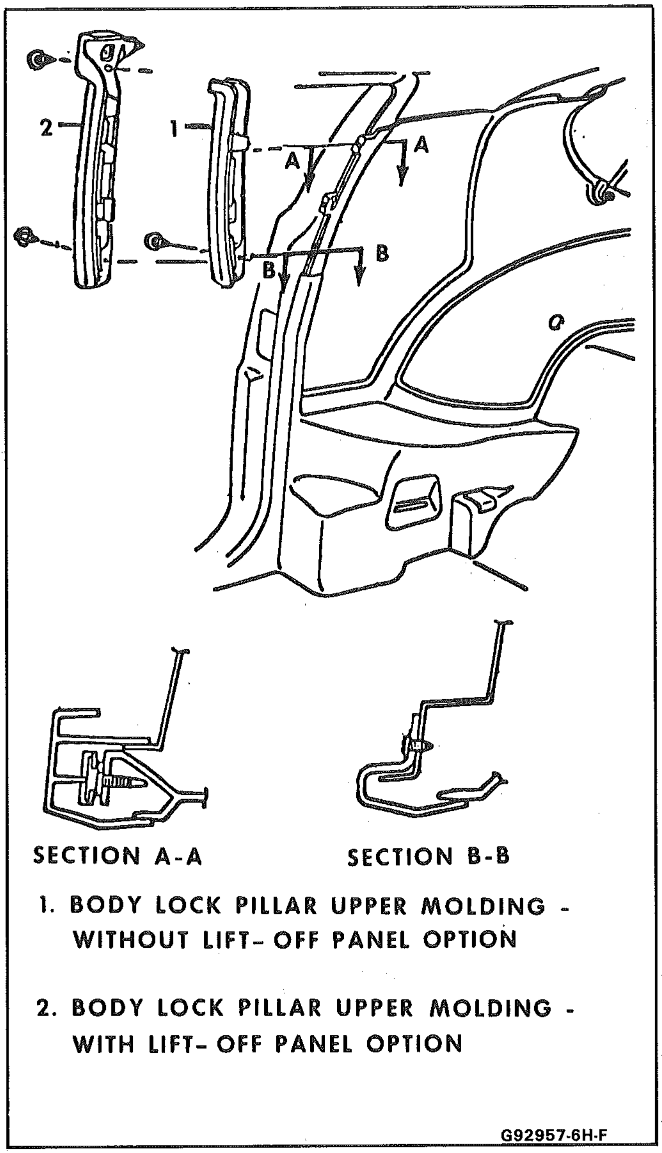


Fig. 3 - Body Lock Pillar Trim Finishing Panel

7. For left side quarter upper trim panel removal, remove nylon screw from left upper end of rear end trim finishing panel. Telescope rear end of quarter trim from rear end trim panel (Fig. 6).
8. Rotate trim finishing panel downward and inboard to disengage from gas support attachment to body, also from rear seatback lock striker on the right side (Fig. 7).
9. Lift up on trim panel and remove.
10. To install, reverse removal procedures.

SPARE TIRE COVER TRIM FINISHING PANEL

Removal and Installation (Fig. 9)

1. Remove nylon drive screws.
2. Grasp spare tire cover trim finishing panel with hand and pull upward to disengage retaining tabs from slots in rear compartment floor.
3. Remove spare tire cover.
4. To install, reverse the removal procedure.

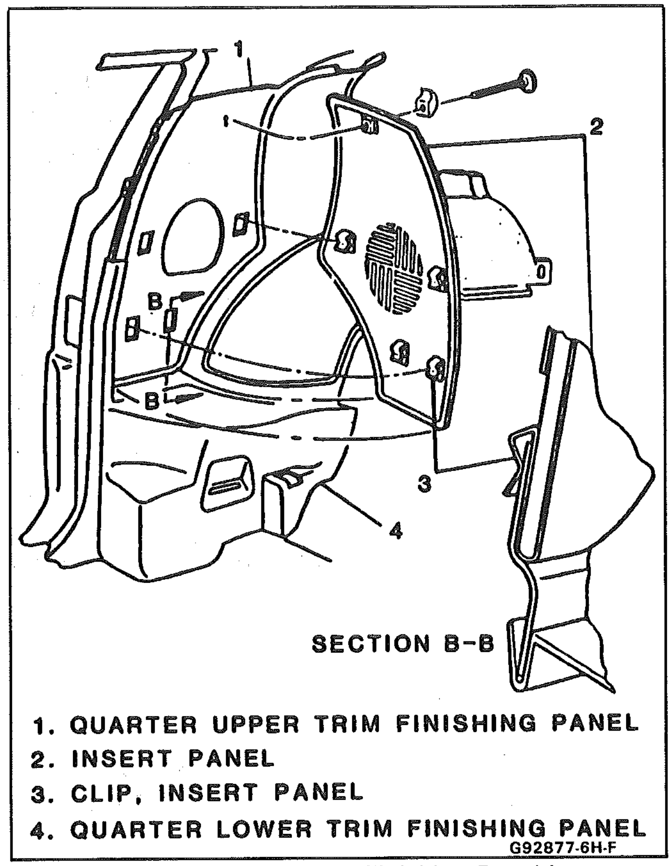


Fig. 4-Quarter Upper Trim Finishing Panel Insert

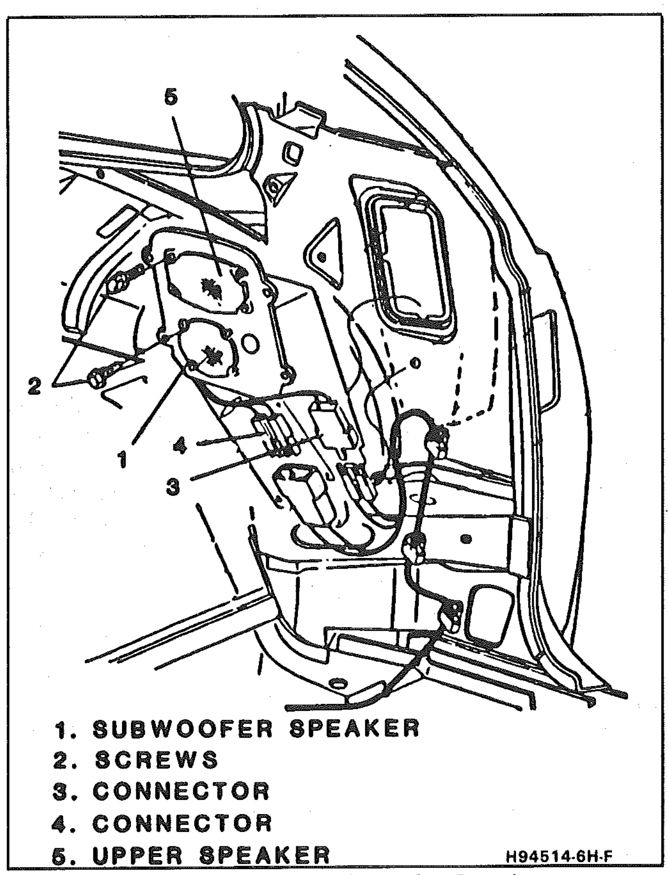


Fig. 5 - Installing Subwoofer Speaker

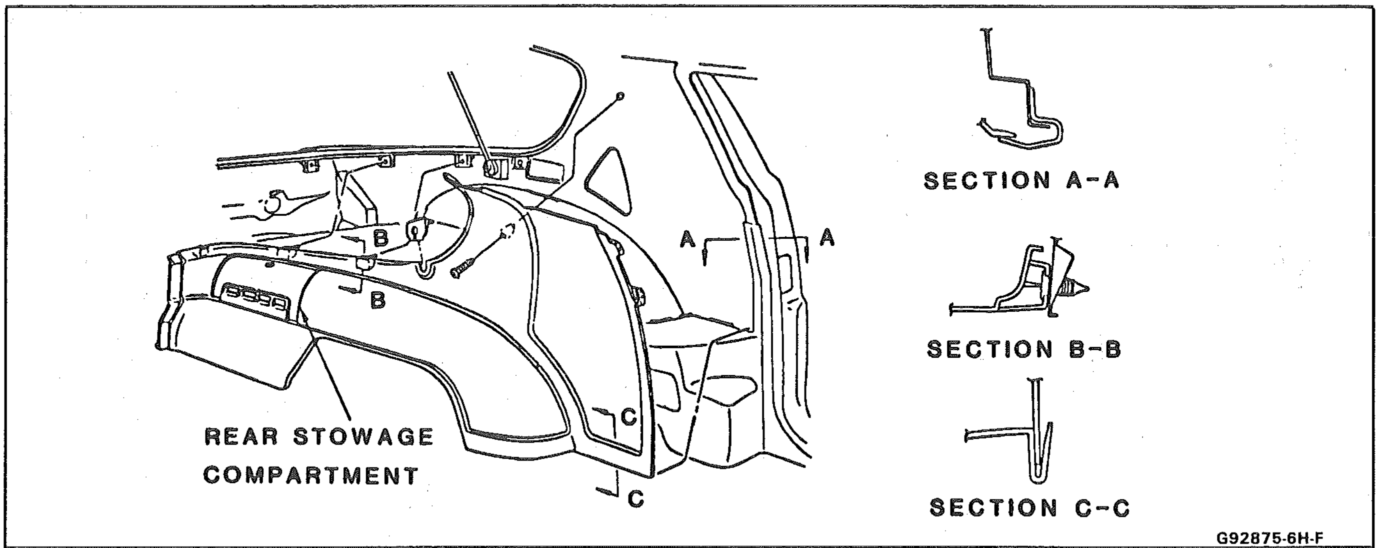


Fig. 6-Quarter Left Upper Trim Finishing Panel and Rear Compartment Stowage Box

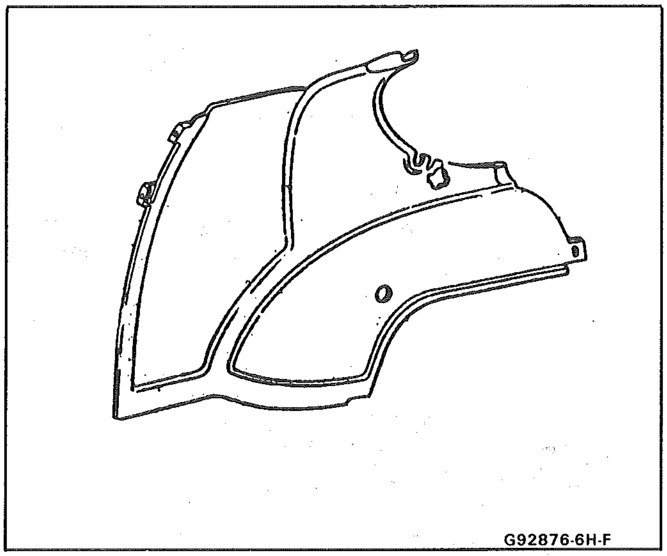


Fig. 7-Quarter Right Upper Trim Finishing Panel

REAR STOWAGE COMPARTMENT BOX ASSEMBLY

The rear stowage compartment box assembly is located in the left quarter upper trim finishing panel (Fig. 10). The door for the rear stowage compartment is equipped with a lock assembly. The lock cylinder is secured in the door with a retainer (Figs. 10 and 11).

The stowage box is serviced as a flat, scored hardboard material that is folded at the scored lines to form the compartment box. To retain the box shape, it is stapled together along the sides (Fig. 12). The prepierced holes in the stowage box are aligned and positioned to studs located on the back side of the left quarter upper trim panel. Drive nuts are used to retain the stowage box to the trim panel.

LUGGAGE SHADE COVER ASSEMBLY

Removal and Installation

1. Open compartment lift window panel.
2. Grasp luggage shade cover assembly with hand and pull rearward to disengage from retainers mounted on the rear compartment lift window trim panel. The vinyl cover material of the luggage shade is attached to a spring-loaded spool and should roll up on the spool when disengaged from the hooks mounted on the quarter trim finishing panels (Figs. 13 and 14).
3. Lift up on the luggage shade assembly to disengage it from supports on the left and right quarter trim finishing panels.
4. Remove luggage shade assembly.
5. To install, reverse removal procedures.

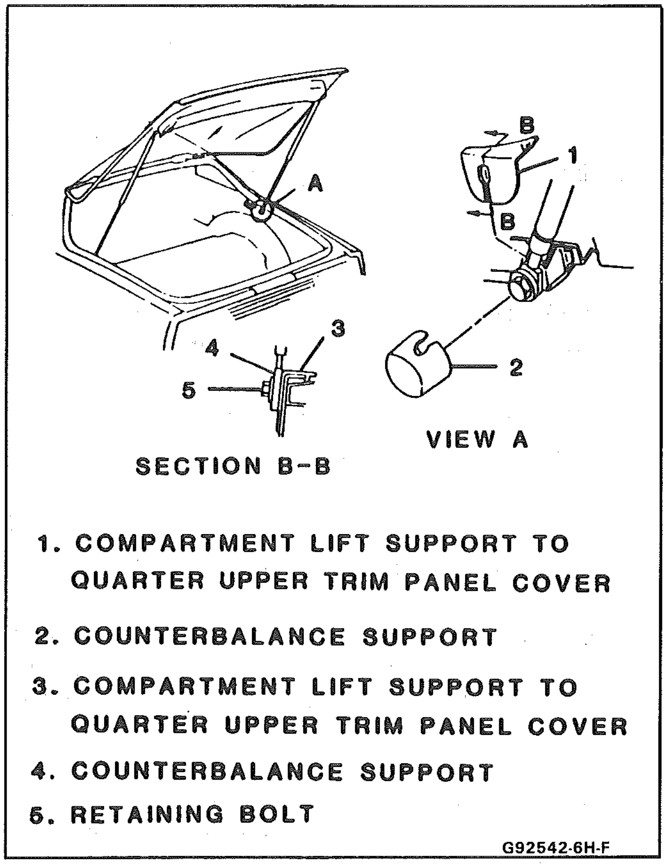
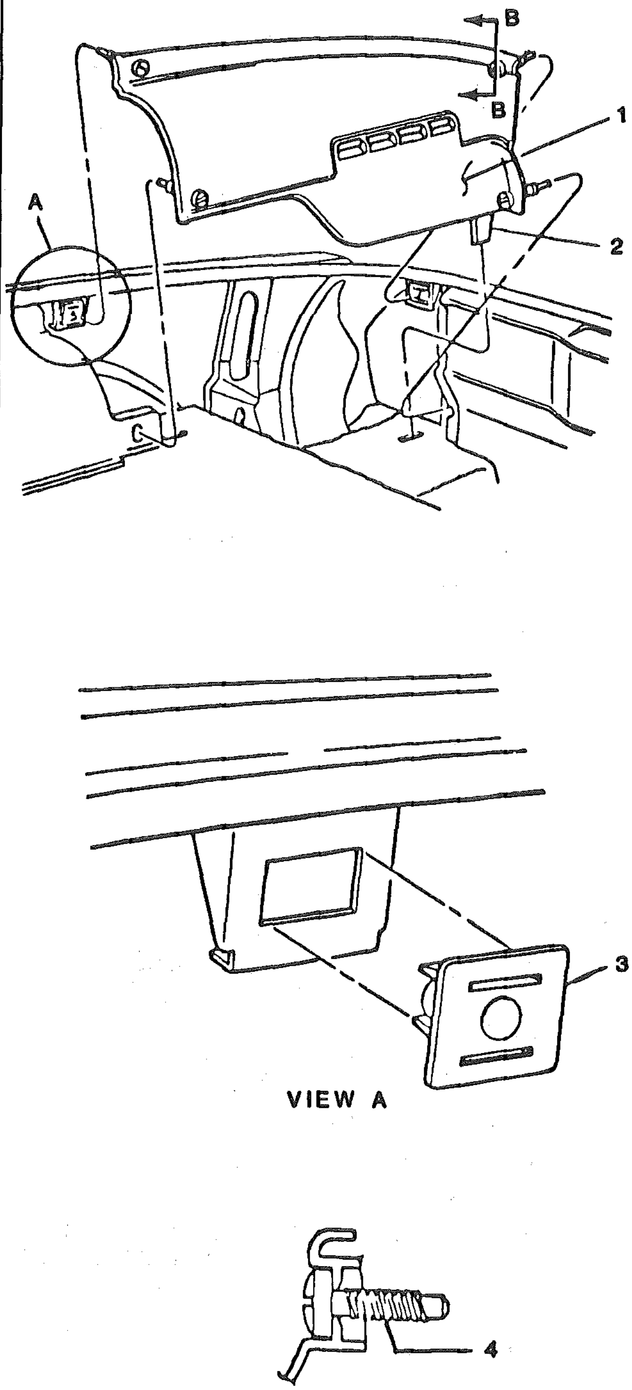


Fig. 8-Gas Support Cover and Closeout Trim Finishing Panels



1. SPARE TIRE TRIM FINISHING PANEL
2. RETAINING TAB
3. SPARE TIRE COVER RETAINER NUT
4. NYLON DRIVE SCREW

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Fig. 9-Spare Tire Trim Finishing Panel

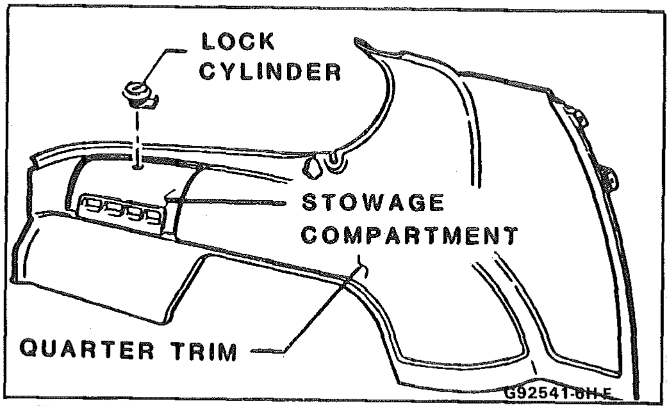
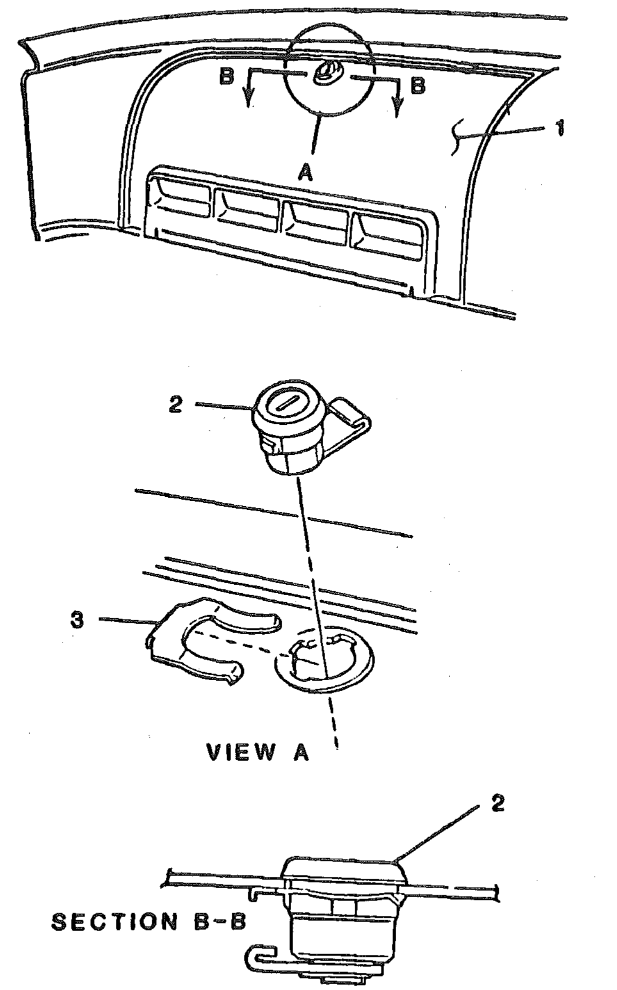


Fig. 10-Rear Stowage Compartment Box Assembly



1. REAR STOWAGE COMPARTMENT DOOR
2. LOCK ASSEMBLY
3. RETAINER

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Fig. 11-Rear Stowage Compartment Door Lock Assembly

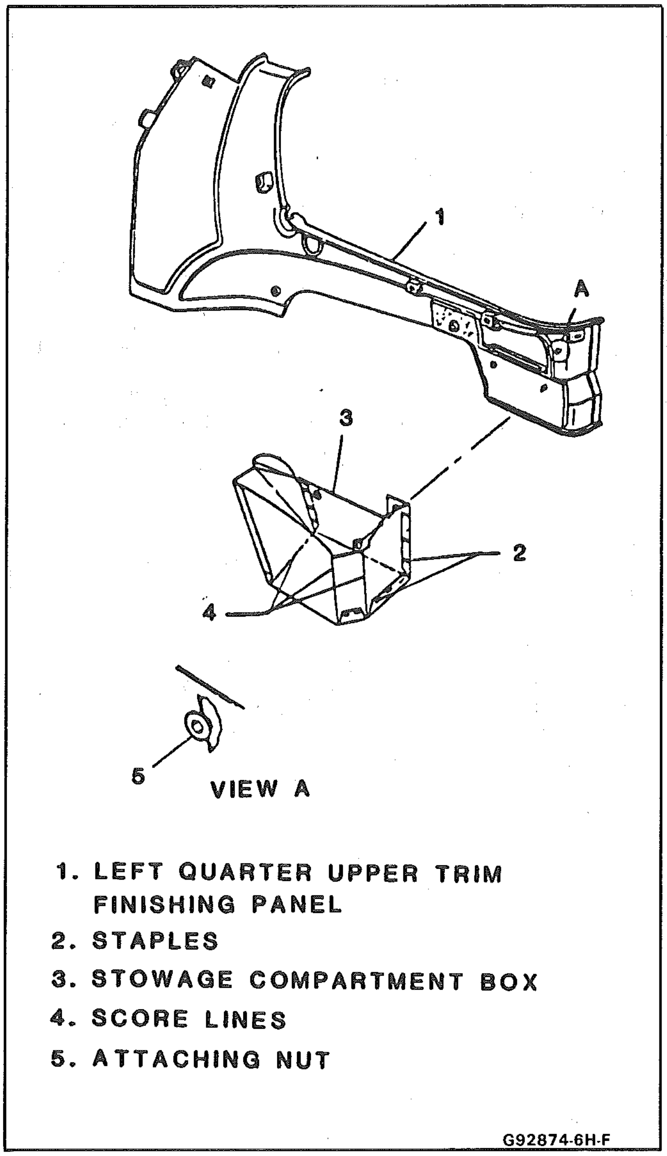


Fig. 12-Stowage Box Installation

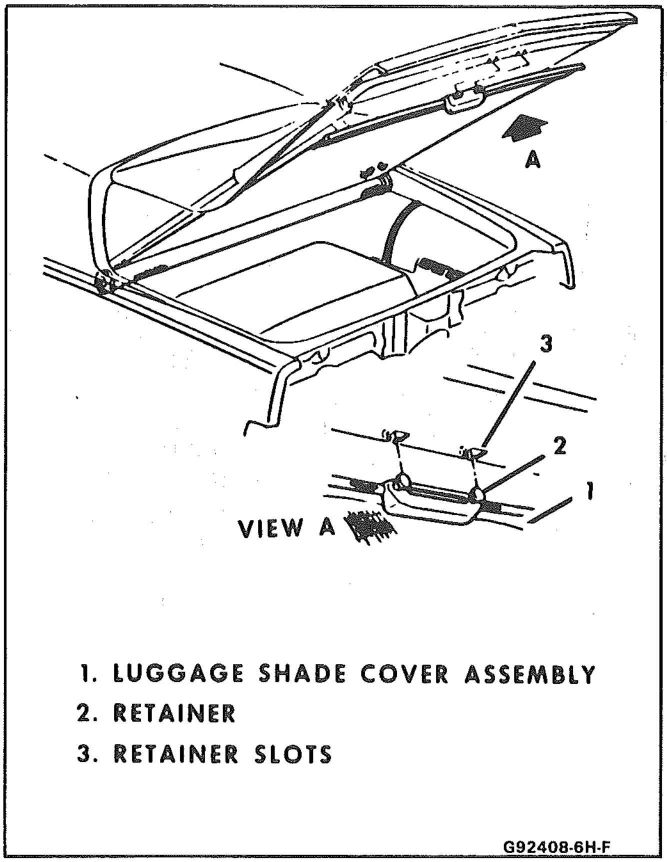


Fig. 13-Luggage Shade Retainer

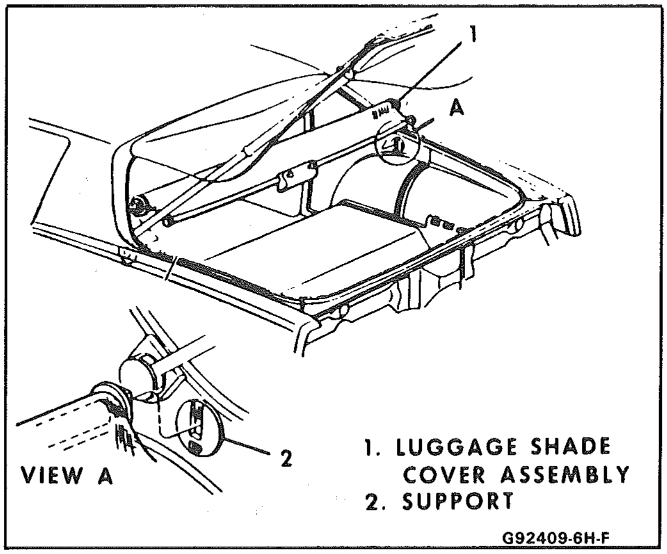


Fig. 14-Luggage Shade Assembly

EXTERIOR MOLDINGS

Exterior moldings are secured to the body by any one or a combination of attaching screws, weld studs and adhesive (urethane or butyl tape). Figure 15 shows typical types of installations.

General Precautions

When removing or installing any lower quarter exterior molding, care should be exercised.

1. Adjacent finishes should be covered with masking tape to prevent damage to finish.
2. Proper tools and care should be used to guard against molding damage.
3. Holes in body panels for screws, bolts or clips that would permit water entry into the body interior must be sealed with body caulking compound or presealed screws, nuts or clips.

ADHESIVE BODY SIDE MOLDINGS

A complete procedure for attaching loose or removed adhesive attached moldings can be found in Section 1H of the body portion of this manual.

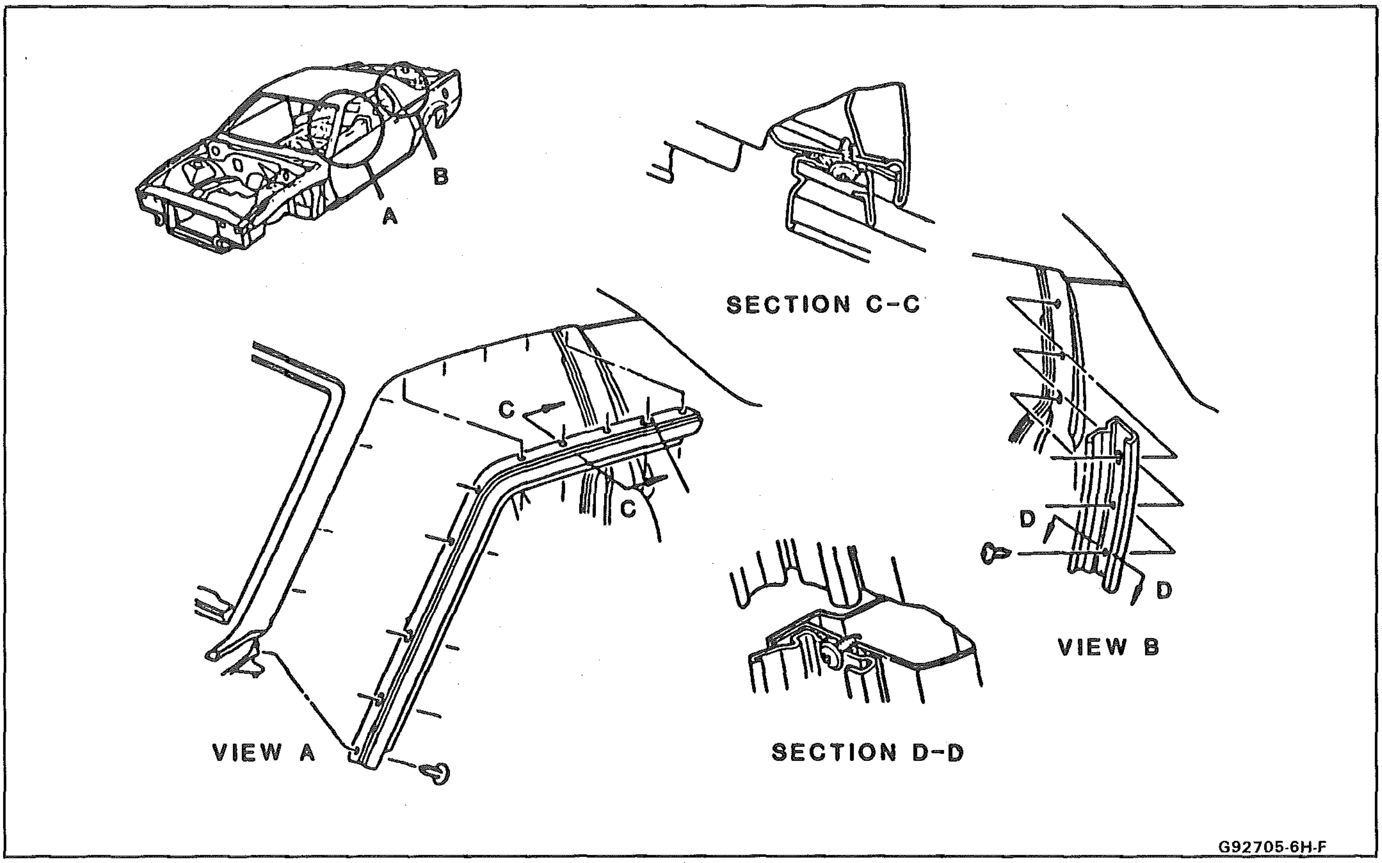


Fig. 15 - Installing Roof Drip and Quarter to Body Reveal Molding

FUEL TANK FILLER DOOR AND POCKET ASSEMBLY

The fuel tank filler door and pocket assembly is attached to the left quarter panel by screws. The filler door is available with an optional lock assembly. The oval head key is used to lock and unlock the fuel tank filler door. The lock striker is rivet retained to the pocket assembly (Figs. 16 and 17).

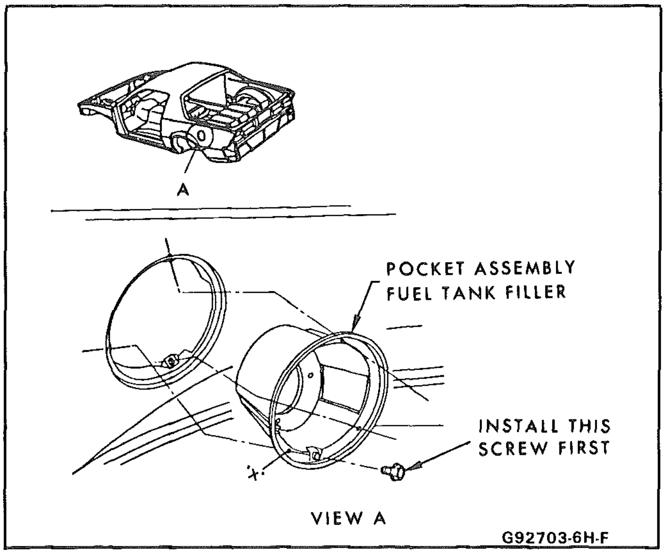


Fig. 16-Pocket Assembly Fuel Tank Filler Door

SPOILER EXTENSION - QUARTER REAR AT REAR COMPARTMENT LIFT OPENING

Removal and Installation (Fig. 18)

1. Raise rear compartment lift window.
2. On left side, open rear compartment stowage door to gain access to plugs and spoiler extension retaining nuts.
3. On right side, remove spare tire trim finishing panel to gain access to plugs and spoiler extension retaining nuts.
4. Remove plugs and retaining nuts; then remove spoiler extension.
5. To install, reverse removal procedures.

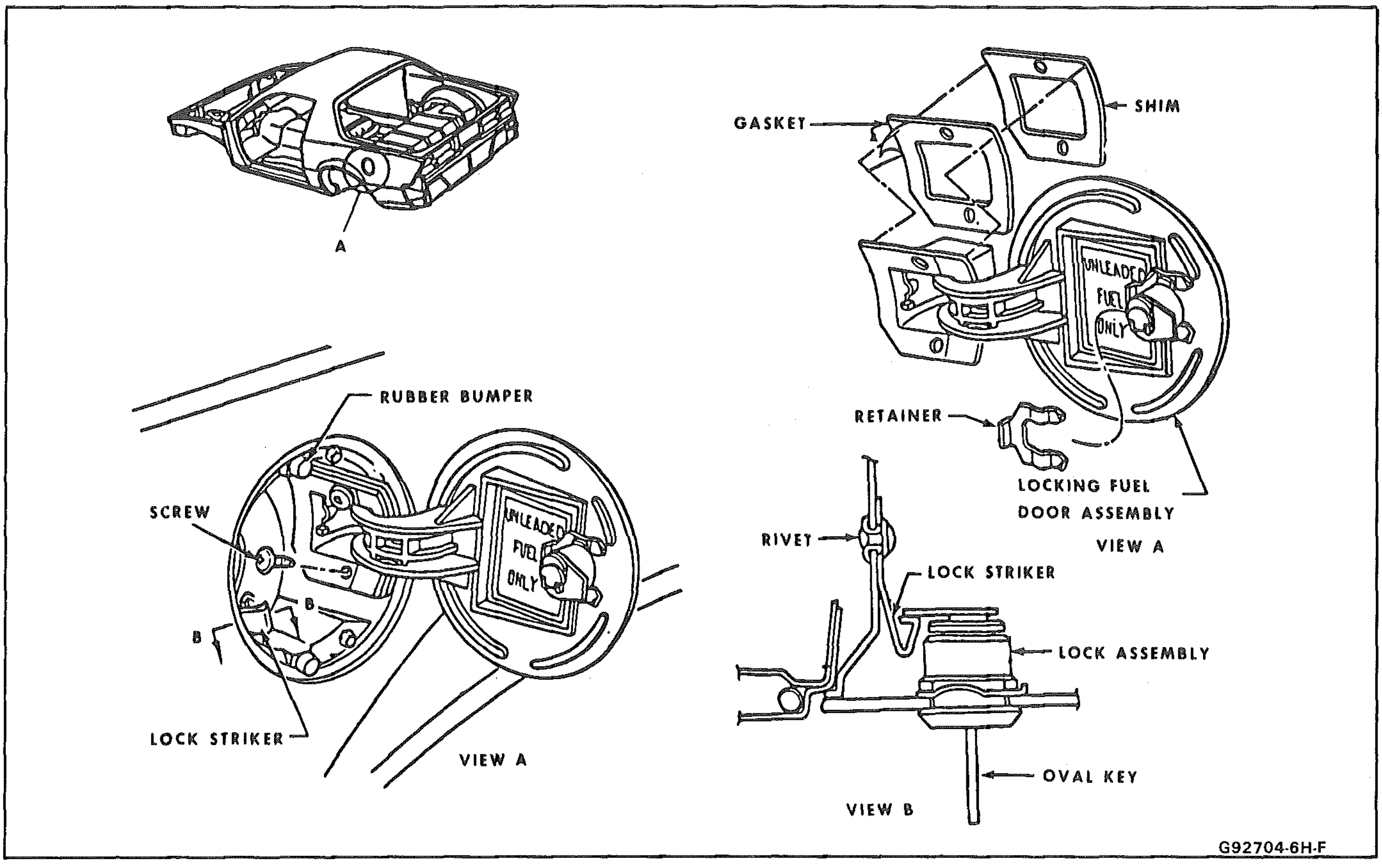


Fig. 17-Locking Fuel Door Assembly

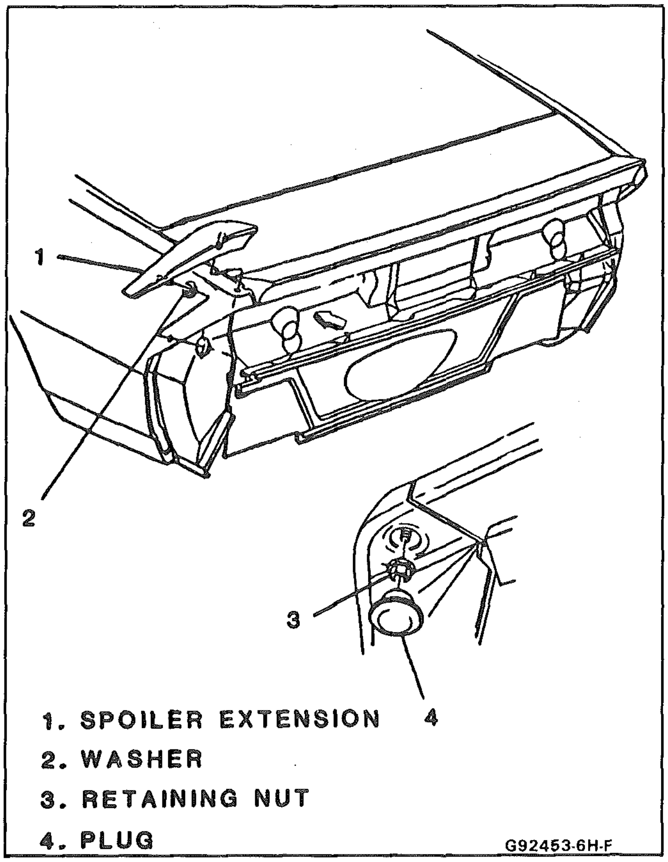


Fig. 18-Spoiler Extension - Quarter Rear

SECTION 7H

REAR END

NOTICE: The anti-theft label found on some major sheet metal, engines, and transmissions must be masked prior to painting, rustproofing, undercoating, etc. The mask **must** be removed following the above operations. Failure to keep the label clean and readable may result in liability for violation of Federal Vehicle Theft Prevention Standard, and subject the vehicle owner to possible suspicion that the part was stolen.

CONTENTS

REAR COMPARTMENT

The service operations for the removal, installation, adjustment and sealing of the compartment lift window assembly, individual hardware components, moldings, emblems and name plates attached to the compartment lift window or rear end panel are contained in this section.

MOLDINGS, EMBLEMS AND NAME PLATES

The moldings, emblems and name plates used on the rear compartment and rear end panels are adhesive attached. Figure 1 illustrates the different types of attachment.

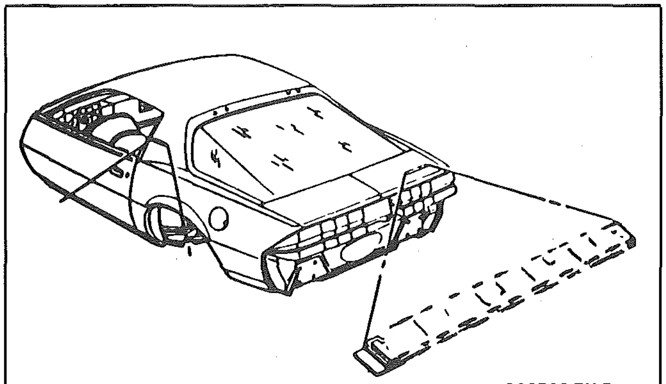


Fig. 1 - Molding, Name Plate and Emblem Retention

General Precautions

When removing or installing any body exterior molding, emblem or name plate, care should be exercised.

1. Adjacent finishes should be covered to prevent damage to finish.
2. Proper tools and care should be used to guard against molding damage.

ADHESIVE-BACKED MOLDINGS, EMBLEMS AND NAME PLATES

Adhesive-backed emblems and name plates can be removed from the body with the use of a hot air gun.

Removal

1. Hold hot air gun 300 mm (12") from the surface of the part to be removed.
2. Apply heat using a circular motion for about 30 seconds; then using care, peel part from body surface.

Installation

To install, body surface must be warm (21°C or 70°F), clean and wax free.

1. Check for proper alignment with adjacent moldings, emblems and/or name plates if applicable.
2. Remove backing from part to be installed and press firmly in place.
3. If reinstalling previously removed part or partially loosened emblem, apply a thin, even film of Loctite 414 Adhesive or equivalent to adhesive portion of emblem, align and press firmly in place.
   a. If a separation occurs between the adhesive-backed tape and name plate or emblem (tape remains on body panel), do not remove tape from body. Wipe back of name plate or emblem and adhesive tape with oil-free naphtha.
   b. Apply a thin even film of Loctite 414 Adhesive or equivalent to the adhesive portion of the emblem or name plate.
   c. Immediately align name plate or emblem and press firmly in place. Hold in place with tape strips.
   d. Allow to set 15 minutes. If cleanup of cement squeeze-out is required, use a cloth

dampened slightly with oil-free naphtha; then remove tape strips.

COMPARTMENT LIFT WINDOW MOLDING

Refinishing

1. Mask off area(s) adjacent to molding(s).
2. Clean with Ditzler's DX-440 wax and grease removing solvent or equivalent.
3. Sand with #400 grit wet or dry sandpaper.
4. Clean with wax and grease removing solvent.
5. Prime with Ditzler's epoxy chromate primer DP 40/401 or equivalent.
6. Sand with #500 grit wet or dry sandpaper.
7. Clean with wax and grease removing solvent.
8. Top coat with flat black acrylic lacquer.
9. Remove masking tape.

When using any of the listed materials, follow the manufacturer's label directions for application procedures and drying time.

Removal

CAUTION: When working with glass assemblies, the use of personal protection items such as safety glasses and work gloves is recommended to minimize the chance of personal injury should the glass break.

1. Remove compartment lift window from body, as described later in this section, and with the aid of a helper, place upside down on a protected work surface.
2. Remove upper hinges.
3. Remove screws retaining moldings to panel.

CAUTION: Perform the urethane burn-out operation in a well ventilated area and avoid direct inhalation of the fumes being emitted as these fumes may be hazardous.

4. Using an acetylene torch with a number 2 tip, start at the top of either the right or left side molding and apply heat for a distance of 200 mm (8″) to outboard edge of molding for 30 to 60 seconds using a back and forth motion (Fig. 2).
5. Immediately grasp heated section of molding with pliers and pull molding away from glass.
6. Repeat steps 4 and 5 for the entire length of molding.
7. Repeat steps 4 through 6 for opposite side molding.

Installation

1. Clean adhesive from glass using a razor blade and cloth dampened with alcohol or oil-free naphtha.
2. Seal original holes in panel where molding retaining screws were removed in step 3 of removal procedure.
3. Apply clear primer in urethane kit (9636067 or equivalent) to glass as shown in Figure 7.
   a. Apply black primer over same areas. Allow to air dry for five minutes.

