1986
PONTIAC
FIERO
SERVICE MANUAL

NOTICE

This manual applies to the 1986 Pontiac Fiero 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 reference 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 1986 Pontiac Models. In all cases, an equivalent may be used.

PONTIAC MOTOR DIVISION
GENERAL MOTORS CORPORATION
PONTIAC, MICHIGAN 48053

S-8610P

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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

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

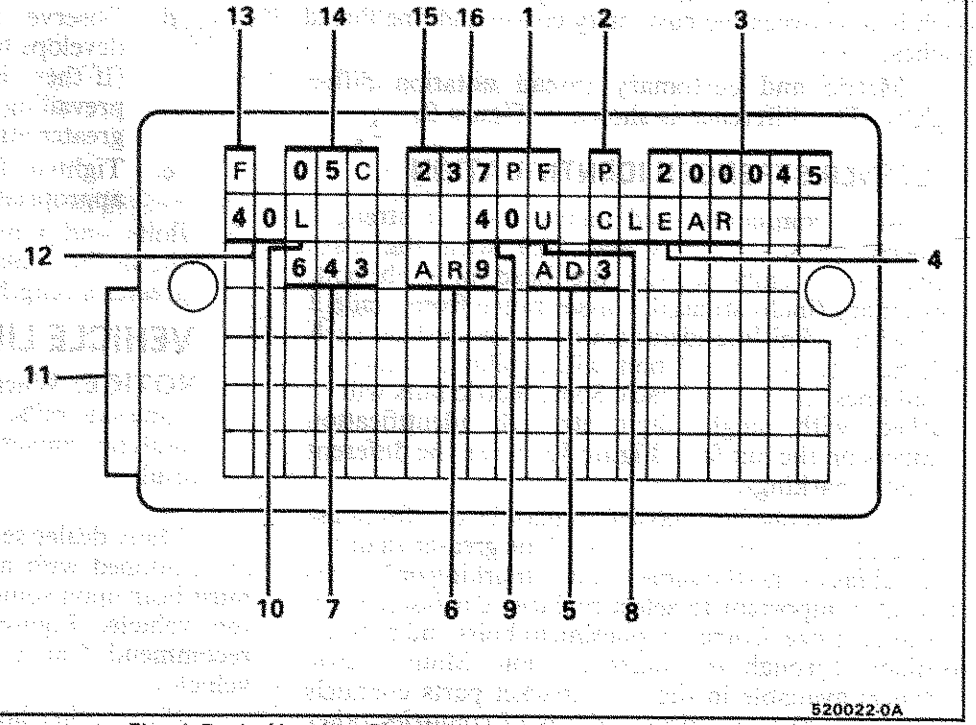


Fig. 1 Body Number Plate

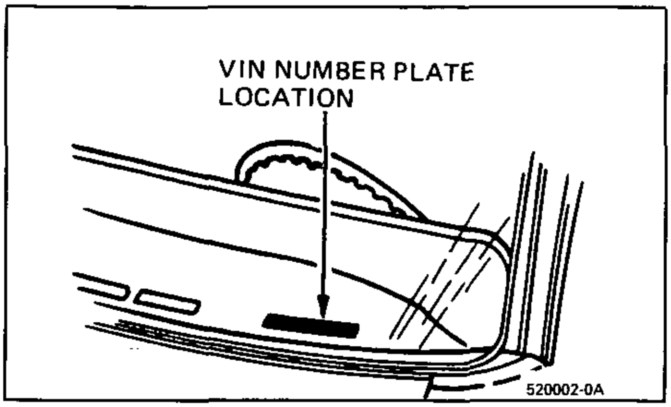


Fig. 2 Vehicle Identification Number Plate Location

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 through 16 indicate the recommended areas for hoist contact for all Pontiac vehicles.

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

PONTIAC
VIN SYSTEM IDENTIFICATION

1 G 2 F W 8 7 H 6 G L 1 2 3 4 5 6

PLANT SEQUENCE NUMBER

PLANT CODE

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

MANUFACTURER	
G	GENERAL MOTORS

MAKE AND TYPE	
2.	PONTIAC

GM PLANT CODES
(V.I.N. POSITION #11)

A	LAKEWOOD
L	VAN NUYS
M&C	LANSING
N	NORWOOD
P	PONTIAC MOTOR
X	FAIRFAX
1	OSHAWA
2	ST. THERESE
7	LORDSTOWN

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

CHECK DIGIT

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 SE
A	H	6000 STE
B	L	Parisienne
B	T	Parisienne Brougham
F	S	Firebird
F	X	Firebird SE
F	W	Trans Am
G	J	Grand Prix
G	K	Grand Prix LE
G	P	G.P. Brougham
G	N	Bonneville
G	S	Bonneville LE
G	R	Bonneville Brougham
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

BODY TYPES
(V.I.N. POSITIONS #6 & #7)

CODE	DESCRIPTION
08	*Coupe—2 Door Hatchback*
19	Sedan—4 Door 6 Window Notchback
27	Coupe—2 Door Notchback
35	Station Wagon—4 Door 3 Seat
37	Coupe—2 Door Notchback Special
67	Coupe—2 Door Convertible
68	Sedan—4 Door 4 Window Hatchback
69	Sedan—4 Door 4 Window Notchback
77	Coupe—2 Door Hatchback
87	Coupe—2 Door Sport

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

V.I.N. CODE	R.P.O CODE	ENG. 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
J	LA5	L4	MPFI TURBO	1.8
L	LN7	V6	MPFI	3.0
R	LR8	L4	TBI	2.5
U	L68	L4	TBI	2.5
X	LE2	V6	2BBL	2.8
W	LB6	V6	MPFI	2.8
Y	LV2	V8	4BBL	5.0
0	LH8	L4	TBI	1.8
2	LQ9	L4	TBI	2.5
S	LB8	V6	MPFI	2.8
Z	LB4	V6	TBI	4.3
9	L44	V6	MPFI	2.8

G20002-0A

Fig. 3 Vehicle Identification Number Data

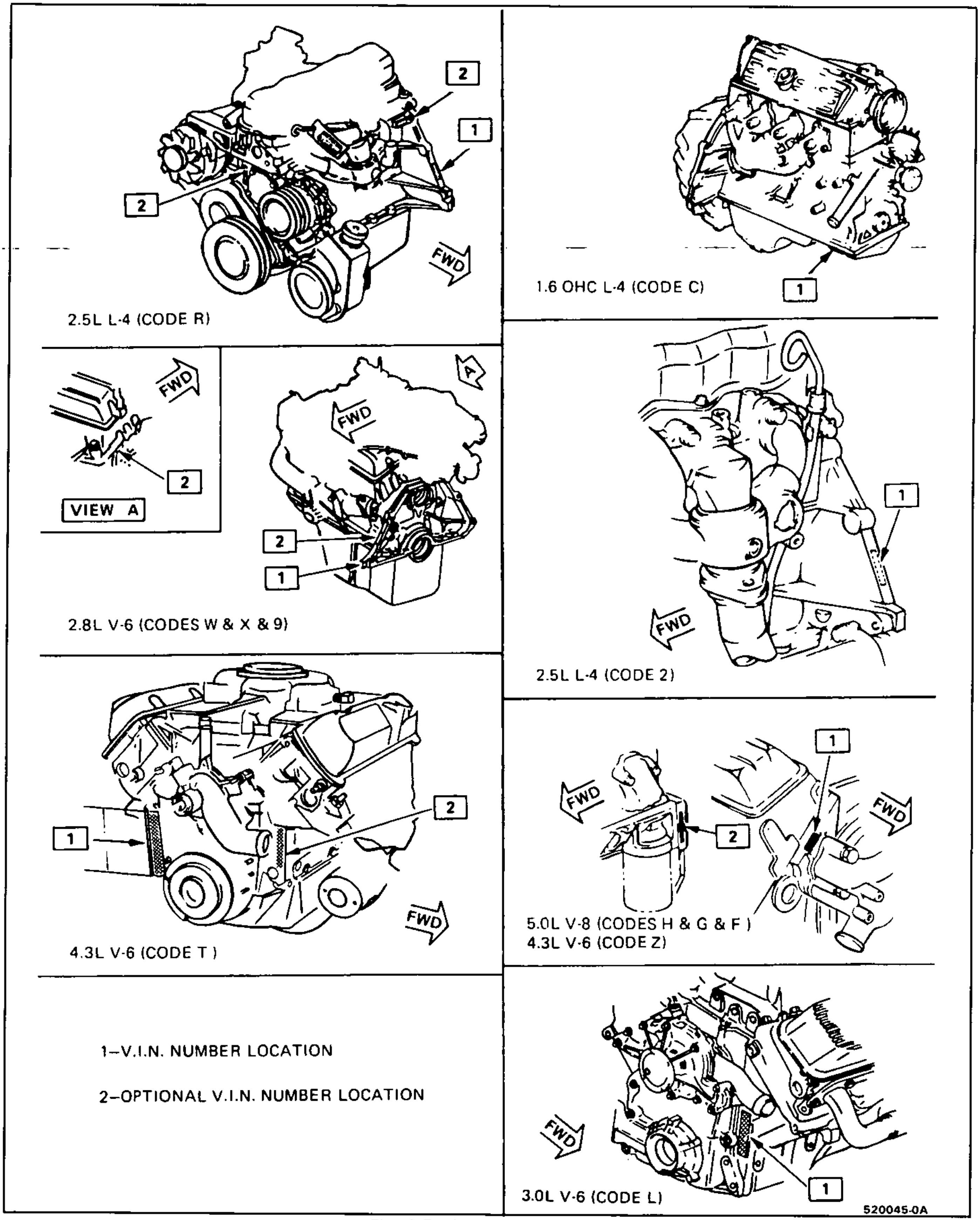


Fig. 4 Engine V.I.N. Location

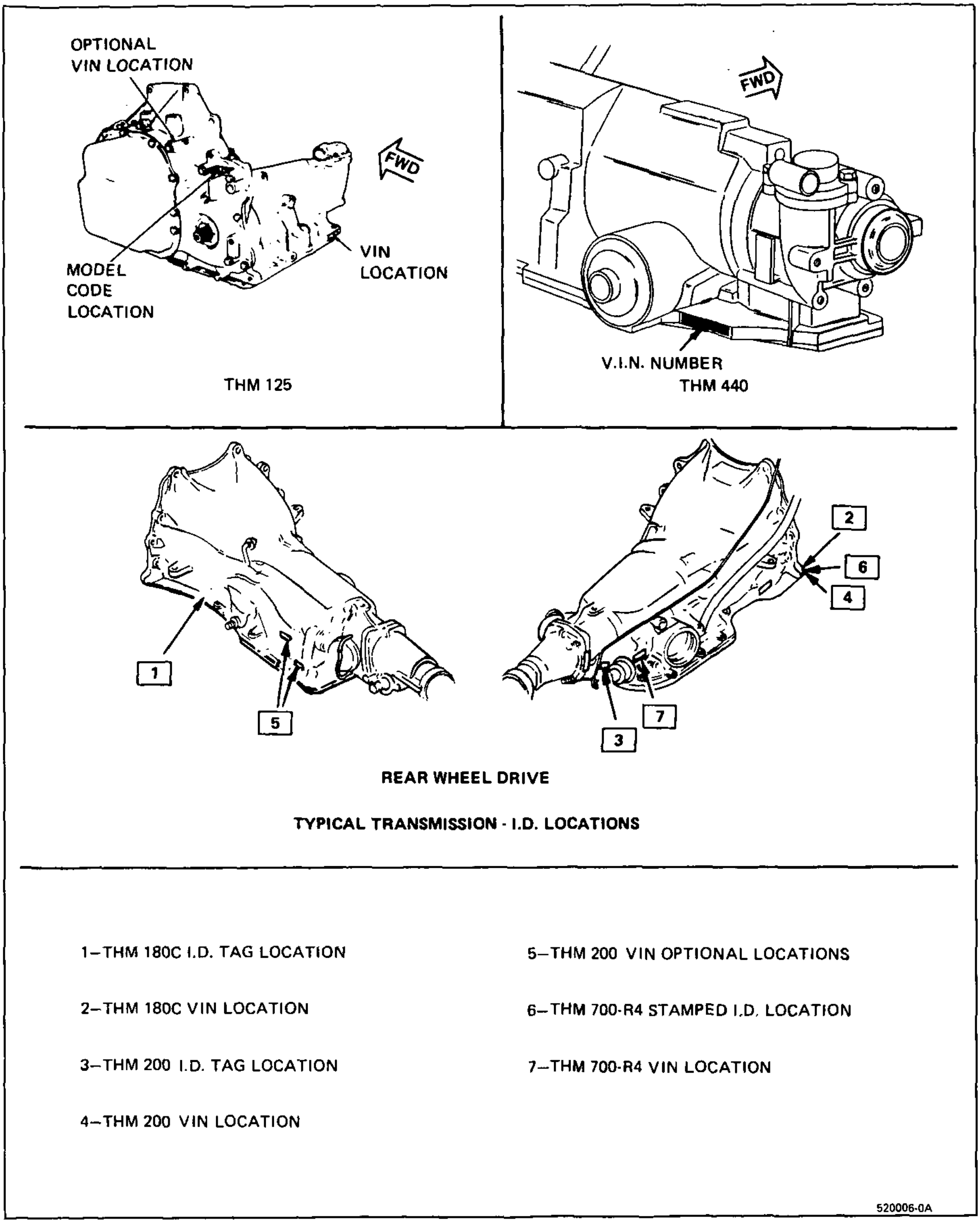
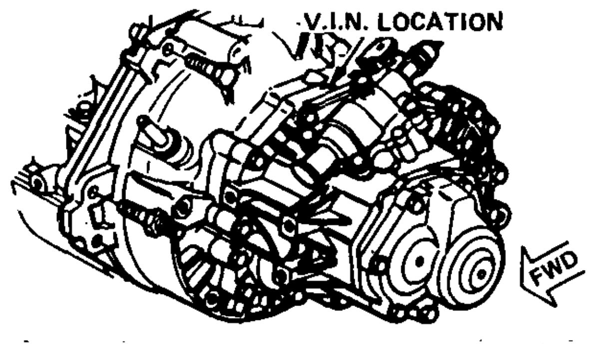
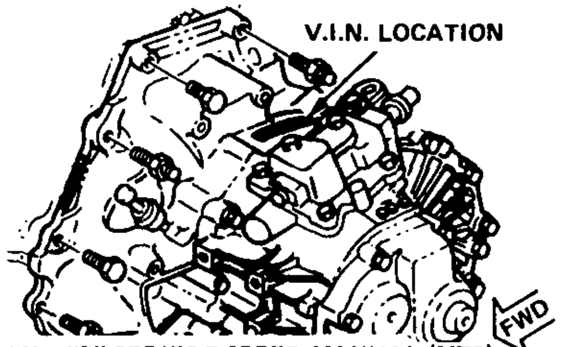


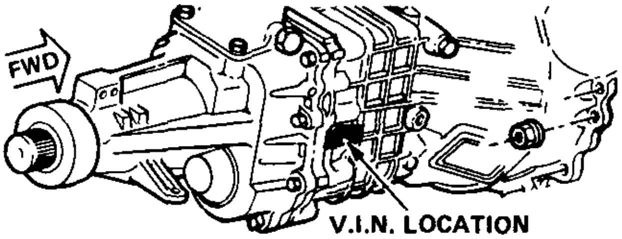
Fig. 5 Automatic Transmission Identification



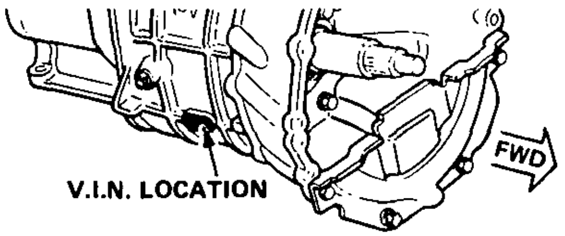
"J" SERIES 5-SPEED MANUAL (MY7 AND MK7)



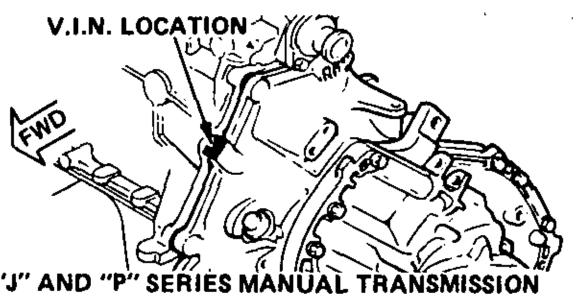
"N" AND "P" SERIES 5-SPEED MANUAL (MT2)



"T" AND "F" SERIES MANUAL TRANSMISSION
5-SPEED MANUAL (MB4, M75)
4-SPEED MANUAL ("F" SERIES ONLY M08)



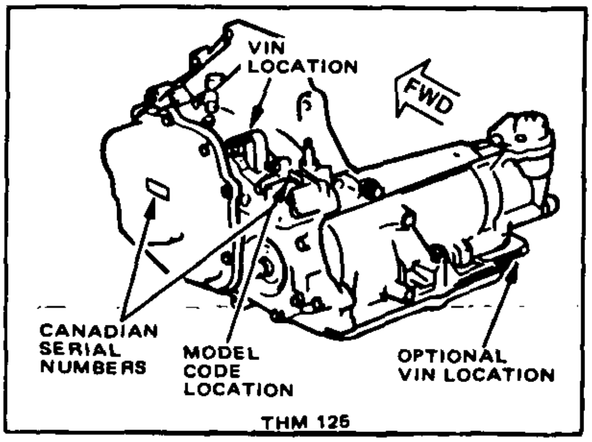
"T" SERIES 4-SPEED MANUAL (MY1)



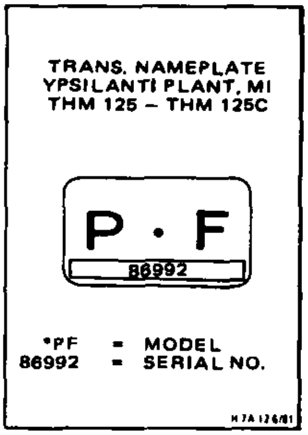
"J" AND "P" SERIES MANUAL TRANSMISSION
4-SPEED MANUAL (M17)
4-SPEED MANUAL (M19 "J" SERIES ONLY)

520041-0A

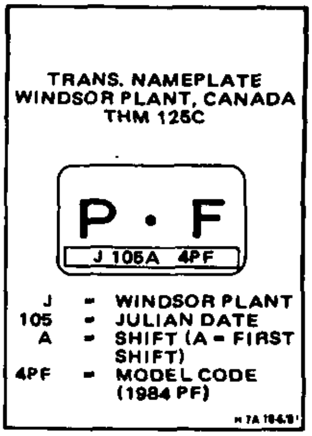
Fig. 6 Manual Transmission Identification



THM 125

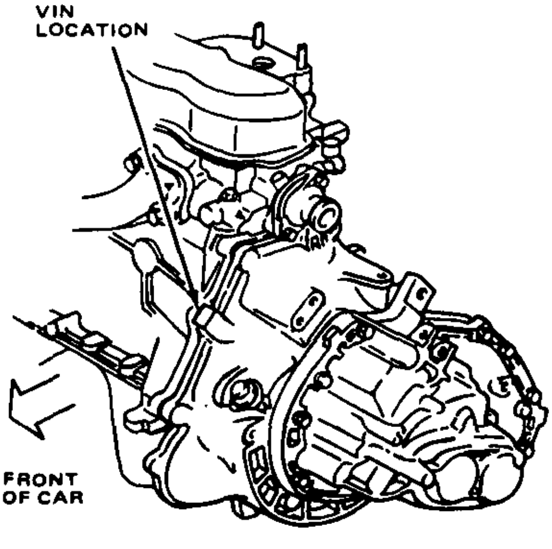


*PF = MODEL
86992 = SERIAL NO.



J = WINDSOR PLANT
105 = JULIAN DATE
A = SHIFT (A = FIRST SHIFT)
4PF = MODEL CODE (1984 PF)

*PF 3.18 AXLE RATIO
*P1 2.84 AXLE RATIO
W/HEAVY DUTY RADIATOR



MANUAL 4S TRANSAXLE

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Fig. 7 Transaxle Identification Location

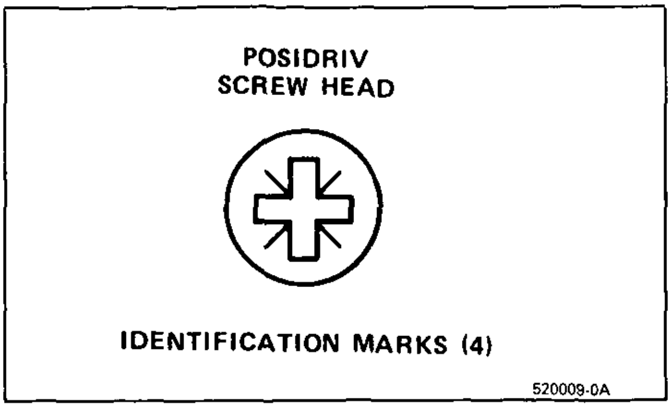
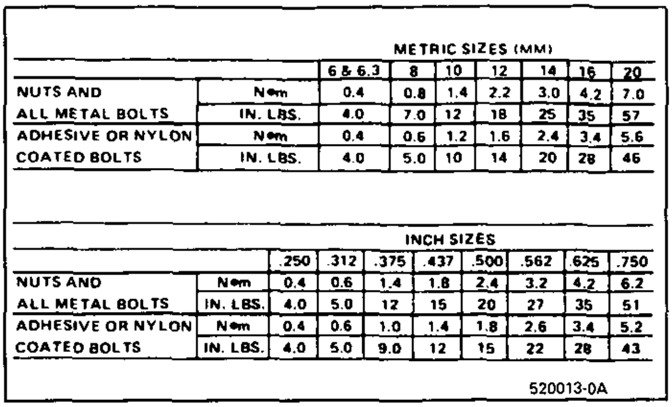


Fig. 8 Cross Recess Screw

PRECAUTIONS AGAINST TIPPING

On front-wheel drive vehicles, the centerline of gravity is further forward than on rear-wheel drive vehicles. Therefore, **whenever removing major components from the rear** of the vehicle, while supported on a hoist, **it is mandatory** to support the vehicle in a manner to prevent the possibility of the vehicle tipping forward.

CAUTION: Failure to follow the procedure outlined may result in unsatisfactory car performance, or a durability failure which may result in loss of control of car.



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

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

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Fig. 10 Fastener Torque Chart

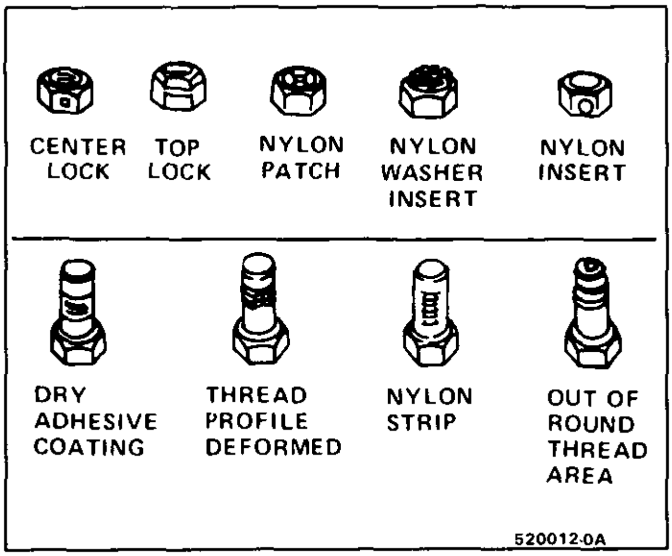


Fig. 11 Prevailing Torque Fasteners

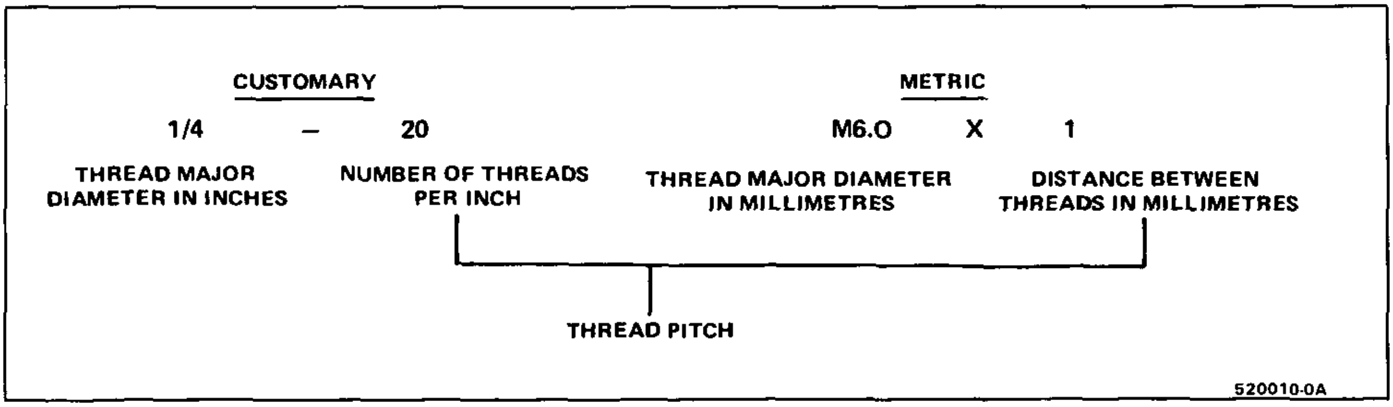
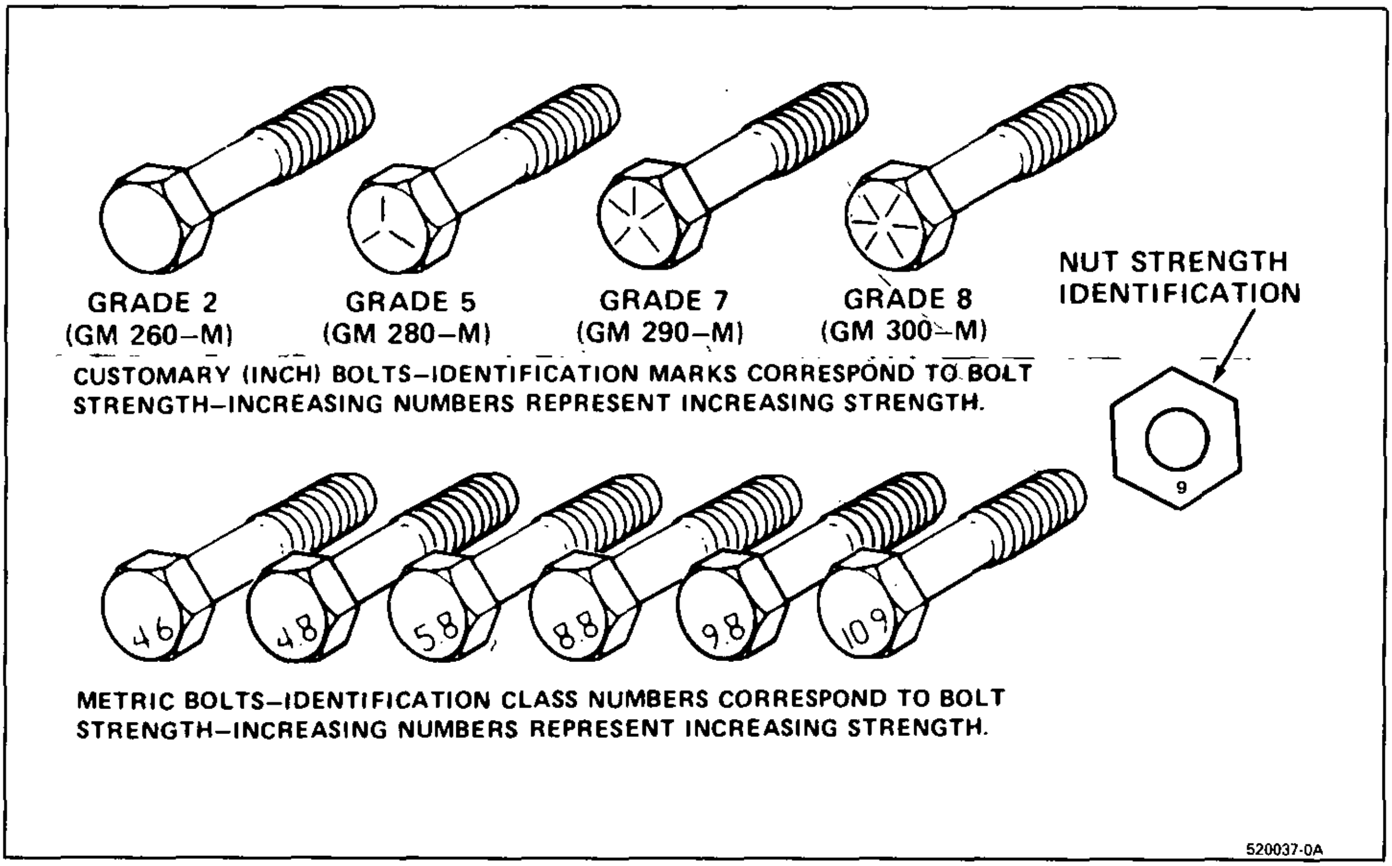


Fig. 9 Thread Notation



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. 12 Bolt Strength Markings

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

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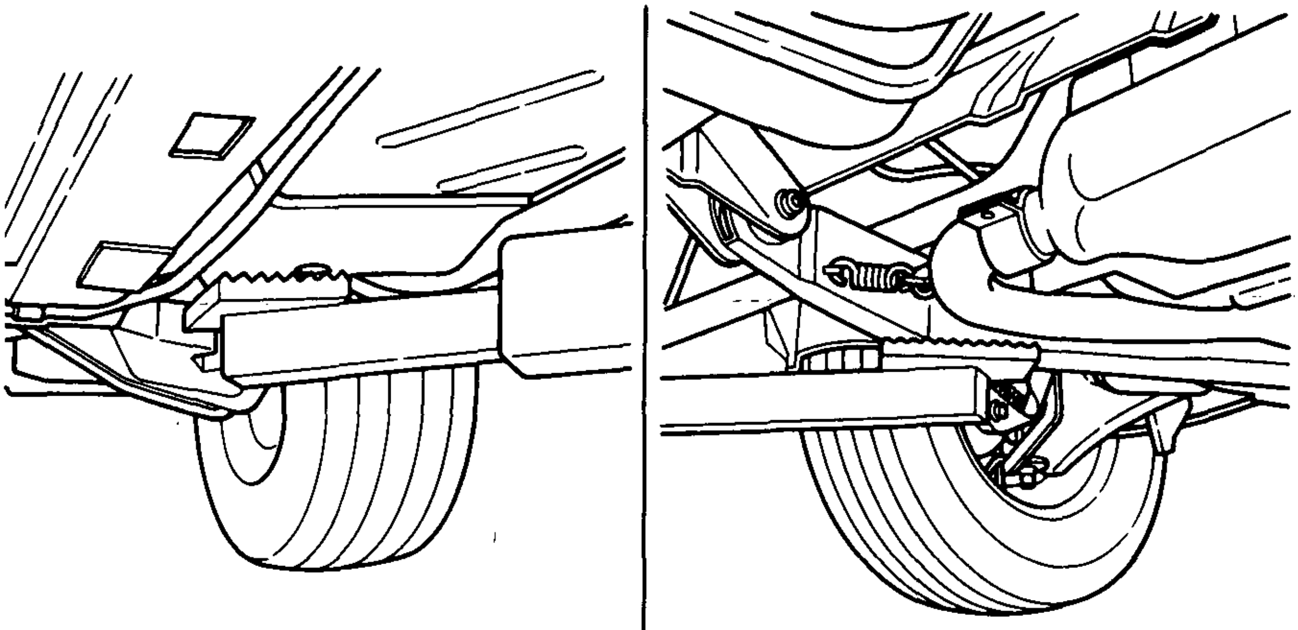
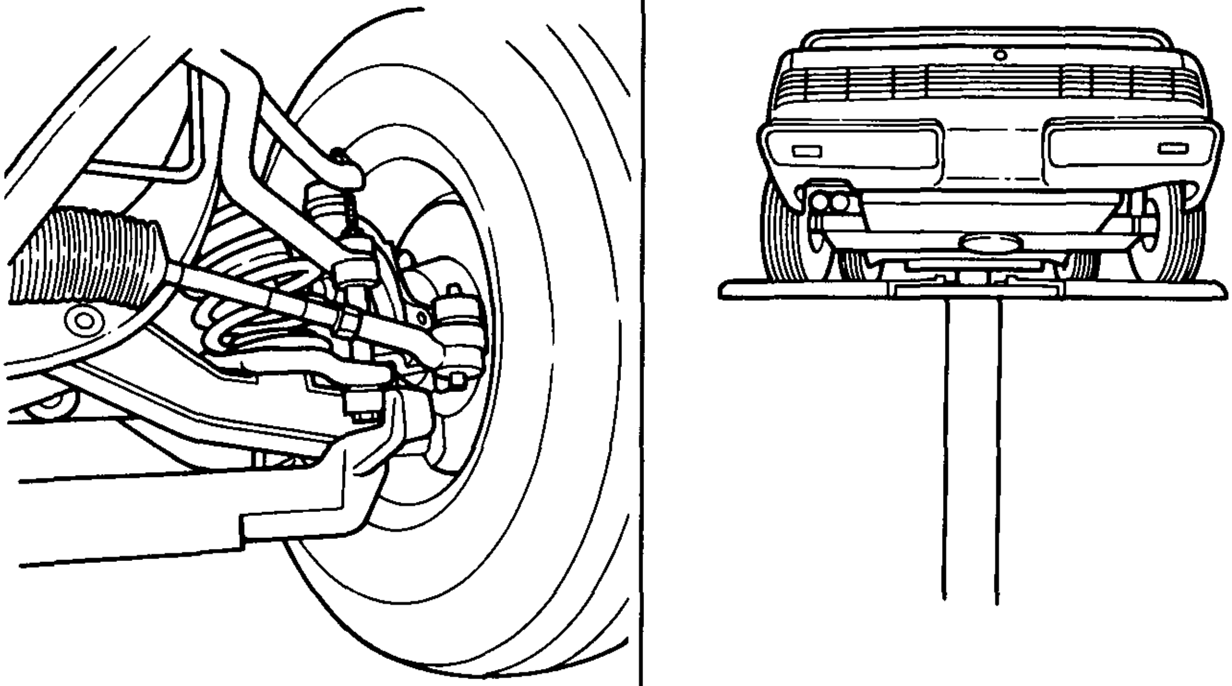
Fig. 13 Conversion Chart - Customary and Metric



FRAME CONTACT HOIST
-REARWARD OF THE FRONT WHEEL-

FRAME CONTACT HOIST
FORWARD OF REAR WHEEL-



SUSPENSION CONTACT HOIST
-UNDER THE FRONT
LOWER CONTROL ARM-

SUSPENSION CONTACT HOIST
-LIFTING ON REAR TIRES-

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Fig. 14 Vehicle Lifting Points "P" Model

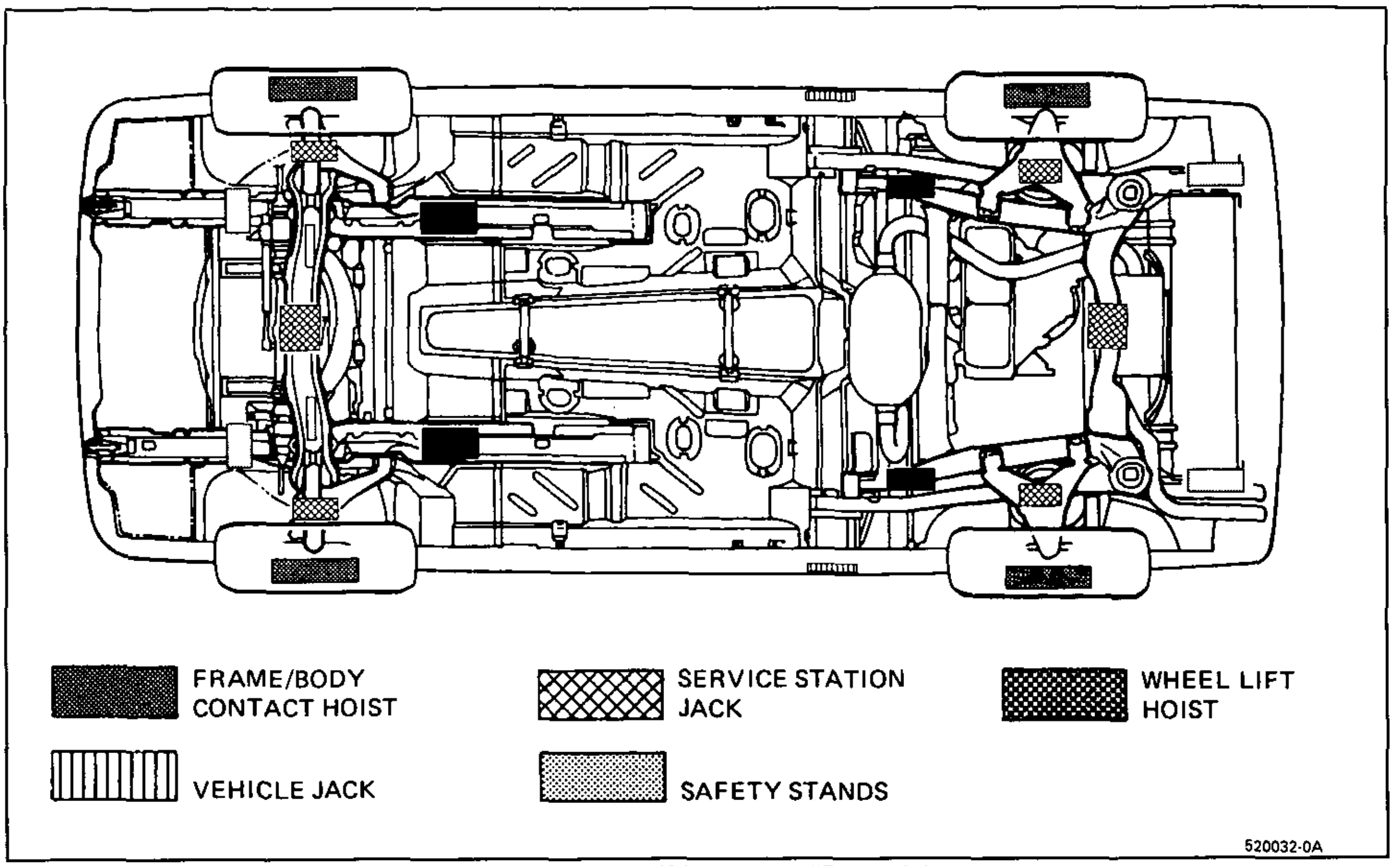
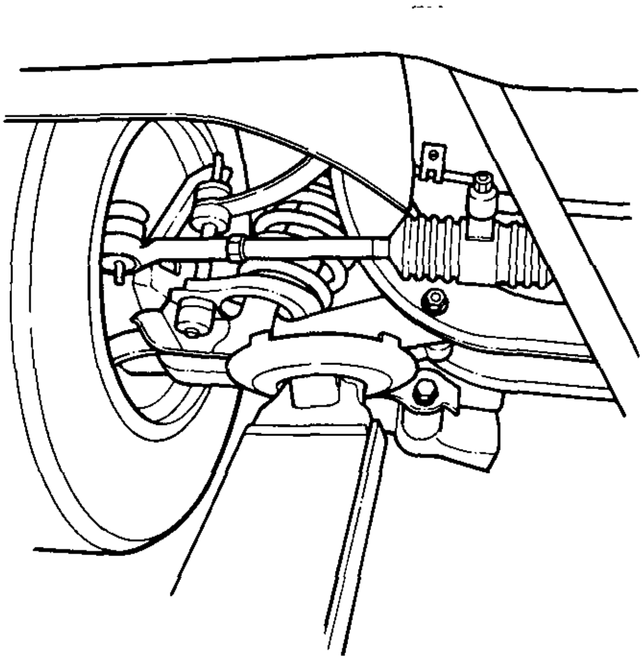
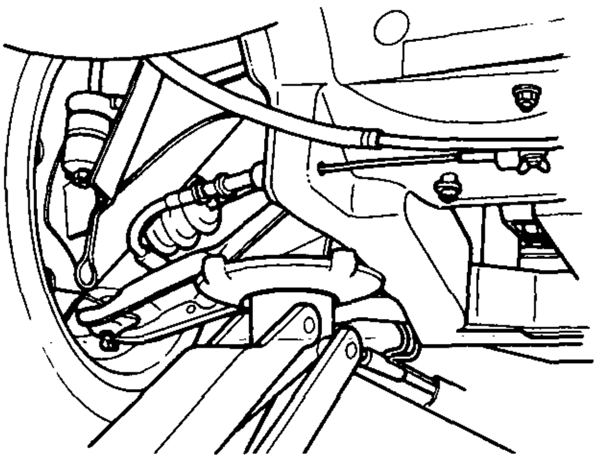


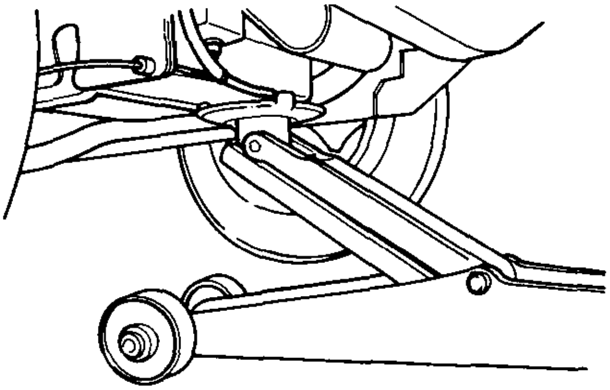
Fig. 15 Vehicle Lifting Points "P" Model



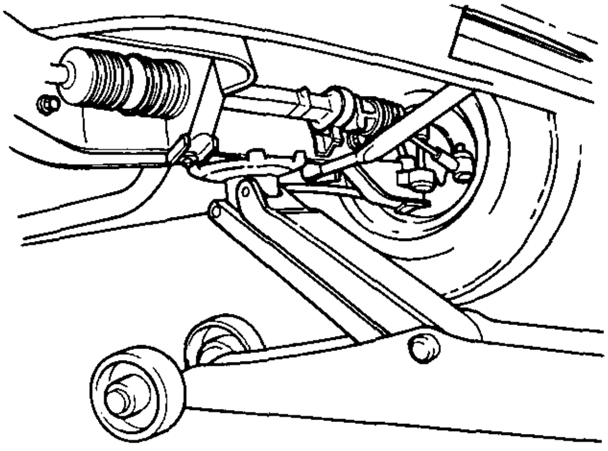
WHEN USING A FLOOR JACK, LIFT ON THE CENTER OF THE FRONT LOWER CONTROL ARM



WHEN USING A FLOOR JACK, LIFT ON THE CENTER OF THE REAR CONTROL ARM



WHEN USING A FLOOR JACK, LIFT ON THE CENTER REAR PORTION OF THE CROSSMEMBER



WHEN USING A FLOOR JACK, LIFT ON THE CENTER OF THE FRONT CROSSMEMBER (SET PARKING BRAKE AND BLOCK REAR WHEELS)

520033-0A

Fig. 16 Vehicle Lifting Points "P" Model

LIST OF AUTOMOTIVE ABBREVIATIONS WHICH MAY BE USED IN THIS MANUAL

Amp. - 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
CL - 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
Dist. - 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
IP - Instrument Panel
ISC - Idle Speed Control

km - Kilometers
km/h - 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
O_2 - 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

T - Turbocharger
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
Turbo - Turbocharger
TV - Throttle Valve
TVBV - Turbocharger Vacuum Bleed Valve
TVRS - Television & Radio Suppression
TVS - Thermal Vacuum Switch

U-Joint - 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

520020-0A

Fig. 17 Automotive Abbreviations

FLUID CAPACITIES

FUEL TANK CAPACITIES

MODELS	IDENTIFIER	METRIC	U.S.
"P"	L4	38.6 Liters	10.3 Gal.

ENGINE OIL CAPACITIES (CRANKCASE)

Engine	VIN Code(s)	W/O Filter	W Filter
2.5L (Gas)	R	2.8 Liters (3 Qts.)	2.8 Liters (3 Qts.)
2.8L (Gas)	9	3.8 Liters (4 Qts.)	3.8 Liters (4 Qts.)

BRAKE MASTER CYLINDER

Models	
All	Fill to 1/4" from top of Master Cylinder with fluid meeting SAE J1703A (DOT 3) specifications.

AUTOMATIC TRANSMISSION CAPACITIES

Type	RPO	Refill	Overhaul
		Metric (U.S. Measure)	Metric (U.S. Measure)
125C	MD9	3.8L (8.0 Pts.)	4.7L (10 Pts.)

MANUAL TRANSMISSION CAPACITIES

Type	RPO	Manufacturer	Liters (U.S. Measure)
4-Speed	M17	Muncie	2.8L (5.9 Pts.)
5-Speed	MT2	Isuzu	2.5L (5.3 Pts.)

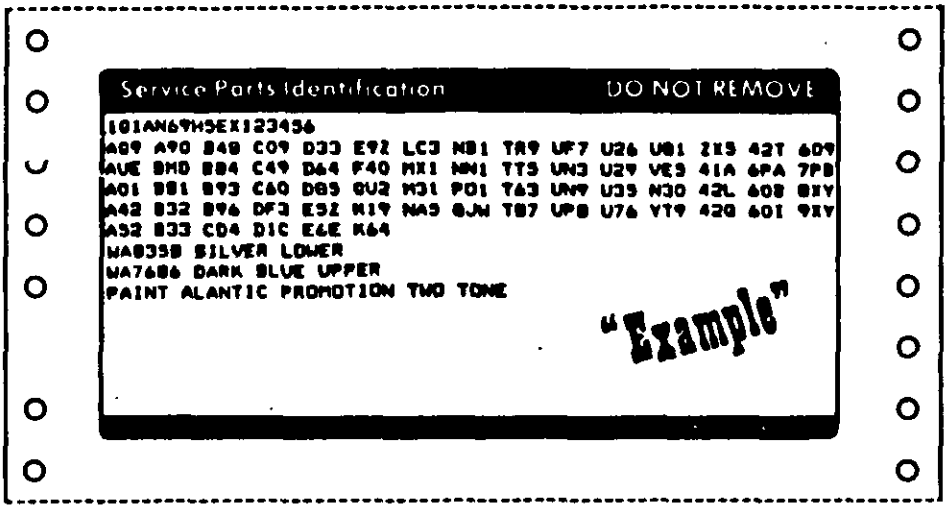
COOLING SYSTEM FLUID CAPACITIES

Models	Engine/Trans.	VIN	Metric (U.S. Measure)
HEATER			
"P"	ALL	R,9	13.0L (13.8 Qts.)
A/C			
"P"	2.5L M.T.	R	13.3L (14.1 Qts.)
"P"	2.5L A.T.	R	13.1L (13.8 Qts.)
"P"	2.8L	9	13.0L (13.8 Qts.)
HEAVY DUTY			
"P"	2.5L	R	13.0L (13.8 Qts.)

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.



Service Parts Identification DO NOT REMOVE

```
1G1AN69H5EX123456
A09 A90 B48 C09 D33 E92 LC3 N81 TR9 UF7 U26 U81 ZX5 42T 609
AUE BMD B84 C49 D64 F40 MX1 NN1 TT5 UN3 U29 VE5 41A 6PA 7PB
A01 B81 B93 C60 D85 QU2 M31 P01 T63 UN9 U35 N30 42L 60B 8XY
A42 B32 B96 DF3 E52 K19 NA5 QJW T87 UPB U76 YT9 420 60I 9XY
A52 B33 C04 D1C E6E K64
WA8358 SILVER LOWER
WA7686 DARK BLUE UPPER
PAINT ALANTIC PROMOTION TWO TONE
```

"Example"

520029-0A

Fig. 18 Service Parts Identification

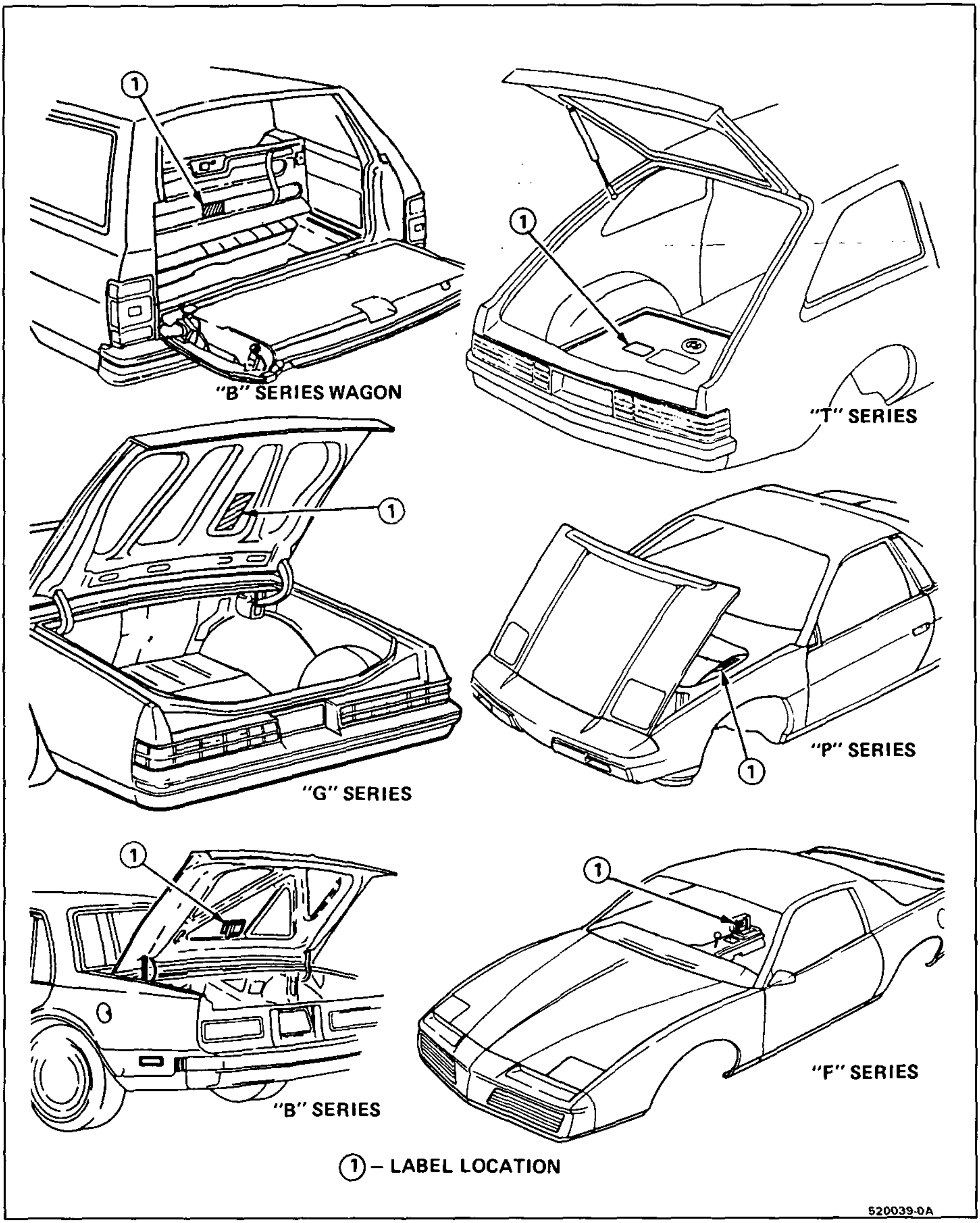


Fig. 19 Label Location

SECTION 0B

MAINTENANCE AND LUBRICATION

CONTENTS

PASSENGER CAR MAINTENANCE SCHEDULE

NORMAL CAR USE

The maintenance items shown 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 Label 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 the Maintenance Schedules I and II (Figure 1) 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.

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, hood latch, hood and door hinges, parking brake cable guides, underbody contact points and linkage. Clean and then lubricate power antenna mast. 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 hook up, cracks, chafing or decay. Correct as necessary.

ITEM 4

Carburetor or TBI 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

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 7

Cooling System Service

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

ITEM 8

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

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.

BE SURE TO USE PROPER LUBRICANT AS SHOWN IN THE "RECOMMENDED FLUIDS AND LUBRICANTS" CHART IN THIS SECTION.

ITEM 9

Transmission/Transaxle Service

The manual transmission or transaxle fluid does not require changing.

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 for extended periods and or low-speed operation such as found in delivery, police, rental or taxi operation.
- Towing a trailer.
- Operating in dusty areas.

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) / KILOMETERS (000)

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48
			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 mi. (5 000 km) or 3 mos.	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
2	Chassis Lubrication	Every other oil change		●		●		●		●		●		●		●		●
3	Carburetor Choke & Hose Inspection* (if equipped)	At 6,000 mi. (10 000 km) and then every 30,000 mi. (50 000 km)		●								●**						
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 6,000 mi. (10 000 km) only		●**														
5	Engine Idle Speed Adjustment (Some Models)*			●**														
6	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 mi. (50 000 km) or 24 mos.										●**						
7	Cooling System Service*											●						
8	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	See explanation																
9	Transmission Transaxle Service																	
10	Vacuum Advance System Inspection (Some Models)*	Every 30,000 mi. (50 000 km)										●						
11	Spark Plug and Wire Service*											●**						
12	PCV Valve Inspection*											●						
13	EGR System Service*	Every 30,000 mi. (50 000 km) or 36 mos.										●						
14	Air Cleaner & PCV Filter Replacement*											●**						
15	Engine Timing Check*	Every 30,000 mi. (50 000 km)										●						
16	Fuel Tank, Cap & Lines Inspection*											●						
17	Thermostatically Controlled Air Cleaner Inspection*											●						

SCHEDULE II

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

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) / KILOMETERS (000)

ITEM NO.	TO BE SERVICED	WHEN TO PERFORM Miles (kilometers) or Months, Whichever Occurs First	7.5	15	22.5	30	37.5	45
			12.5	25	37.5	50	62.5	75
1	Engine Oil Change* (Turbocharged, see †)	Every 7,500 mi. (12 500 km) or 12 mos.	●	●	●	●	●	●
	Oil Filter Change*†	At first and then every other oil change or 12 mos.	●		●		●	
2	Chassis Lubrication	Every 7,500 mi. (12 500 km) or 12 mos.	●	●	●	●	●	●
3	Carburetor Choke & Hose Inspection*	At 7,500 mi. (12 500 km) and then every 30,000 mi. (50 000 km)	●			●**		
4	Carburetor or Throttle Body Mounting Bolt Torque*	At 7,500 mi. (12 500 km) only	●**					
5	Engine Idle Speed Adjustment (Some Models)*		●**					
6	Vacuum or A.I.R. Pump Drive Belt Inspection*	Every 30,000 mi. (50 000 km) or 24 mos.				●**		
7	Cooling System Service*					●		
8	Wheel Bearing Repack (Rear-Wheel Drive Cars Only)	Every 30,000 mi. (50 000 km)				●		
9	Transmission Transaxle Service	See explanation						
10	Vacuum Advance System Inspection (Some Models)*	Every 30,000 mi. (50 000 km)				●		
11	Spark Plug and Wire Service*					●**		
12	PCV Valve Inspection*					●		
13	EGR System Service*	Every 30,000 mi. (50 000 km) or 36 mos.				●		
14	Air Cleaner & PCV Filter Replacement*					●**		
15	Engine Timing Check*	Every 30,000 mi. (50 000 km)				●		
16	Fuel Tank, Cap & Lines Inspection*					●		
17	Thermostatically Controlled Air Cleaner Inspection*					●		

*An Emission Control Service

**In California, these are the minimum Emission Control Maintenance Services an owner must perform according to the California Air Resources Board. General Motors, however, urges that all Emission Control Maintenance Services shown be performed. To maintain your other new car warranties, all services shown in this booklet should be performed.

† *Turbocharged Engines*

- *VIN engine code J — change oil every 3,000 miles (5 000 km) or 3 months, whichever comes first. Change engine oil filter at first oil change, then every other oil change.*
- *VIN engine codes 7 and 9 — change oil and filter every 7,500 miles (12 500 km) or 12 months, whichever comes first.*

NOTE: To determine engine code and displacement, see the Specifications Section of your Owner's Manual.

G20001-0B

Fig. 1 Maintenance Schedules

For automatic transmissions or transaxles, change both the fluid and filter (or service the screen) 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 (or service the screen) every 100,000 miles (160 000 km). See your Owner's Manual for further details.

ITEM 10

Vacuum Advance System Inspection

Applies only to Canadian vehicles without Computer Command Control and Chevette and T1000 non-California models. Check system for proper operation. Check hoses for proper hookup, cracks, chafing or decay. Replace parts as needed.

ITEM 11

Spark Plug and Wire Service

Replace spark plugs with type listed in your Owner's Manual. 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 12

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 13

EGR System Service

Conduct EGR System Service as referenced in the EGR System Chart shown in Section 6E.

ITEM 14

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.

ITEM 15

Engine Timing Check

Adjust timing to underhood label specifications.

ITEM 16

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 17

Thermostatically Controlled Air Cleaner Inspection

Inspect all hoses and ducts for proper hook-up. 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 a 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. All needed repairs should be done before operating your car.

BEFORE OPERATING YOUR CAR

Warning light, buzzer, tone and chime operation –Check operation of all warning lights, buzzers, tone generators and chimes - also all interior lights. See your Owner's Manual for details.

Glass, mirrors, lights and/or reflectors condition –Look for broken, scratched, dirty or damaged glass, mirrors, lights or reflectors that could reduce the view or visibility or cause injury. Replace, clean or repair promptly.

Seat adjuster operation –When adjusting a manual seat, be sure seat adjusters latch by pushing seat forward and backward.

Rearview mirror and sun visor operation –Make sure friction joints hold mirrors and sun visors in place.

Door, trunk and gate latch operation –Make sure that all doors, trunk lid and wagon or hatchback gate close, latch lock and seal tightly.

WHILE OPERATING YOUR CAR

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

Wiper and washer operation –Note the operation and condition of the wiper blades and the flow and aim of the washer spray. This includes the rear window wiper and washer if so equipped.

Defroster operation –Periodically check the air flow from the ducts at the inside base of the windshield. Do this with the heater control set for "defrost" and fan set for "high".

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 the brake warning light goes on, or flashes, or the anti-lock (if equipped) light comes on or remains on, something may be wrong with part of the brake system.

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 –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.

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. Inspect coolant and replace if dirty or rusty. See your Owner's Manual.

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 after washer fluid services are performed.

AT LEAST MONTHLY

Tire pressure check –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".

Light operation –Check operation of license plate light, sidemarker 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 SEMI-ANNUALLY (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 level in accordance with Owner's Manual and keep at proper level. Note: A low fluid level can indicate worn disc brake pads and should be checked.

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.

EACH TIME OIL IS CHANGED

Automatic transmission/transaxle fluid level check –Keep fluid level within operating range on dipstick. See your Owner's Manual.

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

Manual transmission/transaxle fluid level check –Check fluid level and add as required. See your Owner's Manual.

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

Tire and wheel inspection and rotation –Check tires for abnormal wear or damage. Also, check for damaged wheels. To equalize tire wear and obtain maximum tire life, it is suggested that tires be rotated at about 7,500 miles (12 500 km) then each 15, 000 miles (25 000 km) thereafter. See "Tires" in Owner's Manual, for further information.

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 build up in the floor pan or could let exhaust fumes seep into the trunk or passenger compartment.

Throttle linkage inspection –Inspect for damaged or missing parts, interference or binding and lubricate with GM Part No. 9985164 grease or equivalent.

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

Rear axle/final drive service –Check fluid level and add if needed. Note: Rear wheel drive cars equipped with a limited slip differential should have fluid drained and refilled at 7,500 miles (12 500 km). Be sure to use the limited slip additive as shown in Figure 0B-2. See your Owner's Manual.

IF YOU USE YOUR CAR TO PULL A TRAILER CHANGE LUBRICANT EVERY 7,500 miles (12 500 km).

Power Antenna - Clean and then lubricate power antenna mast with light sewing machine oil.

AT LEAST ANNUALLY

Starter safety 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 shifter 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".

Seatback latch operation –Be sure seatbacks latch on those cars with folding seats using mechanical latches. See your Owner's Manual for latch operating information.

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

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

Seatback recliner operation (if equipped) –Make sure the recliner is holding by pushing and pulling on the top of the seatback while it is reclined.

Spare tire and jack storage –Be alert to rattles in rear of car. Make sure the spare 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.

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 (Figure 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. 1050017 or equivalent
Manual Steering Gear (recirculating ball)	Use lubricant meeting requirements of GM-4673-M (GM Part No. 1052182)
Automatic Transmission/Transaxle and 5 speed Manual Transmissions	DEXRON®-II Automatic Transmission Fluid (GM Part No. 1051855)
Manual Transaxle	SAE 5W-30 (GM Part No. 1052931) Engine Oil SF, SF/CC or SF/CD
Manual Transmission (rear-wheel-drive) 3 and 4 speed	Pontiac Firebird 4 speed manual 5W-30SF All others SAE-80W 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	Light oil or general purpose silicone lubricant (GM Part No. 1052276)
Automatic Transmission/Transaxle Shift Linkage	Engine Oil
Clutch Linkage Pivot Points	Engine Oil
Floor Shift Linkage	Engine Oil
Power Antenna Mast	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	Some models require a special gear lubricant additive in addition to (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 or GM Part No. 1050109 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 and linkage, station wagon folding seat, fuel door hinge, rear compartment lid hinges	Engine Oil

**See your Owner's Manual for further details.*

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Fig. 2 Recommended Fluids and Lubricants

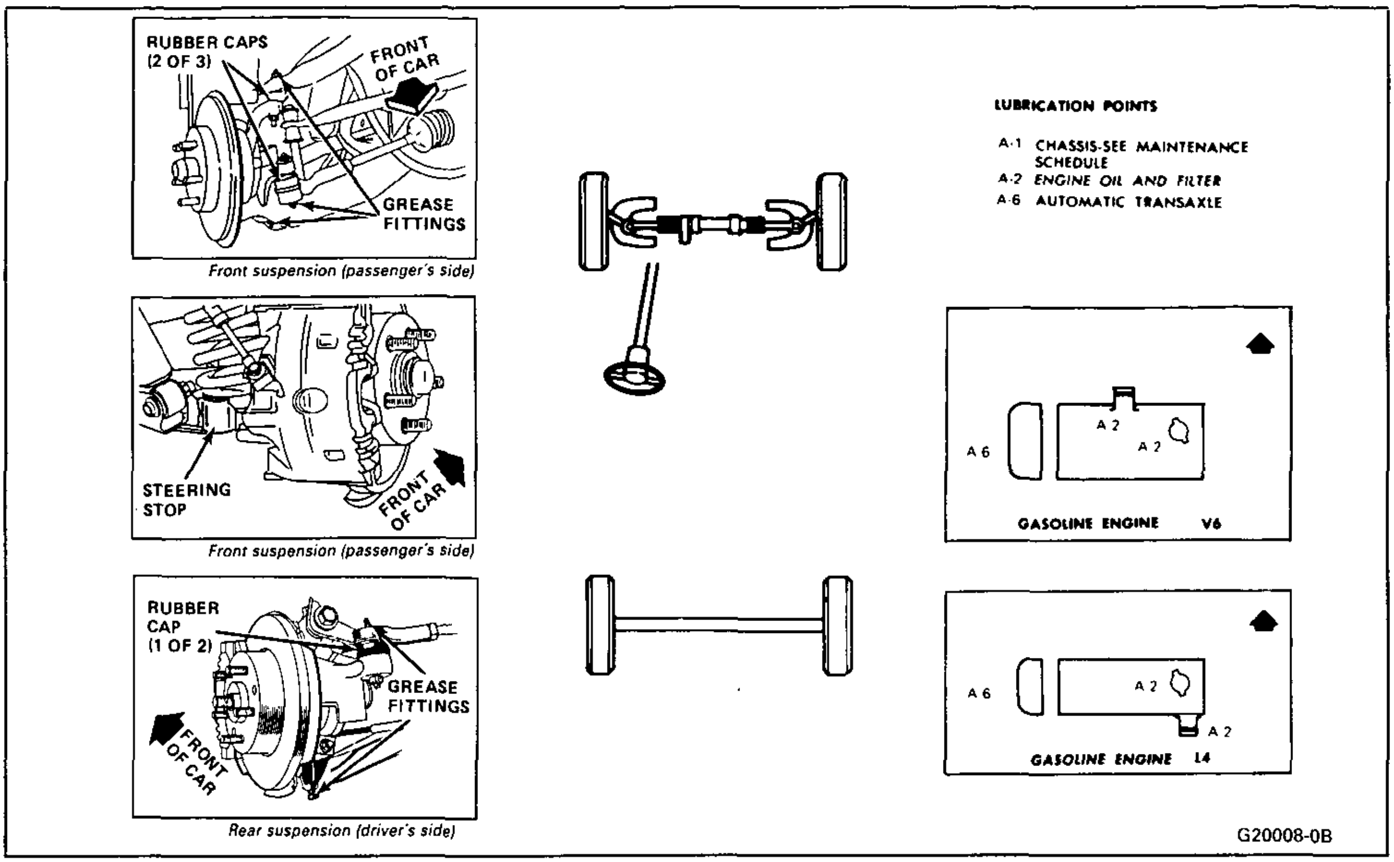


Fig. 801 Typical Lubrication Points

SECTION 1A

HEATING AND VENTILATION

CONTENTS

GENERAL DESCRIPTION

The base heater system is designed to provide heating, ventilation and window defrosting.

The power-vent, heat, and defrost provisions of the base system are controlled within the heater module. The module itself is composed of four (4) components - a blower case, a heater case, an air inlet and distribution case, and a heater outlet. Gaskets are used between the components to prevent air, water and noise entrance into the passenger compartment.

Air distribution is through a heater outlet, defroster duct, and 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 thus heating the inlet air.
3. Temperature Valve
   Regulates the amount of air passing through the heater core, thus controlling the temperature and mix of heated and ambient air.
4. Mode (Defroster, Heater) 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. A total of 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 defrost cables also have the self-adjusting feature. Blower speeds (OFF - LO - MED. - HI) are controllable in all modes (VENT, HEAT, DEFROST) by the switch on the control head.

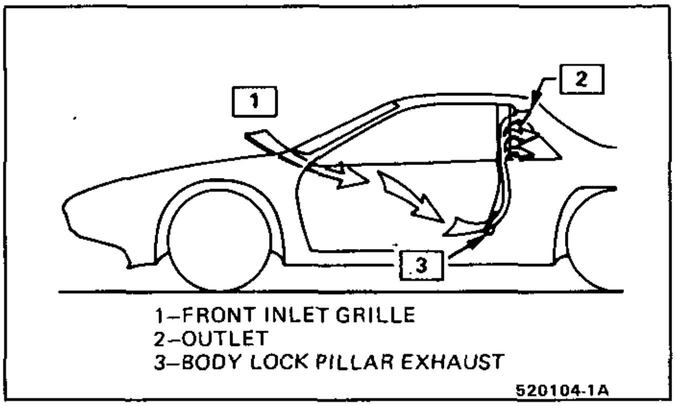


Fig. 1 Interior Body Air Flow & Exit

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 and outboard ends of the instrument panel.

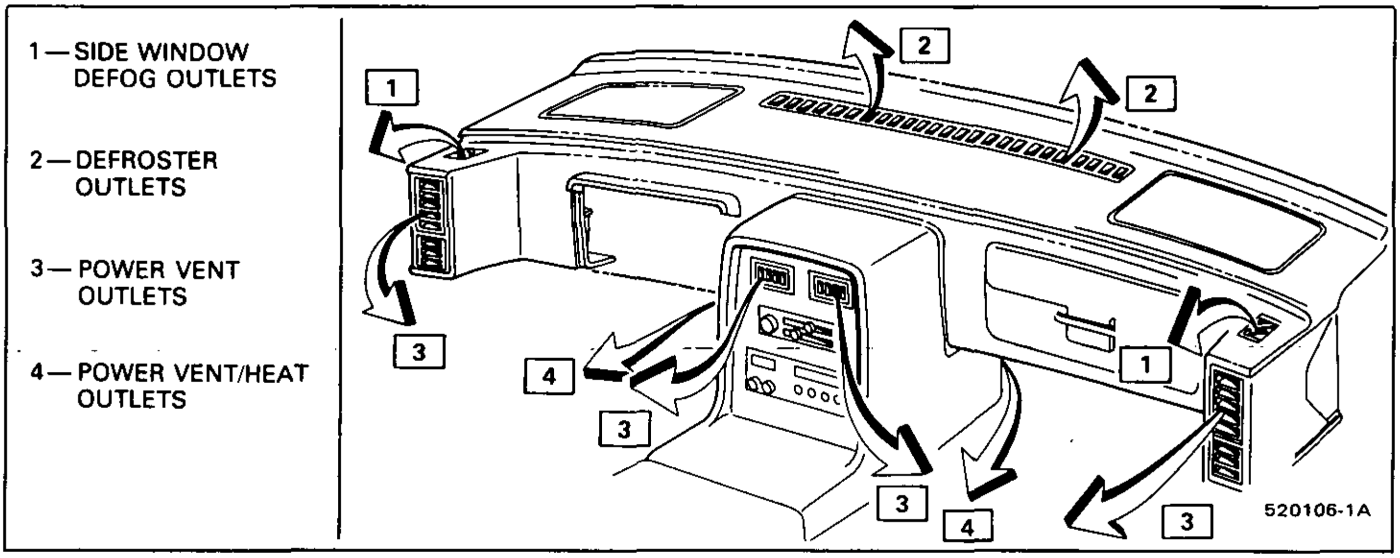
Air cannot be tempered in vent mode. If temp valve is moved off, full cold, hot air will begin discharging from the heater outlet. As temp valve moves toward full hot, air will shift from vent outlets to heater outlet.

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 is provided via side ducts in the outboard corners of the instrument panel. Air flow from these vents will be the same whether in "Heater" mode or "Defrost" mode. Air flow is varied with blower speed.

Varying the mode selector between "Heater" and "Vent" position likewise varies the proportion of air



1—SIDE WINDOW DEFOG OUTLETS
2—DEFROSTER OUTLETS
3—POWER VENT OUTLETS
4—POWER VENT/HEAT OUTLETS

Fig. 2 Ventilation System

coming out the heater, and the center and outboard vent outlets. With the selector in some midway position, air coming out the center and outboard 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, dependent 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.

DIAGNOSIS

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.

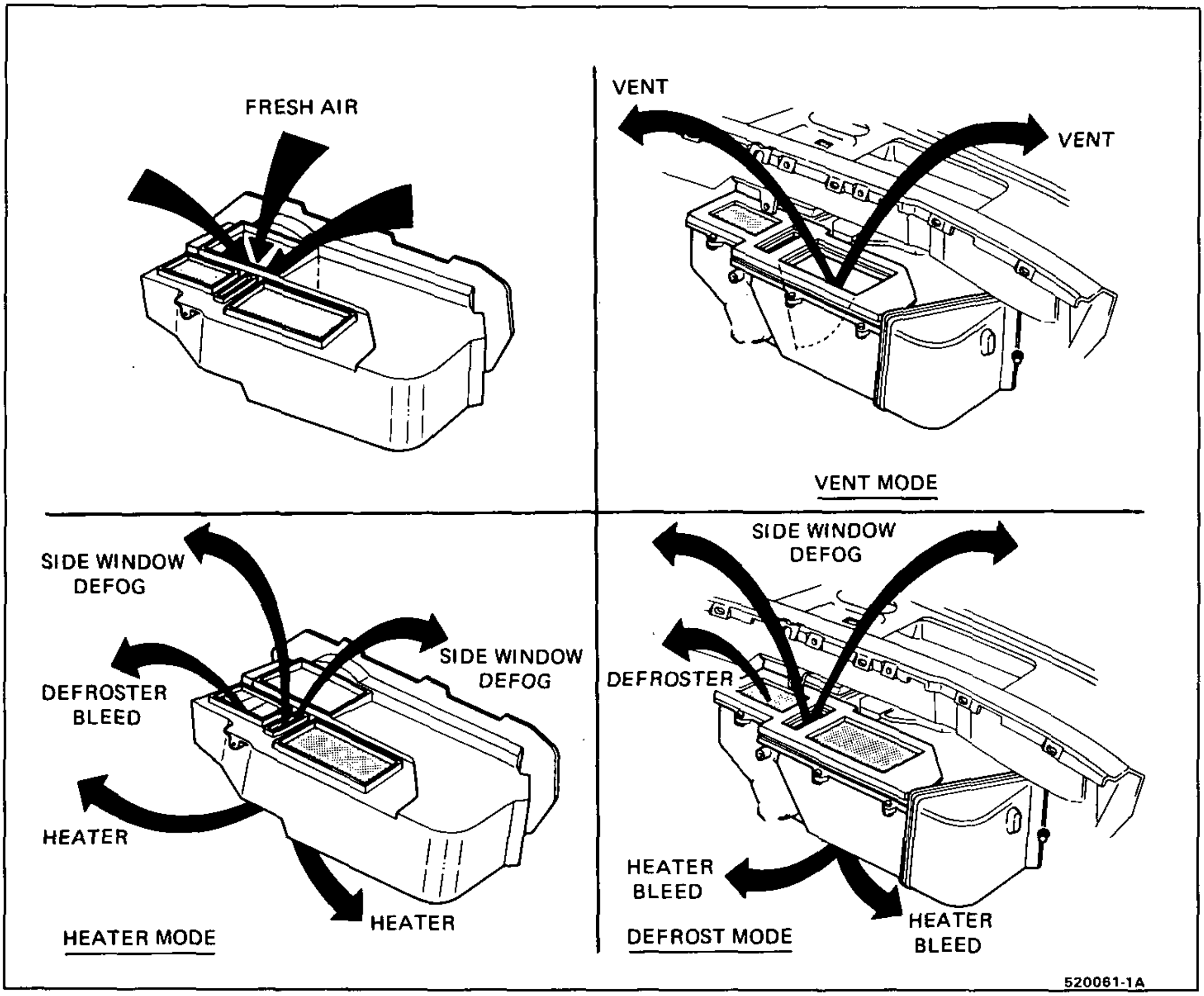
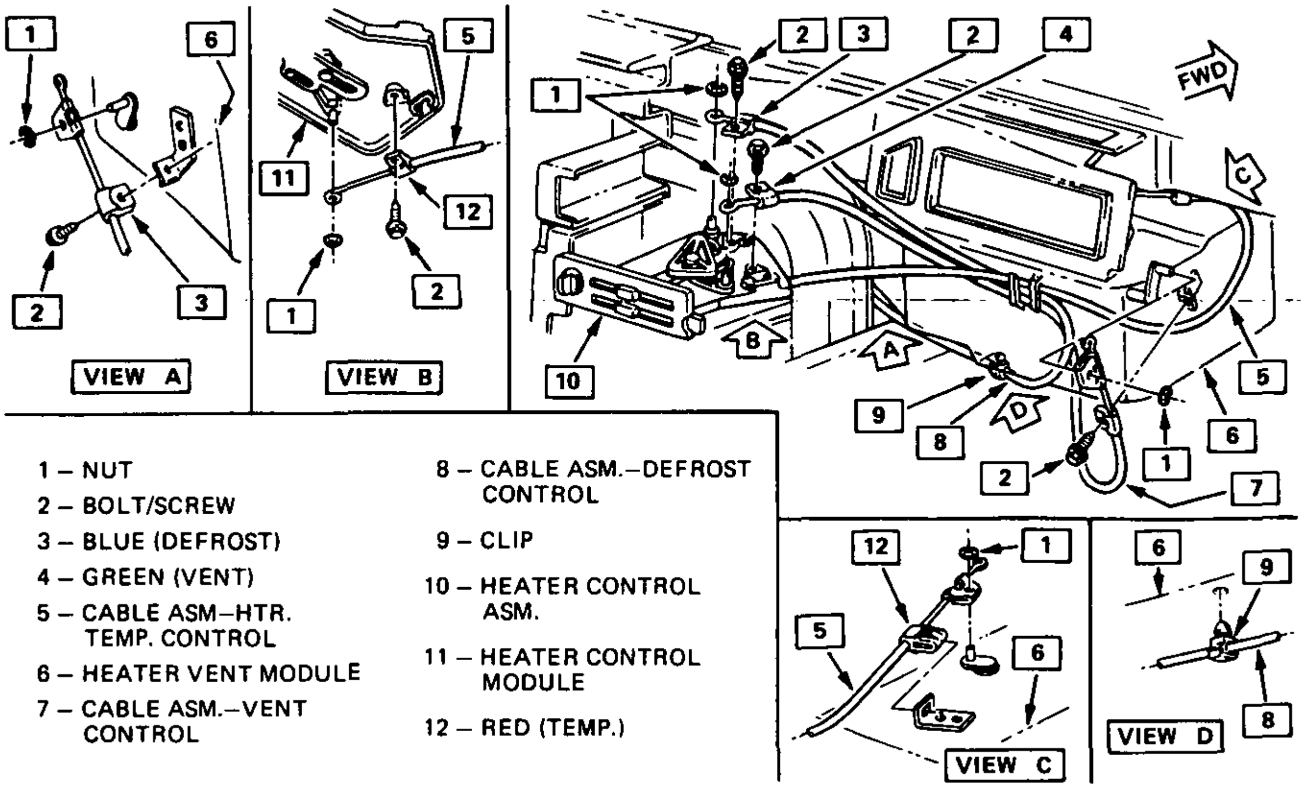


Fig. 3 Module Air Flow



1 – NUT
2 – BOLT/SCREW
3 – BLUE (DEFROST)
4 – GREEN (VENT)
5 – CABLE ASM–HTR. TEMP. CONTROL
6 – HEATER VENT MODULE
7 – CABLE ASM.–VENT CONTROL
8 – CABLE ASM.–DEFROST CONTROL
9 – CLIP
10 – HEATER CONTROL ASM.
11 – HEATER CONTROL MODULE
12 – RED (TEMP.)

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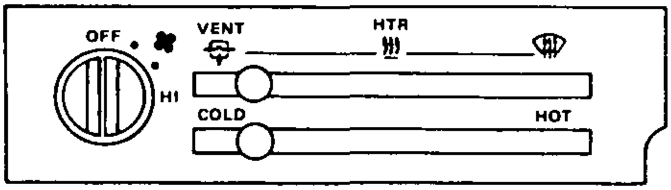
Fig. 4 Typical Heater System Air Flow

HEATER FUNCTION TEST

STEP	CONTROLS			SYSTEM RESPONSE				
	MODE LEVER	TEMPERATURE LEVER	FAN SWITCH	FAN SPEED	I/P AIR OUTLETS	FLOOR AIR OUTLET	DEFROSTER OUTLETS	SEE REMARKS
1	VENT	COLD	OFF	OFF	NO AIR FLOW	NO AIR FLOW	NO AIR FLOW	
2	VENT	COLD	OFF TO HIGH	OFF TO HIGH	AIR FLOW	NO AIR FLOW	NO AIR FLOW	A
3	HEAT	HOT	HIGH	HIGH	NO AIR FLOW	AIR FLOW	MINIMUM AIR FLOW	B,C,D
4	DEFROST	HOT	HIGH	HIGH	NO AIR FLOW	MINIMUM AIR FLOW	AIR FLOW	B,D



REMARKS

A. NOTICEABLE BLOWER SPEED INCREASE MUST OCCUR FROM LOW TO MEDIUM TO HIGH.
B. ENGAGEMENT OF DETENT MUST BE FELT IN EACH MODE.
C. INSPECTOR MUST CHECK TEMPERATURE LEVER FOR EFFORT AND FULL TRAVEL (COLD TO HOT).
D. CHECK FOR AIR FLOW AT SIDE WINDOW DEFOG OUTLETS.

NOTE: ALL VENT OUTLETS MUST BE CHECKED FOR THE FOLLOWING:

1. BARREL ROTATION.
2. VANE OPERATION.
3. BARREL AND VANES MUST HOLD POSITION IN HIGH BLOWER.

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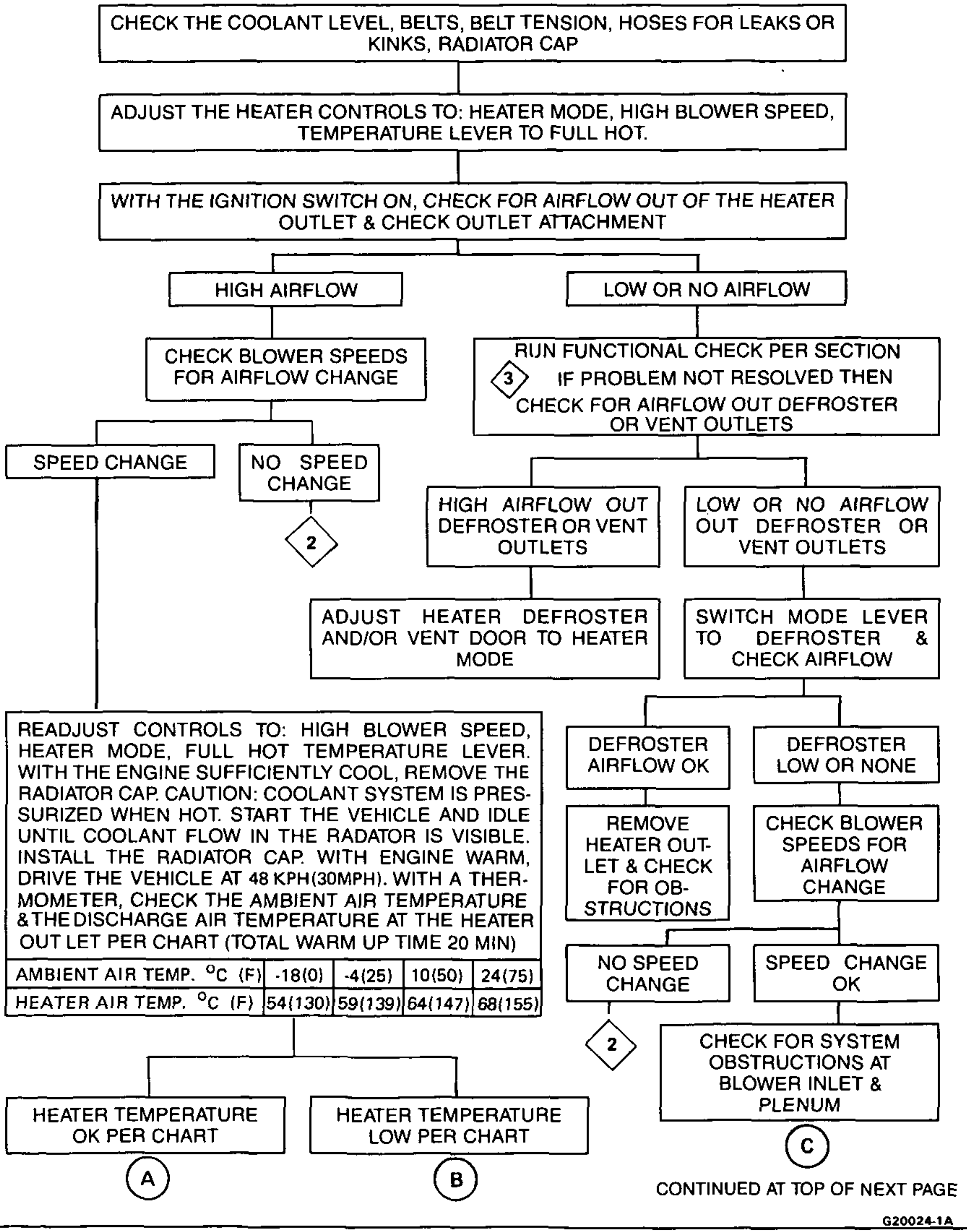
Fig. 5 Heater Functional Test

◇1 INSUFFICIENT HEATING OR DEFROSTING



CHECK THE COOLANT LEVEL, BELTS, BELT TENSION, HOSES FOR LEAKS OR KINKS, RADIATOR CAP

ADJUST THE HEATER CONTROLS TO: HEATER MODE, HIGH BLOWER SPEED, TEMPERATURE LEVER TO FULL HOT.

WITH THE IGNITION SWITCH ON, CHECK FOR AIRFLOW OUT OF THE HEATER OUTLET & CHECK OUTLET ATTACHMENT

HIGH AIRFLOW

CHECK BLOWER SPEEDS FOR AIRFLOW CHANGE

SPEED CHANGE

NO SPEED CHANGE

LOW OR NO AIRFLOW

RUN FUNCTIONAL CHECK PER SECTION ◇3 IF PROBLEM NOT RESOLVED THEN CHECK FOR AIRFLOW OUT DEFROSTER OR VENT OUTLETS

HIGH AIRFLOW OUT DEFROSTER OR VENT OUTLETS

ADJUST HEATER DEFROSTER AND/OR VENT DOOR TO HEATER MODE

LOW OR NO AIRFLOW OUT DEFROSTER OR VENT OUTLETS

SWITCH MODE LEVER TO DEFROSTER & CHECK AIRFLOW

DEFROSTER AIRFLOW OK

REMOVE HEATER OUTLET & CHECK FOR OBSTRUCTIONS

DEFROSTER LOW OR NONE

CHECK BLOWER SPEEDS FOR AIRFLOW CHANGE

NO SPEED CHANGE

SPEED CHANGE OK

CHECK FOR SYSTEM OBSTRUCTIONS AT BLOWER INLET & PLENUM

READJUST CONTROLS TO: HIGH BLOWER SPEED, HEATER MODE, FULL HOT TEMPERATURE LEVER. WITH THE ENGINE SUFFICIENTLY COOL, REMOVE THE RADIATOR CAP. CAUTION: COOLANT SYSTEM IS PRESSURIZED WHEN HOT. START THE VEHICLE AND IDLE UNTIL COOLANT FLOW IN THE RADATOR IS VISIBLE. INSTALL THE RADIATOR CAP. WITH ENGINE WARM, DRIVE THE VEHICLE AT 48 KPH(30MPH). WITH A THERMOMETER, CHECK THE AMBIENT AIR TEMPERATURE & THE DISCHARGE AIR TEMPERATURE AT THE HEATER OUT LET PER CHART (TOTAL WARM UP TIME 20 MIN)

AMBIENT AIR TEMP. °C (F)	-18(0)	-4(25)	10(50)	24(75)
HEATER AIR TEMP. °C (F)	54(130)	59(139)	64(147)	68(155)

HEATER TEMPERATURE OK PER CHART

HEATER TEMPERATURE LOW PER CHART

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Fig. 6 Insufficient Heating or Defrosting Diagnosis Procedure (1 of 2)

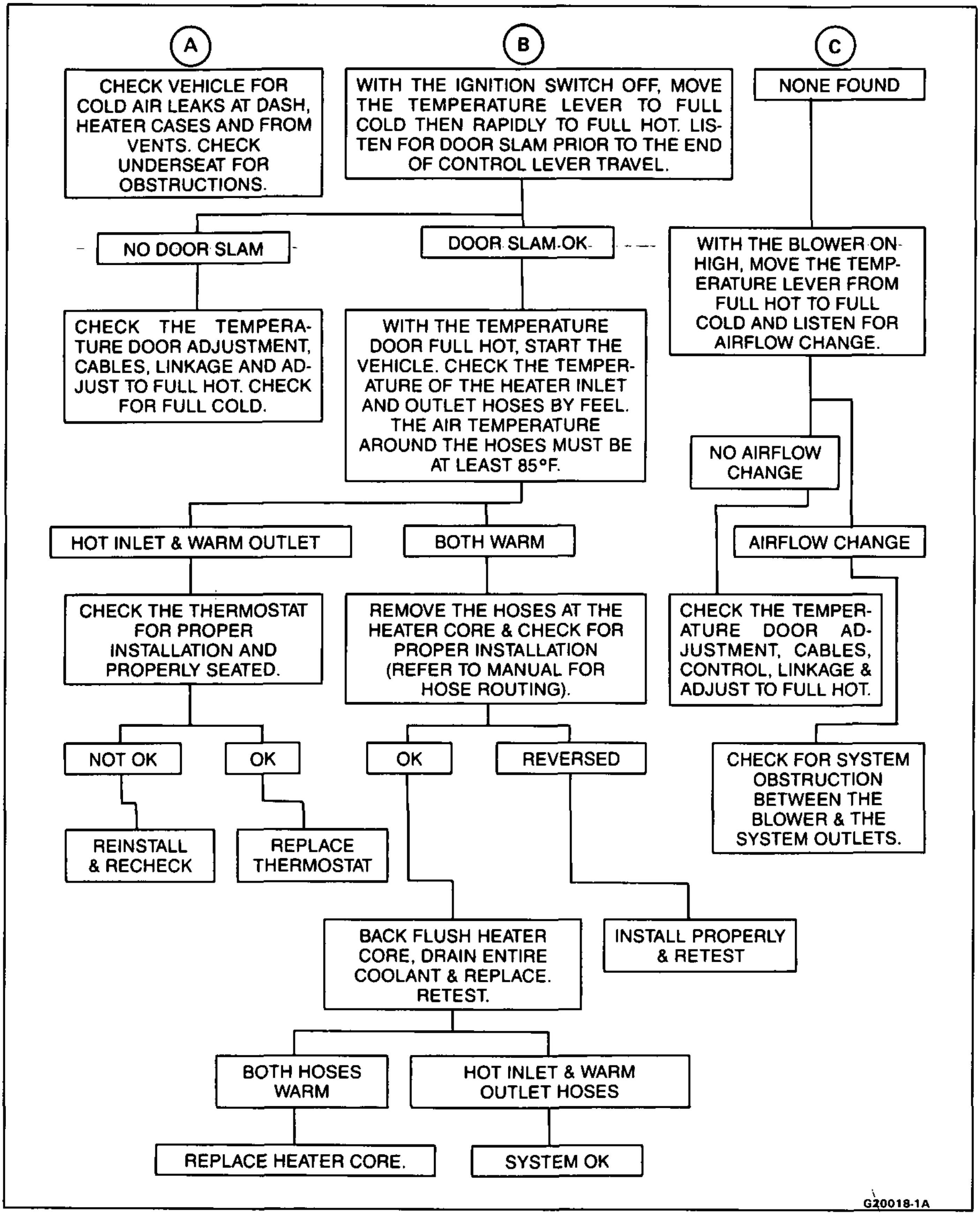


Fig. 7 Insufficient Heating or Defrosting Diagnosis Procedure (2 of 2)

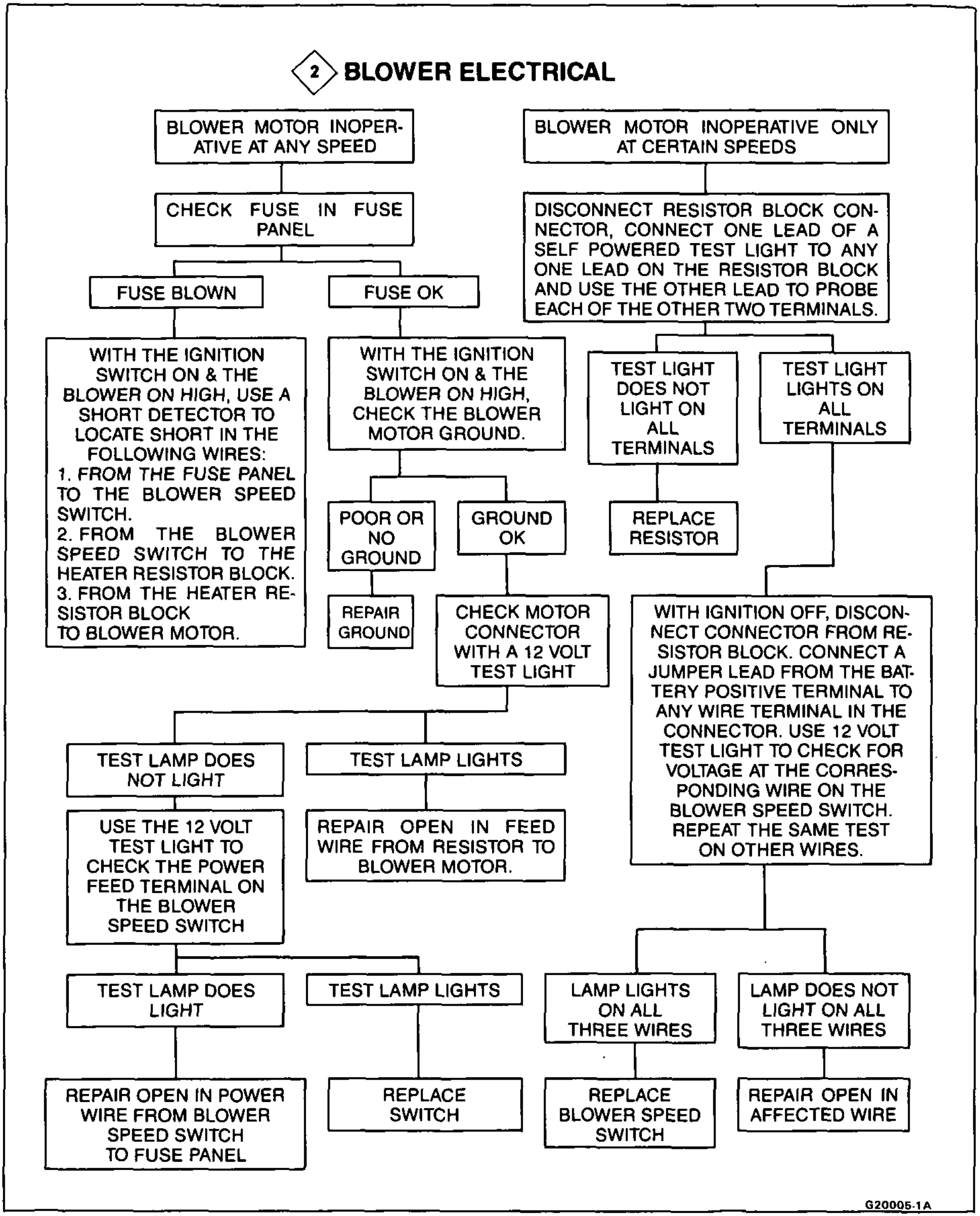
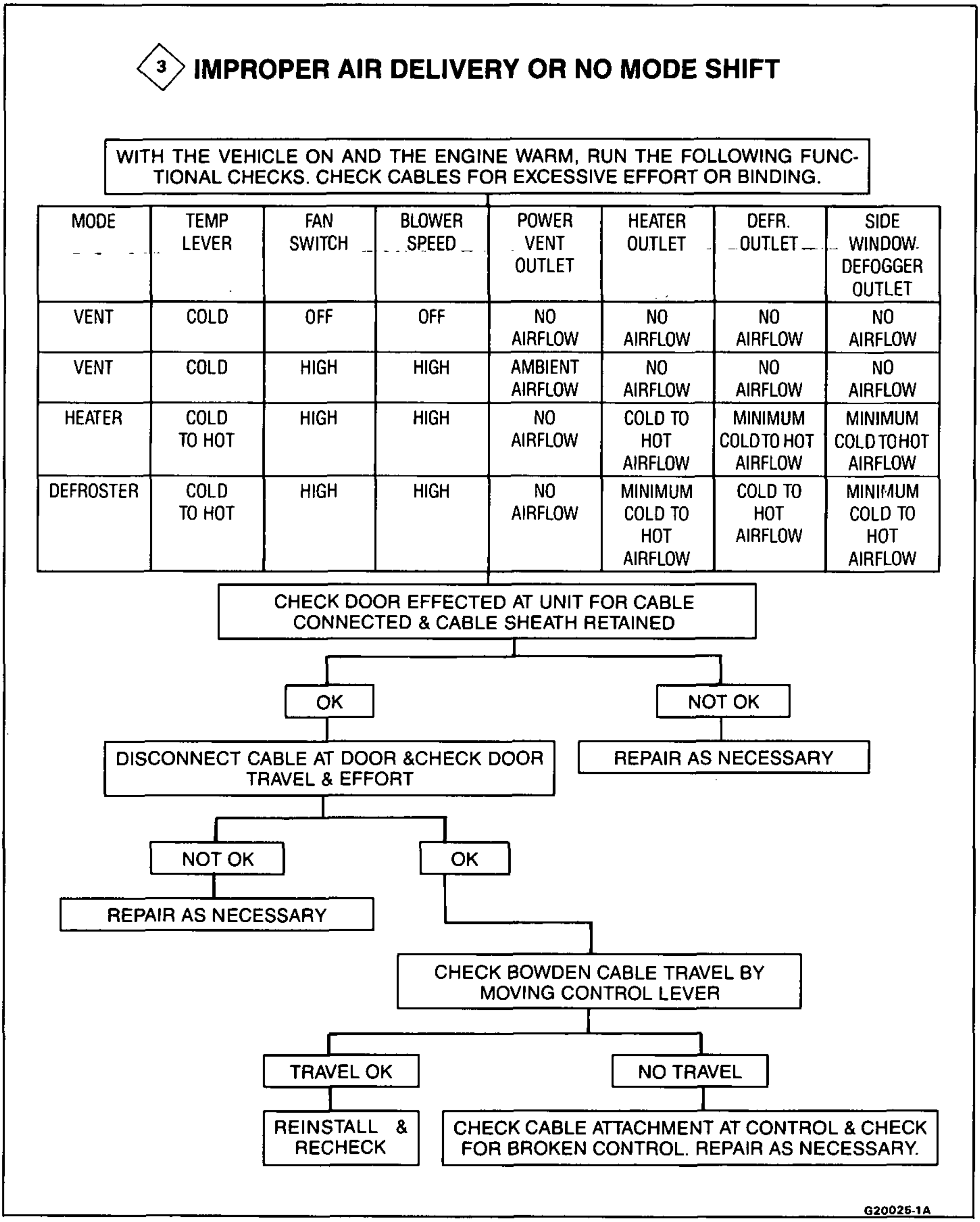


Fig. 8 Blower Electrical Diagnosis



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

Fig. 9 Improper Air Delivery Or No Mode Shift Diagnosis

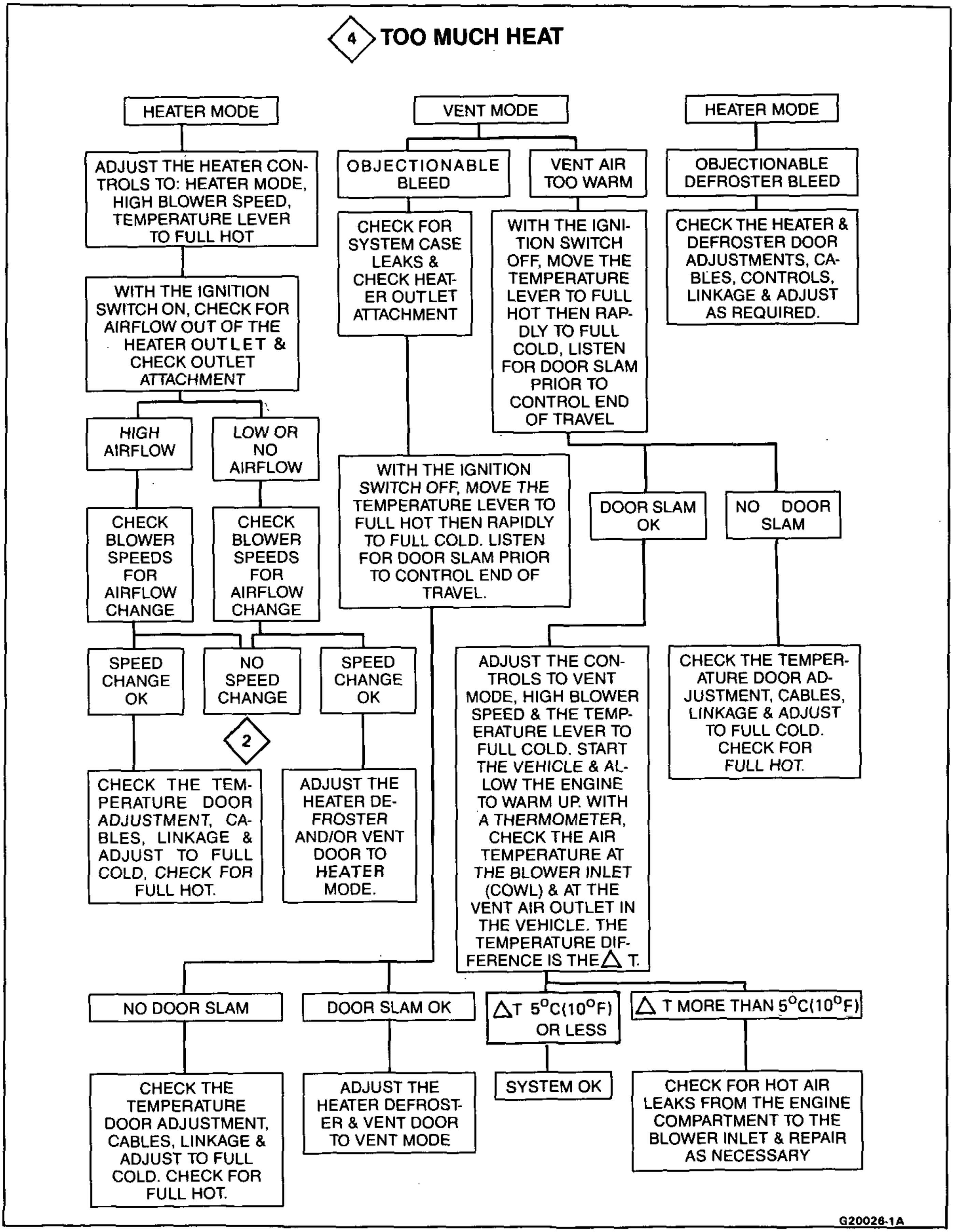


Fig. 10 Too Much Heat Diagnosis

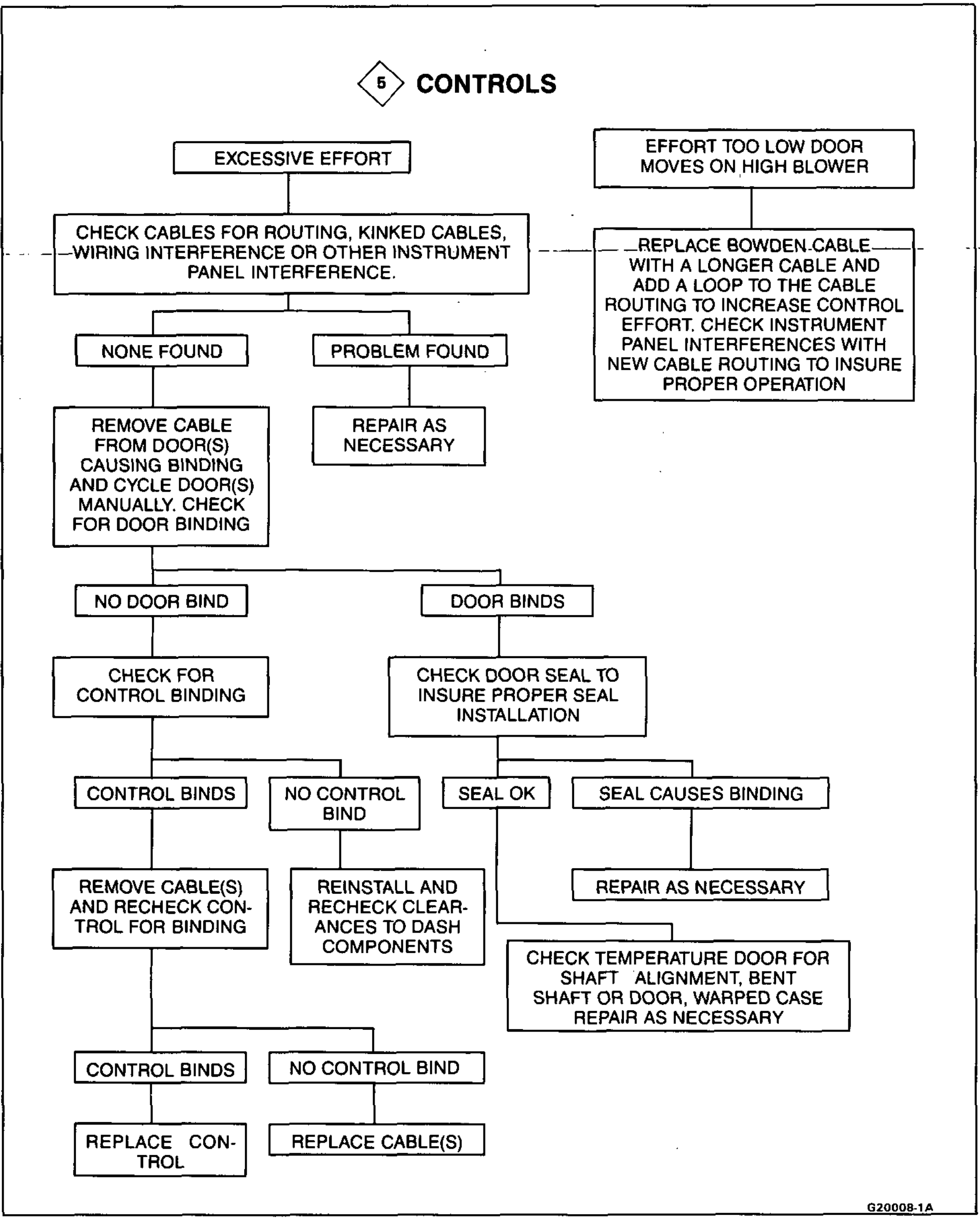


Fig. 11 Heater Controls Diagnosis

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. 12 Blower Noise Diagnosis (1 of 2)

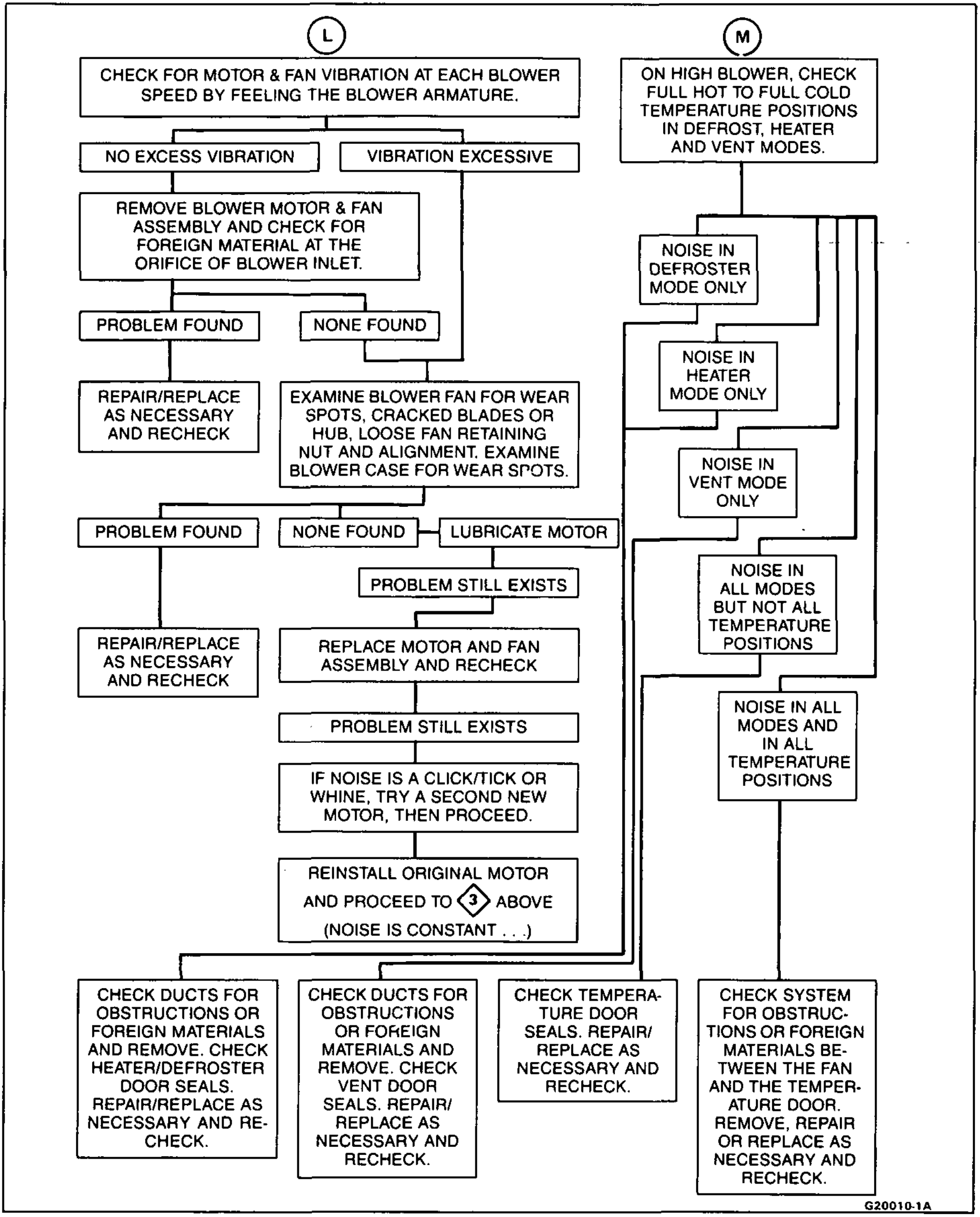
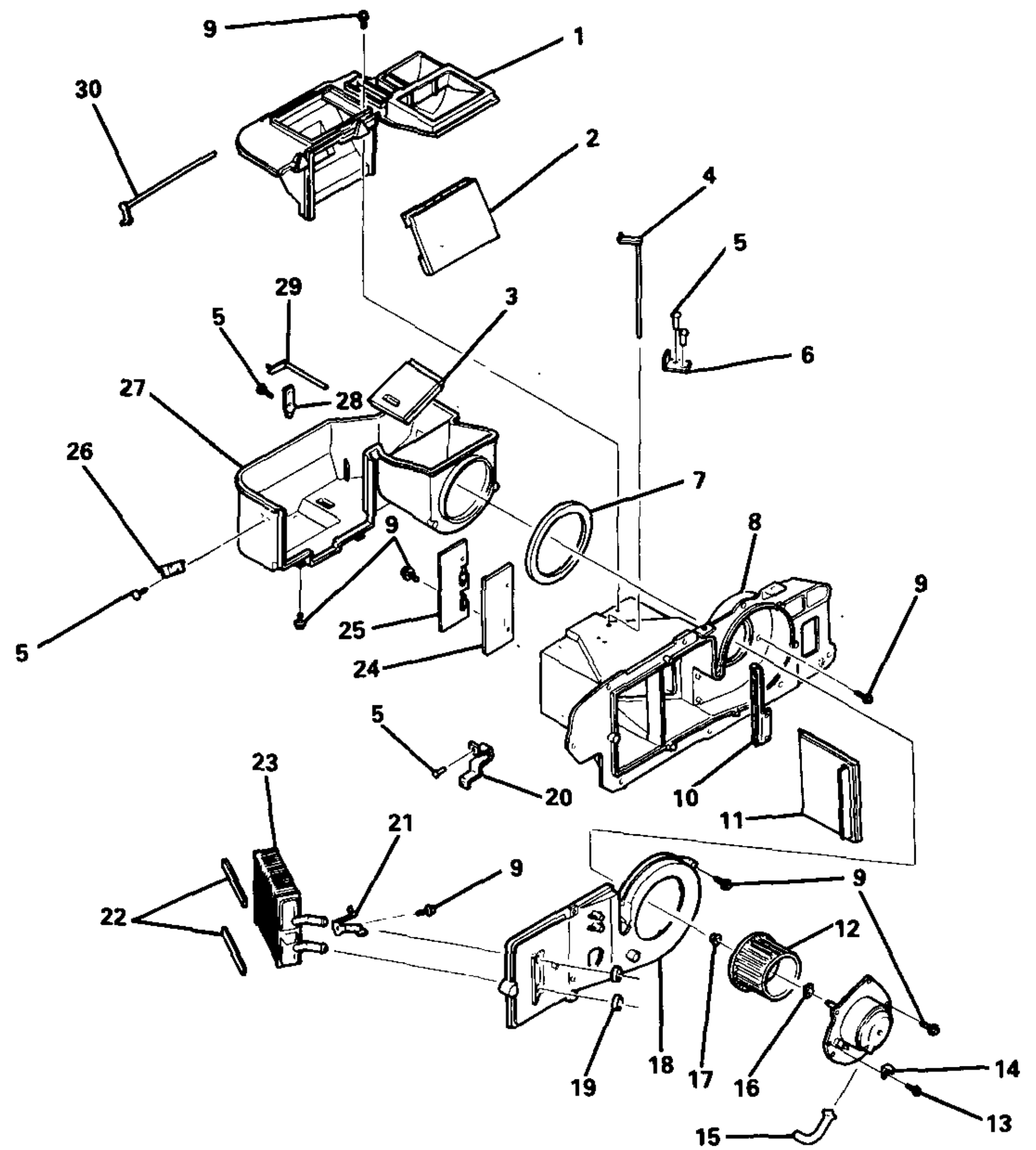


Fig. 13 Blower Noise Diagnosis (2 of 2)



1 — COVER, AIR INL & DIST
2 — VALVE, VENT
3 — VALVE, DEFR
4 — SHAFT, W/LVR, TEMP VLV
5 — RIVET, TRUSS HD (9/16" x 1/4")
6 — BRACKET, CBL MTG
7 — SEAL, HTR & BLO CASE
8 — CASE, HTR
9 — SCREW, HWH TAP (M4.2 x 1.41 x 13)
10 — BAFFLE, AIR
11 — VALVE, TEMP
12 — FAN, BLO
13 — SCREW, HWH TAP (M4.2 x 1.41 x 14)
14 — TERMINAL, BLO MTR GRD (2.530)
15 — TUBE, MTR CLG (9.218)
16 — WASHER, FAN SUPT (9.216)
17 — NUT, BLO FAN
18 — COVER, BLO
19 — SEAL, HTR CORE TUBE
20 — BRACKET, MT
21 — CLAMP, CORE MT
22 — SEAL, HTR CORE
23 — CORE, HTR
24 — SEAL, HTR CORE CASE
25 — CLIP, HTR CORE MT
26 — BRACKET, CBL MT
27 — CASE, AIR INL & DISTR
28 — BRACKET, CBL MT
29 — SHAFT, W/LVR, DEFR VLV
30 — SHAFT, W/LVR, VENT VLV

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Fig. 14 Heater Module Disassembled View

ON-CAR SERVICE PROCEDURES

HEATER CONTROL ASSEMBLY AND BLOWER SWITCH

Remove or Disconnect

1. Negative battery cable.
2. Front pad assembly trim plate.
3. Three controller retaining screws.
4. Controller.
5. Electrical connection at switch.
6. Blower switch from controller.

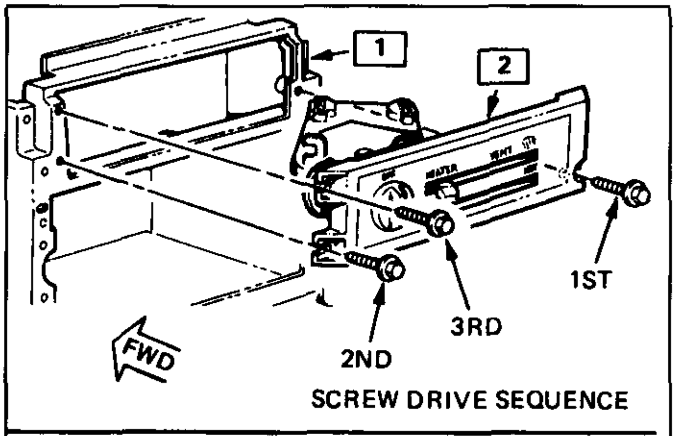


Fig. 15 Heater Control Mounting

Install or Connect

1. Blower switch.
2. Electrical connection at blower switch.
3. Controller.
4. Three controller retainer screws.
5. Front pad assembly trim plate.
6. Negative battery cable.

BLOWER MOTOR AND CAGE

Remove or Disconnect

1. Negative (-) battery cable.
2. Cooling tube.
3. Wires at:
   - Heater blower switch connection.
   - Heater ground connection.
4. Five screws at heater motor.
5. Cage retaining screw, slide cage from motor shaft.

Install or Connect

1. Cage on motor shaft.
2. Heater motor.
3. Cooling tube.
4. Wires at:
   - Heater blower switch console.
   - Heater ground connection.
5. Negative battery cable.

TEMPERATURE CONTROL, POWER VENT, HEATER DEFROST CABLE

Remove or Disconnect

1. R.H. grille and speaker.
2. Front console trim plate.
3. Three controller retaining screws.
4. Controller.
5. Controller cable at control.
6. Cable at heater module.

Install or Connect

1. Cables at heater module.
2. Cable at control.
3. Controller.
4. Controller retainer screws.
5. Front console trim plate.
6. R.H. speaker and grille.

Adjust

After installing and connecting control and temperature cable, move temperatures lever to "HOT" in one quick, "CONTINUOUS, " firm motion until lever stops to adjust cables.

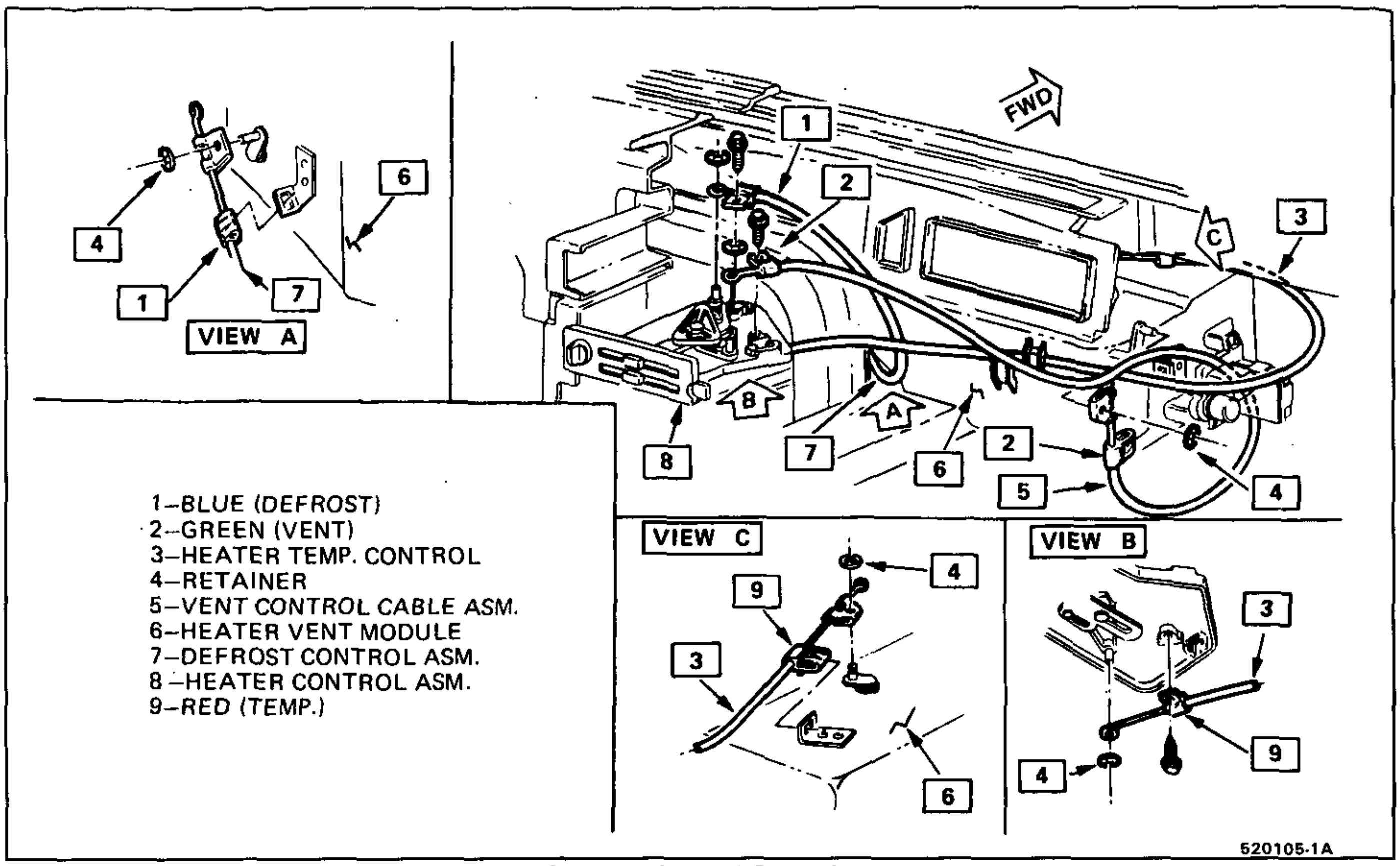
HEATER CORE

Remove or Disconnect

1. Battery negative cable.
2. Wires at:
   - Heater, relay connection
   - Resistor, heater blower
   - Heater, blower switch connection
   - Heater, ground connection
   - Forward courtesy lamp socket (if equipped)
3. Windshield washer fluid container.
4. Heater core inlet and outlet hoses.
5. Heater core grommets.
6. Heater case cover.
7. Heater core retainer.
8. Heater core.

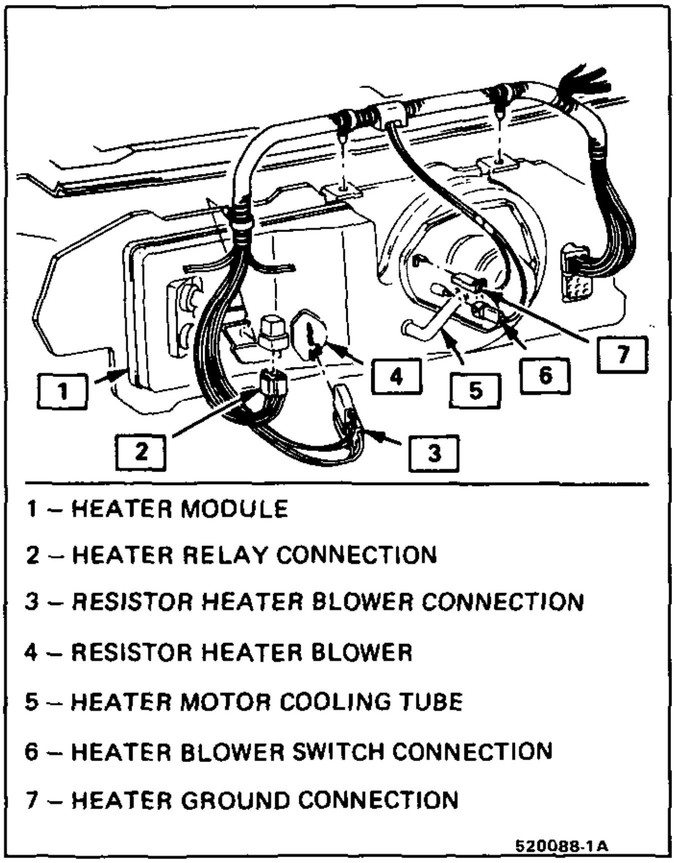
Install or Connect

1. Heater core.
2. Heater core retainer.
3. Heater case cover.
4. Heater core grommets.
5. Wires at:
   a. Heater, relay connection
   b. Resistor, heater blower
   c. Heater, blower switch connection
   d. Heater, ground connection
   e. Forward courtesy lamp socket (if equipped).



1–BLUE (DEFROST)
2–GREEN (VENT)
3–HEATER TEMP. CONTROL
4–RETAINER
5–VENT CONTROL CABLE ASM.
6–HEATER VENT MODULE
7–DEFROST CONTROL ASM.
8–HEATER CONTROL ASM.
9–RED (TEMP.)

Fig. 16 Heater Control Cable Routing



1 – HEATER MODULE
2 – HEATER RELAY CONNECTION
3 – RESISTOR HEATER BLOWER CONNECTION
4 – RESISTOR HEATER BLOWER
5 – HEATER MOTOR COOLING TUBE
6 – HEATER BLOWER SWITCH CONNECTION
7 – HEATER GROUND CONNECTION

Fig. 17 Heater Module Wiring

6. Heater, core inlet and outlet hoses.
7. Refill cooling system as required.
    - *Follow procedures outlined in Section 6B.*
8. Windshield washer fluid container.
9. Battery negative cable.

HEATER CONTROL WIRING

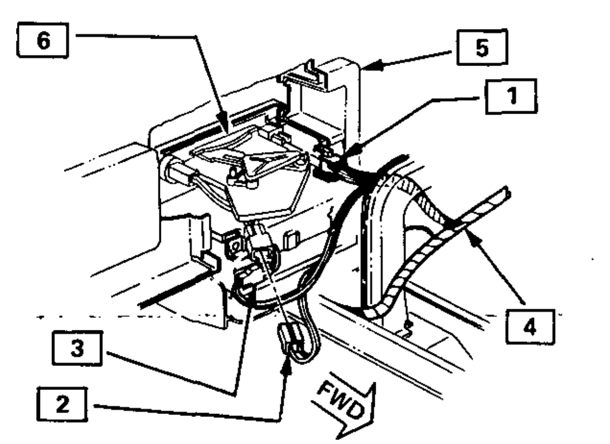
↔ **Remove or Disconnect**

The heater control wiring has been incorporated into the main wiring harness, when repair is required refer to Section 8C of the Service Manual.

HEATER/VENTILATION/DEFROSTER DUCTS

↔ **Remove or Disconnect**

1. Negative (-) battery cable.
2. Courtesy light sockets (if equipped).
3. Hood release.
4. Ram vent control (if equipped).
5. Instrument panel steering column cover.
6. Speakers and speaker grilles.
7. Instrument panel service cover.
8. Four bolts from shifter trim plate (do not remove shifter knob).
9. Front console trim plate.
10. Front console pad assembly.
11. Top bolts of reinforcement to I.P.
12. Instrument panel.



1–HEATER FAN CONNECTION

2–HEATER CONT ILLUMINATION CONNECTION

3–RADIO ILLUMINATION CONNECTION

4–MAIN I/P HARNESS

5–I/P ASM

6–HEATER CONTROL ASM

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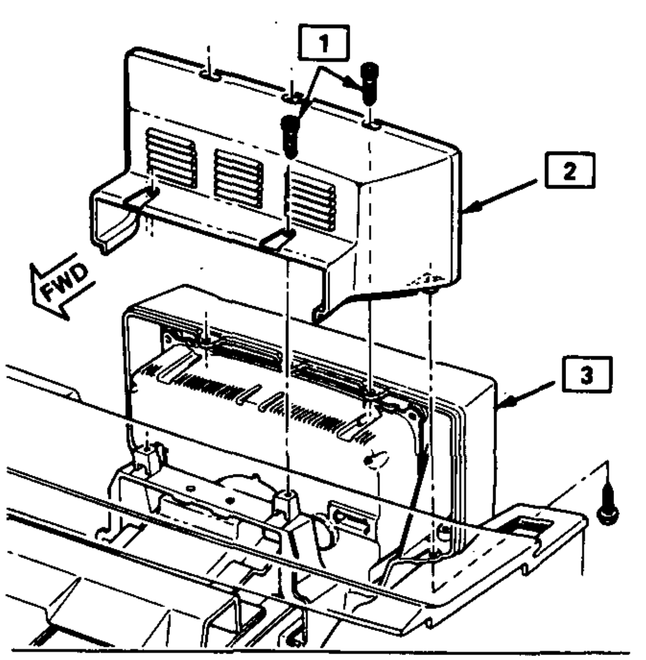
Fig. 18 Heater Control Wiring Harness



1—SCREW

2—INSTRUMENT PANEL COVER

3—INSTRUMENT PANEL HOUSING ASM.

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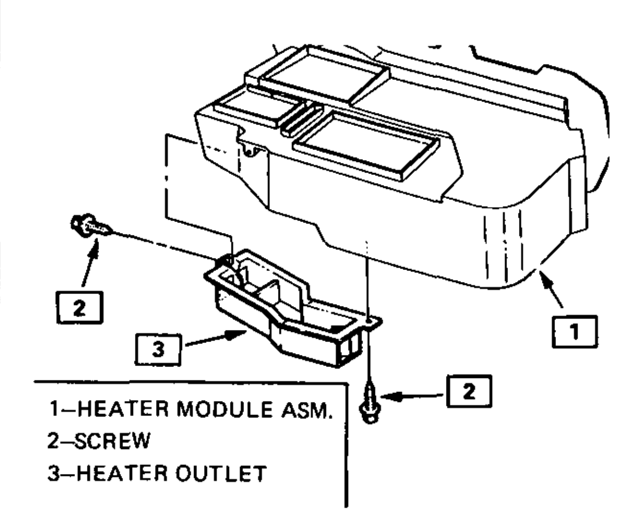
Fig. 19 I. P. Service Cover

13. Instrument panel ducts.

Install or Connect

1. Instrument panel ducts.
2. Instrument panel.
3. Top screws from reinforcement to I.P.
4. Front console pad assembly.
5. Front console trim plate.
6. Shifter trim plate.
7. Instrument panel service cover.
8. Speaker and speaker grilles.
9. Ram vent control (if equipped).
10. Hood release.
11. Courtesy light sockets (if equipped).
12. Instrument panel steering column cover.
13. Negative (-) battery cable.



1–HEATER MODULE ASM.
2–SCREW
3–HEATER OUTLET

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Fig. 20 Lower (Floor) Heater Outlet

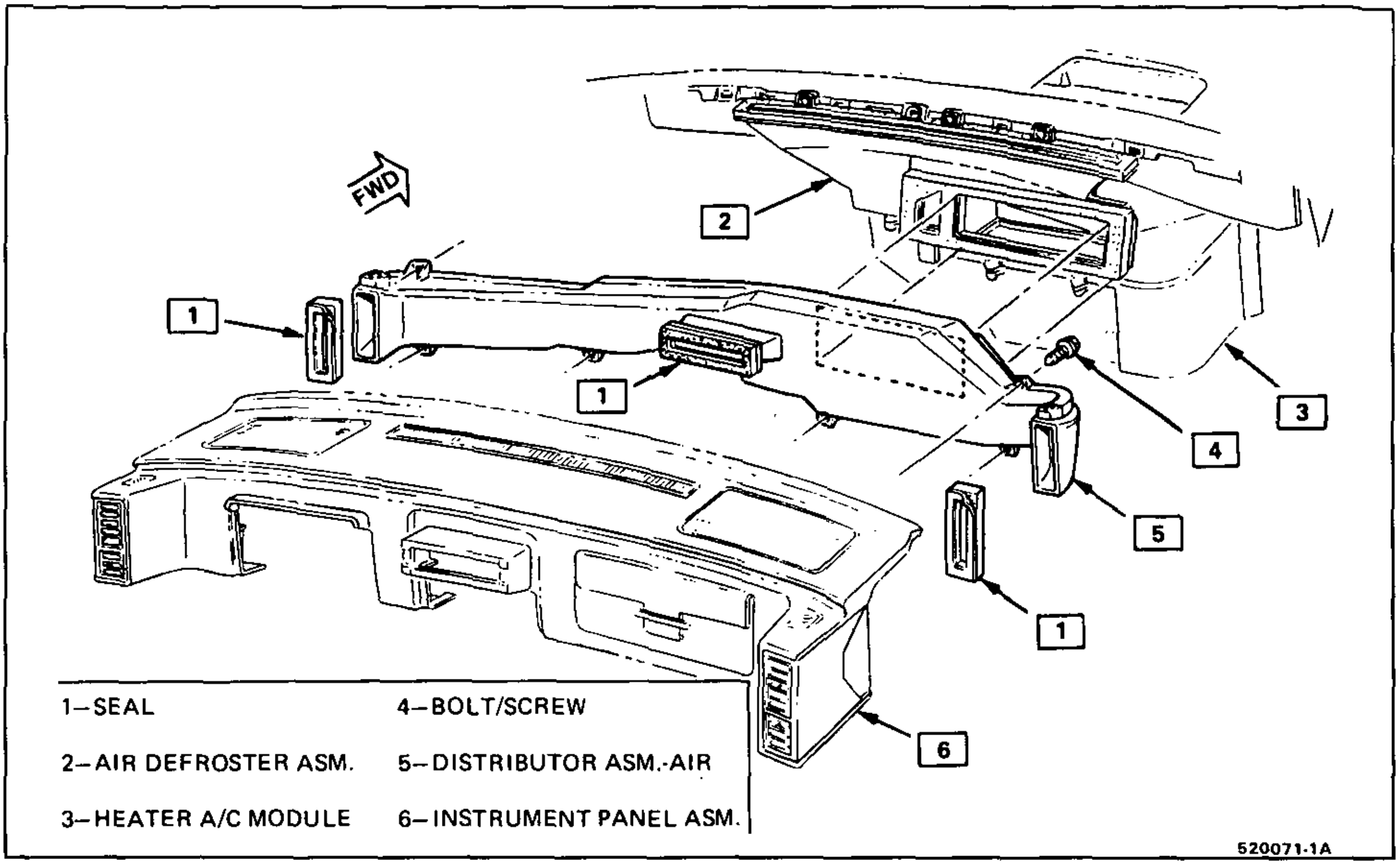
LOWER (FLOOR) HEATER OUTLET

Remove or Disconnect

1. Screw.
2. Outlet.

Install or Connect

1. Outlet.
2. Screw.



1–SEAL
2–AIR DEFROSTER ASM.
3–HEATER A/C MODULE
4–BOLT/SCREW
5–DISTRIBUTOR ASM.-AIR
6–INSTRUMENT PANEL ASM.

Fig. 21 I. P. Duct Assembly

1 – SEAL
2 – DUST PANEL ASSY.
3 – MODULE ASSY.
4 – DEFROSTER DISTRIBUTOR ASSY.
5 – BOLT (4 REQUIRED)
6 – BOLT/SCREW (3)

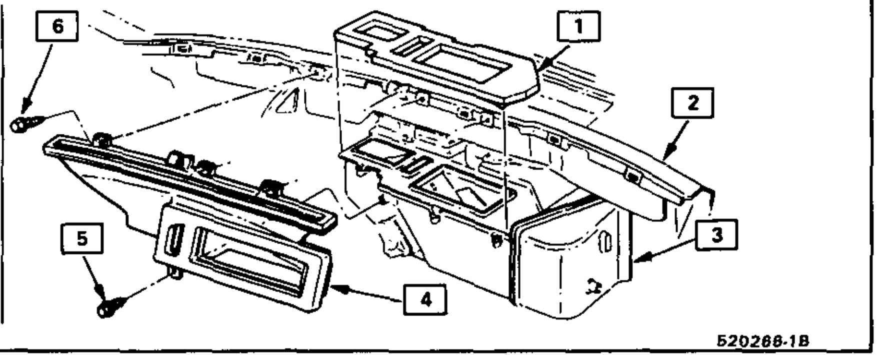


Fig. 22 Defroster Duct Assembly

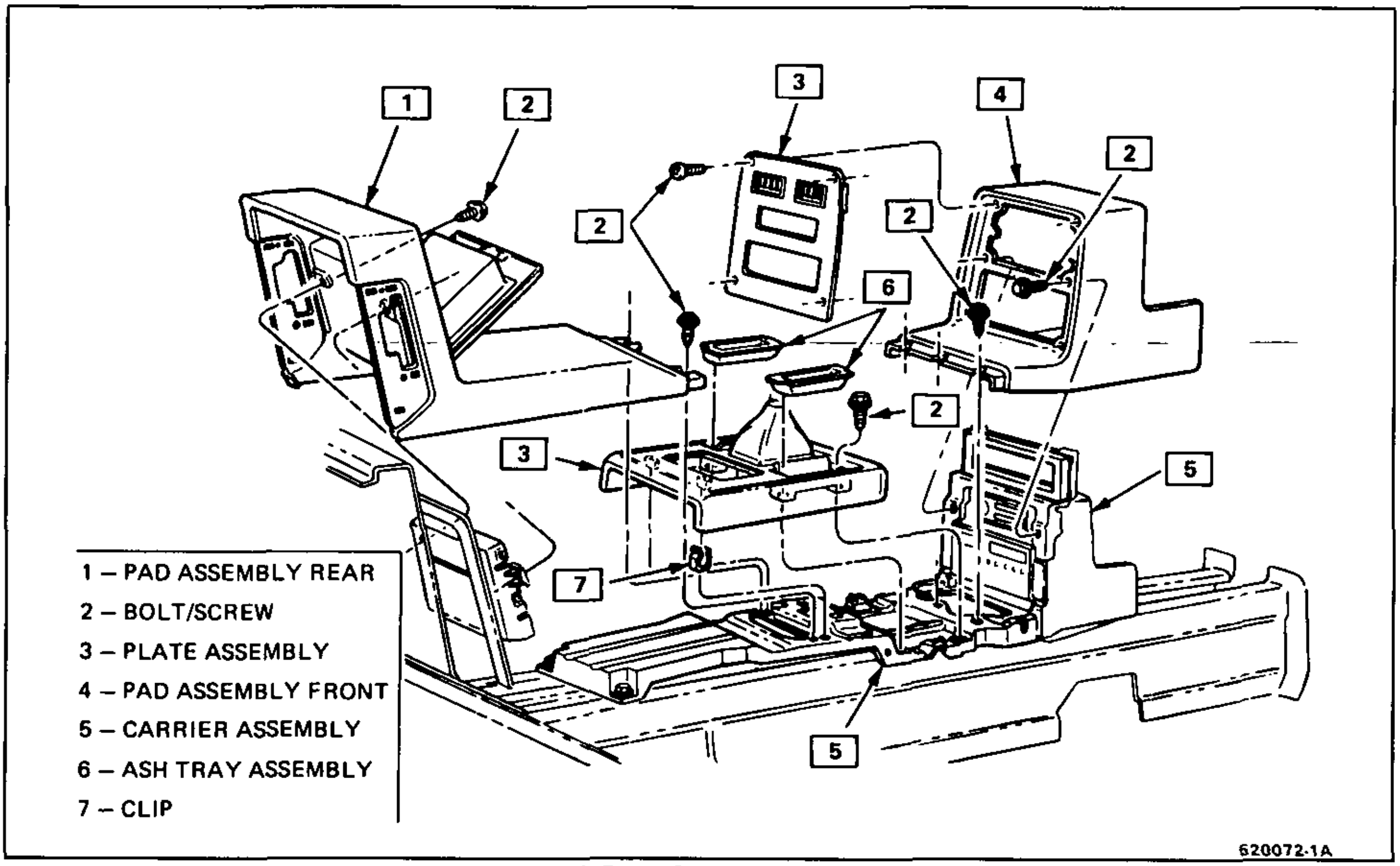


Fig. 23 Front Console Assembly

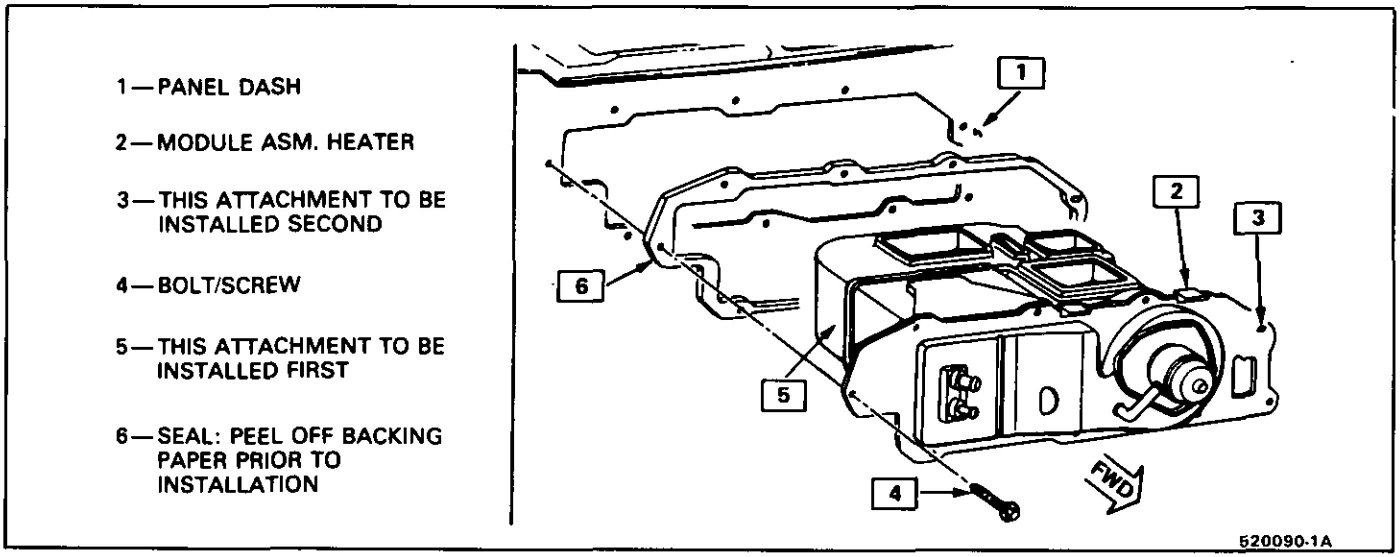
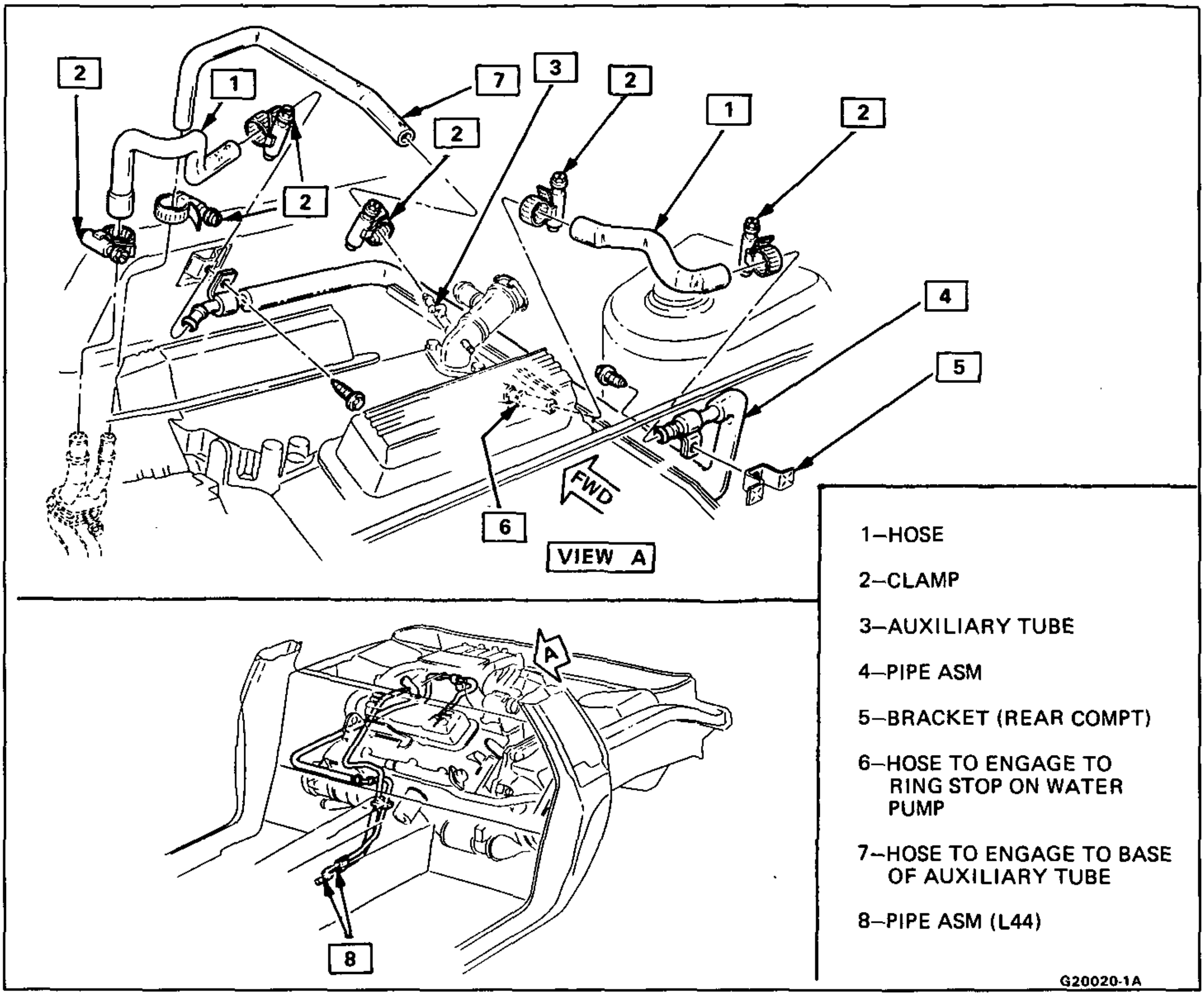
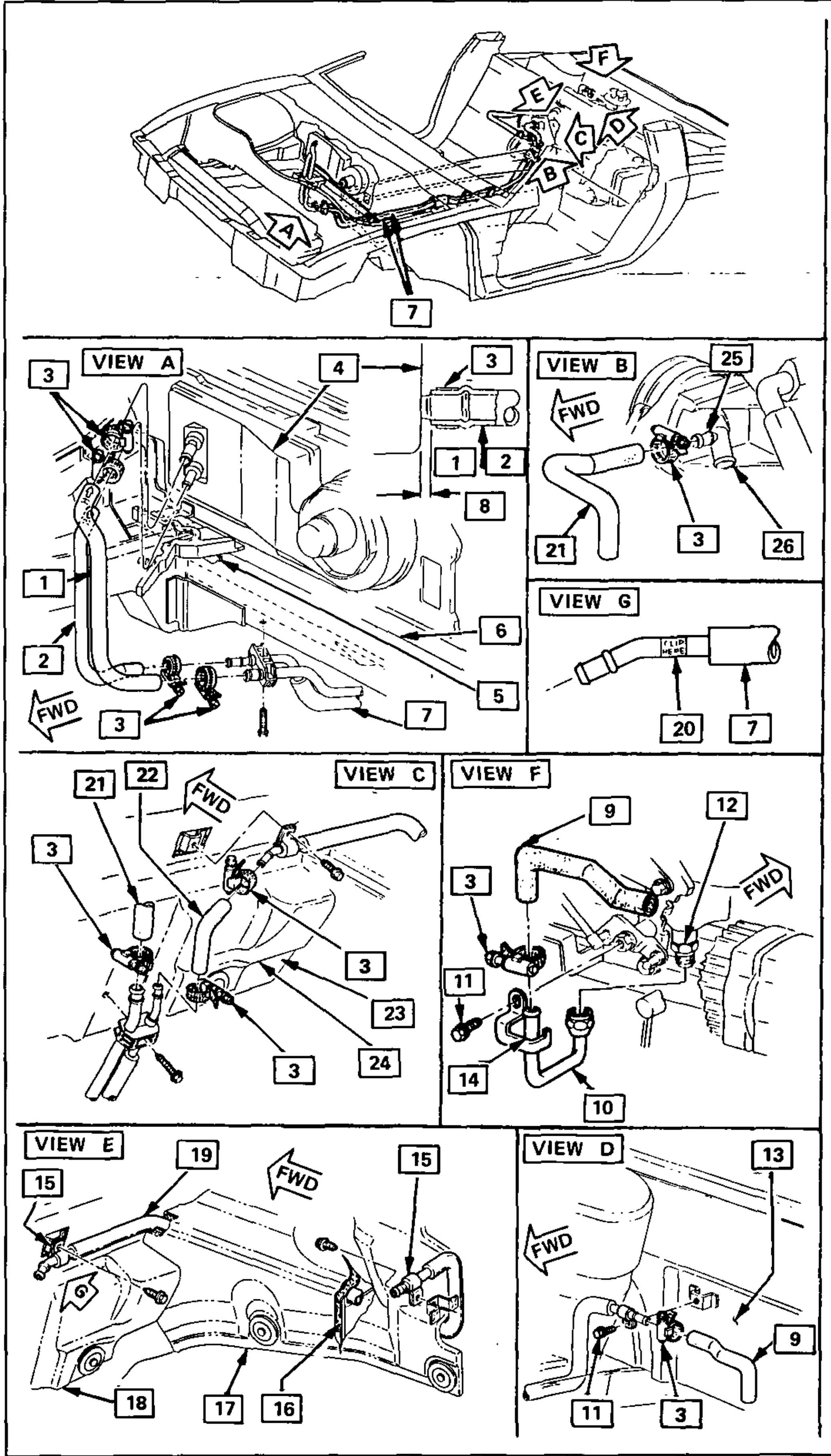


Fig. 24 Heater Module



1–HOSE
2–CLAMP
3–AUXILIARY TUBE
4–PIPE ASM
5–BRACKET (REAR COMPT)
6–HOSE TO ENGAGE TO RING STOP ON WATER PUMP
7–HOSE TO ENGAGE TO BASE OF AUXILIARY TUBE
8–PIPE ASM (L44)

Fig. 25 Heater Hoses and Pipes, Engine Code 9



1–HOSE-OUTLET
2–HOSE-INLET
3–CLAMP
4–MODULE
5–FWD COMPT PAN SEAL
6–TORQUE BAR FWD
7–PIPE ASM
8–12 - 14mm
9–HOSE-INLET (LR8)
10–PIPE ASM-INLET (LR8)
11–BOLT/SCREW
12–INTAKE MANIFOLD
13–ENGINE COMPT
14–INSTALL HOSE TO BRACKET ON PIPE
15–CLIP
16–SIDE RAIL
17–INSULATOR RH
18–INSULATOR FWD
19–PIPE ASM INLET ROUTES ALONG FLANGED EDGE OF SIDE RAIL AND UNDER RH ENGINE INSULATOR
20–INSTALL CLIP OVER TAPE FOR PROPER LOCATION WHEN INSTALLING PIPE ASM
21–HOSE-HTR OUTLET
22–HOSE-HTR INLET
23–RR TORQUE BAR
24–INSULATOR FWD
25–HOSE TO ENGAGE TO RING STOP
26–WATER PUMP

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Fig. 26 Heater Hoses and Pipes

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

For 1986 two different air conditioning systems are available:

(1) 4-Cylinder (1.8 Liter, LH8 and 2.5 Liter; LR8 and L68) engines are equipped with a variable displacement (V-5) air conditioning compressor. This compressor can match the automotive air conditioning demand under all conditions without cycling.

(2) All other engines are equipped with a fixed displacement (R-4 or DA-6) 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 or DA-6 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. Air conditioning systems that use the variable displacement compressor are reference to as V-5 type systems. This type of system was new for the 1985 model year. The two systems are described below.

The V-5 A/C System

The V5 is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with five axially oriented cylinders. The center of control of the compressor displacement is a bellows actuated control valve located in the rear head of the compressor that senses compressor suction pressure. The wobble-plate angle and compressor displacement are controlled by the crankcase-suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point; the valve will maintain a bleed from crankcase to suction; no crankcase-suction pressure differential; and the compressor will have maximum displacement. When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The angle of the wobble-plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase-suction pressure differential creates a total force on the pistons resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

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.

A/C SYSTEM DIFFERENCES

Pressure Cycling Switch

The pressure cycling switch is not used with V-5 A/C systems because the compressor can vary its displacement to match the automotive air conditioning demand under all conditions. The switch is still used with all C.C.O.T. type systems (see pressure cycling switch under SYSTEM COMPONENTS-FUNCTIONAL).

Low Pressure Cut-Out Switch

Because the pressure cycling switch is not used with the V-5 compressor, a low pressure cut-out switch is used to protect the compressor from a low charge condition. The low pressure cut-out switch, located in the rear head of the compressor next to the high pressure cut-out switch, is also used to shut the compressor off in cold weather (see Low-Pressure Cut-Off Switch under SYSTEM COMPONENTS-FUNCTIONAL).

V-5 Compressor Removal

The V-5 Compressor is equipped with a crankcase drain plug located in the body of the compressor. When removing the V-5 and draining oil from the compressor, the crankcase plug **must** be removed and oil drained from the fitting. It is also necessary to drain the oil from the suction and discharge ports to assure complete oil draining. (See Section 1D3 for complete instructions on removal or replacement of a V-5 compressor).

The R-4 and DA-6 compressors do not have a crankcase and oil can only be drained from the suction and discharge ports.

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 and 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.

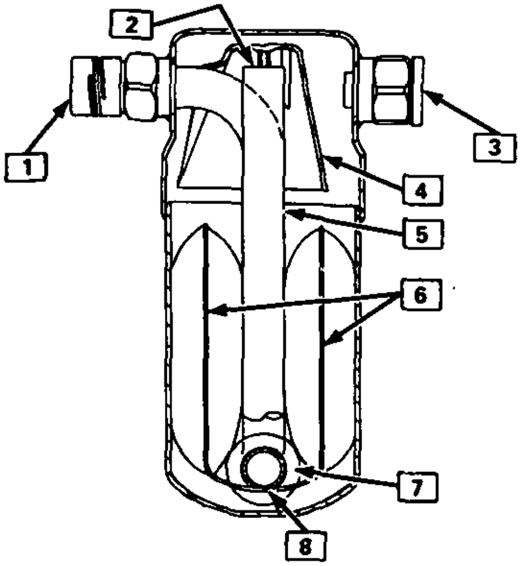
When the engine is turned "OFF" with the A/C system operating, the refrigerant in the system will flow from the high-pressure side of the expansion tube (orifice) to the low-pressure side until the pressure is equalized. This may be detected as a faint sound of liquid flowing (hissing) for 30 to 60 seconds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

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.



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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Fig. 1 Accumulator - Interior Parts

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 maybe 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) provided 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.

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. For R-4 or DA-6 compressors - see C.C.O.T. A/C system diagnostic procedures.
8. For V-5 compressors - see V-5 A/C system diagnostic procedures.

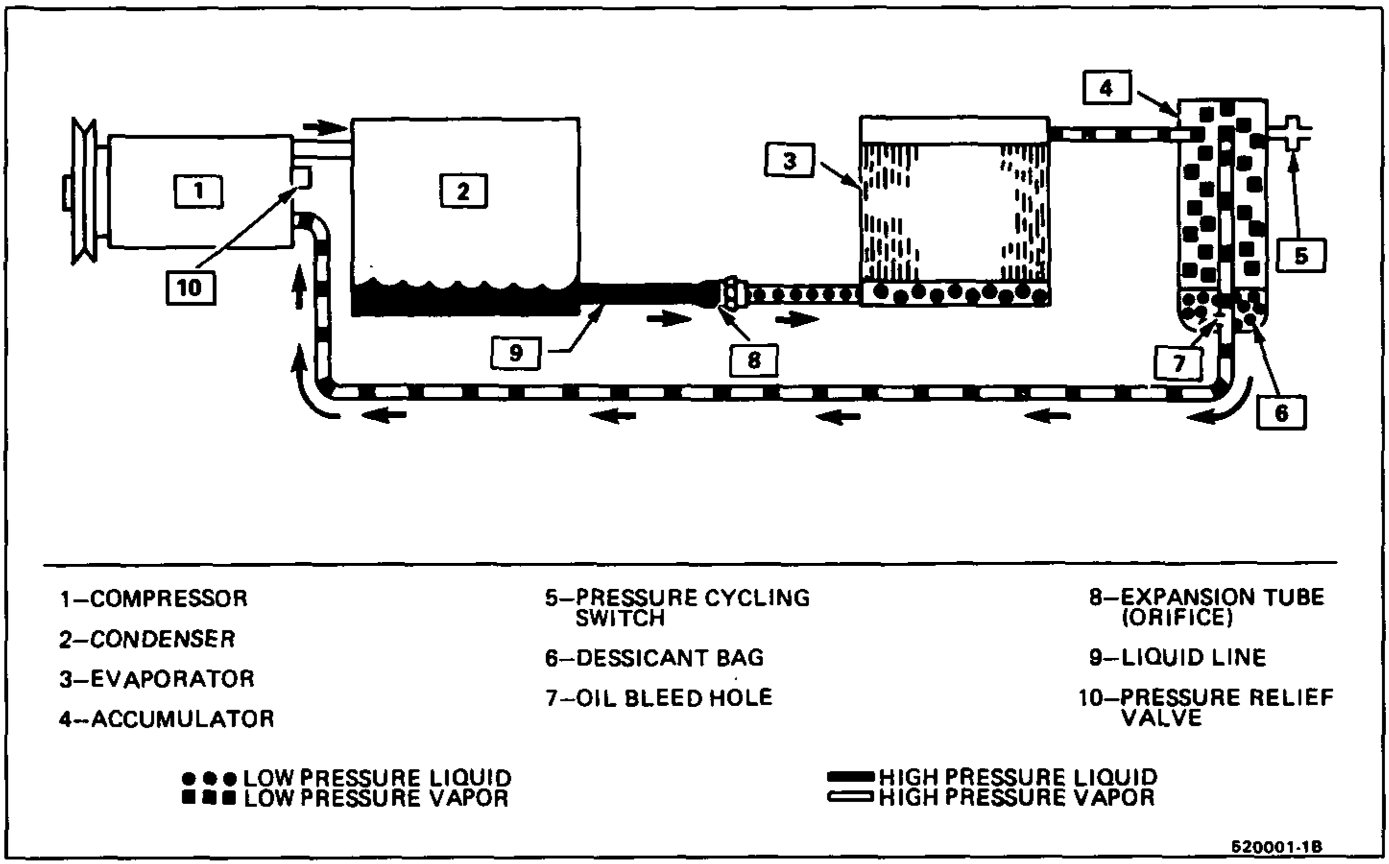


Fig. 2 A/C System-Typical

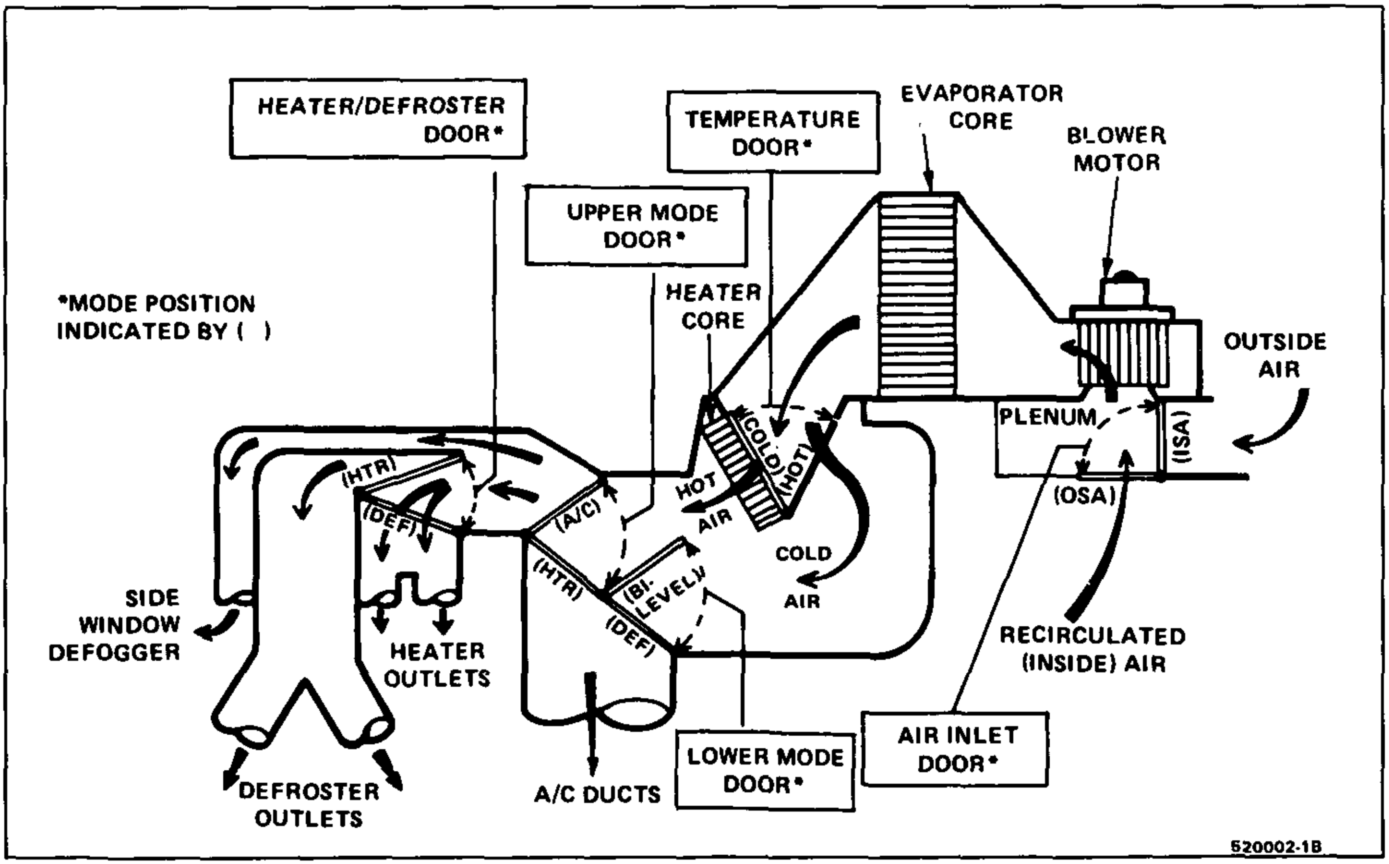
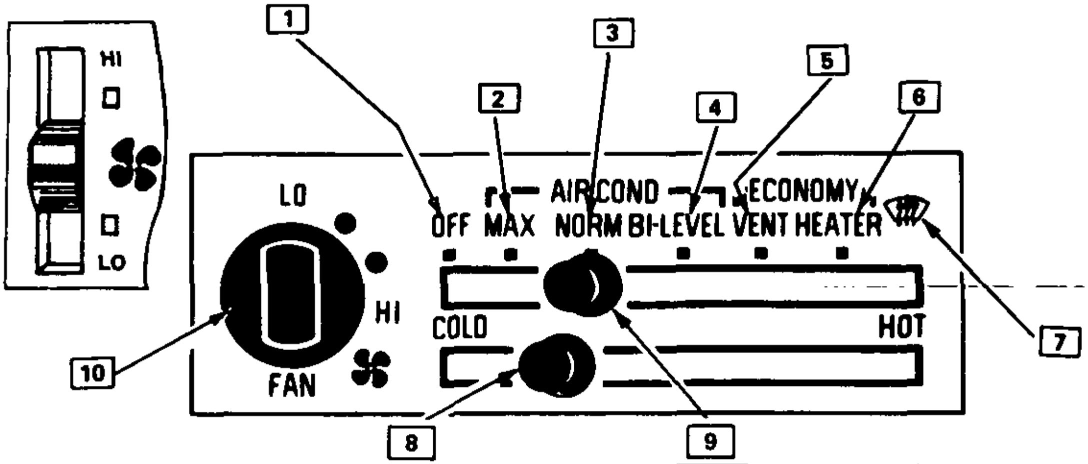


Fig. 3 A/C Air Flow-Typical



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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Fig. 4 A/C Controller-Typical

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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Fig. 5 Pressure-Temperature Relationship of R-12

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 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 SOME DEGREE COOLER THAN AMBIENT--Proper condition: check for other problems (See Testing the Refrigerant System (items 1-6).

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

ELECTRICAL/VACUUM SYSTEM DIAGNOSIS

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

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS "CHART A"

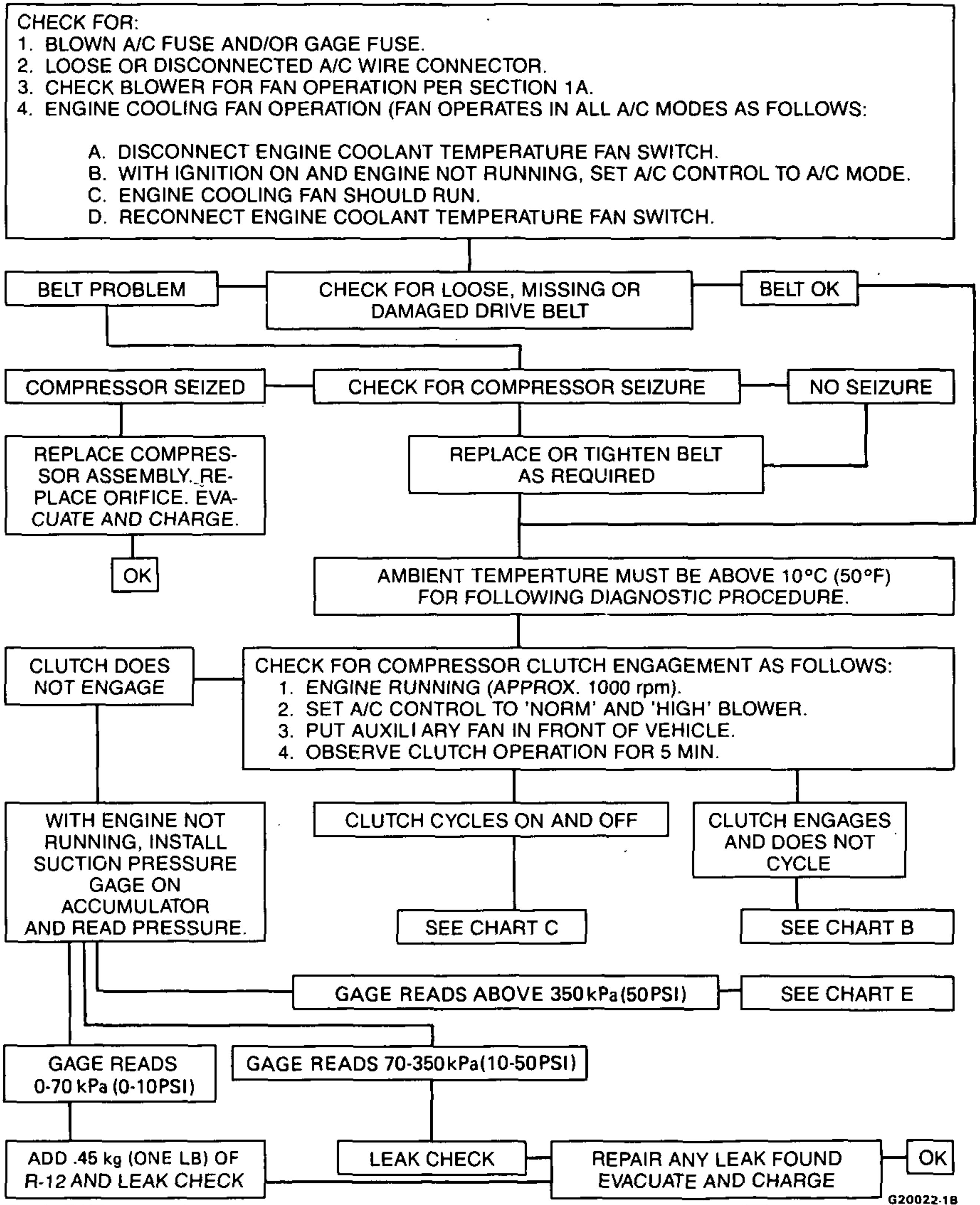


Fig. 6 V-5 A/C System Diagnostic Procedure (1 of 4)

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS "CHART B"

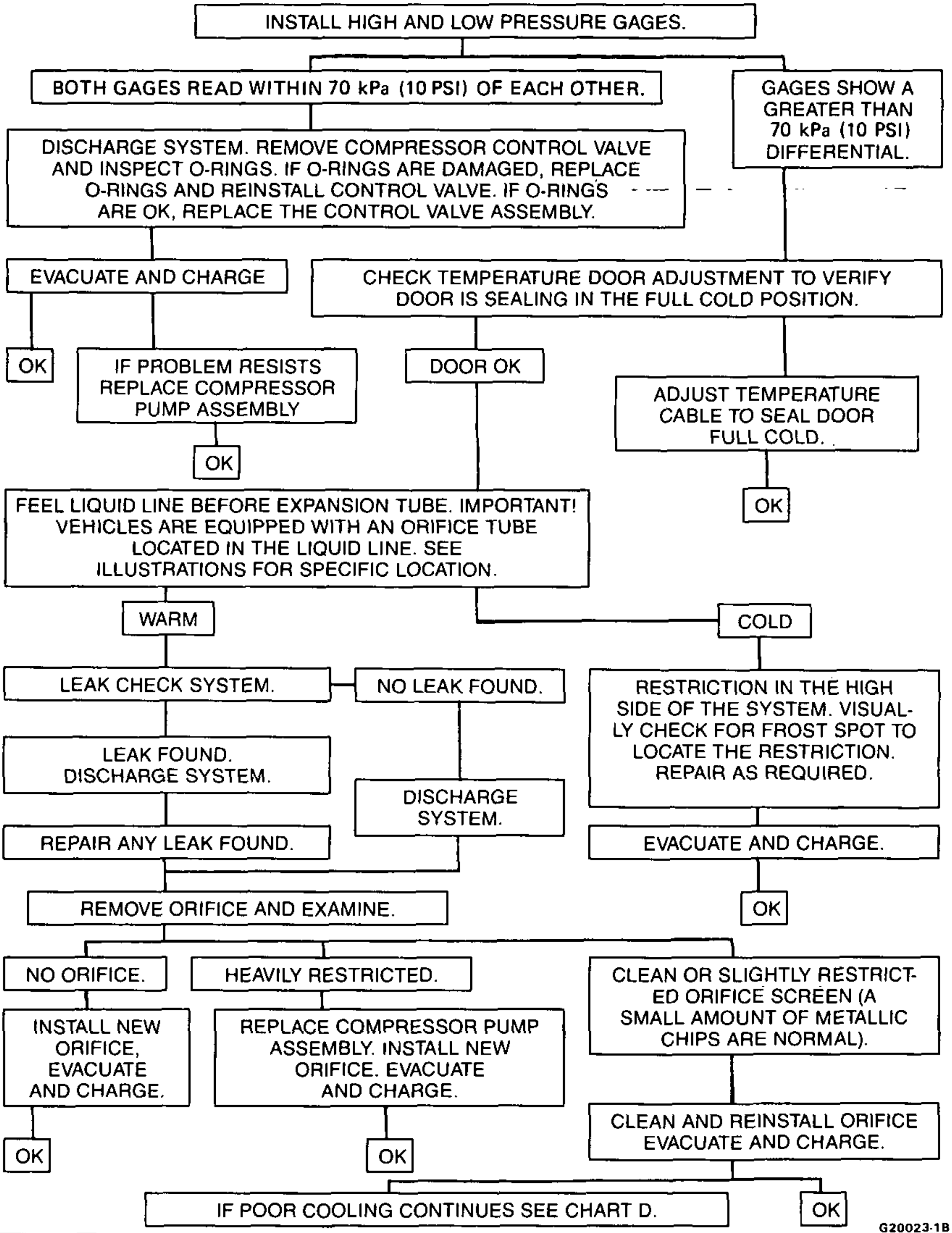
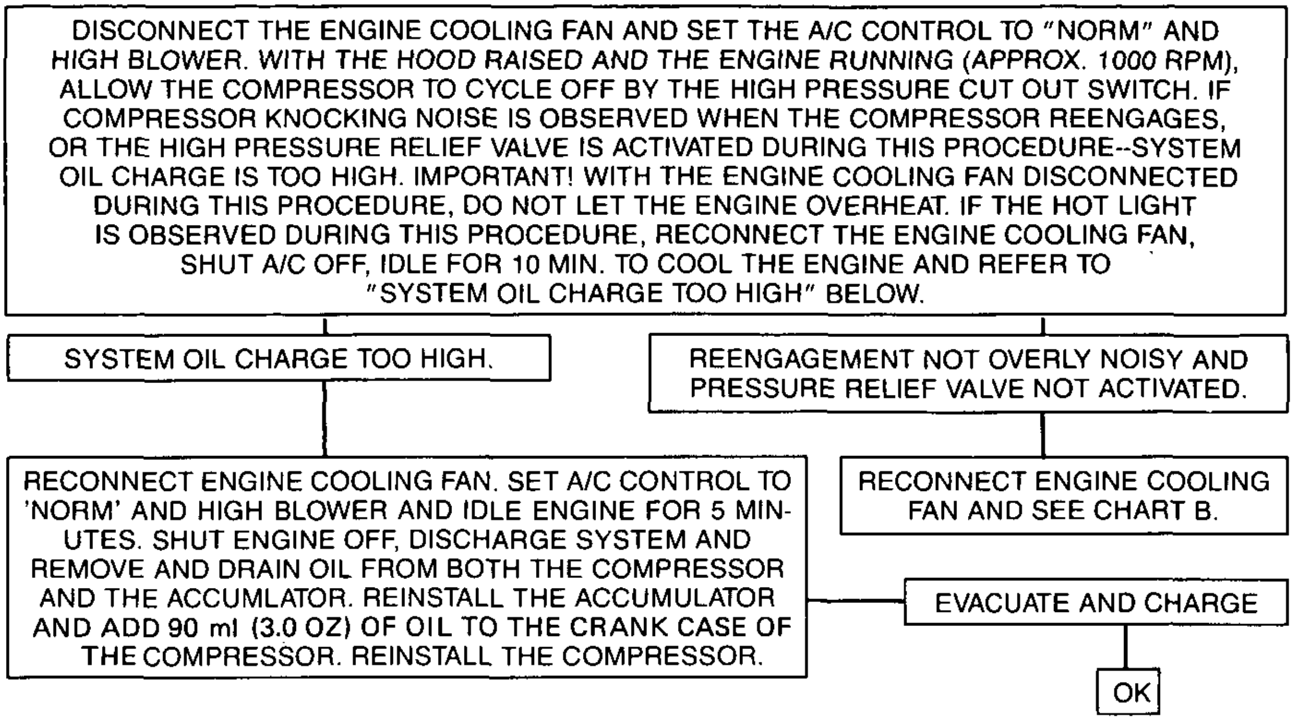


Fig. 7 V-5 A/C System Diagnostic Procedure (2 of 4)

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS "CHART C"



DISCONNECT THE ENGINE COOLING FAN AND SET THE A/C CONTROL TO "NORM" AND HIGH BLOWER. WITH THE HOOD RAISED AND THE ENGINE RUNNING (APPROX. 1000 RPM), ALLOW THE COMPRESSOR TO CYCLE OFF BY THE HIGH PRESSURE CUT OUT SWITCH. IF COMPRESSOR KNOCKING NOISE IS OBSERVED WHEN THE COMPRESSOR REENGAGES, OR THE HIGH PRESSURE RELIEF VALVE IS ACTIVATED DURING THIS PROCEDURE--SYSTEM OIL CHARGE IS TOO HIGH. IMPORTANT! WITH THE ENGINE COOLING FAN DISCONNECTED DURING THIS PROCEDURE, DO NOT LET THE ENGINE OVERHEAT. IF THE HOT LIGHT IS OBSERVED DURING THIS PROCEDURE, RECONNECT THE ENGINE COOLING FAN, SHUT A/C OFF, IDLE FOR 10 MIN. TO COOL THE ENGINE AND REFER TO "SYSTEM OIL CHARGE TOO HIGH" BELOW.

SYSTEM OIL CHARGE TOO HIGH.

RECONNECT ENGINE COOLING FAN. SET A/C CONTROL TO 'NORM' AND HIGH BLOWER AND IDLE ENGINE FOR 5 MINUTES. SHUT ENGINE OFF, DISCHARGE SYSTEM AND REMOVE AND DRAIN OIL FROM BOTH THE COMPRESSOR AND THE ACCUMLATOR. REINSTALL THE ACCUMULATOR AND ADD 90 ml (3.0 OZ) OF OIL TO THE CRANK CASE OF THE COMPRESSOR. REINSTALL THE COMPRESSOR.

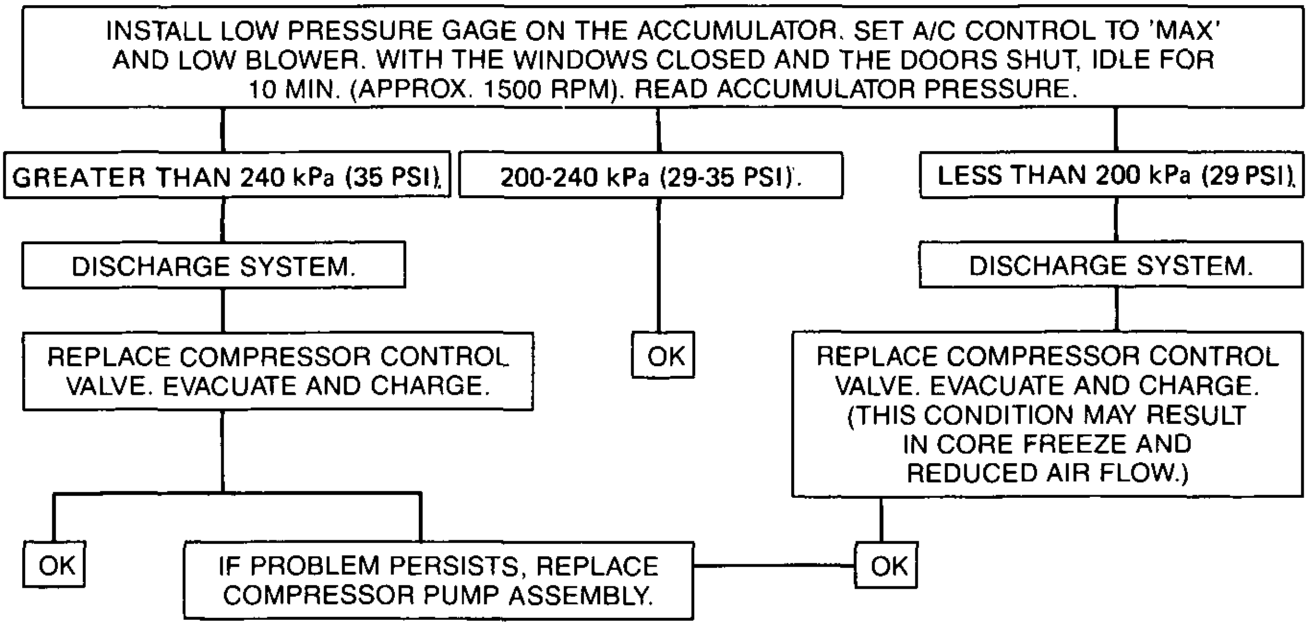
EVACUATE AND CHARGE

OK

REENGAGEMENT NOT OVERLY NOISY AND PRESSURE RELIEF VALVE NOT ACTIVATED.

RECONNECT ENGINE COOLING FAN AND SEE CHART B.

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS "CHART D"



INSTALL LOW PRESSURE GAGE ON THE ACCUMULATOR. SET A/C CONTROL TO 'MAX' AND LOW BLOWER. WITH THE WINDOWS CLOSED AND THE DOORS SHUT, IDLE FOR 10 MIN. (APPROX. 1500 RPM). READ ACCUMULATOR PRESSURE.

GREATER THAN 240 kPa (35 PSI).

DISCHARGE SYSTEM.

REPLACE COMPRESSOR CONTROL VALVE. EVACUATE AND CHARGE.

OK

IF PROBLEM PERSISTS, REPLACE COMPRESSOR PUMP ASSEMBLY.

200-240 kPa (29-35 PSI).

OK

LESS THAN 200 kPa (29 PSI).

DISCHARGE SYSTEM.

REPLACE COMPRESSOR CONTROL VALVE. EVACUATE AND CHARGE. (THIS CONDITION MAY RESULT IN CORE FREEZE AND REDUCED AIR FLOW.)

OK

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Fig. 8 V-5 A/C System Diagnostic Procedure (3 of 4)

V-5 SYSTEM AIR CONDITIONING DIAGNOSIS "CHART E"

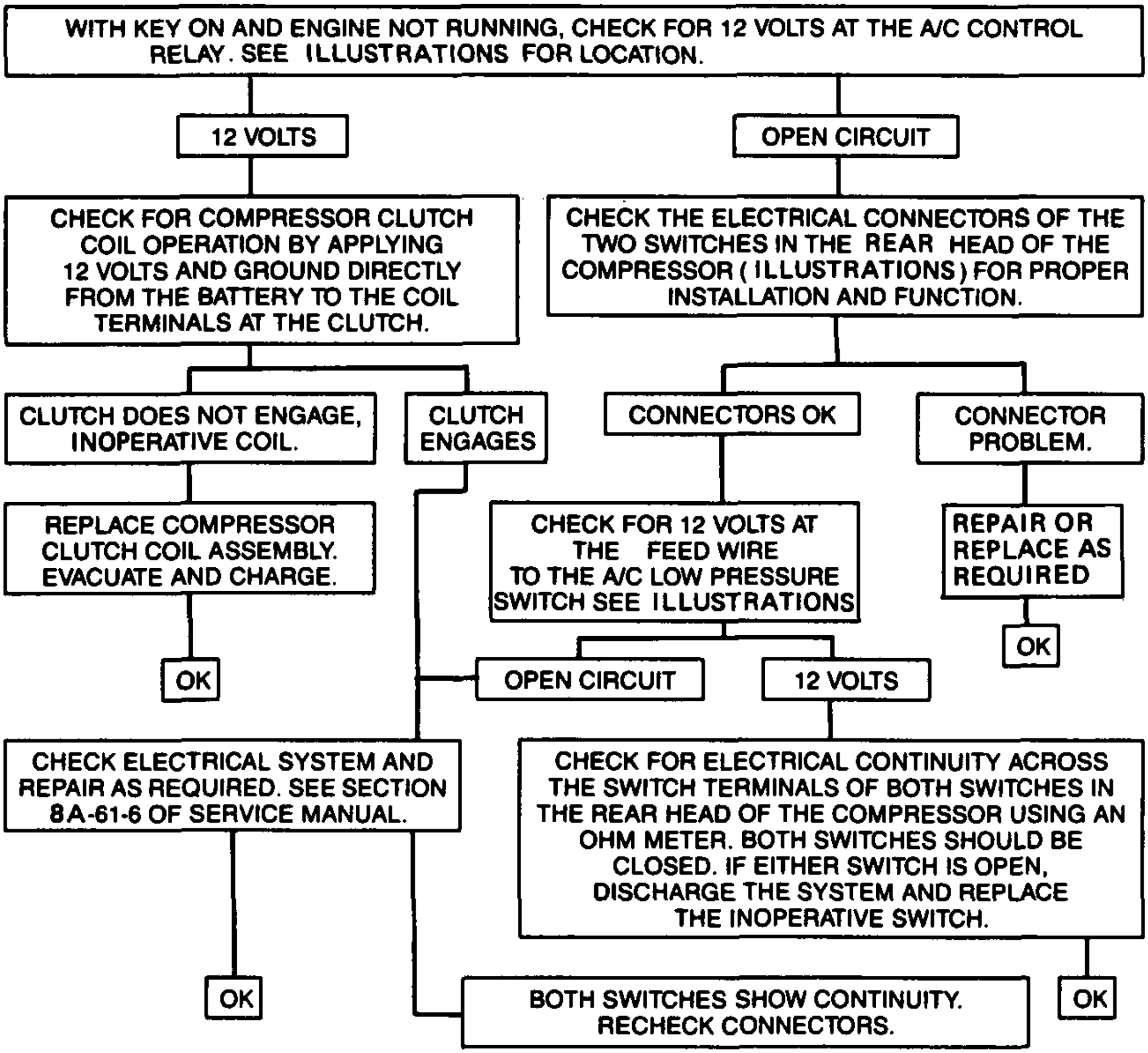

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Fig. 9 V-5 A/C System Diagnostic Procedure (4 of 4)

C.C.O.T. SYSTEM AIR CONDITIONING DIAGNOSIS "CHART A"

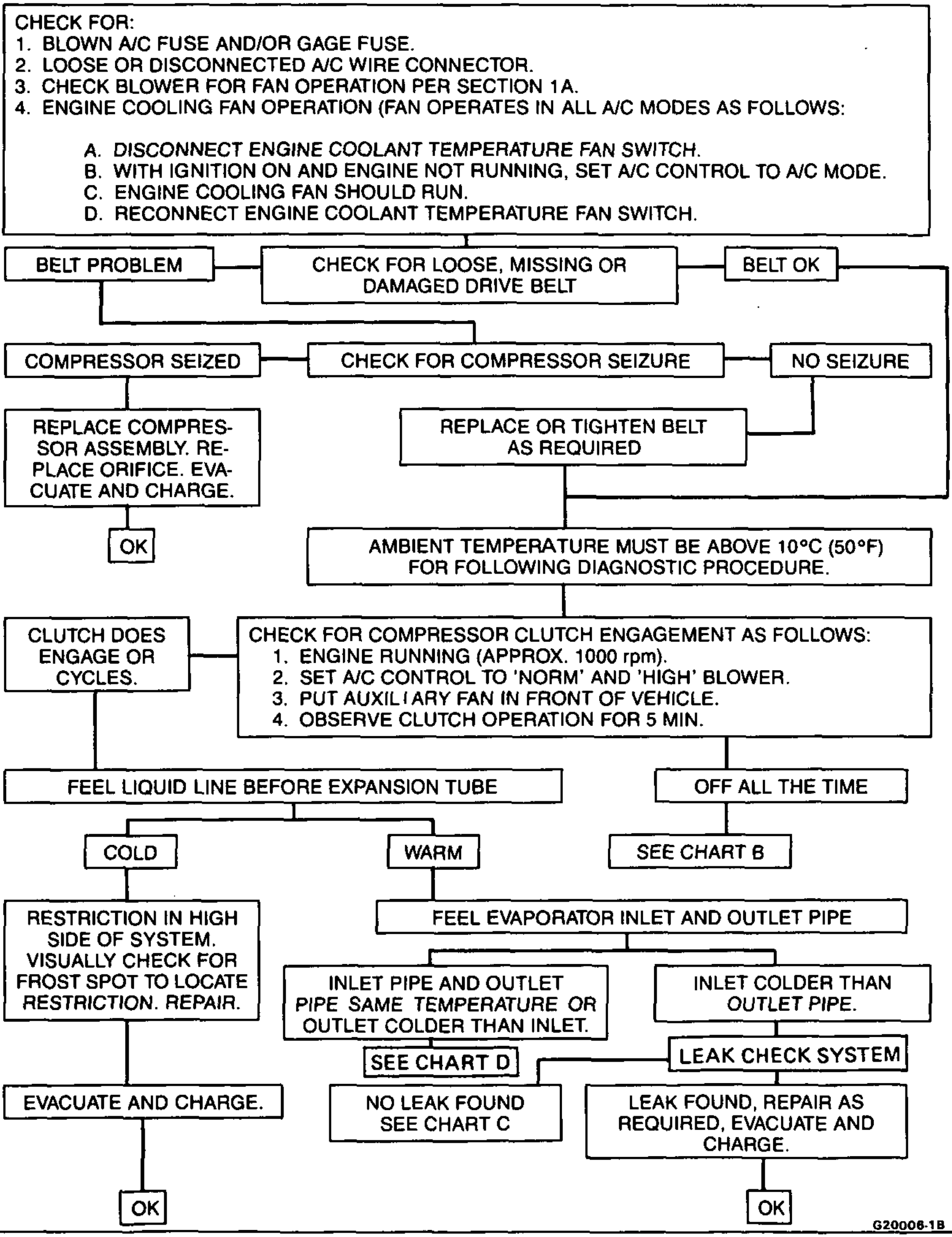


Fig. 10 C.C.O.T. A/C System Diagnostic Procedure (1 of 4)

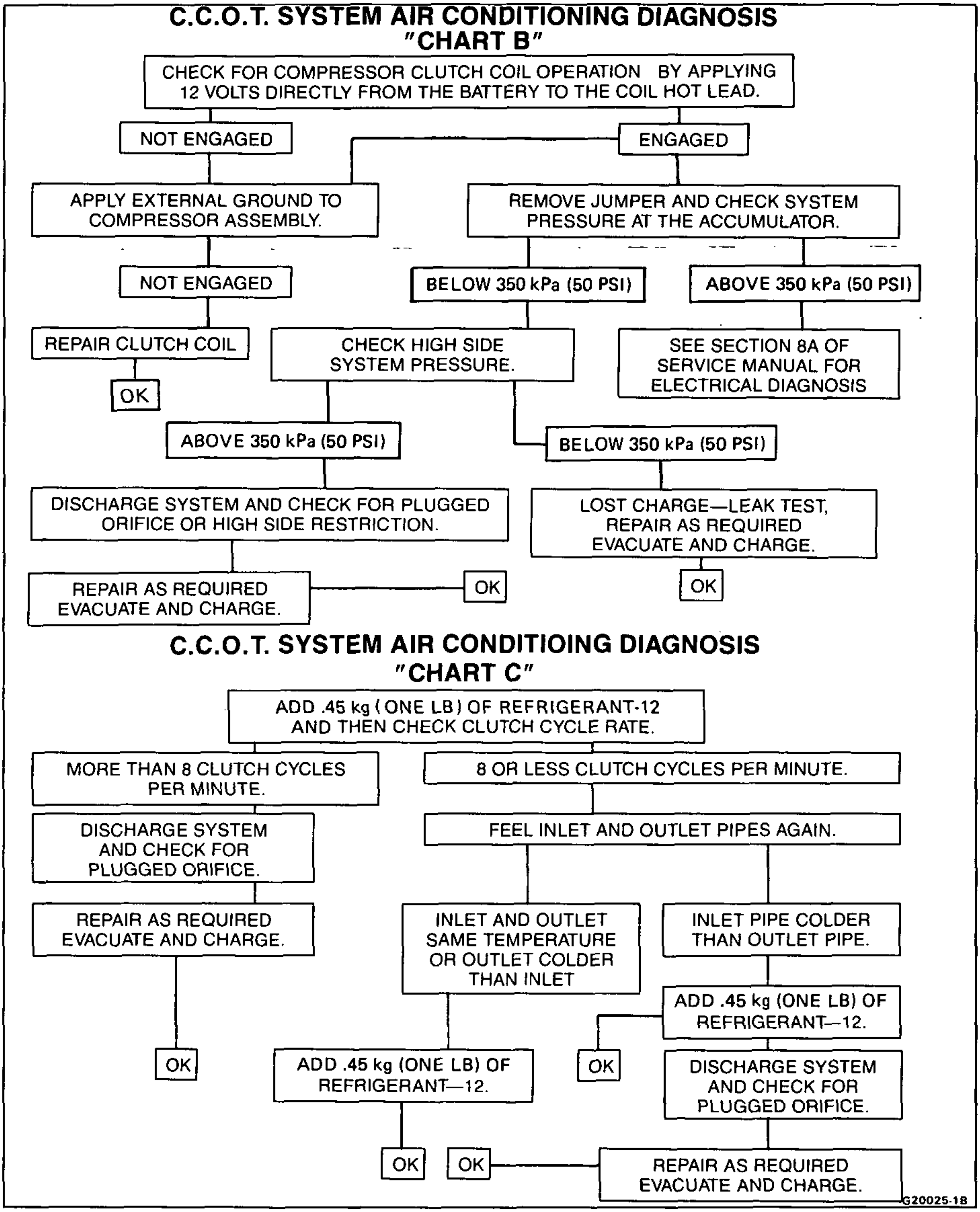
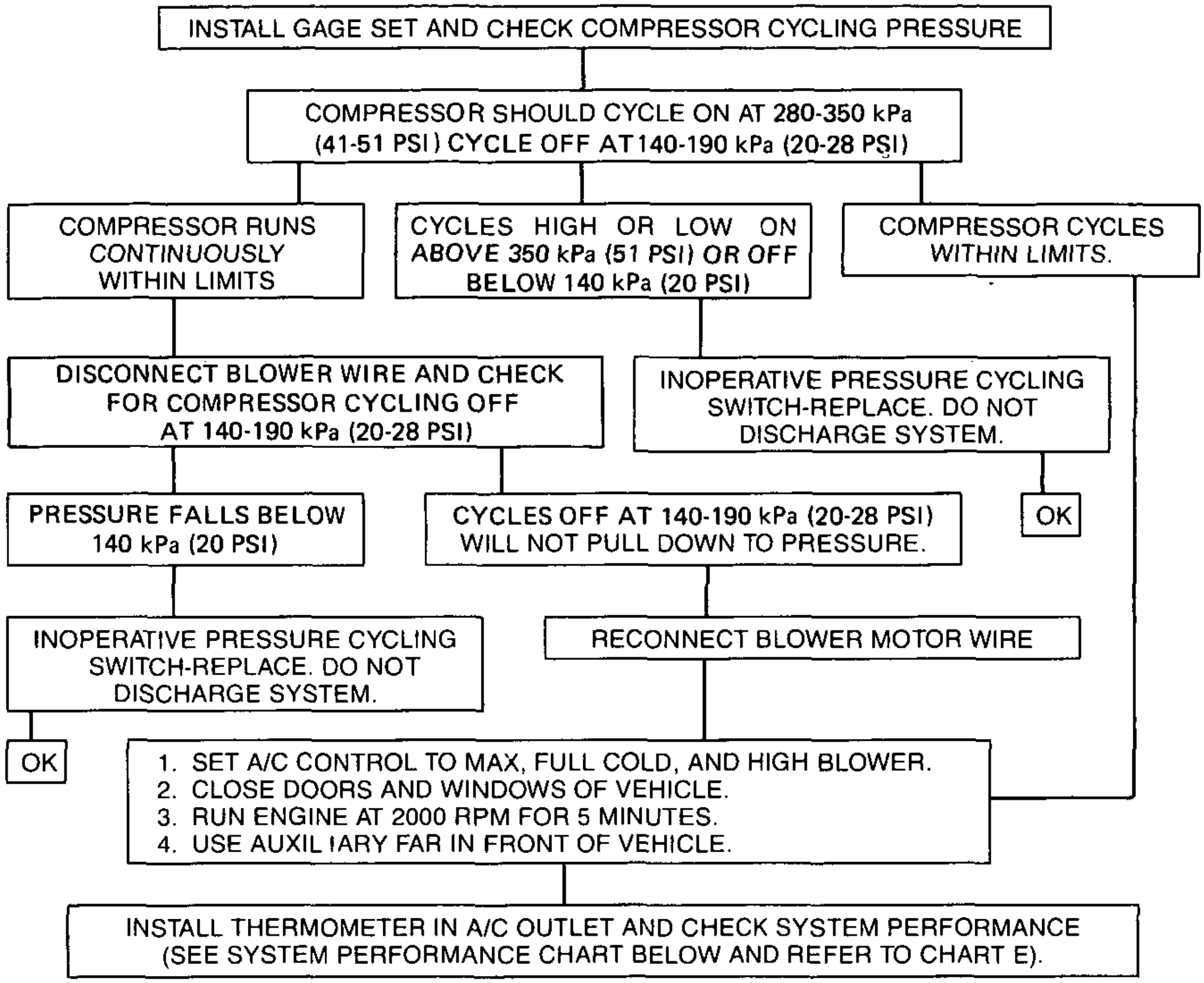


Fig. 11 C.C.O.T. A/C System Diagnostic Procedure (2 of 4)

C.C.O.T. SYSTEM AIR CONDITIONING DIAGNOSIS "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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Fig. 12 C.C.O.T. A/C System Diagnostic Procedure (3 of 4)

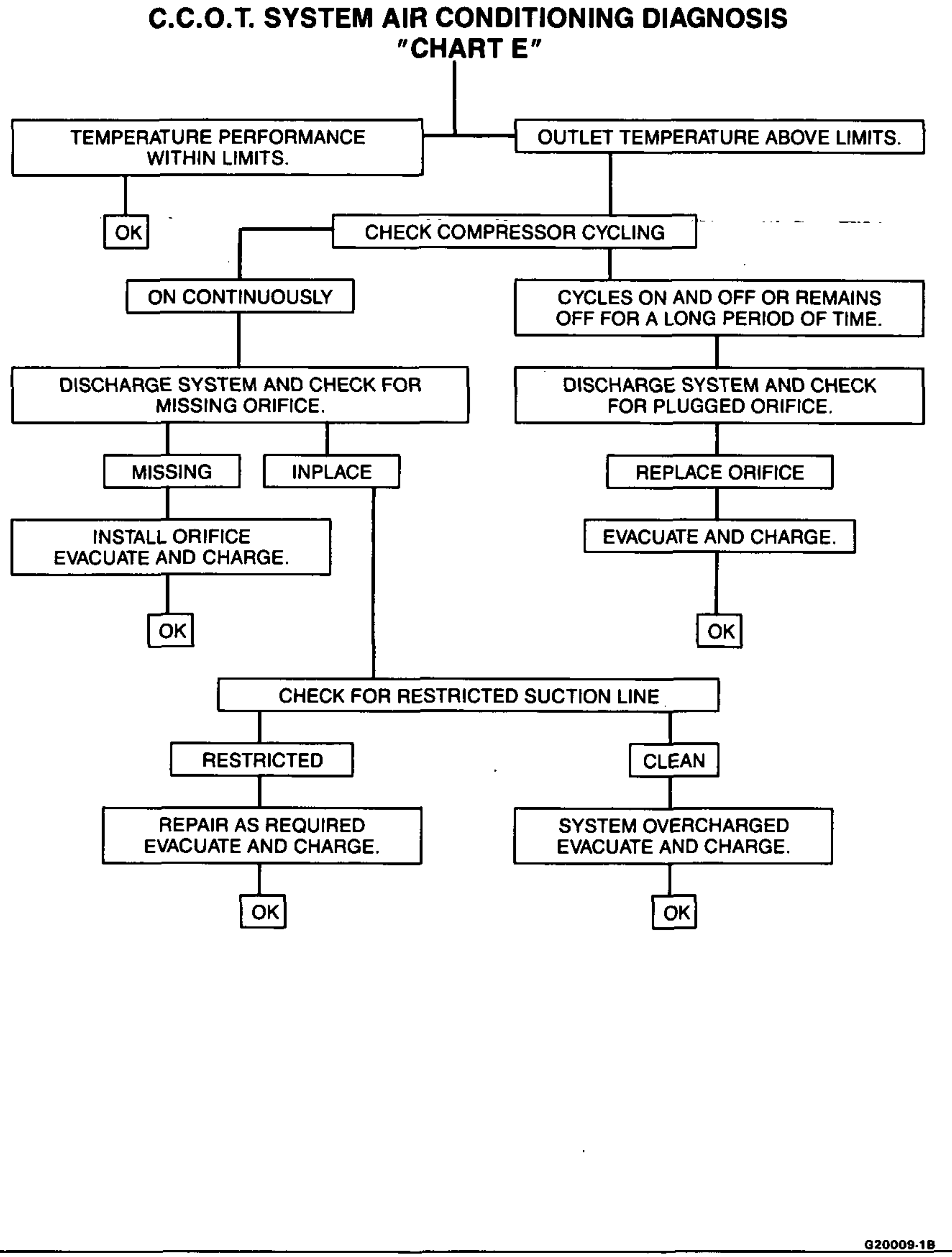


Fig. 13 C.C.O.T. A/C System Diagnostic Procedure (4 of 4)

LEAK TESTING THE REFRIGERANT SYSTEM

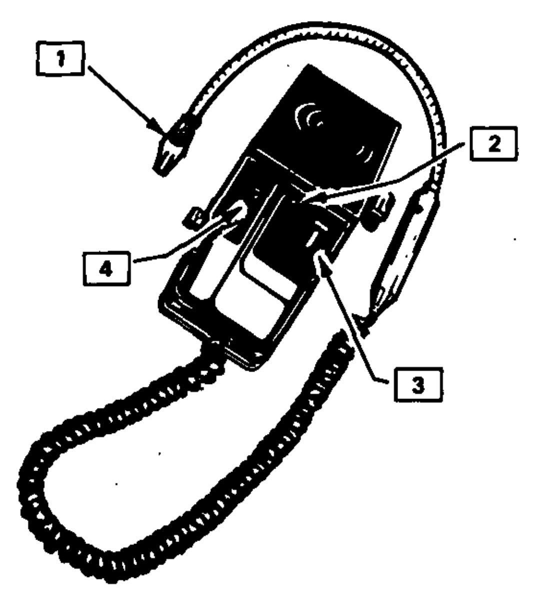
Whenever a refrigerant leak is suspected in the system or a service operation performed which results in disturbing lines or connections, it is advisable to test for leaks.

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-23400 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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Fig. 14 Electronic Leak Detector J-29547

ELECTRONIC LEAK TESTERS

(Fig. 14)

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 manufacturers 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 sub-assemblies 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 (Fig. 15). 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

When replacing O-rings on air conditioning connections, the connection design should be carefully identified to assure installation of the correct O-ring. Some connections will implement a "captive O-ring" design connector that uses an O-ring groove to hold the O-ring (see Figure 16). Assembly and tightening procedure is the same as the standard O-ring design, however, the "captive O-ring" design uses different O-rings. When replacing the O-rings, it is important that the proper O-ring is used.

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 conditioned 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

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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Fig. 15 Pipe & Hose Connection Torque Chart

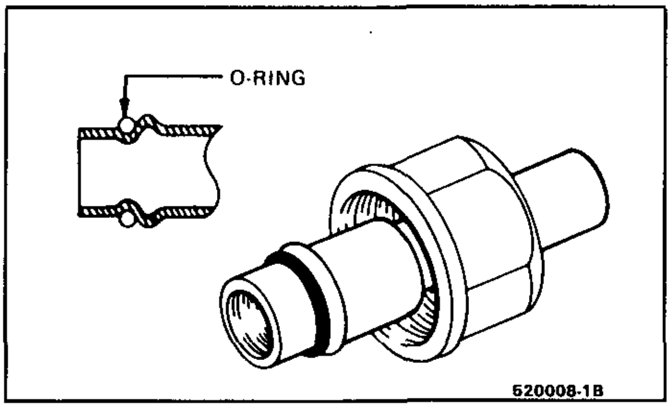


Fig. 16 Captive O-Ring Design

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 (Fig. 7). 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 gage 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 effect 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 gage 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 gage set J-23575-01 and 420ml (14 oz.) disposable cans of Refrigerant-12 (Fig. 10).

Charging lines from the charging station or manifold and gage set require the use of gage adapters to connect to the system service fitting. A straight gage adapter J-5420 and a 90° angle gage 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* Regrigerant-12.
- Always use service valve and pressure gage 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 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 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 gage set. If charging station J-23500-01 or equivalent is not being used, discharge system by slowly connecting a gage hose to low-side service fitting on accumulator and discharging into oil bottle (Fig. 17). 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,

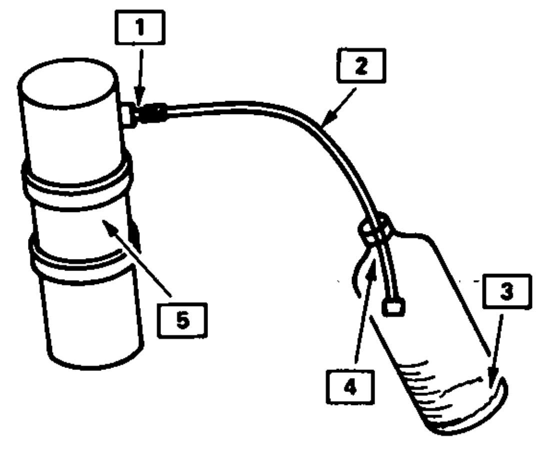


Fig. 17 Discharging the A/C System Without Charging Station

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).

Refrigerant Oil Distribution

- V-5 COMPRESSOR SYSTEM - Requires 240ml (8 fluid ounces) of 525 viscosity refrigerant oil.
- DA-6 COMPRESSOR SYSTEM - Requires 240ml (8 fluid ounces) of 525 viscosity refrigerant oil.
- R-4 COMPRESSOR SYSTEM - Requires 180ml (6 fluid ounces) of 525 vicosity refrigerant oil.
- New oil quantities must be added to the system during component replacement as follows:
  - a. Compressor - Remove, drain oil, measure, replace same amount of new oil plus 30ml (1 fl. oz.). (See Section 1D3 for proper V-5 Compressor Draining Procedures).
  - b. Evaporator - Add 60ml (2 fl. oz.).
  - c. Condenser - Add 30ml (1 fl. oz.).
  - d. Accumulator - Remove, drain oil, measure, replace same amount of new oil as drained, plus 90 ml (3 fl. oz.) to compensate for that retained by the original accumulator dessicant. If no oil can be drained from old accumulator, add 60 ml (2 fl. oz.) new oil to the new 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.

Evacuation and charging is a combined procedure, and all gage 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.

Gage Calibration

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

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

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

Vacuum System Check

Before connecting vacuum pump to the A/C system, run pump connected to the low-pressure gage 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 gage set J-23575-01 as follows. Also see Fig. 10.
    a. Low-pressure gage to accumulator fitting.
    b. Gage set center hose to Refrigerant-12 source.
    c. High-pressure gage to vacuum pump.
2. To begin evacuation of the A/C System with manifold gage set and vacuum pump as illustrated in Fig. 18, slowly open high- and low-side gage valves and begin vacuum pump operation. Pump the system until the low-side gage 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 gage reaches prescribed vacuum, the system is fully evacuated. Close the high-side gage set valve and turn off the vacuum pump.
4. Watch low-side gage to be sure vacuum holds for five (5) minutes. If vacuum is held, disconnect vacuum hose at gage 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

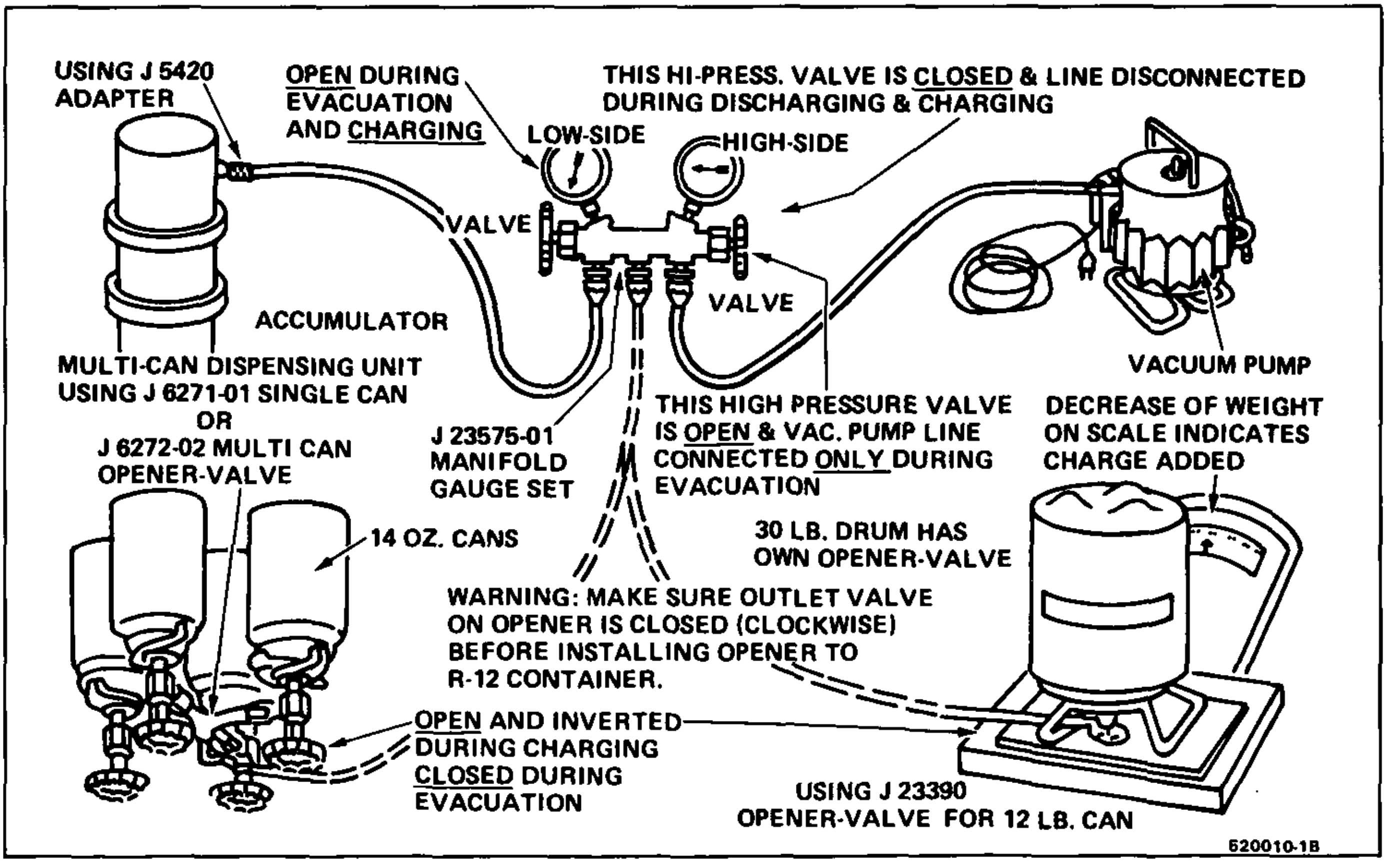


Fig. 18 Charging the System With Disposable Can or Drum

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 gages.
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.

SYSTEM FLUSHING PROCEDURE

A/C refrigerant system flushing is recommended when a compressor fails resulting in considerable black metallic particles throughout the refrigerant system; or in the event that the 525 viscosity refrigerant oil is improperly overcharged; or becomes contaminated.

Use the following procedure to flush the A/C refrigerant system:

1. Discharge the A/C refrigerant system following the discharging, adding oil, evacuating and charging procedures outlied earlier in this section.
2. Disconnect all A/C refrigerant line fittings and discard "O" rings.
3. Remove the orifice tube if contained and discard if required.
4. Make sure all the valves are closed on the manifold gage set, J-5725-04 or equivalent connect the gauge set to a refrigerant 11 (R-11) canister.

   CAUTION: R-11 is the only approved solvent for flushing A/C systems. Extreme caution and adherance to all safety precautions governing the use of refrigerants are necessary when flushing the A/C system.
5. Use flushing tool J-33883 or equivalent and, starting with the evaporator core, slowly force liquid R-11 in bottom of core until liquid R-11 flows from the top of core.
6. Continue the flow of R-11 from top of core to be sure core is completely filled with liquid R-11. When liquid runs out of the top, shut off the core valves and WAIT 5 minutes before draining evaporator.
7. Once again using tool J-33883, repeat steps 5 and 6 to properly flush condenser. WAIT 5 minutes before draining condenser.
8. Flush compressor, if required.
   - Drain compressor through suction, discharge ports and, if applicable, through crankcase fitting.
   - Fill compressor through suction port with R-11 until it runs out of discharge port. On V-5 compressor, it is necessary to remove crankcase drain plug and fill crankcase with R-11.
   - Turn compressor by rotating clutch driver clockwise for 1 or 2 turns, if possible. **DO NOT FORCE.**
   - Wait 5 minutes before draining compressor.
9. Using the caps from a new A/C refrigerant line to keep the R-11 in the tube, fill all lines with R-11 by opening the valve on the R-11 canister and open the valve for the low-side hose on the manifold gauge set. Allow enough R-11 to flow through the refrigerant line to thoroughly remove any foreign materials. Wait 5 minutes before draining lines.
10. Flush out R-11 with R-12. This flushes any R-11 from the A/C system components.

NOTICE: It is important that all the R-11 is thoroughly flushed out of each component. Failure to flush all the R-11 out of the refrigerant system will result in compressor damage and poor performance.

- Component temperature must be 75° minimum to thoroughly remove R-11 from the system.
- Use of heat lamp(s) on the compressor, evaporator and condenser is recommended to assit in the proper evacuation of R-11 and will reduce the evacuation time.

With the system fully discharged, check for remaining pressure. If pressure is found, continue to discharge system for an additional 1/2 hour to assure that R-11 is totally removed from the system.

11. Replace the accumulator.
12. Install a new orifice tube and new "O" rings dipped in clean 525 viscosity refrigerant oil. Reconnect the flushed refrigerant lines and tighten to the recommended torque specifications.
13. If required, install a new or rebuilt compressor as follows to insure proper oil charge.
    - Drain as much oil as possible from the new or rebuilt compressor (see DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURE FOR A/C SYSTEMS).

A residual quantity of oil will remain in the compressor that cannot be drained (see below). Add oil back into the compressor so that the total system capacity is correct (see below) and install the new or rebuilt compressor.

Total System Capacity	Residual Quantity	Add Quantity
V-5 -- 240ml (8 fl. oz.)	= 45ml (1.5 fl. oz.)	+ 195ml (6.5 fl. oz.)
DA-6 -- 240ml (8 fl. oz.)	= 45ml (1.5 fl. oz.)	+ 195ml (6.5 fl. oz.)
R-4 -- 180ml (6 fl. oz.)	= 30ml (1 fl. oz.)	+ 150ml (5 fl. oz.)

14. Evacuate the refrigerant system following the discharging, adding oil, evacuating, and charging procedures outlined earlier in this section.

    NOTICE: It is extremely important that the system is properly evacuated. Failure to evacuate the refrigerant system will result in A/C compressor damage and poor performance.

15. Insert a small charge of R-12 and leak check, if no leak is present, charge the A/C system with the recommended amount of R-12. See Air Conditioning Refrigerant System Capacity in this section.
    Tools Required:
    Flush Gun Kit - (J-33883)
    Manifold Gauge Set - (J-5525-04)
    A/C Hose End Caps

IN-LINE AIR CONDITIONING FILTER/DRYER INSTALLATION

An in-line air conditioning filter/dryer is available for servicing vehicles which have experienced air conditioning system contamination and can help absorb moisture entering the system at higher mileages.

The in-line filter/dryer installation offers the customer a less expensive alternative to system flushing and/or replacement of the receiver dehydrator (accumulator) assembly.

Aluminum Line Installation (AC Delco Part 15-1310):

(Installation instructions are included in the kit).

1. Discharge air conditioning system per recommended procedure.
2. If possible, select an installation location adjacent to area (fender well, etc.) that will allow use of optional bracket.
3. Remove a 4-3/4" section of the line. Remove burrs and loose particles from cut ends.
4. Insert pipe end into can fitting until pipe bottoms in the fitting body (Figure 12). If the fitting requires assembly, the tapered end of the ferrule goes into the fitting body.
5. Tighten fitting nut to "finger tight." Then with open-end wrench, tighten fitting nut an additional 3/4 turn while holding the can with a second open-end wrench. (Figure 12).
6. Repeat assembly procedure for opposite end of can.
7. Evacuate/recharge system per recommended procedure, using additional 1/2 pound of refrigerant to compensate for filter dryer volume (see Service Manual). If system has been severely contaminated, replacement of the orifice tube may be required.

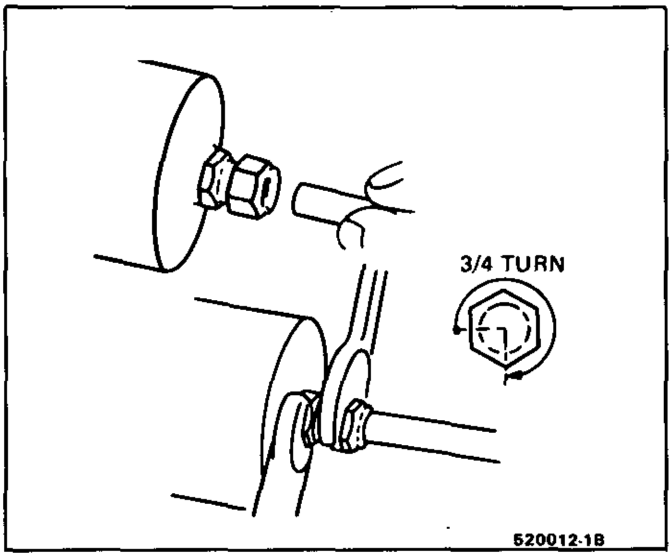


Fig. 19 Aluminum Line Filter Installation

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 no 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 dessicant 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. The expansion (orifice) tube screen experiences continued or repeated plugging.
3. An evaporator fails due to inside-out (internal) corrosion.

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. An open refrigerant line should be capped or have a plastic bag tightly taped around it.

ON-CAR-SERVICE

Accumulator

Remove or Disconnect

1. Negative (-) battery cable.
2. Discharge system.
3. Both lines at accumulator assembly.
4. Electrical connection at pressure cycling switch.
5. Pressure cycling switch.
6. Accumulator bracket bolt.
7. Accumulator assembly.

Install or Connect

1. Accumulator assembly.
2. Accumulator bracket bolt.
3. New O - rings at both lines (lubricate with 525 viscosity refrigerant oil).
4. Both lines at accumulator assembly.
5. Pressure cycling switch.
6. Electrical connection at pressure cycling switch.

Tighten

Torque accumulator lines to 41 N·m (30 ft. lbs.).

Install or Connect

1. Evacuate and charge system.

BLOWER MOTOR & FAN CAGE

Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connections at motor.
3. Cooling tube.
4. Blower motor attaching screws.
5. Blower motor.
6. Fan cage retaining nut.
7. Fan cage.

Inspect

Blower cage for damage to shaft bore, vanes, etc.

Install or Connect

1. Fan cage.
2. Fan cage retaining nut.
3. Blower motor.
4. Blower motor attaching screws.
5. Cooling tube.
6. Electrical connection.
7. Negative (-) battery cable.

Inspect

Check motor for proper operation.

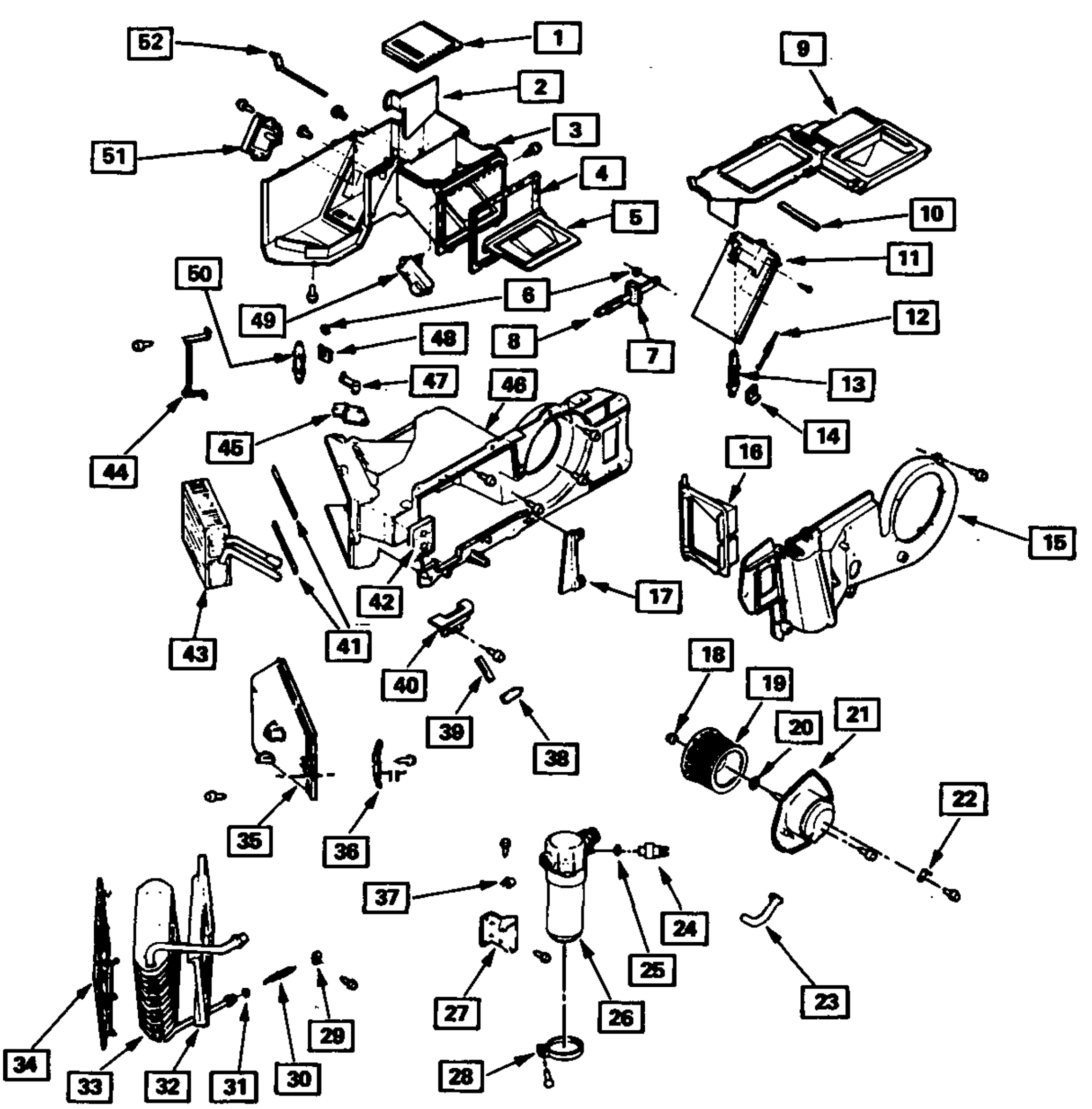
HIGH BLOWER RELAY

Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connection.
3. High blower relay.

Install or Connect

1. High blower relay.
2. Electrical Connection.
3. Negative (-) battery cable.



1 — VALVE, DEFR.
2 — BAFFLE, AIR
3 — CASE, AIR INT. & DIST.
4 — SEAL, CASE
5 — VALVE, W/FITTING
6 — NUT, PUSH ON (M3.6 x 11.23)
7 — SEAL, OPG. LINK
8 — LINK, ADJ. SPR. DEFR.
9 — COVER, CASE AL. & DEFR.
10 — SEAL
11 — VALVE, MODE
12 — SPRING, EXT.
13 — LINK, ADJ. SPR. MODE
14 — RETAINER
15 — CASE, BLOWER
16 — VALVE, TEMP.
17 — BAFFLE, AIR
18 — NUT
19 — FAN
20 — WASHER, FAN SUPT.
21 — MOTOR, ELEC.
22 — TERMINAL, BLO. MTR. GRD.
23 — TUBE, MOTOR COOLING
24 — SWITCH, LOW PRESS ELEC.
25 — GASKET, O-RING
26 — ACCUM., W/FITTING
27 — BRACKET, SUPT. ACCUM.
28 — BRACKET, ACCUM.
29 — CLAMP
30 — ORIFICE
31 — GASKET, O-RING
32 — SEAL, CORE EVAP.
33 — CORE, W/TUBE ASM. EVAP.
34 — FILTER, WATER CORE
35 — COVER, HEATER
36 — CLIP, SPL. MT. CORE
37 — CLAMP
38 — CLAMP, DRAIN TUBE
39 — TUBE, DRAIN
40 — DRAIN, SUMP
SEAL, DRAIN SUMP
41 — SEAL
42 — SEAL, HTR. TUBE
43 — HEATER, CORE
44 — STRAP, MT. CORE
45 — BRACKET, CABLE CONT.
46 — CASE, HTR. EVAP.
47 — LEVER, CONT.
48 — CLIP, TET LINK
49 — ACTUATOR, ELEC. AL.
50 — LINK, ADJ. SPR. AL.
51 — ACTUATOR, ELEC. MODE
52 — SHAFT, W/LEVER DEFR.

520267-1B

Fig. 801 A/C Module Disassembled View

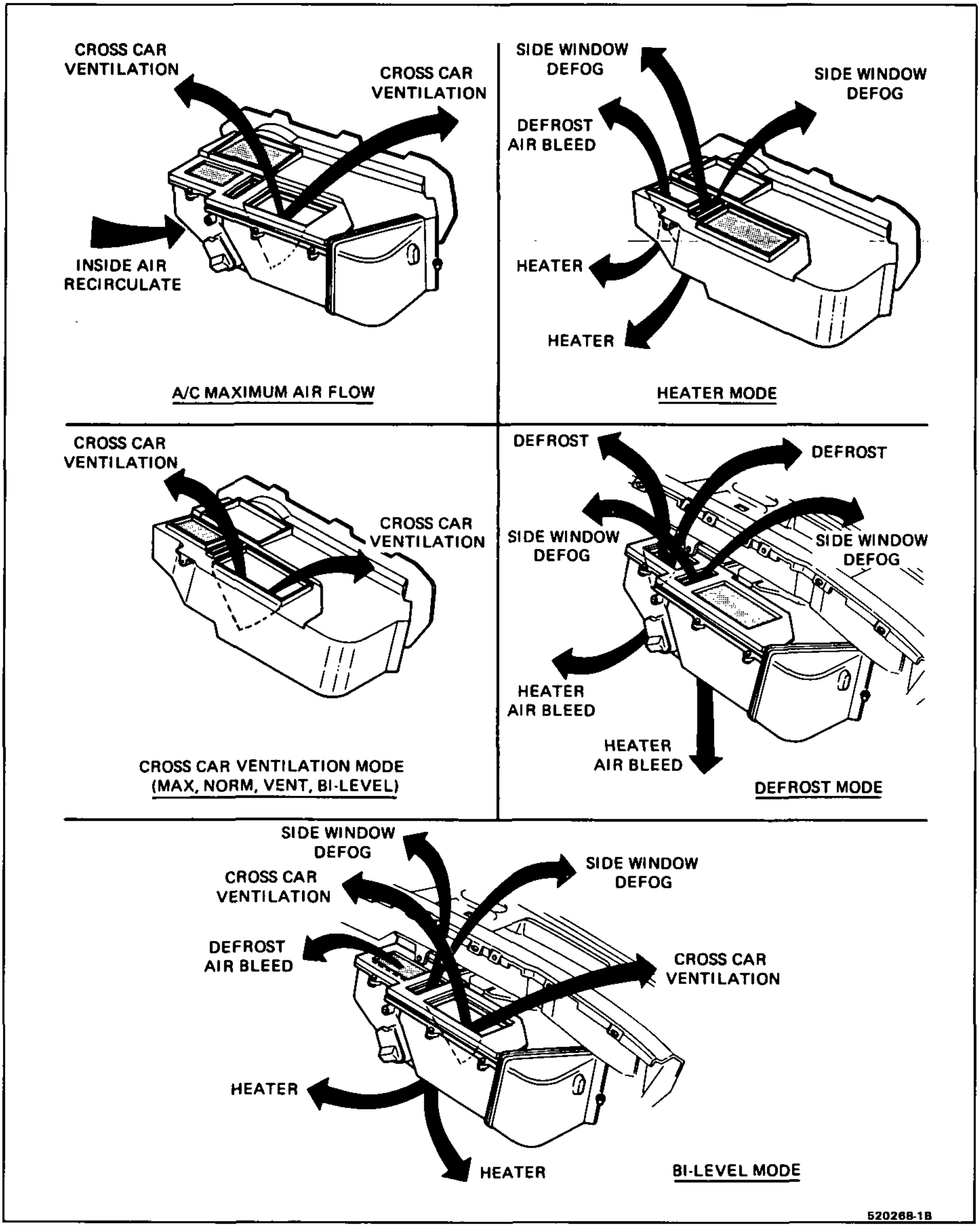


Fig. 802 A/C Module Air Flow

1–NO BLOWER OPERATION IN "OFF" MODE.

2–IN THIS MODE, MAXIMUM COOLING IS OFFERED WITH THE CONDITIONED AIR DISTRIBUTED THROUGH I.P. OUTLETS AND SLIGHT AMOUNT TO FLOOR AT ANY BLOWER SPEED

3–CONDITIONED AIR IS DIRECTED THROUGH I.P. OUTLETS AND SLIGHT AMOUNT TO FLOOR

4–CONDITIONED AIR IS DIRECTED THROUGH I.P. AND FLOOR DISTRIBUTOR OUTLETS WITH SOME ALSO TO WINDSHIELD

5–A NONCOMPRESSOR OPERATING MODE WITH OUTSIDE AIR DELIVERED THROUGH I.P. OUTLETS

6–A NONCOMPRESSOR OPERATING MODE WITH OUTSIDE AIR DISTRIBUTED ABOUT 80% TO FLOOR, AND 20% TO WINDSHIELD AND SIDE WINDOWS

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–FAN CONTROL

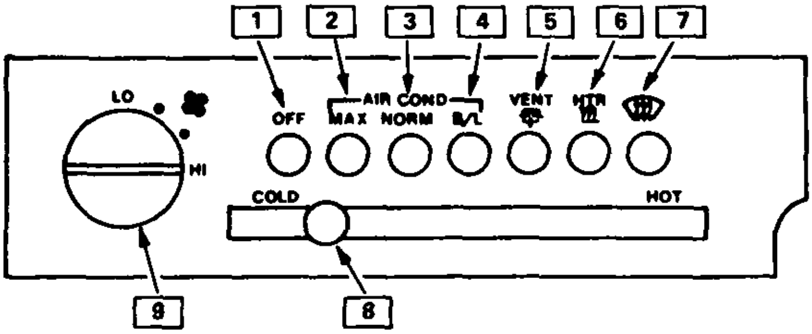


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Fig. 803 A/C Controller

A/C FUNCTIONAL TEST

CONTROL SETTINGS				SYSTEM RESPONSE				
STEP	MODE CONTROL	TEMP. CONTROL	FAN SWITCH	BLOWER SPEED	HEATER OUTLETS	A/C OUTLETS	DEF. OUTLETS	SEE REMARKS
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	A
3	MAX	COLD	LO TO HI	LO TO HI	NO AIR FLOW	AIR FLOW	NO AIR FLOW	B
4	NORM	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	A,C
5	BI-LEVEL	COLD	HI	HIGH	AIR FLOW	AIR FLOW	NO AIR FLOW	A
6	VENT	COLD	HI	HIGH	NO AIR FLOW	AIR FLOW	NO AIR FLOW	A
7	HEATER	HOT	HI	HIGH	AIR FLOW	NO AIR FLOW	MINIMUM AIR FLOW	A,D,E
8	DEF	HOT	HI	HIGH	MINIMUM AIR FLOW	NO AIR FLOW	AIR FLOW	A,E

REMARKS

A. ACTUATOR MOTOR SHOULD BE HEARD DURING MODE CHANGES.

B. NOTICEABLE BLOWER SPEED INCREASE MUST OCCUR FROM LOW TO M_1, M_2, AND HIGH.

C. LISTEN FOR REDUCTION OF AIR NOISE DUE TO RECIRCULATION DOOR CLOSING.

D. INSPECTOR MUST CHECK TEMPERATURE LEVEL FOR EFFORT AND FULL TRAVEL *(COLD TO HOT)*.

E. CHECK FOR AIRFLOW AT SIDE WINDOW DEFOG OUTLETS.

NOTE: ALL A/C OUTLETS MUST BE CHECKED FOR *THE FOLLOWING:*
1. BARREL ROTATION.
2. VANE OPERATION.
3. BARREL AND VANES MUST HOLD POSITION IN HIGH BLOWER.

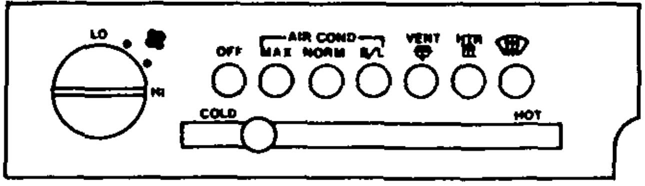

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Fig. 804 A/C Controller Functional Check

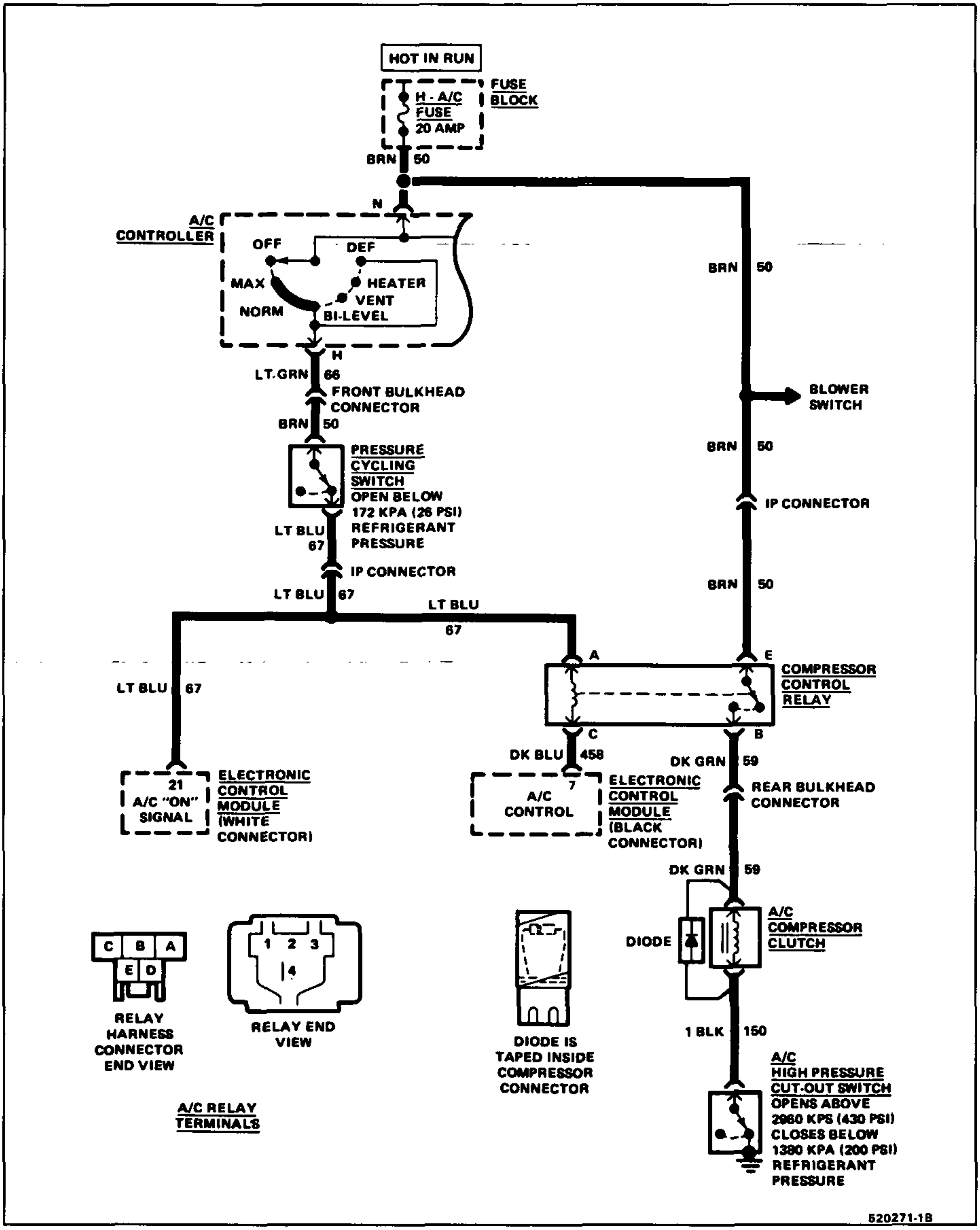


Fig. 805 A/C Compressor Wiring Diagram

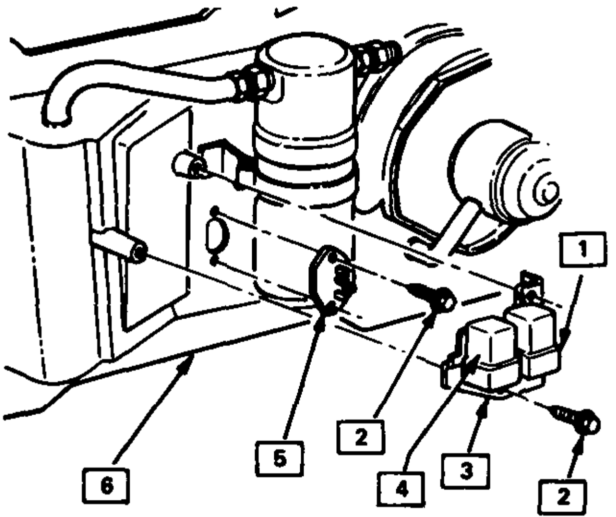
Inspect

Blower for proper operation

A/C POWER SWITCHING RELAY

Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connection.
3. A/C power switching relay.



1–A/C POWER SWITCHING RELAY
2–BOLT/SCREW
3–RELAY BRACKET
4–A/C HIGH BLOWER RELAY
5–RESISTER ASM.
6–A/C HEATER MODULE ASM.

Fig. 806 A/C Power Switching - High Blower Relay and Resistor

Install or Connect

1. A/C power switching relay.
2. Electrical connection.
3. Negative (-) battery cable.

BLOWER RESISTOR

Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connection.
3. Two screws.
4. Blower resistor.

Install or Connect

1. Blower resistor.
2. Two screws.
3. Electrical connection.
4. Negative (-) battery cable.

Inspect

Blower motor for proper operation in all speeds.

Pressure Cycling Switch

Remove or Disconnect

1. Negative (-) battery cable.
2. Electrical connection at switch.
3. Switch from accumulator.

Install or Connect

1. Switch at accumulator.
2. Electrical connection at switch.
3. Negative (-) battery cable.

Compressor High Pressure Cut-Off Switch

Compressor High Pressure Cooling Fan Switch

Remove or Disconnect

1. Negative (-) battery cable.
2. Discharge system.
3. Raise vehicle.
4. Rear compressor mounting bracket.
5. Retaining ring. (See Section 1D).
6. Switch.
7. Discard O-ring.

Install or Connect

1. Lube new O-ring (525 viscosity refrigerant oil).
2. Switch and O-ring. (See Section 1D).
3. Retaining ring.
4. Rear compressor mounting bracket.
5. Lower vehicle.
6. Negative (-) battery cable.
7. Evacuate and charge system.

Expansion Tube (Orifice)

Remove or Disconnect

1. Discharge system.
2. Nut at lower line of evaporator.
3. Expansion tube.

Install or Connect

1. Expansion tube (small screen first).
2. New O - ring (lubricate with 525 viscosity refrigerant oil).
3. Nut at right side of evaporator.

Tighten

Torque liquid line to 41 N·m (30 ft. lbs.)

Install or Connect

1. Evacuate and charge system.

Important

In the event that difficulty is encountered during the removal of a plugged or restricted expansion tube use the following procedure.

Remove or Disconnect

1. Impacted residue.
2. Cycling pressure switch.

Important

Carefully apply heat with heat gun or equivalent approximately 1/4 inch from dimples on inlet pipe. **Do not over heat.**

Remove or Disconnect

1. Orifice tube while applying heat.

Clean

Swab inside of evaporator inlet pipe with R-11 or equivalent solvent.

Install or Connect

1. One ounce of 525 viscosity refrigerant oil to system.
2. Lubricate new orifice tube and refrigerant line O - Ring with 525 viscosity refrigerant oil.
3. Orifice tube (smaller screen first).
4. Liquid coolant line.

Tighten

Torque liquid line to 41 n•m (30 ft. lbs.)

Install or Connect

1. Evacuate and charge system.

A/C Module Wiring Harness

Remove or Disconnect

1. Negative (-) battery cable.
2. All electrical connections at A/C module and windshield wiper motor.
3. Wiring harness at bulk head connector.
4. Harness assembly.

Install or Connect

1. Harness assembly.
2. All electrical connections at A/C module and wiper motor.
3. Wiring harness at bulk head connector.
4. Negative (-) battery cable.

A/C Controller Assembly

Remove or Disconnect

1. Negative (-) battery cable.
2. Four bolts at trim plate assembly.
3. Trim plate assembly.
4. Three bolts at controller.
5. Controller.
6. Electrical connections at controller.
7. Cable at controller.

Install or Connect

1. Cable at controller.
2. Electrical connections at controller.
3. Controller.
4. Three bolts at controller.
5. Trim plate assembly.
6. Four bolts at plate assembly.
7. Negative (-) battery cable.

Inspect

Controller for mode selection operation, fan operation, and temperature lever operation.

Fan Blower Switch

Remove or Disconnect

1. Negative (-) battery cable.
2. Four bolts at trim plate assembly.
3. Trim plate assembly.
4. Three bolts at controller.
5. Controller.
6. Electrical connection at controller blower switch.
7. Blower switch knob.
8. Blower switch retaining nut at back of controller.
9. Fan blower switch.

Install or Connect

1. Fan blower switch.
2. Blower switch retaining nut.
3. Blower switch knob.
4. Electrical connection at controller blower switch.
5. Controller.
6. Three bolts at controller.
7. Trim plate assembly.
8. Four bolts at trim plate assembly.
9. Negative (-) battery cable.

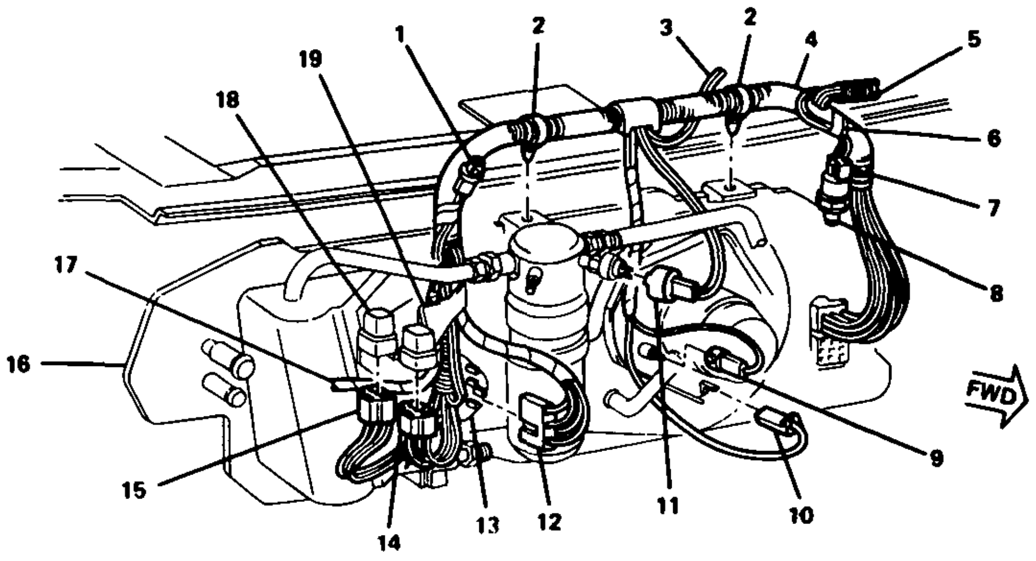
Inspect

Controller for mode selection operation, fan operation, and temperature lever operation.

Temperature Control Cable

Remove or Disconnect

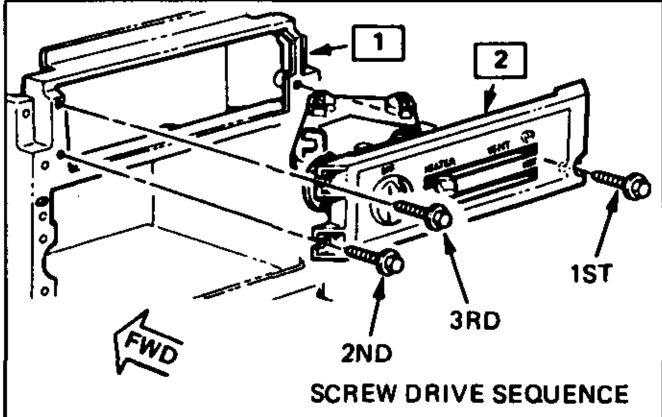
1. Four bolts at trim plate assembly.
2. Trim plate.
3. Three bolts at controller.
4. Controller.
5. Temperature cable at controller.
6. Right speaker grill.
7. Four bolts at speaker.
8. Electrical connection at speaker.



1–TO FORWARD COURTESY LAMP
2–CLIP (WIRE ASSEMBLY)
3–TO FRONT COMPT LAMP SW
4–WIRE ASSEMBLY
5–TO W/S WIPER MOTOR
6–TAPE
7–AMBIENT TEMPERATURE SWITCH CONNECTOR
8–REAR WINDOW DEFROSTER AMBIENT TEMPERATURE SWITCH
9–BLOWER MOTOR CONNECTOR
10–BLOWER MOTOR GROUND CONNECTOR
11–CYCLING PRESSURE SWITCH CONNECTOR
12–A/C RESISTOR CONNECTOR
13–A/C RESISTOR
14–A/C HI BLOWER CONNECTOR
15–A/C POWER SWITCHING RELAY CONNECTOR
16–A/C MODULE
17–TO W/S WASHER PUMP
18–BRACKET & RELAY ASSEMBLY
19–ROUTE HARNESS & LEADS BEHIND BRACKET & RELAY ASSEMBLY AS SHOWN

520239-1B

Fig. 807 A/C Module Wiring



1–CARRIER ASSEMBLY
2–CONTROL ASSEMBLY

520084-1A

Fig. 808 A/C Controller Installation (Heater Control Shown)

9. Speaker.
10. Temperature control cable at heater A/C module.

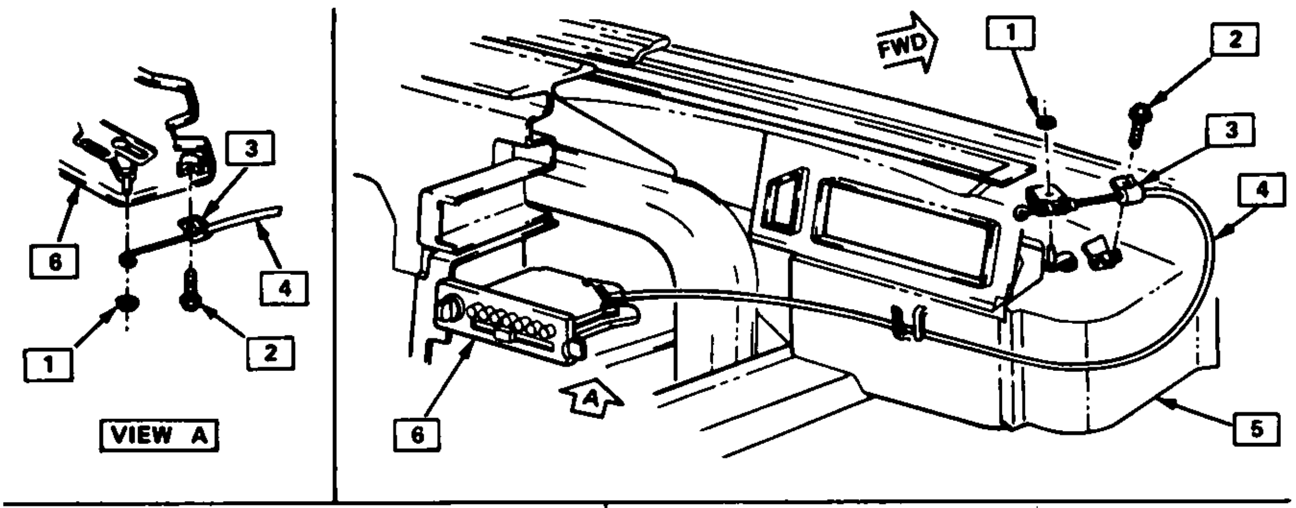
Install or Connect

1. Temperature control cable at heater A/C module.
2. Electrical connection at speaker.
3. Speaker.
4. Four bolts at speaker.
5. Right speaker grill.
6. Temperature cable at controller.
7. Controller.
8. Three bolts at controller.
9. Trim plate.
10. Four bolts at trim plate assembly.

HEATER/VENTILATION/AC/DEFROSTER DUCTS

Remove or Disconnect

1. Negative (-) battery cable.



1—NUT
2—BOLT/SCREW
3—RED
4—CABLE ASM. A/C TEMP. CONT.
5—A/C MODULE
6—A/C CONTROL ASM.

CABLE ADJUSTMENT PROCEDURE

AFTER INSTALLING & CONNECTING CONTROL & TEMPERATURE CABLE, MOVE TEMPERATURE LEVEL TO "HOT" IN ONE QUICK "CONTINUOUS" FIRM MOTION UNTIL LEVER STOPS.

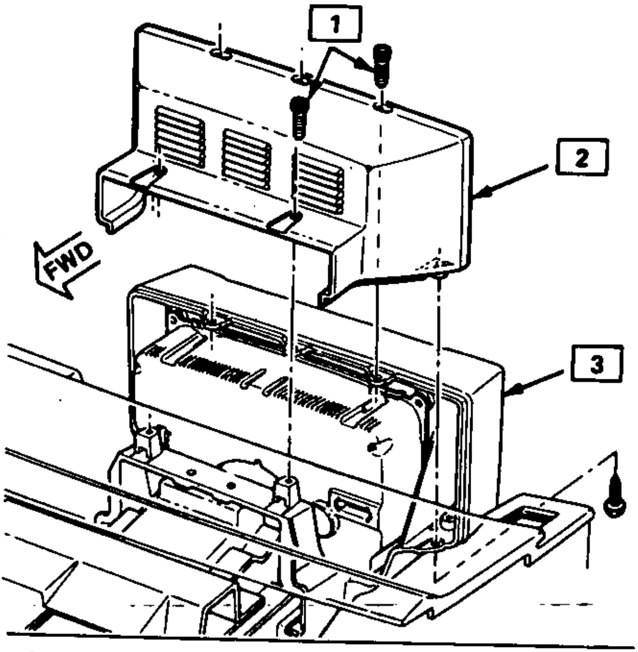
520238-1B

Fig. 809 Temperature Control Cable Routing

2. Courtesy light sockets (if equipped).
3. Hood release.
4. Instrument panel steering column cover.
5. Speakers and speaker grilles.
6. Instrument panel cluster cover.
7. Four bolts from shifter trim plate (do not remove shifter knob).
8. Front console trim plate.
9. Front console pad assembly.
10. Top bolts of reinforcement to I.P.
11. Instrument panel.
12. Instrument panel ducts.

→← Install or Connect

1. Instrument panel ducts.
2. Instrument panel.
3. Top screws from reinforcement to I.P.
4. Front console pad assembly.
5. Front console trim plate.
6. Shifter trim plate.
7. Instrument panel service cover.
8. Speaker and speaker grilles.
9. Hood release.
10. Courtesy light sockets (if equipped).
11. Instrument panel steering column cover.
12. Negative (-) battery cable.



1 – SCREW
2 – INSTRUMENT PANEL COVER
3 – INSTRUMENT PANEL HOUSING ASM.

520108-1A

Fig. 810 I.P. Cluster Cover Mounting

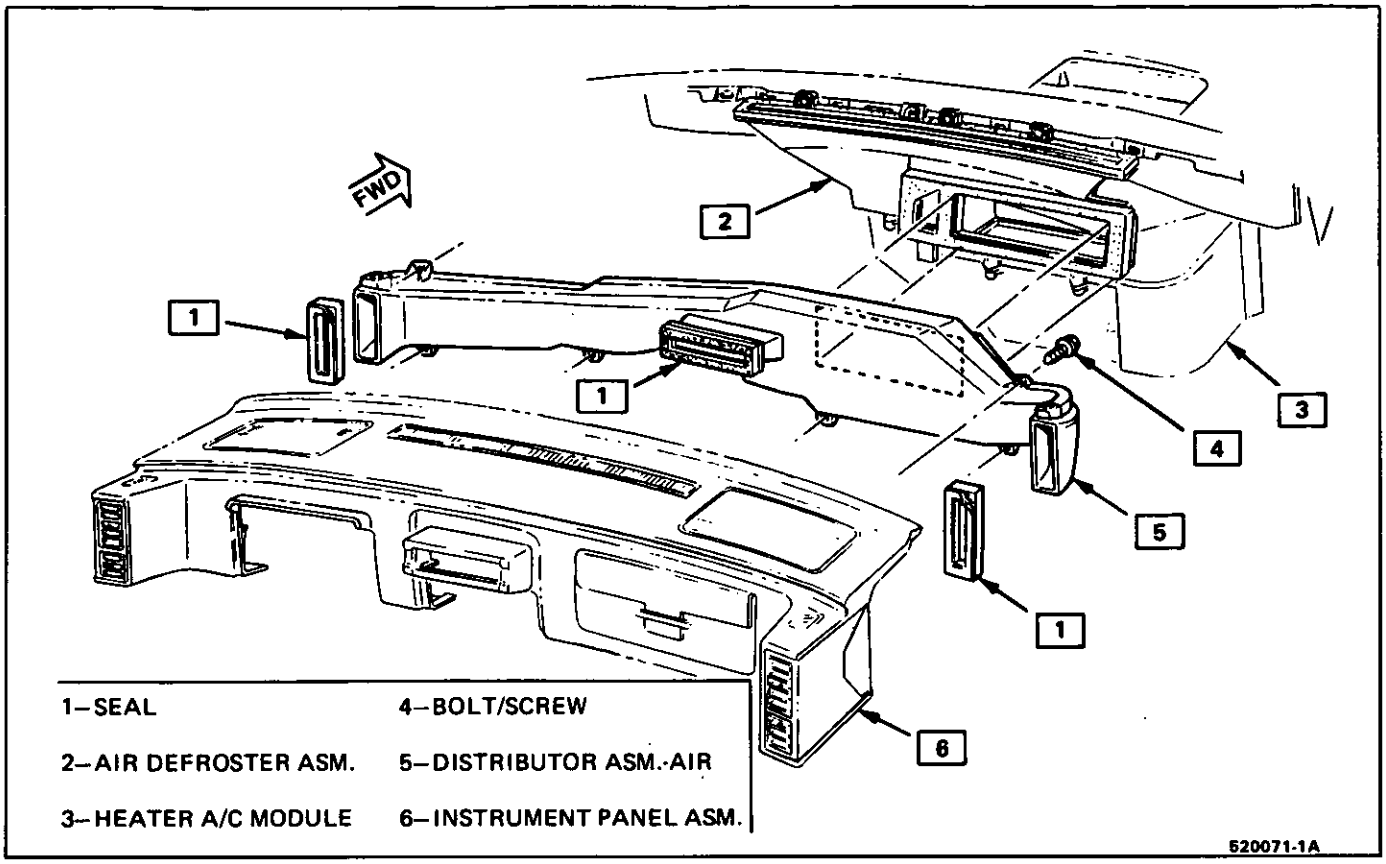


Fig. 811 I.P. Duct Assembly

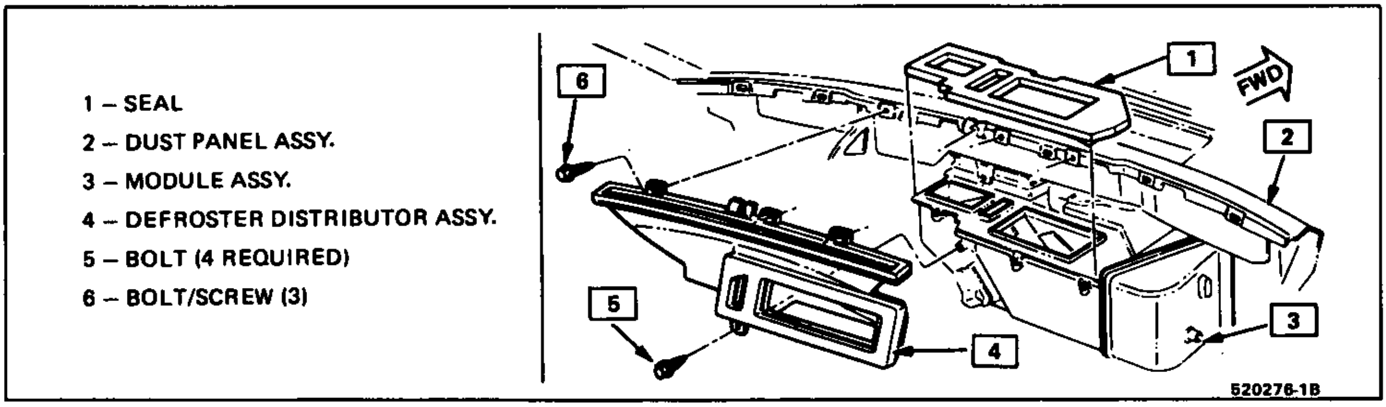


Fig. 812 Defroster Duct Assembly

LOWER (FLOOR) HEATER OUTLET

Remove or Disconnect

1. Screw.
2. Outlet.

Install or Connect

1. Outlet.
2. Screw.

Compressor Clutch Control Relay

Remove or Disconnect

1. Open deck lid.
2. Negative (-) battery cable.
3. Electrical connector.
4. One bolt.
5. Clutch relay assembly.

Install or Connect

1. Clutch relay assembly.
2. One bolt.
3. Electrical connector.
4. Negative (-) battery cable.

Inspect

A/C clutch for proper engagement.

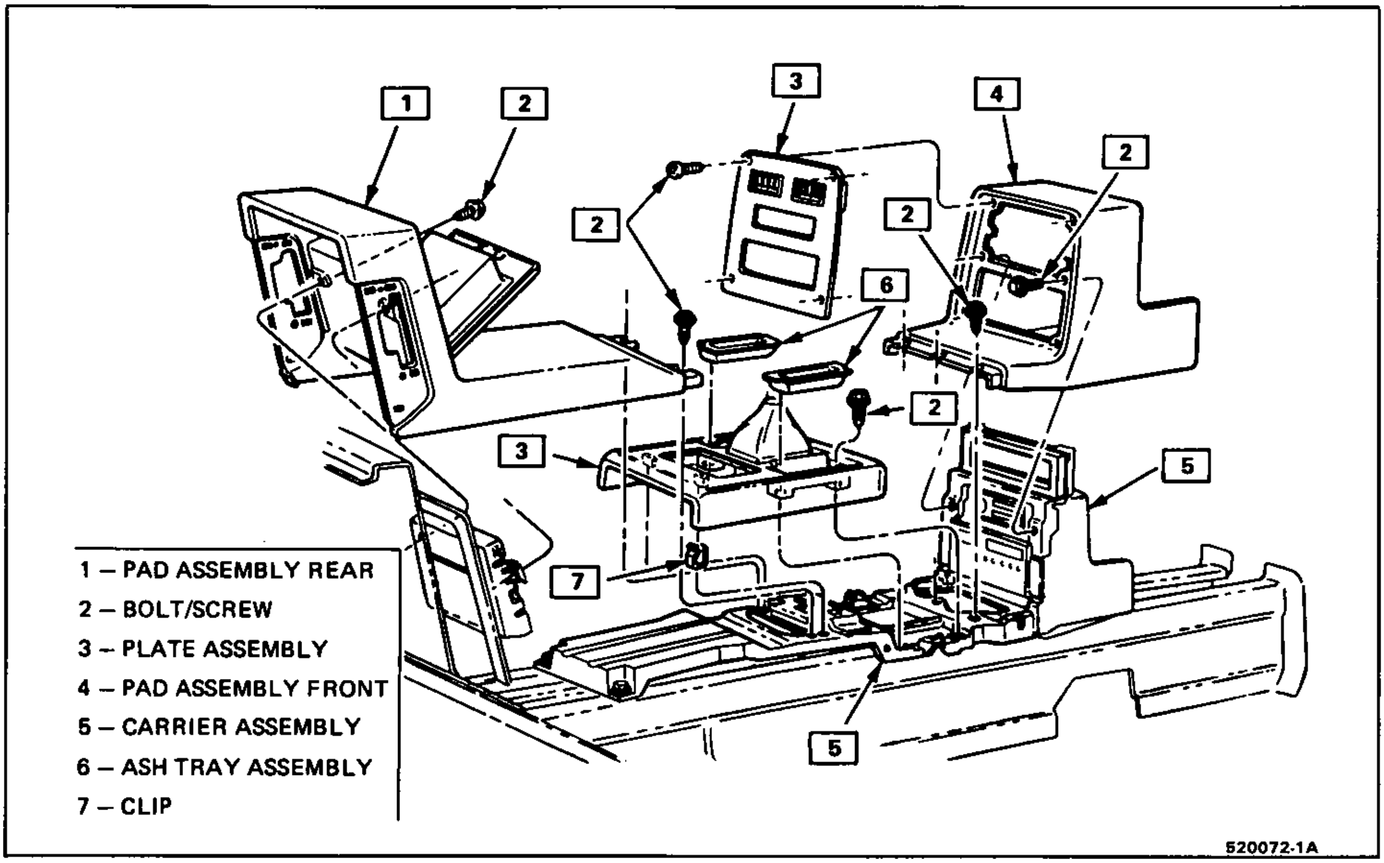


Fig. 813 Front Console Assembly

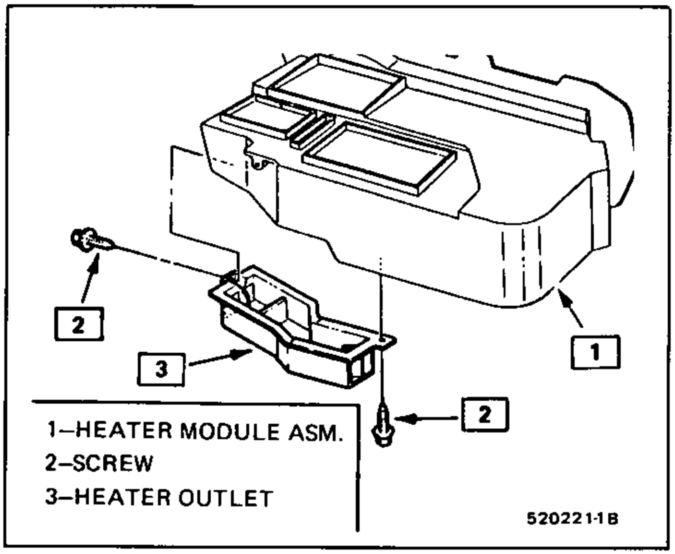


Fig. 814 Floor Heat Outlet

A/C Recirculating-Actuator

↔ **Remove or Disconnect**

1. Negative (-) battery cable.
2. A/C module air outlet.
3. Electrical connection at actuator assembly.
4. Coupling at module door.
5. Bolts at actuator assembly.
6. Actuator assembly.

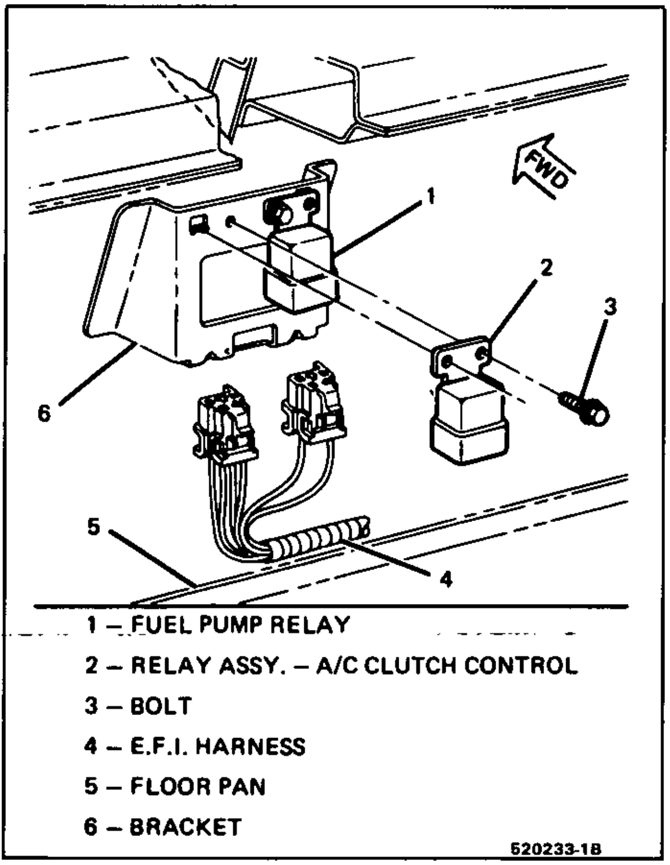


Fig. 815 A/C Clutch Control Relay - Typical

Install or Connect

1. Actuator assembly.
2. Bolts at actuator assembly.
3. Coupling at module door.
4. Electrical connection at actuator assembly.
5. A/C module heater outlet.
6. Negative (-) battery cable.

Heater Core

Remove or Disconnect

1. Open hood.
2. Heater hoses and plug hoses.
3. Speaker grill.
4. Speaker.
5. Heater core cover.
6. Heater core retainers.
7. Heater core.

Install or Connect

1. Heater core.
2. Heater core retainers.
3. Heater core cover.
4. Speaker.
5. Speaker grill.
6. Heater hoses.
7. Refill coolant as required.

Important

When refilling the cooling system refer to Section 6B for the correct procedure. Failure to follow the procedure may result in **permanent damage to the engine.**

Coupled Hose Assembly

Remove or Disconnect

1. Discharge system.
2. Coupled hose assembly at compressor.
3. Coupled hose assembly at outlet tube assembly.
4. Coupled hose assembly at inlet tube assembly.
5. Bolt at coupled hose assembly clamp.
6. Coupled hose assembly.

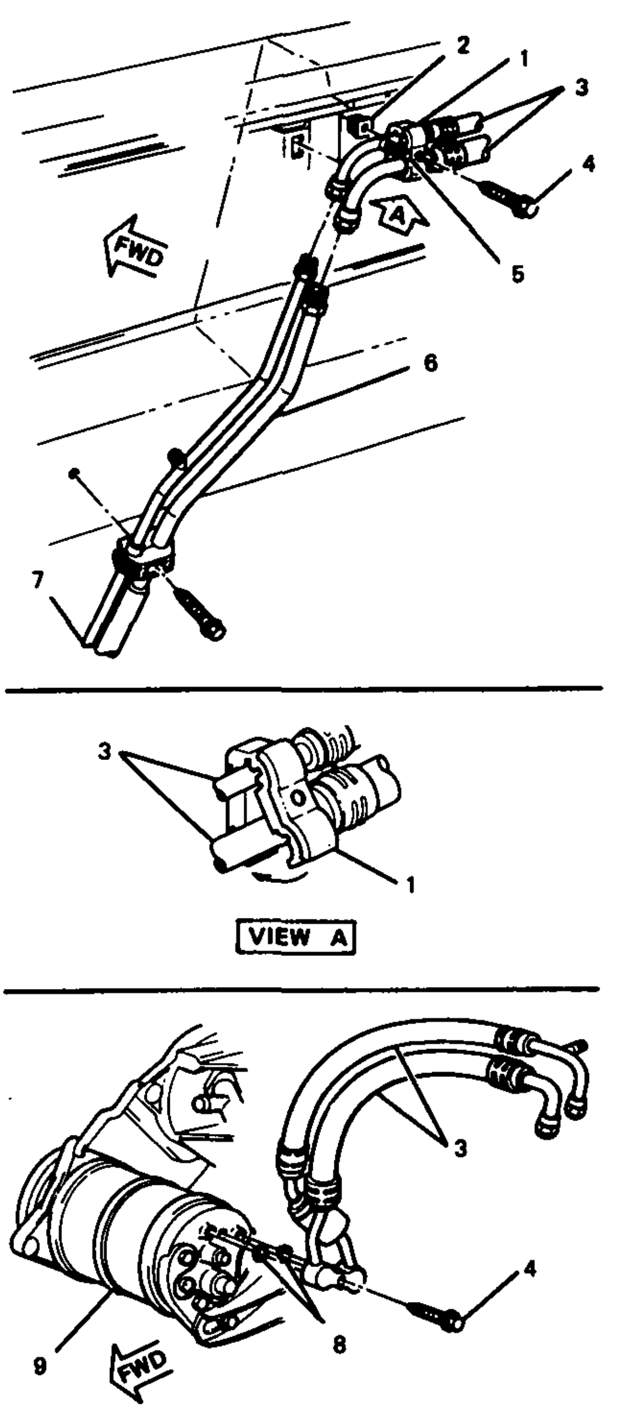
Install or Connect

1. Coupled hose assembly at compressor.
2. New O - ring at all connections (lubricate in 525 viscosity refrigerant oil).
3. Bolt at coupled hose assembly clamp.
4. Coupled hose assembly at inlet tube assembly.
5. Coupled hose assembly at compressor.

Tighten

Torque hose assembly as follows:

- Hose assembly to compressor 4 N·m (3 ft. lbs.).
- Hose assembly to outlet tube 24 N·m (17 ft. lbs.)



1 – CLAMP
2 – NUT
3 – HOSE ASSY.
4 – BOLT
5 – CAP
6 – TUBE & HOSE ASSY. – INLET
7 – TUBE ASSY. – OUTLET
8 – O-RING (COMPRESSOR)
9 – A/C COMPRESSOR

Fig. 816 A/C Coupled Hose Assembly - Typical

- Hose assembly to inlet tube 41 N·m (30 ft. lbs.).

Install or Connect

1. Evacuate and charge system.

Inlet Tube and Hose Assembly

Remove or Disconnect

1. Negative (-) battery cable.
2. Discharge system.
3. Inlet tube at accumulator.
4. Spare tire assembly.
5. Jack assembly.
6. Spare tire storage panel.
7. Front compartment panel seal.
8. Open deck lid.
9. Inlet tube at compressor hose assembly.
10. Raise vehicle.
11. Four underbody A/C tube clamps.
12. Heat shield.
13. Fuel tank reinforcement.
14. A/C inlet tube and hose assembly.

Install or Connect

1. A/C inlet tube and hose assembly.
2. Fuel tank reinforcement.
3. Heat shield.
4. Four underbody A/C tube clamps.
5. Lower vehicle.
6. Inlet tube at compressor hose assembly.

Tighten

Torque to 41 N·m (30 ft. lbs.).

Install or Connect

1. Front compartment panel seal.
2. Spare tire storage panel.
3. Inlet tube at accumulator.

Tighten

Torque to 41 N·m (30 ft. lbs.).

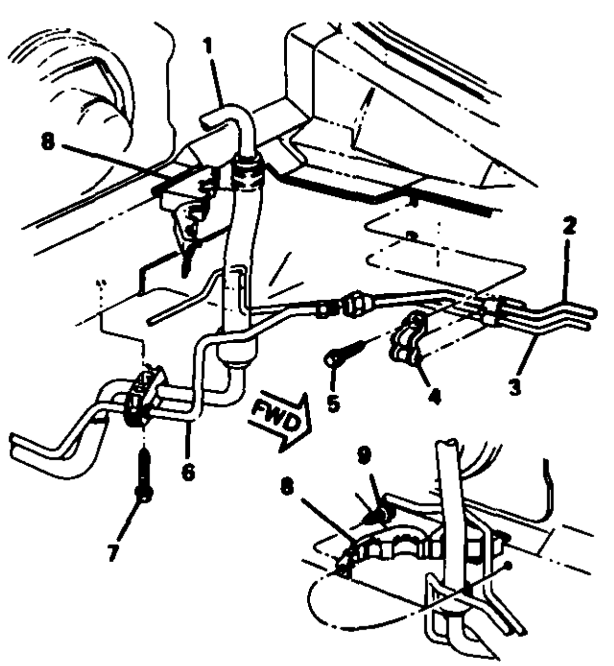
Install or Connect

1. Spare tire assembly.
2. Jack assembly.
3. Negative (-) battery cable.
4. Evacuate and charge system.

A/C Outlet Tube Assembly

Remove or Disconnect

1. Negative (-) battery cable.
2. Discharge system.
3. Spare tire assembly.
4. Jack assembly.
5. Spare tire storage panel.



1–TUBE & HOSE ASSEMBLY (INLET)
2–TUBE ASSEMBLY - A/C EVAPORATOR OUTLET
3–TUBE ASSEMBLY - A/C EVAPORATOR INLET
4–CLIP TUBE ASSEMBLY
5–BOLT/TUBE ASSEMBLY CLIP
6–TUBE ASSEMBLY (OUTLET)
7–BOLT (PIPE ASSEMBLY)
8–FRONT COMPARTMENT PAN SEAL
9–BOLT

620237-1B

Fig. 817 A/C Tube Assembly At Front Compartment

6. Rear compressor outlet tube at front compressor outlet tube.
7. Open deck lid.
8. Compressor outlet tube at compressor hose assembly.
9. Raise vehicle.
10. Heat shield.
11. Four underbody A/C tube clamps.
12. Fuel tank support.
13. A/C outlet tube.

Install or Connect

1. A/C outlet tube.
2. Fuel tank support.
3. Four underbody A/C tube clamps.
4. Heat shield.
5. Lower vehicle.
6. Rear compressor outlet tube to front compressor outlet tube.

Tighten

Torque to 24 N·m (17 ft. lbs.).

Install or Connect

1. Compressor outlet tube at compressor hose assembly.

Tighten

Torque to 24 N·m (17 ft. lbs.).

Install or Connect

1. Spare tire storage panel.
2. Jack assembly.
3. Spare tire assembly.
4. Negative (-) battery cable.
5. Evacuate and charge system.

Evaporator Core

Remove or Disconnect

1. Discharge system.
2. Negative (-) battery cable.
3. Relay bracket.
4. All electrical wiring at module.
5. Evaporator core tube at accumulator.
6. Heater hoses at heater core.
7. Washer fluid reservoir.
8. Bolts from blower housing assembly.
9. Blower housing assembly.
10. Evaporator to condenser tube.
11. Evaporator core.

Install or Connect

1. Evaporator core.
2. New O - ring all connections (lubricate in 525 viscosity refrigerant oil).
3. Evaporator to condenser tube.

Tighten

Torque tube connection to 24 N·m (17 ft. lbs.).

Install or Connect

1. Blower housing assembly.
2. Bolts at blower housing assembly.
3. Heater hoses at heater core.
4. Evaporator core tube to accumulator.

Tighten

Torque tube connection to 41 N·m (30 ft. lbs.).

Install or Connect

1. Relay bracket.
2. All electrical wiring at module.
3. Negative (-) battery cable.
4. Evacuate and charge system.

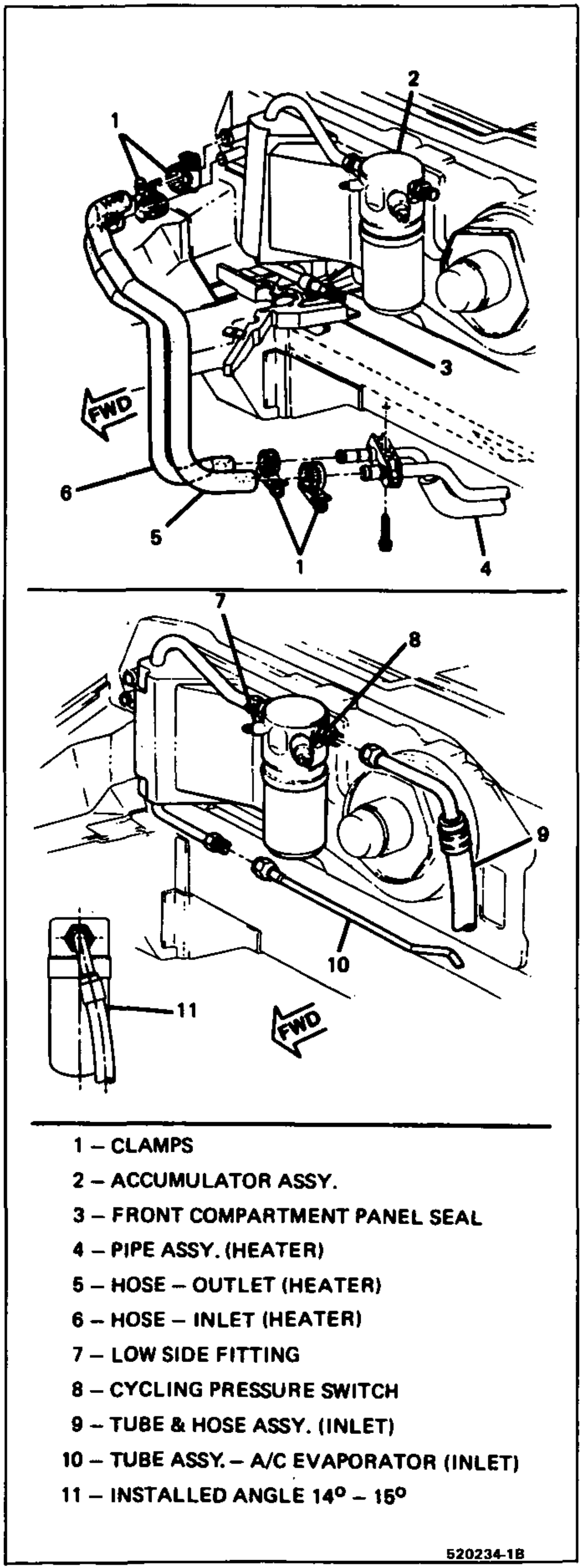


Fig. 818 A/C Tube and Heater Hose Assemblies at Module

5. Washer fluid reservoir.

Inspect

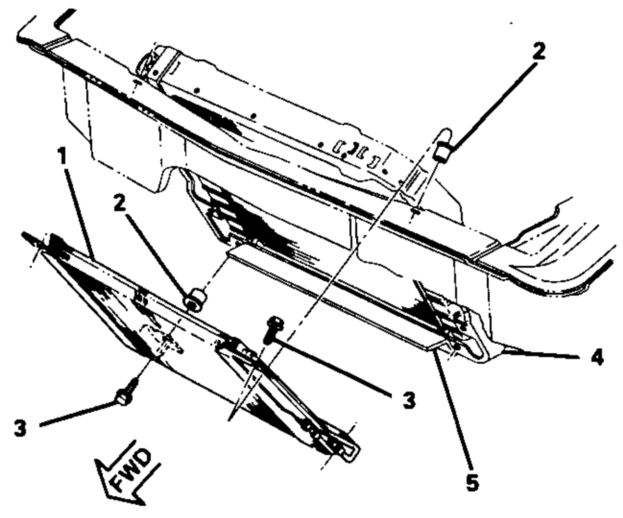
The following for correct operation:

1. Control assembly.
2. Fan blower switch.
3. Compressor clutch cycling.
4. Proper cooling.

Condenser

Remove or Disconnect

1. Discharge system.
2. Upper condenser attaching bolts.
3. Raise vehicle.
4. Grill.
5. Both condenser lines.
6. Lower condenser attaching bolts.
7. Condenser assembly.



1 – CONDENSER ASSY.
2 – NUT
3 – BOLT
4 – LOWER RADIATOR SUPPORT
5 – SEAL

Fig. 819 Condenser Installation

Install or Connect

1. Condenser assembly.
2. Lower condenser attaching bolts.
   - New O - rings at both condenser lines (lubricate with 525 viscosity refrigerant oil).
3. Both condenser lines.

Tighten

Torque tube assemblies as follows:

- Inlet tube assembly at condenser 17 N·m (13 ft. lbs.).
- Outlet tube assembly at condenser 27 N·m (17 ft. lbs.).

Install or Connect

1. Grill.
2. Lower vehicle.
3. Upper condenser attaching bolts.
4. Evacuate and charge system.

A/C Compressor

Remove or Disconnect

1. Negative (-) battery cable.
2. Discharge system.
3. Hoist vehicle.
4. Compressor hose assembly.
5. Compressor assembly.

Install or Connect

1. Compressor assembly.
2. New O - rings at compressor manifold (lubricate with 525 viscosity refrigerant oil).
3. Compressor hose assembly.

Tighten

Torque the following assemblies as follows:

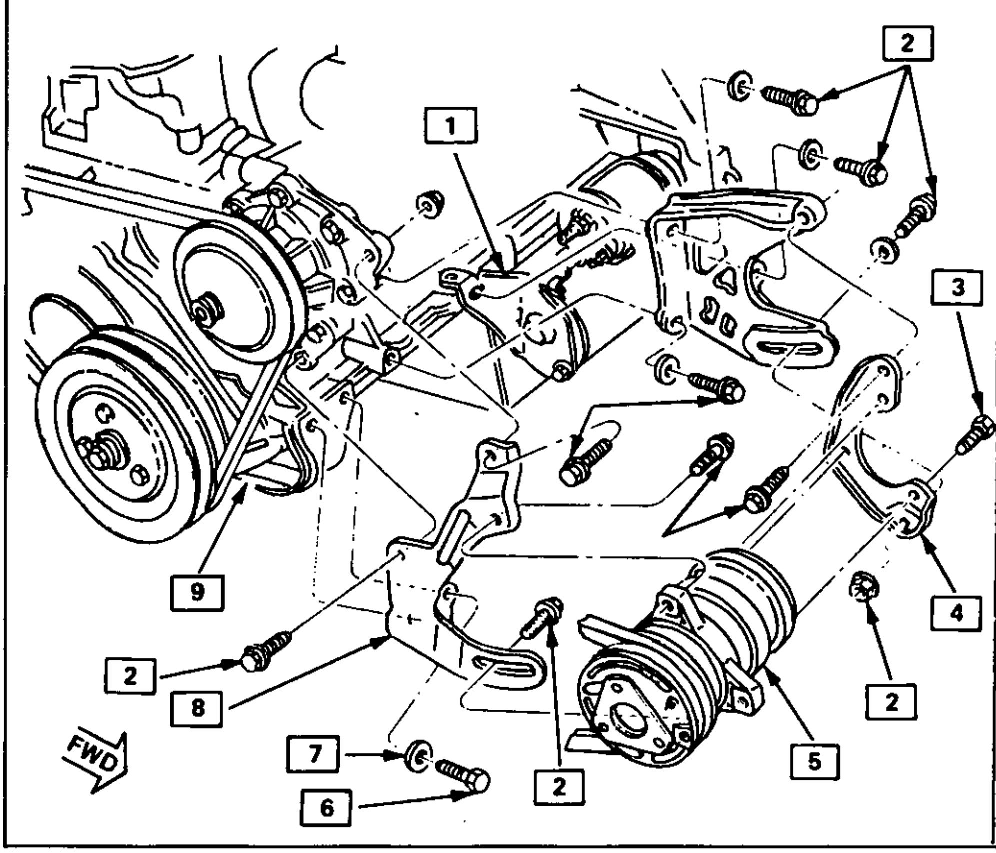
- Compressor hose assembly at compressor to 4 N·m (3 lb.ft.).
- Compressor retaining bolts to 50 N·m (37 lb.ft.)

Adjust

Belt tension to 350 newtons (80 lbs.).

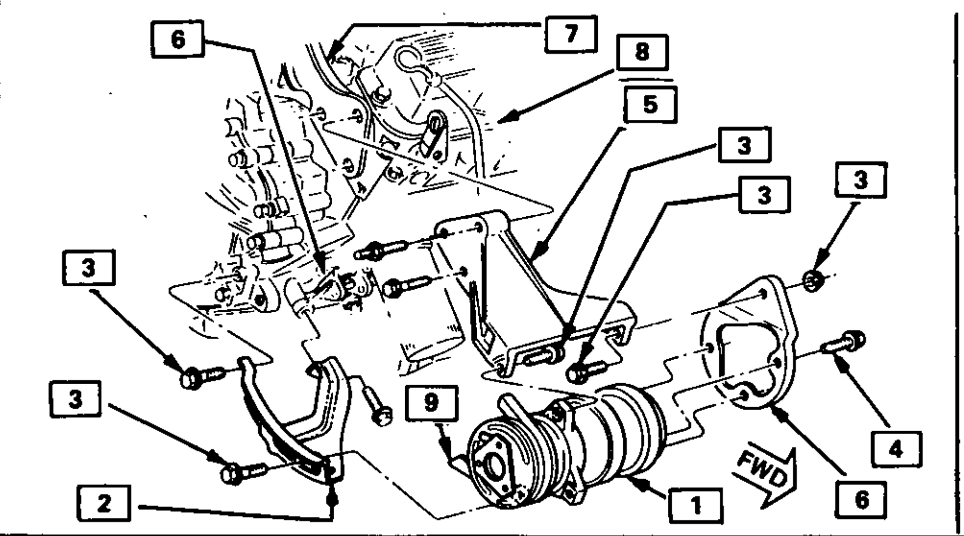
Install or Connect

1. Lower vehicle.
2. Negative (-) battery cable.
3. Evacuate and charge system.



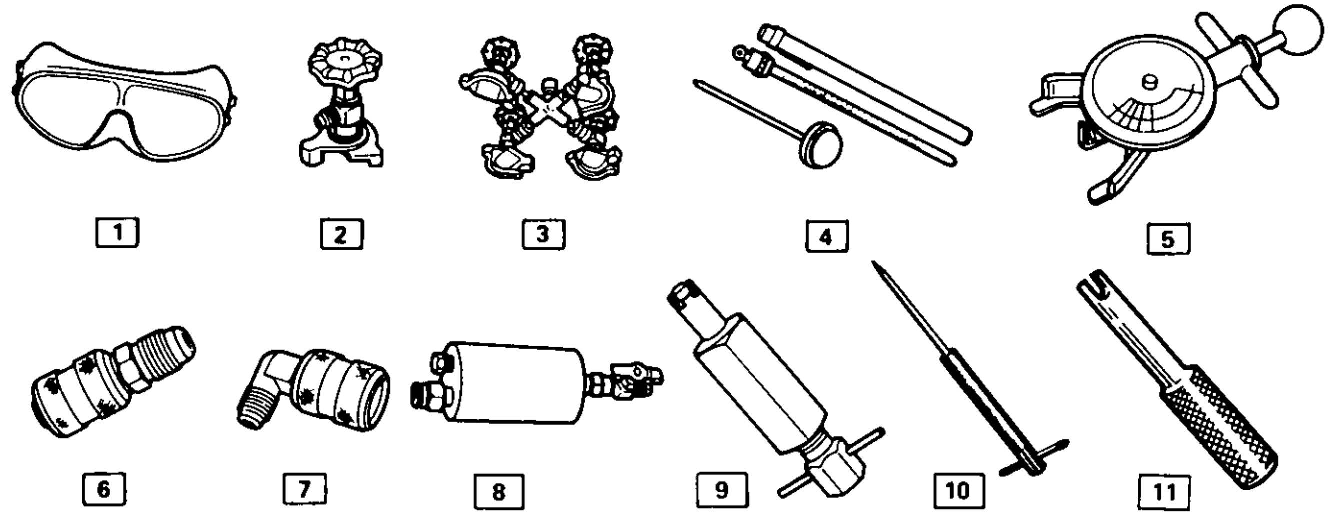
1–STARTER MOTOR BRACKET
2–40–60 N·m (30-44 LB.FT.)
3–20–34 N·m (15-25 LB.FT.)
4–BRACKET
5–COMPRESSOR ASM
6–50–70 N·m (37-52 LB.FT.)
7–WASHER
8–BRACKET ASM
9–ENGINE MOUNTING BRACKET

Fig. 820 A/C Compressor Mounting - Engine Code R



1–COMPRESSOR ASM
2–BRACKET
3–40-60 N·m (30-44LB-FT)
4–20-34 N·m (15-25LB-FT)
5–BRACKET ASM
6–BRACKET
7–TORQUE STRUT BRACKET
8–ENGINE ASM
9–BELT

Fig. 821 A/C Compressor Mounting - Engine Code 9



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

Fig. 822 A/C Special Tools

SPECIFICATIONS

Total R-12 Capacity .... 1.134 kg, (2.5 lbs.)

The 520ml (14 fl.oz.) disposable can of Refrigerant-12 is equivalent to .399 kg, (.88 lb.).

SECTION 1D2

DA-6 AIR CONDITIONING COMPRESSOR OVERHAUL

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

CONTENTS

GENERAL DESCRIPTION

Vehicles using the DA-6 compressor (Fig. 1) may have differences between installations in the mounting brackets, drive systems, pulleys, connections, and system capacities. Basic overhaul procedures are similar between compressors used on different vehicles, except for front head orientation (Fig. 2).

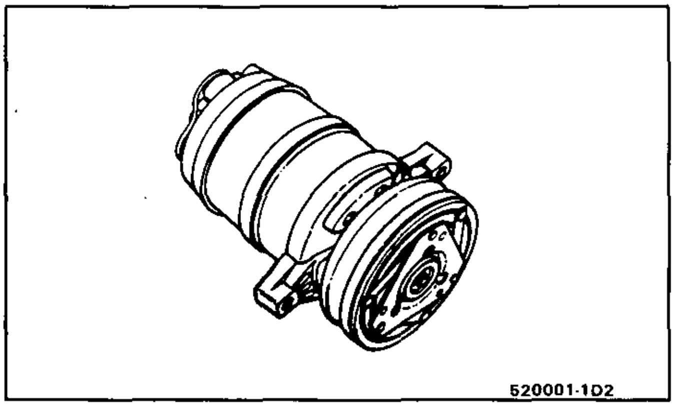


Fig. 1 DA-6 Compressor, V-Groove Pulley & Standard Mounting

When servicing the compressor, keep dirt or foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any "on car" repairs, or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with Trichloroethane, naptha, stoddard solvent, kerosene or equivalent solvent and dried with dry air. Use only lint free cloths to wipe parts.

The operations described below are based on bench overhaul with the compressor removed from the car, except as noted. They have been prepared in order of accessibility of the components. When a compressor is removed from the car for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (see "Refrigerant Oil" Distribution in Section 1B).

Most minor repair procedures may be done on the car without discharging the system. Major repair procedures require that the system be discharged of refrigerant.

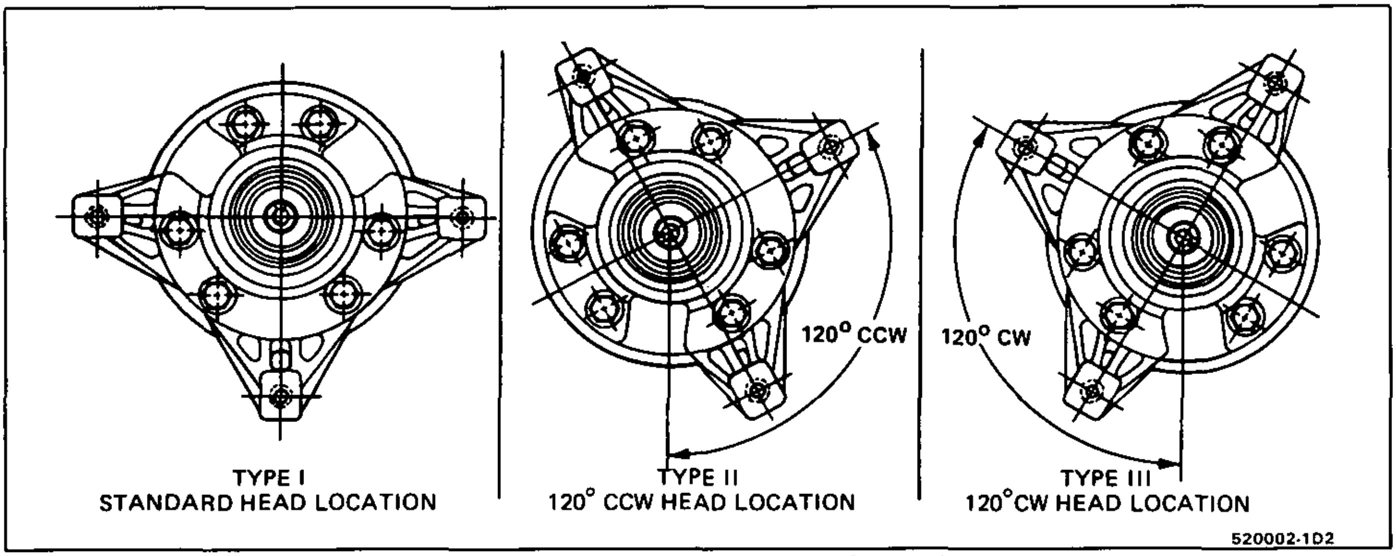


Fig. 2 DA-6 Compressor Front Head Orientation

SERVICE PROCEDURES

MINOR DA-6 COMPRESSOR REPAIR

Illustrations used in the following operations show the compressor removed from the car for easier viewing.

When servicing the compressor, remove only the parts that preliminary diagnosis shows are in need of service.

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

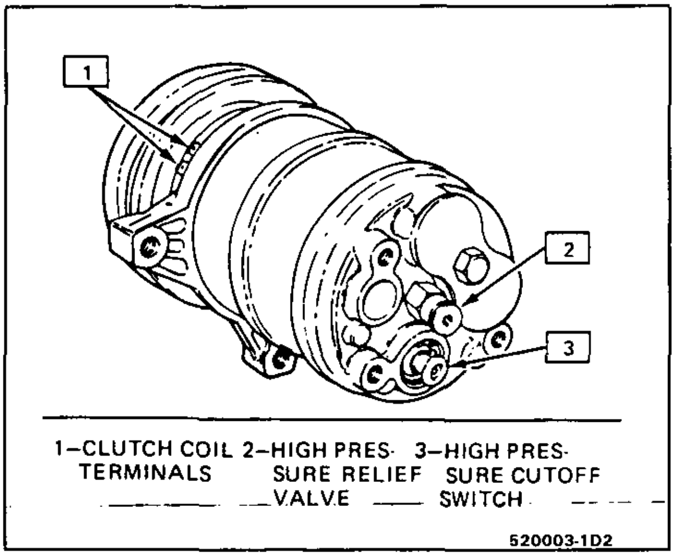


Fig. 3 DA-6 Compressor Rear Head Details

COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

←→ Remove or Disconnect

1. Clamp the holding fixture J-33026 in a vise and attach compressor to holding fixture with thumb screws J-33026-1 (Fig. 6).
2. Keep the clutch hub and drive plate assembly from turning by using the clutch hub holding tool J-33027. Remove the shaft nut using shaft nut socket J-33022 (Fig. 6).
3. With center screw forcing tip in place to thrust against the end of the shaft, thread the Clutch Plate and Hub Assembly Remover J-33013, 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 (Fig. 7).
4. Remove the shaft key and retain for reassembly.

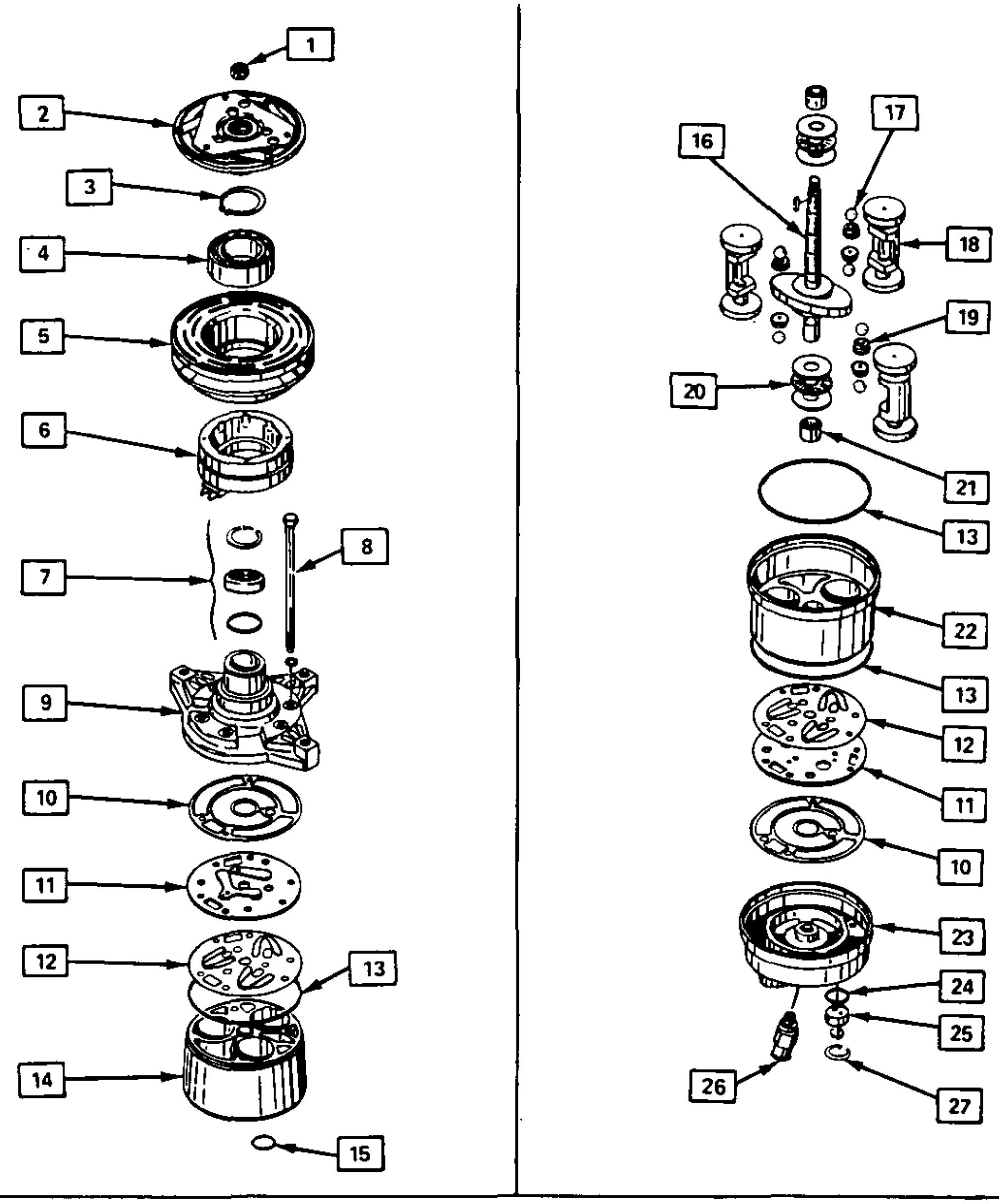
→← Install or Connect

1. Install the shaft key into the hub key groove (Fig. 8). Allow the key to project approximately 3.2mm (1/8") out of the keyway. The shaft key is curved slightly to provide an interference fit in the hub key groove.
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 the hub assembly onto the compressor shaft.

NOTICE: Do not drive or pound on the clutch hub or shaft. Internal damage to compressor may result.

4. Remove the forcing tip from the J-33013 remover - installer center screw and reverse the body direction on the center screw as shown in Fig. 9.
5. Install the clutch plate and hub installer J-33013 with bearing as shown in Fig. 9.

   The body of the J-33013 installer should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft until it lightly contacts the shaft key.



1–SHAFT NUT
2–CLUTCH DRIVER
3–ROTOR BEARING RETAINER
4–PULLEY BEARING
5–PULLEY
6–CLUTCH COIL ASSEMBLY
7–SHAFT SEAL PARTS
8–THROUGH BOLT S (6)
9–FRONT HEAD
10–HEAD GASKET
11–VALVE PLATE
12–SUCTION REED
13–CYLINDER O-RING
14–FRONT CYLINDER
15–DISCHARGE CROSSOVER O-RING
16–SHAFT AND AXIAL PLATE
17–PISTON BALL (6)
18–PISTON (3)
19–SHOE (6)
20–THRUST BEARING AND RACES
21–MAIN BEARING
22–REAR CYLINDER
23–REAR HEAD
24–SWITCH O-RING
25–SYSTEM CONTROL SWITCH
26–HIGH PRESSURE RELIEF VALVE
27–RETAINER RING-SWITCH

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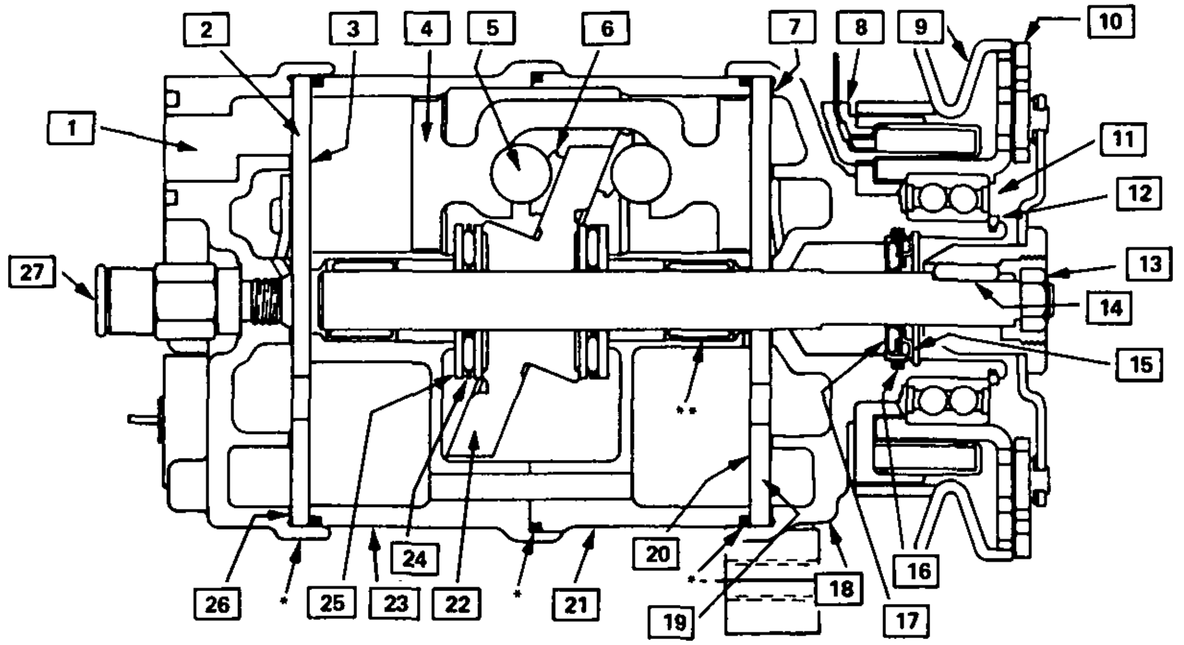
Fig. 4 DA-6 Compressor Components - Disassembled View



1–SUCTION PORT
2–REAR VALVE PLATE
3–SUCTION REED PLATE
4–PISTON & RING ASSY.
5–PISTON BALL
6–SHOE DISC
7–HEAD GASKET
8–CLUTCH COIL ASSY.
9–PULLEY ROTOR
10–CLUTCH DRIVER
11–PULLEY BEARING
12–BEARING RETAINER RINGS
13–SHAFT NUT
14–SHAFT KEY
15–SEAL RETAINER
16–SEAL O-RING
17–SHAFT SEAL
18–FRONT HEAD
19–FRONT VALVE PLATE
20–SUCTION REED PLATE
21–FRONT CYLINDER
22–SHAFT & AXIAL PLAT ASSY.
23–REAR CYLINDER
24–THRUST BEARING
25–THRUST RACE
26–HEAD GASKET
27–PRESSURE RELIEF VALVE
28–REAR HEAD

* CYLINDER O-RING SEALS

** SHAFT BEARING

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Fig. 5 DA-6 Compressor - Cross Section

6. Hold the center screw with a wrench. Tighten the hex portion of the Installer J-33013 body to press the hub onto the shaft. Tighten the body several turns, remove the installer and check to see that the shaft key is still in place in the keyway before installing the clutch plate and hub assembly to its final position. The air gap between frictional surfaces of the clutch plate and clutch rotor should be 0.38-0.64mm (.015-.025").

   - If the center screw is threaded **fully** onto the end of the compressor shaft, or if the body of the installer is held and the center screw is rotated, the key will assume the position as shown in Fig. 14 and will break the clutch hub.

7. Remove installer J-33013, check for proper positioning of the shaft key (even or slightly above the clutch hub). Install the shaft nut. Hold the clutch plate and hub assembly with clutch hub holding tool J-33027 and using shaft nut socket J-33022, tighten the nut against the crankshaft shoulder to 11-22 N·m (8-16 ft. lbs.) torque, using a 0-35 N·m (0-25 ft. lbs.) torque wrench.

8. Spin the pulley rotor by hand to see that the rotor is not rubbing the clutch drive plate.

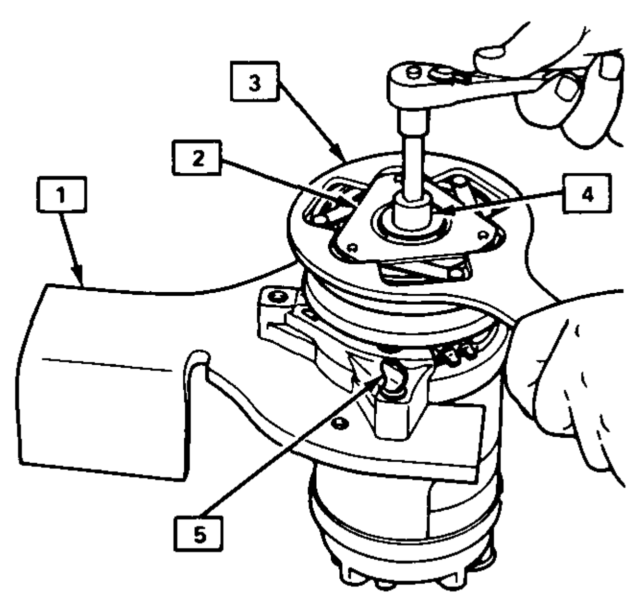
COMPRESSOR CLUTCH ROTOR AND/OR BEARING

↔ **Remove or Disconnect**

1. Remove the clutch plate and hub assembly as described previously.

2. Remove rotor and bearing assembly retaining ring, using snap ring pliers J-6083 (Fig. 10).

3. Install pulley rotor and bearing puller guide J-33023 to the front head (Fig. 11) 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. 12).



1–J 33026 HOLDING FIXTURE
2–CLUTCH PLATE AND HUB HOLDING ASSM.
3–J 33027 CLUTCH HUB HOLDING TOOL
4–J 33022 NUT SOCKET
5–J 33026-1 THUMB SCREW

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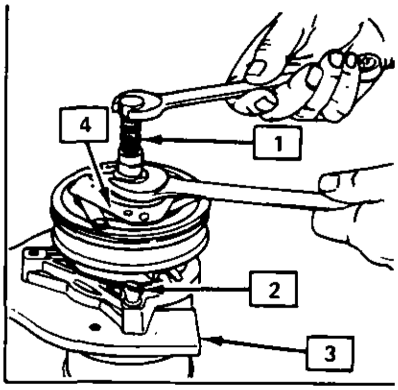
Fig. 6 Removing Shaft Nut



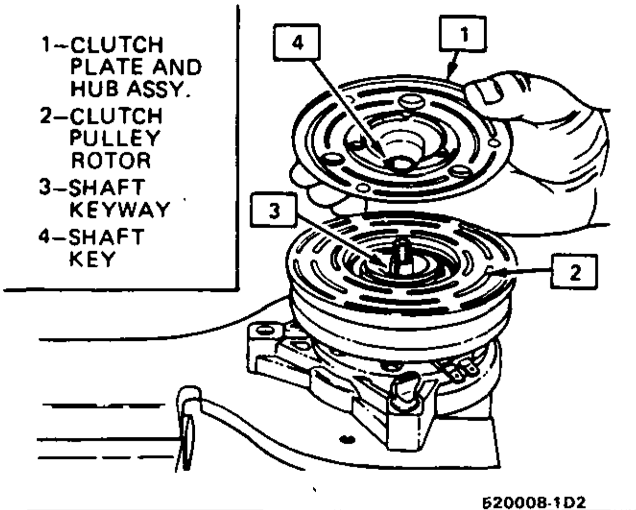
1–J-33013 HUB AND CLUTCH DRIVE PLATE ASSEMBLY REMOVER
2–J-33026-1 THUMB SCREW
3–J-33026 HOLDING FIXTURE
4–CLUTCH PLATE AND HUB ASSEMBLY

520007-1D2

Fig. 7 Clutch Plate and Hub Assembly Removal

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 engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks as shown in Fig. 12.



1–CLUTCH PLATE AND HUB ASSY.
2–CLUTCH PULLEY ROTOR
3–SHAFT KEYWAY
4–SHAFT KEY

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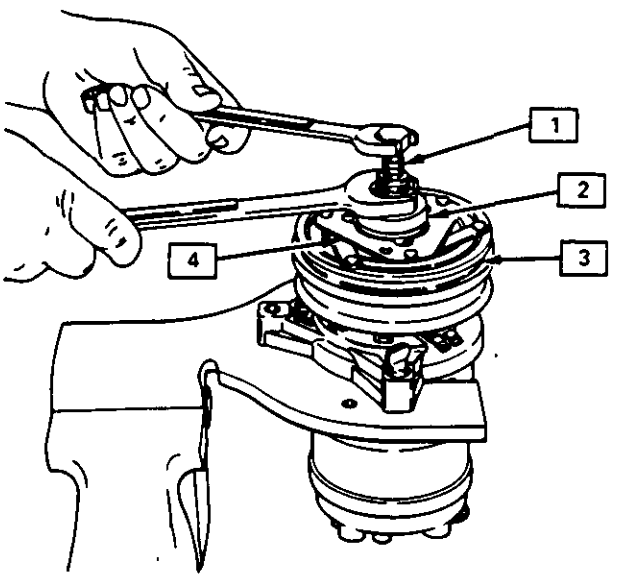
Fig. 8 Shaft Key, Clutch Plate/Hub Installation



1–J-33013 DRIVE PLATE INSTALLER
2–DRIVE PLATE INSTALLER BEARING
3–AIR GAP (.015"–.025") 0.38-0.64mm
4–CLUTCH PLATE HUB ASSY.

520009-1D2

Fig. 9 Installing Clutch Plate & Hub Assembly

6. Drive the bearing out of the rotor hub with rotor bearing remover J-9398 and J-8092 universal handle (Fig. 12).

   It is not necessary to remove the staking in front of the bearing 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.

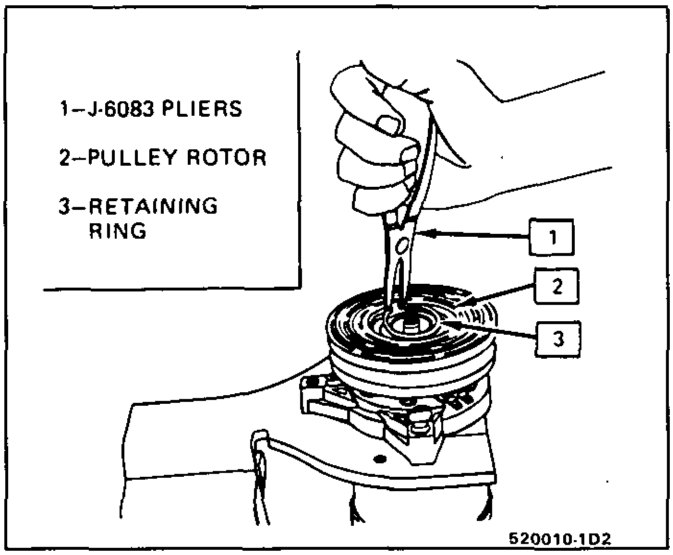


Fig. 10 Removing Pulley Rotor & Bearing Assembly Retaining Ring

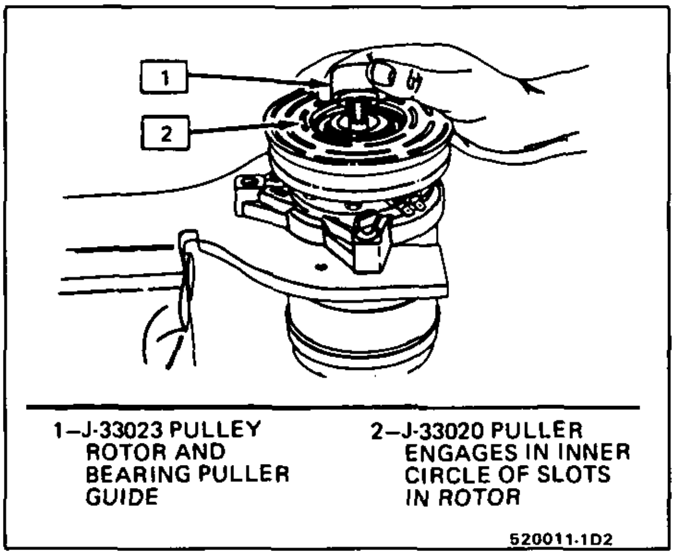


Fig. 11 Installing Pulley Rotor/Bearing Puller Guide

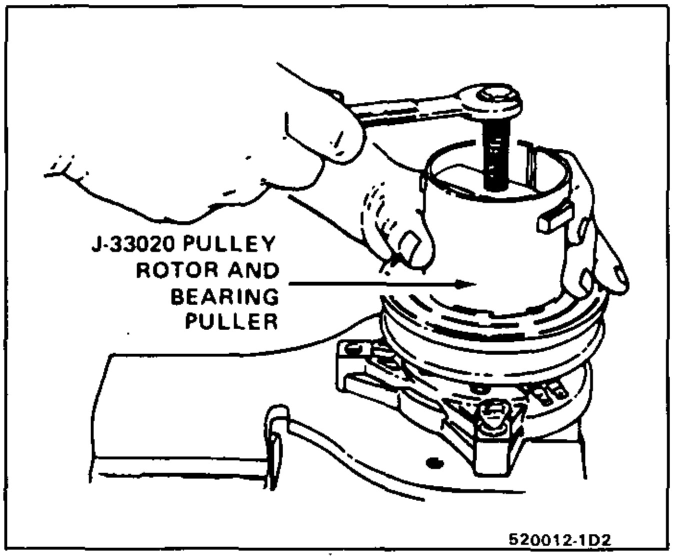


Fig. 12 Removing Pulley Rotor and Bearing Assembly

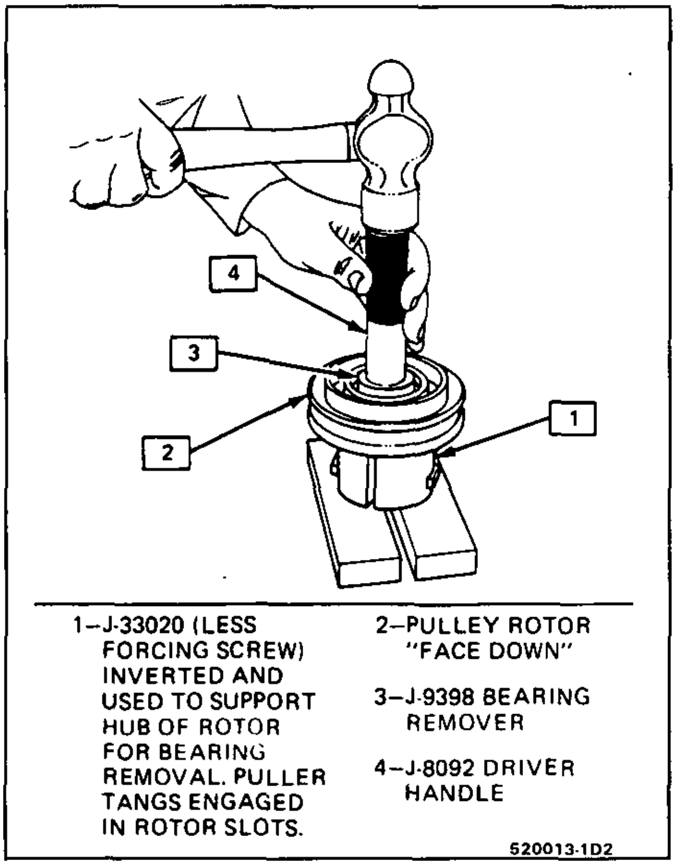


Fig. 13 Pulley Rotor Bearing Removal

→← Install or Connect

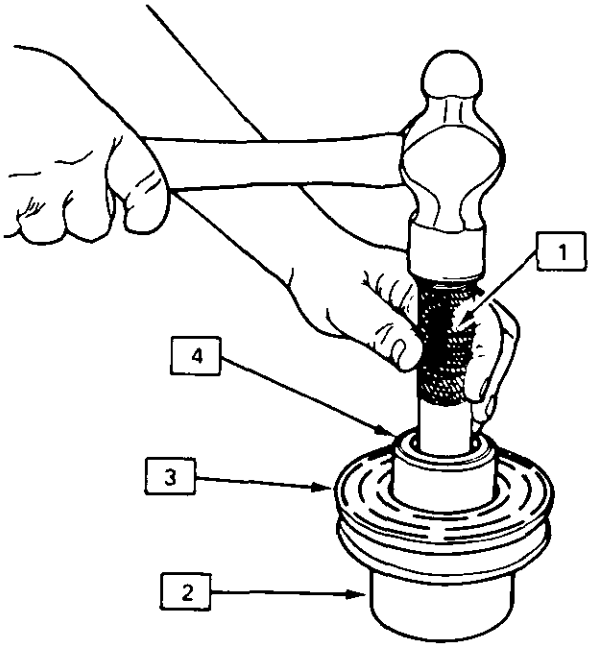
1. Place the pulley rotor on the J-21352-A support block to fully support the rotor hub during bearing installation (Fig. 14).

   NOTICE: 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 universal handle J-8092, drive the bearing fully into the hub (Fig. 14). The installer will apply force to the outer race of the bearing if used as shown.

3. Place bearing staking guide J-33019-1 and bearing staking pin J-33019-2 in the hub bore as shown in Fig. 15. 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 (Fig. 15), and the stake pin should be properly positioned in the guide after each impact on the pin.

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.
   The stake metal should not contact the outer race of the bearing to prevent the possibility of distorting the outer race. Stake three (3) places 120° apart as shown in Fig. 16.
5. With the compressor mounted to the J-33026 holding fixture, position the rotor and bearing assembly on the front head (Fig. 17).
6. Position the J-33017 pulley rotor and bearing installer and J-33023 puller pilot directly over the inner race of the bearing (Fig. 17).



1–J-8092 DRIVER HANDLE

2–J-21352-A SUPPORT BLOCK

3–PULLEY ROTOR

4–J-9481-A BEARING INSTALLER

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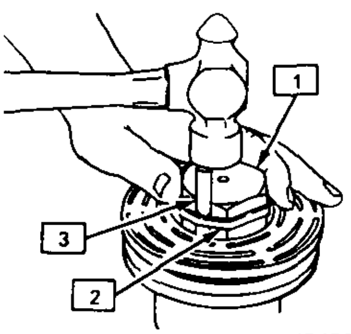
Fig. 14 Installing Pulley Rotor Bearing



1–J33019-1 BEARING STAKING GUIDE

2–RUBBER BAND

3–J33019-2 BEARING STAKING PIN

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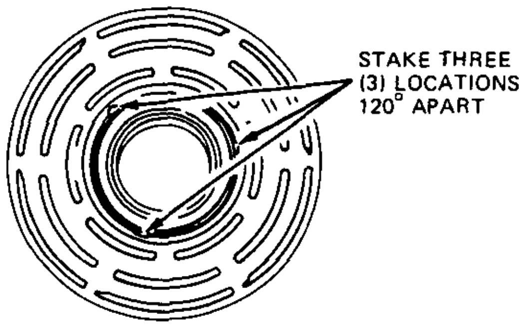
Fig. 15 Staking Bearing In Rotor Hub Bore



STAKE THREE (3) LOCATIONS 120° APART

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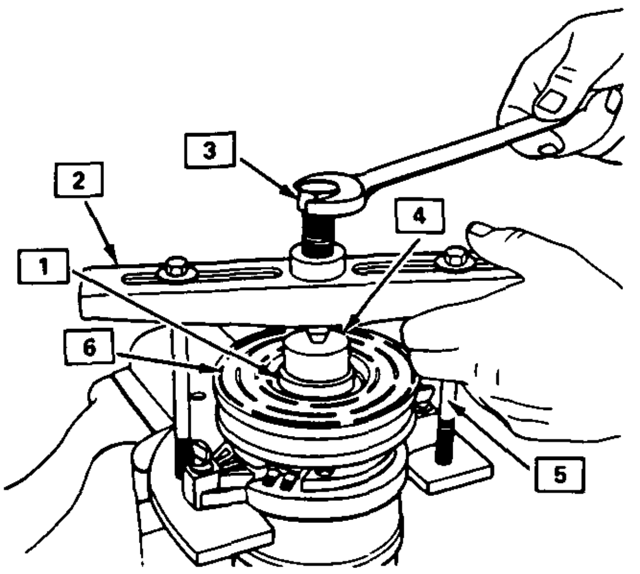
Fig. 16 Bearing Staked In Place



1–J-33017 PULLEY ROTOR AND BEARING INSTALLER

2–J-8433-1 CROSS BAR

3–J-8433-3 SCREW

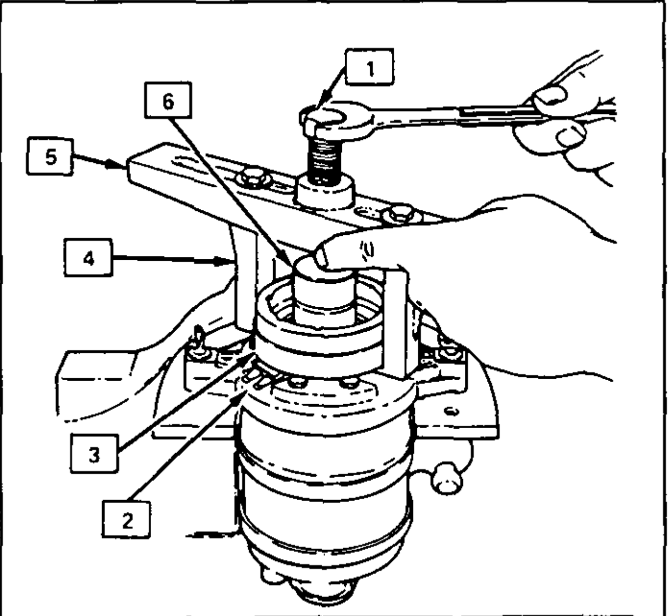
4–J-33023 PULLER PILOT

5–J-33026-2 THRU BOLT

6–PULLEY ROTOR

520017-1D2

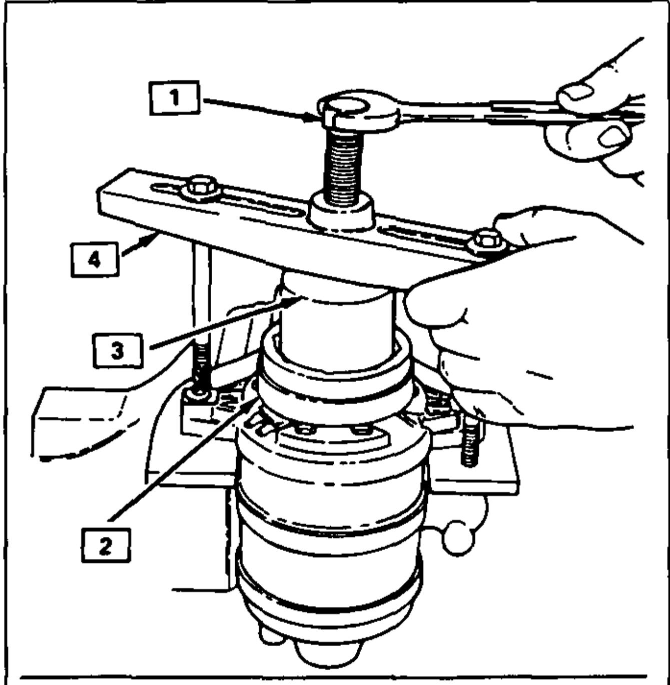
Fig. 17 Installing Pulley Rotor and Bearing Assembly



1–J-8433-3 SCREW
2–MARK COIL TERMINAL LOCATION ON HEAD
3–CLUTCH COIL ASSEMBLY
4–J-33025 PULLER LEG
5–J-8433-1 PULLER CROSS BAR
6–J-33023 PULLER PILOT

520018-1D2

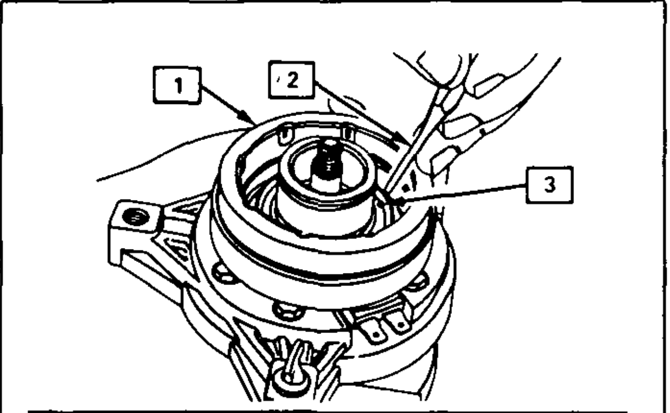
Fig. 18 Clutch Coil Assembly Removal



1–J-8433-3 SCREW
2–CLUTCH COIL ASSEMBLY
3–J-33024 CLUTCH COIL INSTALLER
4–J-8433-1 PULLER CROSS BAR

520019-1D2

Fig. 19 Installing Clutch Coil Assembly



1–CLUTCH COIL
2–DRIFT PUNCH
3–STAKE IN FRONT HEAD (3 PLACES)

520020-1D2

Fig. 20 Staking Clutch Coil To Front Head

7. Position puller crossbar J-8433-1 on the puller pilot J-33023 and assemble the two J-33026-2 through bolts and washers through the puller bar slots and thread them into the J-33026 holding fixture (Fig. 17). The thread of the through bolts should engage the full thickness of the holding fixture.

8. Tighten the center screw in the J-8433-1 puller crossbar to force the pulley rotor and bearing assembly onto the compressor front head (Fig. 17). Should the J-33017 pulley rotor and bearing installer slip off direct in-line contact with the inner race of the bearing, loosen the J-8433-1 center forcing screw and realign the installer and pilot so that the J-33017 installer will properly clear the front head.

9. Install rotor and bearing assembly retainer ring, using snap ring pliers J-6083 (Fig. 10).

10. Reinstall clutch plate and hub assembly as described previously.

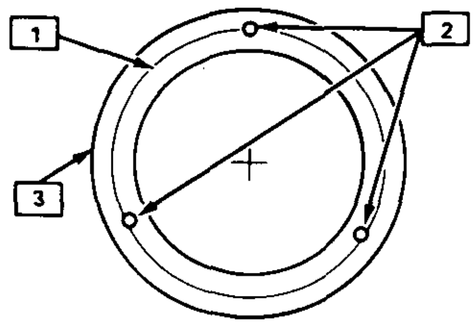
COMPRESSOR CLUTCH COIL

←→ Remove or Disconnect

1. Perform Steps 1 through 4 of "Clutch Rotor and/or Bearings" removal procedure. Mark clutch coil terminal location on compressor front head.
2. Install J-33023 puller pilot on front head of compressor (Fig. 18). Also install J-8433-1 puller crossbar with J-33025 puller legs as shown in Fig. 18.
3. Tighten J-8433-3 forcing screw against the puller pilot to remove the clutch coil.

→← Install or Connect

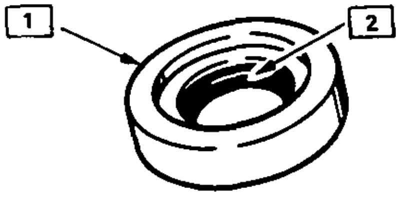
1. Place the clutch coil assembly on the front head with the terminals positioned at the "marked" location.
2. Place the J-33024 clutch coil installer over the internal opening of the clutch coil housing and align installer with the compressor front head.
3. Center the J-8433-1 puller crossbar in the countersunk center hole of the J-33024 clutch coil installer. Install the J-33026-2 through bolts and washers through the crossbar slots and thread them into the holding fixture J-33026 to full fixture thickness (Fig. 19).
4. Turn the center forcing screw of the J-8433-1 puller crossbar to force the clutch coil onto the front head. Be sure clutch coil and J-33024 installer stay "in-line" during installation.
5. When coil is fully seated on the front head, use a 1/8" diameter drift punch and stake the front head at three (3) places 120° apart (Fig. 20), to ensure clutch coil remaining in position.
    - Stake size should be only one half the area of the punch tip and only approximately 0. 28-0.35mm (.010-.015") deep (Fig. 21).
6. Install rotor and bearing assembly and the clutch plate and hub assembly according as described previously.



1–FRONT HEAD SURFACE
3–STAKE FRONT HEAD 0.28-0.35mm DEEP (.010-.015")
3–CLUTCH COIL HOUSING

520021-1D2

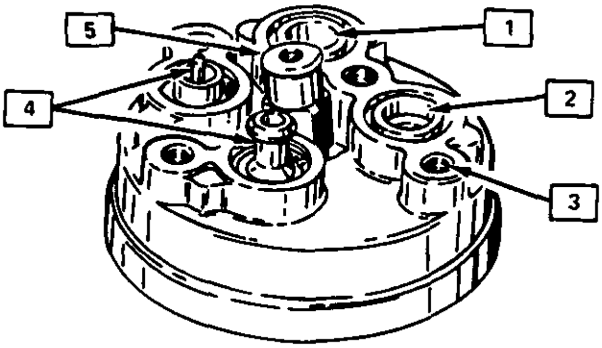
Fig. 21 Details of Stakes In Front Head for Clutch Coil



1–STEEL SHELL
2–LIP SEAL

520033-1D1

Fig. 22 Compressor Shaft Seal



1–SUCTION PORT
2–DISCHARGE PORT
3–MOUNTING BOSS (3)
4–CONTROL SWITCHES
5–PRESSURE RELIEF VALVE

520023-1D2

Fig. 23 Compressor and Clutch Assembly - Rear View

MAJOR DA-6 COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly (Fig. 22), pressure relief valve or rear head mounted pressure switches (Fig. 23), 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 rear head, front head or cylinder and shaft assembly is to be serviced or replaced, the oil in the compressor must be drained, measured and replaced. See Section 1B to determine how much oil to add to new assembly.

A clean workbench covered with a sheet of clean paper, and a place (clean trays, etc.) for all parts being removed and replaced is important, as is the use of the proper, clean service tools.

NOTICE: Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

All parts required for servicing the internal compressor are protected by a preservative 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.

COMPRESSOR SHAFT SEAL REPLACEMENT

Seal Leak Detection

A shaft seal should not be changed because of small amounts of oil found on an adjacent surface. The seal is designed to leak some oil for lubrication purposes. A shaft seal should be changed only when a large amount of sprayed oil is found, and only after actual refrigerant leakage is found by using an approved leak detection procedure (see "LEAK TESTING THE REFRIGERANT SYSTEM," SECTION 1B).

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

↔ Remove or Disconnect

1. Discharge the refrigerant system according to the *directions in* 1B.
2. Loosen and reposition compressor in mounting brackets.
3. Remove clutch plate and hub assembly from compressor as described in minor repairs.
4. Remove the shaft seal retainer ring, using snap ring pliers J-5403 (Fig. 24).
5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal, the shaft itself and O-ring groove. Any dirt or foreign material getting into compressor may cause damage.
6. Place seal protector J-34614 over the end of the shaft to prevent seal damage. 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 (Fig. 25). Discard the seal. The handle should be hand-tightened securely. Do not use a wrench or pliers.
7. Remove and discard the seal O-ring from the compressor neck using O-ring remover J-9553 or J-9553-01 (Fig. 26).
8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these *areas are perfectly clean before installing new* parts.

Inspection

Seals should not be re-used. Always use a new specification service seal kit on rebuild (Fig. 22). Be sure that the face of the seal to be installed is not scratched or damaged in any way. Make sure that the seal is free of lint and dirt that could damage the seal surface or prevent sealing.

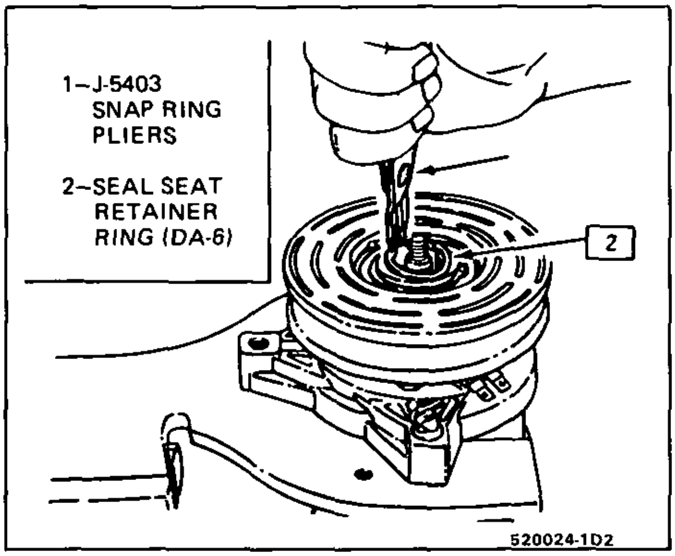


Fig. 24 Removing or Installing Shaft Seal Seat Retaining Ring

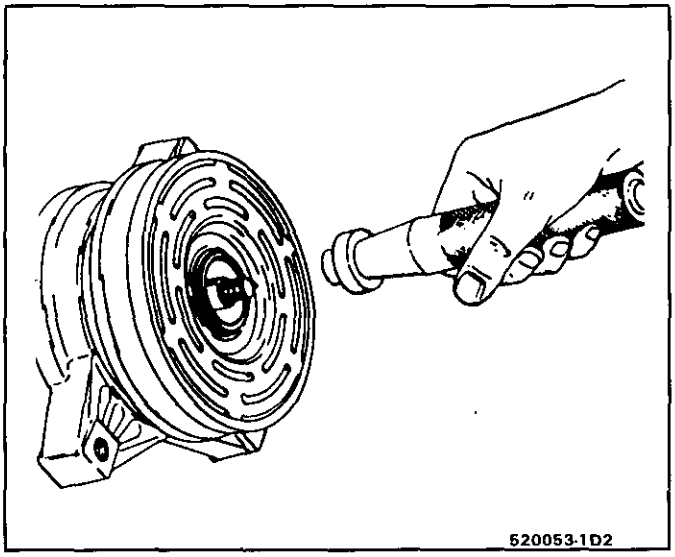


Fig. 25 Removing or Installing Shaft Seal

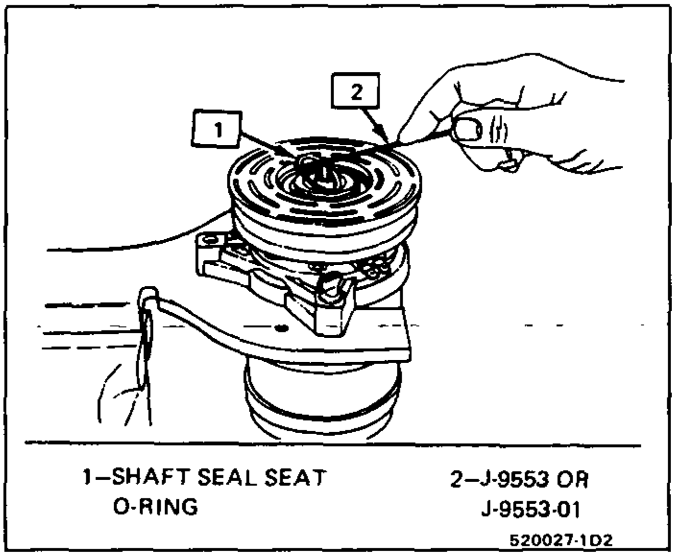


Fig. 26 Removing Shaft Seal Seat O-Ring

Install or Connect

1. Dip the new seal O-ring in clean 525 viscosity refrigerant oil and assemble onto O-ring installer J-33011 (Fig. 27).
2. Insert the O-ring installer J-33011 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 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. Attach the seal to the seal remover and installer J-23128-A and dip the seal in clean 525 viscosity refrigerant oil to coat the seal face and outer surface. Install the seal over the compressor shaft and J-34614 seal protector and push the seal into place with a rotary motion (Fig. 25). Take care not to dislodge the seat O-ring. Be sure seal makes a good seal with O-ring. Remove installer J-23128-A and seal protector J-34614.
4. Install the new seal retainer ring with its flat side against the seal, using snap-ring pliers J-5403 (Fig. 28). Use the sleeve from seal remover-installer J-9393-A to press in on the seal retainer ring so that it snaps into its groove.
5. To leak test, install compressor leak test fixture J-9625-A on rear head of compressor and connect gage charging lines. Pressurize suction and high-side of compressor with Refrigerant 12 vapor to drum pressure. Temporarily install the shaft nut and, with the compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several turns by hand. Leak test the seal area and correct any leak found. Remove shaft nut.
6. Remove any excess oil resulting from installing the new seal parts from the shaft and inside the compressor neck.
7. Install the clutch plate and hub assembly as described in minor repair procedures.
8. Reinstall compressor, belt and tighten bracket.
9. Evacuate and charge the refrigerant system according to directions in 1B.

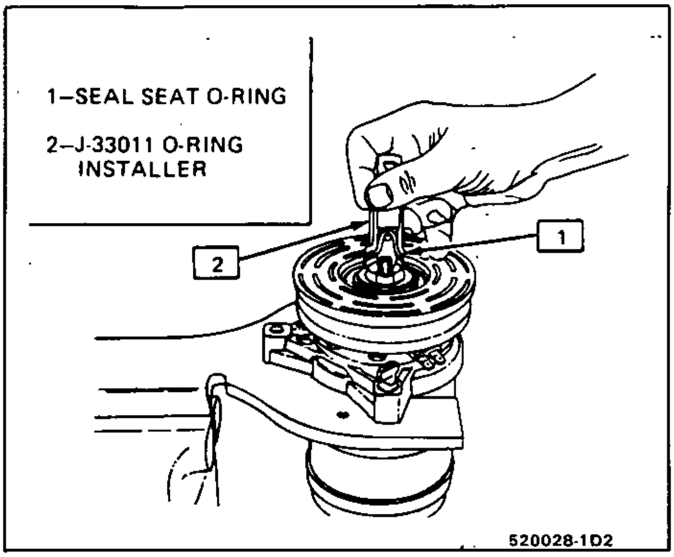


Fig. 27 Installing Seal Seat O-Ring

COMPRESSOR PRESSURE RELIEF VALVE

Remove or Disconnect

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Remove old pressure relief valve (Fig. 23).

Install or Connect

1. Lubricate O-ring of new pressure relief valve and O-ring assembly with new 525 viscosity refrigerant oil. Install new valve and torque in place, 7.5-10.5 N·m (5.5-7.7 lbs. ft.).
2. Evacuate and recharge the system.
3. Leak test per system procedure (Section 1B).

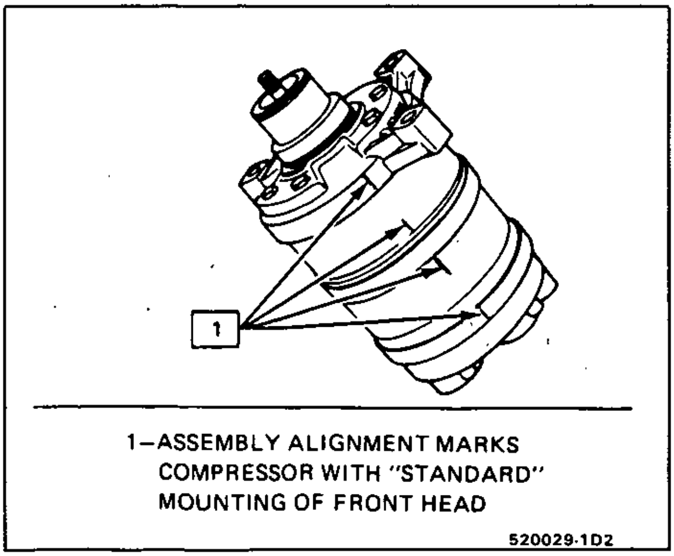


Fig. 28 Compressor Cylinders and Heads Alignment

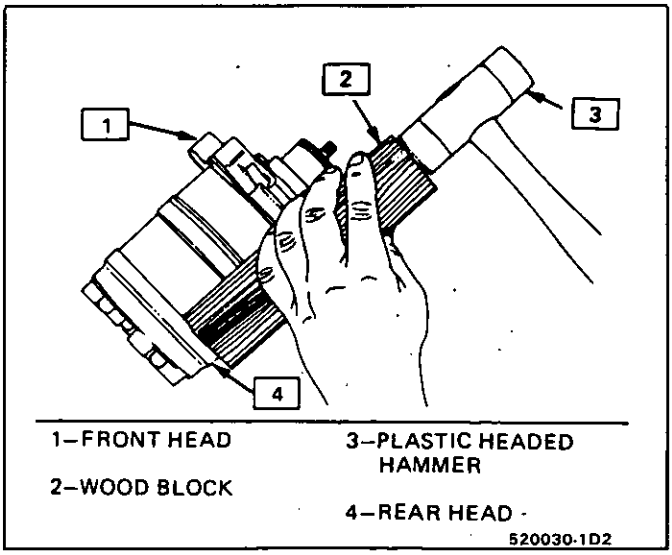


Fig. 29 Tapping Front or Rear Head Free of Cylinder

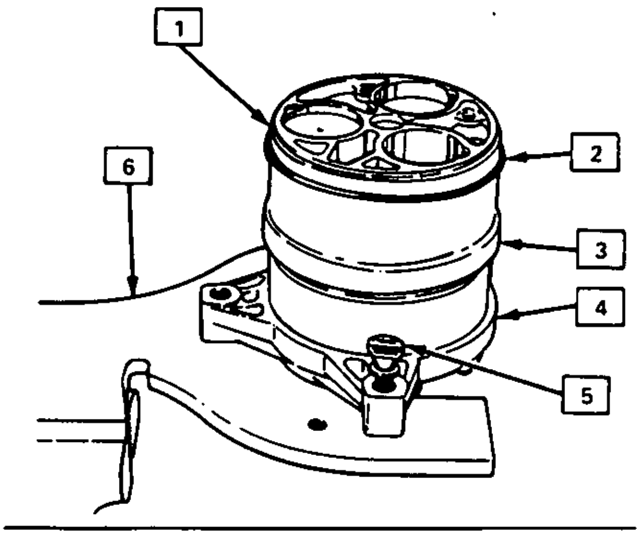


Fig. 30 O-Ring Installation On Rear Cylinder O-Ring Seat Recess

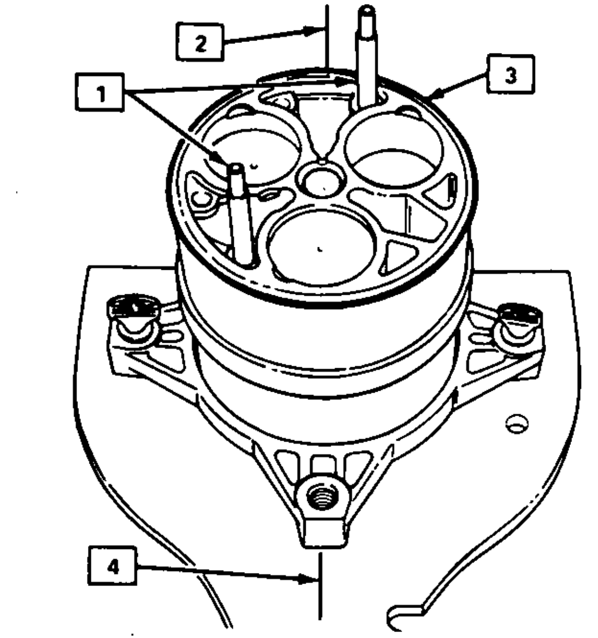


Fig. 31 Assembly Guide Pins In Cylinder Assembly (Standard Head Position)

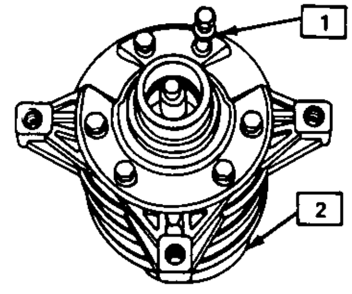


Fig. 32 Front Head Installed: Thru Bolts and Gaskets In Place

COMPRESSOR HIGH-SIDE HIGH-PRESURE CUT-OFF SWITCH

←→ Remove or Disconnect

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Disconnect the electrical connector from the high-pressure cut-off switch in the rear head of the compressor (Fig. 23).
3. Remove the high-pressure cut-off switch retaining ring (Fig. 23), using J-5403 internal snap ring pliers.
4. Remove high-pressure cut-off switch from compressor by pulling on terminal housing.
5. Remove old O-ring seal from switch cavity using J-9553 or J-9553-01 O-ring removal tool or equivalent.

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

6. Check switch cavity and O-ring groove in the rear head for dirt or foreign material and clean as necessary.

→← Install or Connect

1. Install new O-ring coated with clean refrigerant oil into groove in switch cavity.

2. Lubricate the high-pressure cut-off switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J-5403 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. Leak test per procedure.

COMPRESSOR REAR HEAD, HEAD GASKET, REAR VALVE PLATE, SUCTION REED PLATE AND CYLINDER TO REAR HEAD O-RING

↔ Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B and remove the compressor from the car. Drain the oil from the compressor into a container, measure and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.
3. Mark the location and note the alignment of the rear head, compressor cylinder and front head. This is important for reassembly. Depending on application mounting, the front head may be rotated 120° clockwise or 120° counterclockwise from "Standard" position (Fig. 28).
4. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.
5. Using a wood block and plastic headed hammer, tap around the edge of the rear head to disengage head from the compressor cylinder (Fig. 29). Separate the rear head, head gasket, rear valve plate, suction reed plate and cylinder to rear head O-ring. Discard the head gasket and the O-ring.
6. Inspect the rear valve plate, suction reed plate and visible portion of compressor cylinder and replace as necessary.

→← Install or Connect

1. Fasten the front head and cylinder assembly to the J-33026 holding fixture as shown in Fig. 30. Using masking tape or similar tape, tape across the through bolt holes in the front head at the 12 o'clock and 6 o'clock positions to support the J-33016 asembly guide pins in the through bolt holes shown in Fig. 31. Insert the guide pins with the small diameter end "up" in the locations shown.
2. Lubricate a new cylinder to rear head O-ring with clean 525 viscosity refrigerant oil and install O-ring in rear cylinder O-ring groove. The O-ring may be positioned on cylinder as shown in Fig. 30 and then rolled into the O-ring groove but cylinder surface must be clean. Preferrably cleaned with recommended solvent and blown dry with air.
3. Install suction reed plate over the J-33016 and guide pins as shown in Fig. 33.
4. Install rear valve plate over the J-33016 guide pins as shown (Fig. 34).
5. Install head gasket over guide pins as shown (Fig. 35).
6. Carefully assemble rear head onto rear guide pins making sure that the ends of the guide pins insert into the corresponding threaded holes in the rear head (Fig. 36). If guide pins are properly engaged in the through bolt holes in the rear head, the head will not be able to be rotated and will lower "in-line" into position on the rear of the cylinder. Alignment mark on rear head should align with cylinder marks (Fig. 37).
7. Using both hands, press down on the rear head to force it over the O-ring at the rear of the cylinder. Remove the compressor assembly from the holding fixture to the workbench surface.
8. Add new through bolt gaskets to the through bolts and install the bolts into the compressor assembly (Fig. 32). Be sure four (4) of the through bolts thread into the rear head before removing the guide pins.

   Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in.lbs.) is achieved on all six (6) bolts.
9. Install test plate J-9625-A on rear head of compressor and leak test complete compressor assembly according to (Bench-Check) leak testing procedure.
10. Remove test plate, add amount of new 525 viscosity refrigerant oil to be added as determined in Step 1 of Remove Process.
11. Install clutch parts on compressor according to previous procedure and install compressor on car.
12. Evacuate and charge the refrigerant system according to directions in 1B.

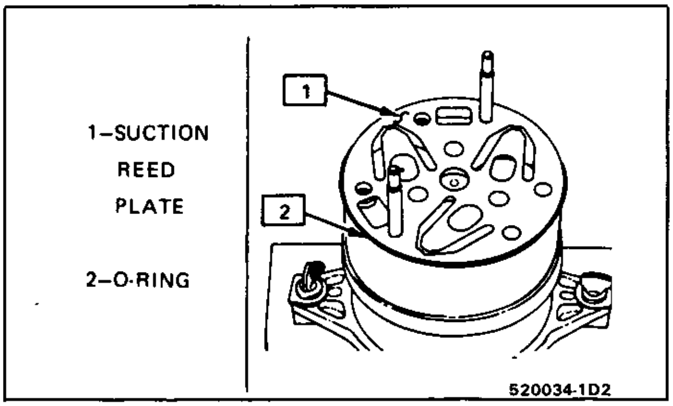


Fig. 33 Suction Reed Plate Assembled To Cylinder Assembly

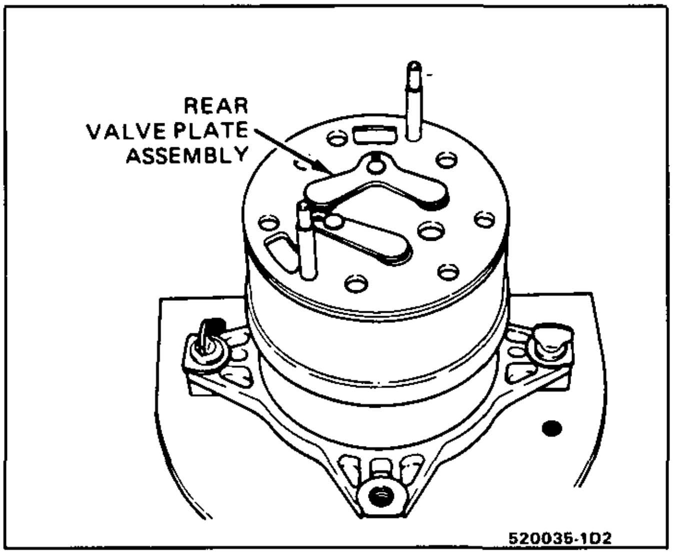


Fig. 34 Rear Valve Plate Assembled To Cylinder Assembly

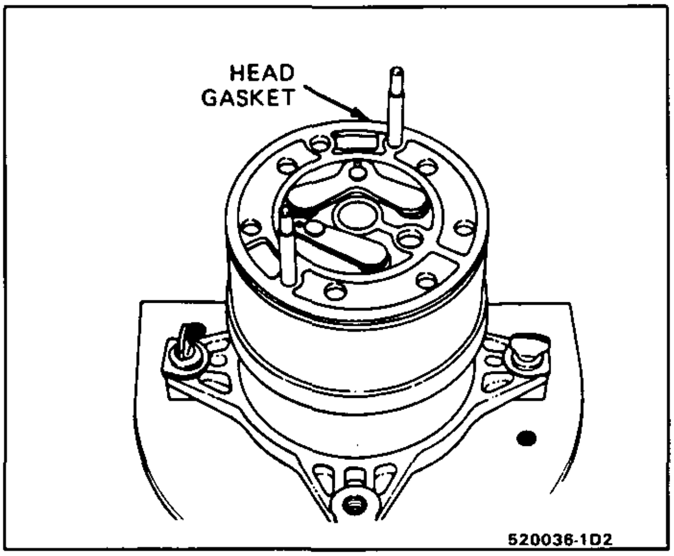


Fig. 35 Head Gasket Assembled Over Rear Valve Plate

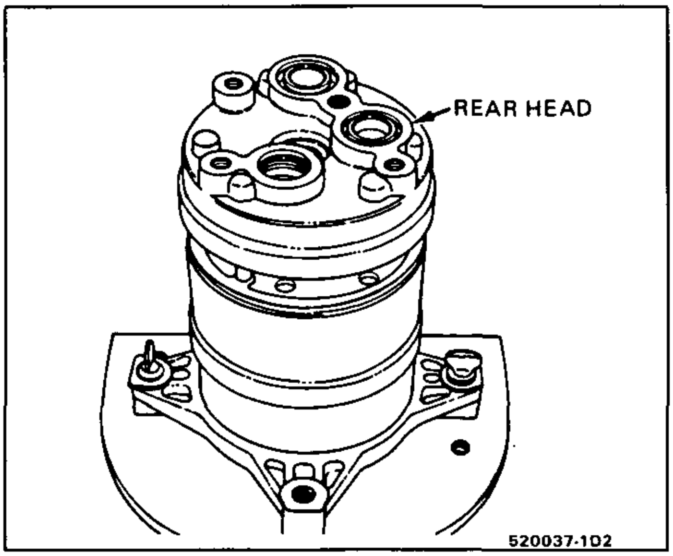


Fig. 36 Rear Head Assembled Onto Assembly Guide Pins

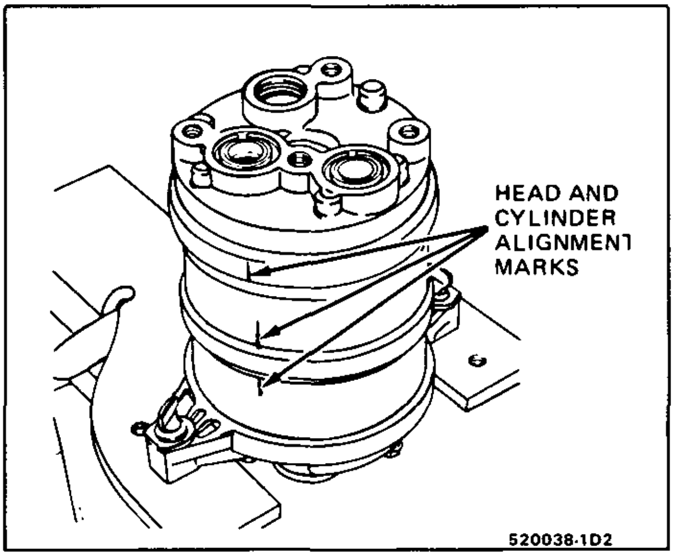
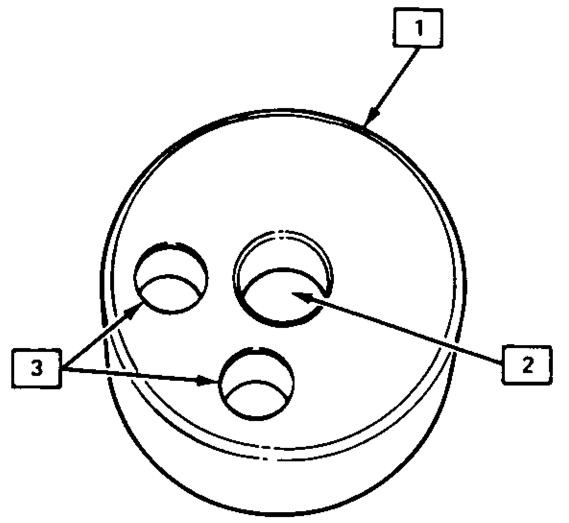


Fig. 37 Rear Head Installed In Aligned Position



1–J-21352-A SUPPORT BLOCK

2–POSITION HIGH RELIEF VALVE IN OPENING

3–POSITION REAR HEAD SWITCH(ES) IN OPENING(S)

520039-1D2

Fig. 38 Support Block For the DA-6 Compressor

COMPRESSOR FRONT HEAD, HEAD GASKET, FRONT VALVE PLATE, SUCTION REED PLATE AND CYLINDER TO FRONT HEAD O-RING

←→ Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B and remove the compressor from the car. Drain the oil from the compressor into a container, measure and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.
3. Remove the shaft seal parts per previous procedure and discard the old seal parts.
4. Mark the location and note the alignment of the front head to the alignment marks on the cylinder. This is important for reassembly. Depending on application mounting, the front head may be rotated 120° clockwise or 120° counterclockwise from the "standard" position (Fig. 28).
5. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.
6. Using a plastic headed hammer, tap the front head at the mounting locations to disengage the head from the compressor cylinder.

   Remove the front head, head gasket, front valve plate, suction reed plate and cylinder to front head O-ring. Discard the head gasket and the O-ring.
7. Inspect the front valve plate, suction reed plate and visible portion of compressor cylinder and replace as necessary.

→← Install or Connect

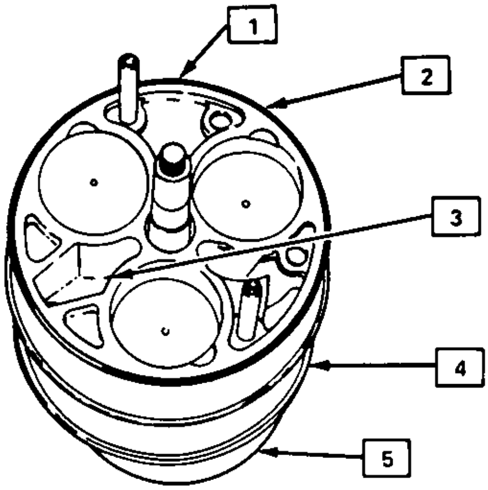
1. Rest the rear head and cylinder assembly on the J-21352 support block (Fig. 38), and install the two (2) J-33016 assembly guide pins in the through bolt holes indicated (Fig. 39).
2. Lubricate a new cylinder to front head O-ring with clean 525 viscosity refrigerant oil and install O-ring in front cylinder O-ring groove.
3. Install suction reed plate over the J-33016 guide pins as shown (Fig. 40).
4. Install front valve plate over the J-33016 guide pins as shown (Fig. 41).
5. Install head gasket over guide pins as shown (Fig. 42).
6. Line up mark on front head (Step 4 of Remove) with the alignment marks on the compressor cylinder and assemble head over guide pins (Fig. 28).

   The front head in Fig. 44 is assembled in the "standard" position and may differ 120° either direction. Assemble front head according to location marked before removal.
7. Using both hands, press down on the front head to force it over the O-ring at the front of the cylinder.
8. Add new through bolt gaskets to the through bolts and install the bolts into the compressor assembly. Be sure four (4) of the through bolts

thread into the rear head before removing the guide pins.

Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in.lbs.) is achieved on all six (6) bolts.

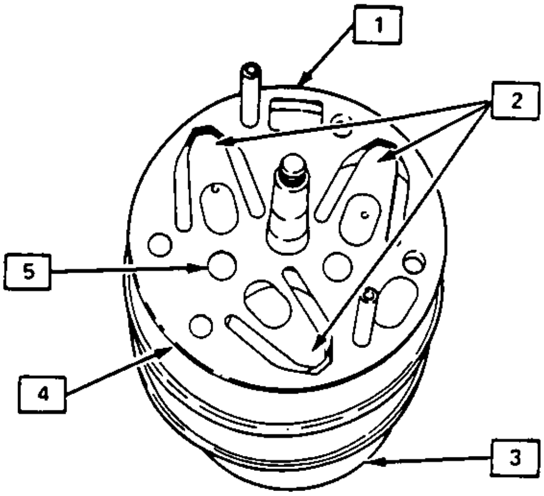
9. Install new shaft seal kit per previous procedure.
10. Add amount of new 525 viscosity refrigerant oil to be added as determined in Step 1 of Remove. Install test plate J-9625-A. Place shaft nut on shaft and rotate compressor shaft several turns.
11. Leak test complete compressor assembly according to (Bench-Check) Leak Testing procedure.
12. Remove shaft nut and install clutch parts on compressor according to previous procedure.
13. Install compressor assembly on car.
14. Evacuate and charge the refrigerant system according to directions in 1B.



1—12 O'CLOCK REFERENCE POSITION
2—CYLINDER-TO-HEAD O-RING INSTALLED INSTALLED ON FRONT OF CYLINDER
3—DISCHARGE CROSS-CAVITY (FRONT)
4—REAR HEAD
5—J-21352-A SUPPORT BLOCK

520040-1D2

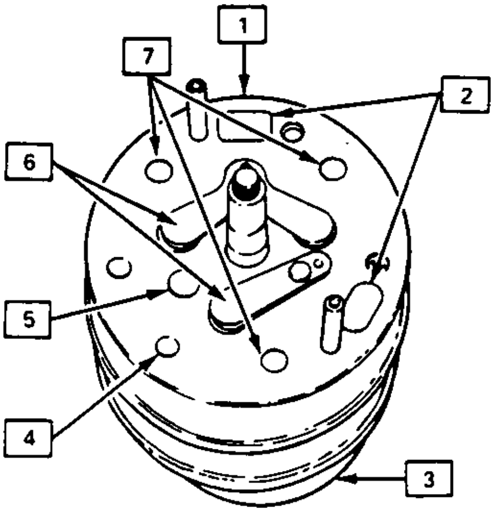
Fig. 39 Cylinder and Shaft Assembly Installed Over Guide Pins Into Rear Head



1—12 O'CLOCK REFERENCE
2—TIPS OF SUCTION REEDS MUST ALL LOCATE ABOVE PECESS IN CYLINDER AT TOP
3—J-21352-A SUPPORT BLOCK
4—O-RING
5—DISCHARGE CROSS-OVER OPENING

520041-1D2

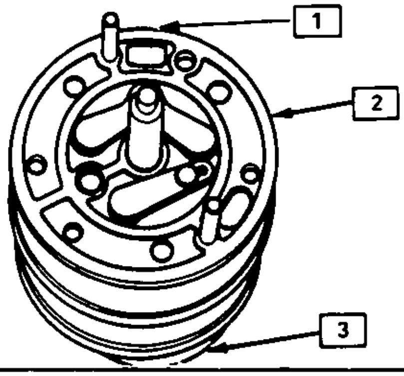
Fig. 40 Suction Reed Installed On Front of Cylinder



1—12 O'CLOCK REFERENCE
2—SUCTION CROSS-OVER OPENINGS
3—J-21352-A SUPPORT BLOCK
4—THROUGH BOLT HOLES (6)
5—DISCHARGE CROSS-OVER OPENING
6—DISCHARGE VALVE REED RETAINERS
7—SUCTION INTAKE OPENINGS

520042-1D2

Fig. 41 Front Valve Plate Installed and Detail Description



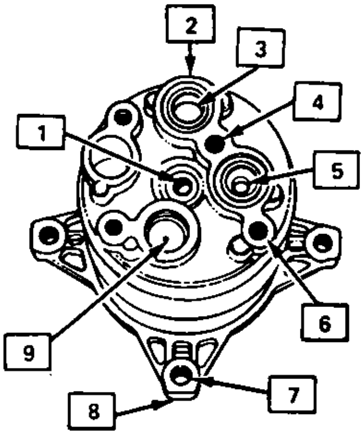
1–12 O'CLOCK REFERENCE

2–HEAD GASKET

3–J-21342-A SUPPORT BLOCK

520043-1D2

Fig. 42 Head Gasket Assembled On Front Valve Plate



1–HIGH PRESSURE RELIEF VALVE OPENING

2–12 O'CLOCK REFERENCE

3–SUCTION PORT

4–HOLE THREAD SIZE M10 x 1.5-6H

5–DISCHARGE PORT

6–HOLE THREAD SIZE M8 x 1.25-6H

7–HOLE THREAD SIZE M10 x 1.5-6H

8–6 O'CLOCK REFERENCE

9–PRESSURE BLEED HOLE IN HIGH PRESSURE SWITCH CAVITY

520044-1D2

Fig. 43 Installation of Compressor Front Head

COMPRESSOR CYLINDER AND SHAFT

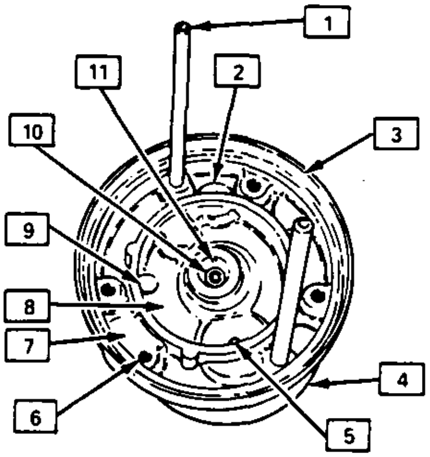
↔ Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B and remove the compressor from the car. Drain the oil from the compressor into a container, measure and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.
3. Remove the shaft seal parts per previous procedure and discard the old seal parts.
4. Mark the location and note the alignment of the front and rear heads in relation to the compressor cylinder (Fig. 28). This is important for reassembly. Depending on application mounting,

the front head may be rotated 120° clockwise or 120° counterclockwise from the "standard" position (Fig. 2).

5. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.
6. Using a plastic headed hammer and wood block, tap around the edge of the rear head to disengage head from the cylinder. Separate the rear head, head gasket, rear valve plate, suction reed plate and cylinder to rear head O-ring. Discard the head gasket and the O-ring.
7. Using a plastic headed hammer, tap the front head at the mounting locations to disengage the head from the compressor cylinder. Remove the front head, head gasket, front valve plate, suction reed plate and cylinder to front head O-ring. Discard the head gasket and the O-ring.

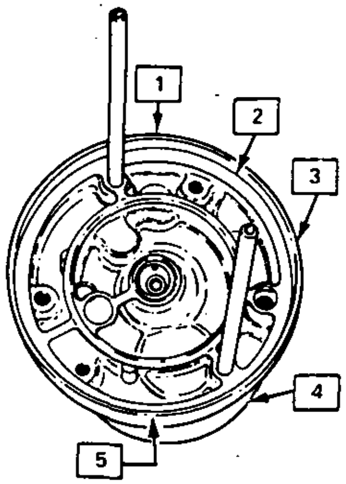
1–J-33016 ASSEMBLY GUIDE PIN (2 REQUIRED)
2–OPENING TO REAR SUCTION PORT (CONSIDER AS 12 O'CLOCK POSITION FOR ASSEMBLY REFERENCE)
3–COMPRESSOR REAR HEAD
4–J-21352-A SUPPORT BLOCK
5–OPENING TO HIGH SIDE PRESSURE SWITCH CAVITY
6–COMPRESSOR THROUGH BOLT HOLES (6)
7–SUCTION PRESSURE (OUTSIDE CAVITY)
8–DISCHARGE PRESSURE (INNER CAVITY)
9–OPENING TO REAR DISCHARGE PORT
10–HIGH PRESSURE RELIEF VALVE
11–DRILLED OPENING INTO HIGH PRESSURE RELIEF VALVE AREA



520045-1D2

Fig. 44 Detail of Compressor Rear Head-Assembly Guide Pins Installed

1–12 O'CLOCK POSITION
2–HEAD GASKET
3–REAR HEAD
4–J-21352-A SUPPORT BLOCK
5–6 O'CLOCK POSITION



520046-1D2

Fig. 45 Head Gasket Installed In Rear Head

1–SUCTION CROSS-OVER OPENING
2–THROUGH BOLT HOLES (6)
3–J-21352-A SUPPORT BLOCK
4–SUCTION PORT (3) (IN VALVE PLATE)
5–DISCHARGE CROSSOVER PORT
6–DISCHARGE PORT (IN VALVE PLATE)

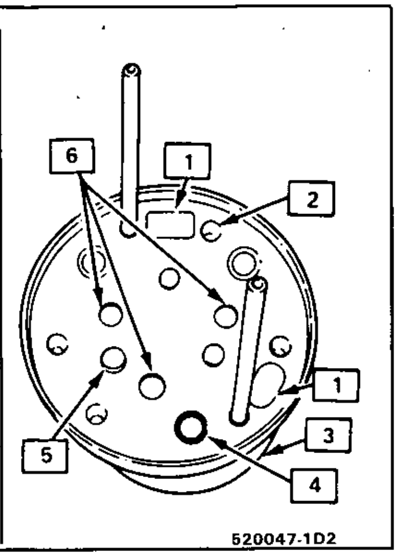


Fig. 46 Rear Valve Plate Installed In Rear Head

1–12 O'CLOCK REFERENCE POSITION
2–SUCTION REED TIPS MUST COVER ALL (3) VALVE PLATE PORTS

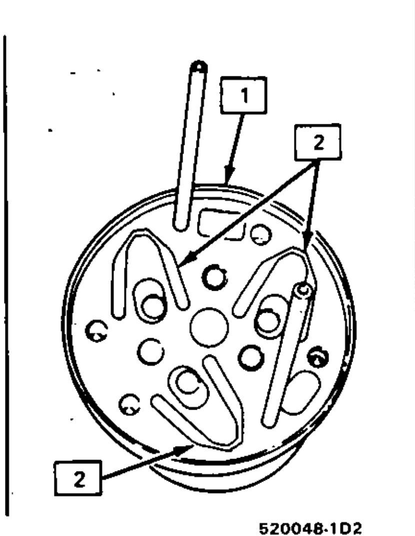
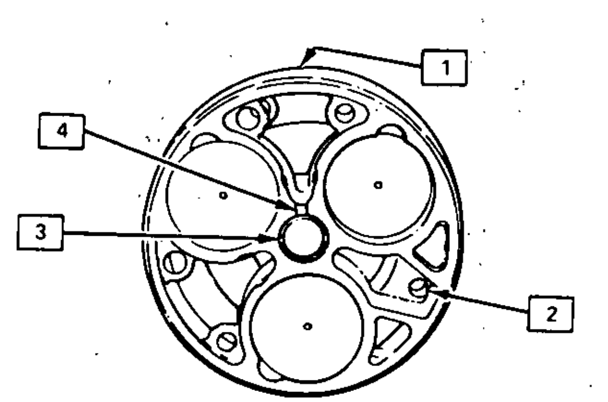


Fig. 47 Suction Reed Plate Properly Installed



1–12 O'CLOCK REF. POSITION
2–DISCHARGE CROSSOVER FRONT TO REAR
3–COMPRESSOR SHAFT
4–OIL HOLE FOR SHAFT LUBRICATION

Fig. 48 Rear View and Detail of DA-6 Cylinder and Shaft Assembly

1–12 O'CLOCK REFERENCE POSITION
2–O-RING IN PLACE ON REAR OF CYLINDER
3–DISCHARGE CROSSOVER FRONT TO REAR
4–SHAFT KEYWAY
5–OIL HOLE FOR SHAFT LUBRICATION

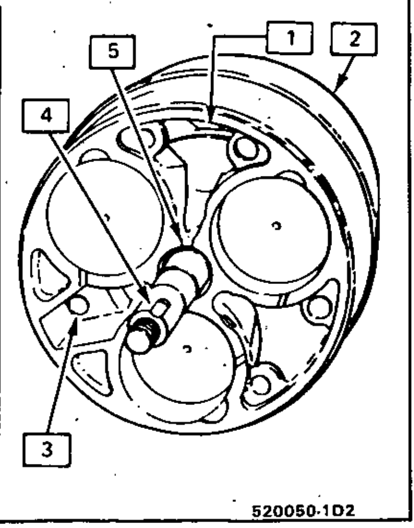


Fig. 49 Front View and Detail of DA-6 Cylinder and Shaft Assembly

8. Inspect the front and rear valve plates, suction reed plates and compressor heads for damage or wear. Replace as necessary.

Install or Connect

1. Place the J-21352-A support block (Fig. 38) on the workbench or suitable flat work surface. Position support block as shown to properly position the rear head for specific detail assembly of the compressor.
2. Place the compressor rear head on the support block as shown in Fig. 44. Install the two (2) J-33016 assembly guide pins into the mounting holes indicated.
3. Assemble the head gasket (Fig. 45) over the guide pins. Gasket must be assembled as shown or the discharge valve reed retainer of rear valve plate will hit the internal segment of the head gasket.
4. Assemble the rear valve plate over the guide pins and lower plate into position (Fig. 46).
5. Assemble the suction reed plate over the guide pins and position as shown (Fig. 47). Be sure all three (3) suction reed tips cover the suction ports in the rear valve plate or the reed plate is improperly assembled. See recess provision in rear of cylinder for suction reed tip movement (Fig. 48).
6. Place compressor front head on holding fixture J-33026 (Fig. 30) and fasten in place with two (2) or three (3) turns of the two (2) thumbscrews.
7. Lubricate a new cylinder to rear head O-ring with clean 525 viscosity refrigerant oil and install O-ring in rear cylinder O-ring groove. The O-ring may be positioned on cylinder as shown in Fig. 30 and then rolled into the O-ring groove but cylinder surface must be clean. (Preferrably cleaned with recommended solvent and blown dry with air.) Oil may also be added to the O-ring seal surface of the rear head to ease assembly.
8. With the O-ring in place on the rear of the cylinder, remove the cylinder and shaft assembly from the front head and assemble over the guide pins using the hole locations indicated in Fig. 49.

   Carefully lower the assembly over the guide pins to the rear head (Fig. 50).

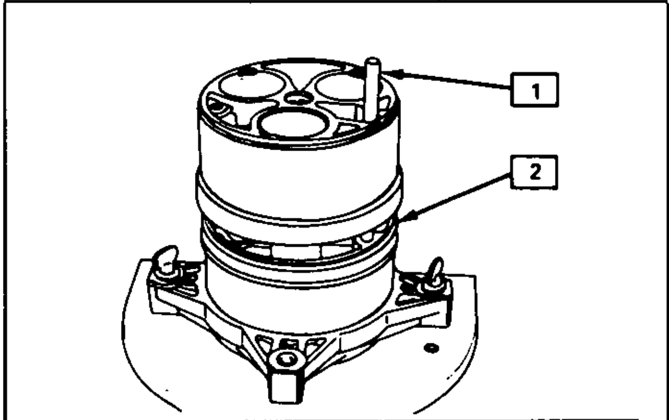


Fig. 50 Cylinder Alignment Rod Through Cylinder Halves

9. Using both hands, press the cylinder and shaft assembly down into the rear head.
10. Lubricate a new cylinder to front head O-ring with clean 525 viscosity refrigerant oil and install O-ring in front cylinder O-ring groove (Fig. 50).
11. Assemble the suction reed plate over the guide pins and position as shown (Fig. 40). Be sure tips of all three suction reeds locate above a recess at top of cylinders or the reed plate is improperly assembled.
12. Assemble the front valve plate over the guide pins and lower plate into position (Fig. 41).
13. Assemble the head gasket over the guide pins (Fig. 42).
14. Remove front head from J-33026 holding fixture and lubricate the O-ring seal surface of the front head with 525 viscosity refrigerant oil to ease assembly.
15. Line up mark on front head (Step 4 of Remove) with the alignment marks on the compressor cylinder and assemble head over guide pins similar and in accordance with assembly detail specified in Fig. 43.
16. Using both hands, press down on the front head to force it over the O-ring at the front of the cylinder.
17. Add new through bolt gaskets to the through bolts and install the bolts into the compressor assembly (Fig. 32). Be sure four (4) of the through bolts thread into the rear head before removing the guide pins. Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in.lbs.) is achieved on all six (6) bolts.
18. Install new shaft seal kit per previous procedure.
19. Add amount of new 525 viscosity refrigerant oil to be added and determined in Step 1 of Remove. Install test plate J-9625-A. Place shaft nut on shaft and rotate compressor shaft several times.
20. Leak test complete compressor assembly according to (Bench-Check) Leak Testing procedure.
21. Remove shaft nut and install clutch parts on compressor according to previous procedure.
22. Install compressor assembly on car.
23. Evacuate and charge the refrigerant system according to directions in 1B.

COMPRESSOR CENTER CYLINDER SEAL

The center cylinder O-ring seal between the cylinder halves is the same O-ring as is used for the seal between the cylinder ends and the front and rear heads.

Should a leak occur at the center cylinder location, the two (2) cylinder halves of the cylinder and shaft assembly may be separated sufficiently to replace the O-ring (approximately 1/2 - 5/8").

1. Disassemble the compressor per previous procedure for Cylinder and Shaft Assembly replacement and remove all parts assembled to the Cylinder and Shaft Assembly.
2. Using a wood or plastic block and plastic headed hammer, tap around the rear cylinder to separate the two (2) cylinder sections and remove the center cylinder O-ring.

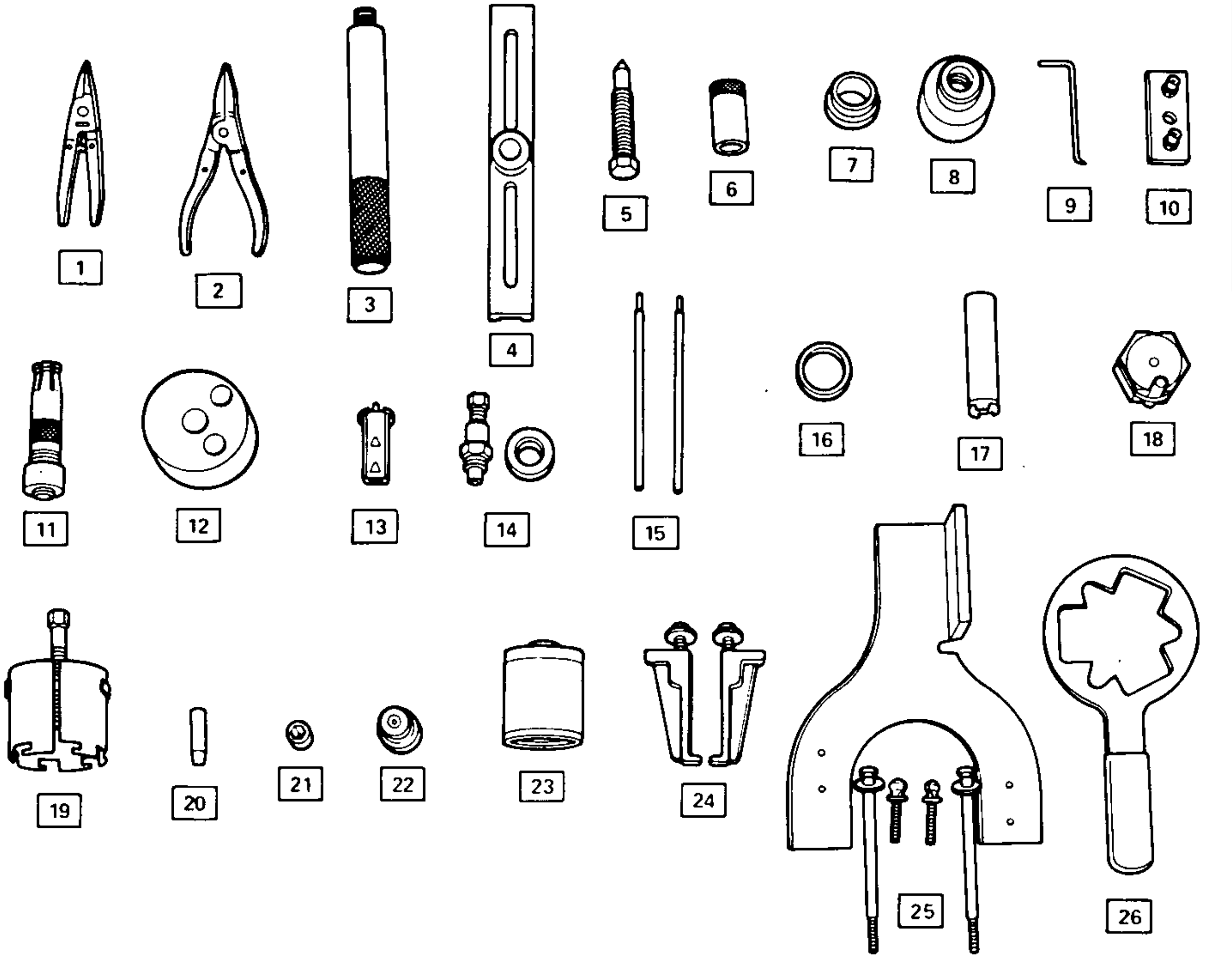
   Depending on piston position, a piston may pull out of a cylinder bore but with recommended alignment and reasonable care in rejoining the cylinder halves, no damage will occur to the piston or piston ring and the piston will re-enter the cylinder bore "in-line."
3. Check to be sure the small O-ring at the discharge crossover location is in place. It may stick to the front half or remain in the recessed location in the rear half. The O-ring may be reused but, if lost, a new cylinder crossover O-ring must be installed to form a seal between the two cylinder halves.
4. Fasten the front head in the J-33026 holding fixture (Fig. 15) and insert the cylinder and shaft assembly into the front head shaft end down.
5. Lubricate the new center cylinder O-ring, O-ring groove of the front cylinder and the O-ring seal surface of the rear cylinder half with clean 525 viscosity refrigerant oil to facilitate assembly. Assemble the O-ring to the center cylinder O-ring groove.
6. Check to see that the discharge crossover O-ring is still in place and insert a piece of 5/16" diameter drill rod or smooth 5/16" diameter drill shank through the discharge crossover passage in both cylinder halves to align the cylinder. For proper piston to cylinder bore alignment the two halves must align.
7. Using both hands, carefully press the cylinder halves together and remove the drill or drill rod used for alignment.