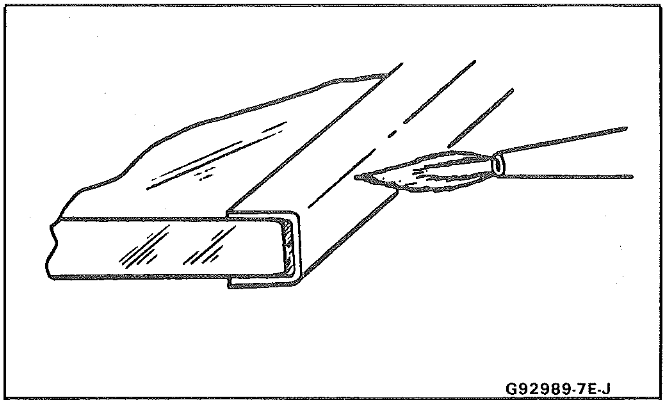


Fig. 2 - Applying Heat to Edge of Molding

   b. Apply black primer to inside of molding channels. Allow to air dry for five minutes.
   c. Apply a 4.5 mm (3/16″) bead of urethane from kit into channel of new molding. Do not apply urethane for a distance of 25 mm (1″) from forward edge of right and left-hand moldings (Fig. 8).
   d. Place escutcheon inside of right and left-hand molding.
   e. Using a clean rubber mallet, drive moldings onto glass starting at upper corners. Be sure to align holes in tabs of moldings with holes in glass.
   f. Apply cloth tape every 200 mm (8″) over moldings and glass sides to keep molding in place while urethane cures. Allow six hours of cure time.
4. Install moldings to panel using screws removed in step 3 of removal procedure. It may be necessary to drill new holes for screw installation.

CAUTION: Do not tighten nuts beyond specified torque or glass breakage and personal injury could result.

5. Install upper hinges to glass. Torque nuts to 16 N·m (11 ft-lb).
6. With aid of helper, install compartment lift window to body and make sure of proper alignment of lift window to body. Torque nuts to 20 to 28 N·m (15 to 20 ft-lb).

COMPARTMENT LIFT WINDOW

The compartment lift window glass assembly consists of a solid formed tempered safety glass with two piece urethane attached black painted moldings. A finishing panel is bolted to the bottom of the glass. Mounted on each side of the lift glass assembly and attached to the body are tubular gas supports which assist in opening. Gas supports vary in output levels depending on options such as a rear window wiper, spoiler or both.

Adjustments

CAUTION: Glass side of hinge assembly has slots. These slots are for production build use and not intended for service adjustment of glass. Follow recommended adjustment

procedure or glass breakage and personal injury could occur.

The compartment lift window assembly height, fore and aft and side adjustments are controlled at the hinge-to-body location. This area of the body has oversize hinge attaching holes (Fig. 3) in addition to the hinge-to-body spacers. Adjustments at the hinge location must be made with gas supports disengaged. Additional height adjustment can also be made at the lower panel by adjusting the rubber bumpers. Bolts holding hinge to body should be tightened 20 to 28 N·m (15 to 20 ft-lb).

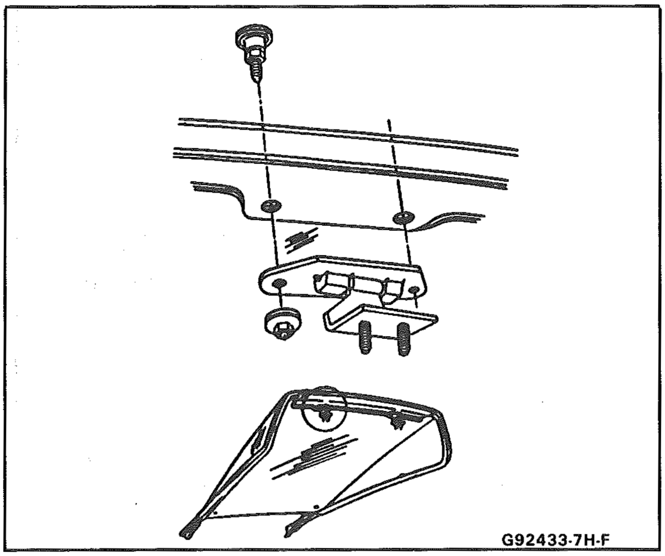


Fig. 3 - Attaching Hatch Lid Hinge

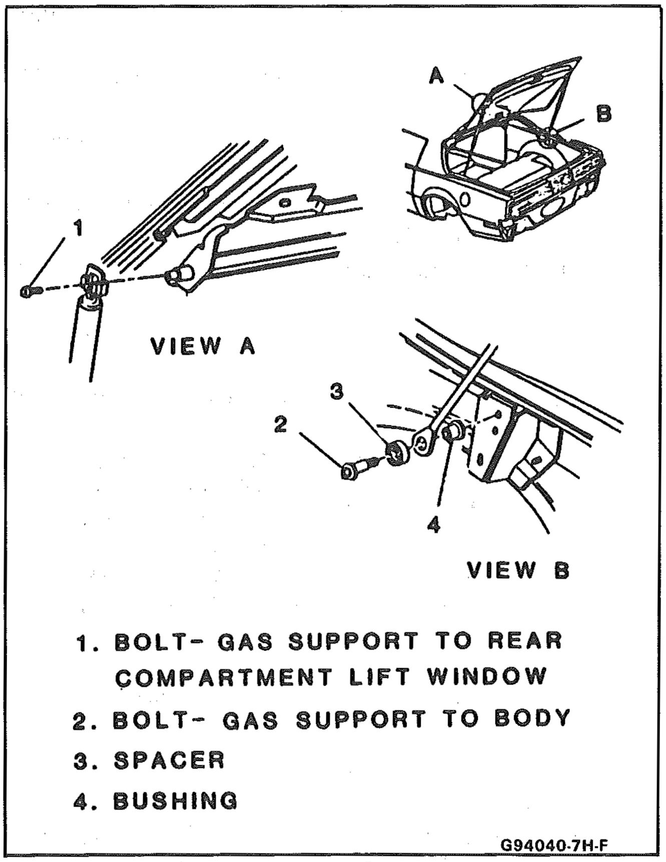


Fig. 4 - Attaching Gas Support

Removal and Installation

1. Prop lid open and place protective covering along edges of rear compartment opening to prevent damage to painted surfaces.
2. Use a 13 mm socket to remove nuts holding glass to hinge (Fig. 3).

   CAUTION: Do not attempt to remove or loosen gas support assembly attachments with lid in any position other than fully open as personal injury may result.
3. While helper supports glass, disengage gas supports from lift window assembly (view A, Fig. 4) and disconnect harness connector for electric grid defogger (if present).
4. With aid of helper, remove lift window assembly from body and place on a protected surface.

   CAUTION: When installing bolts (glass to hinge), be sure to torque only to 16 N·m (11 ft-lb). Overtightening could cause glass to break and possible personal injury. Always wear safety glasses during this operation.
5. To install, reverse the removal procedure. Torque bolt holding gas support to body 5 to 7 N·m (48 to 60 in-lb).

Removal of Compartment Lift Window Panel from Glass

CAUTION: When performing the following operations, personal protection items such as safety glasses and work gloves should be worn to minimize possible personal injury.

1. Place protective coverings around body opening.
2. Place two jackstands in body to support glass. Place protective covering over jackstands.
3. Disconnect electrical connectors from gas support (if present) and remove bolts retaining gas support to lower reinforcement.
4. Lower glass.
5. Remove
   a. Wiper motor and blade assembly (if present)
   b. Gas supports
   c. Lock striker
   d. Nuts holding lower reinforcement to panel, starting with outboard nuts (2, Fig. 5)
   e. Screws retaining lift window molding to panel
6. Remove panel from glass.
   a. Mask off top forward edge of panel next to glass.
   b. Using a flat-bladed sharp tool, cut out foam and butyl sealing strips between panel and glass (1 and 2, Fig. 6). Clean tool frequently to ease cutting operation.
   c. Using a sharp-bladed utility knife, cut urethane between nylon patches and glass. New patches will be required when installing panel to glass.

d. Lift upward on panel and pull from glass, being careful not to distort ends of glass molding.

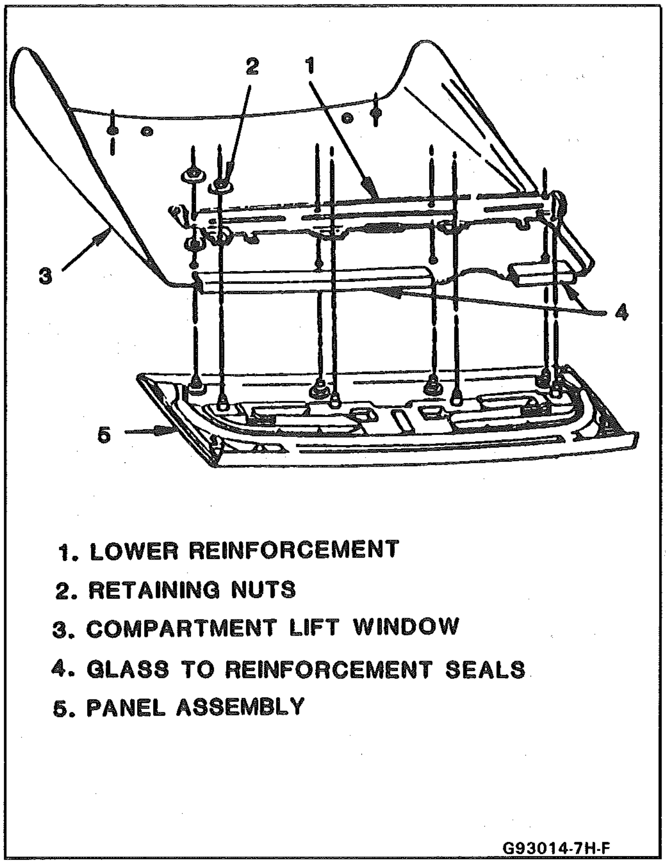


Fig. 5-Panel to Compartment Glass Assembly

Installation and Adjustment

1. Cleaning
   a. Using a razor blade and cloth dampened with alcohol, clean all adhesive from glass.
   b. Clean all adhesive from panel as a bench operation if original panel is to be reinstalled.
   c. Place a small piece of butyl on the bushing side of all black spacers with integral bushings.
2. Install
   a. Front sealing strip (part number 20328200 or equivalent) to forward edge of panel (1, Fig. 6).
   b. Butyl adhesive strip (5/16 square - 3M, part number 08631 or equivalent) next to sealing strip (2, Fig. 6).
3. Seal original holes in panel where glass molding retaining screws were installed with butyl.
4. Prime area shown in Figure 9 with black primer from urethane kit. Allow to air dry for five minutes.
5. Install urethane (part number 9636067 or equivalent) to area primed in above step and smooth material using a flat-bladed tool or tongue depressor.
6. With aid of helper, locate panel to glass in rearmost position.

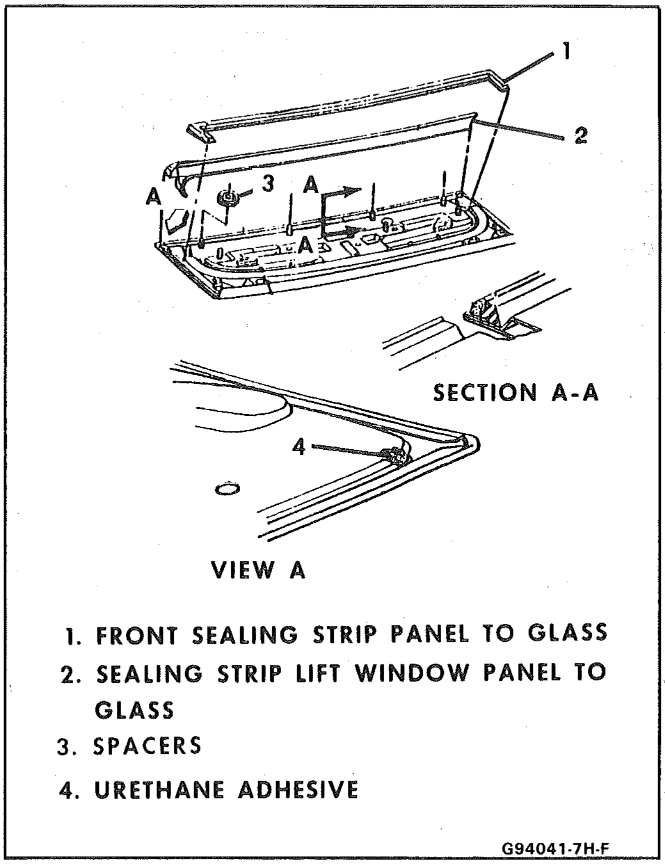


Fig. 6-Installing Sealing Strip to Lift Window Panel

7. Assemble panel to glass.
   a. Place black spacers with bushing over studs with bushing end of spacer going through glass.
   b. Locate lower reinforcement over studs (1, Fig. 5).
   c. Hand tighten all nuts retaining panel to glass.
   d. Locate nylon patches to glass being sure of right and left-hand installation.
8. Lower lift window and align panel to glass and to body.
9. From inside of car, tighten nuts (but not to specified torque).
10. Raise lift window and place jackstands in location to support lid.

CAUTION: When performing next step, overtightening could cause glass to break and personal injury could result. Personal safety items such as work gloves and safety glasses should be worn to minimize possible personal injury.

11. Using a torque wrench, tighten retaining nuts to 16 N·m (11 ft-lb) in the following order:
    a. Forward center
    b. Rearward center
    c. All remaining nuts
12. Install molding to panel. It may be necessary to drill new holes for retaining screws.
13. Installing gas supports.

a. Install bolts - gas support to body at right and left-hand gas supports. Make sure electrical connector is facing inboard. Torque bolts 20 to 28 N·m (15 to 20 ft-lb), Figure 4, view B).
b. Connect electrical connector to gas support (if present).
c. Install bolts at rear of gas supports to lower reinforcement. Torque bolts 5 to 7 N·m (40 to 60 in-lb) and connect electrical connector (if present), Figure 4, view A.

14. Lift lid and remove jackstands from body.
15. Install
    a. Striker to panel
    b. Wiper motor and blade assembly. Torque nut retaining wiper motor to glass 5 to 7 N·m (40 to 60 in-lb).
16. Align lock
    a. Carefully close lid and check striker-to-lock engagement.
    b. If striker does not engage lock correctly, loosen rear end trim panel and loosen bolts holding lock assembly to rear end panel. If equipped with electric lock release solenoid, loosen bolt holding solenoid to rear end panel.
    c. Adjust lock for proper engagement to striker.
    d. Tighten lock and solenoid retaining bolts 9 to 12 N·m (7 to 9 ft-lb).
    e. Replace rear end trim panel.
17. Replace lift window trim panel.

Glass Replacement and Adjustment

CAUTION: When removing glass assemblies from car, the use of personal protection items such as work gloves and safety glasses is recommended to minimize possible personal injury.

Removal

1. Place protective covering along edges of rear compartment to prevent damage to painted surfaces.
2. If glass is broken, remove all broken glass from interior of car.
3. From inside of car, remove plastic covers from bolts holding gas supports to body.
4. If equipped with heated back glass, remove wire connectors from gas supports.
    a. Unlock compartment lift window.
    b. Have helper support lid in partially open position.
5. Remove
    a. Bolts holding gas supports to body
    b. Back body opening upper garnish molding
    c. Nuts retaining lift window hinge to body (Fig. 3)
6. With aid of helper remove lift window from car and place upside down on a protected surface. Note position of hinge shims (if present).
7. Remove
    a. Gas supports from lower reinforcement (view A, Fig. 4)
    b. Hinge assemblies from glass
    c. Trim panel
    d. Wiper and blade assembly (if present)
    e. Lock striker
    f. Electrical contact and wiring harness (if present)
    g. Lower reinforcement (1, Fig. 5)
    h. Screws holding glass finishing molding to panel
    i. Nylon patches at radius joint of panel (Cut through adhesive using a curved blade utility knife.)
8. With aid of helper, turn lift window over and place masking tape along top edge of panel.
    a. If glass is being replaced for any reason other than breakage, use a flat-bladed sharp tool to cut out foam and butyl sealing strips between panel and glass. Clean tool frequently to ease cutting operation.
    b. Lift upward on panel and pull from glass, being careful not to distort ends of glass molding.
9. Clean panel of foam sealing strip and all adhesives. This can be done by using a cloth dampened in alcohol.
10. Remove lower glass sealing strips (4, Fig. 5).
11. Remove and discard plastic spacers.

Installation

1. When a new glass is installed, new glass finishing moldings will be required. Use the following steps to install moldings to glass.
    a. Use clear primer in urethane kit (9636067 or equivalent). Apply primer to glass as shown in Figure 7.
    b. Apply a 4.5 mm (3/16") bead of urethane from kit into molding channel as shown in Figure 8. Do not apply urethane for a distance of 25 mm (1") from center end of each molding.
    c. Place molding escutcheon inside right and left-hand moldings.
    d. Use a rubber mallet and install moldings onto glass making sure to align holes in tabs of molding with holes in glass. Be sure corner area is fully seated.

CAUTION: When performing next step, overtightening could cause glass to break and possible personal injury. The use of personal protection items such as safety glasses and work gloves is recommended to minimize possible personal injury.

2. Install hinge to glass and torque bolts 16 N·m (11 ft-lb).
3. Install the following items:
    a. Glass to reinforcement seals to rear edge of glass (4, Fig. 5).

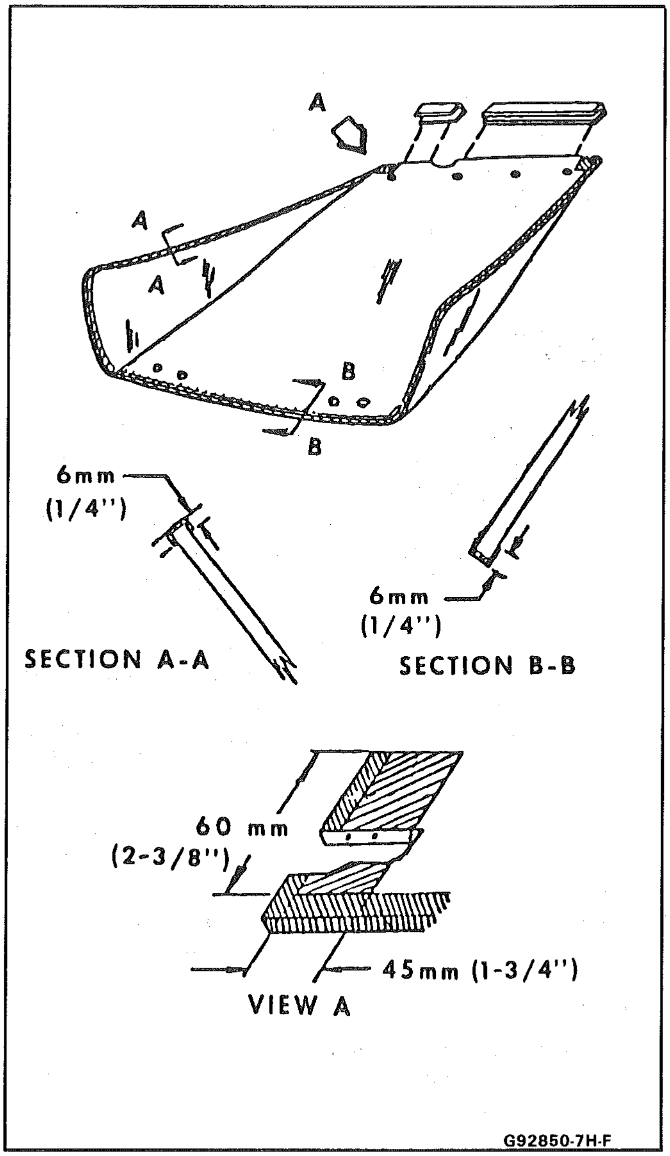


Fig. 7-Priming Compartment Lift Window Glass

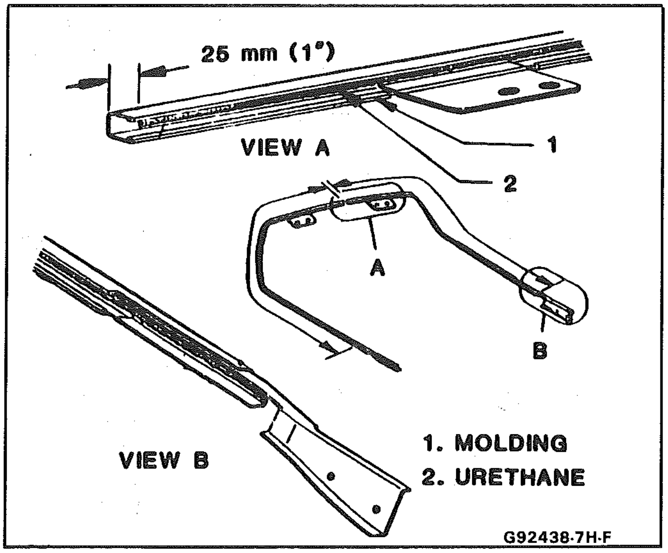


Fig. 8-Compartment Lift Window Finishing Molding

b. Front sealing strip, part number 20328200 or equivalent, (1, Fig. 6).

c. Butyl adhesive strip (5/16" square, 3M - part number 08631 or equivalent) next to sealing strip (2, Fig. 6). Seal holes in panel where glass molding screws were installed using above butyl.

d. Apply black primer (from kit) to panel (Fig. 9). Allow to air dry for five minutes.

e. Apply urethane (part number 9636067 or equivalent) to area of panel primed in above step. Smooth urethane with a flat-bladed tool. If new panel is to be installed, also apply to forward outer drain holes (4, Fig. 6).

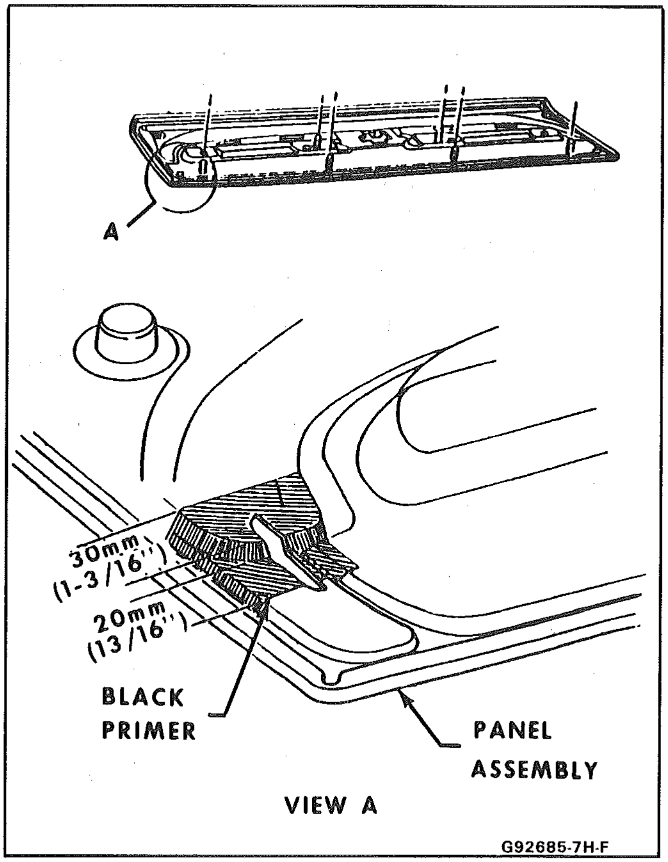


Fig. 9-Priming of Lift Window Panel

4. Install panel to glass.
   a. Place new glass spacers over forward studs on panel (if original glass was broken), Figure 6, item 3.
   b. Place glass on panel by placing holes in glass over studs on panel. Align panel to glass in rearmost position.
   c. Place spacers between glass and lower reinforcement.
   d. Place lower reinforcement over studs on panel (1, Fig. 5).
   e. Apply nylon patches to glass (being sure of right and left-hand part installation).
   f. Hand tighten all nuts retaining the reinforcement to panel.
   g. With the aid of a helper, install compartment lift window assembly to the body. The holes for the hinge body bolts are oversized which allows for some

adjustment. Install original hinge shims to body (Fig. 10). Once the glass is aligned, torque hinge-to-body nuts 20 to 28 N·m (15 to 20 ft-lb).

h. From inside the car, loosen the lower reinforcement-to-panel nuts.
i. From outside the car, position rear panel center and forward 3 mm (1/8") of final desired position.
j. From inside the car, hand tighten the lower reinforcement-to-panel nuts.
k. Raise and prop open compartment lift window.

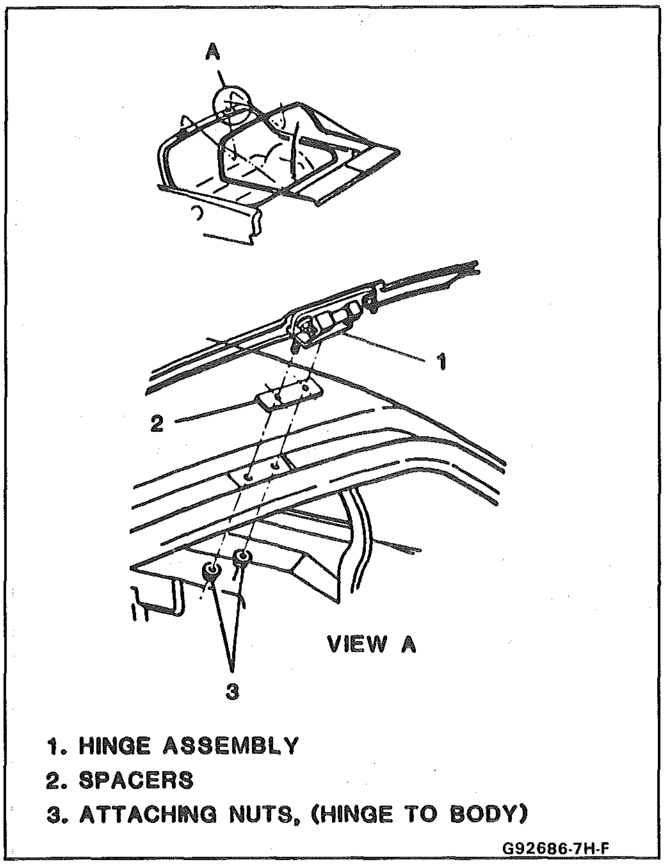


Fig. 10-Installing Lift Window Hinge to Body

CAUTION: Torque of 16 N·m (11 ft-lb) must be maintained when tightening retaining nuts, panel to glass (Fig. 5, item 2) or glass breakage and personal injury could result. Personal protection items such as safety glasses and work gloves should be worn to minimize possible personal injury.

l. Tighten retaining nuts in the following order:
   - Forward center
   - Rear center
   - All remaining nuts
m. Install screws securing glass finishing molding to panel. It may be necessary to drill two small holes in panel for molding retaining screws.

5. While helper supports lift window, install gas supports to body. Be sure that electrical contact at forward edge of gas support (if present) is inboard, then
   a. Torque gas support-to-body bolts 20 to 28 N·m (15 to 20 ft-lb).
   b. Torque gas support-to-lift window bolts 5 to 7 N·m (40 to 60 in-lb).
   c. Reinstall wiring harness and upper electrical contact to lift window panel (if present).
   d. Install wiper motor to lift window (if present); torque all bolts 5 to 7 N·m (3.5 to 5 ft-lb).
   e. Install lock striker to lift window panel and carefully check lock striker-to-lock engagement.
   f. If it is necessary to adjust lock for proper engagement of striker, remove rear end trim panel.
   g. Loosen bolts holding lock to rear end panel (and solenoid if present).
   h. Adjust lock for proper engagement of striker.
   i. Tighten all bolts to torque of 9 to 12 N·m (7 to 9 ft-lb).
   j. Install trim previously removed.

GAS SUPPORT ASSEMBLY

The gas support assemblies used to assist opening are attached to the lid and the body and are secured by retaining bolts. The supports are color coded (lettering on each support) for each option group. The original gas supports have a specified output level and MUST be replaced with a gas support with the same color coded lettering

Removal and Installation

CAUTION: Do not attempt to remove or loosen gas support assembly attachments with lid in any position other than fully open as personal injury may result.

1. Prop lid in full-open position.
2. Remove electrical connector (if present). While helper supports lid, disengage gas supports from lift window assembly (view a and b, Fig. 4).
3. Remove bolt covers, retaining bolts and disengage gas supports.
4. To install, reverse removal procedure.
   When reinstalling gas supports, torque the support-to-body bolts 20 to 28 N·m (15 to 21 ft-lb). The support-to-lift window bolts should be torqued 5 to 7 N·m (40 to 60 in-lb).

Testing Procedure

If the compartment lift window will not stay in the full-open position or does not raise, follow the listed steps to check if the gas support(s) is worn.

In extremely cold temperatures, below -29°C, -20°F, it is normal for the gas pressure to be reduced and this results in a decrease in the hold-open force until warmer weather. A buildup of snow on the lift window will affect the ability of the gas supports to hold the lift window open.

1. If the gas support system is not working properly, get a correct replacement part. Very seldom do gas supports wear out at the same time.
2. Replace a gas support on one side of the car.
3. If lift window falls down, reinstall on the other side the support removed in step 2.
4. If lift window falls down, replace the support installed in step 3 with a new gas support.

COMPARTMENT LID LOCK CYLINDER

The compartment lid lock cylinder on some models is located in the rear end panel behind the license plate. On other models, it is in the center rear end filler section.

The basic method of cylinder attachment where the lock cylinder is located behind the license plate is by means of a lock cylinder retainer. Styles with the lock cylinder in the rear end filler use rivets to retain the lock cylinder (Fig. 11).

Removal and Installation

1. Open rear compartment lid.
2. To gain access to lock cylinder retainer, loosen rear end trim panel.
3. Remove pull-down unit (see procedure).
4. Disconnect connector (4, Fig. 13).
5. On styles with cylinder behind license plate, remove lock cylinder retainer by pulling retainer away from lock cylinder and remove cylinder. With other design, remove tail lamps and center filler (Fig. 12). Drill out lock cylinder rivets (part no. 2011554) using a 6.3 mm (1/4") drill bit and remove lock cylinder.
6. To install, reverse removal procedure. Insure that that gasket mates properly with outer panel to form a watertight seal. Check for proper operation of lock cylinder with key. Then install retainer or new rivets.

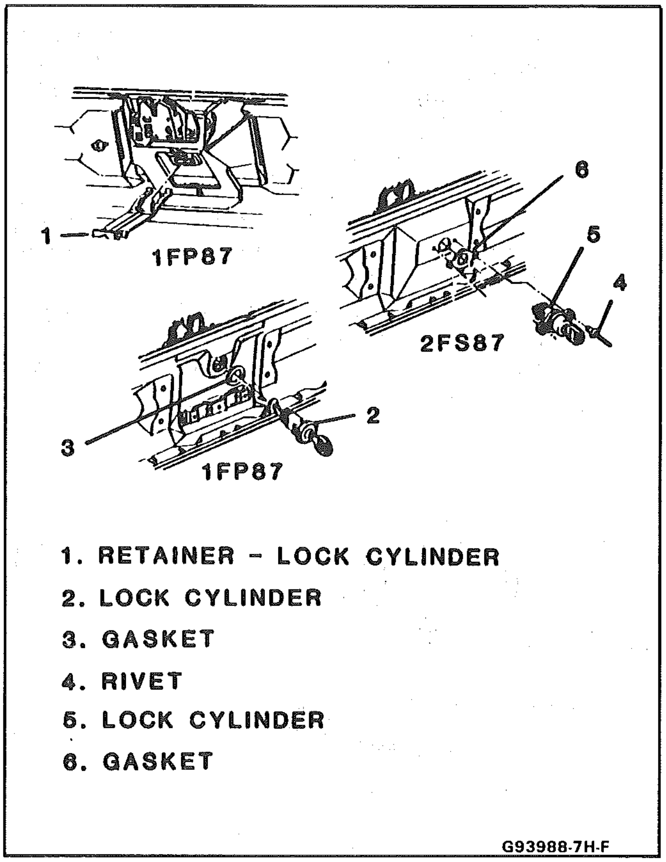


Fig. 11 - Lid Lock Cylinder Installation

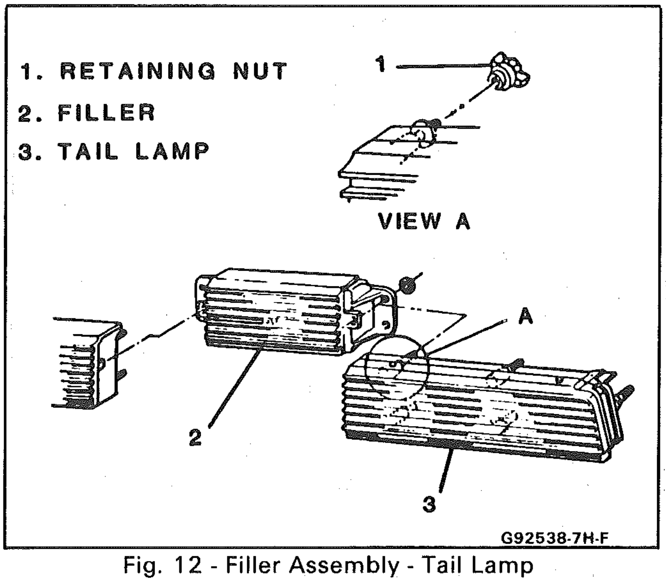


Fig. 12 - Filler Assembly - Tail Lamp

REAR COMPARTMENT PULL-DOWN UNIT

The compartment lid lock is staked to the rear compartment pull-down unit. Service of the lock is not recommended. If a lock is to be replaced, the entire pull-down unit will be required.

Adjust

The pull-down unit can be adjusted for proper lock striker-to-lock engagement. To adjust pull-down unit, loosen screws (8, Fig. 14) and adjust pull-down unit as required and tighten screws.

Remove or Disconnect (Fig. 14)

1. Rear end trim panel
2. Wire connections leading from wire harness (4)
3. Screw (5)
4. Cable from clip (6)
5. Mark location of washers on support (7)
6. Screws (8)

Install or Connect

Unit must be in closed position prior to installing.

1. Screws (8) (make sure washers are in same location as marked in step 5 of removal procedure).
2. Cable to clip and close clip (6).
3. Screw (5)
4. Wire connectors leading from wire harness (4)
5. Trim

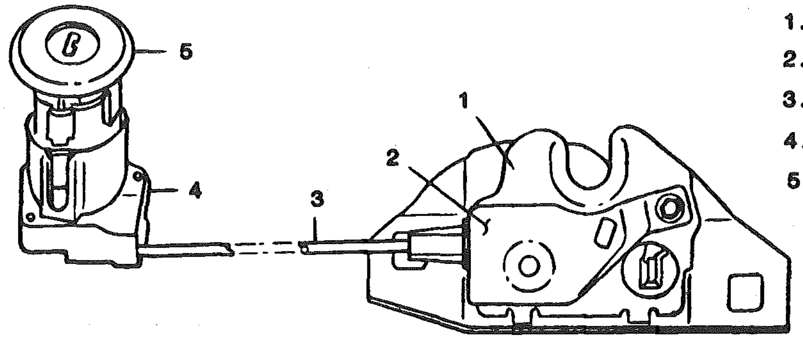


Fig. 13 - Rear Compartment Lock Actuator

Inspect

Make certain unit functions properly and readjust unit if necessary.

SWITCH ON LOCK

Remove or Disconnect (Fig. 14)

1. Pull-down unit
2. Wire connector to motor switch (9)
3. Screw holding switch to unit (2, Fig. 15)
4. Pull wire harness (4) clear of unit
5. Switch (1, Fig. 15)

Install or Connect

1. Screw (2, Fig. 15)

NOTICE: Wiring from switch on lock must be installed between lock and backplate or damage to wiring will occur when unit is cycled.

2. Wire connector to motor switch (9)
3. Pull-down unit

MOTOR

Remove or Disconnect (Fig. 15)

1. Pull-down unit
2. Screws - motor to support (12, Fig. 14)
3. Screw and nut (6) - by placing unit in a vise and using striker removal tool J-23457 or equivalent and one long handle 8 mm (5/16″) wrench (3) and one 13 mm (1/2″) wrench (4).
4. Motor (9)

Install or Connect

1. Motor (9)
2. Screw and nut (6) (using same tools as specified for removal)
3. Screws (12, Fig. 14)
4. Pull-down unit

SWITCH ON MOTOR

Remove or Disconnect (Fig. 15)

1. Pull-down unit
2. Motor (9)
3. Screw (8)
4. Switch (7)

Install or Connect

1. Switch (7)
2. Screw (8)
3. Motor (9)
4. Pull-down unit

LIFT WINDOW RELEASE SOLENOID

When electric lift window release option is specified, a solenoid assembly is attached to the existing lock.

The lift window release allows the lift window to be unlocked from either the inside of the vehicle by means of a switch, or from the outside of the vehicle in the conventional manner.

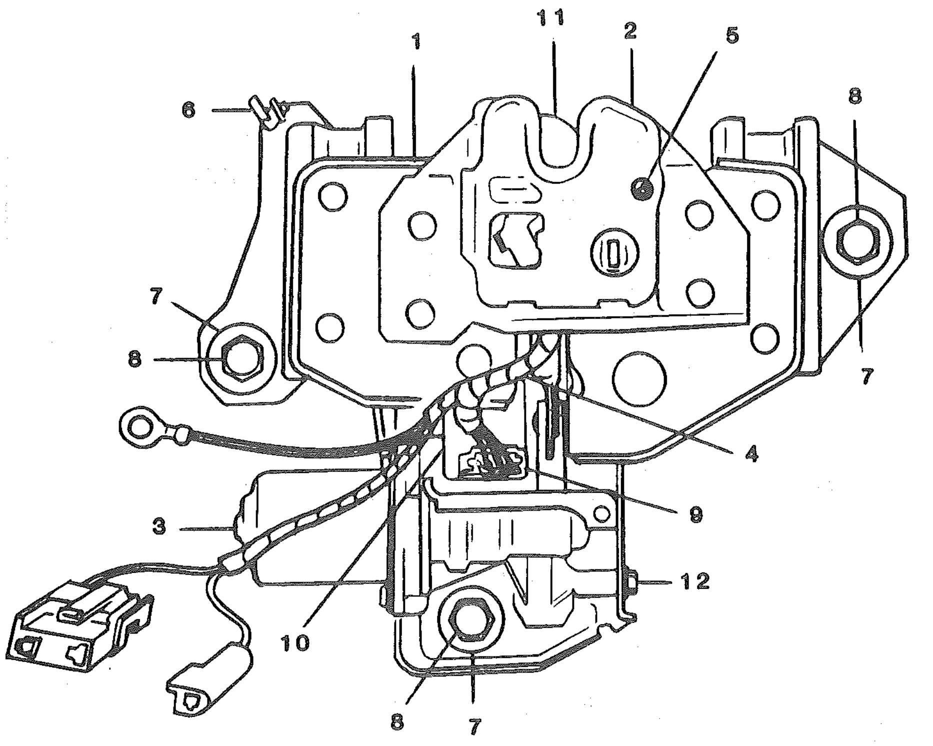
Removal and Installation

1. Open compartment lift window.
2. Remove rear end trim panel fastener and slide panel forward.
3. Remove screw (5, Fig. 14)
4. Remove cable (3, Fig. 13) from clip (6, Fig. 14)
5. Remove pull-down unit
6. Disconnect connector (4, Fig. 13)
7. Remove solenoid
8. To install, reverse the removal procedure.

COMPARTMENT LIFT WINDOW LOCK STRIKER

Removal and Installation

1. Remove compartment lift window inner trim panel.
2. Remove lock striker.
3. To install, reverse removal procedure.



1. PULL-DOWN ASSEMBLY
2. LOCK
3. MOTOR
4. WIRE HARNESS
5. SCREW
6. CLIP
7. WASHERS
8. SCREWS
9. CONNECTOR
10. SWITCH AT MOTOR
11. SWITCH AT LOCK
12. SCREW

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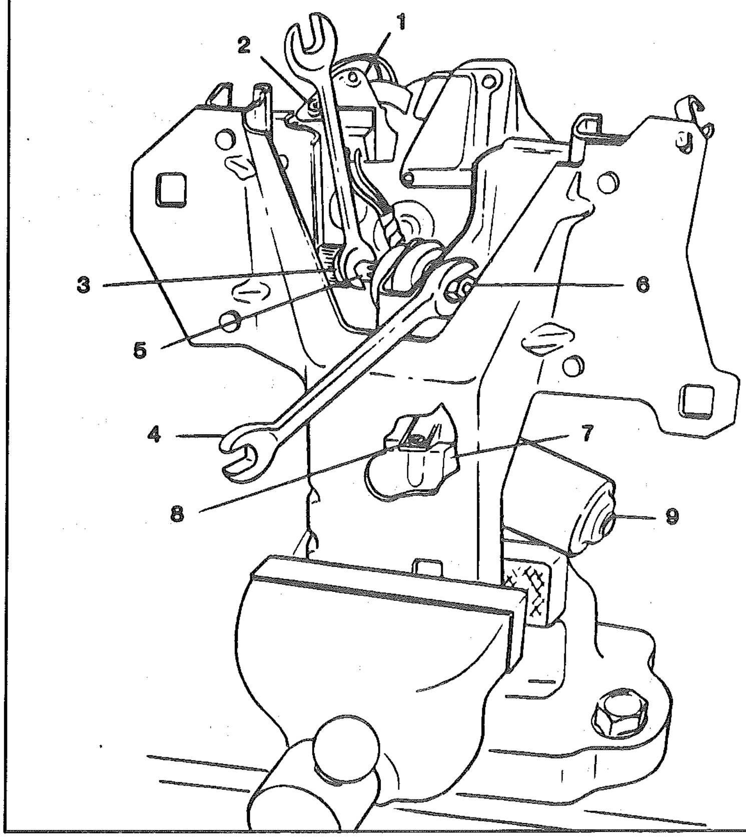
Fig. 14 - Rear Compartment Pull-down Unit Front View



1. SWITCH AT LOCK
2. SCREW
3. WRENCH - 8 mm (5/16")
4. WRENCH - 13 mm (1/2")
5. STRIKER REMOVAL TOOL
6. NUT
7. SWITCH AT MOTOR
8. SCREW
9. MOTOR

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Fig. 15 - Rear Compartment Pull-down Unit Rear View

COMPARTMENT WEATHERSTRIP

A clinch type weatherstrip is used on all styles. The supersoft foam weatherstrip has an integral metal reinforced section which grips and seals the weatherstrip to the gutter flange.

Removal and Installation

1. Separate butt joint at base of opening. Remove and retain plug from old weatherstrip.
2. Peel weatherstrip from gutter flange toward lower corners and then around complete opening.
3. To install, apply weatherstrip to pinchweld flange and begin inserting center of weatherstrip (marked with paint) onto the gutter flange at the forward center of the opening between hinges. Be sure clinch is completely seated to the flange around the entire opening.
4. Cement butt ends together using plug from original weatherstrip.

COMPARTMENT LIFT WINDOW TRIM PANEL

Removal and Installation (Fig. 16)

1. Remove screws.
2. Slide trim panel forward and pull-down on panel to remove.
3. To install, reverse the removal procedure.