   If sufficient force cannot be applied to force the cylinder halves together supported in the holding fixture, remove the cylinder and shaft assembly and place the rear of the assembly on a clean flat surface. Apply pressure of both hands to force the cylinder together.
8. Assemble the compressor per previous Cylinder and Shaft Replacement procedure.

COMPRESSOR 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 or hoses equipped with valve depressors. Suction port (low-side) of compressor has large internal opening. Discharge port (high-side) has smaller internal opening into compressor (Fig. 3).
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, rear head switch location, compressor front and rear head seals, center cylinder seal, through bolt head gaskets 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. If valve depressor-type hoses are used, loosen hose conections at gage manifold to release vapor pressure from compressor.
8. Disconnect both gage adapters J-5420 or hoses from the test plate J-9625-A.
9. Add 3 oz. new 525 viscosity refrigerant oil to the compressor assembly. 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 insure 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 or depressor-type hose 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 J-33026 holding fixture and mount the compressor in a vise so that the compressor will be in a horizontal position and the shaft can be turned with a wrench.
15. Using a wrench, rotate the compressor crankshaft or drive plate hub ten (10) 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 690 kPa (100 psi) or above. A pressure reading of less than 620 kPa (90 psi) 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 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 5403	SNAP RING PLIERS
2–J 6083	SNAP RING PLIERS
3–J 8092	DRIVER HANDLE
4–J 8433-1	PULLER BAR
5–J 8433-3	FORCING SCREW
6–J 9393-A	SEAL SEAT INSTALLER
7–J 9398	BEARING REMOVER
8–J 9481-A	BEARING INSTALLER
9–J 9553-01	"O" RING REMOVER
10–J 9625-A	PRESSURE TESTING CONNECTOR
11–J 23128-A	SEAL-SEAT-REMOVER & INSTALLER
12–J 21352-A	SUPPORT BLOCK
13–J 33011	"O" RING INSTALLER
14–J 33013	HUB & DRIVE PLATE REMOVER AND INSTALLER
15–J 33016	CYLINDER ALIGNMENT RODS
16–J 33017	PULLEY & BEARING ASSEMBLY INSTALLER
17–J 33018	SEAL ASSEMBLY REMOVER & INSTALLER
18–J 33019	BEARING STAKING TOOL
19–J 33020	PULLEY PULLER
20–J 34614	SHAFT SEAL PROTECTOR
21–J 33022	SHAFT NUT SOCKET
22–J 33023	PULLER PILOT
23–J 33024	CLUTCH COIL INSTALLER ADAPTER
24–J 33025	CLUTCH COIL PULLER LEGS
25–J 33026	COMPRESSOR HOLDING FIXTURE
26–J 33027	CLUTCH HUB HOLDING TOOL

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Fig. 51 DA-6 Compressor Overhaul - Special Tools

SECTION 1D3

V5 AIR CONDITIONING COMPRESSOR OVERHAUL

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

CONTENTS

GENERAL DESCRIPTION

Vehicles using the V5 compressor (Fig. 1) may have differences between installations in the mounting brackets, drive systems, pulleys, connections, and system capacities. Basic overhaul procedures are similar between compressors used on different vehicles.

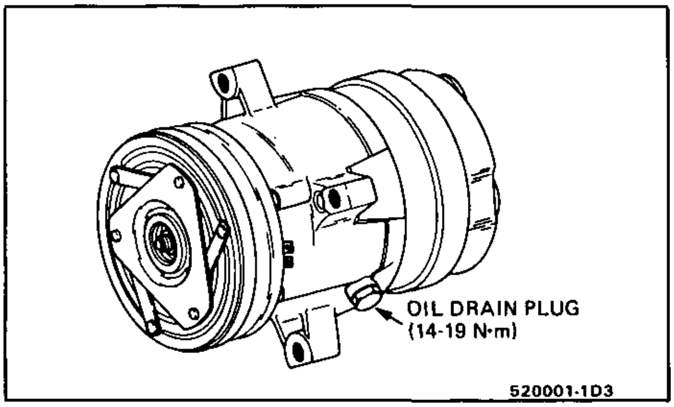


Fig. 1 V5 Compressor, V-Groove Pulley & Standard Mounting

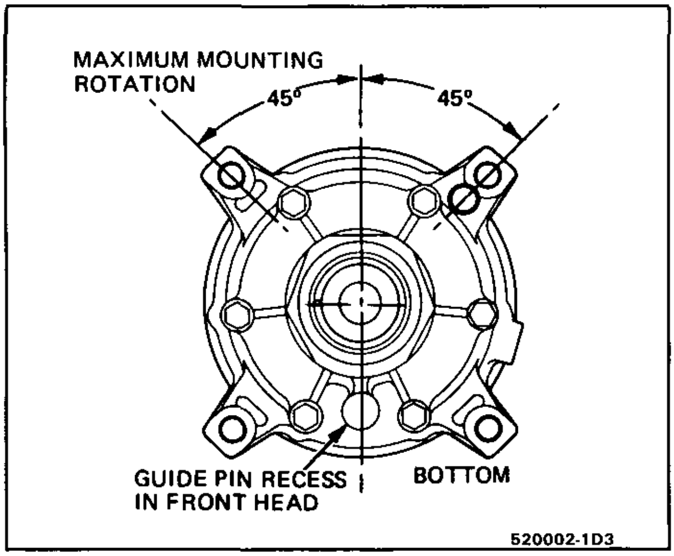


Fig. 2 V5 Compressor Front Head Orientation

When servicing the compressor, keep dirt and foreign material from getting on or into the compressor parts and system. Clean tools and a clean work area are important for proper service. The compressor connections and the outside of the compressor should be cleaned before any "on car" repairs, or before removal of the compressor. The parts must be kept clean at all times and any parts to be reassembled should be cleaned with Trichloroethane, naptha, stoddard solvent, kerosene or equivalent solvent and dried with dry air. Use only lint free cloths to wipe parts.

The operations described below are based on bench overhaul with the compressor removed from the car, except as noted. They have been prepared in order of accessibility of the components. When a compressor is removed from the car for servicing, the amount of oil remaining in the compressor should be drained and measured. This oil should then be discarded and new 525 viscosity refrigerant oil added to the compressor (see "Refrigerant Oil" Distribution in Section 1B).

NOTICE: It is important that the oil drain plug (Figure 1) be removed and the oil drained thru the plug opening to insure complete draining of oil from the compressor.

V5 COMPRESSOR - THEORY OF OPERATION

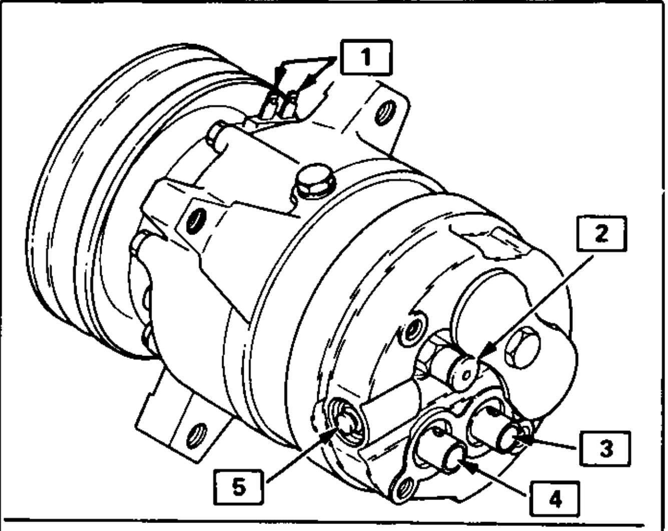
The V5 is a variable displacement compressor that can match the automotive air conditioning demand under all conditions without cycling. The basic compressor mechanism is a variable angle wobble-plate with five axially oriented cylinders. The center of control of the compressor displacement is a bellows actuated control valve located in the rear head of the compressor that senses compressor suction pressure. The wobble-plate angle and compressor displacement are controlled by the crankcase-suction pressure differential. When the A/C capacity demand is high, the suction pressure will be above the control point; the valve will maintain a bleed from crankcase to suction; no crankcase-suction pressure differential; and the compressor will have maximum displacement. When the A/C capacity demand is lower and the suction pressure reaches the control point, the valve will bleed discharge gas into the crankcase and close off a passage from the crankcase to the suction plenum. The angle of the wobble-plate is controlled by a force balance on the five pistons. A slight elevation of the crankcase-suction pressure differential creates total force on the pistons resulting in a movement about the wobble-plate pivot pin that reduces the plate angle.

The compressor has a unique lubrication system. The crankcase-suction bleed is routed through the rotationg wobble-plate for lubrication of the wobble-plate bearing. The rotation acts as an oil separator, which removes some of the oil from the crankcase-suction bleed, rerouting it to the crankcase where it can lubricate the compressor mechanism.

Up to 4 oz. of oil can collect in the crankcase. Therefore, it is important when replacing a compressor that the oil in the old compressor crankcase be drained thru the drain plug and measured (discard after recording amount).

All replacement compressors will be shipped with 8 oz. of oil in the crankcase, the oil must be drained and retained. Then replace the oil in the same amount as previously recorded from the old compressor.

SERVICE PROCEDURES



1—CLUTCH COIL TERMINALS

2—HIGH PRESSURE RELIEF VALVE

3—HIGH SIDE LOW PRESSURE SWITCH

4—HIGH SIDE CUT-OFF SWITCH

5—COMPRESSOR CONTROL VALVE

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Fig. 3 V5 Compressor Rear Head Details

MINOR V5 COMPRESSOR REPAIR

Illustrations used in the following operations show the compressor removed from the car for easier viewing.

When servicing the compressor, remove only the parts that preliminary diagnosis show in need of service.

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

COMPRESSOR CLUTCH PLATE AND HUB ASSEMBLY

←→ Remove or Disconnect

1. Clamp the holding fixture J-34992 in a vise and attach compressor to holding fixture with thumb screws J-34992-1 (Fig. 6).
2. Keep the clutch hub and drive plate assembly from turning by using the clutch hub holding tool J-33027. Remove the shaft nut using shaft nut socket J-33022 (Fig. 6).
3. Thread the Clutch Plate and Hub Assembly Remover J-33013 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 (Fig. 7).
4. Remove the shaft key and retain for reassembly.

→← Install or Connect

1. Install the shaft key into the hub key groove (Fig. 8). Allow the key to project approximately 3.2mm (1/8") out of the keyway. The shaft key is curved slightly to provide an interference fit in the hub key groove.
2. Be sure the frictional surface of the clutch plate and the clutch rotor are clean before installing the clutch plate and hub assembly.

1–SHAFT NUT
2–CLUTCH DRIVER
3–ROTOR BEARING RETAINER
4–PULLEY BEARING
5–PULLEY ROTOR
6–CLUTCH COIL ASM.
7–SHAFT SEAL PARTS
8–THROUGH BOLTS
9–FRONT HEAD
10–FRONT HEAD TO CYLINDER O-RING
11–CYLINDER SHAFT AND GUIDE PIN ASM.
12–REAR HEAD TO CYLINDER O-RING
13–SUCTION REED
14–VALVE PLATE
15–HEAD GASKET
16–REAR HEAD
17–COMPRESSOR CONTROL VALVE ASM.
18–SYSTEM CONTROL SWITCHES
19–HIGH PRESSURE RELIEF VALVE

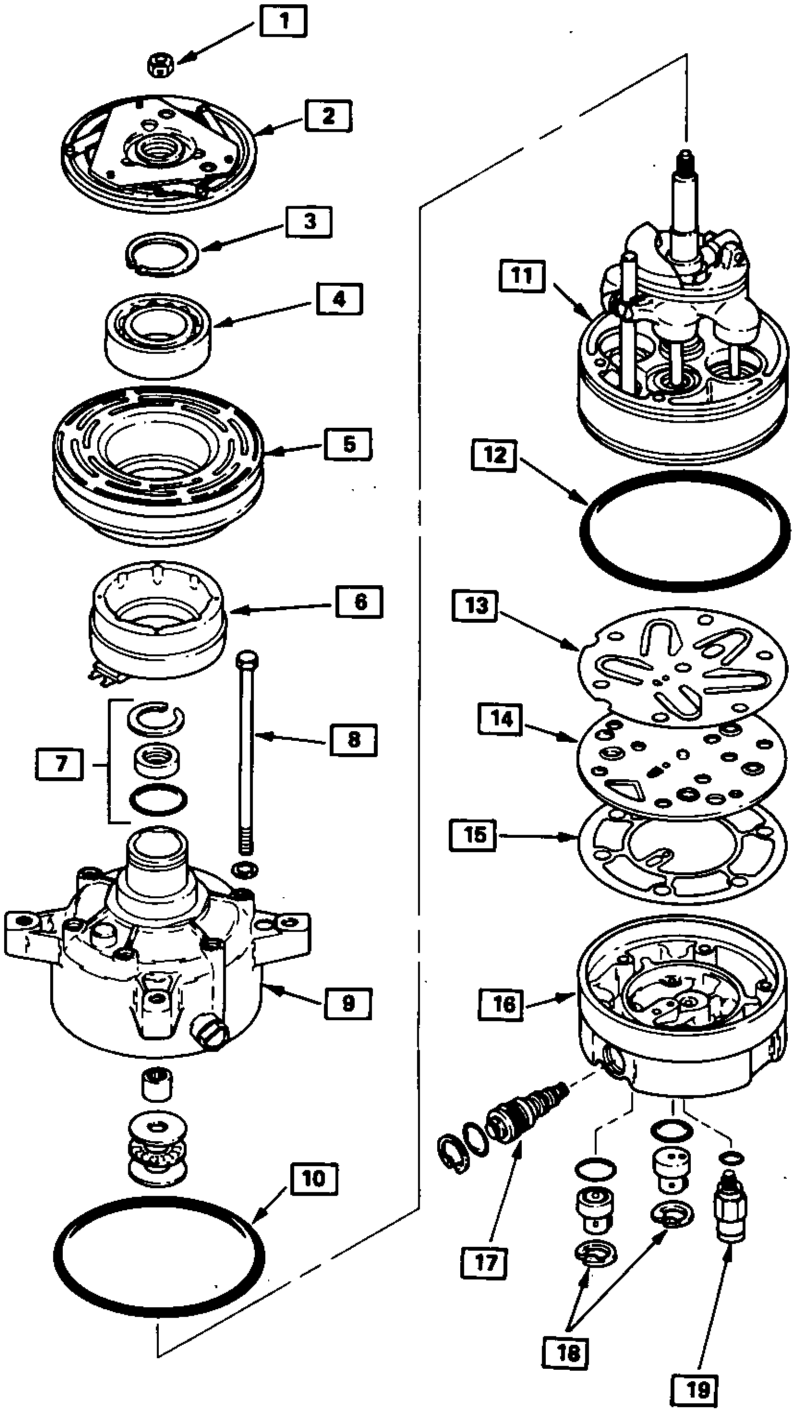
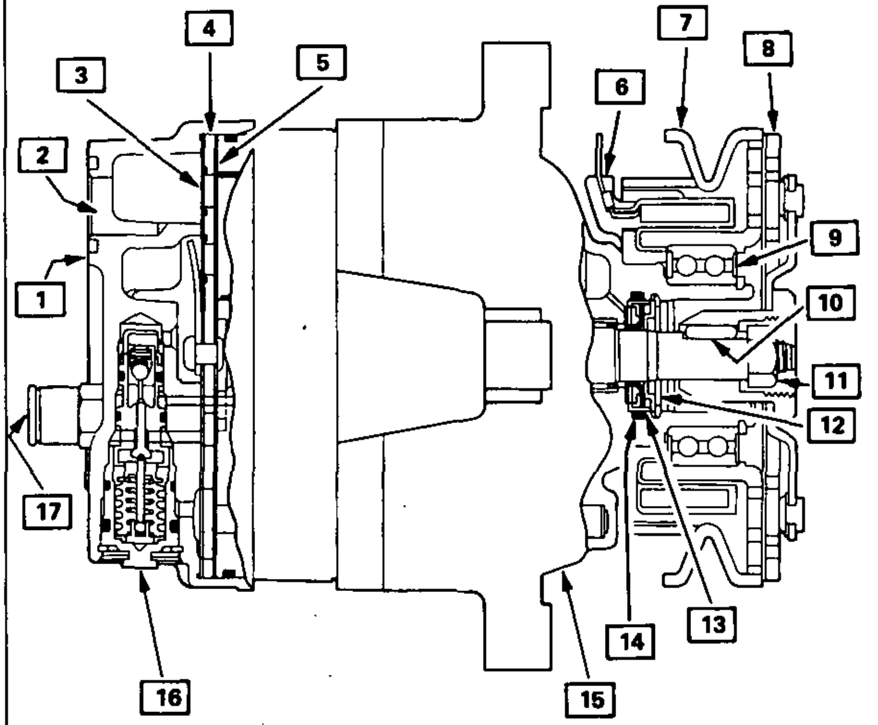


Fig. 4 V5 Compressor Components - Disassembled View



1–REAR HEAD
2–SUCTION PORT
3–REAR HEAD GASKET
4–VALVE PLATE
5–SUCTION REED PLATE
6–CLUTCH COIL
7–PULLEY
8–DRIVE PLATE
9–PULLEY BEARING
10–SHAFT KEY
11–SHAFT NUT
12–FRONT SEAL RETAINER
13–FRONT SEAL
14–FRONT SEAL "O"RING
15–FRONT HEAD
16–COMPRESSOR CONTROL VALVE
17–HIGH PRESSURE RELIEF VALVE

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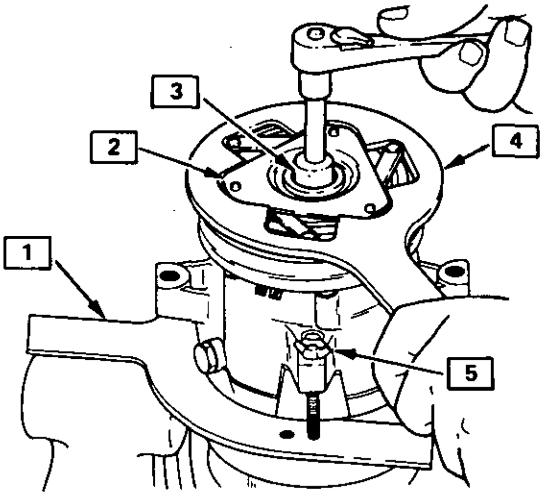
Fig. 5 V5 Compressor - Cross Section



1–J-34992 COMPRESSOR HOLDING FIXTURE

2–CLUTCH PLATE AND HUB ASM.

3–J-33022 NUT SOCKET

4–J-33027 CLUTCH HUB HOLDING TOOL

5–J-34992-1 THUMB SCREW

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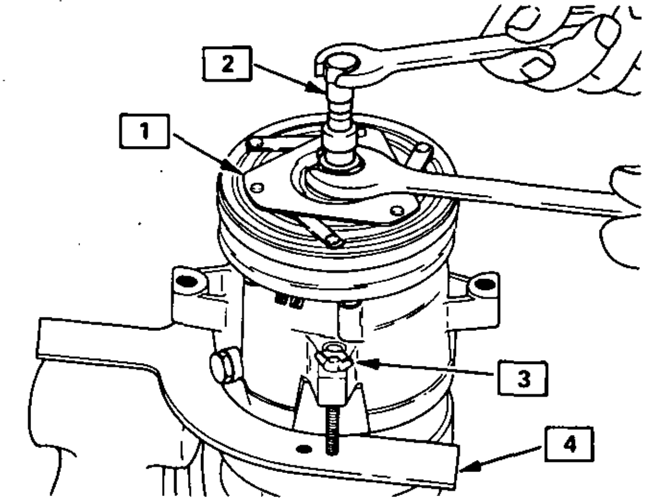
Fig. 6 Removing Shaft Nut



1–CLUTCH PLATE AND HUB ASSEMBLY

2–J-33013 HUB AND CLUTCH DRIVE PLATE ASSEMBLY REMOVER

3–J-34992-1 THUMB SCREW

4–J-34992 HOLDING FIXTURE

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Fig. 7 Clutch Plate and Hub Assembly Removal

3. Align the shaft key with the shaft keyway and place the clutch plate and the hub assembly onto the compressor shaft.

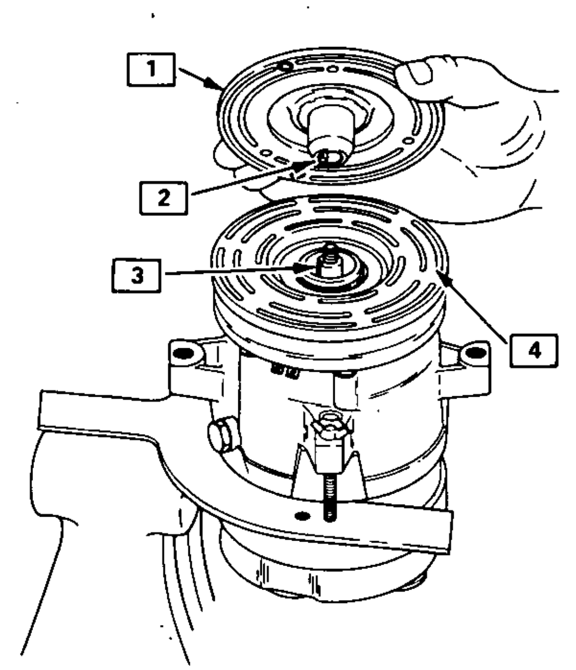
   NOTICE: Do not drive or pound on the clutch hub or shaft. Internal damage to compressor may result.

4. Remove the J-33013 remover - installer center screw and reverse the body direction on the center screw as shown in Fig. 9.
5. Install the clutch plate and hub installer J-33013 with bearing as shown in Fig. 9.
   The body of the J-33013 installer should be backed off sufficiently to allow the center screw to be threaded onto the end of the compressor shaft.
6. Hold the center screw with a wrench. Tighten the hex portion of the Installer J-33013 body to press the hub onto the shaft. Tighten the body several turns, remove the installer and check to see that the shaft key is still in place in the keyway before installing the clutch plate and hub assembly to its final position. The air gap between frictional surfaces of the clutch plate and clutch rotor should be 0.38-0.64mm (.015-.025").
   - If the center screw is threaded **fully** onto the end of the compressor shaft, or if the body of the installer is held and the center screw is rotated, the key will assume the position as shown in Fig. 8 and will break the clutch hub.
7. Remove installer J-33013, check for proper positioning of the shaft key (even or slightly above the clutch hub). Install the shaft nut. Hold the clutch plate and hub assembly with clutch hub holding tool J-33027 and using shaft nut socket J-33022, tighten the nut against the crankshaft shoulder to 11-22 N·m (8-16 ft. lbs.) torque, using a 0-35 N·m (0-25 ft. lbs.) torque wrench.
8. Spin the pulley rotor by hand to see that the rotor is not rubbing the clutch drive plate.

COMPRESSOR CLUTCH ROTOR AND/OR BEARING

↔ Remove or Disconnect

1. Remove the clutch plate and hub assembly as described previously.
2. Remove rotor and bearing assembly retaining ring, using snap ring pliers J-6083 (Fig. 10).
3. Install pulley rotor and bearing puller guide J-33023 to the front head (Fig. 11) 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. 12).
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.



1–CLUTCH PLATE AND HUB
2–SHAFT KEY
3–SHAFT KEYWAY
4–CLUTCH PULLEY ROTOR

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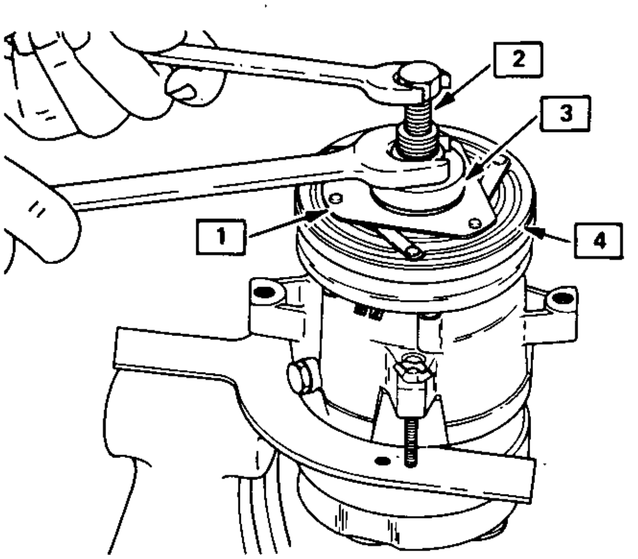
Fig. 8 Shaft Key, Clutch Plate/Hub Installation



1–CLUTCH PALTE AND HUB ASM.

2–J-33013 DRIVE PLATE INSTALLER

3–DRIVE PLATE INSTALLER BEARING

4–AIR GAP (.015"-.025") 0.38-0.64 mm

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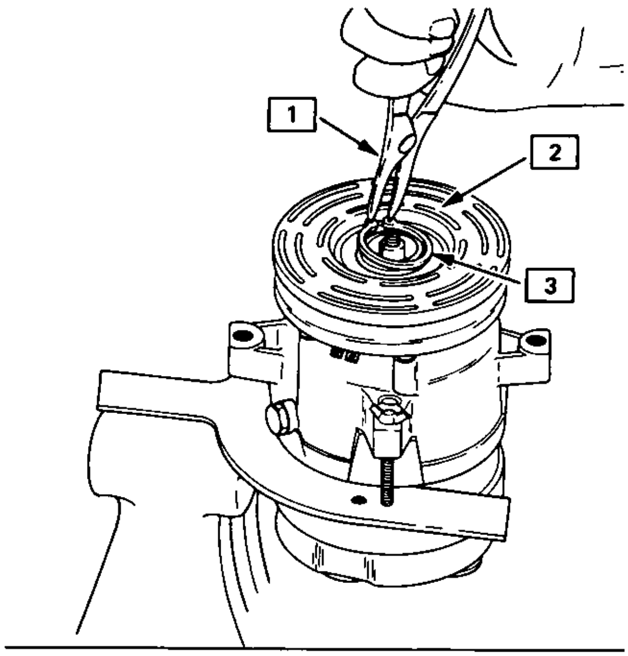
Fig. 9 Installing Clutch Plate & Hub Assembly

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 engaged in the rotor slots, invert the assembly onto a solid flat surface or blocks as shown in Fig. 12.
6. Drive the bearing out of the rotor hub with rotor bearing remover J-9398-A and J-29886 universal handle (Fig. 13).
   It is not necessary to remove the staking in front of the bearing 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.



1–J-6083 PLIERS
2–PULLEY ROTOR
3–RETAINING RING

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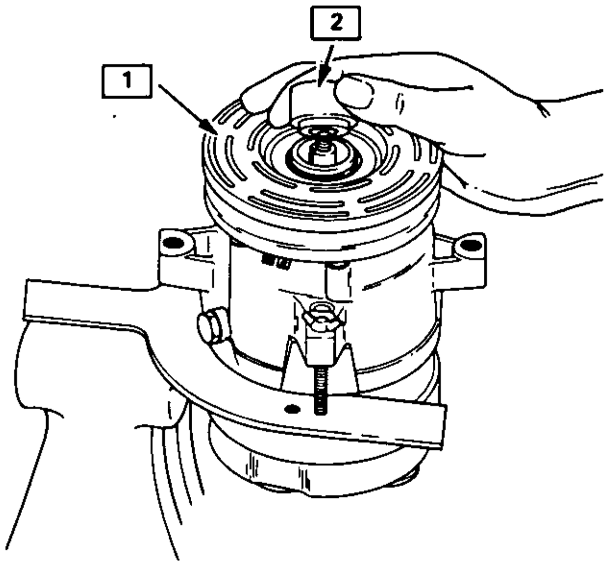
Fig. 10 Removing Pulley Rotor & Bearing Assembly Retaining Ring



1–J-33020 PULLER ENGAGES IN INNER CIRCLE OF SLOTS IN ROTOR

2–J-33023 PULLEY ROTOR AND BEARING PULLER GUIDE

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Fig. 11 Installing Pulley Rotor/Bearing Puller Guide

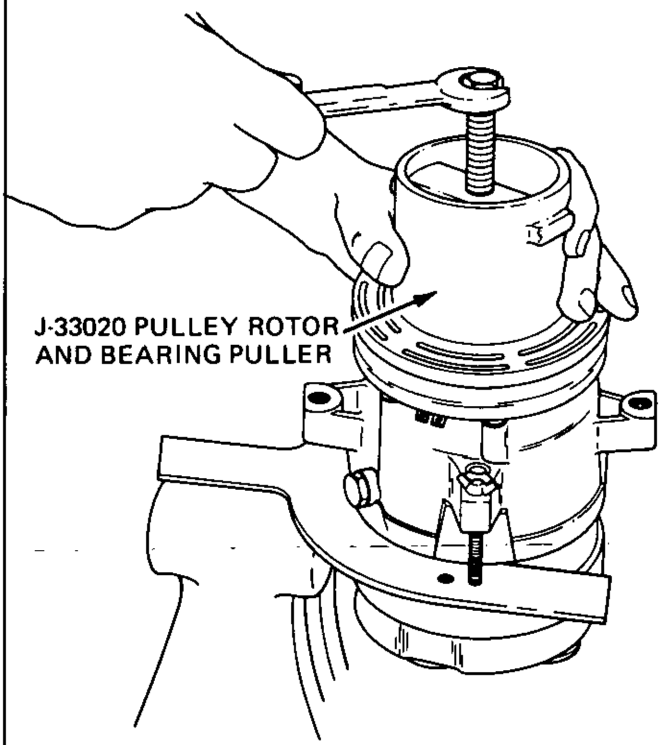

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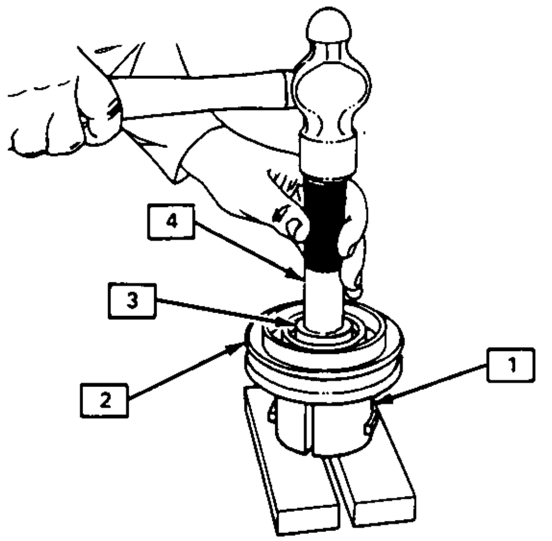
Fig. 12 Removing Pulley Rotor and Bearing Assembly



1–J-33020 (LESS FORCING SCREW) INVERTED AND USED TO SUPPORT HUB OF ROTOR FOR BEARING REMOVAL. PULLER TANGS ENGAGED IN ROTOR SLOTS.

2–PULLEY ROTOR "FACE DOWN"

3–J-9398 BEARING REMOVER

4–J-8092 DRIVER HANDLE

520013-1D2

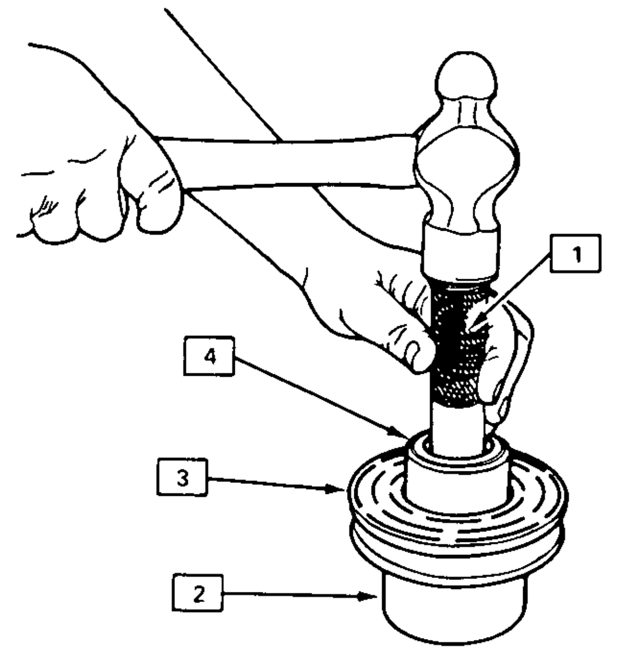
Fig. 13 Pulley Rotor Bearing Removal

→← Install or Connect

1. Place the pulley rotor on the J-35372 support block to fully support the rotor hub during bearing installation (Fig. 14).

NOTICE: 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.

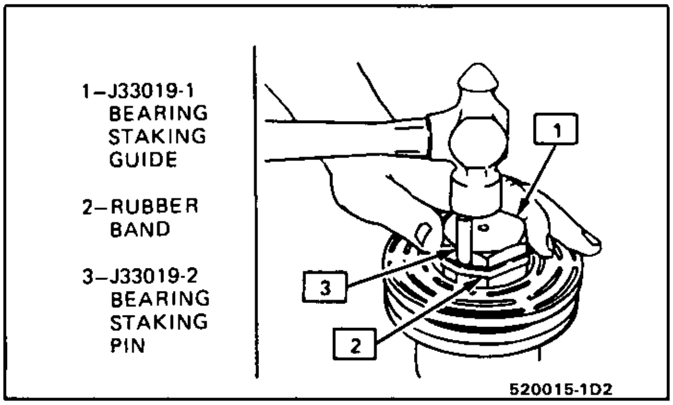
2. Align the new bearing squarely with the hub bore and using puller and bearing installer J-9481-A with universal handle J-29886, drive the bearing fully into the hub (Fig. 14). The installer will apply force to the outer race of the bearing if used as shown.
3. Place bearing staking guide J-33019-1 and bearing staking pin J-33019-2 in the hub bore as shown in Fig. 15. Shift the rotor and bearing assembly on the J-35372 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 (Fig. 15), and the stake pin should be properly positioned in the guide after each impact on the pin.
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.
   The stake metal should not contact the outer race of the bearing to prevent the possibility of distorting the outer race. Stake three (3) places 120° apart as shown in Fig. 16.
5. With the compressor mounted to the J-33026 holding fixture, position the rotor and bearing assembly on the front head (Fig. 17).
6. Position the J-33017 pulley rotor and bearing installer and J-33023 puller pilot directly over the inner race of the bearing (Fig. 17).



1–J-8092 DRIVER HANDLE
2–J-35372 SUPPORT BLOCK
3–PULLEY ROTOR
4–J-9481-A BEARING INSTALLER

520032-1D3

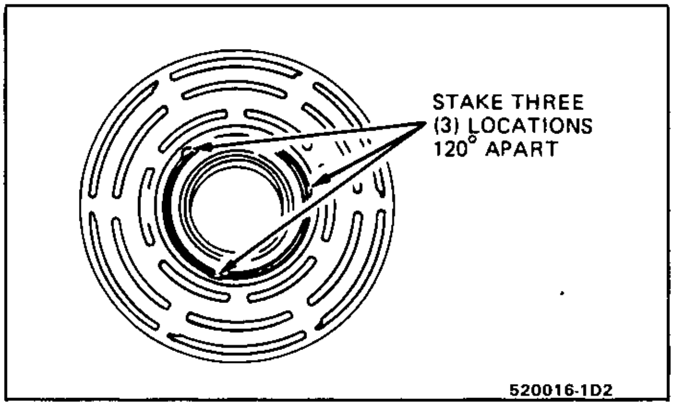
Fig. 14 Installing Pulley Rotor Bearing



1–J33019-1 BEARING STAKING GUIDE
2–RUBBER BAND
3–J33019-2 BEARING STAKING PIN

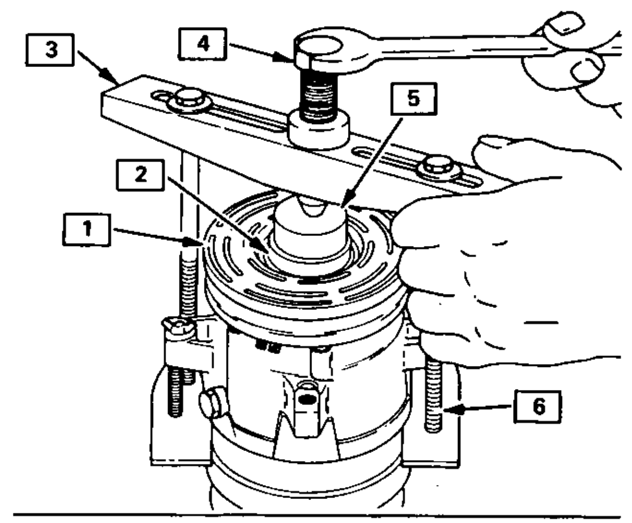
520015-1D2

Fig. 15 Staking Bearing In Rotor Hub Bore



520016-1D2

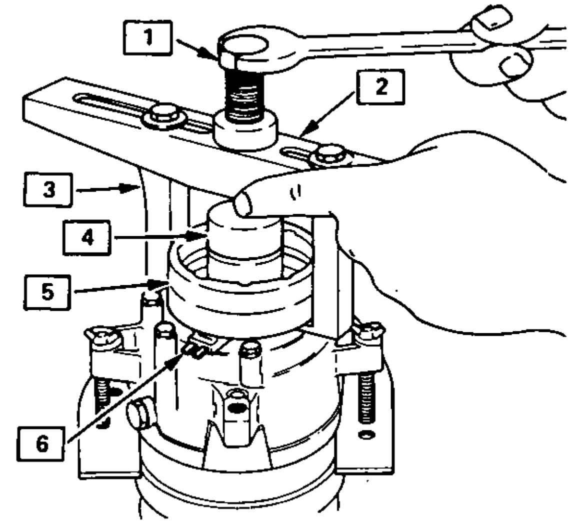
Fig. 16 Bearing Staked In Place



1–PULLEY ROTOR
2–J-33017 PULLEY ROTOR AND BEARING INSTALLER
3–J-8433-1 PULLER BAR
4–J-8433-3 FORCING SCREW
5–J-33023 PULLER PILOT
6–J-34992 COMPRESSOR HOLDING FIXTURE

520013-1D3

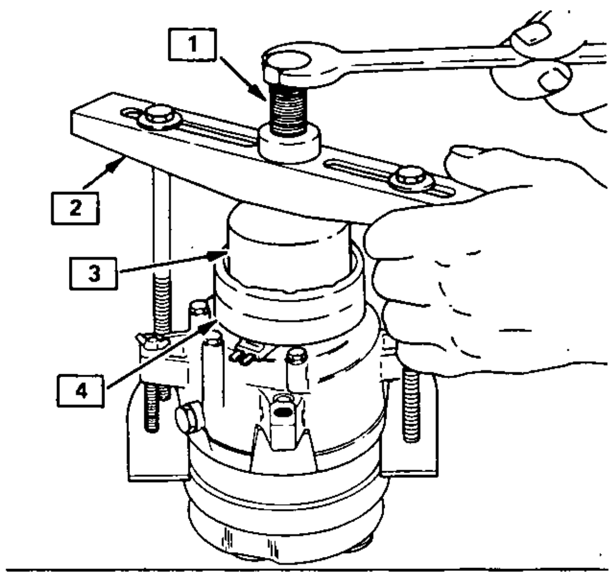
Fig. 17 Installing Pulley Rotor and Bearing Assembly



1–J-8433 SCREW
2–J-8433-1 PULLER CROSS BAR
3–J-33025 PULLER LEG
4–J-33023 PULLER PILOT
5–CLUTCH COIL ASSEMBLY
6–MARK COIL TERMINAL LOCATION ON HEAD

520014-1D3

Fig. 18 Clutch Coil Assembly Removal



1—J-8433-3 SCREW

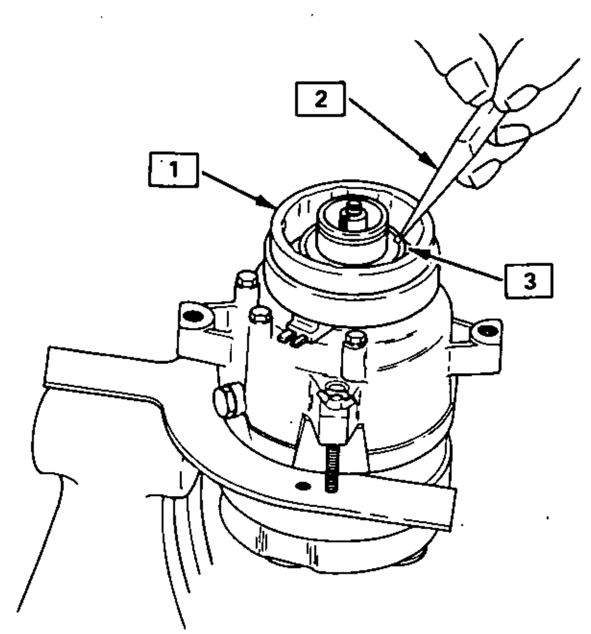
2—J-8433-1 PULLER CROSS BAR

3—J-33024 CLUTCH COIL ASSEMBLY

4—CLUTCH COIL ASSEMBLY

520015-1D3

Fig. 19 Installing Clutch Coil Assembly



1—CLUTCH COIL
2—DRIFT PUNCH
3—STAKE IN FRONT
HEAD (3 PLACES)

520016-1D3

Fig. 20 Staking Clutch Coil To Front Head

7. Position puller crossbar J-8433-1 on the puller pilot J-33023 and assemble the two J-34992-2 through bolts and washers through the puller bar slots and thread them into the J-34992 holding fixture (Fig. 17). The thread of the through bolts should engage the full thickness of the holding fixture.
8. Tighten the center screw in the J-8433-1 puller crossbar to force the pulley rotor and bearing assembly onto the compressor front head (Fig. 17). Should the J-33017 pulley rotor and bearing installer slip off direct in-line contact with the inner race of the bearing, loosen the J-8433-1 center forcing screw and realign the installer and pilot so that the J-33017 installer will properly clear the front head.
9. Install rotor and bearing assembly retainer ring, using snap ring pliers J-6083 (Fig. 10).
10. Reinstall clutch plate and hub assembly as described previously.

COMPRESSOR CLUTCH COIL

↔ Remove or Disconnect

1. Perform Steps 1 through 4 of "Clutch Rotor and/or Bearings" removal procedure. Mark clutch coil terminal location on compressor front head.
2. Install J-33023 puller pilot on front head of compressor (Fig. 18). Also install J-8433-1 puller crossbar with J-33025 puller legs as shown in Fig. 18.
3. Tighten J-8433-3 forcing screw against the puller pilot to remove the clutch coil.

→← Install or Connect

1. Place the clutch coil assembly on the front head with the terminals positioned at the "marked" location.
2. Place the J-33024 clutch coil installer over the internal opening of the clutch coil housing and align installer with the compressor front head.
3. Center the J-8433-1 puller crossbar in the countersunk center hole of the J-33024 clutch coil installer. Install the J-34992-2 through bolts and washers through the crossbar slots and thread them into the holding fixture J-34992 to full fixture thickness (Fig. 19).
4. Turn the center forcing screw of the J-8433-1 puller crossbar to force the clutch coil onto the front head. Be sure clutch coil and J-33024 installer stay "in-line" during installation.
5. When coil is fully seated on the front head, use a 1/8" diameter drift punch and stake the front head at three (3) places 120° apart (Fig. 20), to ensure clutch coil remaining in position.
   - Stake size should be only one half the area of the punch tip and only approximately 0.28-0.35mm (.010-.015") deep (Fig. 21).
6. Install rotor and bearing assembly and the clutch plate and hub assembly according as described previously.

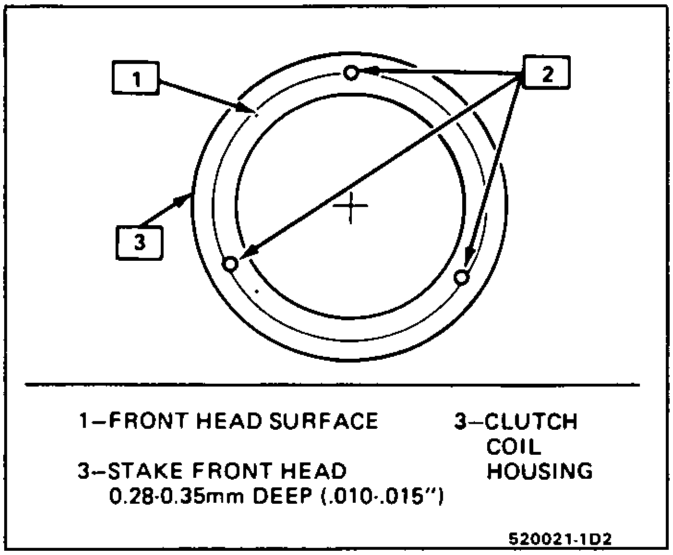


Fig. 21 Details of Stakes In Front Head for Clutch Coil

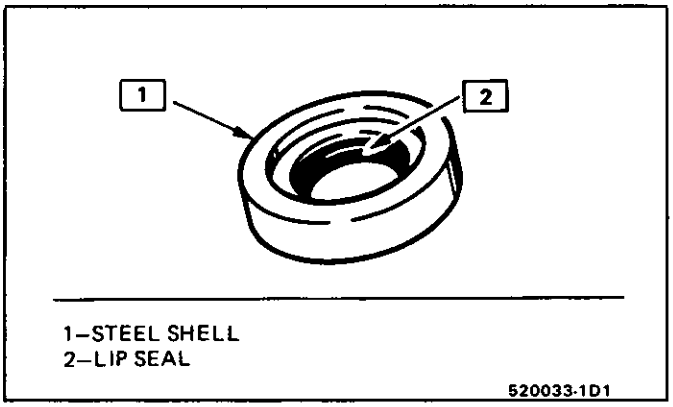


Fig. 22 Compressor Shaft Seal

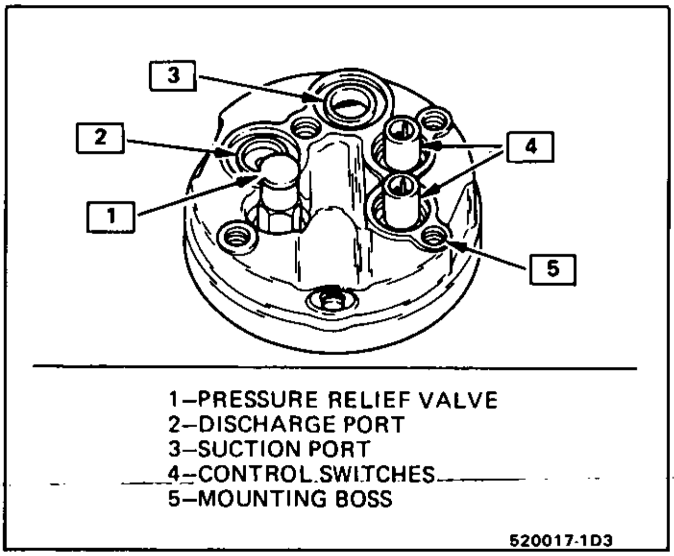


Fig. 23 Compressor and Clutch Assembly - Rear View

MAJOR V5 COMPRESSOR REPAIR PROCEDURES

When replacing the shaft seal assembly (Fig. 22), pressure relief valve or rear head mounted pressure switches (Fig. 23), 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 **rear head** is to be serviced, the refrigerant oil must be measured and replaced. See Section 1B to determine how much oil to add to new assembly.

A clean workbench covered with a sheet of clean paper, and a place (clean trays, etc.) for all parts being removed and replaced is important, as is the use of the proper, clean service tools.

> **NOTICE:** Any attempt to use makeshift or inadequate service tools or equipment may result in damage and/or improper compressor operation.

COMPRESSOR SHAFT SEAL REPLACEMENT

Seal Leak Detection

A shaft seal should not be changed because of small amounts of oil found on an adjacent surface. The seal is designed to leak some oil for lubrication purposes. A shaft seal should be changed only when a large amount of sprayed oil is found, and only after actual refrigerant leakage is found by using an approved leak detection procedure (see "LEAK TESTING THE REFRIGERANT SYSTEM," SECTION 1B).

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

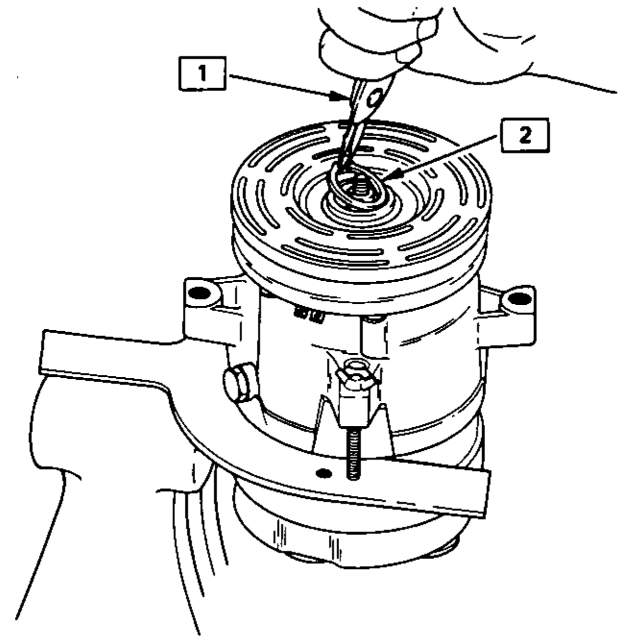
↔ Remove or Disconnect

1. Discharge the refrigerant system according to the directions in 1B.
2. Loosen and reposition compressor in mounting brackets.
3. Remove clutch plate and hub assembly from compressor as described in minor repairs.
4. Remove the shaft seal retainer ring, using snap ring pliers J-5403 (Fig. 24).
5. Thoroughly clean inside of compressor neck area surrounding the shaft, the exposed portion of the seal, the shaft itself and O-ring groove. Any dirt or foreign material getting into compressor may cause damage.
6. 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 (Fig. 25). Discard the seal. The handle should be hand-tightened securely. Do not use a wrench or pliers.
7. Remove and discard the seal O-ring from the compressor neck using O-ring remover J-9553 or J-9553-01 (Fig. 26).

Clean

- Thoroughly clean seal O-ring groove in front head.

8. Recheck the shaft and inside of the compressor neck for dirt or foreign material and be sure these areas are perfectly clean before installing new parts.

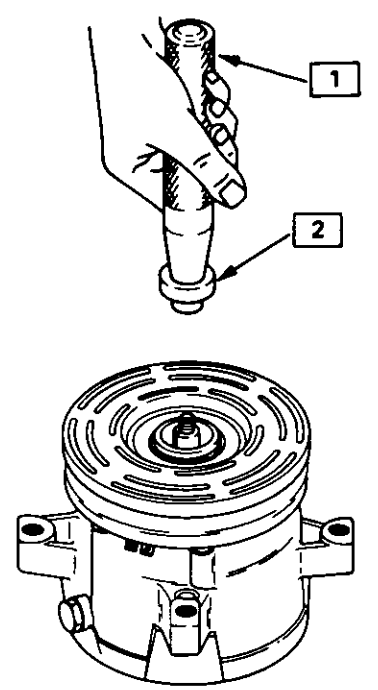


1—J-5403 SNAP RING PLIERS

2—SEAL SEAT RETAINER RING

520018-1D3

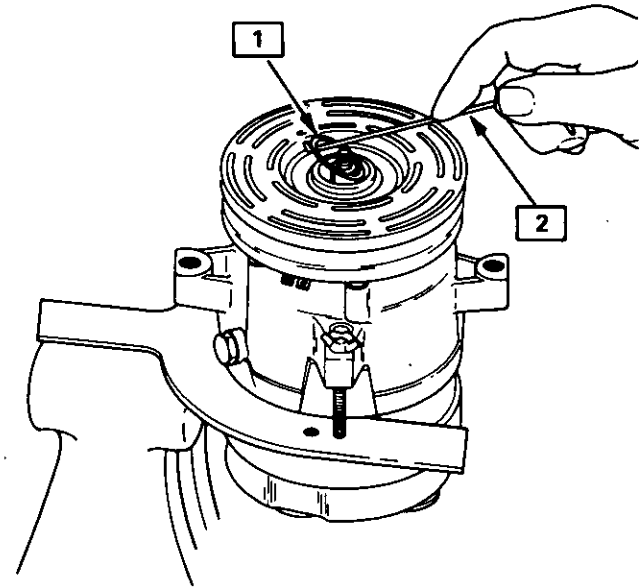
Fig. 24 Removing or Installing Shaft Seal Seat Retaining Ring



1—J-23128-A SEAL SEAT REMOVER AND AND INSTALLER
2—SEAL

520026-1D3

Fig. 25 Removing or Installing Shaft Seal



1—SHAFT SEAL SEAT O-RING

2—J-9553 OR J-9553-01
"O" RING REMOVER

520020-1D3

Fig. 26 Removing Shaft Seal Seat O-Ring

Important

Seals should not be re-used . Always use a new specification service seal kit on rebuild (Fig. 22). Be sure that the seal to be installed is not scratched or damaged in any way. Make sure that the seal is free of lint and dirt that could damage the seal surface or prevent sealing.

Install or Connect

1. Dip the new seal O-ring in clean 525 viscosity refrigerant oil and assemble onto O-ring installer J-33011 (Fig. 26).
2. Insert the O-ring installer J-33011 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 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. Attach the seal to the seal remover and installer J-23128-A and dip the seal in clean 525 viscosity refrigerant oil to coat the seal. Install seal protector J-34614 in the seal, place over shaft and push seal in place with a rotary motion (Fig. 27).
4. Install the new seal retainer ring with its flat side against the seal, using snap-ring pliers J-5403 (Fig. 24). Use the sleeve from seal

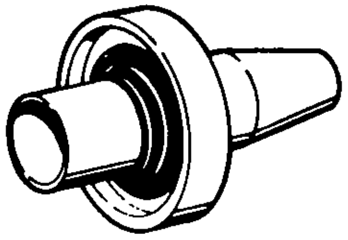


Fig. 27 Lip Seal Installed on Seal Protector

remover-installer J-9393 to press in on the seal retainer ring so that it snaps into its groove.

5. To leak test, install compressor leak test fixture J-9625-A on rear head of compressor and connect gage charging lines. Pressurize suction and high-side of compressor with Refrigerant 12 vapor to drum pressure. Temporarily install the shaft nut and, with the compressor in horizontal position, rotate the compressor shaft in normal direction of rotation several turns by hand. Leak test the seal area and correct any leak found. Remove shaft nut.
6. Remove any excess oil resulting from installing the new seal parts from the shaft and inside the compressor neck.
7. Install the clutch plate and hub assembly as described in minor repair procedures.
8. Reinstall the compressor, belt and tighten bracket.
9. Evacuate and charge the refrigerant system according to directions in Section 1B.

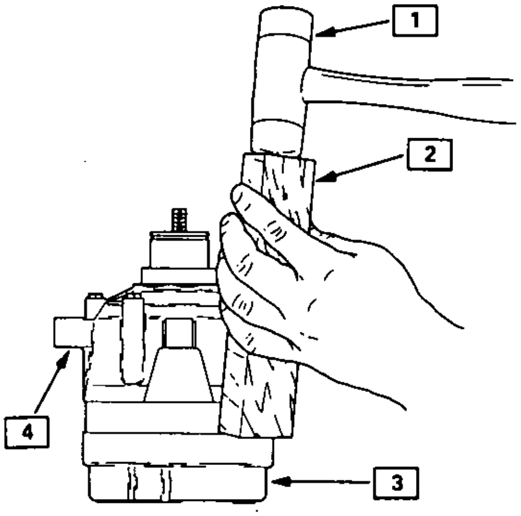
COMPRESSOR PRESSURE RELIEF VALVE

Remove or Disconnect

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Remove old pressure relief valve (Fig. 23).

Install or Connect

1. Lubricate O-ring of new pressure relief valve and O-ring assembly with new 525 viscosity refrigerant oil. Install new valve and torque in place, 7.5-10.5 N·m (5.5-7.7 lbs.ft.).
2. Evacuate and recharge the system.
3. Leak test per system procedure (Section 1B).



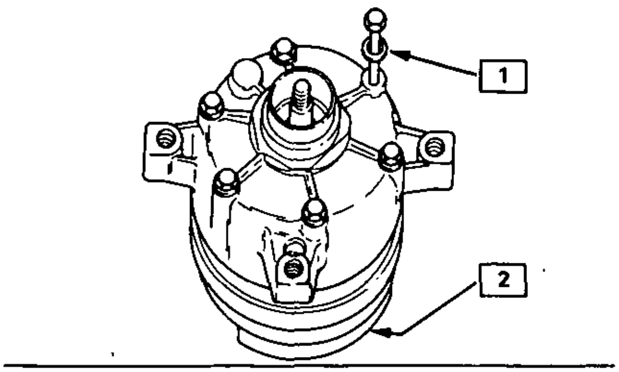
1–PLASTIC HEADED HAMMER

2–WOOD BLOCK

3–REAR HEAD

4–FRONT HEAD

Fig. 28 Tapping Front or Rear Head Free of Cylinder



1–THROUGH BOLT GASKET (6) REQUIRED

2–J-35372

520023-1D3

Fig. 29 Front Head Installed: Thru Bolts and Gaskets In Place

COMPRESSOR HIGH-SIDE HIGH-PRESURE AND HIGH-SIDE LOWER-PRESSURE CUT-OFF SWITCHES

←→ Remove or Disconnect

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Disconnect the electrical connector from the high-pressure cut-off switch in the rear head of the compressor (Fig. 23).
3. Remove the high-pressure cut-off switch retaining ring (Fig. 23), using J-5403 internal snap ring pliers.
4. Remove high-pressure cut-off switch from compressor.
5. Remove old O-ring seal from switch cavity using J-9553 or J-9553-01 O-ring removal tool or equivalent.

   If existing high-pressure cut-off switch will be reinstalled in compressor, a new O-ring seal must be used and preferrably 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 refrigerant oil into groove in switch cavity.
2. Lubricate the high-pressure cut-off switch housing with clean refrigerant oil and carefully insert switch into switch cavity until switch bottoms in cavity.
3. Using J-5403 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. Leak test per procedure.

COMPRESSOR CONTROL VALVE ASSEMBLY

←→ Remove or Disconnect

1. "Discharge the Refrigerant System" according to the DISCHARGING, ADDING OIL, EVACUATING AND CHARGING PROCEDURES FOR A/C SYSTEMS in the Air Conditioning Section 1B.
2. Remove control valve retaining ring using J-5403 internal snap ring pliers.
3. Remove control valve assembly.

→← Install or Connect

1. When reassembling control valve, coat O-rings with 525 viscosity refrigeration oil and push in place with thumb pressure.
2. Using J-5403 snap ring pliers, install valve retaining ring with high point of curved sides against valve housing. Be sure retaining ring is properly seated in ring groove. Leak test per procedure.

COMPRESSOR REAR HEAD, HEAD GASKET, REAR VALVE PLATE, SUCTION REED PLATE AND CYLINDER TO REAR HEAD O-RING

←→ Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B and remove the compressor from the car. Drain the oil from the compressor into a container, measure and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.
3. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.
4. Using a wood block and plastic headed hammer, tap around the edge of the rear head to disengage head from the compressor cylinder (Fig. 28).

Separate the rear head, head gasket, rear valve plate, suction reed plate and cylinder to rear head O-ring. Discard the head gasket and the O-ring.

Install or Connect

1. Place rear head on clean flat surface. Position head with control valve at 6 o'clock position.
2. Assemble guide pins in mounting hole at 11 and 5 o'clock.
3. Assemble head gasket over guide pins, with elongated hole at upper left pin (11 o'clock).
4. Assemble the rear valve plate over guide pins with elongated hole at upper left pin. Lower into place.
5. Assemble the suction reed plate over guide pins insuring the position of the elongated hole at upper left pin. Remove guide pin at 5 o'clock.
6. Lubricate a new cylinder to rear head O-ring with clean 525 viscosity refrigerant oil and install O-ring in cylinder O-ring groove. O-ring seal surface of rear head may be oiled to ease assembly.
7. With O-ring in place on rear of cylinder assembly locate relief boss for compressor guide pin at 6 o'clock, directly above hole in the side of the rear head. Carefully lower cylinder and front head assembly over guide pin to rear head.
8. Using both hands, press cylinder and front head assembly down into rear head.
9. Add new through bolt gasket to the through bolts and install the bolts into the compressor assembly (Figure 29). Be sure four (4) of the through bolts thread into the rear head before removing the guide pins. Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in. lbs.) is achieved on all six (6) bolts.
10. Install new shaft seal kit per previous procedure.
11. Add amount of new 525 viscosity refrigerant oil to be added and determined in Step 1 of Remove. Install test plate J-9625-A. Place shaft nut on shaft and rotate compressor shaft several times.
12. Leak test complete compressor assembly according to (Bench-Check) Leak Testing procedure.
13. Remove shaft nut and install clutch parts on compressor according to previous procedure.
14. Install compressor assembly on car.
15. Evacuate and charge the refrigerant system according to directions in 1B.

COMPRESSOR CYLINDER TO FRONT HEAD O-RING

Remove or Disconnect

1. Discharge the refrigerant system according to the directions in Section 1B and remove the compressor from the car. Drain the oil from the compressor into a container, measure and discard the oil.
2. Remove the clutch drive and hub assembly, pulley rotor and bearing assembly and the clutch coil per previous procedure.
3. Remove the shaft seal parts per previous procedure and discard the old seal parts.
4. Remove the six (6) compressor through bolts and gaskets. Discard the gaskets.
5. Using a plastic headed hammer, tap the front head at the mounting locations to disengage the head from the compressor cylinder.

   Remove the front head, and cylinder to front head O-ring. Discard the O-ring.

   Note assembly sequence of thrust washer and bearing for reassembly.

Install or Connect

1. Rest the rear head on support ring. Install one (1) assembly guide pin through 11 o'clock hole. Locate control valve at 6 o'clock.
2. Lubricate a new cylinder to front head O-ring with clean 525 viscosity refrigerant oil and install O-ring in cylinder O-ring groove.
3. Install thrust washers and bearing in same order as removed.
4. Align guide pin recess in front head with guide pin and using both hands, press down on the front head to force it over O-ring on cylinder assembly.
5. Add new through bolt gasket to the through bolts and install the bolts into the compressor assembly. Be sure four (4) of the through bolts thread into the rear head before removing the guide pin. Assemble clamp to holding fixture.

   Alternately tighten the through bolts in progressive torque until a torque of 8-10 N·m (72-84 in. lbs.) is achieved on all six (6) bolts.
6. Install new shaft seal kit per previous procedure.
7. Add amount of new 525 viscosity refrigerant oil to be added as determined in Step 1 of Remove. Install test plate J-9625-A.
8. Leak test complete compressor assembly according to (Bench-Check) Leak testing procedure.
9. Remove shaft nut and install clutch parts on compressor according to previous procedure.
10. Install compressor assembly on car.
11. Evacuate and charge the refrigerant system according to directions in 1B.

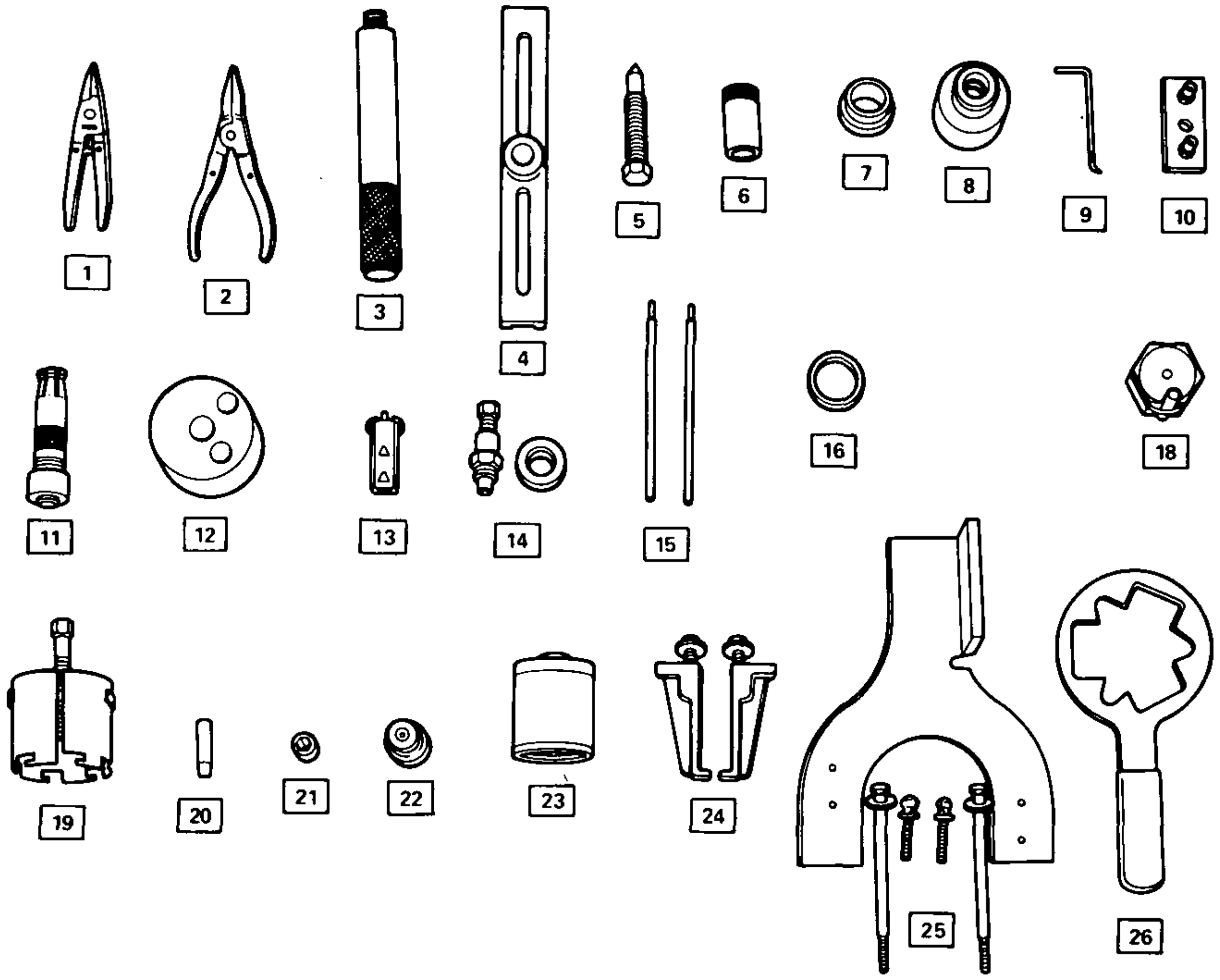
COMPRESSOR LEAK TESTING (EXTERNAL)

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 or hoses equipped with valve depressors. Suction port

(low-side) of compressor has large internal opening. Discharge port (high-side) has smaller internal opening into compressor (Fig. 3).

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, rear head switch location, compressor front and rear head seals, center cylinder seal, through bolt head gaskets 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. If valve depressor-type hoses are used, loosen hose connections at gage manifold to release vapor pressure from compressor.
8. Disconnect both gage adapters J-5420 or hoses from the test plate J-9625-A and remove test plate.



1–J 5403	SNAP RING PLIERS
2–J 6083	SNAP RING PLIERS
3–J 8092	DRIVER HANDLE
4–J 8433-1	PULLER BAR
5–J 8433-3	FORCING SCREW
6–J 9393	SEAL SEAT INSTALLER
7–J 9398-A	BEARING REMOVER
8–J 9481	BEARING INSTALLER
9–J 9553-01	"O" RING REMOVER
10–J 9625	PRESSURE TESTING CONNECTOR
11–J 23128-A	SEAL SEAT REMOVER & INSTALLER
12–J 35372	SUPPORT BLOCK
13–J 33011	"O" RING INSTALLER
14–J 33013	HUB & DRIVE PLATE REMOVER AND INSTALLER
15–J 34993	CYLINDER ALIGNMENT RODS
16–J 33017	PULLEY & BEARING ASSEMBLY INSTALLER
18–J 33019	BEARING STAKING TOOL
19–J 33020	PULLEY PULLER
20–J 34614	SHAFT SEAL PROTECTOR
21–J 33022	SHAFT NUT SOCKET
22–J 33023	PULLER PILOT
23–J 33024	CLUTCH COIL INSTALLER ADAPTER
24–J 33025	CLUTCH COIL PULLER LEGS
25–J 34992	COMPRESSOR HOLDING FIXTURE
26–J 33027	CLUTCH HUB HOLDING TOOL

520024-1D3

Fig. 30 V5 Compressor Overhaul - Special Tools

SECTION 2A

FRAME (CRADLE) AND MOUNTS

CONTENTS

DESCRIPTION

FRAME (CRADLE)

The Fiero body is unitized but, in addition, has a cradle to support the engine, transaxle, rear suspension and other mechanical components.

Unitized construction demands that underbody components be properly aligned to assure correct suspension location. In the event of collision damage, it is important that the underbody be throughly checked and, if necessary, realigned in order to accurately establish proper dimensions.

Since each part adds to the strength of the body, it is essential that proper welding, sealing and rust-proofing methods be used during service. The underbody components should be rust-proofed whenever body repair operations which destroy or damage the original rust-proofing are completed. When rust-proofing critical underbody components, it is essential that a good quality type of air dry primer be used (such as corrosion resistant zinc chromate). Do not use combination type primer-surfacers. There are many tools that may be used to correct collision damage such as frame straightening machines, lighter external pulling tools and standard body jacks.

Refer to Body information at end of this manual for servicing unitized construction bodies.

Body mount provisions are located at each end of the cradle (Figure 1). The body mounts control the motion of the cradle relative to the body and isolate vibration.

ON-CAR SERVICE

UNDERBODY INSPECTION

1. Raise car.
2. Check for obvious floor pan deterioration.
3. Check for loose dirt and dust around the inside of the floor pan reinforcement member access holes. This is the first indication that corrosion may exist in hidden areas, and that repairs may be required before the final cleaning and protective treatment is performed.
4. Ensure that the drain provision in the panels and other components are open.

CRADLE REPAIR

Figure 2

Cars involved in an accident of any nature which might result in a damaged cradle should always be checked for proper cradle alignment in addition to geometry and wheel alignment. Refer to the information at end of this Section for cradle dimension, and Section 3A for front and rear alignment specifications.

The cradle can be removed from the car without removing the engine, or transaxle.

CRADLE REMOVAL

↔ Remove or Disconnect

(Figure 1)

Tools required
- J-28467

CAUTION: If using a twin post hoist place safety stands at the rear most points as shown in Section 0A. If using a single post hoist place two safty stands in the front and two in the rear at the points shown in Section 0A.

1. Engine support fixture.
   - Raise engine enough to take tension off cradle mounts.
2. Hoist vehicle.
3. Exhaust pipe bolts at manifold.
4. Rear wheels and tire assemblies.
5. Both lower control arms at knuckle.
6. Both toe-link rods at knuckle.
7. Emergency brake cable at cradle.
8. Engine and transmission mounting bolts.
9. Cradle bolts.
10. Cradle assembly.
    - Transfer parts.

→← Install or Connect

1. Cradle assembly.
2. Cradle bolts.
   - Front nuts and bolts finger tight first.
3. Engine and transmission mounting bolts.

4. Emergency brake cable at cradle.
5. Both toe-link rods at knuckle.
6. Both lower control arms at knuckle.
7. Exhaust pipe bolts at manifold.
8. Rear wheel and tire assembly.

Tighten

- Torque the following as indicated:
    1. Rear cradle bolts 103 N·m (76 ft. lbs.).
    2. Front cradle nut 90 N·m (67 ft. lbs.).
    3. Engine mount assembly 57 N·m (42 ft. lbs.).
    4. Rear mount assembly 24 N·m (18 ft. lbs.).
    5. Front mount assembly 48 N·m (36 ft. lbs.).
    6. Lower control arm at knuckle 45 N·m (33 ft. lbs.).
    7. Lower control arm at cradle 93 N·m (69 ft. lbs.).
    8. Tow link rod at knuckle 47 N·m (35 ft. lbs.).
        - Replace cotter key.
    9. Tow link rod at cradle 65 N·m (48 ft. lbs.).
    10. Exhaust pipe bolts at manifold 33 N·m (25 ft. lbs.).

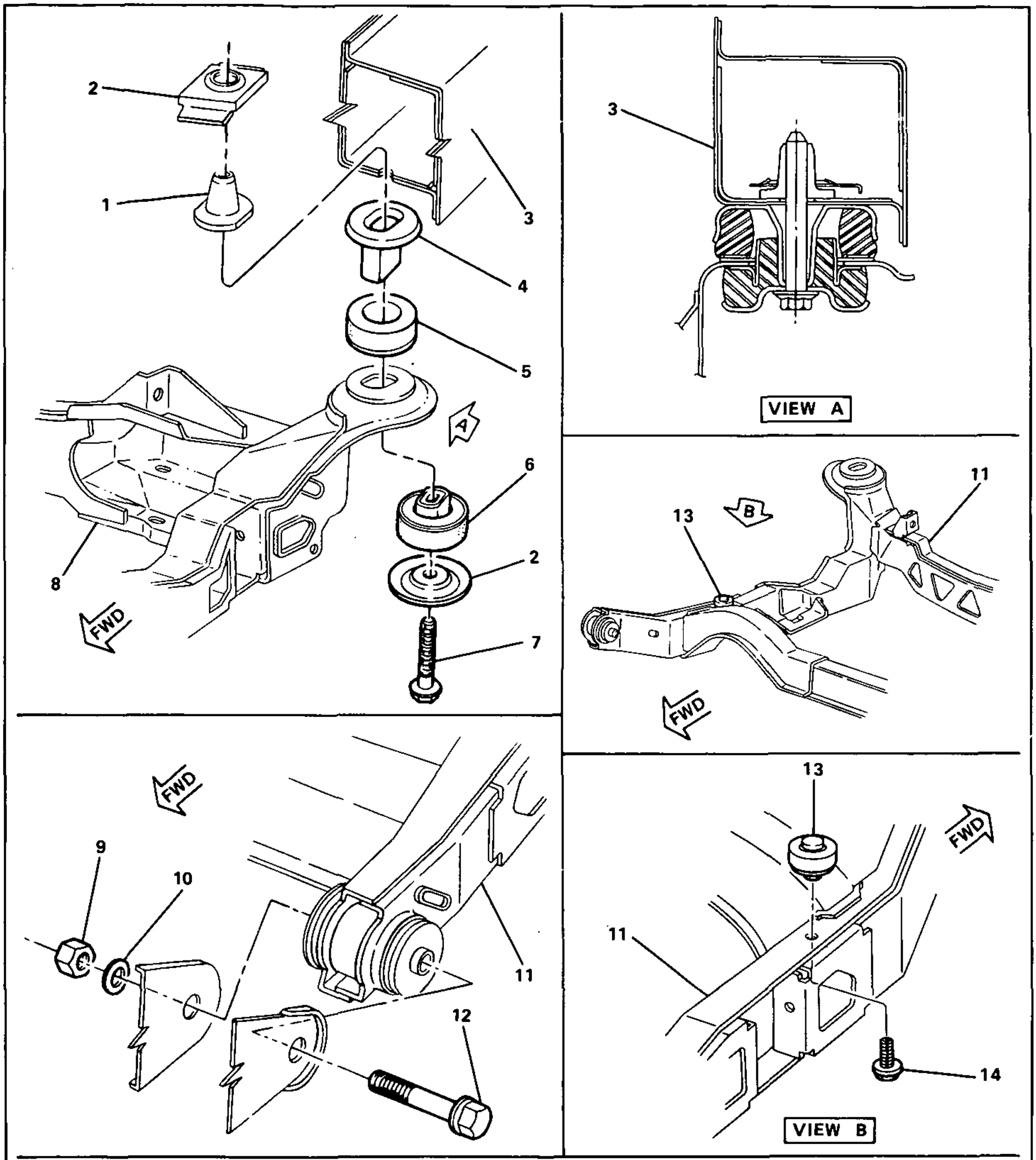
Install or Connect

1. Lower vehicle.
2. Engine support fixture.

Adjust

Toe-in, and parking brake assembly.

- (See Section 3A Front and Rear Alignment and Section 5 Brakes)



1–CAGE NUT
2–RETAINER
3–REAR RAIL
4–SPACER
5–CUSHION-UPPER
6–CUSHION-LOWER
7–BOLT/REAR FRAME MOUNTING
8–FRAME ASSEMBLY
9–NUT/FRONT FRAME MOUNTING
10–WASHER
11–CRADLE ASSEMBLY
12–BOLT/FRONT FRAME MOUNTING
13–DAMPER ASSEMBLY
14–BOLT/DAMPER ASSEMBLY

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Fig. 1 Cradle Mountings and Damper

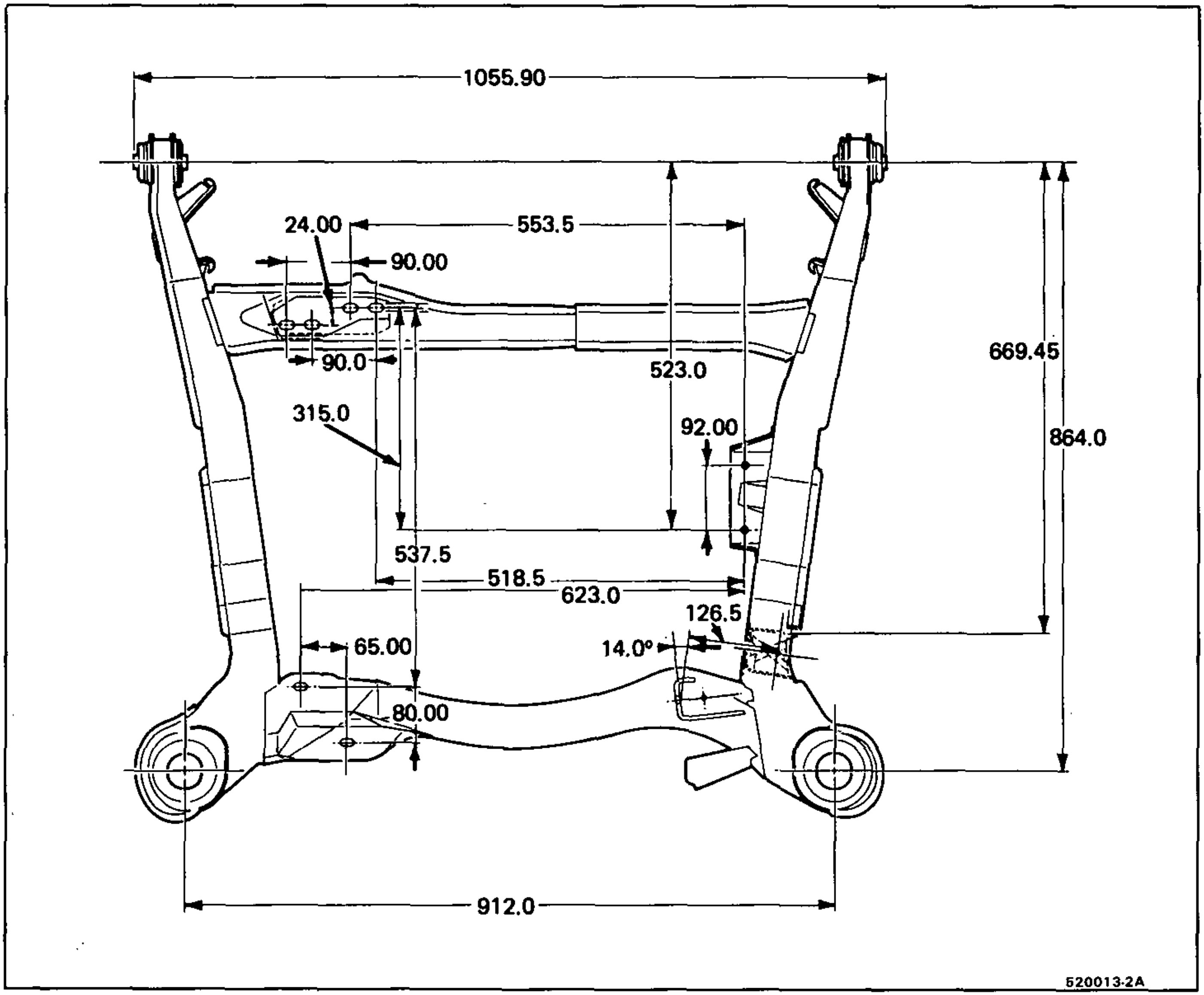


Fig. 2 Cradle Alignment Specifications

1–BATTERY

2–ENGINE

3–ENGINE SUPPORT FIXTURE

4–LEFT STRUT MOUNTING

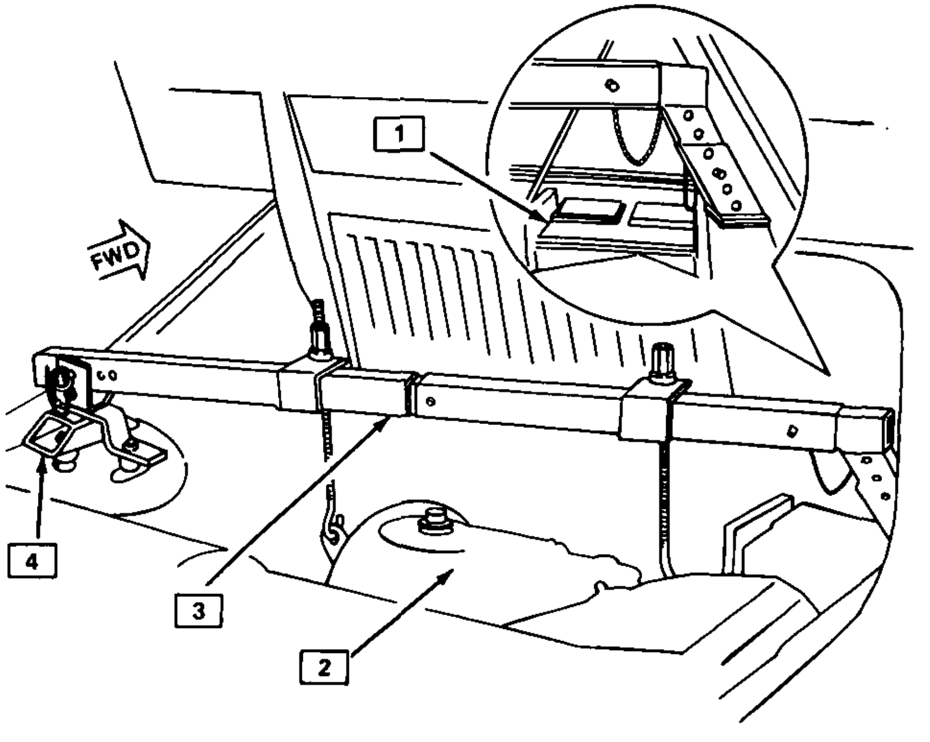


Fig. 3 Engine Support Fixture Mounting

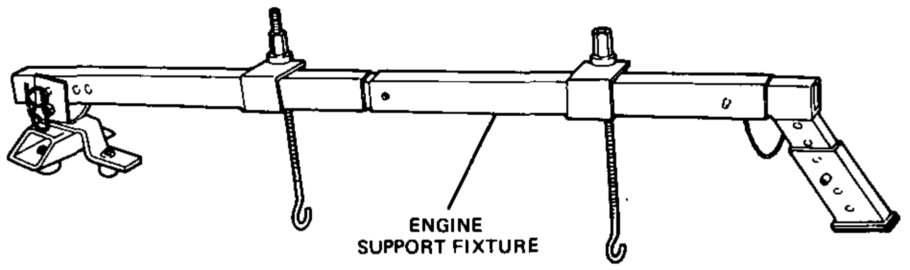


Fig. 4 Special Tool Engine Support Fixture-L4

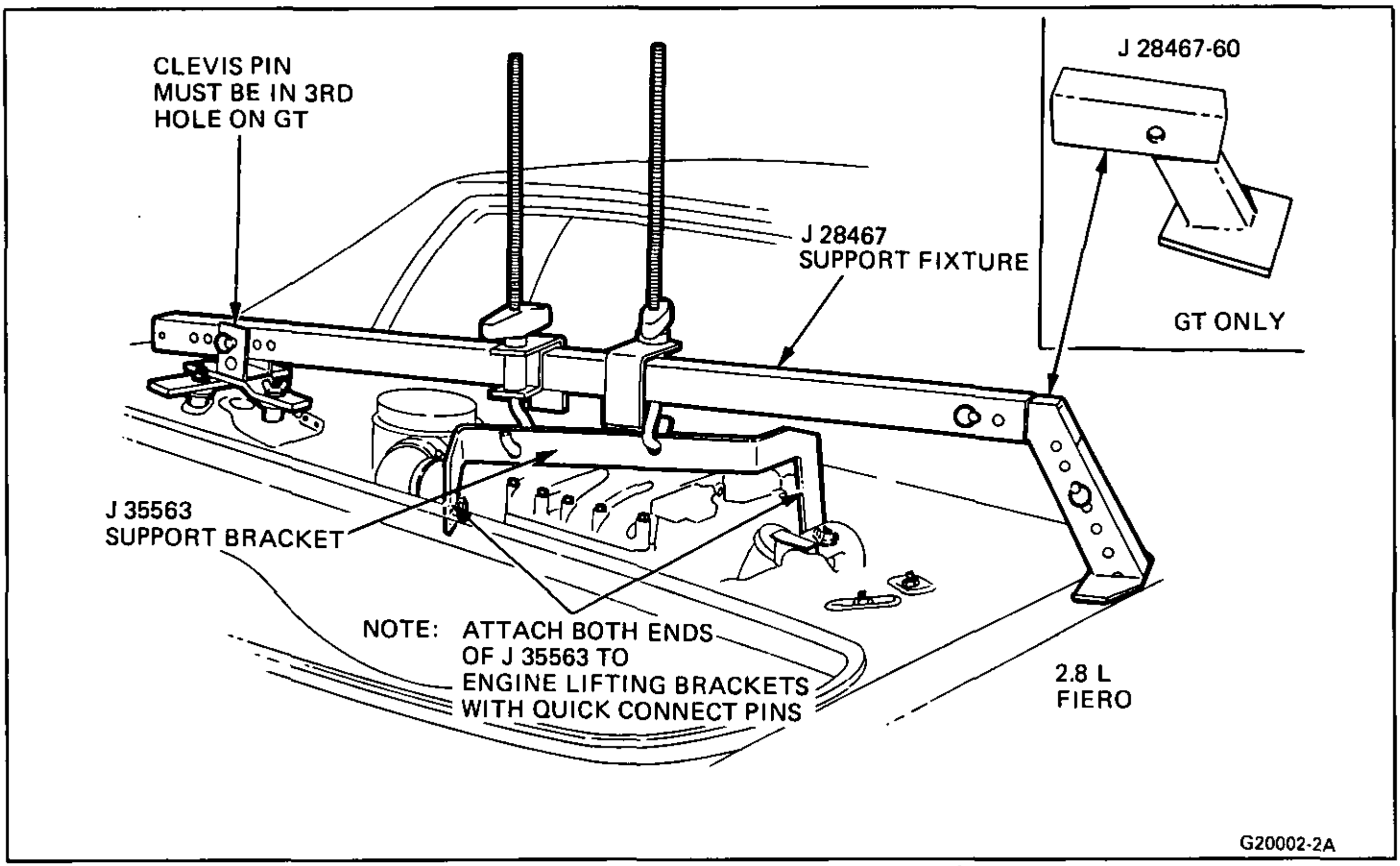


Fig. 5 Special Tool Engine Support Fixture-V6

NOTE: Support leg assembly J-28467-60 must be inserted into the upper right rear rail edge to the scribed mark (about 1$^1/_2$ inches).

SECTION 2B

FRONT & REAR BUMPERS

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 may be used as specified during reassembly to asure 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

The bumpers on all automobiles are designed so that the vehicle can withstand a collision into a fixed barrier at 2.5 mph. After absorbing the energy of a collision, the bumpers return to their original position.

The front and rear bumper face bars (fascias) are made of urethane. Urethane will withstand minor impact and return to its original shape. The front bumper fascia is integral with the front end panel.

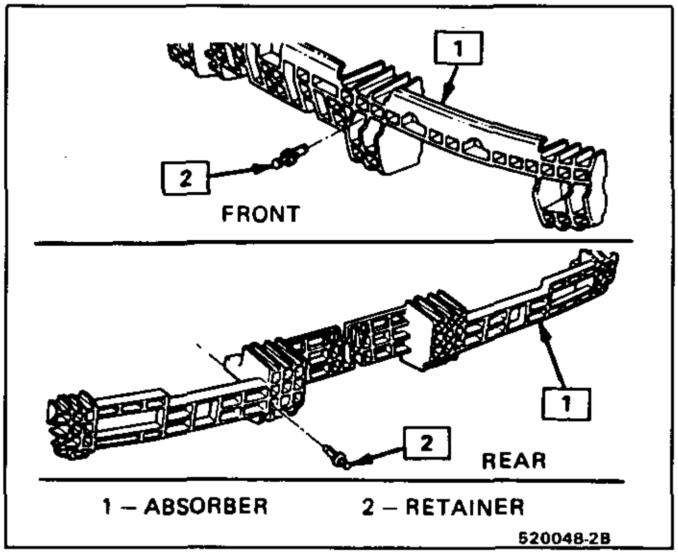


Fig. 1 Energy Absorbing Devices

BUMPER ENERGY ABSORBING UNITS

The absorbing capability for both front and rear bumper systems is achieved through honeycomed energy absorbing devices in each bumper. These units convert the energy of an impact into heat and restoration.

1. Damage
   If there is obvious damage to the unit, it should be replaced.
2. Inspection After Collision
   If the collision was so severe that the bumper did not return to its original position, replace the energy absorber.

FRONT BUMPER

Remove or Disconnect

1. Front end panel.
2. Bumper bar/energy absorber assembly.
   - If energy absorber is to be replaced, drill out push retainer and install new retainers.

Install or Connect

1. Reverse removal procedure

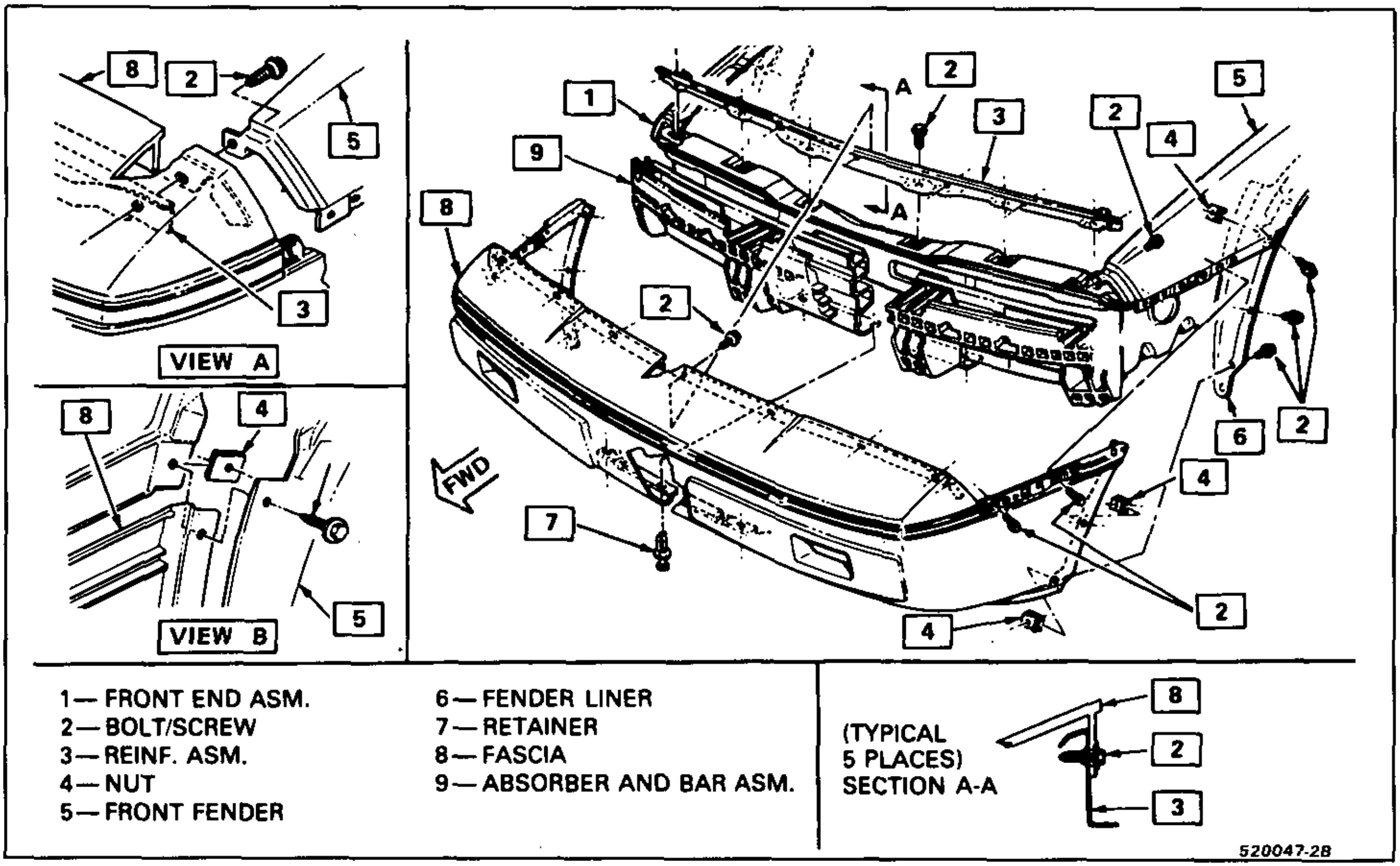
REAR BUMPER

Remove or Disconnect

1. Rear fascia.
2. Bumper bar/energy absorber assembly.
3. If energy absorber is to be replaced, drill out push retainers and install new retainers.

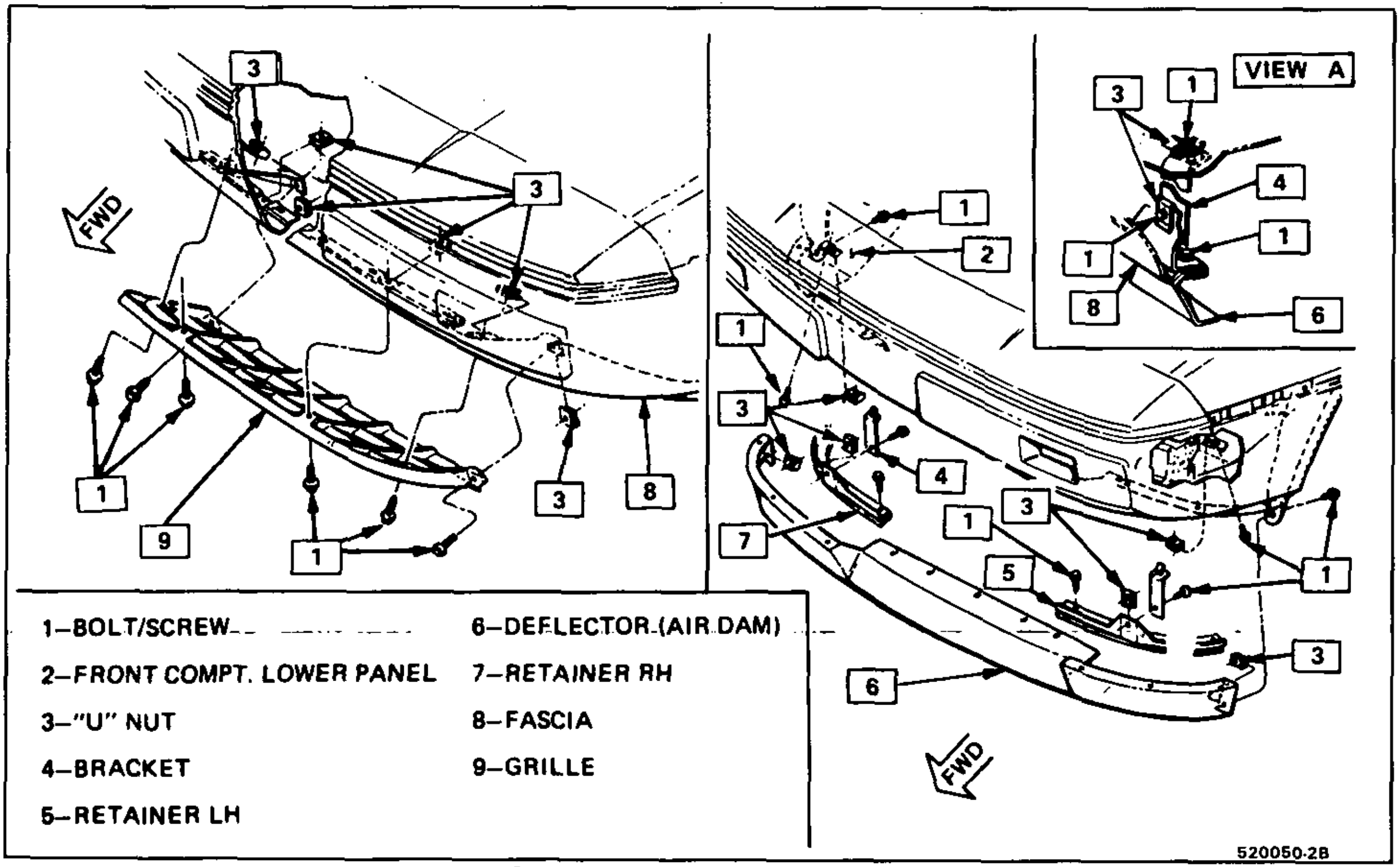
Install or Connect

1. Reverse removal procedure.



1— FRONT END ASM.
2— BOLT/SCREW
3— REINF. ASM.
4— NUT
5— FRONT FENDER
6— FENDER LINER
7— RETAINER
8— FASCIA
9— ABSORBER AND BAR ASM.

Fig. 2 Front Bumper — Non SE/GT



1–BOLT/SCREW
2–FRONT COMPT. LOWER PANEL
3–"U" NUT
4–BRACKET
5–RETAINER LH
6–DEFLECTOR (AIR DAM)
7–RETAINER RH
8–FASCIA
9–GRILLE

Fig. 3 Front Grill and Deflector (Air Dam)

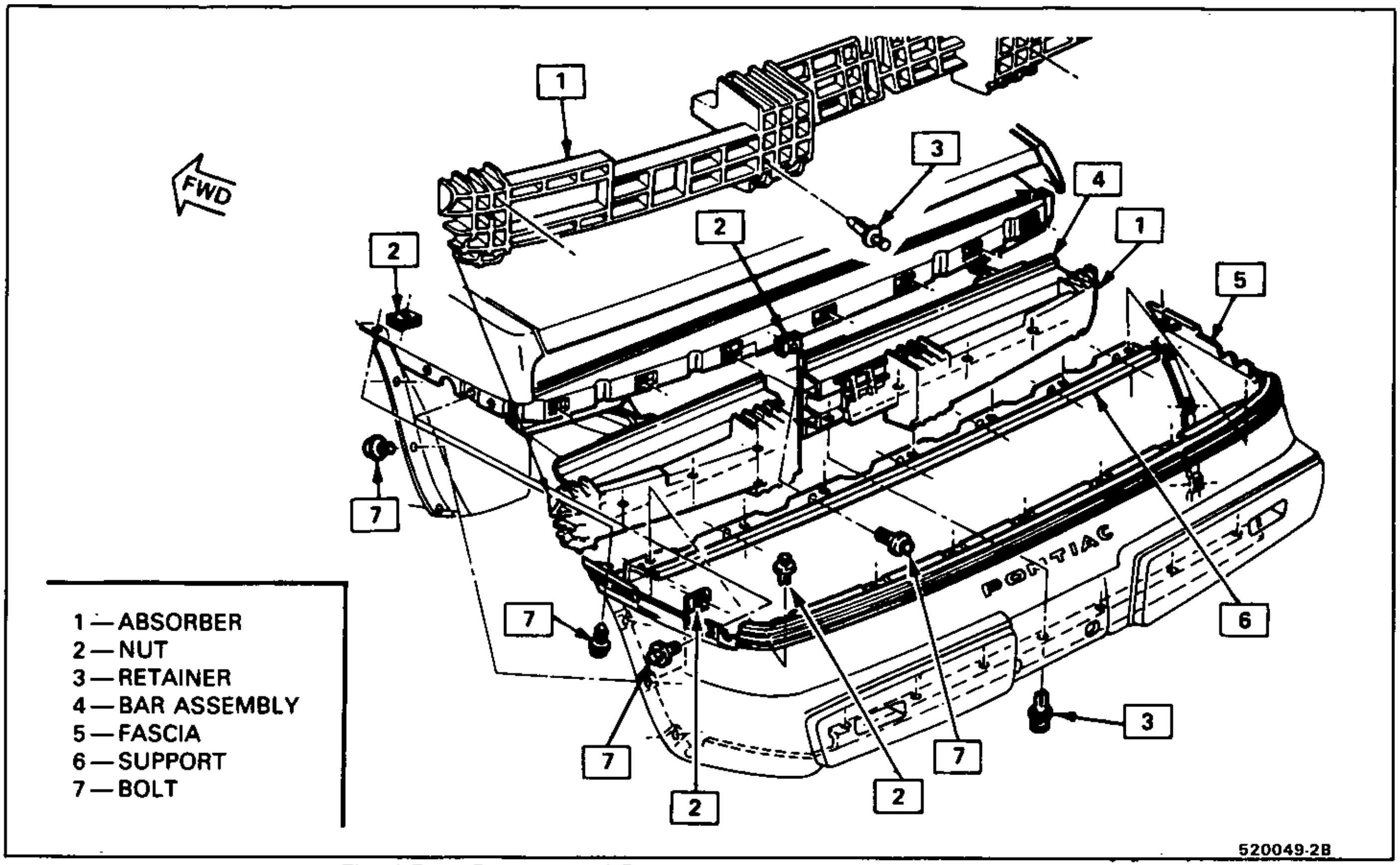


Fig. 4 Rear Bumper and Energy Absorbing Device — Non SE/GT

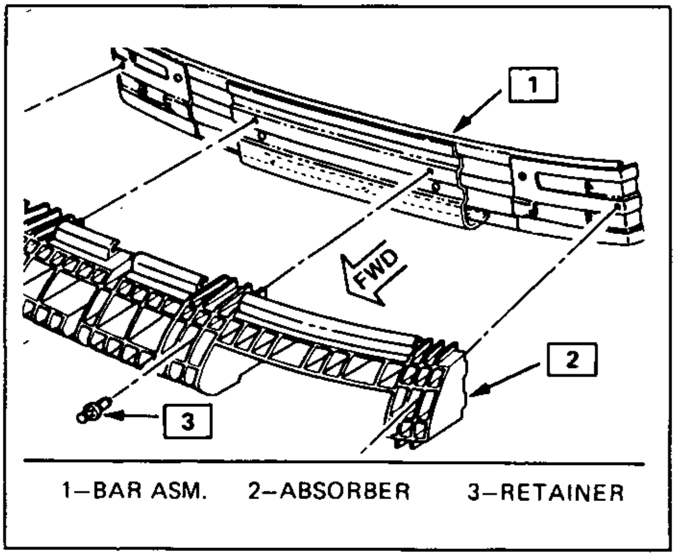


Fig. 5 Front Energy Absorber to Bar Assy — SE/GT

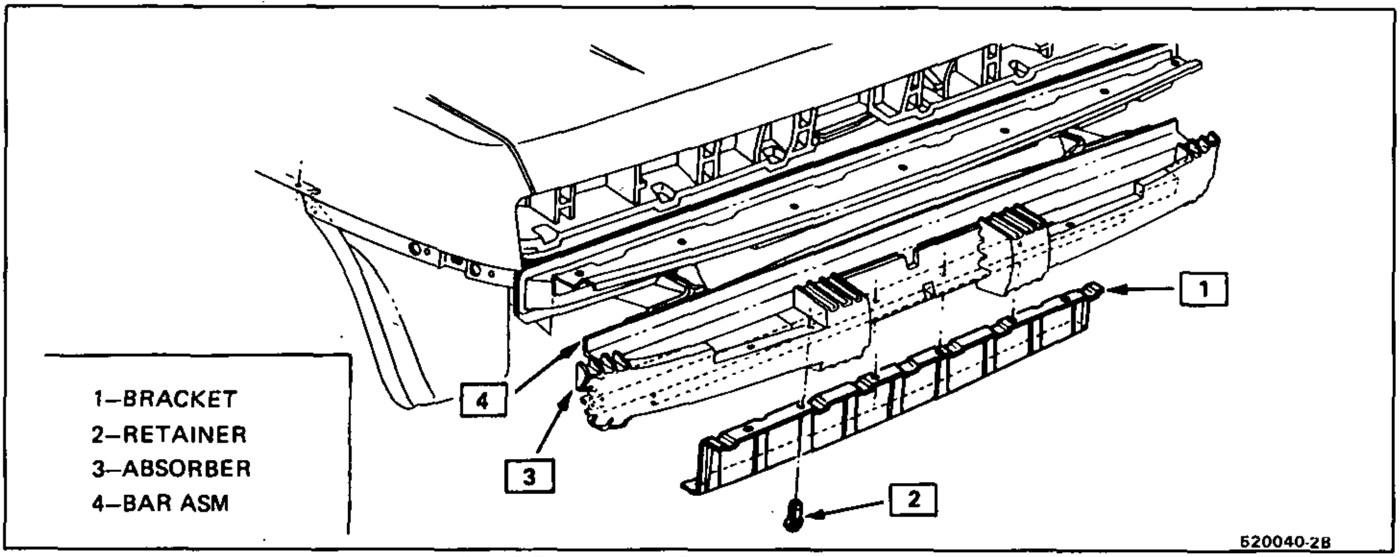


Fig. 6 Rear Fascia Bracket to Impact Bar

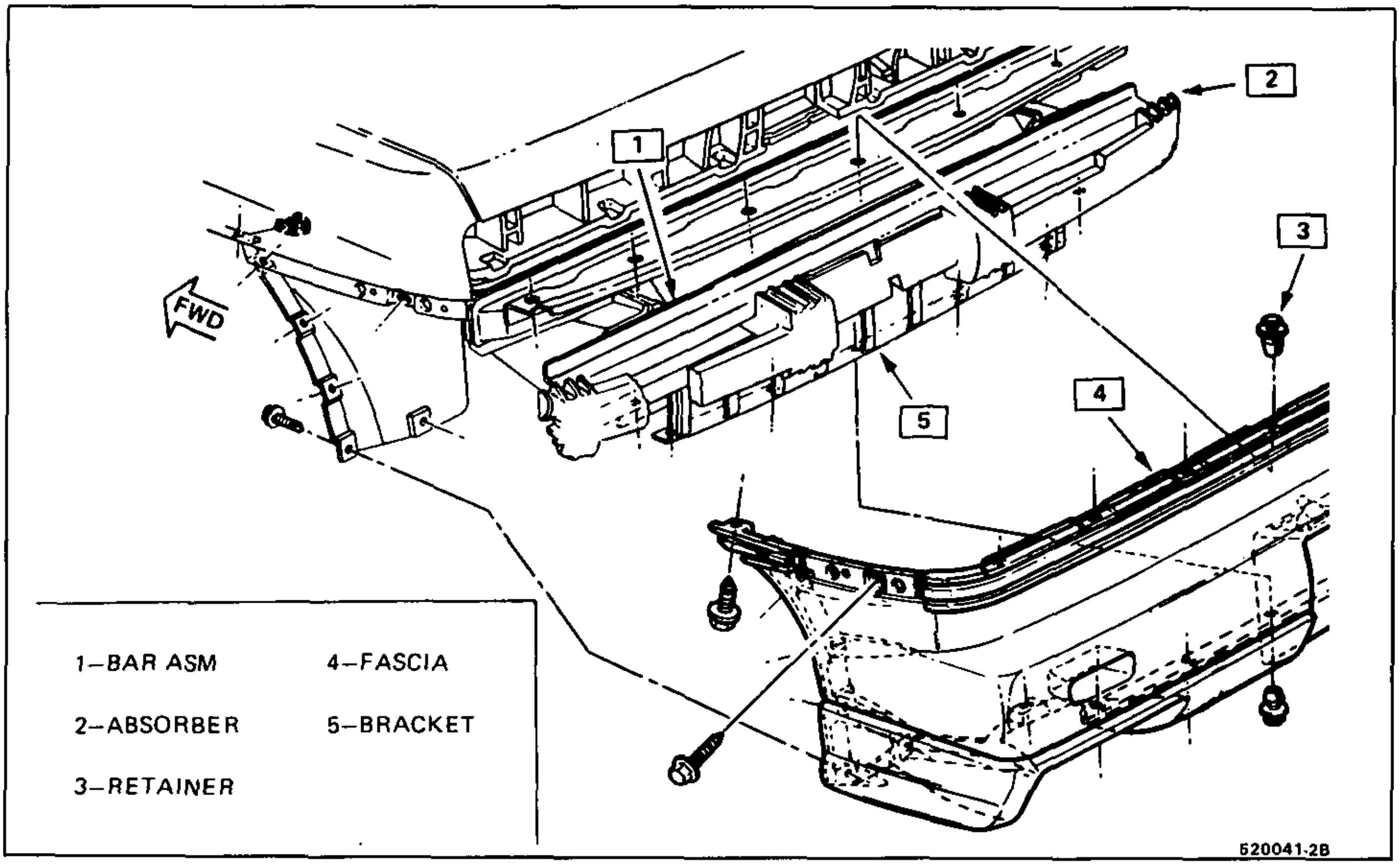


Fig. 7 Rear Fascia Mounting — SE/GT

1—RETAINER CLIP

2—RETAINER

3—BOLT/SCREW

4—FASCIA

5—RETAINER

6—REINFORCEMENT

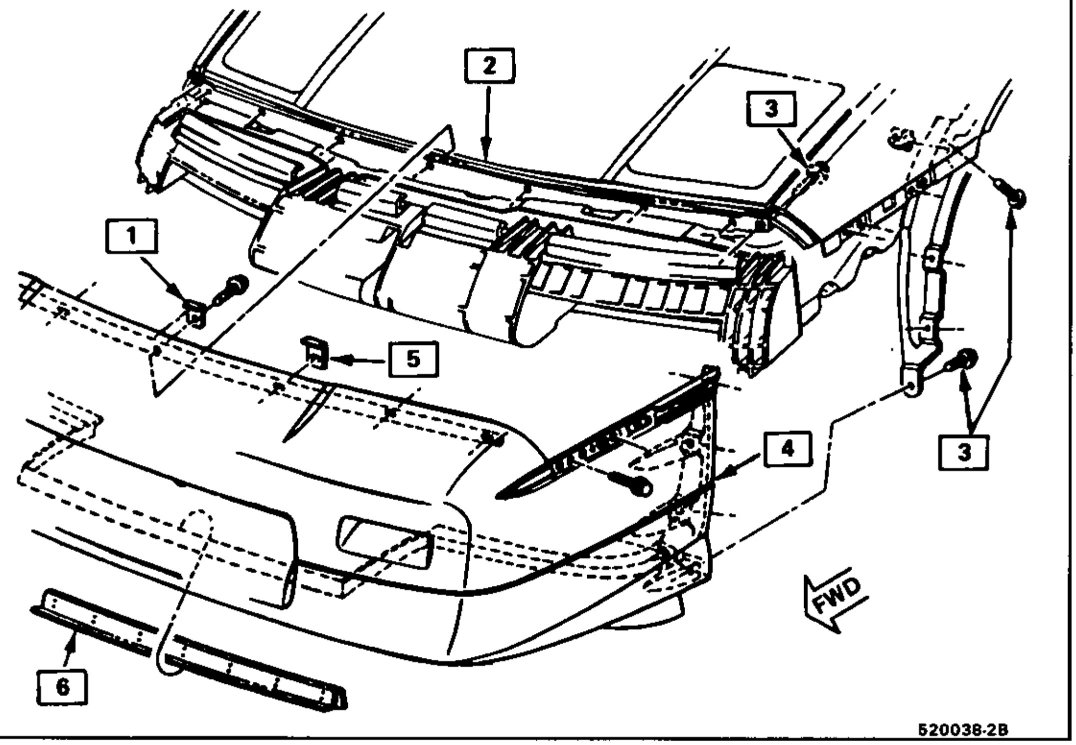


Fig. 8 Front Fascia Mounting — SE/GT

SECTION 2C

BODY PANEL REPAIR

CONTENTS

GENERAL DESCRIPTION

This section describes how to repair body panels, both for structural and surface repairs. Paint repair for the basecoat/clearcoat paint system is also covered.

In many of the following procedures, a particular brand of material may be mentioned. In all cases, equivalent products from other suppliers may be used.

"ENDURAFLEX" PANEL REPAIR

The following information details the procedure to be used for the repair of "Enduraflex" panels when structural integrity must be restored. The bumpers, doors, fenders and lower rear quarters use this material.

1. Remove affected panel where applicable. In many cases, repair may be accomplished without removal of the part.
2. Clean area(s) to be repaired with a wax, grease and silicone removing solvent applied with a water-dampened cloth. On structural-type repair it will also be necessary to clean the underside of the repair area. Wipe dry, then sand the surface about 40mm (1 1/2") away from each side of the break with a #50 grit disc.
3. Align and secure the piece on the faceside of the part with two inch body sealing tape. Use a lightweight clamp, if necessary, to align joint.
4. Cut two pieces of fiberglass cloth large enough to overlap the break 40mm (1 1/2"). Cut only to length required.
5. On a clean, flat surface of nonporous material such as a metal, glass or plastic pallet, deposit equal length beads of each component (3M Flexible Parts Repair Materials #05900 or equivalent). With a paddling motion, mix the two components until a uniform color and consistency is achieved.
6. Apply a layer of the mixture approximately 3mm (1/8") thick on the backside of the panel overlapping the break at least 40mm (1 1/2").
7. Apply one piece of the pre-cut fiberglass cloth to the applied adhesive and cover the cloth with additional adhesive. Apply the second piece of the pre-cut fiberglass cloth to the adhesive and immediately cover the cloth with additional adhesive in sufficient quantity to fill the weave.
8. Allow 20-30 minutes cure time at 16° to 27° C (60° to 80° F). Trim excess repair material at edge if necessary.

Repair the faceside of the panel using the following procedures:

1. Clean topside of panel with a wax, grease and silicone removing solvent applied with a water dampened cloth. Wipe dry.
2. With a random orbit sander fitted with a #180 grit disc, remove the total paint film in and surrounding the area(s) to be repaired. The repair material should not overlap the painted surface.
3. With a drill motor and a 3" #50 grit disc or as an option, a rotary file, cut a "Vee" along the break line approximately 13mm (1/2") wide. Remove all dust and loose particles from the repair area.
4. Mix and apply the repair material. Apply a light coat first over the damage; then continue application to a level slightly above the surrounding contour.
5. Allow the applied mixture to cure 20 to 30 minutes at 16° to 27° C (60°-80° F).
6. Establish rough contour, where possible, with a curved tooth body file. If low areas or pits remain, mix and apply additional adhesive.
7. Block sand using #220 grit sandpaper to establish accurate level and countour with the surrounding surface.
8. For final feathering, use a random orbit sander with a #320 grit disc. See paint repair procedures below.

Below is a list of typical equipment and material necessary to perform the above described repair procedures.

- Wax, grease and silicone removing solvent
- Cloth back body tape
- A supply of 6" #180 grit sanding discs
- A supply of 6" #320 grit sanding discs
- A supply of 3" #50 grit sanding discs
- Random Orbit Sander with a 6" backing pad
- A 1/4" or 3/8" drill motor with a 3" disc holder

- Hand sanding block
- Rubber squeegees
- #220 grit sandpaper
- A non-porous mixing palette
- A wood paddle or putty knife
- A curved tooth body file
- 3M #05900 - Flexible parts repair material or equivalent

PAINT REPAIR

Listed below are repair procedures to the basecoat/clearcoat paint system, for full panel or partial (spot) repairs, and for flexible and non-flexible panels.

NON-FLEXIBLE PANEL PAINT REPAIR

Non-flexible panels are the hood, rear deck lid, roof, and headlamps covers.

PARTIAL (SPOT) REPAIR (FIG. 1)

Basecoat

1. Wash with a mild detergent and water to remove any water soluble contaminates, then clean with a wax and grease removing solvent to remove any tar, silicone or other road film not removed with the detergent wash.
2. Repair and featheredge damaged area(s) as required.
3. If substrate is metal, treat surface with a metal conditioner and conversion coating according to label directions and allow to dry throroughly. Apply primer-surfacer to repair and featheredge damaged area(s) as required. Allow to dry 20-30 minutes before sanding.
4. Using wet or dry #400 grit sandpaper or finer, sand entire area(s) to be refinished with the basecoat color. Areas to be clear coated only, should be wet sanded with #600 or finer sandpaper.
5. Reclean panel(s) with wax and grease removing solvent and then tack wipe.
6. Apply one or two coats of an "adhesion promoter" over and 6-8" beyond the area(s) to be refinished. Allow to flash a minimum of 30 minutes before applying base color coat.
7. Reduce base color 150-200% with an extra slow drying lacquer solvent. The viscosity of the reduced base color is very important in order to match the original finish. The best way of checking the viscosity of a reduced paint material is with a Zahn #2 paint viscosity cup or its equivalent. The temperature influences viscosity directly. If a cold can of paint is brought into an average temperature room (65-70 degrees), it will be thicker and more viscous. Adding solvent to make the paint sprayable is not always the best action. The paint should be allowed to reach workable, or average, room temperatures. Follow manufacturer's recommended paint viscosity cup reading for their material.
8. Spray base color at 35-45 lbs. air pressure at the gun. Apply only the number of coats needed to get full hiding. This will require two or three medium-wet coats. Allow each coat to flash approximately five minutes and spray each coat slightly wider than the previously applied coat. A premixed mist coat of clear acrylic paint material may be used if desired to melt overspray into the base color. Allow to dry for 20 minutes before applying clear coat. Do not sand base color coat unless it is necessary.
9. If basecoat must be sanded, proceed as follows:
    a. Allow base color to dry.
    b. Sand with ultra-fine wet-or-dry sandpaper to remove the imperfection(s).
    c. Reclean and tack wipe the repair area(s).
    d. Apply an additional coat of base color.
    e. Allow to dry 20 minutes before applying the clear coat.

Clearcoat

1. Lacquer Clearcoat
    a. Reduce clearcoat 125-150% with an extra-slow drying lacquer thinner to the recommended paint viscosity cup reading of the paint manufacturer.
    b. Spray at least two medium-wet coats of clear at 35-40 lbs. air pressure at the gun. More may be desired. Spray first coat beyond base color coat and allow to flash for approximately 5-10 minutes. Spray each additional coat of clear slightly beyond the previously applied clearcoat. Allow flash time between coats. After the final coat of clear is applied, apply a mist-coat (clear acrylic and thinner) to melt in overspray. Stay within the applied "adhesion promoter" with all spray operations. Allow the repair to dry overnight, then rub out with a light-cutting hand or machine polishing compound.
2. Enamel Clearcoat

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.

It is madatory that adequate respiratory protection be worn. Examples of such protection are: 3-M models #6984 and #6986 disposable respirators.

Such protections 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.

a. Following paint manufacturer's label directions, activate the Polyurethane Enamel Clearcoat material. Mix material thoroughly. Pot life of activated mixture is approximately eight (8) hours.

b. Reduce clearcoat per label directions. Some activated Polyurethane Enamel Clearcoat materials are ready to spray as packaged under normal conditions. As conditions vary, to enhance flow out and leveling, up to 10% more than the specified enamel reducer may be added to the activated clearcoat mixture. Check the viscosity of the activated mixture with a Zahn #2 paint viscosity cup or its equivalent. Follow the paint manufacturer's labeled recommendations for paint viscosity cup reading.

c. Using 50 lbs. air pressure at the gun, spray two medium-wet coats of enamel clear coat mixture. Allow first coat to set-up for 15-20 minutes before applying the second final coat. Allow to cure overnight. Clean spray painting equipment with lacquer thinner immediately after use.

FULL PANEL PAINT REPAIR (FIG. 2)

Basecoat

1. Wash with a mild detergent and water to remove any water soluble contaminates, then clean with a wax and grease removing solvent to remove any tar, silicone or other road film not removed with the detergent wash.
2. Sand the complete panel(s) with #400 grit or finer wet-or-dry sandpaper. Repair and fetheredge damaged areas as required. Treat all bare metal with recommended metal conditioner and conversion coating. Follow manufacturer's label directions.
3. Apply primer-surfacer to all bare metal areas. Keep primer-surfacer within the damaged area(s). Allow to dry 20-30 minutes before sanding.
4. Using #400 grit or finer sandpaper, sand the primer-surfacer to level the imperfection.
5. Reclean panel(s) with wax and grease removing solvent and then tack wipe.
6. Apply one coat of an "adhesion promoter" over the entire area(s) to be painted. Allow a minimum of 30 minutes dry time.
7. The base color should be reduced 150-200% with an extra-slow drying lacquer solvent. The viscosity of the reduced base color is very important in order to match the original finish. The best way of checking the viscosity of a reduced paint material is with a Zahn #2 paint viscosity cup or its equivalent. Temperature influences viscosity directly. If a cold can of paint is brought into an average temperature room (65-70 degrees), it will be thicker and more viscous. Adding solvent to make the paint sprayable is not always the best action. The paint should be allowed to reach workable or average room temperatures. Follow manufacturer's recommended paint viscosity cup reading for their specific material.
8. Apply two or three medium-wet coat of base color.

Important

Apply only the number of coats necessary to achieve full hiding.

Spray at 35-40 lbs. air pressure at the gun. Allow each coat to flash approximately five minutes before applying the final coat of base color. Allow the final coat to dry for 20 minutes before applying the clear coat.

9. If base coat must be sanded, proceed as follows:
   a. Allow base color to dry.
   b. Sand with ultra-fine wet-or-dry sandpaper to remove the imperfection(s).
   c. Reclean and tack wipe the area(s).
   d. Apply one more additional coat of base color.
   e. Allow to dry 20 minutes before applying the clear coat.

Clear Coat

1. Lacquer Clearcoat
   a. Reduce clear coat 125-150% with an extra-slow drying lacquer thinner to the recommended paint viscosity cup reading of the paint manufacturer.
   b. Spray two medium-wet coats of reduced clear at 35-45 lbs. air pressure at the gun. Allow first coat to flash completely before applying the second coat. At least two coats must be used. Additional coat may be applied if desired. If additional leveling is desired a final coat of premixed mist-coat material (clear acrylic and thinner) can be sprayed at 20 lbs. air pressure at the gun.
   c. Allow overnight dry or longer, then, rub out using a light-cutting hand or machine polishing compound.
2. Enamel Clearcoat

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.

It is mandatory that adequate respiratory protection be worn. Examples of such protection are: 3-M models #6984 and #6986 disposable respirators.

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.

a. Following paint manufacturers label directions, activate the Polyurethane Enamel Clear Coat material. Mix material thoroughly. Pot life of activated mixture is approximately eight (8) hours.

b. Some activated Polyurethane Enamel Clear Coat materials are ready to spray as packaged under normal conditions. As conditions vary, to enhance flow out and leveling, up to 10% more than the specified enamel reducer may be added to the activated clear coat mixture. Check the viscosity of the activated mixture with a Zahn #2 paint viscosity cup or its equivalent. Follow the paint manufacturer's label recommendations for paint viscosity cup reading.

c. Spray two medium coats of activated clear coat material at 50 lbs. air pressure at the gun over entire area(s) to be refinished. For panel repair, allow 15-20 minutes dry time between coats. For overall refinishing, apply first coat, allow to flash, then apply second coat. Spraying medium-wet coats of clear coat material to reduce surface texture (orange peel) and provide optimum appearance. Allow to cure overnight.

FLEXIBLE PANEL PAINT REPAIR SYSTEM

Flexible panels are the bumpers, lower rear quarter, and doors.

Important

Full panel repairs must be performed. Partial (spot) repairs are not recommended.

CAUTION: There are a number of flexible 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.

It is mandatory that adequate respiratory protection be worn. Examples of such protection are: 3-M models #6984 and #6986 disposable respirators.

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

Flexible Undercoat Requirements

If the part to be painted is a replacement, it will be factory primed with an elastomeric enamel-based primer. As long as the original primer is not scratched exposing the plastic substrate, all that is required is to solvent clean, sand with #400 paper or a red "Scotch-Brite" pad, reclean and apply elastomeric color.

However, if the plastic substate is exposed or the part is repaired with flexible filler material, a flexible primer-surfacer must be used to provide the filling properties required. This is to prevent a "bulls-eye" condition or highlighting of the bare substrate or filler repair after color is applied.

Prepare flexible primer-surfacer as follows:

1. Clean the entire part with a wax, grease and silicone removing solvent applied with a water dampened cloth. Wipe dry.

   Important

   The step above begins to prepare the entire part for color coats. Spot repair is not recommended because dry spray at the blend area of applied elastomeric color does not "wet out" satisfactorily.

2. Featheredge the scuff or filler repair with #320 sandpaper, blow off dust and tack wipe.
3. Mix and apply four medium dry coats of flexible primer surfacer. Follow manufacturer's instructions for specific mix ratios and additives.

   Important

   Use a fast evaporating thinner as recommended to reduce the primer-surfacer and do not apply excessively wet coats. Bare flexible plastic surface and/or flexible filler materials have a tendency to swell from thinner absorption, resulting in a visible or "highlighted" repair.

4. Allow to dry at least one hour and block sand with #400 sandpaper. Sand the entire part with #400 sandpaper or red "Scotch-Brite" pad to remove all gloss in preparation for color application.

   When paints are modified with a flex additive, the possiblity of mixture "pot life" exists; therefore, spray equipment should be emptied and flushed immediately after use.

Body Color and Flexible Additive Systems

There are several flexible topcoat systems available for the painter's selection; in most cases it is a matter of personal preference. Basecoat/clearcoat material can be either enamel or lacquer-based. Some manufacturers do not recommend the use of flex additivies in their basecolor material, but do recommend its use for their lacquer and enamel clearcoats.

1. Thoroughly sand the entire part with #400 sandpaper or red "Scotch-Brite" pad to remove all gloss. Reclean.
2. Mix the base color, flexible additive, if recommended, and thinner. Follow manufacturer's label instructions.
3. Apply a sufficient number of coats to achieve complete hiding and color match. Allow flash time between coats.

4. Allow the base color coat to dry 30-60 minutes before applying the clear coat. Do not sand the base coat before applying the clear coat.

Important

If sanding of the base coat is necessary to remove imperfections, such as dirt or sags, sand with #400 grit or finer sandpaper, reclean the area(s). Apply one additional coat of base material and let dry.

Clear Coat Application

1. Mix and reduce clear coat (lacquer or enamel) material per label instructions. Use flex additive if recommended by paint source.
2. Strain the mixture and apply 2-3 coats with 35-40 lbs. air pressure at the gun.
3. Allow each coat to flash completely before applying the next coat. Allow at least 4 hours air dry time or force dry for 30 minutes with a heat lamp at 180°F before putting into service.

Important

Compounding is not necessary when a flexible additive is used in the top coat paint material. The mixture will dry with acceptable gloss. Compounding dulls the gloss of elastomeric finishes causing a flat appearance. The finish cannot be brought back to the same gloss level without applying more paint.

For further information, see Section 1 of the Body Section of this Manual.

SPOT REPAIR WITH LACQUER CLEAR COAT

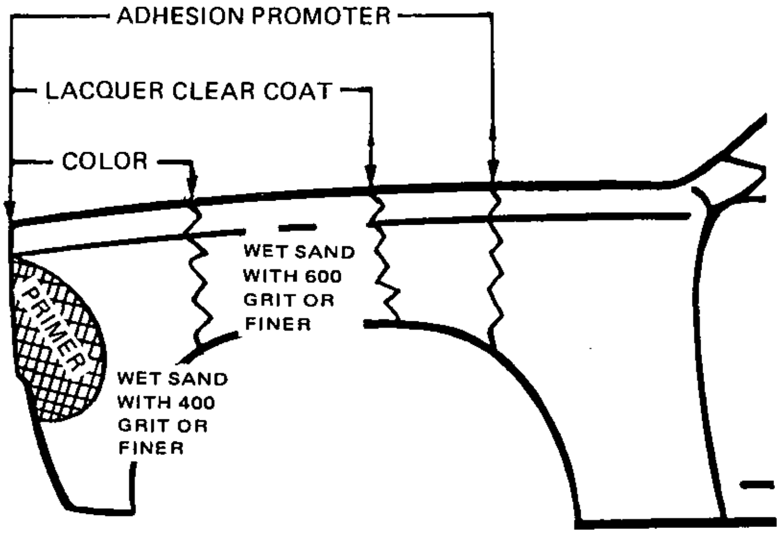
1—WET SAND AREA TO BE PRIMED AND COLOR COATED WITH 400 GRIT OR FINER.

2—WET SAND AREA TO BE CLEAR COATED ONLY, WITH 600 GRIT OR FINER.

3—APPLY ADHESION PROMOTER OVER AND BEYOND SANDED AREAS.

4—APPLY BASE COLOR COAT AS PER LABEL DIRECTION.

5—APPLY LACQUER CLEAR COAT BEYOND BASE COLOR COAT BUT WITHIN ADHESION PROMOTER. ALLOW TO DRY OVERNIGHT AND COMPOUND.



G20012-2C

Fig. 1 Spot Repair With Lacquer Clear Coat

PANEL REPAIR WITH ENAMEL CLEAR COAT

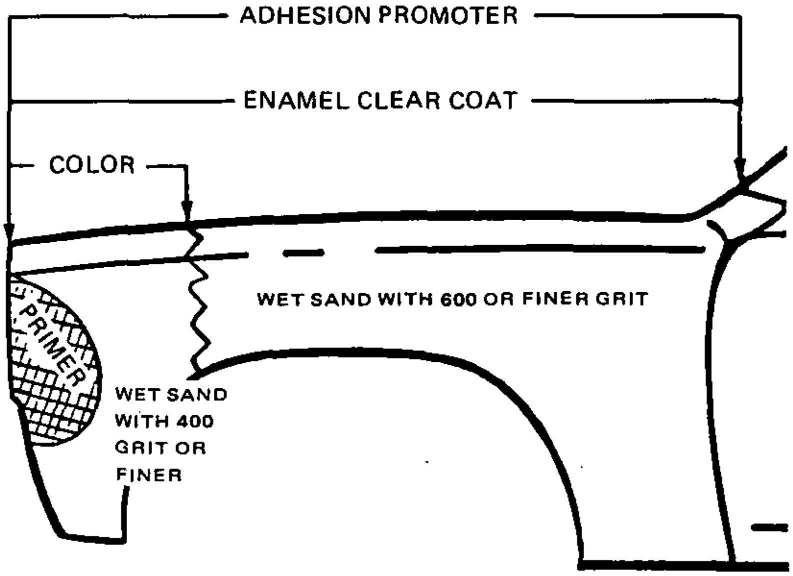
1–WET SAND AREA TO BE PRIMED AND COLOR COATED WITH 400 GRIT OR FINER.

2–WET SAND ENTIRE AREA TO BE CLEAR COATED WITH 600 GRIT OR FINER.

3–APPLY AN ADHESION PROMOTER OVER ENTIRE AREA TO BE COLOR COATED AND CLEAR COATED.

4–APPLY BASE COLOR COAT OVER REPAIR AREA ONLY AS PER LABEL DIRECTIONS.

5–APPLY ENAMEL CLEAR COAT OVER ENTIRE PANEL AS PER LABEL DIRECTIONS.



G20013-2C

Fig. 2 Panel Repair With Enamel Clear Coat

PAINT CODE	STRIPING NAME	FISHER NUMBER	INMONT	SHERWIN-WILLIAMS ACME/ROGERS	MARTIN-SENOUR	DITZLER	DUPONT
11A	White	3967	2080	L10A-2864 5644	32-3929	2058	5338
14A	Light Gray	8670	15165	34869	32-26729	33856	C8529
18A	Gray	8291	14036	34102	32-26700	33750	C8441
19A	Black	848	A946	L10B-1738 3000/4590	3069	9300	99
21A	Light Blue	8658	15073	34863	32-26721	15891	C8520
28A	Dark Blue	8659	15074D	34864	32-26722	15892	C8521
43A	Light Sage	8661	15072	34866	32-26726	45842	C8523
47A	Dark Sage	8662	15075	34867	32-26727	45843	C8524
58A	Lt. Chestnut	8851	16083	35565	32-26779	25775	
65A	Med. Chestnut	8672	15176D	34871	32-26731	25552	
79A	Dark Maroon	8663	15071R	34868	32-26728	51167	C8525

G20006-2C

Fig. 3 Paint Striping Chart

1986 EXTERIOR REFINISH COLORS

P/C NUMBER COLOR NAME	WA CODE	DITZLER	DUPONT	MARTIN SENOUR	SHERWIN-WILLIAMS ACME-ROGERS	INMONT	USAGE
13 SILVER METALLIC	WA-9021	3822	D8590	30-5491	35369	15365	F,N
16 SILVER METALLIC	WA-9004	3880	B8681	30-5531	35425	16027	P
17 BLACK METALLIC	WA-8523	3752	B8537	30-5409	34421	15007G	N
18 MED GRAY MET	WA-7719	3603	B8321	30-5342	33142	13104	P
22 LT BLUE MET	WA-8533	3753	B8538	30-5374	34383	15008F	N
23 BT BLUE MET	WA-8751	3882	B8617	30-5470	35251	16001	F
27 MED BLUE MET	WA-8532	3756	B8539	30-5375	34384	15048V	N
28 BLACK METALLIC	WA-8743	3885	B8618	30-5520	35313	16003	F
40 WHITE	WA-8554	3680	B8469	30-5295	33755	13570	F,N,P
41 BLACK	WA-8555	9700	99S	30-5296	33756	13572	F,P
42 LT SAGE MET	WA-8521	3761	B8540	30-5378	34387	15015G	N
49 DK SAGE MET	WA-8612	3765	B8541	30-5381	34390	15019F	N
51 YELLOW GOLD	WA-8929	3889	B8620	30-5523	35316	16007	F
52 SEDONA TAN	WA-8528	3768	B8542	30-5383	34392	15022	N
56 LT GOLD MET	WA-8962	3891	B8683	30-5533	35427	16032	P
60 CHAMP GOLD MET	WA-8753	3893	B8621	30-5472	35253	16010	F
61 LT CHESTNUT MET	WA-8566	3775	B8543	30-5388	34397	15029G	N
64 DK CHESTNUT MET	WA-8567	3777	B8544	30-5390	34399	15031G	N
66 RUSSET METALLIC	WA-8754	3896	B8622	30-5473	35254	16013	F
68MDNT RUSSET MET	WA-8757	3897	B8623	30-5525	35318	16014	F
74 FLAME RED MET	WA-8748	3823	B8610	30-5485	35320	16017	F,N
81 BRIGHT RED	WA-8774	3794	C8508	30-5464	34983	15265V	F,P
84 GUNMETAL MET	WA-7782	3667	B8403	30-5313	33936	14066D	F,N

G20005-2C

Fig. 4 Exterior Color Chart

1986 INTERIOR REFINISH COLORS

HIGH GLOSS NO.	NAME	W12A CODE	DITZLER	DUPONT	MARTIN SENOUR	SHERWIN-WILLIAMS ACME-ROGERS	INMONT
12DN	Graphite	7701	33622	C8345	32-16905	32989	13199
19N	Black	848	9433	C8535	32-16918	33024	4401
27CN	Dk. Blue	8576	15886	C8439	32-17067	34598	15080D
43BN	Med. Sage	8578	45846	D8533	32-17102	34809	15086
43CN	Dk. Sage	8583	45839	------	32-17103	34811	16062
62AN	Lt. Saddle	7769	25230	C8352	32-16912	32996	13180
62BN	Med. Saddle	8806	25231	------	32-17148	35469	-----
62CN	Dk. Saddle	8613	25503	------	32-17072	34603	16053
62DN	Dk. Saddle	8257	25354	------	32-16951	33716	-----
68CN	Russet	8579	25513	C8542	32-17068	34599	15087R
72CN	Carmine	8577	-----	C8540	32-17085	34639	15084R
72DN	Dk. Carmine	8833	72800	------	32-17162	35544	-----
79CN	Claret	4887	51170	C8537	32-17084	34638	8763
82CN	Med. Gray	8247	33665	C8447	32-16949	33714	14009
82DN	Dk. Gray	8595	33824	------	32-17071	34602	15268

G20018-2C

Fig. 5 Interior Color Chart - High Gloss

1986 INTERIOR REFINISH COLORS

LOW GLOSS NO.	NAME	W5A CODE	DITZLER	DUPONT	MARTIN SENOUR	SHERWIN-WILLIAMS ACME-ROGERS	INMONT
12DN	Graphite	7701	33870	------	32-16963	33767	16042
19N	Black	848	-----	4428	32-16615	J4-8677 92387	12812
27CN	Dk. Blue	8576	-----	C8562	32-17075	34606	16045
43BN	Med. Sage	8578	45879	D8520	32-17127	35178	-----
43CN	Dk. Sage	8583	45871	------	32-17079	34610	15093
62AN	Lt. Saddle	7769	-----	C8590	32-17086	34729	16043
62BN	Med. Saddle	8806	-----	------	32-17163	35545	-----
62CN	Dk. Saddle	8613	25570	------	32-17081	34612	15096
62DN	Dk. Saddle	8257	25581	------	--------	-----	-----
68CN	Russet	8579	-----	------	32-17087	34759	-----
72CN	Carmine	8577	-----	C8563	32-17076	34607	16046
79CN	Claret	4887	51085	C8560	32-16751	30814	12818
82CN	Med. Gray	8247	33873	C8556	32-16965	33769	14088
82DN	Dk. Gray	8595	33874	------	32-17080	34611	15095

G20019-2C

Fig. 6 Interior Color Chart - Low Gloss

SECTION 3

STEERING, SUSPENSION, TIRES AND WHEELS DIAGNOSIS

CONTENTS

GENERAL INFORMATION

Since the problems in steering, suspension, wheels and tires 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
- Steering universal joints from the column to the rack and pinion for loose connectors or wear
- Coupling from the column to the steering gear for loose connectors or wear
- Front and rear suspension, and the rack and pinion 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
- Rear axle alignment
- Rack and pinion 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 (Manual)

Inspect

- Lack of lubrication – ball joints, tie rod ends and rack and pinion
- Front-wheel alignment
- Rack and pinion adjustment

Too Much Play In Steering

Inspect

- Wheel bearings worn
- Rack and pinion attachments loose
- Worn or loose steering intermediate shaft
- Steering gear loose on frame
- Worn or loose steering shaft coupling or joints
- Steering gear adjustments

Poor Returnability (Manual)

Inspect

- Lack of lubrication – ball joints and tie rod ends
- Bind in ball joints
- Bind in steering column
- Lack of lubricant, rack and pinion
- Front-wheel alignment
- Rack and pinion adjustment

Abnormal Noise, Front End

Inspect

- Lubrication – ball joints and tie rod ends
- Damaged strut or mountings
- Worn control arm bushings or tie rod ends
- Loose stabilizer bar
- Loose wheel nuts
- Loose suspension bolts
- Wheel covers
- Rack and pinion adjustment
- Worn 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 bar
- Broken or sagging springs
- Rack and pinion adjustment
- 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 bar
- 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 housing
- Frame or underbody alignment incorrect

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 "over-center" adjustment

MANUAL RACK AND PINION DIAGNOSIS

Excessive Play or Looseness in Steering System

Inspect

- Rack and pinion adjustment
- Wheel bearings worn
- Tie rod end loose
- Rack and pinion mounting loose

Rattle or Chucking Noise in Rack and Pinion

Inspect

- Insufficient or improper lubricant in rack and pinion
- Rack and pinion attachment loose
- Rack bearing adjustment loose

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
- Transaxle linkage adjustment incorrect
- 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

- Intermediate shaft pinch bolts not tightened, tighten pinch bolts to specifications
- Steering gear flange pinch bolts not tightened, tighten pinch bolts to specifications
- 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 8A-110 for turn signal switch electrical troubleshooting.

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 8A-110 for electrical troubleshooting.

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 connection 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 8A-110 for electrical troubleshooting.

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 8A-110 for electrical troubleshooting.

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 8A-110 for electrical troubleshooting.

Turn Signal Lights Flash Very Slowly

- 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 8A-110 for electrical troubleshooting.

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 8A-110 for electrical troubleshooting.

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-84 for electrical troubleshooting.
2. Open in chassis wiring. Check by separating chassis-to-column connector. Connect terminals "E" and "F" female contacts on the chassis side (Fig. 1) (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" connector contacts (Fig. 2). 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.
   - 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

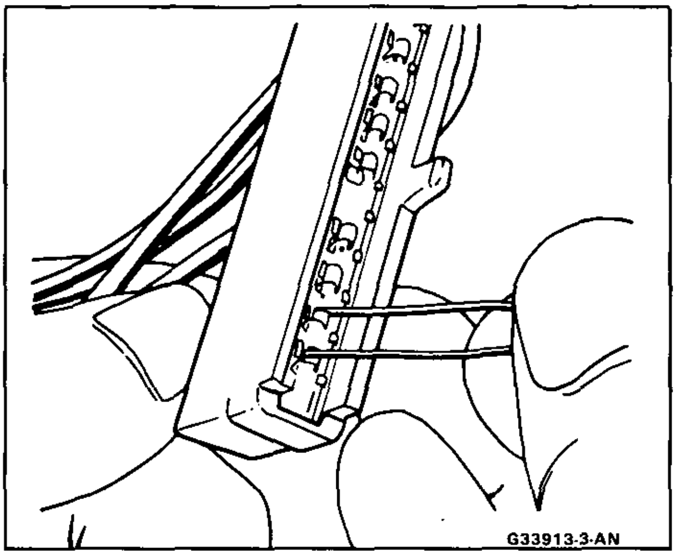


Fig. 1 Checking Reminder at Chassis Connector

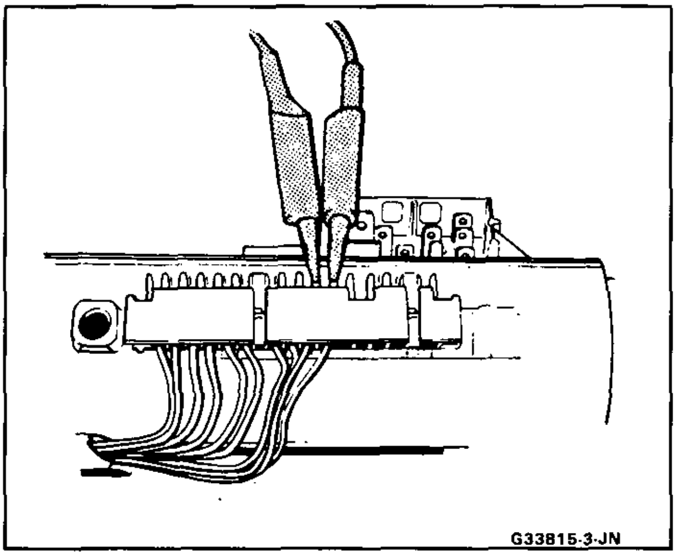


Fig. 2 Checking Reminder at Column Connector

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 connector with jumper (Fig. 2). Check reminder switch pads with continuity meter (Fig. 3). If contact is made, 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 (Fig. 4). 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.

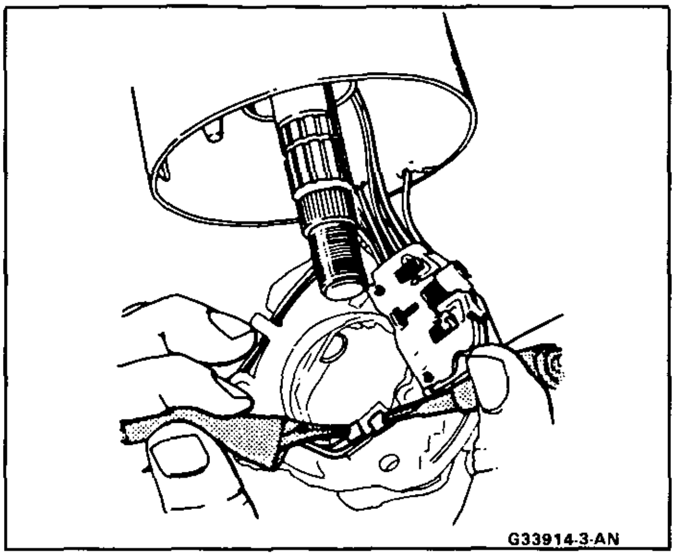


Fig. 3 Checking Reminder Switch Pads

6. Damaged lock cylinder. With the lock cylinder removed, push the key all the way in, then remove it. The actuator tip (Figs. 3 and 5) 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.

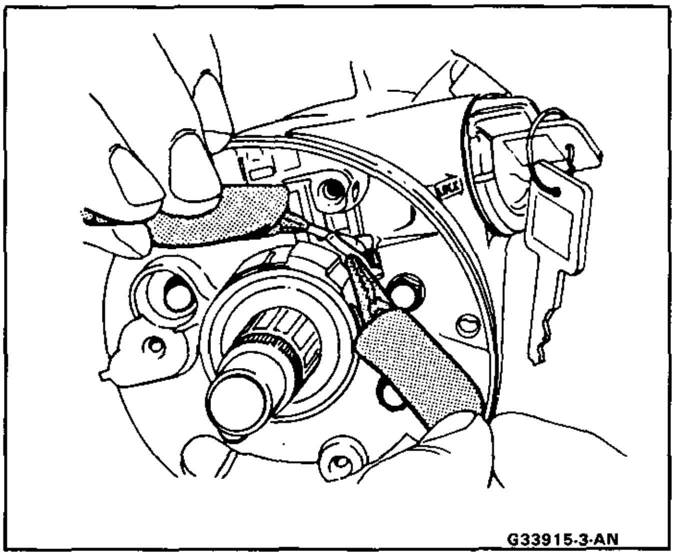


Fig. 4 Checking Reminder Switch

7. Switch appears good but will not operate. Connect continuity meter leads to the reminder switch probes. Press on the actuator pad until the interior points contact (Fig. 7). If contact is not made, replace reminder switch.
8. If the switch contact gap is too large, reset the contact gap by pressing a 0.8 mm (.030") wire-type plug gage with a flat piece of stock onto the actuator pad (Fig. 8). If contact is not made, adjust the switch as shown in Fig. 9 until positive contact is made. Use a continuity meter (light).

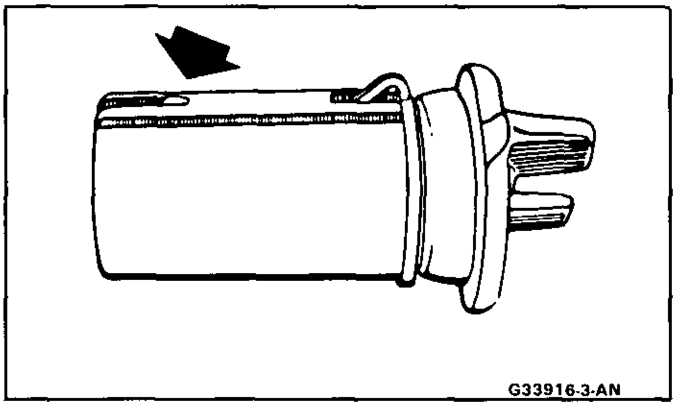


Fig. 5 Lock Cylinder Actuator – Key Removed

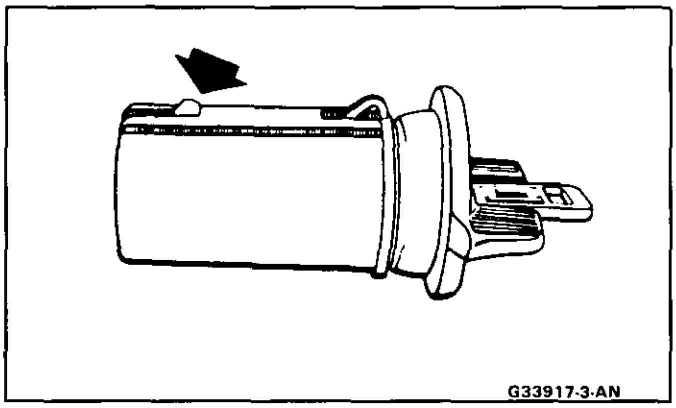


Fig. 6 Lock Cylinder Actuator – Key in Place

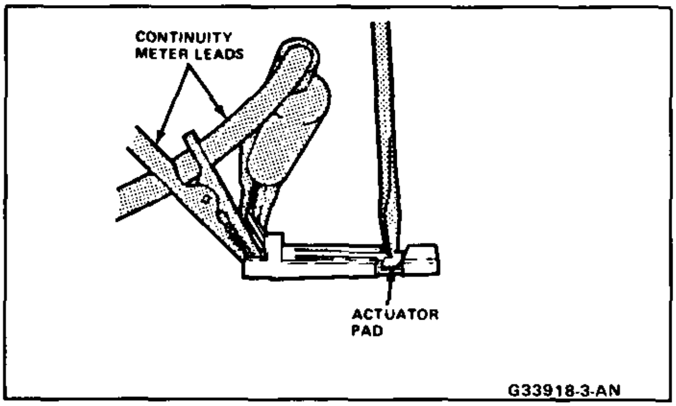


Fig. 7 Checking Switch Continuity

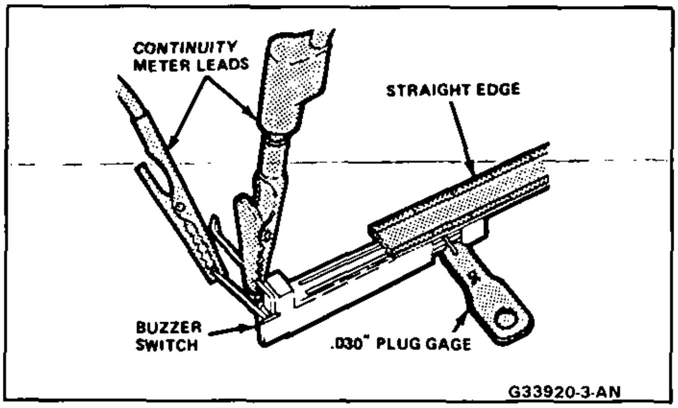


Fig. 8 Checking Contact Gap

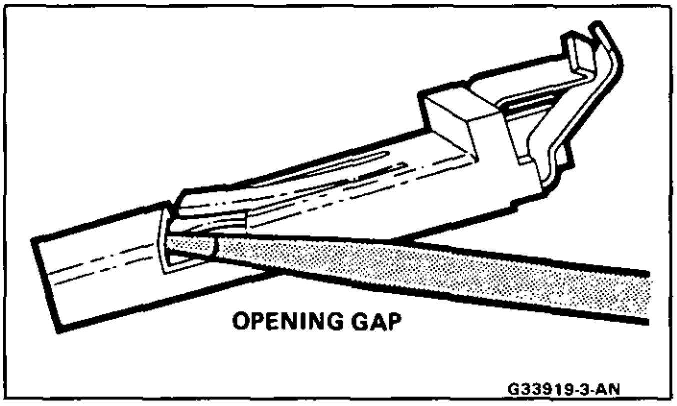


Fig. 9 Adjusting Contact Gap

9. With positive contact at 0.8 mm (.030"), use a 0.6 mm (.025") plug gap wire beneath the flat stock (Fig. 10). No contact should occur. If contact is made, adjust as shown in Fig. 11. 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.

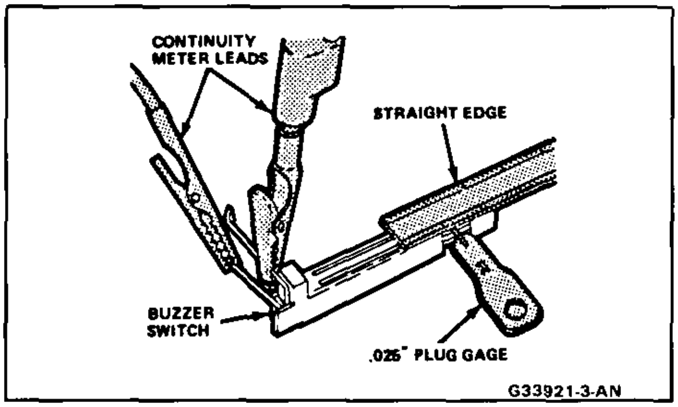


Fig. 10 Checking Contact Gap

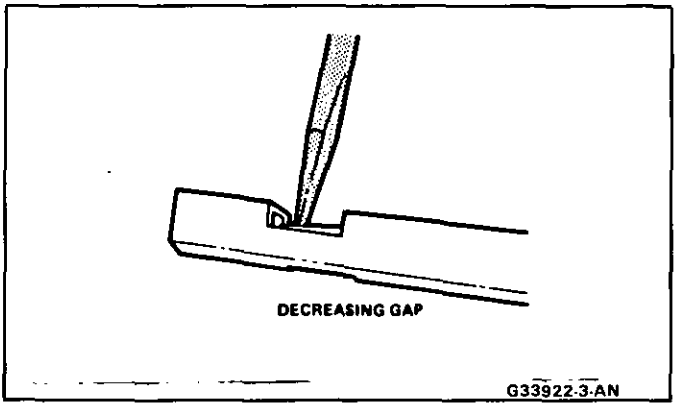


Fig. 11 Adjusting Contact Gap

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 connector contacts, with the key removed from the lock cylinder (Fig. 2). 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 8A-100 for electrical troubleshooting.

PIVOT AND SWITCH ASSEMBLY - WASHER/WIPER CONTROL

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 8A-90 for electrical troubleshooting.

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

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.

Noisy

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.

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.

The bench check is the same as that given for the Electronic Level Control strut dampeners/ shock absorbers, with the following exception.

Clamp the strut dampener/shock UPSIDE DOWN in the vise. If a lag is noticed when it is stroked, it means the gas-filled cell has ruptured and replacement is necessary.

TIRE DIAGNOSIS

Irregular and/or Premature Wear

Figs. 12 and 13

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.

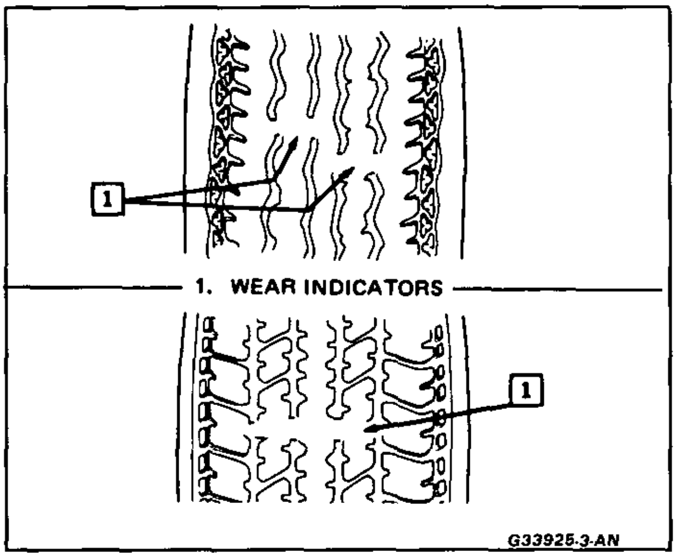


Fig. 12 Tire Wear Indicator

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. 12

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.

Radial Tire Waddle

Fig. 14

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. 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.

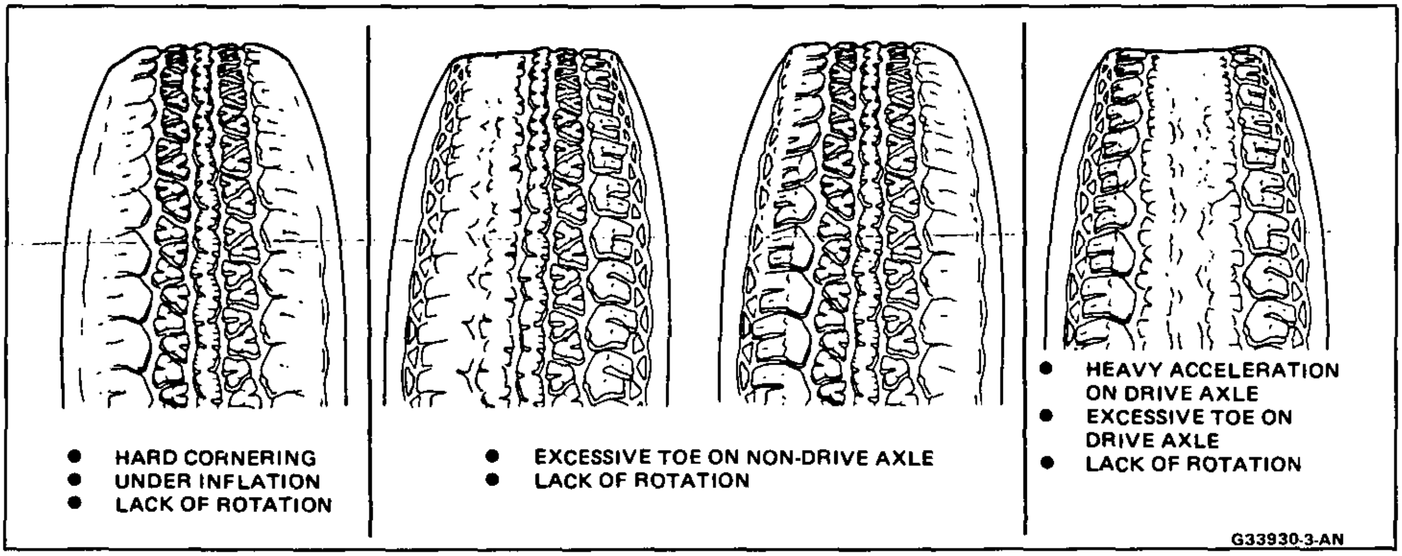


Fig. 13 Tire Wear Diagnosis

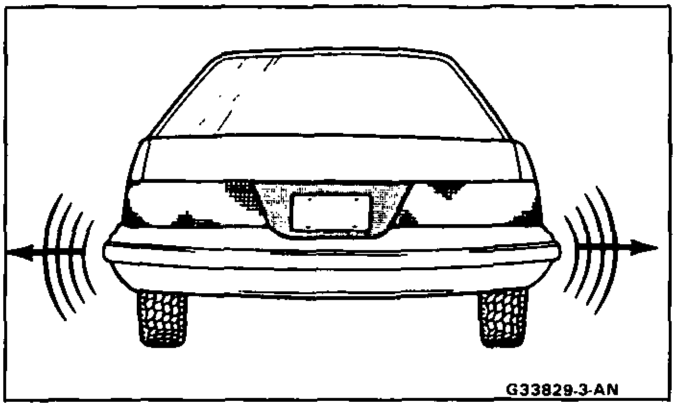


Fig. 14 Tire Waddle

Radial Tire Lead/Pull

Fig. 15

"Lead" is the deviation of the car from a straight path, on a level road with no pressure on the steering wheel.

Lead is usually caused by:

1. Wheel alignment.
2. Uneven brake adjustment.
3. Tire construction.

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. 16 through 18 for vibration diagnosis.

SEALED WHEEL BEARING DIAGNOSIS

See Fig. 19 for Sealed Wheel Bearing Diagnosis.

TAPERED ROLLER BEARING DIAGNOSIS

See Figs. 20 and 21 for Tapered Roller Bearing Diagnosis.

TRIM HEIGHT DIAGNOSIS

See Fig. 22 for Trim Height Diagnosis.

REAR-WHEEL DRIVE
RADIAL TIRE LEAD/PULL CORRECTION CHART

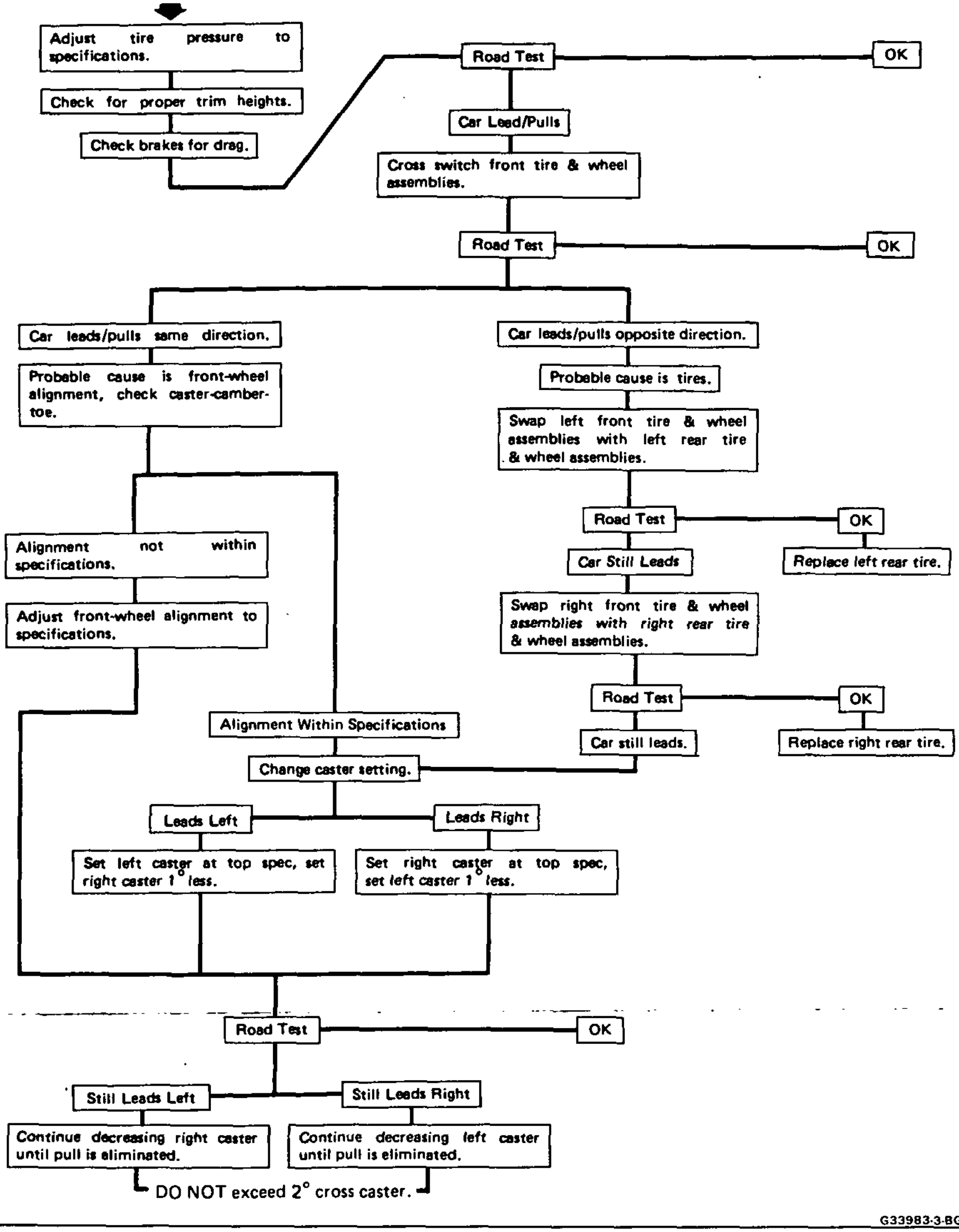


Fig. 15 Radial Tire Lead/Pull Diagnosis – Rear-Wheel Drive

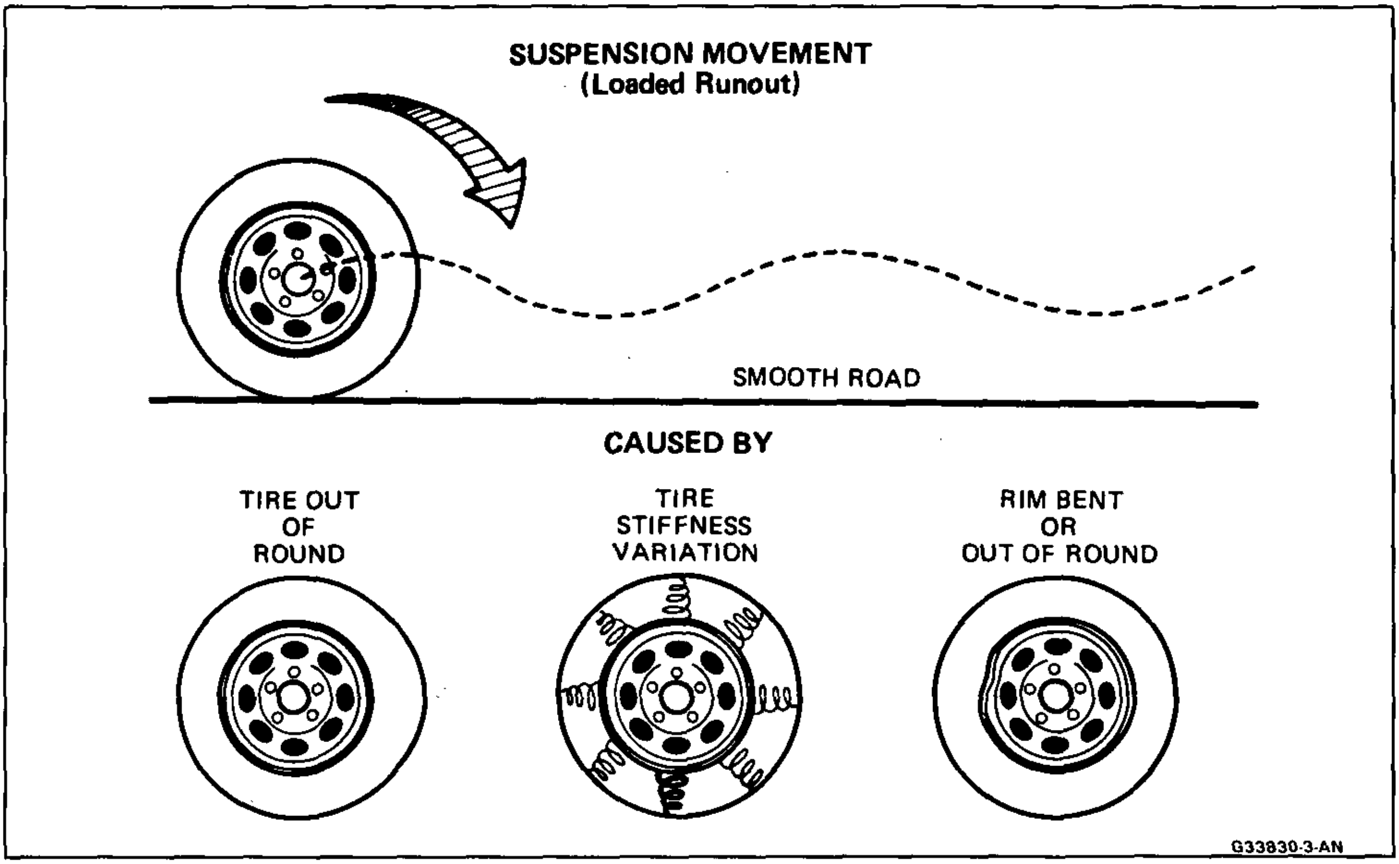


Fig. 16 Causes of Vibrations

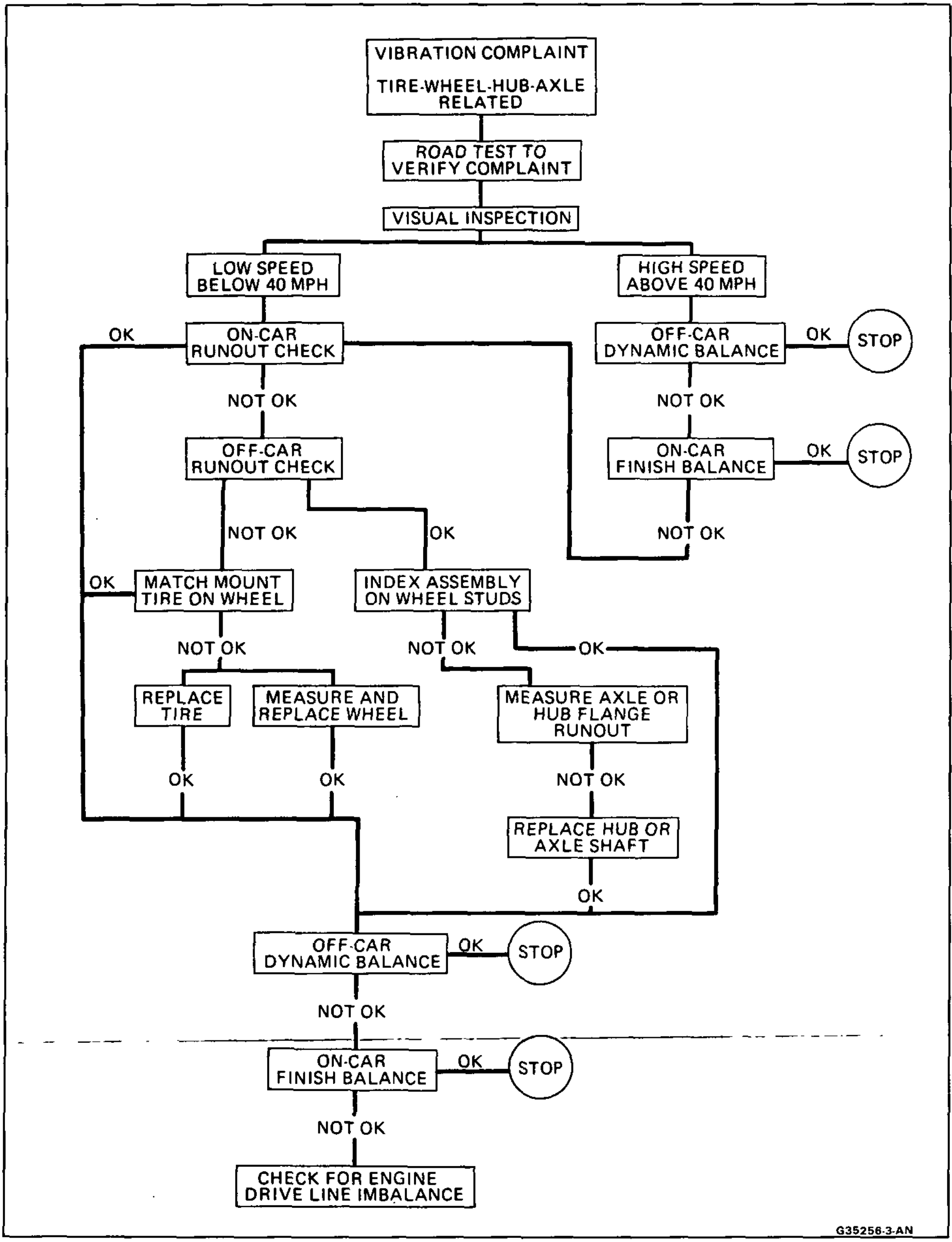


Fig. 17 Vibration Complaint Chart (1 of 2)

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 lateral runout related. Highway speed vibrations, those above 40 mph, can be caused by either imbalance or runout.

Dynamic imbalance tends to "double" itself. If dynamic imbalance is noted at 30 mph, it also will be observed at 60 mph.

The tire and wheel assemblies with the least lateral runout or dynamic imbalance should be mounted on the front.

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 balance 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 .060" 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 .060", 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". If not, proceed to Step D.

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 stud bolts 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 hub or axle shaft flange runout with the dial indicator. 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 under load with a roller drum off the car 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.

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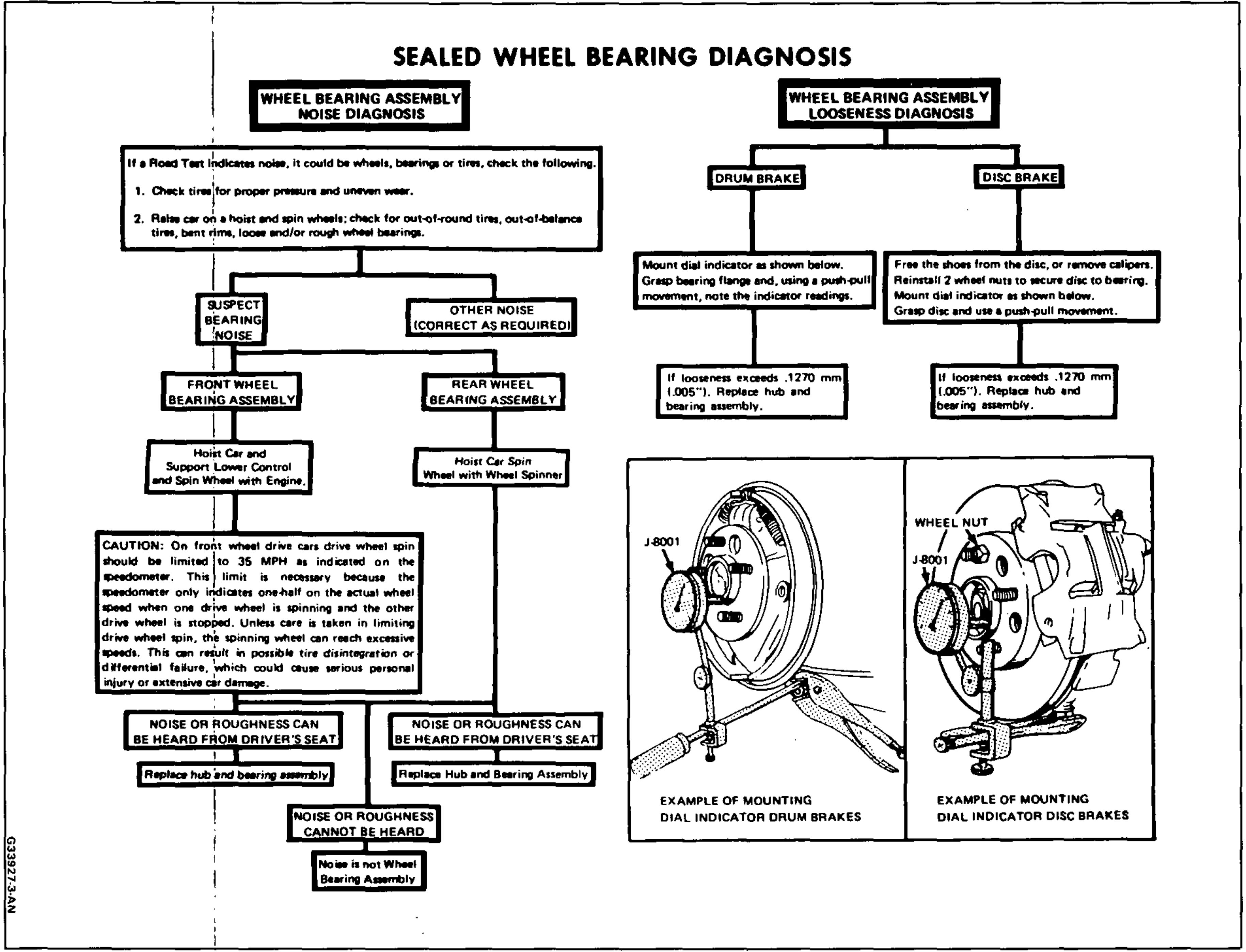
Fig. 18 Vibration Complaint Chart (2 of 2)



SEALED WHEEL BEARING DIAGNOSIS

WHEEL BEARING ASSEMBLY NOISE DIAGNOSIS

If a Road Test indicates noise, it could be wheels, bearings or tires, check the following.

1. Check tires for proper pressure and uneven wear.
2. Raise car on a hoist and spin wheels; check for out-of-round tires, out-of-balance tires, bent rims, loose and/or rough wheel bearings.

CAUTION: On front wheel drive cars drive wheel spin should be limited to 35 MPH as indicated on the speedometer. This limit is necessary because the speedometer only indicates one-half on the actual wheel speed when one drive wheel is spinning and the other drive wheel is stopped. Unless care is taken in limiting drive wheel spin, the spinning wheel can reach excessive speeds. This can result in possible tire disintegration or differential failure, which could cause serious personal injury or extensive car damage.

WHEEL BEARING ASSEMBLY LOOSENESS DIAGNOSIS

DRUM BRAKE: Mount dial indicator as shown below. Grasp bearing flange and, using a push-pull movement, note the indicator readings.

If looseness exceeds .1270 mm (.005"). Replace hub and bearing assembly.

DISC BRAKE: Free the shoes from the disc, or remove calipers. Reinstall 2 wheel nuts to secure disc to bearing. Mount dial indicator as shown below. Grasp disc and use a push-pull movement.

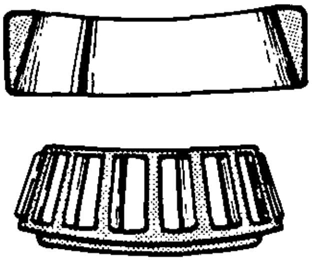
If looseness exceeds .1270 mm (.005"). Replace hub and bearing assembly.

Fig. 19 Sealed Wheel Bearing Diagnosis

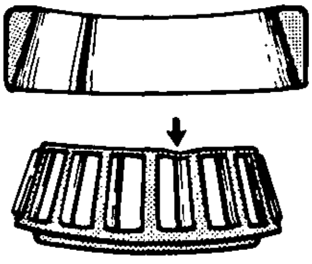
TAPERED ROLLER BEARING DIAGNOSIS

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.



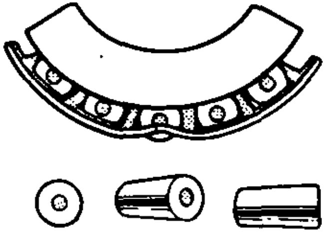
GOOD BEARING



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

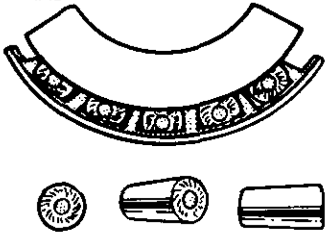
REPLACE BEARING.



BENT CAGE

CAGE DAMAGE DUE TO IMPROPER HANDLING OR TOOL USAGE.

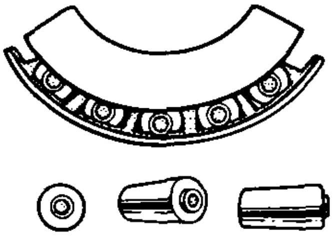
REPLACE BEARING.



GALLING

METAL SMEARS ON ROLLER ENDS DUE TO OVERHEAT, LUBRICANT FAILURE OR OVERLOAD.

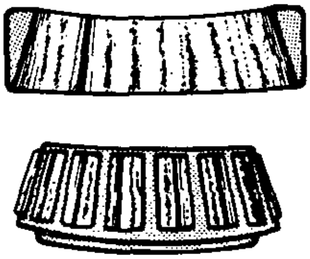
REPLACE BEARING – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



ABRASIVE STEP WEAR

PATTERN ON ROLLER ENDS CAUSED BY FINE ABRASIVES.

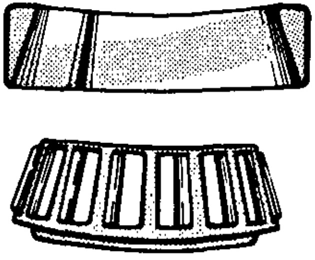
CLEAN ALL PARTS AND HOUSINGS, CHECK SEALS AND BEARINGS AND REPLACE IF LEAKING, ROUGH OR NOISY.



ETCHING

BEARING SURFACES APPEAR GRAY OR GRAYISH BLACK IN COLOR WITH RELATED ETCHING AWAY OF MATERIAL USUALLY AT ROLLER SPACING.

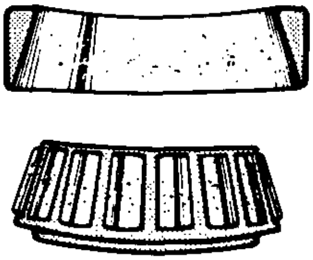
REPLACE BEARINGS – CHECK SEALS AND CHECK FOR PROPER LUBRICATION.



MISALIGNMENT

OUTER RACE MISALIGNMENT DUE TO FOREIGN OBJECT.

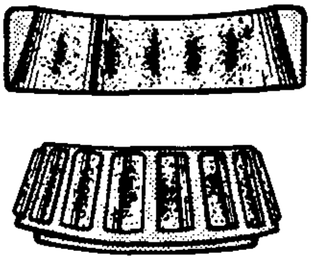
CLEAN RELATED PARTS AND REPLACE BEARING. MAKE SURE RACES ARE PROPERLY SEATED.



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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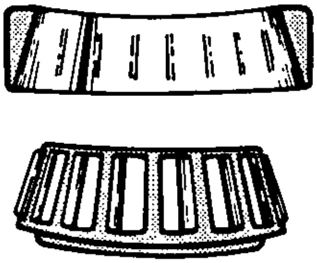
Fig. 20 Tapered Roller Bearing Diagnosis (1 of 2)

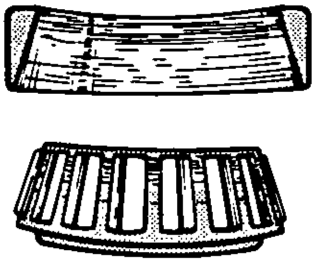
TAPERED ROLLER BEARING DIAGNOSIS - CONT'D



BRINELLING

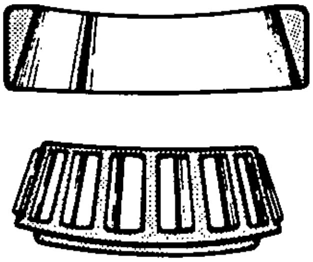
SURFACE INDENTATIONS IN RACEWAY CAUSED BY ROLLERS EITHER UNDER IMPACT LOADING OR VIBRATION WHILE THE BEARING IS NOT ROTATING.

REPLACE BEARING IF ROUGH OR NOISY.



CAGE WEAR

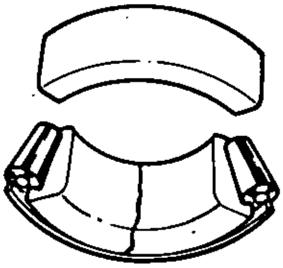
WEAR AROUND OUTSIDE DIAMETER OF CAGE AND ROLLER POCKETS CAUSED BY ABRASIVE MATERIAL AND INEFFICIENT LUBRICATION. CHECK SEALS AND REPLACE BEARINGS.



ABRASIVE ROLLER WEAR

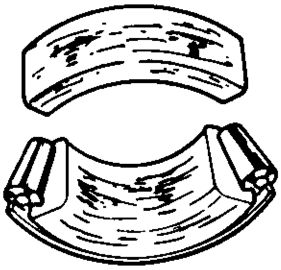
PATTERN ON RACES AND ROLLERS CAUSED BY FINE ABRASIVES.

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.

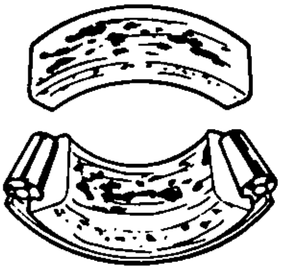


SMEARS

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.

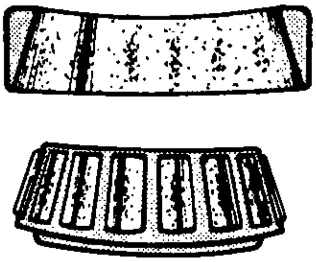
REPLACE SHAFT IF DAMAGED.



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.



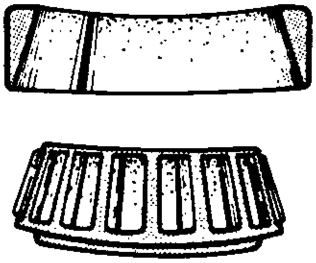
HEAT DISCOLORATION

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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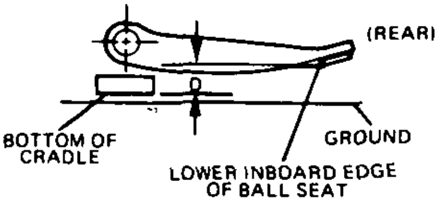
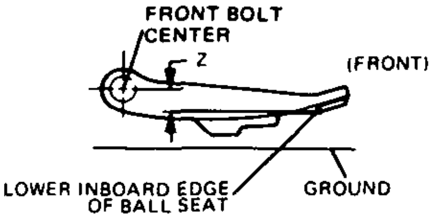
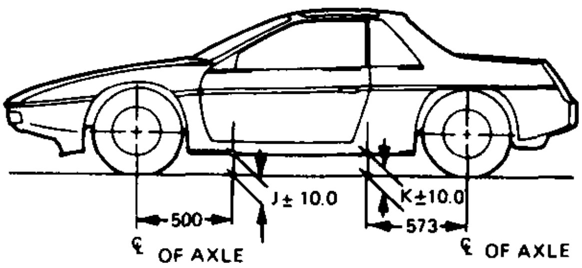
Fig. 21 Tapered Roller Bearing Diagnosis (2 of 2)

TRIM HEIGHT SPECIFICATIONS







ALL MODELS	Z	D	J	K
SUSP TIRE SIZE	SHIPPED	SHIPPED	SHIPPED	SHIPPED
P195/70R 14	48	13	193	188
P185/80R 13	50	12	193	188
P215/60R 14	57	5	193	188

CHECKING VEHICLE TRIM HEIGHTS

SET TIRE PRESSURE TO AGREE WITH VEHICLE TIRE PRESSURE STICKER FOR LOADING "UP TO VEHICLE CAPACITY".

"Z" & "J" DIMENSIONS – LIFT FRONT OF VEHICLE UP APPROXIMATELY 38.0. GENTLY REMOVE HANDS AND LET VEHICLE SETTLE. REPEAT TWICE FOR A TOTAL OF 3 TIMES. MEASURE "Z" & "J" DIMENSIONS. PUSH FRONT OF VEHICLE DOWN APPROXIMATELY 38.0. GENTLY REMOVE HANDS AND LET VEHICLE RISE ON ITS OWN. REPEAT TWICE FOR A TOTAL OF 3 TIMES. MEASURE "Z" & "J" DIMENSIONS.

TRUE HEIGHTS ARE THE AVERAGE OF THE HIGH & LOW MEASUREMENTS.

"D" & "K" DIMENSIONS – LIFT REAR OF VEHICLE UP APPROXIMATELY 38.0. GENTLY REMOVE HANDS AND LET VEHICLE SETTLE ON ITS OWN. REPEAT TWICE FOR A TOTAL OF 3 TIMES. MEASURE THE "D" & "K" DIMENSIONS. PUSH REAR OF VEHICLE DOWN APPROXIMATELY 38.0. GENTLY REMOVE HANDS AND LET VEHICLE RISE ON ITS OWN. REPEAT TWICE FOR A TOTAL OF 3 TIMES. MEASURE "D" & "K" DIMENSIONS.

TRUE HEIGHTS ARE THE AVERAGE OF THE HIGH & LOW MEASUREMENTS.

LOAD CONDITIONS

SHIPPING WEIGHT – VEHICLE IS BUILT TO PARTS LIST SPECIFICATIONS INCLUDING COOLANT TO CAPACITY AND 11.4 LITERS OF GASOLINE.

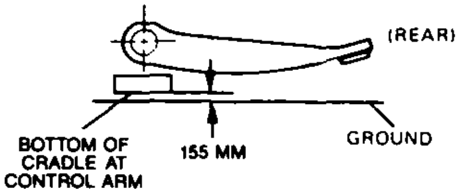
CURB WEIGHT – VEHICLE IS BUILT TO PARTS LIST SPECIFICATIONS INCLUDING COOLANT TO CAPACITY AND FULL TANK OF GASOLINE.

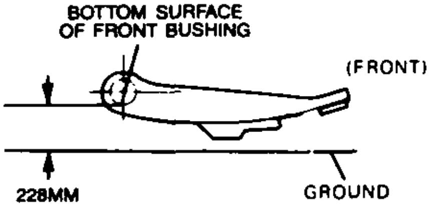
VEHICLE HEIGHT FOR SUSPENSION ALIGNMENT

SET TIRE PRESSURE TO AGREE WITH VEHICLE TIRE PRESSURE STICKER FOR LOADING "UP TO CAPACITY."

SET VEHICLE HEIGHT TO OBTAIN MEASUREMENTS GIVEN AT THE RIGHT. DEPENDING ON ALIGNMENT EQUIPMENT THIS MAY BE POSSIBLE BY USING BLOCKS OR PINS BETWEEN SOME PORTION OF THE BODY AND THE FLOOR. IT IS SUGGESTED THAT TWO BLOCKS BE USED IN THE REAR NEAR THE SIDES OF THE VEHICLE AND ONE BLOCK BE USED IN THE FRONT ON THE CENTERLINE OF THE VEHICLE.

IF VEHICLE HEIGHT CHANGES ARE REQUIRED DO NOT APPLY FORCE TO SUSPENSION COMPONENTS OR THE REAR CRADLE. ALIGNMENT READINGS WILL BE AFFECTED.





G20008-3

Fig. 22 Trim Heights Diagnosis

SECTION 3A

WHEEL ALIGNMENT

CONTENTS

GENERAL DESCRIPTION

ALIGNMENT

Front

Front alignment refers to the angular relationship between the front wheels, the front suspension attaching parts and the ground. The angle of the knuckle away from the vertical, the pointing in or "toe-in" of the front wheels, the tilt of the front wheels from vertical (when viewed from the front of the vehicle) and the tilt of the suspension members from vertical (when viewed from the side of the vehicle), all these are involved in front alignment.

Rear

Rear alignment refers to the angular relationship between the rear wheels, the rear suspension attaching parts and the ground. Camber and toe in are the only adjustments required.

Front and Rear Alignment Requirements

Satisfactory vehicle operation may occur over a wide range of (wheel) alignment settings. Nevertheless, should settings vary beyond certain tolerances, readjustment of alignment is advisable. The specifications stated in column 2 of the applicable vehicle chart in the specifications section of this manual should be used by owners, dealers and repairmen as guidelines in vehicle diagnosis either for repairs under the new vehicle warranty or for maintenance service at customer's request. These specifications provide an acceptable all-around range in that they prevent abnormal tire wear caused by improper wheel alignment.

Governmental Periodic Motor Vehicle Inspection programs usually include wheel alignment among items that are inspected. To provide useful information for such inspections, the specifications stated in column 2 of the aforesaid applicable chart are given and these are well within the range of safe vehicle operation.

In the event the actual settings are beyond the specifications set forth in column 2, or whenever for other reasons the alignment is being reset, it is recommended that the specifications given in column 3 of the applicable chart be used.

ALIGNMENT PRELIMINARY STEPS

Front and Rear

The Pontiac Fiero is designed with independent rear suspension that is service adjustable, making four-wheel alignment possible. This is different from all other Pontiac models, both FWD and RWD, which have solid rear axles with fixed alignment.

Several different types of machines are available for checking all the factors of front end alignment. The alignment should be performed according to the instructions that are furnished with each particular machine. Adjustments should be made with the vehicle level, and at curb weight.

Rear wheel alignment on Fiero can be performed by backing the car onto a two-wheel aligner, or by using the new, more efficient four-wheel aligners some of which are illustrated in the GM dealer equipment catalog. If the vehicle must be backed onto alignment equipment and equipment does not compensate for rear toe measurements, toe-in will read on the equipment as toe-out.

Whenever a tire wear or handling condition is encountered, rear alignment should be measured and reset if necessary. Excessive toe-in or toe-out can cause irregular or premature wear. For best tire wear, toe-in should always be set to the low end of the specification.

Since steering complaints are not always the result of improper alignment, a check should be made to see if any of the following conditions exist. Any such conditions should be corrected before proceeding further.

1. Steering gear loose or improperly adjusted.
2. Steering gear housing loose at frame.
3. Excessive wear or play in spherical joints.
4. Tie rod, toe links or steering connections loose.
5. Improper front spring heights, or improper operation of struts.

6. Unbalanced or underinflated tires.
7. Inconsistant tread wear.
8. Improperly adjusted wheel bearings.
9. Run out of wheels and tires.
10. Shock absorbers not operating properly.
11. Vehicle trim heights.
12. Loose control arms.
13. Consideration must be given to excess loads, such as tool boxes. If this excess load is normally carried in the car it should remain in the car during alignment checks.
14. Consider the condition of the equipment being used to check alignment.
15. Regardless of equipment used to check alignment, the car must be on a level surface both fore an aft and transversely.

Camber Adjustment

Figure 1

Camber is the tilting of the wheels from the vertical when viewed from the rear 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.

Front

Camber angle can be increased approximately 1° by removing the upper ball joint, rotating it one-half turn, and reinstalling it with the flat of the upper flange on the inboard side of the control arm. See Figure 1.

Rear

1. Position the vehicle on your alignment equipment, and follow the manufacturers instructions to obtain a camber reading.
2. Use appropriate sockets and extensions to reach around both sides of the tire and LOOSEN both strut-to-knuckle bolts enought to allow movement between the strut and the knuckle. Remove the tools.
3. Grasp the top of the tire firmly, and move it inboard or outboard until the correct camber is obtained.
4. Again reach around the tire, as in Step 2, and tighten both bolts to 190 N·m (140 lb.ft.).
5. If the accessibility to the bolts prevents applying complete torque, it will be necessary to apply only PARTIAL torque (just enough to hold the correct camber position), then to remove the wheel-and-tire in order to apply FINAL torque. After complete torquing, install the wheel-and-tire.
6. Repeat on other side.

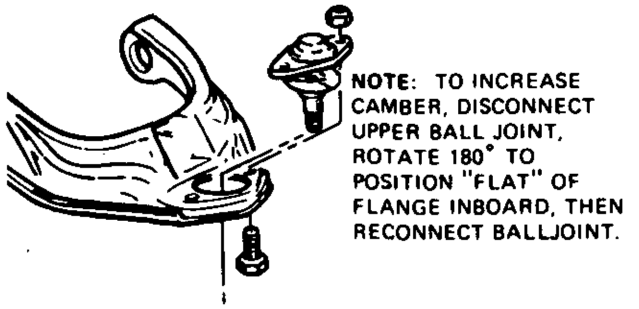


Fig. 1 Upper Ball Joint/Camber Adjustment (Front)

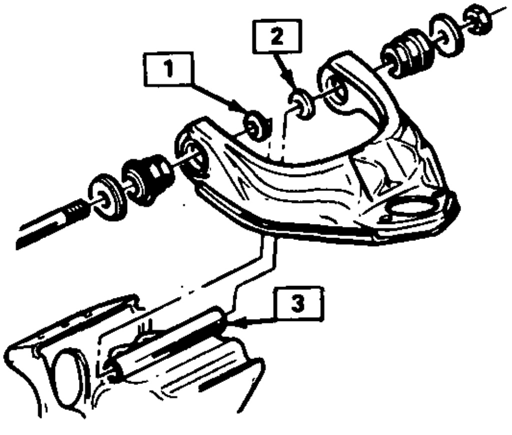
Caster Adjustment

(Figure 2)

Front

Caster angle can be changed with a realignment of washers located between the legs of the upper control arm. For adjustment, a kit containing two washers, one of 3mm thickness and one of 9mm thickness, must be used. Install as shown in Figure 2 to adjust caster. See Section 3C for Upper Control Arm Removal and Installation.

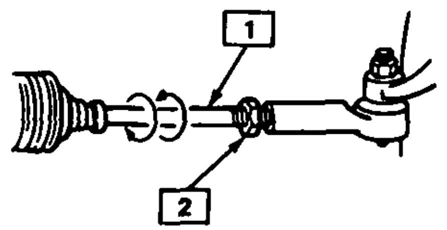
SERVICE CHANGE		
FRONT	REAR	NET CHANGE
3MM	9MM	+1°
9MM	3MM	-1°



1—FRONT WASHER
2—REAR WASHER
3—LOCATING TUBE (LOCATES UPPER CONTROL ARM-TO-FRONT SUSPENSION UNIT)

Fig. 2 Caster Adjustment (Front)

Whenever adjusting caster, it is important to **always use two washers** totaling 12mm thickness, with one washer at each end of locating tube.



1—ADJUST TOE-IN BY ROTATING
2—LOOSEN NUT TO ADJUST TOE-IN

520034-3A

Fig. 3 Adjusting Toe-In (Front and Rear) Typical

Toe-In Adjustment

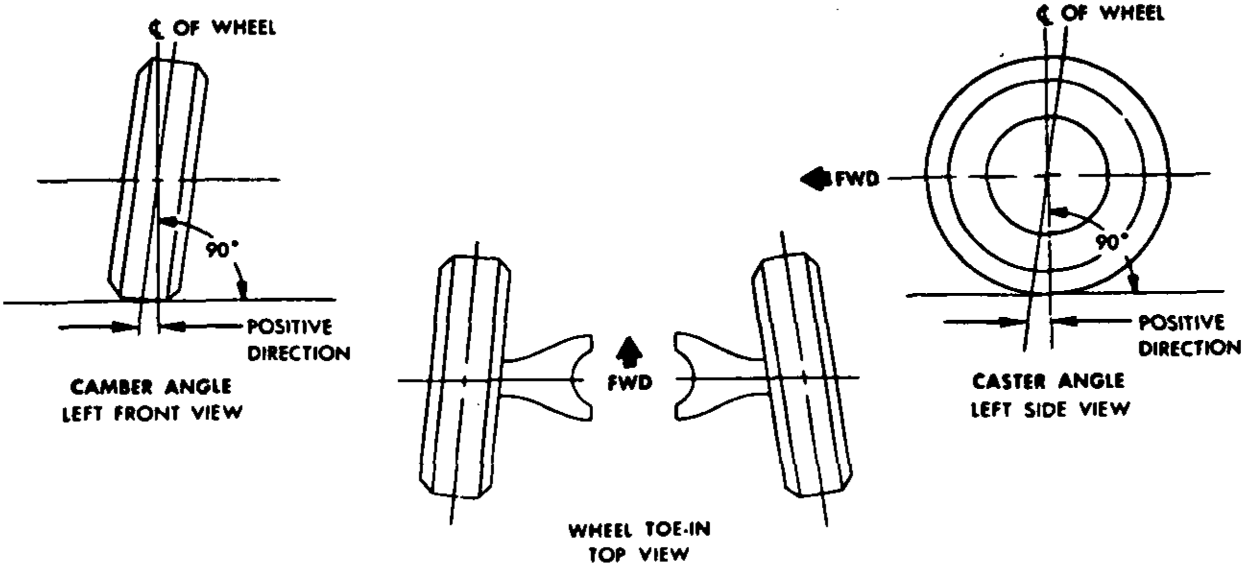
(Figure 3)

Toe-in is the turning in of the wheels. The actual amount of toe-in is normally only a fraction of a degree. The purpose of a toe specifications is to ensure parallel rolling of the rear wheels. (Excessive toe-in or toe-out may increase tire wear). Toe-in also serves to offset the small deflections of the wheel support system which occurs when the car is rolling forward. In other words, even when the wheels are set slightly to toe-in when the car is standing still, they tend to roll parallel on the road when the car is moving.

Front and Rear

1. Position the car on your alignment equipment, and follow the manufacturer's instructions to obtain a toe-in reading.
2. Loosen the jam nuts on the toe link rod.
3. Rotate the toe link rods to adjust the toe to specifications.
4. Tighten the jam nuts to 64 N·m (47 lb.ft.).

NOTICE: Care must be taken that the boots are not twisted, or damage to the boot may result.



520027-3A

Fig. 4 Caster, Camber and Toe-In

		SPECIFICATIONS FOR DIAGNOSIS FOR WARRANTY REPAIRS OR CUSTOMER PAID SERVICE
TOE	DEG (PER WHEEL)	+0.15° ± 0.1°
CAMBER	FRONT	+0.5° ± 0.8°
CASTER	FRONT	+5.0° ± 2.0°
CAMBER	REAR	−1.0° ± 0.5°
TOE	DEG (PER WHEEL) REAR	+0.15° ± 0.1°

- 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 with ± 5.0°.
- Cross car camber must be within 1 degree.

G20010-3A

Fig. 5 Alignment Specifications

SECTION 3B2

MANUAL RACK AND PINION

NOTICE: All steering gear 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

GENERAL DESCRIPTION

The rack and pinion steering system consists of two main components, the rack and the pinion. The motion of turning the steering wheel is transferred to the pinion. The pinion teeth mesh with teeth on the rack, moving the rack. The force is then transmitted through the inner and outer tie rods to the steering knuckles which turn the wheels.

MANUAL RACK AND PINION ASSEMBLY

Figure 1

Remove or Disconnect

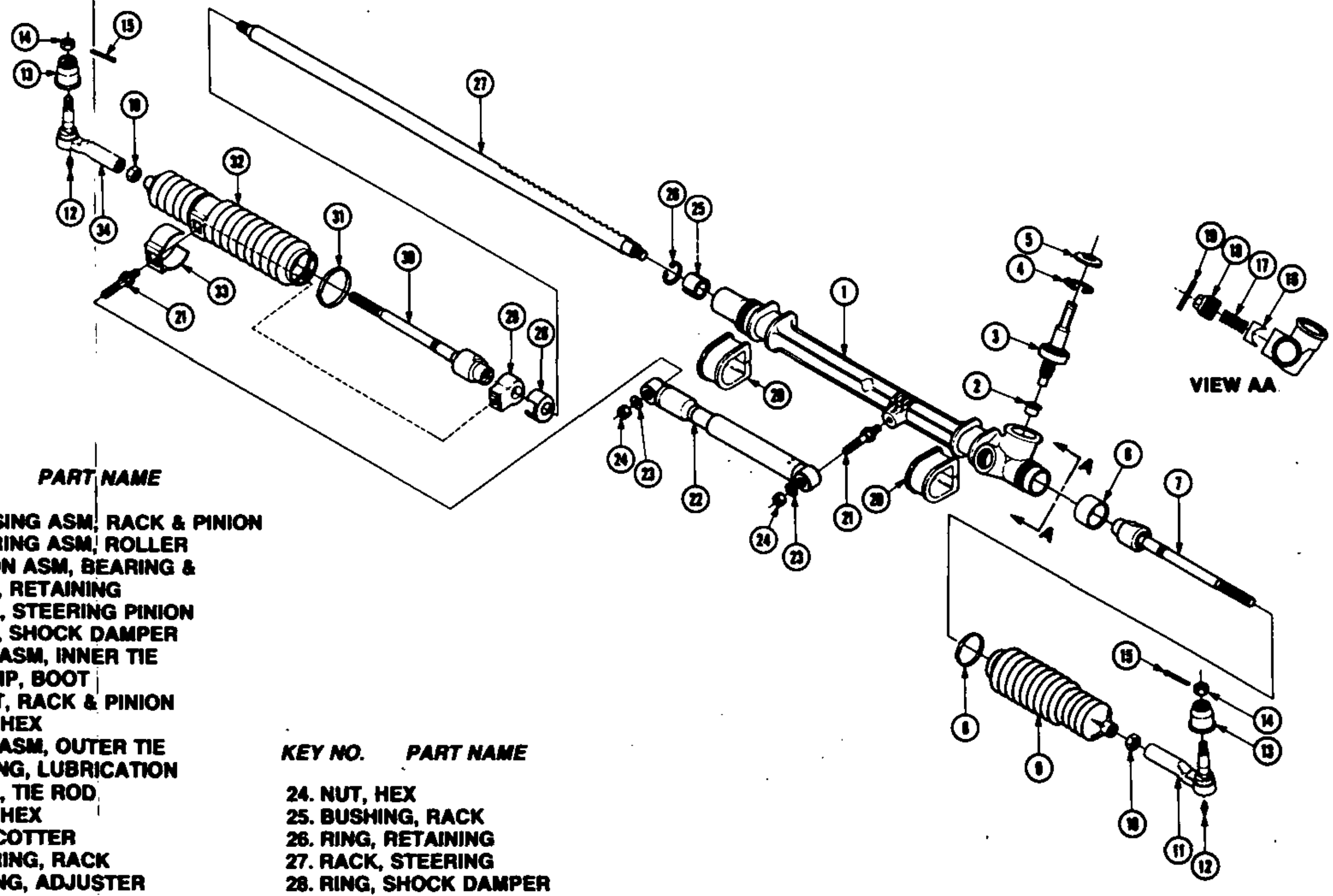
1. Raise vehicle.
2. Both front cross member braces.
3. Flexible coupling pinch bolt to shaft.
4. Outer tie rod cotter pins and nuts on left and right sides. (See Section 3C).
5. Disconnect tie rods from steering knuckles. (See Section 3C)
6. Four bolts holding steering assembly to cross member.
7. Steering assembly.

Install or Connect

1. Position steering assembly to vehicle, stud shaft in position with flexible coupling.
2. Four new bolts at steering assembly to cross member.
3. Tie rods into the steering knuckles (See Section 3C).
4. Tie rod nut on each knuckle assembly. (See Section 3C).
5. Both front cross member braces.

   Tighten

   - Flexible coupling bolt to 62 N·m (46 lb.ft.).
   - Four steering assembly bolts to 29 N·m (21 lb.ft.).
   - Tie rod nut at each knuckle to 39 N·m (29 lb.ft.) 1/6 turn to align cotter pin.
   - Four cross member brace bolts to 27 N·m (20 lb.ft.).
6. Lower vehicle.



KEY NO.	PART NAME
1.	HOUSING ASM, RACK & PINION
2.	BEARING ASM, ROLLER
3.	PINION ASM, BEARING &
4.	RING, RETAINING
5.	SEAL, STEERING PINION
6.	RING, SHOCK DAMPER
7.	ROD ASM, INNER TIE
8.	CLAMP, BOOT
9.	BOOT, RACK & PINION
10.	NUT, HEX
11.	ROD ASM, OUTER TIE
12.	FITTING, LUBRICATION
13.	SEAL, TIE ROD
14.	NUT, HEX
15.	PIN, COTTER
16.	BEARING, RACK
17.	SPRING, ADJUSTER
18.	PLUG, ADJUSTER
19.	NUT, ADJUSTER PLUG LOCK
20.	GROMMET, MOUNTING
21.	STUD, SHOCK DAMPER
22.	DAMPER ASM, STEERING
23.	WASHER, FLAT

KEY NO.	PART NAME
24.	NUT, HEX
25.	BUSHING, RACK
26.	RING, RETAINING
27.	RACK, STEERING
28.	RING, SHOCK DAMPER
29.	ADAPTER, STEERING DAMPER
30.	ROD ASM, INNER TIE
31.	CLAMP, BOOT
32.	BOOT, RACK & PINION
33.	SUPPORT, BOOT
34.	ROD ASM, OUTER TIE

RACK & PINION STEERING ASSEMBLY

520018-3B2

Fig. 1 Manual Rack and Pinion Steering Assembly

1. REMOVE AND INSTALL OUTER TIE ROD

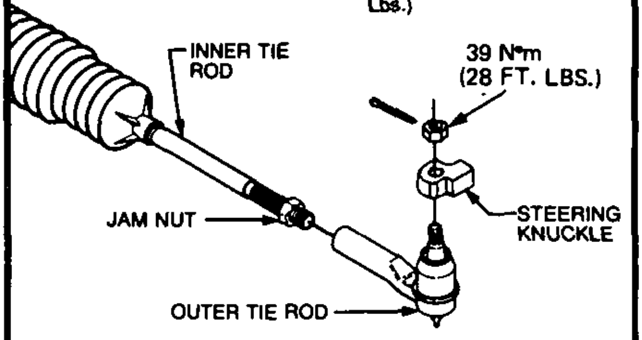
REMOVE

1. Loosen jam nut.
2. Remove tie rod from steering knuckle, using Tool J-24319-01 or BT 7101.
3. Remove outer tie rod.

INSTALL

1. Install parts as shown.
2. Do not tighten jam nut.
3. Make toe-in adjustment by turning inner tie rod.
4. Be sure boot is not twisted.

NOTICE: Torque jam nut to 70 Newton-metres (50 Ft. Lbs.)



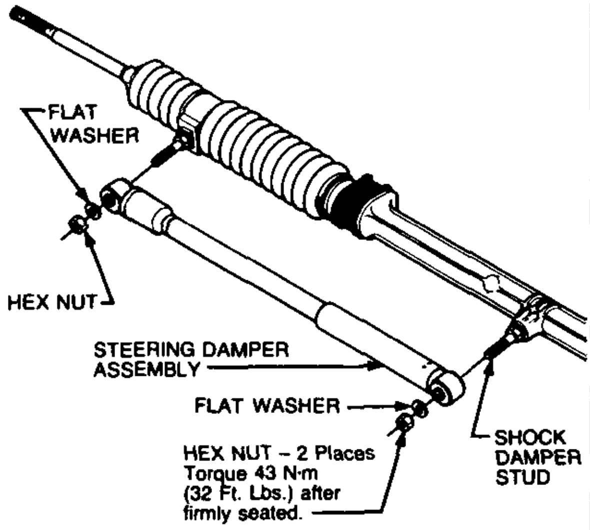
2. REMOVE AND INSTALL STEERING DAMPER ASSEMBLY

REMOVE

1. Hold stud while removing hex nut and flat washer.
2. Remove damper assembly.

INSTALL

1. Install damper assembly.
2. Install flat washers and nuts.
3. Torque to specifications.



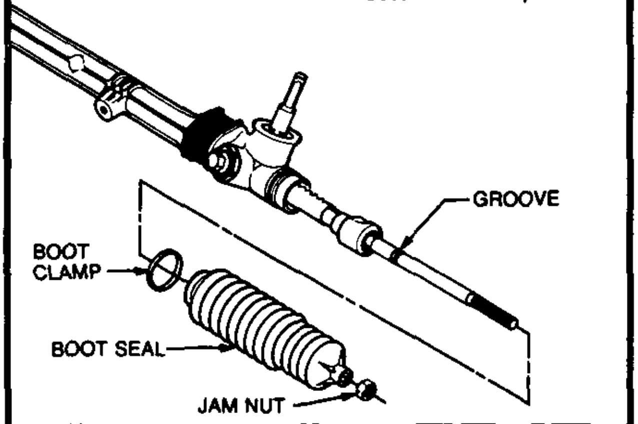
3. REMOVE AND INSTALL BOOT SEAL

REMOVE

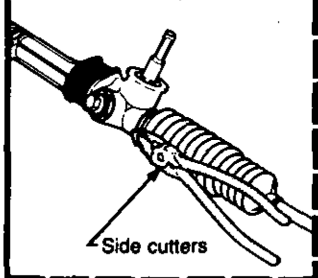
1. Remove jam nut.
2. Cut boot clamp and discard.
3. See insert for proper boot seal removal.

INSTALL

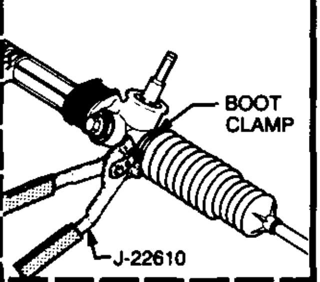
1. Place new clamp on boot before installing boot.
2. See insert for proper installation of boot seal.
3. Engage boot onto housing.
4. Secure boot clamp.



A. Cut boot clamp



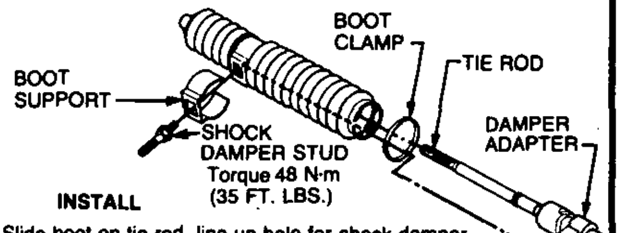
B. Secure boot clamp



C. Right boot seal removal

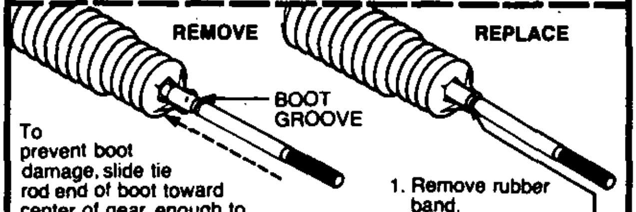
REMOVE

After cutting clamp, stud must be removed before seal removal.



INSTALL

Slide boot on tie rod, line up hole for shock damper stud. (Be sure boot seal is engaged on adapter). Install boot support and stud, torque to spec.



To prevent boot damage, slide tie rod end of boot toward center of gear enough to expose boot groove on the tie rod. Place a rubber band in groove. This fills the groove and allows removal of boot from gear without damage.

1. Remove rubber band.
2. Slide boot on tie rod until boot snaps into groove.

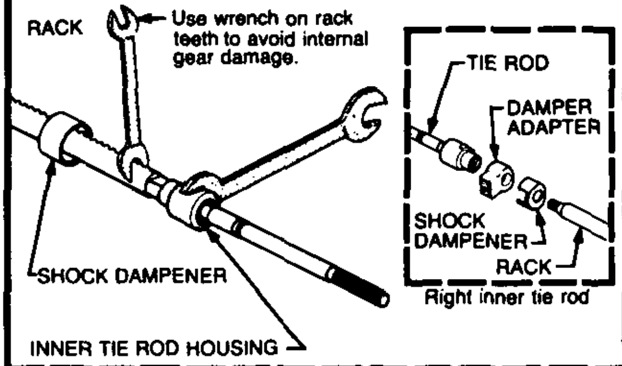
520019-3B2

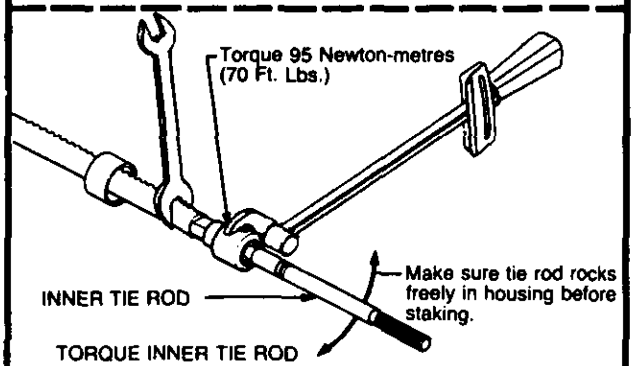
Fig. 2 Manual Rack and Pinion Assembly Service - Chart A

THE FOLLOWING STEPS MUST BE PERFORMED WITH RACK & PINION ASSEMBLY REMOVED FROM CAR

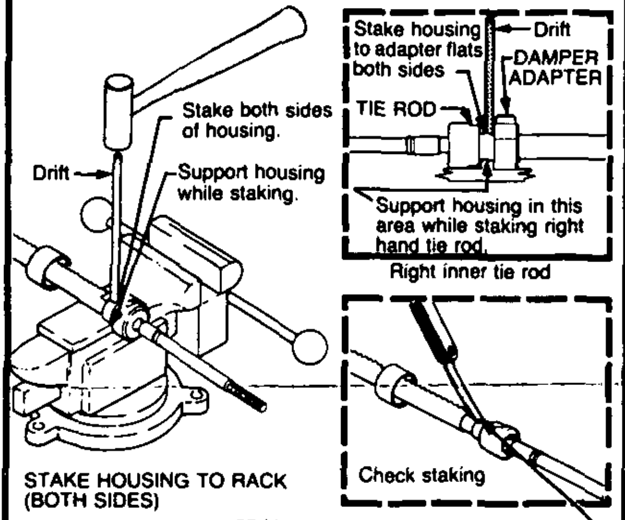
4. REMOVE AND INSTALL INNER TIE ROD

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.
2. Use wrench on rack when either left or right hand tie rods are removed.	2. Torque housing. (Use wrench on rack when tightening right or left tie rod to avoid internal gear damage.)
	3. Slide shock dampener on housing until it engages.





TORQUE INNER TIE ROD

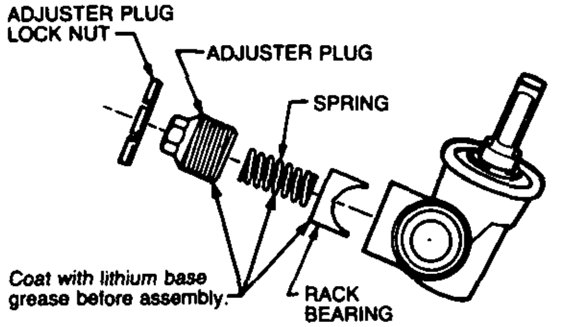


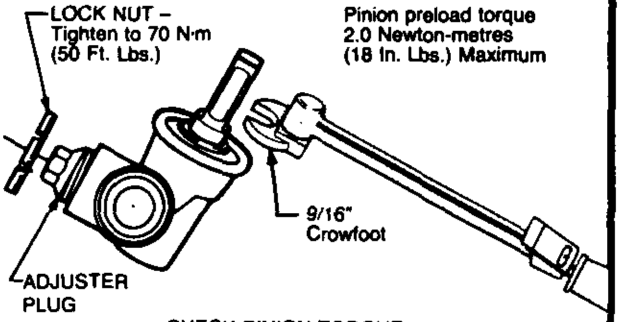
STAKE HOUSING TO RACK (BOTH SIDES)

.25 Millimetres (.010 inch) feeler gage must not pass between rack and housing stake. (Check both sides.)

5. REMOVE AND INSTALL RACK BEARING

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.
	2. Turn adjuster plug clockwise until it bottoms, then back off 60°. Check torque on pinion.
	3. Assemble lock nut and tighten while holding adjuster plug stationary.

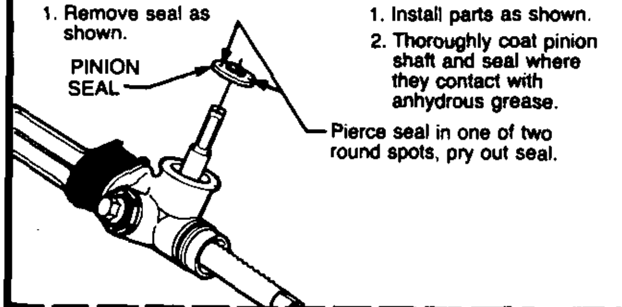


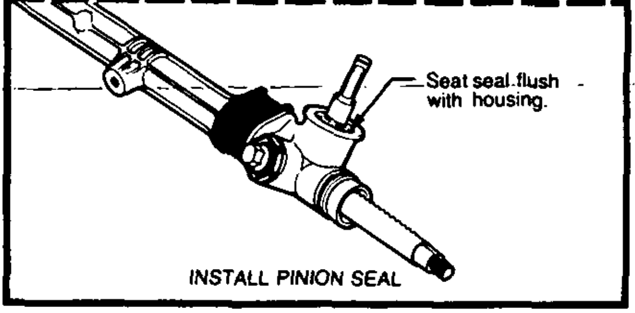


CHECK PINION TORQUE

6. REMOVE AND INSTALL PINION SEAL

REMOVE	INSTALL
1. Remove seal as shown.	1. Install parts as shown.
	2. Thoroughly coat pinion shaft and seal where they contact with anhydrous grease.





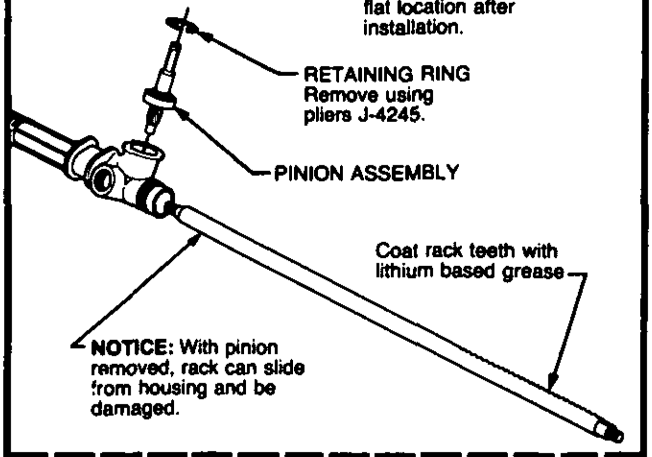
INSTALL PINION SEAL

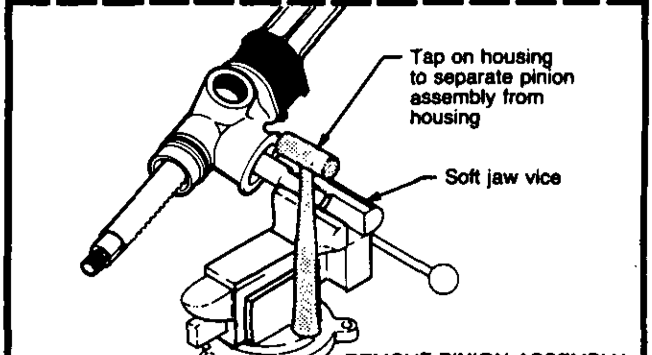
520020-3B2

Fig. 3 Manual Rack and Pinion Assembly Service - Chart B

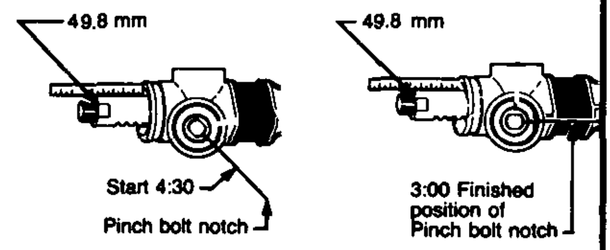
7. REMOVE AND INSTALL PINION SHAFT ASSEMBLY AND RACK

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown. 2. Check for correct rack measurements and pinion flat location after installation.

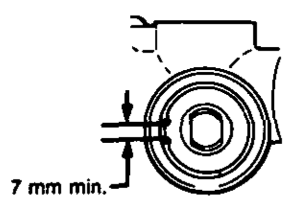




REMOVE PINION ASSEMBLY



INSTALL RACK & PINION

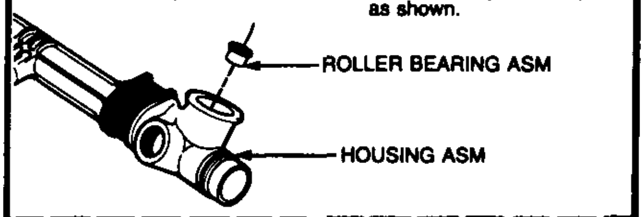


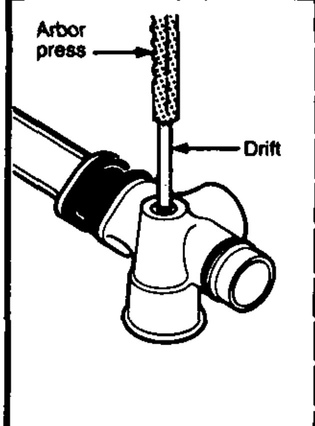
MEASURE RETAINING RING

GREASE CAVITY

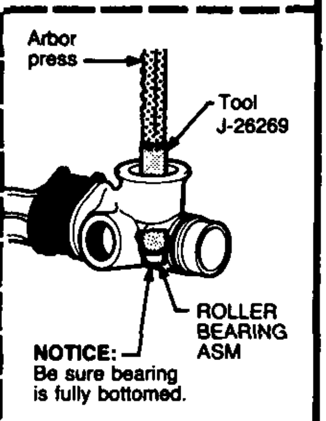
8. REMOVE AND INSTALL ROLLER BEARING ASSEMBLY

REMOVE	INSTALL
1. Remove parts as shown.	1. Install bearing assembly as shown.





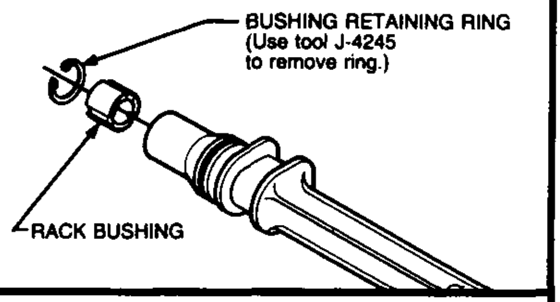
REMOVE ROLLER BEARING



INSTALL ROLLER BEARING

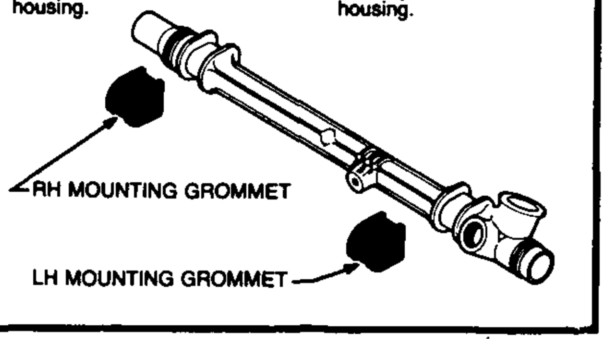
9. REMOVE AND INSTALL RACK BUSHING.

REMOVE	INSTALL
1. Remove parts as shown.	1. Install parts as shown.



10. REMOVE AND INSTALL GROMMET.

REMOVE	INSTALL
1. Separate grommets from housing.	1. Install grommets on housing.



520021-3B2

Fig. 4 Manual Rack and Pinion Assembly Service - Chart C

SECTION 3B4

STEERING WHEELS AND COLUMNS

NOTICE: All steering wheel and column fasteners are important 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 this part.

CONTENTS

On-Car Service

Unit Repair

GENERAL INFORMATION

The 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 lessen the chance of injury to the driver.
2. The ignition switch and lock are mounted on the column.
3. With the column-mounted lock, the ignition and steering operations can be locked to inhibit theft of the car.

The multifunction lever provides for control of the headlight beams, the cruise control, and the windshield washer and wiper.

The column may easily be disassembled and reassembled. To ensure 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. Apply a thin coat of lithium grease to all friction points when reassembling.

When the column assembly is removed from the car, take special care in handling it. The plastic fasteners which maintain column rigidity can be sheared or loosened by: using a steering wheel puller other than the one recommended in this manual; striking sharply on the end of the steering shaft or shift lever; leaning on the assembly; dropping the assembly.

IGNITION LOCK SYSTEMS

All floor shift automatic transaxle models use a Park Lock system (see Fig. 4). This system uses a flexible cable actuator which is attached at one end to the shift lever and the other end is attached to the column mounted ignition switch where it actuates a locking pin. The locking pin engages an ignition switch sliding contact when the shift lever is in "R", "N" or "D" and does not allow the ignition switch slider to move to the "Lock" position. When the shift lever is in "P", the pin disengages from the slider and allows it to move to the "Lock" position. With the shift lever in "P" and the ignition switch slider in "Lock," the locking pin engages a cam on the flexible cable and prevents the shift lever from being moved to another position.

A Key Release column is used with the manual transaxle. A clutch start switch is used so that the clutch pedal must be pushed down before the engine will crank. See Electrical Diagnosis for circuit operation.

SHIFT INDICATOR ADJUSTMENT

Fig. 1

Adjust

- Steering column attachment should be complete.

1. Position shift lever in "N" (Neutral) gate notch.
2. Guide clip on edge of shift bowl to centrally position pointer on "N" (Neutral)
3. Push clip onto bowl

Care must be taken to assure that cable rests on bowl, not on column jacket.

3-Speed Automatic Transaxle – Pointer should cover portions of the "P" (Park), "R" (Reverse), "N" (Neutral) and "D" (Drive) when the shift lever is in its respective position.

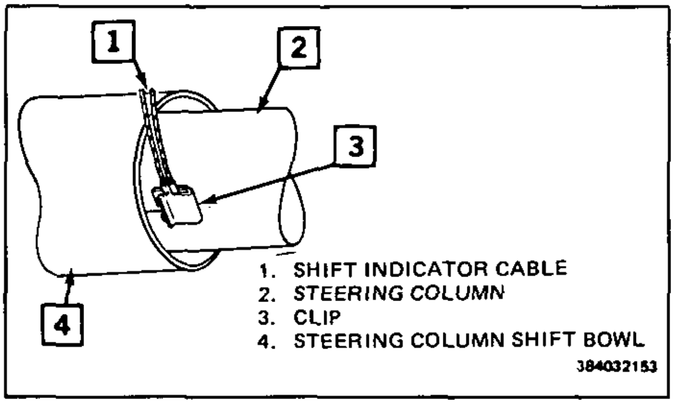


Fig. 1 Shift Indicator Adjustment

MULTIFUNCTION TURN SIGNAL LEVER

Fig. 2

←→ Remove or Disconnect

1. Make sure lever is in center or off position.
2. Pull lever straight out of turn signal switch.
3. If equipped with cruise control, attach mechanic's wire or tool BT-6810 to connector and pull harness through column.

→← Install or Connect

1. If equipped with cruise control, attach connector to mechanic's wire or tool BT-6810 and pull harness through column.
2. Push lever into turn signal switch.

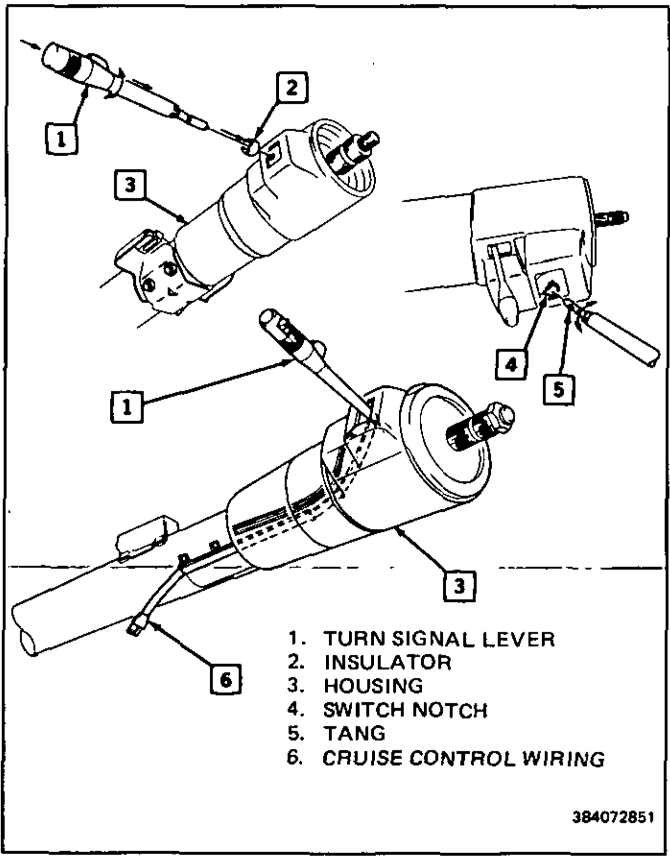


Fig. 2 Multifunction Turn Signal Lever

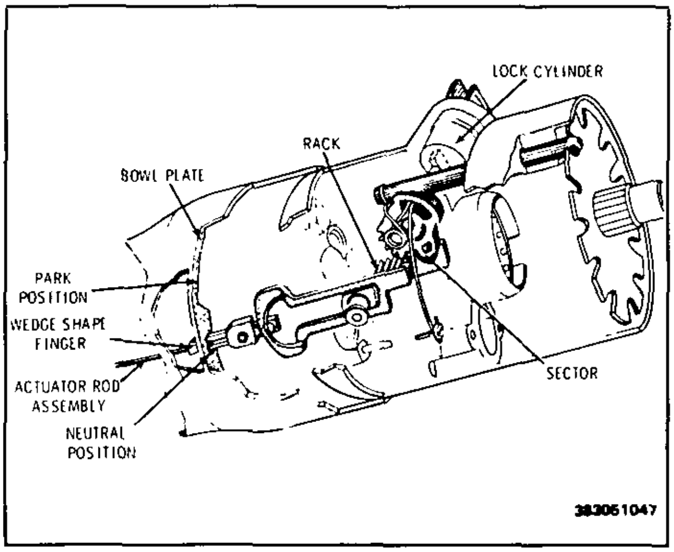


Fig. 3 Mechanical Neutral Start System

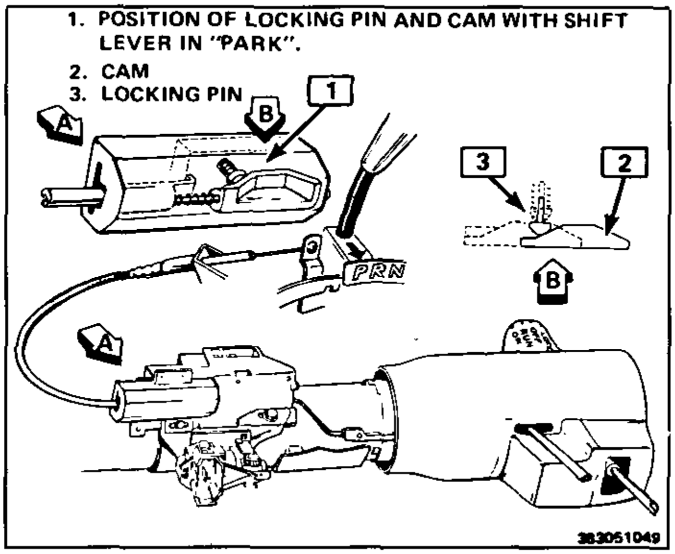


Fig. 4 Park Lock System

STEERING WHEEL

Standard and Tilt

Fig. 5

Tools Required:
J-1859-03 Steering Wheel Puller
BT-61-9 Steering Wheel Puller

←→ Remove or Disconnect

1. Negative battery cable
2. Two screws holding the steering pad
3. Pad and horn lead
4. Retainer and nut
5. Steering wheel with J-1859-03 or BT-61-9

→← Install or Connect

1. Align mark on steering wheel with mark on shaft.
2. Nut

Tighten

- Nut to specification

3. Retainer
4. Horn lead and pad
5. Two screws

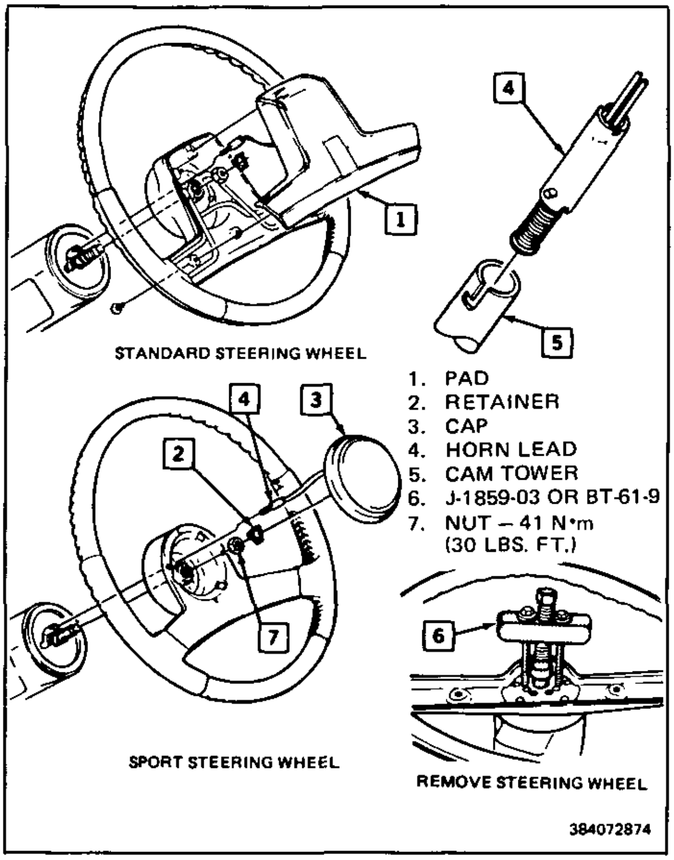


Fig. 5 Steering Wheel

Tilt

Fig. 6

Remove or Disconnect

1. Negative battery cable
2. Two (2) screws retaining steering wheel pad
3. Horn lead for steering wheel pad
4. Steering shaft lock knob bolt positioning screws
5. Steering shaft lock knob bolt from steering shaft
6. Retainer from steering shaft
7. Steering wheel nut
8. Install BT-61-9 and remove steering wheel.

Install or Connect

1. Align mark on the steering shaft with mark on the steering wheel and install steering wheel and nut.

Tighten

- Steering wheel nut to 41 N·m (30 lbs. ft.).

Install or Connect

2. Steering wheel nut retainer.
3. Steering shaft lock knob bolt positioning screws 180° apart.
4. Steering shaft lock knob bolt.
5. Horn lead to steering wheel pad.
6. Two (2) screws retaining wheel pad
7 Negative battery cable

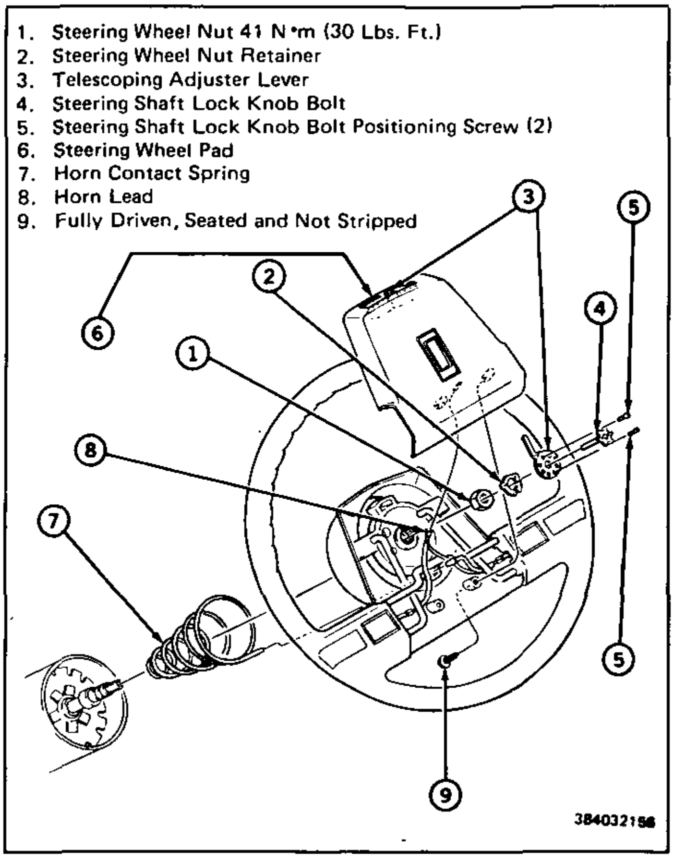


Fig. 6 Tilt Wheel

INTERMEDIATE SHAFT

Fig. 7

Remove or Disconnect

1. Position intermediate shaft seal for access to lower pinch bolt. Locate steering wheel in position to allow access to pinch bolt through the engine compartment
2. Pinch bolt at rack and pinion stub shaft
3. Left I.P. sound insulator
4. Reposition intermediate shaft seal to gain access to upper intermediate shaft pinch bolt
5. Pinch bolt and disconnect intermediate shaft at the steering column
6. Intermediate shaft

Install or Connect

1. Position intermediate shaft
2. Upper pinch bolt

Tighten

- Pinch bolt to 52 N·m (39 lbs. ft.)

3. Pinch bolt at rack and pinion stub shaft

Tighten

- Pinch to 62 N·m (47 lbs. ft.)

4. Left I.P. sound insulator

STEERING COLUMN

Fig. 8

Remove or Disconnect

1. Battery ground
2. Left I.P. sound absorber
3. Left I.P. trim pad and steering column trim collar
4. Horn contact pad – only if column will be disassembled
5. Steering wheel – only if column will be disassembled
6. Steering shaft to intermediate shaft connection
7. Column bracket support bolts and column bracket support nut
8. Shift indicator cable
9. Electrical connectors
10. Shift cable at actuator and housing holder
11. Column assembly

Install or Connect

1. Column Assembly
2. Shift cable and housing
3. Electrical connectors
4. Shift indicator cable
5. Support bolts and nut
6. Intermediate shaft upper shaft bolt

Tighten

- Shift Indicator. See "Shift Indicator Adjustment."
- Support bolts to 27 N·m (20 lbs. ft.)
- Pinch bolt to 52 N·m (39 lbs. ft.)

Install or Connect

7. Steering wheel
8. Horn contact pad
9. Steering column and left I.P. trim
10. I.P. sound insulator
11. Battery ground

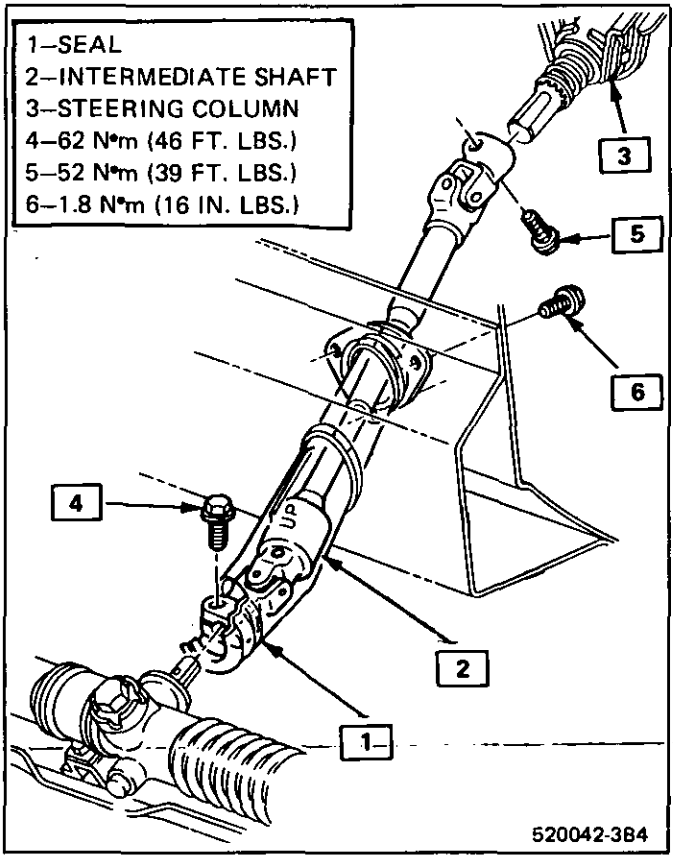


Fig. 8 Steering Column Mounting

REMOVE AND INSTALL STEERING COLUMN

REMOVE

1. Disconnect negative (–) battery cable.
2. Steering column cover.
3. Remove bolt at flex joint.
4. Remove two (2) nuts from lower support.
5. Remove two (2) bolts from upper support.
6. Disconnect all electrical connectors.
7. Remove steering column.

INSTALL

1. Steering shaft at flex joint.
2. Electrical connections.
3. Loosely install two (2) lower nuts and two (2) upper bolts at supports.
4. Center the steering shaft within the steering column jacket bushing and tighten lower attaching bolt. This can be done by moving the steering column jacket assembly up and down or side to side until the steering shaft is centered.
5. Tighten two (2) upper attaching bolts to specifications.
6. Tighten two (2) lower attaching bolts to specifications.
7. Tighten bolt (9) at flex joint to 47 N•m (35 ft. lbs.).
8. Install steering column cover.
9. Connect negative (–) battery cable.

1–STEERING COLUMN SUPPORT

2–STEERING COLUMN

3–BOLT/SCREW 34 N•m (25 FT. LBS.)

4–WIRING HARNESS MUST BE ROUTED UNDER SUPPORT (AS SHOWN) TO PREVENT PINCHED OR CUT WIRES

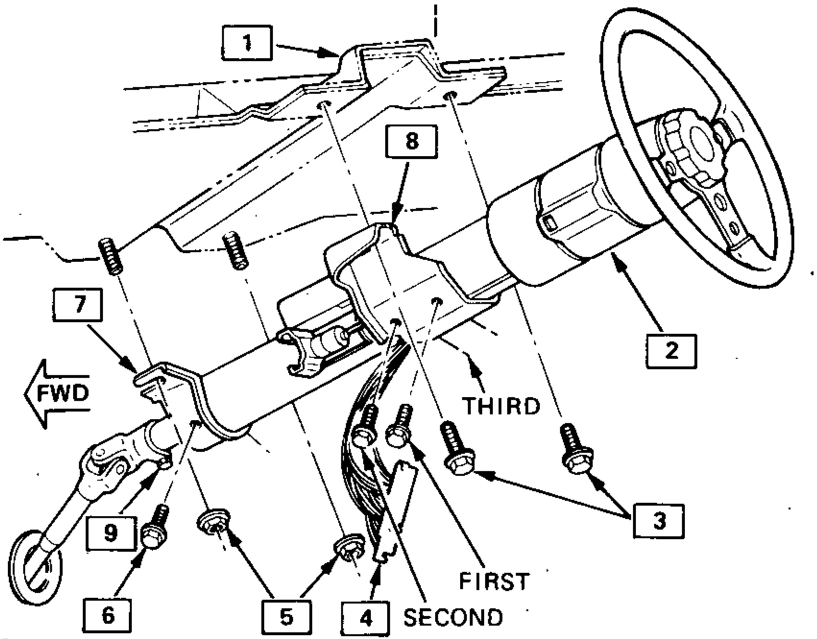
5–NUT 34 N•m (25 FT. LBS.)

6–BOLT/SCREW 30 N•m (21 FT. LBS.) THIS SCREW MUST BE INSTALLED FIRST

7–SUPPORT LOWER

8–SUPPORT UPPER

9–BOLT/SCREW 52N•m (36 FT. LBS.)



BOLT INSTALL SEQUENCE

FIRST → 40 N•m (29 FT. LBS.)
SECOND →
THIRD →

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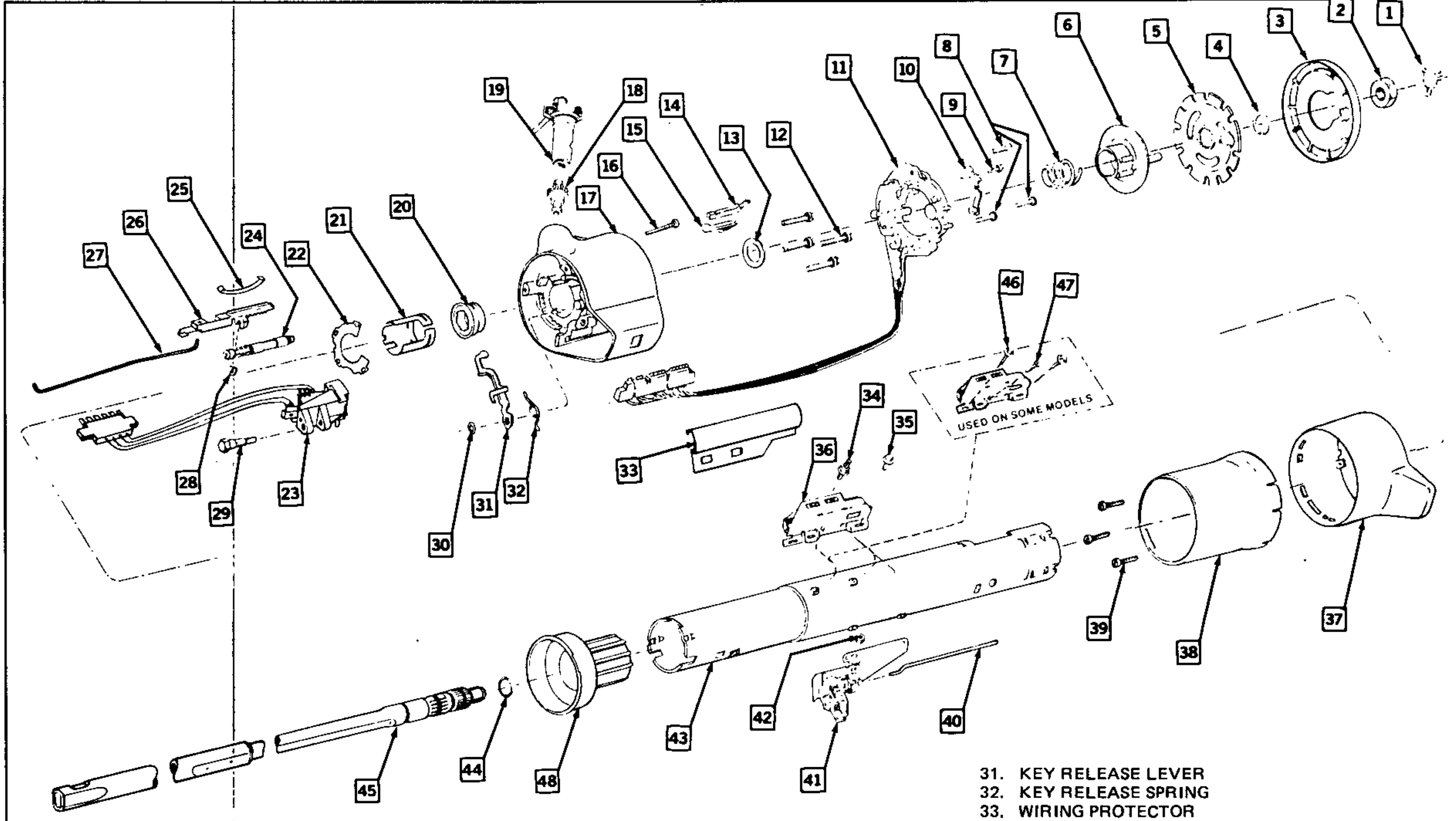
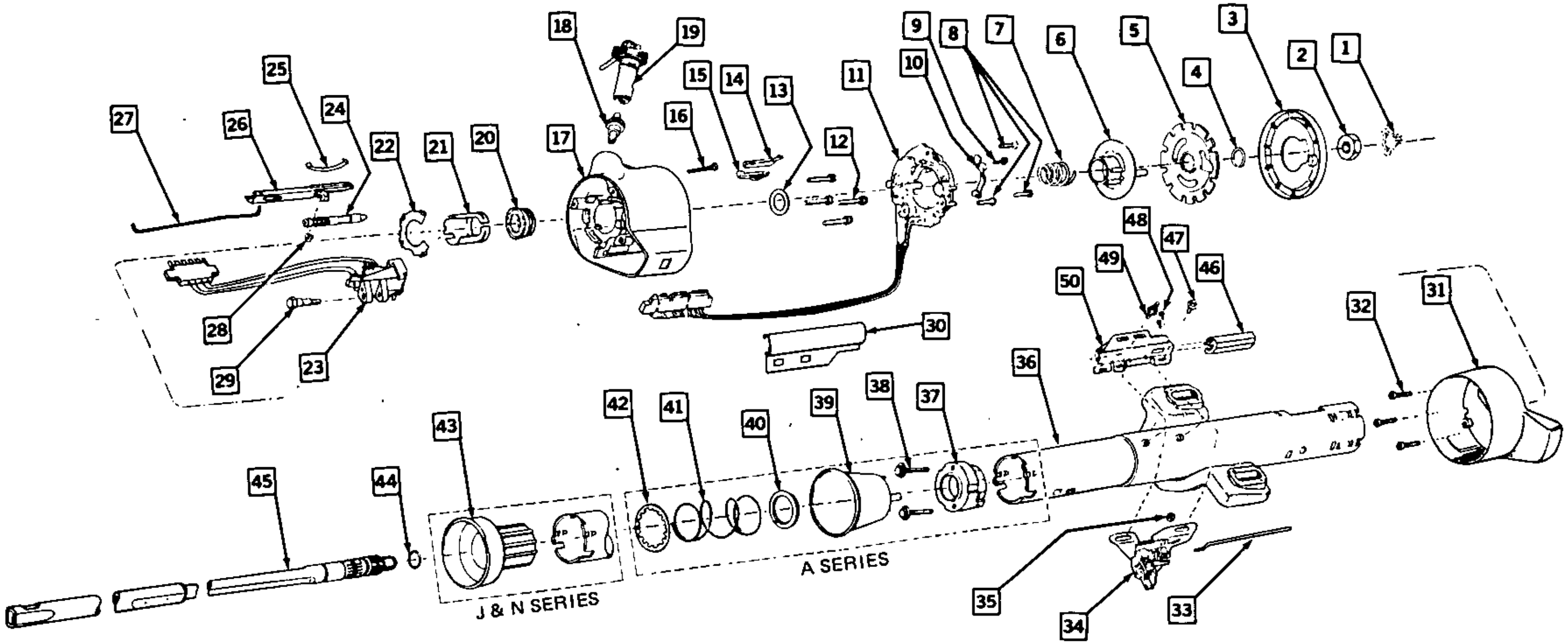
Fig. 7 Intermediate Shaft



1. RETAINER
2. HEXAGON JAM NUT
3. SHAFT LOCK COVER
4. RETAINING RING
5. STEERING SHAFT LOCK
6. TURN SIGNAL CANCELLING CAM ASSY
7. UPPER BEARING SPRING
8. BINDING HEAD CROSS RECESS SCREW
9. ROUND WASHER HEAD SCREW
10. SWITCH ACTUATOR ARM ASSY
11. TURN SIGNAL SWITCH ASSY
12. HEX WASHER HEAD TAPPING SCREW
13. THRUST WASHER
14. BUZZER SWITCH ASSY
15. BUZZER SWITCH RETAINING CLIP
16. LOCK RETAINING SCREW
17. STEERING COLUMN HOUSING
18. SWITCH ACTUATOR SECTOR ASSY
19. STEERING COLUMN LOCK CYLINDER SET
20. BEARING ASSY
21. BEARING RETAINING BUSHING
22. UPPER BEARING RETAINER
23. PIVOT & SWITCH ASSY
24. SPRING & BOLT ASSY
25. RACK PRELOAD SPRING
26. SWITCH ACTUATOR RACK
27. SWITCH ACTUATOR ROD
28. SPRING THRUST WASHER
29. SWITCH ACTUATOR PIVOT PIN
30. WAVE WASHER
31. KEY RELEASE LEVER
32. KEY RELEASE SPRING
33. WIRING PROTECTOR
34. DIMMER AND IGNITION SWITCH MOUNTING STUD
35. WASHER HEAD SCREW
36. IGNITION SWITCH ASSY
37. FLOOR SHIFT BOWL
38. SHIFT BOWL SHROUD
39. BINDING HEAD CROSS RECESS SCREW
40. DIMMER SWITCH ACTUATOR ROD
41. DIMMER SWITCH ASSY
42. HEXAGON NUT
43. STEERING COLUMN JACKET ASSY
44. RETAINING RING
45. STEERING SHAFT ASSY
46. HEX WASHER HEAD TAPPING SCREW
47. FLAT HEAD SCREW
48. STEERING COLUMN JACKET BUSHING

Fig. 9 Key Release Standard Steering Column



1. RETAINER
2. HEXAGON JAM NUT
3. SHAFT LOCK COVER
4. RETAINING RING
5. STEERING SHAFT LOCK
6. TURN SIGNAL CANCELLING CAM ASM
7. UPPER BEARING SPRING
8. BINDING HEAD CROSS RECESS SCREW
9. ROUND WASHER HEAD SCREW
10. SWITCH ACTUATOR ARM ASM
11. TURN SIGNAL SWITCH ASM
12. HEX WASHER HEAD TAPPING SCREW
13. THRUST WASHER
14. BUZZER SWITCH ASM
15. BUZZER SWITCH RETAINING CLIP
16. LOCK RETAINING SCREW
17. STEERING COLUMN HOUSING
18. SWITCH ACTUATOR SECTOR
19. STEERING COLUMN LOCK CYLINDER SET
20. BEARING ASM
21. BEARING RETAINING BUSHING
22. UPPER BEARING RETAINER
23. PIVOT & SWITCH ASM
24. LOCK BOLT
25. RACK PRELOAD SPRING
26. SWITCH ACTUATOR RACK
27. SWITCH ACTUATOR ROD
28. SPRING THRUST WASHER
29. SWITCH ACTUATOR PIVOT PIN
30. WIRING PROTECTOR
31. FLOOR SHIFT BOWL
32. BINDING HD CROSS RECESS SCREW
33. DIMMER SWITCH ACTUATOR ROD
34. DIMMER SWITCH ASM
35. HEXAGON NUT
36. STEERING COLUMN JACKET ASM
37. ADAPTER & BEARING ASM
38. HEX WASHER HEAD TAPPING SCREW
39. BEARING RETAINER
40. LOWER BEARING SEAT
41. LOWER BEARING SPRING
42. LOWER SPRING RETAINER
43. STRG. COLUMN JACKET BUSHING
44. RETAINING RING
45. STEERING SHAFT ASM
46. IGN. SWITCH HOUSING ASM
47. WASHER HEAD SCREW
48. PAN HD SCREW
49. DIMR & IGN SW MOUNTING STUD
50. IGNITION SWITCH ASM

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Fig. 10 Park Lock Standard Steering Column

ALL STANDARD STEERING COLUMNS

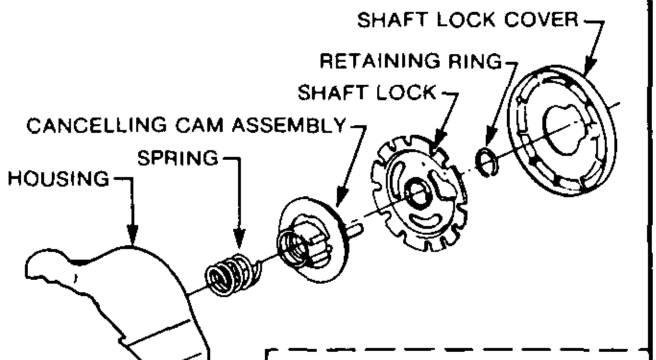
1. REMOVE AND INSTALL LOCK PLATE AND/OR CANCELLING CAM

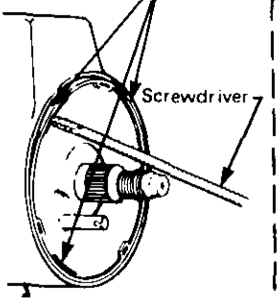
REMOVE

1. Remove parts as shown.

INSTALL

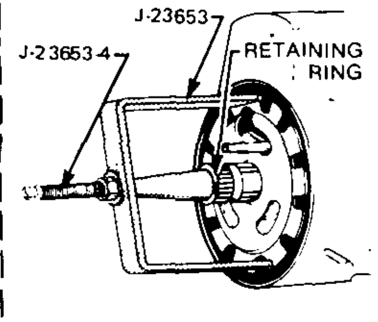
1. Install parts as shown.





Pry out at these locations to remove cover

REMOVE SHAFT LOCK COVER



Tighten nut until tool slightly depresses shaft lock.

REMOVE AND INSTALL RETAINING RING

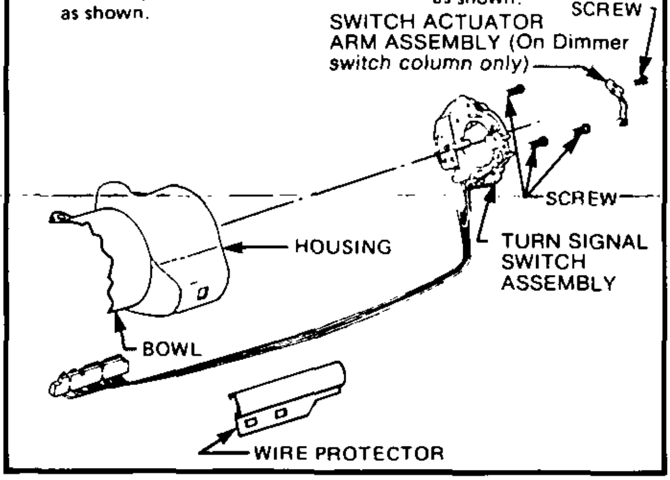
2. REMOVE AND INSTALL TURN SIGNAL SWITCH

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.



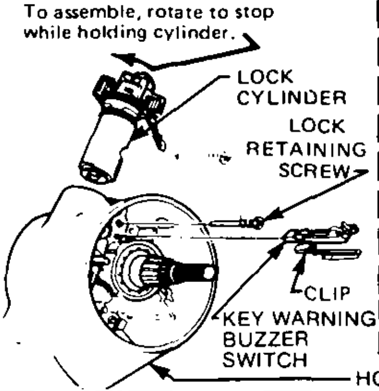
3. REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER

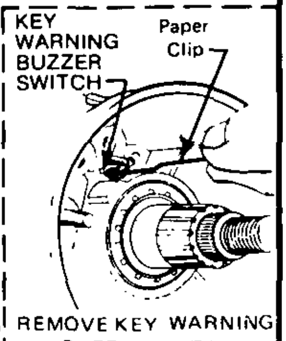
REMOVE

1. Turn lock to "RUN" position and remove key warning buzzer switch.
2. Remove parts as shown.

INSTALL

1. Install lock cylinder.
2. Turn lock to "RUN" position and install key warning buzzer switch.


To assemble, rotate to stop while holding cylinder.



REMOVE KEY WARNING BUZZER SWITCH

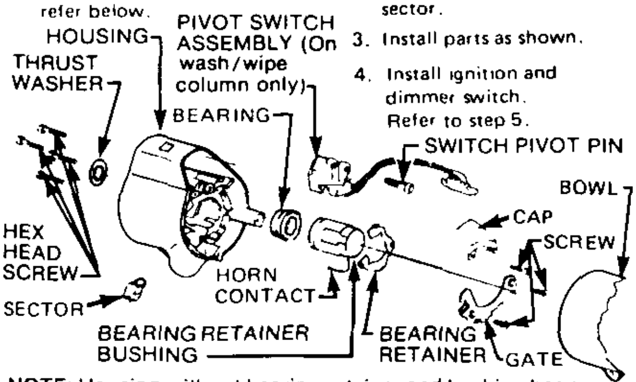
4. REMOVE AND INSTALL HOUSING AND WIPER SWITCH

REMOVE

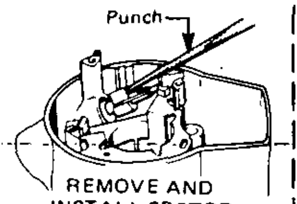
1. Remove ignition and dimmer switch. Refer to step 5.
2. Remove parts as shown.
3. For KEY RELEASE refer below.

INSTALL

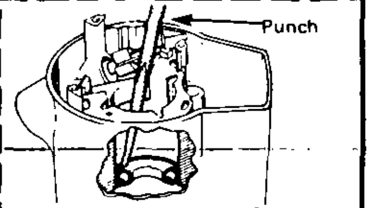
1. For KEY RELEASE refer below.
2. Assemble rack so that first rack tooth engages between first and second tooth of sector.
3. Install parts as shown.
4. Install ignition and dimmer switch. Refer to step 5.



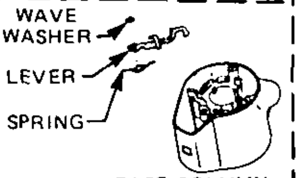
NOTE: Housing without bearing retainer and bushing has spun-in bearing. If repair is necessary, complete housing assembly replacement is necessary.



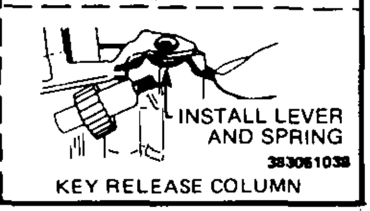
REMOVE AND INSTALL SECTOR



INSTALL BEARING



KEY RELEASE COLUMN



KEY RELEASE COLUMN

Fig. 11 Standard Steering Column Service (1 of 2)

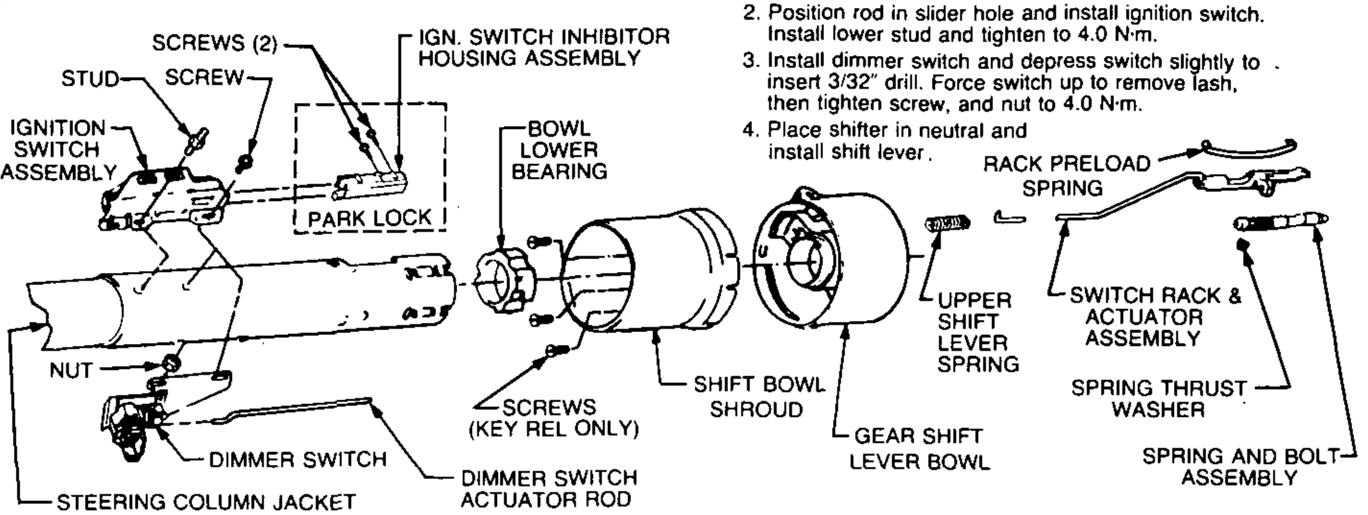
5. REMOVE AND INSTALL IGNITION AND DIMMER SWITCH

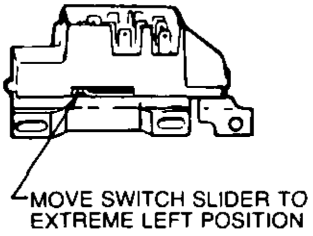
REMOVE

1. Remove parts as shown.

INSTALL

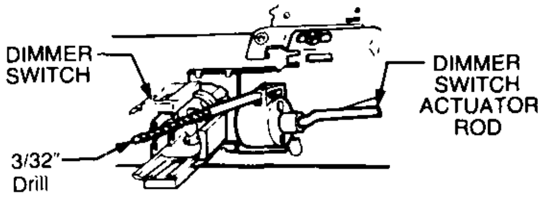
1. Install parts as shown
2. Position rod in slider hole and install ignition switch. Install lower stud and tighten to 4.0 N·m.
3. Install dimmer switch and depress switch slightly to insert 3/32" drill. Force switch up to remove lash, then tighten screw, and nut to 4.0 N·m.
4. Place shifter in neutral and install shift lever.





- KEY RELEASE
  Leave slider at extreme left
- PARK LOCK
  Move slider one detent to the right (off lock)
- ALL OTHER COLUMNS
  Move slider two detents to the right (off unlock)

INSTALL IGNITION SWITCH



ADJUST DIMMER SWITCH

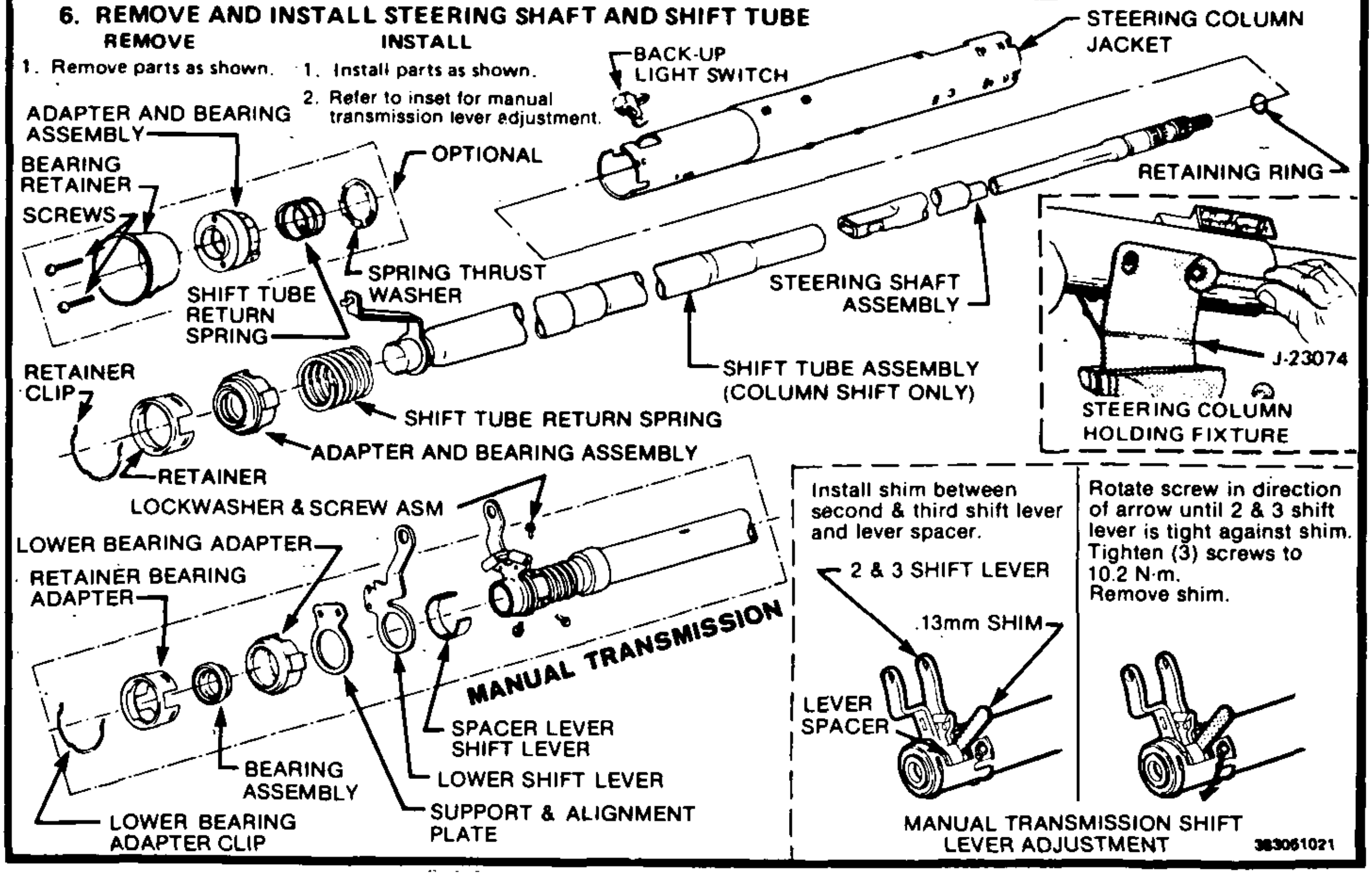
6. REMOVE AND INSTALL STEERING SHAFT AND SHIFT TUBE

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.
2. Refer to inset for manual transmission lever adjustment.

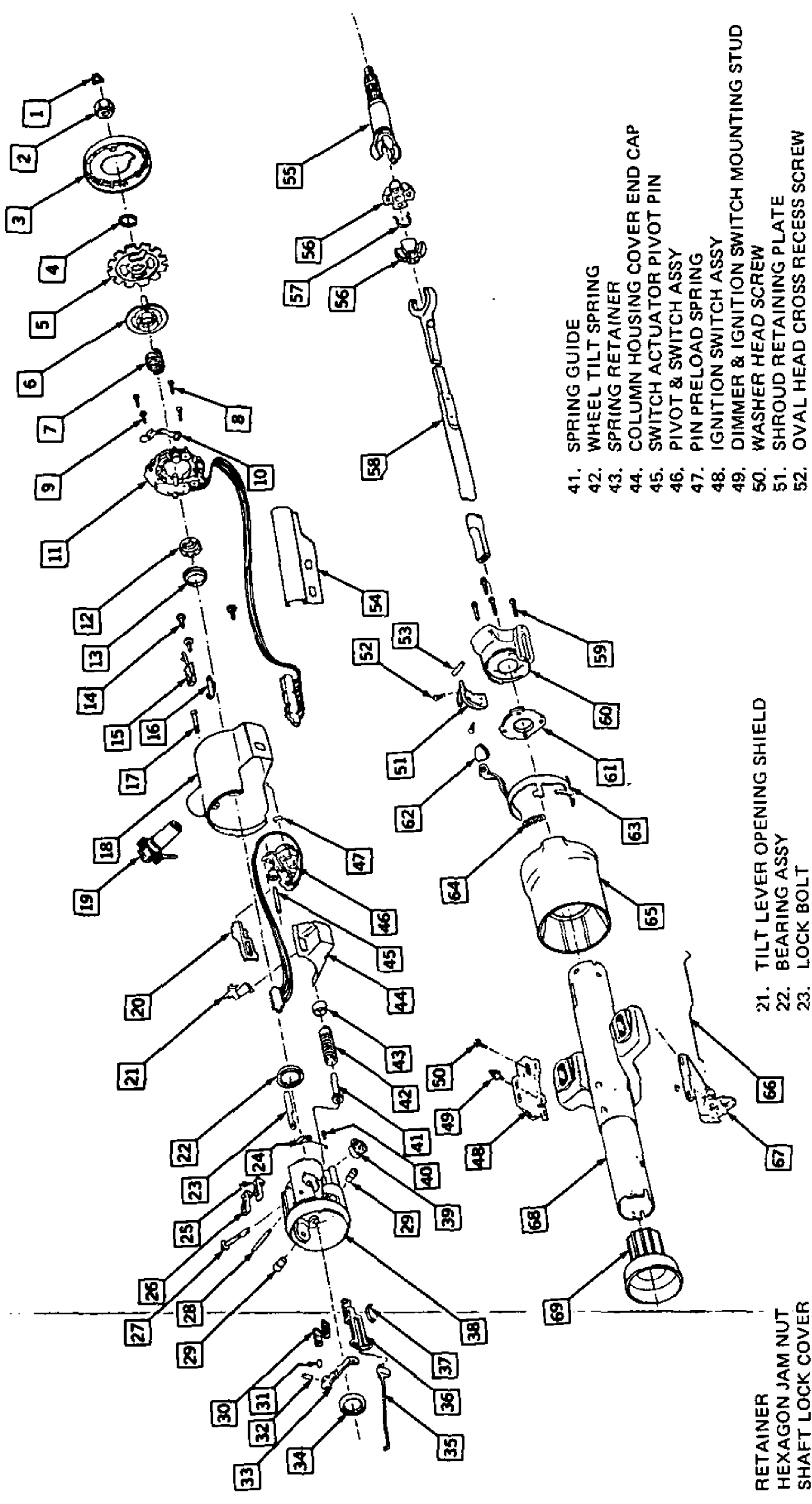


Install shim between second & third shift lever and lever spacer.

Rotate screw in direction of arrow until 2 & 3 shift lever is tight against shim. Tighten (3) screws to 10.2 N·m. Remove shim.

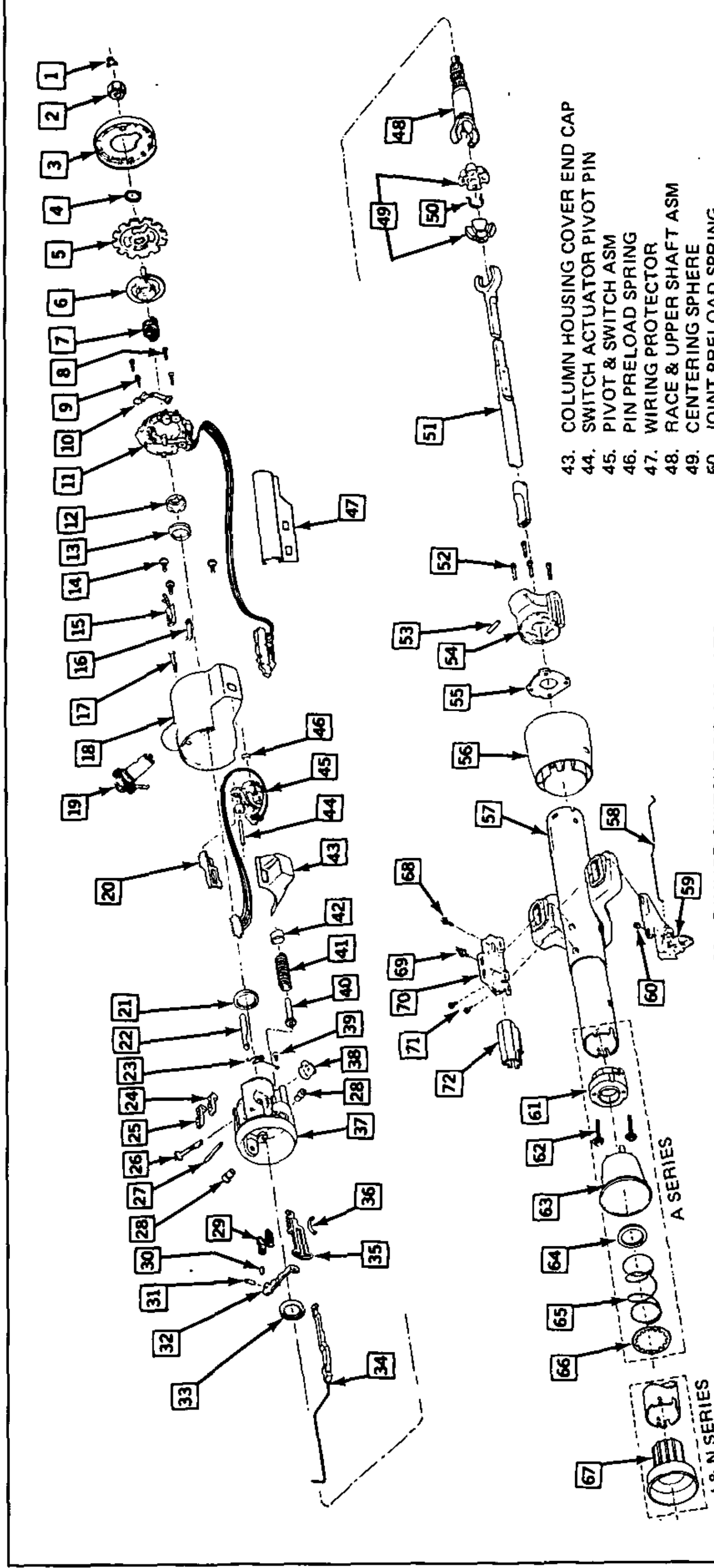
MANUAL TRANSMISSION SHIFT LEVER ADJUSTMENT

Fig. 12 Standard Steering Column Service (2 of 2)



1. RETAINER
2. HEXAGON JAM NUT
3. SHAFT LOCK COVER
4. RETAINING RING
5. SHAFT LOCK
6. TURN SIGNAL CANCELLING CAM ASSY
7. UPPER BEARING SPRING
8. BINDING HEAD CROSS RECESS SCREW
9. ROUND WASHER HEAD SCREW
10. SIGNAL SWITCH ARM ASSY
11. TURN SIGNAL SWITCH ASSY
12. UPPER BEARING INNER RACE SEAT
13. INNER RACE
14. PAN HEAD CROSS RECESS SCREW
15. BUZZER SWITCH ASSY
16. BUZZER SWITCH RETAINING CLIP
17. LOCK RETAINING SCREW
18. LOCK HOUSING COVER
19. STEERING COLUMN LOCK CYLINDER SET
20. DIMMER SWITCH ROD ACTUATOR
21. TILT LEVER OPENING SHIELD
22. BEARING ASSY
23. LOCK BOLT
24. LOCK BOLT SPRING
25. STEERING WHEEL LOCK SHOE
26. STEERING WHEEL LOCK SHOE
27. DRIVE SHAFT
28. DOWEL PIN
29. PIVOT PIN
30. SHOE SPRING
31. RELEASE LEVER SPRING
32. RELEASE LEVER PIN
33. SHOE RELEASE LEVER
34. BEARING ASSY
35. IGNITION SWITCH ACTUATOR ASSY
36. SWITCH ACTUATOR RACK
37. RACK PRELOAD SPRING
38. STEERING COLUMN HOUSING
39. SWITCH ACTUATOR SECTOR
40. HEX WASHER HEAD SCREW
41. SPRING GUIDE
42. WHEEL TILT SPRING
43. SPRING RETAINER
44. COLUMN HOUSING COVER END CAP
45. SWITCH ACTUATOR PIVOT PIN
46. PIVOT & SWITCH ASSY
47. PIN PRELOAD SPRING
48. IGNITION SWITCH ASSY
49. DIMMER & IGNITION SWITCH MOUNTING STUD
50. WASHER HEAD SCREW
51. SHROUD RETAINING PLATE
52. OVAL HEAD CROSS RECESS SCREW
53. DOWEL PIN
54. WIRING PROTECTOR
55. RACE & UPPER SHAFT ASSY
56. CENTERING SPHERE
57. JOINT PRELOAD SPRING
58. LOWER STEERING SHAFT ASSY
59. SUPPORT SCREW
60. STEERING COLUMN HOUSING SUPPORT
61. LOCK PLATE
62. RELEASE LEVER FINGER PAD
63. KEY RELEASE LEVER
64. KEY RELEASE SPRING
65. STEERING COLUMN HOUSING SHROUD
66. DIMMER SWITCH ROD
67. DIMMER SWITCH ASSY
68. STEERING COLUMN JACKET ASSY
69. STEERING COLUMN JACKET BUSHING

Fig. 13 Key Release Tilt Wheel Steering Column



1.	RETAINER
2.	HEXAGON JAM NUT
3.	SHAFT LOCK COVER
4.	RETAINING RING
5.	STEERING SHAFT LOCK
6.	TURN SIGNAL CANCELLING CAM ASM
7.	UPPER BEARING SPRING
8.	BINDING HEAD CROSS RECESS SCREW
9.	ROUND WASHER HEAD SCREW
10.	SIGNAL SWITCH ARM ASM
11.	TURN SIGNAL SWITCH ASM
12.	UPPER BEARING INNER RACE SEAT
13.	INNER RACE
14.	PAN HEAD CROSS RECESS SCREW
15.	ASM BUZZER SWITCH
16.	BUZZER SWITCH RETAINING CLIP
17.	LOCK RETAINING SCREW
18.	LOCK HOUSING COVER
19.	STEERING COLUMN LOCK CYLINDER SET
20.	DIMMER SWITCH ROD ACTUATOR
21.	BEARING ASM
22.	LOCK BOLT
23.	LOCK BOLT SPRING
24.	STEERING WHEEL LOCK SHOE
25.	STEERING WHEEL LOCK SHOE
26.	DRIVE SHAFT
27.	DOWEL PIN
28.	PIVOT PIN
29.	SHOE SPRING
30.	RELEASE LEVER SPRING
31.	RELEASE LEVER PIN
32.	SHOE RELEASE LEVER
33.	BEARING ASM
34.	IGN SWITCH ACTUATOR ASM
35.	SWITCH ACTUATOR RACK
36.	RACK PRELOAD SPRING
37.	STEERING COLUMN HOUSING
38.	SWITCH ACTUATOR SECTOR
39.	HEX WASHER HEAD SCREW
40.	SPRING GUIDE
41.	WHEEL TILT SPRING
42.	SPRING RETAINER
43.	COLUMN HOUSING COVER END CAP
44.	SWITCH ACTUATOR PIVOT PIN
45.	PIVOT & SWITCH ASM
46.	PIN PRELOAD SPRING
47.	WIRING PROTECTOR
48.	RACE & UPPER SHAFT ASM
49.	CENTERING SPHERE
50.	JOINT PRELOAD SPRING
51.	LOWER STEERING SHAFT ASM
52.	SUPPORT SCREW
53.	DOWEL PIN
54.	STEERING COLUMN HOUSING SUPPORT
55.	LOCK PLATE
56.	STEERING COLUMN HOUSING SHROUD
57.	STEERING COLUMN JACKET ASM
58.	DIMMER SWITCH ACTUATOR ROD
59.	DIMMER SWITCH ASM
60.	HEXAGON NUT
61.	ADAPTER & BEARING ASM
62.	HEX WASHER HEAD TAPPING SCREW
63.	BEARING RETAINER
64.	LOWER BEARING SEAT
65.	LOWER BEARING SPRING
66.	LOWER SPRING RETAINER
67.	STRG COLUMN JACKET BUSHING
68.	WASHER HEAD SCREW
69.	DIMMER & IGNITION SWITCH MOUNTING STUD
70.	IGNITION SWITCH ASM
71.	PAN HD SCREW
72.	IGN SWITCH INHIBITOR HOUSING ASM

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Fig. 14 Park Lock Tilt Wheel Steering Column

ALL ADJUSTABLE STEERING COLUMNS

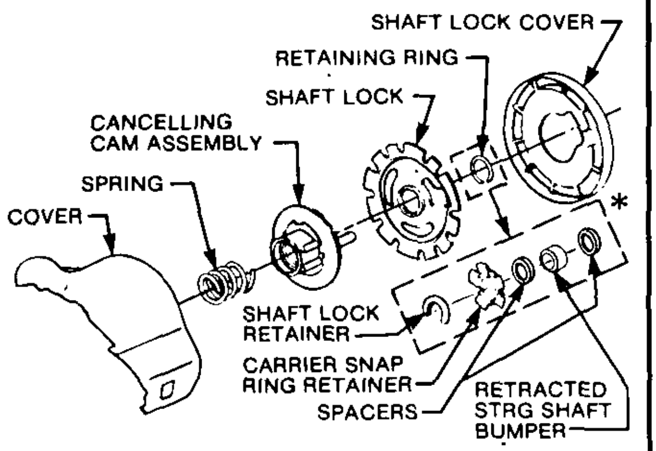
1. REMOVE AND INSTALL SHAFT LOCK AND/OR CANCELLING CAM

REMOVE

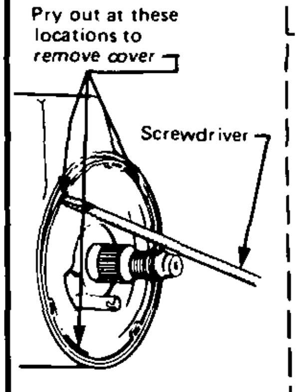
1. Remove parts as shown.

INSTALL

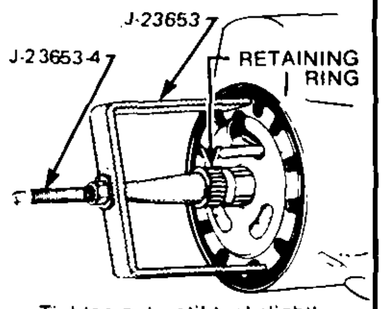
1. Install parts as shown.



*ON TELESCOPE STEERING ONLY



REMOVE SHAFT LOCK COVER



Tighten nut until tool slightly depresses shaft lock

REMOVE AND INSTALL RETAINING RING

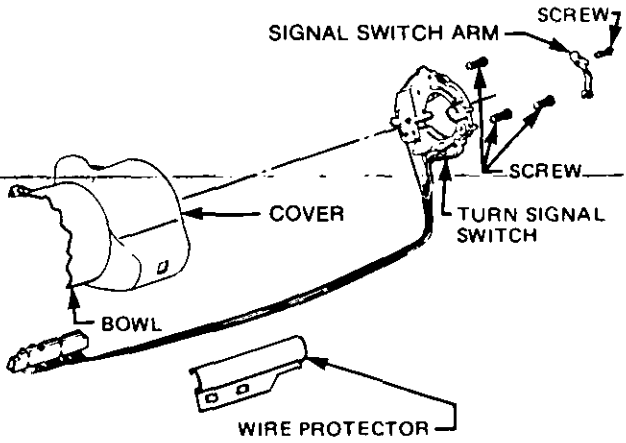
2. REMOVE AND INSTALL TURN SIGNAL SWITCH

REMOVE

1. Remove parts as shown.

INSTALL

1. Install parts as shown.



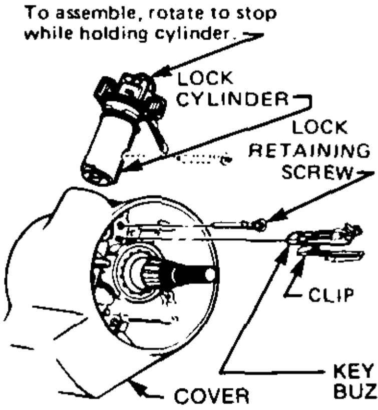
3. REMOVE AND INSTALL IGNITION LOCK AND KEY WARNING BUZZER

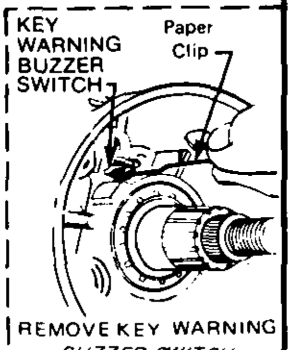
REMOVE

1. Turn lock to "RUN" position and remove key warning buzzer.
2. Remove parts as shown.

INSTALL

1. Install lock cylinder.
2. Turn lock to "RUN" position and install key warning buzzer switch.





REMOVE KEY WARNING BUZZER SWITCH

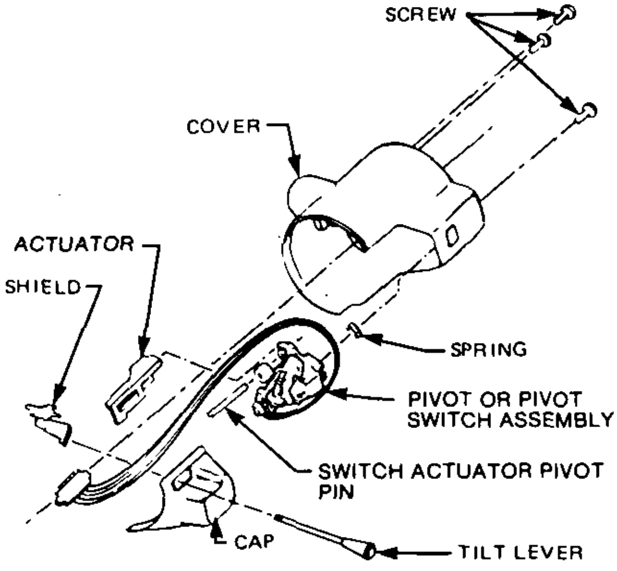
4. REMOVE AND INSTALL COVER AND WIPER SWITCH

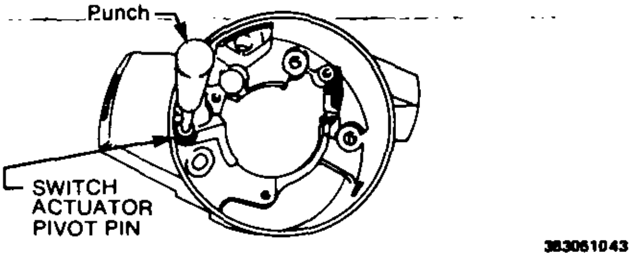
REMOVE

1. Remove parts as shown

INSTALL

1. Install parts as shown.





REMOVE AND INSTALL PIVOT AND SWITCH ASSEMBLY

Fig. 15 Adjustable Steering Column Service (1 of 3)

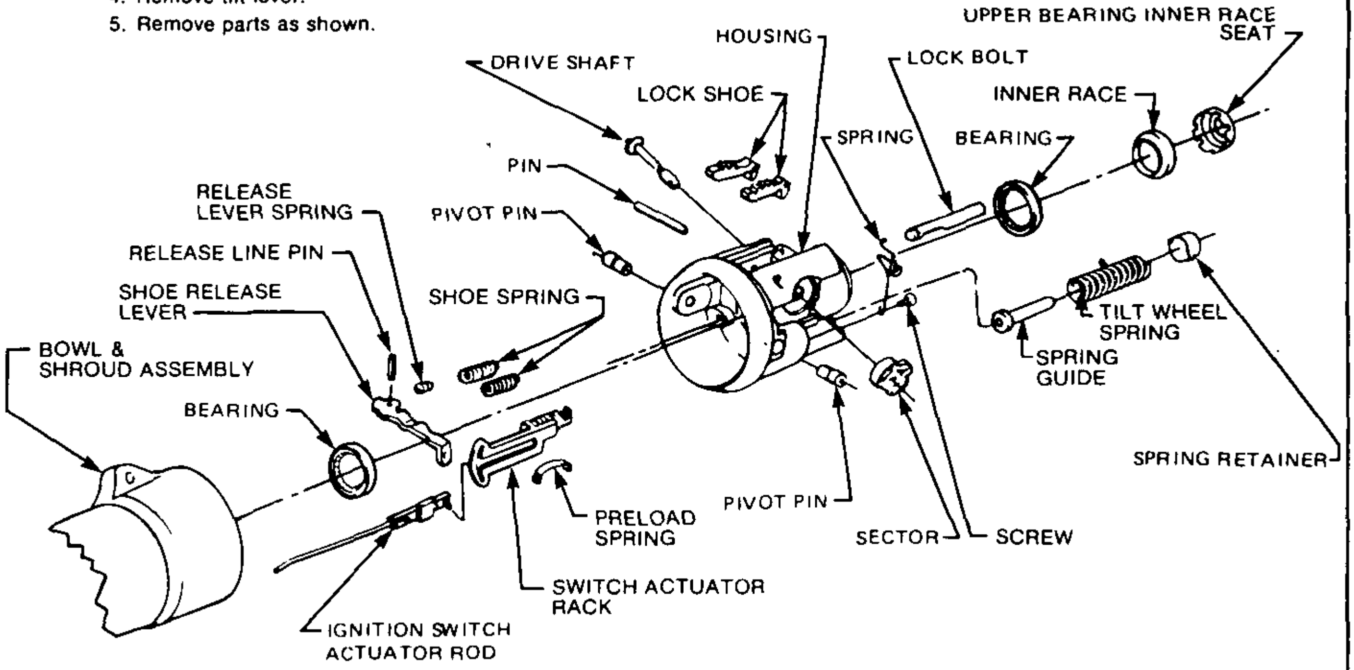
5. REMOVE AND INSTALL HOUSING

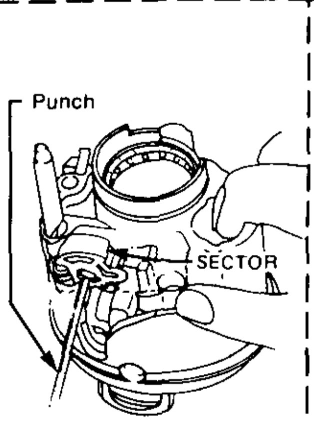
REMOVE

1. Reinstall tilt lever and place column in full "UP" position.
2. Remove tilt spring and pivot pins.
3. Remove housing by pulling upward on tilt lever and pull housing upward until it stops. Move housing to the right to disengage rack from actuator.
4. Remove tilt lever.
5. Remove parts as shown.

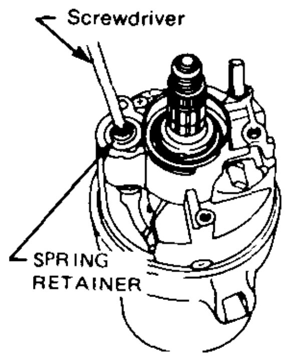
INSTALL

1. Install parts as shown.
2. While holding up on tilt lever to disengage lock shoes install over steering shaft. Move rack downward and hold. Tip housing to the left until rack engages pin on actuator rod. Push housing down until pivot pin holes are in alignment.

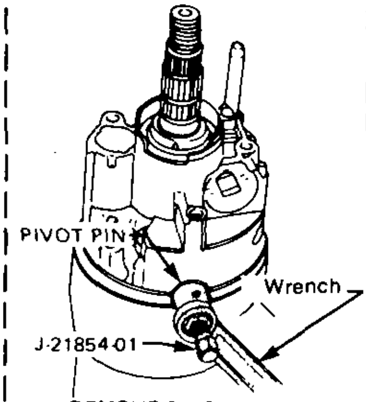




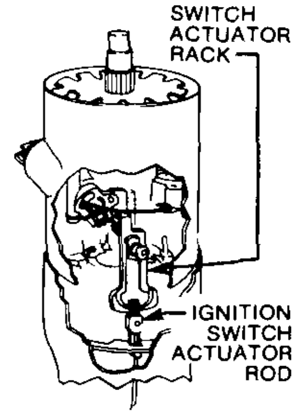
REMOVE DRIVE SHAFT AND SECTOR



REMOVE TILT SPRING RETAINER



REMOVE PIVOT PINS



ENGAGE SWITCH ACTUATOR RACK

6. REMOVE AND INSTALL LOWER STEERING SHAFT ASSEMBLY

REMOVE

1 Remove parts as shown.

INSTALL

1. Install parts as shown.

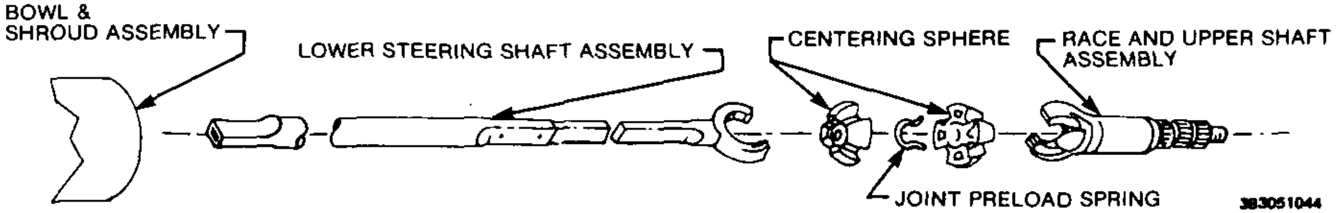


Fig. 16 Adjustable Steering Column Service (2 of 3)

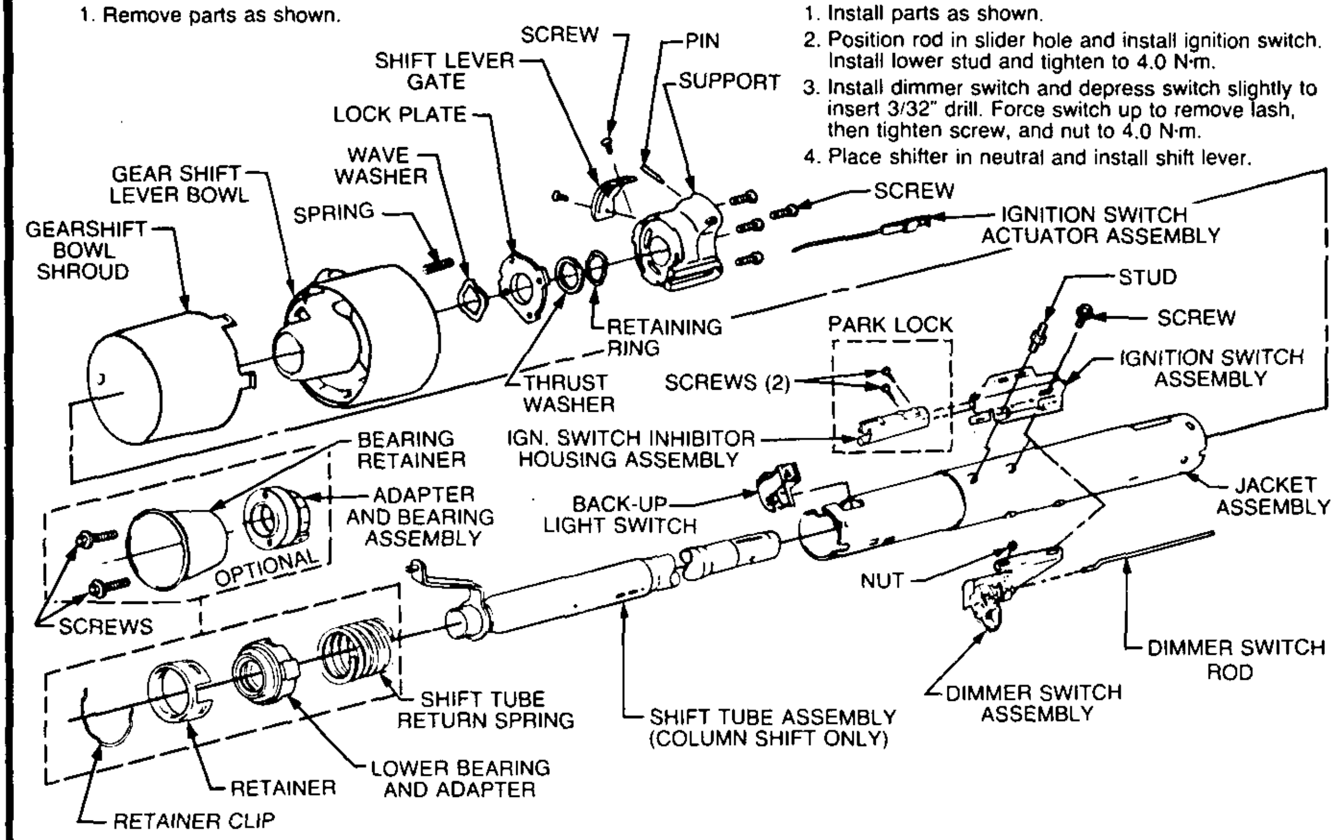
7. REMOVE AND INSTALL SHIFT TUBE, IGNITION AND DIMMER SWITCH ASSEMBLIES

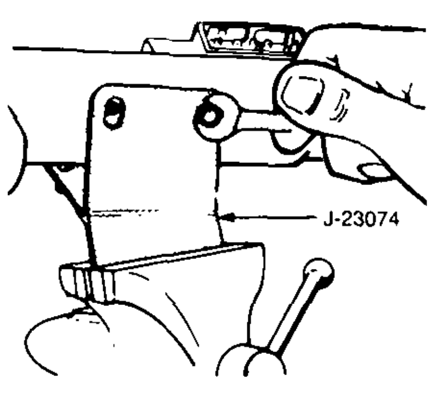
REMOVE

1. Remove parts as shown.

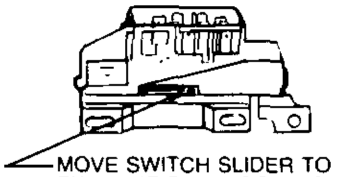
INSTALL

1. Install parts as shown.
2. Position rod in slider hole and install ignition switch. Install lower stud and tighten to 4.0 N·m.
3. Install dimmer switch and depress switch slightly to insert 3/32" drill. Force switch up to remove lash, then tighten screw, and nut to 4.0 N·m.
4. Place shifter in neutral and install shift lever.





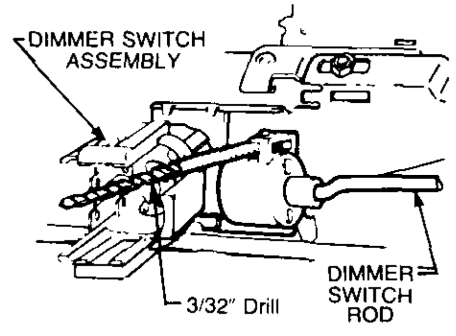
STEERING COLUMN HOLDING FIXTURE



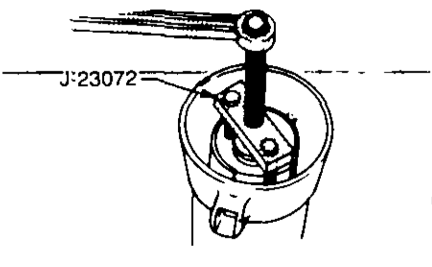
MOVE SWITCH SLIDER TO EXTREME RIGHT POSITION

- KEY RELEASE
  Leave slider at extreme right
- PARK LOCK
  Move slider one detent to *the left* (off lock)
- ALL OTHER COLUMNS
  Move slider two detents to the left (off unlock)

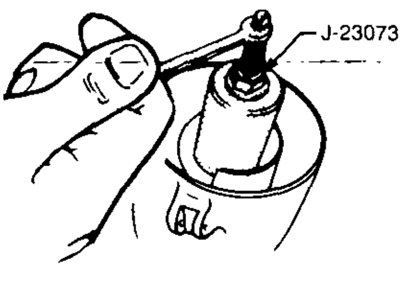
INSTALL IGNITION SWITCH ASSEMBLY



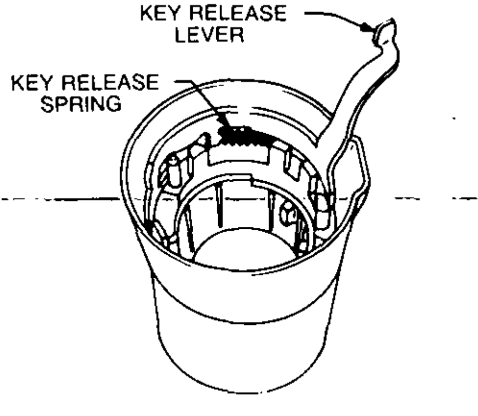
ADJUST DIMMER SWITCH ASSEMBLY



REMOVE SHIFT TUBE ASSEMBLY FROM BOWL



INSTALL SHIFT TUBE ASSEMBLY



KEY RELEASE LEVER

Fig. 17 Adjustable Steering Column Service (3 of 3)

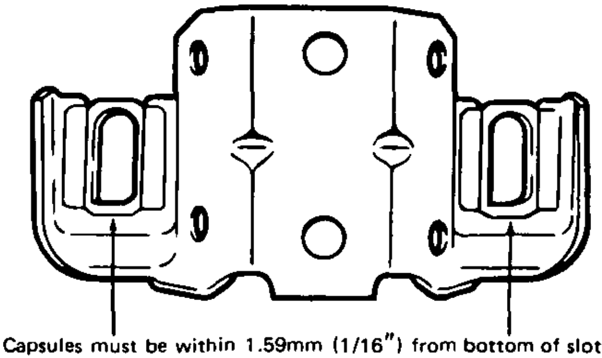
CHECKING STEERING COLUMN FOR ACCIDENT DAMAGE

NOTICE: Vehicles involved in accidents resulting in 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 or jacket should be replaced.
2. Check contact surface "A" (View B). The bolthead must not contact surface "A" or shear load would be increased. If contact is made, replace bracket or jacket.
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 as shown in view C. 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. Check for broken plastic bearing adapter at lower end of steering shaft. If adapter is cracked or broken, it must be replaced.
6. Any vehicle 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.

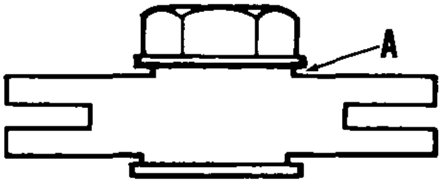
NOTICE: This check cannot be made if the bearing adapter or bushing assembly is broken.



Capsules must be within 1.59mm (1/16") from bottom of slots. If not, replace bracket or jacket assembly.

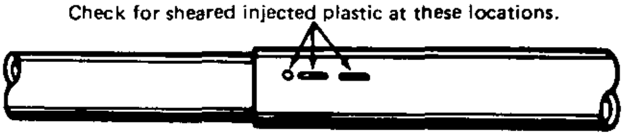
View A

The bolt head must not contact surface "A". If contact is made, the capsule shear load will be increased—replace bracket or jacket assembly.



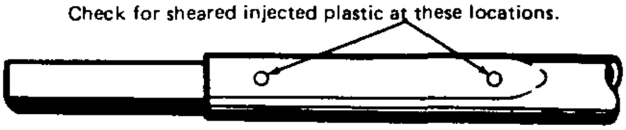
View B

Check for sheared injected plastic at these locations.



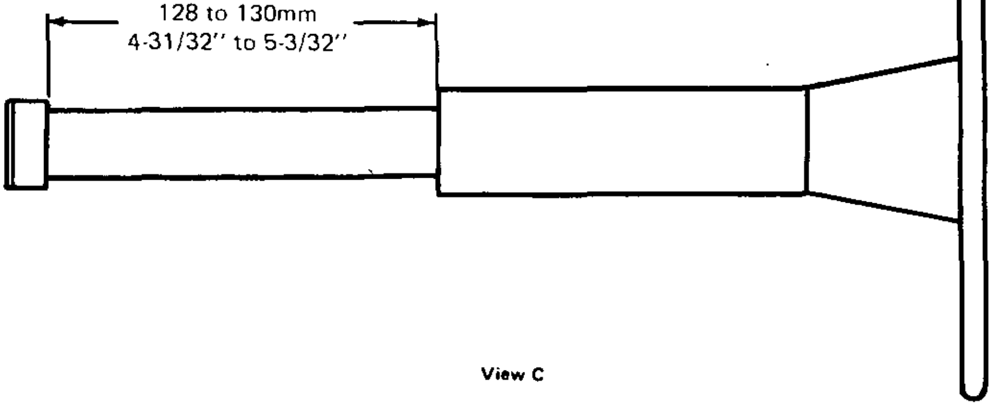
View D

Check for sheared injected plastic at these locations.



View E

MEASURE FROM EDGE
OF LOWER JACKET TO
EDGE OF UPPER JACKET



View C

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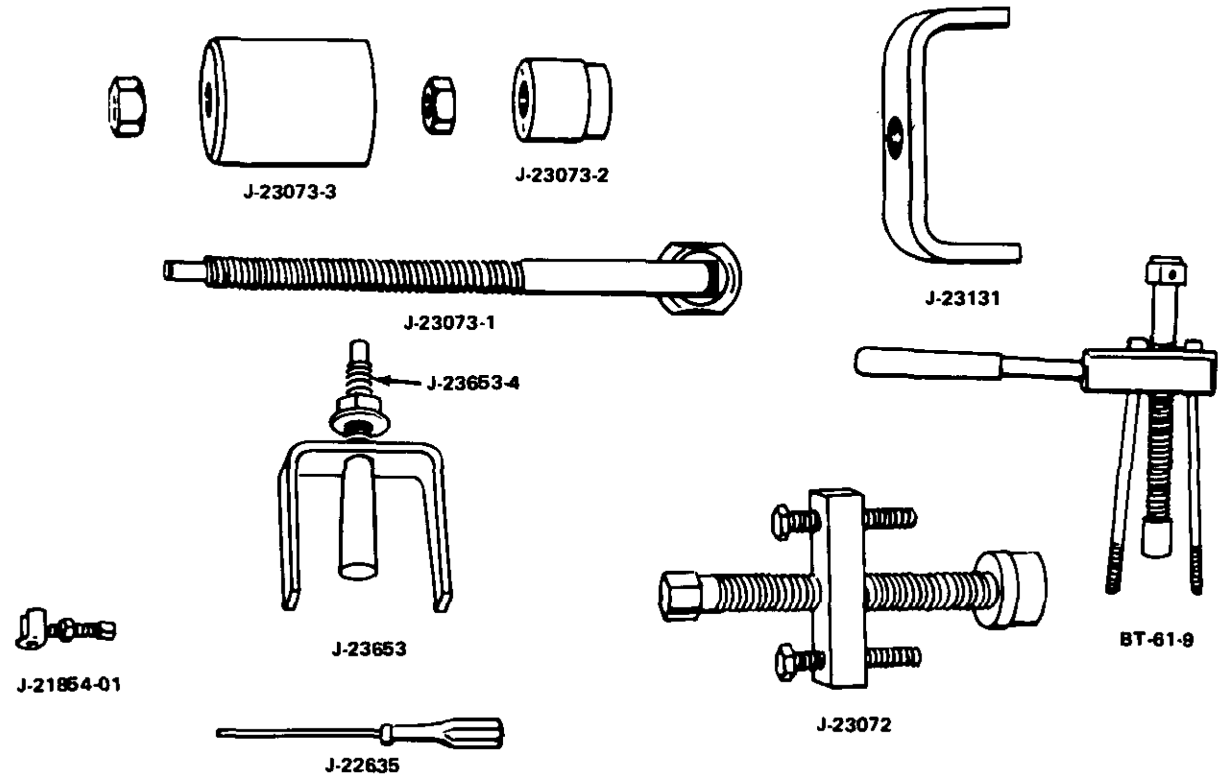
Fig. 18 Checking Steering Column for Accident Damage

TORQUE SPECIFICATIONS

APPLICATION	N·m	FT. LBS.	IN. LBS.
Steering Wheel to Shaft Nut	41	30	
Turn Signal Switch Attaching Screws	3.9		35
Ignition Switch Attaching Screws	3.9		35
Support to Lock Plate Screws (Tilt Column)	5.5		50
Steering Column to Intermediate Shaft	47	35	
Cover to Housing Screws	11		100

SPECIAL TOOLS



BT-61-9	STEERING WHEEL PULLER	J-23073-1-2-3	SHIFT TUBE INSTALLER
J-21854-01	PIVOT PIN REMOVER	J-23131	LOCK PLATE COMPRESSOR
J-22635	LOCK SHOE & RELEASE LEVER	J-23653 &	
J-23072	SHIFT TUBE REMOVER	J-23653-4	LOCK PLATE COMPRESSOR

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Fig. 19 Torque Specifications and Special Tools

SECTION 3C

FRONT SUSPENSION

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 by the terminology "See Notice on page 1 of this Section."

NOTICE: This fastener 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.

CONTENTS

GENERAL DESCRIPTION

The front suspension system uses conventional long and short arm design and coil springs. The control arms attach to the vehicle with bolts and bushings at the inner pivot points, and to the steering knuckle/front wheel spindle assembly at the outer pivot points. Lower ball joints use the "wear indicator" feature.

MAINTENANCE AND ADJUSTMENTS

MAINTENANCE INTERVALS

Recommended intervals for maintenance of front suspension items are covered in Section OB of this manual.

FRONT WHEEL BEARINGS

NOTICE: Tapered roller bearings are used on all series vehicles and they have a slightly loose feel when properly adjusted. A design feature of front wheel tapered roller bearings is that they must never be preloaded. Damage can result from preloading.

Adjusting Front Wheel Bearings

The proper functioning of the front suspension cannot be maintained unless the front wheel taper roller bearings are correctly adjusted. Cones must be a slip fit on the spindle and the inside diameter of cones should be lubricated to insure that the cones will creep. Spindle nut must be a free-running fit on threads.

Check Adjustment

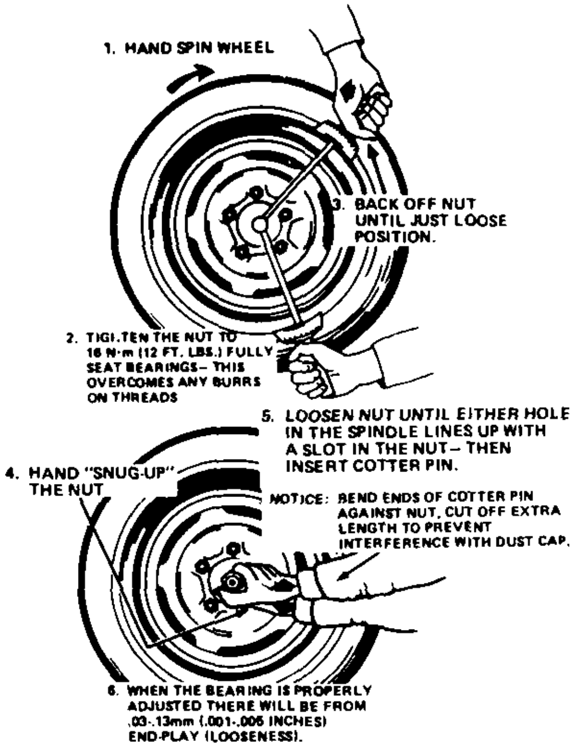
1. Raise vehicle and support at front lower control arm.
2. Spin wheel to check for unusual noise or roughness.
3. If bearings are noisy, tight, or excessively loose, they should be cleaned, inspected and relubricated prior to adjustment. If it is necessary to inspect bearings, see Replacement of Wheel Bearings.

   To check for tight or loose bearings, grip the tire at the top and bottom and move the wheel assembly in and out on the spindle. **Measure movement of hub assembly.** Movement should be from 0.025mm to 0.127mm (.001" - .005"). If movement is not in this range, adjust bearings per adjustment procedure.

Adjustment

Figure 1

1. Raise vehicle.
2. Remove wheel.
3. Remove dust cap from hub.
4. Remove cotter pin from spindle and spindle nut.
5. 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.
6. Back off the nut to the "just loose" position.
7. 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.)
8. 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.



1. HAND SPIN WHEEL

2. TIGHTEN THE NUT TO 16 N·m (12 FT. LBS.) FULLY SEAT BEARINGS– THIS OVERCOMES ANY BURRS ON THREADS

3. BACK OFF NUT UNTIL JUST LOOSE POSITION.

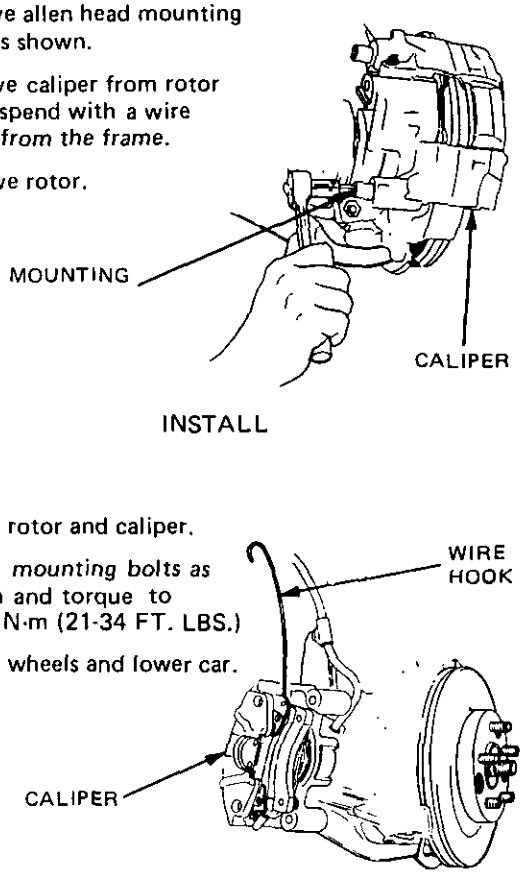
4. HAND "SNUG-UP" THE NUT

5. LOOSEN NUT UNTIL EITHER HOLE IN THE SPINDLE LINES UP WITH A SLOT IN THE NUT– THEN INSERT COTTER PIN.

NOTICE: BEND ENDS OF COTTER PIN AGAINST NUT, CUT OFF EXTRA LENGTH TO PREVENT INTERFERENCE WITH DUST CAP.

6. WHEN THE BEARING IS PROPERLY ADJUSTED THERE WILL BE FROM .03-.13mm (.001-.005 INCHES) END-PLAY (LOOSENESS).

Fig. 1 Wheel Bearing Adjustment



REMOVE

1. Hoist car and remove wheel.
2. Remove allen head mounting bolts as shown.
3. Remove caliper from rotor and suspend with a wire *hook from the frame.*
4. Remove rotor.

INSTALL

1. Install rotor and caliper.
2. *Install mounting bolts as* shown and torque to 28-47 N·m (21-34 FT. LBS.)
3. Install wheels and lower car.

Fig. 2 Remove and Install Caliper

9. Measure the looseness in the hub assembly. There will be from 0.025mm to 0.127mm (.001" to .005") end play when properly adjusted.
10. Install dust cap on hub.
11. Replace the wheel cover or hub cap.
12. Lower vehicle to floor.
13. Perform the same operation for each front wheel.

ON-CAR SERVICE

WHEEL HUB-AND-DISC

Removal (Fig. 2)

1. Raise vehicle on a hoist.
2. Remove the wheel and tire assembly.
3. Remove the brake caliper from the knuckle. (Reference Section 5).
4. Remove hub dust cup, cotter pin, spindle nut and washer and remove hub and bearing. Do not allow bearing to fall out of hub when removing hub from spindle.

Replacement of Bearings

1. Remove outer bearing with fingers.
2. Remove the inner bearing by prying out the grease seal. Discard Seal.
3. Wash all parts thoroughly in cleaning solvent.

Replacement of Bearing Race

1. Drive out old race from hub with a brass drift inserted behind race in notches in hub.
2. Lubricate the new race with a light film of grease.
3. Start the race squarely into the hub and carefully seat the race using an appropriate tool.

Inspection of Bearings

1. Check bearings for cracked separators or pitting.
2. Check races for scoring or pitting. If it is necessary to replace either the outer or inner bearing, it will be necessary to replace the race for that bearing.

Installation and Repacking of Bearings

NOTICE: See NOTICE on page 1 of this section regarding the fasteners.

1. Clean off any grease in the hub and spindle and thoroughly clean out any grease in the bearings. Using a cleaning solvent. Use of a small brush with no loose bristles will be helpful to clean out all old grease. Do not spin the bearing with compressed air while drying it or the bearing may be damaged.
2. Use a GM approved high temperature front wheel bearing grease or equivalent. Do not mix greases as mixing may change the grease properties and result in poor performance.
3. Apply a thin film of grease to the spindle at the outer bearing seat and at the inner bearing seat, shoulder, and seal seat.
4. Put a small quantity of grease inboard of each bearing race in the hub. This can be applied with your finger forming a dam to provide extra grease availability to the bearing and to keep thinned grease from flowing out of the bearing.
5. Fill the bearing cone and roller assemblies 100% full of grease. A preferred method for doing this is with a cone-type grease machine that forces grease into the bearing. If a cone greaser is not available, the bearings can be packed by hand. If hand packing is used, it is extremely important to work the grease thoroughly into the bearings between the rollers, cone, and the cage. Failure to do this could result in premature bearing failure.
6. Place the inner bearing cone and roller assembly in the hub. Then using your finger, put an additional quantity of grease outboard of the bearing.
7. Install a new grease seal using a flat plate until the seal is flush with the hub. Lubricate the seal lip with a thin layer of grease.
8. Carefully install the hub and rotor assembly. Place the outer bearing cone and roller assembly in the outer bearing race. Install the washer and nut. Draw up nut and adjust the wheel bearing as outlined above.
9. Install the brake caliper.
10. Install wheel and tire.
11. Lower vehicle to floor.

Replacement of Wheel Stud Bolts

Figure 3

1. Raise vehicle.
2. Remove tire and wheel.
3. Remove brake caliper.
4. Remove dust cap from spindle.
5. Remove cotter key from spindle bolt.
6. Remove spindle bolt.
7. Carefully remove wheel bearing (do not allow bearing to drop on the ground).
8. Remove rotor assembly.
9. Remove the hub studs with a press. Do not damage the wheel mounting surface on stud flange.

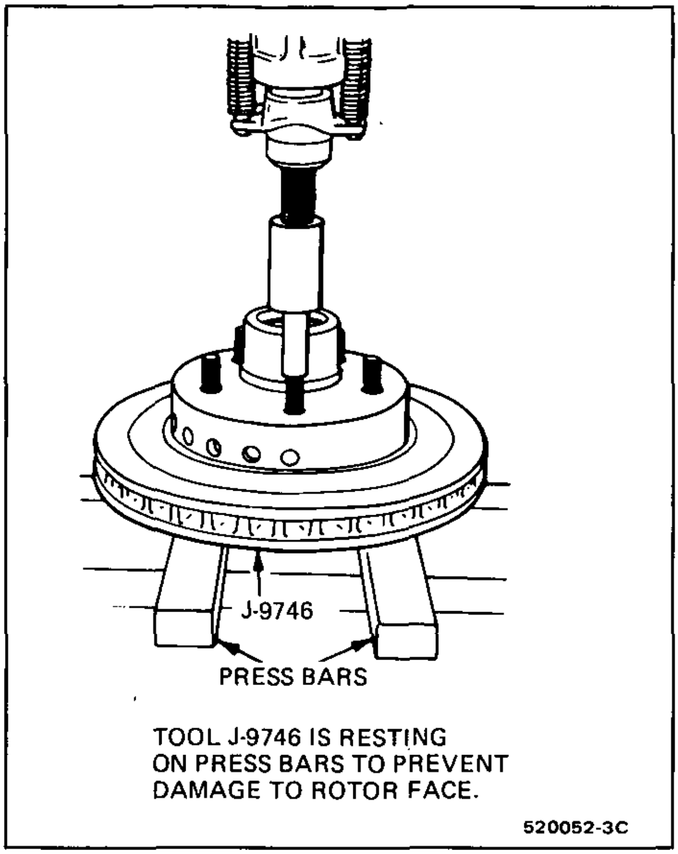


Fig. 3 Removing Stud Bolts

10. Support the hub and disc assembly with tool J-9746 while pressing out the stud stud to prevent any damage to the rotor face.
11. Install new serrated stud into hole in stud. Tap lightly with a hammer to start the serrations into hole making sure that the stud is square with hub flange.
12. Press stud into flange until head is fully seated against flange.

SHOCK ABSORBERS

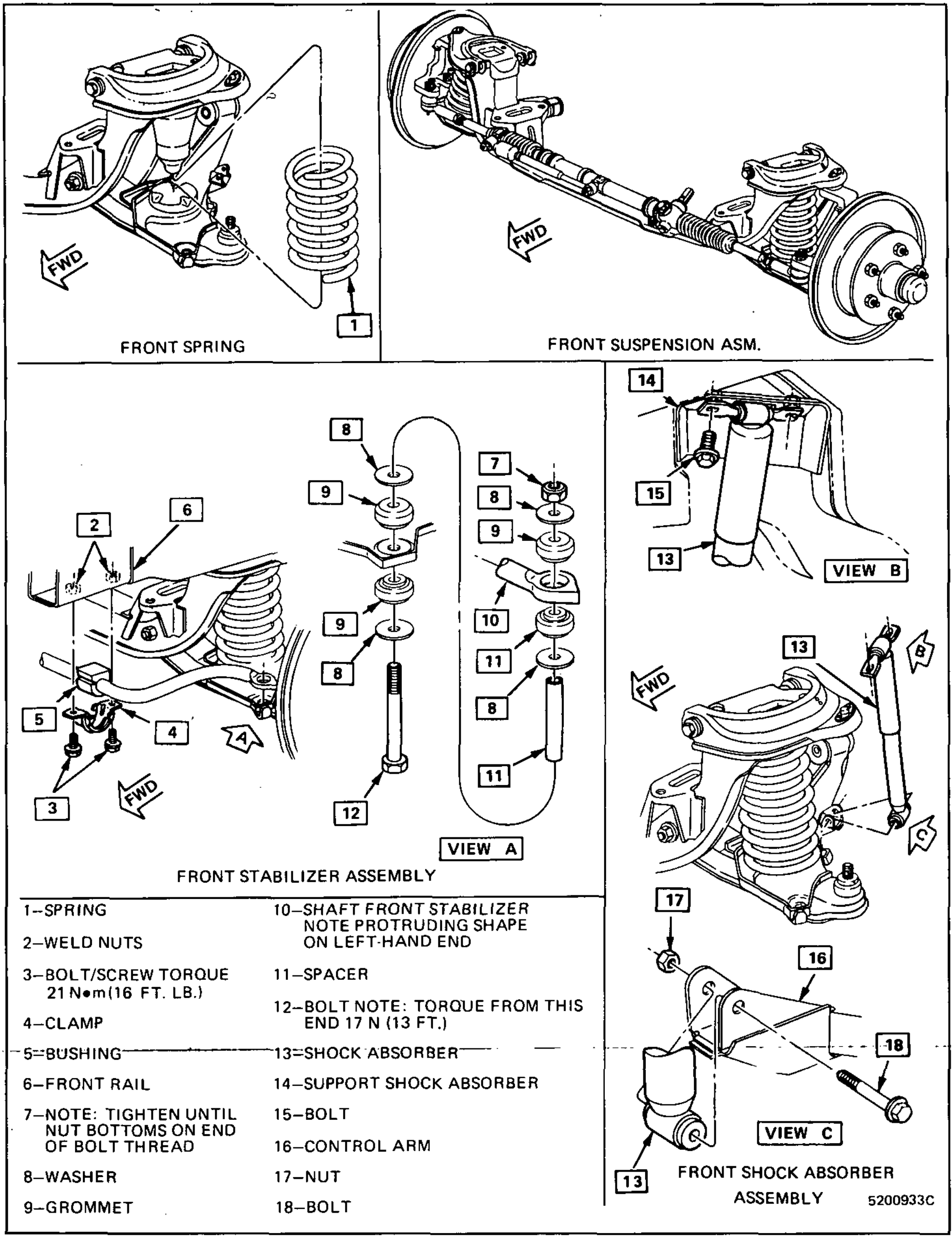
Figure 4

Removal

1. Raise vehicle on a hoist.
2. Remove wheel and tire assembly.
3. Remove the two upper retaining bolts.
4. Remove the nut and bolt from the lower end of the shock absorber.
5. Remove the shock absorber from the vehicle.

Installation

1. With the lower portion of the shock absorber in position, hand tighten the nut and bolt (View C) extend the shock up into the shock absorber support (View B) and torque both bolts to 27 N·m (20 lb.ft.).
2. Tighten the lower nut and bolt. Torque bolt to 48 N·m (35 lb.ft.).
3. Replace wheel and tire assembly.
4. Lower the vehicle to the floor.



FRONT SPRING

FRONT SUSPENSION ASM.

FRONT STABILIZER ASSEMBLY

VIEW A

VIEW B

VIEW C

FRONT SHOCK ABSORBER ASSEMBLY

5200933C

1–SPRING

2–WELD NUTS

3–BOLT/SCREW TORQUE 21 N•m (16 FT. LB.)

4–CLAMP

5–BUSHING

6–FRONT RAIL

7–NOTE: TIGHTEN UNTIL NUT BOTTOMS ON END OF BOLT THREAD

8–WASHER

9–GROMMET

10–SHAFT FRONT STABILIZER NOTE PROTRUDING SHAPE ON LEFT-HAND END

11–SPACER

12–BOLT NOTE: TORQUE FROM THIS END 17 N (13 FT.)

13–SHOCK ABSORBER

14–SUPPORT SHOCK ABSORBER

15–BOLT

16–CONTROL ARM

17–NUT

18–BOLT

Fig. 4 Front Shock Absorber, Stabilizer and Spring Assembly

STABILIZER BAR

Figure 4

Removal

1. Raise the vehicle on a hoist.
2. Remove stabilizer bar nut and bolt and associated pieces from lower control arms.
3. Remove stabilizer bar clamp from body.

Installation

NOTICE: There is a projection on one stalibilzer bar eyelet which indicates the left end of the stabilizer bar. This end should be connected to the lower left control arm.

1. Hold stabilizer bar in place and install the stabilizer bar bushings and clamps. Torque all bolts to 21 N·m (15 lb.ft.).
2. Install the bolts, washers, grommets and spacer in the order shown in View A to the lower control arm and install nut.
3. Tighten the nut until it bottoms on the end of bolt thread.
4. Torque the bolt to 22 N·m (16 lb.ft.) .
5. Lower the vehicle to the floor.

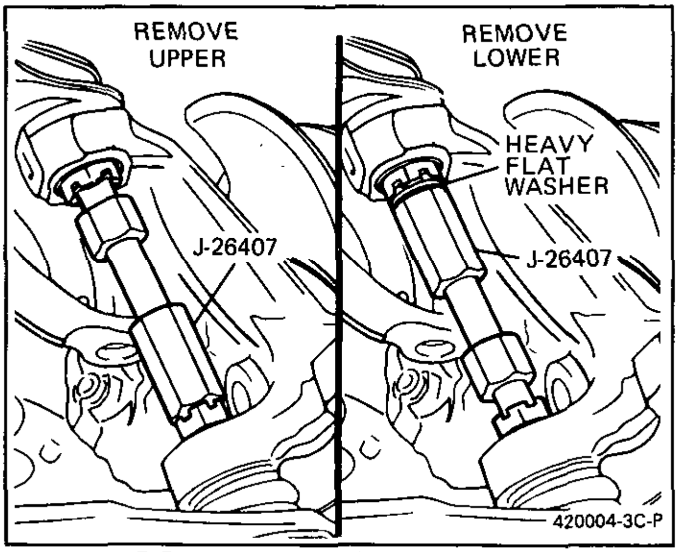


Fig. 5 Removal of Ball Joints From Knuckle

BALL JOINTS

Figure 5

Upper Ball Joint - Removal

1. Raise the vehicle on a hoist.
2. Remove the tire and wheel assembly.
3. Support the lower control arm with a floor jack.
4. Remove upper ball stud nut, then reinstall nut finger tight.
5. Install Tool J-26407 with the cup end over the lower ball stud nut.
6. Turn the threaded end of J-26407 until upper ball stud is free of steering knuckle.
7. Remove Tool J-26407 and remove nut from ball stud.
8. Remove two nuts and bolts attaching ball joint to upper control arm. Note which way the flat of the ball joint is pointing before removing it. The direction of this flat on the ball joint flange should be in the same direction as the one removed unless a change in camber is desired.
9. Remove ball joint.

Upper Ball Joint - Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in the following steps.

Inspect the tapered hole in the steering knuckle. Remove any dirt and if any out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

1. Install bolts and nuts attaching ball joint to upper control arm and torque to 39 N·m (28 lb.ft.), then mate the upper control arm ball stud to the steering knuckle.
2. Install the ball stud nut and torque to 47 N·m (35 lb.ft.). Then turn 1/6 of a turn to align cotter pin.
3. Install cotter pin.
4. Install the tire and wheel assembly.
5. Lower the vehicle to the floor.
6. Set toe.

LOWER BALL JOINT - REMOVAL/INSTALLATION

The lower ball joint is welded to the lower control arm and cannot be serviced separately. Replacement of the entire lower control arm will be necessary if the lower ball joint requires replacement. See lower control arm removal.

FRONT SPRING/LOWER CONTROL ARM

Removal

1. Raise vehicle on a hoist and support to vehicle on the crossmember.
2. Remove wheel and tire assembly.
3. Disconnect stabilizer bar from the lower control arm.
4. Disconnect the tie rod from the steering knuckle.
5. Disconnect the shock absorber at the lower control arm.
6. Support the lower control arm with a jack.
7. Remove the nut from the lower ball joint, then use tool J-26407 to press the ball joint out of the knuckle as shown in figure 5.
8. Swing the knuckle and hub out of the way.
9. Loosen the lower control arm pivot bolts.
10. Install a chain through the coil spring as a safety precaution.

    CAUTION: The coil spring is under load and could result in personal injury if it were released too quickly. Be sure to install a chain and to slowly lower the jack.
11. Slowly lower the jack and remove the spring.

12. Remove the pivot bolts at the chassis and the crossmember and remove the lower control arm.
    - Removal of the pivot bolt at the cross member may require the loosening or removal of the steering assembly mounting bolts.

Installation

1. Install the lower control arm and pivot bolts at crossmember and body. Tighten slightly but do not torque.
2. Position the spring and install the spring into the upper pocket. Align spring bottom to lower control arm pocket.
3. Install spring lower end onto lower control arm. It may be necessary to have an assistant help you compress the spring far enough to slide it over the raised area of the lower control arm seat.
4. Use a jack to raise the lower control arm and compress the coil spring.
5. Install the ball joint through the lower control arm and into the steering knuckle. Install nut to ball joint stud and torque to 75 N·m (55 lb.ft.). Install a new cotter pin.
6. Connect the stabilizer bar and torque the bolt to 22 N·m (16 lb.ft.).
7. Connect the tie rod and torque to 39 N·m (29 lb. ft.).
8. Install the shock absorber to the lower control arm and torque the bolt to 47 N·m (35 lb.ft.).
9. If the bolts were removed or loosened at the steering assembly replace with new bolts and torque to 29 N·m (21 lb.ft.)
10. With the suspension system in its normal standing height, torque the lower control arm to body bolt at 85 N·m (62 lb.ft.) and the lower control arm to crossmember nut at 70 N·m (52 lb.ft.)
11. Check and set alignment as necessary. See Section 3A for Specifications.

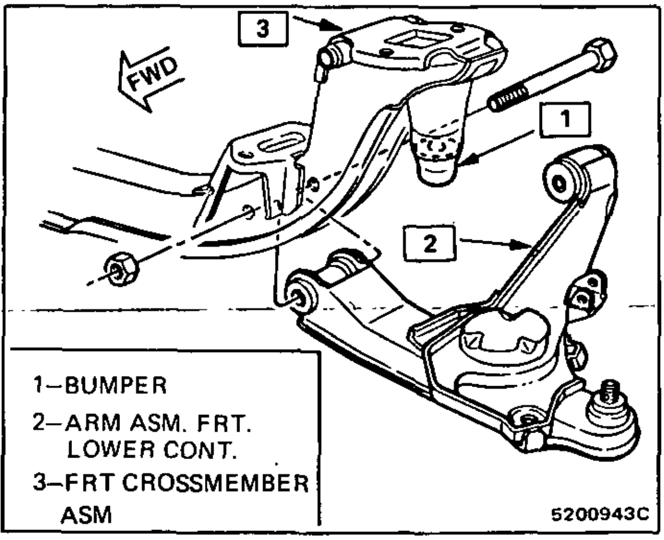


Fig. 6 Lower Control Arm

UPPER CONTROL ARM

Figure 7

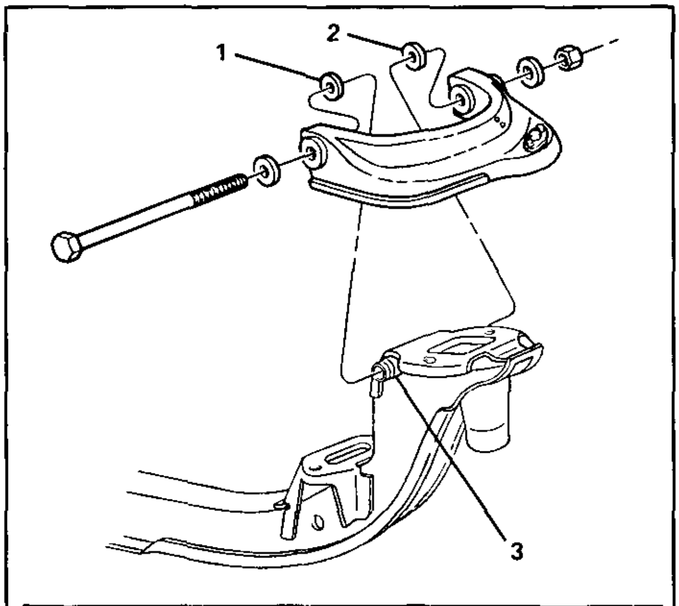
Removal

1. Raise vehicle on a hoist.
2. Remove the tire and wheel assembly.
3. Remove rivet holding brake line clip to upper control arm.
4. Support the lower control arm with a floor jack.
5. Remove upper ball joint from steering knuckle, as described earlier.
6. Remove control arm pivot bolt and remove control arm from vehicle.
7. Transfer ball joint if not damaged or worn.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in the following steps.

Washers and shims must be reinstalled as removed unless a change in geometry is desired.



1 – FRONT WASHER
2 – REAR WASHER
3 – UPPER CONTROL ARM SUPPORT BRACKET

SERVICE CHANGE

FRONT	REAR	NET CHANGE
3MM	9MM	+1°
9MM	3MM	−1°

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Fig. 7 Front Control Arm Shim Arrangement

1. Install upper control arm and pivot bolt to vehicle. The inner pivot bolt must be installed with the bolt head toward the front.
2. Install the pivot bolt nut.
3. Position the control arm in a horizontal plane and torque the nut to 90 N·m (66 lb.ft.).

NOTICE: Bolt may turn when torqued to minimum if nut is not backed up with a wrench. This **does not mean** the joint is loose.

4. Install ball joint to upper control arm and to steering knuckle, as described earlier. Install nut, torque to 47 N·m (35 lb.ft.). Install a new cotter pin.
5. Install wheel and tire.
6. Lower vehicle to floor.

Crossmember Bumper

1. Raise vehicle on a hoist and support to vehicle on the crossmember.
2. Remove wheel and tire assembly.
3. Disconnect stabilizer bar from the lower control arm.
4. Disconnect the tie rod from the steering knuckle.
5. Disconnect the shock at the lower control arm.
6. Support the lower control arm with a jack.
7. Remove the nut from the lower ball joint, then use tool J-26407 to press the ball joint out of the knuckle as shown in figure 5.
8. Swing the knuckle and hub out of the way.
9. Loosen the lower control arm pivot bolts.
10. Install a chain through the coil spring as a safety precaution.

    CAUTION: The coil spring is under load and could result in personal injury if it were released too quickly. Be sure to install a chain and to slowly lower the jack.
11. Slowly lower the jack and remove the spring.
12. Remove bumper.

Installation

1. Replace bumper.
2. Position the spring as shown in Figure 4 and install the spring onto the upper pocket. Be sure spring is aligned with the lower spring pocket.
3. Install spring lower end onto lower control arm. It may be necessary to have an assistant help you compress the spring far enough to slide it over the raised area of the lower control arm seat.
4. Use a jack to raise the lower control arm and compress the coil spring.
5. Install the ball joint through the lower control arm and into the steering knuckle. Install nut to ball joint stud and torque to 75 N·m (55 lb.ft.). Install a new cotter pin.
6. Connect the stabilizer bar and torque the bolt to 22 N·m (16 lb.ft.).
7. Connect the tie rod and torque to 39 N·m (29 lb. ft.). Install a new cotter pin.
8. Install the shock absorber to the lower control arm and torque the bolt to 47 N·m (35 lb.ft.).
9. With the suspension system in its normal standing height, torque the lower control arm to body bolt at 85 N·m (62 lb.ft.), and the lower control arm to crossmember nut at 70 N·m (52 lb.ft.).

STEERING KNUCKLE

Removal

1. Raise vehicle on a hoist and support the lower control arm with a jackstand.

    CAUTION: This keeps the coil spring compressed. Use care to support adequately, or personal injury could result.
2. Remove the tire and wheel assembly.
3. Remove the disc brake caliper, as outlined in Section 5, Brakes. Secure the caliper to the suspension using wire. Do not allow the caliper to hang by the brake hose. Insert a piece of wood between the shoes to hold the piston in the caliper bore. (The block of wood should be about the same thickness as the brake disc.)
4. Remove the hub and disc. See Section 5 Brakes.
5. Remove the splash shield. See Section 5 Brakes.
6. Remove both ball stud nuts (See Ball Joint Removal).
7. Remove the tie rod end from the steering knuckle.
8. Using Tool J-26407, press the upper ball stud from the steering knuckle.
9. Reverse Tool J-26407 to the other ball stud and press lower ball stud from the steering knuckle.
10. Remove ball stud nuts and remove the steering knuckle.

Installation

NOTICE: See NOTICE on page 1 of this section regarding the fasteners referred to in the following steps.

1. Place steering knuckle in position and insert the upper and lower ball studs into knuckle bosses.
2. Install ball stud nuts and tighten to specifications. For L.C.A., torque to 75 N·m (55 lb.ft.). For U. C.A., torque to 47 N·m (35 lb.ft.). Install new cotter pins.
3. Install splash shield to the steering knuckle. Torque to 10 N·m (7 lb.ft.). See Section 5 Brakes.
4. Install the tie rod end to the steering knuckle. Torque to 39 N·m (29 lb.ft.), and install cotter pin.
5. Repack the wheel bearings, follow the Procedure as outlined above. Then install the hub and disc, bearings and nut. Torque to specifications as outlined above.
6. Install the brake caliper. See Section 5 Brakes.
7. Install the tire wheel assembly.
8. Remove the jackstand and lower the vehicle to the floor.

SPECIFICATIONS

TORQUE SPECIFICATIONS

Bolt:	
U.C.A. To Crossmember	90 N·m (66 lb.ft.)
Nut:	
L.C.A. To Crossmember	70 N·m (52 lb.ft.)
Nut:	
U.C.A. Ball Joint To Knuckle	47 N·m (35 lb.ft.)
Note: (Max. 75 N·m (55 lb.ft.) permissable; 1/6 turn to align cotter pin)	
Nut:	
L.C.A. Ball Joint To Knuckle	75 N·m (55 lb.ft.)
Note: (Max. 145 N·m (106 lb.ft.) permissable; 1/6 turn to align cotter pin)	
Bolt:	
Steering Gear To Crossmember	29 N·m (22 lb.ft.)
Nut:	
Tie Rod At Knuckle	39 N·m (29 lb.ft.)
Note: (Max. 54 N·m (39 lb.ft.) permissable; 1/6 turn to align cotter pin)	
Damper To Gear	47 N·m (36 lb.ft.)
Nut:	
Damper To Stud	43 N·m (32 lb.ft.)
Bolt:	
Ball Joint To U.C.A.	39 N·m (28 lb.ft.)
Bolt:	
Crossmember To Body Rail (Lower)	70 N·m (52 lb.ft.)
Note: Replace with new bolts and lubricate	
Bolt:	
Bracket Crossmember To Rail (Upper)	70 N·m (52 lb.ft.)
Note: Replace with new bolts and lubricate	
Bolt:	
Shock To Body	27 N·m (20 lb.ft.)
Nut:	
Shock To L.C.A.	69 N·m (51 lb.ft.)
Note: Torque at bolt	
Bolt:	
K-Brace To Body	27 N·m (20 lb.ft.)
Bolt:	
K-Brace To Crossmember	27 N·m (20 lb.ft.)
Bolt:	
Stabilizer Bar Body Bracket	21 N·m (15 lb.ft.)
Nut:	
Stabilizer Bar At Link	17 N·m (12 lb.ft.)
Note: Torque at bolt (Bottom nut on Shoulder)	
Bolt:	
Cross Member to Upper Rail	70 N·m (52 lb.ft.)
Bolt:	
L.C.A. To Body with Washer	85 N·m (62 lb.ft.)
Note: Torque at bolt	

SECTION 3D

REAR SUSPENSION

NOTICE: All rear 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 parts.

NOTICE: Never attempt to heat, quench or straighten any rear suspension part. Replace it with a new part or damage to the part may result.

CONTENTS

GENERAL INFORMATION

The rear suspension is a Mac Pherson Strut design. This combination strut and spring adapts to the rear wheel drive. The lower control arms pivot from the engine cradle. The cradle has isolation mounts to the body and conventional rubber bushings are used for the lower control arm pivots. The upper end of the strut is insulated by a rubber mount.

NOTICE: Boot protector J-28712 should be installed whenever servicing rear suspension components, in order to prevent damage to the drive axle boot.

MAINTENANCE AND ADJUSTMENTS

Recommended intervals for maintenance of rear suspension items are covered in Section 0-B of this manual.

REMOVE AND INSTALL REAR STRUT DAMPER ASSEMBLY

Remove or Disconnect (Figure 3D-1, 3D-5 and 3D-6)

Tool Required:

- J-28712 Boot Protector

1. Motor compartment cover.
2. Three upper strut nuts.
3. Three upper strut washers.
4. Loosen wheel lug nuts.
5. Raise vehicle and support rear control arm.
6. Wheel and tire.
7. Brake line clip.

Important

Scribe strut and knuckle as shown in Figure 3D-1.

Remove or Disconnect

1. Two strut mounting nuts.
2. Two strut mounting bolts.
3. Strut assembly and spacer plate.

Install or Connect

1. Strut assembly and spacer plate.
2. Two knuckle strut mounting bolts.
3. Two knuckle strut mounting nuts.

Important

Align scribe marks on strut and knuckle. Replace bolts in the same order in which they were removed.

Tighten

Tighten knuckle nuts to 190 N·m (140 ft. lbs.).

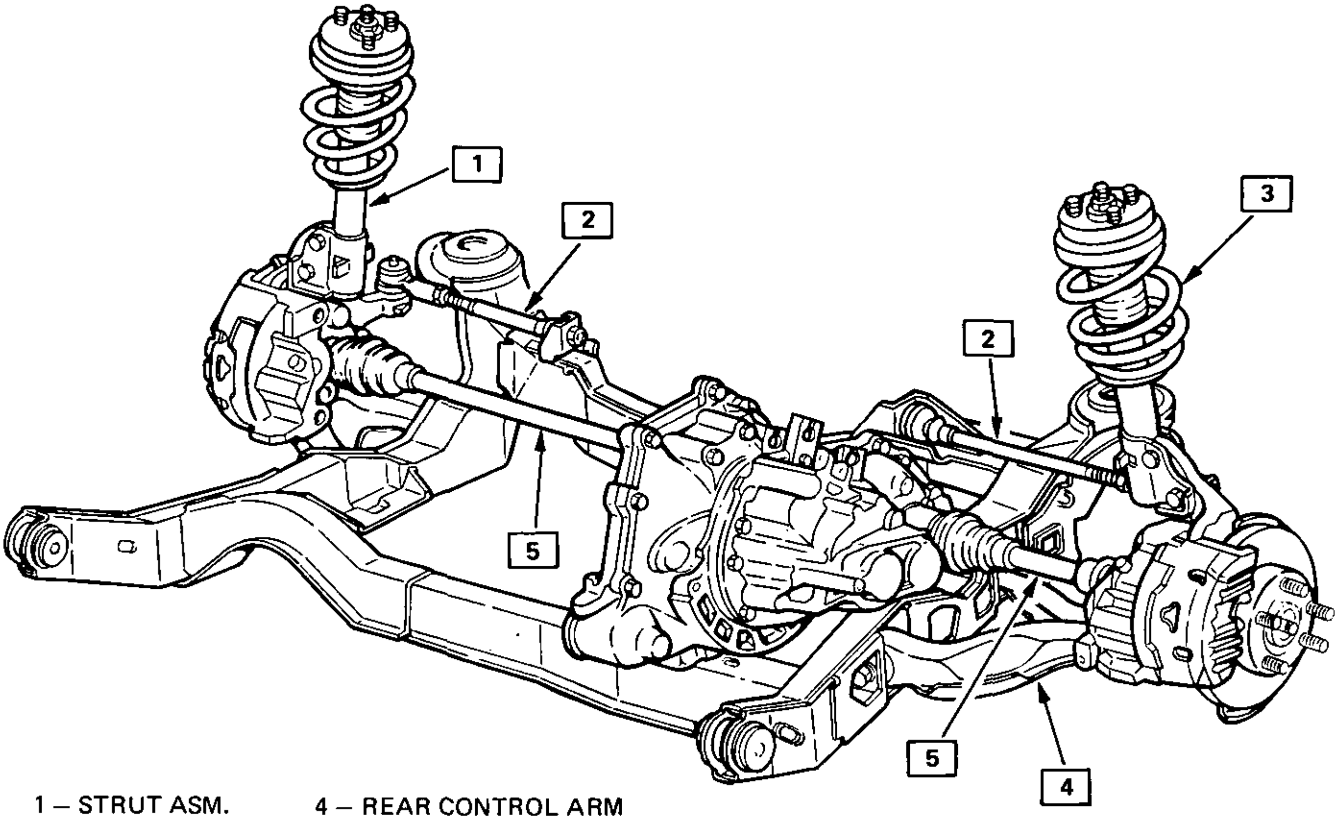
Install or Connect

1. Brake line clip.
2. Wheel and tire (tighten all lug nuts).
3. Lower vehicle.
4. Three upper strut washers.
5. Three upper strut nuts.

Tighten

Three upper strut nuts to 24 N·m (18 ft.lbs.).

6. Motor compartment cover.



1 – STRUT ASM.

2 – TOE LINK RODS

3 – SPRING

4 – REAR CONTROL ARM

5 – DRIVE AXLES

BEFORE DISCONNECTING THE STRUT ASSEMBLY FROM THE KNUCKLE, PLEASE NOTE:

1. REFER TO BOX I AND BOX II, BELOW.
2. WHEN SERVICING ITEMS IN BOX I, USE THE SCRIBING PROCEDURE SHOWN HERE. BY FOLLOWING THIS METHOD, YOU WILL BE ABLE TO RETURN TO YOUR ORIGINAL CAMBER SETTING. IT WILL BE NECESSARY, HOWEVER, TO CHECK/ADJUST THE TOE-IN SETTING.
3. WHEN SERVICING ITEMS IN BOX II, DO NOT SCRIBE THE MARKS. AFTER REINSTALLING THESE ITEMS, YOU MUST CHECK/ADJUST BOTH CAMBER AND TOE-IN.

STRUT MOUNT
JOUNCE BUMPER
STRUT SHIELD
SPRING SEAT
SPRING INSULATOR
DRIVE AXLE REMOVAL

BOX I

REAR RIDE SPRING
STRUT DAMPER
KNUCKLE

BOX II

SCRIBING PROCEDURE

1. USING A SHARP TOOL, SCRIBE THE KNUCKLE ALONG THE LOWER OUTBOARD STRUT RADIUS, AS IN VIEW A.
2. SCRIBE THE STRUT FLANGE ON THE INBOARD SIDE, ALONG THE CURVE OF THE KNUCKLE, AS IN VIEW B.
3. MAKE A CHISEL MARK ACROSS THE STRUT/KNUCKLE INTERFACE, AS IN VIEW C.
4. ON REASSEMBLY, CAREFULLY MATCH THE MARKS TO THE COMPONENTS.

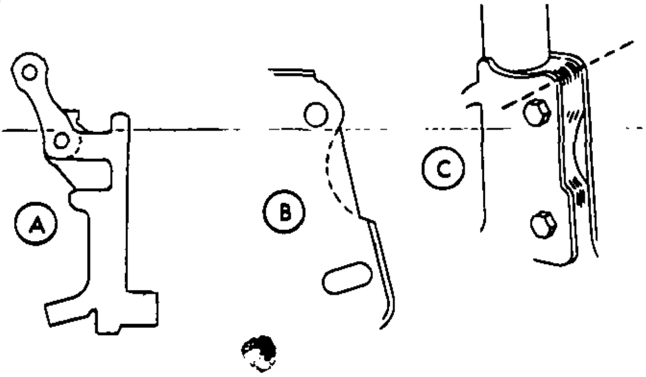


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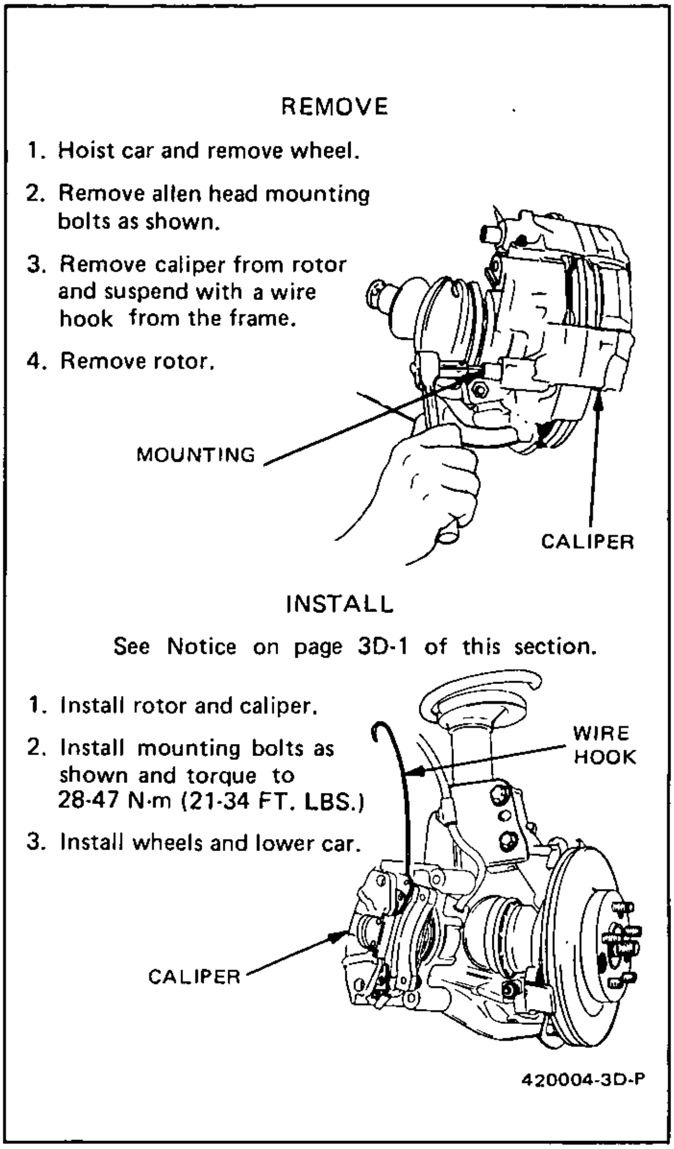
Fig. 3D-1 Rear Suspension



REMOVE

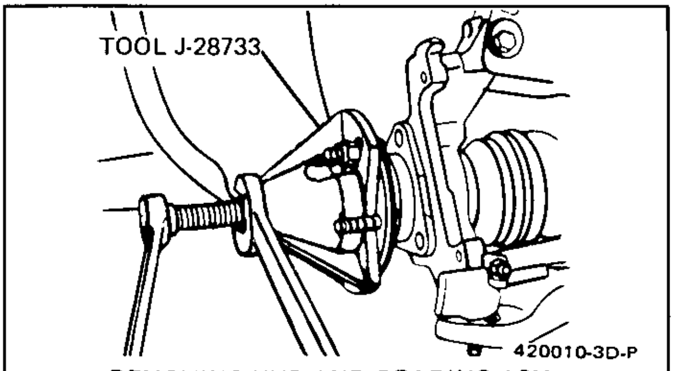
1. Hoist car and remove wheel.
2. Remove allen head mounting bolts as shown.
3. Remove caliper from rotor and suspend with a wire hook from the frame.
4. Remove rotor.

INSTALL

See Notice on page 3D-1 of this section.

1. Install rotor and caliper.
2. Install mounting bolts as shown and torque to 28-47 N·m (21-34 FT. LBS.)
3. Install wheels and lower car.

Fig. 3D-2 Removing & Installing Wheel Caliper

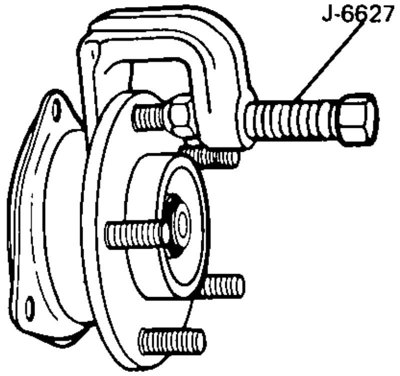


REMOVING HUB-AND-BEARING ASM

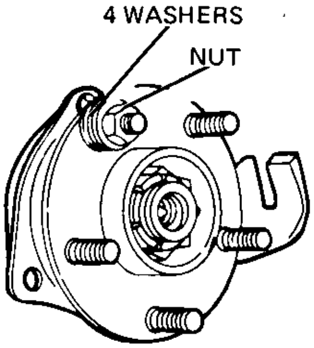
Fig. 3D-3 Removing Hub & Bearing

WHEEL STUDS

Remove or Disconnect (Figure 3D-2 through 3D-4)



REMOVE WHEEL STUD



INSTALL WHEEL STUD

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Fig. 3D-4 Removing & Installing Wheel Stud

Tools Required:
- J-6627 wheel stud remover
- J-28733 Hub spindle remover

1. Raise vehicle.
2. Tire and wheel assembly.
3. Brake caliper (do not allow caliper to hang by the brake hose).
4. Rotor.
5. Hub nut (discard nut).
6. Three hub and bearing bolts.
7. Install Tool J-28733 and remove hub and bearing assembly.
8. Install Tool J-6627 and remove stud.

Install or Connect

1. Stud through hub and bearing assembly.
2. Place washers on stud along with wheel nut (use flat side of nut to draw stud into hub and bearing assembly).
3. Tighten wheel nut until stud is seated.

Remove or Disconnect

1. Wheel nut and washers.

Install or Connect

1. Hub and bearing on axle shaft.

Tighten

Torque three hub and bearing bolts to 85 N·m (62 lb.ft.).

Install or Connect

1. **New** hub nut on axle shaft.

Tighten

Apply partial torque to new hub nut (approx. 100 N·m) (74 lb.ft.).

Install or Connect

1. Rotor.
2. Caliper assembly.

Tighten

Torque caliper mounting bolts to 48 N·m (35 lb. ft.).

Install or Connect

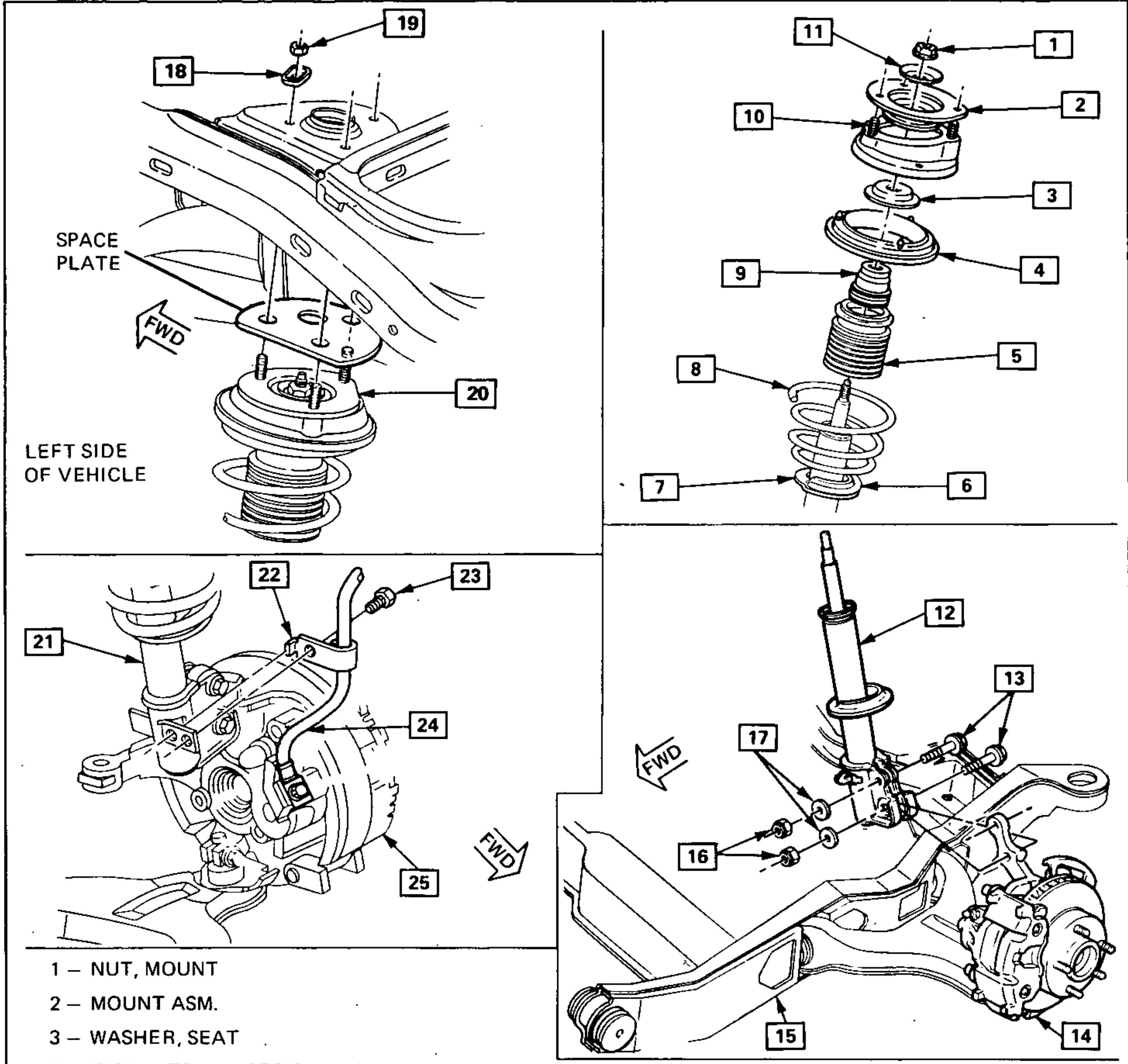
1. Wheel and tire.
2. Lower vehicle.

Tighten

Apply FINAL torque at hub nut to 270 N·m (200 lb.ft.).

Install or Connect

1. Hub cap.



1 – NUT, MOUNT
2 – MOUNT ASM.
3 – WASHER, SEAT
4 – INSULATOR, UPPER SPRING
5 – SHIELD
6 – INSULATOR LOWER SPRING
7 – LOWER SPRING SEAT
8 – SPRING
9 – BUMPER
10 – SEAT ASM.
11 – WASHER, MOUNT UPPER
12 – STRUT ASM. RR. SUSP.
13 – MOUNTING BOLTS STRUT
14 – KNUCKLE & HUB ASM.
15 – CRADLE ASM.
16 – MOUNTING NUTS, STRUT
17 – WASHERS, STRUT LOWER
18 – WASHERS, STRUT UPPER
19 – NUTS, STRUT UPPER
20 – MOUNT ASM.-RR. STRUT
21 – ASM. REAR SUSPENSION
22 – BRAKE LINE CLIP
23 – BOLT, BRAKE LINE CLIP
24 – HOSE ASM. RR BRAKE LH. & RH.
25 – CALIPER ASM.

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Fig. 3D-5 Remove And Install Strut Damper

DISASSEMBLE AND ASSEMBLE STRUT DAMPER AND SPRING ASSEMBLY/SPRING REPLACEMENT.

STRUT DISASSEMBLY PROCEDURE

NOTICE: **Special tool J-26584 must be used to disassemble and assemble strut damper. Care must be used not to damage the special coating on the coil springs, or damage could occur to the coils.**

1. Clamp J-26584 Strut Compressor in vise.
2. Place strut assembly in bottom adapter of compressor and install J-26584-89 (make sure adapter captures the strut and locating pins are engaged).
3. Rotate strut assembly to align top mounting assembly lip with strut compressor support notch.
4. Insert J-26584-430 top adapter on the top spring seal. Position top adapters so that the long stud is at high location to strut flange.
5. Using a ratchet with 1" socket, turn compressor forcing screw clockwise until top support flange contacts the J-26584-430 top adapter. Continue turning the screw compressing the strut spring
6. Place J-26584-430 top adapter over spring seat assembly.
7. Turn strut compressor forcing screw counterclockwise until the strut spring tension is relieved. Remove top adapters, bottom adapter, then remove strut.

STRUT ASSEMBLY PROCEDURE

1. Clamp strut compressor body J-26584 in vise.
2. Place strut assembly in bottom adapter of compressor and install J-26584-89 (make sure adapter captures strut and locating pins are engaged).
3. Rotate strut assembly until mounting flange is facing out, directly opposite the compressor forcing screw.
4. Position spring and components on strut, as shown below. Make sure spring is properly seated on bottom spring plate.
5. Install strut spring seat assembly on top of spring. *The long stud must be 180° from strut mounting flange.*
6. Place J-26584-403 top adapter over spring seat assembly.
7. Turn compressor forcing screw until compressor top support just contacts top adapters (do not compress spring at this time.
8. Install J-26584-27 Strut Alignment Rod through top spring seat and thread rod onto damper shaft, hand tight.
9. Compress spring by turning screw clockwise until enough of the damper shaft is exposed to where the nut can be threaded securely, and thread nut on damper shaft. **DO NOT COMPRESS SPRING UNTIL IT BOTTOMS.**

NOTICE: Be sure that the damper shaft comes through the **CENTER** of the spring seat opening, or damage could occur.

10. Remove alignment rod, position strut mount over damper shaft and spring seat studs. Install washer and nut.
11. Turn forcing screw counterclockwise to back off support and remove strut assembly from compressor.

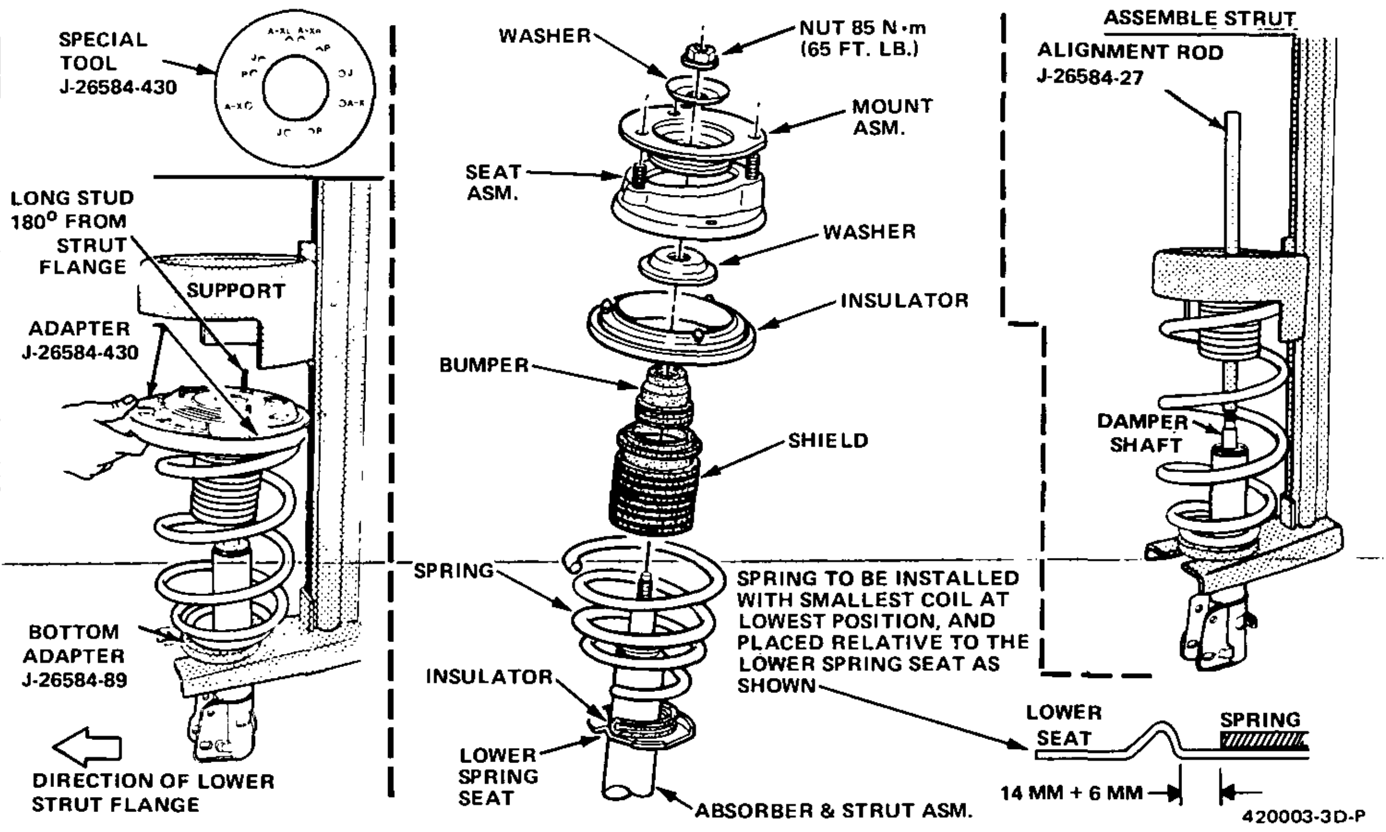


Fig. 3D-6 Disassemble/Reassemble Strut Assembly

REMOVE AND INSTALL CONTROL ARM BALL JOINT

REMOVE

1. Raise car and remove wheel.
2. Remove clamp bolt from LCA ball stud.
3. Disconnect the ball joint from the knuckle. It may be necessary to tap the stud with a mallet.
4. Remove the rivets as shown below.

INSTALL

1. Install ball joint to LCA as shown.
2. Position knuckle over ball stud, to allow the clamp bolt to be installed. Torque to specs.
3. Install wheel and lower car.
4. Check toe-in setting. Adjust as reuuired. See Section 3A.

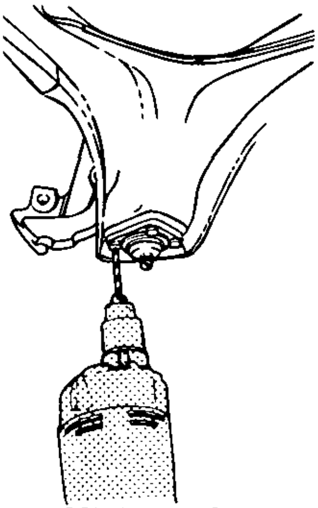
INSPECTION

BALL JOINT SEALS – Ball joint seals should be carefully inspected for cuts and tears. Whenever cuts or tears are found, the ball joint MUST be replaced.

KNUCKLE ASSEMBLY — Inspect the hole in the knuckle assembly clamp area. Remove any dirt. If out-of-roundness, deformation, or damage is noted, the knuckle MUST be replaced.

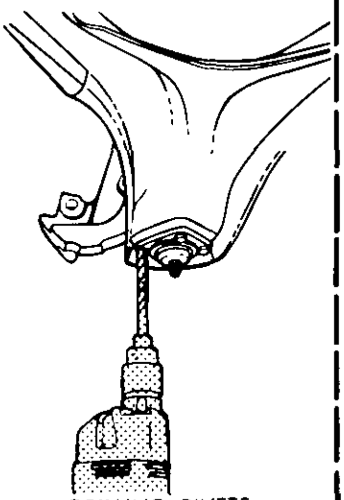
1. Raise rear suspension by placing jack or lift under the cradle.
2. Grasp the wheel at top and bottom and shake top of wheel in an "in-and-out" motion. Observe for any horizontal movement of the knuckle relative to the control arm. Replace ball joint if such movement is noted.
3. If the ball stud is disconnected from the knuckle, and any looseness is detected, or if the ball stud can be twisted in its socket using finger pressure, replace the ball joint.

USING ⅛″ DRILL, DRILL RIVETS APPROXIMATELY ¼″ DEEP IN CENTER OF RIVET

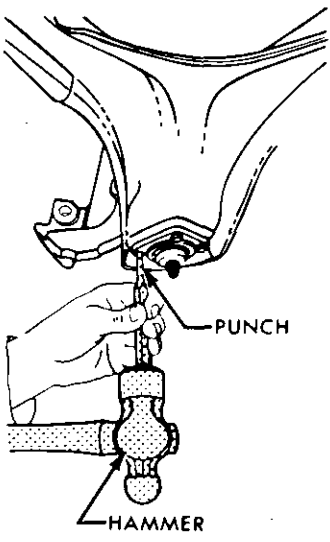


DRILLING RIVETS

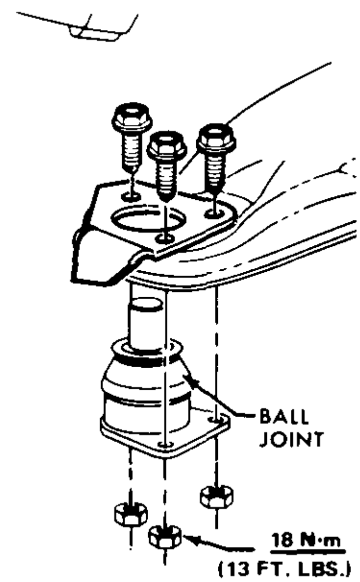
USING ½″ DRILL, DRILL JUST DEEP ENOUGH TO REMOVE RIVET HEAD



DRILLING RIVETS



REMOVE RIVETS



INSTALL BALL JOINT

CAUTION: Use only the ball joint bolts designed for this vehicle. DO NOT use bolts that have been designed for ball joints on other vehicles.

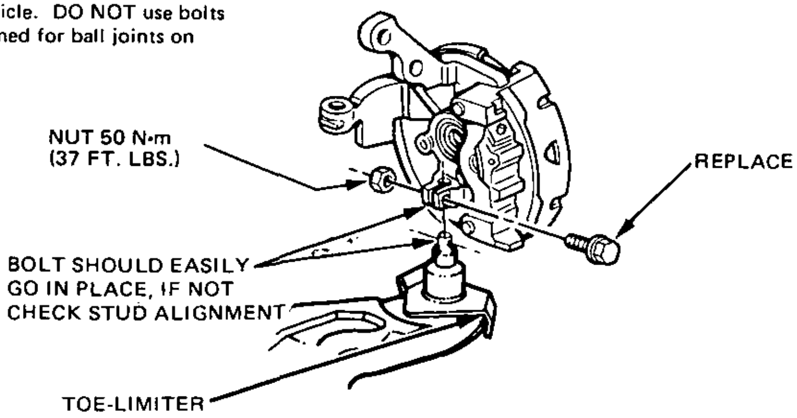


Fig. 3D-7 Remove/Install Ball Joint

REMOVE AND INSTALL LOWER CONTROL ARM AND/OR BUSHINGS.