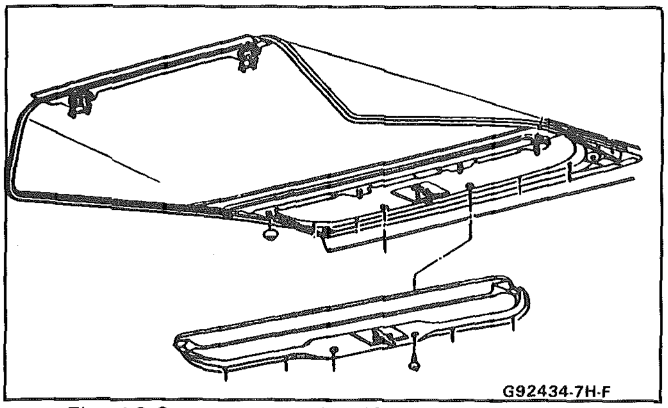


Fig. 16-Compartment Lift Window Trim Panel

LIFT WINDOW WIPER SYSTEM

MOTOR AND BLADE ASSEMBLY

Removal and Installation (Fig. 17)

1. Remove wiper arm blade using tool J-8966 or equivalent.
2. Remove nut and spacer on wiper motor shaft.
3. Raise lid and remove lift window trim panel.
4. Disconnect electrical connectors to wiper motor.
5. Using 4.8 mm (3/16") drill bit, remove rivets holding motor support to lift window panel and remove assembly from car.
6. To remove motor, remove screws retaining wiper motor to motor support.
7. To install, reverse the removal procedure. Use 3/16"x1-5/16" rivets. Torque all bolts and nuts 5 to 7 N·m (40 to 60 in-lb).

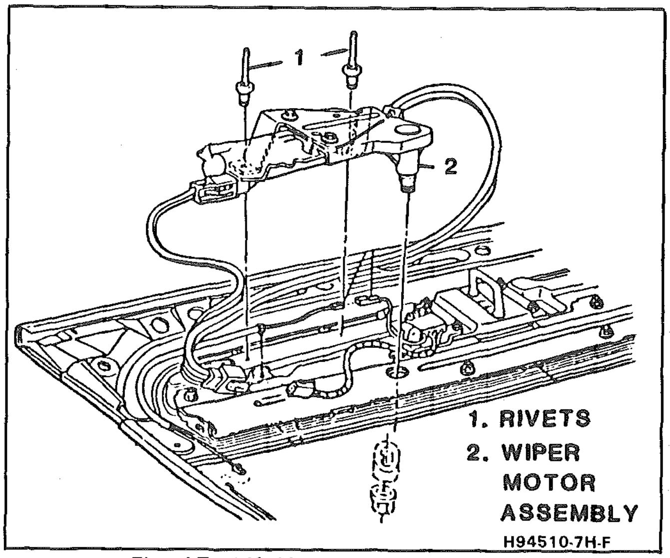


Fig. 17 - Lift Window Wiper Motor

LIFT WINDOW WIPER NOZZLE ASSEMBLY

Washer solvent is supplied to the lift window wiper nozzle through a hose routed from the washer solvent container through the instrument panel subassembly, down the left front lower shroud trim panel, along the rocker panel, up the quarter panel and across the roof to the nozzle.

Removal and Installation

1. Remove interior rear upper roof garnish molding.
2. Pull-down on headlining to gain access to nozzle attachment.
3. Remove hose from nozzle (Fig. 18).
4. Using a 15 mm socket, remove nozzle to roof panel retaining nut and remove nozzle from outside of car.
5. To install, reverse the removal procedure, torque nut 30 to 40 N·m (22 to 29 ft-lb).

REAR COMPARTMENT TRIM AND ELECTRICAL

REAR END TRIM PANEL

Removal and Installation

1. Remove plastic fastener at left-hand side of trim panel.
2. Remove screw at top of trim panel near lower electrical contact.
3. Lift up on trim panel to disengage lower trim panel retaining tabs.
4. Disconnect all wiring connectors and remove trim panel.
5. To install, reverse the removal procedure.

LOWER ELECTRICAL CONTACT

Removal and Installation (Fig. 19)

1. Open compartment lift window and remove rear end trim panel.

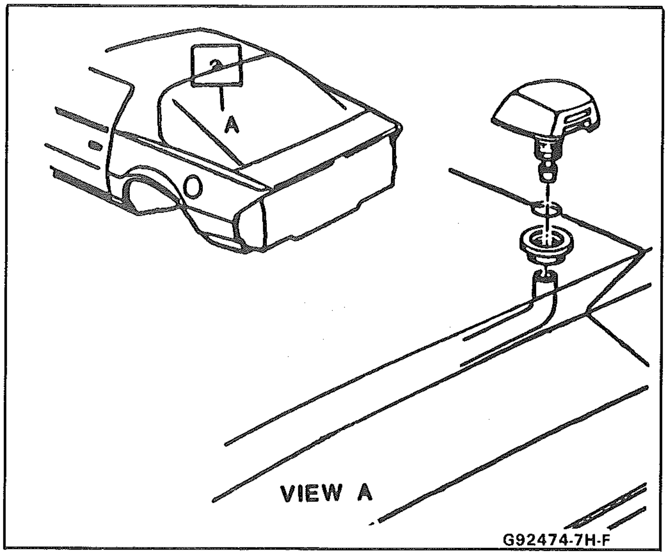


Fig. 18 - Installing Lift Window Wiper Nozzle

2. Remove wire connector from contact.
3. Remove screws holding bezel and lower contact to trim panel.
4. Remove contact.
5. To install, reverse the removal procedure.

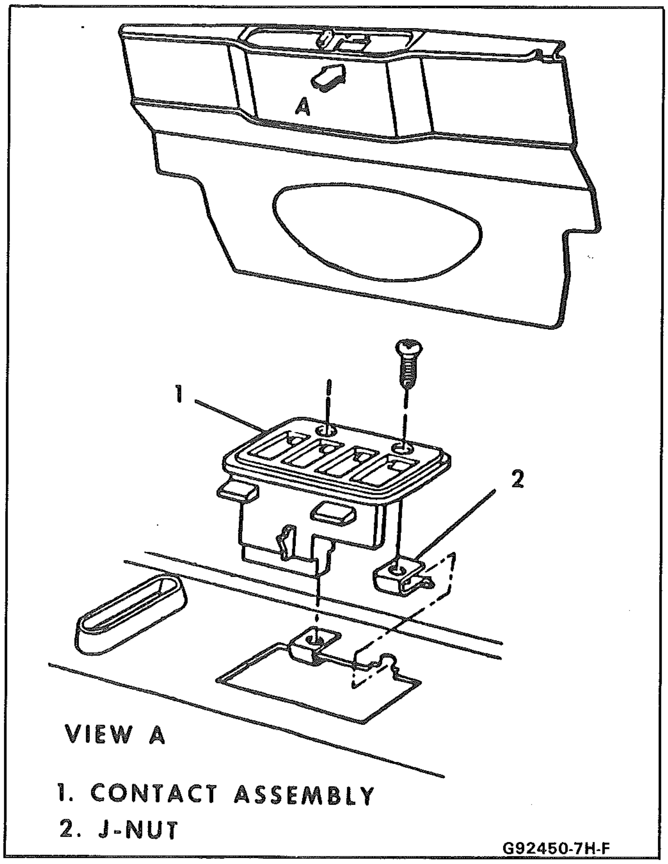


Fig. 19 - Lower Electrical Contact Assembly

UPPER ELECTRICAL CONTACT

Removal and Installation

1. Raise lift window and remove lift window trim panel.
2. Remove nuts holding contact to panel.
3. Disconnect wire connectors and remove contact.
4. To install, reverse the removal procedure. Tighten nuts to 12 to 16 N·m (9 to 12 ft-lb).

LOAD FLOOR COMPARTMENT LID LOCK CYLINDER

Removal and Installation (Fig. 20)

1. Open load floor storage compartment lid.
2. Using a flat-bladed tool, pry lock cylinder retainer away from lock cylinder and remove lock cylinder.
3. To install, reverse the removal procedure.

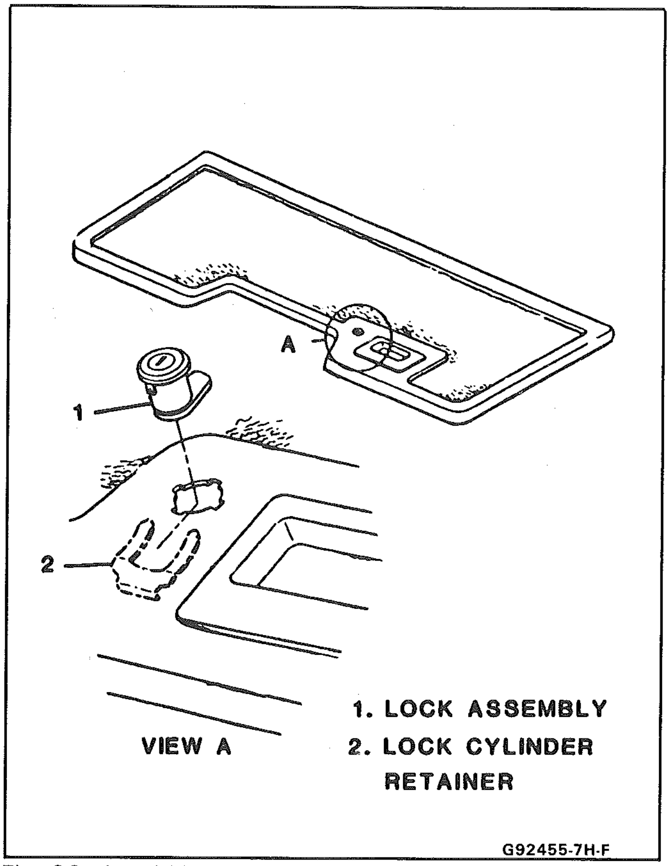


Fig. 20 - Load Floor Storage Compartment Lock Cylinder

LOAD FLOOR STORAGE COMPARTMENT LID STRIKER

Removal and Installation (Fig. 21)

1. Raise load floor storage lid.
2. Remove screws holding striker to rear end panel and remove striker.
3. To install, reverse the removal procedure.

REAR COMPARTMENT LOAD FLOOR STORAGE LID

Removal and Installation (Fig. 22)

1. Raise load floor storage lid.
2. Remove plastic covers to expose hinge retaining nuts.
3. Remove hinge retaining nuts and remove storage lid.

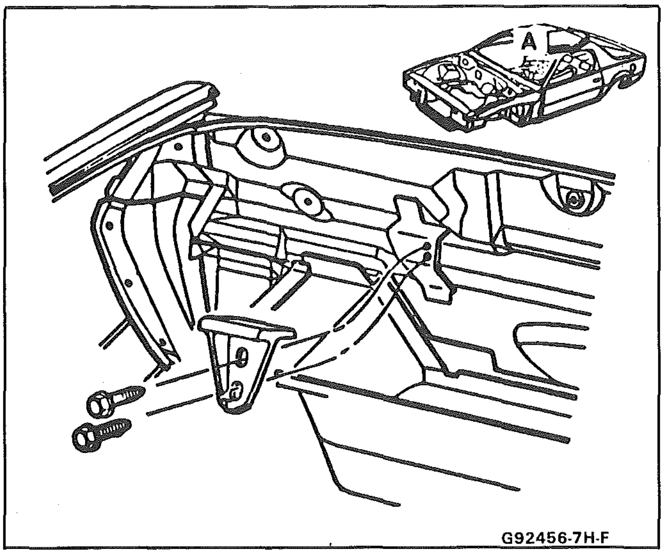


Fig. 21 - Load Floor Storage Compartment Striker

4. To install, reverse the removal procedure. Torque nuts 9 to 12 N·m (7 to 9 ft-lb).

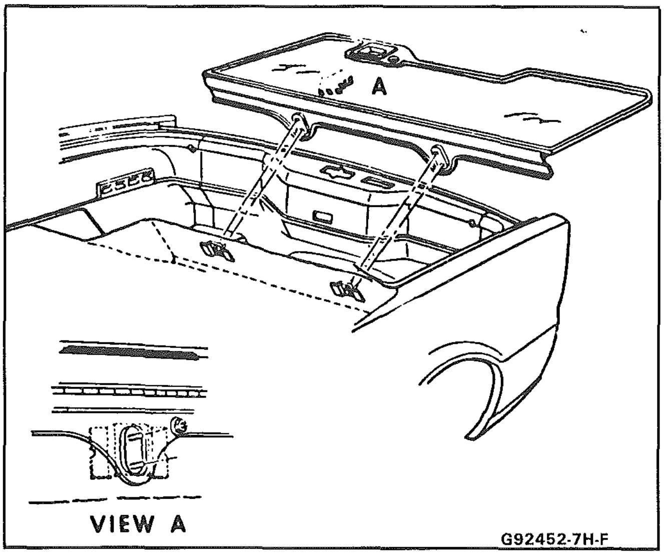


Fig. 22 - Load Floor Storage Lid

REAR COMPARTMENT CARGO LIGHT ASSEMBLY

Bulb Replacement

1. Using a flat-bladed tool, pry up on plastic lens on right-hand side to disengage lens from rear end trim panel (Fig. 23).
2. Remove and replace bulb.
3. To install, reverse the removal procedure.

Lens Replacement

1. Pry lens from rear end trim panel.
2. Disconnect wire connector and remove lens (Fig. 23).
3. To install, reverse the removal procedure.

Switch Replacement

1. Remove screws holding switch bezel to rear end trim panel (Fig. 24).
2. Remove rear end trim panel.

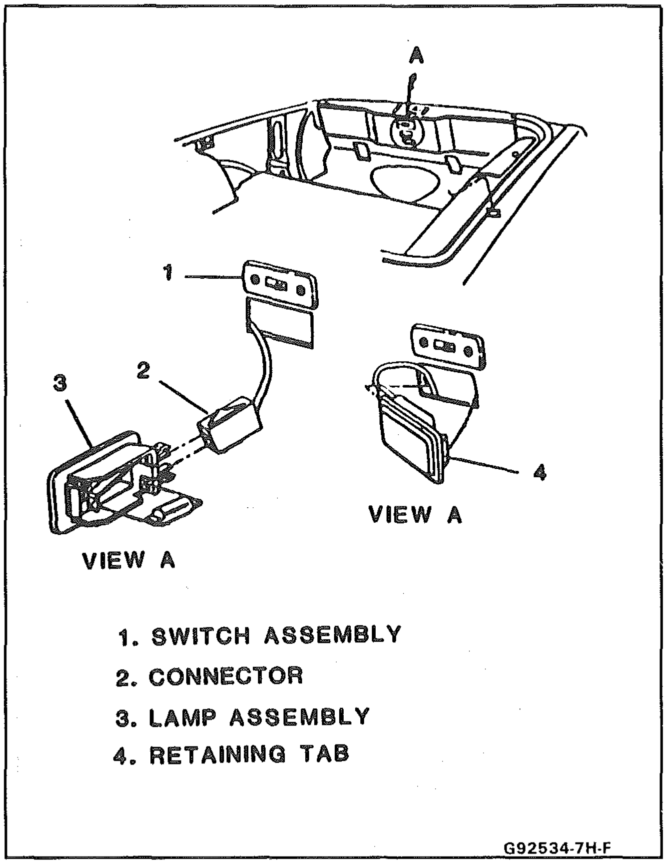


Fig. 23 - Rear Compartment Cargo Light and Switch Assembly

3. Remove switch from rear end panel.
4. Disconnect wire connector.
5. To install, reverse removal procedure.

REAR COMPARTMENT CARPET

Removal and Installation

1. Remove rear seatback and cushion.
2. Remove quarter trim panels.
3. Remove rear end trim panel.
4. Remove load floor storage compartment lid.
5. Remove twin lift-off panel tie downs (if present).
6. Remove load floor carpet assembly.
7. To install, reverse the removal procedure.

COMPARTMENT LIFT WINDOW SPOILERS

SPOILER - 2FS87 STYLE

Removal and Installation

1. Raise lift window and remove plastic plugs from panel (Fig. 25).
2. Remove nuts holding spoiler to panel.
3. Lower lid and lift up spoiler and remove.
4. To install, reverse removal procedure. Torque spoiler retaining nuts 7 to 9 N·m (5 to 7 ft-lb).

AERO-WING SPOILER - 2FS87 STYLE

←→ Remove or Disconnect (Fig. 26)

1. Raise lift window and remove plastic plugs (4)

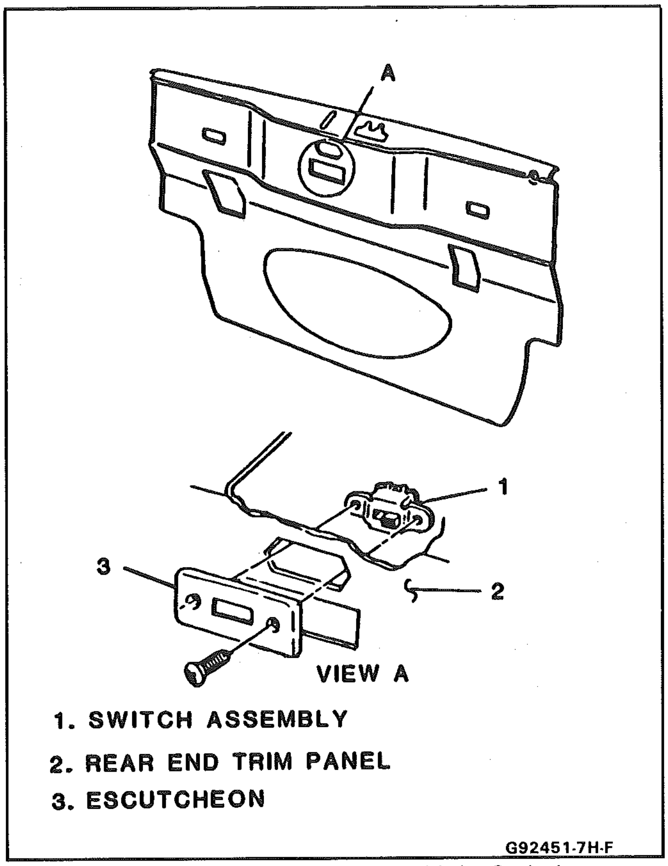


Fig. 24 - Rear Compartment Light Switch

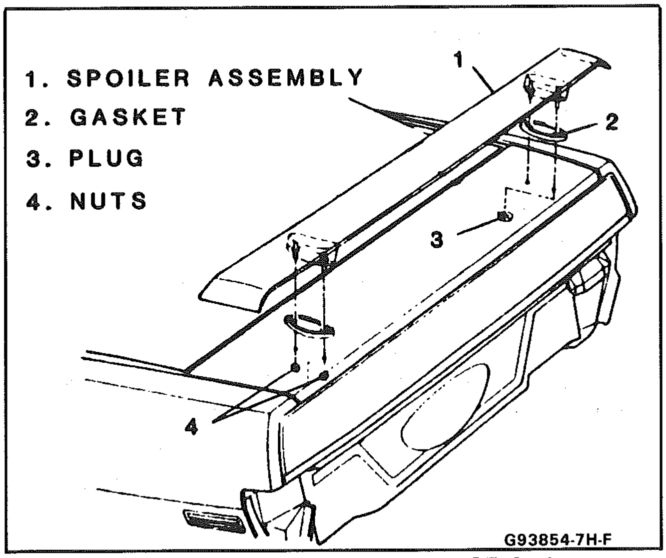


Fig. 25 - Spoiler Assembly - 2FS87 Style

2. Remove screws (5) holding spoiler to lift window.
3. Push on spoiler towards front of car so that fasteners (2) are located over slots in retainers (3) on molding.
4. Lift up on one side of spoiler at fastener locations to disengage fasteners (2) from retainers (3).
5. Repeat step 4 on opposite side.
6. Remove any fasteners that may remain in spoiler using needle nose pliers.

Install or Connect

1. Install new fasteners (2) as far rearward as possible in retainers (3).
2. Locate holes in spoiler over fasteners (2).
3. Push down on one side of spoiler until fasteners are fully seated in spoiler.
4. Repeat step three on opposite side of spoiler.
5. Install screws (5)
6. Install plugs (4)

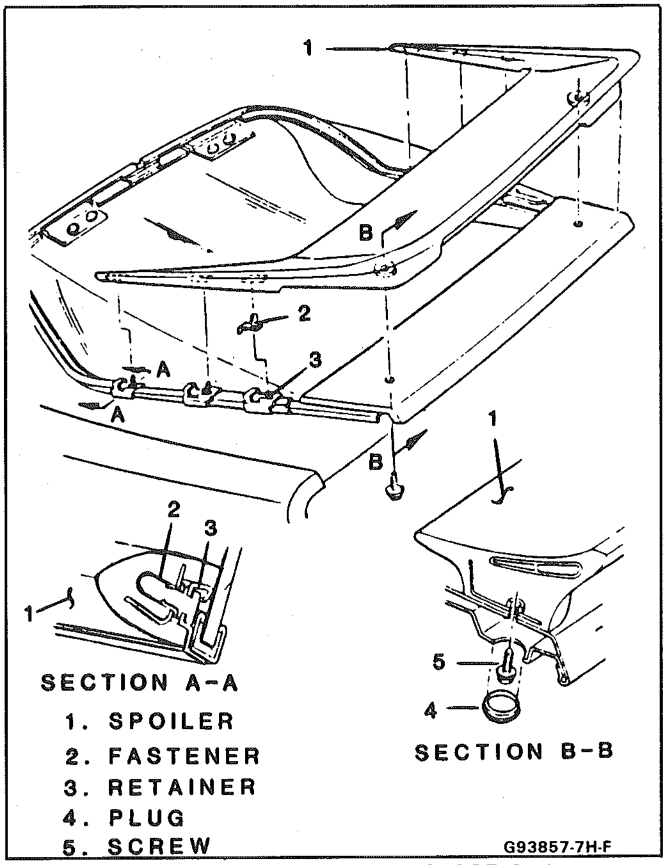


Fig. 26 - Spoiler Assembly - 2FS87 Style

SPOILER - 1FP87 STYLE

Remove or Disconnect (Fig. 27)

1. Raise lift window and remove plastic plugs (2)
2. Remove nuts (3)
3. Remove washers (4)
4. Lower lift window and lift up on spoiler

Install or Connect

1. Locate studs on spoiler through holes in panel
2. Install washers (4)
3. Install nuts (3)
4. Install plugs (2)

REAR SPOILER EXTENSIONS

Some styles have spoiler extensions which are located on the quarter outer panels and are described in Section 6H in the body portion of this manual.

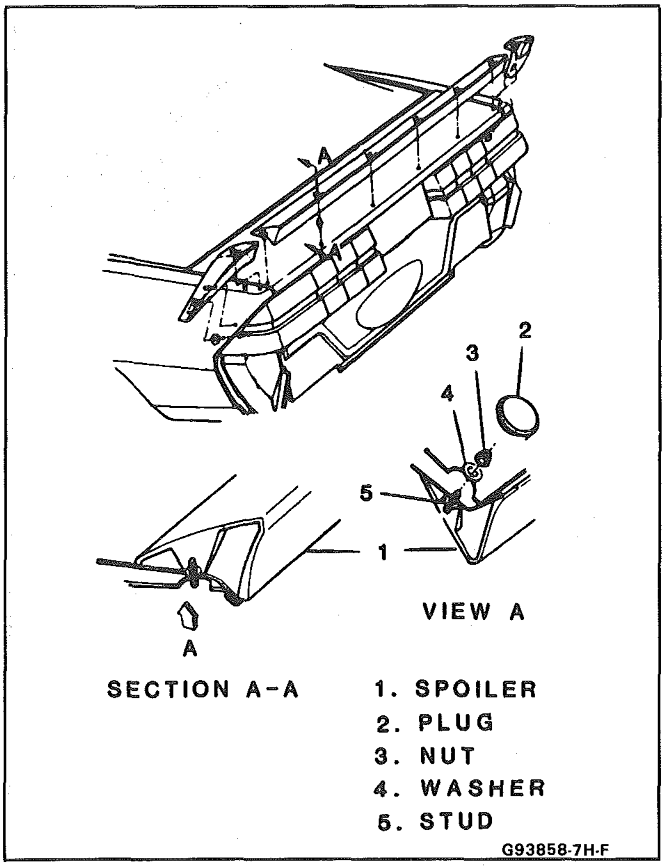


Fig. 27 - Spoiler Assembly, 1FP87 Style

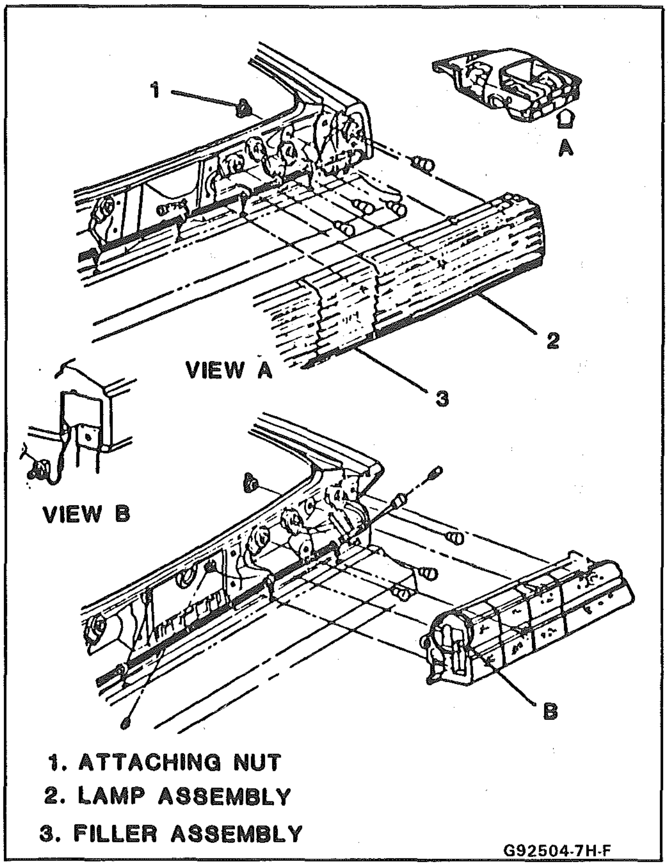


Fig. 28 - Installing Exterior Lamp

EXTERIOR LAMPS

TAIL LAMPS

Various methods are employed to remove and install the components of tail lamp assemblies. Figure 28 will provide a quick reference for performing the basic service operations for each style.

Tail lamp bulbs can be replaced by removing the plastic wing nuts which retain the lamp assemblies to the rear end panel and then removing the lamp assembly.

Do not rework or alter the reflective surface of tail lamps or side marker lamps. Replace defective parts with new service replacement parts.

EXTERIOR LAMP SEALING

Care should be exercised to prevent waterleaks at the tail lamp area when sealing surfaces are disturbed. Damaged gaskets should be replaced.

If new gaskets are not installed, the use of sealer (body caulking compound or equivalent) is recommended at critical areas and where the old gaskets have taken a set.

SIDE MARKER LAMPS

Some styles have a rear quarter side marker lamp which operates in conjunction with the tail lamp circuit. Figure 29 shows the stud and nut method of retention used to retain the side marker lamp to the body. Other styles use a wrap around tail lamp assembly which doubles as a side marker lamp.

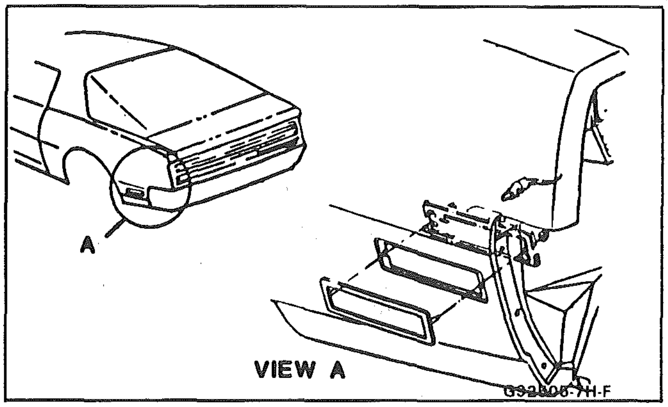


Fig. 29 - Installing Side Marker Lamp

CENTER HIGH-MOUNTED STOP LAMP

Remove or Disconnect (Fig. 30)

1. Nuts (6)
2. Spoiler (see procedure)
3. Wire harness (5)
4. Lamp assembly (1)

Install or Connect

1. Lamp assembly (1) to spoiler
2. Wire harness
3. Spoiler to body (see procedure)
4. Nuts (6)

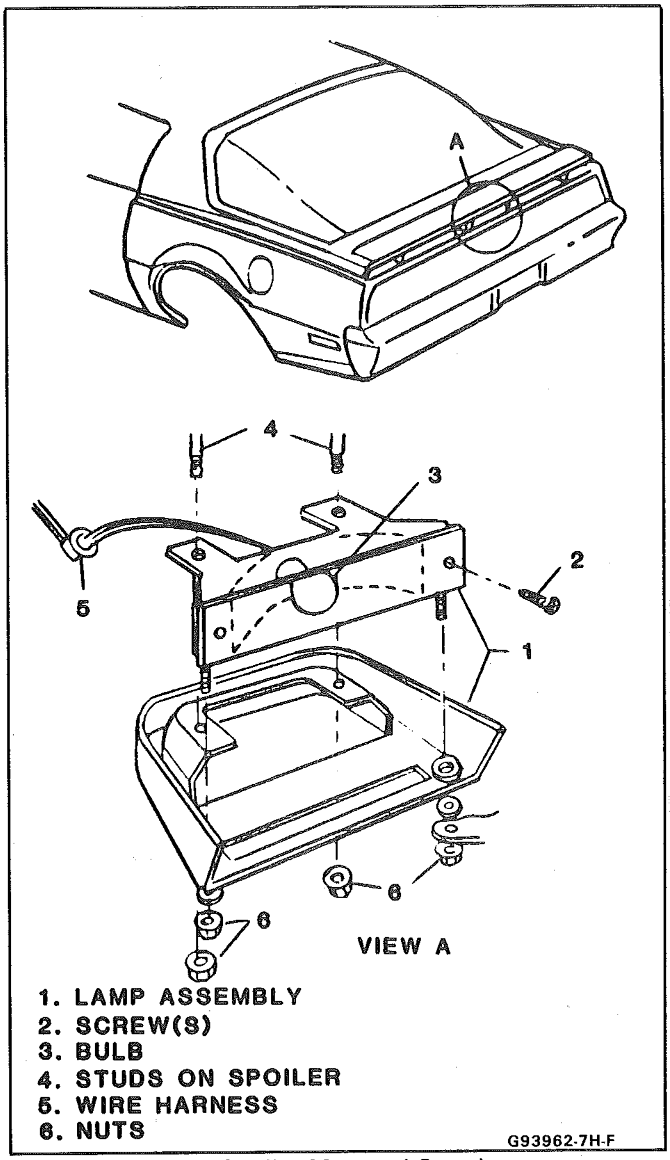


Fig. 30 - Spoiler Mounted Stop Lamp

SECTION 8H

ROOF

CONTENTS

FORMED HEADLINING

The one-piece formed headlining (Fig. 1) consists of a molded fiberglass substrate covered with a foam and cloth facing. The one-piece construction requires the headlining be serviced as a complete assembly.

The headlining is held partially in place by retaining fasteners located in the headlining which fit into slots in the roof panel. Final attachment is accomplished when the interior moldings and attaching screws that retain the sunshade brackets, dome lamp base and coat hooks are installed.

Removal

1. Remove the following items:
   - Back body opening upper garnish molding
   - Windshield side upper garnish molding (1, Fig. 3 or 6)
   - Rear vertical garnish molding
   - Windshield header courtesy reading and console lamp
   - Sunshades
   - Partially remove shoulder belt bezel and belt
   - Coat hooks and rail panel inserts
2. Grasp headlining assembly with both hands at outer edges and move to the right of centerline to disengage fastener assemblies from front attaching slots.
3. Remove headlining assembly through right front door.

Installation

Care must be exercised when loading assembly. Excessive flexing may result in damage.

1. Load the headlining through the rear compartment opening.
2. Align headlining with cutouts for sunshades and dome lamp and install sunshade brackets and dome lamp base. Do not tighten sunshade bracket and dome lamp attaching retainers completely until headlining is aligned properly at all hardware attaching locations.
3. Align headlining to roof inner panel with fasteners positioned over holes in roof panel and using palm of hand, push up on headlining at fastener locations.
4. Install all previously removed hardware and interior moldings.

INTERIOR ROOF ATTACHMENTS

DOME LAMPS

The dome lamp operates in conjunction with the door jamb switch and/or the headlamp switch. The dome lamp harness extends up the right windshield pillar, outboard of the sunshade support and across the roof inner panel to the dome lamp.

Removal and Installation (Typical)

1. Grasp lens portion of dome lamp assembly, squeeze and pull down to remove.
2. Remove bulb from terminal clips.
3. Remove retainers from studs.
4. Disengage wire harness from lamp housing and remove dome lamp housing.
5. To install dome lamp assembly, reverse removal procedure.

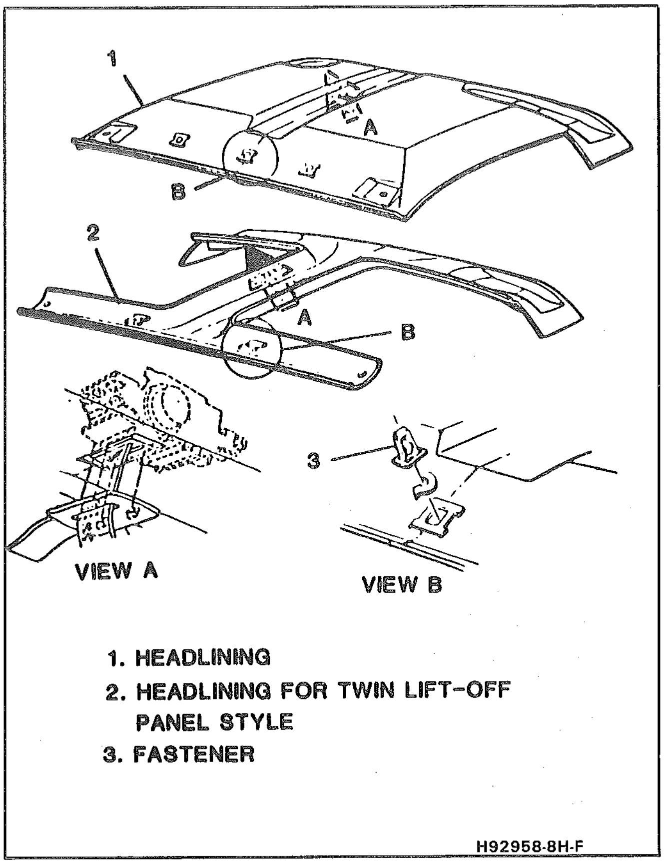


Fig. 1 - Headlining Assemblies

HEADER CONSOLE

The dome light on the console operates in conjunction with the door jamb switches and/or the dome and courtesy light switch on the console. The console switch will turn the light on or off with the doors closed and can also be used to shut off the dome lamp when a door is open. The dome light will illuminate normally again when the door is next opened.

Removal and Installation (Fig. 2)

1. Remove dome lamp lens and take out two screws securing rear of header console to roof.
2. Slide console forward to disengage from roof, disconnect wiring harness and remove console.
3. To install, reverse removal procedure.

SUNSHADE ASSEMBLY

The sunshade assembly is attached to the roof panel with three screws through cutouts in the headlining assembly.

INTERIOR GARNISH MOLDINGS

Interior garnish moldings are constructed of plastic or metal and painted to match the interior of the car. Retention is accomplished with screws and/or plastic clips.

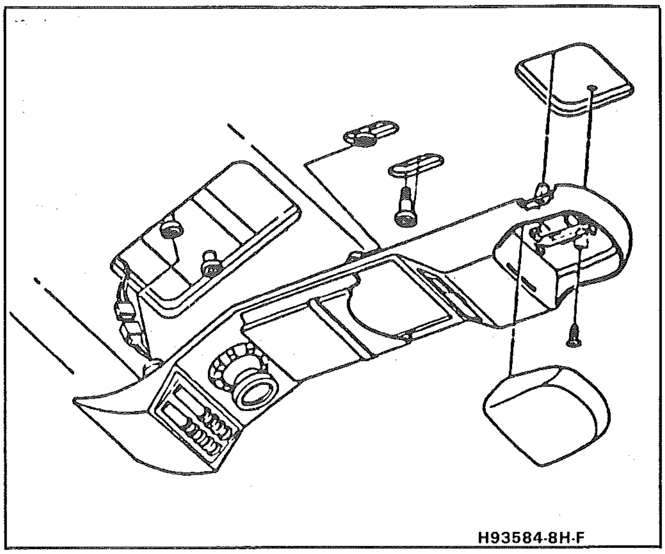


Fig. 2 - Windshield Header Courtesy Reading and Console Lamp

WINDSHIELD SIDE UPPER GARNISH MOLDING

Removal and Installation

1. On styles with twin lift-off panel, remove screw located at upper end of garnish molding.
2. On all styles, pull down on garnish molding to disengage fasteners holding molding to body (Fig. 3) and remove molding.
3. To install, align fasteners on molding to holes in windshield pillar and press molding in place. Replace screw on styles with twin lift-off panels.

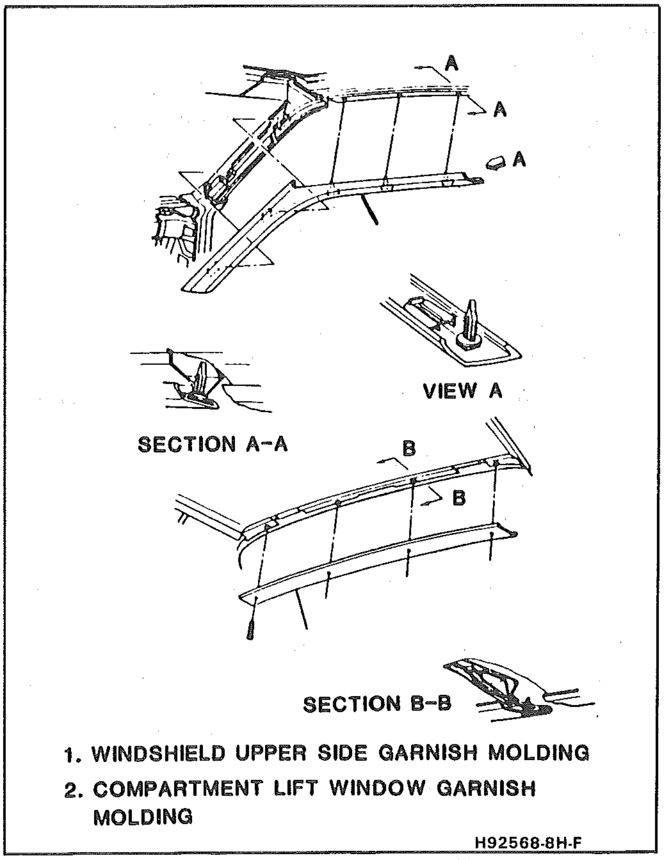


Fig. 3 - Interior Garnish Moldings

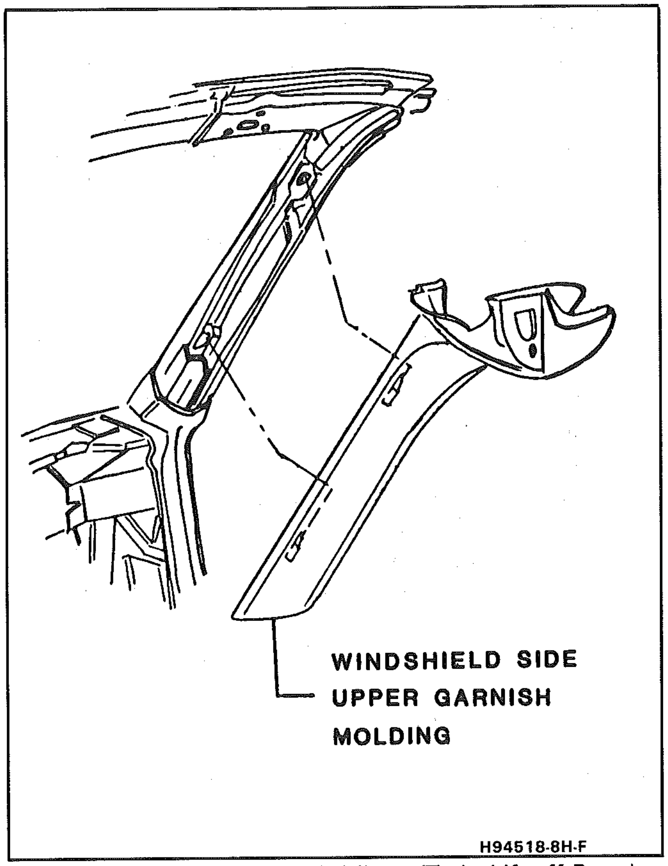


Fig. 4 - Interior Garnish Moldings (Twin Lift-off Panel Equipped Cars)

WINDSHIELD SIDE LOWER GARNISH MOLDING

Removal and Installation

1. Remove attaching screws in dash shroud and pinchweld flange.
2. Pull garnish molding downward to disengage it from windshield side upper garnish molding.
3. To install, position windshield side lower garnish molding to pinchweld flange and telescope upper end of molding into lower end of side upper garnish molding.
4. Position lower garnish molding upper flange to dash and lower flange to shroud.
5. Align holes in molding to holes or slots in pinchweld flange, dash and shroud; then, drive self-tapping screws to secure.

COMPARTMENT LIFT WINDOW OPENING GARNISH MOLDING

The compartment lift window opening garnish molding is installed with screws into the roof inner panel.

Removal and Installation

1. Remove attaching screws and pull downward on molding (Fig. 3, item 2).
2. To install, align holes in molding to slots in roof panel and drive screws to secure.

EXTERIOR ROOF MOLDINGS AND ATTACHMENTS

ROOF DRIP SCALP MOLDINGS

Removal and Installation (Fig. 5)

1. Remove screws holding roof drip molding to roof and remove molding.
2. Remove rear scalp molding by removing screws.
3. To install, reverse removal procedure and seal attaching screws.

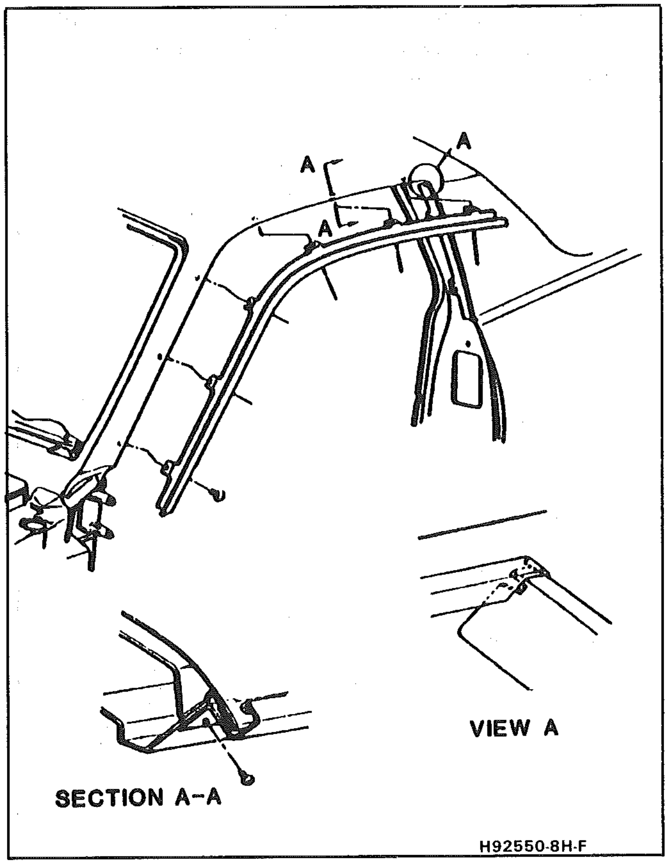


Fig. 5 - Roof Drip Molding

ROOF PANEL EMBLEMS

Roof panel emblems are the stick-on type. To remove, apply heat using a hot air gun, making certain gun is moved in a circular motion and held a minimum of 152 mm (6") from molding.