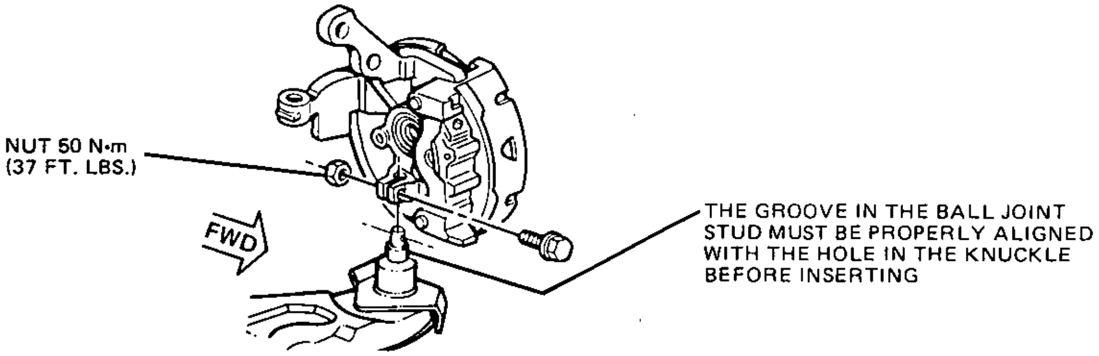
REMOVE

1. Raise car and remove wheel.
2. Remove ball joint clamping bolt.
3. Separate knuckle from ball joint.
4. Remove L.C.A. pivot bolts at frame.
5. Remove control arm.

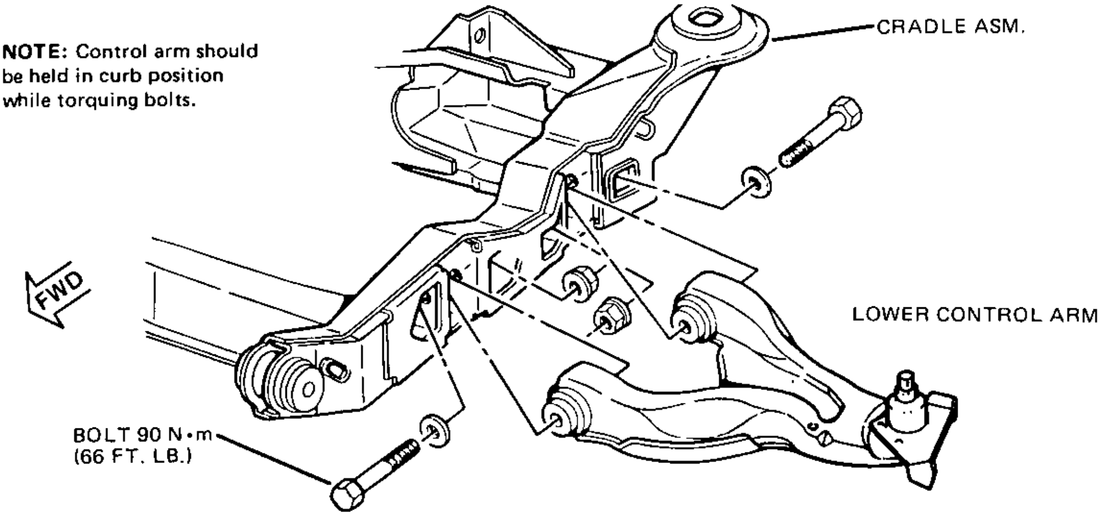
INSTALL

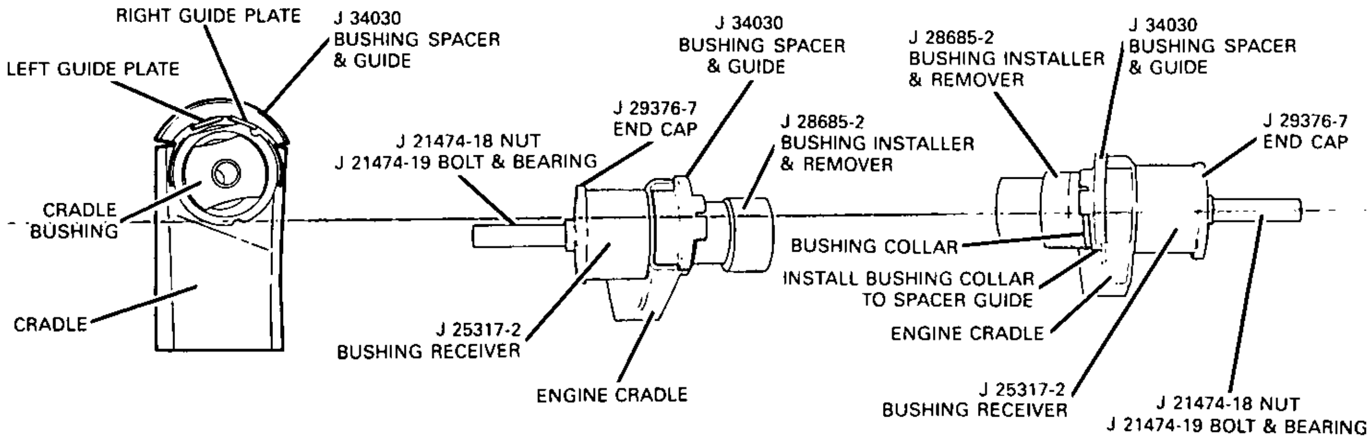
See notice on page 3D-1 of this section.

1. Install parts in reverse order of removal.
2. Install wheel; lower car.
3. Check toe-in and camber settings. Adjust as required. Reference Section 3A.



NOTE: Control arm should be held in curb position while torquing bolts.





REMOVAL OF CRADLE BUSHING

INSTALLATION OF CRADLE BUSHING

420006-3D-P

Fig. 3D-8 Remove/Install Lower Control Arm

REMOVE AND INSTALL REAR WHEEL BEARING.

REMOVE

Steel Wheel

1. Remove hub cap.
2. Loosen lub nut.
3. Raise vehicle and remove wheel and tire.
4. Install drive axle boot protectors tool J-33162 (see art panel below).
5. Remove hub nut, and discard.
6. Remove caliper and rotor (Section 5).
7. Remove hub-and-bearing attaching bolts.

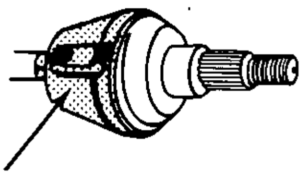
   If bearing assembly is being reused, mark attaching bolt and corresponding holes for installation.
8. Install J-28733 and remove hub-and-bearing assembly.

   If excessive corrosion is present make sure hub-and-bearing is loose in knuckle before using tool J-28733.
9. If installing new bearing, replace knuckle seal.

   Car must not be moved without hub nut installed to proper torque.

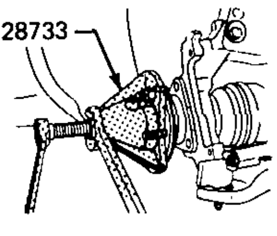
14" Aluminum Wheel

1. Set parking brake.
2. Raise vehicle.
3. Remove wheel and tire assembly.
4. Remove hub nut.
5. Refer to steel wheel removal step 4 through step 9.



USE J-33162 FOR TRI-POT JOINT

INSTALL DRIVE AXLE BOOT PROTECTOR

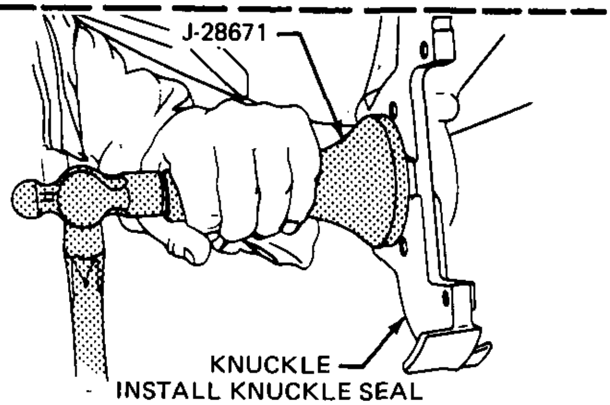


REMOVING HUB-AND-BEARING ASM

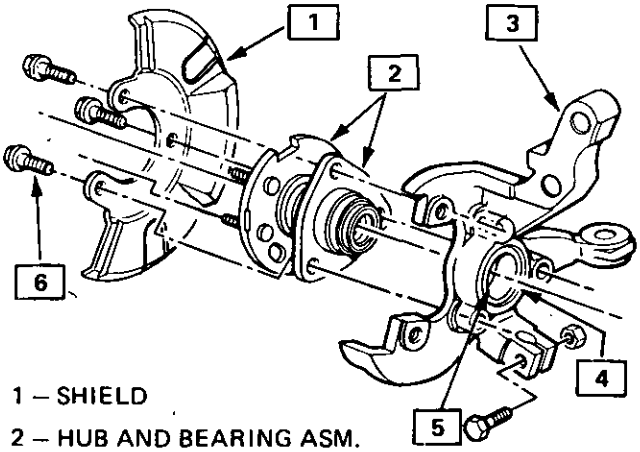
INSTALL

See Notice on page 1 of this section.

1. Clean and inspect bearing mating surfaces and knuckle bore for dirt, nicks and burrs.
2. If installing knuckle seal, use tool J-28671, apply grease to seal & knuckle bore.
3. Push hub-and-bearing on axle shaft.
4. Install parts as shown.
5. Apply PARTIAL torque to new hub nut, until hub-and-bearing assembly is seated (approx. 100 N·m) (74 ft. lbs.).
6. Install rotor and caliper (Section 5).
7. Lower car.
8. Apply FINAL torque to hub nut. (270 N·m) (200 ft. lbs.).



INSTALL KNUCKLE SEAL



1 – SHIELD
2 – HUB AND BEARING ASM.
3 – KNUCKLE
4 – KNUCKLE SEAL ASM.
5 – FILL HUB BEARING CAVITY BETWEEN SEALING LIPS WITH .8 GRAMS OF CHASSIS LUBRICANT.
6 – BOLT 75-95 N·m (55-70 FT. LB.)

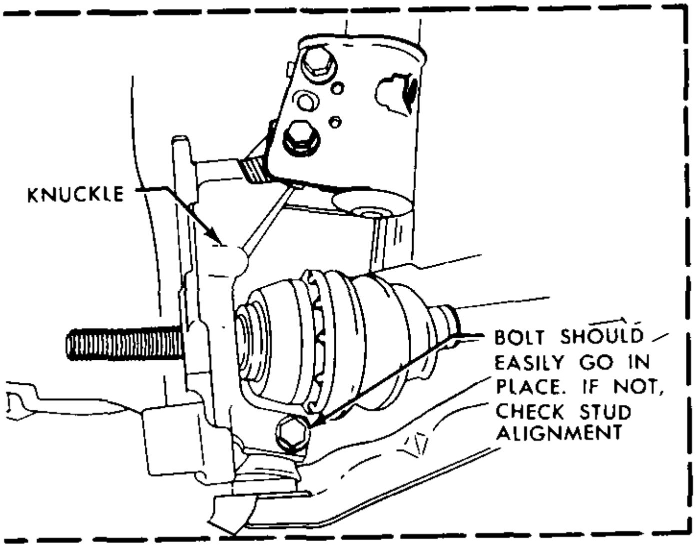
420007-3D-P

Fig. 3D-9 Remove/Install Rear Wheel Bearing

. REMOVE AND INSTALL REAR KNUCKLE.

1. Refer to rear wheel bearing removal, Section 3D.
2. Remove toe-link rod at knuckle.
3. Remove clamp bolt. Disconnect knuckle from ball stud.
4. Remove both through bolts holding strut-to-knuckle. Remove knuckle.

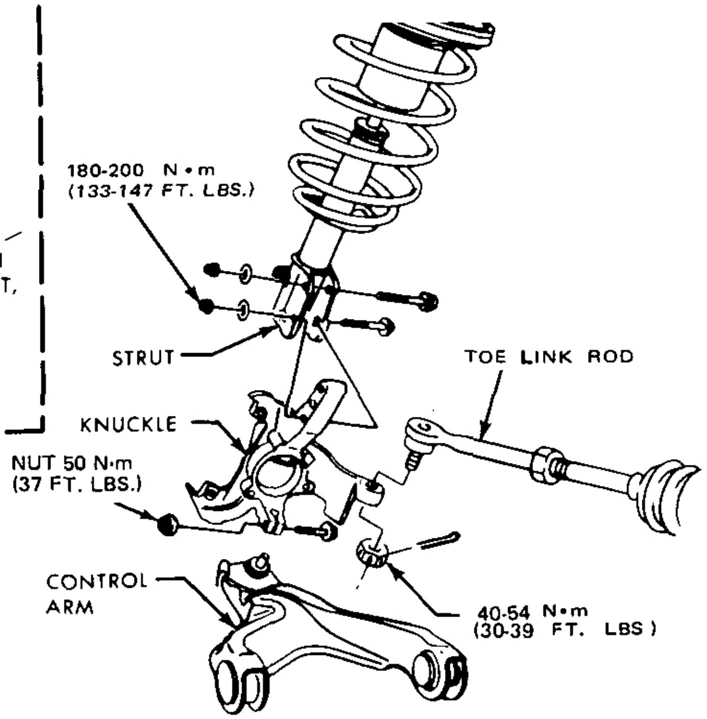
   NOTICE: Whenever separating the ball joint from the knuckle, be careful not to cut or tear the ball joint seal, or damage to the ball joint could occur. If the seal is cut or torn, the ball joint **MUST** be replaced.

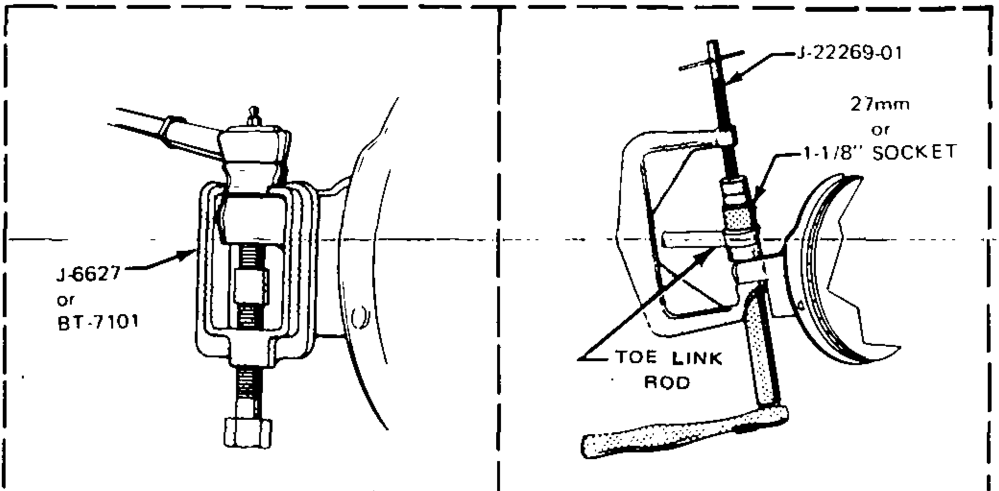


INSTALL

See Notice on page 3D-1 of this section.

1. Install knuckle to ball joint.
2. Loosely install knuckle to strut.
3. Install toe-link rod to knuckle.
4. Refer to wheel bearing installation.
5. Set camber and toe to specifications as shown in Section 3A.





REMOVE TOE LINK ROD

INSTALL TOE LINK ROD

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Fig. 3D-10 Remove/Install Rear Knuckle Assembly

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 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 type tire may seriously affect ride, handling, speedometer/odometer calibration, car ground clearance and tire clearance to the body and chassis. The following should also be considered when replacing tires:

CAUTION: Do not mix different types of tires on the same car such as radial, bias, and bias-belted tires because car handling may be seriously affected and may result in loss of control. This caution does not apply to the compact spare furnished with the car.

1. It is recommended that new tires be installed in pairs on the same axle.
2. If necessary to replace only one tire, it should be paired with the tire having the most tread, to equalize braking traction.
3. Although they may appear different in tread design, tires built by different manufacturers, but with identical TPC specification numbers, can be intermixed on the same car.

ALL SEASONS TIRES

Fig. 1

Most GM cars are now equipped with steel belted All Seasons radial tires as standard equipment. These tires qualify as snow tires, with a 37% higher average rating for snow traction than the non-All Seasons radial tires previously used. Other performance areas, such as wet traction, rolling resistance, tread life, and air retention, were also improved slightly. This was done by improvements in both tread design and tread compounds. These tires are identified by an "M + S" molding in the tire sidewall following the size. The suffix "MS" is also molded in the sidewall after the TPC specification number.

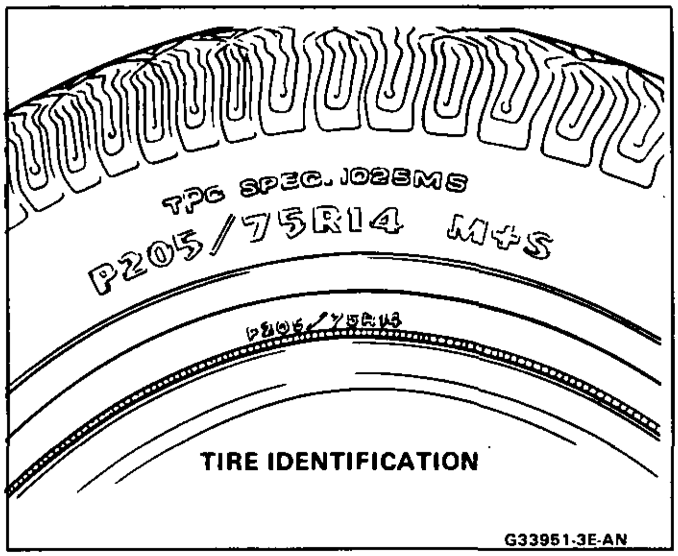


Fig. 1 Tire Identification

The optional handling tires used on some cars are not All Seasons tires. These will not have the "MS" marking after the tire size or TPC specification number.

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.

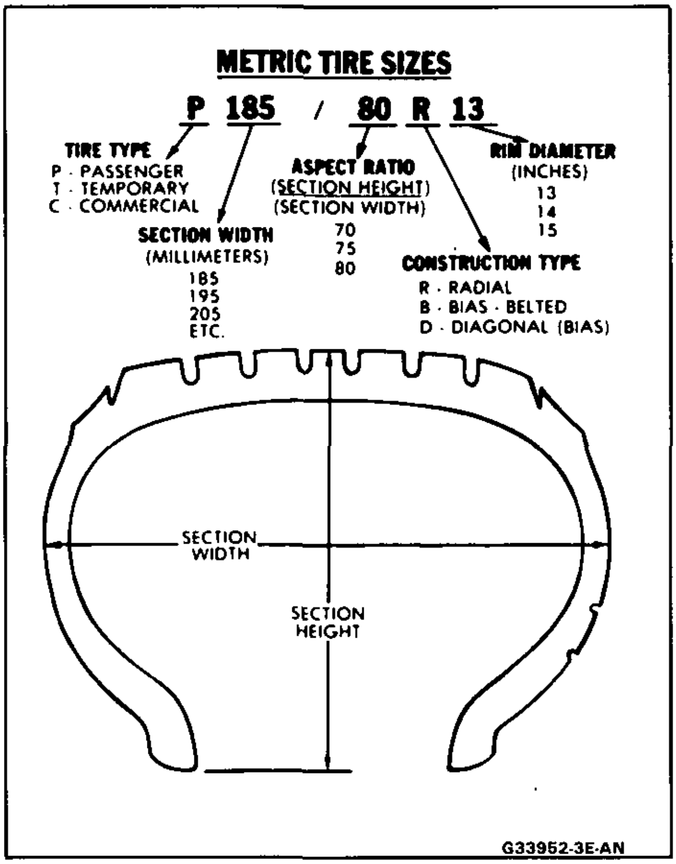


Fig. 2 Metric Tire Size Format

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

G33987-3E-AN

Fig. 3 Inflation Pressure Conversion

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.

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).

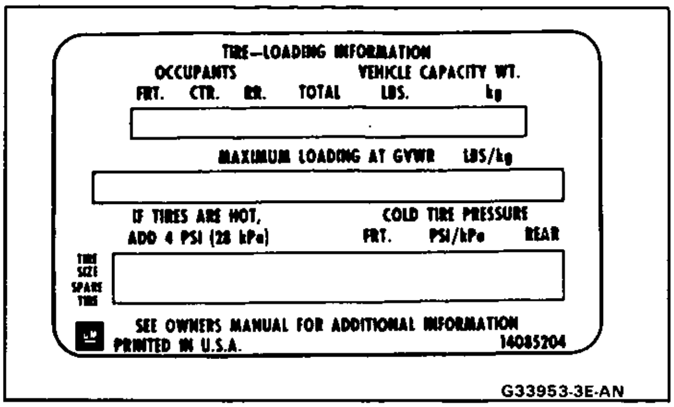


Fig. 4 Tire Placard

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.

METRIC WHEEL NUTS AND WHEEL STUDS

All models use metric wheel nuts and wheel studs. The nut has the word "metric" stamped on it's face and the stud has the letter "M" stamped into the threaded end. The word "metric" is stamped on it's 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

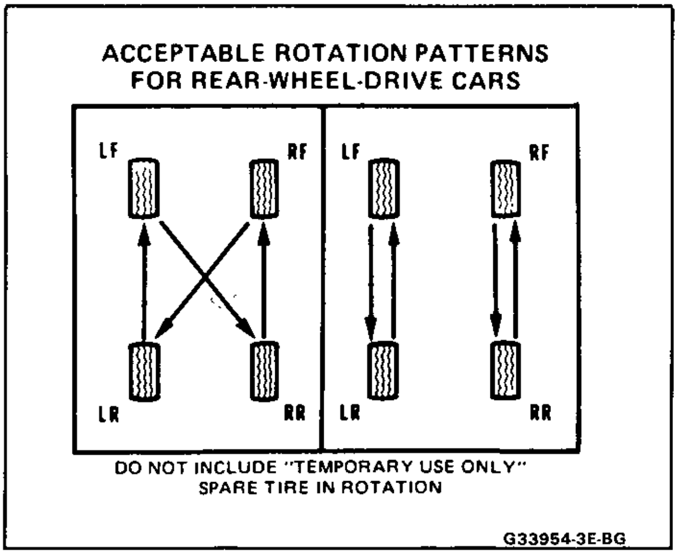
TIRE ROTATION

Figure 5

To equalize wear, rotate tire and wheel assemblies at 7,500 miles and every 15,000 miles thereafter. 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.


ACCEPTABLE ROTATION PATTERNS FOR REAR-WHEEL-DRIVE CARS

DO NOT INCLUDE "TEMPORARY USE ONLY" SPARE TIRE IN ROTATION

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 rear tires is not recommended; the chains may contact and possibly damage the car. If you intend to use chains on the rear 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

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. Retighten 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.
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.

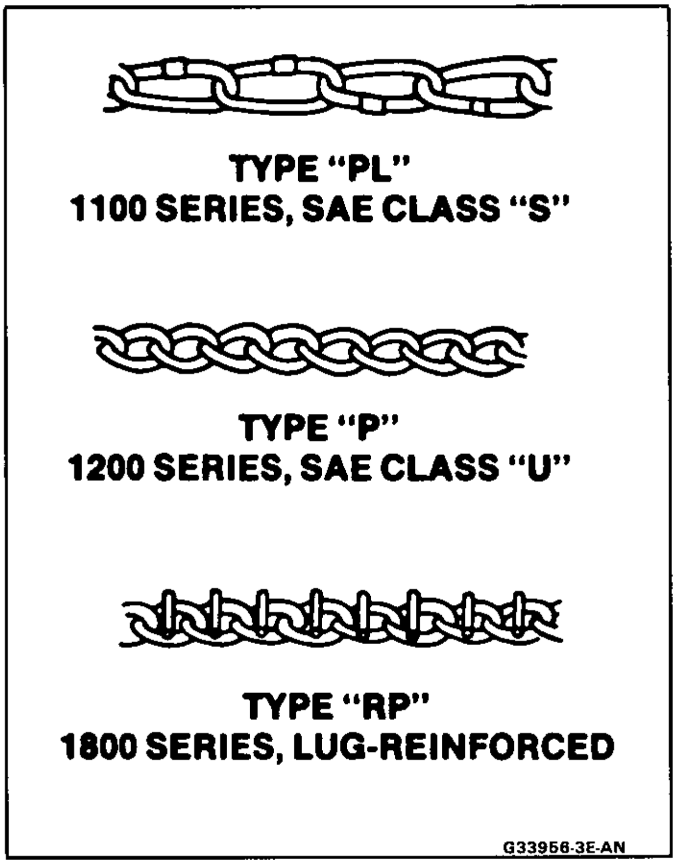


Fig. 6 Examples of Passenger Car Tire Chains

CAUTION: 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.

Wheel nuts must be tightened in sequence and to proper torque to avoid bending wheel or brake drum or rotor. See Figure 7.

CAUTION: 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 wheel to come off while the car is moving, possibly causing loss of control.

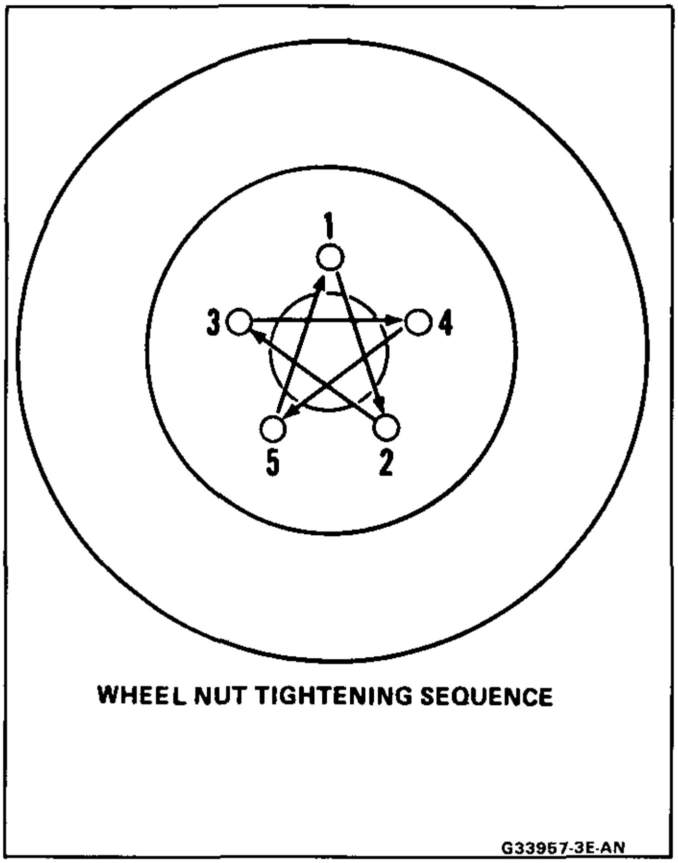


Fig. 7 Wheel Nut Tightening Sequence

TIRE MOUNTING AND DISMOUNTING

NOTE: The folding inflatable spare used on cars with limited-slip differential is not designed to be dismounted/remounted. If this spare requires any type of service, it should be replaced as an assembly.

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 tire's 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).

CAUTION: Do not stand over tire when inflating. Bead may break when bead snaps over safety hump and cause serious personal injury. Do not exceed 275 kPa (40 psi) pressure when inflating. 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. See Figure 8.

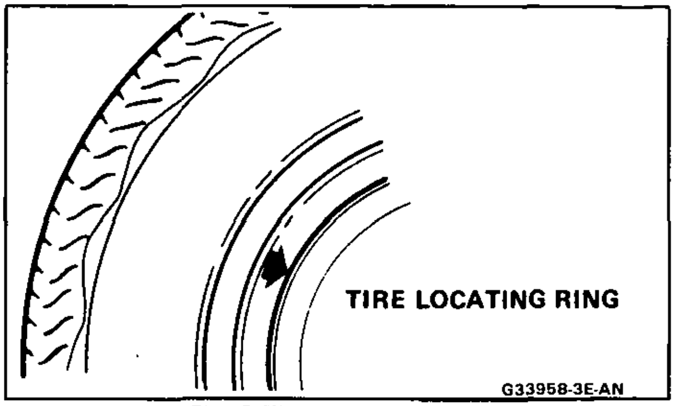


Fig. 8 Tire Locating Ring

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.

WADDLE

Waddle can usually be related to excessive lateral runout of the tire or wheel. Use a dial indicator on the tire's sidewall and on the rim's flange to determine if excessive lateral runout.

MEASURING WHEEL RUNOUT

Figure 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"

COMPACT SPARE

Figure 10

All 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

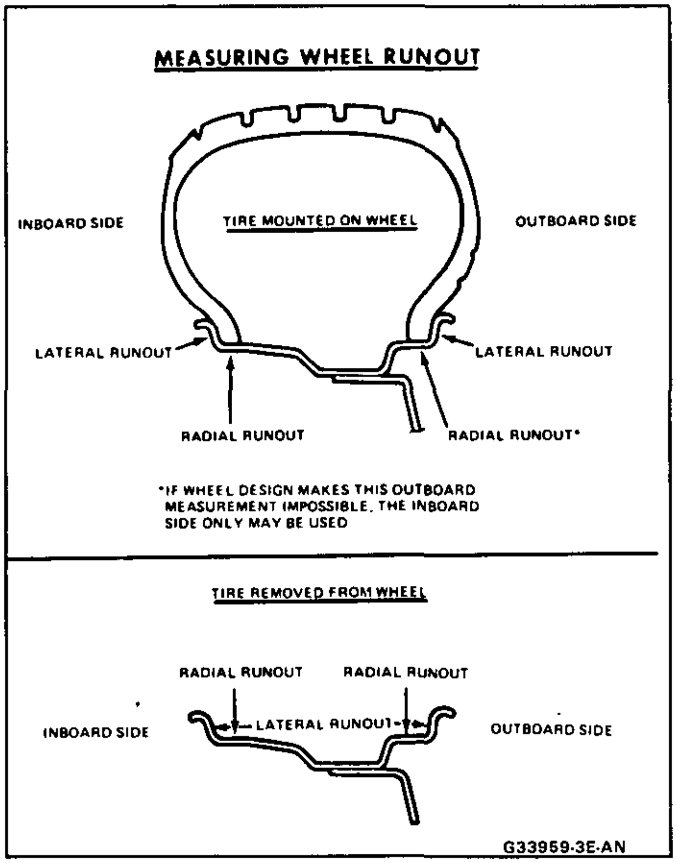


Fig. 9 Wheel Runout

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 it's wheel using present tire changing equipment and procedures. However, due to the thin (4/32") tread depth, repair attempts are not recommended. 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: Do not stand over tire when inflating. Bead may break when bead snaps over safety hump and cause serious personal injury. Do not exceed 275 kPa (40 psi) pressure when inflating any tire, including compact spares. 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.

MATCH MOUNTING

Fig. 11

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. This is done to provide the smoothest possible ride.

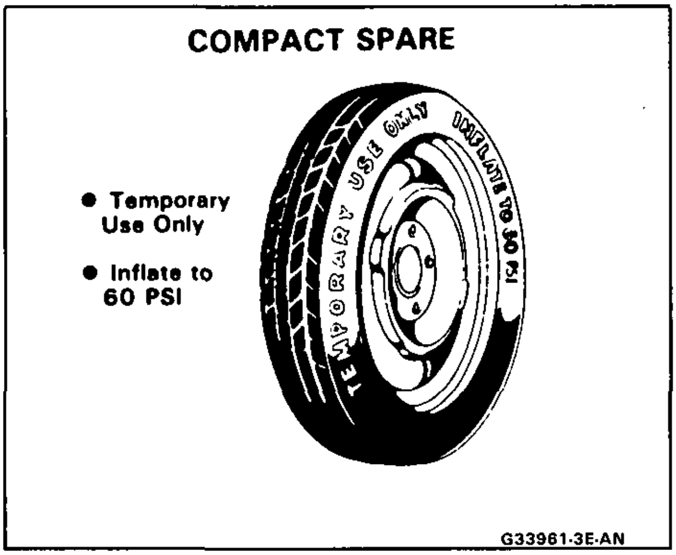


Fig. 10 Compact Spare

The "high spot" of the tire is originally marked by a yellow paint mark or adhesive label on the outboard sidewall. This mark will eventually wash off the tire.

The "low spot" of the wheel will be at the location of the valve stem.

Whenever a tire is dismounted from it's wheel, it should be remounted so that the tire and wheel markings are matched. If the paint mark cannot be located, a line should be scribed on the tire at the valve stem before dismounting to assure that it is remounted in the same position. Replacement tires and wheels that are of original equipment quality will be marked in the same manner.

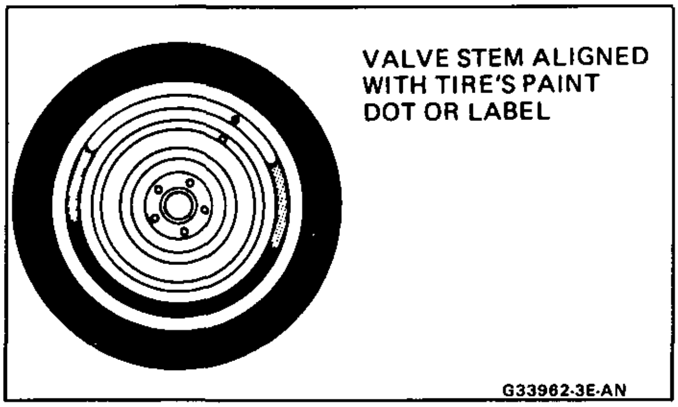


Fig. 11 Matched Tires and Wheels

BALANCING TIRE AND WHEEL ASSEMBLY

Figs. 12 and 13

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.

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

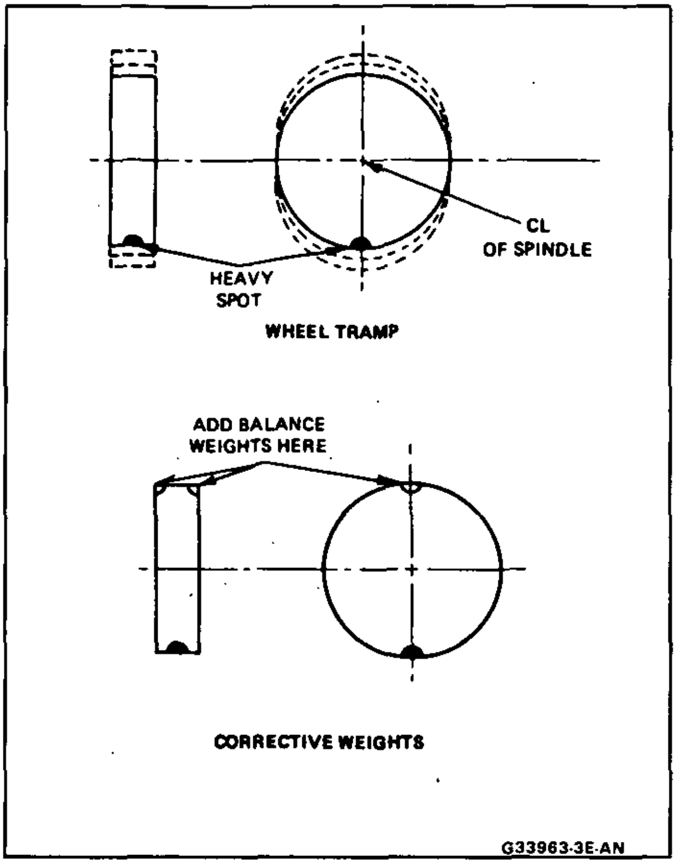


Fig. 12 Static Unbalance Correction

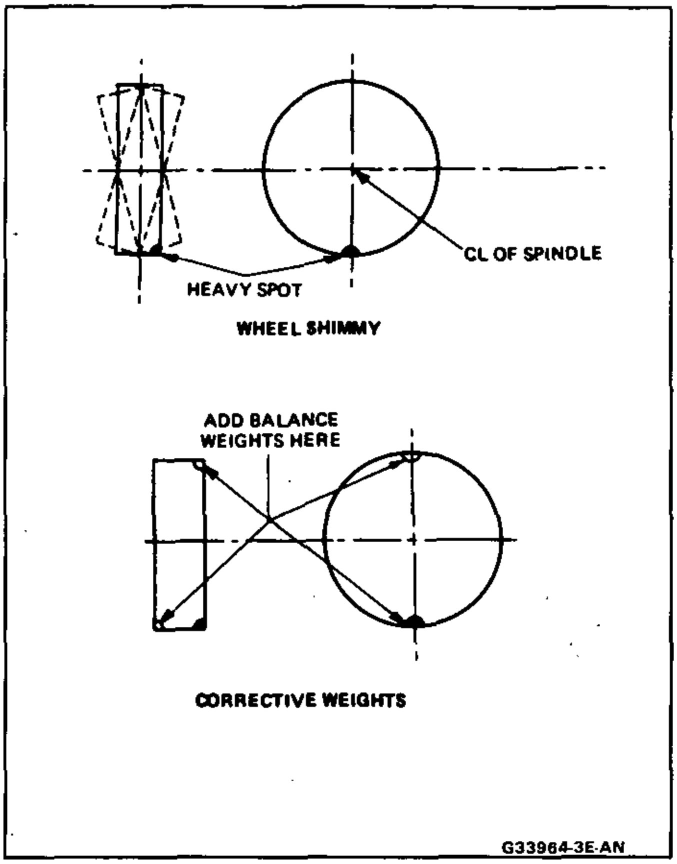


Fig. 13 Dynamic Unbalance Correction

side to side. Assemblies that are dynamically unbalanced may cause wheel shimmy.

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.

On front-wheel-drive cars the front suspension should not be allowed to hang free. When the CV joint is run at a very high angle, extra vibrations can occur, as can damage to seals and joints. Always follow the equipment manufacturer's instructions.

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.

Wheel Weights

Balancing of assemblies with factory aluminum wheels requires the use of special clip-on type wheel weights. These weights are designed to fit over the thicker rim flange of the aluminum wheel.

Self-adhesive wheel weights are also available. Follow the manufacture's instructions for installing the weights.

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 from car
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 from car.
2. Locate leaking areas by inflating tire to 345 kPa (50 psi) and dipping wheel and tire 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.
7. Adjust tire pressure to meet specifications.
8. Balance tire and wheel assembly.
9. Install tire and wheel assembly on car.

ALUMINUM WHEEL REFINISHING

A protective clear 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 clear coating. This can happen at some automatic car wash facilities using agressive silicon carbide tipped tire brushes to clean white walls and tires. Once the protective clear 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 those aluminum wheel rims that are affected by the above condition.

Required Materials:

3M® Scotchbrite Cleaning Pad, Part No. 07445 or equivalent

3M® Brand Troubleshooter Chemical Stripper or equivalent

3M® Medium Buffing Compound, Part No. 05955 or equivalent

3M® Buffing Pad, Part No. 05701 or equivalent

R & M® Pre Kleno Cleaner or equivalent

R & M® Metal Conditioner, Part No. 801 or equivalent

R & M® 893 2K Enamel Clearcoat and 894 Catalyst Hardener

Service Procedure:

1. Remove wheel(s) from the car. This makes stripping, cleaning and recoating much easier.
   - Remove wheel weight and mask off tire. Reference mark tire for reinstallation of weight after recoating of wheel.
2. Removal of original clear coating:
   - Apply a chemical stripper such as 3M® Brand Troubleshooter to wheel rim surface.
   - Wait 10-15 minutes, then wet scrub surface using a 3M® No. 98 Scotchbrite Cleaning Pad, Part No. 07455.
   - Rinse surface thoroughly with clean water.
3. Removal of surface oxidation:
   - Compound surface with 3M® Superbuff Buffing Pad, Part No. 05701 and medium type compound such as 3M® Part No. 05955 or No. 05931. This will remove any existing stain and oxidation from the wheel.

- After compounding, hose off rim with water and scrub with small brush to remove excess compound and air blow dry.

CAUTION: Use of eye goggles is necessary to prevent personal injury.

4. Recoating procedure (R & M®):
   - Use Pre Kleno to clean surface of any surface contaminants.
   - Apply No. 801 metal conditioner. It is recommended that rubber gloves be used for this application.
   - Refer to label for specific directions. If No. 801 metal conditioner is used, make sure it is reduced one part metal conditioner with three parts water.
     a. Apply metal conditioner with clean rag, keeping surface wet.
     b. Wipe off carefully while still wet with clean, dry rag.
   - After removing the original clear coating and preparing the surface, next apply R & M® 893 2K Clear with 894 Urethane Catalyst Hardener. Refer to label for specific directions.

CAUTION: When applying any two part component paint system, wear proper respiratory protection such as 3M® Paint Respirator, Part No. 06984, or Easi-Air Respirator, Part No. 06986 or equivalent.

Wheels should be allowed to air dry for a minimum of over night prior to installing on car.

WHEEL NUT TORQUE

F Series – M12X1.5	110 N·m (80 lbs. ft.)
P Series – M12X1.5	140 N·m (100 lbs. ft.)
T Series – M12X1.5	110 N·m (80 lbs. ft.)

SECTION 4D

DRIVE AXLE

NOTICE: All rear 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. Never attempt to heat, quench or straighten any rear suspension part, replace it with a new part.

CONTENTS

On-Car Service

Unit Repair

GENERAL DESCRIPTION

Drive axles are completely flexible assemblies consisting of an inner Tri-Pot joint and an outer constant velocity joint connected by an axle shaft. The inner joint is completely flexible, plus it has the capability of in and out movement. The outer joint is also flexible, but cannot move in and out.

All drive axles except the R.H. inboard joint of the automatic transaxles incorporate a male spline and interlocks with the transaxle gears through the use of barrel type snap rings. The L.H. inboard shaft attachment, on the automatic transaxle utilizes a female spline which installs over a stub shaft protruding from the transaxle.

The drive axle shaft spline end mating with the steering knuckle and hub assembly will incorporate a slight helix to assure a tight press fit. This will assure no radial play between the hub and drive axle assembly for durability and bearing noise considerations.

DIAGNOSIS

Clicking Noise In Turns

Inspect

Worn or damaged outer C.V. joint. Check for cut or damaged seals.

Clunk When Accelerating From Coast To Drive

Inspect

Worn or damaged outer C.V. joint

Shudder or Vibration During Acceleration

Inspect

1. Excessive joint angle
2. Excessive toe
3. Incorrect trim height
4. Worn or damaged outer C.V. joint
5. Sticking spider assembly

Vibration At Highway Speeds

Inspect

1. Out of balance rear tires or wheels
2. Out of round rear tires or wheels
3. Worn outer C.V. joint
4. Binding or tight joint

ON-CAR SERVICE

DRIVE AXLE

Figs. 1 through 4

Some cars use a silicone (gray) boot on the drive axle joints. Use boot protector J-33162 on these boots. All other boots are made of thermoplastic material (black) and DO NOT require use of the boot protector.

NOTICE: On cars equipped with Tri-Pot joints, care must be exercised not to allow Tri-Pot joints to become overextended. When either end or both ends of the shaft are disconnected, overextending the joint could result in separation of internal components. This could cause failure of the joint. Therefore, it is important to handle the drive axle in a manner that prevents overextending.

CAUTION: To help avoid personal injury when a car is on a hoist, provide additional support for the car at the opposite end from which components are being removed. This will reduce the possibility of the car falling off of the hoist.

Remove or Disconnect

Tools Required:

J-28733 Front Hub Spindle Remover
J-33162 Boot Protector
J-28468 Axle Shaft Remover
J-33008 Axle Shaft Remover
J-29794 Extension
J-2619-01 Slide Hammer

1. Raise car and put transmission in neutral, see Section 0A.
2. Wheel and tire.
3. Bolt to lower ball joint.
4. Loosen tie rod end nut.
5. Install drift punch through rotor and remove hub nut and washer (discard nut).

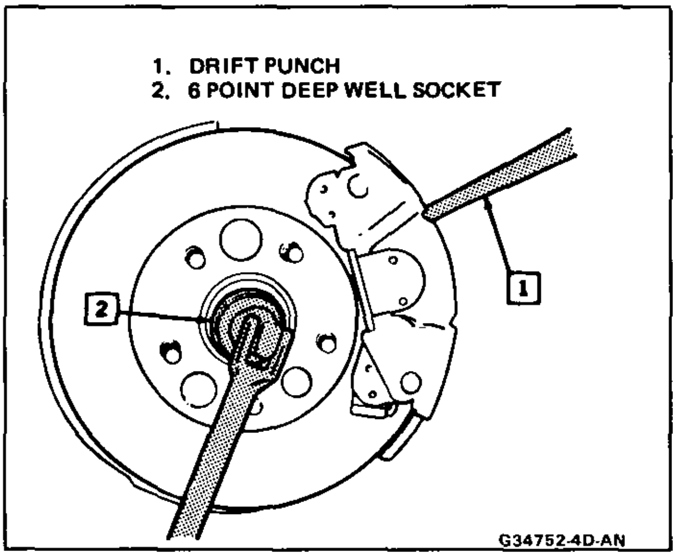


Fig. 1 Removing & Installing Hub Nut

6. Separate tie rod shaft front tie rod end.
7. Remove caliper and rotor.
8. Push down on lower control arm and separate strut from drive axle.
9. Drive axle from hub.
10. Install J-28468 or J-33008 with J-29794 and J-2619-01 slide and remove drive axle from transaxle.

Install or Connect

1. Drive Axle Seal Boot Protectors J-33162 on all Tri-Pot inner joints with silicone boots.

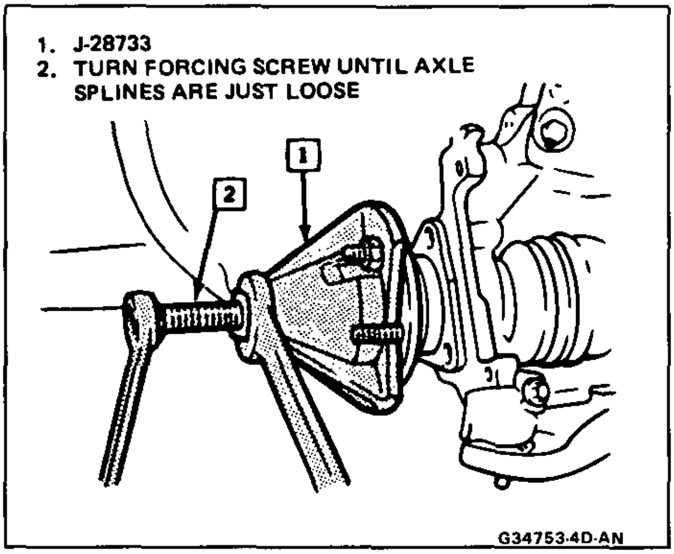


Fig. 2 Loosening Splines Between Drive Axle and Hub

2. Start splines of drive axle into transaxle and push drive axle until it "snaps" into place.
3. Push down on lower control arm and align hub assembly with drive axle.
4. Drive axle on hub.
5. Tie rod shaft and nut to tie rod end.
6. Lower ball joint to hub with bolt and nut. Tighten to 40-50 N·m (30-36 lb.ft.).
7. Insert drift punch through rotor and install washer and new hub nut and tighten to 250-285 N·m (183-208 lb.ft.)
8. Caliper and rotor.
9. Wheel and tire.
10. Lower car. Boot Protector if used.
11. Remove drive axle seal Boot Protector if used.
12. Tires and wheels.
13. Hoist car slightly to allow for removal of the jack stands under the frame.
14. Lower car.

INBOARD THERMOPLASTIC SEAL

Fig. 5

Important

When re-assembling the inboard thermoplastic seal, the drive axle must be collapsed to a specific dimension prior to crimping the clamps. This procedure will prevent ballooning of the seal.

Assemble

1. Crimp clamp at drive axle shaft.
2. Compress joint and seal to specified dimension.
3. Crimp clamp at joint end.

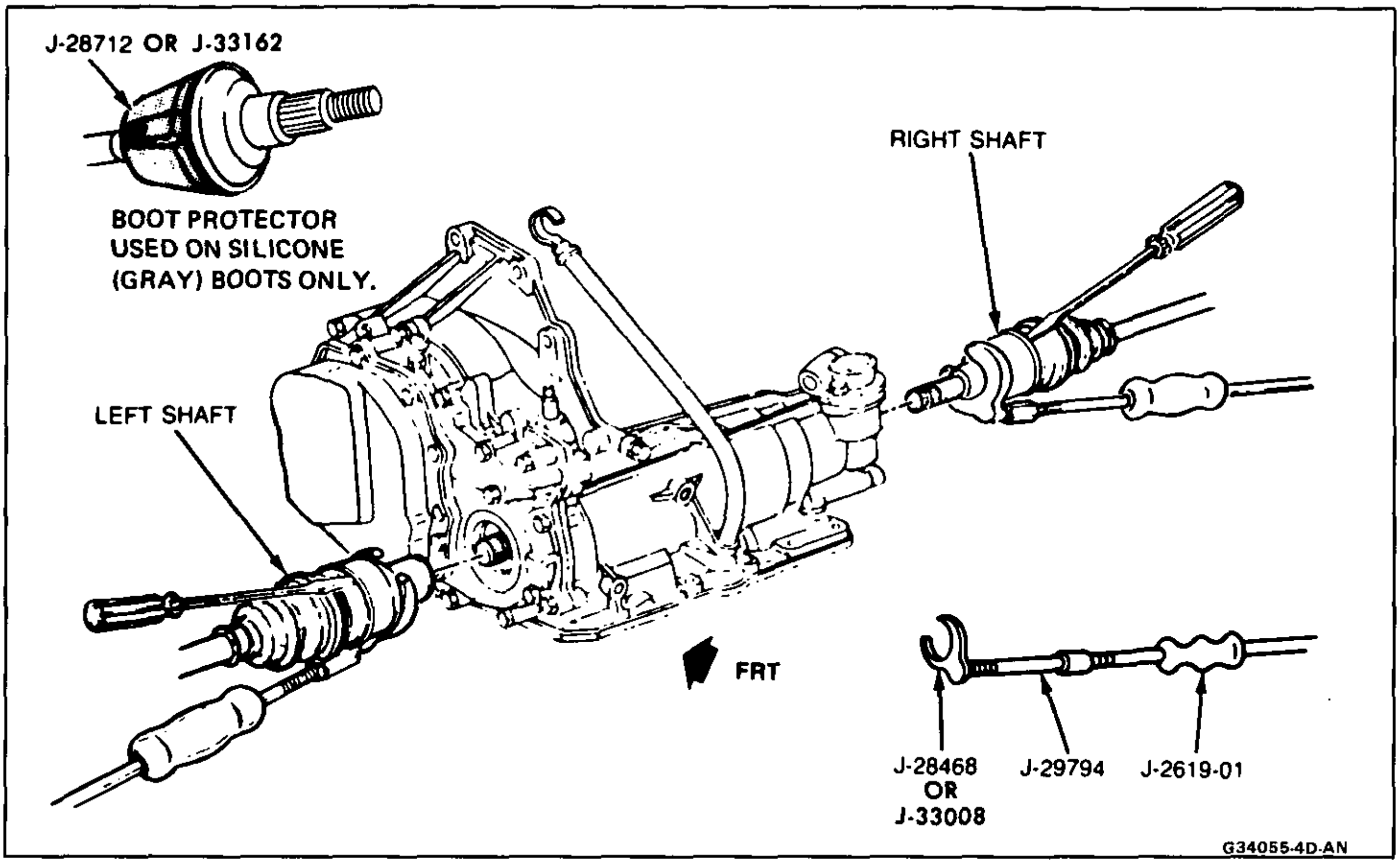


Fig. 3 Drive Axle Removal

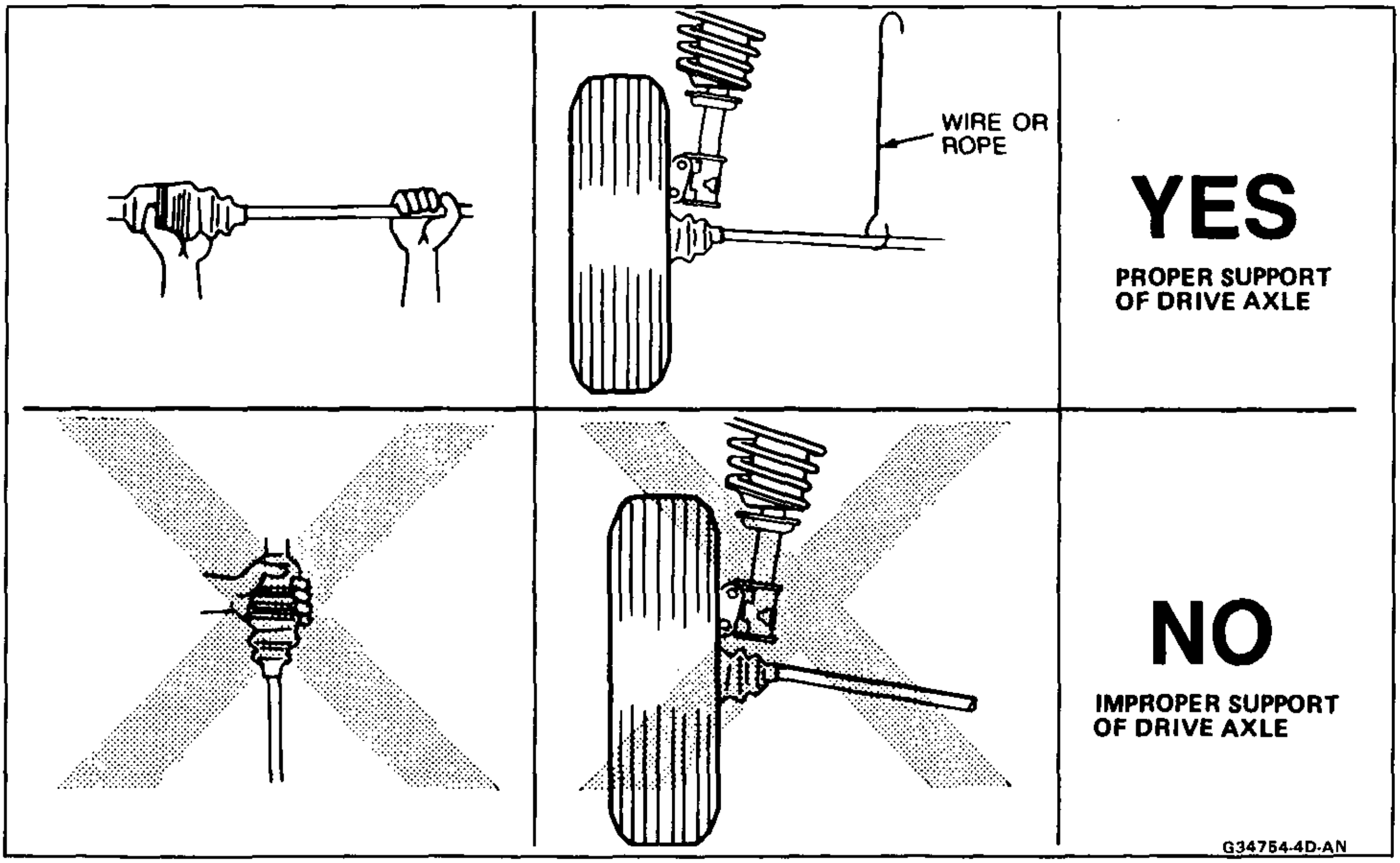
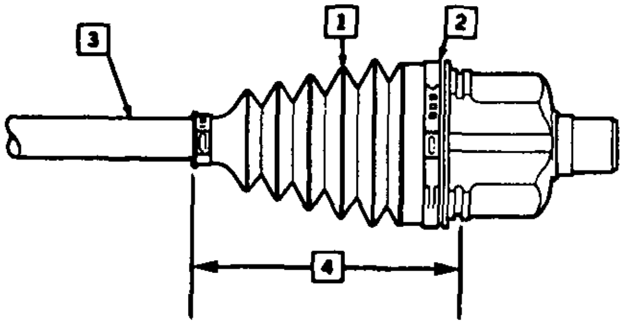


Fig. 4 Tri-Pot Joint Handling Precaution



1. INBOARD THERMOPLASTIC SEAL
2. TRILOBAL TRIPOT JOINT
3. AXLE SHAFT
4. 130 MM (5 1/16") – JOINT AND SEAL ARE TO BE COMPRESSED TO THIS DIMENSION BEFORE CRIMPING CLAMPS.

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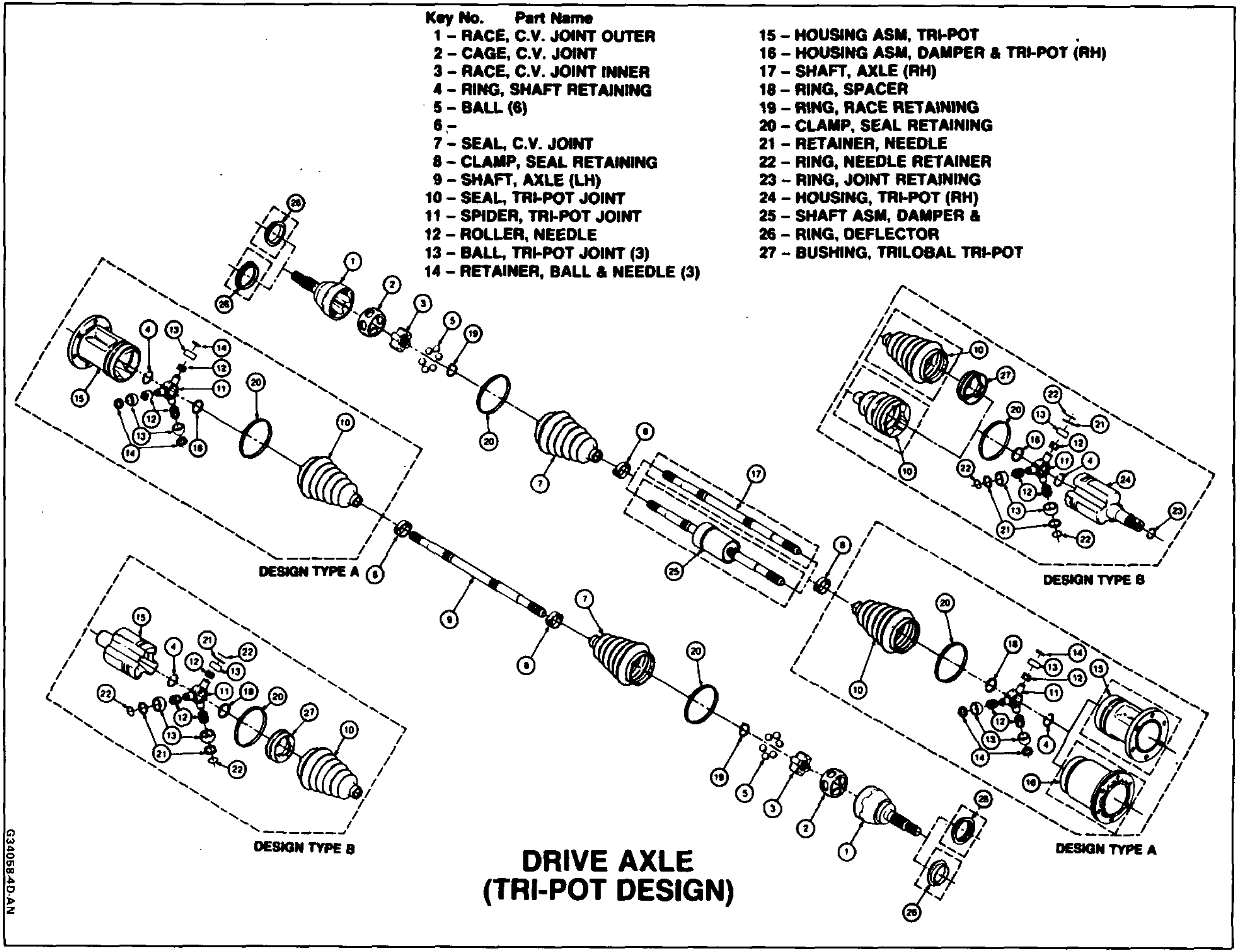
Fig. 5 Inboard Thermoplastic Seal

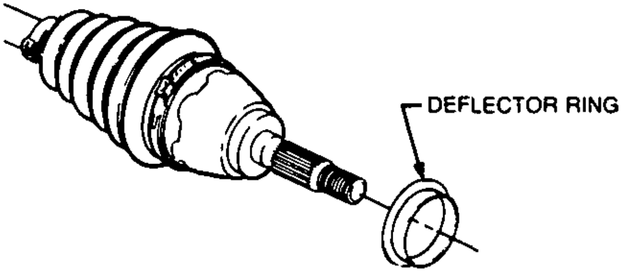


Key No.	Part Name
1	RACE, C.V. JOINT OUTER
2	CAGE, C.V. JOINT
3	RACE, C.V. JOINT INNER
4	RING, SHAFT RETAINING
5	BALL (6)
6	
7	SEAL, C.V. JOINT
8	CLAMP, SEAL RETAINING
9	SHAFT, AXLE (LH)
10	SEAL, TRI-POT JOINT
11	SPIDER, TRI-POT JOINT
12	ROLLER, NEEDLE
13	BALL, TRI-POT JOINT (3)
14	RETAINER, BALL & NEEDLE (3)
15	HOUSING ASM, TRI-POT
16	HOUSING ASM, DAMPER & TRI-POT (RH)
17	SHAFT, AXLE (RH)
18	RING, SPACER
19	RING, RACE RETAINING
20	CLAMP, SEAL RETAINING
21	RETAINER, NEEDLE
22	RING, NEEDLE RETAINER
23	RING, JOINT RETAINING
24	HOUSING, TRI-POT (RH)
25	SHAFT ASM, DAMPER &
26	RING, DEFLECTOR
27	BUSHING, TRILOBAL TRI-POT

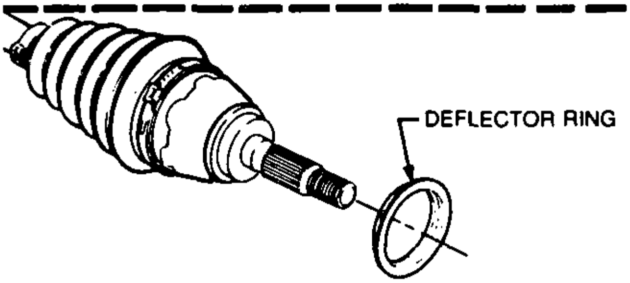
Fig. 6 Tri-Pot Axle

1. REMOVE AND INSTALL DEFLECTOR RING

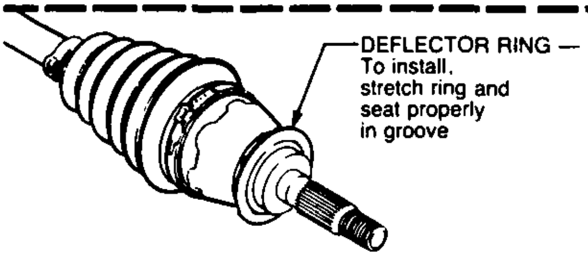
REMOVE	INSTALL
1. For damaged deflector ring, remove parts as shown.	1. Install part as shown.



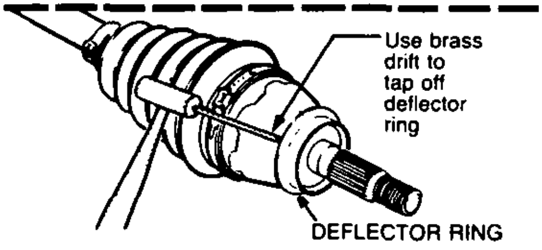
AXLE ASSEMBLY WITH STEEL DEFLECTOR RING



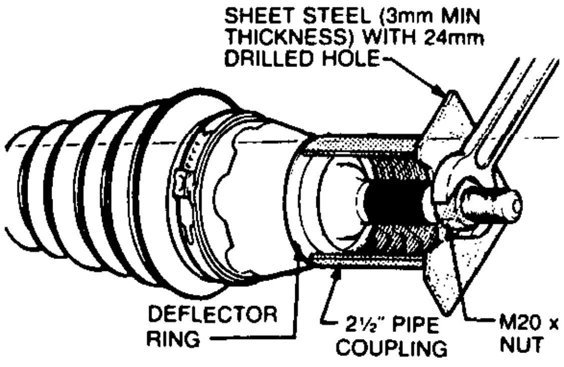
AXLE ASSEMBLY WITH RUBBER DEFLECTOR RING



REMOVE AND INSTALL DEFLECTOR RING (RUBBER)



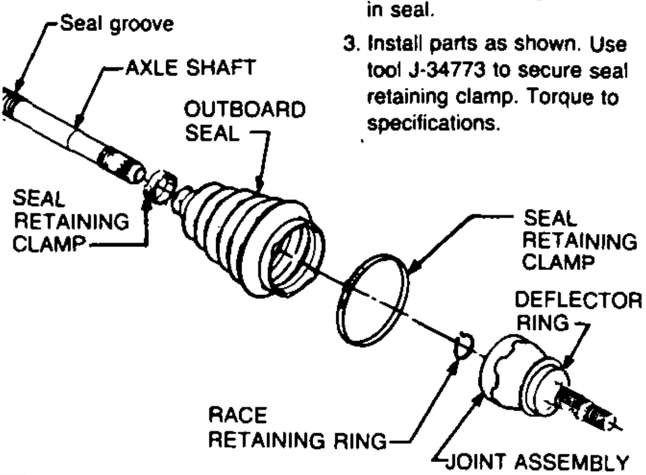
REMOVE DEFLECTOR RING (STEEL)

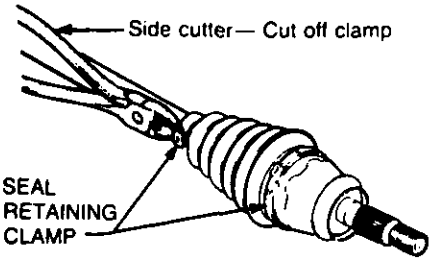


INSTALL DEFLECTOR RING (STEEL)

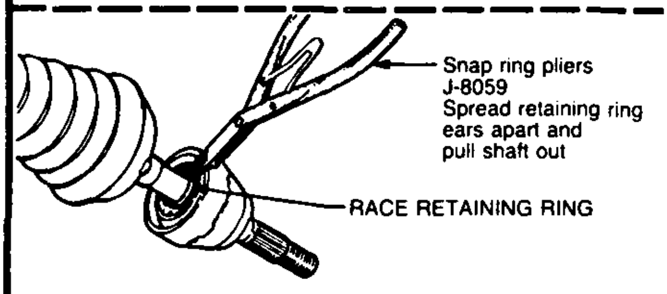
2. REMOVE AND INSTALL OUTER JOINT SEAL

REMOVE	INSTALL
1. Cut seal retaining clamps. 2. Remove parts as shown.	1. Flush grease from joint and repack joint with approx. half of grease provided. 2. Put remainder of grease in seal. 3. Install parts as shown. Use tool J-34773 to secure seal retaining clamp. Torque to specifications.

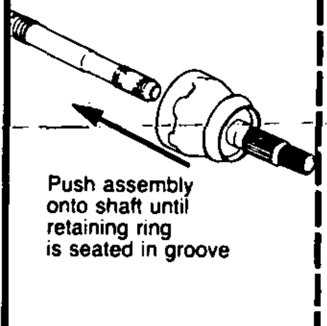




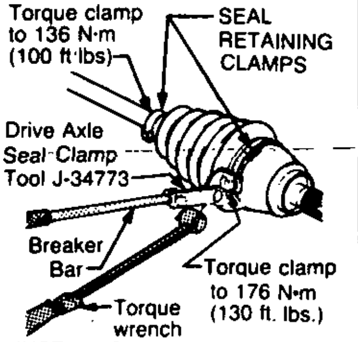
REMOVE CLAMP AND RETAINER



REMOVE JOINT ASSEMBLY



INSTALL JOINT ASSEMBLY



INSTALL SEAL RETAINING CLAMP

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Fig. 7 Unit Repair

3. DISASSEMBLE AND ASSEMBLE OUTER JOINT ASSEMBLY

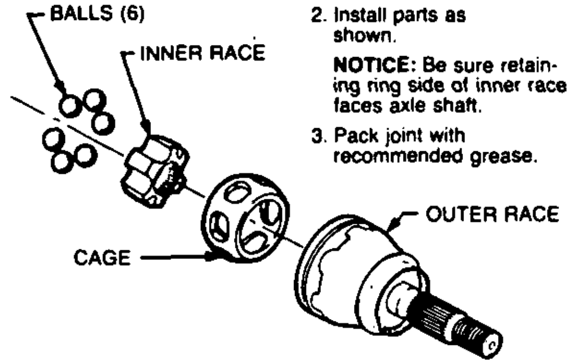
REMOVE

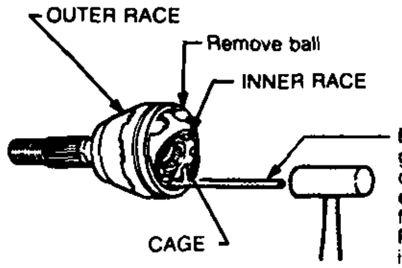
1. Remove parts as shown.

INSTALL

1. Put a light coat of recommended grease on ball grooves of inner and outer races.
2. Install parts as shown.

   NOTICE: Be sure retaining ring side of inner race faces axle shaft.
3. Pack joint with recommended grease.

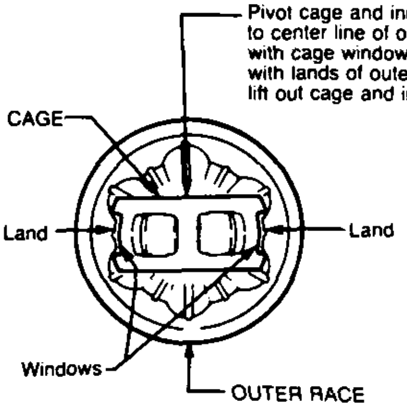




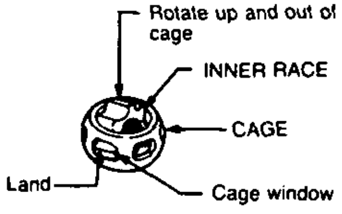
Brass drift gently tap on cage until tilted enough to remove first ball. Remove other balls in similar manner.

DISASSEMBLE AND ASSEMBLE BALLS

Pivot cage and inner race at 90 to center line of outer race with cage windows aligned with lands of outer race, lift out cage and inner race



DISASSEMBLE AND ASSEMBLE CAGE AND INNER RACE TO OUTER RACE



DISASSEMBLE AND ASSEMBLE INNER RACE AND CAGE

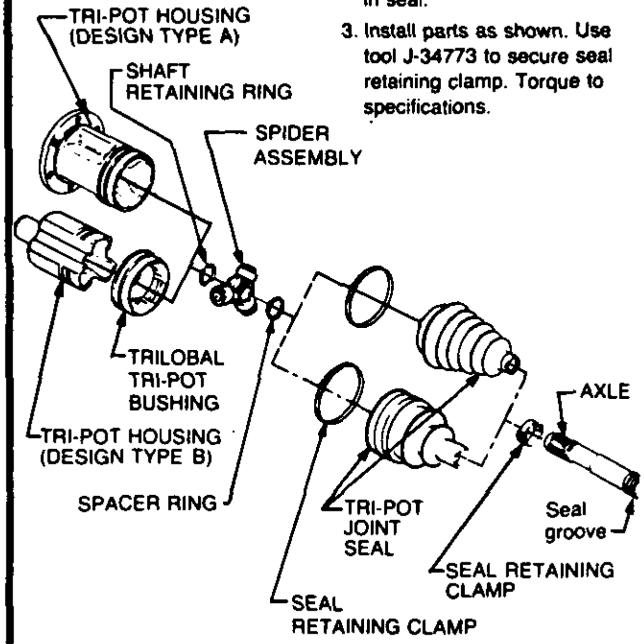
4. REMOVE AND INSTALL INNER TRI-POT SEAL

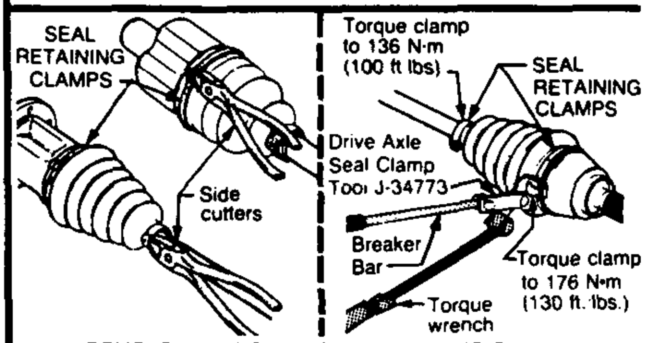
REMOVE

1. Cut seal retaining clamps.
2. Remove parts as shown.

INSTALL

1. Flush grease from housing and repack housing with approx. half of grease furnished with new seal.
2. Put remainder of grease in seal.
3. Install parts as shown. Use tool J-34773 to secure seal retaining clamp. Torque to specifications.





Torque clamp to 136 N·m (100 ft lbs)

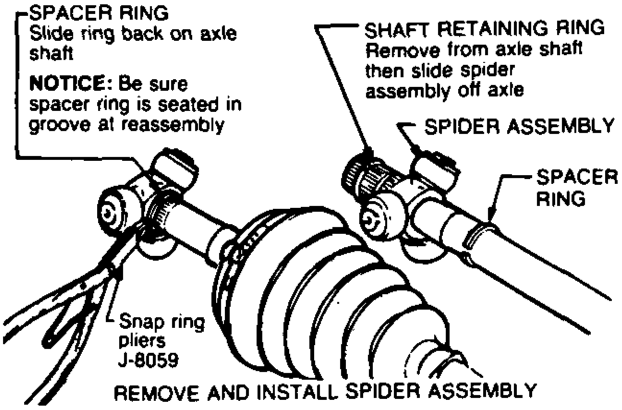
Torque clamp to 176 N·m (130 ft. lbs.)

REMOVE AND INSTALL SEAL RETAINING CLAMP

SPACER RING Slide ring back on axle shaft

NOTICE: Be sure spacer ring is seated in groove at reassembly

SHAFT RETAINING RING Remove from axle shaft then slide spider assembly off axle



REMOVE AND INSTALL SPIDER ASSEMBLY

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Fig. 8 Unit Repair

SPECIAL TOOLS

J-34773	Drive Axle Boot Clamp Tool
J-8059	Snap Ring Pliers
J-2619-01	Slide Hammer Assembly
J-29794	Extension
J-28468 or J-33008	Axle Shaft Remover
J-34826	36 mm Hub Nut Socket
J-28733	Front Hub Spindle Remover
J-28712 or J33162	Drive Joint Boot Protector

SECTION 5

BRAKES

NOTICE: *All brake attaching fasteners are important 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 the part.*

CAUTION: WHEN SERVICING WHEEL 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 WHEEL 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.

CONTENTS

GENERAL DESCRIPTION

MASTER CYLINDER

A composite master cylinder which has an aluminum body and a translucent nylon reservoir with minimum fill indicators is used.

The master cylinder employs a "Quick Take-Up" feature in the rear chamber to reduce excess pedal travel which may result from increased fluid displacement required to move the "Low-Drag Caliper" piston out. The quick take-up master cylinder uses a spring loaded ball check valve to hold pressure in the large-diameter rear chamber so that when the brake is first applied, 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 (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 conventional manner. When the pedal is released, the large-bore chamber replenishes its fluid supply 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 5-1

The quick take-up nylon reservoir master cylinder has two windows incorporated into the master cylinder reservoir. These windows allow the brake fluid level to be checked without removal of the reservoir cover.

DISC BRAKES

Upon application of the brakes, 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 or move on the mounting bolts toward the inner side, or toward the

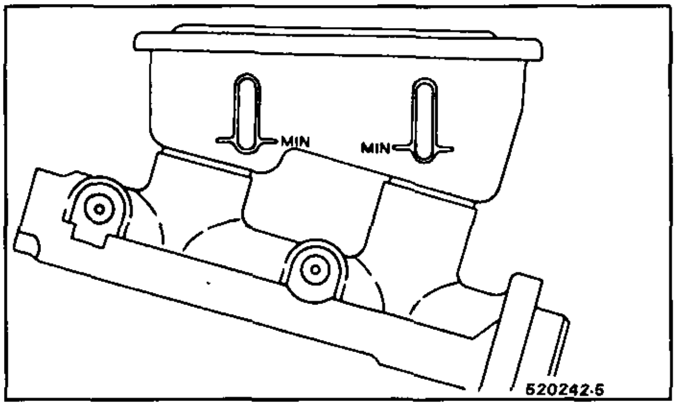

Fig. 5-1 Master Cylinder Reservoir Window (Typical)

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 builds up, the shoe and lining assemblies are pressed against the rotor surfaces with increased force, bringing the car to a stop.

Lining wear is automatically compensated for by the outward movement of the piston and inward movement of the caliper. Brake fluid fills this void as the lining wears.

COMBINATION VALVE

The proportioning section of the combination valve proportions outlet pressure to the rear brakes after a pre-determined rear input pressure has been reached. This is done to prevent early rear wheel lock-up under heavy braking loads.

The valve is designed to have a "by-pass" feature which assures 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.

The pressure differential warning switch is designed to constantly compare front and rear brake pressure from the master cylinder and energize the warning light on the dash in the event of a front or rear system failure. The valve and switch are so designed that the switch will latch in the "warning" position once a failure has occurred. The only way the light can be turned off is to repair the failure and apply a pedal force to develop approximately 450 psi line pressure.

DIAGNOSIS

INSPECTION AND TESTING BRAKES

Brakes should be tested on dry, clean, reasonably smooth and level roadway. A true test of brake performance cannot be made if roadway is wet, greasy or covered with loose dirt so that all tires do not grip the road equally. Testing will also be adversely affected if roadway is crowned so as to throw weight of car toward wheels on one side or if roadway is so rough that wheels tend to bounce.

Test brakes at different car speeds with both light and heavy pedal force; however, avoid locking the brakes and sliding the tires. Locked brakes and sliding tires do not indicate brake efficiency, since heavily braked, but turning wheels will stop a 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 line pressure levels. This is done because best stopping distance and control is achieved without brake lock-up.

Because of the high deceleration capability, a firmer pedal pressure 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. When a car has unequal loading, the most heavily loaded wheels require more braking power than others. A heavily loaded car requires more braking effort.
3. Front End Alignment. Misalignment of the front end, particularly in regard to limits on camber and caster may cause the brake to pull to one side.
4. Front Wheel Bearings. A loose front wheel bearing permits the front wheel to tilt and have spotty contact with the brake shoe linings causing erratic brake operation.

DIAGNOSIS CHART

Condition	Possible Cause	Correction
Pulls (For Radial Tire Lead refer to Section 3E)	1. Incorrect tire pressures.	1. Inflate evenly on both sides to the recommended pressures.
	2. Front end out of line.	2. Check and align to manufacturer's specifications.
	3. Unmatched tires on same axle. For radial tire tread refer to	3. Tires with approximately the same amount of tread should be used on the

	Section 3A.	same axle.
	4. Restricted brake tubes or hoses.	4. Check for soft hoses and damaged lines. Replace with new hoses and new double-walled steel brake tubing.
	5. Malfunctioning caliper assembly.	5. Check for stuck or sluggish pistons and proper lubrication of retainer bolts, bushings, and sleeves. Caliper must be free to slide.
	6. Loose suspension parts.	6. Check all suspension mountings and repair or replace as necessary.
	7. Loose calipers.	7. Check and torque bolts to specifications.
Noise (high pitched without brake applied).	1. Some brake squeak is normal.	
	2. Front and/or rear pad worn out.	2. Replace pads in complete axle sets.
Brake Roughness or Chatter (Pedal Pulsates)	1. Excessive lateral runout.	1. Check per instructions and replace or machine the rotor if not within specifications.
	2. Parallelism not within specifications.	2. Check per instructions and replace or machine the rotor if not within specifications.
	3. Wheel bearings not adjusted.	3. Adjust wheel bearings to correct specifications.
	4. Front shoe and lining reversed (steel against iron).	4. Replace shoe and linings in axle sets and machine rotor to specifications or replace.
Excessive Pedal Effort	1. Malfunctioning power brake.	1. Check power brake and repair if necessary.
	2. Partial system failure.	2. Check front and rear brake system and repair if necessary. If a failed system is found and light did not function, check brake warning light.
	3. Excessively worn pads.	3. Check and replace in axle sets.
	4. Piston in caliper stuck or sluggish.	4. Remove caliper and rebuild.
	5. Fading brakes due to incorrect lining.	5. Remove and replace with original equipment lining.
Excessive Pedal Travel	1. Partial brake system failure.	1. Check both front and rear system for a failure and repair. Also check warning light. It should have indicated a failure.

	2. Insufficient fluid in master cylinder.	2. Fill reservoirs with approved brake fluid. Check for leaks. Check warning light. Bleed system.
	3. Air trapped in system.	3. Bleed system.
	4. Bent pads.	4. Replace axle pads in complete sets.
Dragging Brakes (A very light drag is present in all disc brakes immediately after pedal is released.)	1. Incorrect adjustment of brake light switch and/or cruise control vacuum release valve assembly could keep the brake pedal from returning fully.	1. Insert switch into tubular clip until switch body seats on tube clip. Pull brake rearward against internal pedal stop. Switch will be moved in tubular clip providing proper adjustment.
	2. Master cylinder pistons not returning correctly.	2. With reservoir cover off, check for fluid spurt at bypass holes as pedal is depressed. Check and adjust booster output rod, if necessary, or rebuild master cylinder.
	3. Restricted brake tubes or hoses.	3. Check for soft hoses or damaged tubes and replace with new hoses and new double-walled steel brake tubing.
	4. Incorrect parking brake adjustment on rear brakes.	4. Check and readjust to correct specifications.
	5. Check valve installed in outlet to front disc brakes.	5. Check master cylinder outlet and remove check valve if present.
Grabbing or Uneven Braking Action	1. All conditions listed under PULLS.	1. All corrections listed under PULLS.
	2. Malfunction of combination valve.	2. Replace and bleed system.
	3. Malfunction of power brake unit.	3. Check operation and repair, if necessary.
	4. Binding brake pedal mechanism.	4. Check and lubricate, if necessary. Possibly replace pedal bushing and/or spacer.
Pulsation (roughness) Felt in car during normal brake application.	1. Uneven pad wear caused by caliper not sliding due to improper clearance or dirt.	1. Remove caliper and correct as necessary.
	2. Thickness variation between the two braking surfaces.	2. Machine Rotor as follows: a. Machine rotors to obtain a thickness variation no greater than .013mm, (.0005") and a lateral runout no greater than .102mm, (.004"). b. Check caliper freeness. With rotor removed, install

caliper and mounting bolts (pins). Check for .127mm-.304mm .005"-.012") clearance at both top and bottom of caliper.
If less than .13mm (.005") is found, file with a flat file until at least .13mm (.005") is obtained. DO NOT EXCEED A MAXIMUM of .30mm (.012") per end or .60mm (.024") total clearance.
Caliper clearance to inboard linings must be equal within .102mm (.004") both at the top and bottom of the caliper. This is to ensure correct alignment of caliper to knuckle during a brake application.
c. Remove caliper after freeness check. Clean pins and sleeves, replace O-rings, and apply a light coating of silicone grease or equivalent to all contact points and O-rings.
d. Install reconditioned rotors and adjust wheel bearings as specified.

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	Brakes Tell-Tale 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	
Out-of-Parallel Brake Discs	X												XX		
Excessive Run-Out Disc	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 Stoplight Switch Or Cruise Control Vacuum Dump							X								
Brake Pedal Linkage Interference or Binding			X		X	XX	XX								
Improperly Adjusted Parking Brake							X		X						
Improper Length Master Cylinder Push Rod	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

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Fig. 5-2 Brake Diagnosis

ON-CAR SERVICE

POWER BRAKE VACUUM HOSE FILTER

Figures 5-3 and 5-4

←→ **Remove or Disconnect**

1. Open deck lid.
2. Remove hoses at each end.
3. Loosen clamp.
4. Remove filter assembly.

→← **Install or Connect**

1. Install filter in clamp.
2. Tighten clamp around filter.
3. Install hoses at filter.
4. Close deck lid.

STOP LIGHT SWITCH

Figure 5-6

With pedal in fully released position, the stop light switch plunger should be fully depressed against the 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. Audible 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 pedal stop until audible 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 audible clicking sounds remain.

Brake Pedal Mounting

Figure 5-7

BLEEDING AND FLUSHING BRAKE SYSTEM

Figures 5-8 and 5-9

A bleeding operation is necessary to remove air whenever it is introduced into the hydraulic brake system.

It may be necessary to bleed the hydraulic system at all four brakes if air has been introduced through low fluid level or by disconnecting brake pipes at master cylinder. If a brake pipe is disconnected at any wheel, then that wheel caliper only need be bled. If pipes are disconnected at any fitting located between master cylinder and brakes, then the calipers served by the disconnected pipe must be bled.

Manual Bleed

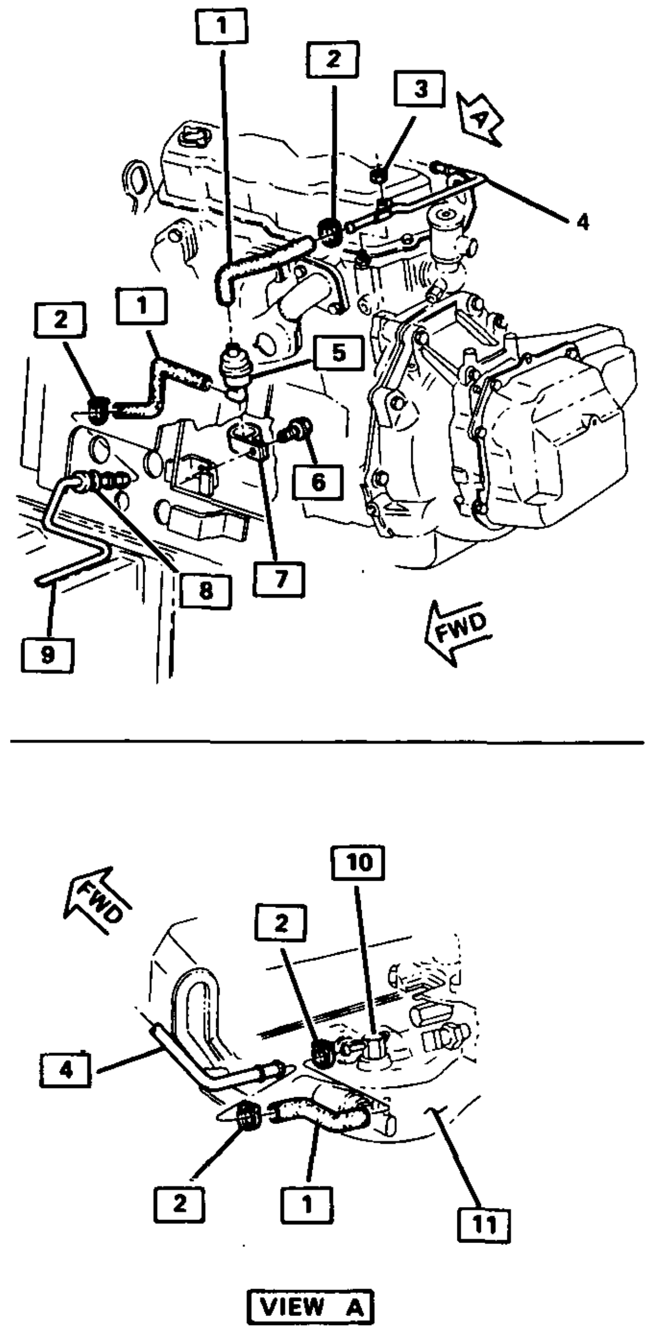
Figure 5-8

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.

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. Care must be taken to prevent brake fluid from contacting any painted surface.
   e. After all air has been removed at the forward connection, bleed the master cylinder at the rear (cowl) connection in the same manner as the front in step "d" above.
   f. If it is known that the calipers do not contain any air, then it will not be necessary to bleed them.
3. Individual calipers are bled only after all air is removed from master cylinder.
   a. Place a proper size box end wrench over the bleeder valve. Attach a transparent tube over valve and allow tube to hang submerged in brake fluid in a transparent container. 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 10 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 manner that makes it difficult to bleed the rear side of the system.
4. If it is necessary to bleed all of the calipers, the following sequence should be followed: 1) right rear; 2) left rear; 3) right front; 4) left front.
5. Check the brake pedal for "sponginess" and the brake warning light for indication of unbalanced pressure. Repeat entire bleeding procedure to correct either of these two conditions.



1 – HOSE
2 – CLAMP
3 – NUT
4 – TUBE
5 – FILTER ASSY.
6 – BOLT
7 – BRACKET
8 – HOLE (FLOOR PAN)
9 – PIPE ASSY.
10 – FITTING
11 – INTAKE MANIFOLD

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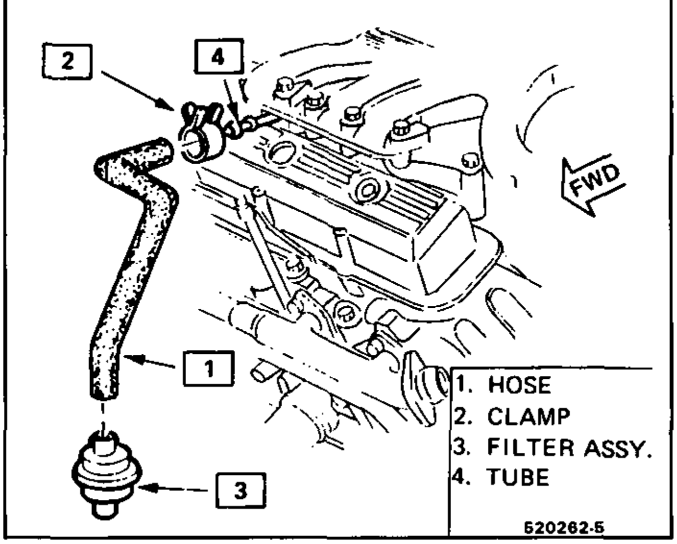
Fig. 5-3 *Power Brake Vacuum Filter, Tube & Hose*



1. HOSE
2. CLAMP
3. FILTER ASSY.
4. TUBE

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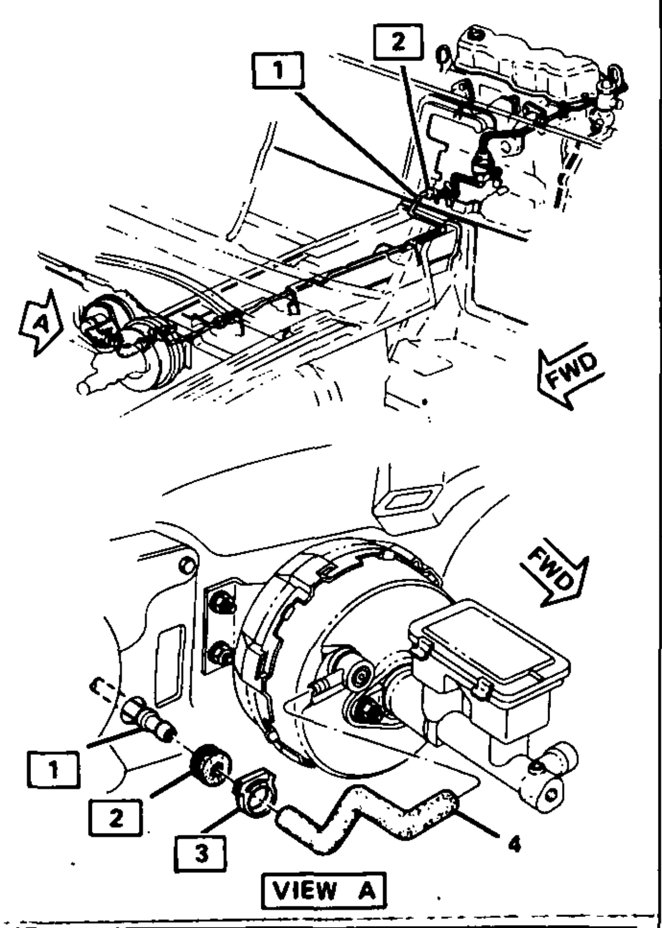
Fig. 5-4 Power Brake Vacuum Filter, Tube & Hose, V-6 Engine



1 – TUBE ASSY.
2 – GROMMET
3 – CLAMP
4 – HOSE

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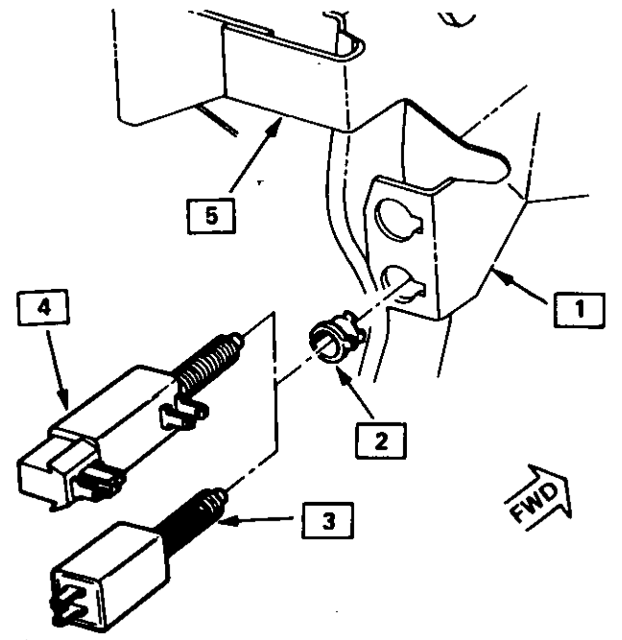
Fig. 5-5 Power Brake Hoses & Tube Assembly



1—PEDAL ASM.
2—RETAINER
3—SWITCH ASM. (W/O CRUISE CONT.)
4—SWITCH ASM. (WITH CRUISE CONT.)
5—PEDAL SUPT. ASM.

Fig. 5-6 Stop Light Switch Adjustment

PRESSURE BLEEDING PLASTIC RESERVOIR MASTER CYLINDER

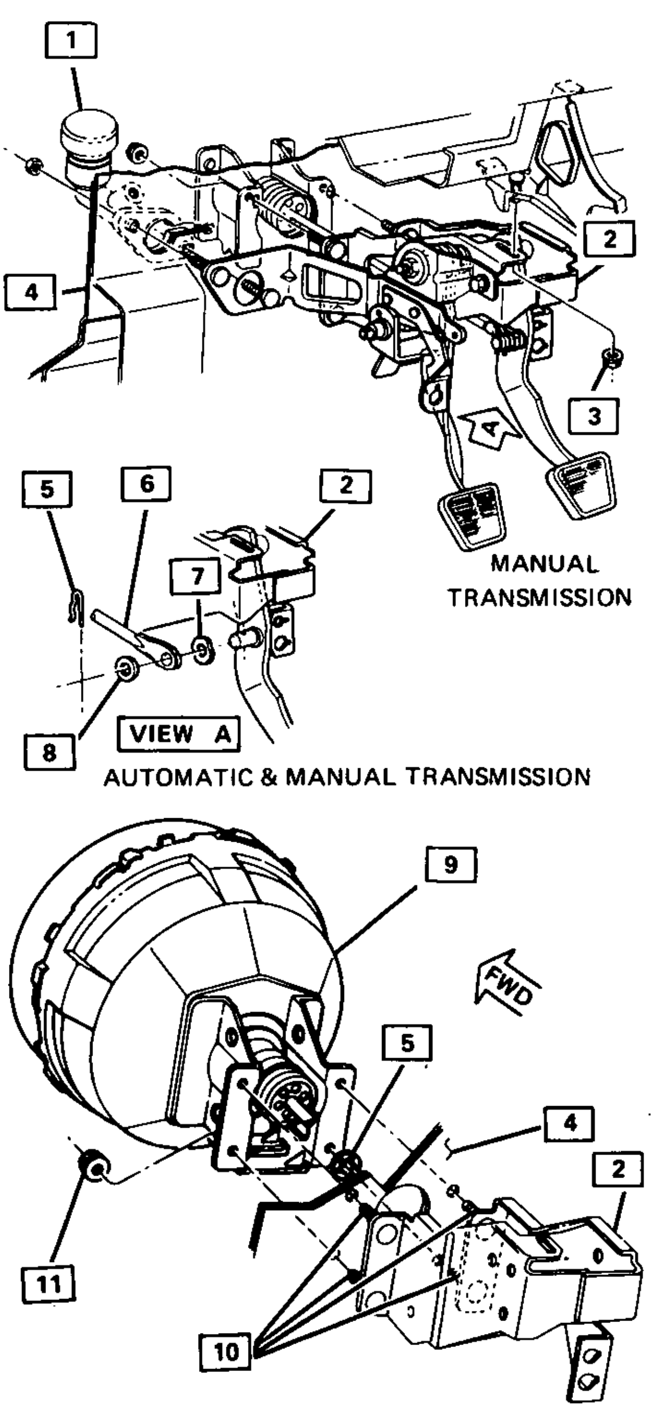
Figure 5-9

Pressure bleeding equipment must be of the diaphragm type. That is, it 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.

1. Install the correct bleeding adapter out of tool package J-26819-30 to the master cylinder.

   It is very important that the correct master cylinder bleeder adapter be used to avoid possible damage to the master cylinder reservoir.
2. Make sure the pressure tank is at least 1/3 full of Delco Supreme #11 brake fluid or its equivalent.

   The bleeder ball must be re-bled each time fluid is added.
3. Charge the bleeder ball to between 20 and 25 psi.
4. When ready to begin bleeding, connect hose to master cylinder bleeding adapter and open the tank valve.
5. The plastic reservoir type bleeder adapter is equipped with a special bleed-off valve. The valve must be depressed until several drops of fluid appear before bleeding the brake system.
6. Disc brake cars require a manual override of the front brake metering or combination valve to permit flow to the front wheels. Therefore, it will be necessary to hold the valve stem open manually with tool J-23709 when pressure bleeding.



1 – CLUTCH MASTER CYLINDER
2 – BRAKE PEDAL ASSY.
3 – NUT
4 – DASH PANEL
5 – RETAINER
6 – PUSH ROD
7 – WASHER
8 – WASHER – FLAT
9 – BOOSTER ASSY.
10 – STUD
11 – NUT (4)

Fig. 5-7 Brake Pedal Mounting

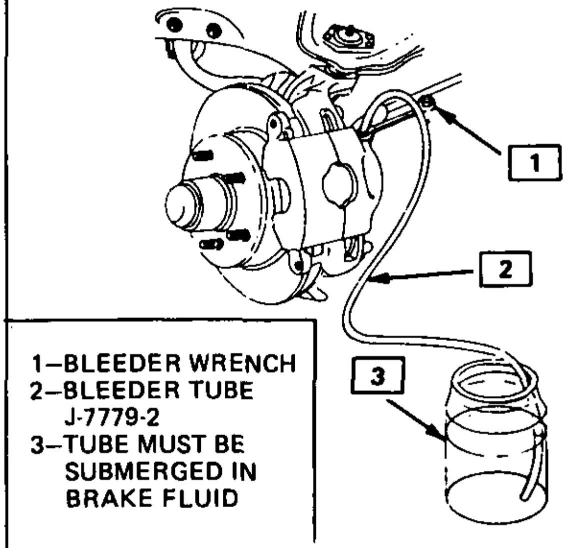


Fig. 5-8 Bleeding Wheel Cylinder

7. Bleed the brakes in the following sequence:
   a. Right rear
   b. Left Rear
   c. Right front
   d. Left front
8. With the proper size wrench over the bleeder valves, attach bleeder tubes. The discharge end must hang submerged 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 bleed valves. Be sure they seal.
11. Repeat steps 7 through 10 until all calipers have been bled.
12. Check the pedal feel for "sponginess" and repeat the entire procedure if necessary.
13. Dispose of all removed brake fluid.
14. Remove the metering valve actuator (J-23709) from the combination valve and tighten the mounting bolt.

FLUSHING BRAKE HYDRAULIC SYSTEM

It is recommended that the entire hydraulic system be thoroughly flushed with clean brake fluid whenever new parts are installed in the hydraulic system. Approximately one quart of fluid is required to flush the hydraulic system.

The system must be flushed if there is any doubt as to the grade of fluid in the system. If fluid has been used which contains the slightest trace of mineral oil,

BLEEDING

1. Install bleeder adapter J-26819, extension J-26819-30 and clamp J-26819-25 as shown.
2. Charge bleeder ball to 20-25 psi.
3. Connect line to adapter. Open line valve and depress bleed-off valve on top of adapter until a few drops of fluid appear.
4. Hoist car.
5. Attach bleeder hose to bleeder valve and submerge opposite end in clean container partially filled with brake fluid.
6. Open bleeder valve ½ to ¾ turn and allow fluid to flow until no air is seen in fluid.
7. Bleeding sequence:
   A. Right rear
   B. Left rear
   C. Right front
   D. Left front

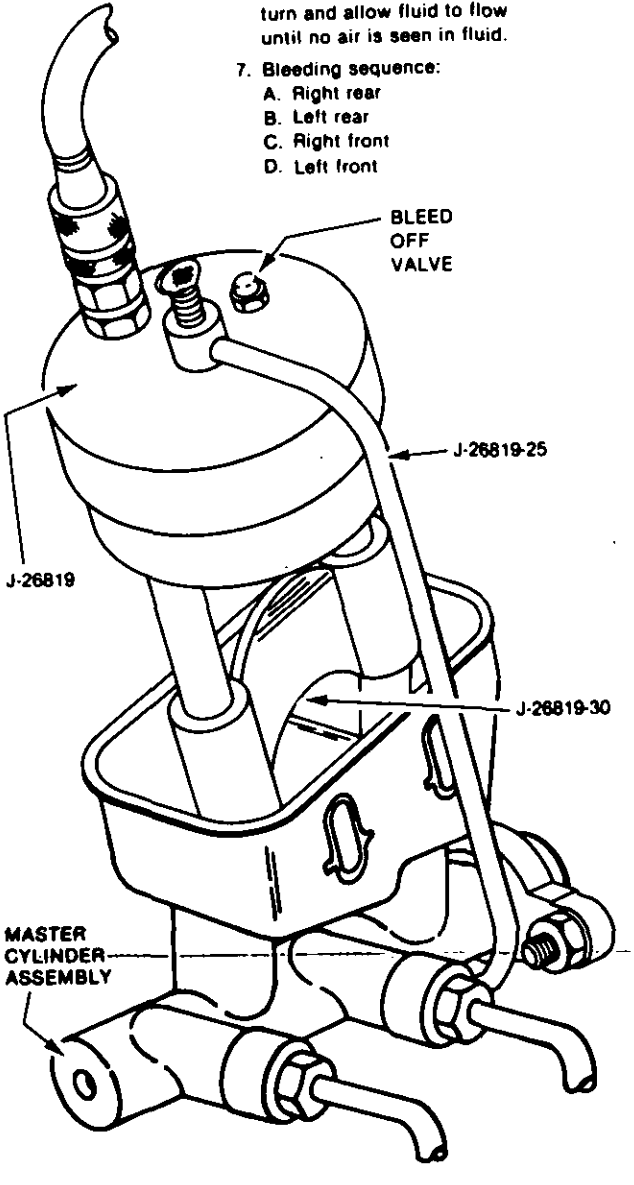


Fig. 5-9 Plastic Reservoir Master Cylinder Pressure Bleeder Adapter

all rubber parts that have been subjected to the contaminated fluid must be replaced.

BRAKE PIPES

Figures 5-10 and 5-11

Replace

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.

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 cord and adding 3mm (1/8") for each double-flare.
3. Make sure fitting ends are installed before starting flare. Double-flare tubing ends using a suitable flaring tool such as J-23530. Follow instructions included in tool set.

CAUTION: An ISO flare must be used, as single-flaring tools cannot produce a flare strong enough to hold the necessary pressure.

4. Bend pipe assembly to match old pipe using a tubing bender. Clearance of 19mm (.750) must be maintained to all moving or vibrating parts.

BRAKE HOSES

Inspect

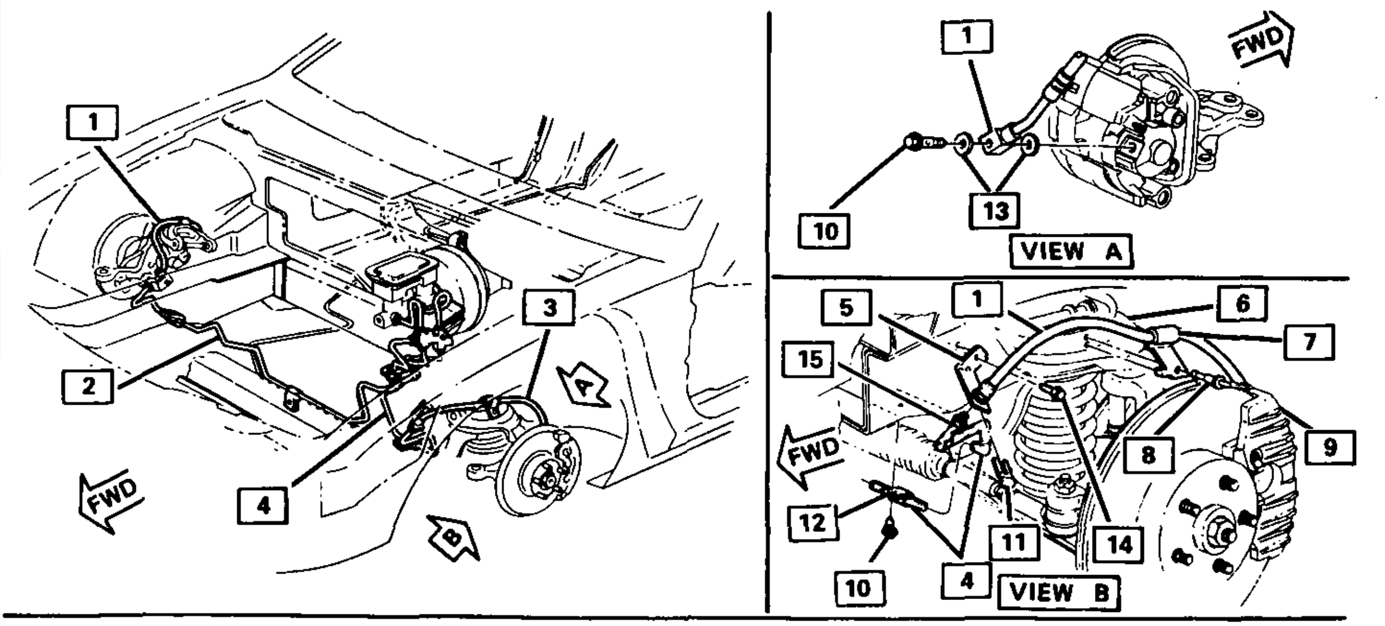
The flexible hydraulic brake hose, which transmits hydraulic pressure from the steel brake line on the body to the calipers, should be inspected at least twice a year when the car is on a lift for lubrication. The brake hose assembly should be checked for road hazard damage, for cracks and chafing of 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 the brake hose it will be necessary to replace it.

Front Brake Hose

Figure 5-10

Remove or Disconnect

1. Clean dirt and foreign material from both hose and fittings.
2. Remove the rivet attaching the brake hose clip to the upper control arm.
3. Disconnect brake pipe from hose fitting using a backup wrench on fitting. Be careful not to bend frame bracket or brake pipe.
4. Remove "U" clip from female fitting at bracket and remove hose from bracket.
5. Remove bolt from caliper end of hose. Remove hose from caliper and discard the two copper gaskets on either side of fitting block.



1 – HOSE ASSY.
2 – PIPE ASSY. – RH
3 – HOSE ASSY. – LH
4 – PIPE ASSY. – LH
5 – BRACKET RH & LH
6 – CONTROL ARM
7 – CLIP (HOSE ASSY.)
8 – RIVET
9 – FRONT CALIPER ASSY.
10 – BOLT/SCREW
11 – RETAINER
12 – CLIP
13 – WASHER
14 – BOLT 3.8 N·m (34 lbs. in.)
15 – HOSE 24 N·m (17 lbs. ft.)

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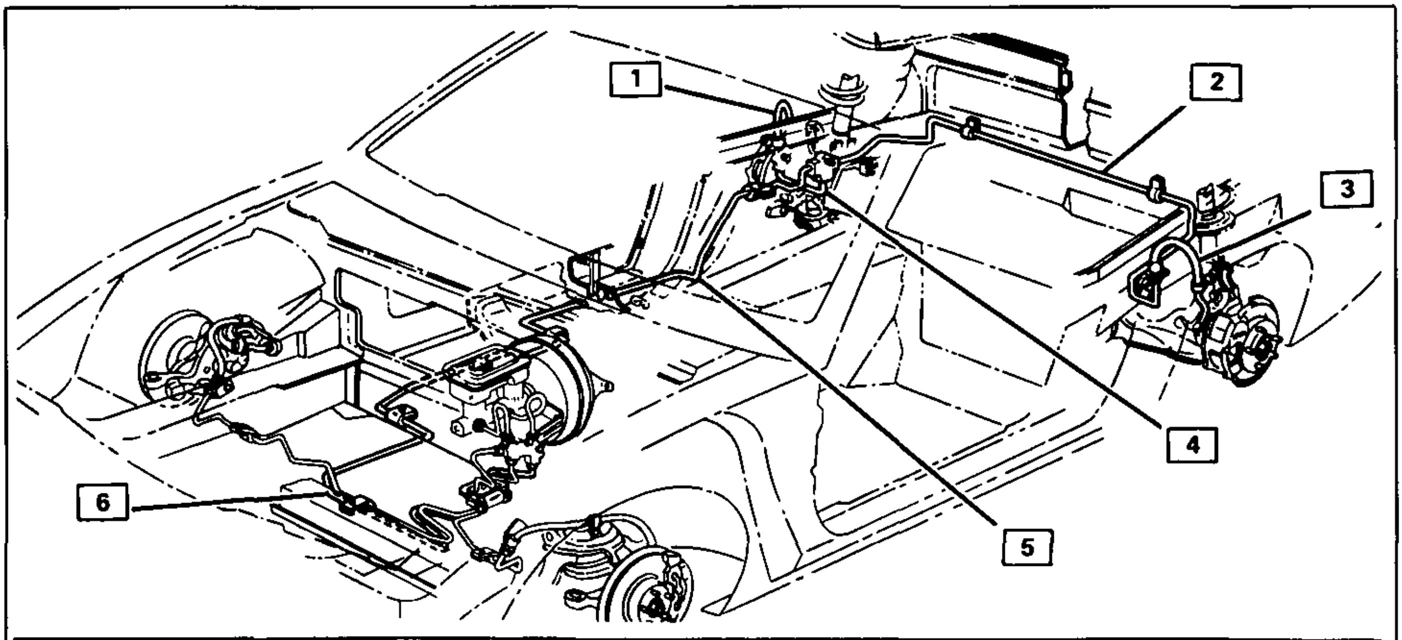
Fig. 5-10 Front Brake Pipes And Hoses



1 – HOSE ASSY. – RH
2 – PIPE ASSY. – LH
3 – HOSE ASSY. – LH
4 – PIPE ASSY. – RH
5 – PIPE – REAR BRAKE
6 – PIPE ASSY.

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Fig. 5-11 Center and Rear Brake Pipes

→← Install or Connect

1. Use new copper gaskets on both sides of fitting block. Lubricate bolt threads with brake fluid. With fitting flange engaged with the caliper orientation ledge, fasten hose to caliper.
2. Fitting fits the bracket in only one position. With least amount of twist in hose, install fitting in this position. There should be no kinks in hose.
3. Rivet brake hose clip to the upper control arm.
4. Install "U" clip to female fitting at frame bracket.
5. Attach brake pipe to hose fitting using a backup wrench on fitting.
6. Inspect to see that the hose doesn't make contact with any part of suspension. Check in extreme right hand and extreme left hand turn conditions. If hose makes any contact, remove and correct.
7. Bleed brake system.

Rear Brake Hose

Figure 5-12

←→ Remove or Disconnect

1. Remove brake hose from brake pipe at the hose mounting bracket with the use of a backup wrench. Be careful not to bend bracket or pipes.
2. Remove "U" clip at the hose mounting bracket.
3. Remove bolt holding brake line to strut.
4. Remove bolt attaching fitting block to caliper.

→← Install or Connect

1. Attach hose assembly to brake tube
2. Attach spring clip to hose mounting bracket.
3. Attach brake hose fitting block to caliper along with new copper gaskets.
4. Attach brake line to strut torque.
5. Fill and maintain brake fluid level in reservoirs. Bleed system.

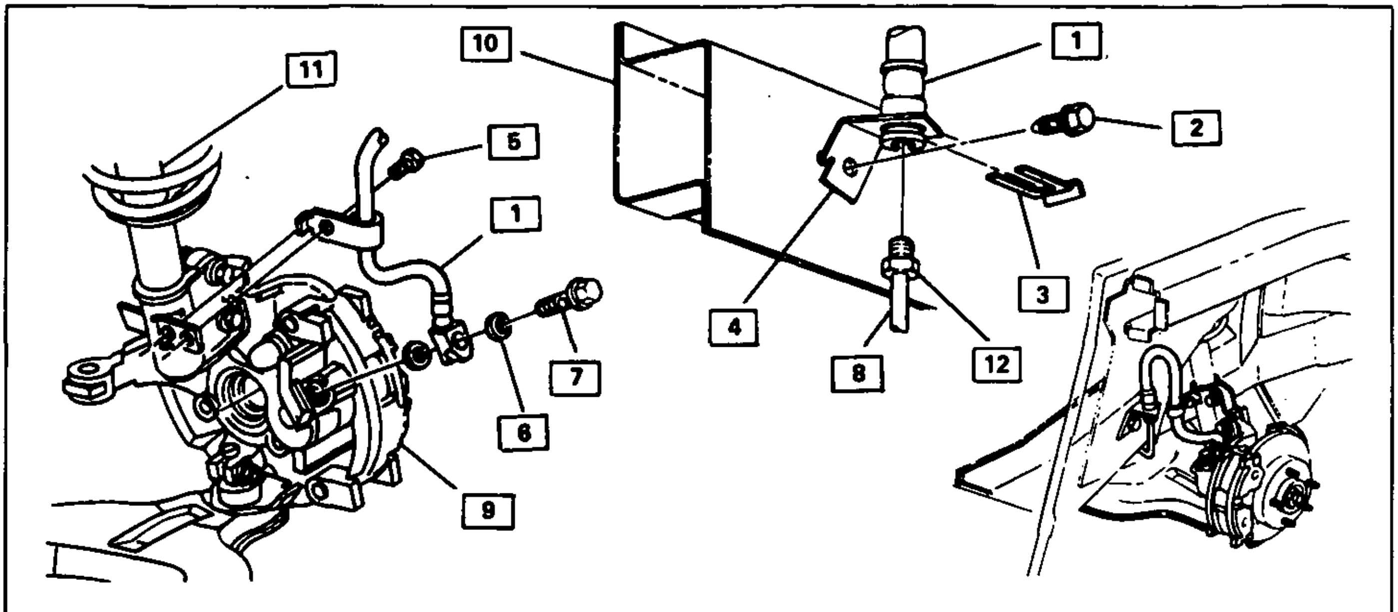
PARKING BRAKE CABLE

Figure 5-13

←→ Remove or Disconnect

Front Cable

1. Raise vehicle.
2. Loosen adjusting nut at equalizaer and separate cables.
3. Remove clip from cable.
4. Remove the two retaining clip bolts in the left wheel well.
5. Lower vehicle.
6. Unsnap the clip holding the parking brake boot to the lever.
7. Remove the seat belt bolt and carpet finishing molding.
8. Remove the shoulder harness retaining bolt.
9. Remove the quarter trim finishing molding.



1–HOSE ASM - RR BRAKE LH & RH

2–BOLT/BRAKE HOSE BRACKET 3.8 N·m (34 lbs. in.)

3–RETAINER

4–BRACKET - BRAKE HOSE LH & RH

5–BOLT/BRAKE HOSE CLIP 17 N·m (13 lbs. ft.)

6–WASHER

7–BOLT/BRAKE HOSE 44 N·m (32 lbs.ft.)

8–PIPE ASM RR–LH

9–CALIPER ASM

10–RAIL

11–ASM - REAR SUSPENSION

12–NUT - 15 N·m (11 lbs. ft.)

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Fig. 5-12 Rear Brake Hose Assembly

10. Pull carpet back and note how cable is routed.
11. Remove the cable from the parking brake lever and push it through the body.

Install or Connect

1. Replace in reverse order.

Rear Cables

Remove/Install

Figures 5-13 and 5-14

1. Raise vehicle.
2. Loosen adjusting nut at equalizer and separate cables.
3. Remove cables at calipers.
4. Disconnect the cables at the cradle with tool J-34065 and remove the cables.
5. Install new cable by reversing removal procedure.
6. Adjust parking brake.

PARKING BRAKE ADJUSTMENT

Figure 5-13

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 more than 9 ratchet clicks.

1. Place parking brake hand lever in the unapplied position.
2. Raise rear wheels off floor.
3. Apply lubricant to groove in equalizer nut.
4. Hold brake cable stud from turning and tighten equalizer nut until cable slack is removed.
5. Make sure caliper levers are against stops on caliper housing after tightening equalizer nut.
6. If levers are off stops, loosen cable until levers do return to stops.
7. Operate parking brake lever several times to check adjustment. Properly adjusted park brake shoes and properly adjusted park brake cable will result in a park brake handle movement of five (5) to eight (8) notches when a force is applied perpendicularly at the handle grip mid-point.
8. Lower rear wheels. Levers **must** be on caliper stops after completion of adjustment. **Back off park brake adjuster if necessary to keep levers on stops**.

PARKING BRAKE LAMP SWITCH

The parking brake lamp switch assembly is bolted to the hand brake mounting bracket and is actuated by the parking brake hand lever.

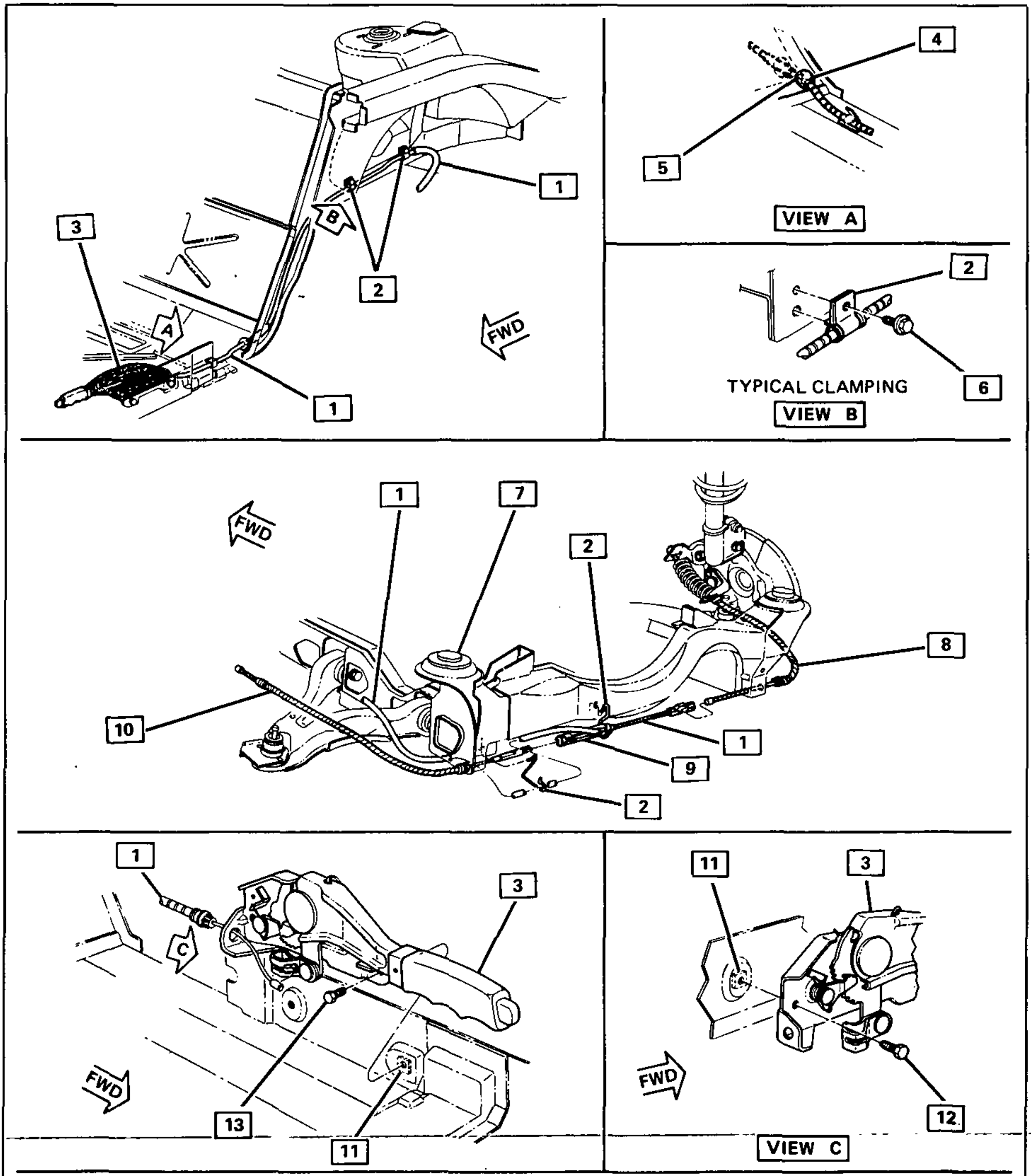
This switch is nonadjustable. The replacement procedure is covered in Section 8B.

COMBINATION VALVE

Testing Electrical Circuit of Combination Valve

Figure 5-16

When removing the electrical wire connector from the pressure differential switch, it is recommended that you squeeze the eliptical shaped



1 – CABLE ASSY., FRONT
2 – CLIP
3 – LEVER ASSY.
4 – GROMMET (CABLE ASSY., FRONT)
5 – HOSE IN FLOOR PAN
6 – BOLT 3.8 N·m (34 lbs. in.)
7 – FRAME ASSY.
8 – CABLE ASSY., RH
9 – EQUALIZER
10 – CABLE ASSY., LH
11 – WELD NUT
12 – BOLT/SCREW 28 N·m (21 lbs. ft.)
13 – BOLT/SCREW. 28 N·m (21lbs. ft.)

G20027-5

Fig. 5-13 Parking Brake Lever Assembly and Cables

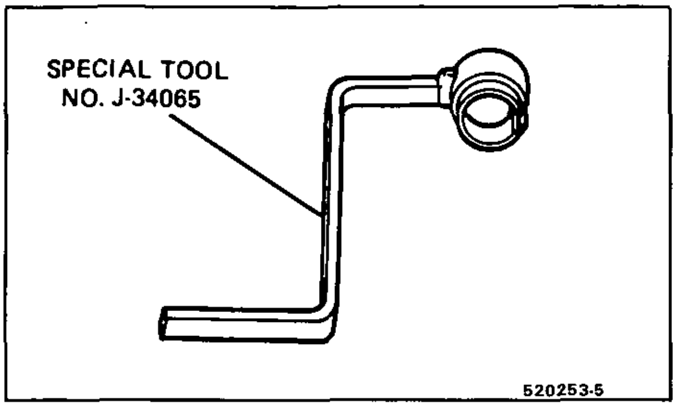


Fig. 5-14 Special Tool J-34065

plastic locking ring and then pull up. This will move the locking tangs away from the switch. A pair of pliers can be used to aid in the removal of the connector.

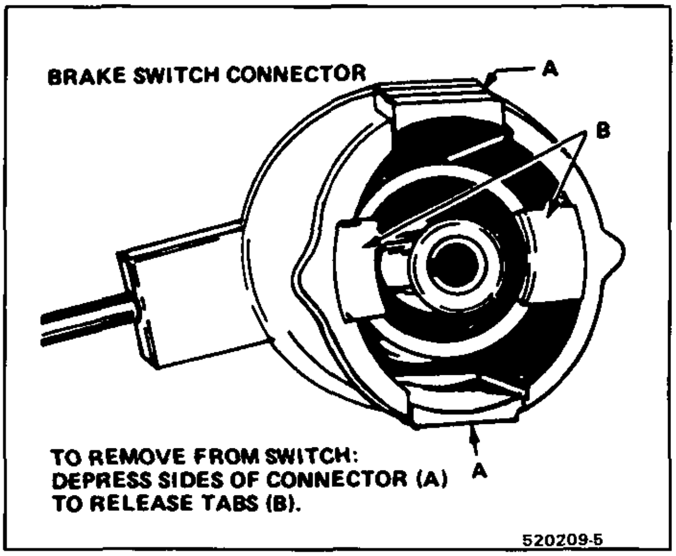


Fig. 5-15 Removing Brake Switch Connector

1. Disconnect wire from switch terminal and use a jumper to connect wire to a good ground.
2. Turn ignition key to "On" - warning lamp should light. If lamp does not light, bulb is burned out or electrical circuit is defective. Replace bulb or repair electrical circuit as necessary.
3. When warning lamp lights, turn ignition switch off. Disconnect jumper and reconnect wire to switch terminal.

Testing Warning Light Switch Portion of Combination Valve

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 a helper applies moderate pressure to the brake pedal. Warning lamp should light. Close bleeder screw before helper releases brake pedal. Reapply brake pedal with moderate-to-heavy pressure. Light should go out.
3. Attach the bleeder hose to a front brake bleeder screw and repeat above test. Warning lamp action should be the same as in Step No. 2. Turn ignition switch off.
4. If warning lamp does not light during Steps 2 and 3 but does light when a jumper is connected to ground, the warning light switch portion of the combination valve is defective. Do not attempt to disassemble the combination valve. If any portion of the combination valve is defective, it must be replaced with a new combination valve.

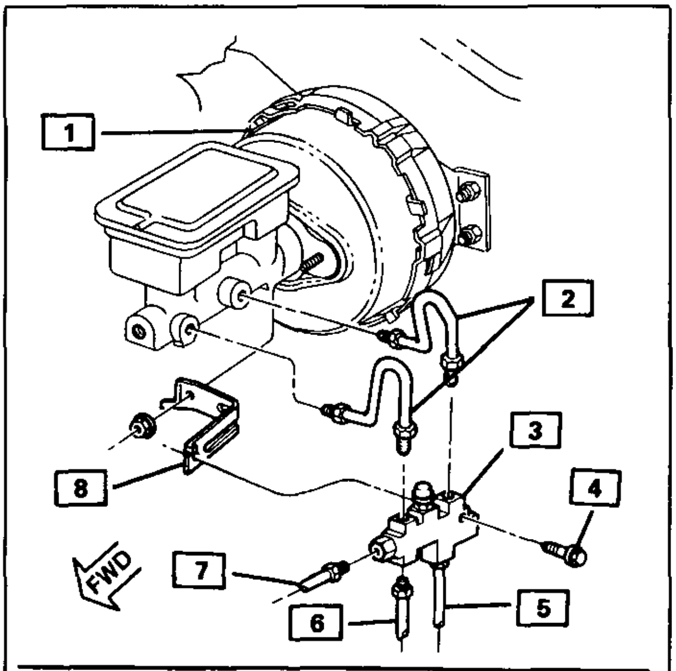
Combination Valve Replacement

↔ **Remove or Disconnect**

Figure 5-16

The combination valve is not repairable and must be serviced as a complete assembly.

1. Disconnect hydraulic lines at combination valve. Plug lines to prevent loss of fluid and entrance of dirt. Disconnect warning switch wiring harness from valve switch terminal.
2. Remove combination valve.
3. Install combination valve by reversing removal steps.
4. Bleed entire brake system. Do not move car until a firm brake pedal is obtained.



1 – BOOSTER ASSY.
2 – PIPE ASSY.
3 – VALVE ASSY.
4 – BOLT
5 – BRAKE PIPE – RR
6 – PIPE ASSY. – R.H.
7 – PIPE ASSY. – L.H.
8 – BRACKET

Fig. 5-16 Combination Valve to Master Cylinder Mounting

MASTER CYLINDER

Filling Brake Master Cylinder

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.

Add fluid as required to bring level to approximately 6mm (1/4") from top of reservoir or within limits identified by steps on inboard front corner of reservoir (see Fig. 5-17). Use Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Fluid must be "DOT 3."

Use only brake fluid rated dot 3 or equivalent. Do not use a container which has been used for mineral oil or a container which is wet as water will mix with brake fluid, lowering the fluid boiling point. Keep all fluid containers capped to prevent water contamination. Facings - Semimetallic-Bonded

SECTION 5A3

COMPOSITE MASTER CYLINDER (RWD)

CONTENTS

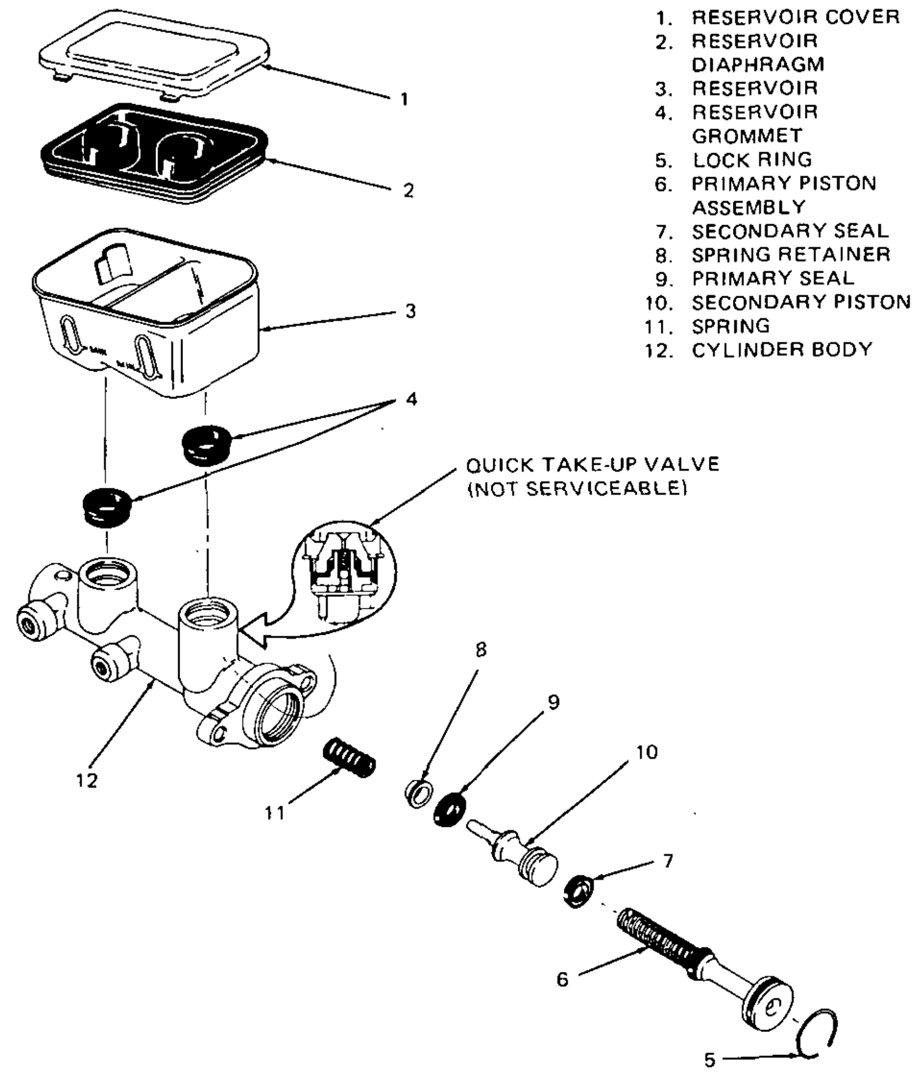


Figure 1

GENERAL DESCRIPTION

This master cylinder is designed for use with a system incorporating low drag calipers. In addition to the standard master cylinder functions, a quick take-up feature is included. This provides a large volume of fluid to the wheel brakes at low pressure with initial brake application. The low pressure fluid quickly provides the displacement requirements created by the seal retracting pistons into the front calipers and spring retraction of the rear drum brake shoes.

> **NOTICE:** *Replace all components included in repair kits used to service this master cylinder. Lubricate rubber parts with clean, fresh 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 brake line disconnected, bleed the brake system. The torque values specified are for dry, unlubricated fasteners.*

ON-CAR SERVICE

MASTER CYLINDER ASSEMBLY

Figure 2

Remove or Disconnect

1. Tube nuts (14) and hydraulic lines
2. Two attaching nuts (15)
3. Master cylinder (13)

Important

- See NOTICE on page 5-1.

Install or Connect

1. Master cylinder (13) and torque attaching nuts (15) to 27 N·m (22 ft. lbs.)
2. Hydraulic lines and torque tube nuts (14) to 24 N·m (216 in. lbs.)
3. Bleed hydraulic system

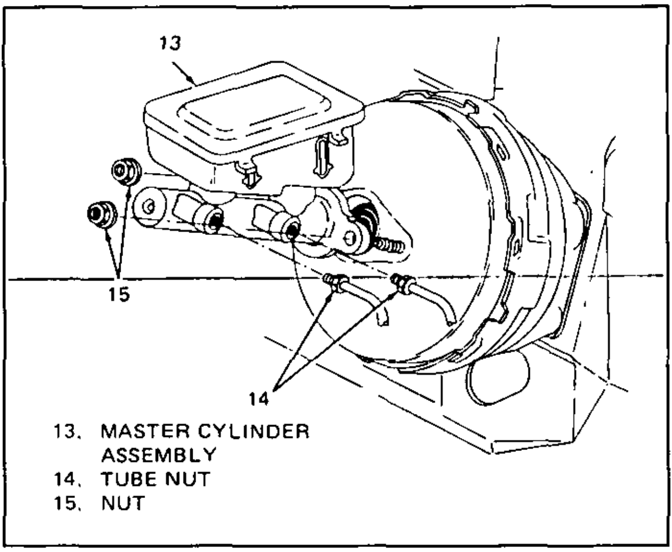


Figure 2 Master Cylinder Assembly

UNIT REPAIR

MASTER CYLINDER OVERHAUL

Disassembly

Figures 3, 4 and 5

Remove or Disconnect

1. Reservoir cover (1) and diaphragm (2)
2. Empty fluid from reservoir.

   Inspect

   - Reservoir cover (1) and diaphragm (11) for:
     - Cuts
     - Cracks
     - *Deformation*
   - Replace damaged parts.
3. Lock ring (5) while depressing primary piston (6)
4. While directing compressed air into outlet port at the blind end of the bore (other outlet plugged):
   - primary piston (6)
   - secondary piston (10)
   - spring retainer (8)
   - spring (11)
5. From secondary piston (10):
   - seals (7 and (9)
   - spring retainer (8)
6. Clamp master cylinder body (12) in vise as shown in Figure 4.

   Important

   - Do not clamp on master cylinder body (12).
   - Do not remove quick take-up valve from body.
   - Valve is not serviceable separately.

Clean

- All parts in clean denatured alcohol
- Dry with compressed air.

Inspect

- Master cylinder bore for scoring or corrosion
- If noted, replace master cyinder.
- No abrasives shall be used in bore.

Assembly

Figures 3 and 5

Important

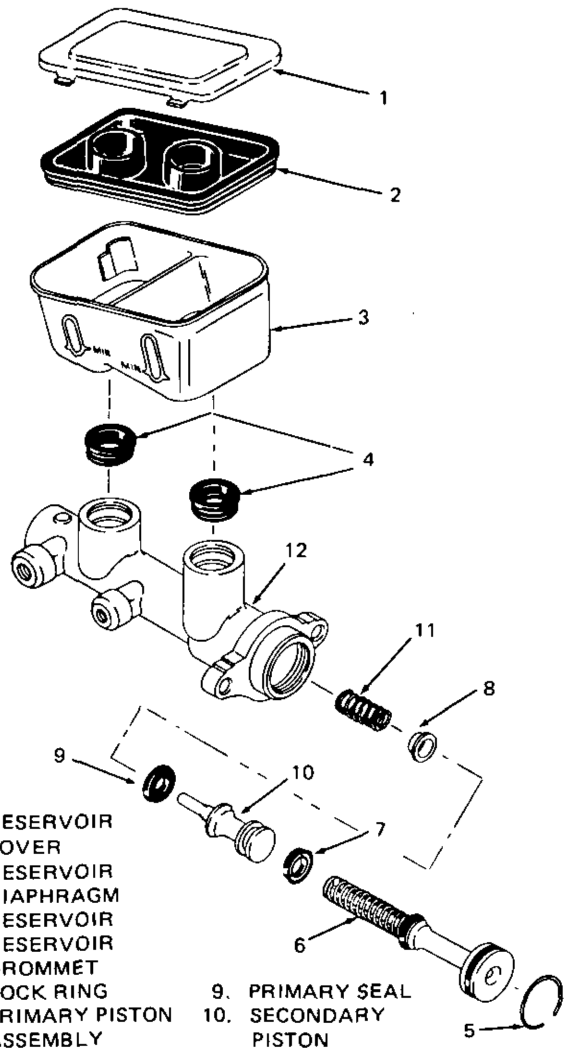
- See NOTICE on page 5-1.

Install or Connect

1. Lubricate new reservoir grommets (4) with brake fluid or silicone grease.
   - Grommets (4) into master cylinder body (12)
   - Make sure grommets (4) are properly seated.

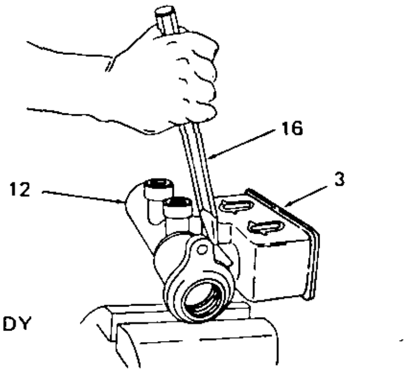
- Reservoir (3) to master cylinder body (12) using rocking motion as shown in Figure 5

2. Lubricate new seals (7 and 9) with clean brake fluid.
   - Seals (7 and 9) onto secondary piston (10)
   - Position as shown in Figure 3.
3. Spring (11), spring retainer (8) and secondary piston assembly (7, 9 and 10) into cylinder bore
4. Lubricate primary piston (6) seals with clean brake fluid.
   - Primary piston assembly (6) into cylinder bore
   - Depress primary piston (6) and install lock ring (5).
5. Diaphragm (2) into reservoir cover (1) and install on reservoir (3)



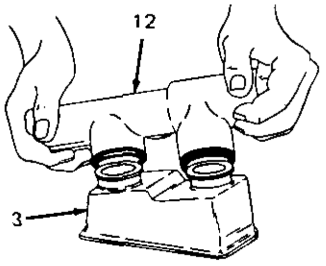
1. RESERVOIR COVER
2. RESERVOIR DIAPHRAGM
3. RESERVOIR
4. RESERVOIR GROMMET
5. LOCK RING
6. PRIMARY PISTON ASSEMBLY
7. SECONDARY SEAL
8. SPRING RETAINER
9. PRIMARY SEAL
10. SECONDARY PISTON
11. SPRING
12. CYLINDER BODY

Figure 3 Master Cylinder Assembly



3. RESERVOIR
12. CYLINDER BODY
16. PRY BAR

Figure 4 Removing Reservoir



3. RESERVOIR
12. CYLINDER BODY

Figure 5 Installing Reservoir

SECTION 5B1

FRONT CALIPER DISC BRAKE ASSEMBLY 3000/3100 SERIES

CONTENTS

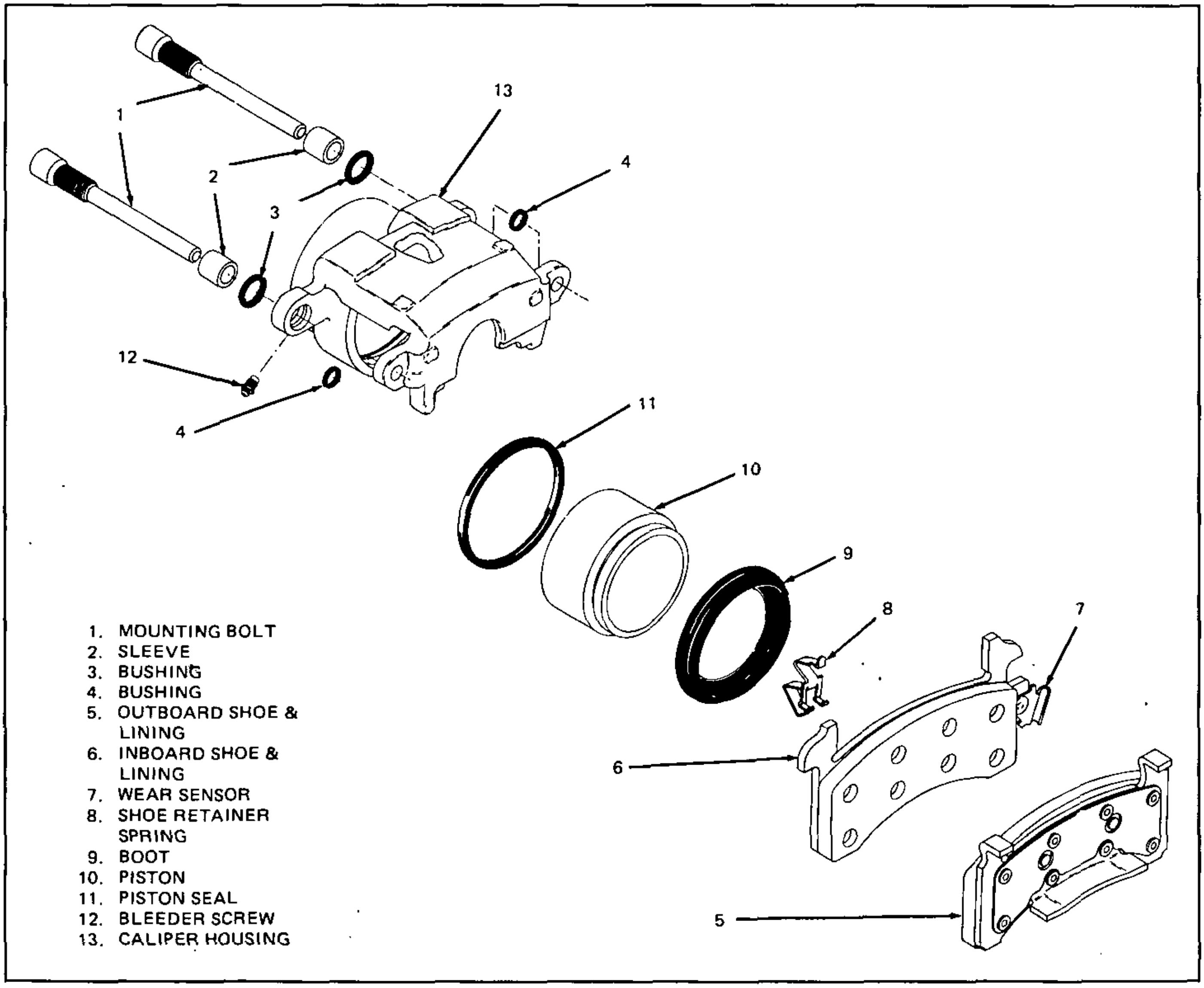


Figure 1

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. Hydraulic force, created by applying force to the brake pedal, is converted by the caliper to friction. The hydraulic 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.

> **NOTICE:** Replace all components included in repair kit used to service the caliper. Lubricate parts as specified. Do not use lubricated shop air on brake parts as damaged to rubber components may result. If any component is removed or line disconnected, bleed the brake system. Replace shoe and linings in axle sets only. The torque values specified are for dry, unlubricated fasteners.

ON-CAR SERVICE

CALIPER ASSEMBLY

Figures 1 thru 5

Remove or Disconnect

1. 2/3 of brake fluid from master cylinder assembly
2. Raise car & suitably support, see Section 0A.
   - Mark relationship of wheel to axle.
   - Wheel and tire
   - Reinstall two lug nuts to retain rotor.
3. Position C-clamp (14) as shown in Figure 2 and tighten until piston (10) bottoms in bore (13).
4. C-clamp (14)
5. Bolt holding inlet fitting (15) as shown in Figure 3
6. If only shoe and lining are being replaced, do not remove inlet fitting.
7. Allen head mounting bolts (1) shown in Figure 3
8. If only shoe and linings are being replaced, caliper (13) from rotor and suspend with a wire hook (17) from front frame or suspension as shown in Figure 4
   - 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 with other chassis parts. Excessive tension could cause the rings to move out of their proper locations or cause structural damage.

Inspect

- Mounting bolts for corrosion
- If corrosion is found, use new bolts when installing caliper.
- Do not attempt to polish away corrosion.

Important

- See NOTICE on page 5-1.

Install or Connect

1. Caliper over rotor in mounting bracket (18)
2. Mounting bolts (1) and torque to 51 N·m (38 ft. lb.)

   Measure

   - Clearance between caliper (13) and bracket (18) stops to provide proper clearance
3. Inlet fitting (15) (if removed) and torque to 45 N·m (33 ft. lb.)
4. Wheels and tires
   - Remove lug nuts securing rotor to hub.
   - Lower car
5. Fill master cylinder to proper level.
   - Bleed brakes if inlet fitting was removed.
   - Recheck fluid level.

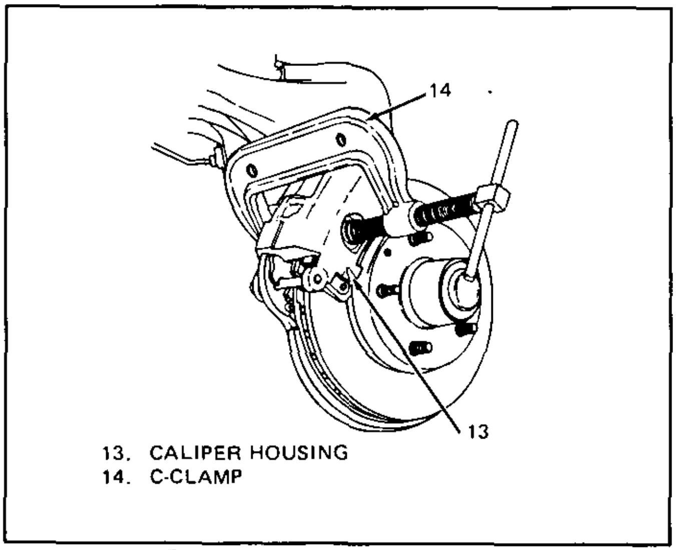


Figure 2 Compressing Piston

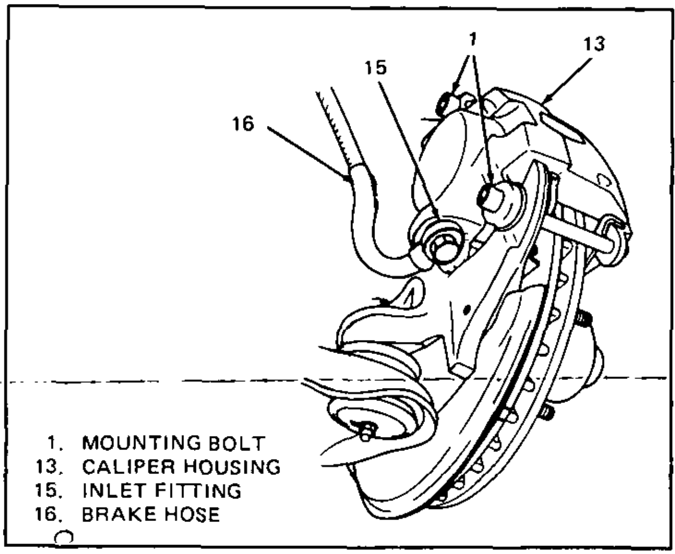


Figure 3 Caliper Attachment

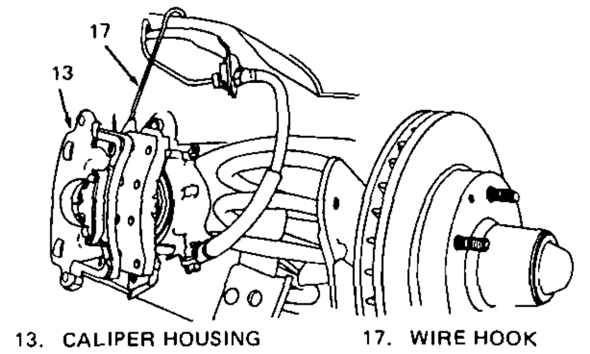
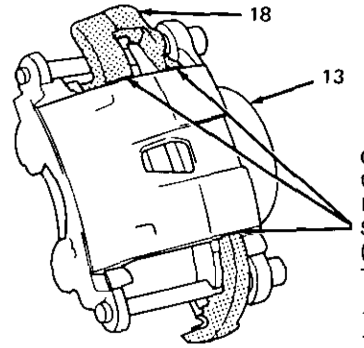


Figure 4 Suspending Caliper



CLEARANCE BETWEEN CALIPER AND BRACKET STOPS SHALL BE 0.13-0.30 MM (0.005-0.012 IN.) THREE PLACES

Figure 5 Caliper to Bracket Clearance

SHOE AND LINING ASSEMBLIES

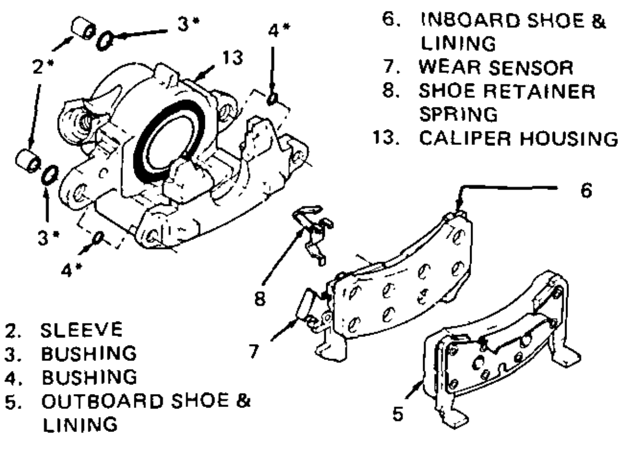
Figures 6 thru 10

Remove or Disconnect

1. Shoe and lining assemblies (5 and 6) from caliper (13)
2. Sleeves (2) from mounting bolt holes
3. Bushings (3 and 4) from grooves in mounting bolt holes

Install or Connect

1. Lubricated parts as follows:
   - New bushings (3 and 4) in grooves in mounting bolt holes
   - New sleeves (2) in mounting bolt holes
2. Retainer spring (8) on inboard shoe (6) as shown in Figure 7
3. Inboard shoe and lining (6) as shown in Figure 8 with wear sensor (7) at leading edge of shoe during forward rotation
4. Outboard shoe and lining as shown in Figure 9
5. Caliper as previously described
6. After installation of calipers, apply approximately 778N (175 lb.) of force three times to brake pedal.
7. Position 12-inch channel lock pliers (19) over brake shoe ears and bottom edge of caliper (13) as shown in Figure 10.
8. Clinch shoe ears to caliper.



* LUBRICATE WITH SILICONE GREASE (OR EQUIVALENT)

Figure 6 Shoe and Lining Assembly

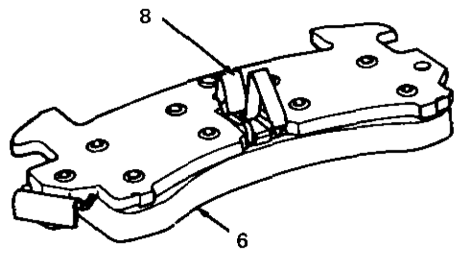


Figure 7 Inboard Shoe and Retainer

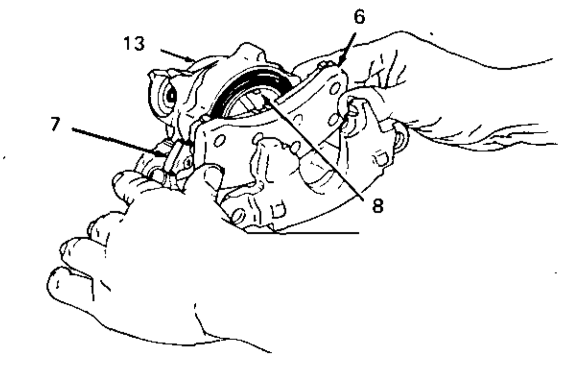


Figure 8 Installing Inboard Shoe and Lining

UNIT REPAIR

CALIPER OVERHAUL

Tool Required:

J-26267 Boot Seal Installer

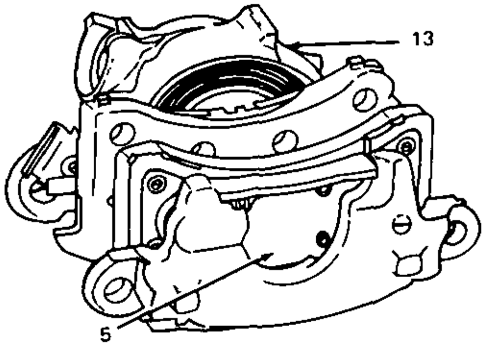


Figure 9 Installing Outboard Shoe and Lining

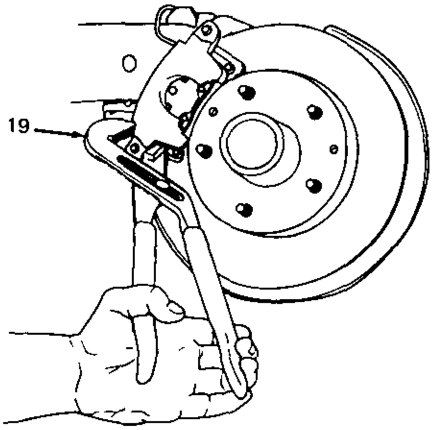


Figure 10 Clinching Procedure

Disassembly

Figures 11 thru 13

Remove or Disconnect

1. Piston (10) as shown in Figure 12 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 compressed 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.

2. Boot (9) as shown in Figure 13, being careful not to scratch housing bore
3. Piston seal (11) from groove (20) in caliper bore with a piece of wood or plastic. Do not use a metal tool as damage to bore may result.

Inspect

- Caliper bore for:
  - Scoring
  - Nicks
  - Corrosion
  - Wear
- Use crocus cloth to polish out light corrosion
- Replace caliper housing if bore will not clean up with crocus cloth

4. Bleeder valve (12)

Assembly

Figures 11, 14 and 15

Important

- See NOTICE on page 5-1.

Clean

- All parts in clean, denatured alcohol
- Dry with compressed air.
- Blow out all passages in housing (13) and bleeder valve (12).

Install or Connect

1. Bleeder valve (12) to 12 N·m (110 in. lb.)
2. Lubricate new seals (9 and 11) and caliper housing (13) bore with brake fluid
   - Piston seal (11) into caliper bore groove (20)
   - Make sure seal is not twisted.
   - *Boot (9) onto piston (10) as shown in Figure 14*
3. Piston (10) into bore of caliper and push to bottom of bore
4. Boot (9) in caliper housing counterbore and seat as shown in Figure 15 using J-26267
5. After installation of caliper assembly, apply approximately 778N (175 lb.) of force three times to the brake pedal.

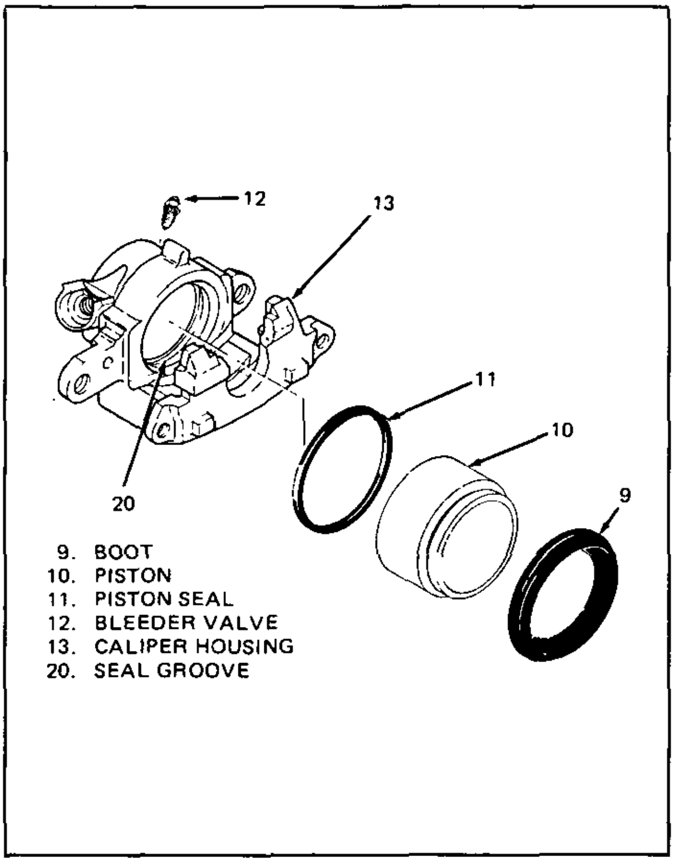


Figure 11 Caliper Assembly

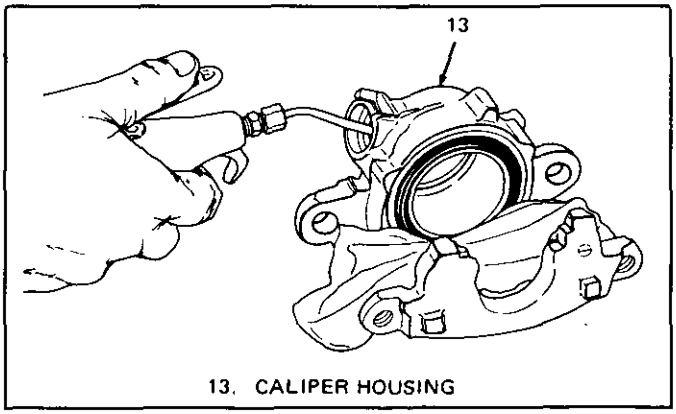


Figure 12 Removing Piston

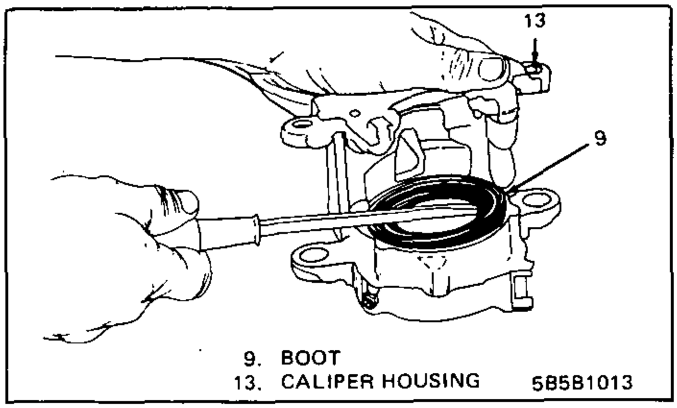


Figure 13 Removing Boot

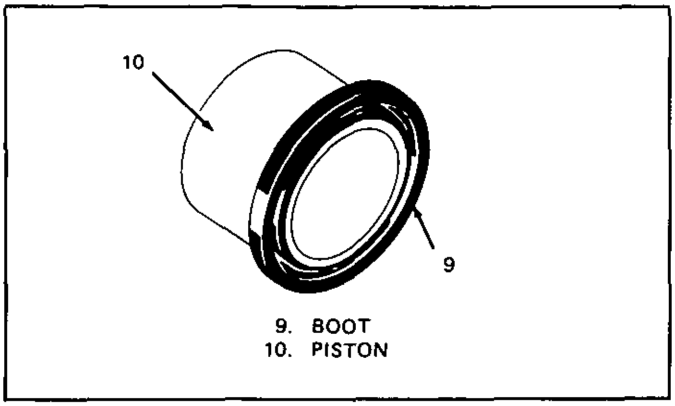


Figure 14 Installing Boot Onto Piston

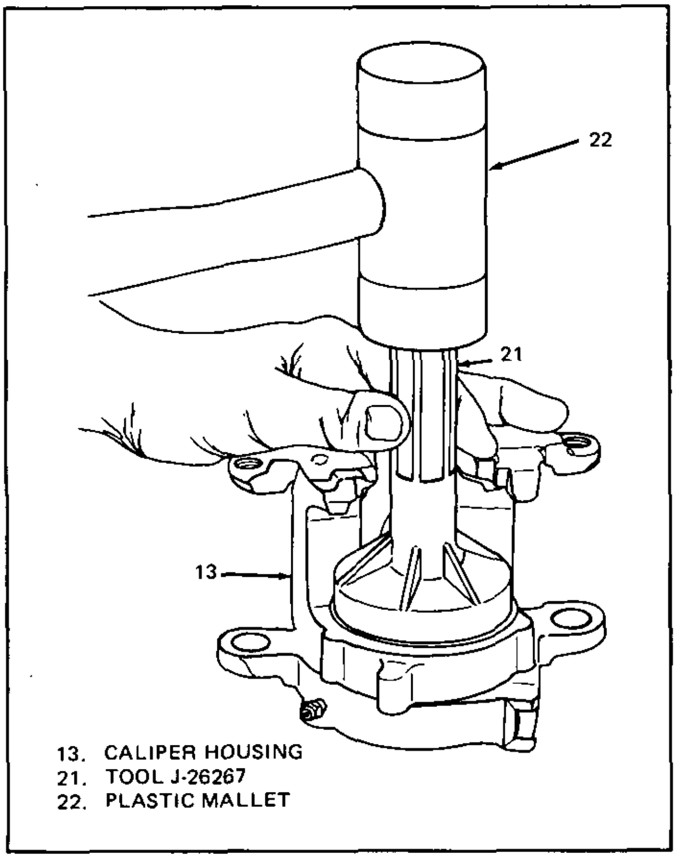


Figure 15 Seating Boot Into Housing

SECTION 5B4

REAR DISC BRAKE CALIPER

NOTICE: *All brake attaching fasteners are important 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 the part.*

CAUTION: WHEN SERVICING WHEEL 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 WHEEL 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.

CONTENTS

GENERAL DESCRIPTION

This caliper has a single bore and is mounted to the support bracket with two mounting bolts. During normal braking, hydraulic force, created by applying force to the brake pedal, is converted by the caliper to friction. The hydraulic 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 the caliper. Lubricate parts as specified. Do not use lubricated shop air on brake parts as damage to rubber components may result. If any component is removed or line disconnected, bleed 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.

ON-CAR SERVICE

CALIPER ASSEMBLY

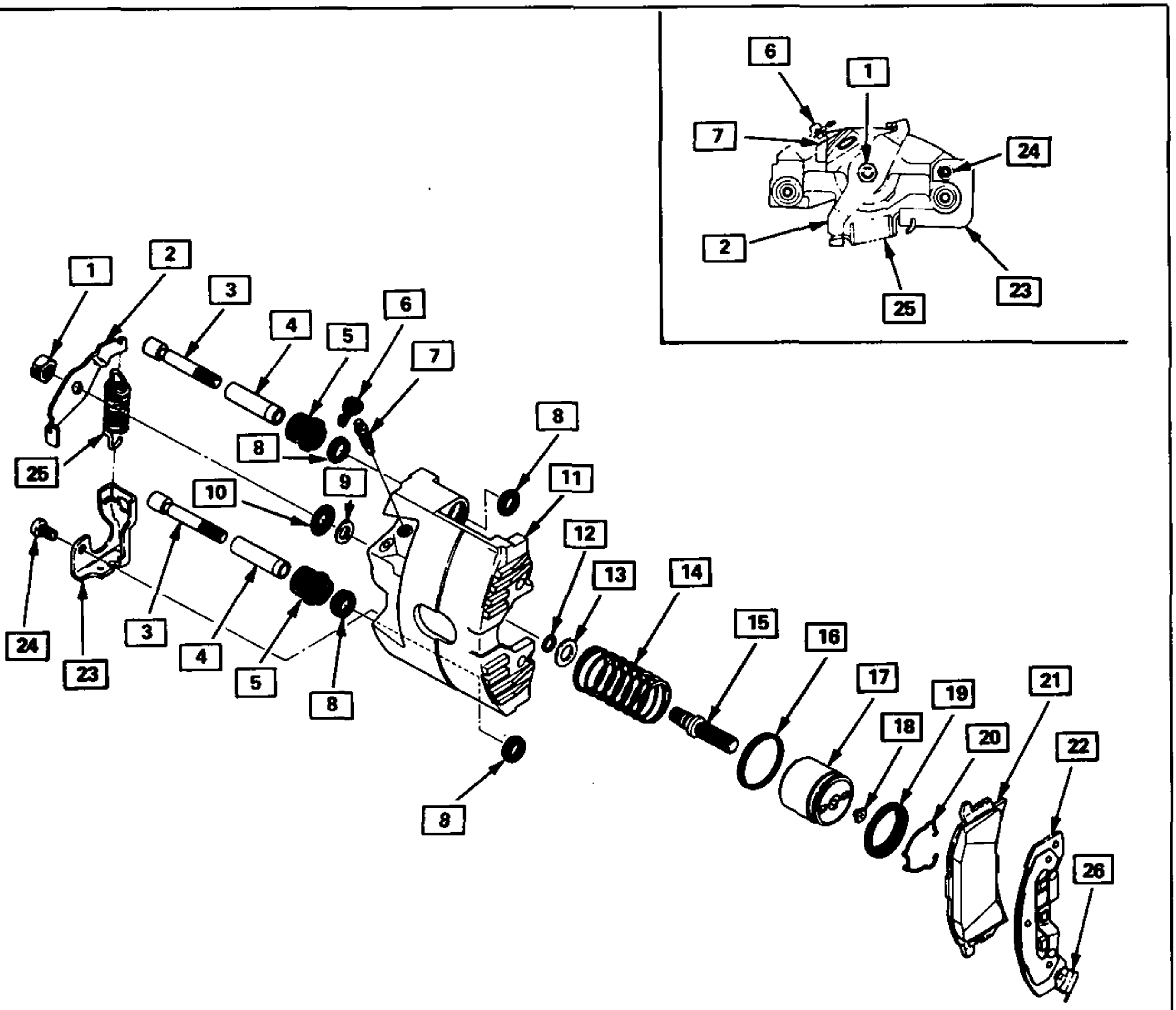
Figures 2 thru 5

Remove or Disconnect

1. 2/3 of brake fluid from master cylinder assembly.
2. Hoist car.
   - Mark relationship of wheel to axle.
   - Wheel and tire.
   - Reinstall two lug nuts to retain rotor.
3. Loosen tension on parking brake cable at equalizer.
   - Cable (27) and spring (3) from lever (2) as shown in Figure 2.
   - Lock nut (1) while holding lever.
   - Lever (2), lever seal (6) and anti-friction washer (7).
4. Position c-clamp over inboard surface of caliper housing (25) and outboard surface of mounting bracket (31) as shown on Figures 3 & 4.
5. Squeeze c-clamp to compress piston back into caliper bore and provide clearance between linings and rotor.
6. Bolt (30) attaching inlet fitting (29) shown in Figure 3, only if caliper overhaul or replacement is required. (Plug open lines).
7. If caliper overhaul or replacement is not required and hydraulic connection can be maintained, do not remove fitting (29).
8. Mounting bolts (8) shown in Figure 3 using No. 50 Torx wrench.
9. Caliper from rotor and mounting bracket, and support to prevent strain on brake hose.

Inspect

- Lever seal (6) and anti-friction washer (7) for wear as shown in Figure 2. Replace if worn.



1–NUT
2–LEVER
3–MOUNTING BOLT
4–SLEEVE
5–BOLT BOOT
6–PROTECTOR
7–BLEEDER VALVE
8–BUSHING
9–ANTI-FRICTION WASHER
10–LEVER SEAL
11–CALIPER HOUSING
12–SHAFT SEAL
13–THRUST WASHER
14–BALANCE SPRING
15–ACTUATOR SCREW
16–PISTON SEAL
17–PISTON ASSEMBLY
18–TWO WAY CHECK VALVE
19–CALIPER BOOT
20–SHOE DAMPENING SPRING
21–INBOARD SHOE & LINING
22–OUTBOARD SHOE & LINING
23–BRACKET
24–BOLT
25–RETURN SPRING
26–WEAR SENSOR

520220-5

Fig. 1 Rear Caliper Assembly

- Mounting bolts (8) and sleeves (9) for corrosion as shown in Figure 5.
- If corrosion is found, use new bushings, bolts and/or sleeves when installing caliper.
- Do not attempt to polish away corrosion.

Important

- See NOTICE on page 5B4-1.
- Liberally fill both cavities in housing (25) between bushings (11) with silicone grease as shown in Figures 4 & 5.

Install or Connect

1. Sleeves (9) in caliper.
2. Caliper (25) over rotor in mounting bracket (31) as shown in Figures 3 & 4.
3. Mounting bolts (8) and torque to 41-61 N·m (30-45 lb.ft.) as shown in Figure 3.
4. Inlet fitting (29), if remove and torque to 20 N·m (15 lb.ft.).
   - Use 2 new copper washers.

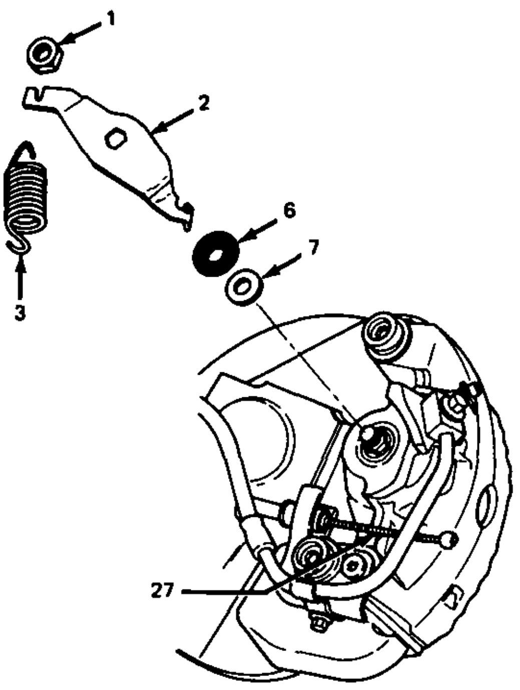
   Clean

   - Any contamination from caliper surface in area of lever seal (6)as shown in Figure 2.
   - Lubricate lever seal with silicone brake lube.
5. Anti-friction washer (7) and lever seal (6) as shown in Figure 2. (Seat lever seal (6) against caliper housing).
6. Lever (2) on actuator screw hex with lever pointing as shown in Figure 2.
7. Nut (1) while holding lever (2).

Important

- Make sure lever stays properly installed on actuator screw hex as nut is torqued.

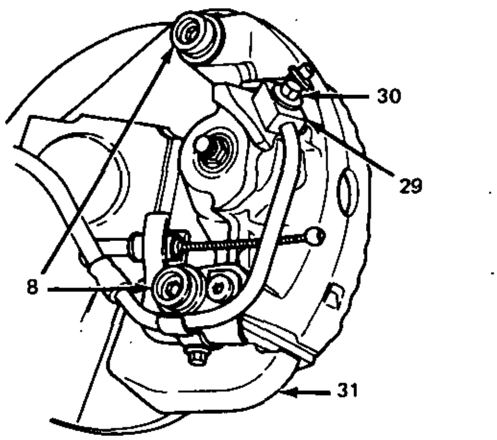
8. Torque nut (1) to 41-54 N·m (30-40 ft.lb.) then rotate lever (2) back against stop on caliper.
9. Spring (3).
10. Parking brake cable (27).
    - Tighten cable at equalizer until lever starts to move off stop on caliper.
    - Loosen adjustment until lever moves back against stop.
11. Wheels and tires.
    - Remove lug nuts securing rotor to hub.
    - Lower car.
12. Fill master cylinder to proper level with clean brake fluid.
    - Bleed brake system if inlet fitting was removed.
    - Recheck fluid level.



1. NUT
2. LEVER
3. RETURN SPRING
6. LEVER SEAL
7. ANTI-FRICTION WASHER
27. CABLE

520026-5

Fig. 2 Parking Brake Lever Attachment



8. MOUNTING BOLT
29. BRAKE PIPE FITTING
30. BOLT
31. MOUNTING BRACKET

520028-5

Fig. 3 Caliper Attachment

SHOE AND LINING ASSEMBLIES

Figures 5 thru 9

Remove or Disconnect

1. Caliper as previously described.
2. Shoe and lining assemblies (12 and 13) from caliper (25) as shown in Figures 6 & 7.

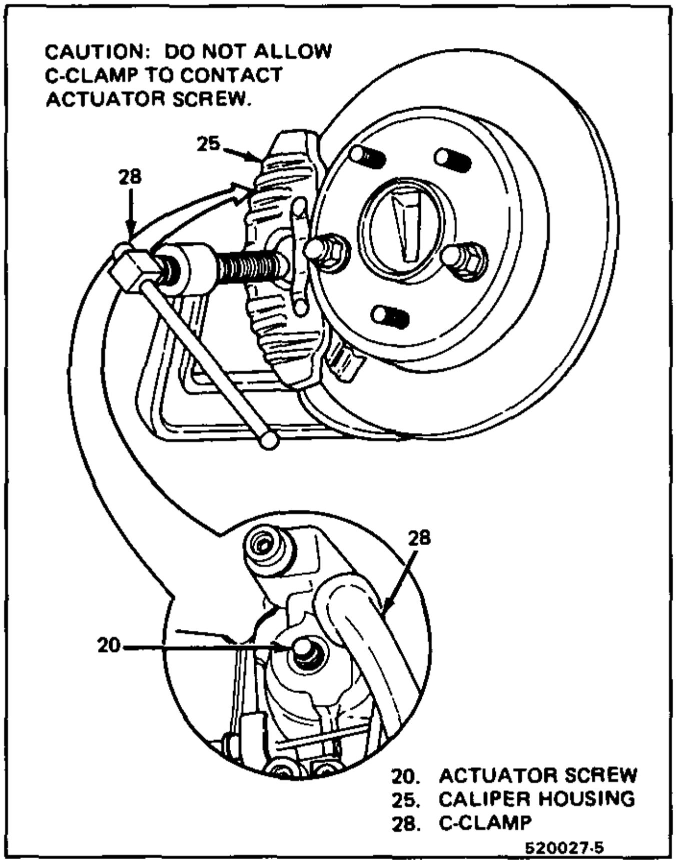

CAUTION: DO NOT ALLOW C-CLAMP TO CONTACT ACTUATOR SCREW.

Fig. 4 Compressing Piston

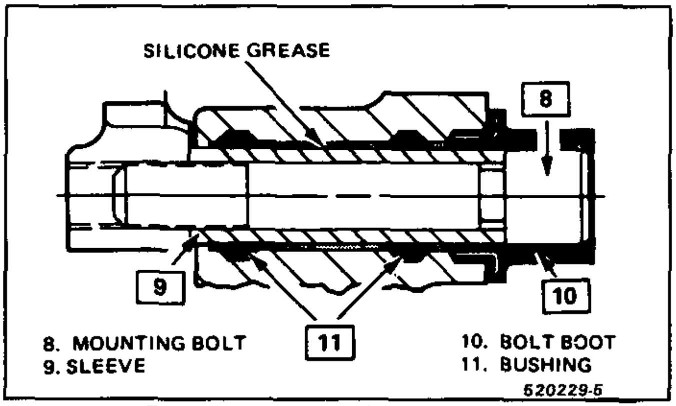


Fig. 5 Lubricating Caliper Cavity

- Use screwdriver between outboard shoe (12) and caliper (25) to disengage spring tabs from holes in caliper as shown in Figure 7.

3. Sleeves (9) from mounting bolt holes as shown in Figure 6.
4. Bolt boot (10) from caliper (25) as shown in Figures 6 & 7.
5. Bushings (11) as shown in Figure 6.
6. Flexible two way check valve (16) from end of piston using a small screwdriver.

Important

- Bottom piston in cylinder bore before installing new shoe and linings.

Install or Connect

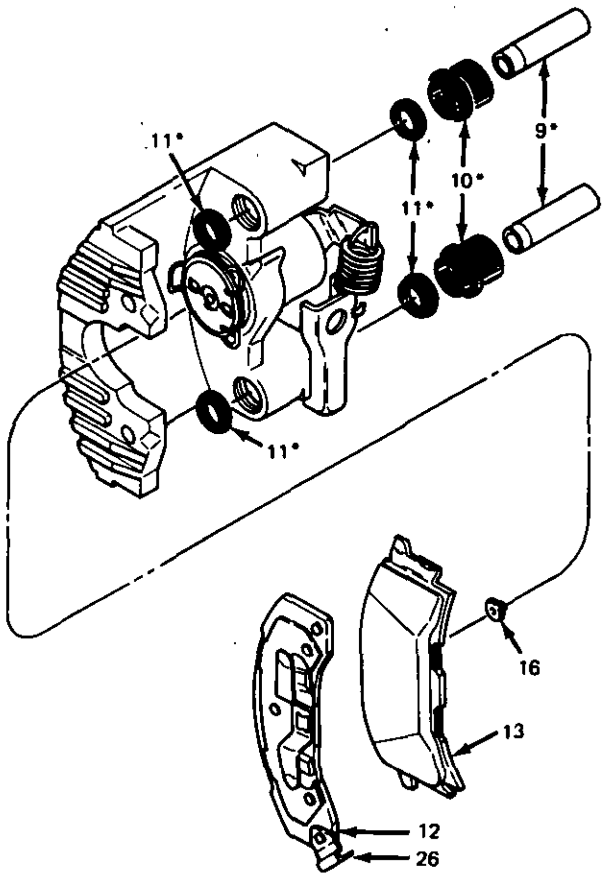
1. Lubricated parts as follows:
   - New bushings (11) in grooves in mounting bolt holes as shown in Figure 5.
   - New bolt boot (10) in mounting bolt holes.
   - New sleeves (9) in mounting bolt holes.
   - New two way check valve (16) and press into end of piston as shown in Figure 9.
2. Inboard shoe and lining (13) in caliper as shown in Figure 6.
   - Check that D-shaped tabs (33) on shoe will engage D-shaped notches (32) in piston as shown in Figure 8.
   - If tabs and notches do not line up, use J-7624 or equivalent to turn piston.
   - Wear sensor (26) must be at leading edge of shoe during forward wheel rotation as shown in Figure 6.
   - Slide edge of inboard metal shoe under ends of dampening spring (14) and snap shoe into position flat against piston as shown in Figure 8.
3. Outboard shoe and lining (12) as shown in Figure 6.
   - Make sure ends of spring on outboard shoe (12) snap into caliper recesses.
4. After installation of caliper assembly, apply approximately 778N (175 lb.) of force three times to the brake pedal to seat linings.

PARKING BRAKE ADJUSTMENT

Adjustment of parking brake cable is necessary whenever the rear brake cables have been loosened or disconnected. A need for parking brake cable adjustment is indicated if the hydraulic brake system operates with good reserve, but a firm parking brake pedal feel cannot be achieved with less than 16 full strokes of the parking brake pedal.

Adjust

1. Cycle brake system.
   - A. Apply service brake with a pedal force of approximately 41 lb. ft.(55 N·m).
   - B. Fully apply parking brake (may require up from four to six pedal strokes) using approximately 41 lb. ft. (55 N·m) on the final apply and release.
2. Check parking brake pedal assembly for full release by turning ignition on and inspecting "BRAKE" warning lamp. Lamp should be off. If "Brake" warning lamp is on and parking brake appears to be fully released, operate the manual pedal release lever and pull downward on front parking brake cable to remove slack from pedal assembly.
3. Raise car.
4. Check parking brake levers on rear calipers. Levers should be against the stops on caliper housing. If levers are not against stops, check for binding in rear brake cables and position levers against stops.

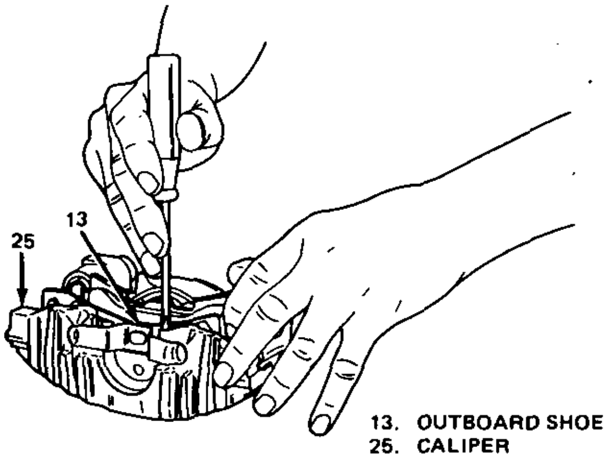


9. SLEEVE
10. BOLT BOOT
11. BUSHING
12. OUTBOARD SHOE & LINING
13. INBOARD SHOE & LINING
16. TWO WAY CHECK VALVE
26. WEAR SENSOR

* LUBRICATE WITH SILICONE GREASE OR EQUIVALENT.

520029-5

Fig. 6 Shoe and Lining Assembly

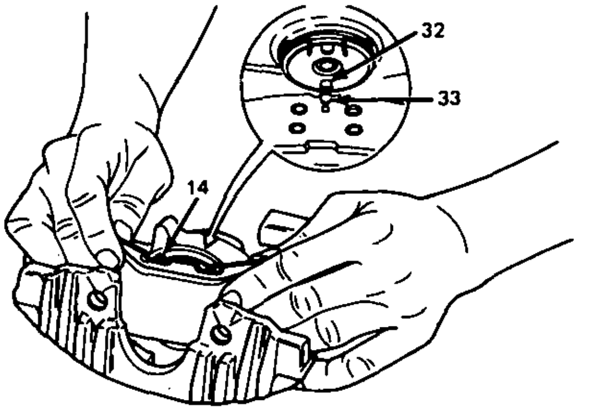


13. OUTBOARD SHOE
25. CALIPER

520030-5

Fig. 7 Outboard Shoe Spring

5. Tighten parking brake cable at adjuster until either the left or right lever begins to move off of stop.



14. SHOE DAMPENING SPRING
32. D-SHAPED NOTCH IN PISTON
33. D-SHAPED TAB ON SHOE

520031-5

Fig. 8 Inboard Shoe and Retainer

6. Loosen adjuster until lever which moved off of stop in Step 4 is again resting on stop. **Both levers should be resting on caliper stops after completing this step.**
7. Operate parking brake several times to check adjustment. A firm pedal feel should be obtained by operating assembly less than 17 full clicks.
8. Inspect left and right caliper levers. Both levers must be resting on stops after adjustment of parking brake.
9. Check operation of parking brake. If possible, place vehicle on a grade and check parking brake holding ability.

UNIT REPAIR

CALIPER OVERHAUL

Tools Required:
J-23072 Piston Installer
J-28678 Boot Seal Installer

Figs. 9 thru 11

↔ Remove or Disconnect

1. Shoe dampening spring (14) from end of piston (17) as shown in Figure 9.
2. Nut (1) and lever (2), if installed.
3. Lever seal (6) and anti-friction washer (7), if installed.
4. Support caliper in a vise and pad caliper interior with a clean shop towel and remove piston.
   - Use a wrench to rotate actuator screw (19) as shown in Figure 10.
   - Rotate in parking brake apply direction.
5. Actuator screw (19) by pressing on threaded end.
6. Shaft seal (22) and thrust washer (21) as shown in Figure 9.
7. Boot (18) as shown in Figure 11, being careful not to scratch housing bore (25).
8. Piston seal (18) from groove in caliper bore with a piece of wood or plastic. Do not use a metal tool as damage to the bore may result.

Inspect

- Caliper bore and seal groove for:
  - Scoring
  - Nicks
  - Corrosion
  - Wear
- Use crocus cloth to polish out light corrosion. Replace caliper housing if bore or seal groove will not clean up with crocus cloth.

9. Protector (23) and bleeder valve (24).
10. Remove bracket (5) only if damaged.

Assemble

Figs. 9, 12 thru 14

Important

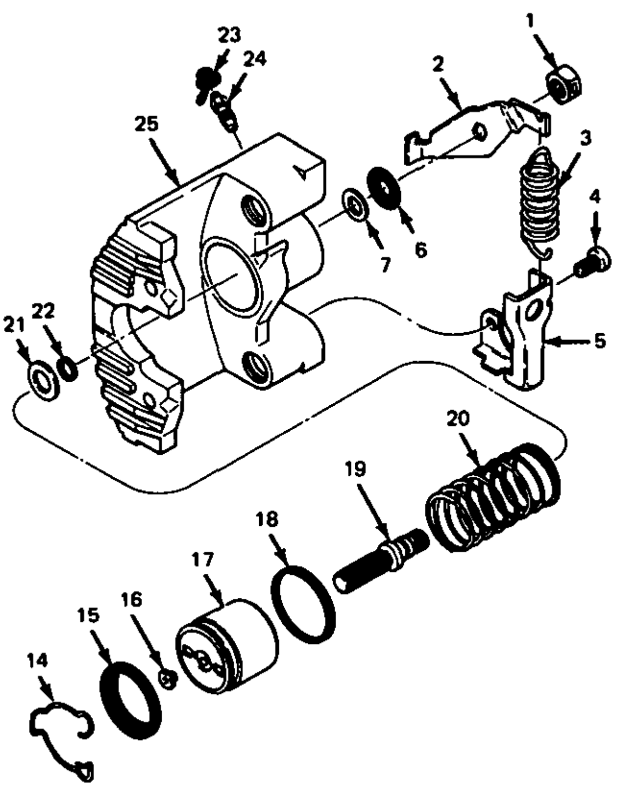
- See NOTICE on page 5B4-1.

Clean

- All parts in clean, denatured alcohol.
- Dry with unlubricated compressed air.
- Blow out all passages in housing (25) and bleeder valve (24) with unlubricated air as shown in Figure 9.

Install or Connect

1. Bleeder valve (24) to 9-16 N·m (80-140 in.lb.).
2. Protector (23) on bleeder valve (24).
3. Bracket (5), if removed, with bolt (4) to 33-52 N·m (24-38 ft. lb.).
4. Lubricate new seals and caliper housing bore (25) with brake fluid.
   - Piston seal (18) into caliper bore groove.
   - Make sure seal is not twisted.
   - Boot (15) on piston (17) with inside lip of boot in piston groove and boot fold toward end of piston that contacts inboard brake shoe.
5. Thrust washer (21) on actuator screw (19) with copper side of washer towards the piston assembly and the grayish surface towards the caliper housing.
6. Shaft seal (22) onto actuator screw (19) after lubricating with clean brake fluid.
7. Actuator screw (19) in piston (17) after lubricating with clean brake fluid.
8. Balance spring (20) into piston recess.
9. Lubricate piston (17) with clean brake fluid.
   - Start piston (17) into caliper bore (25).
   - Push piston to bottom of bore using J-23072 (35) as shown in Figure 12.
10. Before removing J-23072 (35), lubricated anti-friction washer (7) and lever seal (6) over end of actuator screw (19) as shown in Figures 9 & 12.
    - Make sure sealing bead on lever seal (6) is against housing (25)as shown in Figure 9.
    - Install lever (2) on actuator screw (19).
    - Rotate lever away from stop slightly and hold while installing nut (1).
    - Torque nut 41-54 N·m (30-40 lb.ft.), then rotate lever back to stop.
11. Boot (15) (Figure 9) in caliper housing counterbore and seat using J-28678 (36) as shown in Figure 13.
12. Dampening spring (14) in groove in end of piston as shown in Figure 14. It may be necessary to move parking brake lever off the stop to extend piston and make spring groove accessible.