To install, wash affected area with detergent and water and wipe dry. Wipe panel and adhesive side of emblem with oil-free naphtha or alcohol. Use Loctite 414 adhesive (part no. 1052621) or equivalent and press emblem in place. Apply constant pressure to emblem for 30 seconds. Bonding starts immediately. Emblem cannot be repositioned after contact with the car.

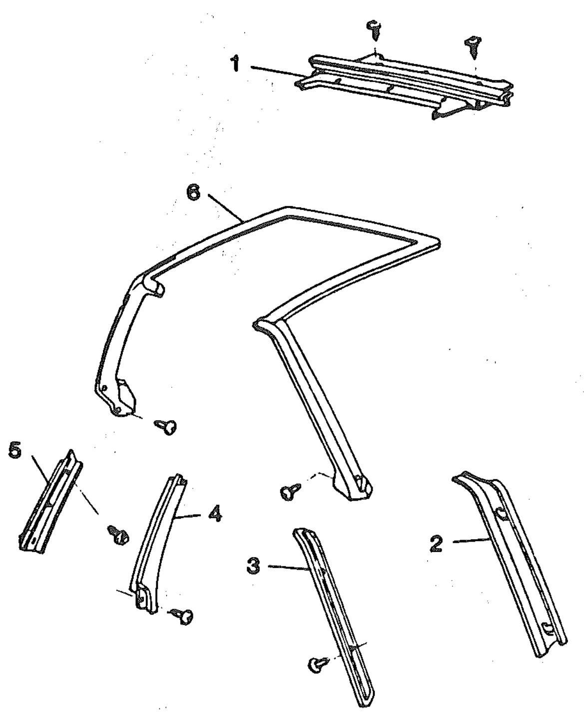
TWIN LIFT-OFF PANEL

The side roof mounted twin lift-off panels are manually operated. The panel glass is curved to match the contour of the roof and is made of tinted, tempered glass. The roof opening weatherstrips are of one-piece construction and are molded to the shape of the roof opening.

Removal and Installation

The twin lift-off glass panels can be removed and stored in two storage bags located in the rear compartment.

1. Remove glass panel by moving inward on the release handle.
2. Pivot entire glass upward slightly and pull outward to disengage glass panel from under center upper finishing molding.
3. Store glass panel(s) in storage bag(s).
4. To install, place edge of glass panel on top of weatherstrip lip, lift slightly and carefully insert glass under center upper finishing molding. Lower and latch in place.



1. CENTER FINISHING PANEL
2. WINDSHIELD PILLAR UPPER GARNISH MOLDING
3. WINDSHIELD PILLAR LIFT-OFF PANEL WEATHERSTRIP RETAINER
4. BODY LOCK PILLAR TRIM PANEL
5. BODY LOCK PILLAR WEATHERSTRIP RETAINER
6. LIFT-OFF PANEL OPENING WEATHERSTRIP

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Fig. 6 - Lift-off Panel Sealing

Glass Panel Assembly Installation

If a new glass panel is being installed, transfer lift-off trim panel cover, handle and attaching screw, glass panel weatherstrip and weatherstrip retainer, auxiliary sealing strip and latch assembly from original glass panel to new glass panel as a bench operation.

Lift-off Glass Panel Adjustments

The glass panel is adjustable within the roof opening. This adjustment can be made by loosening the striker assembly attaching bolts that adjust up and down travel of the glass panel assembly. In and out and fore and aft adjustment can also be made by loosening the support plate attaching nuts.

To obtain a flush fit of lift-off panel to roof, proceed as follows:

1. Disengage lift-off panel from roof.
2. Remove windshield pillar upper garnish molding (2, Fig. 6).
3. Remove body lock pillar upper trim panel (4).
4. Loosen retaining nuts securing front and rear support plates (9 and 11, Fig. 7).
5. Adjust front and rear striker assemblies (10 and 11) fore and aft as required.
6. Retighten nuts to 6 to 8 N·m (4.5 to 6 ft-lb).
7. Loosen retaining screws securing front and rear striker assemblies.
8. Adjust strikers up and down as required.
9. Retighten screws to 5 to 7 N·m (4 to 5 ft-lb).
10. Install glass assembly and check for proper fit.

LIFT-OFF PANEL WEATHERSTRIP

Removal (5, Fig. 7)

To remove the lift-off panel weatherstrip, proceed as follows:

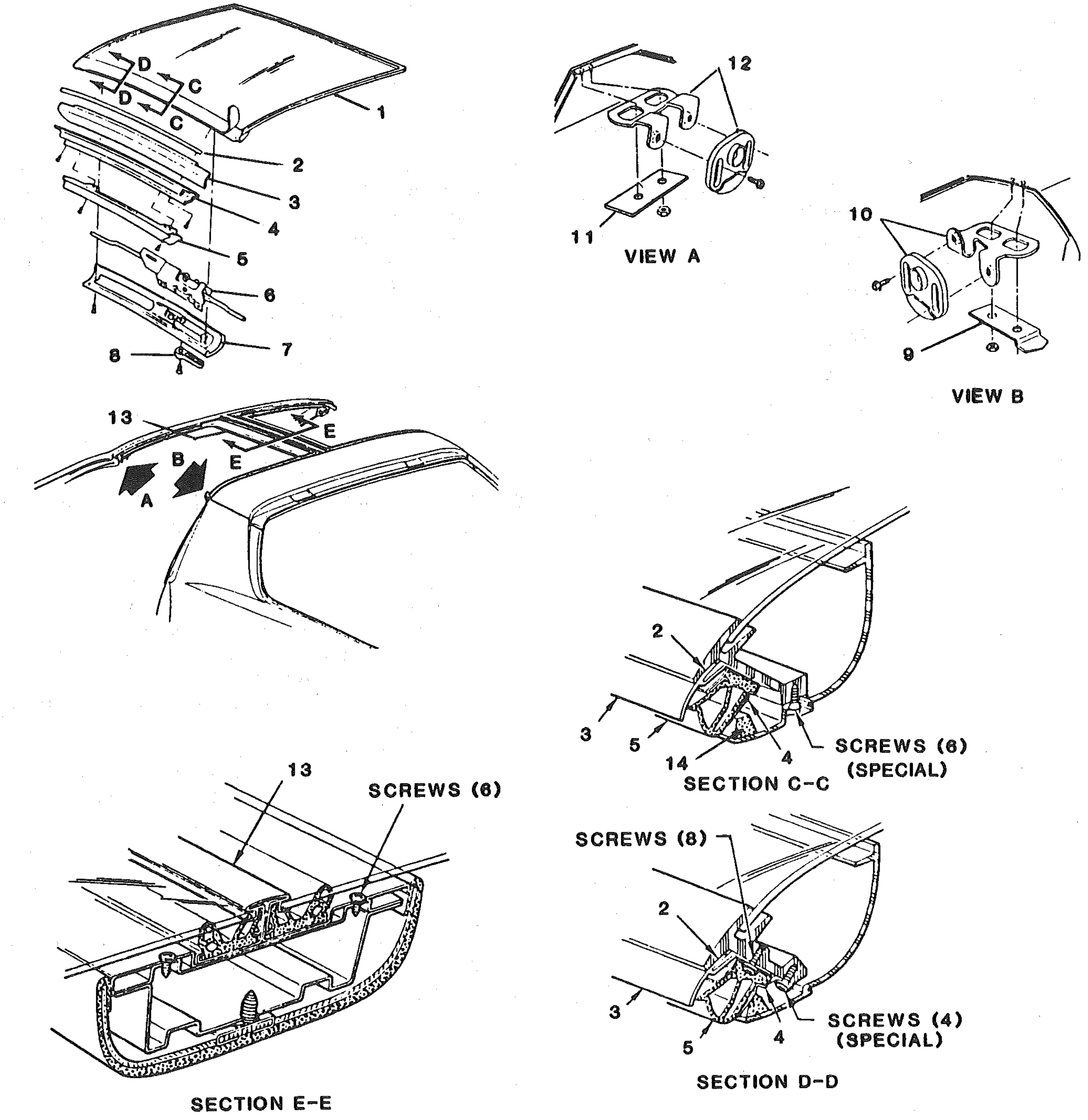
1. Disengage and remove lift-off panel and place upside down on a protected surface.
2. Remove handle and lift-off panel cover.
3. Remove screws holding tabs at each end of lift-off panel weatherstrip.

NOTICE: The following operation must be performed carefully to prevent damaging the lift-off panel weatherstrip.

4. Begin to remove weatherstrip from weatherstrip retainer by carefully pulling on weatherstrip while breaking sealer bond between weatherstrip and retainer with a flat-bladed tool (such as tool J-21104 or equivalent). A suitable release agent (Kent Special Release Agent or equivalent) or heat gun will aid in breaking the weatherstrip adhesive bond. Remove plastic tabs on weatherstrip through retainer slots.

Installation

1. Scrape excess sealer from weatherstrip retainer.
2. Apply a bead of black weatherstrip adhesive to weatherstrip retainer.
3. Insert weatherstrip plastic tabs into slots of weatherstrip retainer. Using a flat-bladed tool, close retainer lip around weatherstrip. Install attaching screw loosely.
4. Reinstall lift-off panel handle and engage lift-off panel to roof.
5. Align miter joints of weatherstrip at front and rear and tighten screws through holes in weatherstrip tab.



1. LIFT-OFF GLASS PANEL
2. SEALING STRIP TAPE
3. PANEL SEALING STRIP
4. WEATHERSTRIP RETAINER
5. LIFT-OFF PANEL WEATHERSTRIP
6. LATCH ASSEMBLY
7. TRIM COVER
8. LOCKING HANDLE
9. REAR SUPPORT PLATE
10. REAR STRIKER AND SUPPORT ASSEMBLY
11. FRONT SUPPORT PLATE
12. FRONT STRIKER AND SUPPORT ASSEMBLY
13. CENTER FINISHING PANEL
14. ANTI-RATTLE BUMPER

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Fig. 7 - Lift-off Panel Assembly

6. Remove handle and reinstall cover and handle to lift-off panel.

LIFT-OFF PANEL WEATHERSTRIP RETAINER

Removal and Installation (4, Fig. 7)

1. Disengage and remove lift-off panel.
2. Place lift-off panel upside down on a clean protected surface.
3. Remove handle and lift-off panel cover.
4. Remove lift-off panel weatherstrip.
5. Remove screws located along retainer and carefully lift up retainer using a flat-bladed tool.
6. To install, reverse removal procedure.

LIFT-OFF PANEL SEALING STRIP

Removal and Installation (3, Fig. 7)

1. Disengage and remove lift-off panel.
2. Place lift-off panel upside down on a clean protected surface.
3. Remove handle and lift-off panel cover.
4. Remove lift-off panel weatherstrip and weatherstrip retainer.
5. Remove sealing strip by pulling upward.
6. To install, reverse removal procedure.

LIFT-OFF PANEL LOCKING LATCH ASSEMBLY

Removal and Installation (6, Fig. 7)

1. Remove lift-off panel from body.
2. Remove handle.
3. Remove lift-off panel cover.
4. Remove weatherstrip and weatherstrip retainer.
5. Pull back sealing strip for access to latch attaching screws.
6. Remove attaching screws from retaining plates and remove latch assembly from lift-off panel.
7. To install, reverse removal procedure.

LIFT-OFF PANEL LOCK

Removal and Installation (Fig. 7)

1. Remove lift-off panel from body.
2. Remove handle.
3. Remove lift-off cover.
4. Drill out rivets from shield over lock and remove shield.
5. Remove clip securing rear of lock cylinder to latch assembly.
6. Remove clip at rear of lock cylinder securing locking pawl, separate pawl from lock and lift out lock.
7. To install, reverse removal procedure.

LIFT-OFF PANEL OPENING WEATHERSTRIP

Removal (Figs. 6 and 8)

The lift-off panel opening weatherstrip can be removed as follows:

1. Remove lift-off panel.
2. Remove plastic fasteners located at each end of lift-off panel opening weatherstrip using tool J-21104 or equivalent.

NOTICE: The following operation must be performed carefully to prevent damage to the weatherstrip.

3. Grasp weatherstrip and pull upward gently while inserting a flat-bladed tool between weatherstrip retainer and weatherstrip to break cement bond. Disengage weatherstrip front and rear retaining hooks that protrude from the weatherstrip and install through the vertical wall of the weatherstrip retainer. Using a suitable release agent (Kent Special Release Agent or equivalent) or heat gun will aid in breaking the weatherstrip adhesive bond.

Installation

1. Scrape excess sealer from weatherstrip retainer.
2. Apply a continuous bead of black weatherstrip adhesive to both sides of retainer channel and T-bar grooves.
3. Using a flat-bladed tool, engage the weatherstrip at the T-bar area and begin tucking in corners and top edges of weatherstrip, working around to the sides of the opening. Once the weatherstrip is located, the lift-off panel should be placed on top of the strip so that proper adjustments between the lift-off panel weatherstrip and the lift-off panel opening weatherstrip can be made, and also to allow for correct alignment between the retainer tab and the lift-off panel weatherstrip.
4. Install retainer tab attaching screw.
5. Insert lock pillar end of weatherstrip into retainer (starting at lift-off panel opening and working downward).
6. Insert windshield pillar end of weatherstrip into retainer (outboard edge first).
7. Replace lift-off panel.

LIFT-OFF GLASS PANEL CHANNEL

Disassembly (Fig. 9)

1. Place lift-off glass assembly on a clean, protected surface.
2. Using a single edge razor blade, cut the urethane material between the glass and glass channels as shown in Figure 9.
3. Place glass assembly upside down and with a razor blade cut the channels next to the channel lip as shown in Section A-A.
4. Grasp edge or end of channel and pull upward and/or outward to disengage channel from glass. Use of the razor blade may be needed to free channel sections from glass.
5. Remove excess urethane from glass with razor blade and clean glass surfaces with a glass cleaner.

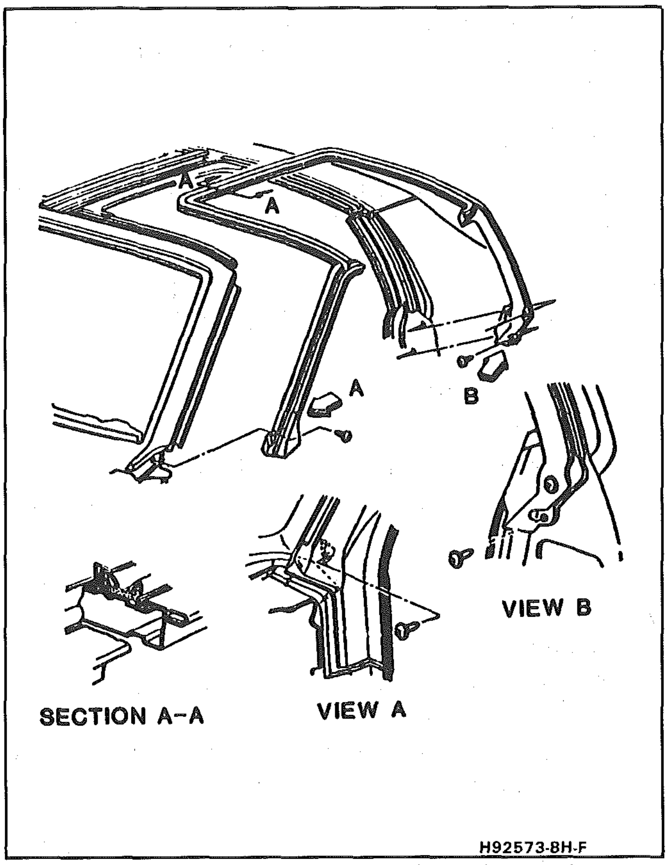


Fig. 8 - Lift-off Panel Opening Weatherstrip Installation

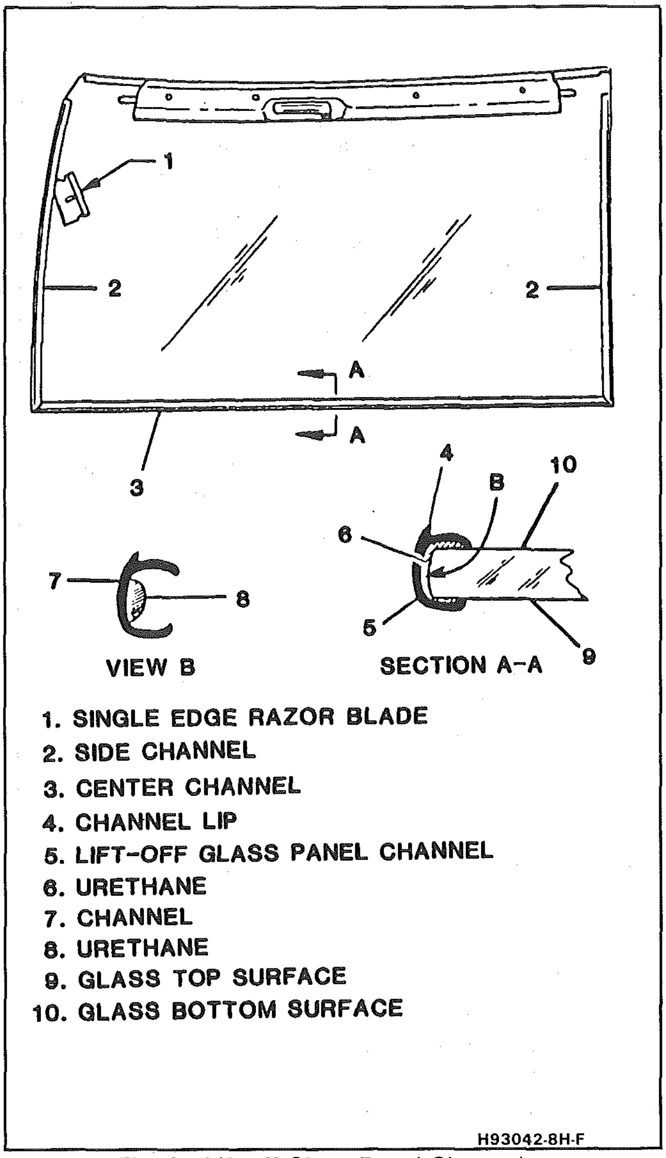


Fig. 9 - Lift-off Glass Panel Channel

Reassembly (Fig. 9)

1. Apply clear Silane Glass Primer (Essex #435.18) or equivalent to edges of glass and interior sides of channels.
2. Position new channels on glass and remove any excess material in the area of the glass and metal frame.
3. Remove channels and apply a small bead of urethane material into the interior of the channels.
4. Install long center channel over edge of glass (Section A-A) and press firmly into position.
5. Install side channels by first placing end of each channel against the end of the center channel, then over edge of glass making certain channel is under the metal frame before pressing channel firmly in position.
6. Place cloth-backed tape over channels to hold channels firmly in place. To reduce the urethane curing time, water can be applied to the channel installation.
7. Allow sufficient time for urethane to cure, trim off excess urethane and install lift-off panel assembly.

CENTER UPPER FINISHING MOLDING

Removal and Installation (Figs. 7 and 10)

The center upper finishing molding can be removed as follows.

1. Remove lift-off glass panels.
2. Remove both lift-off panel weatherstrips as previously described.
3. Remove center upper finishing molding assembly attaching screws and remove finishing molding.
4. To install, reverse removal procedure.

Be sure to seal around complete perimeter of center upper finishing molding to eliminate possible waterleaks.

CONVERTIBLE TOP - OPERATION

TO LOWER TOP

NOTICE: The vehicle must be parked on a level surface with trunk lid closed before lowering the top.

1. Set the parking brake and shift automatic transmission to "**PARK**" (Manual Transmission the "**REVERSE**").
2. Turn the ignition to "**RUN**" position.
3. Lower the side windows.
4. Unlock the rear seatback, and fold down.

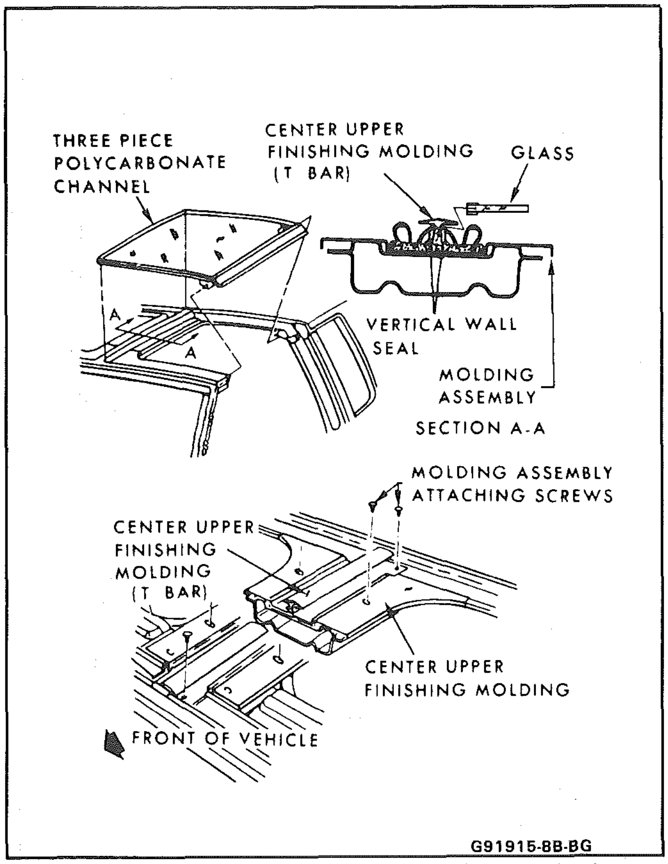


Fig. 10 - Center Upper Finishing Molding (T-bar)

5. Push the release lever located on the side of the tonneau panel to release the rear bow.
6. Raise the rear bow to its vertical position.
7. Press the tonneau panel release switch to release tonneau panel.
8. Raise the tonneau panel to its vertical position.
9. Lower the rear bow to its original position.

NOTICE: Before lowering the top, make sure there are no items in the top storage area.

10. Rotate each top latching handle outboard to release the top from the windshield header.
11. Grasp the front edge of the top header bow; lift upward and rearward.

NOTICE: Avoid jamming the convertible top bows against one another which could result in damage to the bows or top cover.

12. Push the No. 2 bow rearward and slowly bring the top rearward until it is all the way down.
13. Lower and latch the tonneau panel. Make sure the tonneau panel is latched securely by gently lifting up on both forward ends of the tonneau panel.

NOTICE: Do not sit or place excessive weight on the tonneau panel when the top is down. Damage to the tonneau panel may result.

14. Return the rear seatback to the upright position. Make sure it is locked by pushing forward and rearward on the top of the seatback.

TO RAISE TOP

NOTICE: The vehicle must be parked on a level surface with trunk lid closed.

1. Set the parking brake and shift automatic transmission to "**PARK**" (Manual Transmission to "**REVERSE**").
2. Turn the ignition to "**RUN**" position.
3. Lower the side windows.
4. Unlock the rear seatback, and fold it down.
5. Press the tonneau panel release switch to release tonneau panel.
6. Raise the tonneau panel to its vertical position.
7. Grasp the top header bow, lift and slowly raise the top.
8. Continue to raise the top until it is against the windshield header.
9. Press downward with the palm of your hand until the guide pins drop into the windshield header.
10. While holding the top in place, rotate each latching handle forward, securing the top the windshield header.
11. Raise the rear bow to its vertical position.
12. Lower the latch the tonneau panel. Make sure the tonneau panel is latched securely by gently lifting up on both forward ends of the tonneau panel.
13. Lower the rear bow and align the pin on the rear bow into the hole in the tonneau panel.
14. Pull the release lever located on the side of the tonneau panel to secure the rear bow.
15. Return the rear seatback(s) to the upright position. Make sure it is locked by pushing forward and rearward on the top of the seatback(s).

NOTICE: Do not sit or place excessive weight on the top when the top is in its up position. Damage to the top may result.

HEADER INNER GARNISH

Fig. 11

←→ Remove or Disconnect

1. Sunshades
2. Screw (3)
3. Header inner garnish (2)

→← Install or Connect

1. Header inner garnish
2. Screw (3)
3. Sunshades (4)

"A" PILLAR INNER GARNISH

Fig. 11

Remove or Disconnect

1. Screw (1)
2. "A" pillar inner garnish

Install or Connect

1. "A" pillar inner garnish
2. Screw (1)

HEADER "A" PILLAR SEAL

Figs. 11 and 12

Remove or Disconnect

1. Sunshades (4, Fig. 11)
2. Header inner garnish
3. Screws (1, Fig. 12)
4. Header "A" pillar seal (2). Grasp seal and pull upward gently while inserting a flat-bladed tool between seal retainer and seal to break cement bond. Using a suitable release agent or heat gun will aid in breaking the cement bond.

Install or Connect

1. Scrape excess sealer from seal retainer.
2. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent,to the retainer channel.
3. Header "A" pillar seal (2, Fig. 12) using a flat-bladed tool, engage seal into retainer.
4. Screws (1)
5. Header inner garnish (2, Fig. 11)
6. Sunshades

SIDE RAIL SEAL AND RETAINER

Fig. 13

Remove or Disconnect

1. Side rail seal using a suitable release agent or heat gun grasp seal and gently pull while inserting a flat-bladed tool between seal and seal retainer to break cement bond.
2. No. 1 bow garnish molding (see procedure).
3. Screws (2)
4. Side rail seal retainer

Install or Connect

1. Scrape excess sealer from seal retainer.
2. Side rail seal retainer.
3. Screws
4. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent, to the retainer channel.
5. Side rail seal using a flat-bladed tool, engage seal into retainer.
6. No. 1 bow garnish molding (see procedure).

MAIN PILLAR SEAL AND RETAINER

Fig. 13

Remove or Disconnect

1. Main pillar seal using a suitable release agent or heat gun, grasp seal and gently pull while inserting a flat-bladed tool between seal and seal retainer to break cement bond.
2. Screws (5)
3. Main pillar seal retainer

Install or Connect

1. Scrape excess sealer from seal retainer
2. Main pillar seal retainer
3. Screws (5)
4. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent, to the retainer channel.
5. Main pillar seal using a flat-bladed tool, engage seal into retainer

NO. 5 BOW SEAL

Fig. 13

Remove or Disconnect

1. Main pillar seal and retainer (see procedure).
2. Screws (8)
3. No. 5 bow seal using a suitable release agent or heat gun, grasp seal and gently pull while inserting a flat-bladed tool between seal and seal retainer to break cement bond.

Install or Connect

1. Scrape excess sealer from seal retainer.
2. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent, to the retainer channel.
3. No. 5 bow seal using a flat-bladed tool, engage seal into retainer.
4. Screws (8)
5. Main pillar seal and retainer (see procedure).

NO. 1 BOW GARNISH MOLDING

Fig. 14

Remove or Disconnect

1. Release and raise No. 5 bow to its full vertical position.
2. Release and raise tonneau panel to its full vertical position.
3. Lower the No. 5 bow to its original position.
4. Unlatch the top from the windshield header and lower the top halfway.
5. Screws (1)
6. No. 1 bow garnish by pulling garnish down over latch handles.

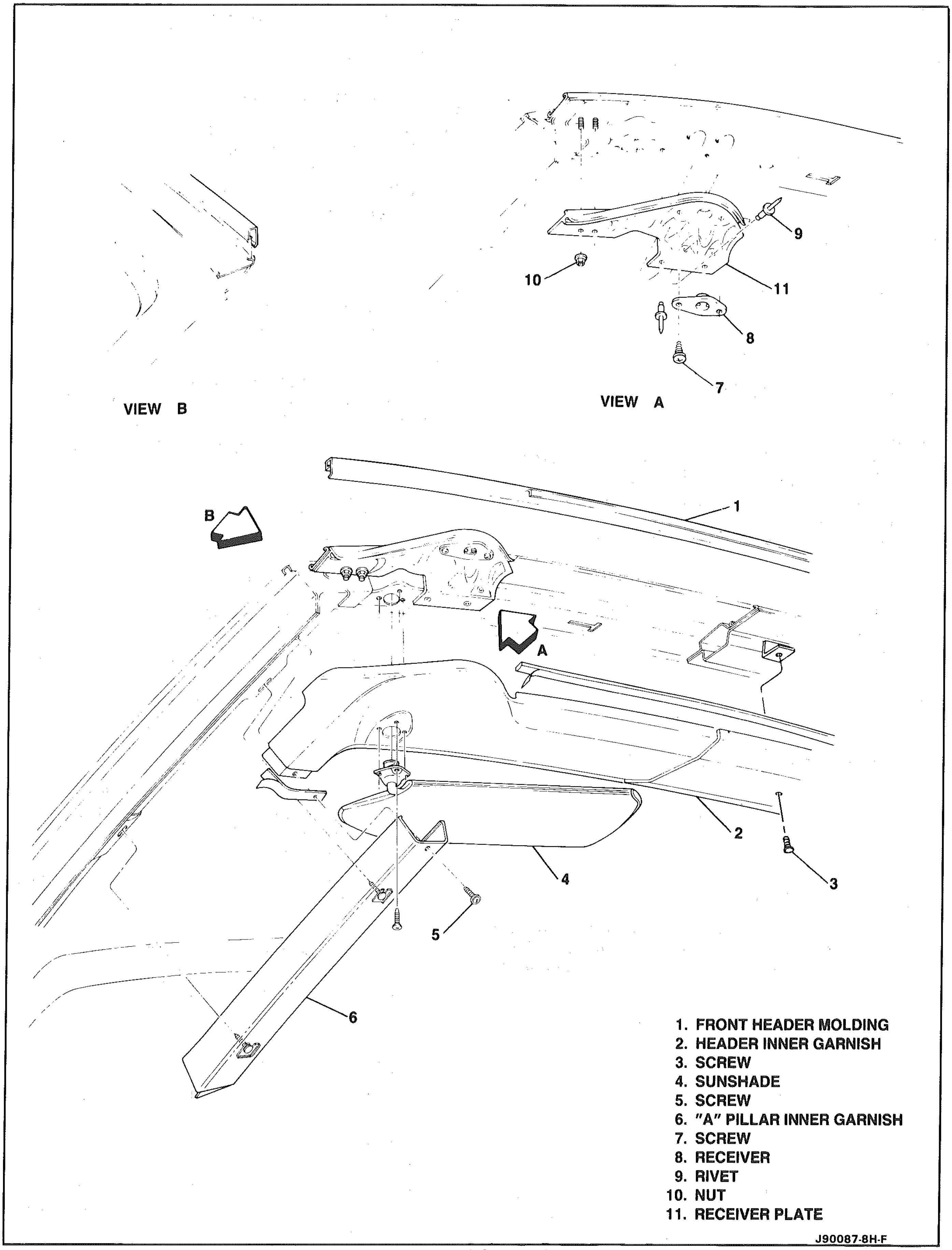


Fig. 11 Header and Garnish Molding

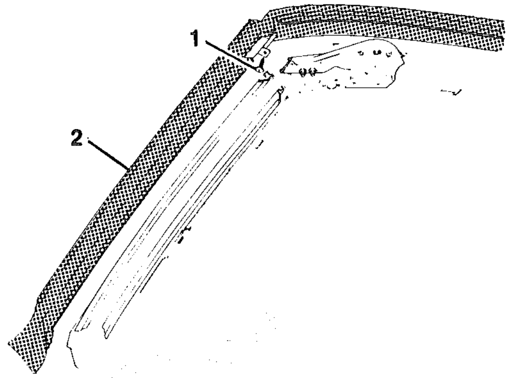


Fig. 12 "A" Pillar Sealer

Install or Connect

1. No. 1 bow garnish by sliding garnish over latch handles
2. Screws (1)
3. Latch top to windshield header
4. Raise NO. 5 bow to full vertical position.
5. Lower and latch tonneau panel
6. Lower and latch No. 5 bow to tonneau panel

TOP COVER ASSEMBLY

Figs. 13 through 16

Remove or Disconnect

1. Release and raise the No. 5 bow to its full vertical position.
2. Release and raise the tonneau panel to its full vertical position.
   Lower the No. 5 bow to its original position.
4. Unlatch the top from the windshield header and lower the top halfway.
5. Screws (1, Fig. 14)
6. No. 1 bow garnish by pulling garnish down over latch handles.
7. Screws (2, Fig. 13)
8. Side rail seal and retainer assemblies
9. Detach top cover and flaps from No. 1 bow.

Important

To aid in loosening top cover, heat can be applied with a hot air gun held about 25 mm (1") from top cover and rotated in a circular motion to avoid overheating.

10. Screws securing side retention cables
11. Screws (3)
12. No. 2 and No. 3 bow top cover retainers form listing pockets.
13. Main pillar seal using a suitable release agent (Kent Special Release Agent or equivalent or heat gun), grasp seal and gently pull while inserting a flat-bladed tool between seal and seal retainer to break cement bond.
14. Screws (5)
15. Main pillar seal retainer
16. Detach top cover quarter flaps from rear rails (5, Fig. 15).
17. Pull side retention cables from top cover side listing pockets.
18. Raise the top to the windshield header. Then raise the No. 5 bow to its full vertical position.
19. Screws (8, Fig. 13)
20. No. 5 bow seal using a suitable release agent grasp seal and gently pull while inserting a flat-bladed tool between seal and seal retainer to break cement bond.
21. Detach top cover form No. 5 bow.

Install or Connect

1. Position top cover to framework.
2. Insert No. 2 and No. 3 bow top cover retainers into top cover listing pockets.
3. Insert side retention cables into top cover side listing pockets. A length of welding rod can be used to pull cable through side listing pocket.
4. Raise top slightly off windshield header and attach side retention cables to No. 1 bow with screw.
5. Align No. 2 and No. 3 bow top cover retainers to No. 2 and No. 3 bows and secure with screws.
6. Latch top to windshield and align top cover quarter flaps to rear rails.
7. Apply adhesive such as Hughes HC-4183, 3M 8046 or equivalent to cementing area or rear rails and to corresponding surface of top cover quarter flaps.
8. Position and secure top cover quarter flaps to rear rails.
9. Raise No. 5 bow slightly and position top cover to No. 5 bow.
10. Aling top cover center notch with No. 5 bow latch pin.
11. Apply adhesive such as Hughes HC-4183, 3M 8046 or equivalent to cementing area of No. 5 bow and to corresponding surface of top cover.
12. Attach top cover to No. 5 bow, starting at center working toward each outboard end.
13. Trim off all excess top material along No. 5 bow seal channel.
14. Apply continuous bead of 3M Super Weatherstrip Adhesive, Part Number 08008 or equivalent to the channel of the No. 5 bow.
15. No. 5 bow seal using flat-bladed tool, engage seal into seal channel.
16. Screws (8)
17. Latch No. 5 bow to tonneau panel.
18. Pull top cover straight forward to seams over No. 1 bow to desired fullness.
19. While maintaining tension on top cover over top No. 1 bow make pencil mark on cover outer surface along forward edge of No. 1 bow.

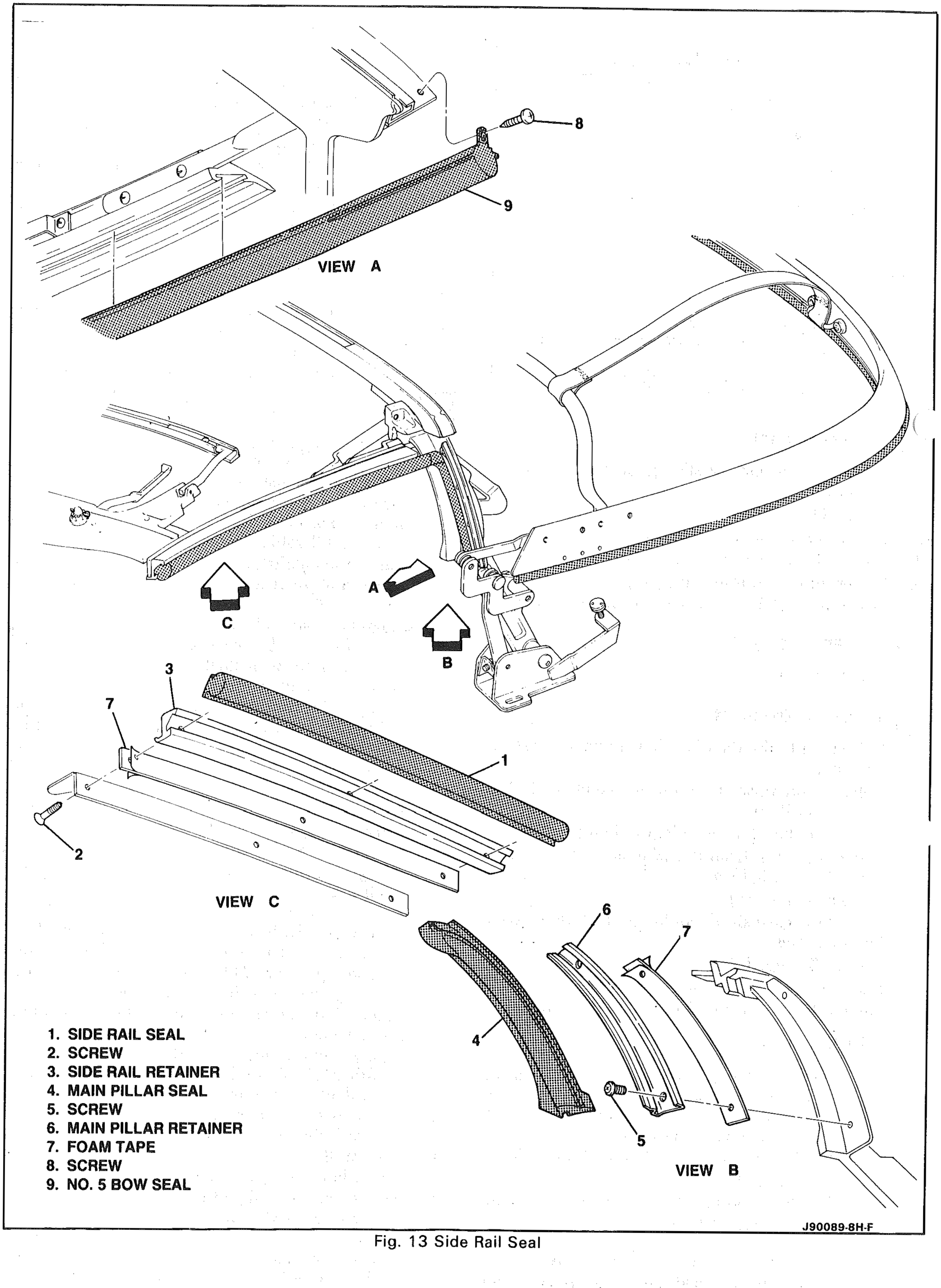
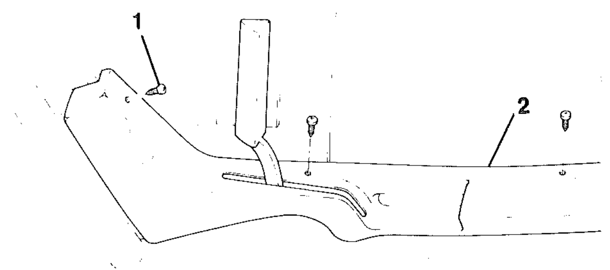


Fig. 13 Side Rail Seal



1. SCREW
2. NO. 1 BOW GARNISH MOLDING

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Fig. 14 No. 1 Bow Garnish Molding

20. Release and raise the tonneau panel to its full vertical position.
21. Release and raise the tonneau panel to its full vertical position.
22. Lower the No. 5 bow to its original position.
23. Unlatch the top from the windshield header and lower the top halfway.
24. Apply adhesive such as Hughes HC-4183, 3M 8046 or equivalent to cementing area of No. 1 bow and to corresponding surface of top cover and flaps.
25. Pull top cover 6 mm (1/4") past reference mark over No. 1 bow and secure top to No. 1 bow starting at center working toward outboard ends.
26. Raise and latch top to windshield header and latch No. 5 bow to tonneau panel. Check appearance of top cover, top opeation and latching effort to top. If additional tension is needed in top cover, repeat step 25 and pull top cover farther forward.
27. Trim off excess material along No. 1 bow.
28. Main pillar seal retainers.
29. Screws (5)
30. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent to the retainer channels.
31. Main pillar seals using a flat-bladed tool, engage seal into retainer.
32. Side rail seal and retainer assemblies
33. Screws (2)
34. No. 1 bow garnish by sliding garnish over latch handles.
35. Screws (1)

SIDE STAY PAD

Fig. 15

Remove or Disconnect

1. Top cover assembly
2. Tape over rivets
3. Rivets using 3.2 mm (1/8") drill bit.
4. Staples from No. 2 and No. 3 bows. Note location and spacing of staples before removal.
5. Rivet using 3.2 mm (1/8") drill bit.
6. Screws (11)
7. Rear stay pad and side stay pad from No. 4 bow by sliding off.

Install or Connect

1. Side stay pad and rear stay pad onto the No. 4 bow.
2. Screws
3. Rivet using 1/8" x 3/16" aluminum rivet.
4. Position side stay pad to No. 1 bow and install rivets using 1/8" x 3/16" aluminum rivets.
5. Tape (7)
6. With top latched to windshield header and No. 5 bow latched to tonneau panel, staple side stay pad to No. 2 and No. 3 bows using 5/16" x 5/16" stainless steel staples.
7. Top cover assembly (see procedure).

REAR STAY PAD

Fig. 17

Remove or Disconnect

1. Unlatch No. 5 bow and raise it to full vertical position.
2. Rivet using 3.2 mm (1/8") drill bit.
3. Screws (16)
4. Rear stay pad bracket
5. Screws (11)
6. Rear stay pad by sliding stay pad off the end of the No. 4 bow.

Install or Connect

1. Rear stay pad to No. 4 bow.
2. Screws (11)
3. Rear stay pad bracket
4. Screws (16)
5. Rivet using 1/8" x 3/16" aluminum rivet.
6. Lower No. 5 bow and latch it to the tonneau panel.

NO. 1 AND NO. 2 BOW ASSEMBLY

Figs. 13 through 17

Remove or Disconnect

1. Lower side windows
2. Unlock and fold down rear seatback.
3. Release No. 5 bow from tonneau panel, by pushing release lever located on the side of tonneau panel.
4. Raise No. 5 bow to full vertical position.
5. Release tonneau panel by pressing the tonneau release switch and raise tonneau panel to full vertical position.
6. Lower No. 5 bow to its original position.
7. Unlatch to top and lower it halfway.
8. Screws (1, Fig. 14)
9. No. 1 bow garnish by pulling garnish down over latch handles.
10. Screws (2, Fig. 13)
11. Side rail seal and retainer assemblies

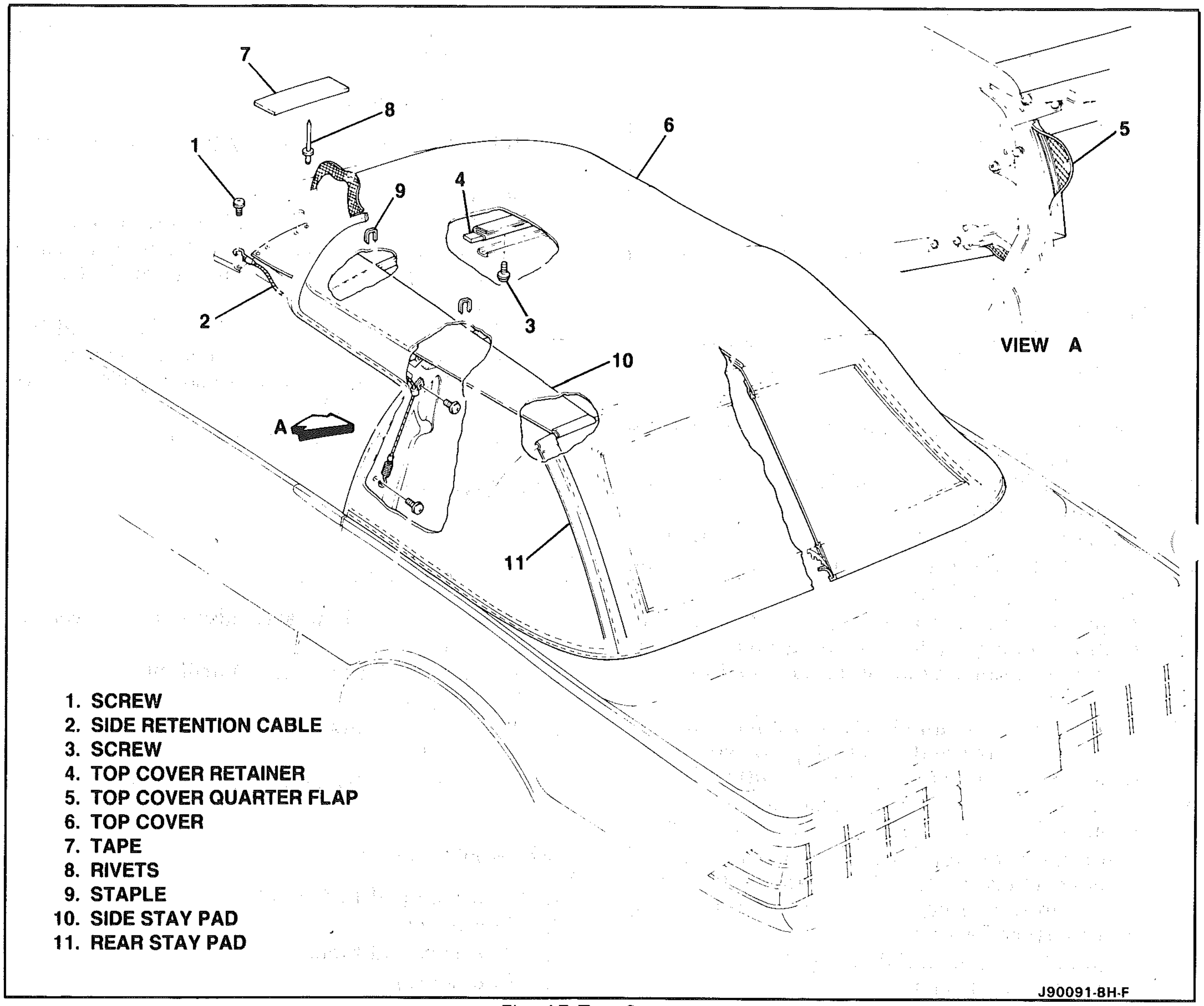


Fig. 15 Top Cover

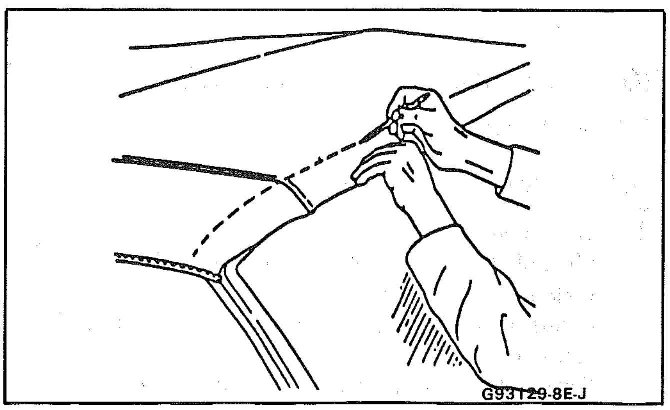


Fig. 16 Marking Top Cover Forward Edge

12. Screws (3, Fig. 15)
13. No. 2 bow top cover retainer from listing pocket.
14. Detach top cover and flaps from No. 1 bow.

Important

To aid in loosening top cover heat can be applied with a hot air gun held about 25 mm (1") from top cover and rotated in a circu motion to avoid overheating.

15. Screw securing side retention cables.
16. Side stay pads from No. 1 bow. Using a 3.2 mm (1/8") drill bit, drill out rivets.
17. Side stay pads from No. 2 bow. Note location and spacing of staples before removal.
18. Bolts (6, Fig. 17)
19. Bolts (5)
20. No. 1 and No. 2 bow assembly

Install or Connect

1. No. 1 and No. 2 bow assembly
2. Bolts (5)
3. Bolts (6)
4. Side stay pad to No. 1 bow. Using 1/8" x 3/8" aluminum rivets
5. Latch top to windshield header and staple side stay pads to No. 2 bow. Using 5/16" x 5/16" stainless steel staples

6. Lower top halfway and fold top cover back over No. 1 bow. Secure side retention cables to No. 1 bow with screw
7. Top cover retainer into listing pocket and align top cover retainer to No. 2 bow.
8. Screws (3)
9. Apply adhesive such as Hughes HC-4183, 3M 8046 or equivalent to cementing area of No. 1 bow and to corresponding surface of top cover and flaps.
10. Align and attach flaps and top cover to No. 1 bow.
11. Side rail seal and retainer assemblies with screws
12. No. 1 bow garnish by sliding garnish over latch handles.
13. Screws (1)
14. Latch the top to the windshield header
15. Raise No. 5 bow to full vertical position.
16. Lower and latch tonneau panel
17. Lower No. 5 bow and engage the pin into the latching hole on the tonneau panel.
18. Secure the No. 5 bow to tonneau by pulling the release lever, located on the side of the tonneau panel.

NO. 3 BOW

Figs. 15 and 17

←→ Remove or Disconnect

1. Unlatch No. 5 bow and raise it to full vertical position.
2. Screws retaining No. 3 bow top cover retainer.
3. Screws retaining rear stay pad brackets to No. 5 bow.
4. Pull No. 4 bow rearward and fold top cover forward over the No. 3 bow.
5. Mark location of No. 3 bow (forward and rearward edges) on the side stay pads, using a sharpened grease pencil.
6. Side stay pads from No. 3 bow. Note location and spacing of staples before removal.
7. Screws (8, Fig. 17)
8. No. 3 bow

→← Install or Connect

1. No. 3 bow
2. Screws (7, Fig. 17)
3. Side stay pads to No. 3 bow according to reference marks. Using 5/16" x 5/16" stainless steel staples.
4. Rear stay pad and brackets to No. 5 bow with screws
5. Fold top cover rearward back over No. 3 bow and align top cover retainer and listing pocket with No. 3 bow.
6. Screws (3, Fig. 15)
7. Lower No. 5 bow and latch it to the tonneau panel.

NO. 4 BOW

Fig. 17

←→ Remove or Disconnect

1. Unlatch No. 5 bow and raise it to full vertical position.
2. River using 3.2 mm (1/8") drill bit.
3. Screws (11)
4. No. 4 bow by sliding rear and side stay pads off the No. 4 bow.

→← Install or Connect

1. No. 4 bow by sliding rear and side stay pads onto the No. 4 bow.
2. Screws (11)
3. Rivets using 1/8" x 3/16" aluminum rivets.
4. Lower No. 5 bow and latch it to the tonneau panel.

NO. 5 BOW

Fig. 13

←→ Remove or Disconnect

1. Main pillar seal and retainer (see procedure).
2. Screws attaching seal to rear rail
3. Unlatch No. 5 bow and raise it to full vertical position.
4. No. 5 bow seal using a flat-bladed tool (such as J-21104 or equivalent, a suitable release agent or heat gun will aid in breaking the seal adhesive bond. Carefully pull on seal while inserting tool between seal and retainer to break adhesive bond.
5. Detach top cover form No. 5 bow.

   ! Important

   To aid in loosening top cover heat can be applied with a hot air gun held about 25 mm (1") from top cover and rotated in a circular motion to avoid overheating.
6. Screws and rear stay pad bracket
7. Screws and No. 4 bow
8. Screws (13)
9. No. 5 bow

→← Install or Connect

1. No. 5 bow
2. Screws (13)
3. Inspect to make sure No. 5 bow latching pin is properly aligned to latching lock on tonneau panel.
4. Adjust No. 5 bow to tonneau cover as required.
5. Screws (13)
6. No. 4 bow
7. Screws (11)
8. Rear stay pad brackets with rear stay pads
9. Screws (16)
10. Raise and position rear edge of top cover to No. 5 bow.

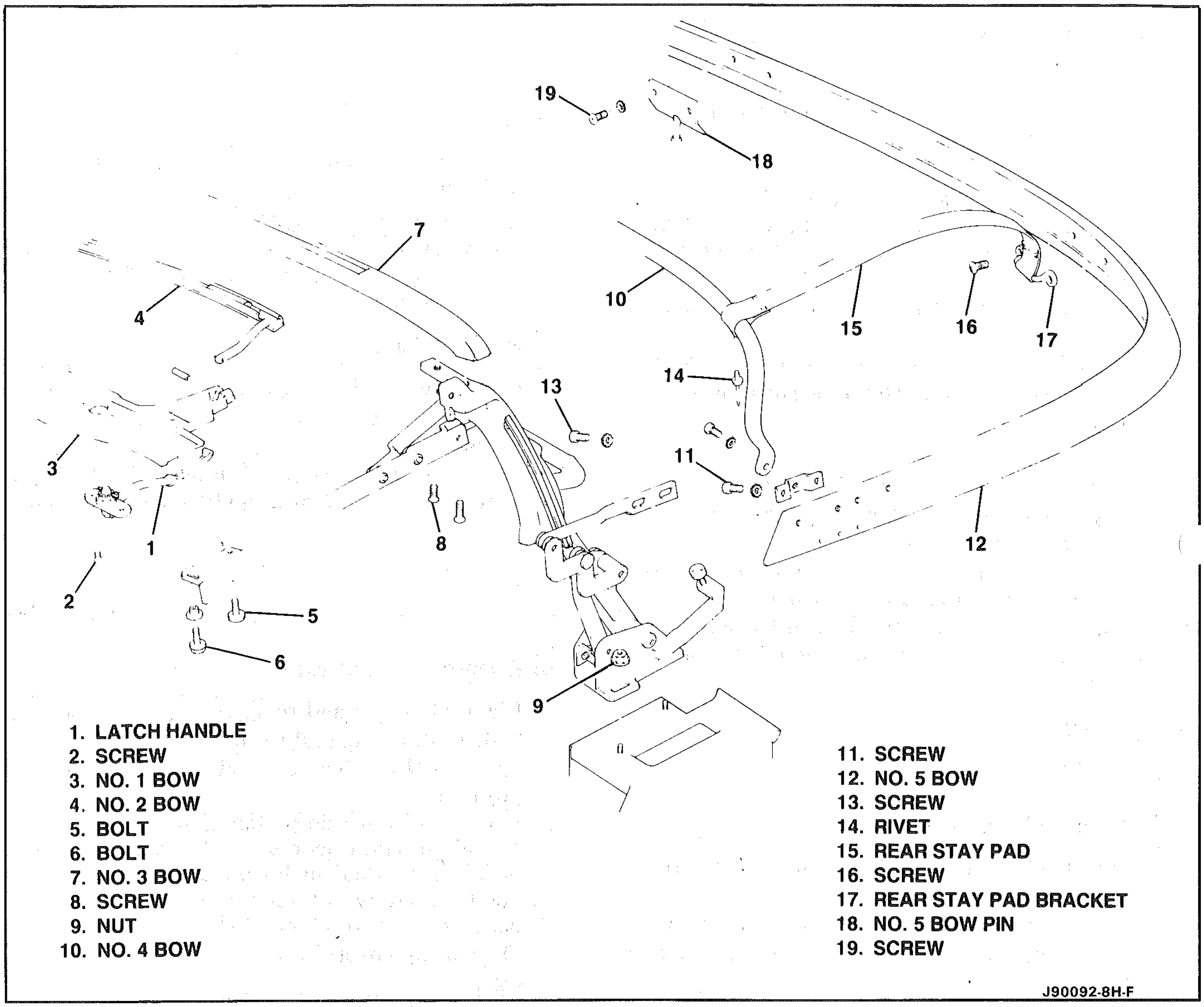


Fig. 17 Top Stack

11. Apply adhesive such as Hughes HC-4183, 3M 8046 or equivalent to cementing area of No. 5 bow, to corresponding surface of top cover.
12. Position and secure top cover to No. 5 bow, starting at center working toward outboard ends.
13. Scrape excess adhesive from the channel of the No. 5 bow.
14. Apply continuous bead of 3M Super Weatherstrip Adhesive, part number 08008 or equivalent to the channel of the No. 5 bow.
15. No. 5 bow seal using a flat-bladed tool, engage seal into seal channel.
16. Screws attaching seal to rear rail.
17. Lower No. 5 bow and latch it to the tonneau panel.
18. Main pillar seal and retainer (see procedure)

TOP STACK ASSEMBLY COMPLETE

Fig. 17

Remove or Disconnect

1. Release and raise No. 5 bow to its full vertical position.
2. Release and raise tonneau panel to its full vertical position.
3. Nuts (9)
4. Unlatch the top from the windshield header.
5. With aid of helper, lift the complete top stack assembly from car.

Install or Connect

1. Position the top stack assembly to body
2. Latch top to windshield header
3. Nuts (9)
4. Lower and latch tonneau panel then lower and latch No. 5 bow

Inspect

Top stack assembly fit to body.

Adjust

Top stack as necessary by loosening nuts and shifting top stack

6. Tighten nuts to 10 N·m (13 ft-lbs)

QUARTER INNER UPPER TRIM CAP

Fig. 18

Remove or Disconnect

1. Lower top completely.
2. Screws (2)
3. Quarter inner upper trim cap and bezel

Install or Connect

.. Quarter inner upper trim cap and bezel
2. Screws (2)

QUARTER TRIM PANEL

Fig. 18

Remove or Disconnect

1. Rear seat cushion
2. Sill plate and carpet retainer
3. Quiarter inner upper trim cap
4. Lock pillar finish molding
5. Screws
6. Pull quarter trim panel out and disconnect speaker wire connector
7. Push seat belt through slot in trim panel
8. Quarter trim panel

Install or Connect

.. Position quarter trim panel to body. Thread seat belt through slot in trim panel and connect wire connector to speaker.
2. Screws
3. Lock pillar finish molding
4. Quarter inner upper tirm cap
5. Sill plate and carpet retainer
6. Rear seat cushion

QUARTER CAP BELT MOLDING

Fig. 19

The quarter cap belt moldings are attached to the body by screws and adhesive tape shown in Figure 19. The quarter cap belt molding can be removed from the body with the use of a hot air gun to break the adhesive tape bond.

Important

When removing or installing quarter cap belt molding, care should be exercised.

- Adjacent finishes should be protected to prevent damage to finish.
- Proper tools and care should be used to guard against molding damage.

Remove or Disconnect

1. Quarter inner upper trim cap
2. Screws (1)
3. Quarter cap belt molding using hot air gun held about 300 mm (12") from the surface. Apply heat in a circular motion and carefully lift the molding from the body surface.

Clean

- Wash quarter panel area with soap and water and wipe dry.
- Wipe quarter panel and adhesive side of molding with a clean rag using oil-free Naptha or alcohol to remove all traces of adhesive tape from quarter panel and back side of molding.

Install or Connect

1. Apply a double-coated adhesive tape such as 3M Super Automotive Attachment Tape (Part Number 4210) or equivalent to the molding.
2. Quarter cap belt molding warm quarter panel with heat lamp or heat gun about 21°C (70°F). Align molding and press firmly in place.
3. Screws (1)
4. Quarter inner trim cap (see procedure)

TONNEAU PANEL LATCH

Fig. 20

Remove or Disconnect

1. Quarter trim panel (see procedure)
2. Cable (1)
3. Screws (3)
4. Latch (4)

Install or Connect

1. Latch (4)
2. Screws (3)
3. Cable (1)
4. Quarter trim panel (see procedure)

Important

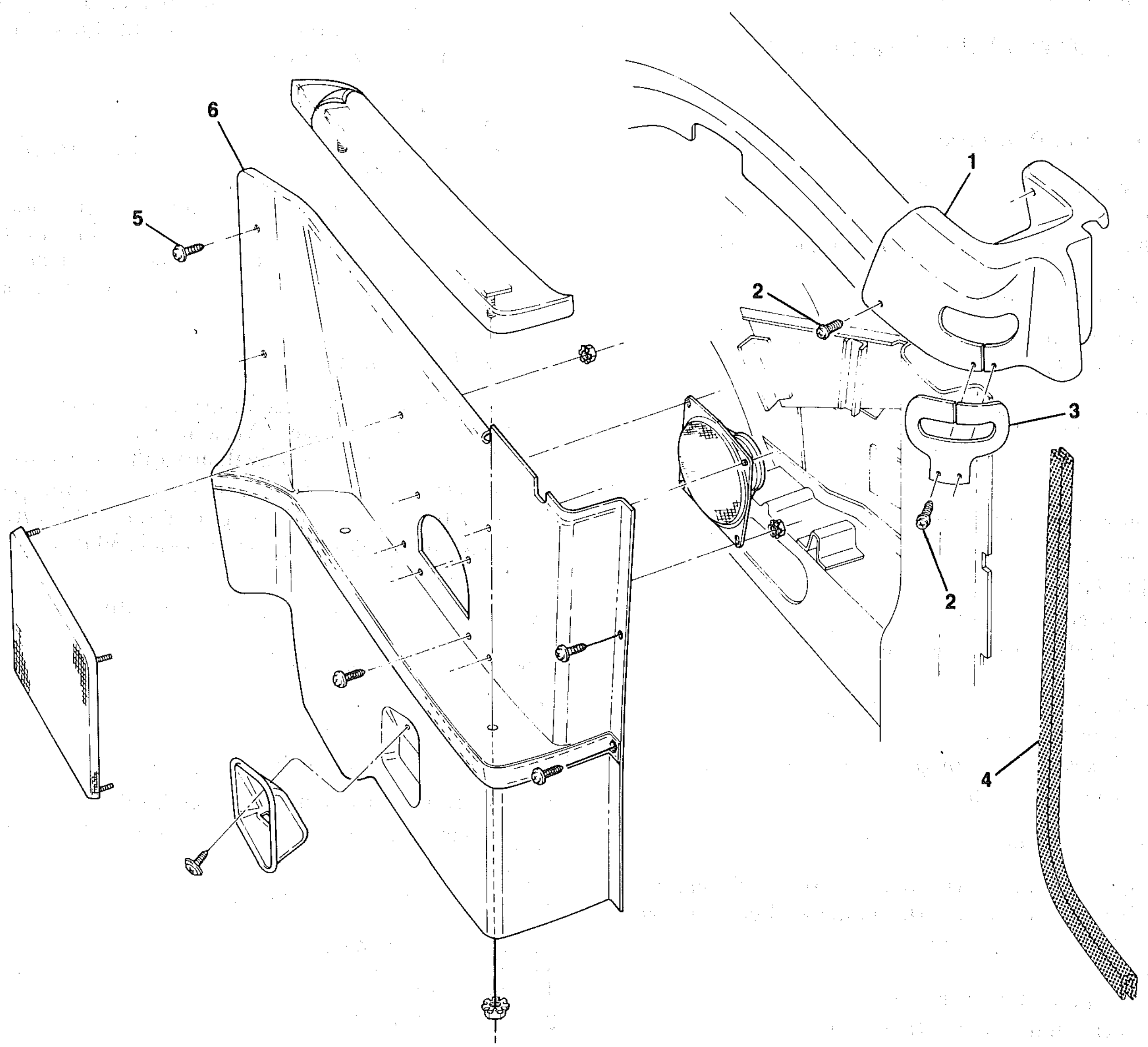
Latch as required and retighen screws.

TONNEAU RELEASE SOLENOID

Fig. 20

Remove or Disconnect

1. Quarter trim panel (see procedure)
2. Cable from latch p
3. Wire connector (6)
4. Screws (7)
5. Solenoid (8)



1. QUARTER INNER UPPER TRIM CAP
2. SCREW
3. SEAT BELT BEZEL
4. LOCK PILLAR FINISH MOLDING
5. SCREW
6. QUARTER TRIM PANEL

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Fig. 18 Quarter Inner Upper Trim

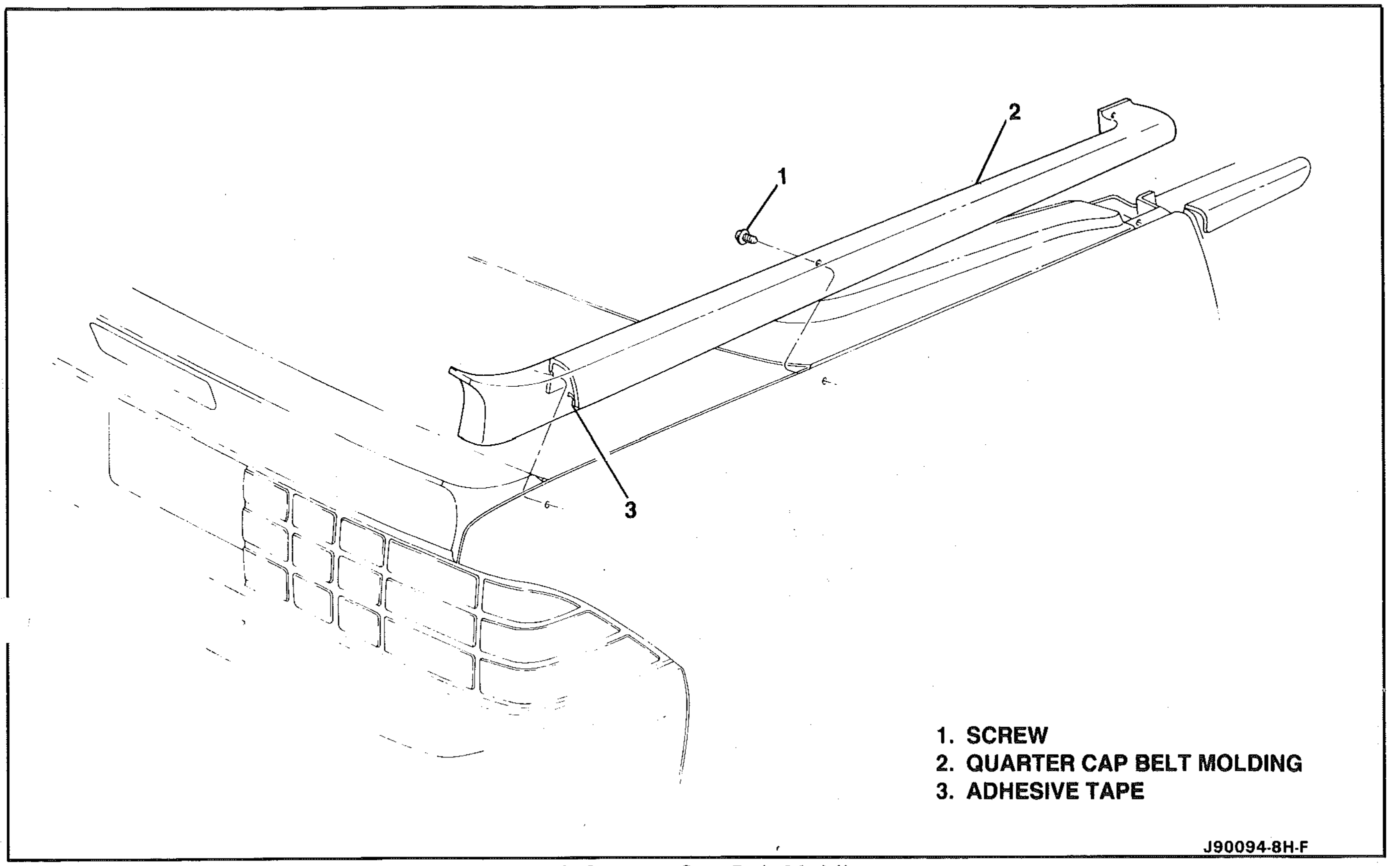


Fig. 19 Quarter Cap Belt Molding

Install or Connect

1. Solenoid (8)
2. Screws (7)
3. Cable to latch (6)
4. Wire connector
5. Quarter trim panel (see procedure)

O. 5 BOW RELEASE HANDLE

Fig. 21

Remove or Disconnect

1. Release and raise No. 5 bow to its full vertical position.
2. Release and raise tonneau panel to its full vertical position.
3. Rod from No. 5 bow release handle
4. Screws (2)
5. No. 5 bow release handle

Install or Connect

1. No. 5 bow release handle
2. Screws (2)
3. Rod to No. 5 bow release handle
4. Lower and latch tonneau panel
5. Lower and latch No. 5 bow to tonneau panel

NO. 5 BOW LATCH

Fig. 21

Remove or Disconnect

1. Release and raise No. 5 bow to its full vertical position.
2. Release and raise tonneau panel to its full vertical position.
3. Rod from No. 5 bow release handle
4. Nuts (4)
5. No. 5 bow latch

Install or Connect

1. No. 5 bow latch
2. Nuts (4)
3. Rod to No. 5 bow release handle
4. Lower and latch tonneau panel
5. Lower and latch No. 5 bow to tonneau panel

TONNEAU PANEL

Fig. 21

Remove or Disconnect

1. Place protective coverings along adjacent body panels.
2. Nuts (10)
3. Tonneau panel with aid of helper.

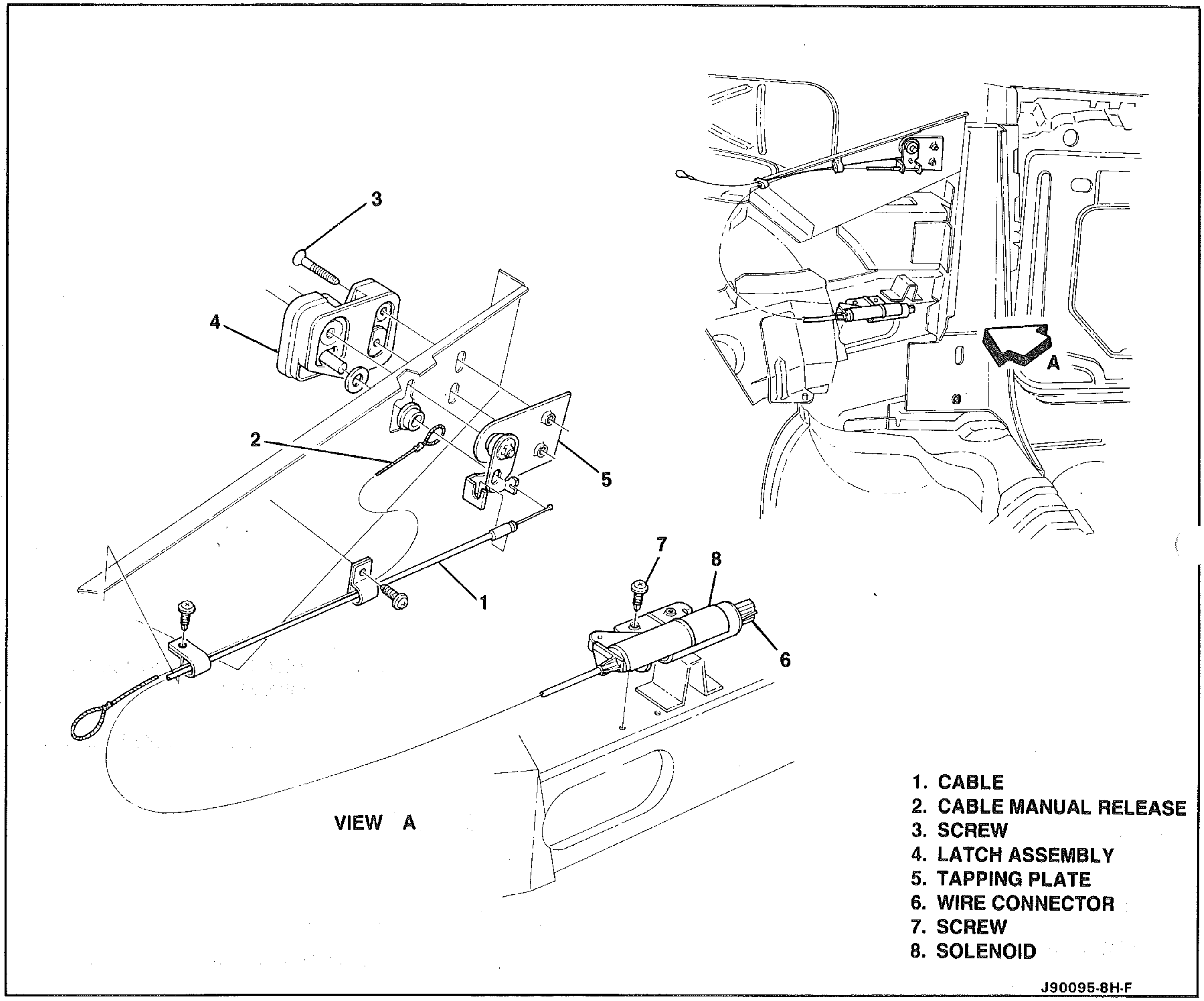


Fig. 20 Tonneau Panel Latch

Install or Connect

1. Tonneau panel to hinge.
2. Nuts (10)

Adjust Front to Rear

1. Loosen bolts, hinge to tonneau panel.
2. Align as necessary.
3. Tighten nuts, hinge to tonneau panel.

Adjust Up and Down at Front Corners

1. Remove quarter trim panel (see Section 6H).
2. Loosen bolts, tonneau panel latch to body.
3. Latch as necessary.
4. Tighten screws.
5. Install quarter trim panel (see Section 6H).

TONNEAU PANEL SEAL

Fig. 21

Remove or Disconnect

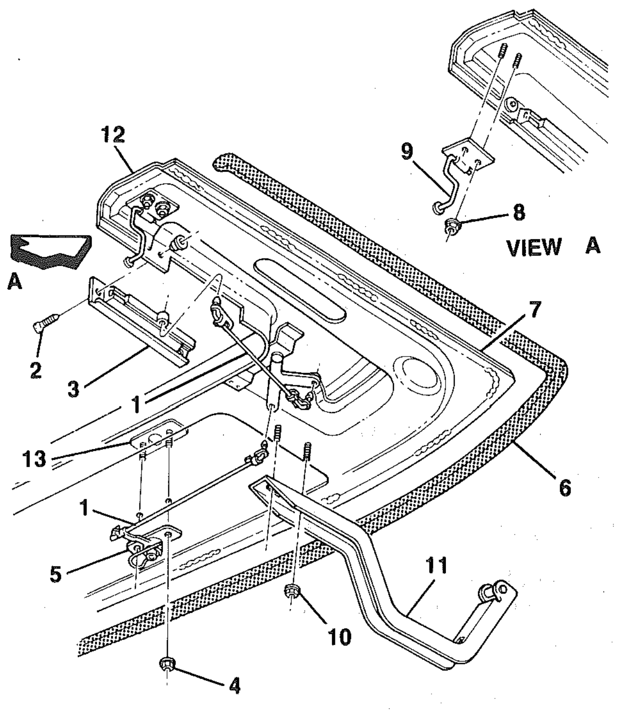
1. Raise tonneau panel.
2. Grasp seal and carefully pull on seal to remove.

Inspect

All adhesive from tonneau panel.

Install or Connect

1. Apply a double-coated adhesive tape such as 3M Scotch Adhesive Transfer Tape (Part Number 06494) or equivalent to the seal.
2. Tanneau panel seal



1. ROD
2. SCREW
3. NO. 5 BOW RELEASE HANDLE
4. NUT
5. NO. 5 BOW LATCH
6. TONNEAU PANEL SEAL
7. TONNEAU PANEL
8. NUTS
9. STRIKER
10. NUT
11. HINGE
12. APPLIQUE ASSEMBLY
13. NO. 5 BOW RECEIVER PLATE

J90096-8H-F

Fig. 21 No. 5 Bow Release

DECK LID SPOILER

Fig. 22

Remove or Disconnect

1. Nuts (1)
2. Deck lid spoiler

Install or Connect

Important

Care should be exercised to prevent waterleaks in the rear compartment area when sealing surfaces are disturbed. Holes in the deck lid panel for mounting studs that would permit water entry into the rear compartment must be sealed with a presealed washer or body caulking compound.

1. Deck lid spoiler
2. Nuts (1)

Inspect

To make sure deck lid spoiler is properly aligned from side to side and fore and aft to quarter cap belt moldings.

Adjust

Spoiler to quarter cap belt moldings as required.

3. Nuts to 6 N·m (4 ft-lbs)

CENTER HIGH MOUNTED STOP LAMP

Fig. 22

Remove or Disconnect

1. Screws (3)
2. Wire harness connector
3. Lamp

Install or Connect

1. Wire harness connector
2. Lamp
3. Screws (3)

DECK LID

Fig. 23

The deck lid consists of an inner and outer panel that is hemmed around the perimeter and bonded together with structural adhesive. Opening assist is performed by the use of gas support assemblies.

Remove or Disconnect

1. Prop lid open and place protective covering along edges of deck lid to prevent damage to painted surfaces.
2. Gas support assemblies by disengaging lid and body side retaining clips from ends of gas support assemblies.

CAUTION: Do not attempt to remove or loosen gas support assemblies attachments with deck lid in any position other than fully open as personal injury may result.

3. Bolts (2)
4. Deck lid with aid of helper

Install or Connect

1. Deck lid to hinges with aid of helper.
2. Bolts (2)
3. Gas support assemblies

Adjust

Front to rear, side to side, up and down and rotated adjustments.

1. Loosen bolts (2)
2. Align as necessary
3. Tighten bolts (2)

Up and down adjustment at rear corners.

1. Loosen rubber bumper to raise.

2. Tighten rubber bumper to lower.

DECK LID PANEL SEAL

Fig. 23

Remove or Disconnect

Grasp seal and carefully pull up on seal to remove from pincheweld flange.

Clean

All adhesive from pinchweld flange.

Install or Connect

1. Apply a 3 mm (1/8") bead of weatherstrip adhesive 2 mm (5/64") below top on pinchweld flange, around the complete perimeter of rear compartment opening.
2. Starting at top forward center of opening, install seal to flange making sure seal is fully seated to flange.

DOOR CAP BELT MOLDING

Fig. 24

The door cap belt moldings are attached by stud and barrel nut retainers.

Important

When removing or installing any door cap belt molding, care should be exercised.

- Adjacent finishes should be protected to prevent damage to finish.
- Proper tools and care should be used to guard against molding damage.

FRONT BELT RETRACTOR ASSEMBLY

Fig. 25

Remove or Disconnect

Tools Required:

J-23457 or BT-1707 seat belt anchor bolt and lock striker removing tool.

1. Rear seat cushion
2. Quarter trim panel
3. Bolt securing lap belt retractor
4. Bolt securing shoulder belt "D" ring
5. Bolt securing shoulder belt retractor

Install or Connect

Reverse of removal procedure and torque bolts as required.

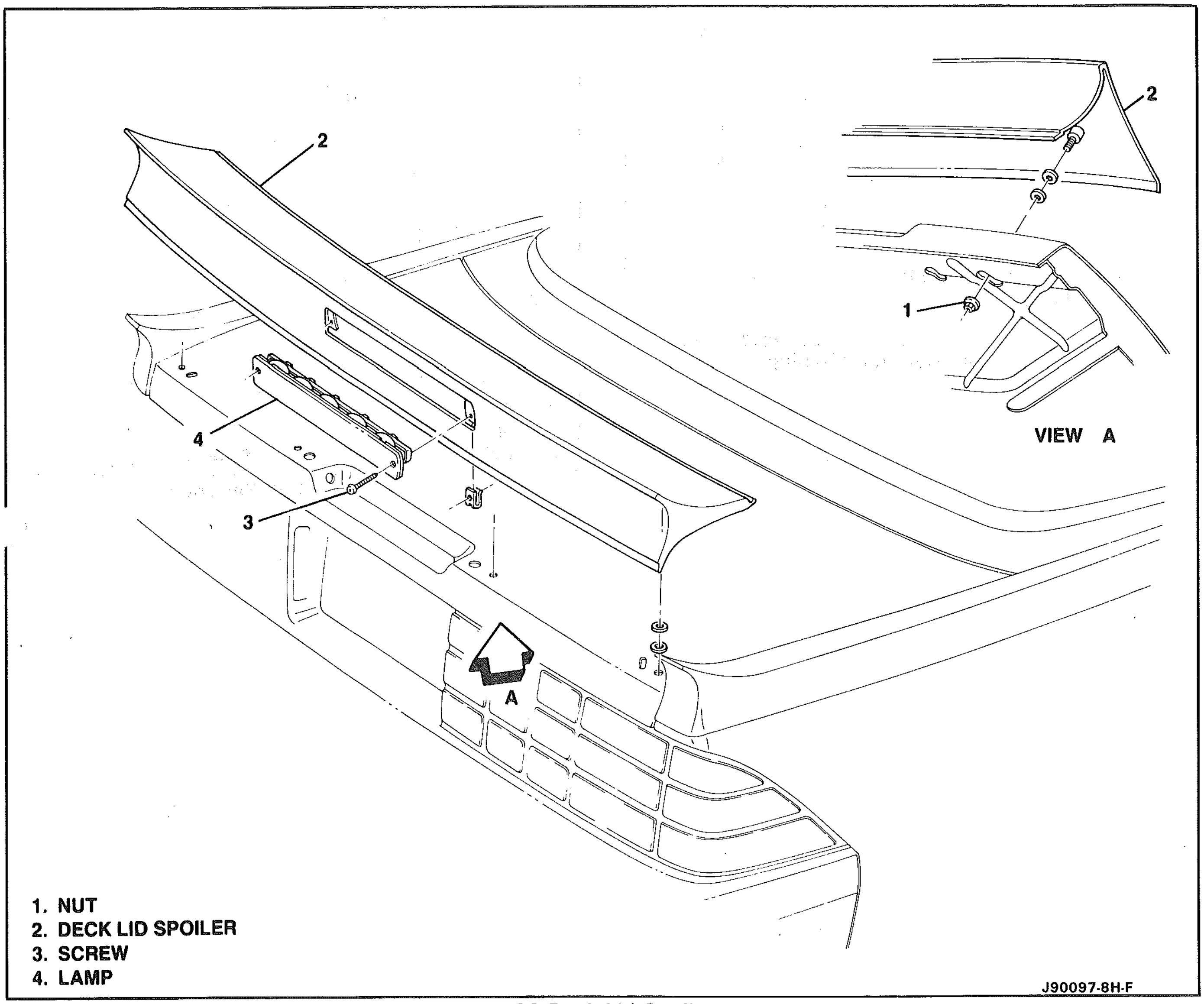


Fig. 22 Deck Lid Spoiler

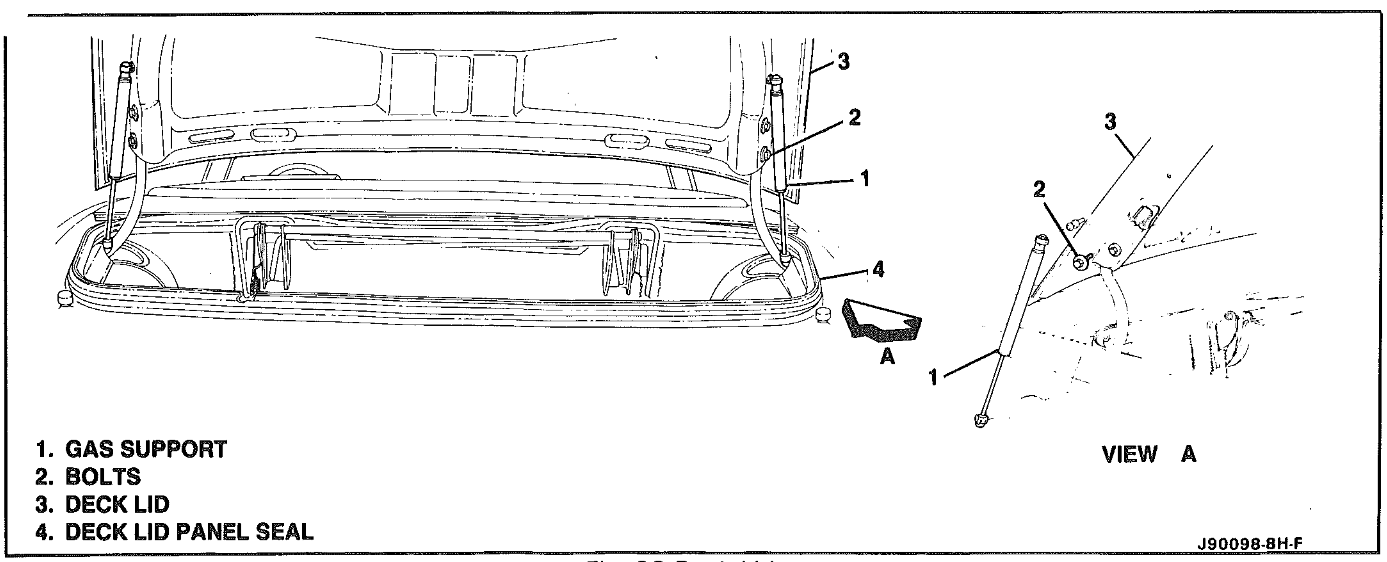


Fig. 23 Deck Lid

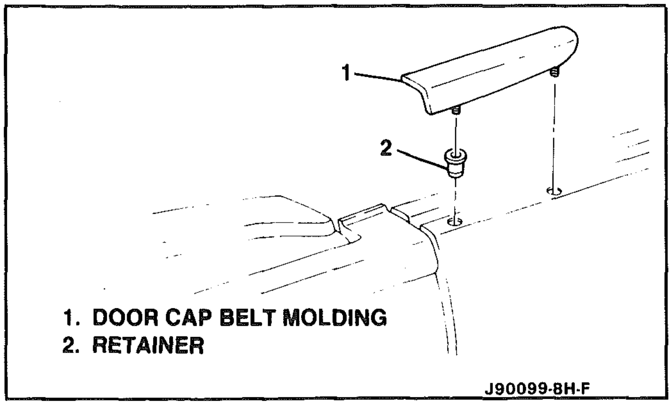


Fig. 24 Door Cap Belt Molding

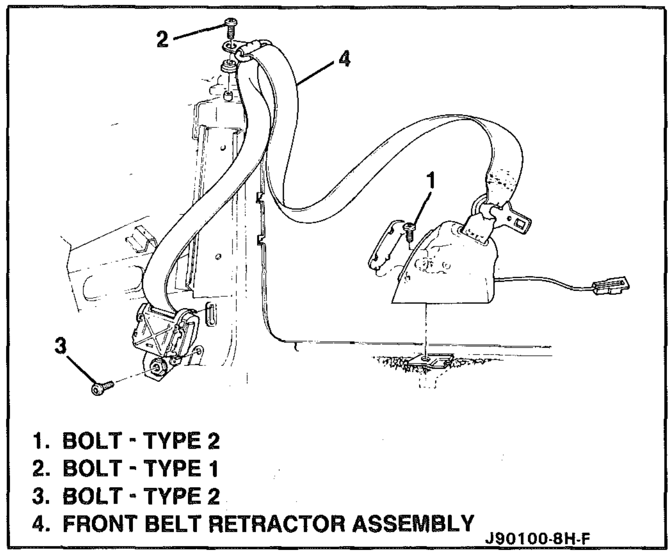


Fig. 25 Front Belt Retractor

SECTION 9H

SEATS

NOTICE: Lap belt to floor pan and shoulder belt to roof panel or quarter panel fasteners are important attaching parts in that they could affect the performance of vital parts and systems, and/or could result in major repair expense. They must be replaced with one of the same part number or with an equivalent part if replacement becomes necessary. Do not use a replacement part of lesser quality or substitute design. Torque values must be used as specified during reassembly to assure proper retention of these parts.