1. NUT
2. LEVER
3. RETURN SPRING
4. BOLT
5. BRACKET
6. LEVER SEAL
7. ANTI-FRICTION WASHER
14. SHOE DAMPENING SPRING
15. CALIPER BOOT
16. TWO WAY CHECK VALVE
17. PISTON ASSEMBLY
18. PISTON SEAL
19. ACTUATOR SCREW
20. BALANCE SPRING
21. THRUST WASHER
22. SHAFT SEAL
23. PROTECTOR
24. BLEEDER VALVE
25. CALIPER HOUSING

520032-5

Fig. 9 Caliper Assembly

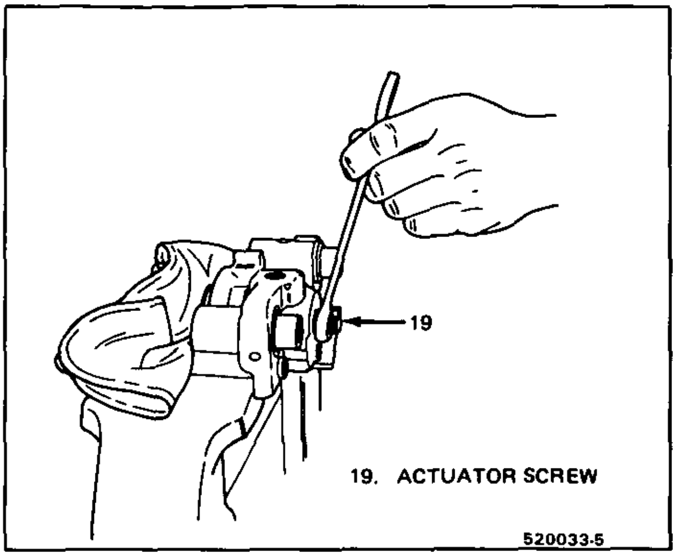


Fig. 10 Removing Piston

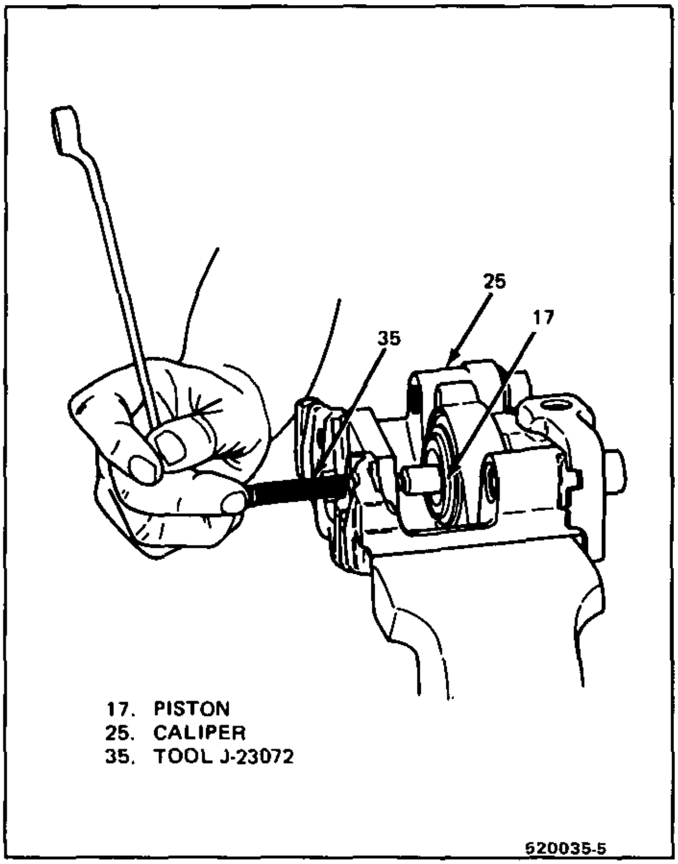


Fig. 12 Installing Piston

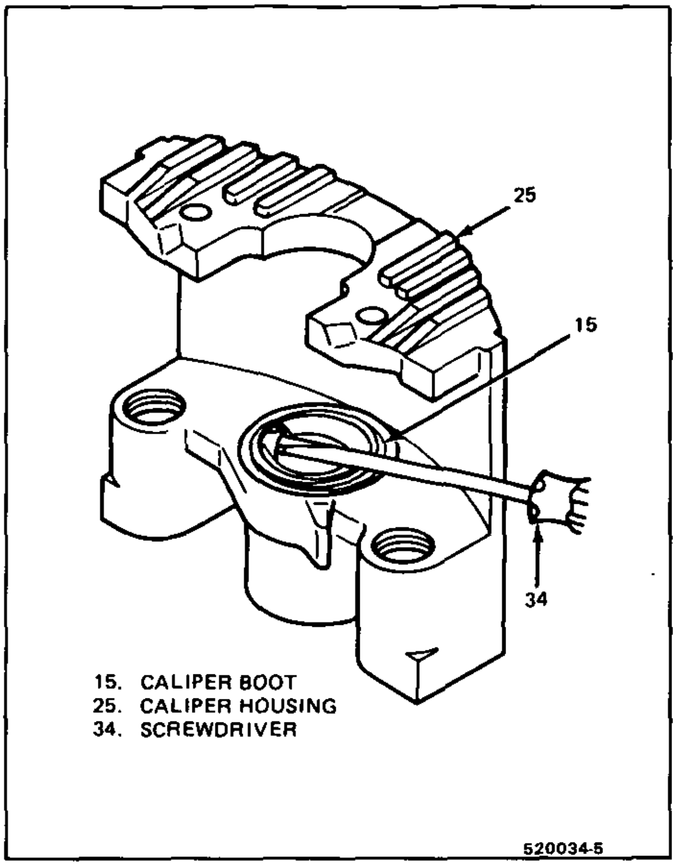


Fig. 11 Removing Boot

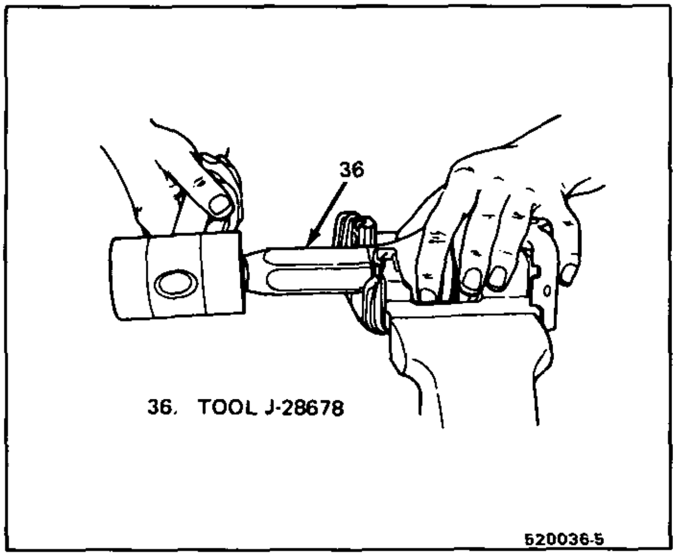
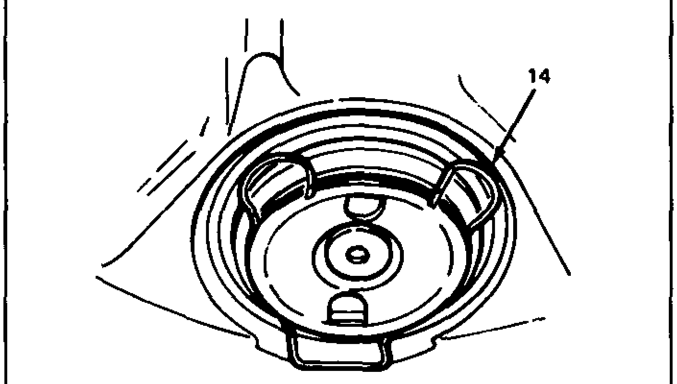


Fig. 13 Seating Boot Into Housing



14. SHOE DAMPENING SPRING

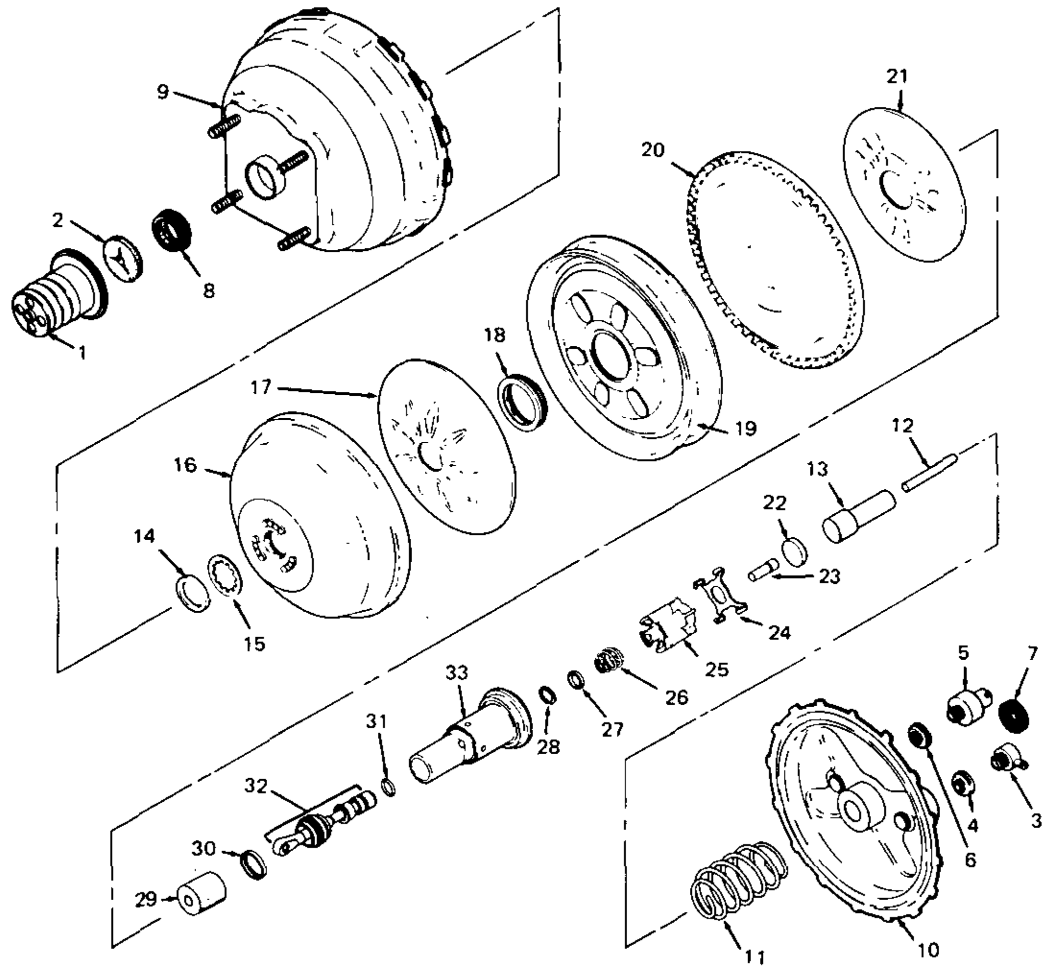
520037-6

Fig. 14 Installing Shoe Dampening Spring

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

Figure 1 Booster Assembly

GENERAL DESCRIPTION

This booster is a tandem vacuum suspended unit. It may have a single or dual function vacuum switch to activate the brake warning light in case of low booster vacuum or vacuum pump malfunction. In a normal operating mode, with the service brakes in the released position, a 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.

> **NOTICE:** Use all components included in repair kits used to service this booster. Lubricate rubber parts, where indicated, with silicone grease provided in kits. The torque values specified are for dry, unlubricated fasteners. If any hydraulic component is removed or brake line disconnected, bleed the brake system.

ON-CAR SERVICE

BOOSTER ASSEMBLY

Figure 2

Remove or Disconnect

1. Master cylinder (34) from booster (35)
2. Booster attaching nuts (36)
3. Booster pushrod (32) from brake pedal and booster (35) as shown in Figure 2

Important

- See NOTICE on page 5-1.

Install or Connect

1. Booster pushrod (32) to brake pedal
2. Booster (35) and attaching nut (36) to 38 N·m (28 ft. lb.)
3. Master cylinder (34) to booster (35) and attaching nuts (37) to 38 N·m (28 ft. lb.)

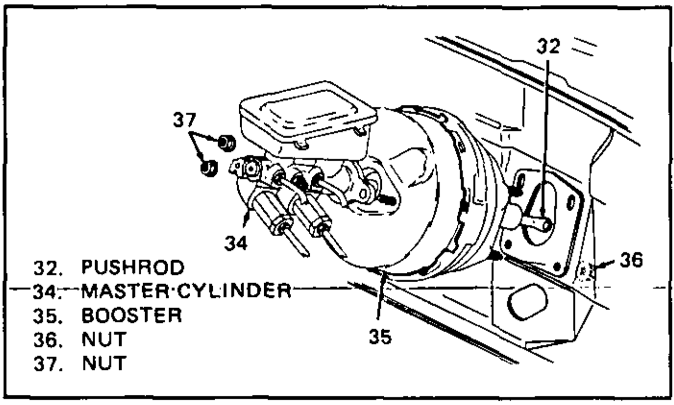


Figure 2 Booster Mounting-Typical

EXTERIOR COMPONENTS

Figure 3

Remove or Disconnect

1. Boot (1) and silencer (2)
2. Vacuum check valve (3) and grommet (4)
3. Vacuum switch (5) (some models) and grommet (6)
4. Front housing seal (7)

Important

1. See NOTICE on page 5-1.
2. Lubricate inside and outside diameters of grommets (4 and 6)and front housing seal (7).

Install or Connect

1. Grommet (4) and vacuum check valve (3)
2. Grommet (6) and vacuum switch (5) (some models)
3. Front housing seal (7)
4. Silencer (2) and boot (1)

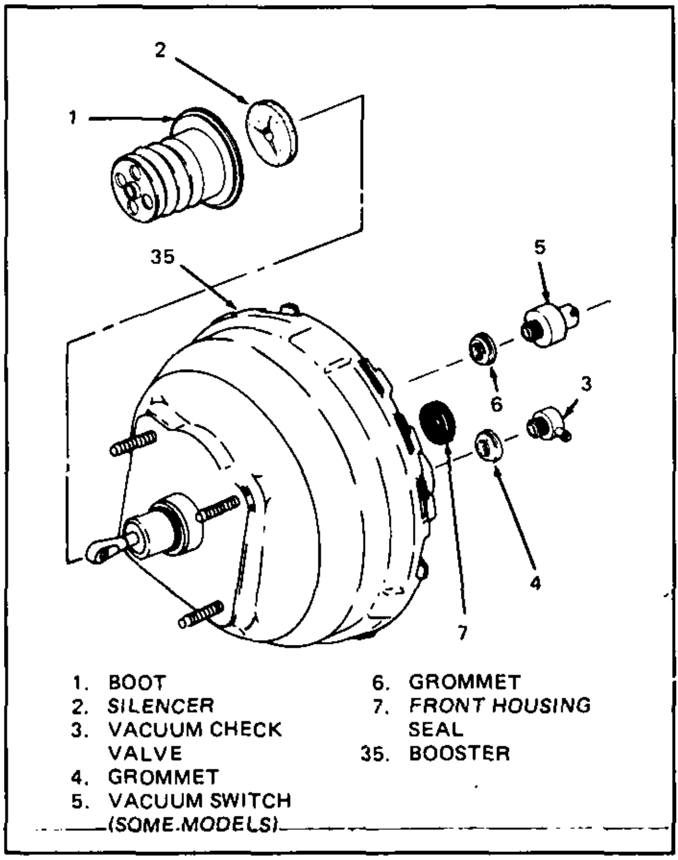


Figure 3 Exterior Components

UNIT REPAIR

BOOSTER

Tools Required:

J-23456 Power Brake Booster Disassembly and Reassembly Tool

Figures 4 thru 6

Disassembly

Remove or Disconnect

1. Scribe a mark on front and rear housings (9 and 10) to aid assembly.
2. Apply pressure with Tool J-23456 and turn counterclockwise to unlock housings as shown in Figure 5.
3. Primary piston bearing (8) from housing (9)
4. Return spring (11) and power piston group (38)

Assembly

Install or Connect

1. Return spring (11)
2. Power piston group (38)
3. Primary piston bearing (8) to housing (9)
4. Align scribe marks on housings (9 and 10).
5. Apply pressure with Tool J-23456 and turn clockwise to lock front and rear housings (9 and 10) as shown in Figure 5.
   - Assembly can be aided by connecting a vacuum source to the booster.
   - Stake housing as shown in Figure 6 after locking.
   - Do not stake a tab that has been prevously staked.

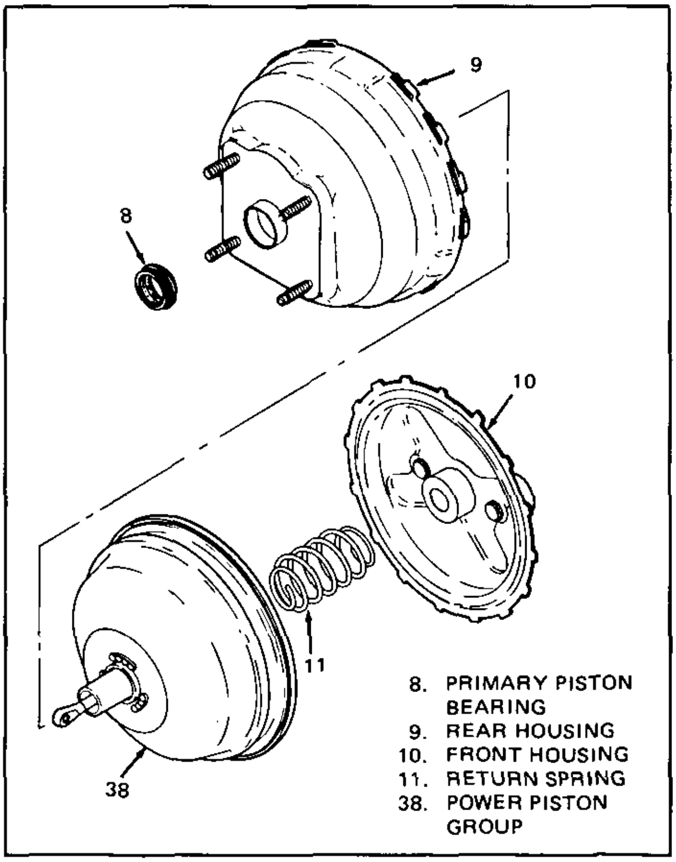


Figure 4 Booster Inner Components

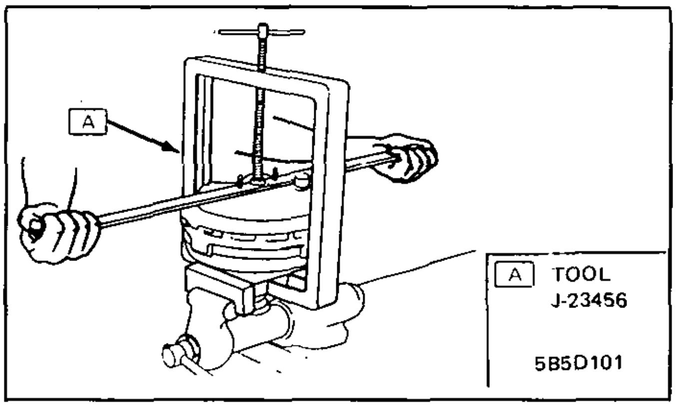


Figure 5 Unlocking and Locking Booster

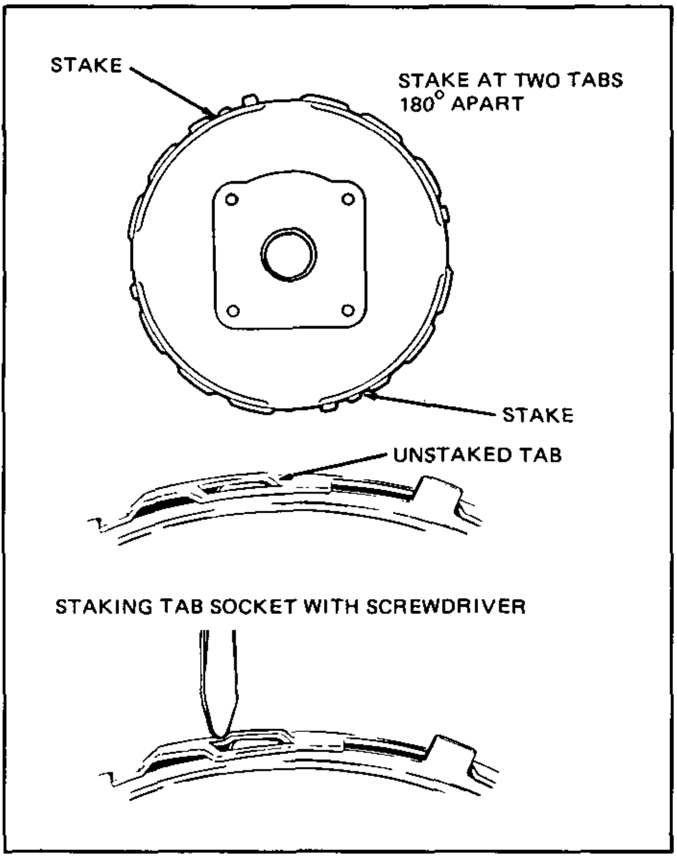


Figure 6 Staking Procedure

UNIT REPAIR

POWER PISTON GROUP

Tool Required:
J-28458 Retainer Installer

Figures 7 thru 11

Disassembly

Remove or Disconnect

1. Piston rod (12), reaction retainer (13) and power head silencer (14)
2. Grasp assembly at outside edge of 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).

3. Primary diaphragm (16) and primary support plate (17)
4. Secondary piston bearing (18) and housing divider (19)
5. Secondary diaphragm (20) and secondary support plate (21)
6. Push rod (32) and power piston assembly (41)

Assembly

Install or Connect

1. Lubricate inside diameter of secondary diaphragm (20) lip and fit into secondary support plate (21).
2. Secondary diaphragm (20) and support plate (21) as shown in Figure 8
3. Lubricate inside diameter of secondary piston bearing (18) and install in housing divider (19) with flat surface of bearing on same side as 6 raised lugs on divider.
4. Secondary piston bearing (18) and divider (19) as shown in Figure 9
5. Lubricate inside diameter of primary diaphragm (16) lip and fit in primary support plate (17).
6. Primary diaphragm (16) and support plate (17) as shown in Figure 10
7. Diaphragm retainer (15) and seat as shown in Figure 11 using J-28458 Installer
8. Silencer (14), reaction retainer (13) and piston rod (12)

POWER PISTON OVERHAUL

Tool Required:
J-23175-A Retainer Installer

Figures 12 thru 14

Disassembly

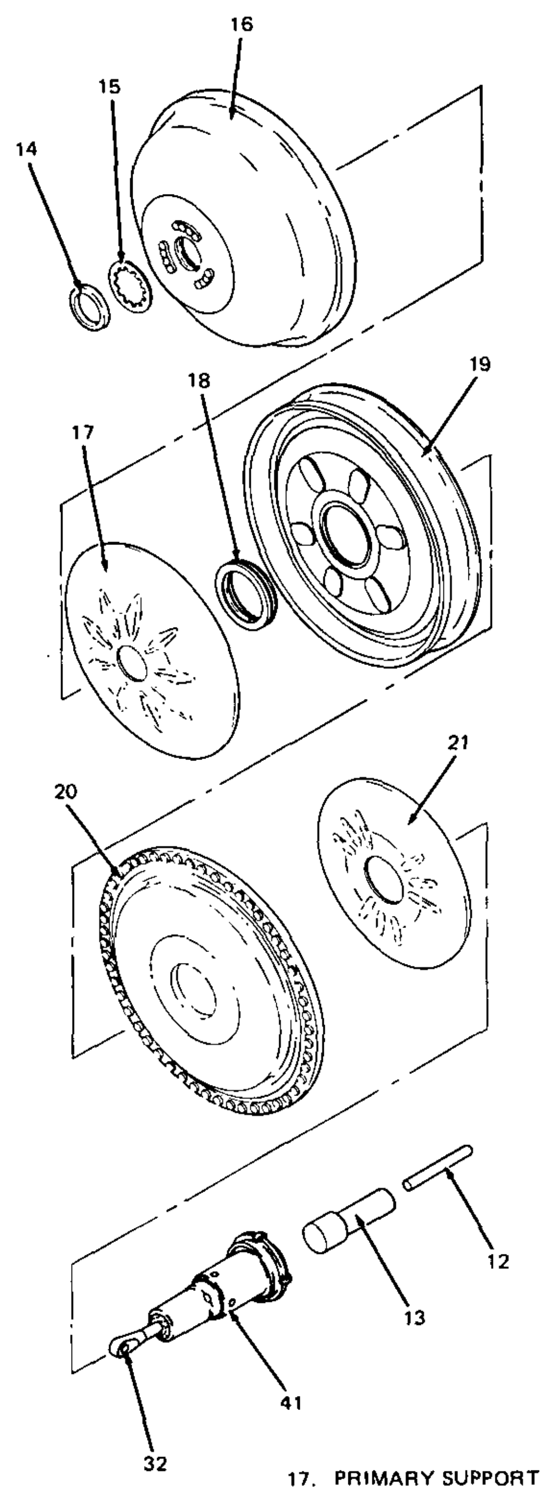
Remove or Disconnect

1. Reaction disc (22) and reaction piston (23)
2. Reaction body retainer (24) by prying tangs with a screwdriver
3. Reaction body (25), air valve spring (26) and reaction bumper (27)
4. Retaining ring (28) from air valve pushrod assembly (32) using No. 2 Truarc pliers
5. Filter (29), retainer (30) and O-ring (31)
6. Air valve pushrod assembly (32) by inserting screwdriver through eyelet and pulling straight out

Assembly

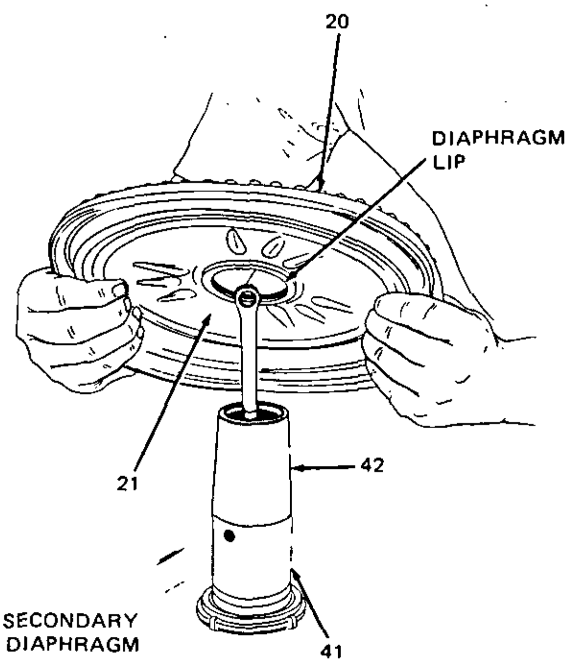
Install or Connect

1. Air valve pushrod assembly (32) into power piston (41)
2. Filter (29), O-ring (31) and retainer (30) as shown in Figures 13 and 14 using J-28458 Installer



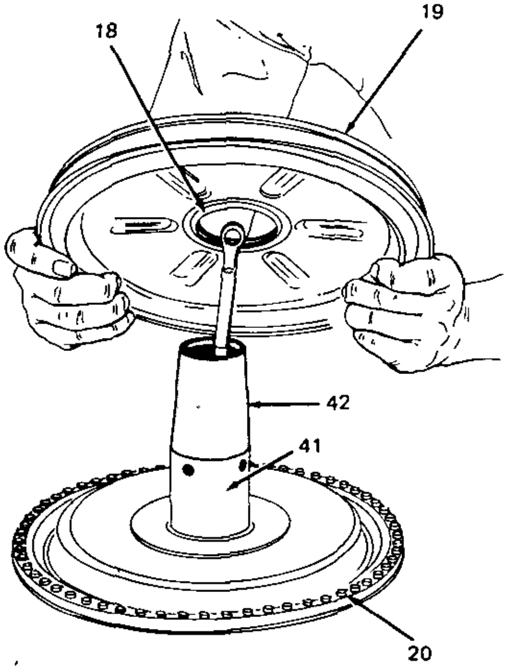
12. PISTON ROD (GAGED)
13. REACTION RETAINER
14. POWER HEAD SILENCER
15. DIAPHRAGM RETAINER
16. PRIMARY DIAPHRAGM
17. PRIMARY SUPPORT PLATE
18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
32. PUSHROD
41. POWER PISTON ASSEMBLY

Figure 7 Power Piston Group



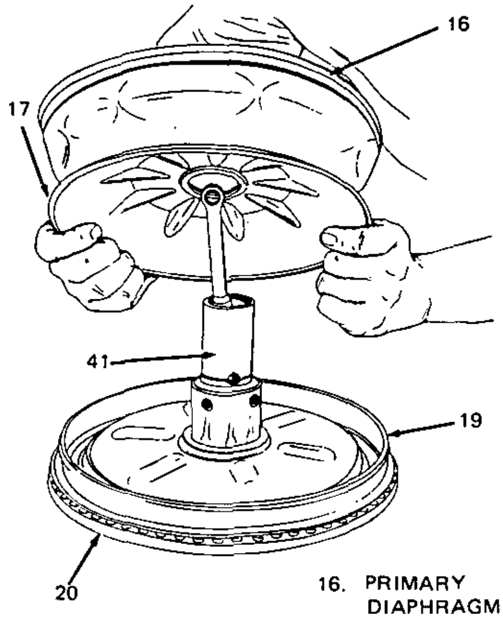
20. SECONDARY DIAPHRAGM
21. SECONDARY SUPPORT PLATE
41. POWER PISTON ASSEMBLY
42. TOOL J-28458

Figure 8 Secndary Diaphragm and Support



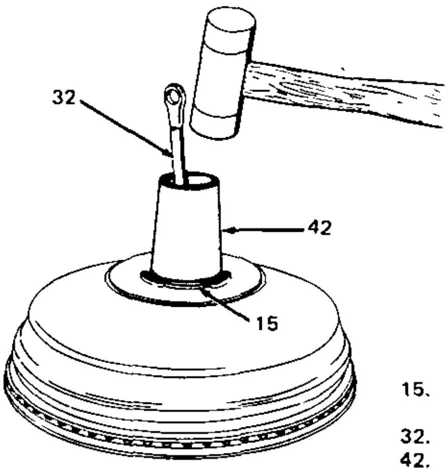
18. SECONDARY PISTON BEARING
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
41. POWER PISTON ASSEMBLY
42. TOOL J-28458

Figure 9 Secondary Piston Assembly



16. PRIMARY DIAPHRAGM
17. PRIMARY SUPPORT PLATE
19. HOUSING DIVIDER
20. SECONDARY DIAPHRAGM
41. POWER PISTON ASSEMBLY

Figure 10 Primary Diaphragm and Support



15. DIAPHRAGM RETAINER
32. PUSHROD
42. TOOL J-28458

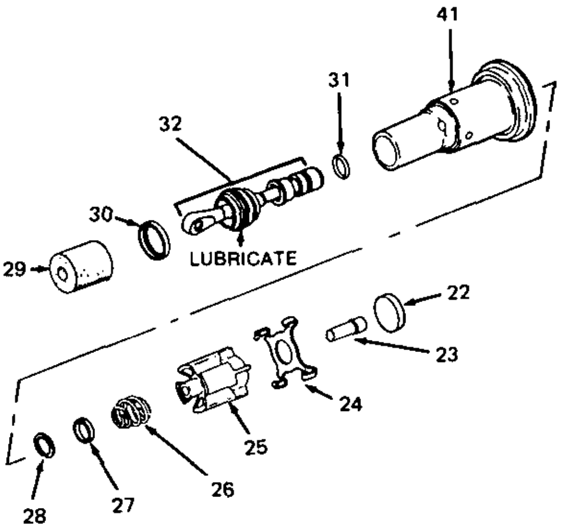
Figure 11 Seating Diaphragm Retainer

3. Retaining ring (28) into air valve pushrod assembly (32)
4. Reaction bumper (27), air valve spring (26) and reaction body (25)
5. Reaction body retainer (24), reaction piston (23) and reaction disc (22)

GAGING PROCEDURE

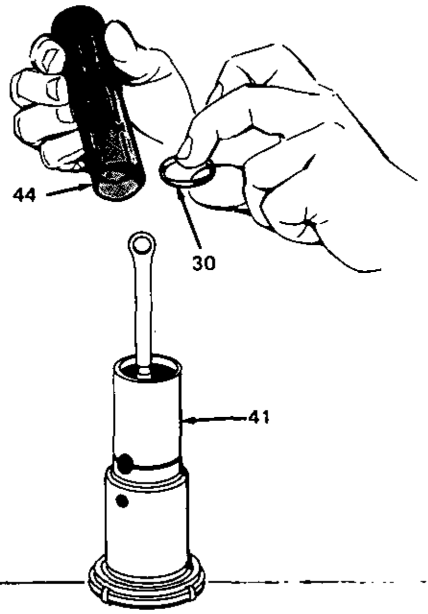
Measure

- After assembly of booster, position gage (43) over piston rod (12) as shown in Figure 15.



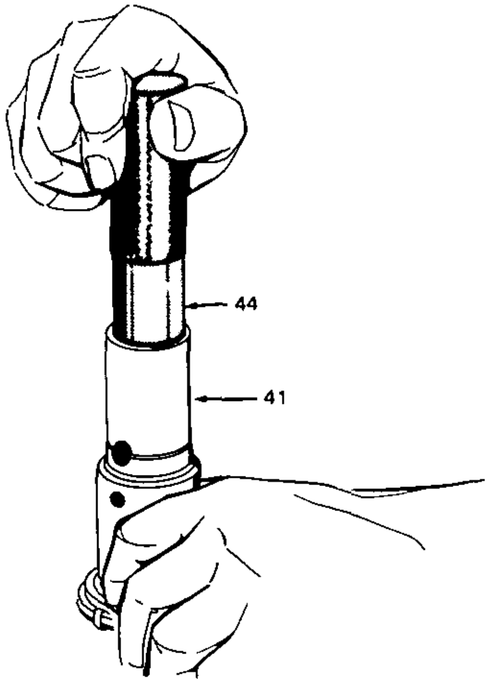
22. REACTION DISC
23. REACTION PISTON
24. REACTION BODY RETAINER
25. REACTION BODY
26. AIR VALVE SPRING
27. REACTION BUMPER
28. RETAINING RING
29. FILTER
30. RETAINER
31. O-RING
32. AIR VALVE PUSHROD ASSEMBLY
41. POWER PISTON

Figure 12 Power Piston



30. RETAINER
41. POWER PISTON ASSEMBLY
44. TOOL J-23175-A

Figure 13 Retainer Assembly



41. POWER PISTON ASSEMBLY
44. TOOL J-23175-A

Figure 14 Installing Retainer Into Piston

- 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.

12. PISTON ROD
43. GAGE J-22647

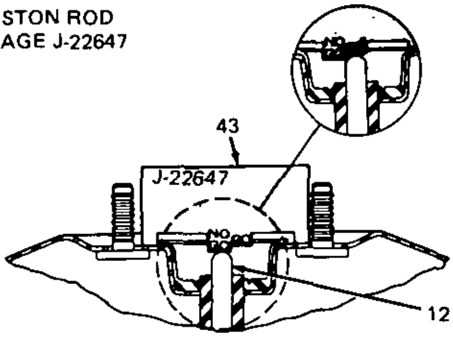


Figure 15 Gaging Piston Rod

SECTION 5E

TORQUE SPECIFICATIONS

Use a reliable torque wrench to tighten the parts listed to insure proper tightness without straining or distorting parts. These specifications are for clean and lightly lubricated threads only; dry or dirty threads produce increased friction which prevents accurate measurement of tightness.

PART, LOCATION	TORQUE
Brake Pedal to Power Brake Booster	
Nut	27 N·m (19 lbs. ft.)
Brake Pedal Bracket to Dash	
Nut	29 N·m (21 lbs. ft.)
Parking Brake Control Handle Assembly	
Bolt	34 N·m (25 lbs. ft.)
Combination Valve to Master Cylinder Bracket	
Bolt	6 N·m (4 lbs. ft.)
Brake Pipes to Master Cylinder	
Nut	20 N·m (15 lbs. ft.)
Brake Pipe to Combination Valve	
Nut	26 N·m (19 lbs. ft.)
Brake Pipe to Brake Hose	
Nut	17 N·m (12 lbs. ft.)
Front Flexible Hose Bracket to Front Rail	4.6 N·m (3 lbs. ft.)
Rear Flexible Hose Bracket to Rear Rail	4.6 N·m (3 lbs. ft.)
Junction Block to Rear Rail	10 N·m (7 lbs. ft.)
Wheel Stud	
Nut 12mm Stud	
Standard Wheel	110 N·m (81 lbs. ft.)
Aluminum Wheel	140 N·m (105 lbs. ft.)
Aluminum Wheel Nut Caps	2 N·m (15 lbs. in.)
Nuts, Power Cylinder Mounting	
Bracket to Front Cowl	38 N·m (27 lbs. ft.)
Caliper Mounting Knuckle Assemblies Bolt	48 N·m (35 lbs. ft.)
Front Splash Shield to Steering Knuckle Bolt	10 N·m (7 lbs. ft.)
Rear Splash Shield to Knuckle Bolt	94 N·m (69 lbs. ft.)
Caliper Bleeder Screw	15 N·m (11 lbs. ft.) Max.
Front Brake Hose to Caliper Bolt	40 N·m (30 lbs. ft.)
Rear Brake Hose to Caliper Bolt	20 N·m (15 lbs. ft.)

SPECIFICATIONS

Pedal Travel	64mm (2.52")
Master Cylinder Piston Diameter	25.4mm (1.00")
Power Head	200mm Tandem (7.874")

FRONT DISC BRAKES

Disc - Min. Refinish Thickness	246 x 11.31mm (9.68 x .44")
- Replacement (Discard) Thickness	9.9mm (.390")
Facings	Semimetallic Integrally Molded
Caliper Bore	49.0mm (1.96")

REAR DISC BRAKES

Disc-Min. Refinish Thickness	247 x 12.7mm (9.72 x 0.50")
—Replacement (Discard) Thickness	11.4mm (0.45")
Facings	Semimetallic-Integrally Bonded
Caliper Bore	48.0mm (1.92")

SECTION 6

ENGINE GENERAL INFORMATION

CONTENTS

Engine Mechanical

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.

For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian Service Manual supplement.

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:

6A1 - 2.5L L-4 Engine
6A2 - 2.8L V-6 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.

6C1-E4ME 4BBL Carburetor
6C2-E2ME 2BBL Carburetor
6C3-E2SE 2BBL Carburetor
6C4-6510C 2BBL Carburetor

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
6E1 - Carbureted
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 6E1 - Carbureted Engines
- 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.

Important

- Any bolts that are suspected to be damaged must be replaced.

2. Cylinder head for cracks, especially between valve seats, and in the exhaust ports
3. Cylinder head deck for corrosion, sand inclusions and blow holes.
   - Do not attempt to weld the cylinder head, replace it.
4. Cylinder head deck, intake and exhaust manifold mating surfaces for flatness (Figure 2). These surfaces may be re-conditioned by parallel grinding. If more than .39 mm (.010") V6, or .152 mm (.006") V8 must be removed, replace the head.

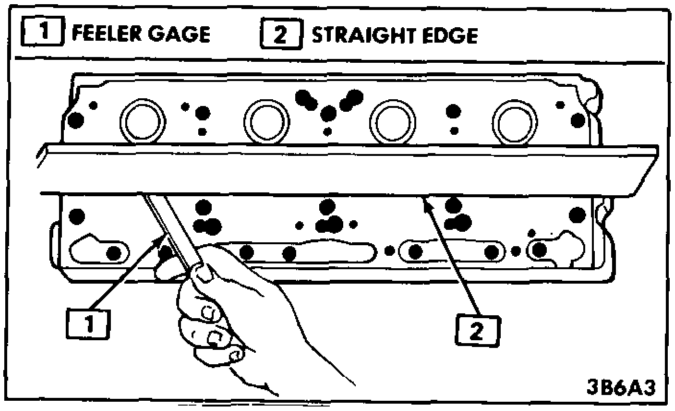


Figure 2 Checking Cylinder Head Flatness

5. All threaded holes for damage. Threads may be reconditioned with thread inserts (refer to Thread Repair).
6. Seating surfaces
   - Water jacket plugs
7. Valve guides for wear.
   - Since the valve guide serves to support and center the valve grinder, it is essential that the valve guide is serviced before reconditioning the valve seats. The valve guide must be cleaned properly before any measuring or servicing takes place. If the valve guide requires reaming, this must be done first.
8. Valve seats for excessive wear and burned spots.
   - Valve seats may be reconditioned by grinding. An oscillating type valve seat grinder is preferred. Follow the grinder manufacturer's instructions. Refer to Figure 3 for seat angles. If, after grinding, the new seat is too wide, it may be narrowed by using a 20° or 70° stone. The 20° stone will lower the seat and the 70° stone will raise the seat. If the seats are reconditioned, the valves also must be reconditioned or replaced.

Assemble

Tool Required:

J-22677 Installer

1. Oil gallery and cooling jacket plugs. Coat plugs with GM 1050026 sealer, or equivalent.
2. Spark plugs.
3. Valve and spring mechanism (refer to specific engine section).

NOTICE: To avoid damage, install spark plugs after cylinder head had been reinstalled.

VALVE DISASSEMBLY

Disassemble

- Valve and spring mechanism (refer to Specific Engine Section)

Important

- Be sure that the valve train components are kept together and identified so that they can be reinstalled in their original location and with the same mating surfaces as when removed.

NOTICE: Avoid breaking the valve guide. If the valve stem has mushroomed due to rocker arm wear, remove burrs by chamfering the valve stem with an oil stone or file. Do not remove the valve from the guide using a hammer and drift punch.

Clean

- Valves of carbon, oil and varnish. Carbon can be removed with a wire brush, varnish by soaking in carburetor cleaning fluid.

CAUTION: Safety glasses must be worn when using a power wire brush. Avoid inhaling of fumes and exposure of skin to carburetor cleaning fluid, as bodily injury may result.

  - Do not scratch the valve stem with the wire brush.

VALVE GUIDES

Measure

- Valve guide clearance (Figure 4)
  - Insert the valve into its guide. Lift it 3mm (1/8") off the seat and move it side to side, measuring the amount of movement with a dial indicator, or
  - With a hole gage, measure the valve guide I.D. and measure the valve stem with a micrometer and compare the clearance.
- Refer to Figure 3 for allowable clearances.
- The valve guides may be reamed oversize and an oversized valve installed (Figure 5).

Reaming Valve Guides

SECTION 6A

GENERAL ENGINE MECHANICAL

CONTENTS

CYLINDER HEAD

Important

- Before removing the cylinder head(s) from the engine and before disassembling the valve mechanism, perform a compression test and record the results.
- During disassembly, be sure that the valve train components are kept together and identified so that they can be re-installed in their original locations and with the same mating surfaces as when removed.

Disassemble

1. Valve mechanism (refer to specific engine section)
2. Oil gallery and water jacket plugs
   - Threaded plugs
   - Cup plugs, if damaged or leaking
     - Obtain a suitable self-threading screw.
     - Drill a hole in the plug.
     - Install the self-threading screw.
     - Pry out plug.
3. Spark plugs

Inspect

- Cylinder head gasket and mating surfaces for leaks, corrosion and blow-by. If the gasket has failed, determine the cause:
  - Improper installation
  - Loose or warped cylinder head
  - Missing dowel pins

Clean

- Cylinder head bolts (Check specific engine section to determine if new bolts must be used).
- Cylinder head. Remove all varnish, soot and carbon to the bare metal. **DO NOT** use a motorized wire brush on any gasket sealing surface.
- Valve guides (Figure 1)
- Threaded holes
- Remains of sealer from plug holes

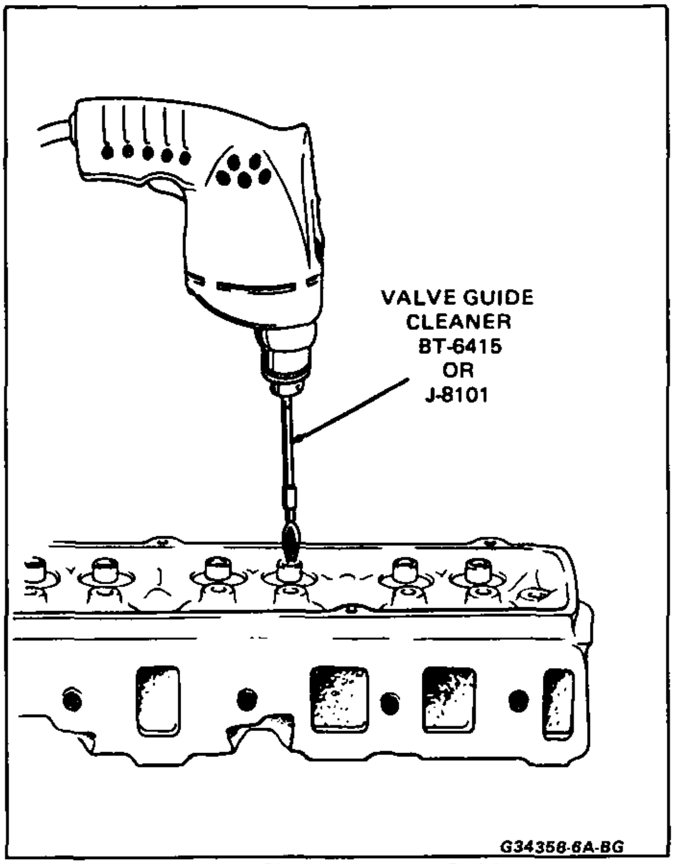


Figure 1 Cleaning Valve Guide

CAUTION: Safety glasses must be worn when using a power wire brush to avoid injury to the eyes.

Inspect

1. Cylinder head bolts for damaged threads, or stretching, and damaged heads caused by improper use of tools.

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.

OIL LEAK DETECTION VIA BLACK LIGHT PROCESS

(2.5L L-4 ENGINE)

BLACK LIGHT PROCESS CHECK

This method uses a flourescent dye added to the engine oil. One ounce of dye should be circulated in the engine oil for a minimum of five (5) minutes. In some cases it may be necessary to drive the car before the dye will show. Ideal situation is to install dye in the customer's vehicle a few days before the scheduled repair. Prior to the black light inspection of the engine, the dipstick should be held under the black light to assure that the dye has mixed thoroughly with the engine oil. Oil with dye additive will be a bright yellow when exposed to a black light. Oil without dye additive will show a light purple in color. It is not necessary to clean the engine prior to inspection. The difference between oil leaking with the dye additive, versus old oil, is quite evident. Tracer dye used should be GM Dealer Eguipment Group Part~~-No.-~~041-00007.

EXTERNAL AIR PRESSURE

An adapter with an air fitting can be made to fit into PCV hole of the rocker arm cover or dipstick hole. This can be attached to an air supply that is regulated at 2 to 3 psi. Extreme caution should be used to assure that air pressure does not exceed 3 psi. Leaks could be created if air pressure exceeds 3 psi. The air cleaner pipe to rocker arm cover hole must be plugged. With air being forced into the crankcase, the oil will be pushed to the source of the oil leak, where it can be detected with the black light. If a black light is not being used, sometimes spraying the suspected area with soapy water will confirm the leak. Test can be performed with or without the engine running.

COMPONENT REMOVAL

To properly detect an oil leak at the rear of an engine, it is necessary to remove the transmission. This process, in conjunction with black light, will eliminate all guess work in regard to rear oil leaks.

NOTE: When analyzing an engine with the black light and flourescent dye method, variables can sometimes occur. The technician using the black light should be aware of the following:

- Short run times will not always allow dye to surface at suspected oil leak area. Recommendation: Pressurize engine.
- Extended run times can sometimes spread dye over a large area, which may cause actual leak detection to become most difficult. Recommendation: Clean and pressurize engine.

DISPLACEMENT					1.8L	2.5L	2.8L	3.0L	3.8L	4.3L, 5.0L	5.0L
ENGINE VIN CODE					O J	2, R, U	X, W, S	L	A	Z, H, G, F	Y
VALVE	INTAKE		FACE ANGLE		46°	45°	45°	45°	45°	45°	44°
			MARGIN (MIN.)	IN	-	-	-	0.025	0.025	-	0.025
				MM	-	-	-	0.635	0.635	-	0.635
		SEAT	ANGLE		45°	46°	46°	46°	46°	46°	45°
			WIDTH	IN	0.051-0.055	0.035-0.075	0.049-0.059	0.062	0.062	0.031-0.063	0.037-0.075
				MM	1.30-1.40	0.897-1.897	1.25-1.50	1.57	1.57	0.79-1.57	0.94-1.90
			RUNOUT	IN	0.002	0.002	0.002	0.002	0.002	0.002	0.002
				MM	0.05	0.05	0.05	0.05	0.05	0.05	0.05
			STEM CLEARANCE	IN	0.0006-0.002	0.0011-0.0026	0.001-0.0027	0.0015-0.0035	0.0015-0.0035	0.001-0.0027	0.001-0.0027
				MM	0.015-0.042	0.025-0.068	0.025-0.068	0.038-0.089	0.038-0.089	0.025-0.069	0.026-0.068
	EXHAUST		FACE ANGLE		46°	45°	45°	45°	45°	45°	60°
			MARGIN (MIN.)	IN	-	-	-	0.025	0.025	-	0.025
				MM	-	-	-	0.635	0.635	-	0.635
		SEAT	ANGLE		45°	46°	46°	46°	46°	46°	59°
			WIDTH	IN	0.067-0.071	0.058-0.097	0.063-0.075	0.075-0.104	0.075-0.104	0.063-0.094	0.050-0.100
				MM	1.70-1.80	1.468-2.468	1.60-1.91	1.905-2.642	1.905-2.642	1.57-2.36	1.27-2.54
			RUNOUT	IN	0.002	0.002	0.002	0.002	0.002	0.002	0.004
				MM	0.05	0.05	0.05	0.05	0.05	0.05	0.10
			STEM CLEARANCE	IN	0.001-0.0024	0.0011-0.0026	0.001-0.0027	0.0015-0.0032	0.0015-0.0032	0.001-0.0027	0.0015-0.0032
				MM	0.030-0.060	0.025-0.068	0.025-0.068	0.038-0.089	0.038-0.089	0.025-0.069	0.038-0.081
SPRING	LOAD		FREE LENGTH	IN	1.89	2.08	1.91	2.03	2.03	2.03	1.96
				MM	48.0	52.83	48.5	51.56	51.56	51.56	49.78
			CLOSED	Lbs@IN	78-88@1.44	78-86@1.66	88@1.57	88-98@1.727	59-69@1.727	76-84@1.70	76-84@1.670
				N@MM	346-390@36.5	347-383@42.6	391@40.0	391-435@44.0	262-306@44.0	338-374@43.2	338-374@42.42
			OPEN	Lbs@IN	170-183@.98	170-180@1.26	195@1.18	210-230@1.340	174-190@1.340	194-206@1.25	184-194@1.270
				N@MM	755-812@25.0	756-801@31.85	867@30.0	934-1022@34.03	774-845@34.0	863-916@31.8	800-863@32.26
INSTALLED HEIGHT				IN	-	1.69	-	1.697-1.757	1.697-1.757	1.719	-
				MM	-	42.93	-	43.10-44.62	43.10-44.62	43.66	-

G20001-6A

Figure 3 Valve and Spring Specifications

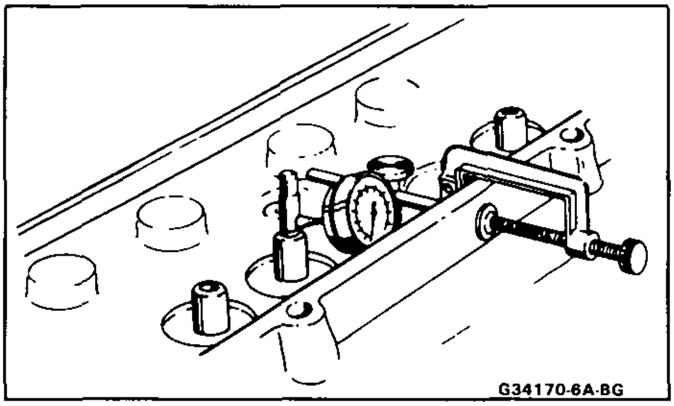


Figure 4 Measuring Valve Guide Clearance

Engine(s)	Nominal Size	Reamer (Oversize - 05)
1.6 & 1.8L	8mm	.19mm (.0075″) 05
	8mm	.381mm (.015″) 05
	8mm	.762mm (.030) 05
2.5L	11/32	.076mm (.003″) 05
		.127mm (.005″) 05
2.8L	11/32	.076mm (.003″) 05
		.381mm (.015″) 05
		.762mm (.030″) 05

3.0 & 3.8L	11/32	.076mm (.003") 05 .152mm (.006") 05
4.3L & 5.0L	11/32	.076mm (.003") 05 .127mm (.005") 05

NOTICE: Avoid breaking reamer flutes, or jamming the reamer into the valve guide, due to packing of chips or carbon. Clean the valve guides before reaming. Do not push down on the reamer.

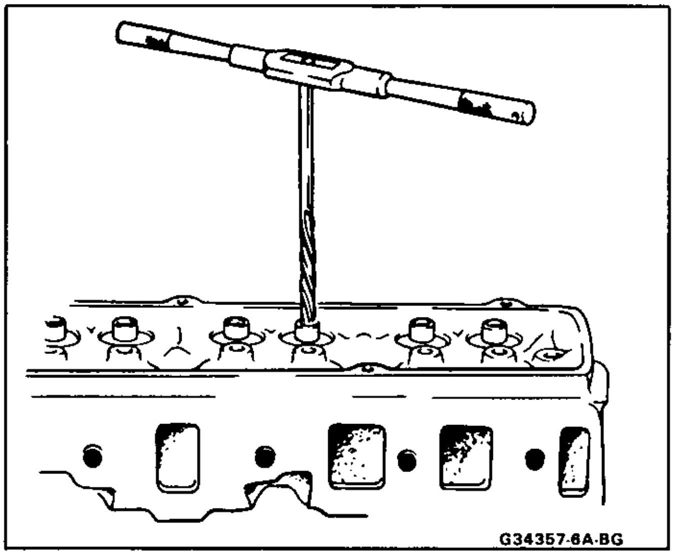


Figure 5 Reaming Valve Guide

VALVES

Measure

- Valve run out. Lift the valve off its seat and apply a dab of Prussian blue on the valve face. Seat the valve and carefully rotate it. The Prussian blue traces, transferred to the valve seat, are an indication of concentricity of the valve seat.
- Clean all traces of Prussian blue. Apply a dab of Prussian blue on the valve seat and repeat the check. The traces of Prussian blue transferred to the valve face indicates valve run out. Recondition valve seat/face, or replace valves, as required.

Inspect

- Valve stem tip for wear (Figure 6). The valve stem tip may be reconditioned by grinding. If the valve has rotators and the stem tip wear pattern indicates rotator failure, or if the rotators bind or stick, they must be replaced.
- Follow the grinder manufacturer's instructions. Make sure the new surface is perpendicular to the valve stem.
- Valve lock (keeper) and oil seal grooves for chipped or worn lands. Replace the valve if chipped or worn.

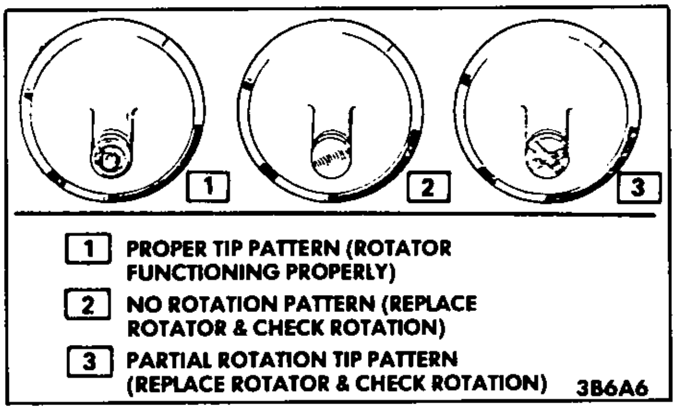


Figure 6 Valve Stem Tip Wear

- Valve face for burning or cracking. If pieces are broken off, inspect the corresponding piston and cylinder head area for damage.
- Valve stem for burrs and scratches. Burrs and **minor** scratches may be removed with an oil stone.
- Valve stem for straightness and valve head for bending or distortion. Use "V" blocks. Bent or distorted valves must be replaced.
- Valve face for grooving. If the groove is so deep that re-facing would result in a knife edge (destroying the margin), the valve must be replaced.
- The valve face may be reground to specifications, if it is otherwise in good condition (Figure 3). If the valve face cannot be ground within the limits given, it must be replaced.
- Measure valve margin after grinding valves. If the margin is less than the minimum recommended margin, replace the valve.

NOTICE: New valves must not be lapped. Lapping destroys the protective coating on the valve face.

VALVE SPRINGS

Inspect

- Valve springs (refer to Figure 3 for specifications)
  - Expanded height (Figure 8)
  - Spring ends. If they are not parallel, the spring is bent and must be replaced.
  - Spring load (Figure 9). If below specification, replace.
- Valve spring seating surface of the valve rotators, or spring retainers, for wear or gouging. Replace as required.

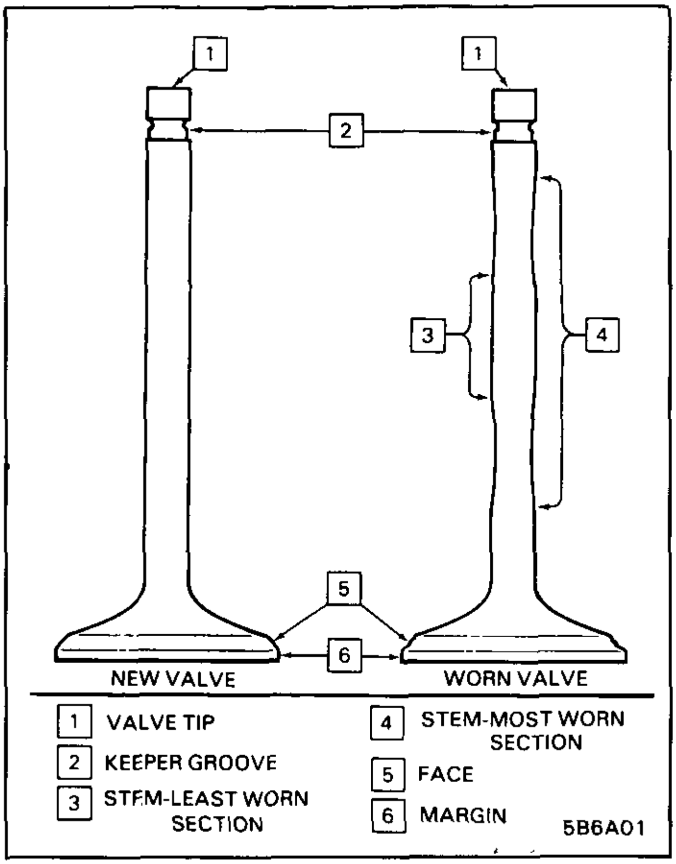


Figure 7 Valve Wear

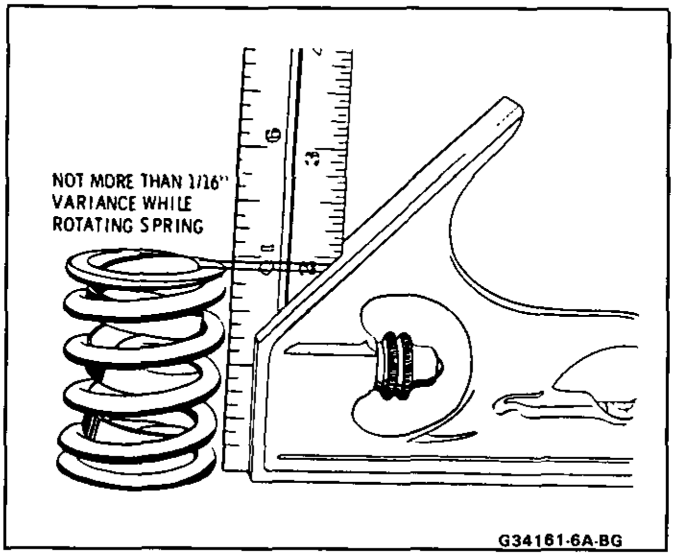


Figure 8 Checking Valve Springs

VALVE SEALS

Important

- If seals are the **Umbrella type**, push them down as far as they will go (Figure 10). If oversize valves have been installed, oversized valve stem seals must be used. Intake and exhaust valve stem seals may be different.
- If valve stem seals are the **"O" Ring type** be sure they are properly seated in the groove and not twisted.

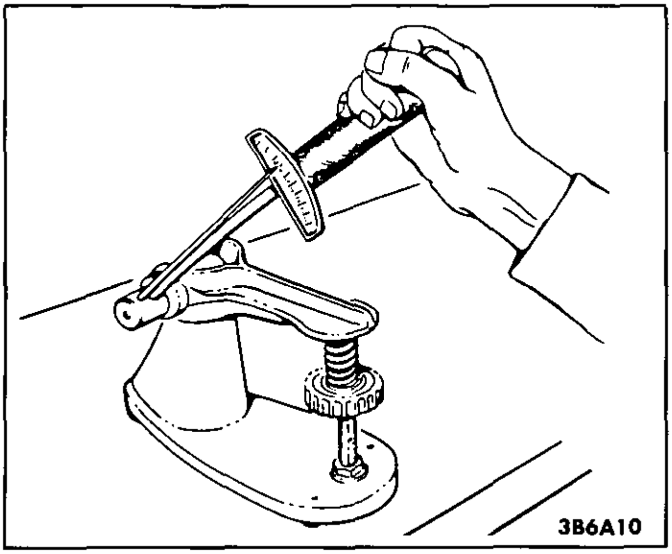


Figure 9 Checking Valve Spring Load

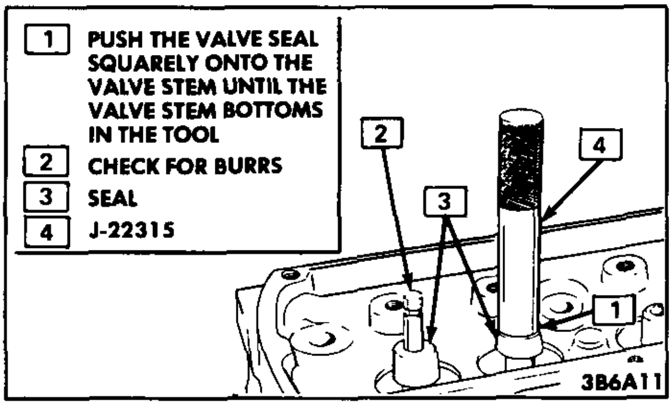


Figure 10 Locating Valve Seal (Typical)

VALVE INSTALLATION

There are several different methods of measuring to determine correct valve installation after regrinding valves or valve seats. Dimensional specifications in specific engine section will indicate method to be used.

VALVE STEM HEIGHT (BRIDGE-TYPE TOOL)

Tool Required:
J-25289

- Installed valve stem height (Figure 11). Excessive valve stem height is caused by lowering of the valve seat and excessive valve face grinding during reconditioning. To correct, remove the valve and shorten the valve stem by grinding. (Refer to Figure 12 for specifications.)
- Valve stem-to-rotator height (Figure 12)

NOTICE: If below specification (Figure 12), the valve must be replaced to avoid interference of the rotator with the rocker arms.

VALVE STEM HEIGHT (STEEL RULE)

1. Place the valve in its guide and hold it in the closed position.

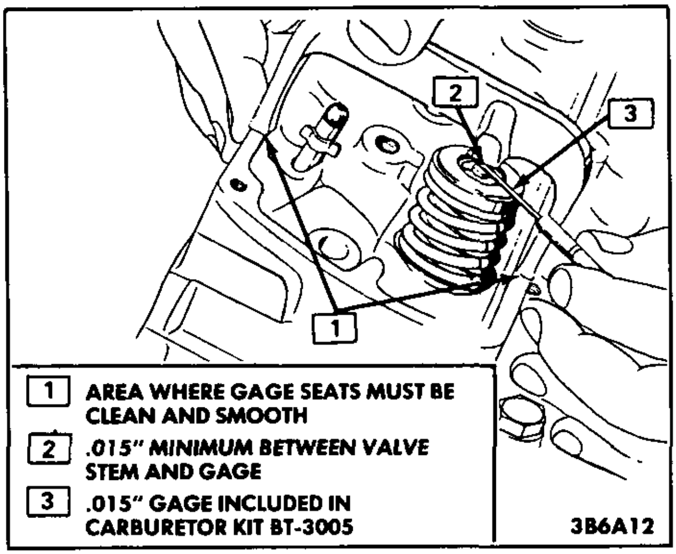


Figure 11 Measuring Valve Stem Height (Bridge-type Tool)

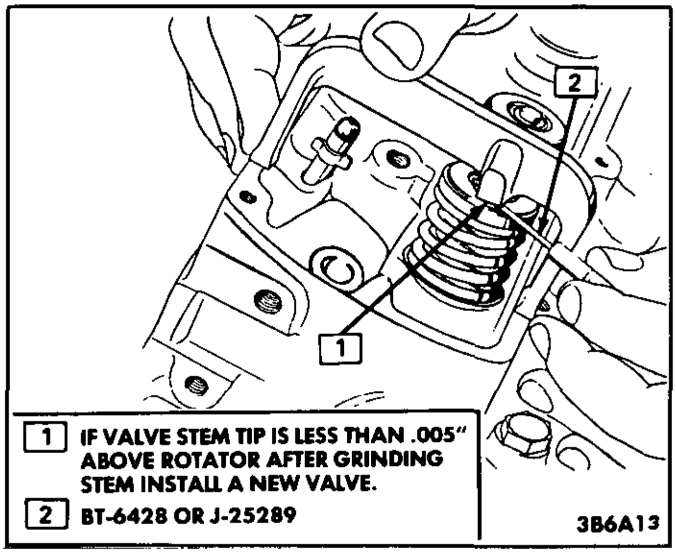


Figure 12 Measuring Valve Rotator Height

2. With a steel machinists rule, measure from the machined spring seat to the valve tip.
3. The measurement should be as specified in the specific engine section.

VALVE SPRING INSTALLED HEIGHT

Measure

- Valve spring installed height (Figure 13). Excessive valve spring installed height is caused by the lowering of the valve seat by wear and grinding, and valve face grinding during reconditioning. To correct the valve spring installed height, add shims under the valve spring.

1. Place the valve in the guide.
2. Install valve spring retainer and keepers.
3. Pull up on the valve spring retainer to seat it.
4. With a steel machnist's rule or other suitable measuring device, measure the distance from the machined spring seat to the spring-side of the retainer.
5. The measurement should be as specified in the specific engine section. If not within specifications, shim the valve seat as required.

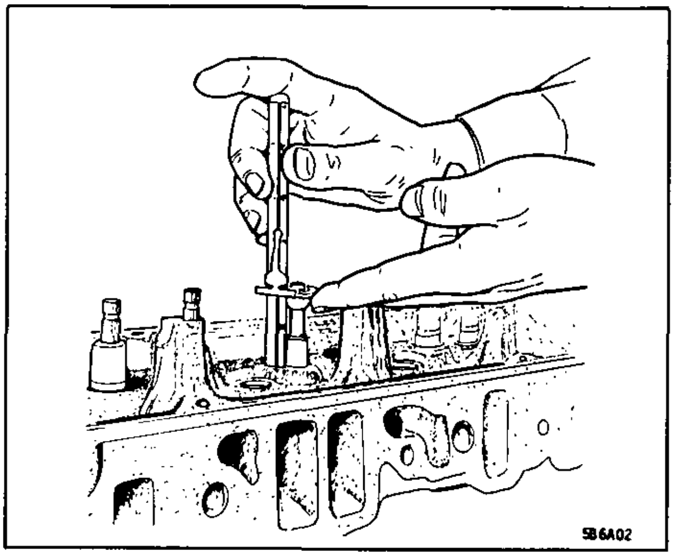


Figure 13 Measuring Valve Spring Installed Height

OIL PUMP

Three types of oil pumps are used. They are the engine oil pan (sump pump) (Figure 14), the front cover gear type (Figure 15), or the front cover Gerotor type (Figure 16).

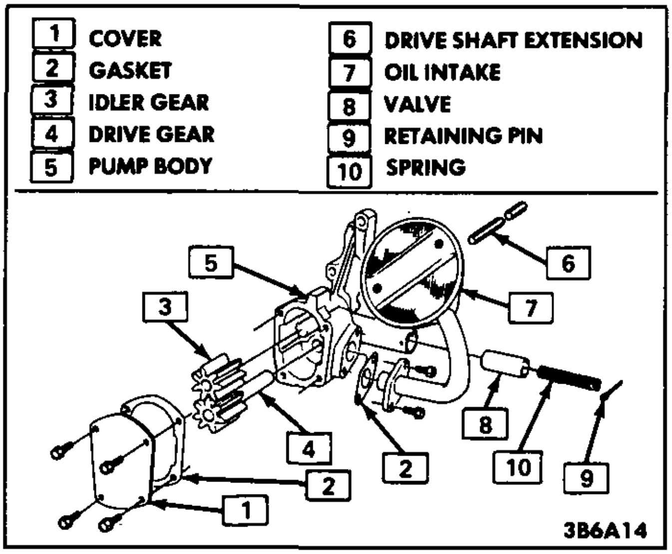


Figure 14 Oil Pump (Typical), Sump Type

SUMP OR GEAR PUMPS

Disassemble

1. Drain oil from pump.
2. Drive shaft and drive shaft extension, if any.
3. Suction pipe and screen assembly.
4. Pump cover.
5. Pump gears.
6. Pressure regulator valve.
   - Plug or cotter pin.
   - Spring.

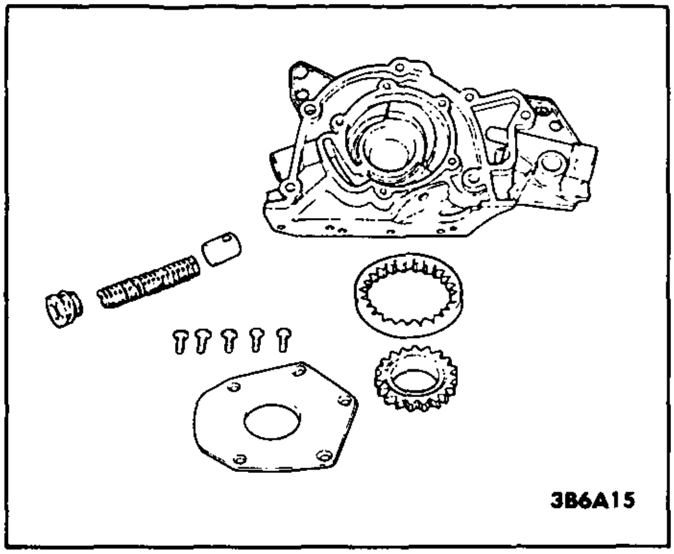


Figure 15 Oil Pump, Front Cover Gear Type

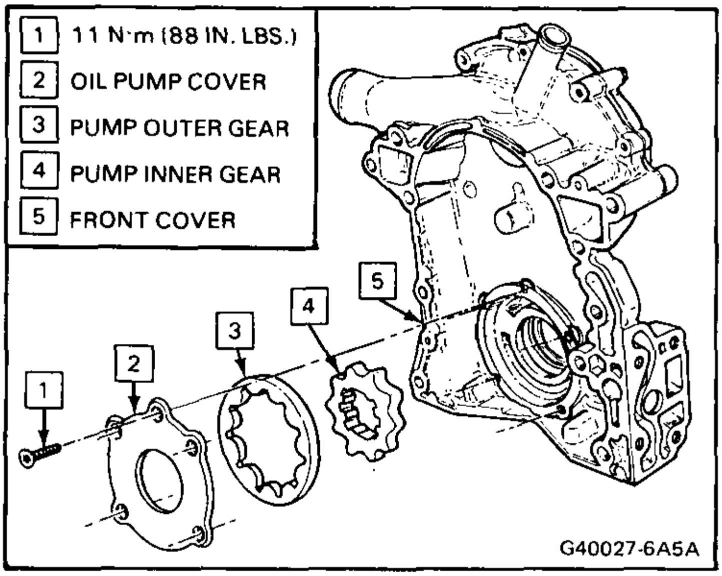


Figure 16 Gerotor Oil Pump

  - Valve. If the valve is stuck, soak the pump housing in carburetor cleaning solvent.

CAUTION: The pressure regulator valve spring is under pressure. Exercise caution when unscrewing the plug, or removing the cotter pin, as bodily injury may result.

Clean

- All parts of sludge, oil and varnish.
- Varnish may be removed by soaking in carburetor or cleaning solvent.

CAUTION: Avoid breathing of fumes, or exposure of the skin to the cleaning solvent, as bodily injury may result.

Inspect

- For foreign material and determine its source.
- Pump housing and cover for:
  - Cracks
  - Scoring
  - Casting imperfections
  - Damaged threads
  - Do not attempt to repair the pump housing.
  - If in doubt, replace the housing.
- Idler gear shaft, if used. If loose in the housing, replace the pump or timing chain cover, depending on model.
- Pressure regulator valve for:
  - Scoring
  - Sticking. Burrs may be removed with a fine oil stone.
- Pressure regulator valve spring for:
  - Loss of tension
  - Bending
  - If in doubt, replace the spring.
- Suction pipe and screen assembly for:
  - Looseness, if permanently pressed into the pump body. If the pipe is loose, or has been removed, it must be replaced with a new pump body and screen assembly.
  - Broken wire mesh or screen
- Gears for:
  - Chipping
  - Galling
  - Wear
- Drive shaft and drive shaft extension, if any, for:
  - Looseness
  - Wear

Measure

- Refer to oil pump specifications (Figure 17)
- Gear lash. Install gears, marking toward the timing cover and measure in several places (Figure 18).
- Pump housing gear pocket (Figure 19)
- Gears (Figure 20)
- Gear side clearance, if applicable (Figure 21)
- Gear end clearance (Figure 22)

Important

- When deciding pump servicability based on end clearance, consider depth of wear pattern in the pump cover and/or cover plate.

Assemble

1. Lubricate all internal parts with engine oil during assembly.
2. Pump gears. Gear mark facing the timing cover.

NOTICE: To avoid engine damage, it is essential that **all** pump cavities are packed with petroleum jelly **before** installing the gears to assure priming.

3. Cover and gasket

NOTICE: To avoid engine damage, use **only** original equipment gaskets. Gasket thickness is **critical** to proper functioning of the pump.

DISPLACEMENT				1.8L	2.5L	2.8L	3.8L	3.0L	5.0L	4.3L, 5.0L
ENGINE VIN CODE				O, J	2, R, U	X, W, S	·A	L	Y	Z, H, G, F
LASH			IN	0.004-0.008	0.009-0.015	0.009-0.015	0.0015-0.003	0.006	0.0004-0.007	.0037-.0077
			MM	0.10-0.20	0.23-0.38	0.23-0.38	0.038-0.076	0.152	0.01-0.190	.09-.20
GEAR POCKET	DEPTH		IN	0.395-0.397	0.995-0.998	1.195-1.198	0.868-0.870	0.461-0.462	1.500-1.509	-
			MM	10.03-10.08	25.27-25.35	30.36-30.44	22.04-22.10	11.71-11.73	38.10-38.125	-
	DIAMETER		IN	3.230-3.235	1.503-1.506	-	1.670-1.675	3.508-3.512	1.534-1.539	-
			MM	82.02-82.15	38.18-38.25	-	42.4-42.5	89.10-89.20	38.960-39.096	-
	LENGTH		IN	0.393-0.394	0.999-1.002	1.199-1.200	0.872-0.874	0.459-0.460	1.5075-1.5095	-
			MM	*9.98-10.0*	*25.37-25.45*	*30.45-30.48*	*22.15-22.20*	*11.66-11.68*	*38.29-38.341*	-
GEAR	DIAMETER	DRIVE GEAR (INNER)	IN	2.317-3.319	1.496-1.500	1.498-1.500	1.664-1.666	2.839	1.529-1.531	-
			MM	58.85-58.90	38.05-38.10	38.05-38.10	42.26-42.32	72.11	38.836-38.887	-
		IDLER GEAR (OUTER)	IN	3.225-3.227	-	1.498-1.500	1.664-1.666	3.500-3.497	1.529-1.531	-
			MM	81.910-81.964	-	38.05-38.10	42.26-42.32	88.90-88.82	38.836-38.887	-
	SIDE CLEARANCE	DRIVE GEAR	IN	0.014-0.018	0.004 max.	0.003-0.004	0.003-0.005	-	0.0015-0.0045	.004 max.
			MM	0.035-0.045	0.10 max.	0.08-0.10	0.08-0.13	-	0.040-0.120	.10 max.
		IDLER GEAR	IN	0.004-0.007	0.004 max.	0.003-0.004	0.003-0.005	-	0.0015-0.0045	-
			MM	0.11-0.19	0.10 max.	0.08-0.10	0.08-0.13	-	0.040-0.120	-
END CLEARANCE			IN	0.001-0.004	0.002-0.005	0.002-0.005	0.002-0.006	0.001-0.0035	0.0025-0.0065	.006 max.
			MM	0.03-0.10	0.05-0.13	0.05-0.13	0.05-0.15	0.025-0.089	0.063-0.165	.15 max.
INNER GEAR TIP CLEARANCE			IN	-	-	-	-	0.006	-	-
			MM	-	-	-	-	0.152	-	-
OUTER GEAR DIAMETER CLEARANCE			IN	-	-	-	-	0.008-0.015	-	-
			MM	-	-	-	-	0.203-0.381	-	-
VALVE TO BORE CLEARANCE			IN	-	0.0015-0.0035	0.0015-0.0035	0.004-0.008	0.004-0.008	0.0025-0.0050	-
			MM	-	0.038-0.089	0.038-0.089	0.102-0.203	0.102-0.203	0.063-0.127	-

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Figure 17 Oil Pump Specification

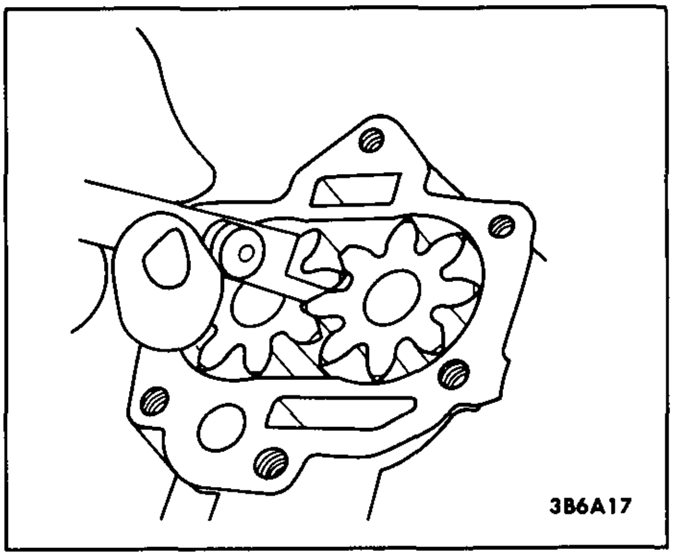

Figure 18 Measuring Oil Pump Gear Lash

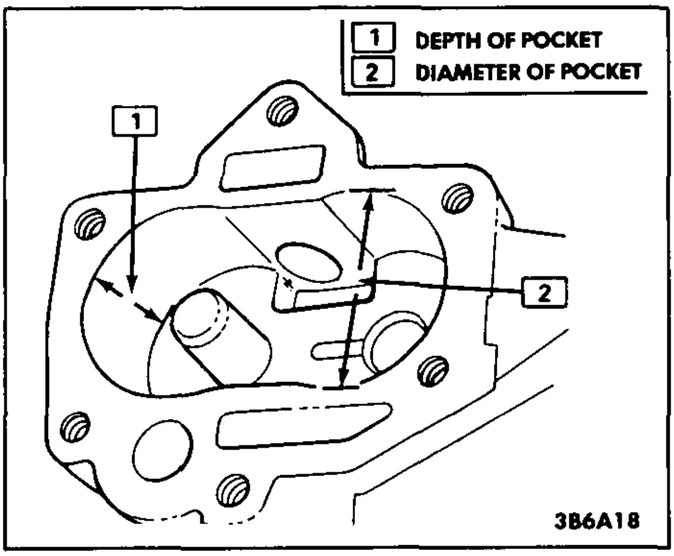

Figure 19 Measuring Oil Pump Gear Pocket

4. Pressure regulator valve and spring

5. Cotter pin or plug, depending on model

Important

- Plug Type - Coat threads with "Loctite 573", or equivalent.

- Cotter Pin Type - Make sure the pin is properly secured.

Tighten

- Pump cover bolts to 14 N·m (124 lb. in.) 3.0, 3.8L and 11 N·m (97 lb. in.) 5.0L.
- Pressure regulating valve plug, if any, to 20 N·m (177 lb. in.)
- Suction tube bolts to 10 N·m (90 lb. in.)

Install or Connect

Tool required:

J-8369 Suction Pipe Installer

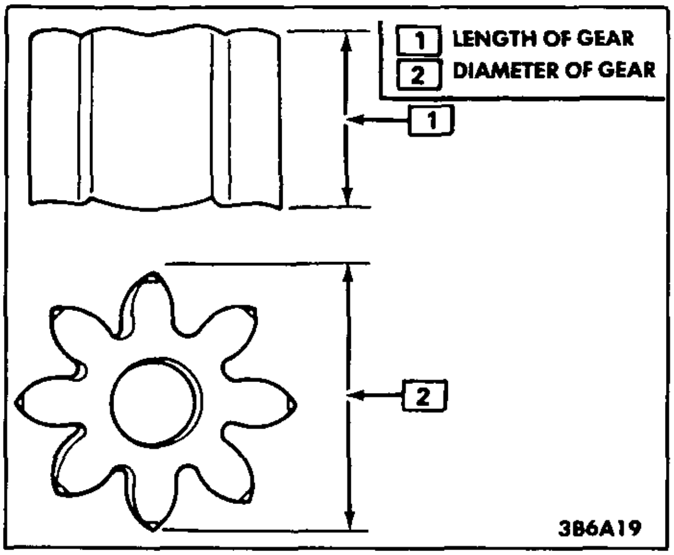

Figure 20 Measuring Oil Pump Gears

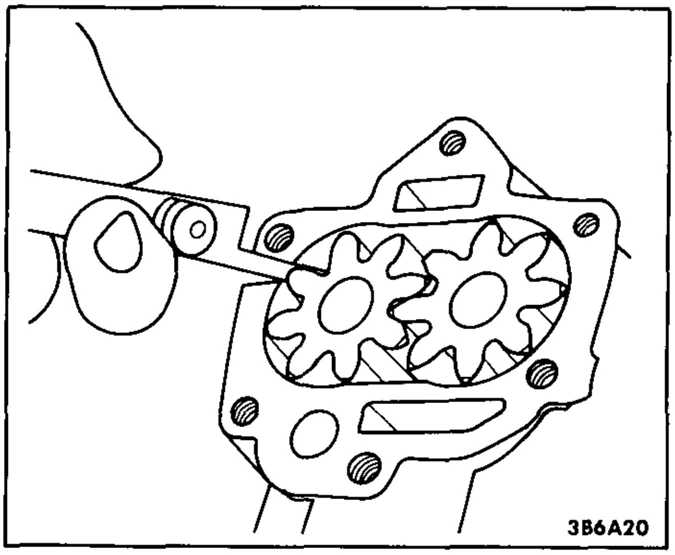

Figure 21 Measuring Gear Side Clearance

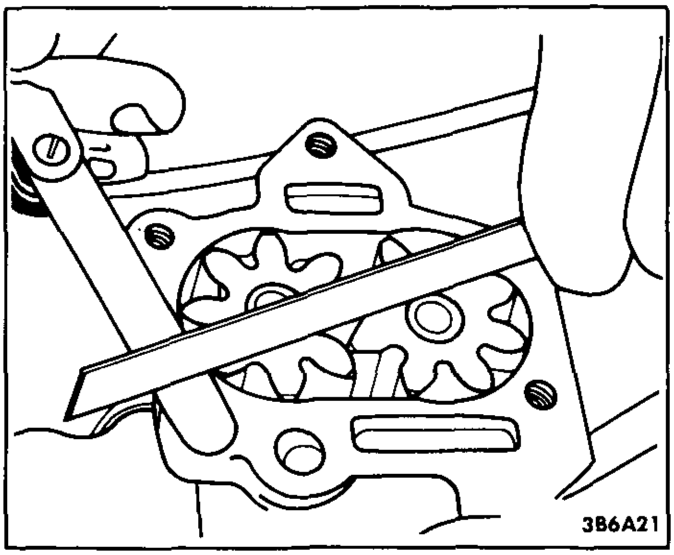

Figure 22 Measuring Oil Pump End Clearance

- A new suction pipe "O" ring seal or gasket, unless pressed in.
- Pressed in type, apply GM 1050026 sealer, Fel Pro-Set and Seal or equivalent, to a new pipe and tap into place with a plastic hammer, using installing Tool J-8369.

Tighten

- Suction tube bolts to 7 N·m (62 lb. in.), unless pressed in.

  Important

  - Whenever the oil pump is overhauled, clean the oil pan of oil and sludge, replace the oil filter and fill crankcase with clean oil.

Inspect

- Remove the oil pressure sending unit and install a pressure gage.
- Start engine and observe oil pressure

NOTICE: If the oil pressure does not build up almost immediately, remove the oil pan and check oil pump suction pipe attachment to the pump. If necessary, dismantle the oil pump, fill all cavities with petroleum jelly and reassemble. Running the engine without measurable oil pressure will cause extensive damage.

GEROTOR OIL PUMP

Disassemble

1. Remove oil filter adapter, pressure regulator valve and valve spring.
2. Remove oil pump cover attaching screws and cover.
3. Remove pump gears.

Clean

- All parts in cleaning solvent. Remove varnish, sludge and dirt.
- All traces of old gasket material.

Inspect

- Pump cover and housing (crankcase front cover) for:
  - Cracks
  - Scoring
  - Porous or damaged casting
  - Damaged threads
  - Excessive wear or galling.
- Pressure regulator valve for:
  - Scoring
  - Sticking in the valve bore
  - Burrs
- Pressure regulator valve spring for:
  - Tension loss
  - Bending
  - If in doubt, replace spring
- Gears for:
  - Chipping

  - *Galling*
  - Excessive Wear

Measure

- Oil pump gears for:
  - Inner gear tip clearance. Max. .152 mm (.006″). See Figure 23.
  - Outer gear diameter clearance. .203 mm - .381 mm (.008″ - .015″). See Figure 24.
  - Gear end clearance (gear drop in housing). .025 mm - .089 mm (.001″ - .0035″). See Figure 25.

Assemble

1. Lubricate gears with clean motor oil.
2. Assemble gears in housing.
3. Pack pump cavity with petroleum jelly.
4. Install pump cover and tighten bolts to 11 N·m (97 lb. in.).
5. Install pressure regulator valve spring and valve.
6. Install oil filter adapter using a new gasket.

Tighten

- Oil filter adapter bolts to 41 N·m (30 lb. ft.).

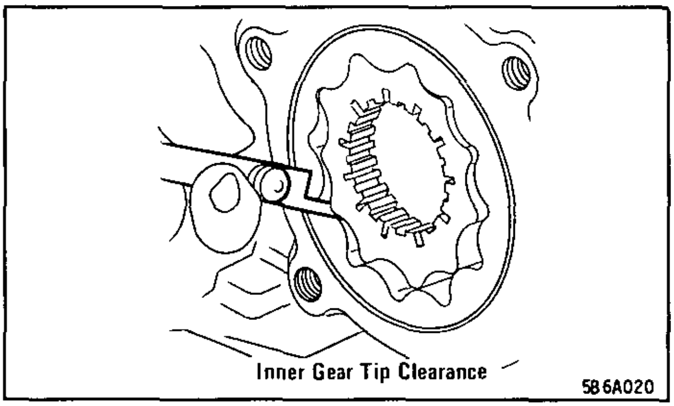

Figure 23 Inner Gear Tip Clearance-Gerotor

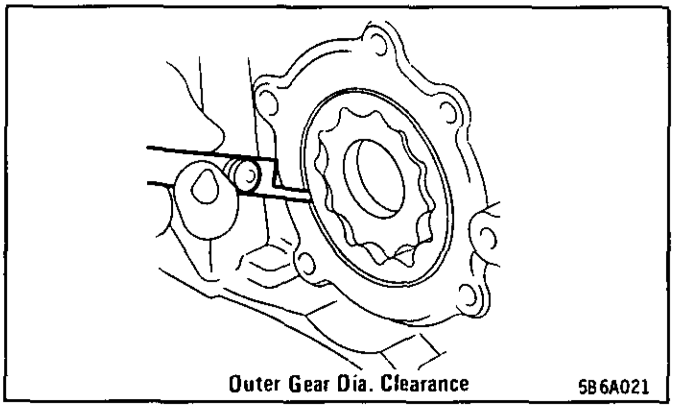

Figure 24 Outer Gear Diameter Clearance-Gerotor

CONNECTING ROD AND MAIN BEARINGS

Engine bearings are of the precision insert type. They are available for service use in standard and various undersizes (Figures 26, 27).

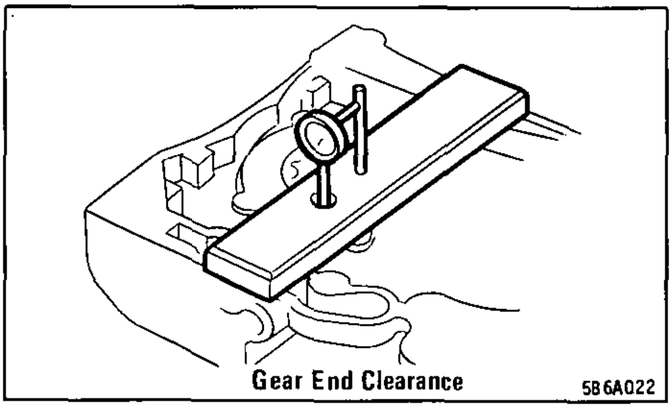

Figure 25 Gear End Clearance (Gear Drop In Housing) -Gerotor

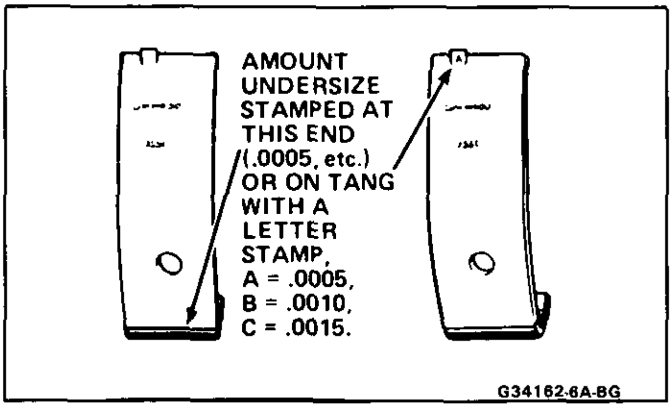

Figure 26 Bearing Insert Markings

Inspect

1. Bearing surfaces for:
   - Wear
   - Gouges
   - Imbedded foreign material. If foreign material is found, determine its nature and source. Inspect oil pan sludge and residue.
2. Outer surfaces for:
   - Wear. Surface wear indicates either movement of the insert or high spots in the surrounding material (spot wear).
   - Overheating (discoloration)
   - Looseness or rotation (flattened tangs and wear grooves)
3. Thrust surfaces (main thrust bearing) for:
   - Wear
   - Grooving. Grooves are caused by irregularities of the crankshaft thrust surface. Refer to Crankshaft.

   Important

   - Bearing failure, other than normal wear, *must be investigated carefully. Inspect the* crankshaft or connecting rod and the bearing bores.
4. Bearing cap bolts. If bolts are stretched, replace them.

Measure

- Bearing clearance. To determine the correct *replacement insert size, the bearing clearance*

	DISPLACEMENT		1.8L	2.5L	2.8L	3.0L, 3.8L	5.0L	4.3L, 5.0L
	VIN CODE		O, J	2, R, U	S, X, W	A, L	Y	Z, H, G, F
CONNECTING ROD BEARING	JOURNAL O.D.	IN	1.9278-1.9286	2.0	1.9983-1.9994	2.2487-2.2495	2.1238-2.1248	2.0986-2.0998
		MM	48.971-48.987	50.8	50.758-50.784	57.117-57.137	53.9445-53.9699	53.304-53.335
	RUNOUT	IN	.0002	.0005	.0002	.0003	.0005	.0005
		MM	.005	.013	.005	.008	.0013	.013
	TAPER	IN	.0002	.0005	.0002	.0003	.0005	.0005
		MM	.005	.013	.005	.008	.0013	.013
	CLEARANCE	IN	.0007-.0024	.0005-.0026	.0014-.0037	.0005-.0026	.0004-.0033	.0013-.0035
		MM	.019-.063	.013-.07	.035-.095	.013-.06	.01-.08	.033-.089
	SIDE CLEARANCE	IN	.0027-.0095	.006-.022	.0063-.0173	.004-.015	.006-.020	.006-.014
		MM	.070-.242	.15-.6	.16-.44	.10-.38	.15-.5	0.15-0.36
CRANKSHAFT MAIN BEARING	JOURNAL O.D.	 IN MM IN MM	Brown: 2.2830-2.2833 57.988-57.995 Green: 2.2827-2.2830 57.982-57.988	 2.3 58.42	 2.585-2.586 65.659-65.684	 2.4995 63.487	 2.4985-2.4995 63.4619-63.4873 #1 2.4988-2.4998 63.4695-63.4949	F 2.4484-2.4493 in 62.189-62.212 mm I 2.4481-2.4490 in 62.182-62.207 mm R 2.4479-2.4488 in 62.177-62.200 mm
	RUNOUT	IN	.0002	.0005	.0002	.0003	.0002	.0002 max.
		MM	.005	.013	.005	.008	.051	.005
	TAPER	IN	.0002	.0005	.0002	.0003	.0002	.0002 max.
		MM	.005	.013	.005	.008	.051	.005
	CLEARANCE	IN	.0006-.0016	.0003-.0022	.0016-.0032	.0003-.0011	‡.0005-.0021	*
		MM	.015-.041	.013-.56	.041-.081	.008-.023	.0127-.053	
	END PLAY	IN	.003-.012	.0035-.0085	.002-.0067	.003-.009	.0035-.0135	.002-.006
		MM	.07-.30	.09-.20	.05-.17	.08-.23	.0889-.3429	.051-.152
	NOTE F = FRONT I = INTERMEDIATE R = REAR						‡ No. 5: .0020-.0034 in. .050-.086 mm	F *.008-.0020 in .020-.031 mm I .0011-.0023 in .028-.058 mm R .0017-.0032 in .043-.081 mm

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Figure 27 Connecting Rod and Crankshaft Specifications

must be measured accurately. Either of the following two methods may be used, however, method "A" gives more reliable results and is preferred.

Important

- Method "A" yields measurements from which the bearing clearance can be **computed**. Method "B" yields the bearing clearance **directly**. Method "B" does **not** give any indication of bearing run-out.
- Do not mix inserts of different nominal size in the same bearing bore.

- Method "A"

1. Measure the crankshaft journal diameter with a micrometer in several places, approximately 90° apart, and average the measurements.
2. Taper and run-out. (Refer to Figure 27 for allowable limits.)
3. Bearing insert I.D. with an inside micrometer. Measure using new inserts if the inserts are being replaced.

Important

- The bearing cap must be torqued to specification when the measurement is taken.
- If the readings are within limits, select a suitable set of inserts. If the readings are unsatisfactory, the crankshaft journal must be re-conditioned and undersized bearing inserts installed.
- Crankshafts which have rolled fillets cannot be reground. They must be replaced.

- Method "B"

1. Install bearing inserts and crankshaft into block.
2. Place a piece of gaging plastic across the **entire** bearing width.
3. Seat the bearing cap carefully by tapping it lightly with a suitable tool.

NOTICE: In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass, lead or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

4. Torque bearing cap bolts to specification.

Important

- **Do not** rotate the crankshaft.

5. Remove the bearing cap, leaving the gaging plastic in place. It does **not** matter whether the gaging plastic adheres to the journal or to the bearing cap.
6. Measure the flattened gaging plastic at its **widest point** with the scale printed on the gaging plastic package (Figure 28).
7. Remove all traces of the gaging plastic after measuring.

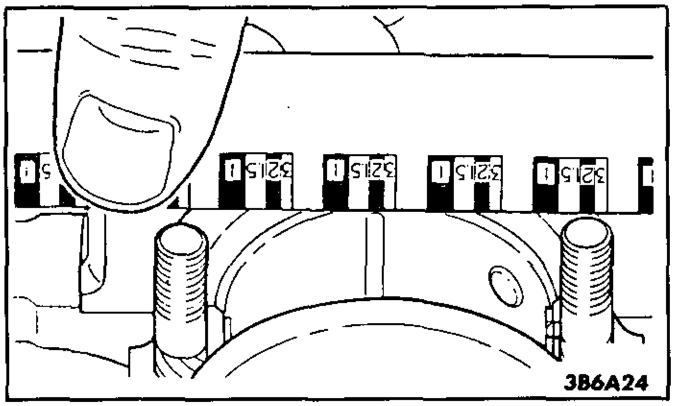


Figure 28 Measuring Bearing Clearance

8. Select a set of bearing inserts that will produce the desired clearance (Figure 27).

Install or Connect

NOTICE: Bearing inserts must not be shimmed, scraped or filed. Do not touch the bearing surface of the insert with the bare fingers. Skin oil and acids will etch the bearing surface.

Important

- Make sure the bearing cap bolt holes and the cap mating surfaces are clean and dry. (Refer to Rear Main Bearing for rear main bearing cap sealing procedure.)

1. Dip bearing cap bolts in clean engine oil.
2. Place inserts into the bearing cap and into the engine block or connecting rod.

NOTICE: Upper and lower inserts may be different. Be careful to align holes. Do not obstruct any oil passages.

Important

- The inserts will project slightly when put into place. Make sure they project an equal distance on both sides. Make sure the insert tangs are engaged.

3. In the case of a thrust bearing type main bearing insert, coat the thrust surface with GM 1050169 special lubricant, or equivalent.
4. Lubricate the bearing surface with clean engine oil.
5. Crankshaft or connecting rod.

NOTICE: Avoid damage to the crankshaft journal. Use connecting rod stud protectors, or guide pins.

6. Bearing cap. Tap gently into place with a suitable tool.

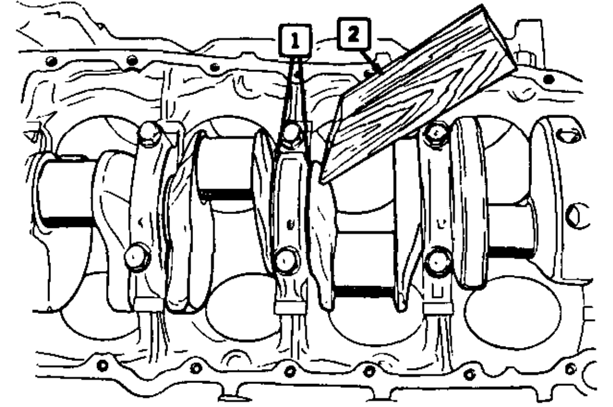
NOTICE: In order to prevent the possibility of cylinder block and/or main bearing cap damage, the main bearing caps are to be tapped into their cylinder block cavity using a brass, lead or leather mallet before attaching bolts are installed. Do not use attaching bolts to pull main bearing caps into their seats. Failure to observe this information may damage a cylinder block or bearing cap.

7. Bearing cap bolts

Tighten

- Bolts evenly, then back off one full turn and torque to specification.

8. Seat the crankshaft thrust bearing (Figure 29)



1. CENTER MAIN BEARING THRUST FLANGES
2. WOOD BLOCK

BUMP SHAFT IN EACH DIRECTION TO ALIGN THRUST FLANGES OF CENTER MAIN BEARING.

Figure 29 Seating the Crankshaft Thrust Bearing (Typical V Engine)

Inspect

- Pry the connecting rods back and forth and check for binding. If necessary, loosen and retighten the bearing cap.

Measure

- Crankshaft end play (Figure 30)
- Connecting rod side clearance (Figure 31, 32)

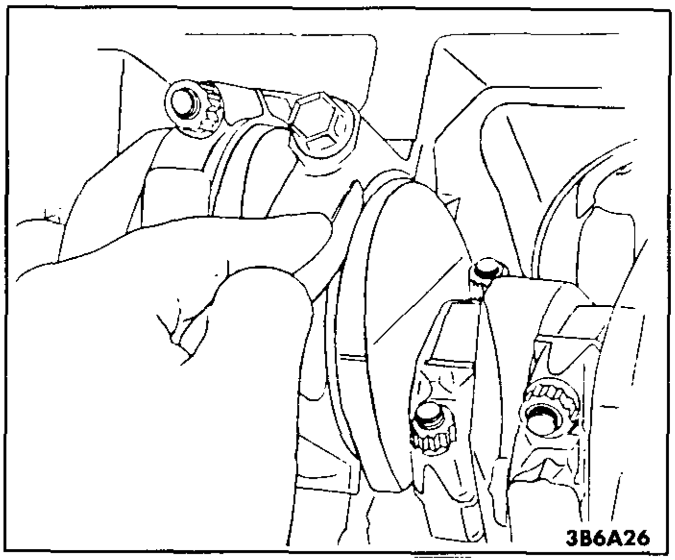


Figure 30 Measuring Crankshaft End Play

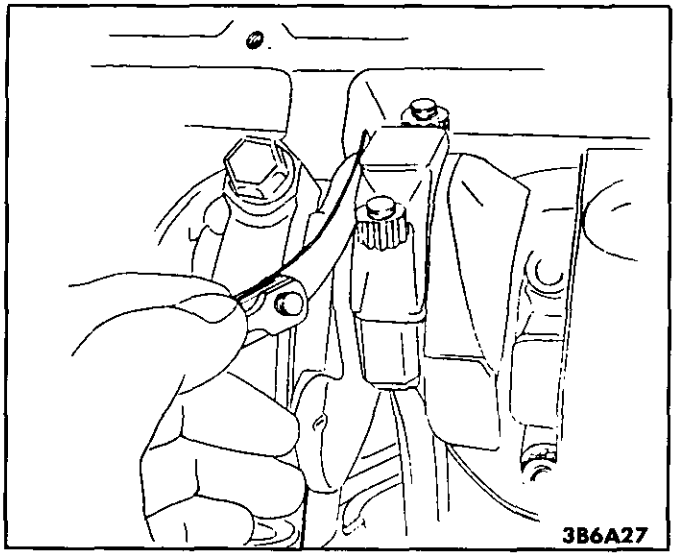


Figure 31 Measuring Connecting Rod Side Clearance (Single Rod Journal)

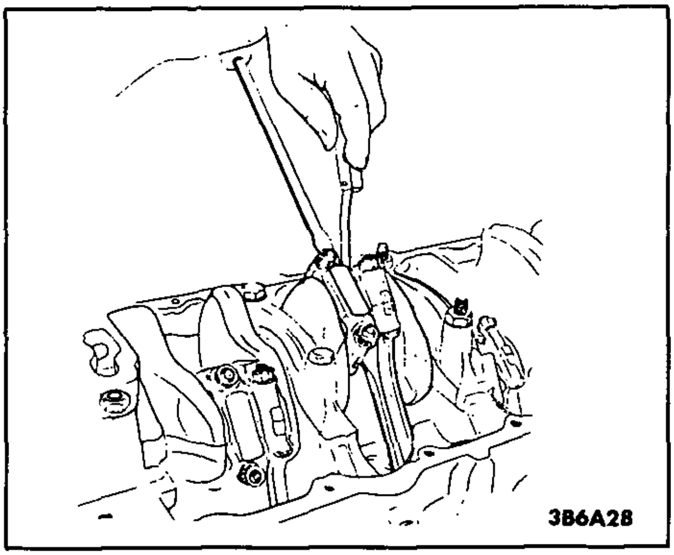


Figure 32 Measuring Connecting Rod Side Clearance (Double Rod Journal)

Clean

- Oil pump intake screen
- Oil pan

Install or Connect

- Oil pan
- Engine oil filter
- Fill crankcase with clean engine oil

Inspect

- Remove oil pressure sending unit and install an oil pressure gage.
- Start engine and observe oil pressure.

NOTICE: If the oil pressure does not build up almost immediately, remove the oil pan and check oil pump suction pipe attachment to the pump. If necessary, dismantle the oil pump, fill all cavities with petroleum jelly and re-assemble. Running the engine without measurable oil pressure will cause extensive damage.

- Check for bearing knock. If necessary, dismantle and check for adequate oil supply and proper clearances.

CRANKSHAFT

Clean

- Oil, sludge and carbon
- Probe oil passages for obstructions

Inspect

- Keyway
- Threads
- Bearing journals and thrust surfaces for:
  - Cracks
  - Chips
  - Gouges
  - Roughness
  - Grooves
  - Overheating (discoloration)

Important

- Inspect the corresponding bearing inserts for imbedded foreign material and determine its source.
- If cracks, severe gouges or burned spots are found, the crankshaft must be replaced. **Slight** roughness may be removed with fine polishing cloth soaked in clean engine oil. Burrs may be removed with a fine oil stone.

Measure

- Crankshaft journals. With a micrometer (or dial indicator in the case of the main bearing journals) measure taper and run-out (Figure 27). If the readings are within specifications, note results for later selection of bearing inserts (refer to Connecting Rod and Main Bearings). If not within limits, the journals may be reconditioned by grinding (except crankshafts with rolled fillets which must be replaced).

Important

- Note the location of main bearing high spots. If they are not in line, the crankshaft is bent and must be replaced.

PISTONS, RINGS AND CONNECTING RODS

Remove or Disconnect

1. Mark the piston with the number of the cylinder from which it is being removed.
2. Mark the connecting rod and the rod cap so that they can be reassembled correctly.
3. Turn the crankshaft to bottom dead center.

Clean

- Carbon from the top end of the cylinder

NOTICE: If there is a pronounced ridge at the top of the piston travel, this ridge must be removed with a ridge reamer before removing piston and connecting rod assembly.
Do not use force. Avoid breaking piston rings and damaging the piston.

4. Connecting rod cap
5. Connecting rod and piston assembly. Push out with a suitable tool.

NOTICE: Install thread protectors to avoid damage to the crankshaft journal (Figure 33).

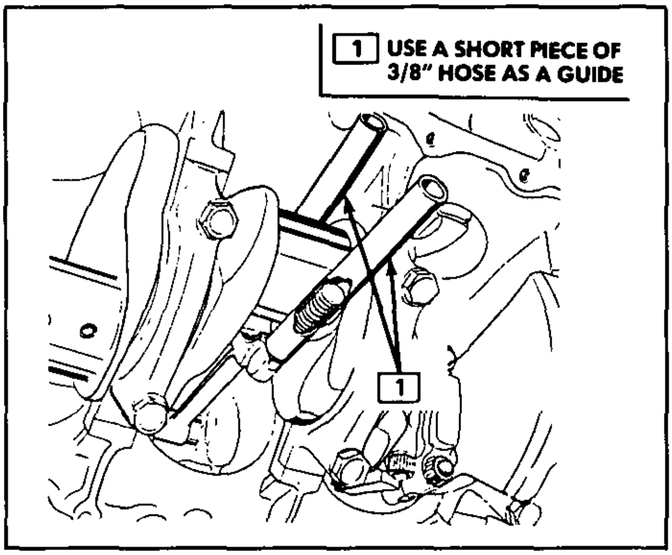


Figure 33 Connecting Rod Protectors (Typical)

Piston Pin-Press Fit and Piston Rings

Disassemble

Tool required:

J-24086 Piston Pin Remover/Installer

- Piston and connecting rod assembly

CAUTION: Use care when handling the piston. Worn piston rings are sharp and may cause bodily injury.

1. Piston rings. Use a suitable tool to expand the rings. Piston rings must not be reused.
2. Place the piston and connecting rod assembly into Fixture J-24086 and press out the piston pin (Figure 34).

Clean

- Piston, piston pin and connecting rod
  - Sludge
  - Carbon
  - It is essential that the piston ring grooves are cleaned of carbon to the bare metal.
  - Varnish from the piston pin by soaking in carburetor cleaning solution.

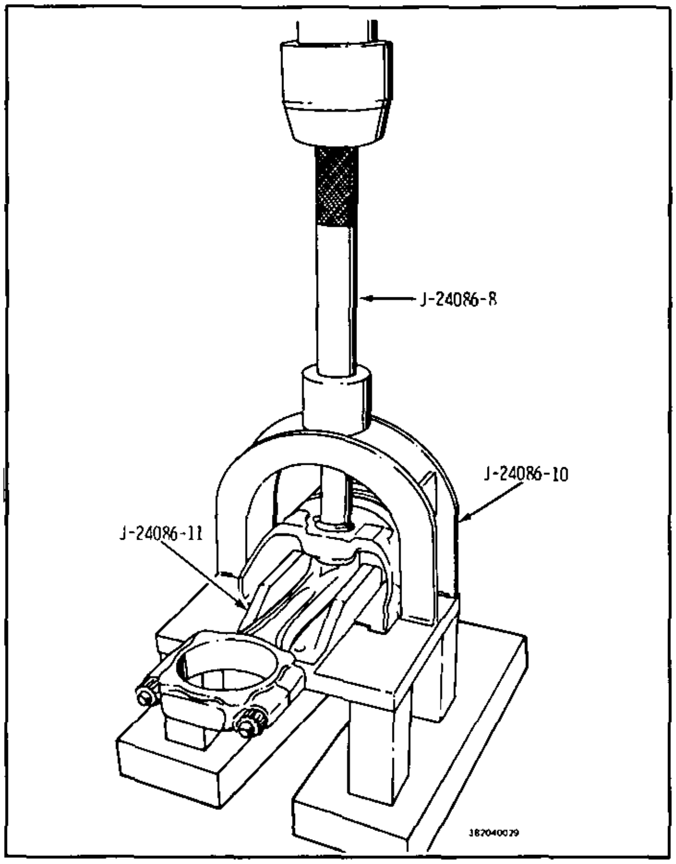


Figure 34 Removing Piston Pin Using Tool J-24086

CAUTION: Avoid inhaling fumes or exposure of the skin to carburetor cleaning fluid, as bodily injury may result.

  - Do not scrape the piston skirt.

Inspect

- Connecting rod for:
  1. Bending or twisting
     - Install the connecting rod cap and torque to specifications.
     - Place the connecting rod assembly on a checking fixture and check for bending or twisting.
  2. Do not attempt to straighten the connecting rod. If bent or twisted, replace it. Check new connecting rods before using them.
  3. Outside of the connecting rod bearing and the I.D. of the connecting rod lower end for wear indicating high spots in the connecting rod lower end.
  4. Connecting rod bolts for stretching by comparing them with a new bolt.
  5. Upper end for scoring
- Piston pin for:
  1. Scoring
  2. Galling caused by improper installation
  3. Fit in connecting rod and piston
- Piston for:
  1. Scoring of the skirt
  2. Cracks.

3. Broken ring groove lands.
4. Wear

Measure

- Piston Rings
  1. Select a set of new piston rings
  2. Piston ring end gap (Figure 35)
     - Place piston into the cylinder at the bottom of the ring travel.
     - Place a piston ring on top of the piston.
     - Back off the piston.
     - Measure the ring gap (Figure 35). If the gap is below specification (Figure 37), increase the gap by carefully filing off excess material.

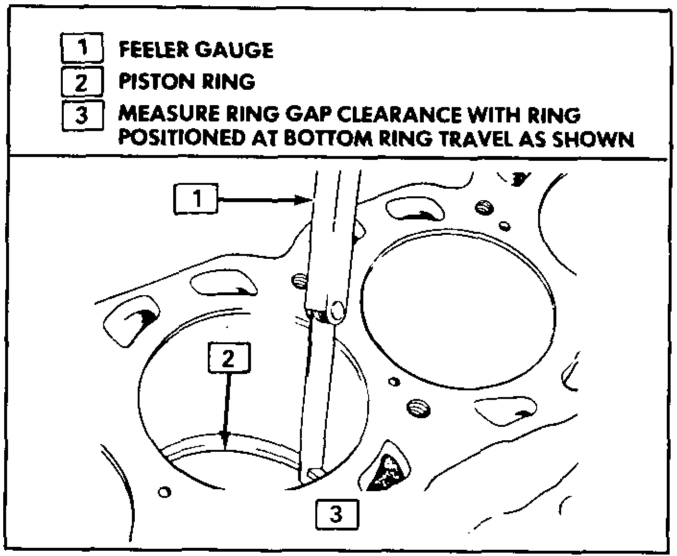


Figure 35 Measuring Piston Ring Gap

  3. Piston ring side clearance (compression rings)
     - Roll the piston ring around the groove in which it is to be installed and measure the side clearance (Figure 36). If the ring is too thick, try another ring. If no ring can be found that fits the specifications (Figure 37), the ring may be ground to size with emery paper placed on a plate of glass.

NOTICE: Do not attempt to cut the ring groove, although high spots in the ring groove may be cleaned up by careful use of a point file.

Assemble

- Connecting rod and piston assembly
  Tool required:
  J-24086 Piston Pin Remover/Installer

Important

- The piston must be mounted on the connecting rod in such a manner that the mark on the piston (Figure 38) lines up with the side of the connecting rod that faces the front of the engine.

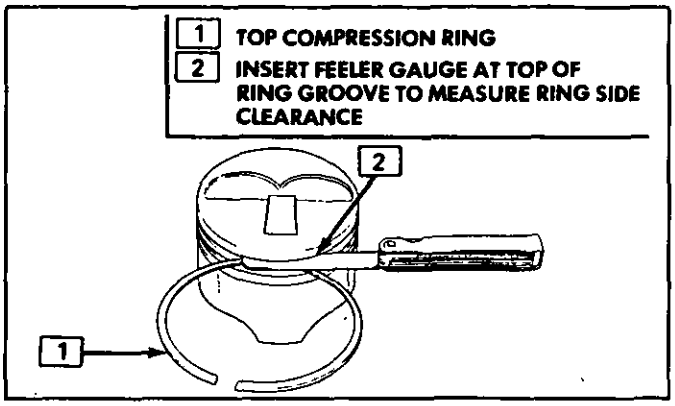


Figure 36 Measuring Piston Ring Side Clearance

1. Place piston and connecting rod into Fixture J-24086 (Figure 39)
2. Adjust plunger of the fixture.
3. Coat the piston pin with clean engine oil.
4. Press the piston pin into place.

Inspect

- Piston for freedom of movement

Install or Connect

1. Oil control ring assembly
   - Expander
   - Lower oil control ring
   - Upper oil control ring
2. Upper and lower compression ring. Manufacturers mark facing up.

NOTICE: Use a piston ring expander to install the rings. Avoid expanding the rings more than necessary, which may cause ring damage.

Important

- In order to provide an effective compression seal, the ring gaps must be staggered (Figure 40).

Install or Connect

1. Lubricate cylinder wall and piston rings with clean engine oil.
2. Turn crankshaft to bottom dead center.
3. Connecting rod stud thread protector, if required (Figure 33)
4. Piston ring compressor (Figure 41)
5. Align piston and connecting rod assembly according to the mark on the piston (Figure 38) and insert in the cylinder.

NOTICE: Guide the lower connecting rod end carefully to avoid damaging the crankshaft journal.

6. Remove thread protectors.

		DISPLACEMENT VIN CODE		1.8L O, J	2.5L 2, R, U	2.8L X, W, S	3.0L, 3.8L A, L	5.0L Y	4.3L Z
CYLINDER		*DIAMETER*	*IN*	*3.336-3.342*	*4.00*	*3.5036-3.5067*	*3.80*	*3.80*	*4.00*
			MM	84.75-84.80	101.6	88.90-89.07	96.5	96.5	101.6
		OUT OF ROUND (MAX)	IN	.005	.001	.001	.0005	.001	.001
			MM	.13	.02	.02	.013	.025	.025
		TAPER (MAX)	IN	.005	.005	.001	.0005	.0076-.0177	.0005
			MM	.13	.13	.02	.013	.0003-.0007	.013
PISTON	CLEARANCE	TOP	IN	.0000-.0008 (VIN 0)	* *.0014-.0022	.0017-.003	.001-.002	.00075-.00175	.0007-.0017
			MM	.00-.02 (VIN 0)	.036-.056	.04-.07	.02-.05	.019-.044	.017-.043
			IN	.0004-.0012 (VIN J)	-	-	•	-	-
			MM	.01-.03 (VIN J)	-	-		-	-
	PIN	DIAMETER	IN	-	.938-.942	.9052-.9056	.9391-.9394	.9803-.9807	.9270-.9273
			MM	-	23.825-23.927	22.99-23.00	23.85-23.86	24.90-24.91	23.55-23.56
		FIT IN PISTON	IN	.0002	.0002-.0004	.00025-.00036	.0004-.0007	.0003-.0005	.001
			MM	.005	.005-.010	.0065-.0091	.010-.018	.0076-.0127	.025
		FIT IN ROD	IN	PRESS FIT	PRESS FIT	.00078-.0021	.00075-.00125	.0003-.0013	*.0008-.0016
			MM			.020-.053	.019-.032	.0076-.033	.020-.041
PISTON RINGS	GAP	TOP COMPRESSION	IN	.012-.020	.010-.020	.01-.02	.013-.023	.009-.019	.010-.020
			MM	.304-.508	.25-.50	.25-.50	.33-.58	.2286-.4826	.25-.50
		2ND COMPRESSION	IN	.012-.020	.010-.020	.01-.02	.013-.023	.009-.019	.010-.025
			MM	.304-.508	.25-.50	.25-.50	.33-.58	.2286-.4826	.25-.62
		OIL CONTROL	IN	.016-.055	.020-.060	.020-.055	.015-.035	.015-.055	.015-.055
			MM	.406-1.40	.50-1.52	.51-1.40	.38-.89	.38-1.40	.38-1.40
	SIDE CLEARANCE	*TOP* COMPRESSION	*IN*	*.002-.004*	*.002-.003*	*.001-.003*	*.003-.005*	*.0018-.0038*	*.0012-.0032*
			MM	.05-.10	.05-.08	.030-.08	.08-.13	.0457-.0965	.031-.081
		2ND COMPRESSION	IN	.001-.0025	.001-.003	.0016-.0037	.003-.005	.0018-.0038	.0012-.0032
			MM	.03-.06	.03-.08	.04-.094	.08-.13	.0457-.0965	.031-.081
		OIL CONTROL	IN	0-.0047	.015-.055	.008	.0035	.001-.005	.002-.007
			MM	0-.120	.38-1.40	.20	.09	.03-.13	.05-.178

* Press Fit • BTM IN .0015-.0035 MM .04-.09 * * Measured 1.8 inch down from piston top

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Figure 37 Cylinder and Piston Specifications

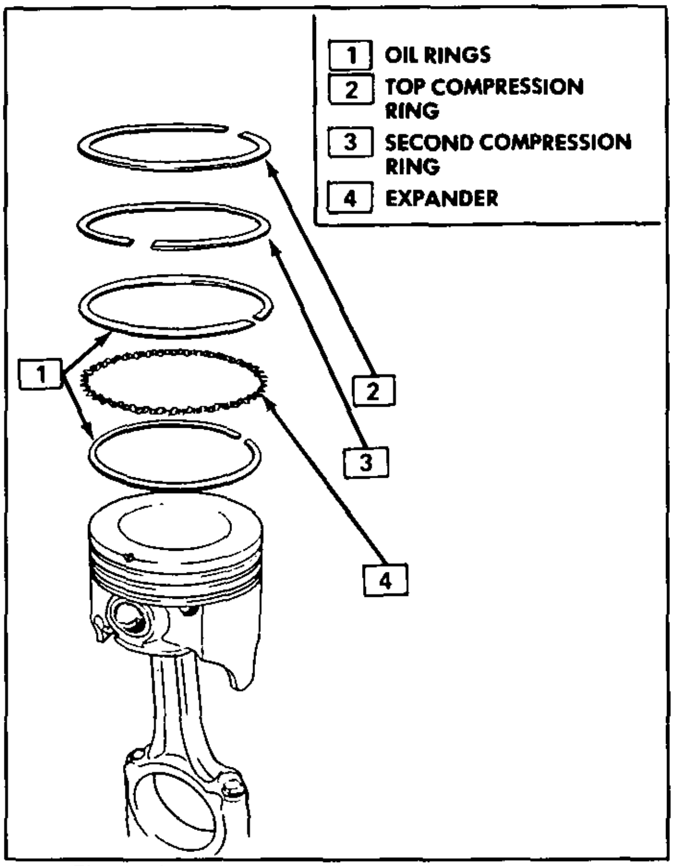


Figure 38 Piston and Rod Assembly (Typical)

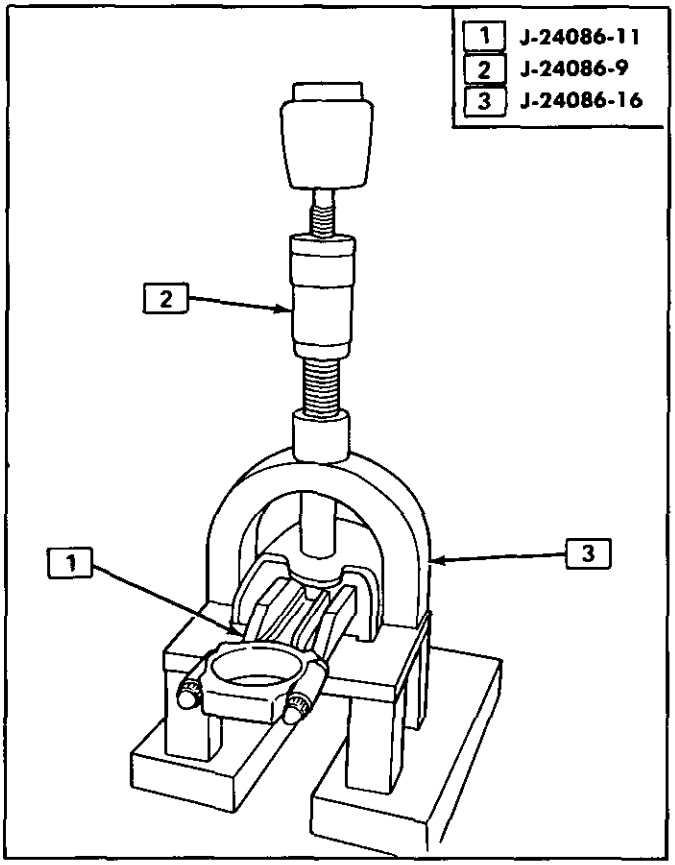


Figure 39 Installing Piston Pin Using Tool J-24086

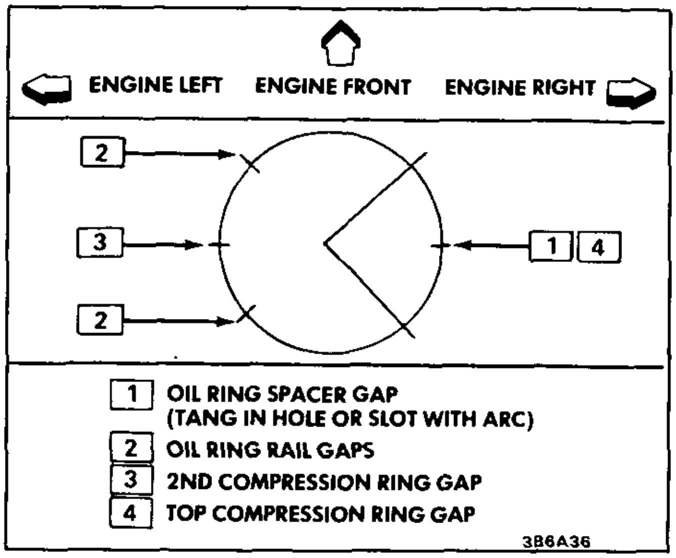


Figure 40 Piston Ring Gap Locations

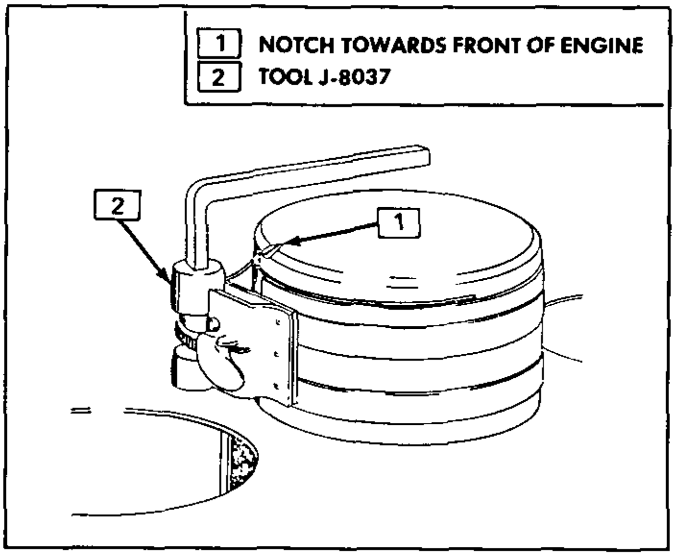


Figure 41 Installing A Piston Using A Piston Ring Compressor

7. Connecting rod bearing (refer to Connecting Rod and Main Bearing).

8. Bearing cap.

Important

- Carefully tap the bearing cap into place. Do not pull the cap down with the cap bolts or nuts.

Tighten

- Cap bolts or nuts, then loosen one full turn and torque to specification.

Inspect

- Pry the connecting rod back and forth with a suitable tool and check for binding. If necessary, loosen and retighten the bearing cap.

CAMSHAFT AND CAMSHAFT BEARINGS

Camshaft

Remove or Disconnect

- Refer to specific Engine Mechanical Section

Inspect

- Sprocket
- Keyway and threads
- Bearing surfaces and lobes for:
  - Wear
  - Galling
  - Gouges
  - Overheating (Discoloration)

Important

- Do not attempt to repair the camshaft, replace it if damaged.
- If a new camshaft is installed, all valve lifters must be replaced (except roller lifters).

Measure

- Cam lobe lift
  1. Lubricate the camshaft bearings with 1051396, or equivalent.
  2. Carefully insert the camshaft. If the camshaft bearings are badly worn or damaged, set the camshaft on "V" blocks instead.
  3. Attach a dial indicator with a ball socket attachment and measure the cam lobe lift (Figure 42). If any one cam lobe lift is out of specification, replace the camshaft.

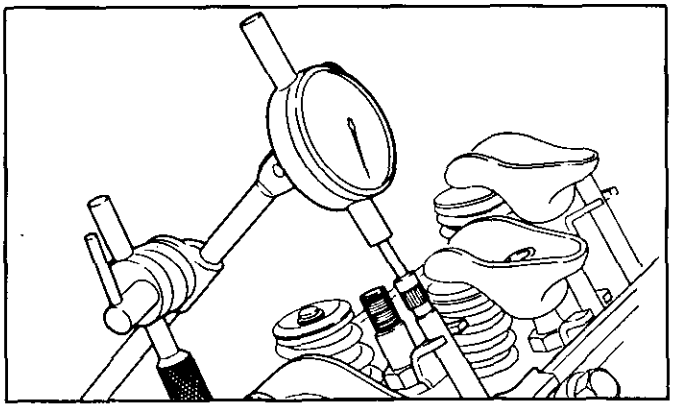


Figure 42 Measuring Cam Lobe Lift

- Bearing journals
  - With a micrometer, measure run-out and diameter. If out of specification, replace the camshaft.

Important

- If a new camshaft has been installed, add GM 1051396 EP lubricant or equivalent to the engine oil.

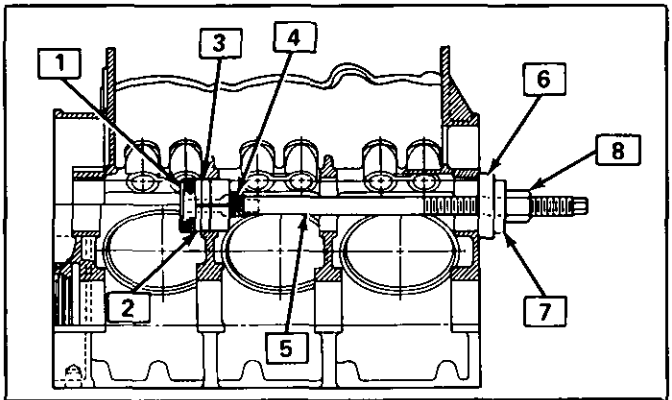
- Coat cam lobes with 1052367, or equivalent.

Camshaft Bearings

Tool Required:
J-33049 Camshaft Bearing Remover/Installer

Remove or Disconnect

1. Camshaft and rear cover (refer to Specific Engine Section)
2. Camshaft Bearings
   - Select the proper pilot, nut and thrust washer
   - Assemble bearing puller (Figure 43). Make sure the puller nut engages a sufficient number of threads.
   - Pull out bearings



1	BACK-UP NUT	5	2 PIECE PULLER SCREW
2	EXPANDING COLLET	6	PULLING PLATE
3	BEARING	7	THRUST BEARING
4	EXPANDING MANDREL	8	PULLING NUT

Figure 43 Removing/Installing Camshaft Bearings (Typical)

Important

- Camshaft bearings must not be reused once they have been removed.

Clean

- Sealing surfaces on the camshaft rear cover and on the cylnder block

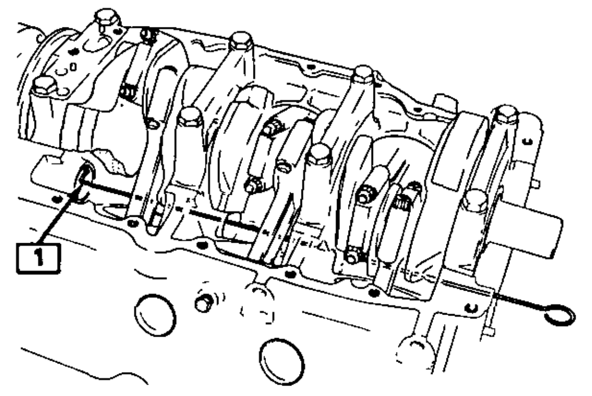
Install or Connect

1. Camshaft bearings
   - Select front, rear and intermediate camshaft bearings.
   - Select the proper pilot, nut and thrust washer
   - Assemble installing tool.
   - Place bearing onto the tool and index the oil hole(s) of the bearing with the oil passage(s) in the cylinder block. Pull bearing into place (Figure 43).

NOTICE: Proper alignment of the oil holes is critical. Restriction of the oil flow will cause severe engine damage.

Inspect

- With a piece of 3/32" brass rod with a 90° bend at the end, probe the bearing oil holes and verify that they are properly aligned (Figure 44).



1 90° BEND

CHECKING OIL HOLE ALIGNMENT WITH BRASS ROD. MAKE ROD AS SHOWN USING 3/32" ROD ABOUT 762mm (30") LONG

Figure 44 Checking Camshaft Bearing Oil Hole Alignment

2. Camshaft Rear Cover (soft plug)
   - Apply a 3mm (1/8") bead of GM 1052366 RTV sealer, Fel Pro-Black RTV, or equivalent, to the cover before installing.

VALVE LIFTERS

Operation

Oil is supplied to the lifter through a hole in the side of the lifter body which indexes with a groove and hole in the lifter plunger. Oil is then metered past the oil metering valve in the lifter, through the push rods to the rocker arms. (Figure 45).

When the lifter begins to move up the cam lobe, the ball check is held against its seat in the plunger by the ball check spring which traps the oil in the base of the lifter body below the plunger. The plunger and lifter body then raise as a unit, pushing up the push rod to open the valve. The force of the valve spring which is exerted on the plunger through the rocker arm and push rod causes a slight amount of leakage between the plunger and lifter body. This "**leak-down**" allows a slow escape of trapped oil in the base of the lifter body. As the lifter rolls down the other side of the cam lobe and reaches the base circle or "**valve closed**" position, the plunger spring quickly moves the plunger back (up) to its original position. This movement causes the ball check to open against the ball spring and oil from within the plunger is drawn into the base of the lifter. This restores the lifter to zero lash.

Valve Lifter Diagnosis

1. Momentarily noisy when car is started:

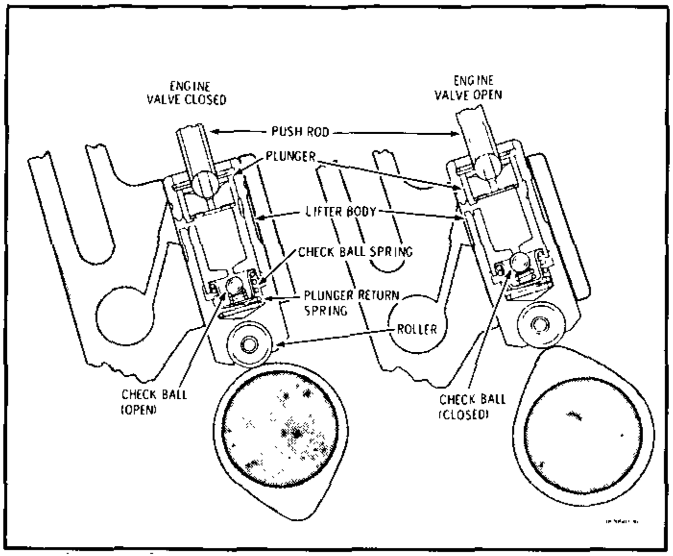


Figure 45 Valve Lifter Operation (Roller Shown)

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 until proper level is obtained. See Section 0A.
   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. See Section 0A.
   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 "L" (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.

   To check valve spring and guide clearance, remove the valve covers.
   a. Occasionally this noise can be eliminated by rotating the valve spring and valve. Crank engine until noisy valve is off its seat. Rotate spring. This will also rotate valve. Repeat until valve becomes quiet. If correction is obtained, check for an off square valve spring. If spring is off square more than 1/16" in free position, replace spring. (Figure 8).
   b. Check for excessive valve stem to guide clearance. If necessary, correct as required.

6. Valves noisy regardless of engine speed:

   This condition can be caused by foreign particles, or excessive valve lash.

   Check for valve lash by turning engine so the piston in that cylinder is on top dead center of firing stroke. If valve lash is present, the push rod can be freely moved up and down a certain amount with rocker arm held against valve. If OK, clean suspected valve lifters.

   Valve lash indicates one of the following:
   a. Worn push rod.
   b. Worn rocker arm.
   c. Lifter plunger stuck in down position, due to dirt or carbon.
   d. Faulty lifter.

Checking of the previous four items:

1. Look at the upper end of push rod. Excessive wear of the spherical surface indicates one of the following conditions.
   a. Improper hardness of the push rod ball. The push rod and rocker arm must be replaced.
   b. Improper lubrication of the push rod. The push rod and rocker arm must be replaced. The oiling system to the push rod should be checked.
2. If push rod appears in good condition and has been properly lubricated, replace rocker arm and recheck valve lash.
3. If valve lash exists and push rod and rocker arm are ok, trouble is in the lifter. Lifter should be replaced.

Important

- Valve lifters may be cleaned to eliminate sticking due to sludge and varnish. They must be reinstalled in their original position on the engine. Valve lifter components must be reassembled into the lifter from which they were removed.
- There are two types of valve lifters: a flat tappet hydraulic type (Figure 46) for most engines and a roller tappet type (Figure 47). They function in a similar manner.

- If the camshaft was replaced, the lifters must also be replaced (except roller lifters).

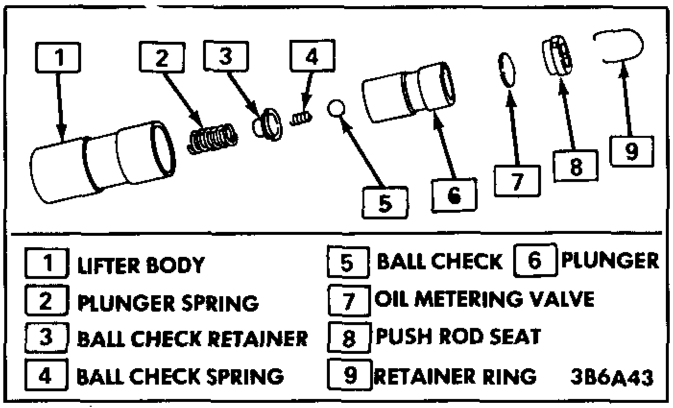


Figure 46 Valve Lifter - Flat Tappet

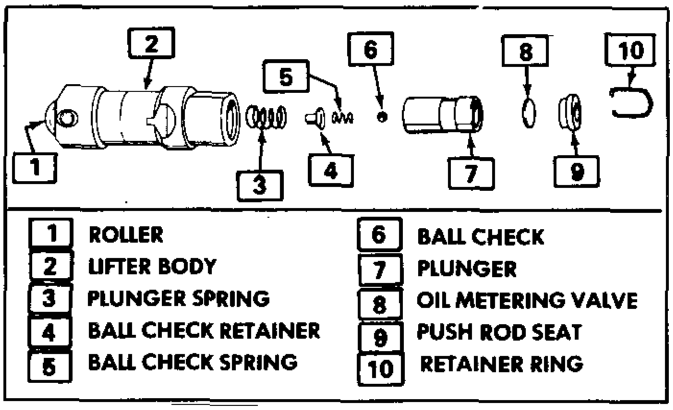


Figure 47 Valve Lifter - Roller Tappet

Disassemble

- Valve lifter

Remove or Disconnect

1. Push rod seat retainer. Hold plunger down with a push rod and remove retainer with a small screwdriver.
2. Push rod seat
3. Metering valve
4. Plunger. If the plunger is stuck, turn the lifter body upside down and tap on a flat surface. If the plunger cannot be moved, soak in carburetor cleaning fluid.

CAUTION: Do not breathe fumes and avoid skin contact with carburetor cleaning fluid.

5. Ball check valve assembly. Remove with a small screwdriver.
6. Plunger spring

Clean

- Sludge
- Varnish

Inspect

- 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.
- Roller (if equipped) for:
  - Freedom of movement. Replace the lifter if it binds or roughness can be felt.
  - Excessive looseness in the roller bearings. Replace if necessary.
  - Flat spots. Replace the lifter, if worn.
  - Pitting. Replace the lifter if pitted.
- Push rod seat. If worn, inspect the push rod. Replace if worn.

Important

- Do not attempt reconditioning by taking parts from other unserviceable lifters.
- Cleanliness is very important. Lint or dirt will cause the lifter to fail.

Assemble

1. Check ball on small hole in the bottom of the plunger.
2. Check ball spring. Insert in ball retainer.
3. Ball retainer. Place ball retainer and spring over the check ball and press retainer into position in the plunger with a small screwdriver.
4. Plunger spring, over the ball retainer.
5. Lifter body over the spring and plunger. Line up oil holes in the lifter body and the plunger.
6. Fill the lifter with SAE 10 engine oil
   - With a 3mm (1/8") drift pin push down the plunger until the oil holes in the lifter body and the plunger are aligned.
   - Insert a 1.5mm (1/16") pin through the oil holes, locking the plunger down, with the plunger spring compressed.
   - Remove the 3mm (1/8") drift pin.
   - Fill the lifter with SAE 10 engine oil.
7. Metering valve
8. Push rod seat
9. Push rod seat retainer
10. Push down on the push rod seat to relieve the plunger spring pressure and remove the 1.5mm (1/6") pin.

Important

- Test lifter leak-down rate (refer to Leak-Down Rate Test).
- Flat Tappet: Coat the lifter bottom with GM P/N 1052367, or equivalent. If new lifters were installed, add GM P/N 1052367 EP lubricant, or equivalent, to the engine oil.
- Roller Tappet: Dip lifter in GM P/N 1052365, or equivalent.

VALVE LIFTER LEAK-DOWN RATE TEST (FLAT TAPPET LIFTERS ONLY)

Tool Required:

J-5790 Tester (Figure 48)

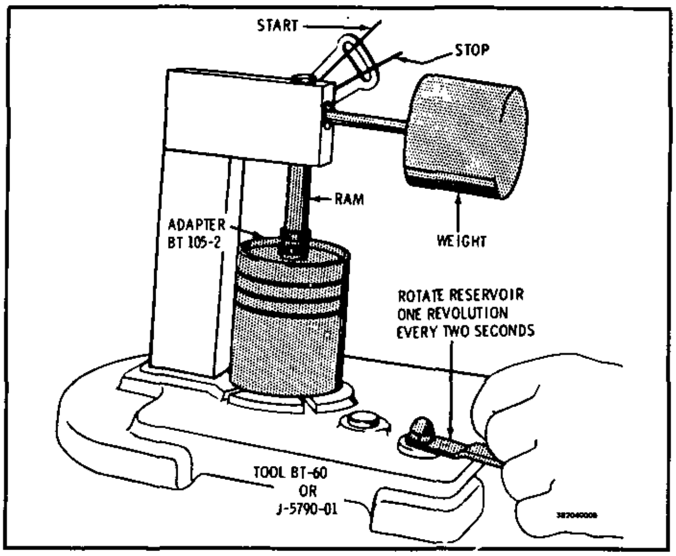


Figure 48 Measuring Valve Lifter Leak-Down Rate

With J-5790-01 test the valve lifter leak-down rate:

1. Fill tester cup to approximately one inch from top with the special fluid, which is available from tester manufacturer.
2. Swing weight arm out of the way, raise ram, and position lifter into boss in center of tester cup.
3. Adjust ram (with weight arm clear of ram) so that the point is positioned on the set line (marked "S"). Tighten jam nut to maintain setting.
4. Operate lifter through full travel of plunger by pumping weight arm to fill lifter with test fluid and force out air.

   Important

   - Lifter must be completely submerged at all times.
   - Continue pumping for several strokes after definite resistance is felt.

5. Raise weight arm to allow plunger spring to expand fully; lower arm onto ram and commence turning crank slowly (1 revolution every 2 seconds).
6. Time indicator travel from lower line (first line above set line) to line marked .094 or 3/32", while rotating cup with crank. Lifter is satisfactory if rate is between 12 and 90 seconds.

CYLINDER BLOCK

Disassemble

- Cooling jacket plugs
  - Obtain a suitable self-threading screw
  - Drill a hole into the plug
  - Install the self-threading screw
  - Pry out plug
- Oil gallery screw plugs

  Important

  - Some plugs have holes drilled to spray oil on the timing chain and the distributor gear. Note the position of these plugs to aid in re-assembly.
- Camshaft bearings
  Refer to Camshaft and Camshaft Bearing.

  Important

  - Caustic cleaning solution destroys the bearing material. All bearings must be replaced after cleaning with a caustic solution. Do not clean bearing material or aluminum parts with caustic solutions.

Clean

- Sealing material from mating surfaces
- Boil in caustic solution
  - Flush with clean water or steam
- Oil passages
- All blind holes
- Spray or wipe cylinder bores and machined surfaces with engine oil

Inspect

- Deck surface for flatness. Use a straight edge and a feeler gage (Figure 49). Minor irregularities may be carefully machined. If more than .25 mm (.010") gasoline V6, or .127 mm (.005") V8 must be removed, replace the block.
- Oil pan rail and timing cover attaching area for nicks. **Minor** irregularities may be cleaned up with a flat mill file.
- Transmission case mating surface

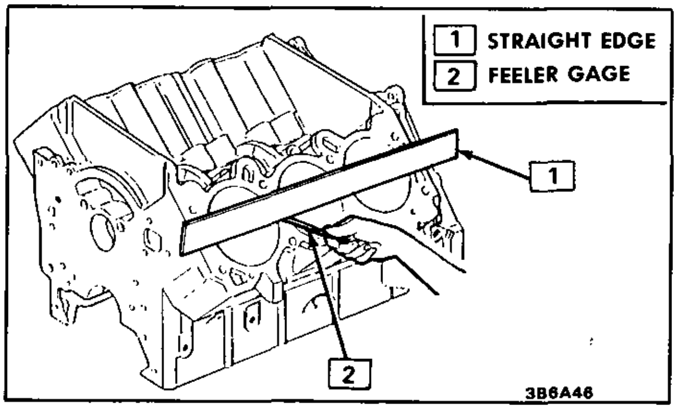


Figure 49 Checking Cylinder Block for Flatness

NOTICE: If this surface is not flat, a broken flexplate may result.

- Temporarily install the crankshaft. Measure crankshaft flange run-out (refer to Crankshaft).

Measure

- Six mounting hole bosses (Figure 50)
  1. Hold gage plate flat against the crankshaft flange (Figure 50).

2. Place dial indicator stem on the transmission mounting bolt hole boss (Item 1, Figure 50) and set indicator to 0.
3. Record the readings obtained on the remaining transmission mounting bolt hole bosses. Measurements should not vary more than .203 mm (.008").
4. If the readings vary more than .203 mm (.008"), recheck crankshaft flange run out. If the run out is excessive, replace the crankshaft.

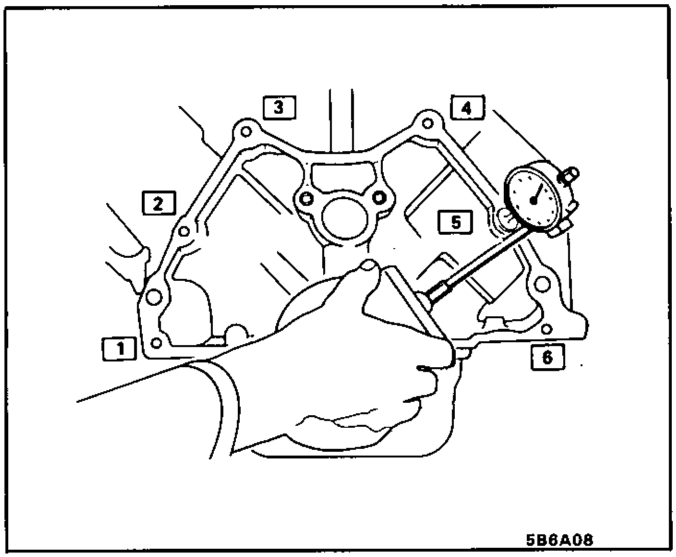


Figure 50 Measuring Transmission Mounting Surface Run Out

- Threaded holes. If necessary, clean with a tap or drill out and install thread inserts (refer to Thread Insert Repair).

Important

- The following inspections as well as reconditioning, if necessary, must be carried out with the main bearing caps installed and torqued to specification.
- Make sure main bearing caps are installed correctly, with the arrows pointing toward the front of the engine.

- Bearing bores, with a bore gage, measure concentricity and alignment (Figure 51)
  - Camshaft
  - Crankshaft
  - If outside specification, replace the block.
  - If an examination of the outside of the bearing inserts indicates minor high spots, they may be carefully removed.
- Cylinder bore, with bore gage J-8087 measure for wear, taper, run-out and ridging (Figure 52)
- If the bore is worn beyond limits (Figure 53), it may be re-bored, honed and fitted with oversize pistons. The smallest available oversize should be selected (refer to Piston Fitting).

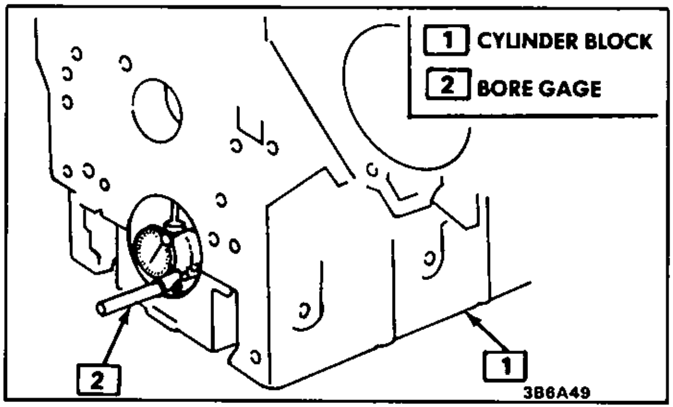


Figure 51 Measuring Bearing Bore

Important

- Leave sufficient material to allow finish honing in conjunction with fitting the piston.
- If the bore is glazed but otherwise serviceable, break the glaze lightly with a hone and replace the piston rings.
- Make sure the honing stones are clean, sharp and straight. Move the hone slowly up and down to produce a 45° cross-hatch pattern. Clean bore thoroughly with soap and water. Dry and rub in clean engine oil, remeasure.

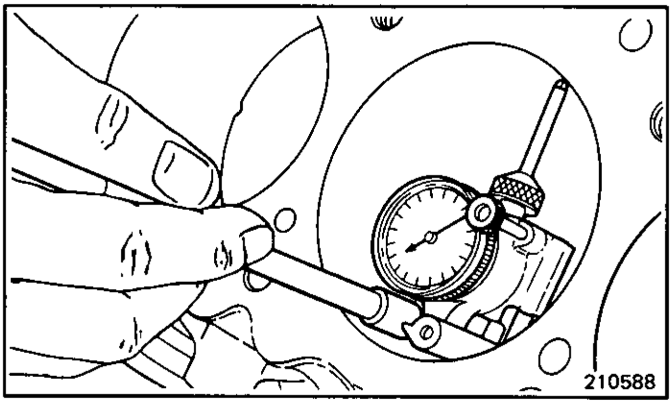


Figure 52 Measuring Cylinder Bore For Taper And Out of Round

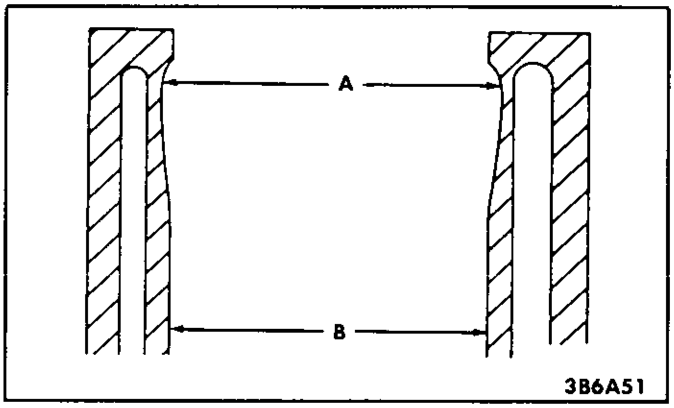


Figure 53 Cylinder Wear Pattern

Assemble

- Cooling jacket plugs. Apply GM 1050026 sealer, Fel Pro-Set and Seal, or equivalent.
- Oil gallery screw plug

  Important

  - Make sure plugs with oil holes are reinstalled in their original position to provide lubrication to the timing chain and to the distributor. Refer to Specific Engine Section.
- Camshaft bearings (refer to Camshaft and Camshaft Bearings)

PISTON FITTING

Important

- When fitting pistons, both piston and cylinder bore condition must be considered together. Production and service pistons have the same nominal weight and can be intermixed without affecting engine balance. If necessary, used pistons may be fitted selectively to any cylinder of the engine, providing they are in good condition.
- Do not cut oversized pistons down, or engine balance will be affected.

Measure

1. Piston. If worn or damaged, replace with a standard or oversized piston.
2. Cylinder bore (Figure 54), refer to Cylinder Block. If worn beyond specifications, rebore and hone to size.

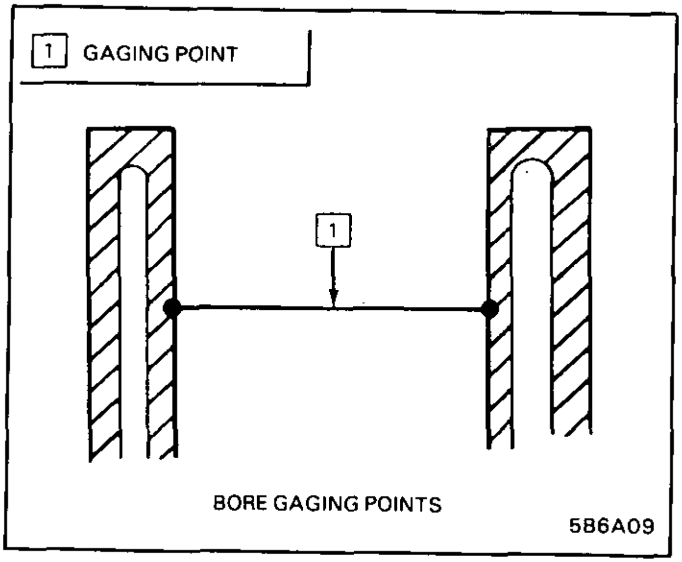


Figure 54 Cylinder Bore Gaging Point

Important

- Finish hone when selecting piston.

3. Fit piston to cylinder.

Important

- Both piston and cylinder bore must be dry.

Clean

- Scrub the cylinder bore and the piston with soap and water and remove all foreign material. Dry and rub in clean engine oil.

Measure

1. Check piston to cylinder bore clearance as follows:
   a. Measure the cylinder bore diameter with a telescopic gage.
   b. Measure the cylinder bore diameter. When measuring piston for size or taper, measurement must be made as shown in Figure 55.

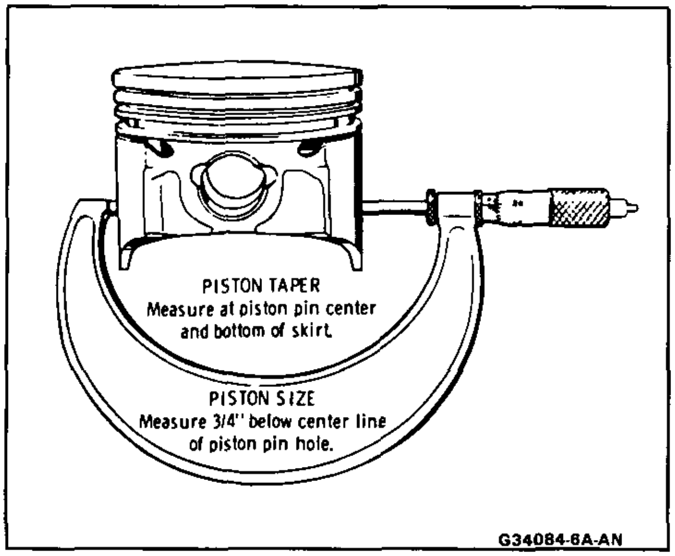


Figure 55 Measuring Piston

   c. Subtract piston diameter from cylinder bore diameter to determine piston to bore clearance.
   d. Compare piston to bore clearance obtained with that specified (Figure 37).
   e. Determine if piston to bore clearance is in acceptable range.
2. If a used piston is not acceptable, check service piston sizes and determine if a new piston can be selected. (Service pistons are available in standard and several oversizes.)
3. If cylinder bore must be reconditioned, measure new piston diameter. Then hone cylinder bore to obtain preferred clearance.
4. Select new piston and mark piston to identify the cylinder for which it was fitted. (On some cars oversized pistons may be found. These pistons will be .010" oversize.)

Clean

- Scrub the cylinder bore and the piston with soap and water and remove all foreign material. Dry and rub in clean engine oil.

FLEXPLATE BALANCE

Flexplate imbalance can be corrected by the use of balance weights clipped to the flexplate (Figure 56).

1. Mark the flywheel in four locations, 90° apart.
2. Install one clip at one of the marked locations.

Inspect

- Start engine and, with transmission/transaxle in "Neutral", note the vibration.
  - If vibration has increased, relocate clip 180° from its present position.
  - If vibration has decreased, install an additional clip next to the first clip.
  - If no change is noticed, relocate the clip 90° from its present location.
- Continue until vibration is reduced. Fine adjustments may be made by moving the clips in small increments.

NOTICE: Make sure the clips are properly secured to avoid shifting at high engine speed.

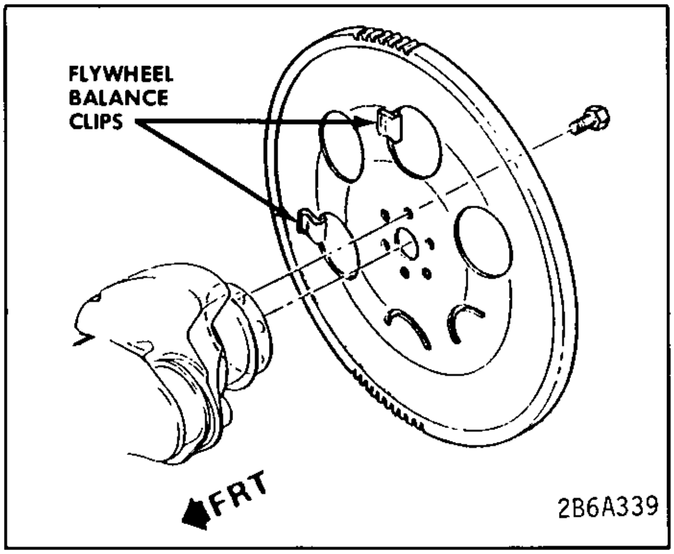


Figure 56 Flexplate Balance Clip Location (Typical)

THREAD REPAIR

Damaged threads may be reconditioned by drilling out, rethreading and installing a suitable thread insert.

Tools Required:

General purpose thread repair kits are available commercially. J-33425 is recommended for spark plug threads.

CAUTION: Wear safety glasses to avoid eye damage.

1. Determine size, pitch and depth of damaged thread. If necessary, adjust stop collars on cutting tool and tap to the required depth.

Important

- Refer to the kit manufacturer's instructions regarding the size of drill and tap to be used.

2. Drill out damaged thread. Clean out chips.
3. Tap hole. Lubricate tap with light engine oil (except when tapping into aluminum). Clean the thread.

Important

- Avoid build-up of chips. Back out the tap every few turns and remove chips.

4. Thread the thread insert onto the mandrel of the installer (Figure 57). Engage the tang of the insert onto the end of the mandrel.
5. Lubricate the insert with light engine oil (except when installing in aluminum) and install.

Important

- When correctly installed, the insert should be flush to one turn below the surface.

6. If the tang of the insert does not break off when backing out the installer, break the tang off with a drift punch.

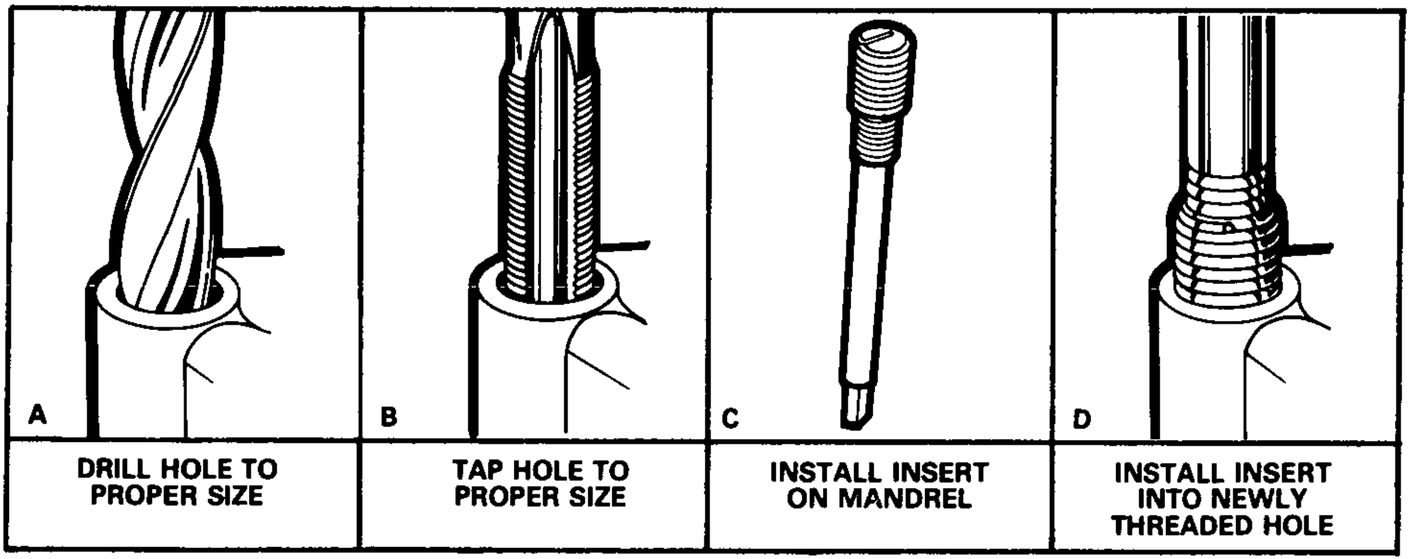


Figure 57 Repairing Threaded Holes

SECTION 6A1

2.5 LITER L4 ENGINE

CONTENTS

"FOR VEHICLES SOLD IN CANADA AND EQUIPPED WITH NON-CLOSED LOOP ENGINES, ALSO REFER TO THE APPROPRIATE CANADIAN SERVICE MANUAL SUPPLEMENT."

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast iron and has four (4) in-line cylinders which are numbered from front to rear 1 through 4. Five main bearings support the crankshaft, which is retained by recessed bearing caps that are machined with the block for proper alignment and clearance. Because roller tappets are used, lifter retainers and guides are installed in the block to keep the lifters in proper position.

Cylinders are completely encircled by coolant jackets. (For details of engine cooling system, see ENGINE COOLING, Section 6B).

CYLINDER HEAD

The cast iron cylinder head provides a compression ratio of 9.0:1. It is cast with individual intake and exhaust ports for each cylinder. Intake ports have a swirl configuration to increase turbulence of the charge and provide faster burn, which improves driveability while reducing emissions. Valve guides are integral and rocker arms are retained on individually threaded shoulder bolts.

Combustion chambers are cast to insure uniform shape for all cylinders and enhance swirl in the cylinder. Spark plugs are located near intake valves for maximum power.

Intake valves are large to provide easy breathing for high combustion efficiency. Intake and exhaust valve seat angles are 46° to assure valve-to-seat contact at the outer diameter of the seat.

The cylinder head has straight valve guides, cast integrally. External shields are used on both intake and exhaust valves to reduce the amount of oil splashed against the stems. Valve stem seals are used on intake and exhaust valves plus, on the intake side only, a positive seal is used to prevent excess oil from entering the valve guides. Face angles of both intake and exhaust valve seats are 45°.

VALVE TRAIN

A very simple ball pivot-type valve train is used (Fig. 1). Motion is transmitted from the camshaft through the roller 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 and ball are retained by a shoulder bolt.

VALVE LIFTERS

Hydraulic valve lifters have roller tappets to reduce friction between the valve lifter and camshaft lobe. Lifter retainers and guides are installed in the block to keep lifters from rotating on the camshaft lobes.

Hydraulic valve lifters keep all parts of the valve train in constant contact and adjust automatically to maintain zero lash under all conditions.

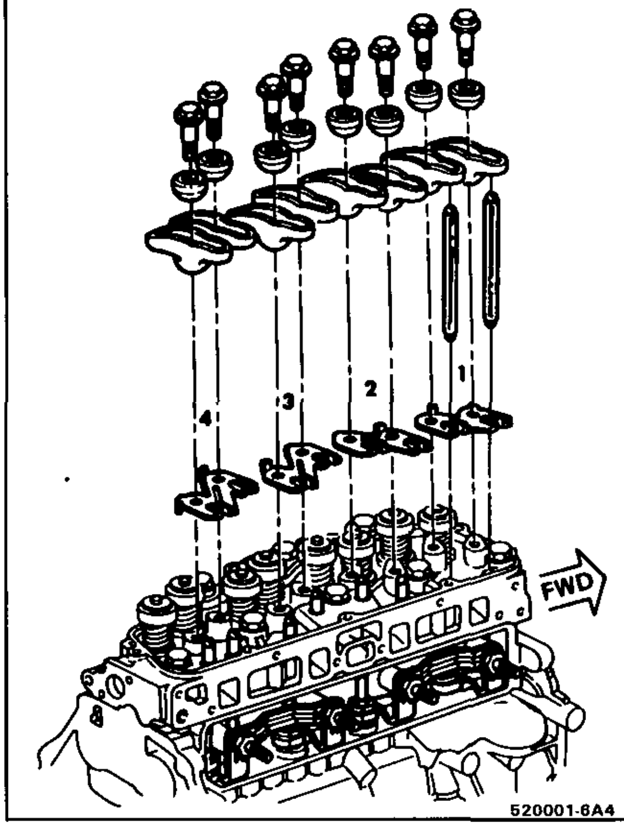


Fig. 1 Valve Train

The hydraulic lifter rides in a cylinder block boss and consists of a steel body with a roller tappet, a plunger spring, ball check retainer, ball check spring, ball check, plunger, oil metering valve, push rod seat and retainer ring.

INTAKE MANIFOLD

The intake manifold is cast aluminum and uses a single level design. A cast passage in the manifold allows engine coolant to pass through to utilize hot water heat for intake air and EFI system warm-up. An EGR port is also cast in the manifold and receives exhaust gases from an internal exhaust passage in the cylinder head.

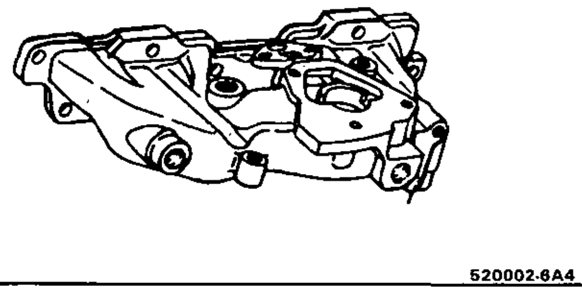


Fig. 2 Intake Manifold

EXHAUST MANIFOLD

The exhaust manifold is made of stainless steel and directs exhaust gases from the combustion chambers. The manifold is equipped with a heat shield that is used to route heated air to the air cleaner for better fuel vaporization.

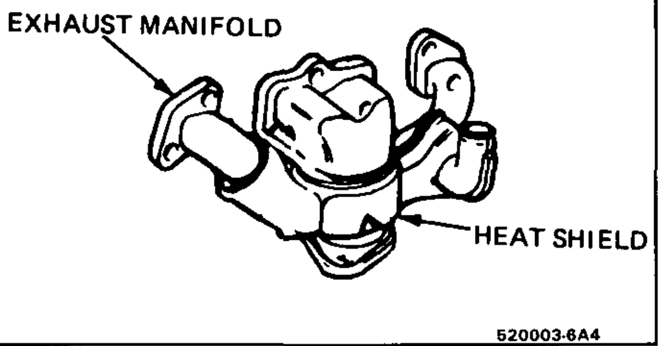


Fig. 3 Exhaust Manifold

CAMSHAFT AND DRIVE

The cast iron camshaft is supported by three bearings and is gear driven. An iron crankshaft gear drives the camshaft through a pheonolic fabric composition gear with a steel hub (Fig. 4).

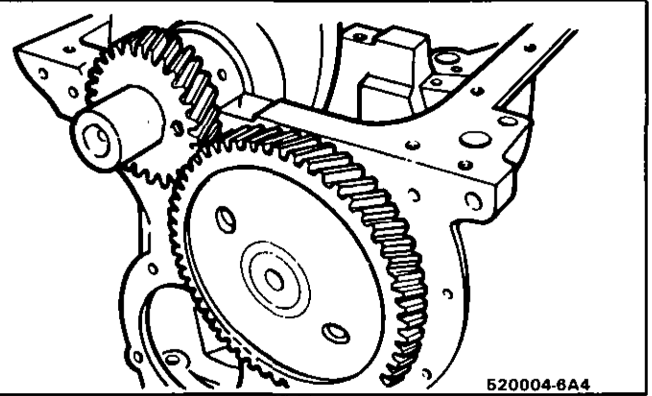


Fig. 4 Camshaft and Crankshaft Gears

Cam lobes are hardened and ground with no front to rear taper; since lifters do not "orbit" with cam rotation.

Camshaft bearings are lubricated through oil holes which intersect the main gallery.

PISTONS AND CONNECTING RODS

The pistons are of a lightweight, cast aluminum slipper skirt type and cam ground so that the diameter across the thrust face is larger than the diameter fore and aft of the engine. Two compression rings and one oil control ring are used, all of which are located above the piston pin (Fig. 5).

Piston pins are offset toward 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 tempered steel and have a floating fit in the pistons. They are retained in the connecting rods by a press fit.

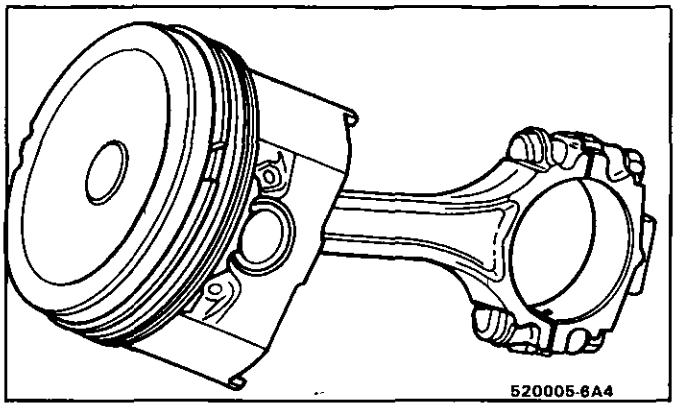


Fig. 5 Piston and Rod Assembly

Connecting rods are made of Armasteel. Full pressure lubrication is directed to the connecting rods by drilled oil passages from the adjacent main bearing journal. Oil holes at the connecting rod journals are located so that oil is supplied to give maximum lubrication just prior to full bearing load.

CRANKSHAFT AND BEARINGS

The crankshaft is cast nodular iron and is supported by five main bearings. Number five bearing is the thrust bearing.

Main bearings are lubricated from oil holes intersecting the main oil gallery, which runs parallel to the crankshaft bores along the right side of the block.

ENGINE LUBRICATION

Engine lubrication is accomplished through a gear-type pump. The pump picks up engine oil from the oil pan sump, pumps it through the full flow oil filter into an oil passage which runs along the right side of the block and intersects the lifter bosses. Oil from this passage is then routed to the crankshaft main bearings and camshaft bearings through smaller drilled passages. Oil is supplied to the rocker arms through holes in the hydraulic lifters which feed oil up the tubular push rods to the rocker arms. The oil is metered by discs under the push rod seat. Three valves are incorporated into the oil system to insure proper flow of oil. A bypass valve in the oil pickup screen insures adequate oil flow if the screen should become restricted. Another bypass valve is located at the oil filter mounting, allowing oil flow in case the filter becomes plugged or restricted. The pressure regulator valve, located in the oil pump body, maintains adequate pressure for the lubrication system and bypasses any excess back to the suction side of the pump. Many internal engine parts have no direct oil feed and are supplied by either gravity or splash from other direct feed components. Timing gears are lubricated by oil which is supplied through a passage from the front of the camshaft to a calibrated nozzle above the crankshaft gear. Engine lubrication diagram is shown in Fig. 6. A full flow oil filter is standard equipment on the engine. The filter is mounted on a machined boss on the side of the engine. All oil from the pump passes through the filter before going to the engine oil galleries. In the filter, the oil passes through a filtering element where dirt and foreign particles are removed.

SERVICE PROCEDURES

ROCKER ARM COVER

Remove or Disconnect

1. Air cleaner.
2. PCV valve and hose.
3. Accelerator and TV cables.
4. EGR valve.
5. Rocker arm cover bolts.
6. Wires from spark plugs and clips.
7. Rocker arm cover by tapping with rubber hammer.

NOTICE: Do not pry on cover or damage to sealing surfaces may result.

Clean

- Sealing surfaces on rocker arm cover and cylinder head. Use degreaser to dry surfaces.

Install or Connect

Fig. 7

1. Apply a continuous 3/16" (5 MM) diameter bead of RTV sealant (No 1052915 or equivalent) around cylinder head sealant surface inboard at bolt holes.

NOTICE: Keep sealant out of the bolt holes to prevent damage to the cylinder head.

2. Rocker arm cover and retaining bolts - 5 N·m (4 lb. ft.).
3. Spark plug wires and clips.
4. PCV valve and hose.
5. Accelerator and TV cables.
6. EGR valve and gasket.
7. Air cleaner.

Inspect

- For oil leaks.

ROCKER ARMS, PUSH RODS AND GUIDES

Remove or Disconnect

1. Rocker arm cover.
2. Rocker arm bolt and ball.
3. If replacing push rod only, loosen rocker arm bolt and swing arm clear of push rod.
4. Rocker arm, push rod and guide.

Important

- Store used components in order so they can be reassembled in the same location.

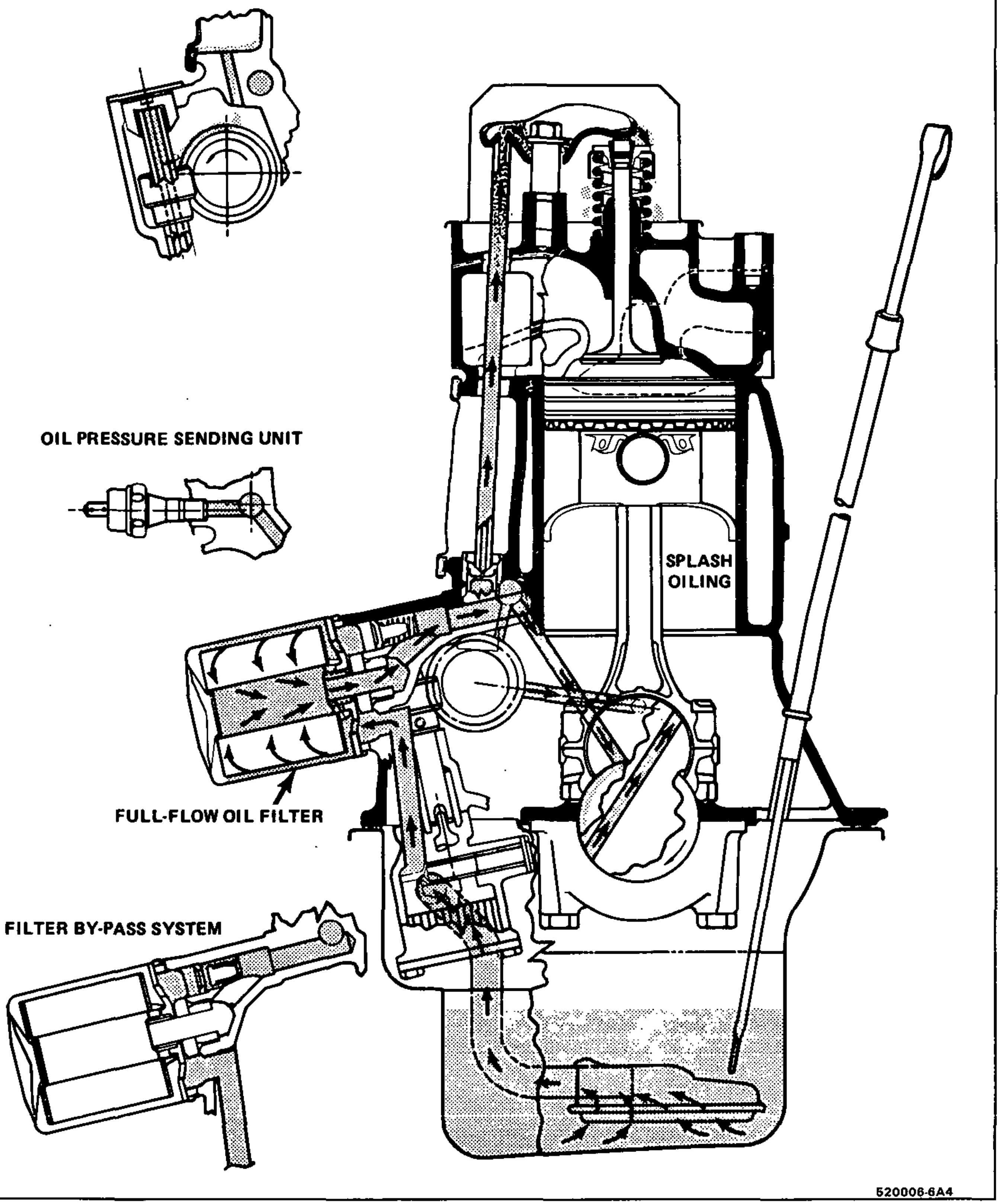


Fig. 6 Engine Lubrication

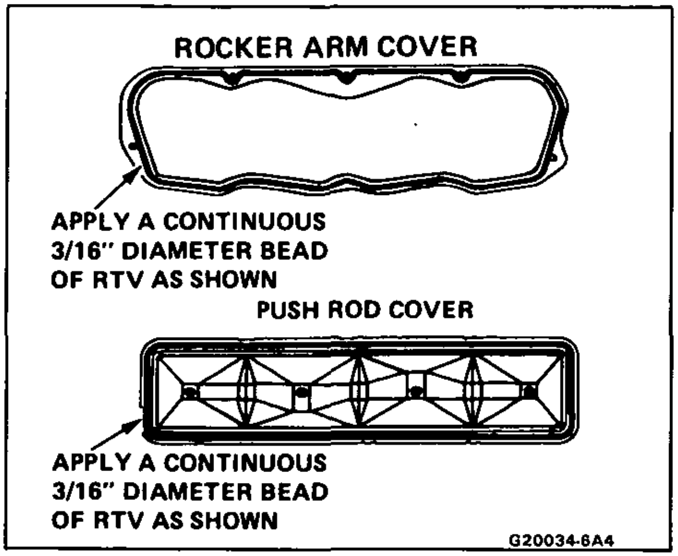


Fig. 7 Push Rod Cover and Rocker Arm Cover RTV Application

- Push rod guides are different and must be reassembled in previous location.
- When new rocker arms and/or rocker arm balls are used, coat their bearing surfaces with "Molykote" or its equivalent.

Install or Connect

1. Push rod through cylinder head, and into lifter seat.
2. Guide, rocker arm, ball, and bolt. Torque 32 N·m (24 lb. ft.).
3. Rocker arm cover.

VALVE SPRING, SHIELD AND/OR SEALS

Tools required

J23590 Air Adapter.
J5892-A Spring Compressor (or J5892-1).
J5892-1 can be modified to replace J5892-A by grinding 1/16" from slotted end.

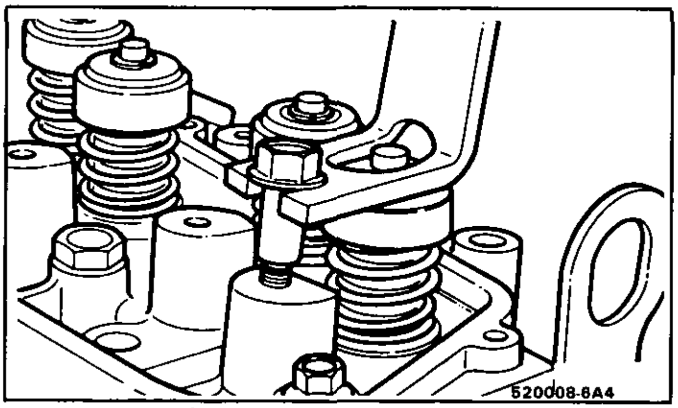


Fig. 8 Compressing Valve Springs

Remove or Disconnect

Figs. 8 and 9

1. Rocker arm cover.
2. Rocker arm(s).

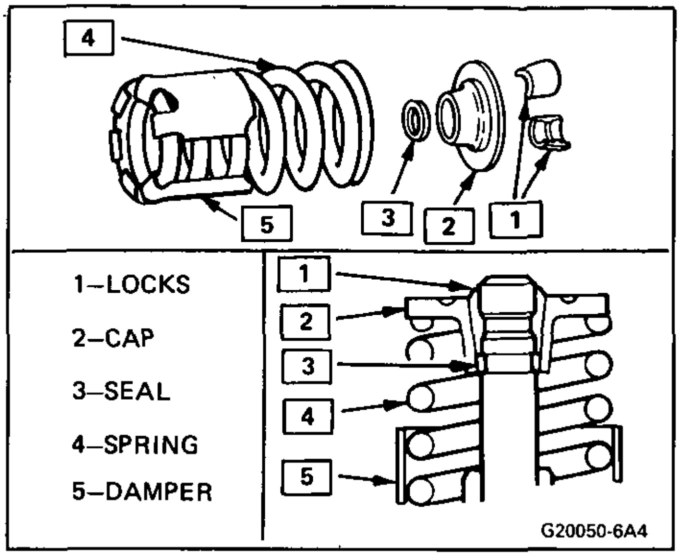


Fig. 9 Upper Valve Train Parts

3. Spark plug(s).
4. Valve stem components.
   a. Insert tool J23590 in spark plug hole.
   b. Apply compressed air to hold valves in place.
   c. Using tool J5892-A, or modified J5892-1, compress the valve spring.
   d. Remove locks.
   e. Carefully release spring pressure.
   f. Remove tool.
   g. Remove cap, shield, spring and seal.

Important

- Always use new valve stem seals.

Install or Connect

1. Valve stem components.
   a. Assemble spring, shield and cap.
   b. Using tool J5892-A, or modified J5892-1, compress the valve spring.
   c. Install new valve stem seal (lubricate to aid assembly).
   d. Insert locks.
   e. Carefully release spring pressure. Be sure locks are in place.
      - See Section 6A General Engine Mechanical for detail of valves and spring specification.
      - Assemble used parts in original locations.

Remove or Disconnect

- Release air pressure.
- J23590.

2. Spark plugs.
3. Rocker arms.
4. Rocker arm cover.

Inspect

- For oil leaks.

- For proper completion of repair.

INTAKE MANIFOLD

Remove or Disconnect

1. Battery cable.
2. Air cleaner and heat stove pipe.
3. PCV valve and hose at TBI.
4. Coolant.
5. Fuel lines.
6. Vacuum hoses.
7. From TBI assembly.
   - Wiring.
   - Throttle linkage.
8. Linkage - transaxle downshift.
9. Cruise control and linkage - if applicable.
10. Throttle linkage and bell crank - place on one side for clearance.
11. Heater hose.
12. Generator brace.
13. Ignition coil.
14. Retaining bolts and intake manifold.

Clean

- All gasket surfaces on cylinder head and intake manifold.

Install or Connect

1. Intake manifold, with new gasket.
2. Retaining bolts and washers.

Tighten

- In sequence, and to specification shown in Fig. 10.

3. Ignition coil.
4. Generator brace.
5. Heater hose.
6. Throttle linkage and bell crank.
7. Cruise control and linkage, if fitted.
8. Linkage - transaxle downshift.
9. To TBI assembly.
   - Wiring.
   - Throttle linkage.
10. Vacuum hoses.
11. Fuel lines.
12. Engine coolant.
13. PCV valve and hose at TBI.
14. Air cleaner and heat stove pipe.
15. Battery cable.

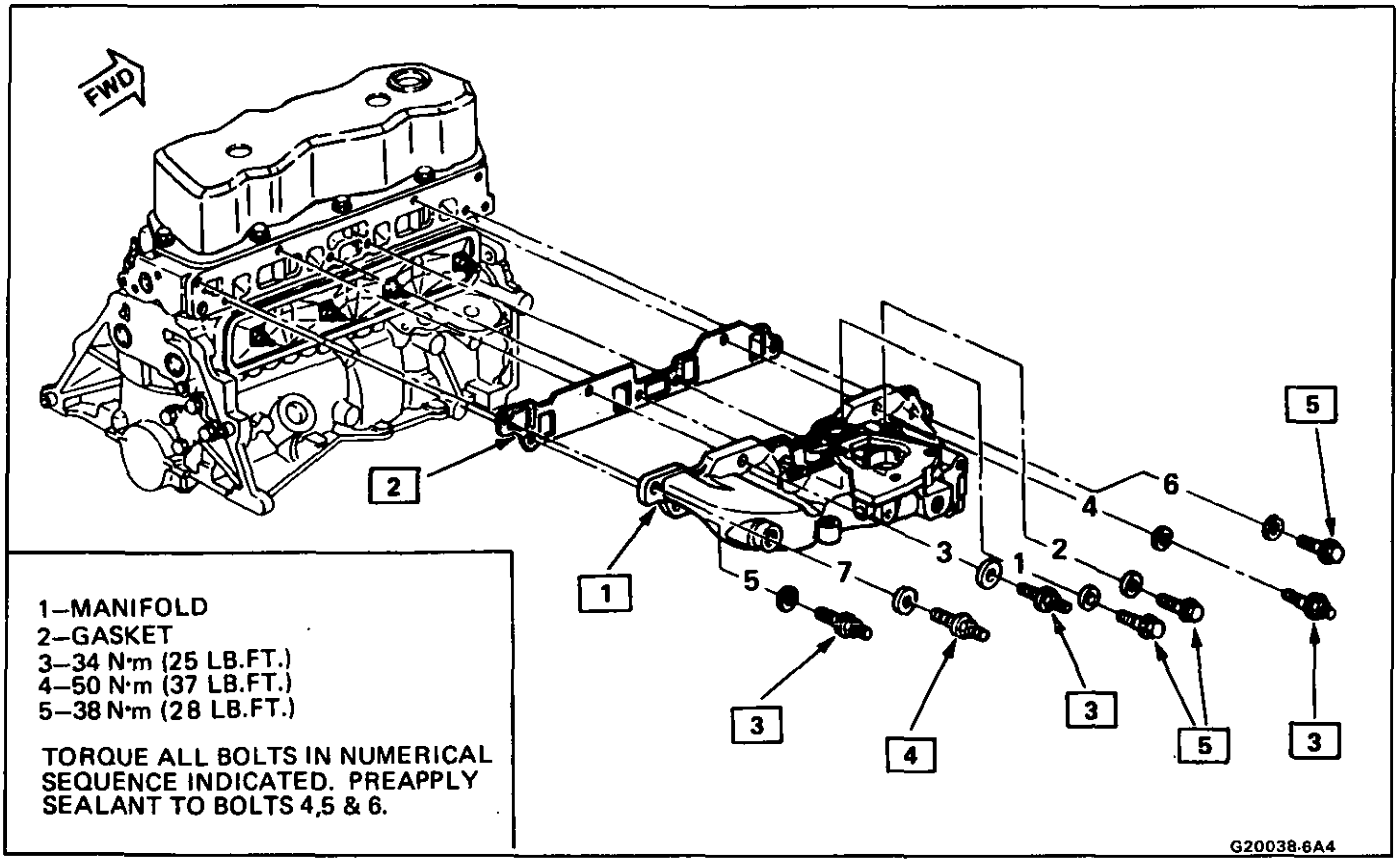
Inspect

- For fluid and vacuum leaks.

VALVE LIFTERS

Remove or Disconnect

1. Rocker arm cover.
2. Intake manifold.



1–MANIFOLD
2–GASKET
3–34 N·m (25 LB.FT.)
4–50 N·m (37 LB.FT.)
5–38 N·m (28 LB.FT.)

TORQUE ALL BOLTS IN NUMERICAL SEQUENCE INDICATED. PREAPPLY SEALANT TO BOLTS 4,5 & 6.

Fig. 10 Intake Manifold Bolt Torque Sequence

3. Push rod cover.
4. Loosen rocker arms, rotate to clear push rods (in pairs so that lifter guide can be removed).
5. Remove push rods.
6. Retainer and guide.
7. Remove lifter.

Important

- Identify component location for reassembly.

Inspect

- For inspection and overhaul of valve lifters refer to Section 6A General Engine Mechanical.

Clean

- If new lifter is to be installed, clean all sealer coating from inside of new lifter.

Install or Connect

1. Lubricate bearing surfaces with engine oil.
2. Lifters in lifter bore.
3. Guide and retainer.
4. Push rods.
5. Position rocker arms and guides.

Tighten

- With lifter on base circle of camshaft, tighten rocker arm bolts 32 N·m (24 lb. ft.).

6. Push rod cover.
7. Intake manifold.
8. Rocker arm cover.

Inspect

- For oil leaks.
- For proper completion of repair.

CYLINDER HEAD

Remove or Disconnect

1. Engine coolant.
2. Raise car.
3. Exhaust pipe.
4. Lower car.
5. Battery ground cable.
6. Oil level indicator tube.
7. Air cleaner.
8. From TBI assembly.
   - Wiring.
   - Throttle linkage.
   - Fuel lines.
9. Heater hose from intake manifold.
10. Ignition coil.
11. Wiring connections from intake manifold and cylinder head - all.
12. Vacuum hoses.
13. Engine strut rod bolt from upper support (A and P Carlines only).
14. A/C brackets, A/C compressor (swing aside) (if top mounted).
15. Generator brackets (swing aside).
16. Power steering pump bracket-upper (if top mounted).
17. Radiator hoses.
18. Rocker arm cover.
19. Rocker arms.
20. Push rods.
21. Cylinder head bolts.
22. Cylinder head.

OFF CAR SERVICE OF CYLINDER HEAD ASSEMBLY

- For inspection and overhaul of cylinder head refer to Section 6A General Engine Mechanical.
- Intake and exhaust manifolds may be removed to service cylinder head.