CONTENTS

RESTRAINT SYSTEMS

LAP AND SHOULDER BELTS

The front seat belts incorporate a 4-to-8 second fasten seat belt reminder lamp and sound signal designed to remind the driver if the lap and shoulder belts are not fastened when the ignition is turned to the on position. If the driver's seat belt **is buckled,** the alarm will not operate; however, the fasten seat belt reminder lamp will stay on for a 4-to-8 second period. If the driver's seat belt **is not buckled,** the reminder lamp and sound signal will automatically shut off after the 4-to-8 second interval. To diagnose a system failure, refer to Seat Belt Reminder Lamp/Alarm Diagnosis in Section 8A.

The shoulder belt is attached to the front seat lap belt latch plate and connected to an inertia locking retractor installed to the roof panel above the right and left side of the front seat. The shoulder belt remains unlocked to allow the occupants to move freely while the vehicle is being operated. When the vehicle decelerates or changes direction abruptly, the shoulder belt is locked in position by a pendulum that causes a locking bar to engage a cog of the retractor mechanism.

The retractor has a comfort lock feature that allows the occupant to adjust the shoulder belt for proper fit and comfort. When engaged, the comfort lock prevents full retraction of the webbing to eliminate occupant discomfort due to webbing load on the shoulder. The occupant can readjust the comfort lock during vehicle operation as described below.

When servicing or replacing lap and shoulder belts, refer to the following precautionary items:

1. Lap and shoulder belts will be serviced as follows:
   a. Retractor portion(s) of front seat lap and shoulder belt for outboard passenger and driver.
   b. Buckle portion of front seat lap belt for outboard passenger and driver.
   c. All belts other than those mentioned in above steps a and b will be serviced in complete sets.
   d. Do not intermix standard and deluxe belts on front or rear seats.
2. Keep sharp edges and damaging objects away from belts.
3. Avoid bending or damaging any portion of the belt buckle or latch plate.
4. Do not bleach or dye belt webbing (clean with a mild soap solution and water).
5. When installing lap or shoulder belt anchor bolt, start bolt by hand to assure that bolt is threaded straight.

NOTICE: See NOTICE on page 9H-1 of this section.

6. Do not attempt repairs on lap or shoulder belt retractor mechanisms or lap belt retractor covers. Replace with new service replacement parts.

Comfort Lock Operational Checks and Requirements

The shoulder belt comfort lock feature must function as follows:

1. Extend the webbing from the retractor to a distance approximating buckled position.

	PART NAME	METRIC TYPE	THREAD	LENGTH (mm)	TORQUE N·m	TORQUE ft-lbs
	BOLT	1	M12-1.75	36	35-48	26-35
	BOLT	2	M12-1.75	25	35-48	26-35
	BOLT	3	M12-1.75	30	35-48	26-35
	BOLT	4	M8-1.25	20	20-24	15-17
	BOLT	5	M12-1.75	39	35-48	26-35
	BOLT	6	M12-1.75	35	35-48	26-35
	BOLT	7	M12-1.75	43	35-48	26-35
	BOLT	8	M12-1.75	31	35-48	26-35
	BOLT	9	M12-1.75	49	35-48	26-35
	STUD	10	M6-1.00	15	N/A	N/A
	BOLT	11	M12-1.75	53	35-48	26-35
	NUT	12	M12-1.75		35-48	26-35
	NUT	13	M10-1.50		30-40	22-29
	NUT	14,	M6-1.00		10-14	7-10
	NUT	15	M8-1.25		18-25	14-19
	STUD	16	M8-1.25	13	N/A	N/A

NOTICE

SEE NOTICE AT BEGINNING OF SECTION

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Fig. 2 - Seat Belt Fastener Torque Chart

2. Let the belt retract a minimum of 178 mm (7").
3. Extract the belt for 25 mm to 76 mm (1" to 3") and release the belt. The comfort lock must engage and prevent retraction.
4. Extract belt 25 mm to 76 mm (1" to 3") and release. The belt must return to the comfort lock position previously set. Full retraction is a failure of the system.
5. Extract belt 178 mm (7") and release. The belt must retract fully without locking.

Removal and Installation

Refer to appropriate illustration for removing and installing lap belts and shoulder belts (Figs. 2 through 10). Tighten **all** lap and shoulder belt anchor bolts as specified.

NOTICE: See NOTICE on page 9H-1 of this section.

Check position of factory installed lap belt and shoulder belt anchors and reinstall anchor plates in same position as shown in illustrations.

FRONT SEAT SHOULDER BELT RETRACTOR ASSEMBLY

Removal and Installation

1. Removal of the headlining is not necessary for access to the shoulder belt retractor.
2. Separate shoulder belt guide from the shoulder belt (Fig. 4).
3. Remove bolts holding retractor in place (Fig. 5).
4. Install retractor in the exact same position and secure to roof rail anchorage with 20 to 24 N·m (15 to 17 ft-lb) torque.
5. To complete installation, reverse removal procedures.

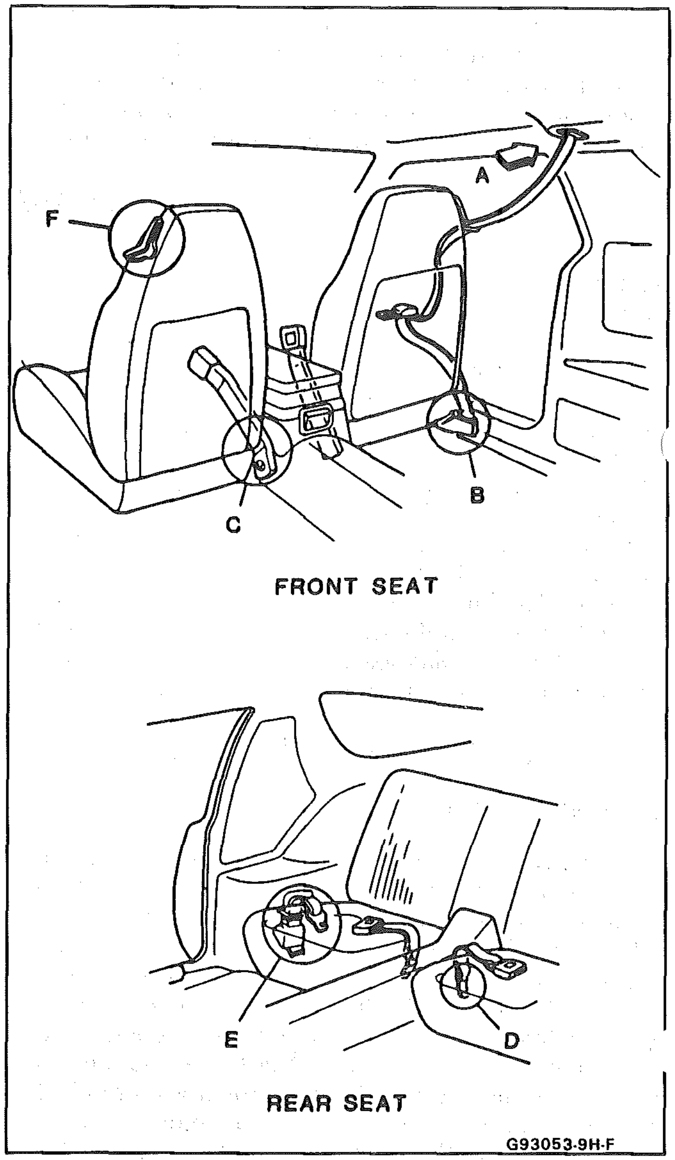


Fig. 3 - Front and Rear Shoulder and Lap Belt Installation

CHILD SEAT

The child seat may be used only in a forward facing seating location. When the child seat is used in the front seat location, it is easily installed by connecting the child seat top strap to the belt at the seating position immediately to the rear (Fig. 11). The outboard belt should be fully extended on the retractor. Occupants should not be allowed to sit at locations where the belts are being utilized for the child seat.

If a child seat is to be used, in a second seat position, a special dealer-installed anchor must be used to anchor the child seat top strap. In order to assure the correct top strap angle, the child seat is only to be used at the seating position for which the top strap anchor is installed. The following instructions explain how to install the anchor for the child seat top strap.

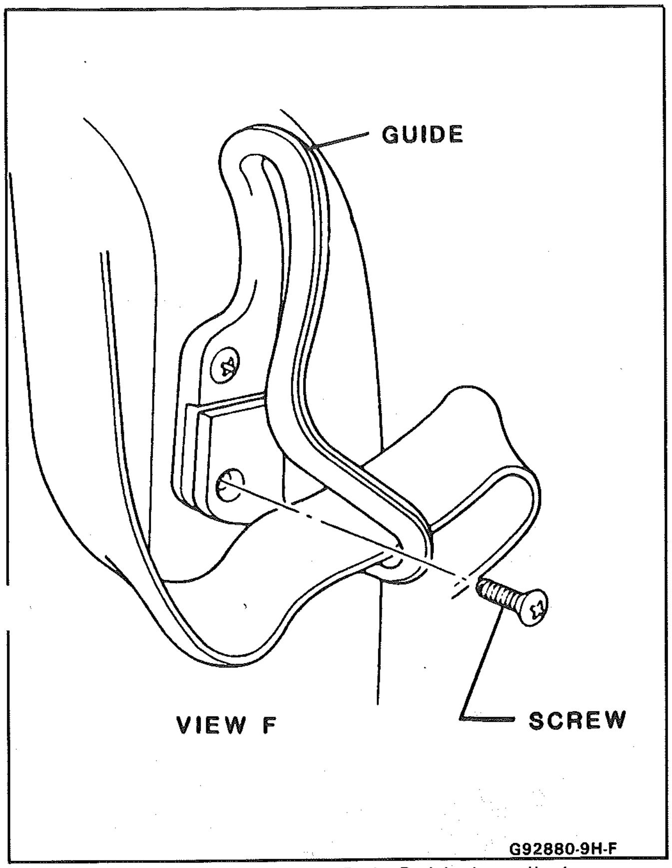


Fig. 4 - Front Shoulder Belt Guide Installation

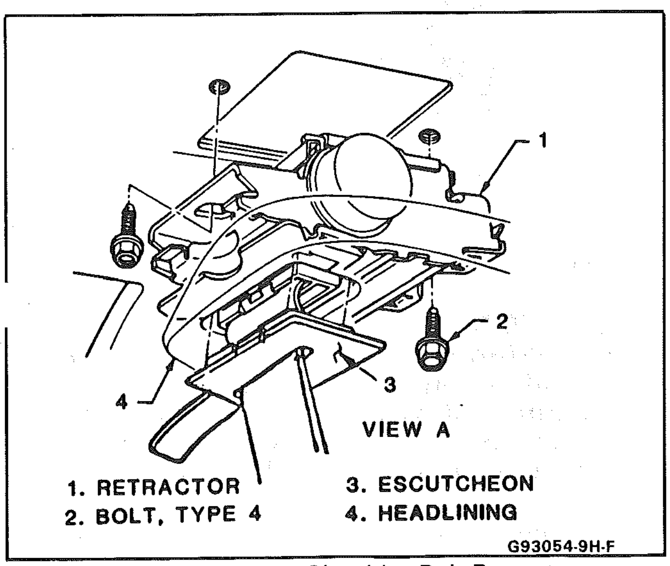


Fig. 5 - Front Seat Shoulder Belt Retractor

Top Strap Anchor Installation (Fig. 12)

All hardware should be supplied or available from the child seat manufacturer. Be sure the child seat position does not conflict with any additional requirements provided by the manufacturer.

1. Open hatch lid.
2. Locate and center-punch a drill point on the RH or LH vertical wall of the storage compartment as shown in View A, Figure 12.
3. Cut a 9 mm (11/32") hole through the carpet and insulation.
4. Drill a 9 mm (11/32") hole as marked in step 2.

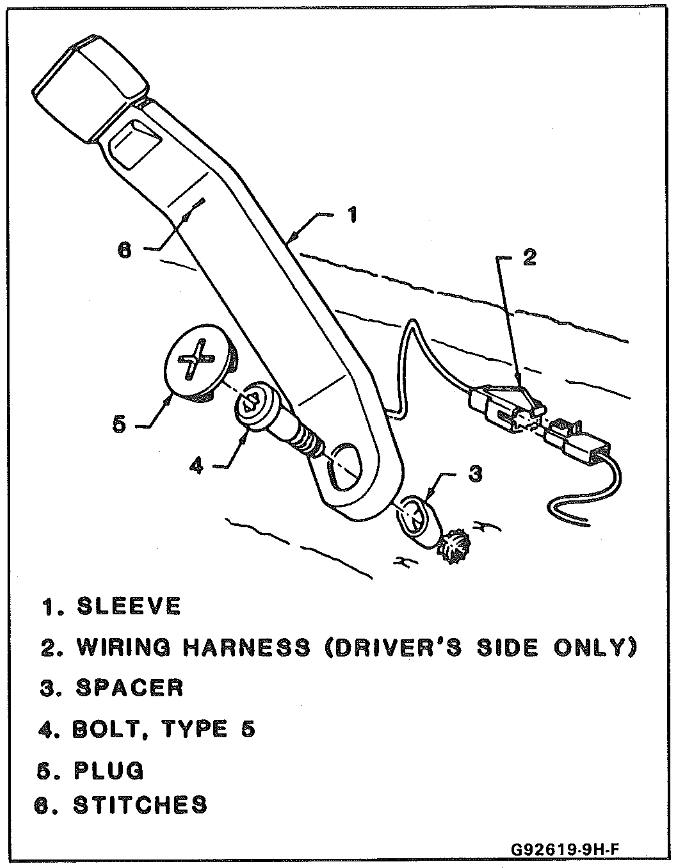


Fig. 6 - Front Seat Inner Belt Attachment

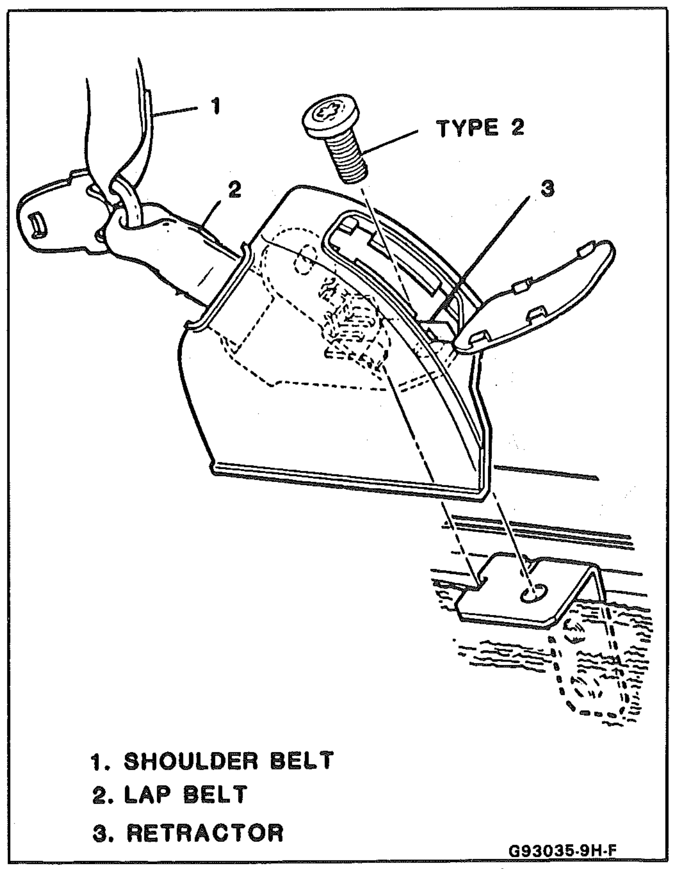


Fig. 7 - Front Seat Outer Belt Attachment

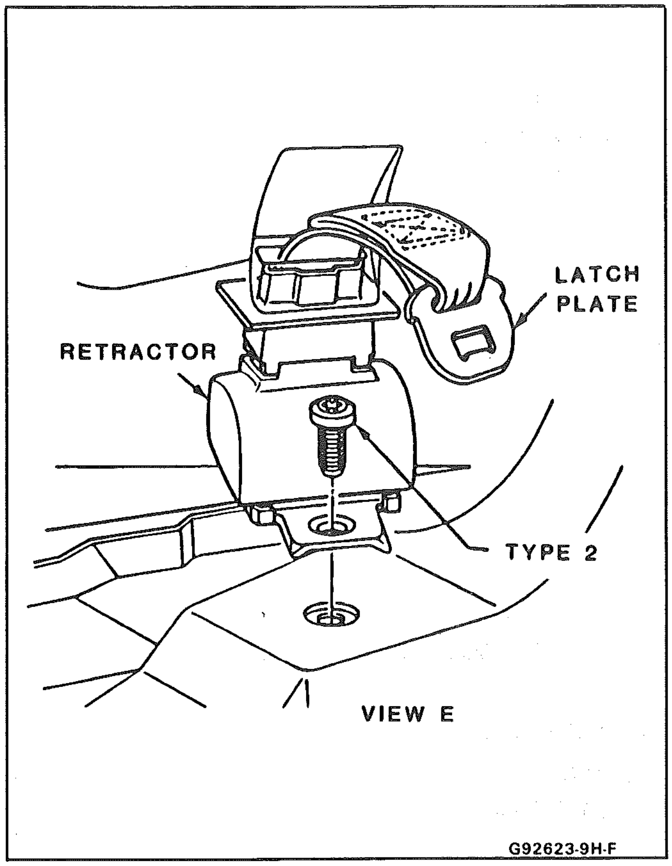


Fig. 8 - Rear Seat Outer Belt Attachment

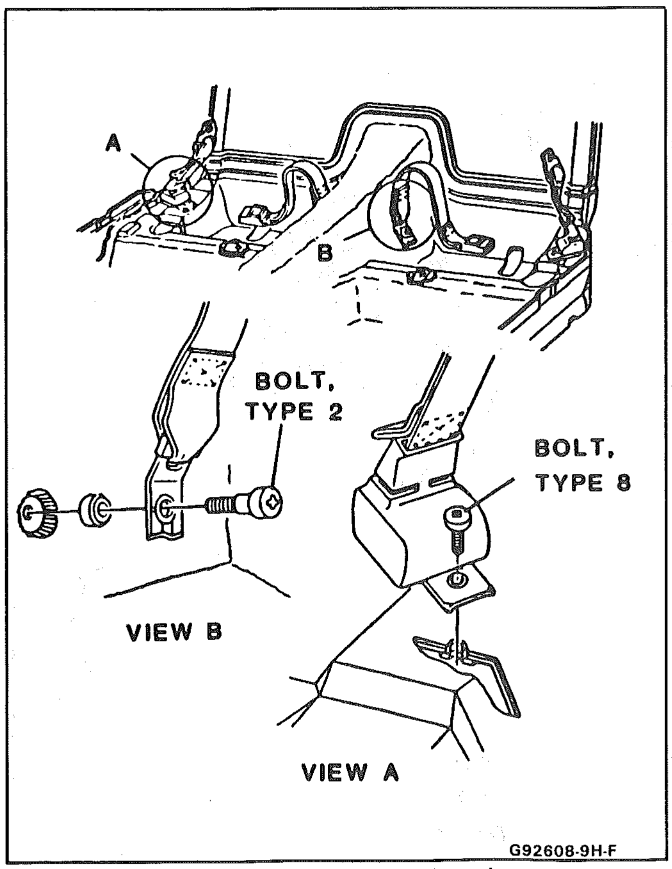


Fig. 9 - Rear Seat Inner Belt Attachments

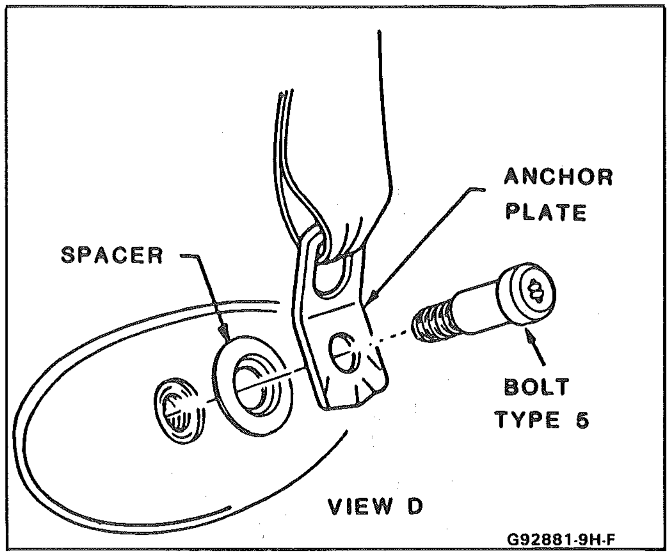


Fig. 10 - Rear Seat Inner Belt Attachment

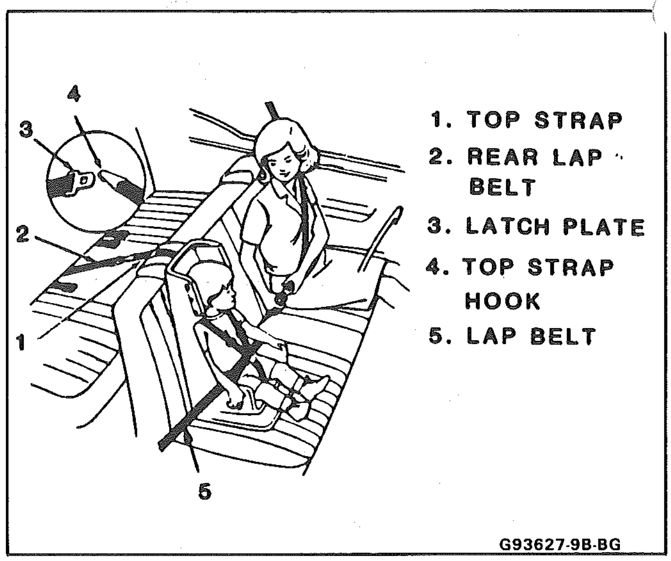


Fig. 11 - Front Seat Installation of Child Seat

CAUTION: Any holes penetrating to the exterior of the vehicle must be sealed. Apply a sealant between the anchor bolt washers and the sheet metal to prevent carbon monoxide from entering the vehicle. In the event that the child seat anchorage assembly is removed, all bolt holes penetrating to the exterior of the vehicle must be resealed.

5. Apply butyl or acrylic caulking sealer around outside of hole.
6. Install top strap anchor bracket (4) and secure with bolt (5), washer (1) and locknut (2). Tighten locknut.
7. Install child seat and secure with child seat belt according to manufacturer's instructions.

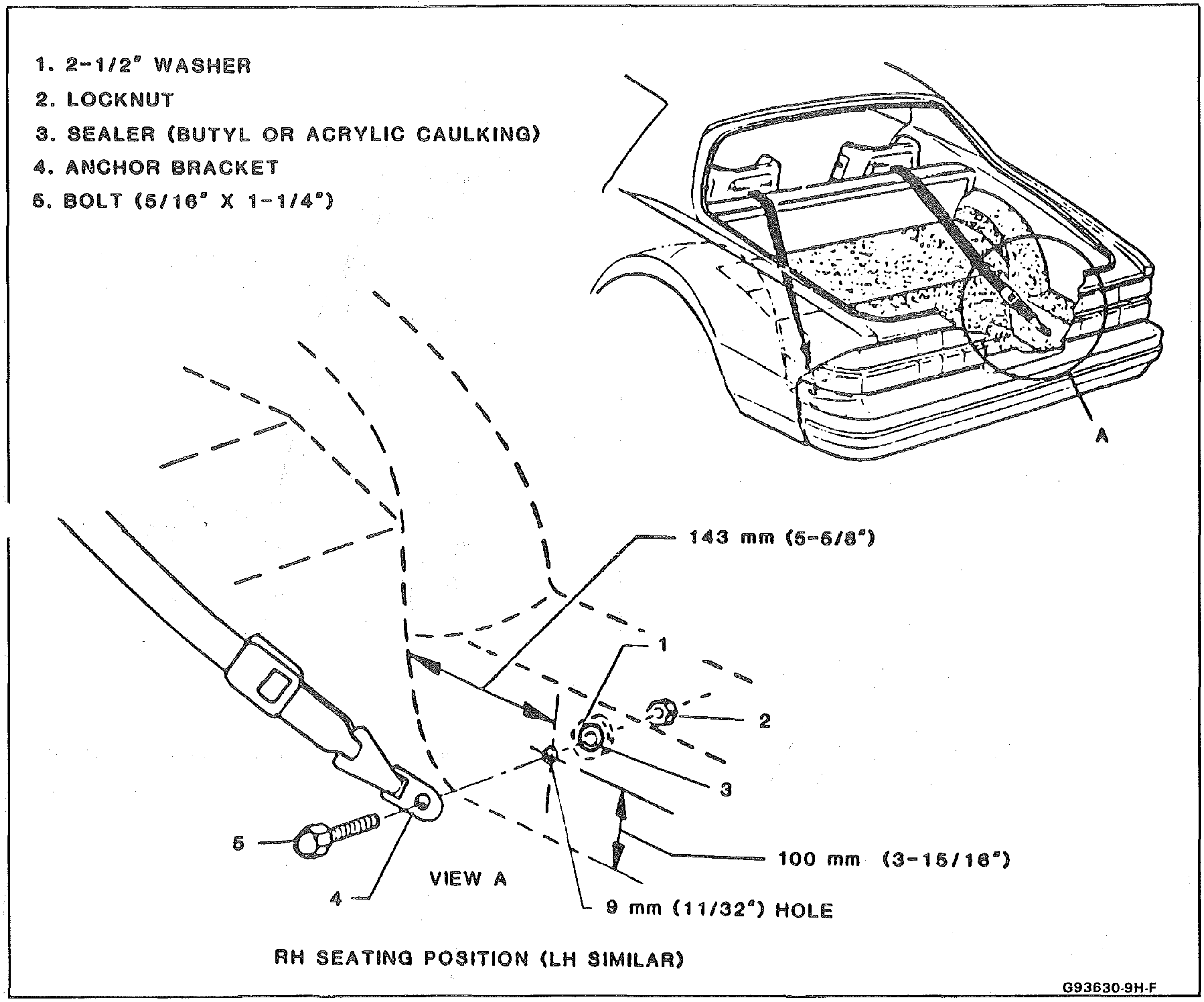


Fig. 12 - Top Strap Anchor Installed

FRONT SEATS

There are four bucket type seat options used: AR9 and AF9 (Chevrolet) and AR9, AQ9 and AS5 (Pontiac) All styles have an inertia type front seatback lock system. This system allows the seatback to move freely without requiring the occupant to release a lock lever for access to the rear seat area. During a sudden stop, deceleration, or if the front of the car is declined 20 degrees or more, the seatback inertia locking system locks the front seatbacks in an upright position. A manual seatback lock release lever is provided to allow manual release of the inertia lock when the front of the car is declined 20 degrees or more. The release lever is located at the lower rear center of the seatback.

Front and rear seat cushions and backs have formed foam pads, which fit the contours of the full panel seatback frame assembly and also the designed contour of the seat cushion frame.

There are no front seat dealer forward or rearward relocation provisions provided at either seat adjuster-to-floor pan attachments or seat adjuster-to-seat frame attachments.

Do not attempt to change the designed seat position by altering the designed seat adjuster-to-floor pan anchor provisions or seat adjuster-to-seat frame anchor provisions as it could affect the performance of the seat system.

FRONT SEATBACK HEAD RESTRAINT

Front seatback head restraints with a single post (Fig. 13) can be adjusted to various positions. All other style seats incorporate the head restraint as part of the one-piece back design. To remove single post head restraints, use head restraint lock releasing tool BT-7933 or fabricate from 0.4 mm (1/64") flexible steel strap (Fig. 14). The flat surface of this tool will release the spring lock tab.

Removal and Installation

1. Raise head restraint to full-up position.
2. Insert lock release tool down front surface of head restraint post until it stops. Push head restraint and tool fully downward at the same time; then lift restraint out of seatback.

3. To install head restraint, insert post into guide and push downward to full-down position. Check that lock spring engages and prevents head restraint from being removed.

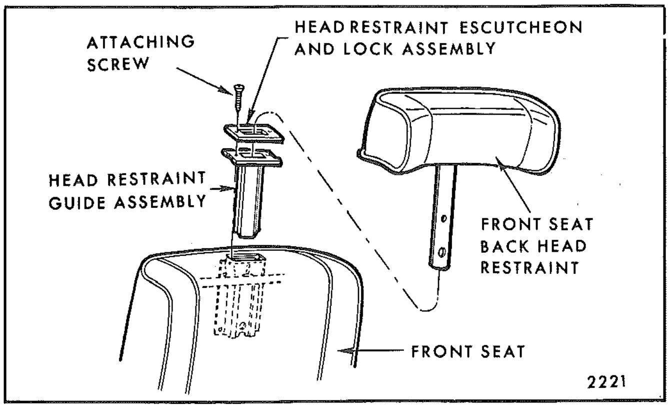


Fig. 13 - Head Restraint Assembly

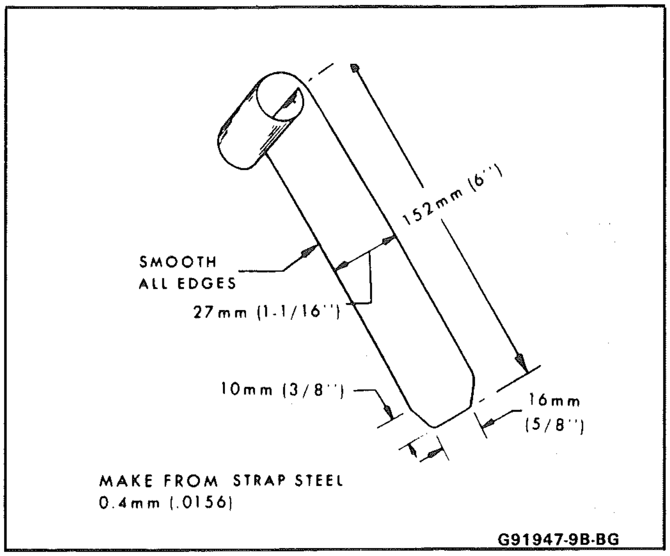


Fig. 14 - Head Restraint Antiremoval Lock Releasing Tool

RECLINING SEATBACK

All styles have bucket seats with a tubular frame design seatback (Fig. 15) and a recliner control mechanism. The tubular frame seatback has a single side, recliner control mechanism. This recliner mechanism, which is mounted on the outboard side of the seat, is the sole control of the seatback angle. The inner hinge arm attaching bolt acts only as a point of rotation for the seatback. The inertia lock is an integral part of the recliner control mechanism (Fig. 16).

To recline the seatback, rearward pressure must be applied to the seatback before lifting the recliner release handle. When pressure is applied against the seatback, the lockout lever tab disengages from the cam plate tab. Then the release handle can be moved, allowing the seatback to move rearward. Releasing the handle will allow the cam plate to move counterclockwise and cause the sector lock teeth to engage the upper hinge arm, locking the seatback in the desired reclined position. To return the seatback to an upright position, raise the recliner release handle.

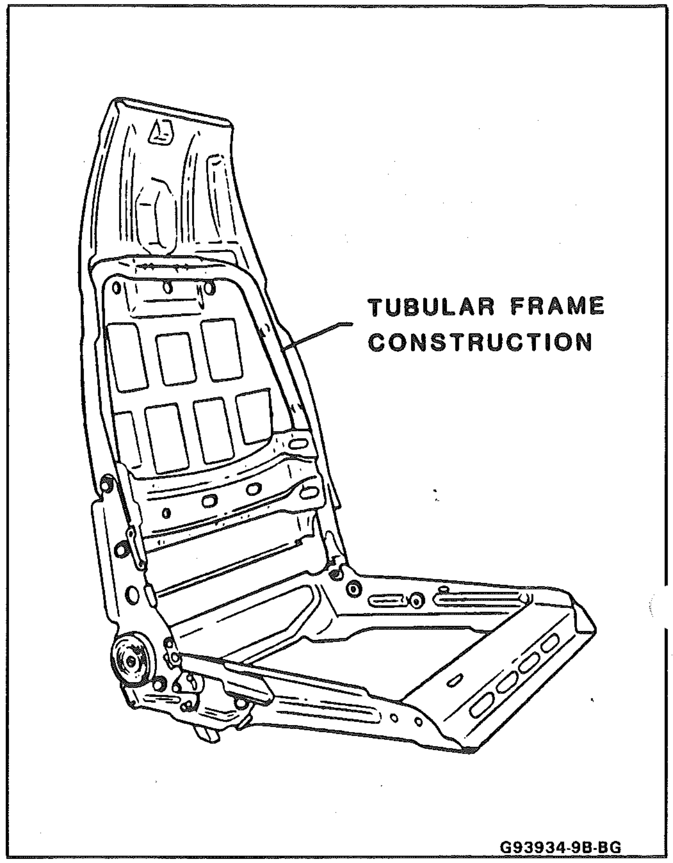


Fig. 15 - Seat Assembly Tubular Frame Construction

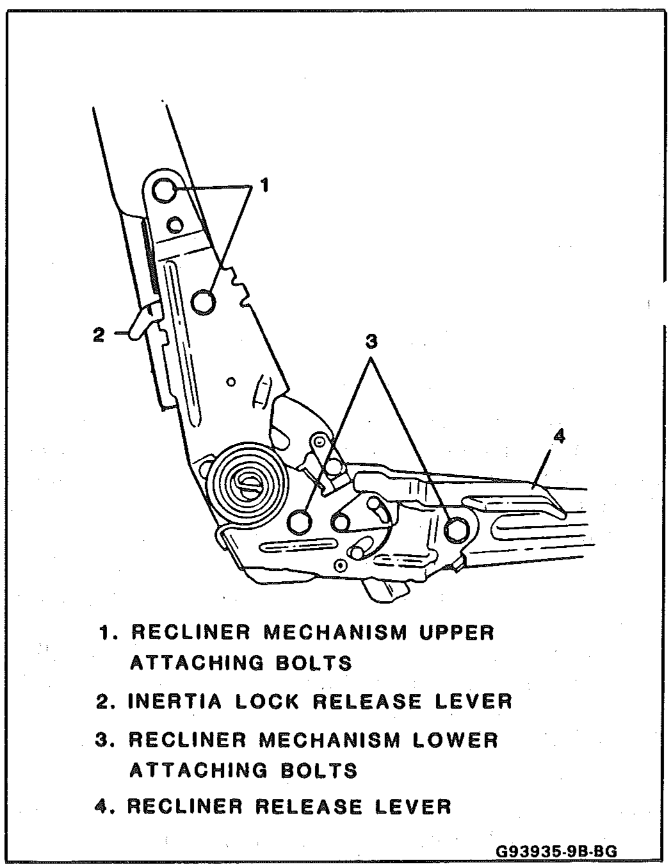


Fig. 16 - Recliner Mechanism with Inertia Lock

RECLINER CONTROL MECHANISM

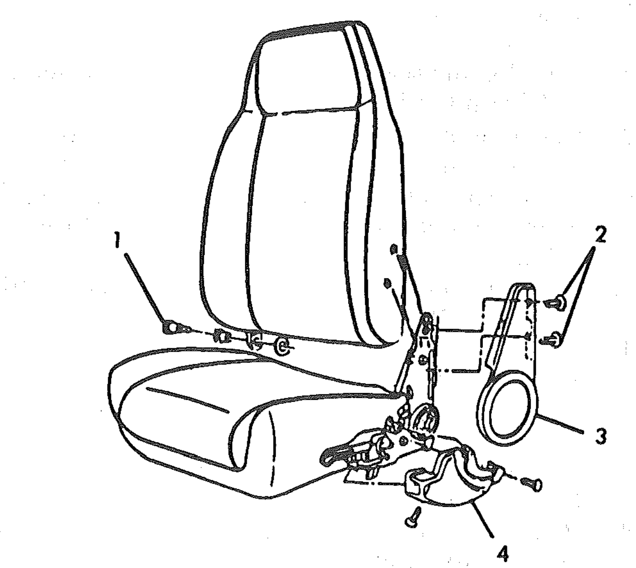
Removal and Installation (Fig. 17)

1. Place reclining seatback in full-up position.
2. Remove upper recliner mechanism cover.
3. Remove lower recliner mechanism cover.
4. Remove two upper and two lower recliner mechanism attaching bolts and remove recliner control mechanism.
5. To install, reverse removal procedure.

FRONT SEATBACK

Removal and Installation (Fig. 17)

1. Place seatback in full-up position.
2. Move seat to full-forward position.
3. Remove upper recliner mechanism cover.
4. Remove both recliner mechanism upper attaching bolts.
5. Remove seatback inner hinge arm escutcheon and attaching bolt and remove seatback.
6. To install, reverse removal procedure.



1. INNER HINGE ARM ATTACHING BOLT
2. RECLINER MECHANISM UPPER ATTACHING BOLTS
3. UPPER RECLINER MECHANISM COVER
4. LOWER RECLINER MECHANISM

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Fig. 17 - Recliner Mechanism Upper and Lower Escutcheon

FRONT SEATBACK INERTIA LOCK CHECK

The inertia lock is an integral part of the seatback recliner mechanism. If the inertia lock needs to be replaced, the entire recliner mechanism must be replaced. Operation of the front seatback inertia lock may be checked as follows.

When checking lock in either the in-car check or out-of-car check, pull upward on the release lever; then release the lever. Lever must return with no evidence of binding or interference. Where required, replace inertia lock assembly and repeat check after installation.

In-Car Check

1. In an area clear of other cars or obstructions, with driver buckled in restraint system and with aid of an assistant in rear seat also buckled in restraint system holding sides of passenger seatback (near top of seatback) with arms stiff and body relaxed, drive car forward between 10 and 15 mph (16 to 24 km/h); then quickly apply brakes to stop car as fast as possible without skidding wheels. Seatback inertia lock should lock; top of seatback should not move forward more than 38 mm (1-1/2"). When performing this operation on driver's seatback, driver should lean slightly forward.
2. If either driver or passenger seatback lock does not lock on first locking position, perform the following out-of-car check.

Out-of-Car Check

1. Remove seat assembly from car and place right side up on a clean surface.
2. Raise rear of seat until seatback is 6 degrees forward of vertical position and place blocks under rear of seat to hold seat in this position. Use "angle meter" as shown in Figure 18. Angle meters can be purchased at hardware or department stores.
3. Check that seatback lock locks seatback in locking position. If lock does not lock, remove lock and install new lock assembly.
4. If installing a new lock, check that lock mechanism moves freely prior to installation. After installation, check lock as described in steps 1 through 3.

FRONT SEAT MANUAL RECLINER CHECK

1. Operate recliner mechanism lever and apply force in aft direction to adjust the seatback into the fully reclined position, checking ease of lever operation and seatback movement. Release recliner lever, checking ease of lever operation and that seatback remains fully reclined.
2. Operate recliner lever and manually position seatback forward to an intermediate reclined position. Release recliner lever.
3. Apply manual force to the upper seatback in the rearward direction to check for positive recliner locking action.
4. Operate recliner mechanism lever to adjust the seatback to normal position, checking ease of lever operation and seatback full return. Release recliner lever.
5. Apply manual force to the upper seatback in the rearward direction to check for positive recliner locking action. Recliner release lever should return to normal position without any assistance from operator.

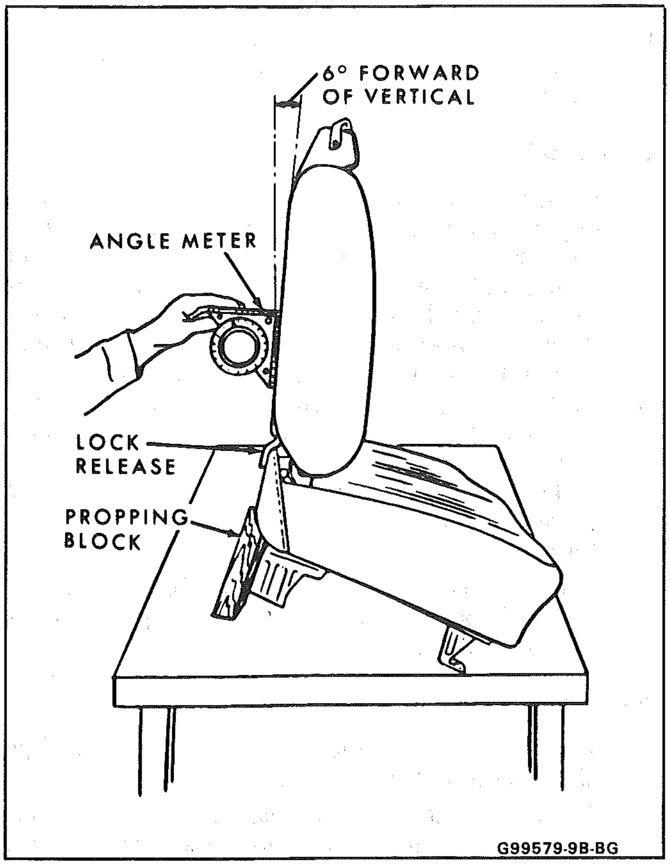


Fig. 18 - Front Seatback Inertia Lock Check - Out of Car

SEAT TORQUE SPECIFICATIONS

The following torque specifications should be used when servicing seat assemblies:

Bolt or Nut Location and Torque

Many service replacement assemblies such as front seat cushion and back frame assemblies and rear compartment pan assembly may have unthreaded nuts for attachment of seat adjusters, seatback and lap belts. Threads must be formed in these unthreaded nuts with either the original or a new proper size thread forming bolt. Apply 67 to 89 newtons (15 to 20 pounds) of straight-in pressure to start thread forming action of bolt into an unthreaded nut.

NOTICE: See NOTICE on page 9H-1 of this section.

1. Seat adjuster-to-floor pan or adjuster-to-seat frame bolts or nuts - 20 to 28 N·m (15 to 21 ft-lb).
2. Front seatback outer control assembly to seatback frame - 15 to 20 N·m (11 to 15 ft-lb).
3. Front seatback frame to recliner mechanism - 20 to 28 N·m (15 to 21 ft-lb).
4. Front seatback inner pivot hinge arm to seat cushion frame - 20 to 28 N·m (15 to 21 ft-lb).
5. Rear folding seatback panel pivot support to outer bottom of seatback - 46 N·m (34 ft-lb).
6. Rear folding seatback lock bolt - 12 to 16 N·m (9 to 12 ft-lb).
7. Rear folding seatback lock striker to wheelhouse - 46 N·m (34 ft-lb).
8. Seat motor and transmission support attaching bolts or nuts - 9 to 15 N·m (7 to 11 ft-lb).
9. Passenger and driver retractor seat belt bolt to quarter inner panel - 35 to 48 N·m (26 to 35 ft-lb).
10. Passenger and driver seat buckle side belt to body - 35 to 48 N·m (26 to 35 ft-lb).
11. Passenger and driver inner seat belt to floor pan - 35 to 48 N·m (26 to 35 ft-lb).
12. Shoulder belt anchor bolt to rocker panel - 35 to 48 N·m (26 to 35 ft-lb).
13. Rear inner seat belt anchor bolt to floor pan - 35 to 48 N·m (26 to 35 ft-lb).
14. Rear seat retractor assembly anchor bolt to floor pan - 35 to 48 N·m (26 to 35 ft-lb).

MANUAL SEAT ADJUSTER - DIAGNOSIS CHART

CONDITION	APPARENT CAUSE	CORRECTION
1. Adjuster will not lock.	1. Locking wire too tight.	1. Loosen locking wire tension enough to provide full engagement of lock bar in locking slots of adjuster lower channel.
	2. Adjuster lock bar spring disconnected or broken.	2. Connect spring or install new spring (Fig. 23).
	3. Adjuster lock bar sticking or binding.	3. Lubricate lock bar pivot. If bar is binding, eliminate cause of binding or replace adjuster.

2. Adjuster will not unlock.	1. Locking wire too loose or disconnected.	1. Tighten locking wire enough to allow lock bar to disengage from locking slots in adjuster lower channel when lock control lever is activated.
	2. Adjuster lock bar sticking or binding.	2. Lubricate lock bar pivot. If bar is binding, eliminate cause of binding or replace adjuster.
3. When left adjuster locks, right adjuster is between lock positions.	1. Right adjuster either rearward or forward of left adjuster.	1. Loosen adjuster-to-floor pan bolts or nuts. Move one adjuster forward or rearward as far as possible and the other adjuster the opposite direction.
Seat hard to move forward or rearward.	1. Adjusters new, not broken in.	1. Operate seat to full forward and full rearward positions several times to work new tightness out of channels.
	2. Adjuster(s) improperly lubricated.	2. Lubricate adjuster channels with Lubriplate Auto-Lube A or equivalent.
	3. Adjuster(s) binding due to bent or damaged channels.	3. Replace adjuster.
	4. Adjusters not in parallel alignment with each other.	4. Loosen floor pan attaching bolts or nuts, align adjusters parallel on floor pan and retighten nuts.

POWER SIX-WAY SEAT ADJUSTER MECHANICAL DIAGNOSIS CHART

If it is apparent or suspected that the trouble is in the electrical system, refer to chassis manual Section 8A.

CONDITION	APPARENT CAUSE	CORRECTION
1. Horizontal operation of seat not smooth (jerky) - apparent hard operation.	1. Improper lubrication of adjuster shoes and channels.	1. Lubricate adjuster upper channel and plastic shoes.
	2. Adjuster horizontal actuator gear too tight to rack gear.	2. See Horizontal Actuator Adjustment.
	3. Adjuster shoes too tight in upper channel.	3. Install new shoes on adjuster lower channel.
2. Horizontal chuck or looseness.	1. Horizontal actuator improperly adjusted to rack gear.	1. See Horizontal Actuator Adjustment.
3. One adjuster will not operate horizontally.	1. Horizontal drive cable disconnected or damaged.	1. Check horizontal drive cables, replace if damaged.
	2. Horizontal actuator inoperative.	2. Replace horizontal actuator assembly.

4. One adjuster will not operate vertically.	1. Vertical drive cable disconnected or damaged. 2. Vertical gearnut inoperative.	1. Check vertical drive cables, replace if damaged. 2. Replace vertical actuator assembly.
5. Both adjusters will not operate horizontally and/or vertically.	1. Inoperative horizontal and/or vertical solenoid in transmission. 2. Damaged, broken or inoperable solenoid plunger, shaft, dog, dog spring, gear or drive gear.	1. See chassis manual Section 8A. 2. Replace damaged, broken or inoperable solenoid part with new part.
6. Vertical chuck or looseness.	1. Excessive clearance at vertical gearnut tension spring.	1. Grind down top of vertical gearnut shoulder nut 0.40 to 1.19 mm (1/64" to 3.64") maximum.

Front Seat Adjustments

Seat Adjustment at Floor Pan Attachment

A small amount of fore and aft or side adjustment is available at the seat adjuster-to-floor pan attaching bolts which can be used toward alignment of the seat assembly or alignment of the seat adjusters with each other. This adjustment can be used to help correct the following conditions:

1. Hard or slow operation due to adjusters not being parallel with each other.
2. Passenger side of manually operated seat must be moved forward or rearward slightly to engage in locked position due to one adjuster being forward or rearward of the other.
3. Seat assembly slightly too far to right or left.

Power Six-Way Seat Adjuster Horizontal Actuator Adjustment

With seat adjuster assembly installed on seat or seat installed in body, horizontal movement (chucking) can be corrected by adjusting the horizontal actuator and pinion gear in tight to the adjuster lower track rack gear as follows:

Adjust

1. Operate seat to full-up position and about 3/4 full-forward position.
2. Loosen horizontal actuator attaching screws. Using a large screwdriver, inserted as shown in Figure 19, apply outward pressure on horizontal actuator (enough to equal 67 to 111 newtons (15 to 25 pounds) on horizontal actuator) and at the same time energize horizontal switch to move seat fore and aft slightly; this helps seat the horizontal actuator pinion gear teeth tight to the lower track rack gear teeth and eliminate any free play between gear teeth. While maintaining outward pressure against horizontal actuator, tighten actuator attaching screws.

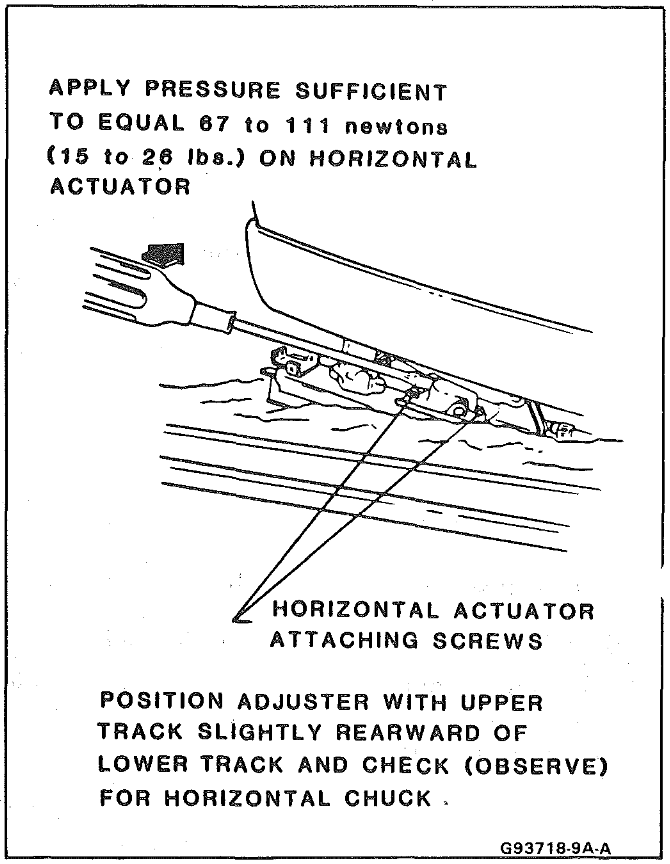


Fig. 19-Horizontal Actuator Adjustment - Power Six-Way Seat

MANUAL SEAT ADJUSTER CONTROL ARM KNOB

Manual seat adjuster control arm knobs are a press fit on the adjuster control arm. The knobs can generally be removed and reinstalled several times without losing adequate retention. If removing or installing a control knob on a trimmed seat assembly, place a protective cover over trim material in area of knob (Fig. 20).

Removal

To remove adjuster control knob, use body spoon and locking type pliers as shown in Figure 20.

Installation

1. Make pencil mark on seat adjuster control arm 25 mm (1") from end of arm as a guide for full depth fit.
2. Secure locking type pliers to control arm below pencil line.
3. Insert knob on arm and press firmly while holding restraint with locking type pliers. If necessary, use rubber mallet.
4. Gate marks on knob should face down on bucket seats and to the rear on regular seats. Care should be taken not to bend the control arm.

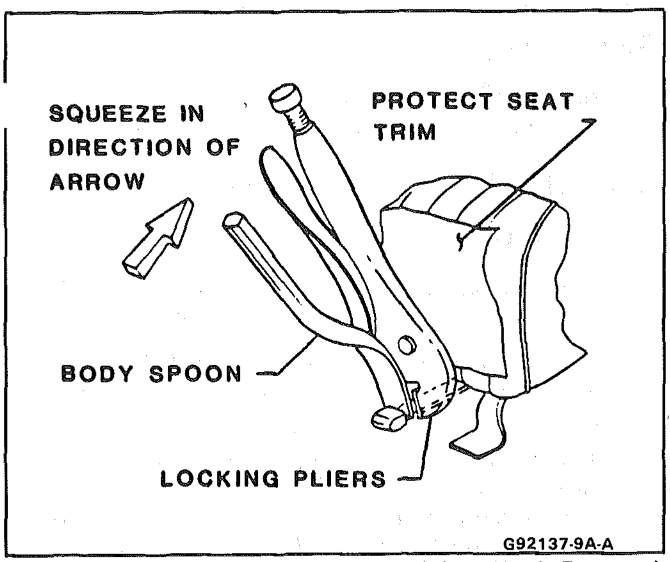


Fig. 20 - Front Seat Adjuster Control Arm Knob Removal and Installation

FRONT SEAT ASSEMBLY - MANUAL AND POWER SEATS

Seat assemblies are secured to the floor pan by nuts installed on floor pan anchor plate studs.

The manually operated front seat assemblies have manual seat adjusters to provide fore and aft movement of the seat. When the control lever located at the front of the seat is actuated to the left, the seat adjusters unlock, permitting horizontal travel of the seat. When the seat is in the desired position and the locking lever is released, the seat is locked.

The power six-way seat adjusters are actuated by three 12V, reversible, permanent magnet motors with a built-in circuit breaker. The motors are energized by a toggle-type control switch bolted on the seat side panel (Fig. 21).

The three motors respectively direct drive the front and rear vertical gearnuts and a horizontal actuator. When the adjusters reach the limit of travel, their torque is absorbed through the rubber mounted grommets between the motor and the support. An overload relay is provided in the circuit should excessive stall torque be applied to the motor.

Front seats are secured to the floor pan by nuts installed into weld studs on floor pan anchor plates.

Removal and Installation

1. Operate seat to full-forward position. If six-way power seat is operable, operate seat to full-forward and up positions. Where necessary to gain access to adjuster-to-floor pan attaching nuts, remove adjuster rear foot covers and/or carpet retainers.
2. Remove track covers where necessary; then remove adjuster-to-floor pan rear attaching nuts. Operate seat to full-rearward position. Remove adjuster front foot covers; then remove adjuster-to-floor pan front attaching nuts.
   On seats with power adjusters, tilt seat rearward and disconnect feed wire connector.
3. Remove seat assembly from car.
4. Prior to installing seat assembly, check that both seat adjusters are parallel and in phase with each other. In the event the adjusters are out of phase (one adjuster reaches its maximum horizontal or vertical travel in a given direction before the other adjuster), phase adjusters as described in step 5c under Front Seat Adjuster Assembly - Removal and Installation.
5. To install seat assembly, reverse removal procedure.
6. Tighten seat adjuster-to-floor pan attaching bolts or nuts 20 to 28 N·m (15 to 21 ft-lb). Check operation of seat assembly to full limits of travel.

FRONT SEAT ADJUSTER ASSEMBLY - MANUAL AND POWER

Removal and Installation

1. Remove front seat assembly with adjusters attached and place upside down on a clean, protected surface.
2. On manual seat adjusters, remove seat adjuster assist spring from adjuster being removed. If removing right adjuster, squeeze hooked end of seat adjuster locking wire together and slide retaining spring over hump in locking wire and remove locking wire from adjuster.
3. On power-operated seats, disconnect drive cables at adjuster being removed by squeezing oblong connector to detach.
4. Remove adjuster-to-seat bottom frame front and rear attaching bolts or nuts and remove seat adjuster from seat (Fig. 22). On some seats, spacers are installed between the seat adjusters and seat frame or seat adjuster and floor pan. Note location of spacers for reinstallation in same position(s).
5. To install, reverse removal procedure.

NOTICE: See NOTICE on page 9H-1 of this section.

a. If a manual adjuster is being replaced, install new adjuster control knob as described under Manual Seat Adjuster Control Arm Knob.
   When installing manual seat adjusters, the right and left seat adjuster sliding

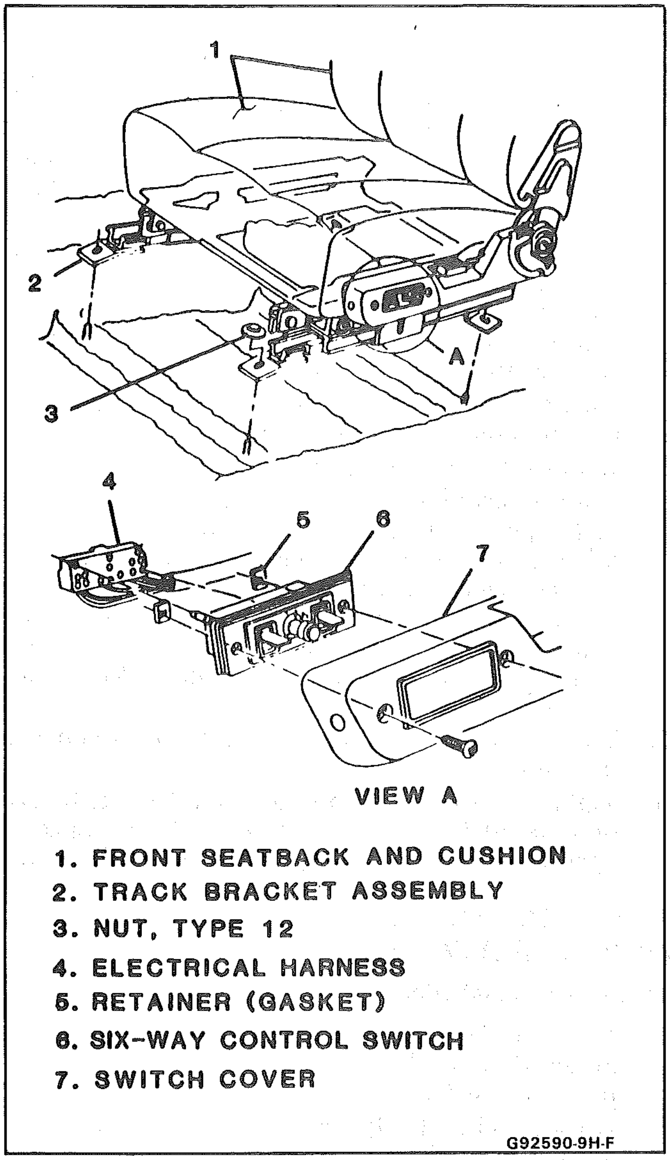


Fig. 21 Seat to Floor Pan and Six-Way Power Seat Control Switch Installation

mechanism should be in same relative position when attaching adjuster to seat bottom frame. Tighten seat adjuster-to-seat frame attaching bolts 20 to 28 N·m (15 to 21 ft-lb).

b. After installing manual adjusters to seat frame, check operation of adjusters.

c. When installing power seat adjusters, check that both adjusters are parallel and in phase with each other. In the event the adjusters are out of phase (one adjuster reaches its maximum horizontal or vertical travel in a given direction before the other adjuster), phase adjusters as follows:

Horizontal travel - operate seat control switch until one adjuster reaches full-forward position. Detach horizontal drive cable from adjuster which has reached full-forward position. Operate seat forward until other adjuster reaches full-forward position; then connect horizontal drive cable and check horizontal travel of seat.

Front or rear vertical travel - operate seat control switch until one adjuster has reached fully raised position at both front and rear vertical travel limits. Disconnect both front and rear vertical drive cables from adjuster which has reached the fully raised position. Operate seat control switch until other adjuster reaches the fully raised position at both front and rear vertical travel limits; then connect previously removed front and rear vertical drive cables. Check vertical travel by operating adjusters through one or two complete cycles. The above operation may be repeated on an as-required basis if adjusters do not appear to be in phase after test cycle.

SIX-WAY POWER SEAT ADJUSTERS, THREE-MOTOR DIRECT DRIVE

The following procedures cover replacement of the major component parts of the seat adjusters.

Horizontal and Vertical Drive Cables (Fig. 24)

Removal and Installation

1. Remove front seat assembly from body and place upside down on clean protected surface.
2. Cables may be disconnected by squeezing oblong connectors at motors, gearnuts and adjuster drives.

   Cable connector at motor for inboard (passenger side) or outboard (driver side) rear vertical gearnut requires initial removal of nut securing motor support bracket (7) to gain access to connector at motor.
3. Install cables reverse of removal procedure.

Permanent Magnet Electric Motors (Fig. 24)

Removal and Installation

1. Remove front seat assembly and place upside down on clean protected surface.
2. Disconnect motor feed wires from motors.
3. Remove nut securing front of motor support bracket to inboard adjuster and withdraw assembly from adjuster and gearnut drives.
4. Disconnect drive cables from motors and complete removal of support bracket with motor attached.
5. Grind off peened over end(s) of grommet assembly securing motor to support and separate motor(s) as required from support.
6. To install, reverse removal procedure except as noted.
7. Drill out top end of grommet assembly using an 8 mm (3/16") drill.
8. Install grommet assembly to motor support bracket and secure motor to grommet using 3/16" rivet.

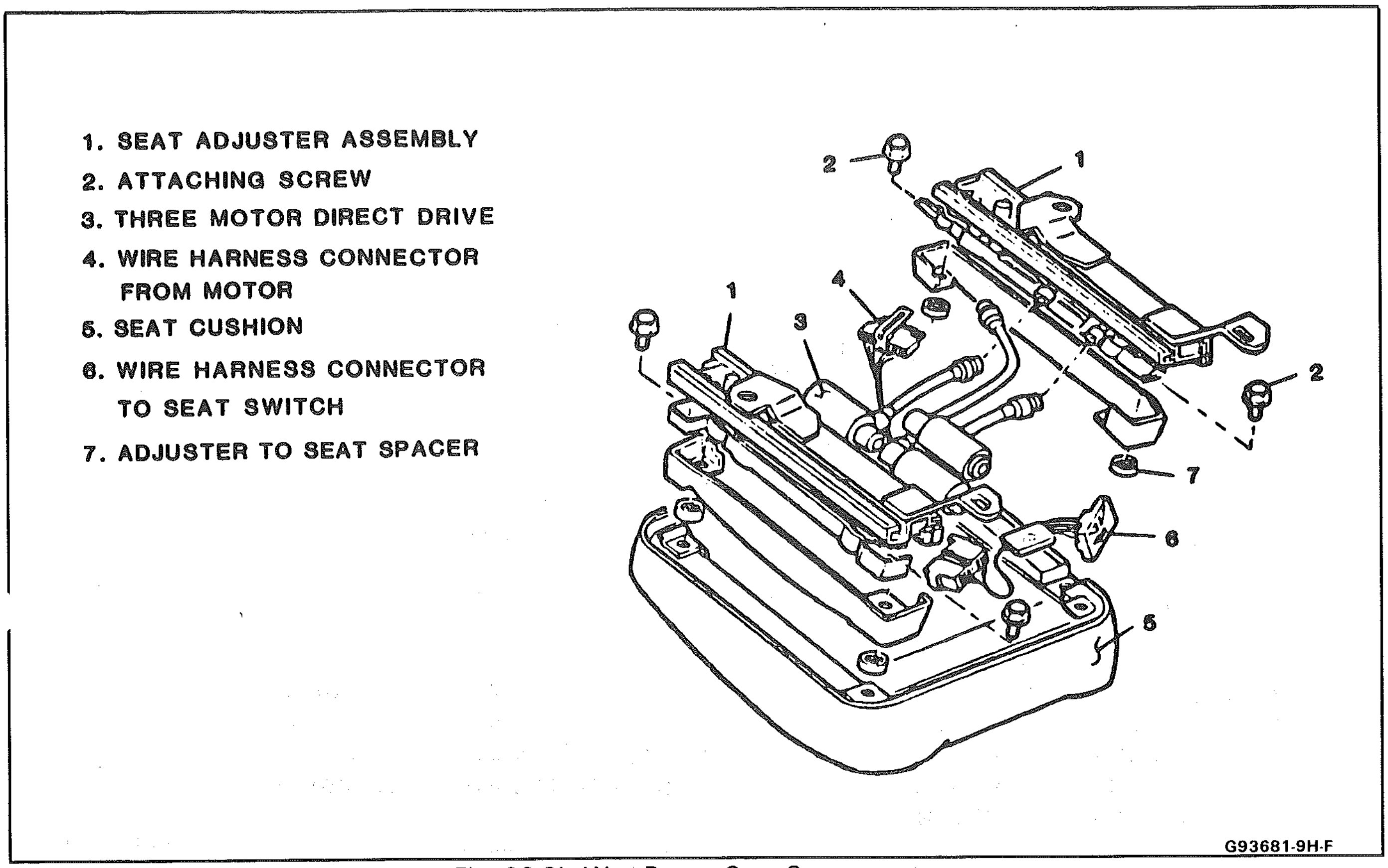


Fig. 22-Six-Way Power Seat Components

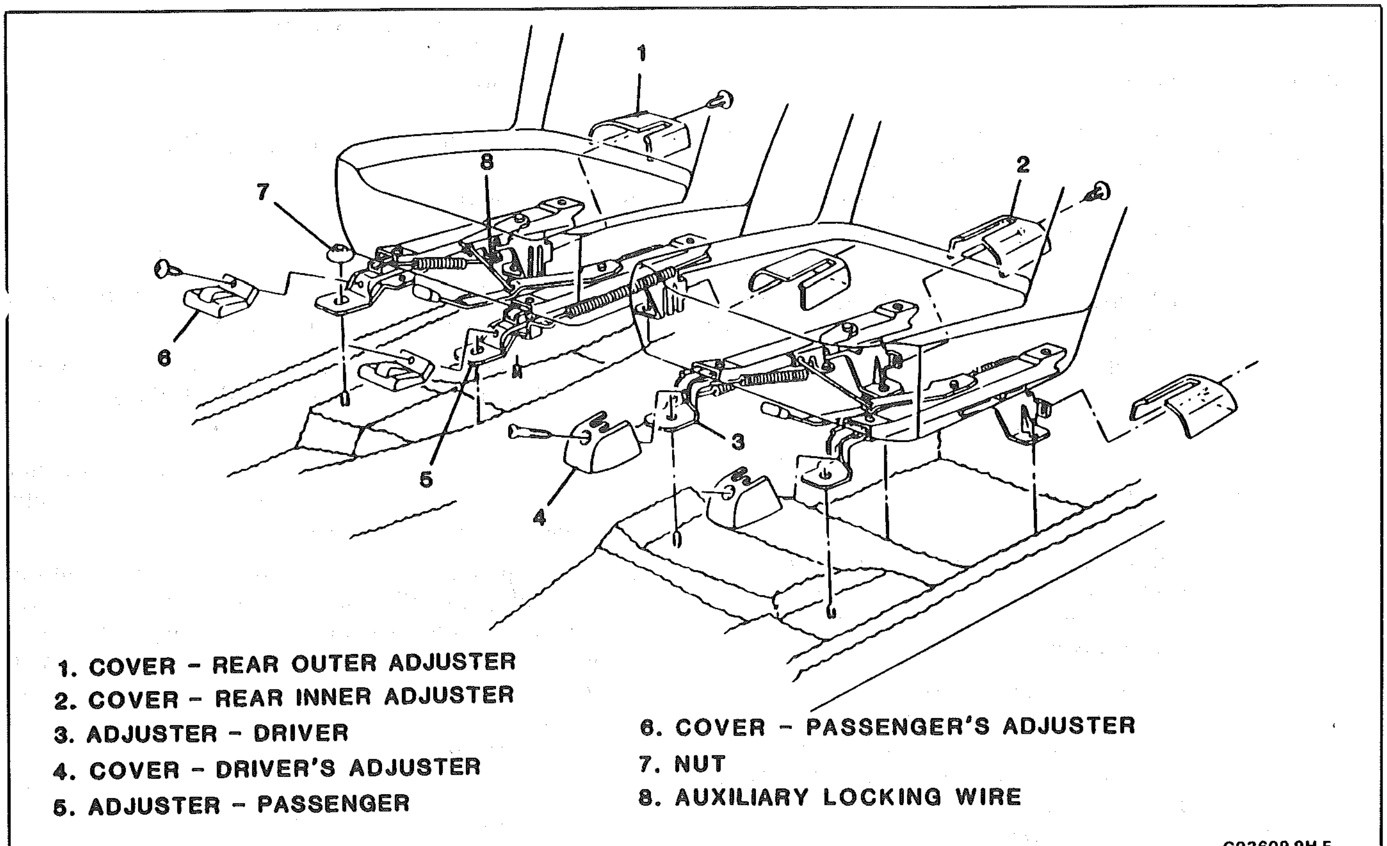


Fig. 23 Seat to Floor Pan Components and Installation - Manual Seat

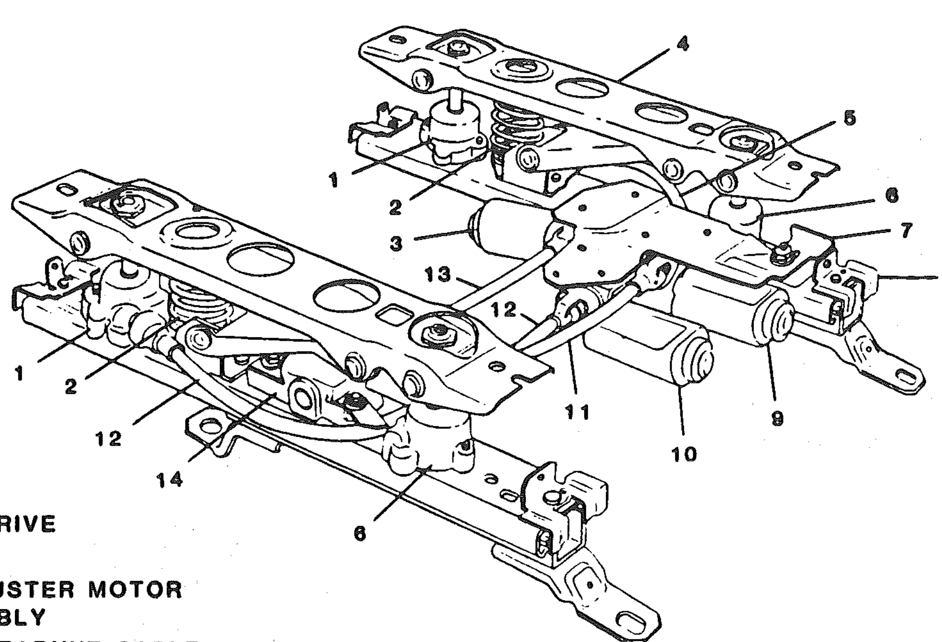


Fig. 24 - Six-Way Seat Adjuster Assembly - Three-Motor Low Profile Direct Drive

Horizontal Actuator (Fig. 25)

Removal and Installation

1. Remove seat assembly from body and place upside down on a clean, protected surface.
2. Disconnect drive cables as described under Horizontal and Vertical Drive Cables.
3. Remove affected adjuster assembly from seat and place in bench vise to prevent accidental ejection of compressed vertical assist spring when rear gearnut attaching nut is removed.
4. At top of adjuster, remove rear vertical gearnut attaching nut and tension spring. Open vise slowly to relieve assist spring compression and remove. At top of adjuster remove front vertical gearnut attaching nut.
5. Lift front of adjuster upper channel upward, then remove screws securing horizontal actuator to adjuster upper channel assembly and remove actuator from adjuster.
6. To install, reverse removal procedure. When installing horizontal actuator, be sure actuator drive gear is fully engaged with teeth on lower channel rack gear. With actuator attaching screws tight, there should be no free motion between upper and lower adjusting channels. Adjust actuator as required until all free motion between channels has been removed (see Power Six-Way Seat Adjuster Horizontal Actuator Adjustment under Front Seat Adjustments). Be sure seat adjusters are in phase before installing seat assembly into body. See step 5c under Front Seat Adjuster Assembly - Removal and Installation.

Front/Rear Vertical Gearnut (Fig. 25)

Removal and Installation

1. Operate seat to full-forward position.
2. Remove front seat assembly from body and place upside down on a clean, protected surface.
3. Disconnect drive cables as described under heading Horizontal and Vertical Drive Cables and remove affected adjuster assembly from seat.
4. Follow previous description for top of adjuster removal of vertical gearnut attaching nuts, tension springs and assist spring.
5. Lay adjuster on its side and remove as required vertical gearnut attaching screws; the remove gearnut from adjuster. Depending on which gearnut is being removed, it may be necessary to manually crank the horizontal actuator to gain access to vertical gearnut attaching screws on bottom of lower channel.
6. If vertical gearnut is being replaced with a new part, transfer gearnut shoulder nut and tension spring to new gearnut assembly.
7. To install, reverse removal procedure. Be sure adjusters are in phase before installing seat assembly into body. See step 5c under Front Seat Adjuster Assembly - Removal and Installation.

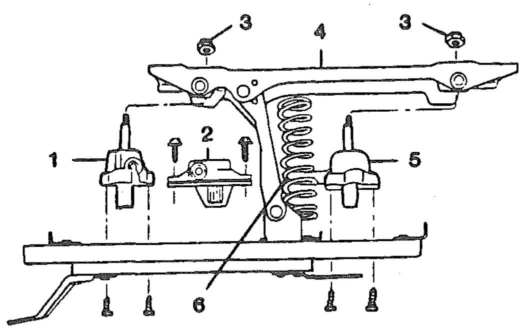


Fig. 25 - Six-Way Seat Adjuster Components

SIX-WAY POWER SEAT SWITCH ASSEMBLY

Removal and Installation

1. Carefully disengage switch cover plate (escutcheon) using a flat-bladed tool and remove (Fig. 26).
2. Remove switch assembly cover attaching screws.
3. Remove switch assembly cover.
4. Lift up on switch assembly and disconnect wire harness connector assembly.
5. To remove power seat bracket support assembly, remove attaching screws that retain the assembly to the seat cushion frame.
6. To install, reverse removal procedures. Identification arrow on harness connector face must point to the rear of vehicle for proper operation of the six-way power seat assembly.

FOUR-WAY MANUAL SEAT ADJUSTER

The four-way manual seat adjuster cannot be disassembled for repair except to replace the assist springs or release lever knob (Fig. 27). The adjuster, in addition to providing for forward and rearward seat travel, also allows the seat cushion to be raised or lowered in the front for additional comfort. To raise the front of the cushion, pull up on the bar lever in front of seat and push back on the seatback until the desired position is reached. To lower the front of the seat cushion, again pull up on the bar lever in front of the seat, but push down on the front of the seat cushion.

SEATBACK LOCK STRIKER/SIDE INNER BAR STOP

Both the seatback lock striker located on the outboard side of the seat cushion and seatback side outer bar stop located on the outboard side of the seat cushion consist of a single metal bolt and washer assembly threaded into a tapped plate located in the seat cushion frame assembly.

Removal and Installation

1. Using door and tailgate striker removal tool J-23457, BT-7107 or equivalent, remove striker or stop from seatback side arm.
2. To install striker or stop, start thread engagement by hand to assure that bolt is threaded straight, then tighten striker or stop 46 N·m (34 ft-lb). Use tool J-23457, BT-7107 or equivalent.

HIGH PERFORMANCE ARTICULATING AQ9 SEAT (2FS87)

Head Restraint

Remove or Disconnect

1. Fully extend headrest and work boot (12, Fig. 28) and escutcheon (9) downward from underside of head restraint. Separate escutcheon from boot.
2. Insert lock release tool (Fig. 14) down front surface of head restraint post until it stops. Push both the head restraint and tool fully downward at the same time; then leaving the tool in place, lift out the head restraint from the seatback.

Disassemble

1. Rotate head restraint knob to fully extend pad (2, Fig. 28).
2. Pry off RH and LH knob covers (5).
3. RH and LH knobs (6).
4. Pry head restraint pad (2) from inner cover (3).
5. Further disassembly will be obvious upon inspection.

Assemble

Reassemble reverse of disassembly procedure.

Install or Connect

1. Reassemble escutcheon to boot and insert head restraint post through escutcheon and into post guide (10) in seatback frame.
2. Push head restraint to full-down position and check that lock spring engages and prevents head restraint from being removed.

Lateral and Lumbar Bladders

Remove or Disconnect

1. Disconnect hose coupling (6, Fig. 29) and electrical connectors (3 and 5). Remove seat and place on clean protected surface.

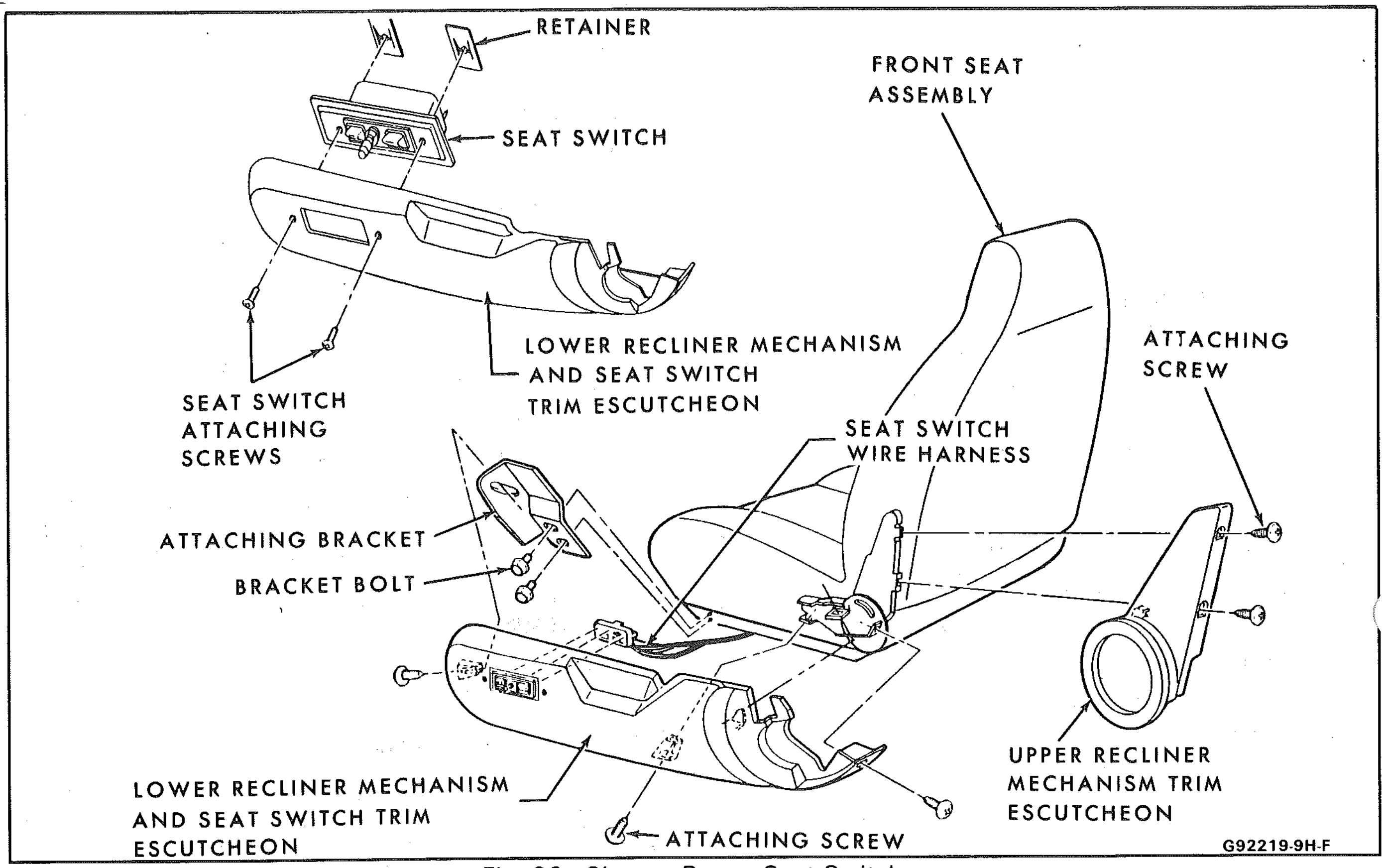


Fig. 26 - Six-way Power Seat Switch

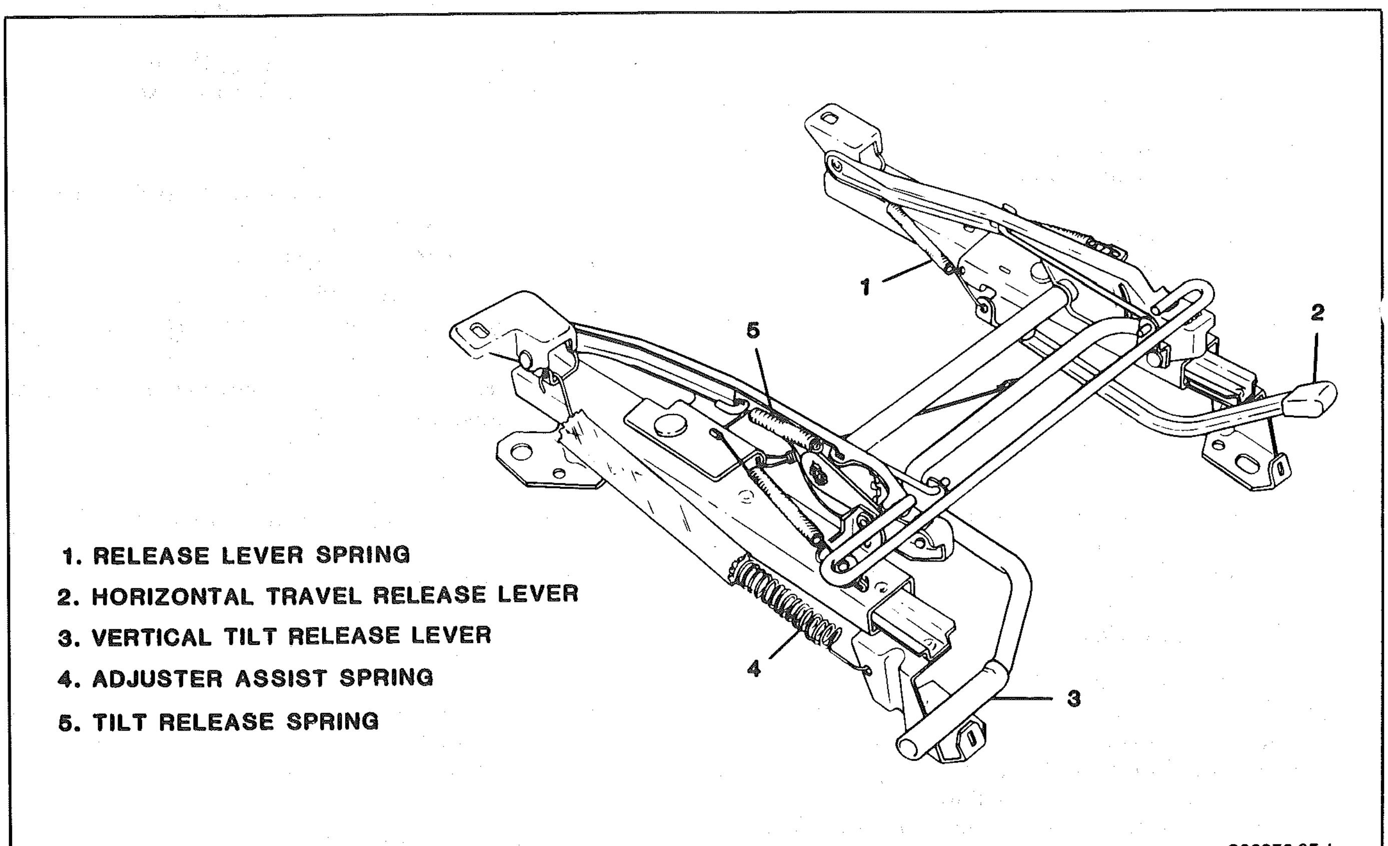
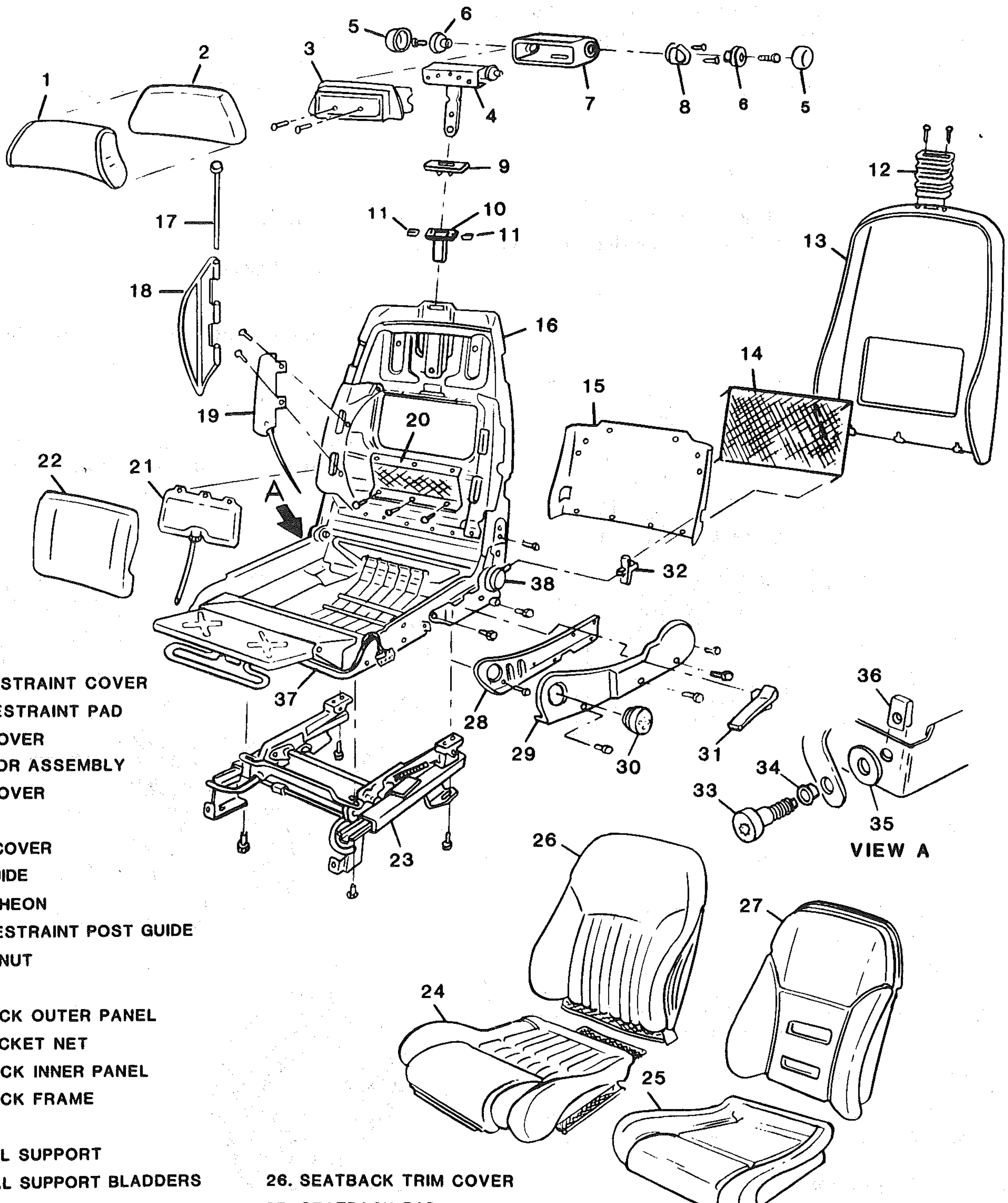


Fig. 27 - Four-Way Manual Seat Adjuster



1. HEAD RESTRAINT COVER
2. HEAD RESTRAINT PAD
3. INNER COVER
4. ACTUATOR ASSEMBLY
5. KNOB COVER
6. KNOB
7. OUTER COVER
8. BELT GUIDE
9. ESCUTCHEON
10. HEAD RESTRAINT POST GUIDE
11. SPRING NUT
12. BOOT
13. SEATBACK OUTER PANEL
14. MAP POCKET NET
15. SEATBACK INNER PANEL
16. SEATBACK FRAME
17. PIN
18. LATERAL SUPPORT
19. LATERAL SUPPORT BLADDERS AND HOSE ASSEMBLY
20. LUMBAR SUPPORT HINGE
21. LUMBAR BLADDER AND HOSE ASSEMBLY
22. LUMBAR PANEL
23. ADJUSTER ASSEMBLY
24. CUSHION TRIM COVER
25. CUSHION PAD
26. SEATBACK TRIM COVER
27. SEATBACK PAD
28. TRIM PANEL
29. FINISH PANEL
30. SWITCH ASSEMBLY
31. RECLINER HANDLE
32. INERTIA LEVER KNOB
33. INNER HINGE PIVOT BOLT
34. BUSHING
35. WASHER
36. SPRING NUT
37. CUSHION FRAME
38. RECLINER ASSEMBLY

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Fig. 28 - High Performance Articulating Seat (AQ9)

2. Adjuster assembly (23, Fig. 28).
3. Disconnect hoses from solenoid valve (1, Fig. 29).
4. Head restraint (ref. Head Restraint procedures).
5. Boot (12, Fig. 28)
6. Screws from underside of seatback outer panel (13) and lift off panel
7. Inner panel (15)
8. Seatback trim cover (26)
9. Seatback pad (27)
10. Lateral bladders and hose assembly (19).
11. Lumbar panel (22), lumbar bladder and hose assembly (21)

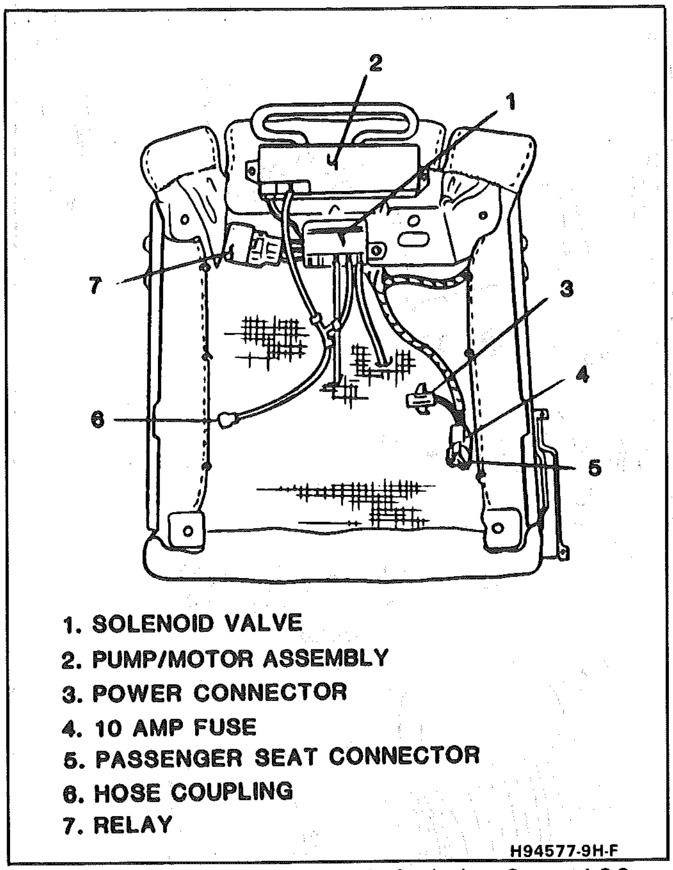


Fig. 29 - High Performance Articulating Seat - AQ9 (Underside View)

Install or Connect

Install reverse of removal procedure. Bladders must be installed with rough side toward seat frame.