Clean

- Clean all oil and foreign material from gasket surfaces of head and block. Surfaces must also be free of nicks or heavy scratches.
- Retaining bolt and cylinder block threads must be clean. Dirt will affect bolt torque.

Install or Connect

1. New gasket over dowel pins in cylinder block.
2. Cylinder head into place over dowel pins.
3. Cylinder head retaining bolts with specified threads coated with sealing compound - fingertight.

Tighten

- Cylinder head bolts gradually with torque wrench to 25 N·m (18 lb. ft.) in sequence shown in Fig. 11.
- Repeat sequence, bringing torque to 30 N·m (22 lb. ft.) on all bolts except number 9. Torque number 9 to 40 N·m (29 lb. ft.).
- Repeat sequence. Turn all bolts, except number 9, 120 degrees (two flats). Turn number 9 1/4 turn (90 degrees).

4. Push rods.
5. Rocker arms.
6. Rocker arm cover.
7. Radiator hose.
8. Power steering pump bracket - upper (if top mounted).
9. Generator bracket and belt.
10. A/C compressor and bracket (if top mounted).
11. Engine strut rod bolt (A and P Carlines only).
12. All wiring connections to intake manifold and cylinder head.
13. Vacuum hoses.
14. Ignition coil.
15. Heater hose to intake manifold.
16. To TBI assembly.
    - Wiring.
    - Throttle linkage.

1–APPLY SEALING COMPOUND PART NUMBER 1052080 OR EQUIVALENT TO THREADS ON BOLTS SHOWN.

2–MOUNTING SURFACES OF BLOCK ASM., HEAD ASM. AND BOTH SIDES OF GASKET MUST BE FREE OF OIL AND FOREIGN MATERIAL.

3–LOCATING PINS

NUMBERS SHOWN DESIGNATE BOLT POSITIONS AND BOLT TIGHTENING SEQUENCE.

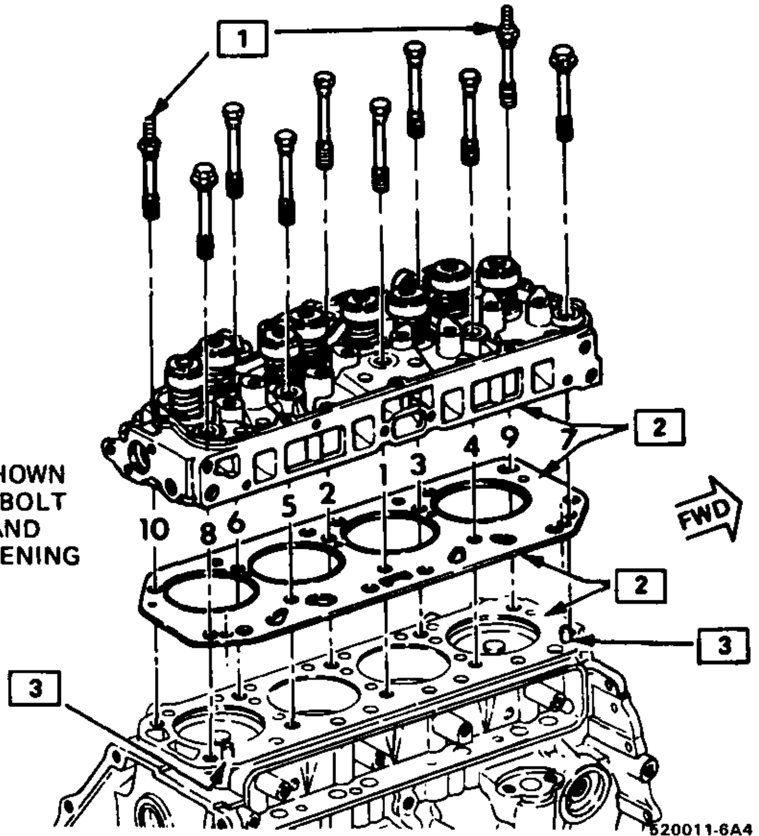


Fig. 11 Cylinder Head Tightening Sequence

- Fuel lines.

17. Oil level indicator tube.
18. Air cleaner.
19. Coolant.
20. Raise car.
21. Exhaust pipe.
22. Lower car.

Inspect

- For fluid leaks.
- For proper completion of repair.

CRANKSHAFT PULLEY HUB AND/OR OIL SEAL

Remove or Disconnect

1. Drive belts.
2. Splash shield - right front inner (A, P and N Carlines only).
3. Pulley bolt, pulley and hub.
4. Oil seal.
    - Pry from front cover with large screwdriver. Do not distort cover.

Install or Connect

Tool Required:
J34995 Seal Installer.

1. Loosen front cover bolts.
2. New seal - with J34995. Lip toward rear of engine.
3. Lubricate balancer and seal lip with engine oil.
4. With J34995 in place, tighten front cover bolts.
5. Hub on crankshaft - bottom out against crankshaft gear.
6. Hub bolt - 220 N·m (162 lb. ft.).
7. Drive belts - tension to specification.
8. Splash shield - right front.

Important

- Pulley to hub bolts should be coated with Drylock #209 or equivalent.

Inspect

- For pulley alignment.
- For oil leaks.

OIL PUMP

Remove or Disconnect

1. Oil pan.
2. Flange mounting bolts - two, and nut from main bearing cap bolt.
3. Pump and screen, as an assembly.

Inspect

- Refer to Section 6A General Engine Mechanical for oil pump inspection and overhaul procedures.

Install or Connect

1. Pump and screen.

- Align pump shaft with drive shaft tang.
- Pump should slide easily into place over lower bushing - no gasket. If not, remove and relocate drive slot.

2. Pump bolts - 30 N·m (22 lb. ft.).
3. Oil pan.

REAR MAIN BEARING OIL SEAL AND/OR FLYWHEEL

Remove or Disconnect

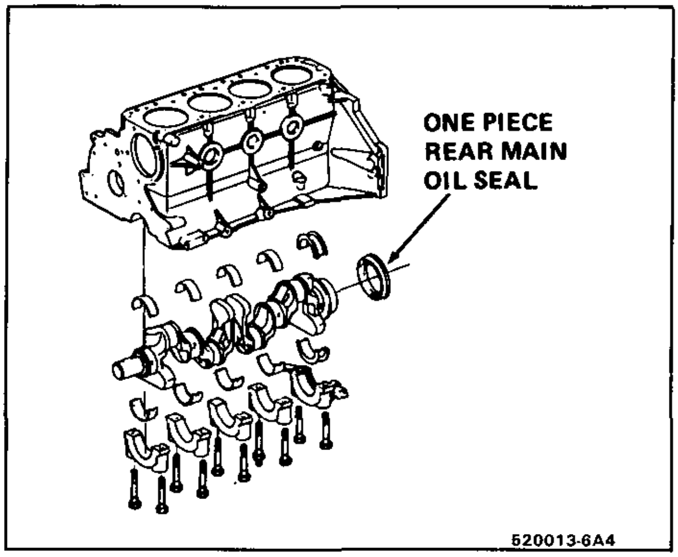


Fig. 12 Crankshaft with Bearings and Seal

Important

- The rear main bearing oil seal is a one piece unit and can be replaced without removal of oil pan or crankshaft.

1. Transmission assembly - See Section 7.
2. Retaining bolts and flywheel.
3. If equipped with manual transmission - pressure plate and disc.
4. Rear main seal - pry out.

Clean

- Block and crankshaft-to-seal mating surfaces.

Install or Connect

Tool required:
J34924-A Seal Installer.

1. Rear main seal to block.
   - Press evenly into place with J34924.
   - Lubricate outside of seal to aid assembly.
2. Flywheel - 75 N·m (55 lb. ft.) - automatic; 93 N·m (69 lb.ft.) - manual.
3. Pressure plate and disc - if equipped with manual transmission.
4. Transmission Assembly - See Section 7.

Inspect

- For oil leaks.

CONNECTING ROD AND PISTON

Remove or Disconnect

Tool required:
J6305-11 Guide Set.

1. Cylinder head.

Clean

- Ridge or deposits from upper end of cylinder bore. Protect piston with cloth.

2. Raise car.
3. Oil pan.
4. Connecting rod bearing cap.
5. Piston and connecting rod.
   - Check identification of piston and connecting rod.
   - Use J6305-11 to protect crankshaft journal.

   Refer to Section 6A General Engine Mechanical for servicing of connecting rods, pistons, rings and bearings.
6. Lower car.

Install or Connect

1. Guide Set J6305-11 on connecting rod bolts.
2. Rod and piston assembly into cylinder.
   - Notches in top of piston to front of engine.
3. Raise car.
4. Connecting rod to crankshaft - remove J6305-11.
5. Connecting rod bearing cap.
6. Rod nuts - 44 N·m (32 lb. ft.).
7. Oil pan.
8. Lower car.
9. Cylinder head assembly.

Inspect

- For proper completion of repair.

CRANKSHAFT

Remove or Disconnect

1. Engine.
2. Engine oil.
3. Mount engine on suitable stand.
4. Spark plugs.
5. Fan pulley (F Carline only).
6. Crankshaft pulley and hub assembly.
7. Oil pan and oil pump assembly.
8. Timing gear cover.
9. Crankshaft timing gear.
10. Connecting rod bearing caps with bearings and identify each for reinstallation.
11. Push connecting rod and piston assemblies away from crankshaft.
12. Main bearing caps with bearings and identify for reinstallation.
13. Crankshaft.

    Refer to Section 6A General Engine Mechanical for servicing of crankshaft.

→← Install or Connect

1. With new upper bearings installed, position crankshaft in block.
2. Main bearing caps (with new lower bearings), but do not tighten cap bolts. Oil bearings prior to assembly.
3. Pull connecting rods (with new upper bearings installed) and pistons into place.
4. Rod bearing caps (with new bearings), but do not tighten nuts. Oil bearings prior to assembly.
5. With rubber mallet, hit both ends of crankshaft to center thrust bearing rearward first - then forward last.
6. Tighten main bearing caps 95 N·m (70 lb. ft.) then check crank end play. It should be between .0015" and .0085".
7. Tighten connecting rod bearing caps - 44 N·m (32 lb. ft.).
8. Recheck bearing clearances using plastic gage method.
9. *Key from old crankshaft keyway in the crankshaft.*
10. Crankshaft timing gear and ALIGN TIMING MARKS ON TIMING GEARS BY ROTATING CRANKSHAFT IF NECESSARY.
11. Timing gear cover using new seal.
12. Oil pump assembly and oil pan, using new rear seal in rear main bearing cap and new front seal in timing gear cover.
13. Coat front cover oil seal contact area of pulley hub with oil and push into position.
14. Crankshaft pulley and hub.
15. Fan pulley and fan (F Carline only).
16. Spark plugs.
17. Remove engine from stand.
18. Engine in car.
19. Add engine oil.

ON CAR SERVICE

ENGINE AND TRANSAXLE MOUNTS

Figs. 801, 802, 803 and 804

Tool required:

J28467 Engine Support Fixture (and attachments).

CAUTION: Support fixture J28467 must be located in center of cowl and its fasteners properly tightened before supporting engine and transaxle. Bodily injury could result with improper use of this support fixture. Refer to Section 2A for installation of this engine support fixture J-28467.

Engine Mount

←→ Remove or Disconnect

1. Support engine with J28467, or other suitable equipment.
2. Bolt - forward torque reaction rod.
3. Raise vehicle.
4. Nuts - engine mount to chassis.
5. Nuts - upper, mount to engine support bracket.
6. Engine mount.

→← Install or Connect

1. *Support engine with J28467, position mount.*
2. Nuts - mount to engine bracket - 52 N·m (38 lb. ft.).
3. Nuts - mount to chassis (Fig. 801).
4. Lower vehicle.
5. Bolt - forward torque reaction rod.
6. Remove support fixture.

Automatic Transaxle Mount

←→ Remove or Disconnect

1. Support engine and transaxle with J28467 (See Section 2A).
2. Bolt - forward torque reaction rod.
3. Upper mount nuts.
4. Raise vehicle.
5. Nuts - lower mount.
6. Mount.

→← Install or Connect

1. Position mount.
2. Nuts - lower mount - 45 N·m (33 lb. ft.)
3. Lower vehicle.
4. Nuts - upper mount - 45 N·m (33 lb. ft.).
5. Bolt - forward torque reaction rod.
6. Remove support fixture.

Manual Transmission Mounts

←→ Remove or Disconnect

1. Support engine and transaxle with J28467.
2. Bolt - forward torque reaction rod.
3. Raise vehicle.
4. Nuts - front engine mount to frame.
5. Nuts - rear engine mount to frame.
6. Nut - front engine mount to engine bracket.
7. Nut - rear engine mount to engine bracket.
8. Mounts, front and rear.

→← Install or Connect

1. Position front and rear mounts.
2. Nut - *rear engine mount to engine bracket* - 48 N·m (35 lb. ft.).
3. Nut - front engine mount to engine bracket - 48 N·m (35 lb. ft.).

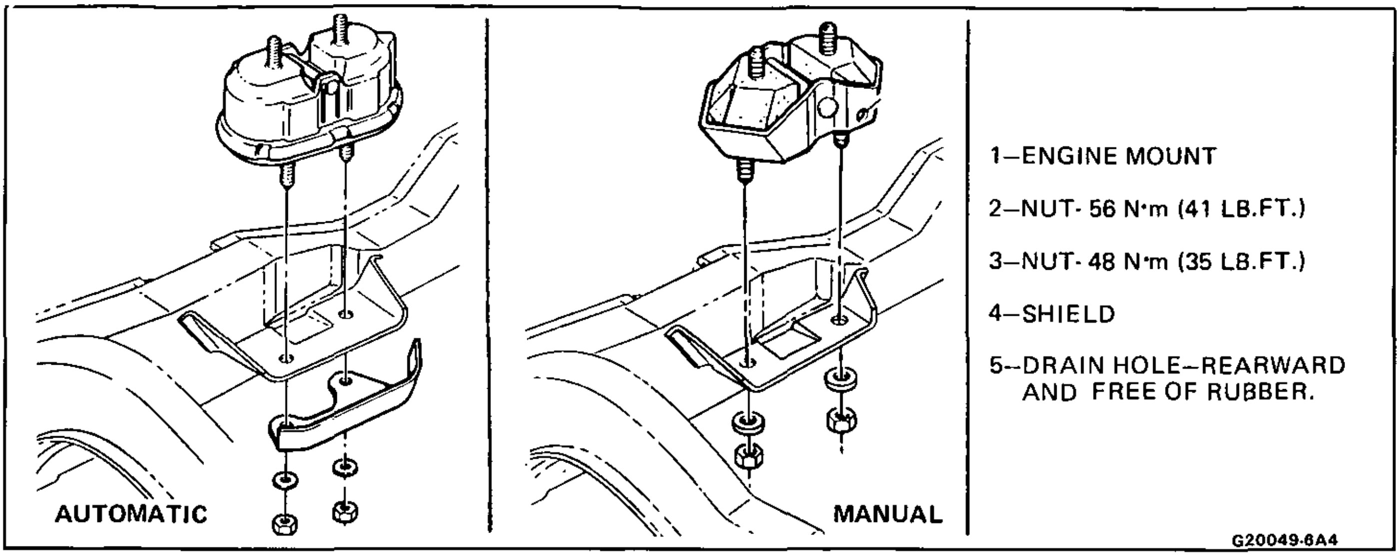


Fig. 801 Engine Mount to Frame

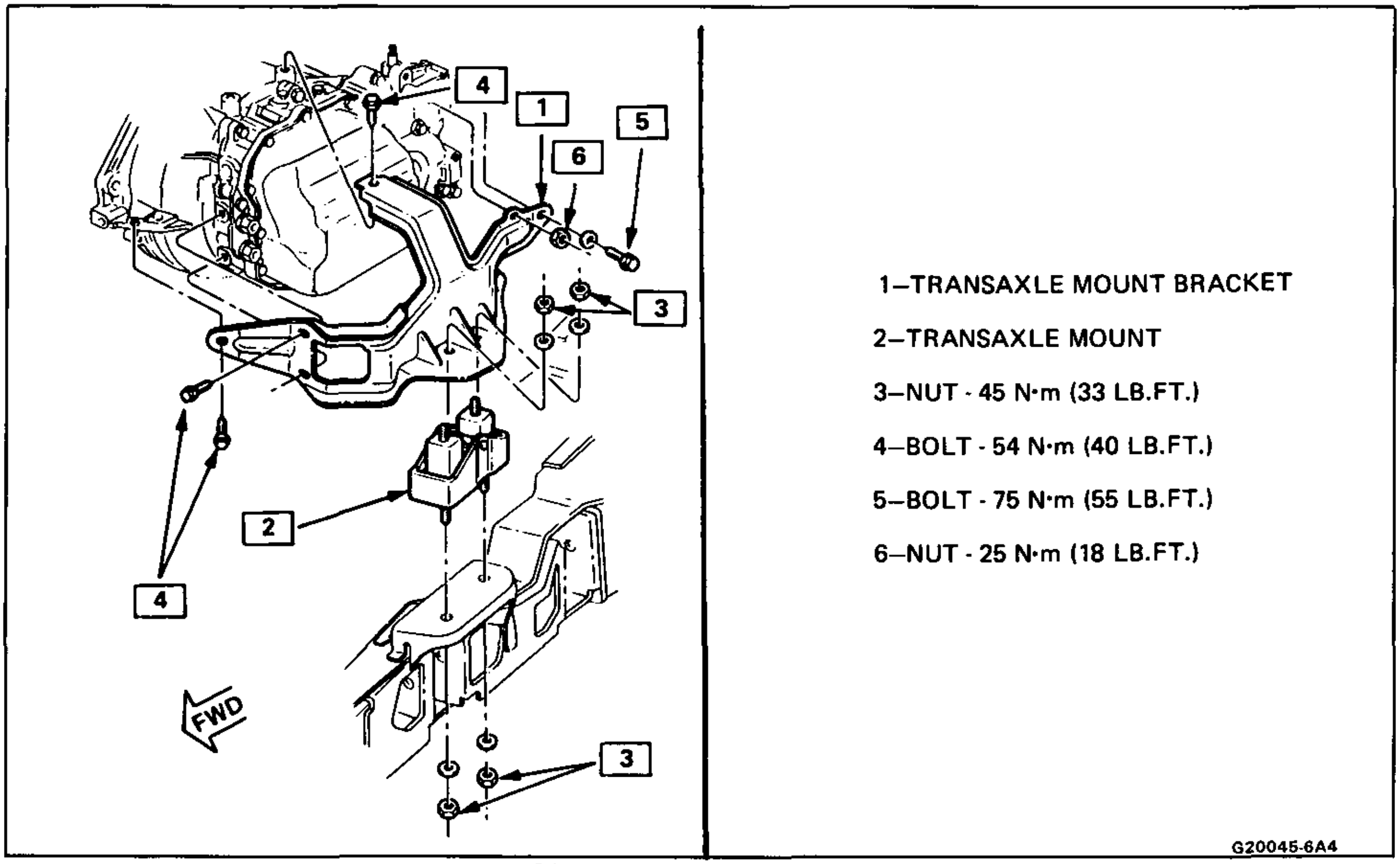


Fig. 802 Automatic Transaxle Mount

4. Nuts - rear engine mount to frame - 24 N·m (18 lb. ft.).
5. Nuts - front engine mount to frame - 48 N·m (35 lb. ft.).
6. Lower vehicle.
7. Bolt - forward torque reaction rod.
8. Remove support fixture.

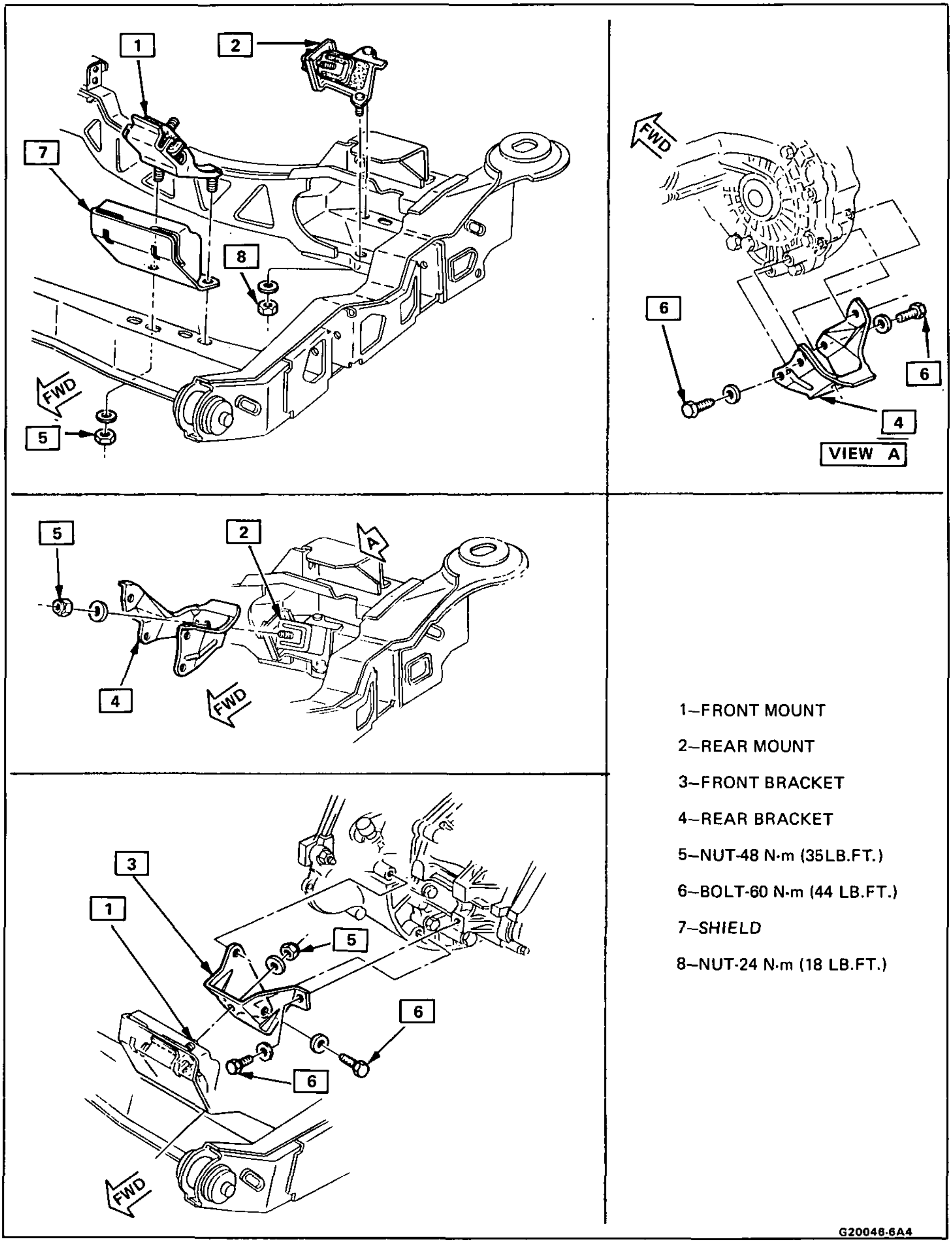
Engine Torque Strut

↔ Remove or Disconnect

1. Rear strut bolt.
2. Front strut bolt.
3. Strut.

→← Install or Connect

1. Loosely insert front strut bolt.



1–FRONT MOUNT

2–REAR MOUNT

3–FRONT BRACKET

4–REAR BRACKET

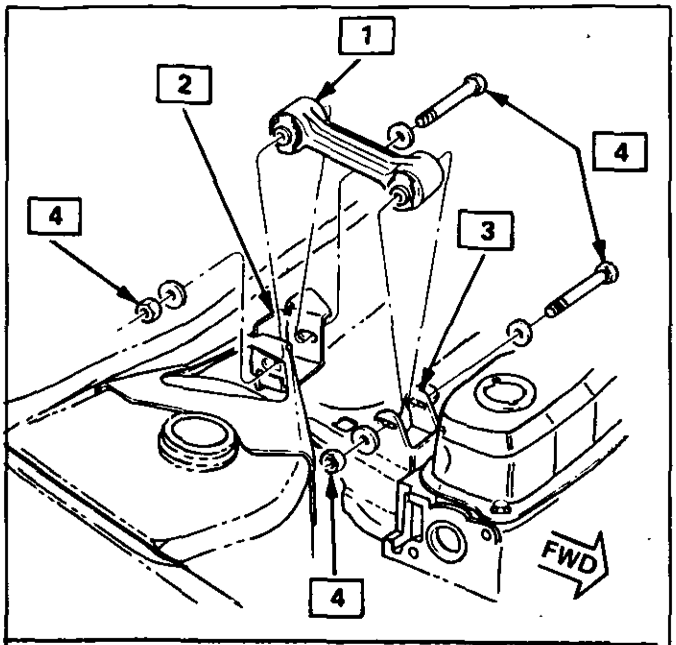
5–NUT-48 N·m (35LB.FT.)

6–BOLT-60 N·m (44 LB.FT.)

7–*SHIELD*

8–NUT-24 N·m (18 LB.FT.)

Fig. 803 Manual Transaxle Mounts



1—ENGINE TORQUE STRUT
2—BRACKET, TIE BAR
3—BRACKET, ENGINE
4—STRUT BOLT & NUT – 57 N·m (42 LB.FT.)

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Fig. 804 Engine Torque Strut

- Displace engine rearward with a horizontal load of 200-250 Newtons, applied through centerline of slots. Tighten while load is applied.

2. Front strut bolt - 57 N·m (42 lb. ft.).
3. Rear strut bolt - 57 N·m (42 lb. ft.).

PUSH ROD COVER

Remove or Disconnect

1. Intake manifold.
2. Push rod cover attaching nuts - four.
3. Cover.

NOTICE: Do not pry on the cover or damage to the sealing surfaces may result.

Clean

- Sealing surfaces on push rod cover and cylinder block.
- Dry surfaces with degreaser.

Install or Connect

Fig. 7

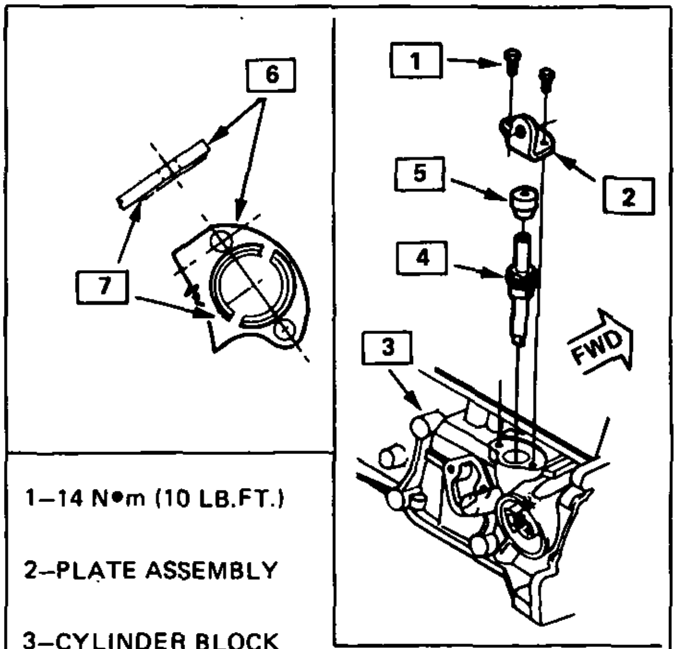
1. Apply a continuous 3/16" (5 mm) diameter bead of RTV sealant (No. 1052915 or equivalent) around sealing surface of push rod cover.
2. Cover, and retaining nuts - 10 N·m (90 lb. in.).
3. Intake manifold.

Inspect

- For fluid leaks.

OIL PUMP DRIVE SHAFT

Remove or Disconnect



1—14 N•m (10 LB.FT.)
2—PLATE ASSEMBLY
3—CYLINDER BLOCK
4—SHAFT AND GEAR ASSEMBLY
5—BEARING
6—PLATE
7—APPLY A CONTINUOUS 1/16" DIAM. BEAD OF RTV AS SHOWN

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Fig. 805 Oil Pump Drive Shaft Assembly

Fig. 805

1. Retainer plate bolts, pump drive shaft and bushing.

Clean

- Sealing surfaces on cylinder block and retainer plate.

Install or Connect

1. Bushing and oil pump drive shaft - rotate until indexed.
2. Apply 1.6mm (1/16") bead of RTV to retainer plate.
3. Retainer plate and bolts - 14 N·m (10 lb. ft.).

Inspect

- For proper completion of repair.

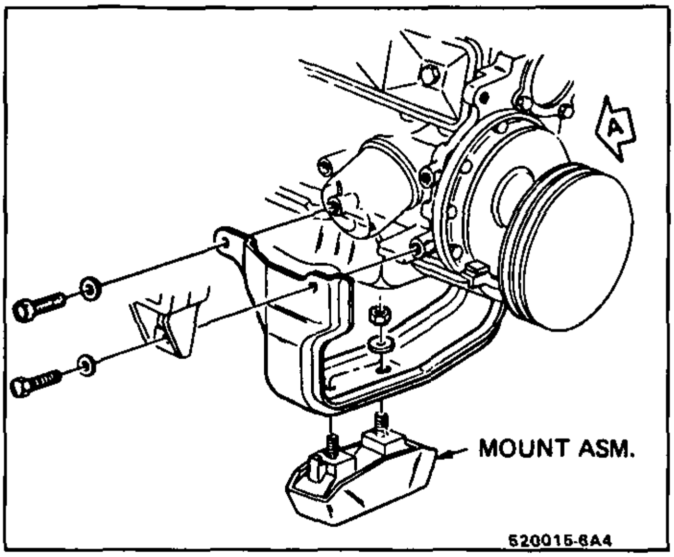


Fig. 807 Engine Support Bracket

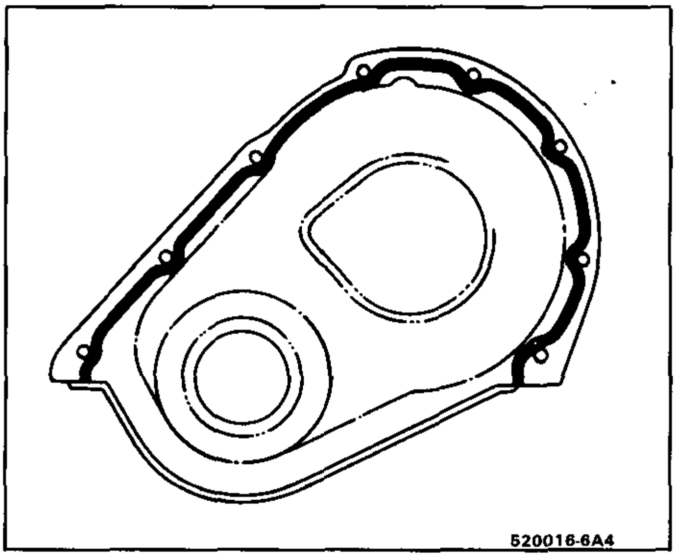


Fig. 808 Timing Gear Cover Sealer Application

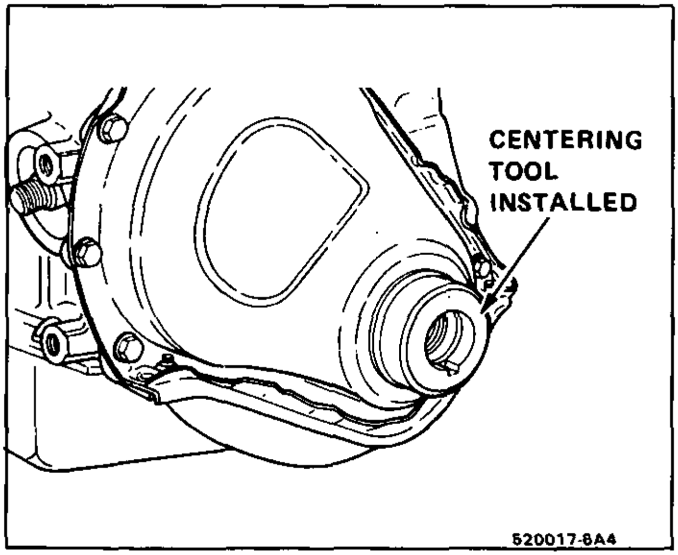


Fig. 809 Front Cover Centering Tool Installed

Clean

- Sealing surfaces of cylinder block and timing gear cover.

Install or Connect

(Fig. 808)

1. Oil pan front seal in timing gear cover.
2. Apply a 3/8" wide by 3/16" bead of RTV to joint at oil pan and timing gear cover.
3. Apply a 1/4" wide by 1/8" thick bead of RTV sealer to timing gear cover at block mating surfaces.
4. Centering tool J34995 in timing gear cover oil seal (Fig. 809).
5. Partially tighten two opposing cover screws with centering tool in place.
6. Remaining cover to block screws.

   Tighten

   - All timing gear cover to cylinder block screws - 10 N·m (90 lb. in.). Remove centering tool J34995.

7. Engine mount and bracket. Lower engine and remove J28467.
8. Hub and pulley.

ENGINE ASSEMBLY

Remove or Disconnect

Tools required:

J-28467 Engine Support Fixture.
J-34065 Parking Brake Cable Retainer Compressor.

1. Battery cables.
2. Engine coolant.
3. Rear compartment lid and side cover panels.

   Important

   - Do not remove the torsion rod retaining bolts.

4. Air cleaner.
5. Throttle and shift cables.
6. Heater hose at intake manifold.
7. Vacuum hoses to all non-engine components.
8. Fuel lines at TBI and filter.
9. Fuel pump relay and oxygen sensor connector.
10. Transaxle cooler lines (automatic only).
    - Slave cylinder from manual transaxle equipped vehicles.
11. Ground strap - engine to chassis.
12. Radiator hoses and heater hoses.
13. Engine harness connector at bulkhead.
14. Discharge A/C system (if equipped).
    - Disconnect A/C lines at compressor and seal.
15. Rear console.
16. ECM harness - through bulkhead panel.

17. Install engine support fixture.
18. Engine strut bracket.
19. Raise vehicle.
20. Rear wheels.
21. Torque converter bolts (automatic only).
22. Parking brake cable and calipers.
    - Do not disconnect brake hoses, support calipers out of way.
23. Strut bolts - mark struts for realignment. (See Section 3D).
24. A/C wiring (if equipped).
25. Cradle bolts.
26. Parking brake cable at cradle.
    - Use tool J-34065 to release parking brake cables at cradle.
27. Lower vehicle.

Important

- Support engine - transaxle and cradle assembly on dolly: (be sure to support the outboard ends of the lower control arms) disconnect engine support fixture.

28. Raise vehicle, leaving engine, transaxle and cradle assembly on dolly.
29. Separate engine and transaxle.

Install or Connect

1. Reconnect engine, transaxle and cradle.
2. Lower vehicle over dolly.
3. Cradle bolts (4-in sequence).
    - Install front bolts finger tight
    - Torque rear bolts - 103 N·m (76 lb. ft.).
    - Torque front bolts - 90 N·m (66 lb. ft.).
4. Raise vehicle.
5. Strut bolts.
6. Caliper and park brake cable.
7. A/C wiring (if equipped).
8. Torque converter bolts (automatic only).
9. Rear wheels.
10. Lower vehicle.
11. Engine strut bracket.
12. Radiator hose and heater hoses.
13. Ground strap.
14. Transaxle cooler lines (automatic only).
15. Fuel pump relay and oxygen sensor connector.
16. Fuel lines at TBI and filter.
17. Vacuum hoses.
18. Throttle and shift cables.
19. Air cleaner.
20. Engine harness and ECM harness.
21. Rear console.
22. Engine coolant.
23. Battery cables.
24. Charge A/C (if equipped).
25. Engine compartment lid and side cover panels.

Inspect

- For proper completion of repair.
- For fluid and exhaust leaks.

EXHAUST MANIFOLD

Remove or Disconnect

1. Air cleaner and EFI bracket tube.
2. Raise vehicle.
3. Exhaust pipe.
4. Lower vehicle.
5. Oxygen sensor connector.
6. Retaining bolts and washers.
7. Exhaust manifold and gasket.

Clean

- Sealing surfaces of cylinder head and manifold.
- Retaining bolts and threads - lubricate.

Install or Connect

1. Exhaust manifold, with new gasket.
2. Retaining bolts and washers.

Tighten

- In sequence and to specification shown in Fig. 811.

3. Raise vehicle.
4. Exhaust pipe.
5. Lower vehicle.
6. Air cleaner and EFI pre-heat tube.
7. Oxygen sensor connector.

Inspect

- For exhaust leaks.

CAMSHAFT

Remove or Disconnect

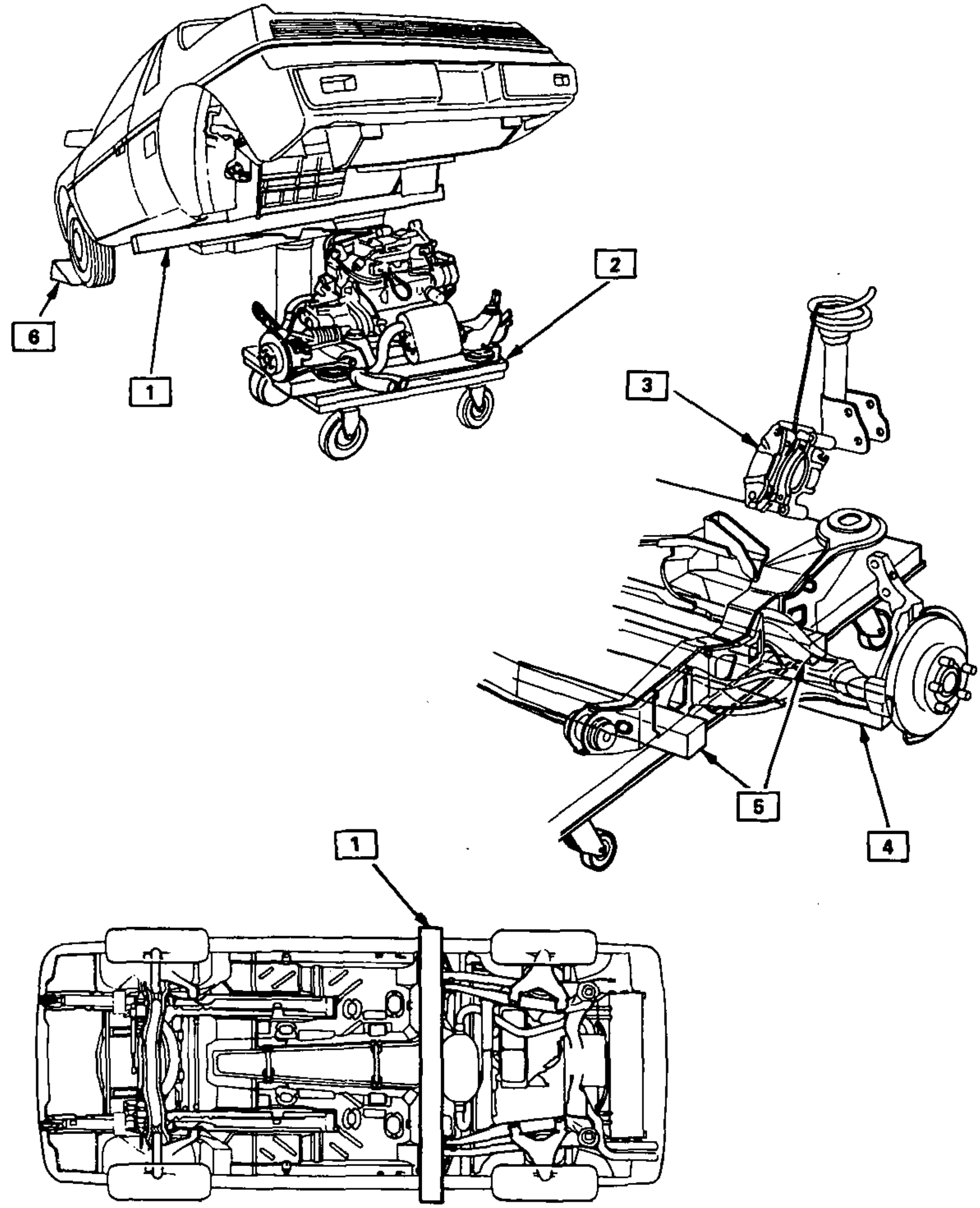
Figs. 812, 813 and 814

1. Engine assembly from vehicle, leaving engine and transaxle attached in cradle.
2. Rocker arm cover and push rods.
3. Push rod cover and valve lifters.
4. Distributor.
5. Front engine mount and bracket assembly (support engine and transaxle).
6. Oil pump drive shaft.
7. Front pulley and hub.
8. Timing gear cover.
9. Camshaft thrust plate screws.
10. Camshaft and gear through front of block.

Important

- Support shaft to avoid damage to bearings.

11. Gear from camshaft.
    - Use arbor press and adapter.
    - Position thrust plate to avoid damage by interference with woodruff key as gear is removed.



1 — PLACE 4x4 AT VEHICLE JACKING LOCATIONS

2 — SUITABLE 4 WHEEL SUPPORT DOLLY

3 — CALIPER SUPPORTED

4 — SUPPORT CONTROL ARM ON BOTH SIDES. **DO NOT** SUPPORT ON THE ROTOR OR SHIELD

5 — 4x4's

6 — WHEEL CHOCKS

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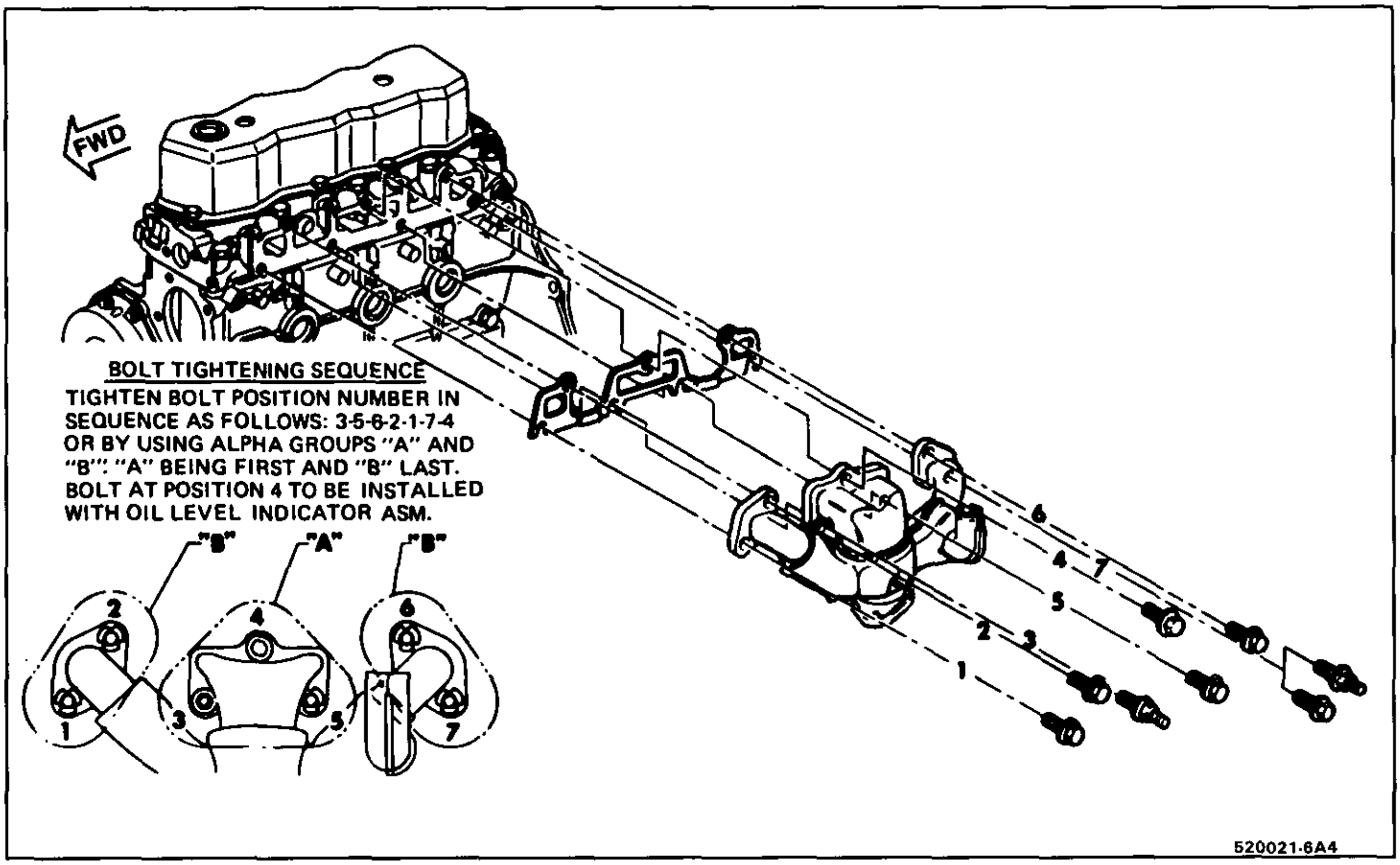
Fig. 810 Engine Removal and Cradle Support Points



BOLT TIGHTENING SEQUENCE
TIGHTEN BOLT POSITION NUMBER IN SEQUENCE AS FOLLOWS: 3-5-6-2-1-7-4 OR BY USING ALPHA GROUPS "A" AND "B". "A" BEING FIRST AND "B" LAST. BOLT AT POSITION 4 TO BE INSTALLED WITH OIL LEVEL INDICATOR ASM.

Fig. 811 Exhaust Manifold

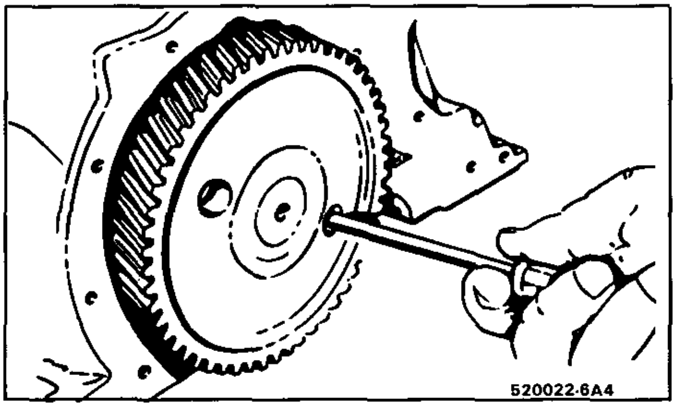


Fig. 812 Removing Camshaft Thrust Plate Screws

- Refer to Section 6A General Engine Mechanical.

Assemble

1. Support camshaft at back of front journal in arbor press using press plate adapters.
2. Position spacer ring, thrust plate over end of shaft and woodruff key in keyway.
3. Press gear on shaft - bottom against spacer ring.

Measure

End clearance of thrust plate should be .0015" to .0050". Fig. 814.

- Less than .0015" - replace spacer ring.
- More than .0050" - replace thrust plate.

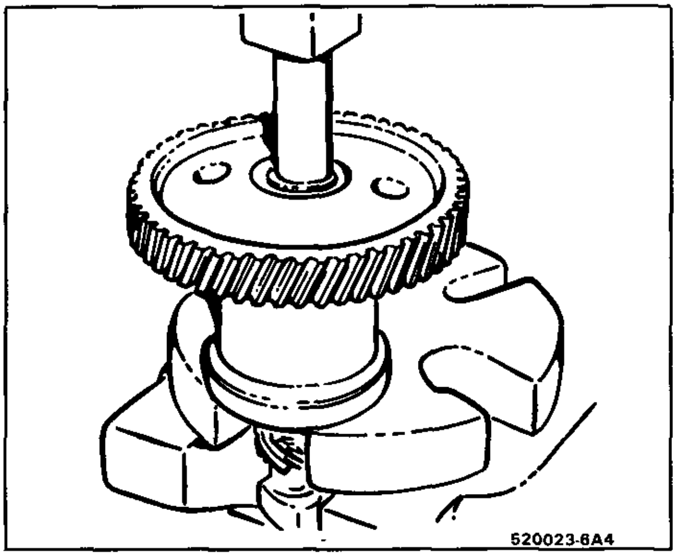


Fig. 813 Removing Camshaft Timing Gear

Install or Connect

1. Camshaft and gear into cylinder block.
   - Do not damage bearings on cam.
   - Lubricate camshaft journals with high *quality engine oil supplement.*
2. Rotate camshaft and crankshaft so that the timing marks on gear teeth line up. Engine is now in No. 4 cylinder firing position.

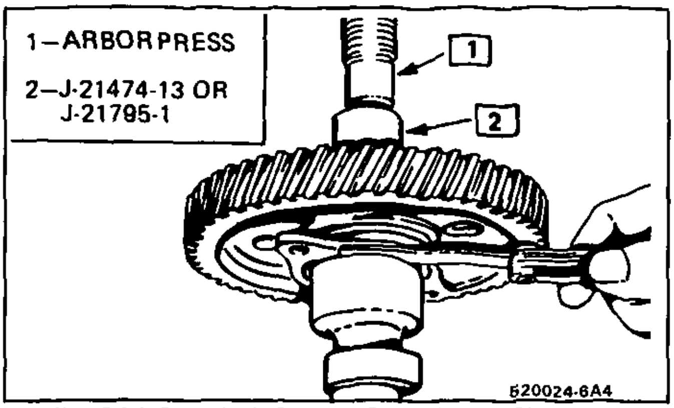


Fig. 814 Camshaft Timing Gear/Thrust Plate End Clearance

3. Camshaft thrust plate to block screws - 10 N·m (90 lb. in.).
4. Timing gear cover.
5. Front pulley and hub (line up key). Center bolt 212 N·m (160 lb. ft.).
6. Oil pump drive shaft.
7. Front engine mount and bracket.
8. Distributor.
9. Valve lifters and push rod cover.
10. Push rods, rocker arms and cover.
11. Engine/transaxle assembly into vehicle.

Inspect

- For proper completion of repair.

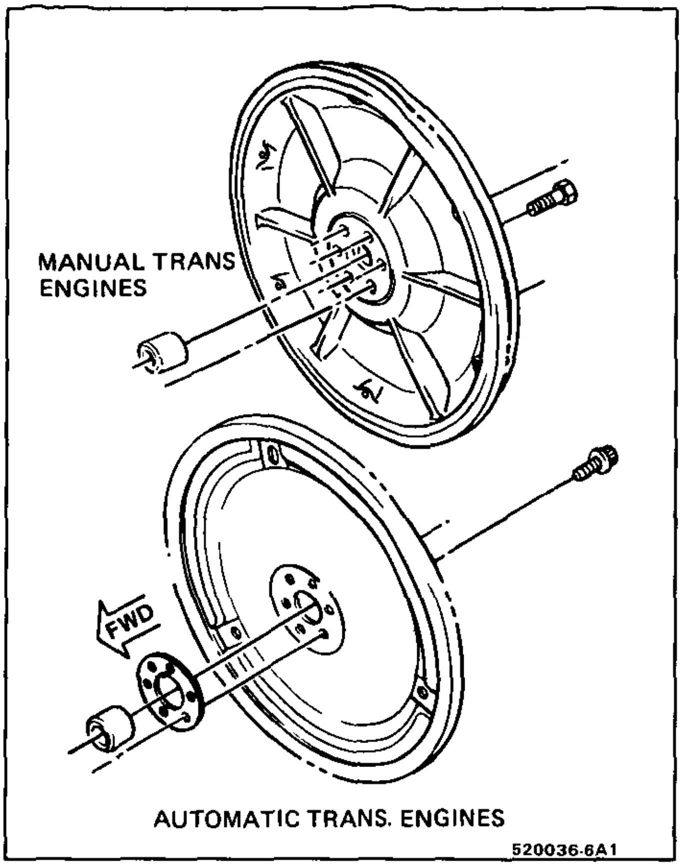


Fig. 815 Flywheel Attachment "Manual and Automatic Transaxle"

LUBRICATION

OIL CAPACITY

Without Filter Change	2.838 Liters (3 Qts.)
With Filter Change	2.838 Liters (3 Qts.)
Filter Type	PF 47 or Equivalent
Oil Pressure at RPM	(36-41 lb. @ 2000 RPM)

SPECIFICATIONS

BOLT TORQUE

Bolt Main Bearing to Block	95 N·m (70 lb. ft.)
Nut Connecting Rod	44 N·m (32 lb. ft.)
Bolt Oil Pan to Block	10 N·m (90 lb. in.)
Plug Oil Pan Drain	34 N·m (25 lb. ft.)
Nut Oil Screen Support	50 N·m 37 lb. ft.)
Bolt Oil Pump to Block	30 N·m (22 lb. ft.)
Bolt Oil Pump Cover	14 N·m (10 lb. ft.)
Nut Push Rod Cover To Block	10 N·m (90 lb. in.)
Stud Roller Lifter Guide Retainer to Block	10 N·m (90 lb. in.)
Bolt Harmonic Balancer	220 N·m (162 lb. ft.)
Bolt Flywheel To Crankshaft	60 N·m (44 lb. ft.)
Nut EFI Assembly to Manifold	20 N·m (15 lb. ft.)
Bolt EFI Assembly to Manifold	20 N·m (15 lb. ft.)
Bolt Intake Manifold To Cyl. Head	(see text)
Bolt Exhaust Manifold To Cyl. Head	(see text)
Bolt Distributor Retaining Clamp	20 N·m (15 lb. ft.)
Bolt EGR Valve to Manifold	22 N·m (16 lb. ft.)
Bolt Water Outlet Housing	27 N·m (20 lb. ft.)
Bolt Thermostat Housing	27 N·m (20 lb. ft.)
Bolt Water Pump To Block	34 N·m (25 lb. ft.)
Bolt Timing Gear Cover To Block	10 N·m (90 lb. in.)
Clamps Radiator Hoses All	2 N·m (17 lb. in.)
Bolt Rocker Arm	32 N·m (24 lb. ft.)
Bolt Cylinder Head To Block	(see text)
Bolt Rocker Arm Cover	5 N·m (45 lb. in.)
Bolt Camshaft Thrust Plate To Block	10 N·m (90 lb. in.)

ENGINE SPECIFICATIONS (ENGLISH)

GENERAL DATA

TYPE	2.5L L-4	COMPRESSION PRESSURE	
DISPLACEMENT	151 CU. IN.	COMPRESSION RATIO	9.0:1
BORE AND STROKE	4.00" x 3.00"	FIRING ORDER	1, 3, 4, 2
		CYLINDER NUMBERS	4

VALVE SYSTEM

VALVE	INTAKE	EXHAUST	VALVE LIFTER	
FACE ANGLE	45°	45°	TYPE	HYDRAULIC
HEAD DIAMETER	1.75"	1.50"	LEAK DOWN RATE	12 TO 90 SEC. WITH 50 LB LOAD
STEM DIAMETER	.343"-.342"	.342"-.343"	LIFTER BODY DIAMETER	.8420" - .8427"
STEM-TO-GUIDE CLEARANCE			LIFTER BORE DIAMETER	.8435" - .8445"
SEAT ANGLE	46°	46°	CLEARANCE IN BORE	.0025"
SEAT WIDTH	.035"-.075"/.058"	.097"	PLUNGER TRAVEL	.125"
SEAT RUN-OUT	–	–	VALVE TRAIN	
SPRING			PUSH ROD LENGTH	8.3996"
FREE LENGTH	2.08"		ROCKER ARM RATIO	1.75:1
INSTALLED HEIGHT	1.69"	1.69"	VALVE LASH	0
LOAD - CLOSED	78-86 @ 1.66		CAMSHAFT	
- OPEN	170-180 @ 1.26		LOBE LIFT - INTAKE	.398"
DAMPER			- EXHAUST	.398"
FREE LENGTH			JOURNAL - DIAMETER	1.869"
APPROX. NO. OF COILS			- CLEARANCE	.0007"-.0027"
CAMSHAFT END PLAY	.0015"-.0050"			

OIL PUMP

GEAR LASH	.009"-.015"	SIDE CLEARANCE	
GEAR POCKET - DEPTH	.995"-.998"	- DRIVE GEAR	.004" MAX
- DIAMETER	1.503"-1.506"	- IDLER GEAR	.004" MAX
GEAR - LENGTH	.999"-1.002"	END CLEARANCE	.002"-.005"
- DIAMETER	1.496"-1.500"	VALVE-TO-BORE CLEARANCE	

CRANKSHAFT

MAIN JOURNAL		CRANKPIN	
DIAMETER	2.3"	DIAMETER	2.0"
TAPER	.0005"	TAPER	.0005"
OUT-OF-ROUND-MAX	.0005"	OUT-OF-ROUND-MAX	.0005"
CLEARANCE	.0005"-.0022"	CLEARANCE	.0005"-.0026
CRANKSHAFT END PLAY	.0035"-.0085"	ROD SIDE CLEARANCE	.006"-.022"

CYLINDER AND PISTON

CYLINDER BORE		PISTON RING GAP	
DIAMETER	4.0"	TOP COMPRESSION	.010"-.020"
OUT-OF-ROUND-MAX	.001"	SECOND COMPRESSION	.010"-.020"
TAPER	.005"	OIL CONTROL	.020"-.060"
PISTON CLEARANCE .0014-.0022* *MEASURED 1.8 INCH DOWN FROM PISTON TOP		PISTON RING SIDE CLEARANCE	
		TOP COMPRESSION	.002"-.003"
		SECOND COMPRESSION	.001"-.003"
PISTON PIN		OIL CONTROL	.015"-.055"
DIAMETER	.938"-.942"		
FIT IN PISTON	.0002"-.0004"		
FIT IN ROD	PRESS		

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Fig. 816 Engine Specifications (English)

ENGINE SPECIFICATIONS (METRIC)

GENERAL DATA

TYPE	2.5L L-4	COMPRESSION PRESSURE	
DISPLACEMENT	151 CU. IN.	COMPRESSION RATIO	9.0:1
BORE AND STROKE	4.00" x 3.00"	FIRING ORDER	1, 3, 4, 2
		CYLINDER NUMBERS	4

VALVE SYSTEM

VALVE	INTAKE	EXHAUST	VALVE LIFTER	
FACE ANGLE	45°	45°	TYPE	HYDRAULIC
HEAD DIAMETER	43.688	38.1	LEAK DOWN RATE	12 TO 90 SEC. WITH 50 LB
STEM DIAMETER	8.6995-8.68172/8.68172-8.9665		LIFTER BODY DIAMETER	21.3868-21.4046 MM
STEM-TO-GUIDE CLEARANCE	.0254-.06858/		LIFTER BORE DIAMETER	21.425-21.450 MM
	.0254-.06858		CLEARANCE IN BORE	.635 MM
SEAT ANGLE	46°	46°	PLUNGER TRAVEL	3.175 MM
SEAT WIDTH	.897-1.897 / 1.468-2.468		VALVE TRAIN	
SEAT RUN-OUT	–	–	PUSH ROD LENGTH	213.35 MM
SPRING			ROCKER ARM RATIO	1.75:1
FREE LENGTH	52.8		VALVE LASH	0
INSTALLED HEIGHT	42.926		CAMSHAFT	
LOAD - CLOSED	35-39 @ 42.16		LOBE LIFT - INTAKE	10.3124 MM
- OPEN	55-82 @ 32.00		- EXHAUST	10.3124
DAMPER			JOURNAL - DIAMETER	47.4726 MM
FREE LENGTH	–		- CLEARANCE	.01778-.0685 MM
APPROX. NO. OF COILS	–			
CAMSHAFT END PLAY	.0381-.127			

OIL PUMP

GEAR LASH	.23-.38	SIDE CLEARANCE	
GEAR POCKET - DEPTH	25.27-25.35	- DRIVE GEAR	.10 MAX.
- DIAMETER	38.18-38.25	- IDLER GEAR	.10 MAX.
GEAR - LENGTH	25.37-25.45	END CLEARANCE	.05-.13
- DIAMETER	38.05-38.10	VALVE-TO-BORE CLEARANCE	

CRANKSHAFT

MAIN JOURNAL		CRANKPIN	
DIAMETER	58.42	DIAMETER	50.8
TAPER	.013	TAPER	.013
OUT-OF-ROUND-MAX	.013	OUT-OF-ROUND-MAX	.013
CLEARANCE	.013-.56	CLEARANCE	.013-.07
CRANKSHAFT END PLAY	.09-.20	ROD SIDE CLEARANCE	.15-.6

CYLINDER AND PISTON

CYLINDER BORE		PISTON RING GAP	
DIAMETER	101.6	TOP COMPRESSION	.30-.50
OUT-OF-ROUND-MAX	.02	SECOND COMPRESSION	.30-.50
TAPER	.13	OIL CONTROL	.5-1.5
PISTON CLEARANCE .036-.056 MEASURED 46mm DOWN FROM PISTON TOP		PISTON RING SIDE CLEARANCE	
		TOP COMPRESSION	.05-.08
		SECOND COMPRESSION	.03-.08
PISTON PIN		OIL CONTROL	.38-1.40
DIAMETER	23.825-23.927		
FIT IN PISTON	.005-.010		
FIT IN ROD	PRESS		

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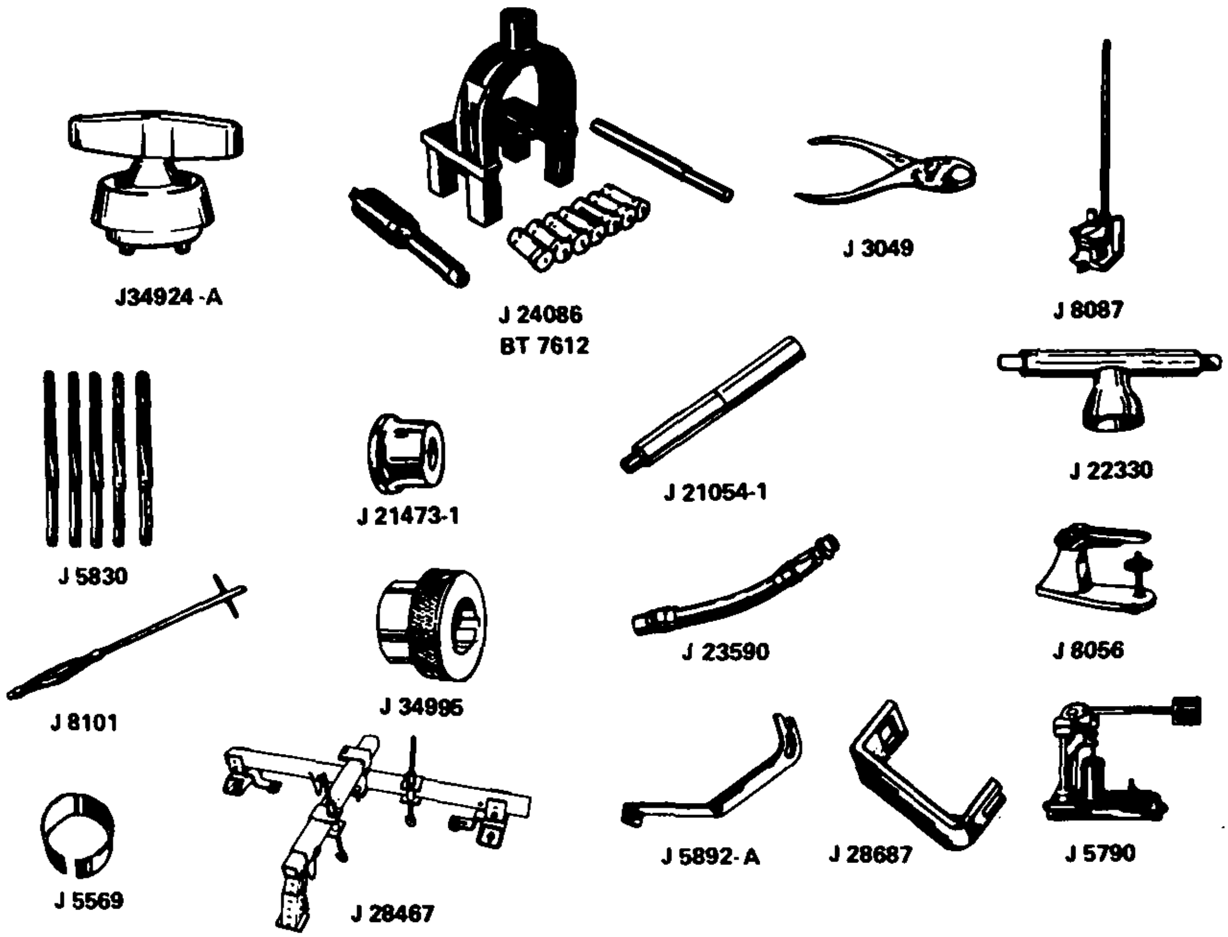
Fig. 817 Engine Specifications (Metric)



TOOL NO.	NAME
J 24086 BT 7612	PISTON PIN TOOL
J 3049	VALVE LIFTER REMOVER
J 8087	CYLINDER BORE CHECKING GAUGE (RANGE 2-1/2"–9")
J 5830	VALVE GUIDE REAMER SET
J 21473-1	CAMSHAFT BUSHING REMOVER & INSTALLER ADAPTER (USE WITH J 21054-1)
J 21054-1	HANDLE (CAMSHAFT BUSHING REMOVER & INSTALLER) (USE WITH J 21473-1)
J 22330	VALVE SEAL INSTALLER & TESTER
J 8101	VALVE GUIDE CLEANING TOOL
J34924-A	REAR CRANKSHAFT OIL SEAL INSTALLER

TOOL NO.	NAME
J 34995	TIME COVER SEAL ALIGNER & INSTALLER
J 23590	AIR LINE ADAPTER
J 8056	VALVE & CLUTCH SPRING TESTER
J 5569	PISTON RING COMPRESSOR (4")
J 28467	ENGINE LIFTING FIXTURE
J 5892-A	VALVE SPRING COMPRESSOR
J 5790	HYDRAULIC VALVE LIFTER LEAKDOWN TESTER (INCLUDES ONE GALLON J 5268 TEST OIL)
J 28687	OIL SENDING UNIT WRENCH (GAUGE OPTION ONLY)

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Fig. 818 Special Tools

SECTION 6A2

2.8 LITRE V-6 VIN CODE 9 (L44)

CONTENTS

ON CAR SERVICE

"FOR VEHICLES SOLD IN CANADA AND EQUIPPED WITH NON-CLOSED LOOP ENGINES, ALSO REFER TO THE APPROPRIATE CANADIAN SERVICE MANUAL SUPPLEMENT."

GENERAL DESCRIPTION

CYLINDER BLOCK

The cylinder block is made of cast alloy 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 (1, 3, 5) are on the rear of the car. Cylinders (2, 4, 6) left bank, are on the bulkhead side of the car.

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 & 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 & DRIVE

The camshaft is cast alloy iron with tapered 13.2 mm 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. 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 & CONNECTING RODS

The pistons are cast aluminum, with steel struts, using two compression rings and one oil control ring. The piston pin is offset 1.5 mm toward 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 rocker 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 for vehicles equipped with MPFI is a three-piece cast aluminum unit. It centrally supports a fuel rail with 6 fuel injectors. Refer to Section 6C3 for MPFI sub-assembly removal.

EXHAUST MANIFOLDS

The exhaust manifolds are cast nodular iron.

ENGINE LUBRICATION

(Figures 1 thru 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 become plugged or develop excessive pressure drop. The by-pass is designed to open at 69-83 kPa.

Oil is routed from the filter 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.

Oil is directed from the left gallery, by means of intersecting 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 in the crankcase casting, to supply the camshaft lobes. Oil also drains past specific hydraulic lifter flats to oil camshaft lobes directly.

The passages supplying oil to the camshaft bearings also supply the crankshaft main bearings through intersecting vertically drilled holes. Oil from the crankshaft main bearings is supplied to the connecting rod bearings by means of intersecting passages drilled in the crankshaft.

The front cam bearing has a .25 mm deep slot on its outside diameter to supply oil to the cam sprocket thrust face.

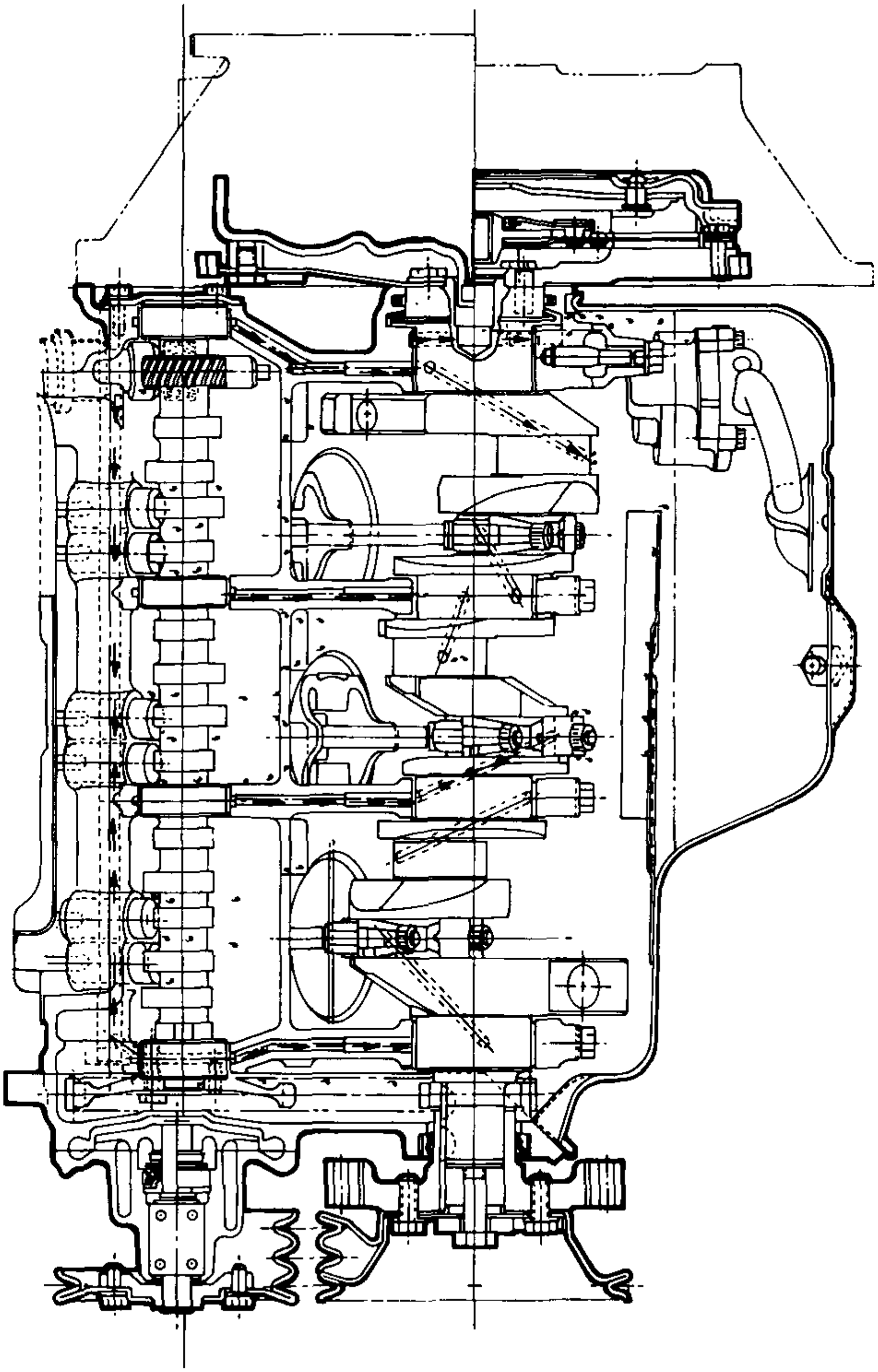


Figure 1 Engine Lubrication (1 of 4)

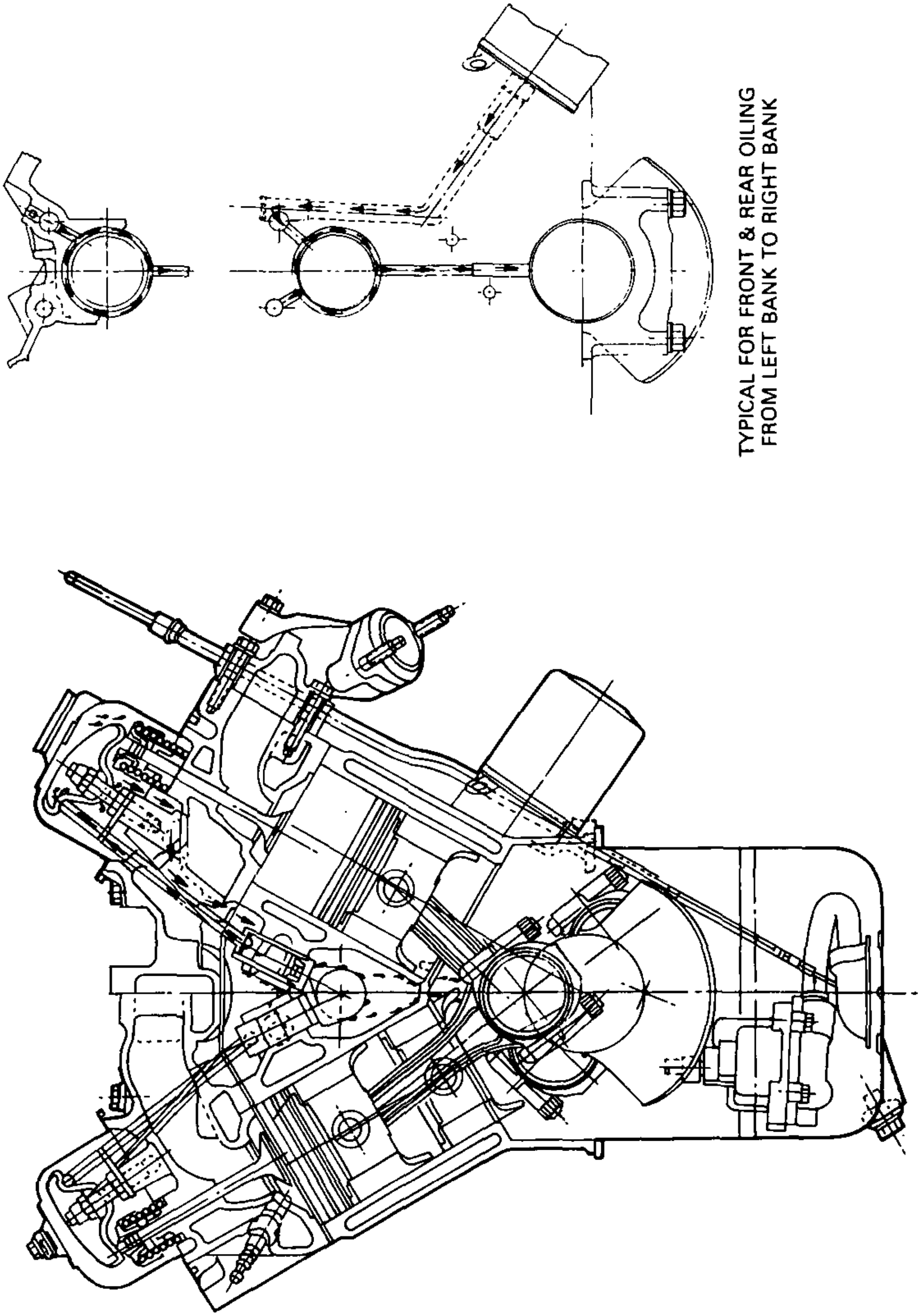


Figure 2 Engine Lubrication (2 of 4)

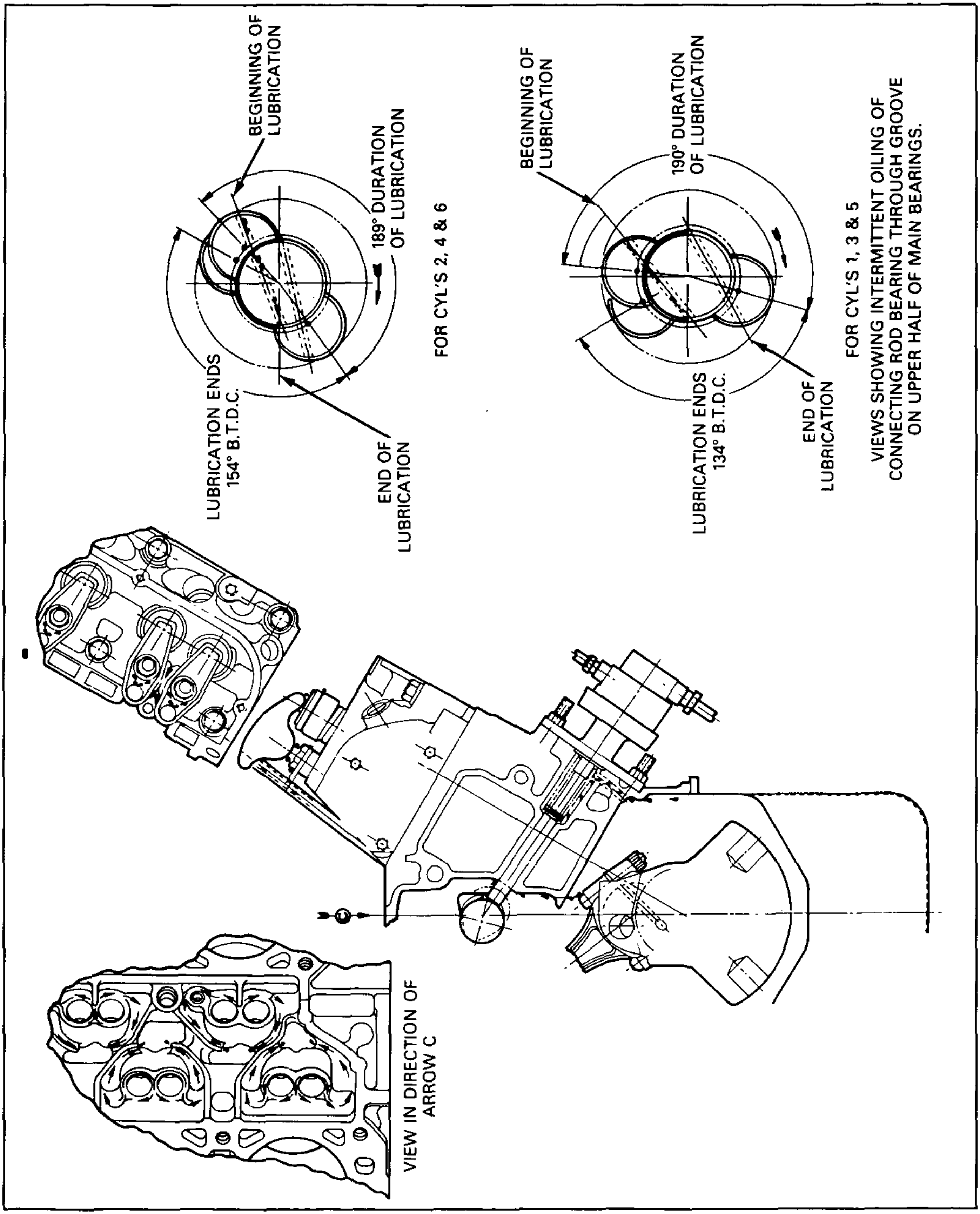


Figure 3 Engine Lubrication (3 of 4)

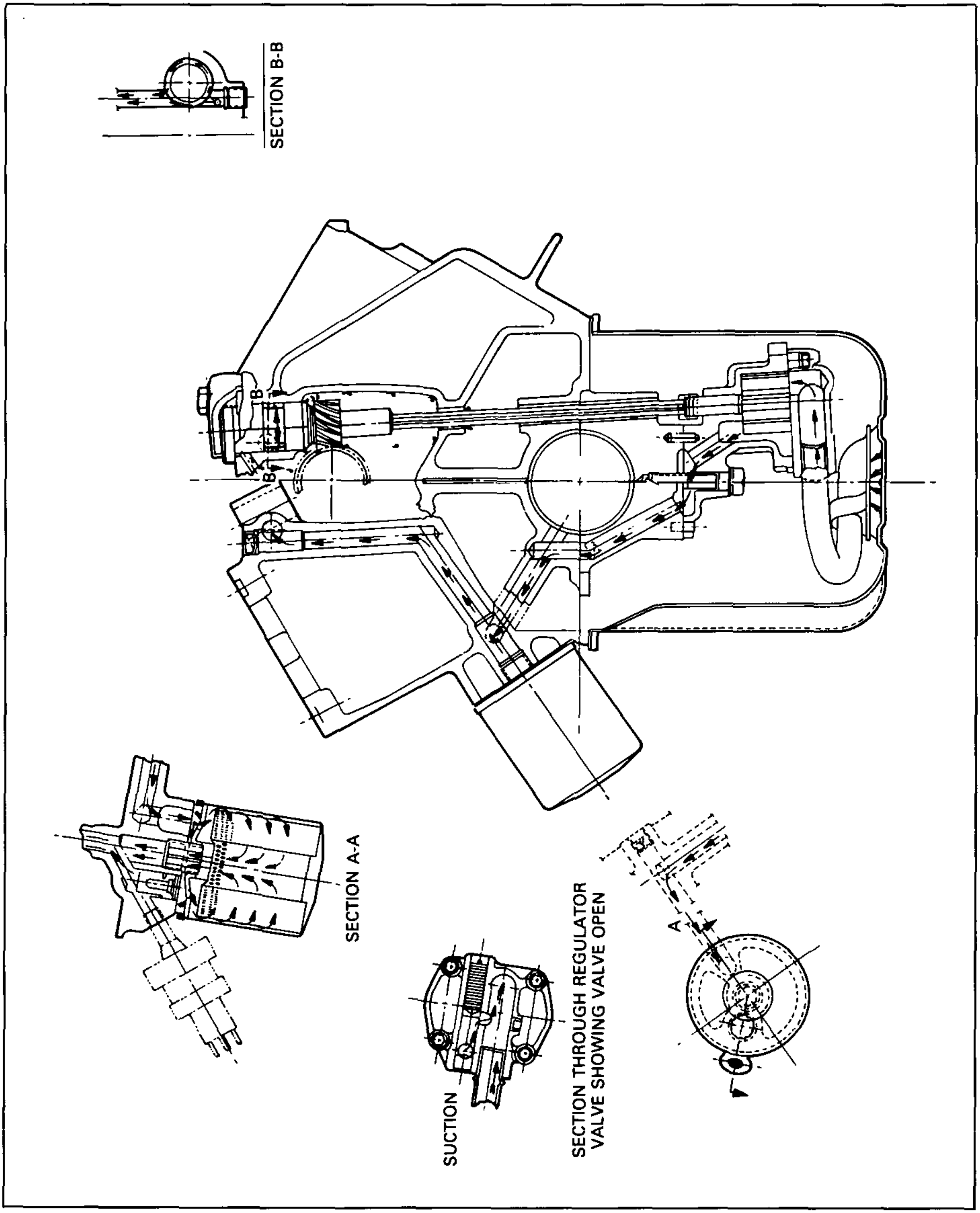


Figure 4 Engine Lubrication (4 of 4)

ON CAR SERVICE

ENGINE ASSEMBLY

Remove or Disconnect

Tools Required:

- J28467 Engine Support Fixture W/J35563 Support Bracket
- J34065 Parking Brake Cable Retainer Compressor

1. Battery cables and plastic battery protector.
2. Engine coolant.
3. Rear compartment lid (two men) and side cover panels.

Important

Do not remove the torsion rod retaining bolts.

4. Intake flex duct - throttle body to elbow.
5. Throttle and shift cables.
6. Heater hoses at engine.
7. Vacuum hoses to components not engine mounted.
8. Fuel lines.
9. Fuel pump relay.
10. Transaxle cooler lines (automatic only).
    - Slave cylinder from manual transaxle, and shield.
11. Ground strap - engine to chassis, at engine.
12. Radiator hoses.
13. Engine harness to junction block (both terminals on power distribution block).
14. Rear heat shield (center).
15. Discharge A/C system (if equipped).
    - Disconnect A/C lines at compressor and seal.
    - Disconnect wiring.
16. Rear console.
17. ECM harness - through bulkhead panel.
18. Engine strut front bolt.
19. Install engine support fixture and support bracket.
20. Raise vehicle.
21. Rear wheels.
22. Parking brake cables and calipers.
    - Do not disconnect brake hoses, support calipers out of way.
23. Strut bolts (2 per side).

Important

To retain camber setting on rear wheels, scribe legible mark (see Section 3D).

24. Loosen cradle bolts (4).
25. Lower vehicle.
26. Support engine - transaxle assembly and cradle on dolly.
27. Remove cradle bolts (4).
28. Lower onto dolly and remove J28467.
29. Raise vehicle leaving engine, transaxle and cradle assembly on dolly.
30. Separate engine and transaxle.

Install or Connect

1. Reconnect engine, transaxle and cradle.
2. Lower vehicle over dolly.
3. Cradle bolts (4-in sequence).
    - Install front bolts finger tight.
    - Torque rear bolts - 103 N·m (76 lb.ft.).
    - Torque front bolts - 90 N·m (66 lb.ft.).
4. Raise vehicle.
5. Strut bolts (align with marks).
6. Parking brake cables and calipers.
7. Rear wheels.
8. Lower vehicle.

9 Engine strut front bolt.

10. ECM harness - feed through bulkhead panel.
11. Rear console.
12. Charge A/C system (if equipped).
    - Connect A/C lines at compressor and seal.
    - Connect wiring.
13. Rear heat shield.
14. Engine harness to junction block.
15. Radiator hoses and heater hoses.
16. Ground strap.
17. Transaxle cooler lines (automatic only).
    - Slave cylinder to manual transaxle, and shield.
18. Fuel pump relay.
19. Fuel lines.
20. Vacuum hoses.
21. Throttle and shift cables.
22. Intake hose - throttle body to elbow.
23. Engine coolant.
24. Battery cables and plastic battery protector.
25. Rear compartment lid and side panels.

POWERTRAIN MOUNTS

Powertrain mounts (Figures 5 and 6) 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 Powertrain Mounts

Raise the engine to remove weight from the mounts and to place a slight tension on the rubber. Observe all mounts while raising engine.

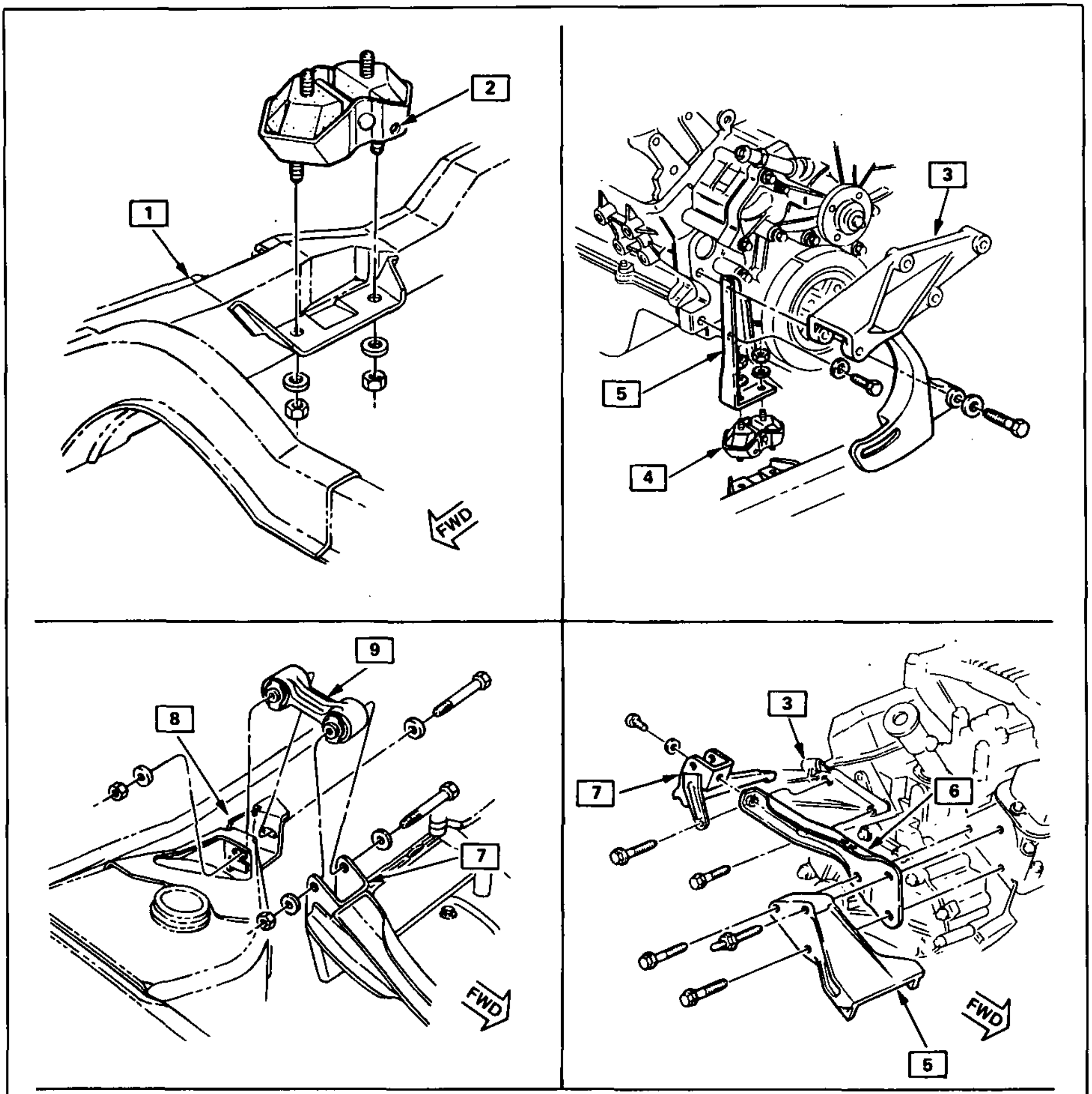
If a powertrain mount exhibits:

a. Hard rubber surface covered with heat check cracks,

b. Rubber separated from a metal plate of the mount or,

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



1–CRADLE

2–DRAIN HOLE–AWAY FROM CRADLE

3–GENERATOR BRACKET

4–ENGINE MOUNT

5–BRACKET

6–BRACKET ENGINE FRONT

7–BRACKET, STRUT

8–SUPPORT STRUT

9–STRUT

NOTE: TO POSITION STRUT IN SUPPORT, PUSH ENGINE REARWARD WITH A HORIZONTAL LOAD OF 200-250 NEWTONS. LOAD IS APPLIED ON A LINE DIRECTLY THROUGH CENTER OF SUPPORT SLOTS. TIGHTEN BOLT WITH LOAD APPLIED.

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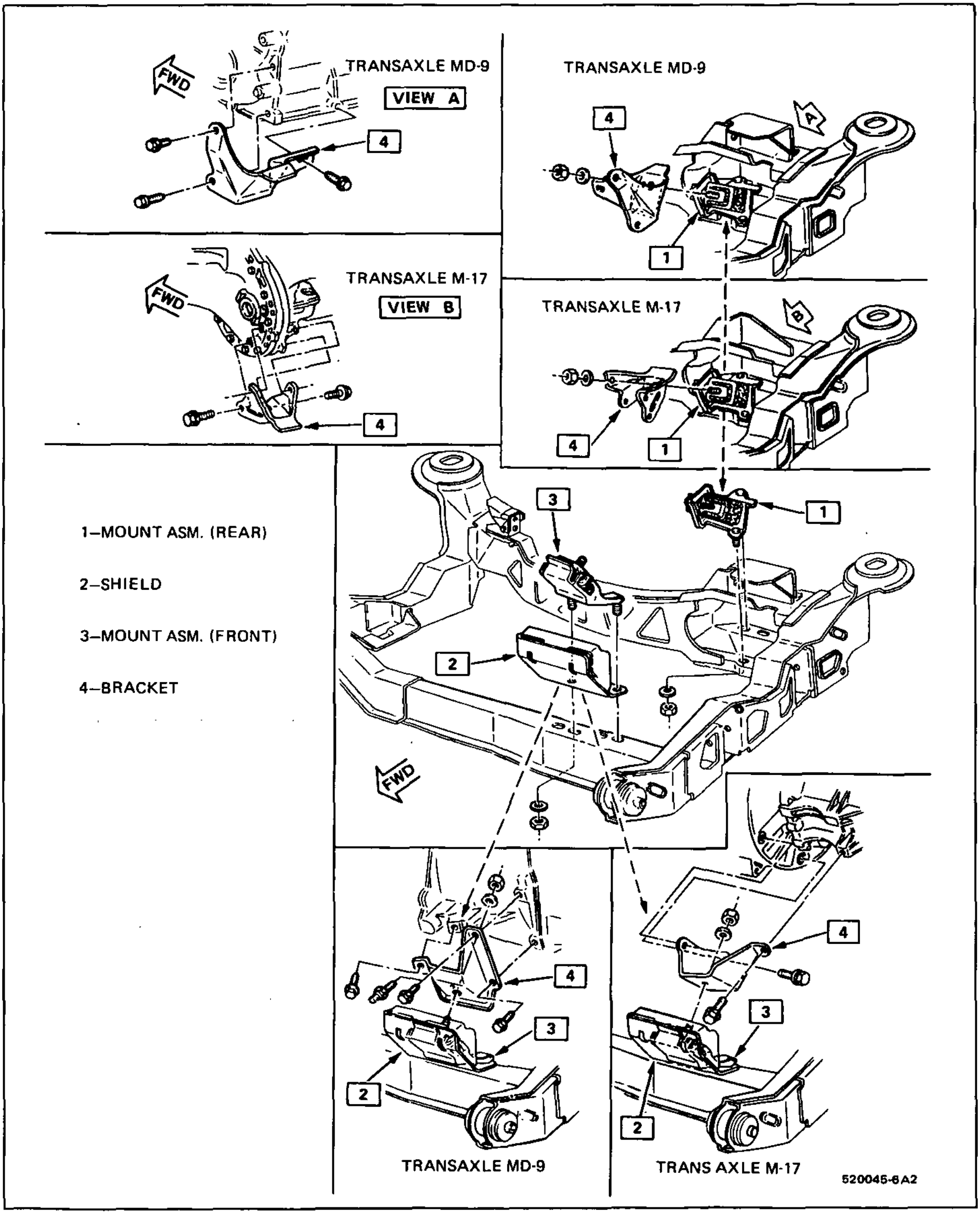
Figure 5 Engine Mounts and Torque Strut



1–MOUNT ASM. (REAR)

2–SHIELD

3–MOUNT ASM. (FRONT)

4–BRACKET

Figure 6 Cradle and Transaxle Mounts

and tighten the screws or nuts attaching the mount to the engine, frame, or bracket.

ENGINE AND TRANSAXLE MOUNTS

Tool Required:

J28467 Engine Support Fixture W/J35563 Support Bracket.

CAUTION: Engine support fixture J28467 must be located properly in cowl and its fasteners tightened before supporting engine and transaxle. Bodily injury could result with improper use of this support fixture. See instructions furnished with tool for proper installation.

ENGINE MOUNT

Figure 5

Remove or Disconnect

1. Engine compartment lid (2 men) and side cover panels.

   Important

   Do not remove torsion rod retaining bolts.
2. Support engine with J28467 and J35563.
3. Bolt - torque reaction rod.
4. Raise vehicle.
5. Nuts - engine mount to chassis.
6. Nuts - upper, mount to engine support bracket.
7. Engine mount.

Install or Connect

1. Nuts - engine mount to chassis and bracket - 55 N·m (41 lb.ft.).
2. Lower vehicle.
3. Bolt - torque reaction rod - 57 N·m (42 lb.ft.).
4. Remove engine support fixture.

NOTICE: After engine mount is properly installed, observe both transaxle mounts for proper alignment (Figure 7). If window "A" is not properly located, loosen the mount to cradle retaining nuts and allow the mount to reposition itself. If allowed to remain out of position, drive train component failure could occur.

ENGINE STRUT

Figure 5

Remove or Disconnect

1. Bolt and nut - strut to engine bracket.
2. Bolt and nut - strut to chassis.
3. Strut

Install or Connect

1. Strut, bolt and nut to chassis - 57 N·m (42 lb.ft.).
2. Bolt and nut - strut to engine bracket - 57 N·m (42 lb.ft.)

FORWARD TRANSAXLE MOUNT

Figure 6

Remove or Disconnect

1. Engine compartment lid (2 men) and side cover panels.

   Important

   Do not remove torsion rod retaining bolts.
2. Support engine and transaxle with J28467 and J35563.
3. Raise vehicle.
4. Nuts - mount to cradle and support bracket.
5. Mount and shield.

Install or Connect

1. Position shield and mount.
2. Nuts - mount to cradle and support bracket - 48 N·m (35 lb.ft.).
3. Lower vehicle.
4. Remove support fixture.

REAR TRANSAXLE MOUNT

Figure 6

Remove or Disconnect

1. Engine compartment lid (2 men) and side cover panels.

   Important

   Do not remove torsion rod retaining bolts.
2. Support engine and transaxle with J28467 and J35563.
3. Raise vehicle.
4. Nuts - mounts to cradle and support bracket.
5. Mount.

Install or Connect

1. Position mount.
2. Nuts - mount to cradle - 24 N·m (18 lb.ft.).
3. Nuts - mount to bracket - 48 N·m (35 lb.ft.).
4. Lower vehicle.
5. Remove support fixture.

ROCKER ARM COVER

Front

Remove or Disconnect

1. Negative battery cable.
2. Engine compartment lid (2 men) and both side covers.

   Important

   Do not remove the torsion rod retaiing bolts.
3. Vacuum boost line and tube.
4. Throttle and downshift cables, and bracket.
5. Cruise control cable, if applicable.

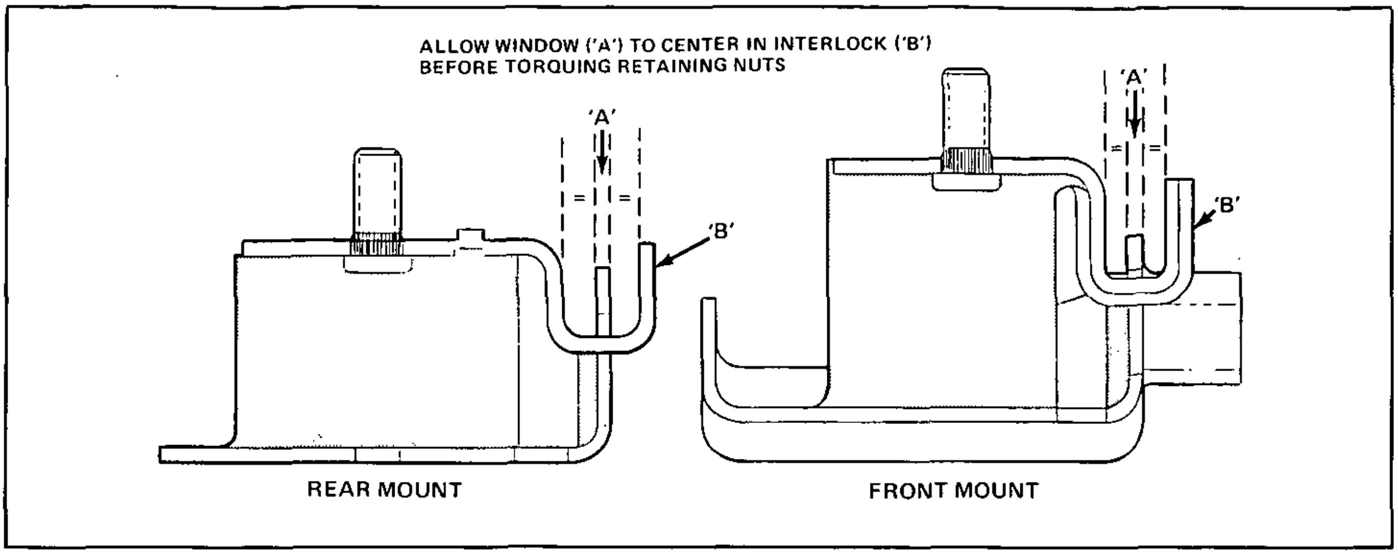


Fig. 7 Transaxle Mount Alignment

6. Ground cable.
7. PCV from rocker arm cover.
8. Oil dip stick tube.
9. Plug wires and bracket.
10. Engine lift hook.
11. Rocker arm cover bolts.
12. Rocker arm cover.

Important

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 release, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Clean

Sealing surfaces on cylinder head and rocker arm cover with degreaser.

Install or Connect

1. Place a 3mm diameter (1/8") dot of GM 1052917 RTV sealer, or equivalent, at the intake manifold and cylinder head split line.
2. Rocker arm cover gasket, using care to line up holes in the gasket with bolt holes in the cylinder head.
3. Rocker arm cover and bolts. Torque to 10 N·m (90 lb.in.).
4. Plug wires and bracket.
5. Oil dip stick tube.
6. PCV to rocker arm cover.
7. Ground cable.
8. Cruise control cable, if applicable.
9. Throttle and downshift cables, and bracket.
10. Vacuum boost line and tube.
11. Engine compartment lid (2 men) and both side covers.
12. Negative battery cables.

Rear

Remove or Disconnect

1. Negative battery cable.
2. Bolt - torque reaction rod at cylinder head bracket.
3. Swing torque reaction rod up and remove bolt connecting cylinder head bracket to bracket at front of engine.
4. Loosen lower bolt of torque reaction rod bracket at front of engine.
5. Upper two bolts of torque reaction rod bracket at front of engine.
6. Bolt-torque reaction rod bracket at cylinder head/exhaust manifold connection.
7. Wiring harness (in covering sleeve) between rocker arm cover and lower plenum.
8. Cover bolts.
9. Cover.

Important

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 release, CAREFULLY pry until loose. DO NOT DISTORT SEALING FLANGE.

Clean

Sealing surfaces on cylinder head and rocker arm cover with degreaser.

Install or Connect

1. Place a 3mm diameter (1/8") dot of GM 1052917 RTV sealer or equivalent, at the intake manifold and cylinder head split line.
2. Rocker arm cover gasket, using care to line up holes in the gasket with bolt holes in the cylinder head.
3. Rocker arm cover and bolts. Torque to 10 N·m (90 lb.in.).

4. Wiring harness between rocker arm cover and lower plenum.
5. Bolt-torque reaction rod bracket at cylinder head/exhaust manifold connection.
6. Upper two bolts of torque reaction rod bracket at front of engine.
7. Tighten lower bolt of torque reaction rod bracket at front of engine.
8. Replace bolt connecting cylinder head bracket to bracket at front of engine.
9. Bolt-torque reaction rod at cylinder head bracket.
10. Negative battery cable.

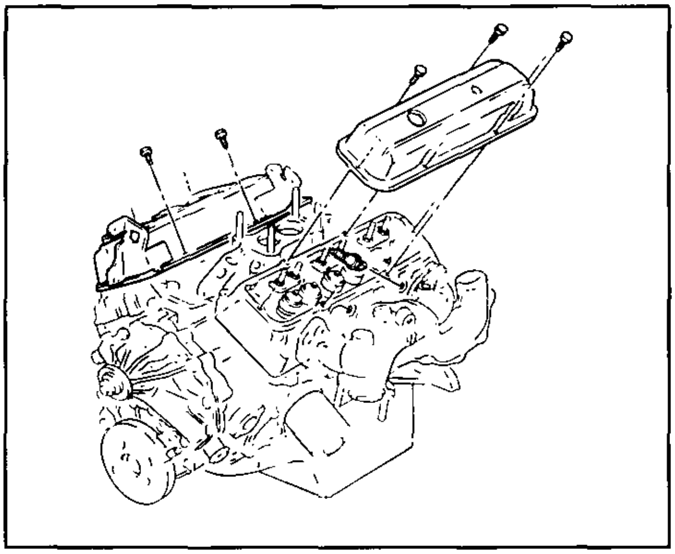


Fig. 8 Rocker Arm Cover Installation

INTAKE MANIFOLD

Figure 9

- Refer to Section 6E3 for MPFI removal.

Remove or Disconnect

1. Negative battery cable.
2. Both rocker arm covers.
3. Engine coolant.
4. Intake hose - throttle body to elbow.
5. Distributor (mark position of rotor).
6. Shift linkage.
    - Throttle
    - Downshift
    - Cruise control
7. Throttle body to upper plenum.
8. Radiator hose.
9. Radiator fill inlet.
10. Inlet and return heater hose and pipe to throttle body.
11. Wiring harness.
12. Heater hoses.
13. Vacuum hoses.
14. Brake vacuum booster pipe and bracket.
15. EGR pipe.
16. Upper manifold plenum and gaskets.
17. Intermediate intake manifold and gasket.
18. Lower intake manifold and gaskets.

Clean

- All gasket surfaces on cylinder head and intake manifolds.

Install or Connect

1. Lower intake manifold and gasket - torque in sequence - 26 N·m (19 lb.ft.).
2. Intermediate intake manifold and gaskets - torque in sequence - 21 N·m (15 lb.ft.).
3. Upper manifold plenum and gaskets - torque in sequence.
4. EGR pipe.
5. Brake vacuum booster pipe and bracket.
6. Vacuum hoses.
7. Heater hoses.
8. Wiring harness.
9. Inlet and return heater hose and pipe to throttle body.
10. Radiator fill inlet.
11. Radiator hose.
12. Throttle body to upper plenum.
13. Shift linkage.
    - Throttle
    - Downshift
    - Cruise Control
14. Distributor
15. Intake hose - throttle body to elbow.
16. Engine coolant.
17. Both rocker arm covers
18. Negative battery cable.

Inspect

- For proper timing
- Coolant level
- For fluid leaks

EXHAUST MANIFOLDS AND CROSSOVER

Figure 10

FRONT

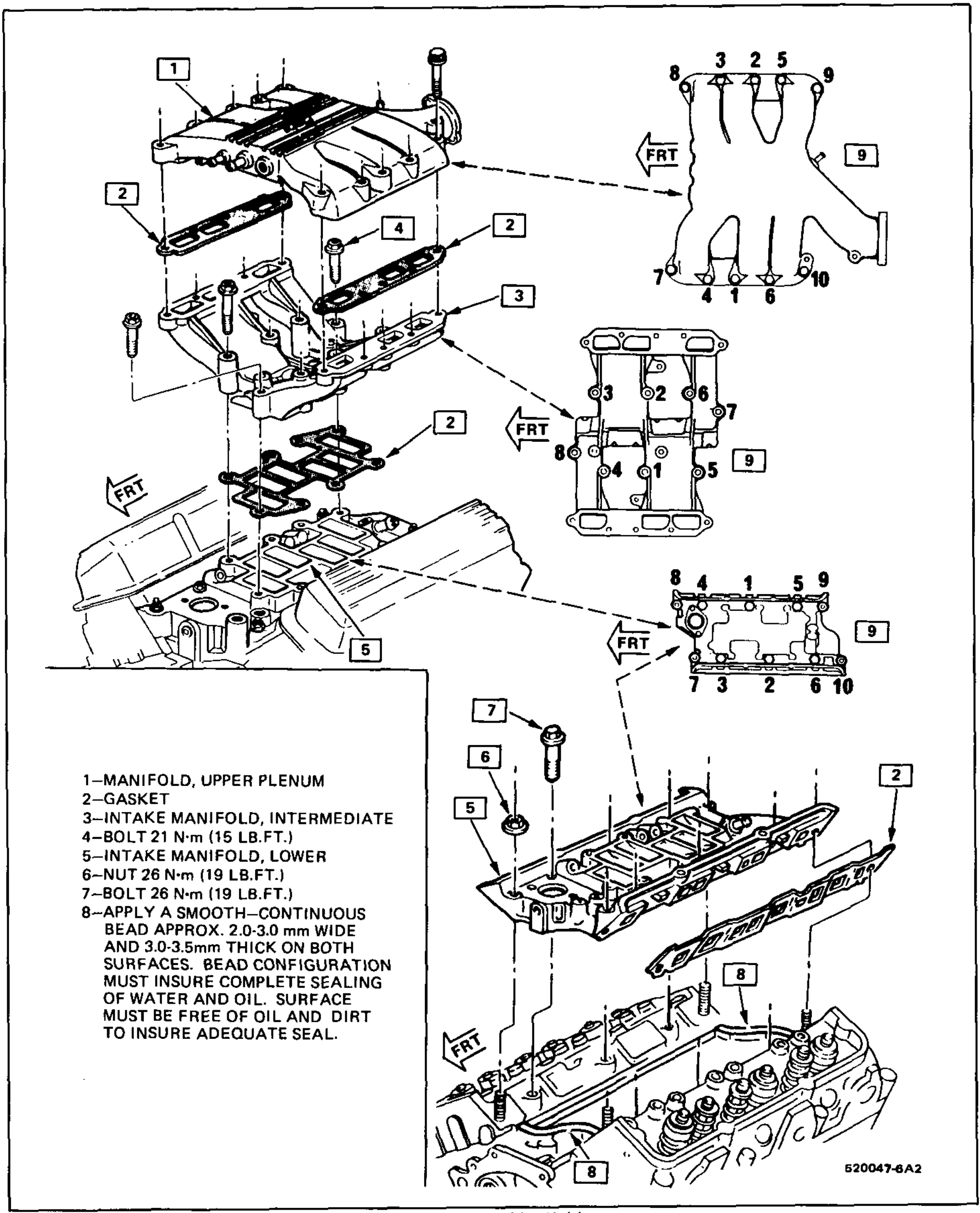
Remove or Disconnect

1. Negative battery cable.
2. Rear compartment lid (2 men)

Important

Do not remove the torsion rod retaining bolts.

3. Brake vacuum hose.
4. Manifold heat shield.
5. Crossover bolts (front).
6. Raise car.
7. Front converter heat shield.
8. Manifold bolts (lower)
9. Lower car.
10. Manifold bolts (upper).
11. Manifold.



1–MANIFOLD, UPPER PLENUM
2–GASKET
3–INTAKE MANIFOLD, INTERMEDIATE
4–BOLT 21 N·m (15 LB.FT.)
5–INTAKE MANIFOLD, LOWER
6–NUT 26 N·m (19 LB.FT.)
7–BOLT 26 N·m (19 LB.FT.)
8–APPLY A SMOOTH–CONTINUOUS BEAD APPROX. 2.0-3.0 mm WIDE AND 3.0-3.5mm 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.

Fig. 9 Intake Manifold

Install or Connect

1. Manifold - position with upper bolts - 24 N·m (18 lb.ft.).
2. Raise car.
3. Manifold - lower bolts - 24 N·m (18 lb.ft.)
4. Front converter heat shield.
5. Lower car.
6. Crossover bolts - 30 N·m (22 lb.ft.).
7. Manifold heat shield.
8. Brake vacuum hose.
9. Rear compartment lid.
10. Negative battery cable.

Inspect

- For exhaust or vacuum leaks.

REAR

Remove or Disconnect

1. Manifold to crossover bolts.
2. Manifold bolts and manifold.

Install or Connect

1. Manifold and manifold bolts - 24 N·m (18 lb.ft.)
2. Manifold to crossover bolts - 30 N·m (22 lb.ft.)

Inspect

- For exhaust or vacuum leaks.

CROSSOVER PIPE

Remove or Disconnect

1. Rear compartment left side panel.
2. Intake flex duct - throttle body to elbow.
3. EGR hose.
4. Shift cables at transaxle.
5. EGR tube from exhaust crossover to intake manifold.
6. Front and rear crossover shields.
7. Oxygen sensor connector.
8. Bolts at front and rear exhaust manifolds.
9. Raise vehicle.
10. Bolts at catalytic converter.
11. Lower vehicle.
12. Crossover pipe
13. Oxygen sensor at pipe.
14. EGR valve and adapter at pipe.

Install or Connect

1. Assemble oxygen sensor, EGR valve and adapter to crossover pipe.
2. Crossover.
3. Crossover to manifold bolts (front and rear) 30 N·m (22 lb.ft.).
4. Raise vehicle.
5. Bolts at catalytic converter - 20 N·m (15 lb.ft.).
6. Lower vehicle.
7. Oxygen sensor connector.
8. Front and rear crossover shields.
9. EGR tube from exhaust crossover to intake manifold.
10. Shift cables at transaxle.
11. EGR hose.
12. Intake flex duct - throttle body to elbow.
13. Rear compartment left side panel.

Inspect

- For exhaust leaks.

VALVE MECHANISM

Figure 11

Remove or Disconnect

1. Rocker arm covers
2. Rocker arm nuts
   - Keep components in a rack so they may be reinstalled in the same location
3. Rocker arm pivot balls
4. Rocker arms
5. Push rods

Install or Connect

1. Push rods. Be sure they seat in lifter
2. Rocker arms
3. Rocker arm pivot balls

Important

- Coat bearing surfaces of rocker arms and pivot balls with "Molykote" or equivalent.

4. Rocker arm nuts until lash is eliminated

Adjust

- Rotate engine until mark on torsional damper lines up with "O" mark on the timing tab, with the engine 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.

  With the engine in the #1 firing position, the following valves may be adjusted.

  Exhaust -- 1, 2, 3

  Intake -- 1, 5, 6
- Back out adjusting nut until lash is felt at the push rod, then turn in adjusting nut until all lash is removed (Figure 12). (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).
- 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

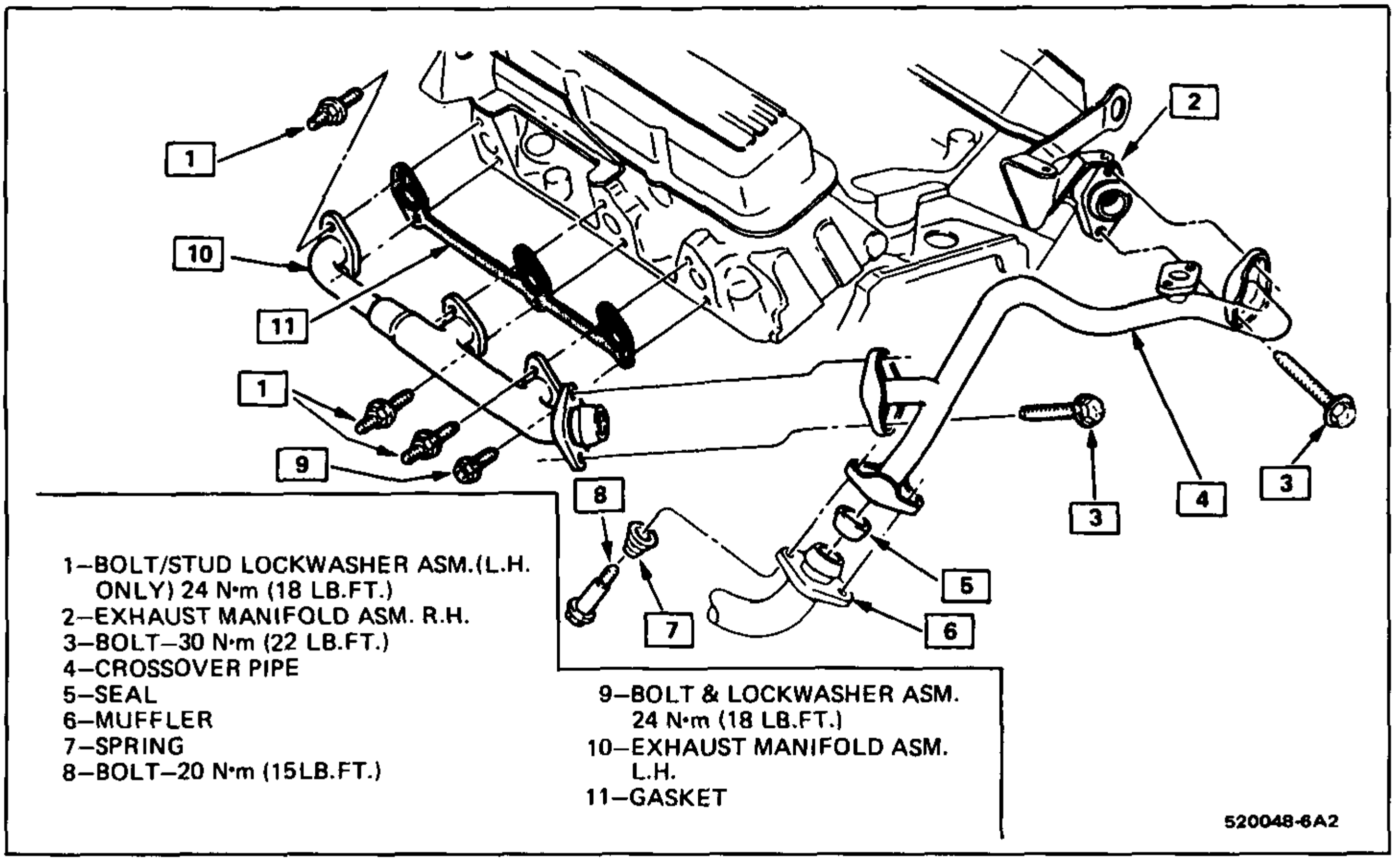


Fig. 10 Exhaust Manifold

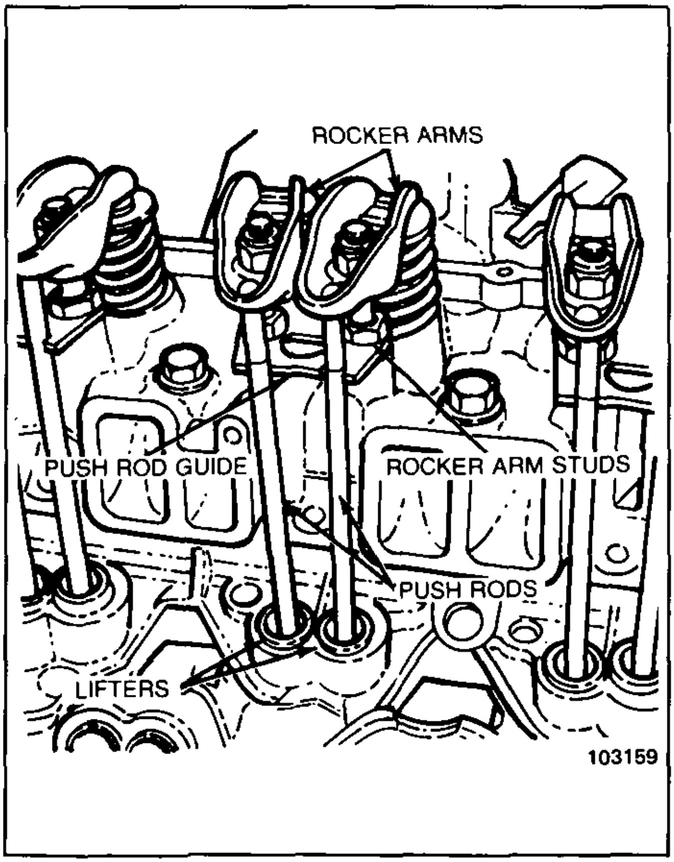


Fig. 11 Valve Mechanism

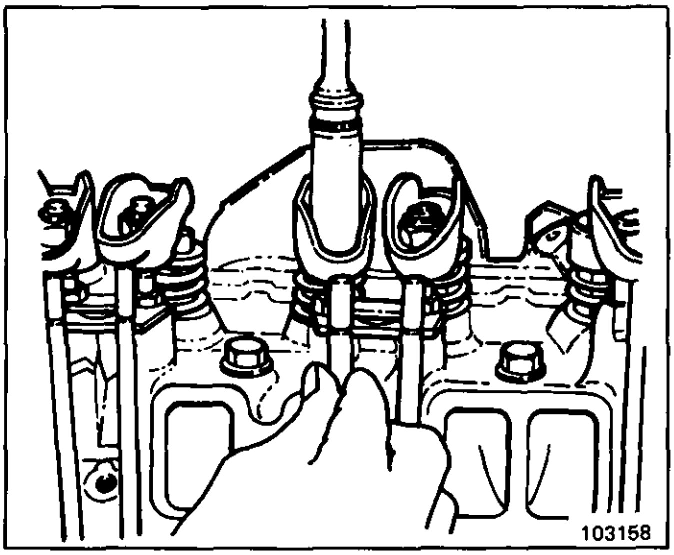


Figure 12 Adjusting Valve Lash

Intake -- 2, 3, 4

5. Rocker arm covers.

Inspect

- Start engine. Check timing and idle speed.

VALVE STEM OIL SEAL AND/OR VALVE SPRING

Remove or Disconnect

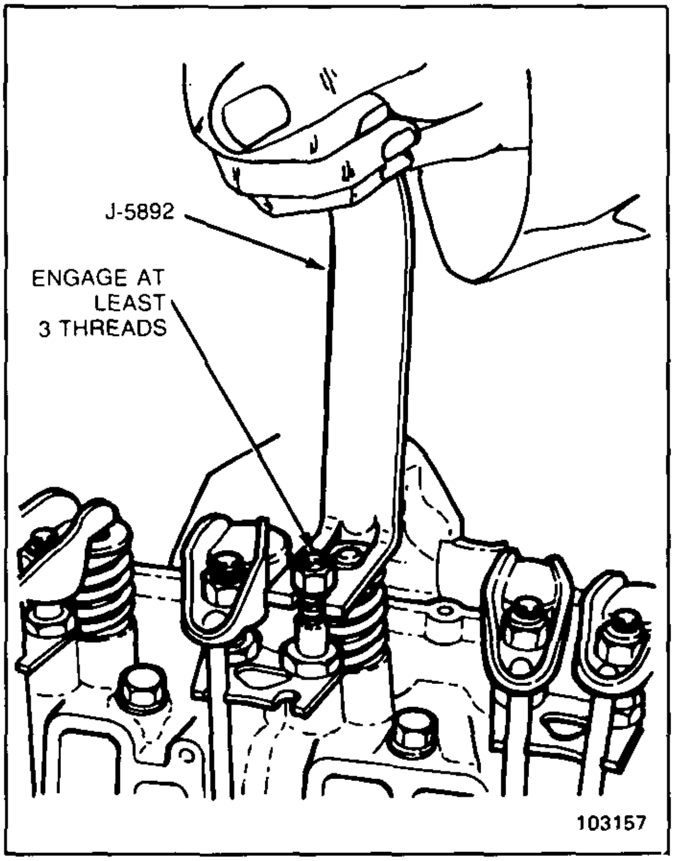


Figure 13 Depressing Valve Spring

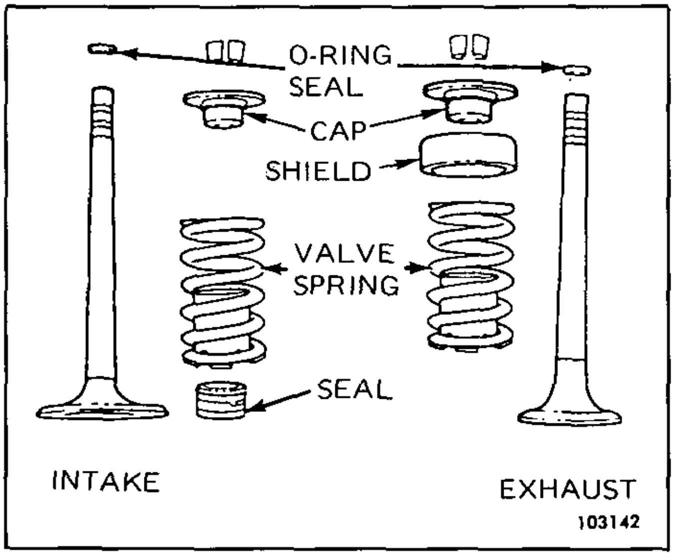


Figure 14 Valve Stem Seal

Figures 13 and 14

Tools required:

- J23590 Air line adapter
- J5892 Valve spring compressor
- J23994 Tester

1. Rocker arm cover
2. Spark plug
3. Rocker arm
4. Push rod
5. Install air line adapter Tool J23590 in spark plug port and apply compressed air to hold the valves in place.
6. With tool J5892 compress the valve spring

Disassemble

- Valve locks
- Valve cap
- Oil shedder (exhaust valve only)
- Valve spring
- Damper

7. Valve stem oil seal

Install or Connect

Assemble

- Valve damper
- Valve spring
- Oil shedder (exhaust only)
- Valve cap
- Valve stem seal over the valve stem and valve guide base (intake only)
  - Use plastic sleeve provided.
  - Press over valve guide boss.

1. With tool J5892 compress the valve spring
2. Square cut "0" ring around the valve stem in the lower groove, making sure it is not twisted.

NOTICE: To prevent damage from twisting, coat seal with engine oil.

3. Valve locks. If necessary, hold them in place with grease.
4. Release valve spring

Inspect

- Make sure valve locks are seated
- With tool J23994, apply vacuum to the valve cap to make sure no air leaks past the seal

5. Spark plug

Tighten

- To 15 N·m (11 lb. ft.)

6. Push rod
7. Rocker arm

Adjust

- Valve lash

8. Rocker arm cover

VALVE LIFTERS

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.

Where O.S. lifters are used, the cylinder case will be marked with a daub of white paint "0.25" (mm) O.S. stamped on the lifter boss (Figure 15).

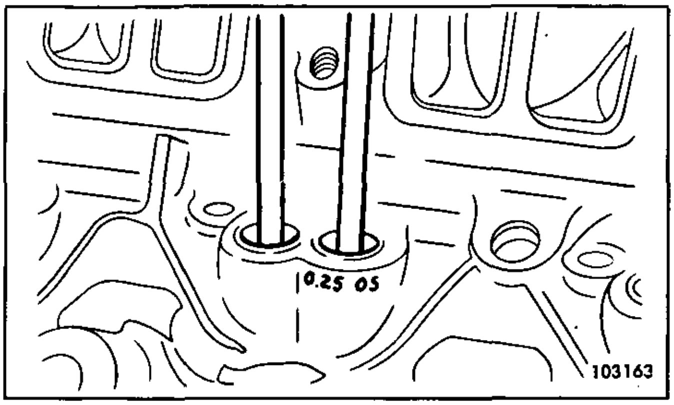


Figure 15 Oversize Lifter Marking

If the lifters are removed, they must be reinstalled in their original location. If replacement is necessary use lifters with a narrow flat ground along the lower 3/4 of lifter. These flats provide additional oil to the cam lobe and lifter surfaces.

Remove or Disconnect

1. Drain coolant.
2. Intake manifold.
3. Valve mechanism.
4. Valve lifter.

Inspect

- For inspection and overhaul procedures refer to Section 6A General Engine Mechanical

Install or Connect

Whenever new valve lifters are being installed, coat foot of valve lifters with "Molykote" or equivalent.

1. Valve lifter.
2. Valve mechanism
3. Intake manifold.
4. Engine coolant

Adjust

- Valve lash

CYLINDER HEAD

Left

Remove or Disconnect

1. Raise vehicle.
2. Drain coolant from block.
3. Lower vehicle.
4. Intake manifold
5. Exhaust crossover pipe.
6. Generator bracket
7. Oil level indicator tube.
8. Loosen rocker arms until able to remove push rods.
9. Cylinder head bolts.
10. Cylinder head.

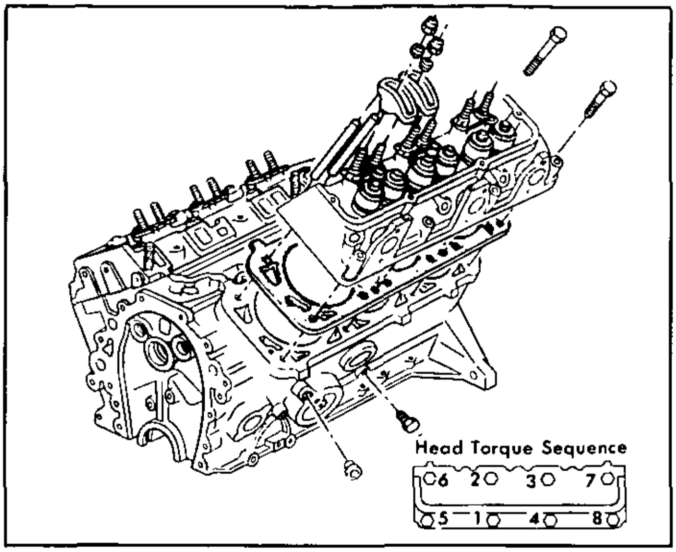


Figure 16 Cylinder Head Installation

Clean

- Gasket surfaces on the head, cylinder block and intake manifold.
- Cylinder block bolt threads
- Cylinder head bolts

Inspect

- For cylinder head overhaul procedures, refer to Section 6A General Engine Mechanical

Install or Connect

1. Place the gasket in position over the dowel pins, with the note "This Side Up" showing.
2. Cylinder head.
3. Coat cylinder head bolt threads with GM 1052080 Sealer, or equivalent, and install bolts.

   Tighten

   - Bolts in sequence - 90 N·m (66 lb.ft.) (Figure 16).
4. Push rods and loosely retain with rocker arms.

   Important

   - Make sure lower ends of push rods are in lifter seats.

   Adjust

   - Valve lash.
5. Intake manifold and gaskets.
6. Oil level indicator tube bracket to head.
7. Heat stove pipe and air supply pipe.
8. Attach alternator bracket and stud.
9. Exhaust pipe.
10. Exhaust Crossover Pipe.

Right

Remove or Disconnect

1. Raise vehicle.
2. Drain block.
3. Exhaust pipe
4. Lower vehicle.
5. Cruise control servo bracket.
6. Intake manifold.
7. Exhaust crossover pipe.
8. Loosen rocker arms until able to remove push rods.
9. Cylinder head bolts.
10. Cylinder head.

Clean

- Gasket surfaces on the head, cylinder block and intake manifold.
- Cylinder block bolt threads.
- Cylinder head bolts.

Inspect

- For cylinder head overhaul procedures, refer to Section 6A General Engine Mechanical

Install or Connect

1. Place the gasket in position over the dowel pins, with the note "This Side Up" showing.
2. Cylinder head.
3. Coat the cylinder head bolt threads with GM 1052080 sealer, or equivalent, and install bolts.

Tighten

- Bolts in sequence - 90 N·m (66 lb.ft.) (Figure 16).

4. Push rods and loosely retain with rocker arms.

Important

- Make sure lower ends of push rods are in lifter seats.

5. Intake manifold and gaskets.
6. Exhaust crossover pipe.
7. Cruise control servo bracket.
8. Raise vehicle.
9. Exhaust pipe.
10. Lower vehicle.

Adjust

- Drive belts.
- Valve lash.

TORSIONAL DAMPER

NOTICE: The inertia 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 on the hub will destroy the tuning of the torsional damper, and the engine timing reference.

The torsional damper has (3) timing notches on the inertia ring. The #1 cylinder timing reference mark will be identified by a dab of white paint in production. If a new damper assembly is installed, mark the new assembly in the same location for future reference. #1 cylinder reference is the first mark clockwise from the keyway when viewing the engine from the front.

Remove or Disconnect

Tool Required:
J23523 Puller

1. Negative battery cable.
2. Accessory drive belts.
3. Raise vehicle.
4. Inner fender splash shield (right side).
5. Accessory drive pulley.
6. Damper retaining bolt.
7. With Tool J23523 installed on damper, turn puller screw, and remove damper.

Install or Connect

Tool Required:
J29113 Installer

1. Coat front cover seal contact area (on damper) with engine oil.
2. Apply sealant to key and keyway.
3. Place damper in position over key on crankshaft.
4. Pull damper onto crankshaft.

Assemble

- Tool J-29113 on crankshaft.
- Pull damper into position and remove tool from damper.

5. Accessory drive pulley and damper retaining bolts. Torque to specifications.
6. Inner fender splash shield.
7. Lower vehicle.
8. Accessory drive belts.
9. Negative battery cable.

Adjust

- Accessory drive belts.

CRANKCASE FRONT COVER

Remove or Disconnect

1. A/C compressor and bracket.
2. Water pump. (Figure 17).
3. Raise vehicle.
4. Torsional damper.
5. Oil pan to cover bolts.
6. Lower vehicle.
7. Front cover.

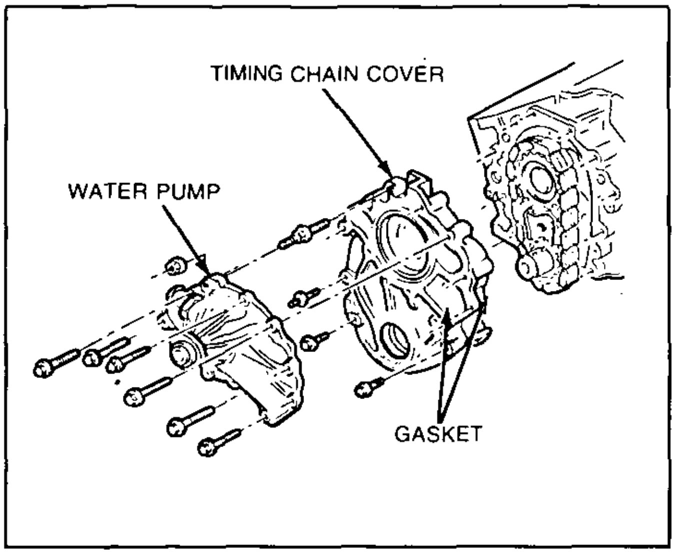


Figure 17 Water Pump/Front Cover Orientation

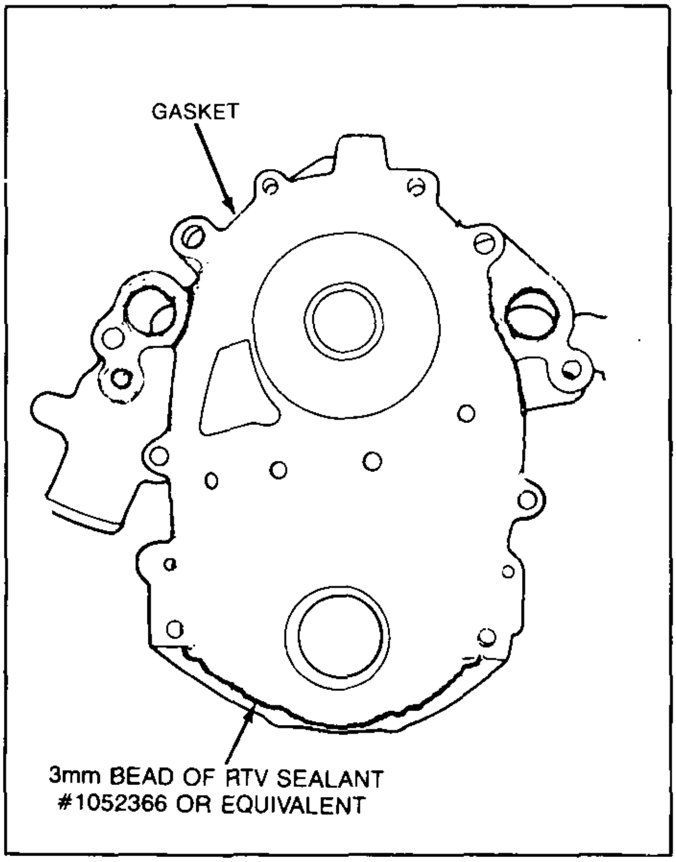


Figure 18 Front Cover Sealant Placement

Clean

- Sealing surfaces on the front cover and cylinder block.
- Sealing surfaces with degreaser

Install or Connect

1. New gasket, making sure not to damage sealing surfaces
2. Apply a continuous 3mm (1/8") bead of GM 1052917 RTV sealer or equivalent to oil pan sealing surface of front cover (Figure 18).
3. Place front cover on the engine. Install stud bolt and bolts.
4. Water pump (Section 6B.)
5. Retaining bolts and nut, and tighten to specifications.
6. Raise vehicle.
7. Oil pan to cover screws.
8. Torsional damper.
9. Lower vehicle.
10. A/C compressor and bracket
11. Accessory drive belts.
12. Cooling system.
13. Negative battery cable.

Adjust

- Accessory drive belts

Inspect

- Coolant level
- Leaks

OIL SEAL FRONT COVER

Remove or Disconnect

1. Torsional damper
2. Pry out seal with a suitable tool

Install or Connect

Tool Required:
J23042 Seal Installer.

1. Lubricate seal with clean engine oil
2. Insert in front cover with lip facing the engine.
3. Insert Tool J23042 and drive seal into place.
4. Torsional damper

Inspect

- For fluid leaks

TIMING CHAIN AND SPROCKETS

Remove or Disconnect

Tools required:
J5825 Crankshaft sprocket remover
J5590 Crankshaft sprocket installer

1. Crankcase front cover.
2. Place #1 piston at top dead center, with the marks on the camshaft and crankshaft sprockets aligned.
3. Camshaft sprocket and chain (Figure 19).

Important

- If the sprocket does not come off easily, a light blow on its lower edge (with a plastic mallet) should dislodge the sprocket.

4. Crankshaft sprocket with Tool J5825.

Install or Connect

1. Crankshaft sprocket with Tool J5590.

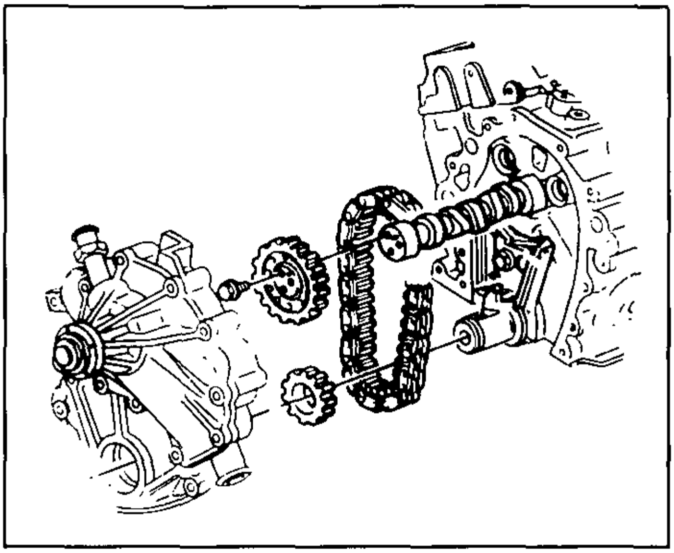


Figure 19 Timing Chain and Sprockets

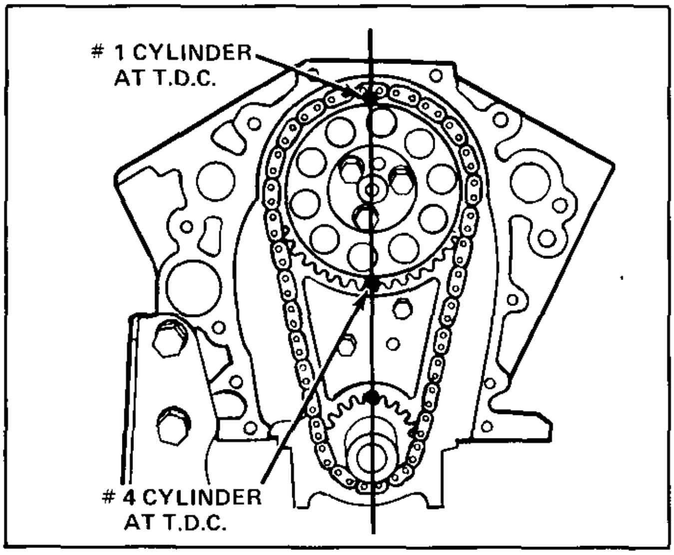


Figure 20 Camshaft Timing

2. Apply "Molykote" or equivalent to the sprocket thrust surface.
3. Hold the sprocket with the chain hanging down and align the marks on the camshaft and crankshaft sprockets. (Figure 20).
4. Align dowel in camshaft with dowel hole in camshaft sprocket.
5. Draw the camshaft sprocket onto camshaft, using the mounting bolts. Torque to specifications.
6. Lubricate timing chain with engine oil.
7. Crankcase front cover.

CAMSHAFT

Remove or Disconnect

1. Engine (on cradle).
2. Valve lifters.
3. Crankcase front cover.
4. Timing chain and sprocket.
5. Rear cover (Figure 21).
6. Camshaft.

NOTICE: All camshaft journals are the same diameter and care must be exercised in removing camshaft to avoid damage to bearings.

Inspect

- For inspection of camshaft, replacement of camshaft bearings, and overhaul of lifters refer to Section 6A General Engine Mechanical.

Install or Connect

Important

- Whenever a new camshaft is installed, coat camshaft lobes with GM E.O.S. or equivalent.

1. Lubricate camshaft journals with engine oil
2. Camshaft
3. Timing chain and sprocket.
4. Rear cover.
5. Crankcase front cover.
6. Lifters.
7. Engine

Inspect

- For proper completion of repair
- For fluid leaks

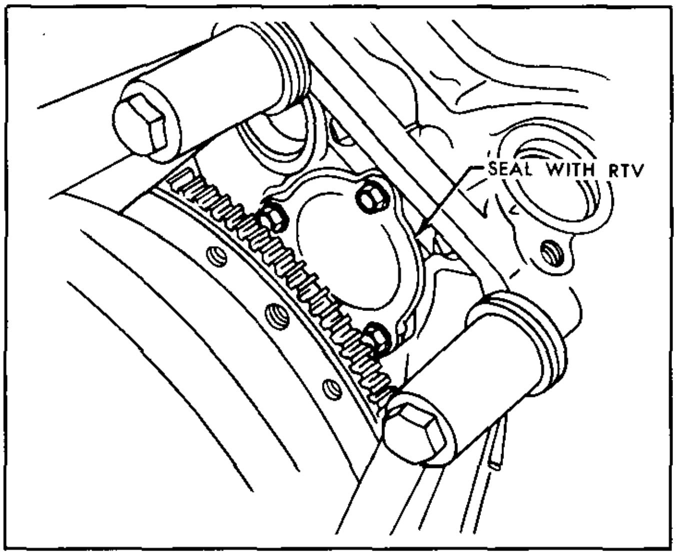


Figure 21 Camshaft Rear Cover

OIL PAN

Figure 22

Remove or Disconnect

1. Negative battery cable.
2. Raise vehicle.
3. Drain crankcase.
4. Flywheel shield or clutch housing cover.
5. Starter.
6. Oil pan bolts.
7. Oil pan.

Clean

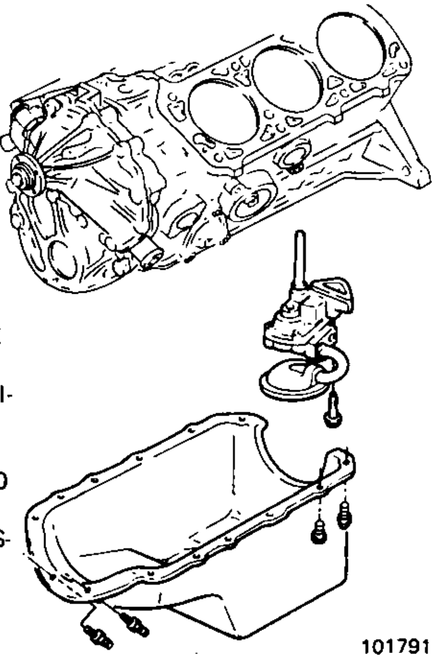
- Oil pan flanges
- Oil pan rail
- Front cover
- Rear main bearing cap
- Threaded holes

Install or Connect

1. Place a 3mm (1/8") bead of GM 1052917 RTV sealant, or equivalent, on the oil pan sealing flange.
2. Oil Pan
3. Oil pan bolts and torque to specification
4. Starter.
5. Flywheel shield or clutch housing cover.
6. Lower vehicle.
7. Fill crankcase.
8. Negative battery cable.

Inspect

- For leaks
- Proper oil level



FOR LE2, ENGINE OIL PRESSURE 69kPa (10 psi) MINIMUM AT 500 RPM AND 207-310 kPa (30-45 psi) AT 2000 RPM. FOR LH7, ENGINE OIL PRESSURE 345-379 kPa (50-55 psi) AT 2000 RPM.

Figure 22 Oil Pan and Pump

OIL PUMP

Figure 23

Remove or Disconnect

1. Oil pan.
2. Pump and drive shaft extension

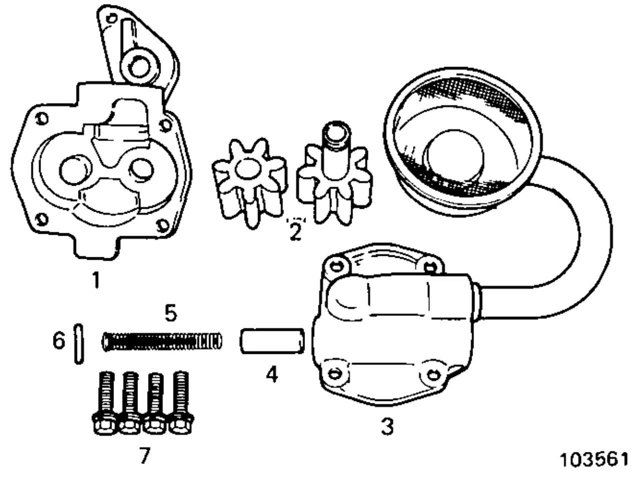


Figure 23 Oil Pump - Exploded

Inspect

- For inspection and overhaul of oil pump, refer to Section 6A General Engine Mechanical.

Install or Connect

1. Oil pump and drive shaft extension. Engage drive shaft extension in cover end of the distributor drive gear.
2. Pump to rear bearing cap bolt and torque to specifications.
3. Oil pan.
4. Oil in crankcase

Inspect

- Proper oil level
- For oil pressure
- For oil leaks

CONNECTING ROD AND MAIN BEARINGS

Inspect

- For inspection, fitting and replacement of connecting rod bearings, refer to Section 6A General Engine Mechanical.

PISTONS, RINGS, AND CONNECTING RODS

Remove or Disconnect

1. Cylinder heads.
2. Oil pan.

Inspect

- Examine the cylinder bores above the ring travel. 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. Connecting rod bearing cap and bearing insert.

Important

- Install guide hose over threads of rod bolts to prevent damage to bearing journal and connecting rod bolt threads.

4. Push connecting rod and piston assembly through the top of the cylinder bore.

Install or Connect

1. Connecting rod and piston assembly using proper ring compressor and connecting rod bolt guide hose.
2. Connecting rod bearing and cap. Tighten to specification.
3. Oil pan.
4. Cylinder head.

CRANKSHAFT

The crankshaft can be removed while the engine is disassembled for overhaul, or without complete disassembly. Refer to Section 6A General Engine Mechanical.

GENERAL DATA

TYPE	60° V-6
DISPLACEMENT	2.8 Liters
RPO	L44
BORE	89
STROKE	76
COMPRESSION RATIO	8.5:1/8.9:1
FIRING ORDER	1-2-3-4-5-6

Cylinder Bore

DIAMETER	88.992-88.070
OUR 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-.0092
FIT IN ROD	.0187-.0515 Press

Camshaft

LIFT	
Intake	5.87 6.67
Exhaust	6.67 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-.21
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

	SIZE	N·m	LB. FT.
A/C Bracket to Cover	M10X1.5	35-50	25-35
A/C Cmpr Attachment	M10X1.5	40-54	30-40
A/C Brackets	M10X1.5	27-41	20-30
Camshaft Sprocket	M8X1.25	20-27	15-20
Camshaft Cover (Rear)	M6X1.0	8-12	6-9
Clutch Cover to Flywheel	M8X1.25	18-24	13-18
Cylinder Head	M11X1.5	88-122	65-90
Connecting Rod Cap	M9X1.0	46-54	34-40
Crankshaft Pulley	M10X1.5	27-41	20-30
Crankshaft Pulley Hub	M12X1.5	90-115	66-84
Distributor Hold Down Bolt	M10X1.5	27-41	20-30
EGR Valve	M8X1.25	18-24	13-18
Engine Mounting Bracket	*M12X1.75*	*95-125*	*70-92*
Engine Mounting Torque Strut Bracket	M10X1.5	40-54	30-40
Exhaust Manifold	M8X1.25	30-38	22-28
Flex Plate to Torque Converter	M10X1.5	34-47	25-35
Flywheel	M10X1.0	61-75	45-55
Front Cover	M8X1.25	18-24	13-18
	M10X1.5	27-41	20-30
Fuel Pump	M8X1.25	18-24	13-18
Generator Bracket (to Head)	M10X1.5	40-54	30-40
Generator Brace (to Cover)	M10X1.5	27-41	20-30
Generator Pivot Bolt	M10X1.5	27-41	20-30
Generator Adjust Bolt	M8X1.25	20-34	20-25
Heater Return Nipple	1/2" Pipe	19-27	14-20
Heater Supply Nipple	1/2" Pipe	19-27	14-20
Intake Manifold	M8X1.25	27-34	20-25
Main Bearing Caps	M11X1.5	85-100	63-74

	SIZE	N·m	LB. FT.
Oil Level Gage Tube	M10X1.5	27-41	20-30
Oil Filter	M18X1.5	9-23	7-17
Oil Filter Connector	M18X1.5	32-46	24-34
Oil Pan	M6X1.0	8-12	6-9
	M8X1.25	19-30	14-22
Oil Pump	M10X1.5	35-47	26-35
Oil Pump Cover	M6X1.0	8-12	6-9
Oil Pressure Switch	–	5-7	4-5
Oil Drain Plug	*1/2-20*	*20-27*	*15-20*
P/S All Bolts	M10X1.5	34-41	25-30
P/S All Nuts	M10X1.5	50-56	36-41
P/S Bracket (to Head)	M10X1.5		
P/S Brace (to Block)	M10X1.5	27-41	20-30
Rear Lifting Bracket	M10X1.5	40-60	30-44
Rocker Arm Cover	M6X1.0	8-12	6-9
Rocker Arm Stud	M10X1.5	58-66	43-49
Spark Plug	*M14X1.25*	*10-20*	*7-15*
Starter Motor	M10X1.5	36-50	26-37
Strut Bracket Asm Nut & Bolt	M10X1.5	50-56	36-41
Timing Chain Tensioner	*M8X1.25*	*18-24*	*13-18*
Transmission to Engine Block	M12X1.75	65-85	48-63
Water Outlet	M10X1.5	27-41	20-30
Water Pump	M6X1.0	8-12	6-9
	M8X1.25	18-24	13-18
	M10X1.5	27-41	20-30
Water Pump Pulley	M8X1.25	18-24	13-18

Figure 24 Engine Bolt Torques

SECTION 6B

ENGINE COOLING

GENERAL DESCRIPTION

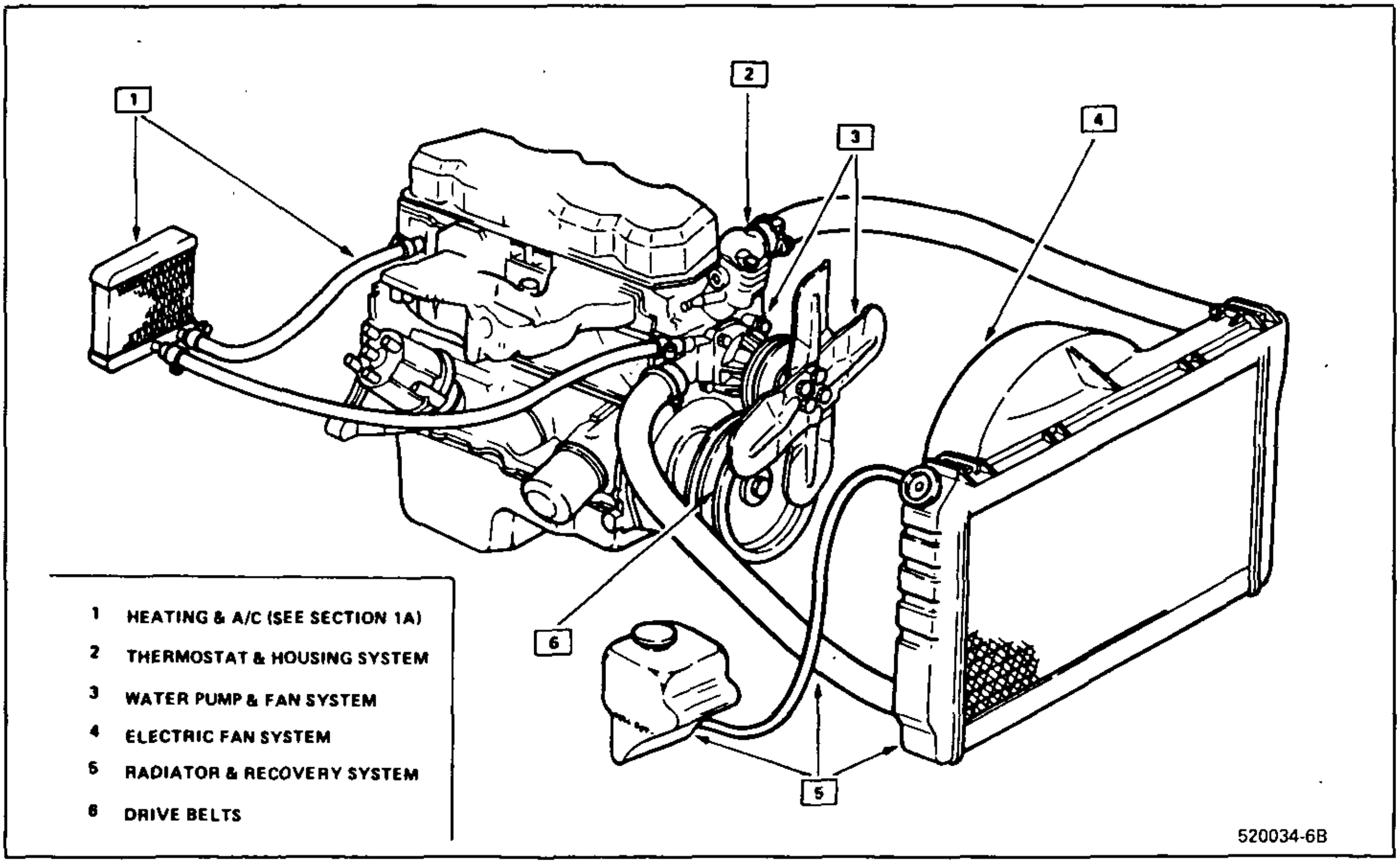


Fig. 1 Cooling System Components

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 2). 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.

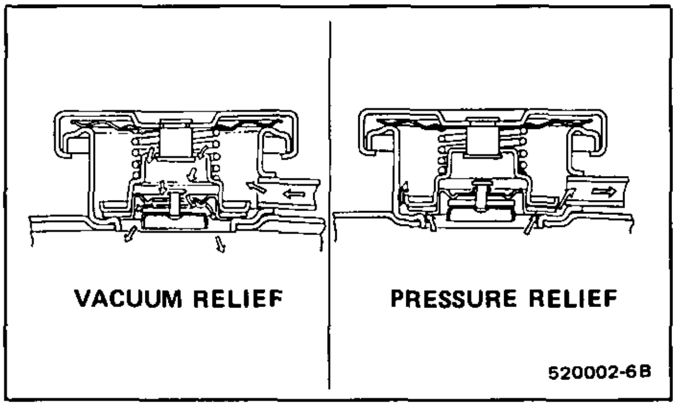


Fig. 2 Pressure-Type Radiator Cap

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 L4 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).

Fans

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

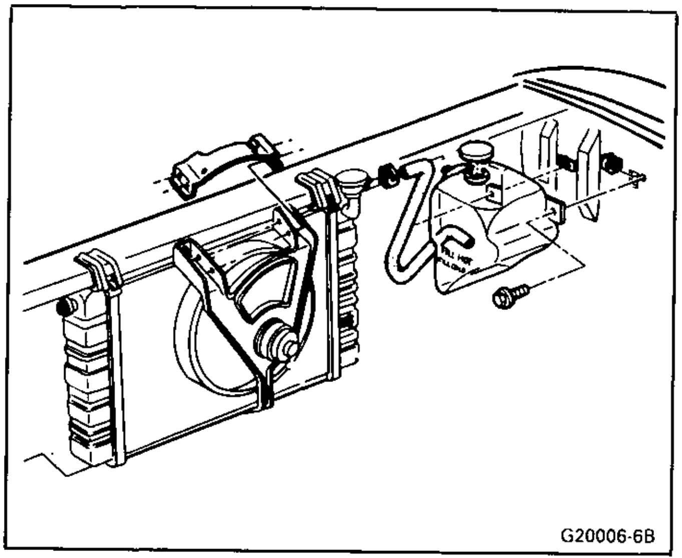


Fig. 3 Coolant Recovery Bottle

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 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.

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.

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), and 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

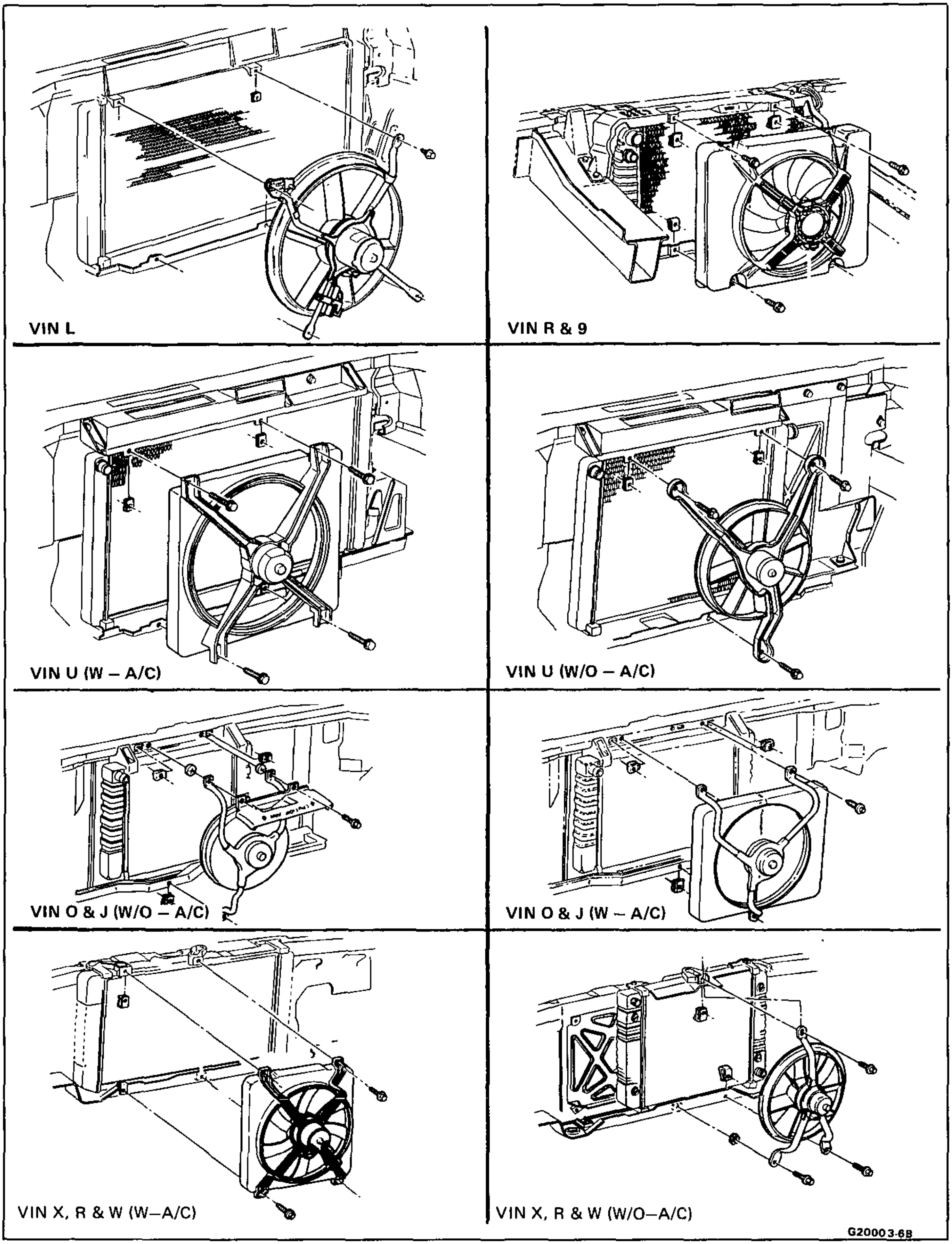
The following diagnostic information covers common problems and possible causes. When the proper diagnosis is made the problem should be corrected by part replacement, adjustment, or repair as required. Refer to the appropriate section of the service manual for these procedures.

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.

NOTICE: If recommended quality antifreeze is used, supplemental inhibitors or additives claiming



VIN L

VIN R & 9

VIN U (W – A/C)

VIN U (W/O – A/C)

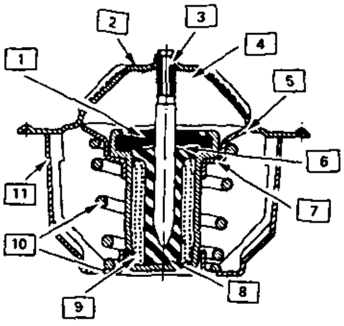
VIN O & J (W/O – A/C)

VIN O & J (W – A/C)

VIN X, R & W (W–A/C)

VIN X, R & W (W/O–A/C)

Fig. 4 Electric Fan Mounting



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. 5 Pellet Type Thermostat

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 checked, 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).

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. 6 Cooling System Diagnosis Chart (1 of 3)

BOILING/ENGINE OVERHEAT/ ENGINE COOLANT LOSS

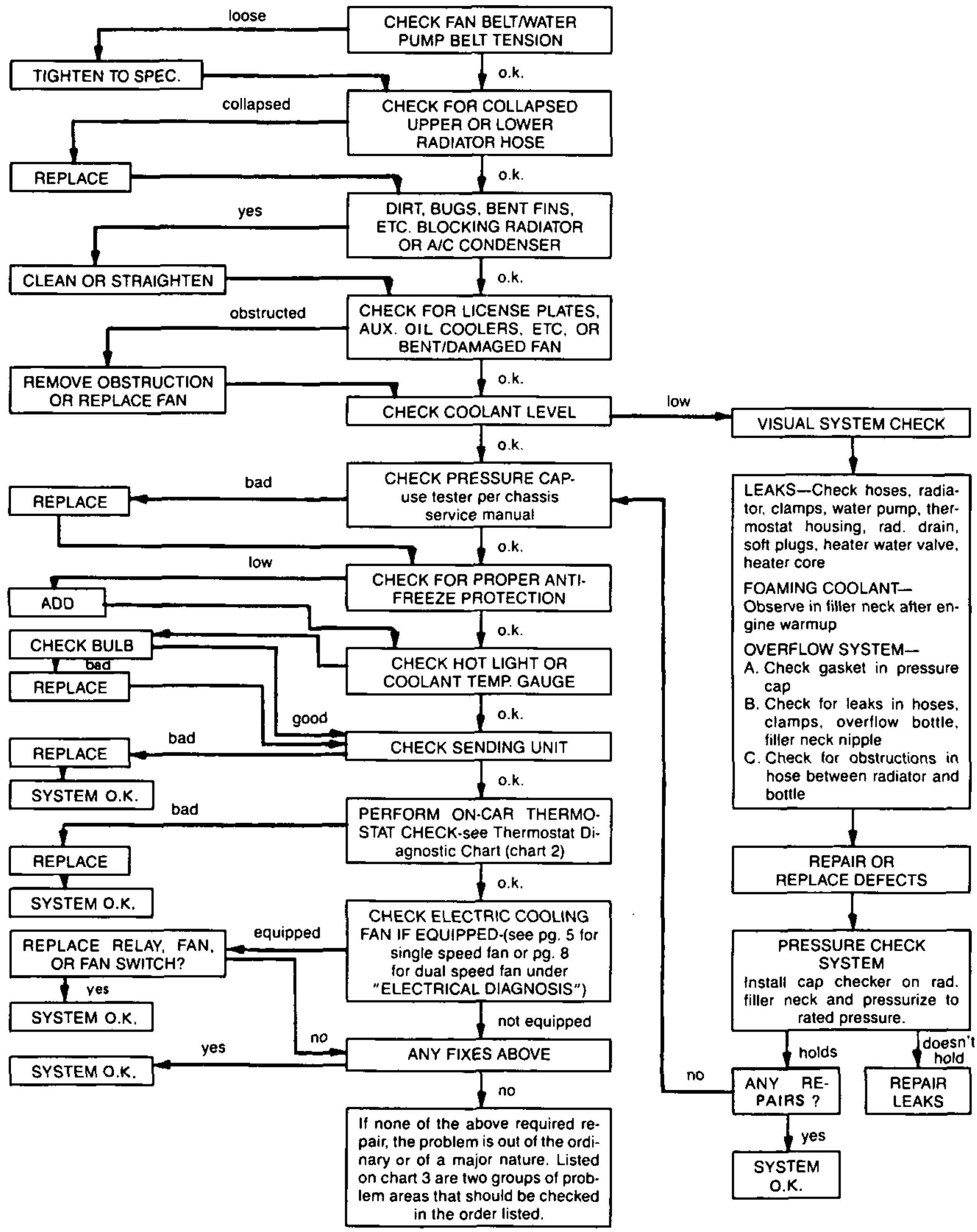

Fig. 7 Cooling System Diagnosis Chart (2 of 3)

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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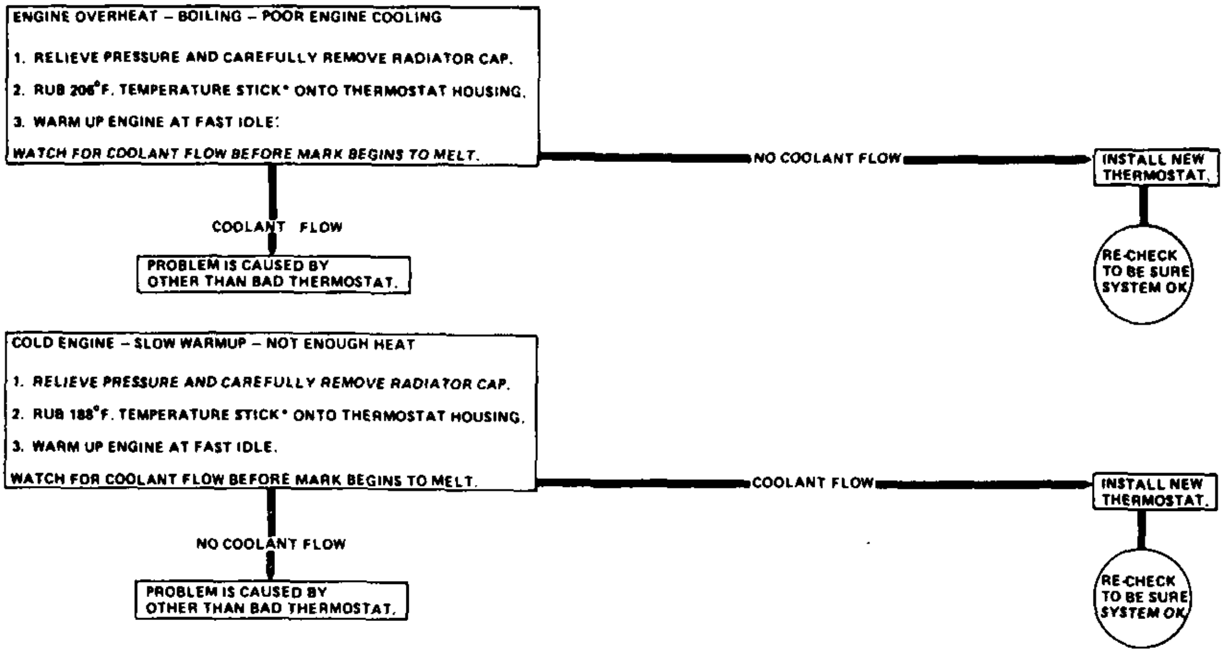
Fig. 8 Cooling System Diagnosis Chart (3 of 3)



*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. 9 Thermostat Diagnosis Chart

NOTICE: Alcohol or methanol base coolants, or plain water, are not recommended at any time.

Testing Coolant

Refractometer Test

Cleaning

Before each use, swing back the plastic cover at the slanted end of the Tester, exposing both the measuring window and the bottom of the plastic cover. **WIPE BOTH CLEAN AND DRY** with tissue or clean soft cloth. Close the plastic cover (Figure 10).

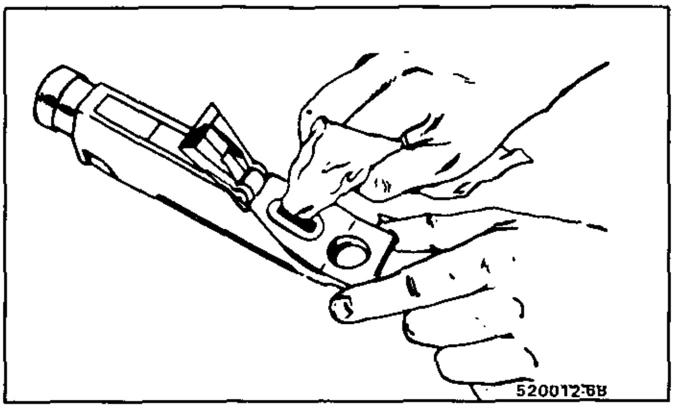


Fig. 10 Cleaning Refractometer

Testing

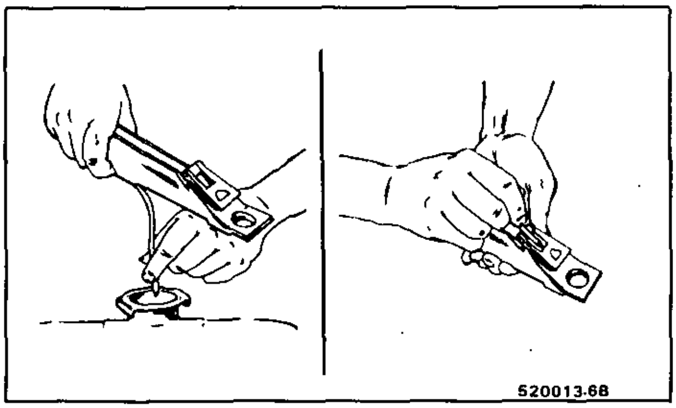


Fig. 11 Procedure For Collecting Coolant

Do not remove clear plastic pump from Tester. Release tip of pump from Tester housing and insert into radiator filler neck. Be sure to insert well below level of fluid. Press and release bulb to draw up a sample of coolant (Figure 11). Bend plastic tube around Tester so that tip can be inserted in cover plate opening. Eject a few drops of coolant into measuring surface by pressing bulb (Figure 11).

Never open plastic cover when taking readings. Evaporation of water from the fluid sample being tested can affect the reading.

Reading

Point the instrument toward any light source and look into eyepiece (Figure 12). The antifreeze protection reading is at the point where the dividing line between light and dark (edge of the shadow) crosses the scale; antifreeze on right-hand scale, battery charge on left.

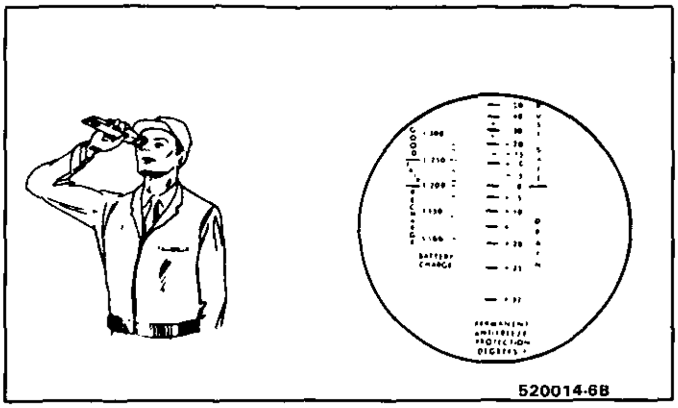


Fig. 12 Reading Refractometer

The Tester temperature scale is reversed from a standard thermometer scale; below zero readings are on upper half of scale (Figure 12). Readings on lower half of scale (above zero readings) indicate solutions without enough antifreeze concentration to provide adequate rust protection.

A little experience will enable you to obtain the best contrast between the light and dark portions of the field of view. Tilt the instrument toward the light source until best results are obtained. If the "edge of the shadow" is not sharp, the measuring surfaces were not sufficiently well cleaned or dried. Wipe dry as explained above and make new test.

UNIT REPAIR

Thermostat (A series)

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant, partially.
3. Water outlet to thermostat housing attaching bolts.
4. Water outlet.
5. Thermostat.

Clean

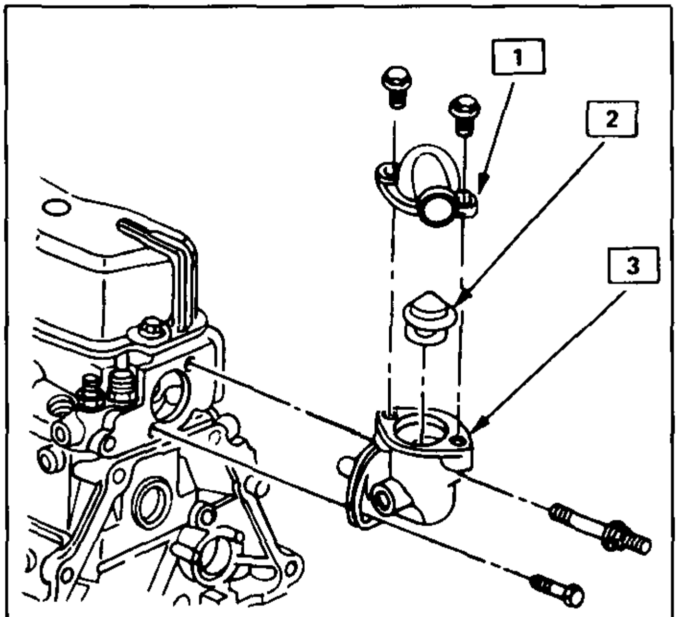
- Thermostat housing mating surfaces.
- Water outlet mating surfaces.

Install or Connect

1. A 3mm (1/8") bead of RTV sealer, 1052289 or equivalent, to thermostat housing.
2. Thermostat in thermostat housing.
3. Water outlet to thermostat housing while sealer is still wet.
4. Attaching bolts and torque to 23 N·m (17 lb.ft.).
5. Engine coolant.
6. Negative battery cable.

Inspect

- For correct completion of repair.



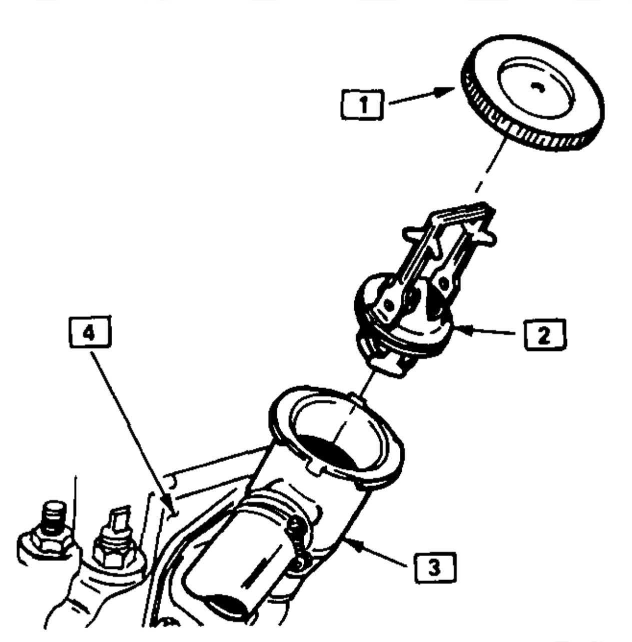
1—HOUSING OUTLET

2—THERMOSTAT

3—THERMOSTAT HOUSING

520015-6B

Fig. 13 Thermostat Housing and Outlet Asm. (A Series)



1 THERMOSTAT HOUSING CAP

2 THERMOSTAT

3 THERMOSTAT HOUSING ASM.

4 CYLINDER HEAD

520016-6B

Fig. 14 Thermostat and Housing Asm. (J, N and P Series, 1.8L and 2.5L)

- For coolant leaks.

Thermostat (J, P, and N Series, 1.8L and 2.5L)

Remove or Disconnect

1. Thermostat housing cap.
2. Grasp the handle of thermostat and gently pull upward.

Clean

- Thermostat housing and thermostat O-ring.
- Apply suitable lubricant to O-ring, after cleaning, for easier installation

Install or Connect

1. Thermostat in housing, pushing down to insure the thermostat is properly seated.
2. Thermostat housing cap.

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 reponse 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 9.5 N·m (85 lb. in.).
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 1.8L Engine

Remove or Disconnect

1. Timing belt.
2. Timing belt rear protective covers.
3. Drain cooling system.
4. Lower radiator hose from the water pump.
5. Water pump attaching bolts.
6. Water pump and seal ring.

Clean

- Water pump and engine block sealing surfaces.

Install or Connect

1. A 2mm (3/32") bead of sealant on the water pump sealing surface.
2. Water pump while sealer is still wet.
3. Water pump attaching bolts.
4. Hose to the water pump.
5. Timing belt rear protective covers.
6. Timing belt and adjust to specifications.
7. Engine coolant.

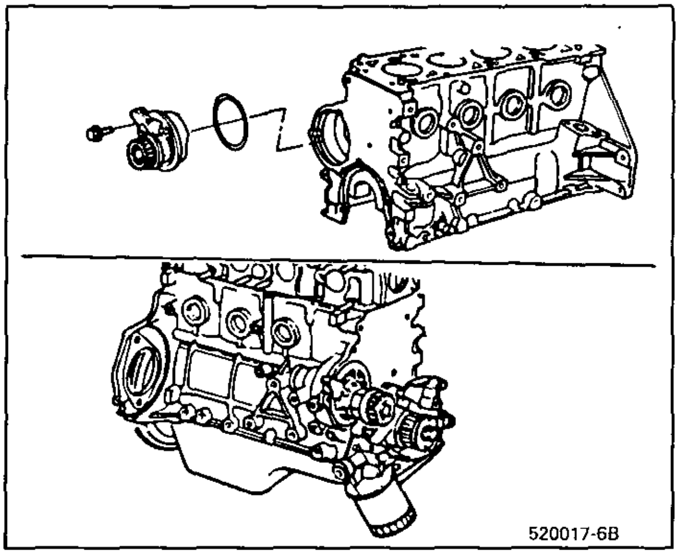


Fig. 15 Water Pump - 1.8L

Inspect

- For proper completion of repair.
- For coolant leaks.

Water Pump 2.5L Engine

Remove or Disconnect

Tools Required:

J25034-B Pulley Remover, or
J29785-A Pulley Remover
J25033-B Pulley Installer

1. Negative battery cable.
2. Cooling system.
3. Accessory drive belts.
4. Fan and pump pulley (VIN 2 only).
5. Water pump front cover assembly attaching bolts.
6. Water pump front cover assembly.

Disassemble

- Pulley from old water pump front cover assembly using J25034-B or J29785-A (All except VIN 2).

Clean

- Water pump mating surfaces.

Assemble

- Pulley to new water pump front cover assembly using J25033-B (All except VIN 2).

Install or Connect

1. A 3mm (1/8") bead of sealant on water pump sealing surface.
2. Water pump front cover assembly, while sealer is still wet, attaching bolts and torquing to specification. Bolts must also be coated with RTV sealer to avoid coolant leaks.
3. Generator or A/C compressor.
4. New fan and pump pulley, or transfer from old unit (VIN 2 only).
5. Accessory drive belts and adjust.
6. Engine coolant.
7. Negative battery cable.

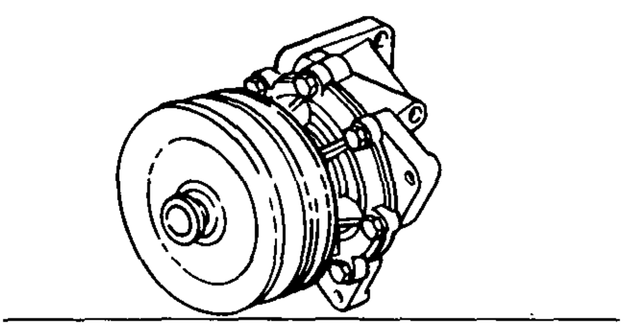


Fig. 16 Removing and Installing Water Pump Pulley

Water Pump 2.8L Engine

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant.
3. Drive belts.
4. Radiator and heater hose.
5. Water pump attaching bolts.
6. Water pump.

Clean

- Water pump mating surfaces.

Install or Connect

1. A 2mm (3/32") bead of sealant on the water pump sealing surface.
2. Water pump attaching bolts with sealer and torque bolts to specifications.
3. Radiator and heater hose.
4. Accessory drive belts to proper tension.

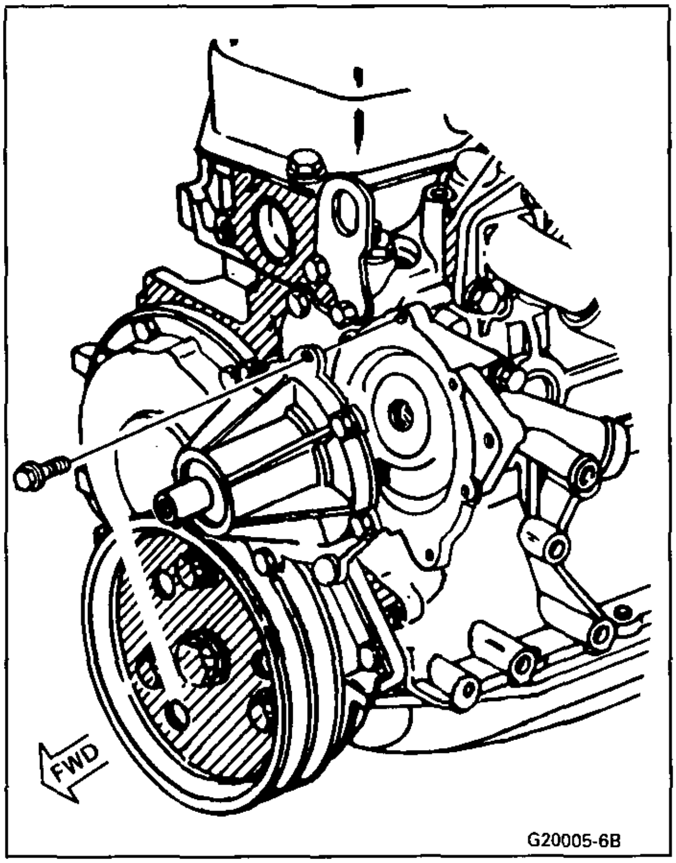


Fig. 17 Water Pump Front Cover Assembly Mounting - 2.5L Transverse

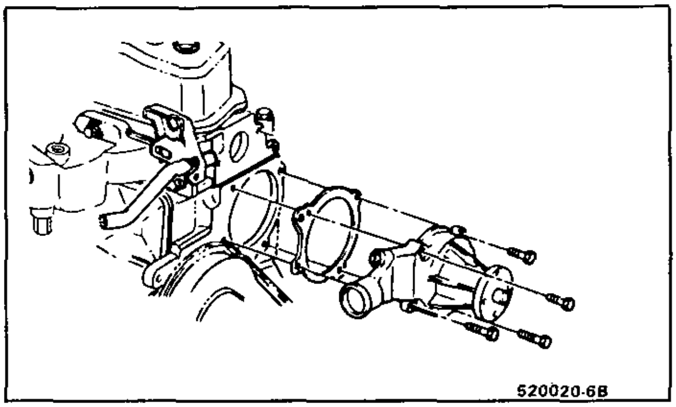


Fig. 18 Water Pump Mounting - 2.5L Longitudinal

5. Engine coolant.
6. Negative battery cable.

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.).

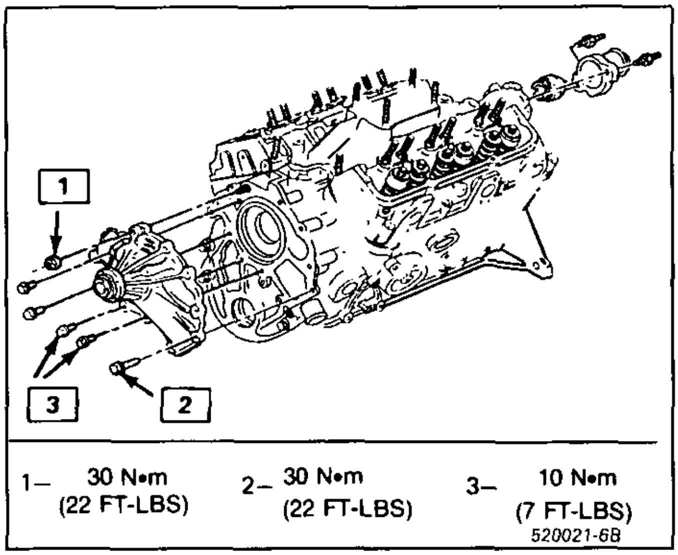


Fig. 19 Water Pump Mounting - 2.8L

2. Coolant hose to bottle.
3. Fill bottle to appropriate mark.

Radiator

Remove or Disconnect

1. Negative battery cable.
2. Engine coolant.
3. Engine forward strut brace at radiator and swing strut rearward.

Important

- To prevent shearing of rubber bushing, loosen bolt before swinging strut.

4. Forward lamp harness from fan frame and unplug fan connector.
5. Fan attaching bolts.
6. Fan and frame assembly.
7. Hood latch from radiator support.
   Scribe latch location before removal so it may be reinstalled in the same location.
8. Coolant hoses from radiator and coolant recovery tank hose from radiator neck.
9. Transmission oil cooler lines from radiator, if applicable.
10. Radiator to radiator support attaching bolts and clamps.
11. Radiator from car.

Install or Connect

1. If new radiator, transfer fittings from old radiator to new radiator.
2. Radiator in vehicle, locating bottom of radiator in lower mounting pads.
3. Radiator to radiator support attaching clamp and bolts. Torque to 10 N·m (7 lb. ft.).
4. Transmission oil cooler lines, if applicable. Torque nuts to 27 N·m (20 lb. ft.).
5. Coolant hoses to radiator. Torque clamps to 2 N·m (18 lb. in.).

6. Coolant recovery hose to radiator neck.
7. Hood latch to radiator support. Torque bolts to 25 N·m (18 lb. ft.).
8. Fan assembly making sure bottom leg of frame fits into rubber grommet at lower radiator support.
9. Fan attaching bolts; torque to 10 N·m (88 lb. in.).
10. Fan connector and forward lamp harness to fan frame.
11. Swing engine forward strut and brace forward, until brace contacts radiator support. Install brace to radiator support attaching bolts and torque to 50 N·m (37 lb. ft.). Be sure to connect engine ground strap to strut brace.
12. Engine coolant.
13. Negative battery cable.

Inspect

- For proper completion of repair.
- For leaks.

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. 20). 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. 21).