Seatback Assembly

Remove or Disconnect

1. Disconnect hose coupling (6, Fig. 29) and electrical connectors (3 and 5). Remove seat and place on clean protected surface.
2. Adjuster assembly (23, Fig. 28).
3. Disconnect hoses from solenoid valve (1, Fig. 29).
4. Head restraint (ref. Head Restraint procedures).
5. Boot (12, Fig. 28).
6. Screws from underside of seatback outer panel (13) and remove panel.
7. Two upper 1/2" bolts from recliner assembly (38).
8. Inboard finish panel (29).
9. Inner hinge pivot bolt (33).
10. Seatback frame assembly (16).

Install or Connect

Install reverse of removal procedures.

Switch Assembly

Remove or Disconnect

Reach behind switch assembly (Fig. 30) and release two of the switch retainer tangs. Withdraw and disconnect switch.

Install or Connect

Install reverse of removal procedure and locate tab on switch body with slot on finish panel (29, Fig. 28).

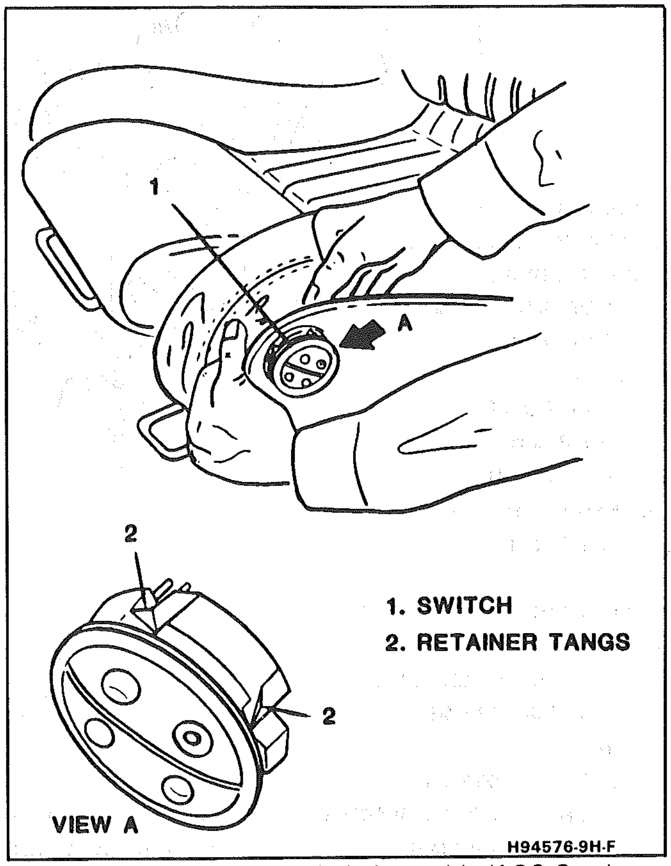


Fig. 30 - Removing Switch Assembly (AQ9 Seat)

Relay, Solenoid Valve and Pump/Motor Assembly

Remove or Disconnect

1. Disconnect hose coupling (6, Fig. 29) and electrical connectors (3 and 5). Remove seat and place on clean protected surface.
2. Adjuster assembly (23, Fig. 28).
3. Relay (7, Fig. 29).

4. Pump/motor assembly (2).
5. Solenoid valve (1).

Install or Connect

Install reverse of removal procedures.

Recliner Assembly

Remove or Disconnect

1. Switch assembly (ref. Switch Assembly procedures).
2. Outer finish panel (29, Fig. 28).
3. Head restraint (ref. Head Restraint procedures).
4. Boot (12)
5. Screws from underside of seatback outer panel (13) and remove panel.
6. Upper and lower bolts securing recliner assembly (38) to seatback frame (16) and cushion frame (37).

REAR SEATS

REAR SEAT CUSHION ASSEMBLY

Removal and Installation

Remove 38 mm seat cushion attaching bolts located at center of right and left sections of rear seat cushion (Fig. 31). Lift cushion upward and remove from vehicle.

To install, reverse removal procedure. Torque seat cushion attaching bolts 16 to 21 N·m (11 to 15 ft-lb).

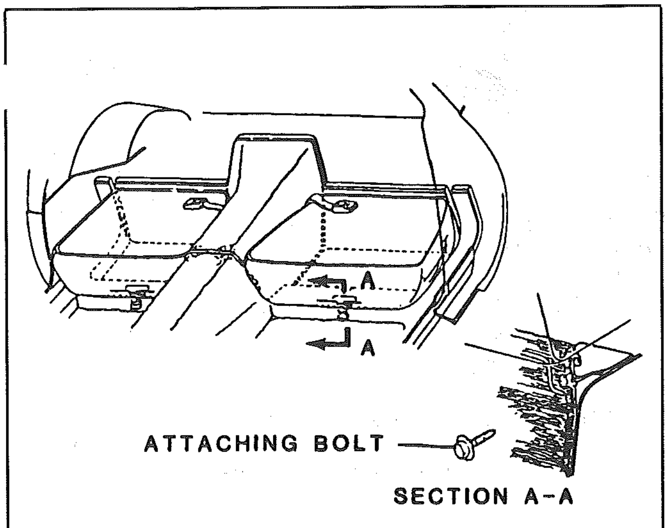
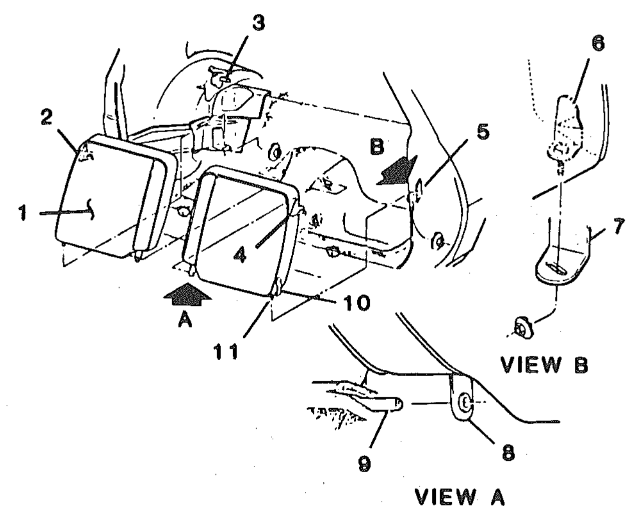


Fig. 31 - Rear Seat Cushion

FOLDING REAR SEATBACK

The folding rear seatback provides additional load floor area when lowered. The rear seatback has a positive acting seatback lock located on the right side. The lock must be disengaged to lower the seatback. When the rear seatback is raised to the up position, the lock hook engages the striker and locks the seatback securely in place (Fig. 33). Some styles may be equipped with a split folding rear seatback which has a positive-acting seatback lock on both the right and left sides. The split rear seatback is not designed to lay flat but allows for additional load floor area and allows for a third passenger in the rear when one side is folded down (Fig. 32).



1. FOLDING REAR SEATBACK ASSEMBLY
2. LOCK ASSEMBLY
3. STRIKER
4. LOCK ASSEMBLY
5. WHEELHOUSE SUPPORT
6. FOLDING REAR SEAT STUD
7. WHEELHOUSE SUPPORT SLOT
8. INNER PIVOT SUPPORT
9. FLOOR PAN PIVOT PIN
10. PIVOT SUPPORT BRACKET
11. REAR SEAT STUD

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Fig. 32 - Split Folding Rear Seatback Installation

PIVOT SUPPORT, SPLIT AND FULL WIDTH FOLDING SEATBACK ASSEMBLY

Removal and Installation

1. Remove rear seat cushions.
2. Remove left and right folding rear seatback panel pivot support bracket retaining nuts (Fig. 34).

3. Remove inner seat pivot support from floor pan pivot pin on left and/or right seatback panel.
4. Remove left and/or right seatback panel by lifting on outboard portion of seat for clearance and remove from car.
5. Place folding seatback assembly on a clean work surface. Using a striker bolt removal tool, J 23457 or equivalent, remove pivot assembly bolt (Fig. 33).
6. To install, reverse removal procedure.
7. Drive attaching pivot bolt to a torque range of 24 to 34 N·m (18 to 24 ft-lb).

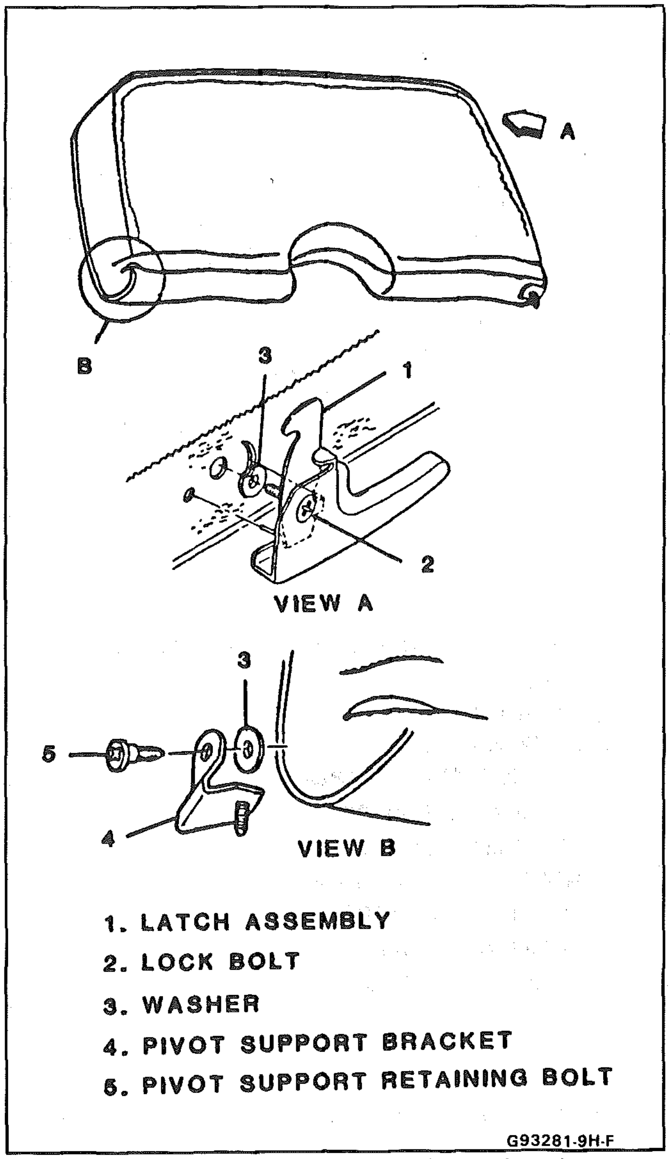


Fig. 33-Folding Rear Seatback Hardware Attachments

FOLDING SEATBACK LOCK

The full width folding second seatback has a seatback lock located on the right side of the seatback. The seatback can be folded down by pulling the lock handle forward while lowering the seatback. The split folding seatback has a seatback lock located on both the right and left sides of the seatback panels.

Removal and Installation

1. Remove seat cushion.
2. Remove folding seatback assembly.
3. Remove lock bolt that secures latch assembly to folding seatback panel (Fig. 33).
4. To install, reverse removal procedures. Drive compartment lock bolt to a specified torque of 12 to 16 N·m (9 to 12 ft-lb).

REAR SEATBACK LOCK STRIKER

Removal and Installation

1. Fold rear seatback forward.
2. Using lock striker removal tool J-23457, BT-7107 or equivalent, remove striker (Fig. 35).
3. To install, reverse removal procedure. Torque lock striker 46 N·m (34 ft-lb).

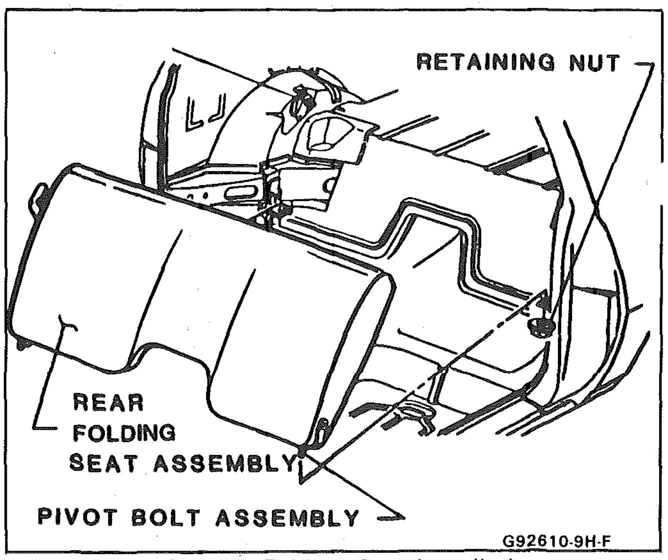


Fig. 34-Rear Folding Seat Installation

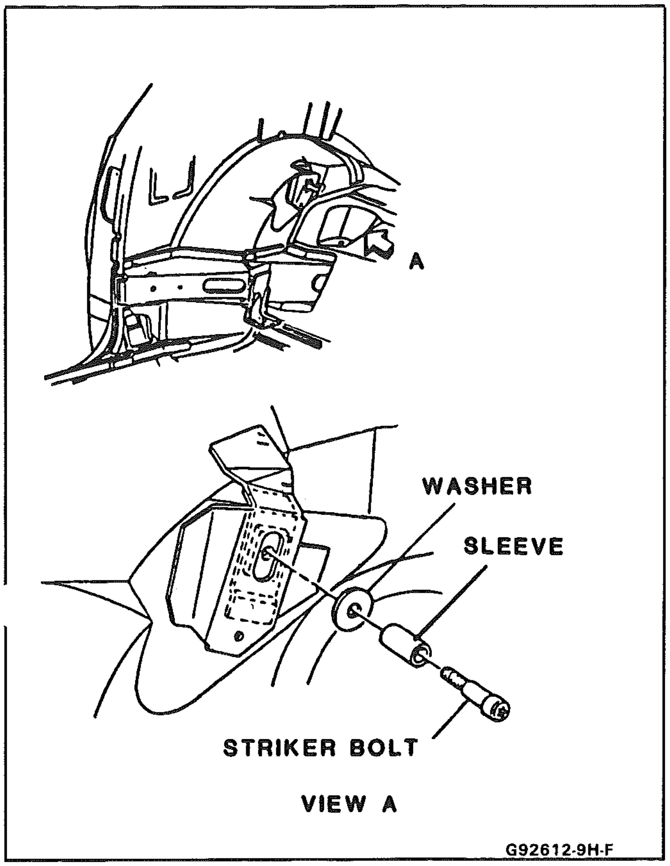


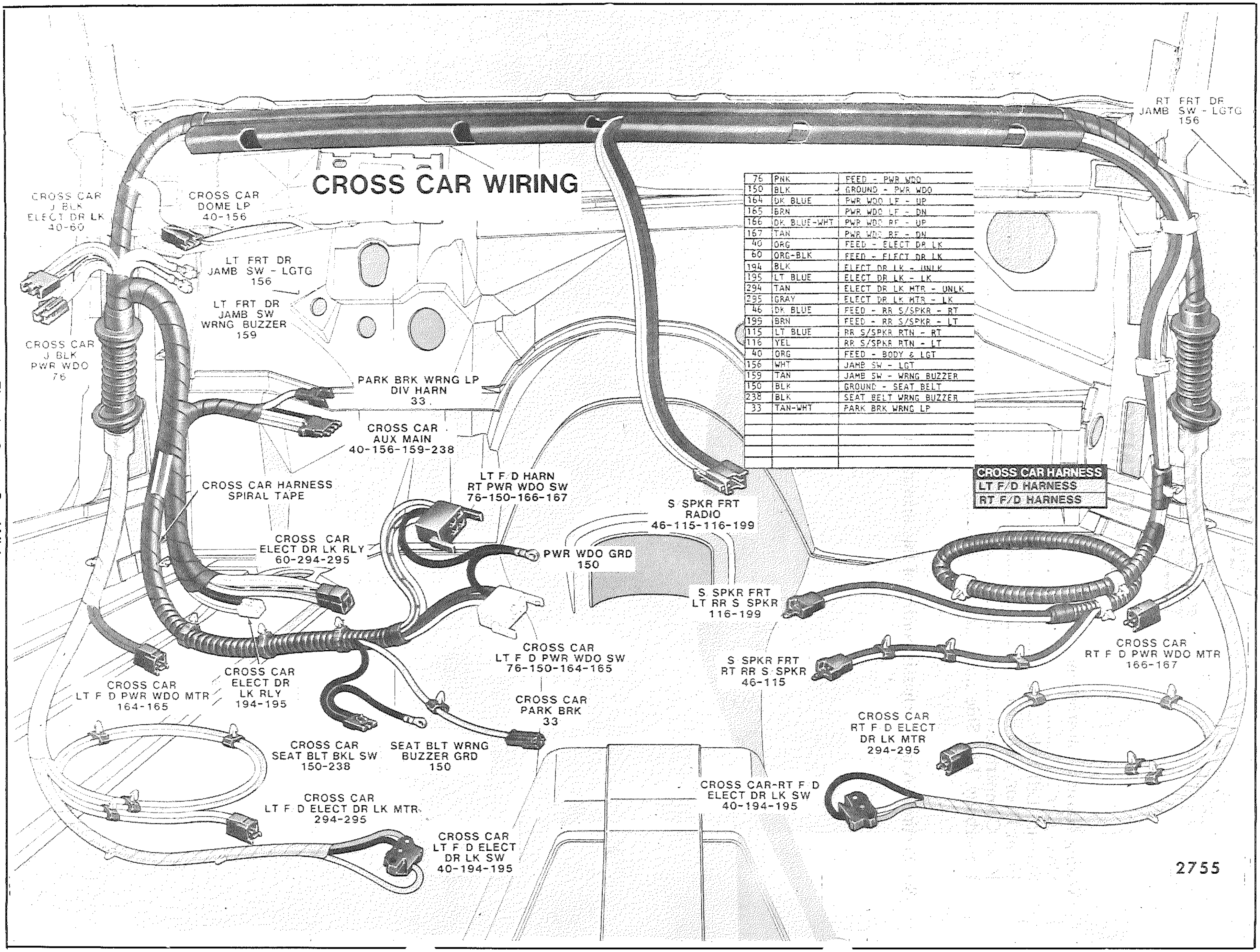
Fig. 35-Rear Seatback Lock Striker Bolt Installation

SECTION 10H

ELECTRICAL

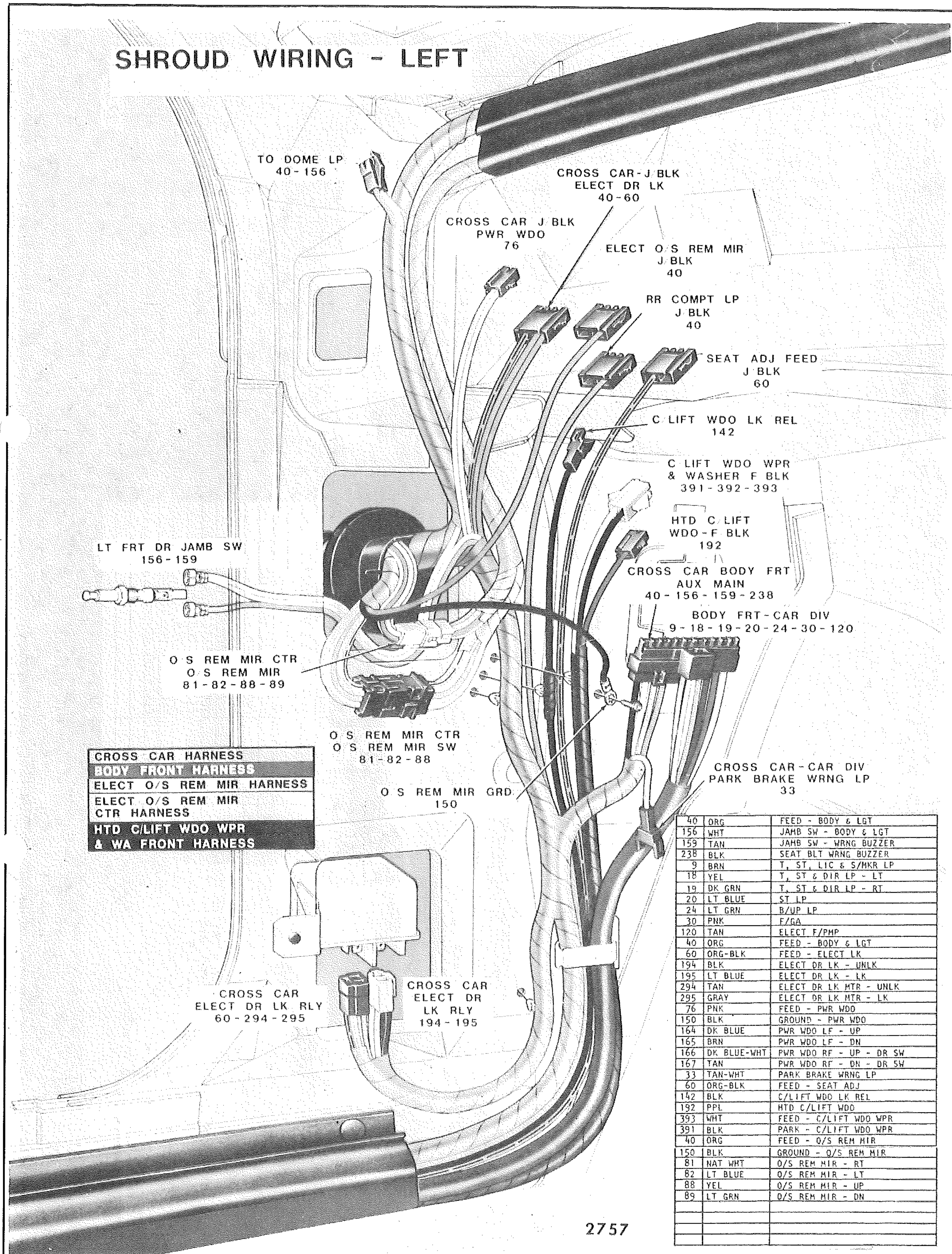
CONTENTS

See Section 8A in the chassis portion of this manual for detailed diagnostics.



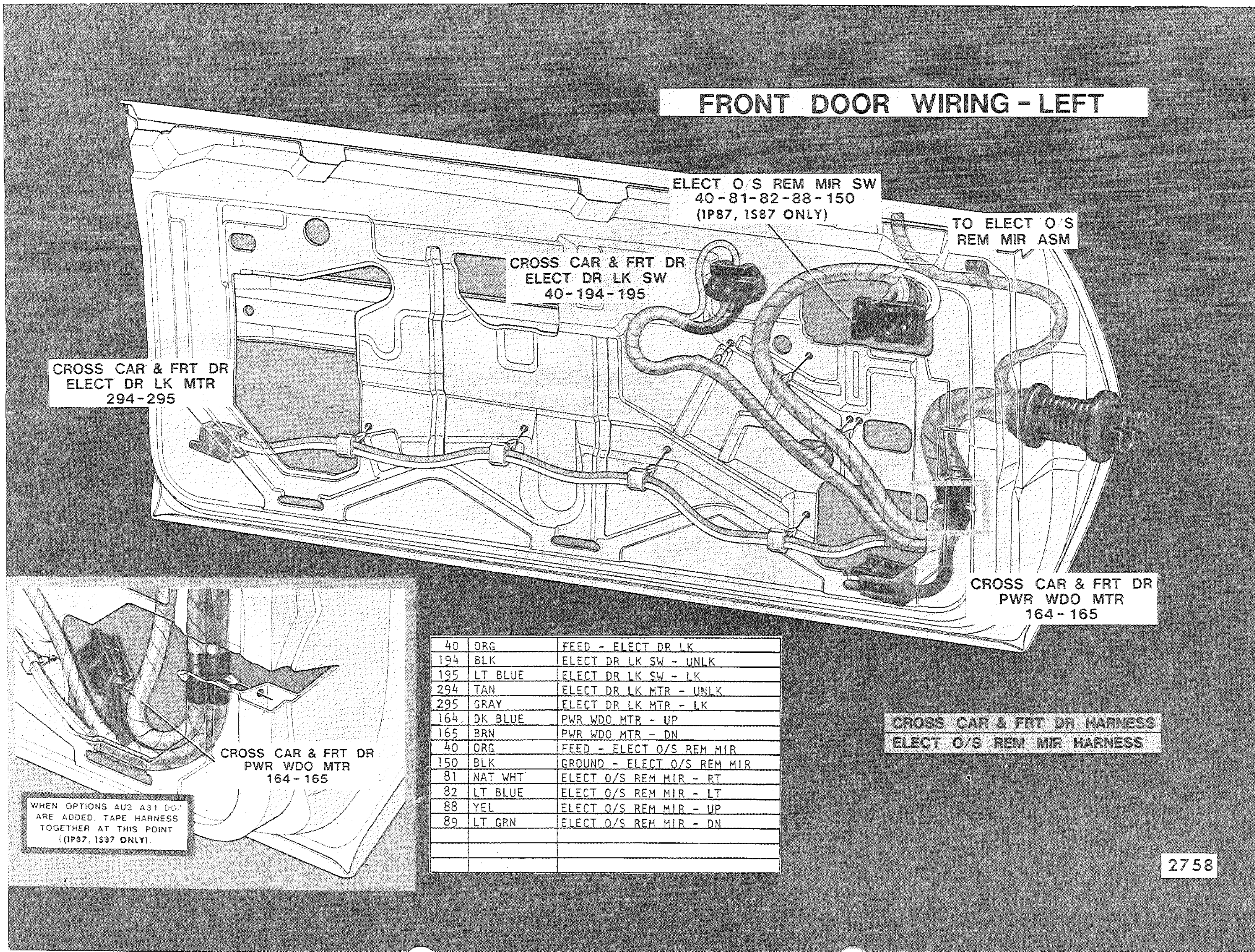
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLUE	PWR WDO LF - UP
165	BRN	PWR WDO LF - DN
166	DK BLUE-WHT	PWR WDO RF - UP
167	TAN	PWR WDO RF - DN
40	ORG	FEED - ELECT DR LK
60	ORG-BLK	FEED - ELECT DR LK
194	BLK	ELECT DR LK - UNLK
195	LT BLUE	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
46	DK BLUE	FEED - RR S/SPKR - RT
199	BRN	FEED - RR S/SPKR - LT
115	LT BLUE	RR S/SPKR RTN - RT
116	YEL	RR S/SPKR RTN - LT
40	ORG	FEED - BODY & LGT
156	WHT	JAMB SW - LGT
159	TAN	JAMB SW - WRNG BUZZER
150	BLK	GROUND - SEAT BELT
238	BLK	SEAT BELT WRNG BUZZER
33	TAN-WHT	PARK BRK WRNG LP

Fig. 1 - Cross Car Wiring



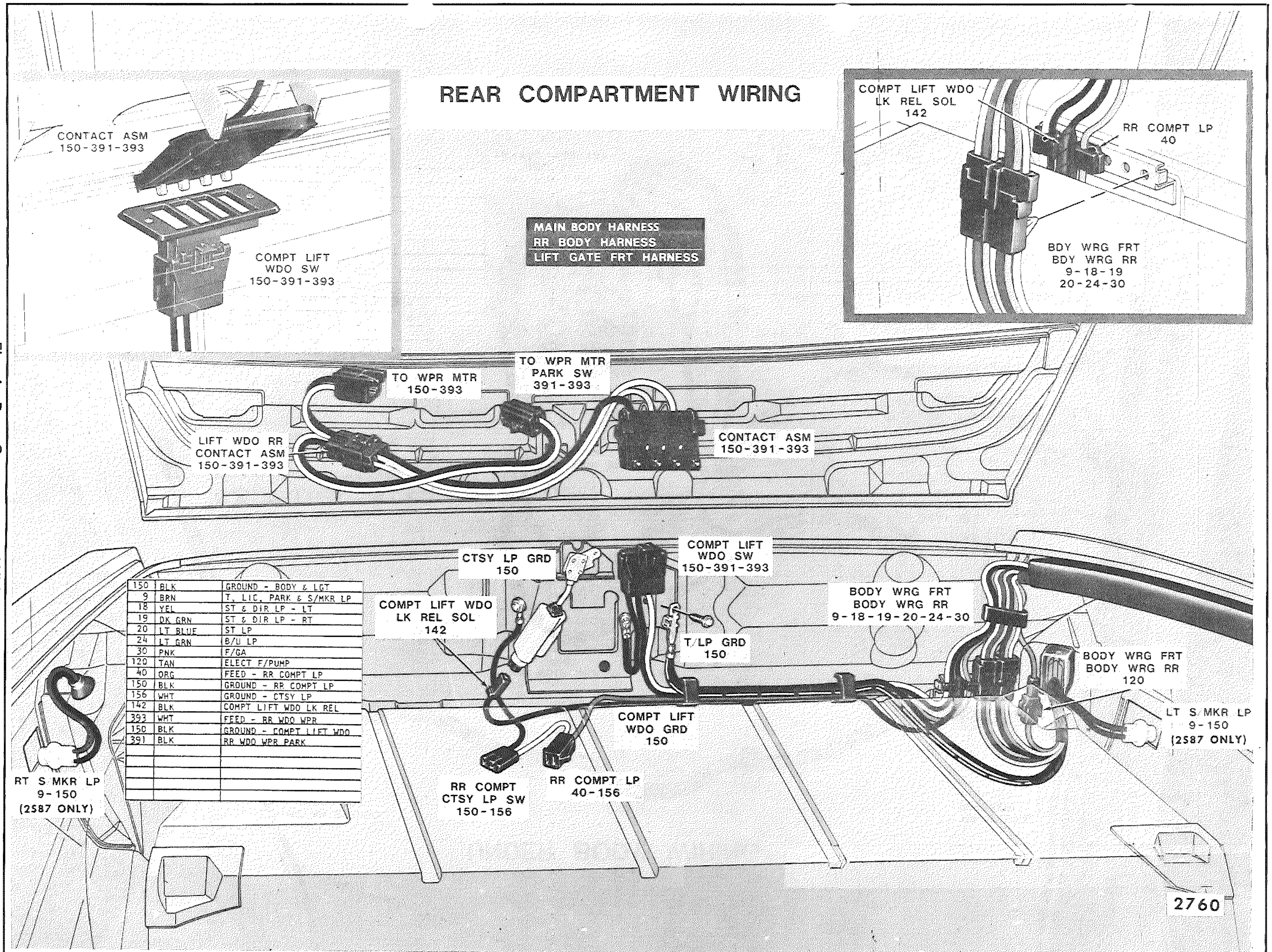
40	ORG	FEED - BODY & LGT
156	WHT	JAMB SW - BODY & LGT
159	TAN	JAMB SW - WRNG BUZZER
238	BLK	SEAT BLT WRNG BUZZER
9	BRN	T, ST, LIC & S/MKR LP
18	YEL	T, ST & DIR LP - LT
19	DK GRN	T, ST & DIR LP - RT
20	LT BLUE	ST LP
24	LT GRN	B/UP LP
30	PNK	F/GA
120	TAN	ELECT F/PMP
40	ORG	FEED - BODY & LGT
60	ORG-BLK	FEED - ELECT LK
194	BLK	ELECT DR LK - UNLK
195	LT BLUE	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLUE	PWR WDO LF - UP
165	BRN	PWR WDO LF - DN
166	DK BLUE-WHT	PWR WDO RF - UP - DR SW
167	TAN	PWR WDO RF - DN - DR SW
33	TAN-WHT	PARK BRAKE WRNG LP
60	ORG-BLK	FEED - SEAT ADJ
142	BLK	C/LIFT WDO LK REL
192	PPL	HTD C/LIFT WDO
393	WHT	FEED - C/LIFT WDO WPR
391	BLK	PARK - C/LIFT WDO WPR
40	ORG	FEED - O/S REM MIR
150	BLK	GROUND - O/S REM MIR
81	NAT WHT	O/S REM MIR - RT
82	LT BLUE	O/S REM MIR - LT
88	YEL	O/S REM MIR - UP
89	LT GRN	O/S REM MIR - DN

Fig. 2 - Shroud Wiring, Left - 1FP87 Shown, Other Styles Similar



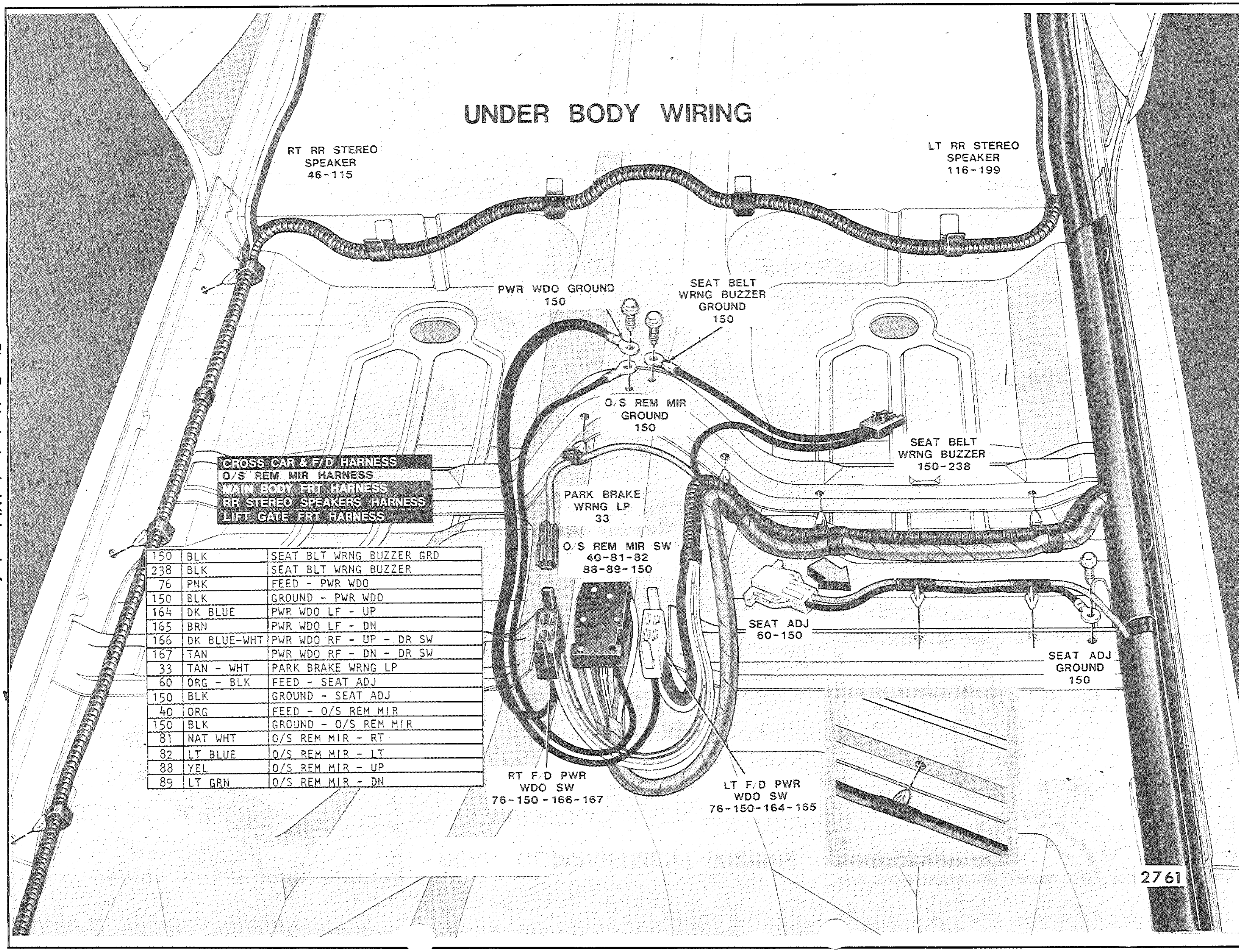
40	ORG	FEED - ELECT DR LK
194	BLK	ELECT DR LK SW - UNLK
195	LT BLUE	ELECT DR LK SW - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
164	DK BLUE	PWR WDO MTR - UP
165	BRN	PWR WDO MTR - DN
40	ORG	FEED - ELECT O/S REM MIR
150	BLK	GROUND - ELECT O/S REM MIR
81	NAT WHT	ELECT O/S REM MIR - RT
82	LT BLUE	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN

Fig. 3 - Front Door Wiring, Left Side



150	BLK	GROUND - BODY & LGT
9	BRN	T, LIC, PARK & S/MKR LP
18	YEL	ST & DIR LP - LT
19	DK GRN	ST & DIR LP - RT
20	LT BLUE	ST LP
24	LT GRN	B/U LP
30	PNK	F/GA
120	TAN	ELECT F/PUMP
40	ORG	FEED - RR COMPT LP
150	BLK	GROUND - RR COMPT LP
156	WHT	GROUND - CTSY LP
142	BLK	COMPT LIFT WDO LK REL
393	WHT	FEED - RR WDO WPR
150	BLK	GROUND - COMPT LIFT WDO
391	BLK	RR WDO WPR PARK

Fig. 4 - Rear Compartment Wiring



150	BLK	SEAT BLT WRNG BUZZER GRD
238	BLK	SEAT BLT WRNG BUZZER
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLUE	PWR WDO LF - UP
165	BRN	PWR WDO LF - DN
166	DK BLUE-WHT	PWR WDO RF - UP - DR SW
167	TAN	PWR WDO RF - DN - DR SW
33	TAN - WHT	PARK BRAKE WRNG LP
60	ORG - BLK	FEED - SEAT ADJ
150	BLK	GROUND - SEAT ADJ
40	ORG	FEED - O/S REM MIR
150	BLK	GROUND - O/S REM MIR
81	NAT WHT	O/S REM MIR - RT
82	LT BLUE	O/S REM MIR - LT
88	YEL	O/S REM MIR - UP
89	LT GRN	O/S REM MIR - DN

Fig. 5 - Underbody Wiring, Left

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