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

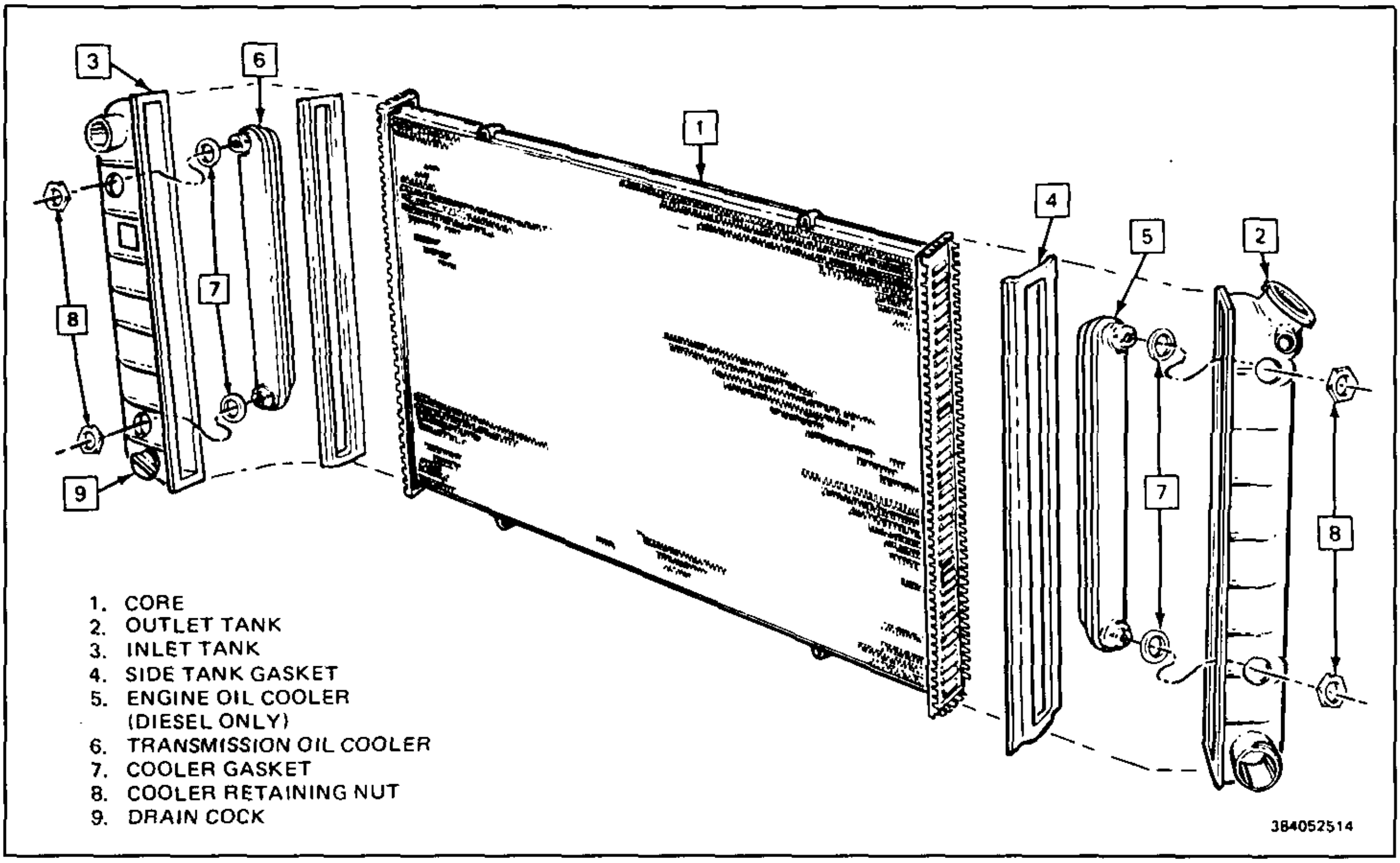


Fig. 20 Aluminum Radiator

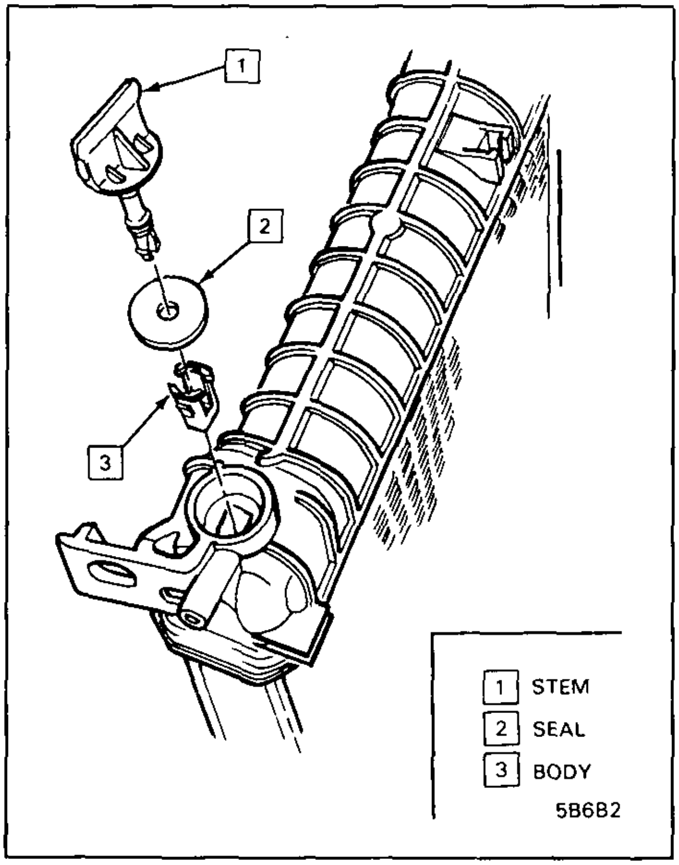


Fig. 21 Aluminum Radiator Drain Cock

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.

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 22). 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.

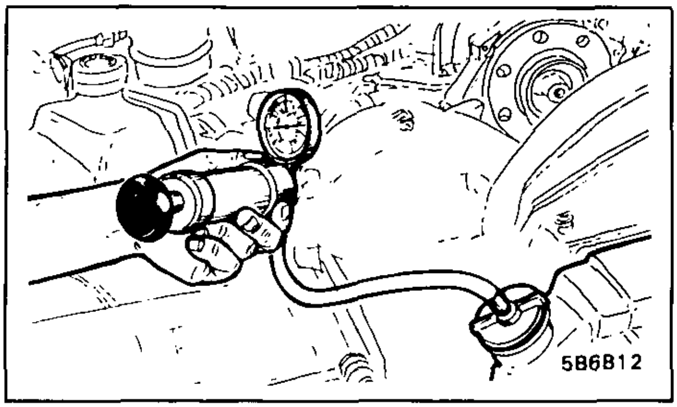


Fig. 22 Pressure Testing Radiator

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 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. 23).
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.

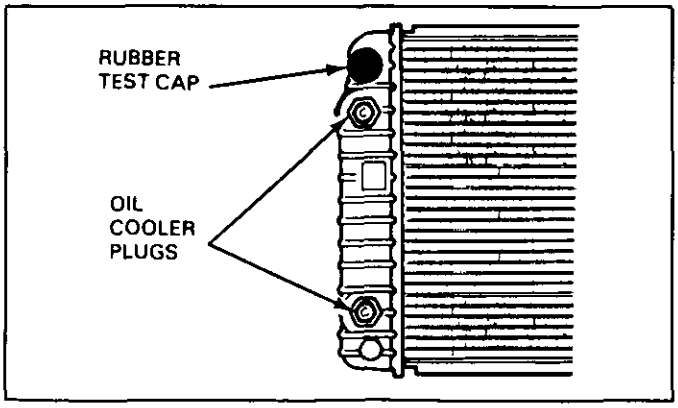
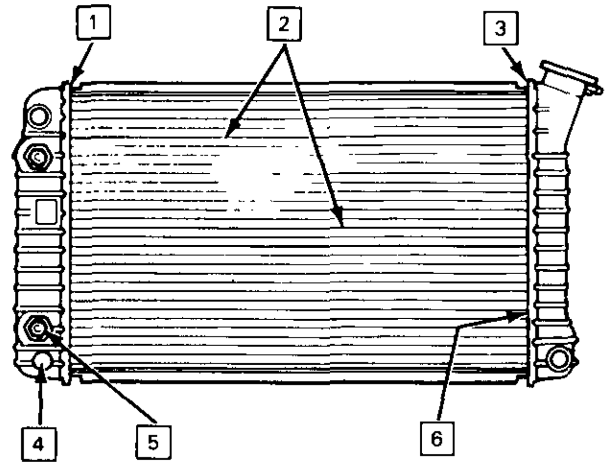


Fig. 23 Aluminum Radiator and Oil Cooler Plugs

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.



1 INLET TANK GASKET
2 CORE TUBES
3 OUTLET TANK GASKET
4 DRAIN COCK GASKET
5 OIL COOLER GASKETS
6 JOINT BETWEEN TUBE AND HEADER

5B6B13

Fig. 24 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. 25).

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. 26).

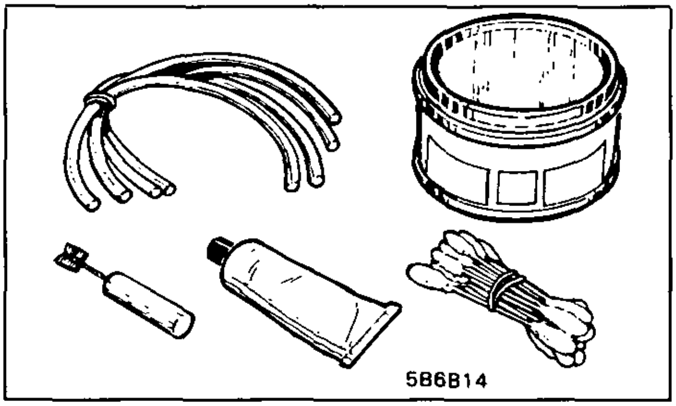


Fig. 25 Hot Melt Adhesive Repair Kit

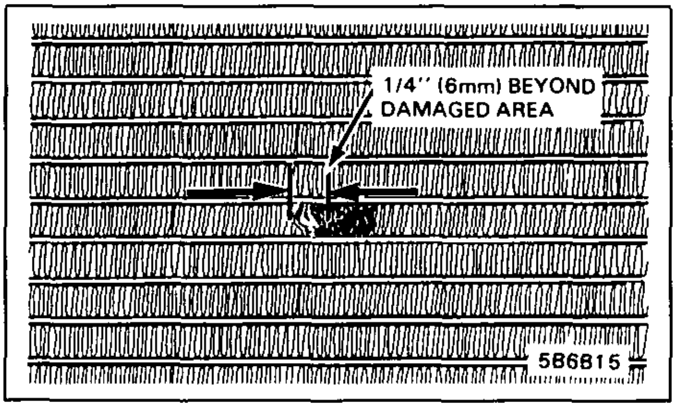


Fig. 26 Fins Removed from Damaged Area

Tube Blocking

If a tube is severely damaged, it can be blocked off. (Fig. 27).

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).

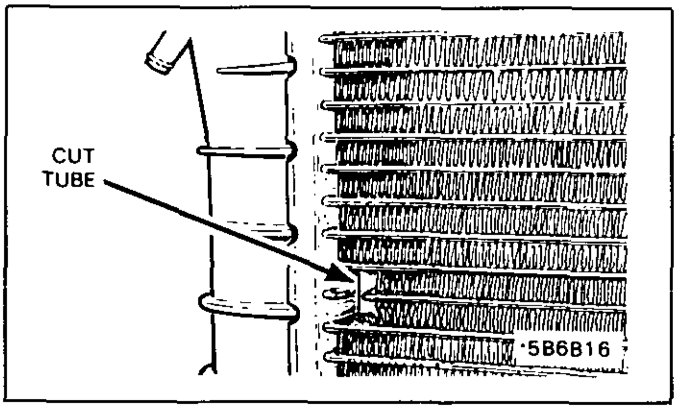


Fig. 27 Tube Blocking

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. 28). The side tank can also be submerged in a tank of water up to the header (Fig. 29).

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.

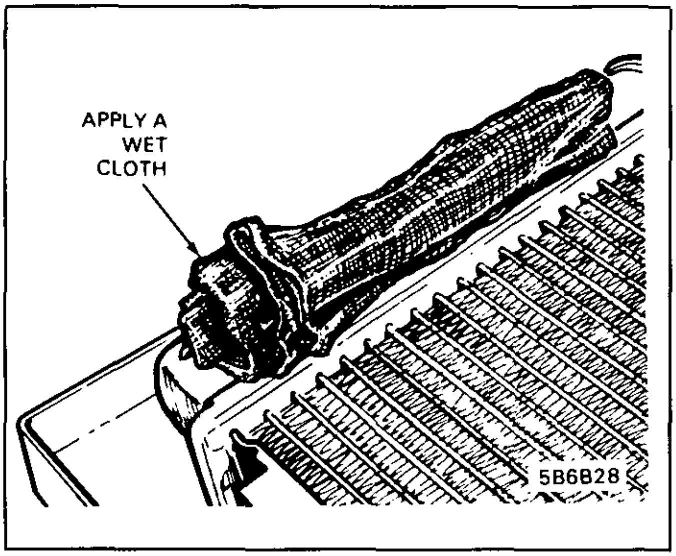


Fig. 28 Using Wet Cloth on Side Tank

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.

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. 28); or submerge the tank in water (Fig. 29).

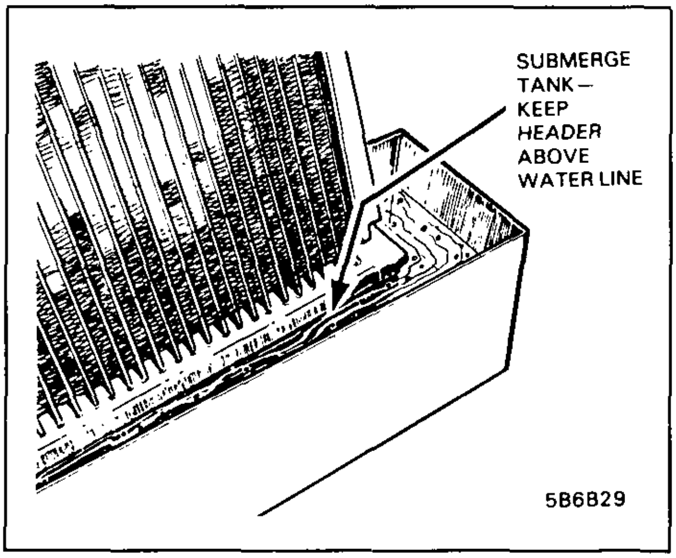


Fig. 29 Submerging Side Tank

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. 30).

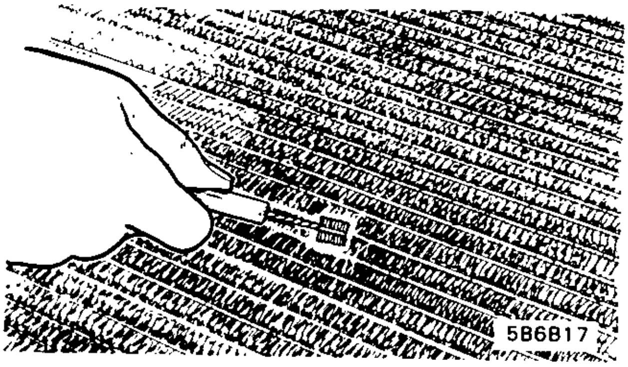


Fig. 30 Cleaning Area With Steel Brush

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.**
- **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. 31).

Fig. 31 Scrubbing Area with Primer

7. Heat the repair area with the heat gun or by moving the torch in a circular pattern (Fig. 32). Use a soft, small blue flame (like a gas stove flame).

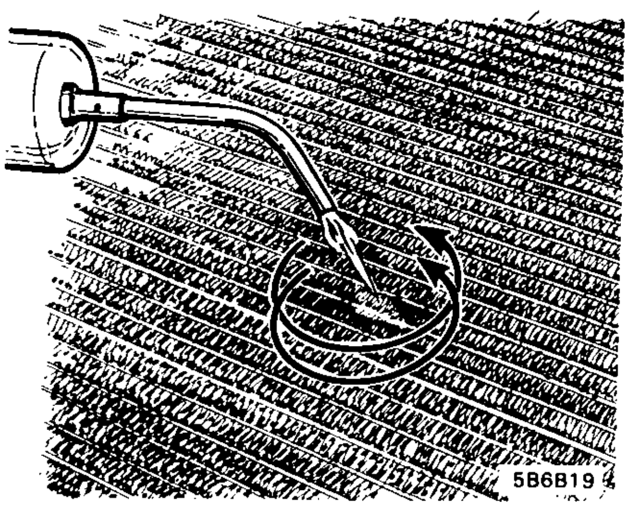


Fig. 32 Heating the Repair Area

8. Withdraw the torch and rub the adhesive stick on the repair area (Fig. 33). 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.**

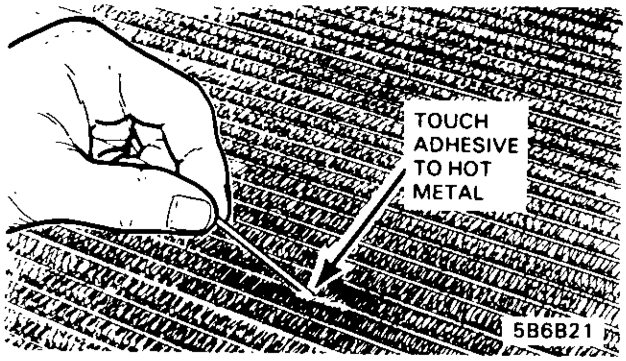


Fig. 33 Applying Hot Melt Adhesive

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.
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 or locking-type pliers (Fig. 34). If this method doesn't seal the leak, remove the tank for further inspection.

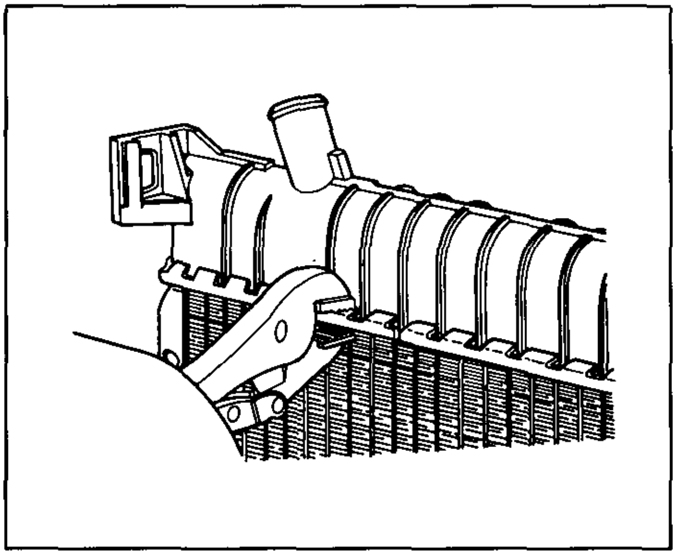


Fig. 34 Tightening Clinch Tabs

1. Pry open the clinch tabs, except those under inlet, outlet, and filler necks, using J-33419-1 or a screwdriver (Fig. 35). Lift the tabs only enough to allow removal.

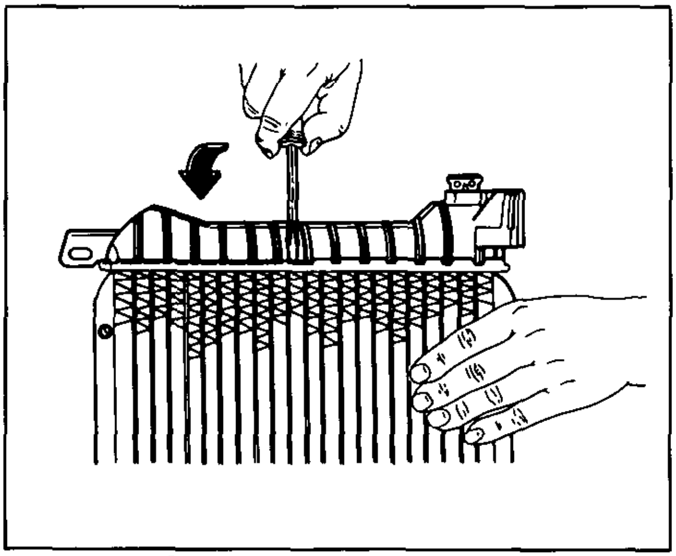


Fig. 35 Opening Clinch Tabs

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 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. 36.

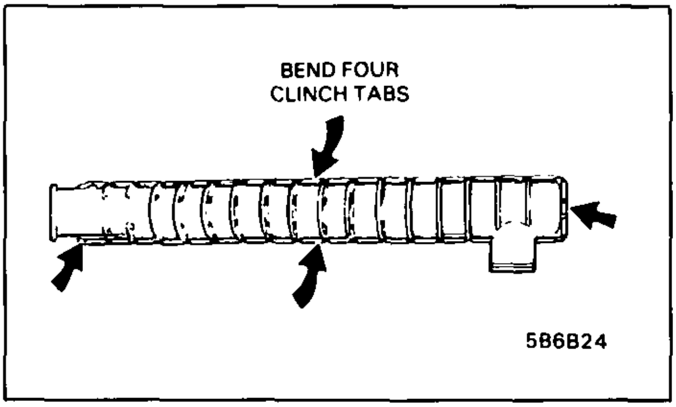


Fig. 36 Seating Tank to Core

10. Clamp remaining clinch tabs around the header using the clinching tool or pliers (Fig. 37).

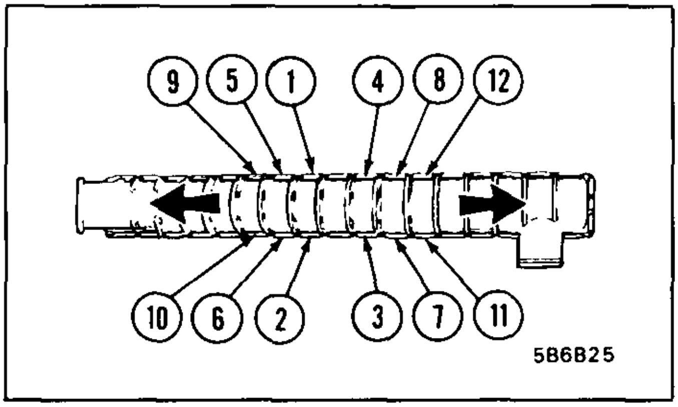


Fig. 37 Clinching Sequence

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. 38).

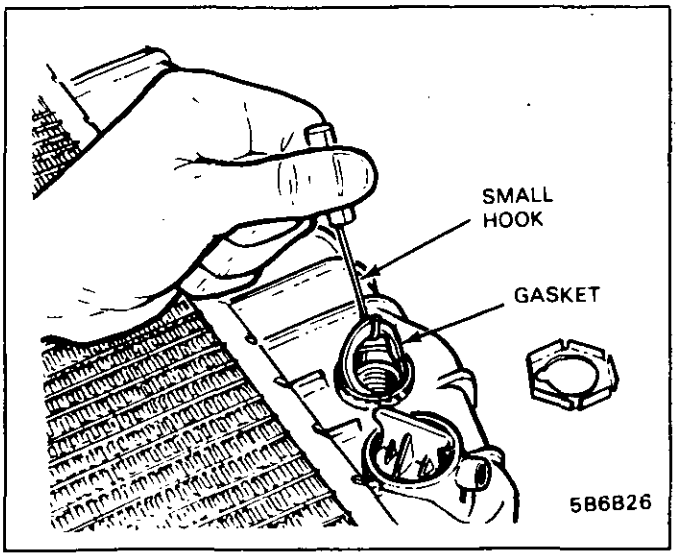


Fig. 38 Removing Oil Cooler Gasket

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.

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. 21).

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.

Accessory Drive Belts

Drive belt tension is important in maintaining proper operation of engine accessory drive systems and in extending normal belt life. When drive belts require replacement or adjustment, follow specifications listed below using belt tension tools J-23600-B or BT 33-95-ACBN.

WATER PUMP RETAINING BOLTS

ENGINE	VIN	N·m - (lb. ft.)
1.8 Liter	0,J	25 - 19
2.5 Liter	R	30 - 22
2.5 Liter	2	27 - 20
2.5 Liter	U	29 - 21
2.8 Liter	W,X,9	21 - 16
3.0 Liter	L	11 - 97*

*lb.-in.

ACCESSORY DRIVE BELT TENSIONING CHART

ENGINE	VIN	TENSIONING	GENERATOR	POWER STEERING.	AIR CONDITIONING	A.I.R. PUMP
1.6L L-4	C	New	650N/145 lb.	650N/145 lb.	750N/165 lb.	
		Used	300N/70 lb.	300N/70 lb.	400N/90 lb.	
1.8L L-4	J	New	750N/165 lb.	750N/165 lb.	700N/155 lb.	
		Used	450N/100 lb.	450N/100 lb.	350N/80 lb.	
1.8L L-4	O	New	700N/155 lb.■		700N/155 lb.	
		Used	350N/80 lb.		350N/80 lb.	
1.8L L-4	O	New	650N/145 lb.†	750N/165 lb.	700N/155 lb.	
		Used	350N/80 lb.	450N/100 lb.	350N/80 lb.	
2.5L L-4	R	New	650N/145 lb.	650N/145 lb.	750N/165 lb.	
		Used	300N/70 lb.	300N/70 lb.	350N/80 lb.	
2.5L L-4	2	New	650N/145 lb.•	650N/145 lb.		
		Used	300N/70 lb.	300N/70 lb.		
2.5L L-4	2	New	750N/165 lb.★	650N/145 lb.	750N/165 lb.	
		Used	400N/90 lb.	300N/70 lb.	400N/90 lb.	
2.5L L-4	U	New	750N/165 lb.	800N/175 lb.	750N/165 lb.	
		Used	400N/90 lb.	450N/100 lb.	400N/90 lb.	
2.8L V-6	S	New	650N/145 lb.	600N/135 lb.	650N/145 lb.	650N/145 lb.
		Used	300N/70 lb.	300N/70 lb.	300N/70 lb.	300N/70 lb.
2.8L V-6	X&W	New	650N/145 lb.	600N/135 lb.	650N/145 lb.	450N/100 lb.
	9	Used	300N/70 lb.	300N/70 lb.	300N/70 lb.	200N/50 lb.
3.8L V-6	A	New	650N/145 lb.	650N/145 lb.	750N/165 lb.	650N/145 lb.
		Used	300N/70 lb.	300N/70 lb.	400N/90 lb.	300N/70 lb.
4.3L V-6	Z	New	650N/145 lb.	650N/145 lb.	750N/165 lb.	650N/145 lb.
		Used	300N/70 lb.	300N/70 lb.	400N/90 lb.	300N/70 lb.
5.0L V-8	H&G	New	650N/145 lb.	650N/145 lb.	750N/165 lb.	650N/145 lb.
		Used	300N/70 lb.	300N/70 lb.	400N/90 lb.	300N/70 lb.
5.0L V-8	F	New	600N/135 lb.	650N/145 lb.	750N/165 lb.	650N/145 lb.
		Used	400N/90 lb.	300N/70 lb.	400N/90 lb.	300N/70 lb.
5.0L V-8	Y	New	650N/160 lb.*			
		Used	400N/90 lb.*			
5.0L V-8	Y	New	700N/160 lb.°	750N/165 lb.°	750N/165 lb.°	
		Used	500N/110 lb.°	500N/110 lb.°	400N/90 lb.°	
5.0L V-8	Y	New				650N/145 lb.°★
	(.380MM)	Used				400N/90 lb.°★
5.0L V-8	Y	New				350N/80 lb.°•
	(.312MM)	Used				250N/60 lb.°•

■ = W/O P/S † = W P/S • = W/O A/C ★ = W A/C * = Cogged ° = Non-Cogged

G20004-6B

Fig. 39 Accessory Drive Belt Tensioning Chart

SECTION 6C

FUEL SYSTEM

CONTENTS

GENERAL DESCRIPTION

DIAGNOSIS

ON CAR SERVICE

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

FUEL SYSTEM PRESSURE RELIEF

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components. To do this:

2.5L-TBI ENGINE (LR8)

- 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.

2.8L-MPFI ENGINE (L44)

For MPFI fuel system pressure relief procedure, see Section 6E3.

When repair to the fuel system has been completed, start engine and check all connections that were loosened for possible leaks.

Any time fuel system is being worked on, always keep a dry chemical (Class B) fire extinguisher near the work area.

FUEL SYSTEM

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.

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 6E for information relative to operation and diagnosis of TBI units.

Multi Port Fuel Injection (MPFI)

The ECM is in complete control of this fuel delivery system during all driving conditions.

The intake manifold function, like that of a diesel, is used only to let air into the engine. The fuel is injected by separate injectors that are mounted near the intake valve.

The ECM monitors all the vehicle functions, as in the carbureted or TBI system.

With Multi Port Injection System, there is no need for a thermac, EFE, barosensor, A.I.R. system or dual bed converter. This sytem provides better cold driveability, less exhaust emissions and a better throttle response.

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 types of damage and replace as necessary.

The air cleaner is remotely mounted. It is connected to the throttle body by air intake ducting.

The intake manifold is of a totally new design, as it is only used to pass air. It is tuned and offers vehicle performance improvement.

The throttle body design is very simple as it handles only air. It also utilizes an integral idle air control unit to govern idle speed and a throttle position sensor (TPS). The IAC and TPS are both controlled by the ECM.

See Figure 1

Electric Fuel Pump

The electric fuel pump is attached to the bottom of the fuel sending unit.

See Figure 2

From the pump, fuel passes through an in-line fuel filter to the TBI or fuel rail. To control fuel pump operation, a fuel pump relay is used.

When the ignition switch is turned to the "ON" 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 the fuel pump off. The relay will once again activate the fuel pump when the ECM receives distributor reference pulses.

FUEL PUMP RELAY

All Electronic Fuel Injection (EFI) engines use a fuel pump relay. The EFI system relays are located on left upper panel in the engine compartment as shown in Figure 3.

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 was designed to allow any remaining fuel tank pressure to escape during the cap removal operation. A built-in torque limiting device prevents over-tightening. 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, only a cap with the same features should be used. Failure to use the correct cap can result in a serious malfunction of the system.

FUEL TANK

The fuel tank is located under the middle of the vehicle.

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.

See Figure 4

Anti-squeak pieces are used on top of the tank to reduce rattles and other annoying noises.

FUEL GAGE SENDER

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.

Some sending units have two and others have three places to attach hoses. One line is for the fuel feed line. 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 a fuel return line to the tank.

FUEL AND VAPOR PIPES

The fuel feed and return pipes extend from the fuel gage sending unit to the engine compartment. The pipes are secured to the underbody with clip and screw assemblies. Both fuel feed pipes must be properly routed and retained, and should be inspected

1. FILTER ASM
2. BRACKET
3. INLET PIPE
4. RETURN PIPE
5. TORQUE BAR

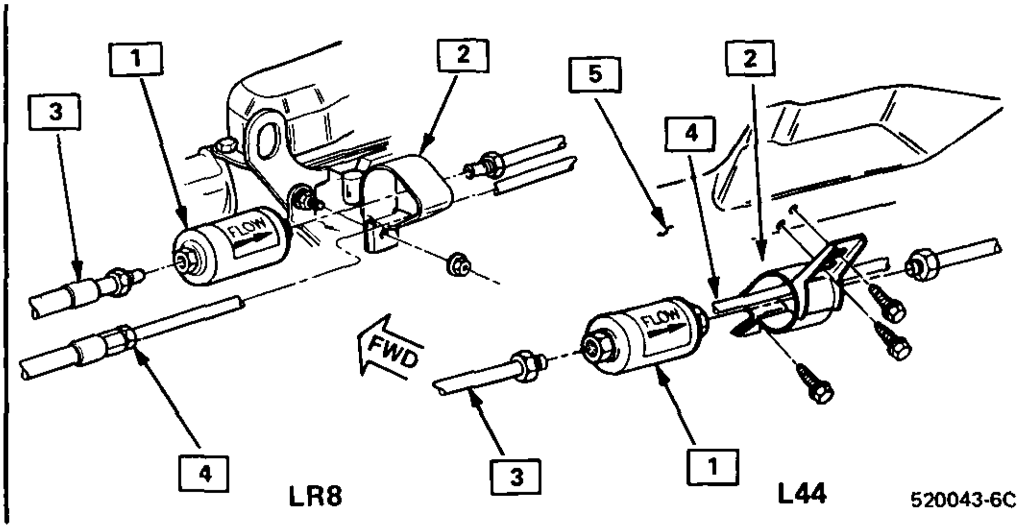


Fig. 1 Fuel Filter

1– FUEL TUBE
2– RUBBER COUPLER AND SOUND ISOLATOR
3– ELECTRIC FUEL PUMP
4– FILTER STRAINER
5– FUEL LEVEL SENDER
6– RETURN TUBE
7– SPLASH CUP LIQUID VAPOR SEPARATOR

FEATURES SEPARATELY SERVICEABLE PUMP, SENDER, AND STRAINER

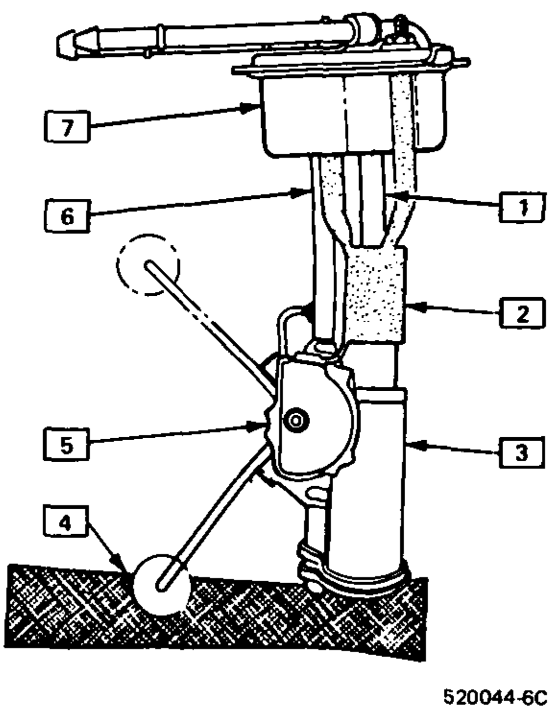
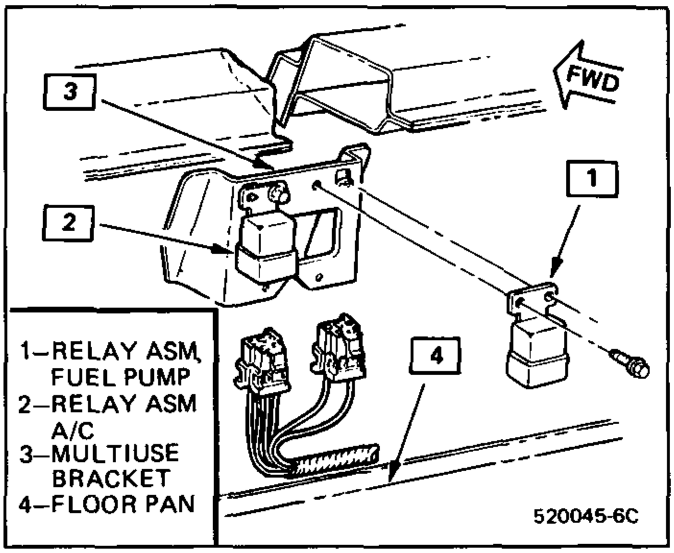


Fig. 2 Electric Fuel Pump & Sending Unit-Typical



1–RELAY ASM, FUEL PUMP
2–RELAY ASM A/C
3–MULTIUSE BRACKET
4–FLOOR PAN

Fig. 3 Fuel Pump Relay

occasionally for leaks, kinks or dents. If evidence of dirt is found in the system or fuel filter during disassembly, the pipe should be disconnected and blown out. Check the fuel strainer on fuel gage sending unit for damage, or omission.

The vapor pipe extends from the fuel gage sender to the canister. However, it does not follow the same route as the fuel feed pipe.

If replacement of a fuel feed pipe or vapor pipe is required use brazed seamless steel tubing, meeting GM Specification 123M, or its equivalent.

Under no conditions use *copper or aluminum* tubing to replace steel tubing. Those materials do not have satisfactory durability to withstand normal vehicle vibrations and corrosion.

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

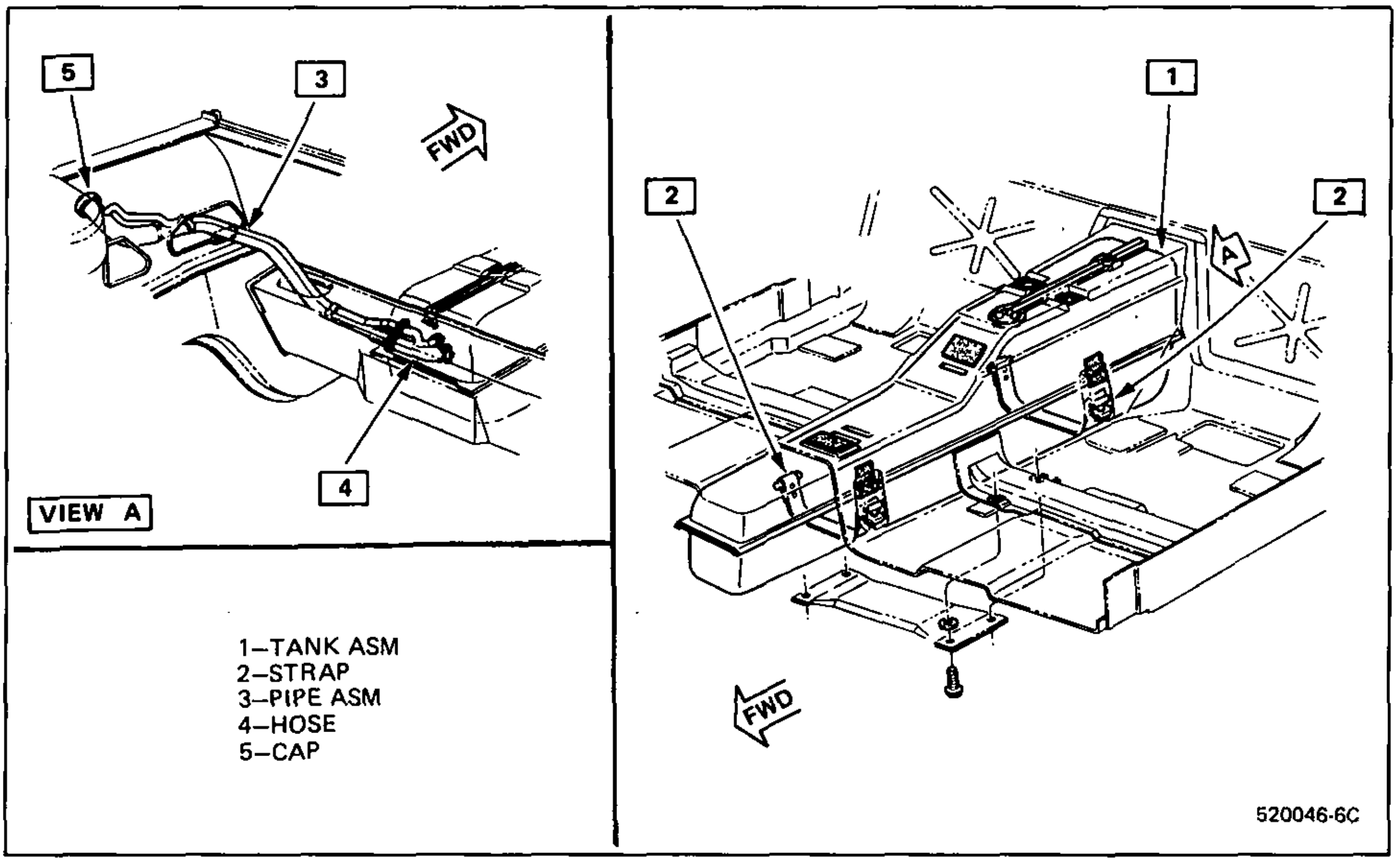


Fig. 4 Fuel Tank

are installed as removed and that all linkage and cables are not rubbing or binding in any manner.

ACCELERATOR CONTROL CABLE

- 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.
- Flexible components (hoses, wires, conduits, etc.) must not be routed within 50.0mm (2.0 in.) of moving parts of accelerator linkage outboard of support unless routing is positively controlled.

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 jute 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 bind between fully closed throttle and 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.

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

An Evaporative Emission Control System (EEC) is used to reduce emission of fuel vapors from the vehicle fuel system. (See Section 6E Emission Control System.) The system allows evaporating fuel vapors to be stored for burning during combustion, rather than being vented to atmosphere when the engine is not operating. This is accomplished by venting the fuel tank through a vapor canister containing activated charcoal. The system utilizes a sealed fuel tank with a dome that collects vapors and allows them to pass on into a line connected to the vapor canister. The canister absorbs these fuel vapors in a bed of activated charcoal and retains them until the canister is purged or cleared by air drawn through the filter at the bottom of the canister. The absorbing occurs when the vehicle is parked (engine off) and the purging or cleaning of the charcoal bed occurs when the engine is operated.

The amount of vapor drawn into the engine at any time is too small to have any effect on fuel economy or engine operation.

With this closed system, it is extremely important that only vapors be transferred to the engine. To avoid the possibility of liquid fuel being drawn into the system, the following features are included as part of the total system:

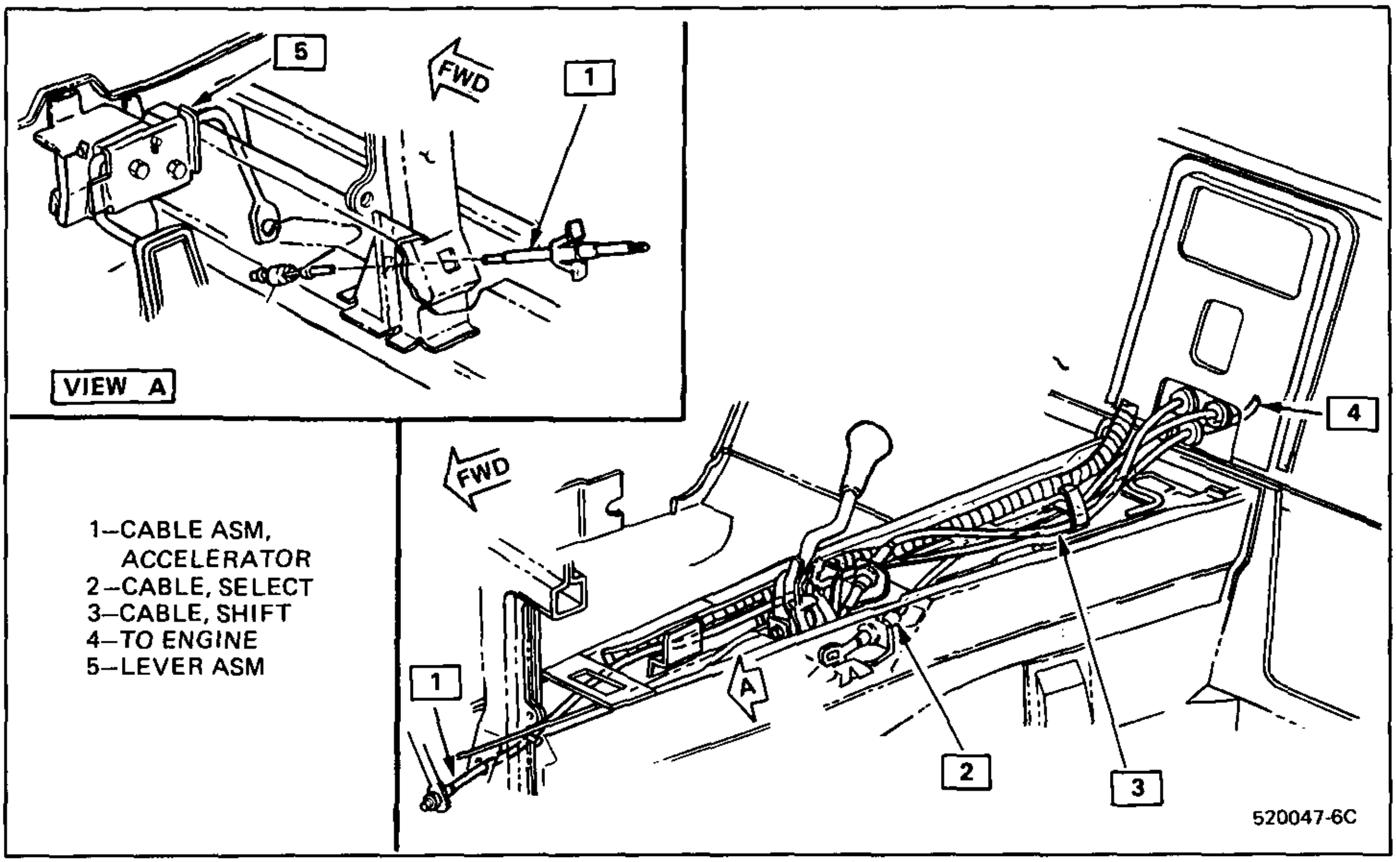


Fig. 5 Accelerator Cable Routing

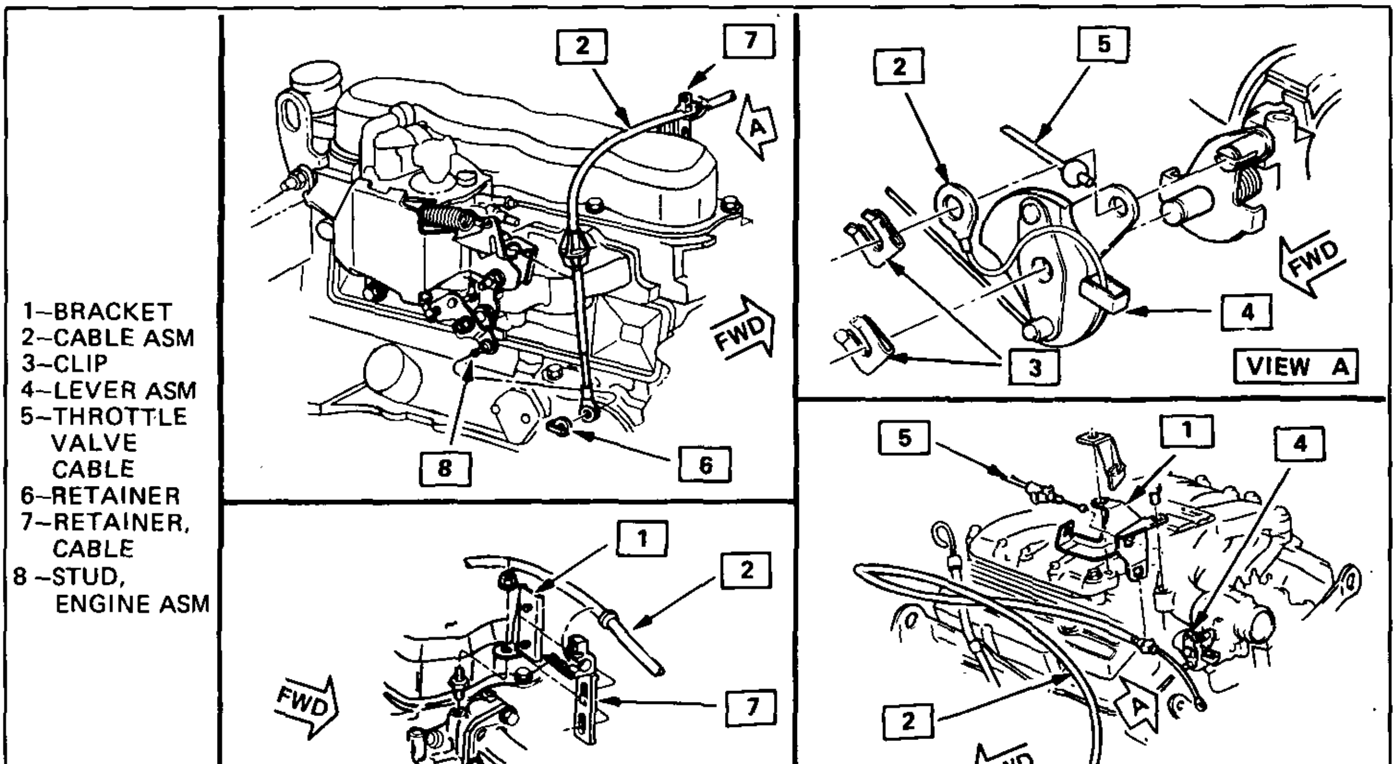


Fig. 6 Accelerator Cable to Engine

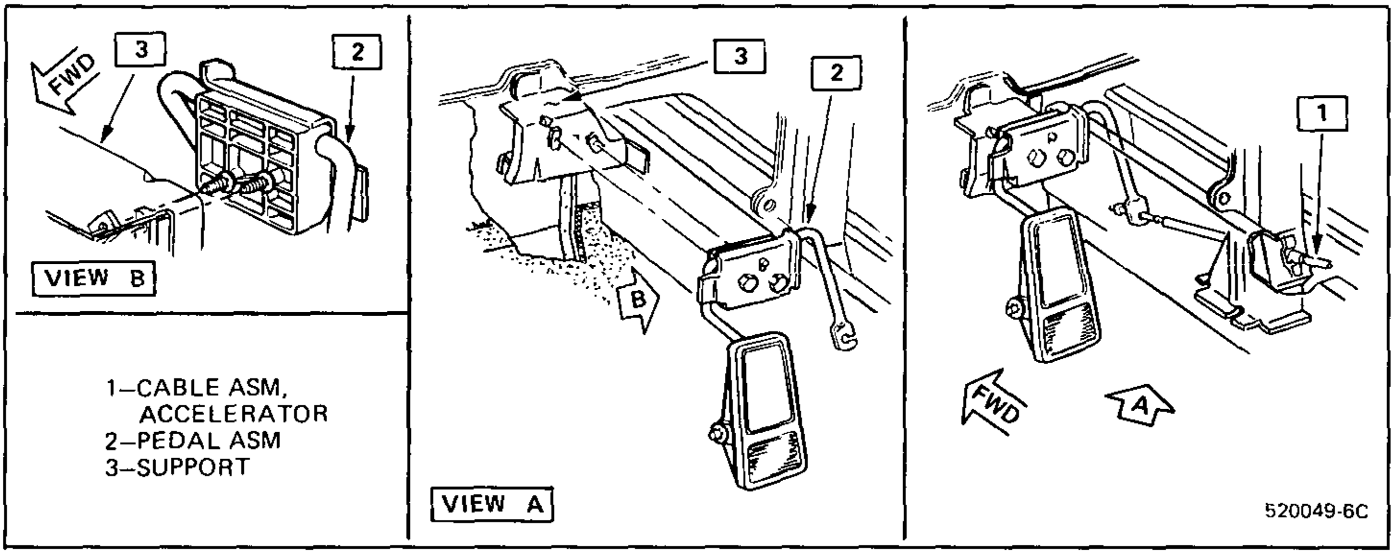


Fig. 7 Accelerator Pedal Assembly

- A fuel tank overfill protector is provided to assure adequate room for expansion of liquid fuel volume with temperature changes.
- At one point fuel tank venting system is provided on all series to assure that the tank will be vented under any normal car attitude. This is accomplished by using a dome type fuel tank.
- To protect the tank from mechanical damage in the event of excessive internal or external pressures resulting from the operation of this closed system, a pressure-vacuum relief valve, located in the fuel cap, will control the tank internal pressure.

CANISTER PURGE VALVE AND SOLENOID

The Electronic Control Module (ECM) controls the vacuum to the canister purge valve by using an electrically operated solenoid valve. When the computer command control system is in "Open Loop", the solenoid valve is energized and blocks vacuum to the canister purge valve. When the system is in "Closed Loop", the solenoid vavle is de-energized and vacuum is supplied to operate the purge valve. This releases the fuel vapors, collected in the canister, into the induction system. (See Section 6E Emission Control System).

If the Canister Purge Valve is faulty, the canister assembly must be replaced.

FUEL TANK PRESSURE CONTROL VALVE

A Fuel Tank Pressure Control Valve is used with the vapor canister in the line to fuel tank. Its purpose is to control the rate of fuel vaporization from the tank when the engine is not running and to act as a tank vent when engine is running.

The diaphragm operating pressure difference is small (3-4 PSI) so PCV vacuum can move the valve. Fuel tank pressure can build on a warm day, so it will act on the lower side of the diaphragm and open the valve when pressure rises high enough. The higher pressure on the tank slows the evaporation of the fuel while allowing some vapor (through orifice) to the canister. (See Section 6E Emission Control System.)

DIAGNOSIS

All diagnosis related to the fuel system not found in the diagnosis section can be found in the Engine Performance Diagnosis located at the beginning of Section 6. Also see Section 6E for Emission Component Diagnosis (EECS, EGR, PCU and EFE).

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing fuel system components.

When repair to the system has been completed, start the engine and check all connections that were loosened for possible leaks.

INSPECTION OF FUEL SYSTEM

Make certain that there is fuel in the tank.

The fuel tank, cap and lines should be inspected for road damage, which could cause leakage. Inspect fuel cap for correct sealing or indication 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 area, (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 SYSTEM PRESSURE TEST - 2.5L-TBI ENGINE (LR8)

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 the 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 again for 3.0 seconds to assure relief of any remaining pressure.

- With ignition "OFF", replace "Fuel Pump" fuse.

1. Remove air cleaner and plug thermal vacuum port on throttle body unit.
2. Remove steel fuel pipe between throttle body unit and fuel filter. Use backup wrench to hold fuel nut on throttle body and fuel filter when removing fuel line.
3. Install fuel pressure gage between throttle body and fuel filter. A 9-15 psi gage, such as J-29658, should be used.
4. Start car and observe fuel pressure reading. It should be 9-13 psi; if not, refer to EFI Diagnosis Chart A-5.
5. Remove fuel pressure gage (system must first be depressurized).
6. Reinstall steel fuel line from filter to throttle body and torque to 26-34 N·m (19-25 lb. ft.).
7. Start car and observe for fuel leaks.
8. Remove plug covering thermal vacuum port on throttle body and install air cleaner.

FUEL PUMP FLOW TEST - 2.5L TBI ENGINE (LR8)

1. Test fuel pump by connecting hose from the fuel filter fuel feed line to a suitable unbreakable container.
    a. **EFI Electric Fuel Pump.** 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 vacuum and/or pressure.

FUEL SYSTEM PRESSURE TEST - 2.8L-MPFI ENGINE (L44)

Fuel system diagnosis on this engine is in Section 6E3.

FUEL TANK AND LINES

Inspect the fuel tank, cap and lines for road damage, which 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 area, (3) be sure to have dry chemical (Class B) fire extinguisher handy, (4) wear safety glasses and (5) *siphon or pump fuel into an explosion proof container.*

CANISTER PURGE VALVE TEST

1. Remove purge valve control vacuum line at canister and check for vacuum with engine operating above idle speed (above 1500 RPM). If no vacuum is present, perform EGR system functional test (Section 6E).
2. Apply external vacuum source (such as hand-operated vacuum/pressure pump J-23738 *in combination with manometer J-23951) to the* purge valve control diaphragm. A good valve will hold vacuum.
3. If the valve will not hold vacuum, replace canister.
4. If the valve holds vacuum, remove purge line and check for vacuum with engine operating. If no vacuum is present, check PCV hoses and PCV system (Section 6E). Repair or replace as necessary.

FUEL TANK PRESSURE CONTROL VALVE

1. Disconnect vapor return hose at canister end. Remove fuel filler cap from tank.
2. Apply a low pressure flow through vapor return hose. A restricted flow rate should be detected.
3. Disconnect vacuum control hose at valve end. Connect hand vacuum pump to valve port and apply 3 inches of mercury. Observe vacuum reading for 20 seconds. If vacuum drops more than 1 inch, replace valve.
4. With vacuum applied again, apply a low pressure flow through vapor return line. An unrestricted flow rate should be detected. If flow rate is restricted with vacuum applied, check for blockage in vapor return line to fuel tank. If no difference in flow rate can be detected with or without vacuum applied, replace valve.
5. Reconnect vacuum hoses (refer to Vehicle Emission Label) and re-install fuel filler cap.

PRESSURE CHECKING EEC SYSTEM

1. Engine must be cold and at room temperature.
2. Remove tank line at canister and observe for liquid in the line. Connect a regulated low pressure source (such as Tool J-23699) to the tank vapor line.
3. Apply 15 in. Hg pressure to the fuel vapor line.
    a. Observe for excessive loss of pressure (more than 3 inches in five minutes).
    b. If negligible pressure loss occurs, check for *fuel vapor smell or fuel loss at points listed* in Diagnostics under Possible Cause.
    c. Remove fuel filler cap and check for pressure in tank.
4. Remove fuel cap and check vent line for obstructions.

Any loss of fuel or vapor from the fuel filler cap would indicate one or more of the following:

- An unsatisfactory seal between the cap and filler neck.
- A malfunction of filler cap release valve.

EVAPORATIVE SYSTEM PRESSURE TEST

1. Stabilize vehicle at normal operating temperature.
2. Remove tank vapor line at canister and check for liquid in the line. Connect hand-operated

vacuum/pressure pump J-23738 to the tank vapor line. Tee one hose from manometer J-23951 into the tank vapor line between J-23738 and the tank. Vent the other manometer hose to atmosphere.

3. Apply 15 in. Hg. pressure to the tank vapor line.
   a. Check for excessive pressure loss - greater than 3 in. Hg pressure in five minutes.
   b. If excessive pressure loss occurs, check for fuel vapor odor or fuel loss at areas specified in Diagnosis.
   c. Remove filler cap and check tank pressure.
4. With the fuel cap removed, use J-23738 to force air through the vapor vent line to check for restrictions.

ON CAR SERVICE

FUEL PRESSURE RELIEF PROCEDURE

CAUTION: To reduce the risk of fire and personal injury, it is necessary to relieve the fuel system pressure before servicing any fuel system components.

2.5L-TBI ENGINE (LR8)

When repair to the system has been completed, start the engine and check all connections that were loosened for possible leaks.

1. Remove "fuel" pump fuse from fuse block located in the passenger compartment.
2. Start engine and let run until engine stops running due to lack of fuel.
3. Engage starter again for 3 seconds, to assure that all pressure has been relieved from the system.
4. With ignition OFF replace fuel pump fuse.

Unless the procedure is followed before servicing fuel line or connections, fuel spray could occur .

2.8L - MPFI ENGINE (L44)

For MPFI fuel system pressure relief procedure, see Section 6E3.

FUEL TANK

Draining Fuel Tank

NOTICE: If a car is to be stored for any appreciable length of time, the fuel should be drained from the complete system, including EFI unit and fuel pump, all fuel lines, and the fuel tank in order to prevent gum formations and improper engine performance.

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.

FUEL SYSTEM CLEANING PROCEDURE

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 battery and engine harness connector on HEI distributor. Have dry chemical (Class B) fire extinguisher near the work area.
2. Relieve fuel system pressure (see "Fuel System Pressure Relief").
3. Disconnect negative battery cable.
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 pump assembly, if so equipped, and inspect condition of strainer. If strainer is contaminated, a new strainer should be installed upon reassembly.
8. Complete draining of tank by rocking it and allowing fuel to run out of fuel meter/pump assembly opening.
9. Purge fuel tank with running hot water for at least five minutes. Pour water out of fuel meter opening. (Rock tank to be sure that removal of water is complete.)
10. Disconnect fuel feed pipe at the engine end and use air pressure to clean fuel line. Apply air pressure in the direction opposite fuel flow. On vehicles equipped with a fuel return line, clean line in similar manner. Disconnect pipe at engine end and apply air pressure to clean return line. Reconnect and torque all pipes to 26-34 N·m (19-25 lb. ft.).
11. Use low air pressure to clean pipes on fuel gage sending assembly unit.
12. Install new strainer on fuel meter/pump assembly,if required. Install fuel gage sending unit and pump with new gasket in 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 rear. Connect a hose to rear 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 LEAK TEST PROCEDURE

1. Plug all outlets as follows:
    a. Install plug at filler neck and vent hoses.
    b. Install fuel meter with new gasket and plug fuel line.
    c. Install short piece of fuel line hose on fuel meter vent tube.
2. Apply air pressure to tank through vent tube. Use extreme caution to prevent rupturing the tank. When air can be heard escaping from filler neck cap (approximately 7 to 10 kPa or 1 to 1-1/2 lbs. of pressure) pinch the fuel line hose to retain pressure.
3. Test repaired area for leaks with soap solution, or by submersion. If leak is noted, make repair and retest.

FUEL TANK REPLACEMENT

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. See Fuel Gage Sending Unit Replacement.

FUEL TANK

Removal

1. Relieve fuel system pressure, (see Fuel System Pressure Relief).
2. Disconnect negative battery cable.
3. Drain fuel tank (see Draining Fuel Tank).
4. Raise vehicle on hoist.
5. Disconnect fuel filler neck hose and vent hose.
6. Support fuel tank.
7. Remove fuel tank strap support bolts and lower tank enough to disconnect fuel sending unit wire and ground wire.
8. Disconnect fuel line, fuel vapor line and fuel return line.
9. Remove tank.

Installation

Reverse removal procedure. Replace all sound deadeners that were removed. Replace fuel and check for leaks.

FUEL GAGE SENDING UNIT

Removal

1. Remove fuel tank, see Fuel Tank Removal.
2. Using Tool J-24187, or equivalent, remove locking cam.
3. Remove sending unit and gasket, with fuel pump.
4. Remove strainer and clean by blowing out with compressed air. Reinstall in correct orientation on pump.
5. Remove fuel pump from sending unit by pulling fuel pump assembly into rubber connector and sliding pump away from bottom support. Care should be taken to prevent damage to rubber insulator and fuel strainer during removal. After pump assembly is clear of bottom support, pull pump assembly out of rubber connector for removal.

Installation

Reverse removal procedure to install. When installing locking cam, it may be necessary to compress gasket slightly by pressing down on tool. Once cam lock is started under retaining tangs, pressure may be released.

FUEL, FUEL RETURN, AND EMISSION PIPE REPAIR OR REPLACEMENT

1. If replacement of a fuel feed, fuel return or emission pipe is required, use welded steel tubing meeting GM Specification 124-M, or its equivalent.
2. Do not use copper or aluminum tubing to replace steel tubing. These materials do not have satisfactory durability to withstand normal vehicle vibrations.
3. When rubber hose is used to replace pipe, use only reinforced fuel resistant hose which is identified with the word "Fluroelastomer" on the hose. Hose inside diameter must match pipe outside diameter.
4. Do not use rubber hose within 100mm (4") of any part of the exhaust system, or within 10 inches of the catalytic converter.
5. In repairable areas, cut a piece of fuel hose 100mm (4 inches) longer than portion of the line removed.

    If more than a 6 inch length of pipe is removed, use a combination of steel pipe and hose so that hose lengths will not be more than 10 inches.

    Follow the same routing as the original pipe.
6. Cut ends of pipe remaining on car square with a tube cutter. Using the first step of a double flaring tool, form a bead on the end of both pipe sections. If pipe is too corroded to withstand bead operation without damage, the pipe should be replaced. If a new section of pipe is used, form a bead on both ends of it also.
7. Use screw type hose clamp No. 2494772, or equivalent. Slide clamps onto pipe and push hose 51mm (2 inches) onto each portion of fuel pipe. Tighten clamps on each side of repair.
8. Pipes must be properly secured to the frame to prevent chafing.

VAPOR CANISTER

Removal

1. Loosen screw holding canister retaining bracket.
2. Rotate canister retaining bracket and remove canister from retainer.
3. Disconnect hoses from canister, noting their position for later installation.

Installation

1. Connect canister hoses in position noted in Step 3 above.
2. Install canister in retainer.
3. Rotate canister retaining bracket to secure canister and tighten screw.

CANISTER FILTER

Replacement

1. Remove vapor canister.
2. Pull out filter from bottom of canister with your fingers.
3. Install new filter.
4. Install vapor canister.

FUEL PUMP

Removal

1. Relieve fuel system pressure. (See "Fuel System Pressure Relief").
2. Disconnect negative battery cable.
3. Raise vehicle on hoist.
4. Remove fuel tank (see "Fuel Tank Removal").
5. Remove fuel meter/pump assembly by turning cam lock ring counter clockwise. Lift fuel meter/pump assembly from fuel tank and remove fuel pump from fuel meter.
6. Pull fuel pump up into attaching hose while pulling outward away from bottom support. Care should be taken to prevent damage to rubber insulator and strainer during removal. After pump assembly is clear of bottom support, pull pump assembly out of rubber connector for removal.

Installation

1. Inspect fuel pump attaching hose for any signs of deterioration. Replace if necessary. Also check rubber sound insulator at bottom of pump, replace if required.
2. Push fuel pump assembly into attaching hose.
3. Install fuel meter/pump assembly into tank assembly. Use new O-ring during reassembly.
4. Install cam lock over fuel meter/pump assembly and lock by turning clockwise.
5. Reverse fuel tank removal procedure for remainder of installation.

ACCELERATOR CONTROLS

Check for correct opening and closing positions by operating accelerator pedal. Make sure that the EFI unit reaches wide open throttle position. If it does not, inspect for damaged or bent brackets, levers, or other components; or, for poor carpet fit under the accelerator pedal.

If any binding is present in the linkage, check for:

1. Proper routing of cable.
2. Kinked or damaged cable.
3. Free movement of:
   a. EFI lever at EFI unit.
   b. Cable at EFI lever stud.
   c. Accelerator lever at bearing support.
   d. Pedal at lever.

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 jute 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 secure, all components of the accelerator linkage must operate freely without binding between fully closed throttle and wide-open throttle.
- Wires, hoses, cables or other obstructions must not be placed within 13mm (33/64 in.) of cable or rod at any point in their travel.

ACCELERATOR CONTROL CABLE

Removal

1. Negative battery cable.
2. Cable attachments from E.F.I. unit and related cable brackets.
3. Shift knob and console covers and supports.
4. Disconnect E.C.M. electrical harness and remove E.C.M. unit.
5. Remove accelerator cable at instrument panel support and pedal assembly.
6. Remove accelerator cable through rear body panel and out of console.

Installation

Reverse procedure to install accelerator control cable.

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 (see Fig. 1) is standard on all cars. (See Specifications in Fig. 10 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.

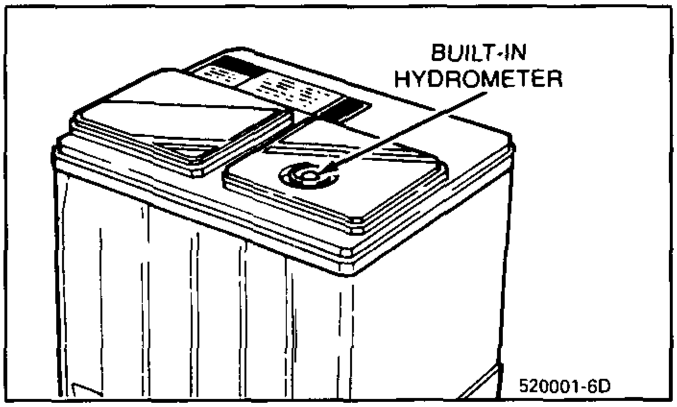


Fig. 1 Sealed Battery

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).

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. 12).

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.

CHARGING SYSTEM-SI

One type of charging system is the SI regulator charging system.

The brown field wire to the generator is used to turn on the generator. A 10 ohm resistance, provided by either the generator warning lamp or the choke heater relay with optional voltmeter, is needed to protect the diode trio.

Although several models of generators are available, with different idle and maximum outputs, their basic operating principles are the same.

The generator uses a solid state regulator that is mounted inside the generator. All regulator components are enclosed in a solid mold, and this unit along with the brush holder assembly is attached to the slip ring end frame. The regulator voltage cannot be adjusted.

The generator rotor bearings contain enough grease to eliminate the need for periodic lubrication. Two brushes carry current, through two slip rings, to the field coil mounted on the rotor. Under normal conditions, this arrangement provides long periods of attention-free service.

Stator windings are assembled inside a laminated core that forms part of the generator frame. A rectifier bridge connected to the stator windings contains six diodes and electrically changes stator a.c. voltage to d.c. voltage, which appears at the generator output terminal. Generator field current is supplied through a diode trio, which also is connected to the stator windings. A capacitor, or condenser, mounted in the end frame, protects the rectifier bridge and diode trio from high voltages and suppresses radio noise.

No periodic adjustments or maintenance of any kind are required on the entire generator assembly.

CHARGING SYSTEM-CS

Another type of charging system is the CS Charging System. Two sizes are available; CS-130 and CS-144, denoting 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.

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 (Fig. 2). 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. 3 shows a typical magnetic probe hole. Consult manufacturer's instructions for use of this equipment.

Secondary Wiring

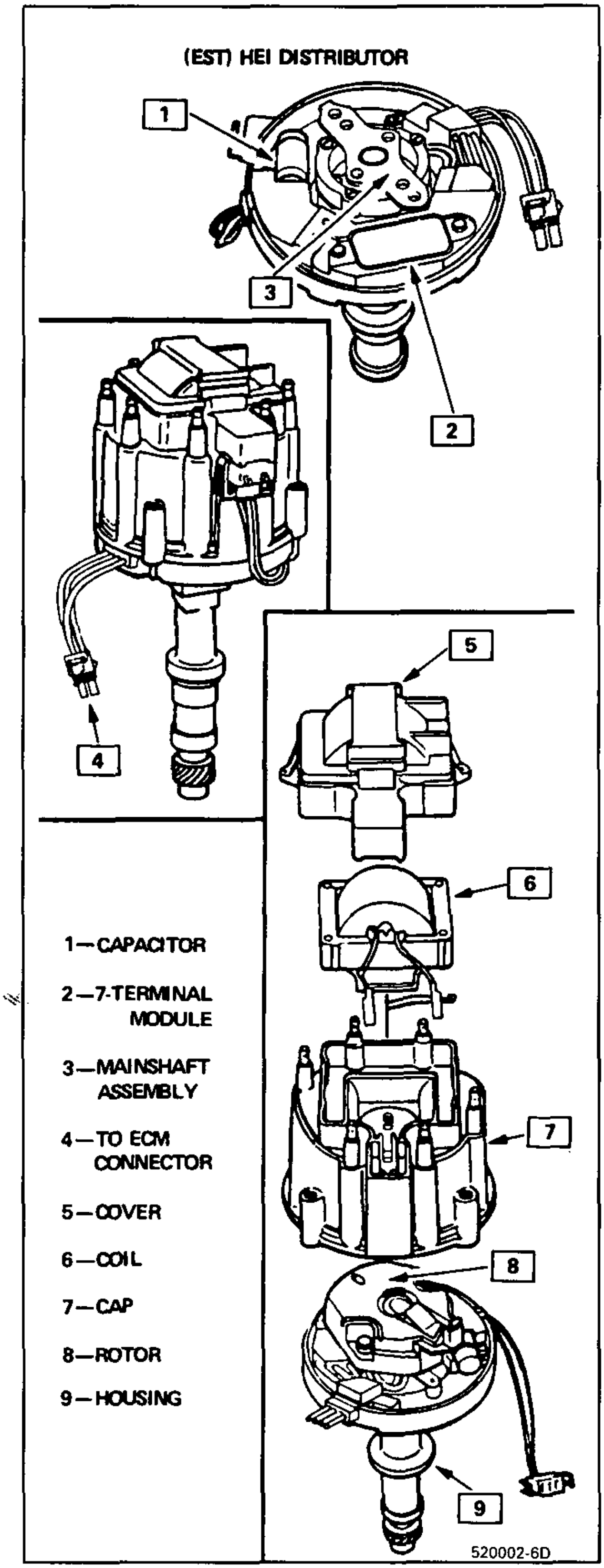
The spark plug wiring used with the HEI system is a carbon impregnated cord conductor, encased in an 8MM (5/16") diameter silicone rubber jacket. The silicone jacket withstands very high temperatures and also provides an excellent insulator for the higher voltage of the HEI system. Silicone spark plug 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 1.8L). No gasket is used on these tapered seat plugs. See Fig. 5 for an explanation of letter coding on spark plugs.

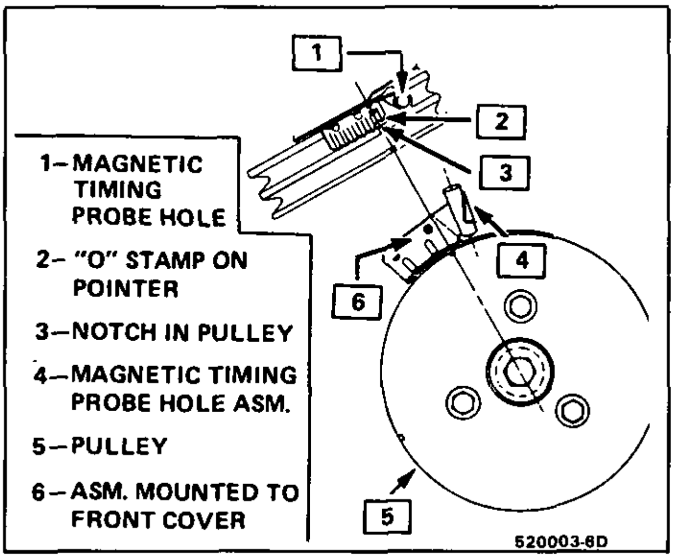
See Engine Exhaust Emissions Section (6E) for spark plug application and gap sizes. Always replace plugs with the correct plug listed on the tune-up label.

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 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 miss-firing. 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



1—CAPACITOR
2—7-TERMINAL MODULE
3—MAINSHAFT ASSEMBLY
4—TO ECM CONNECTOR
5—COVER
6—COIL
7—CAP
8—ROTOR
9—HOUSING

Fig. 2 HEI (EST) Distributor

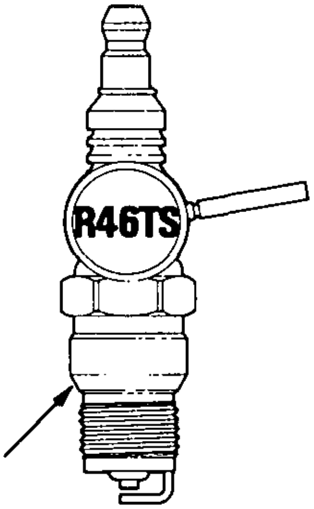


1–MAGNETIC TIMING PROBE HOLE
2–"O" STAMP ON POINTER
3–NOTCH IN PULLEY
4–MAGNETIC TIMING PROBE HOLE ASM.
5–PULLEY
6–ASM. MOUNTED TO FRONT COVER

Fig. 3 Magnetic Timing Probe Hole

PREFIX AND SUFFIX LETTERS IDENTIFY A SPECIFIC TYPE SPARK PLUG. NUMBERS RELATE TO THREAD SIZE AND HEAT RANGE AS FOLLOWS:

R = Resistor
4 = 14 mm Thread
6 = Heat Range
T = Taper Seat
S = Extended Tip



TAPERED SEAT NO GASKET

G20199-6D

Fig. 4 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. 5 Spark Plug Coding

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.

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. 6.

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. 6, 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

GENERAL ELECTRICAL SYSTEM

See Figs. 7 and 8.

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. 9).
   a. Connect a voltmeter and a battery load tester across the battery terminals.
   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 Fig. 10. Read voltage after 15 seconds, then remove load.
   d. If voltage does not drop below the minimum listed in Fig. 11, 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.)

CHARGING SYSTEM-SI

Noise from a generator may be caused by a loose drive pulley, loose mounting bolts, worn or dirty bearings, defective diode or defective stator.

A basic wiring diagram showing lead connections is shown in Section 8A. To avoid damage to the electrical equipment, always observe the following precautions:

- Do not reverse connections to the generator.
- Do not short across or ground any of the terminals in the charging circuit, except as directed by the instructions.
- NEVER operate the generator with the output terminal disconnected.
- When connecting a charger or a booster battery to the car battery, see Battery Charging Section.
- In some cars, a voltmeter may be used instead of an indicator lamp. In this case, item "A", pertaining to faulty indicator lamp operation, should be omitted from the troubleshooting procedure.

Trouble in the charging system will show up as one or more of the following conditions:

A. Faulty indicator lamp operation.
B. Choke lamp stays on after engine is running. (Gage Cars.)
C. An undercharged battery, as evidenced by slow cranking or hydrometer dark.
D. An overcharged battery, as evidenced by spewing of electrolyte from the vents.

A. Faulty Indicator Lamp Operation

Check the indicator lamp for normal operation as shown in Fig. 13.

If the indicator lamp operates normally, proceed to "Undercharged Battery" section. Otherwise, proceed to **one** of the following three **abnormal** conditions:

1. **Switch Off, Lamp On** - Unplug the connector from the generator No. 1 and No. 2 terminals. If the lamp stays on, there is a short between these two leads. If the lamp goes out, replace the

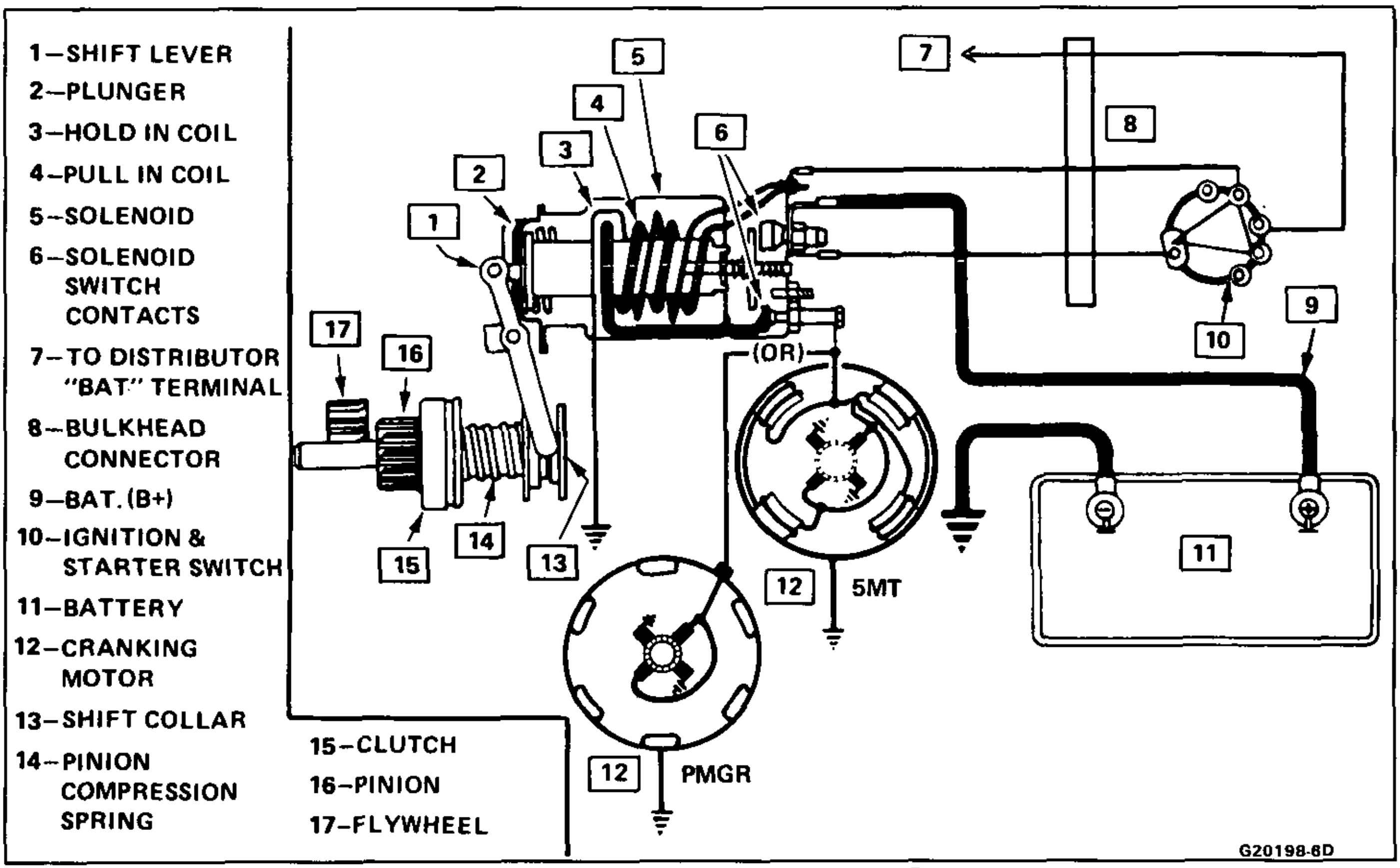


Fig. 6 Cranking Circuit - 5MT or PMGR

rectifier bridge as covered in the "SERVICE PROCEDURES" section. This condition will cause an undercharged battery.

2. **Switch On, Lamp Off, Engine Stopped** - This condition can be caused by the defects listed in Part 1 above, or by an open in the circuit. To determine where an open exists, proceed as follows:
   a. Check for a blown fuse, a burned out bulb, defective bulb socket, or an open in No. 1 lead circuit between generator and ignition switch.
   b. If no defects are found, proceed to "Undercharged Battery" section.
3. **Switch On, Lamp On, Engine Running** - Check for a blown fuse (where used) between indicator lamp and switch, and also in A/C circuit. The other possible causes of this condition are covered in the "UNDERCHARGED BATTERY" section.

If a defect has been found and corrected at this point, no further checks need be made.

B. Choke Lamp on After Start

On some models, the choke heater is controlled by the charging circuit(refer to "Choke Heater," Section 8A).

If the generator fails to produce from 12 to 16 volts after the engine is running at a speed above idle, the choke heater relay will be grounded through the brown white wire to the generator at terminal 1. This will cause the relay points to remain open, thus stopping current flow back through the choke heater relay. This will cause the choke indicator to light. See Section 8A for information regarding this circuit.

Check generator terminal 1 for voltage during fast idle. If voltage is zero see unit repair.

C. Undercharged Battery

This condition, as shown by slow cranking or hydrometer dark, can be caused by one or more of the following conditions, even though the indicator lamp may be operating normally. This procedure also applies to cars with a voltmeter.

1. Determine that the undercharged condition has not been caused by accessories having been left on for extended periods.
2. Check the drive belt for proper tension (see Section 6B).
3. If a battery defect is suspected, refer to Battery Section.
4. Inspect the wiring for defects. Check all connections for tightness and cleanliness, including slip connectors at the generator and cowl. Battery cable connections at battery, starter and engine ground should also be checked.
5. With ignition switch on and all wiring harness leads connected, connect a voltmeter from:
   a. Generator "BAT" terminal to ground
   b. Generator No. 1 terminal to ground
   c. Generator No. 2 terminal to ground

A zero reading indicates an open between voltmeter connection and battery. Generators have a built-in feature, which avoids overcharge

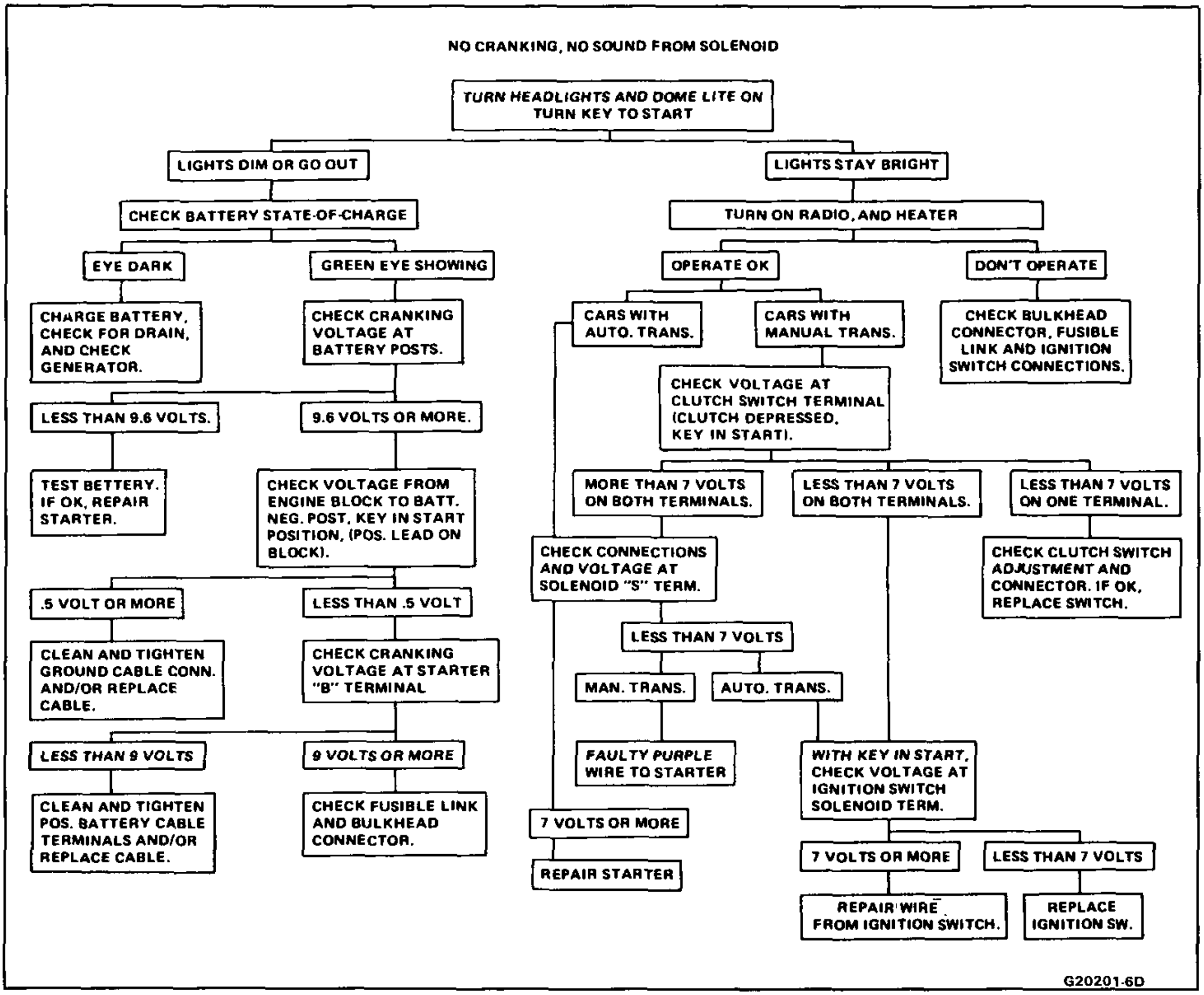
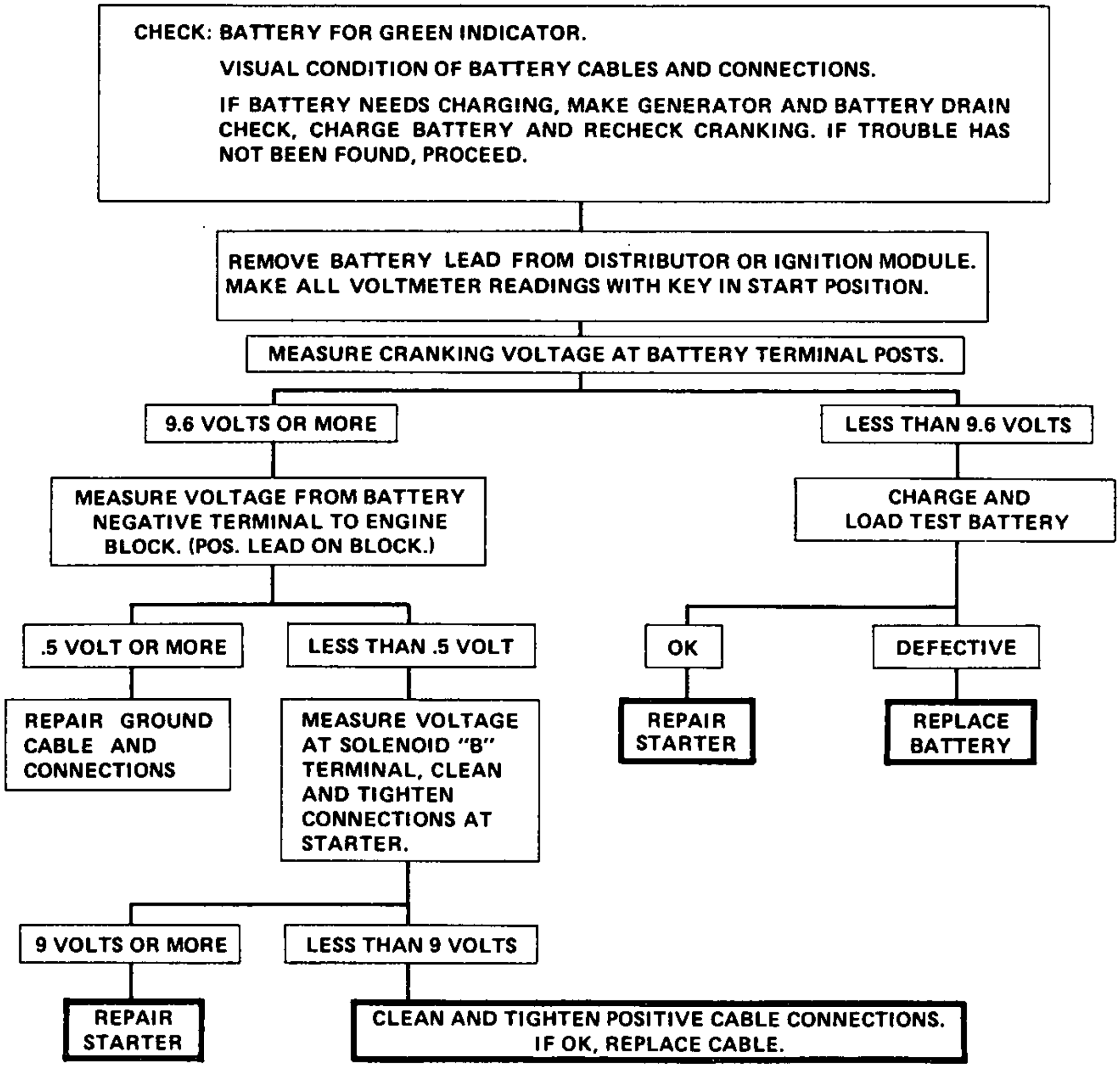


Fig. 7 Electrical System General Diagnosis - 1 of 2

and accessory damage by preventing the generator from turning on if there is an **open** in the wiring harness connected to the No. 2 (sensing) generator terminal.

6. With all accessories turned off, connect a voltmeter across the battery. Operate engine at moderate speed. If voltage is 16 or more on 12-volt system, remove generator for repair.
7. If Steps 1 through 6 check satisfactorily, check generator as follows:
   a. Disconnect negative battery cable.
   b. Connect an ammeter or generator tester in the circuit at the "BAT" terminal of the generator.
   c. Reconnect negative battery cable.
   d. Turn on radio, windshield wipers, lights on high beam and blower motor on high speed. Connect a carbon pile across the battery.
   e. Operate engine at about 2000 RPM, and adjust carbon pile as required, to obtain maximum current output.
   f. If current output is within 10 amperes of rated output as stamped on generator frame, generator is not defective; recheck Steps 1 through 5.
   g. If current output is not within 10 amperes of rated output, determine if test hole (Fig. 14) is accessible. If accessible go to Step h. If not accessible, disassemble generator and make tests listed in Figs. 25 through 27 Generator Disassembly, Test and Reassembly.
   h. Ground the field winding by inserting a screwdriver into the test hole (Fig. 14). Make sure tab is within 19mm (3/4 inch) of casting surface. Do not force screwdriver deeper than one inch into end frame.
   i. Operate engine at about 2000 RPM, and adjust carbon pile as required to obtain maximum current output.
   j. If output is now within 10 amperes of rated output, check field winding as covered in Fig. 25 ("Testing Stator"), and test regulator with an approved regulator tester.
   k. If output is still not within 10 amperes of rated output, check the field winding, diode

SLOW CRANKING, SOLENOID CLICKS OR CHATTERS



CHECK: BATTERY FOR GREEN INDICATOR.

VISUAL CONDITION OF BATTERY CABLES AND CONNECTIONS.

IF BATTERY NEEDS CHARGING, MAKE GENERATOR AND BATTERY DRAIN CHECK, CHARGE BATTERY AND RECHECK CRANKING. IF TROUBLE HAS NOT BEEN FOUND, PROCEED.

REMOVE BATTERY LEAD FROM DISTRIBUTOR OR IGNITION MODULE. MAKE ALL VOLTMETER READINGS WITH KEY IN START POSITION.

MEASURE CRANKING VOLTAGE AT BATTERY TERMINAL POSTS.

9.6 VOLTS OR MORE

MEASURE VOLTAGE FROM BATTERY NEGATIVE TERMINAL TO ENGINE BLOCK. (POS. LEAD ON BLOCK.)

.5 VOLT OR MORE

REPAIR GROUND CABLE AND CONNECTIONS

LESS THAN .5 VOLT

MEASURE VOLTAGE AT SOLENOID "B" TERMINAL, CLEAN AND TIGHTEN CONNECTIONS AT STARTER.

9 VOLTS OR MORE

REPAIR STARTER

LESS THAN 9 VOLTS

CLEAN AND TIGHTEN POSITIVE CABLE CONNECTIONS. IF OK, REPLACE CABLE.

LESS THAN 9.6 VOLTS

CHARGE AND LOAD TEST BATTERY

OK

REPAIR STARTER

DEFECTIVE

REPLACE BATTERY

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.

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Fig. 8 Electrical System General Diagnosis - 2 of 2

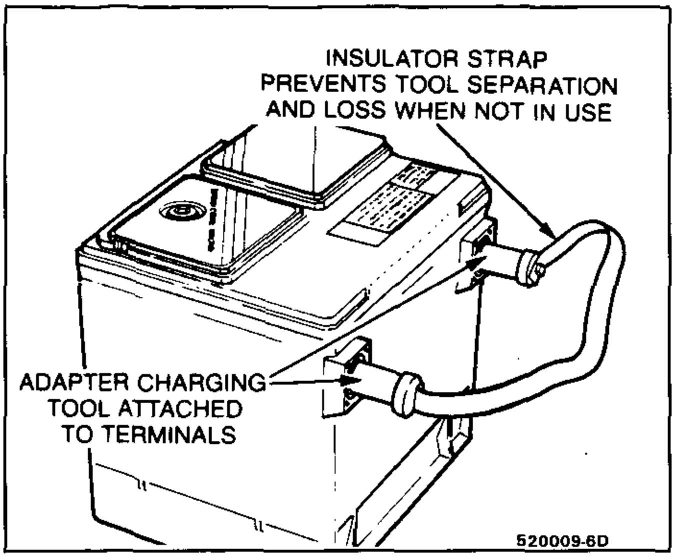

Fig. 9 Side Terminal Battery Adapters

trio and rectifier bridge, as covered in Figs. 25 and 26 ("Testing Stator", "Testing Trio" and "Testing Rectifier Bridge").

D. Overcharged Battery

1. To determine battery condition, refer to battery section of "Diagnosis".
2. If an obvious overcharge condition exists as evidenced by spewing of electrolyte, proceed to Fig. 25 ("Testing Stator") and check field winding for grounds and shorts. If defective, replace field and test regulator with an approved regulator tester.

   Generator Tester - Many testers are available to check the generator. They provide a quick on-car test, and can save time over conventional diagnostic methods. Consult manufacturer's instructions for usage.

Generator Diagnostic Tester Indications

Tool J-26290

This tester is designed as a quick check to determine if the generator should be removed from the car. It will indicate about 98% of charging system faults.

BE CERTAIN ENGINE IS AT **FAST IDLE** WHEN USING TESTER IN PART 2.

Connect tester as shown in Fig. 15.

1. **Engine Off:** (Lights and Accessories Off)
   a. Light flashes--Skip steps b and c and go to Part 2.
   b. Light on--Indicates fault in tester which should be replaced.
   c. Light off--Pull plug from generator:
      - *Flashing light--indicates that the* generator should be removed and the rectifier bridge replaced.
      - Light off--indicates faulty tester or no voltage to tester. Check for 12-volts at #2 terminal of harness connector. Repair wiring or terminals if 12-volts is not available. Replace tester if 12-volts is available.
2. **Engine at Fast Idle:** (Lights and Accessories Off)
   a. Light off--Charging system good, DO NOT remove generator.
   b. Light on--Indicates a component failure within the generator. Remove generator and check diode trio, rectifier bridge and stator.
   c. Light flashing--Indicates a problem within the generator. Remove generator and check regulator, rotor, field coil, brushes and slip rings.

Transistorized Voltage Regulator Test

1. Connect a fast charger and a voltmeter to the battery as shown in Fig. 16.
2. Turn on the ignition and slowly increase the charge rate. The generator lamp in the car will dim at the voltage regulator setting. Voltage regulator setting should be a miminum of 13.5 volts and a maximum of 16.0 volts.

NOTE: This test works if the rotor circuit is good, even if the stator, rectifier bridge, or diode trio is bad.

Charging System - CS

A basic wiring diagram for the CS charging system is shown in Figure 21. When operating normally, the indicator lamp will come on when the switch is turned on and go out when the engine starts. If the lamp operates abnormally, or if an undercharged or overcharged battery condition occurs, the following procedure may be used to diagnose the charging system. Remember that an undercharged battery is often caused by accessories being left on overnight, or by a defective switch which allows a lamp, such as a trunk or glove box lamp, to stay on. Also, this generator does not have a test hole.

To diagnose the CS-130 and CS-144 charging systems, use the following procedure:

1. Visually check belt and wiring.
2. For vehicles without charge indicator lamp, go to step 5.
3. With switch on, engine stopped, lamp should be on. If not, detach harness at generator, and ground "L" terminal.
   a. Lamp lights, replace or repair generator.
   b. Lamp does not light, locate open circuit between grounding lead and ignition switch. Lamp may be open.
4. With switch on, engine running at moderate speed, lamp should be off. If not, detach wiring harness at generator.
   a. If lamp goes off, replace or repair generator.
   b. If lamp stays on, check for grounded "L" terminal wire in harness.
5. Battery undercharged or overcharged.
   a. Detach wiring harness connector from generator.

SERIES	ENGINE CODE	STANDARD	HIGH CAPACITY
A	LR8 R	1981296	N/A
	LE2 X	1981103	1981104
	LB6 W	1981104	1981296
B	LB4 Z	1981296	N/A
	LV2 Y	1981577	1981607
	LG4 H	1981577	1981607
F	LQ9 2	1981296	N/A
	LB8 S	1981577	1981607
	L69,LG4 G-H	1981577	1981607
	LB9	1981577	1981607
G	LD5 A	1981104	1981607
	LG4 H	1981104	1981607
	LB4 Z	1981296	N/A
J	LH8 O	1981296	N/A
	LA5 J	1981296	N/A
N	L68 U	1981296	N/A
	LN7 L	1981296	N/A
P	LR8 R	1981296	N/A
	L44 9	1981104	1981607
T	L17 C-w/Manual	1981101	1981103
	L17 C-w/Automatic	1981102	1981103

BATTERY	COLD CRANKING AMPS-0°F	RESERVE CAPACITY MINUTES	LOAD TEST AMPS	REPLACEMENT BATTERY
1981101	315	75	160	70-50
1981102	410	80	200	70-60
1981103	410	80	200	70-60
1981104	500	90	250	75-60
1981296	630	90	315	75A-60
1981577	525	75	260	70-60S
1981607	570	90	280	75A-72

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Fig. 10 Battery Applications & Specifications

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

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Fig. 11 Minimum Voltage

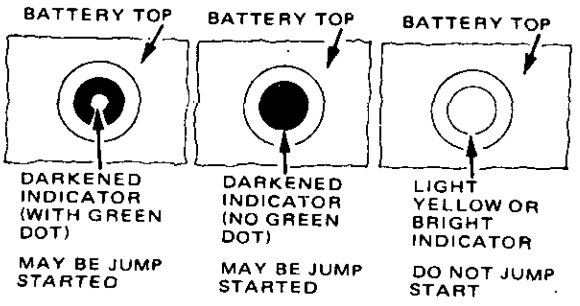

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Fig. 12 Built-In Hydrometer

b. With switch on, engine not running, connect voltmeter from ground to "L" terminal.

c. Zero reading indicates open circuit between terminal and battery. Correct as required.

d. Reconnect harness connector to generator, run engine at moderate speed.

e. Measure voltage across battery. If above 16V, replace or repair generator.

f. Turn on accessories, load battery with carbon pile to obtain maximum amperage. Maintain voltage at 13V or below.
   - *If within* 15 *amperes of rated output,* generator is OK.
   - If not within 15 amperes of rated output, replace or repair generator.

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 excessive 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 Figs. 27A thru 27E 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.

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 Figs. 7 and 8 to isolate problem.

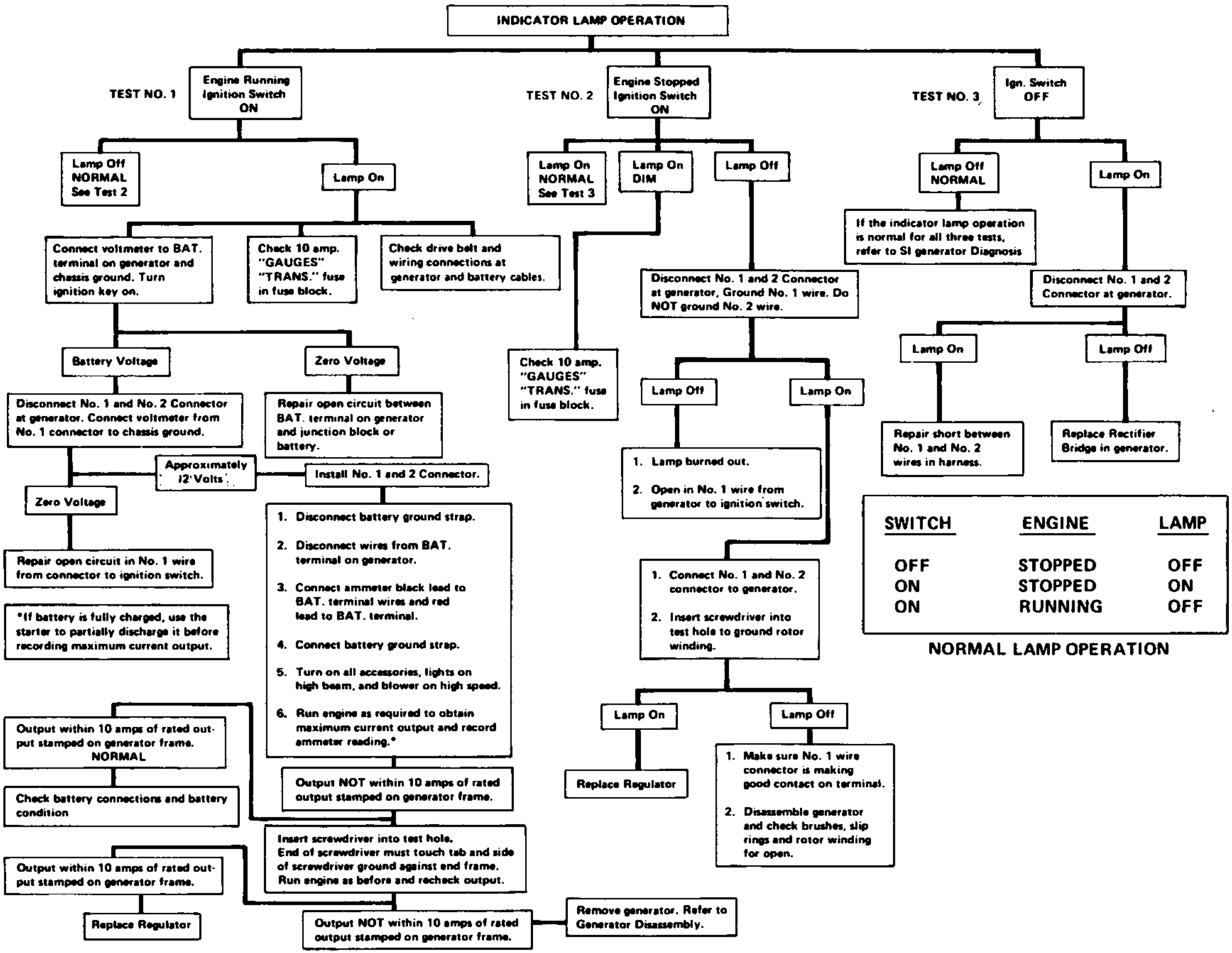
Battery: To determine the condition of the battery, follow the testing procedure outlined in the Battery Section.

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. 17 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



SWITCH	ENGINE	LAMP
OFF	STOPPED	OFF
ON	STOPPED	ON
ON	RUNNING	OFF

NORMAL LAMP OPERATION

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Fig. 13 Indicator Lamp Operation

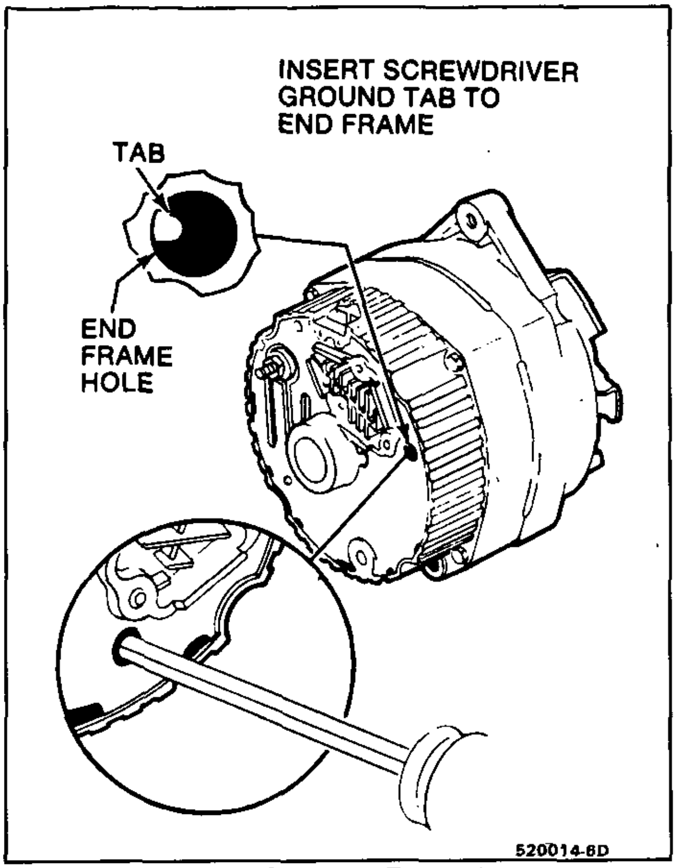


Fig. 14 Generator Test Hole

so that the marked teeth are in the area of the starter pinion gear.

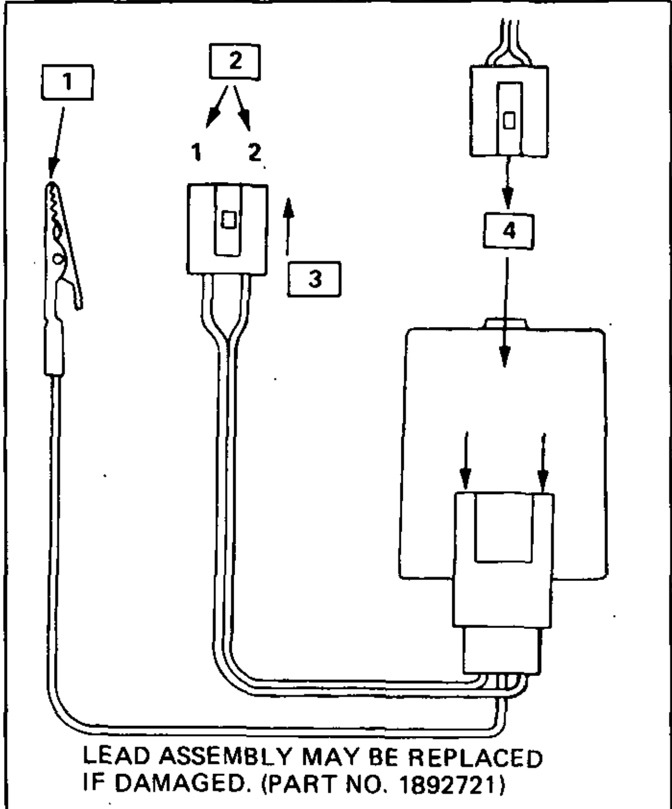
c. Disconnect negative battery cable to prevent cranking of engine.

d. Check pinion to flywheel clearance, as shown in Fig. 18, 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. 18. 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 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 Figs. 30 thru 35 for Starter Motor Disassembly, Test and Reassembly.



LEAD ASSEMBLY MAY BE REPLACED IF DAMAGED. (PART NO. 1892721)

J-26290 DIAGNOSTIC TESTER CONNECTIONS

1–CLIP TO GROUND

2–DELCOTRON SI GENERATOR TERMINALS

3–PLUG INTO GENERATOR

4–PLUG HARNESS CONNECTOR FROM GENERATOR INTO TESTER

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Fig. 15 Generator Diagnostic Tester - SI

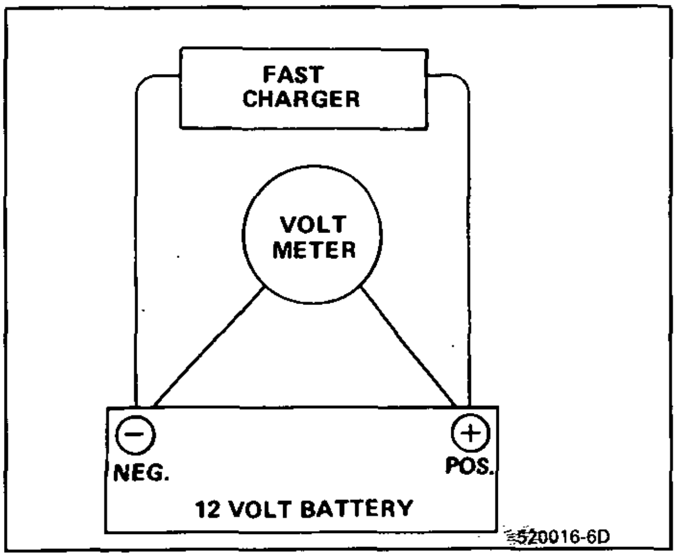

Fig. 16 On-Car Voltage Regulator Test - SI

PMGR starter motors are serviced only by complete unit replacement.

	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. 17 Starter Motor Noise Diagnosis

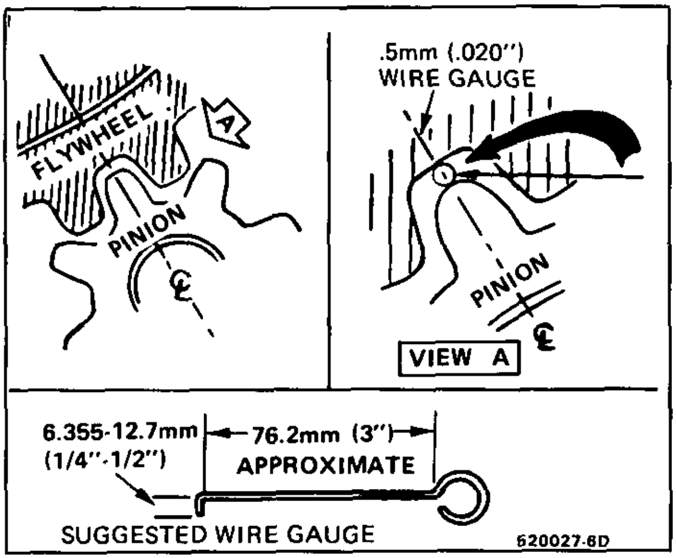


Fig. 18 Flywheel to Pinion Clearance

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.

SERVICE PROCEDURES

BATTERY

BATTERY CHARGING

When it is necessary to charge the battery, the following basic rules must be followed:

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. 9.) 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 tested as outlined in BATTERY TESTING.

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 VERY FLAT OR COMPLETELY DISCHARGED BATTERY (OFF THE VEHICLE)

The following procedure should be used to recharge a very flat or 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.

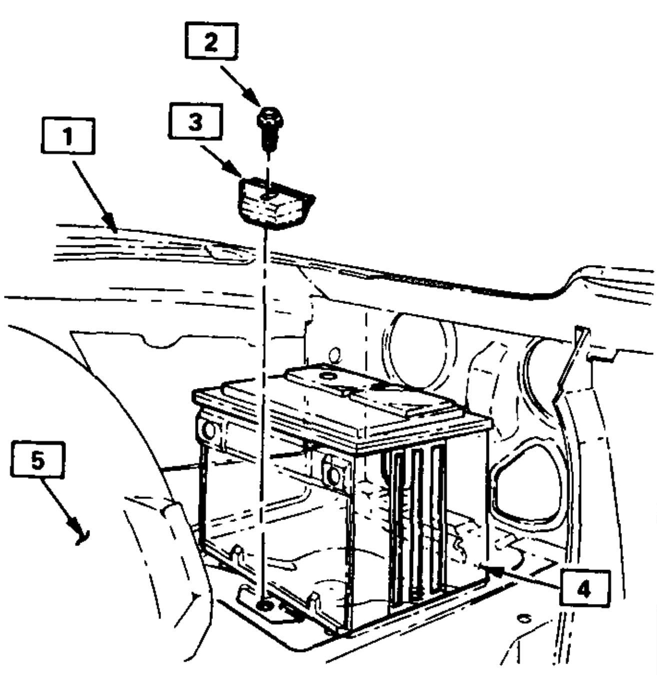
1. Set parking brake and place automatic transmission in "PARK" (NEUTRAL for manual transmission.) **Turn off the ignition, turn off lights, and all other electrical loads.**
2. Check the built-in hydrometer. If it is clear or light yellow, replace the battery.
3. Attach the end of one jumper cable to 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.

REMOVE AND INSTALL BATTERY

1. Disconnect negative cable.
2. Disconnect positive cable.
3. Remove retainer screw and retainer.
4. Remove battery.
5. To install, reverse removal procedure.
6. Torque battery cables to 12 N·m (9 lb. ft.).

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).



1—FENDER
2—BOLT/SCREW
3—RETAINER
4—BATTERY (REF.)
5—FENDER SKIRT

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Fig. 19 Battery Hold-Down

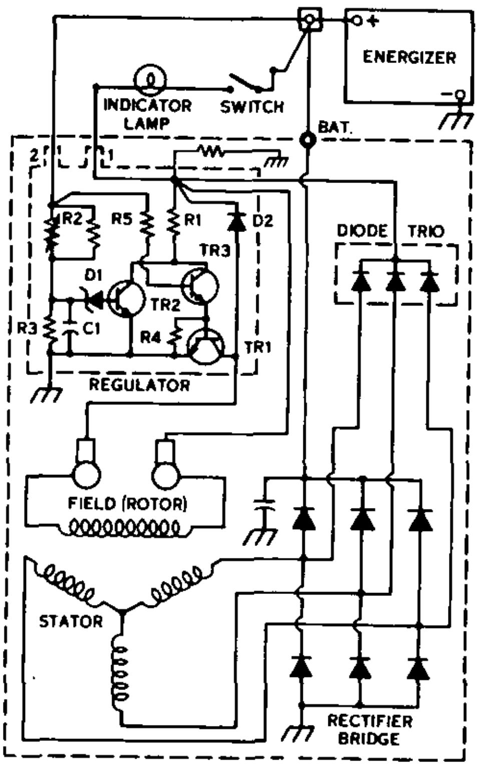

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Fig. 20 SI Charging System Wiring Diagram

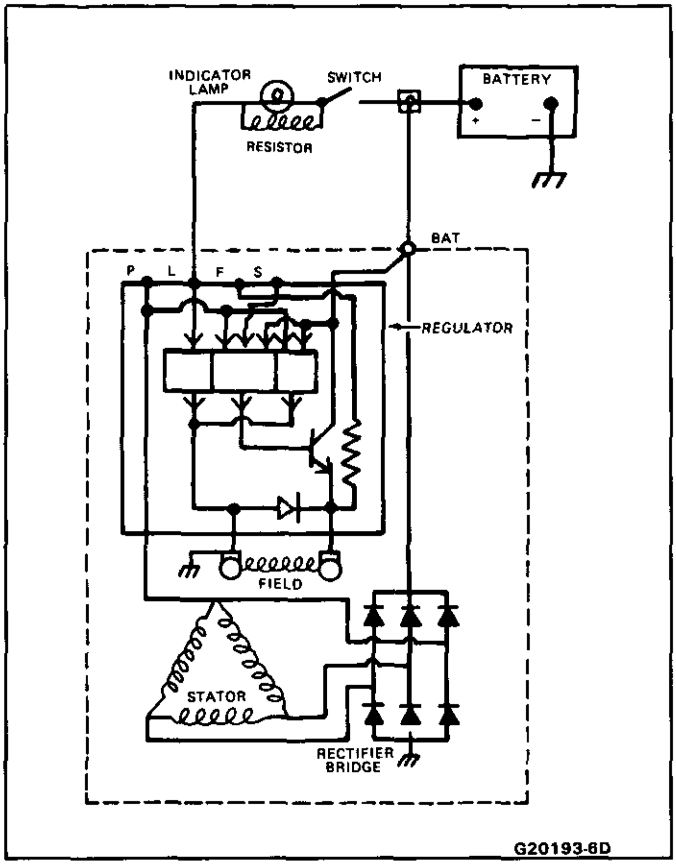


Fig. 21 CS Charging System Wiring Diagram

- When adjusting belt tension, apply pressure at center of generator, never against either end frame.

Remove From Car

1. Disconnect negative battery cable at battery.

   CAUTION: Failure to observe this step may result in an injury from hot battery lead at generator.
2. Remove two terminal plug and battery leads on back of generator.
3. Loosen adjusting bolts.
4. Remove generator drive belt.
5. Remove thru bolts which retain generator.
6. Remove generator from car.

GENERATOR BENCH CHECK-SI

To check the generator in a test stand, proceed as follows:

1. Make connections as shown in Fig. 22, except leave the carbon pile disconnected. IMPORTANT - Ground polarity of battery and generator must be the same. Use a fully charged battery, and a 10 ohm resistor rated at six watts or more between the generator No. 1 terminal and the battery.
2. Slowly increase the generator speed and observe the voltage.
3. If the voltage is uncontrolled with speed and increases above 16 volts on a 12-volt system, test regulator with an approved regulator tester, and check field winding. NOTE: The battery must be fully charged when making this check.
4. If voltage is below 16 volts on a 12-volt system, connect the carbon pile as shown.
5. Operate the generator at moderate speed and adjust the carbon pile, as required, to obtain maximum current output.
6. If output is within 10 amperes of rated output, as stamped on generator frame, generator is good.
7. If output is not within 10 amperes of rated output, keep battery loaded with carbon pile, and ground generator field.
8. Operate generator at moderate speed and adjust carbon pile, as required, to obtain maximum output.
9. If output is now within 10 amperes of rated output, test regulator with an approved regulator tester, and check field winding.
10. If output is not within 10 amperes of rated output, check the field winding, diode trio, rectifier bridge, and stator.

GENERATOR BENCH CHECK-CS

To check generator in a test stand, proceed as follows:

1. Make connections as shown in Figure 23, 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.
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.

TESTING VOLTAGE REGULATOR - SI

1. Connect voltmeter and fast charger to 12-volt battery as shown in Fig. 24.
2. Connect regulator and test light as shown, observe battery polarity.
3. Test light should be on.
4. Turn on fast charger and slowly increase charge rate. Observe voltmeter, light should go out at the voltage regulator setting. Voltage regulator setting should be a minimum of 13.5 volts and a maximum of 16.0 volts.

The test light is connected into the circuit, exactly as the rotor is when the regulator is inside the generator. The regulator shuts off the current to the

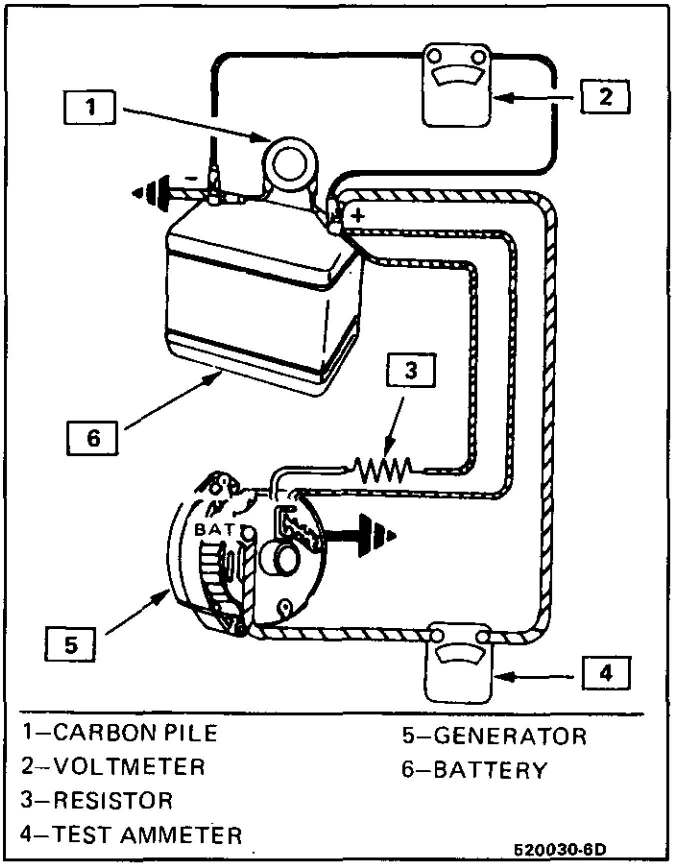


Fig. 22 Generator Bench Check - SI

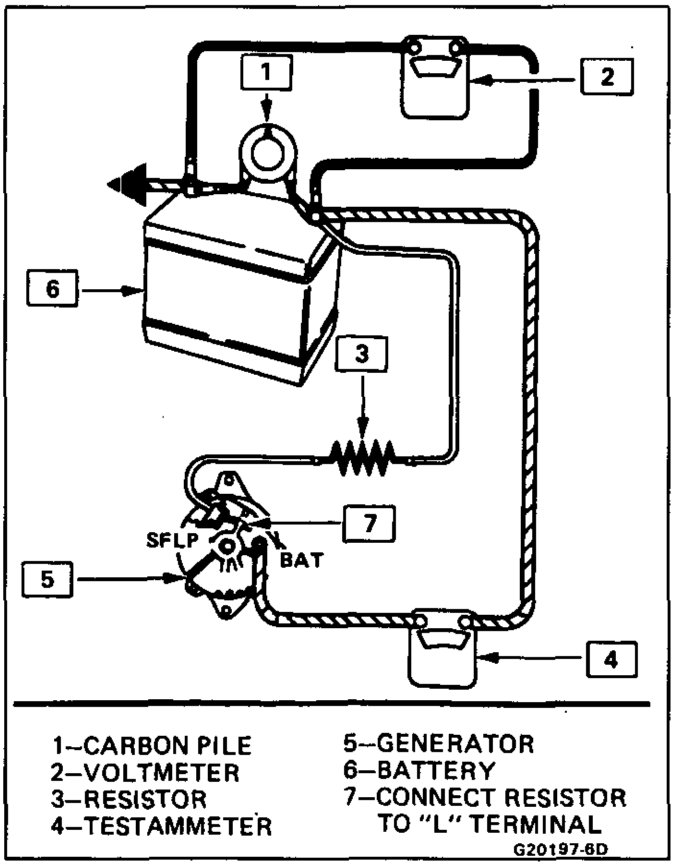


Fig. 23 Generator Bench Check - CS

test light when the regulator setting is reached. This voltage will vary with temperature differences.

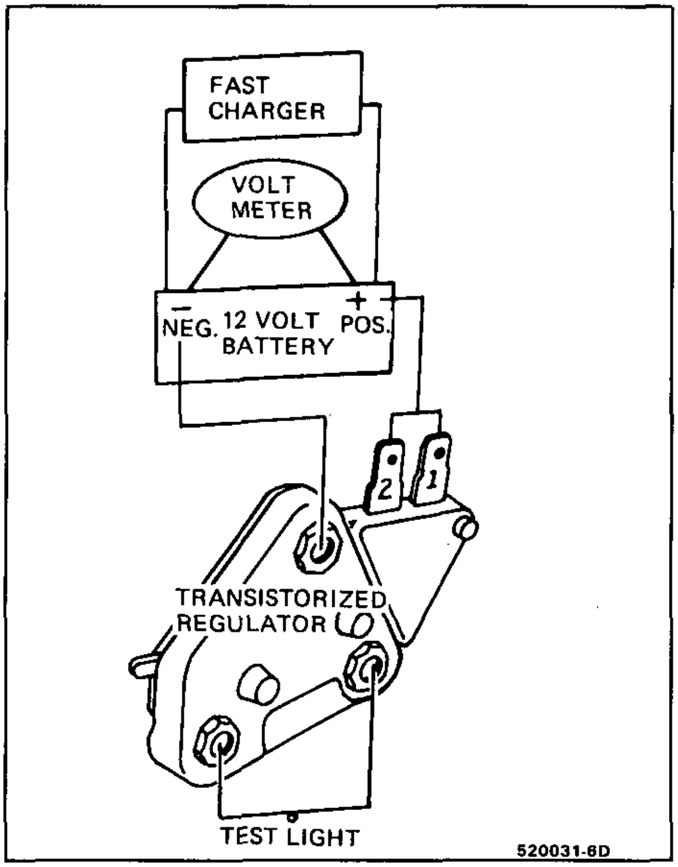


Fig. 24 Off-Car Voltage Regulator Test - SI

Install In Car

1. If removed from car, install generator to mounting bracket with bolts, washers and nuts. Do not tighten.
2. Install generator drive belt.
3. Tighten belt to the specified belt tension. See Engine Cooling Section for proper belt tensioning procedures.
4. Tighten bolts.
5. Install generator terminal plug and battery leads to generator.
6. Connect negative battery cable.

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 of On-Car Service. 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 and Install

1. Disconnect 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. Remove distributor cap by turning four screws counterclockwise. Move cap out of the way.
3. Disconnect 4 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. Remove 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 below).

Module

It is not necessary to remove the distributor from car.

Removal

1. Remove distributor cap and rotor.
2. Remove two module attaching screws, and lift module up.
3. Disconnect 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. 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.

Installation

To install, reverse removal procedure.

Pick-Up Coil

Removal

1. Remove distributor from car and follow instructions in Figs. 27A through 27E, as applicable.

Rotor

Fig. 2

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. 2

Removal

1. Remove distributor cap.
2. Remove three coil cover attaching screws, and lift off cover.
3. Remove coil attaching screws and lift ignition coil and leads from cap.

Installation

To install, reverse removal procedure.

Capacitor

Fig. 2

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.

Removal

1. Remove distributor cap and rotor.
2. Remove capacitor attaching screw and unplug connector from module. It may help to loosen the module.

Installation

1. To install, reverse above procedure.
2. Install hold-down screw making sure ground lead is under screw.

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 (see Fig. 3). 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.

CRANKING SYSTEM

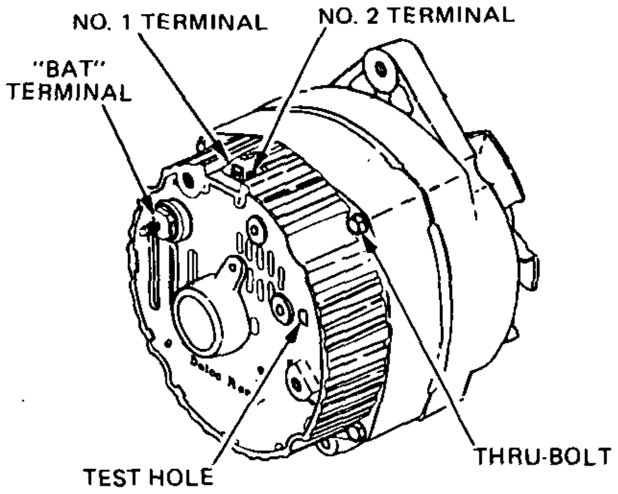
Starting motors do not require lubrication except during overhaul (PMGR starting motors are unit replacement only).

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 silicon grease General Electric CG321, Dow Corning 33 Medium, or equivalent, on the shaft underneath the overrunning clutch assembly.
2. Avoid excessive lubrication.

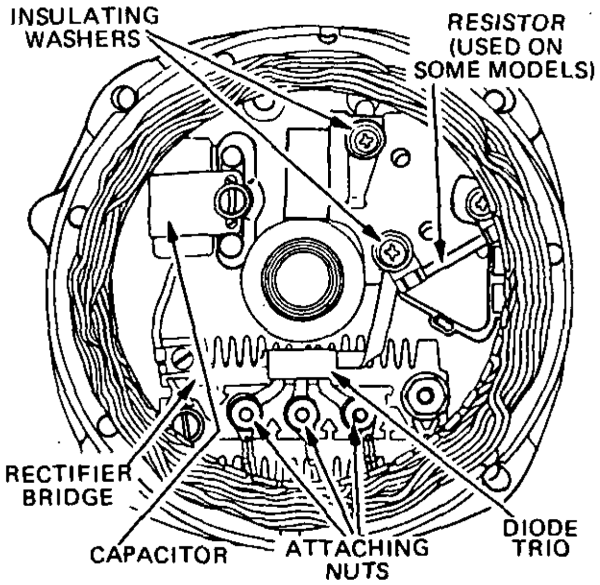
10 SI, 12SI, 15SI, 17SI AND 27SI GENERATORS DISASSEMBLY, TEST AND REASSEMBLY (GENERATOR REMOVED FROM ENGINE)

THRU-BOLT LOCATION



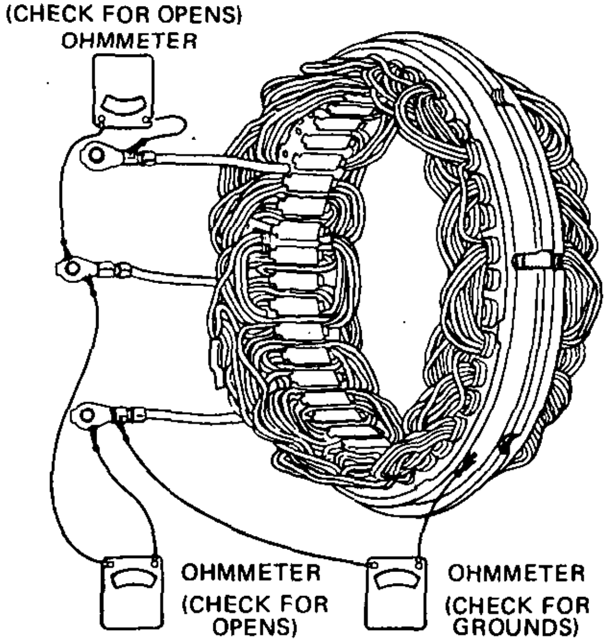
1. Make scribe marks on end frames to facilitate reassembly.
2. Remove four thru-bolts and separate drive end frame assembly from rectifier end frame assembly.

END FRAME VIEW



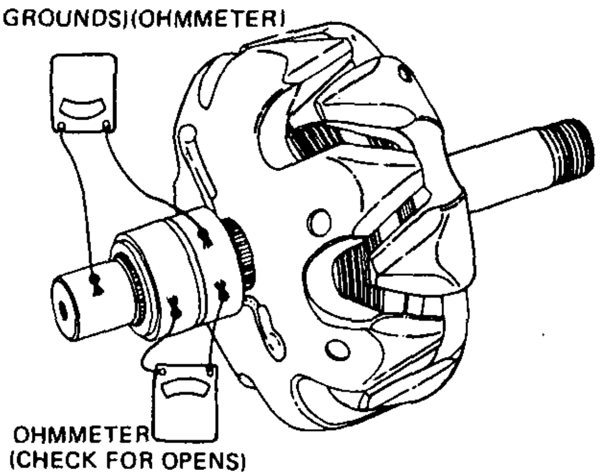
3. Remove three attaching nuts and regulator attaching screws.
4. Separate stator, diode trio and regulator from end frame. NOTE: The regulator cannot be tested on the work bench except with a regulator tester.

TESTING STATOR



5. On 10SI and 12SI, check stator for opens with ohmmeter (two checks). If either reading is high (infinite),. replace stator.
6. On all series, check stator for grounds. If reading is low, replace stator.

TESTING ROTOR



7. Check rotor for grounds with ohmmeter. Reading should be very high (infinite). If not, replace rotor.
8. Check rotor for opens. Should read 2.4-3.5 ohms. If not, replace rotor.

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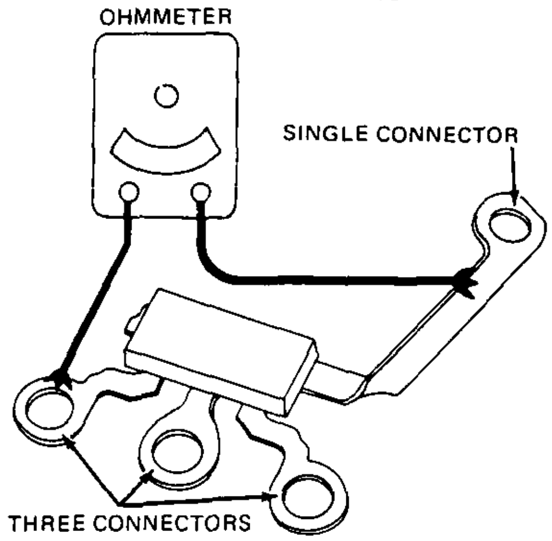
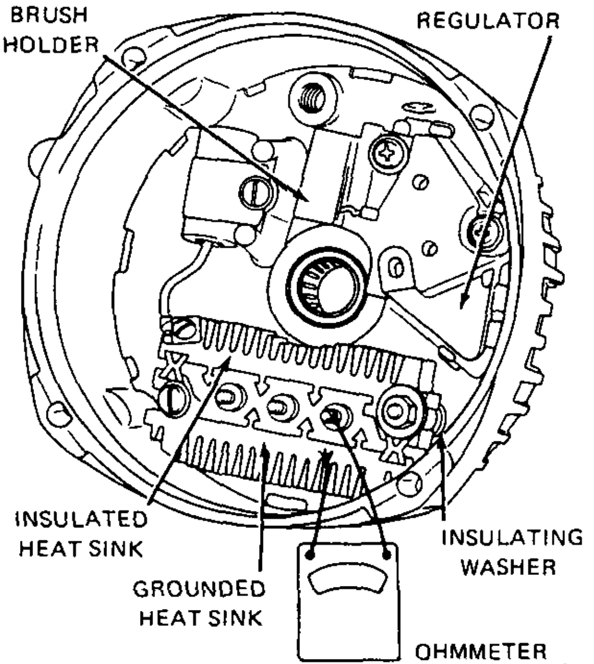
Fig. 25 Generator Disassembly, Test, and Reassembly 1 of 3

TESTING TRIO



9. To check diode trio, connect ohmmeter as shown, then reverse lead connections. Should read high and low. If not, replace diode trio.
10. Repeat same test between single connector and each of other connectors.

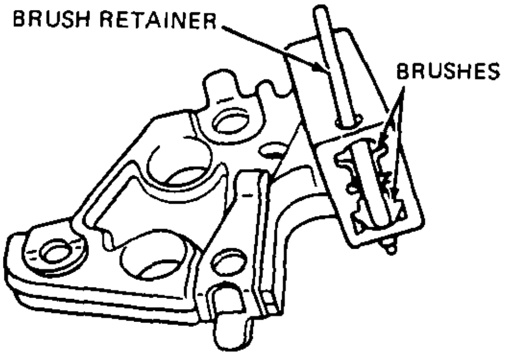
TESTING RECTIFIER BRIDGE



11. Check rectifier bridge with ohmmeter connected from grounded heat sink to flat metal on terminal. Reverse leads. If both readings are the same, replace rectifier bridge.
12. Repeat test between grounded heat sink and other two flat metal clips.
13. Repeat test between insulated heat sink and three flat metal clips.

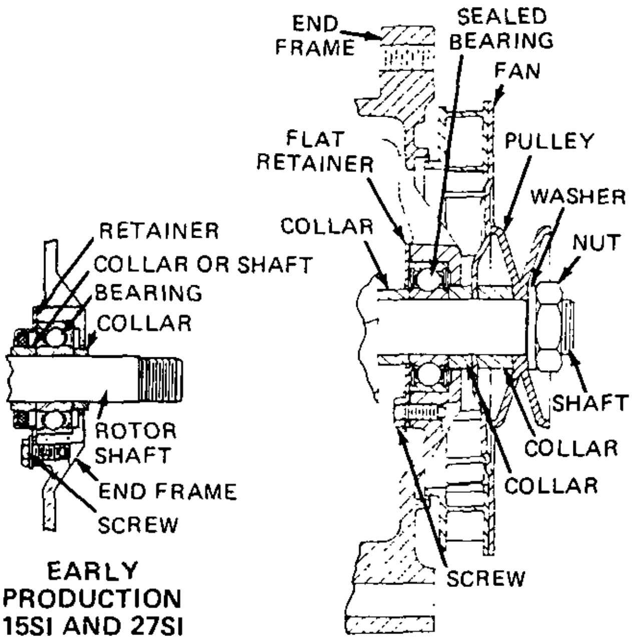
To replace bridge, remove attaching screws.

BRUSHES RETAINED IN HOLDER



14. Clean brushes with soft, dry cloth.
15. Put brushes in holder and hold with brush retainer wire.

DRIVE END BEARING



EARLY PRODUCTION 15SI AND 27SI

10SI, 12SI, AND LATE PRODUCTION 15SI AND 27SI

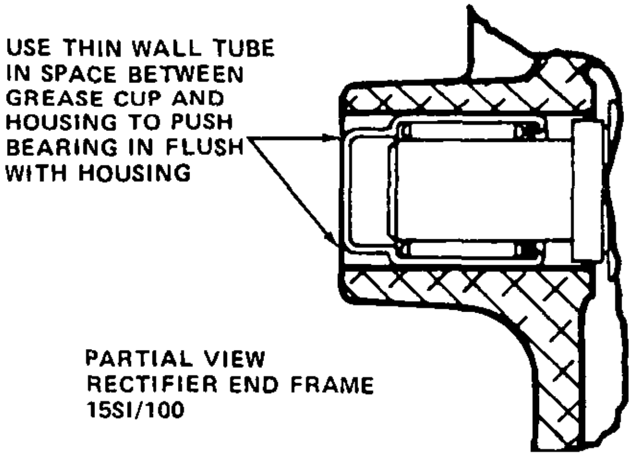
16. Observe stack-up of parts in both illustrations.

    To remove rotor and drive end bearing, remove shaft nut, washer and pulley, fan and collar. Push rotor from housing.
17. Remove retainer plate inside drive end frame and push bearing out. Clean all parts with soft cloth.
18. Press against outer race to push bearing in. Fill cavity between retainer plate and bearing with Part No. 1948791 lubricant on early production 15SI and 27SI. Series 10SI, 12SI and late production 15SI and 27SI use sealed bearing -- no lubricant is required. Assemble retainer plate.
19. Press rotor into end frame. Assemble collar, fan, pulley, washer and nut. Torque shaft nut to 40-60 lb.-ft., (54-82 N-M).

520033-6D

Fig. 26 Generator Disassembly, Test, and Reassembly 2 of 3

RECTIFIER END BEARING 15SI SERIES

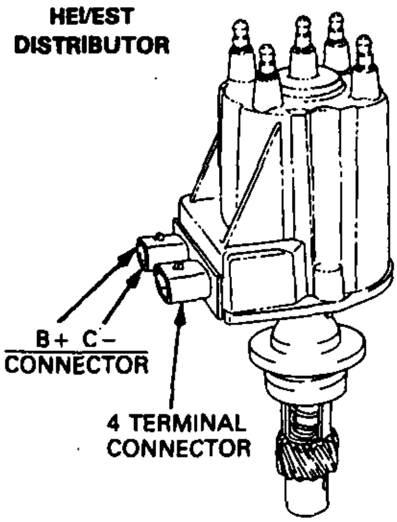


20. PUSH SLIP RING END BEARING OUT FROM OUTSIDE TOWARD INSIDE OF END FRAME.
21. ON 10SI AND 12SI, PLACE FLAT PLATE OVER NEW BEARING, PRESS FROM OUTSIDE TOWARD INSIDE UNTIL BEARING IS FLUSH WITH END FRAME.
22. ON 15SI, SEE ILLUSTRATION.
23. ASSEMBLE BRUSH HOLDER, REGULATOR, RESISTOR, DIODE TRIO, RECTIFIER BRIDGE AND STATOR TO SLIP RING END FRAME.
24. ASSEMBLE END FRAMES TOGETHER WITH THRU-BOLTS. REMOVE BRUSH RETAINER WIRE.

520034-6D

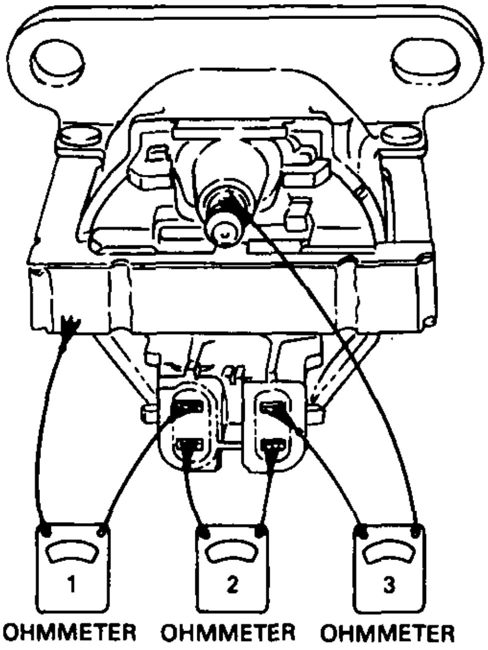
Fig. 27 Generator Disassembly, Test, and Reassembly 3 of 3

DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (SEPARATELY MOUNTED COIL)



1. A TYPICAL DISTRIBUTOR USED WITH A SEPARATELY MOUNTED COIL IS SHOWN.

TESTING IGNITION COIL



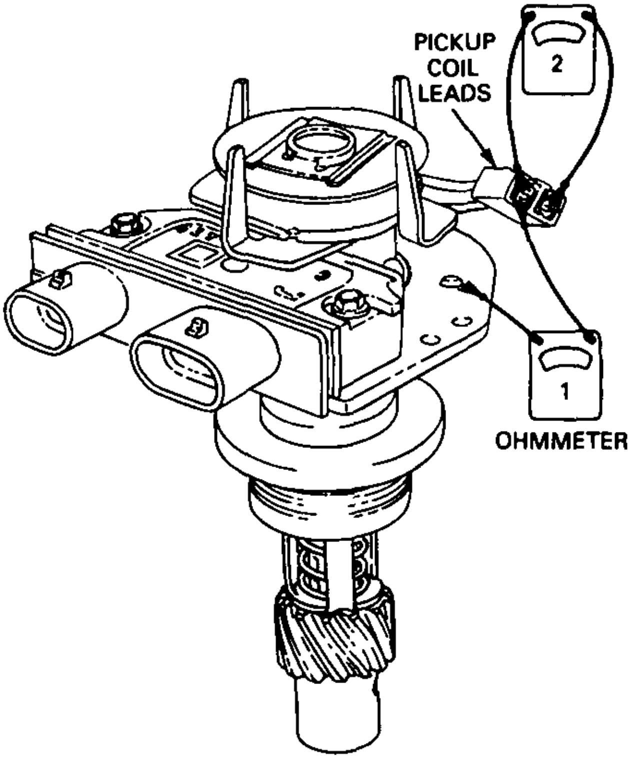
2. CHECK IGNITION COIL WITH OHMMETER FOR OPENS AND GROUNDS:

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.

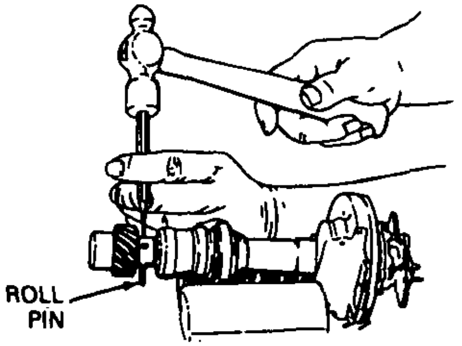
4. CONNECT OHMMETER PART 1 AND PART 2.

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

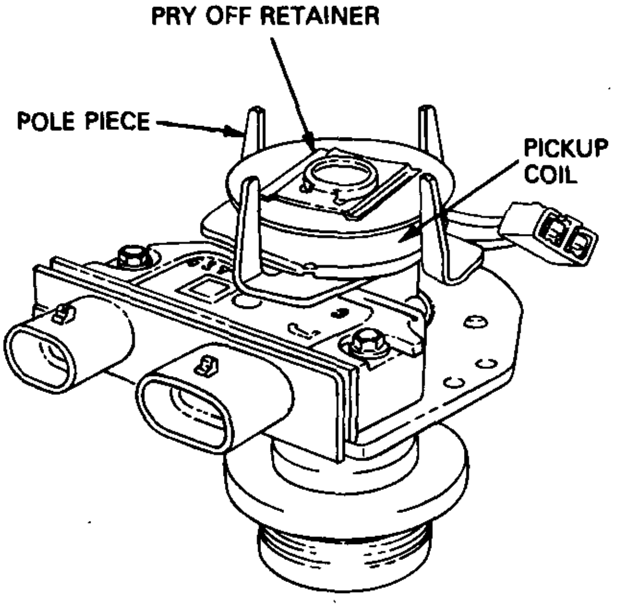


6. DRIVE ROLL PIN FROM GEAR AND REMOVE SHAFT ASSEMBLY. MARK GEAR AND SHAFT FOR CORRECT REASSEMBLY.

520035-6D

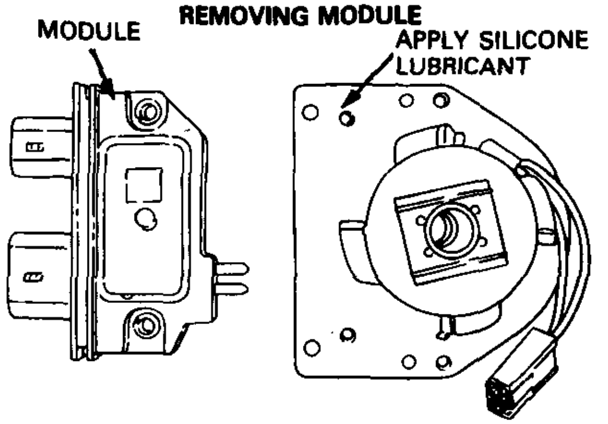
Fig. 27A Distributor Disassembly, Test and Reassembly (Separate Coil) 1 of 2

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

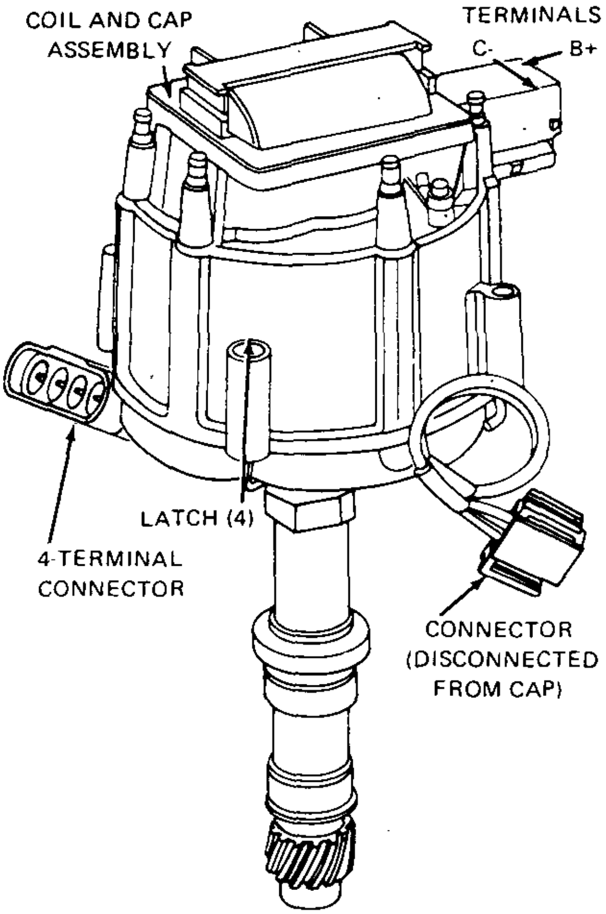
10. WIPE DISTRIBUTOR BASE AND MODULE CLEAN, APPLY SILICONE LUBRICANT BETWEEN MODULE AND BASE FOR HEAT DISSIPATION.
11. ATTACH MODULE TO BASE. ATTACH PICKUP CONNECTOR TO MODULE.
12. ASSEMBLE PICKUP POLE PIECE AND RETAINER.
13. ASSEMBLE SHAFT, GEAR PARTS AND ROLL PIN.
14. SPIN SHAFT TO INSURE THAT TEETH DO NOT TOUCH.
15. INSTALL ROTOR AND CAP.

520133-6D

Fig. 27B Distributor Disassembly, Test and Reassembly (Separate Coil) 2 of 2

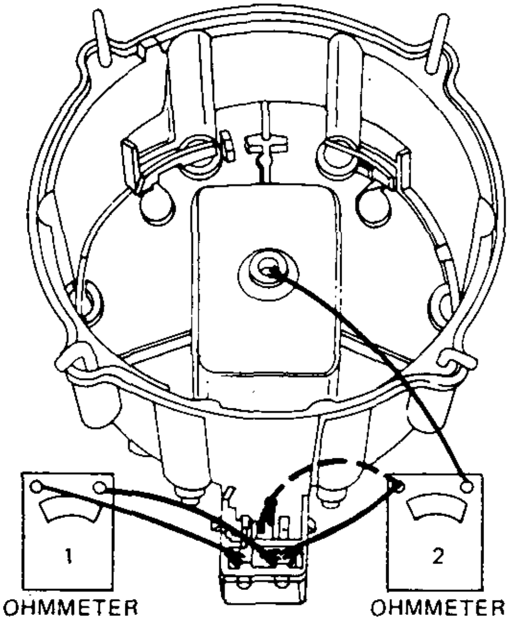
DISTRIBUTOR DISASSEMBLY TEST AND REASSEMBLY (COIL IN CAP)

"COIL IN CAP" DISTRIBUTOR



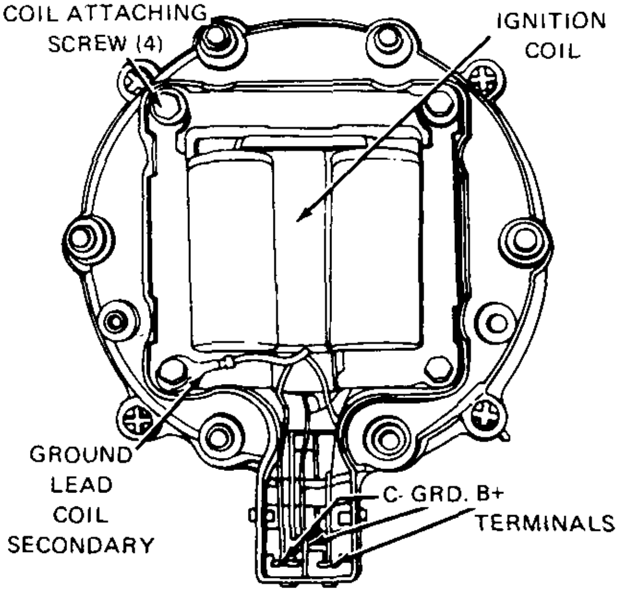
1. A 6-cyl. EST distributor with coil-in-cap is illustrated.
2. Detach wiring connector from cap, as shown.
3. Turn four latches and remove cap and coil assembly from lower housing.

TESTING IGNITION COIL



4. Connect ohmmeter. Test 1.
5. Reading should be zero, or nearly zero. If not, replace coil. Step 8.
6. Connect ohmmeter both ways. Test 2. Use high scale. Replace coil only if both readings are infinite. Step 8.
7. If coil is good, go to Step 13.

IGNITION COIL ATTACHING SCREWS



8. Remove coil-cover attaching screws and lift off cover.

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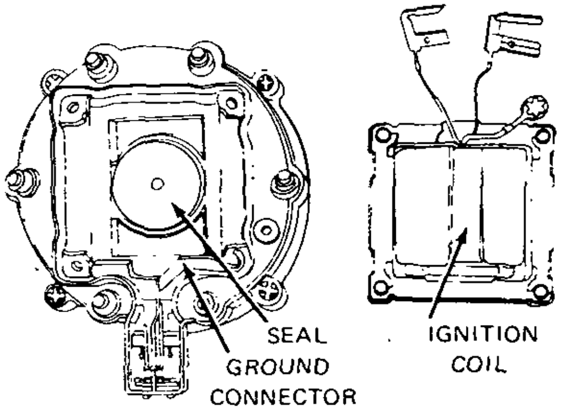
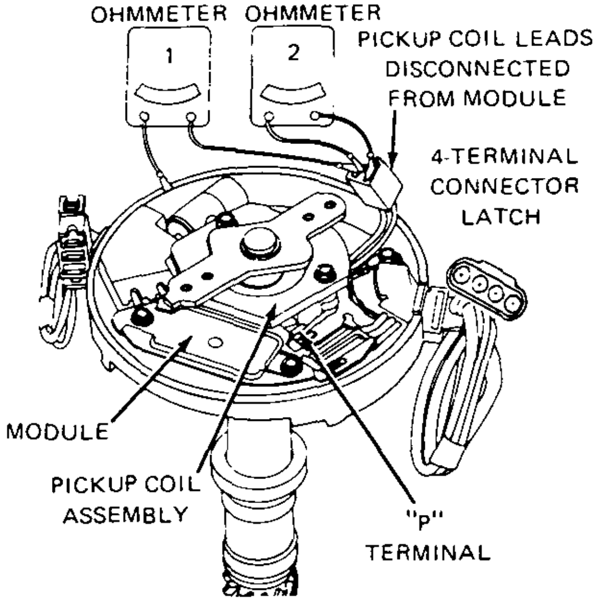
Fig. 27C Distributor Disassembly, Test and Reassembly (Coil in Cap) 1 of 3

IGNITION COIL REMOVED FROM CAP



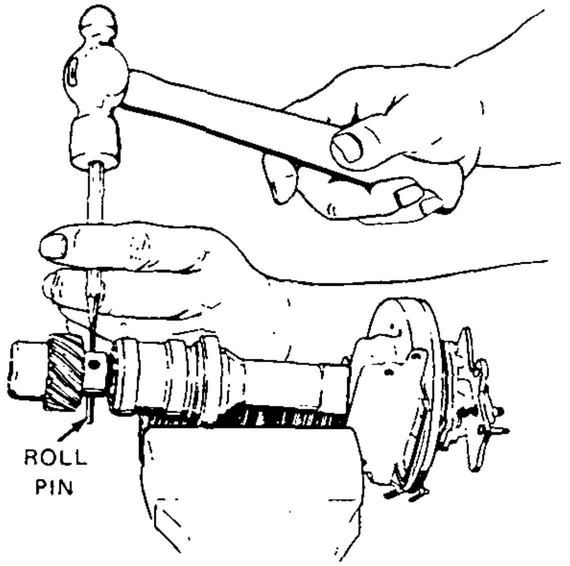
9. Remove ignition coil attaching screws and lift coil with leads from cap.
10. Remove ignition coil arc seal.
11. Clean with soft cloth and inspect cap for defects. Replace, if needed.
12. Assemble new coil and cover to cap.

TESTING PICKUP COIL



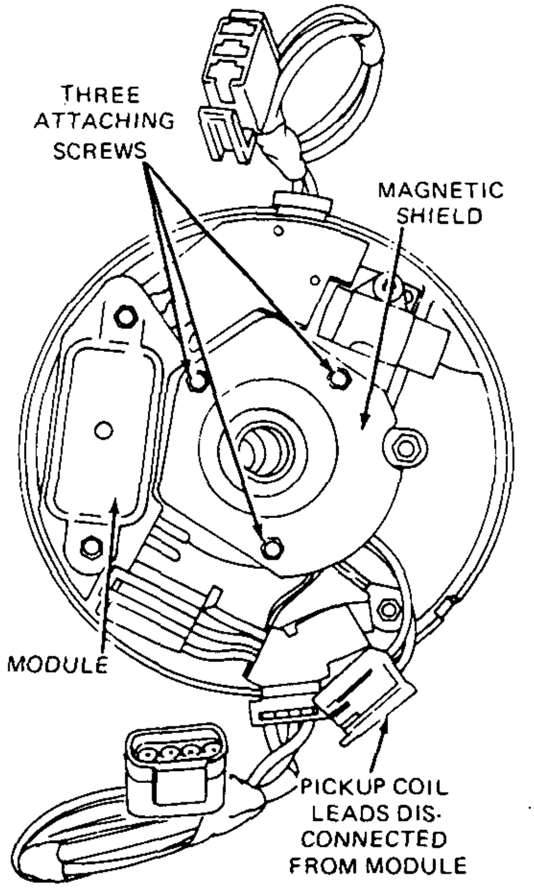
13. On all distributors, including distributors with Hall Effect Switch identified in Step 27, remove rotor and pickup coil leads from module.
14. Connect ohmmeter Test 1 and then Test 2.
15. If vacuum unit is used, connect vacuum source to vacuum unit. Replace unit if inoperative. Observe ohmmeter throughout vacuum range; flex leads by hand without vacuum to check for intermittent opens.
16. Test 1 — should read infinite at all times.
    Test 2 — should read steady at one value within 500-1500 ohm range.
    NOTE: *Ohmmeter may deflect if operating vacuum unit causes teeth to align. This is not a defect.*
17. If pickup coil is defective, go to Step 18. If okay, go to Step 23.

DRIVING PIN FROM SHAFT



18. Mark distributor shaft and gear so they can be reassembled in same position.
19. Drive out roll pin.

SHAFT ASSEMBLY REMOVED

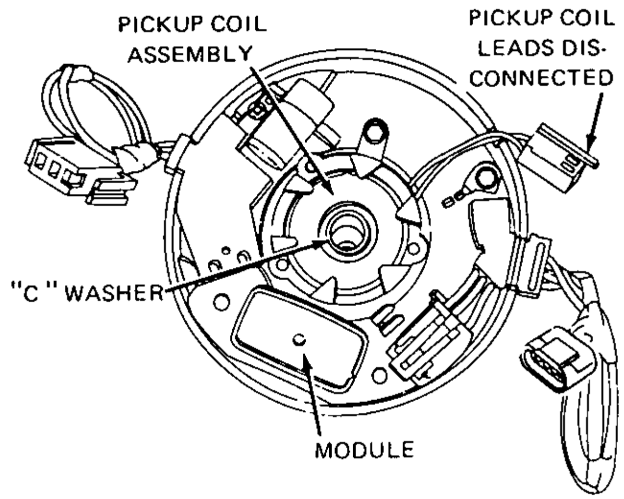


20. Remove gear and pull shaft assembly from distributor.

G20207-6D

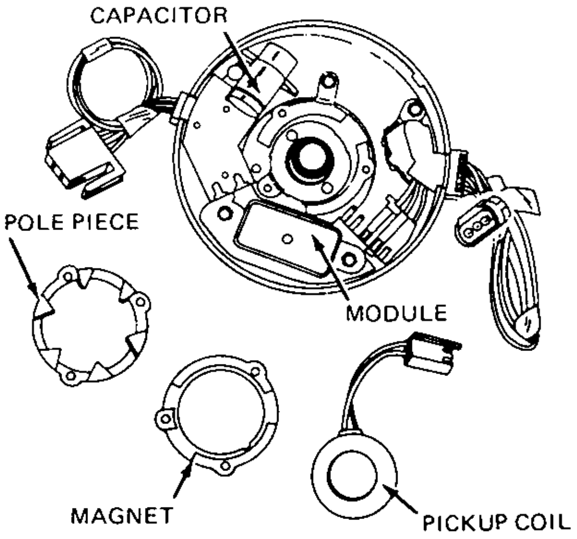
Fig. 27D Distributor Disassembly, Test and Reassembly (Coil in Cap) 2 of 3

ALUMINUM NON-MAGNETIC SHIELD REMOVED



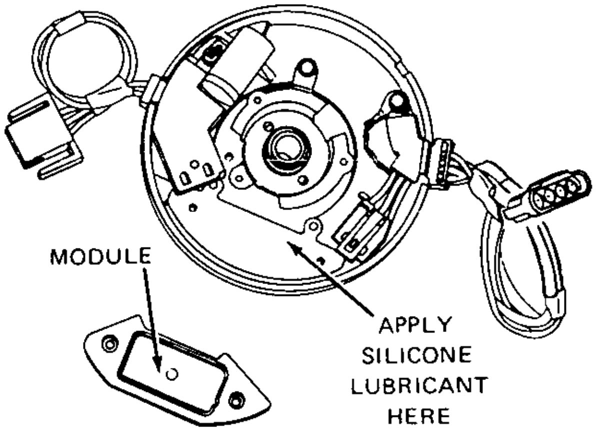
21. Remove three attaching screws and remove magnetic shield.

PICKUP COIL REMOVED AND DISASSEMBLED



22. Remove retaining ring and remove pickup coil, magnet and pole piece.

MODULE REMOVED



23. Remove two module attaching screws, and capacitor attaching screw. Lift module, capacitor and harness assembly from base.
24. Disconnect wiring harness from module.
25. Check module with an approved module tester.
26. Install module, wiring harness, and capacitor assembly. Use silicone lubricant on housing under module.

REASSEMBLY

27. Assemble pickup and thin "C" washer.
28. Assemble shaft, gear parts and roll pin.
29. Spin shaft to insure that teeth do not touch.
30. Loosen, then re-tighten pickup coil teeth to eliminate contact.
31. Install rotor and cap.

G20208-6D

Fig. 27E Distributor Disassembly, Test and Reassembly (Coil in Cap) 3 of 3

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

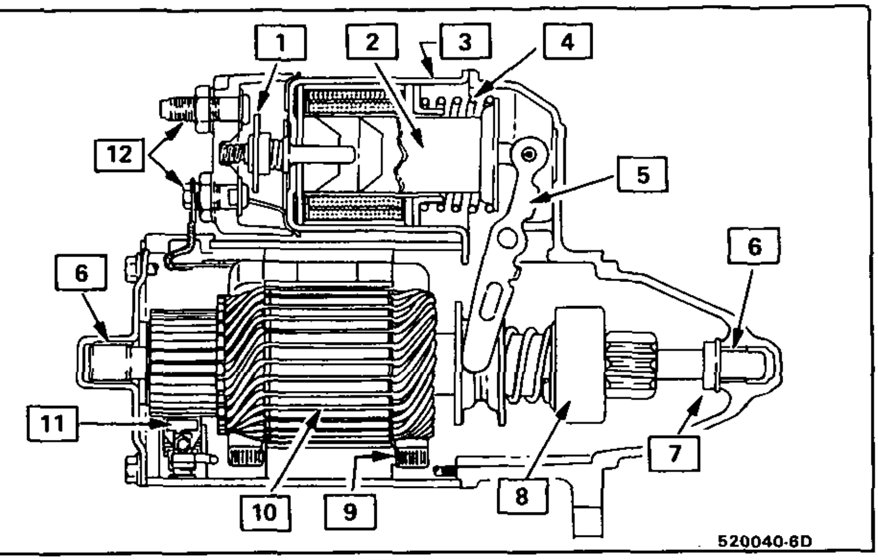
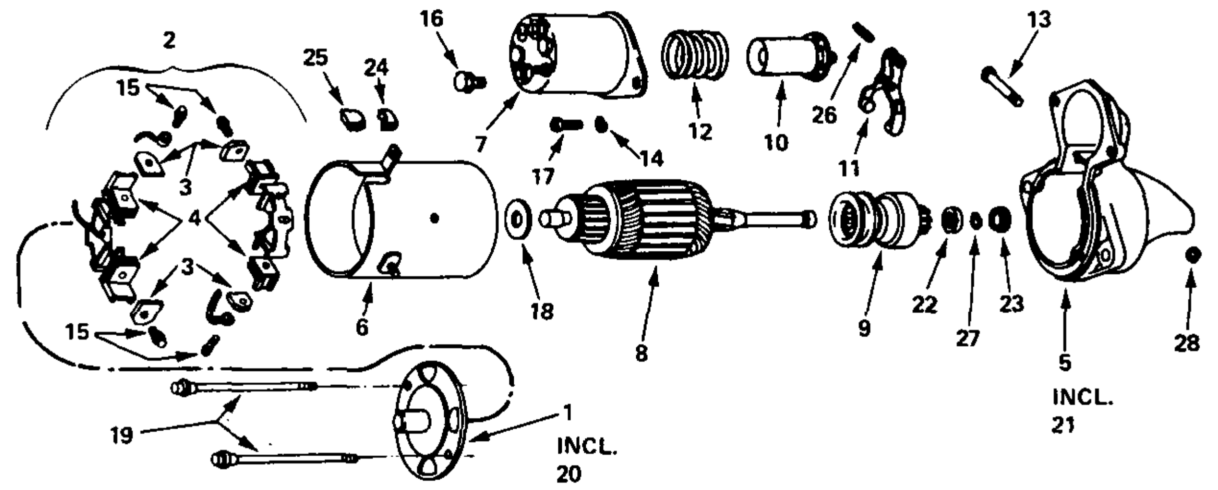


Fig. 28 Cross Section of 5MT Starting Motor



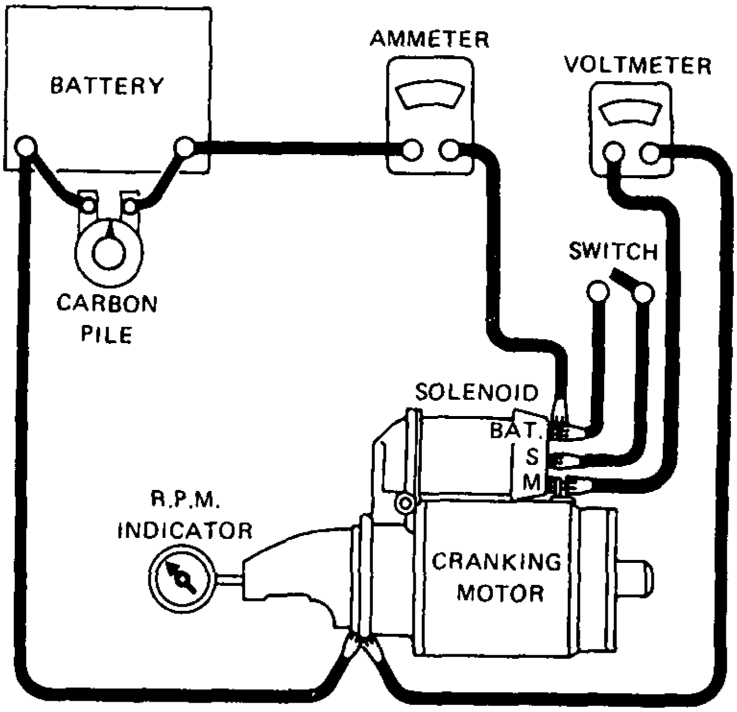
1–FRAME–COMMUTATOR END
2-BRUSH AND HOLDER PKG.
3-BRUSH
4-BRUSH HOLDER
5-HOUSING–DRIVE END
6-FRAME AND FIELD ASM.
7-SOLENOID SWITCH
8-ARMATURE
9-DRIVE ASM.
10-PLUNGER
11-SHIFT LEVER
12-PLUNGER RETURN SPRINGER
13-SHIFT LEVER SHAFT
14-LOCK WASHER
15-SCREW–BRUSH ATTACHING
16-SCREW–FIELD LEAD TO SWITCH
17-SCREW–SWITCH 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

520041-6D

Fig. 29 5MT Starting Motor - Exploded View

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.

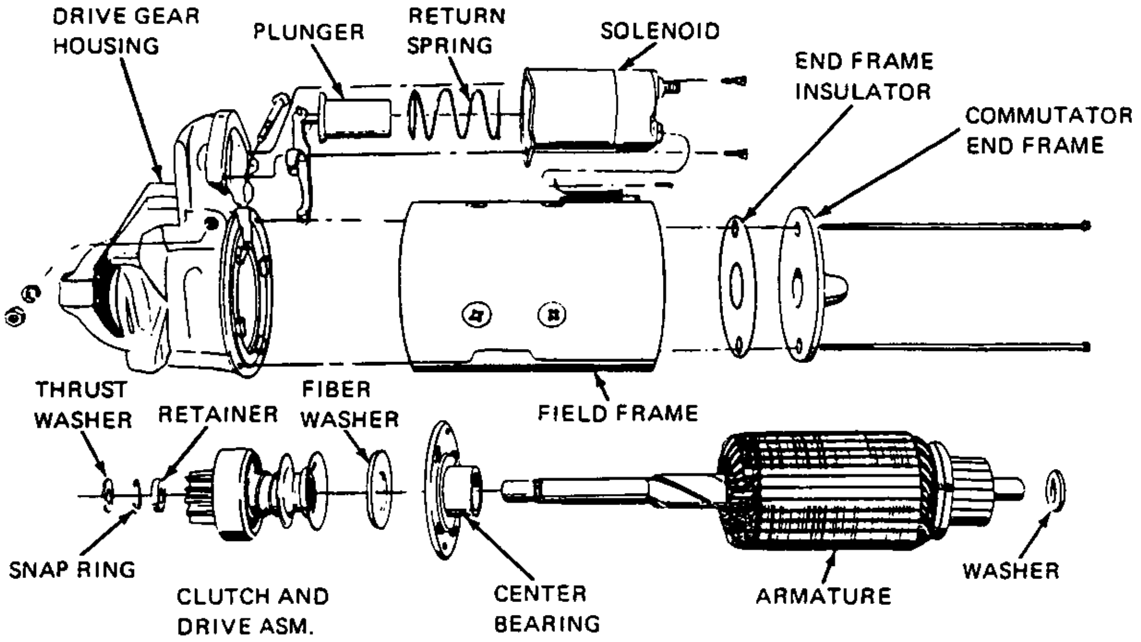
Make connections as shown. Close the switch and compare the RPM, current, and voltage readings with the specifications If the specified current draw does not include the solenoid, deduct from the ammeter reading the specified current draw of the solenoid hold-in winding. Make disconnections only with 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.

520042-6D

Fig. 30 Starter Motor Disassembly, Test, and Reassembly 1 of 6

STARTER DISASSEMBLY

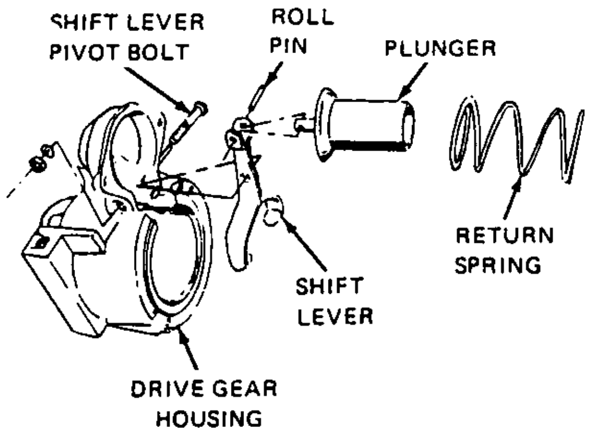


7. Remove screw from field coil connector and solenoid mounting screws. Rotate solenoid 90° and remove along with plunger return spring. Solenoid may now be serviced without further starter disassembly at this time.

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

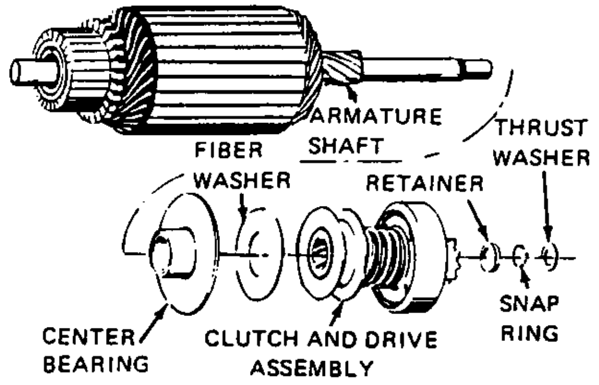


Steps 10 and 11 are required only on diesel starters.

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.

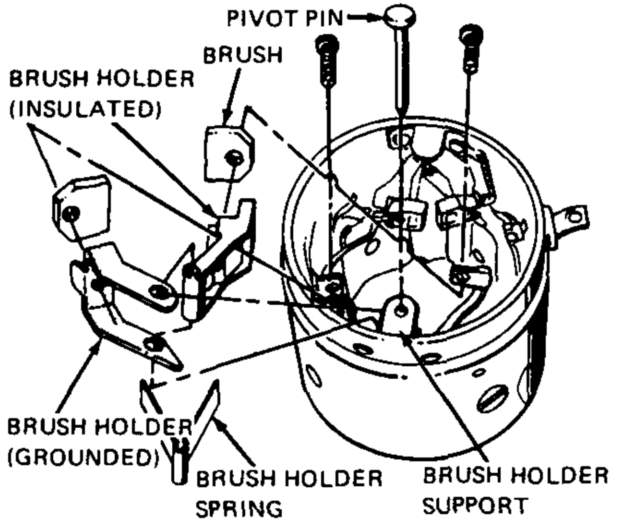
13. The shift lever and plunger may be disassembled at this time by removing the roll pin.

520043-6D

Fig. 31 Starter Motor Disassembly, Test, and Reassembly 2 of 6

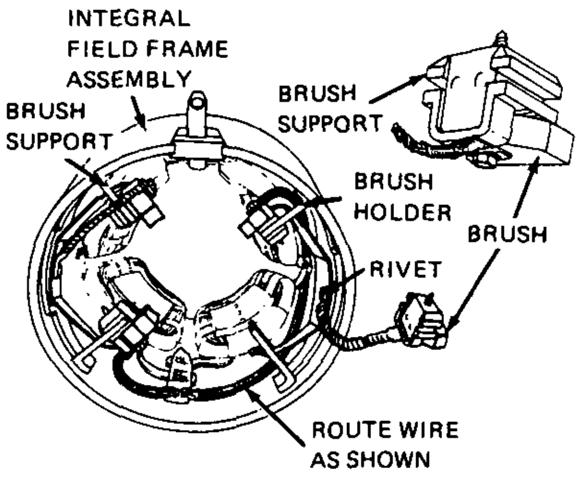
REPLACE BRUSH HOLDER

(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.

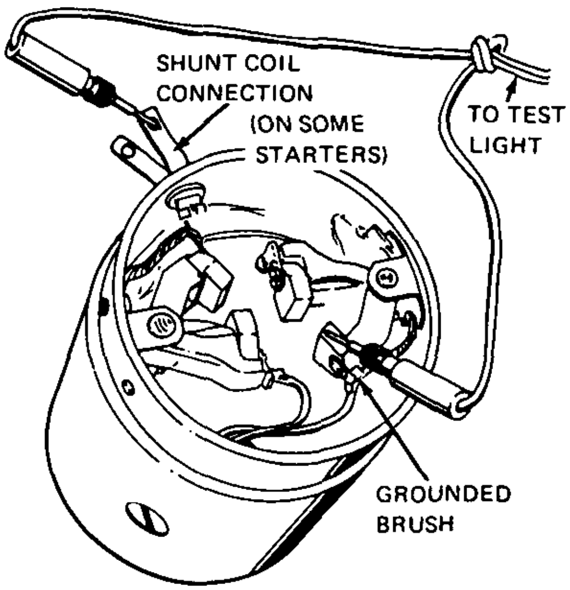
(SMALL 5MT STARTER)



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.

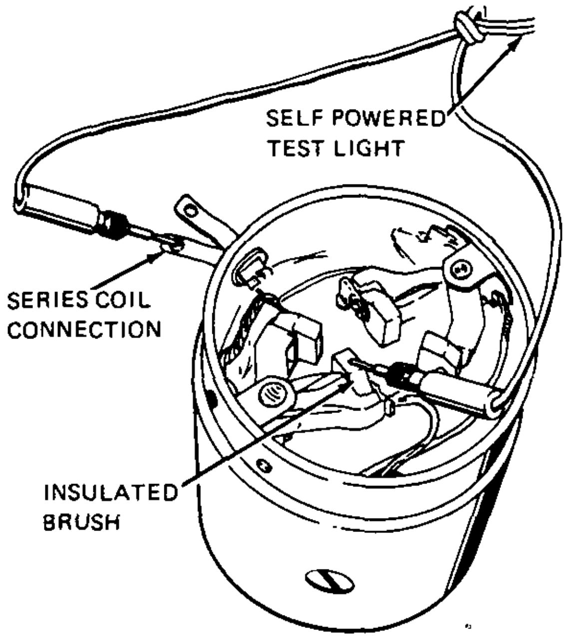
18. Inspect armature commutator. If commutator is rough, it should be turned down. Do not undercut or turn to less than 1.650" O.D. Do not turn out-of-round commutators. Inspect the points where the armature conductors join the commutator bars to make sure they have a good connection. A burned commutator 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.

520044-6D

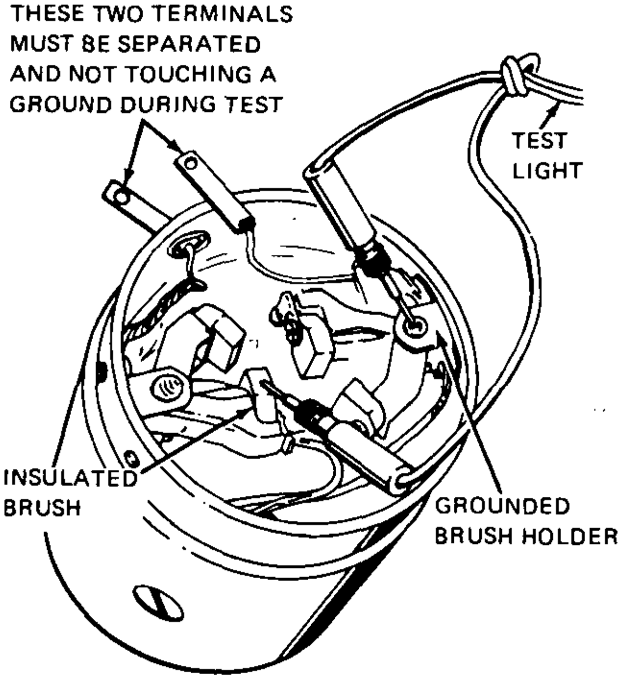
Fig. 32 Starter Motor Disassembly, Test, and Reassembly 3 of 6

TESTING SERIES COIL FOR OPEN



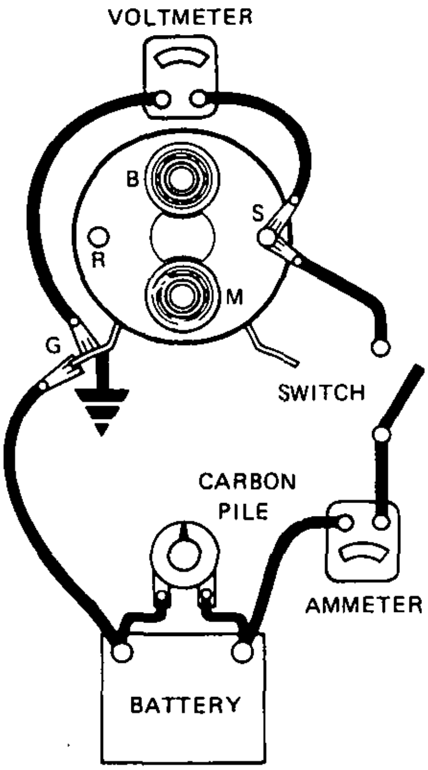
c. Using a test lamp, place one lead on the series coil terminal and the other lead on the insulated brush. If the lamp fails to light, the series coil is open and will require repair or replacement. This test should be made from each insulated brush to check brush and lead continuity.

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 14.5 to 16.5 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 41 to 47 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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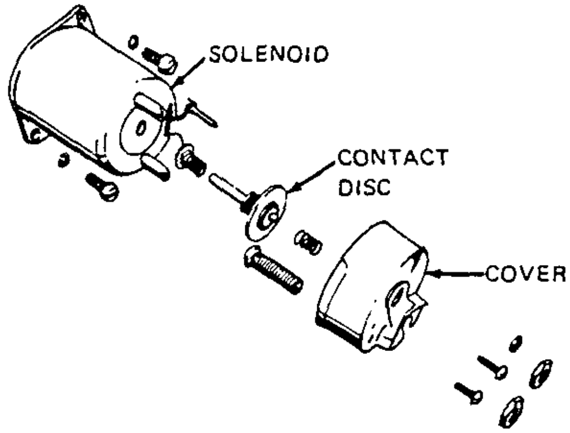
Fig. 33 Starter Motor Disassembly, Test, and Reassembly 4 of 6

SOLENOID SWITCH DISASSEMBLY



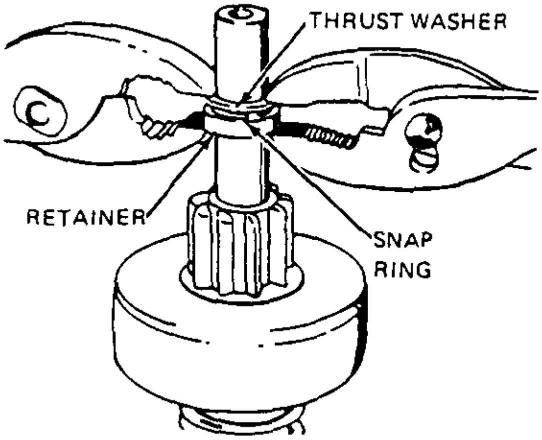
f. The starter solenoid switch is serviced as an assembly. The cover can be removed to inspect the contacts and contact disc if necessary.

STARTER ASSEMBLY

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.

INSTALLING RETAINER, WASHER AND RING



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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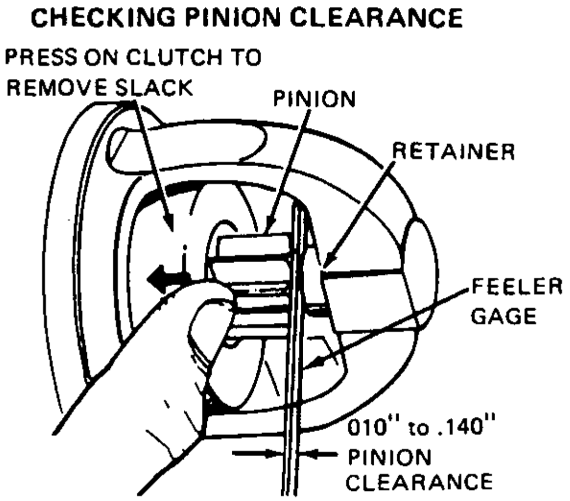
Fig. 34 Starter Motor Disassembly, Test, and Reassembly 5 of 6



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. 35 Starter Motor Disassembly, Test, and Reassembly 6 of 6

ON-CAR SERVICE

STARTER

←→ Remove or Disconnect

1. Negative battery cable.
2. Wiring to solenoid.
3. Raise car.
4. Remove heat shield.
5. Bolt - starter rear bracket (LR8 only).
6. Starter to engine bolts (2).
7. Starter - through area forward of converter toward front of engine.

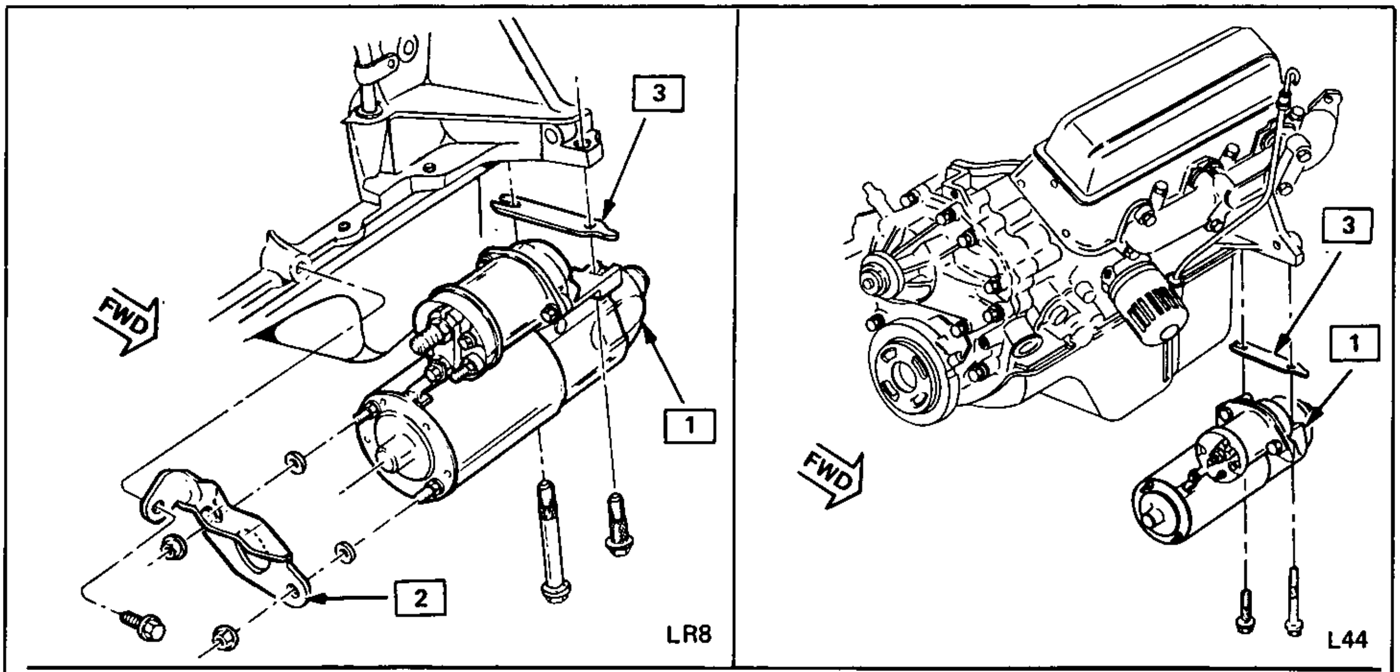
→← Install or Connect

1. Starter and two attaching bolts – 43 N·m (32 lb.ft.).

! Important

- Replace any shims that were removed.

2. Rear bracket (LR8 only).
3. Replace heat shield.
4. Lower car.
5. Wiring to solenoid.
6. Negative battery cable.



1. STARTER
2. BRACKET
3. SHIM

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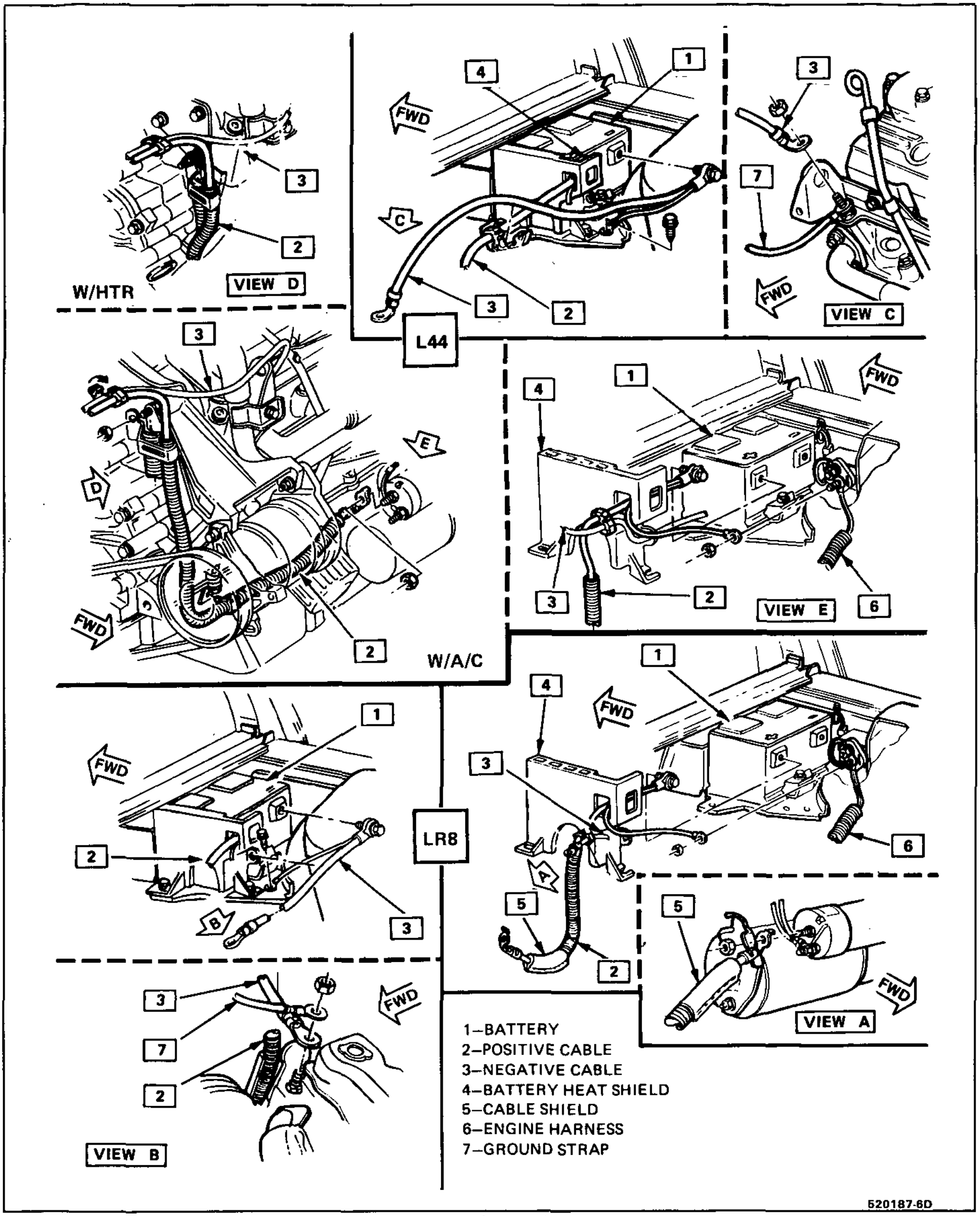
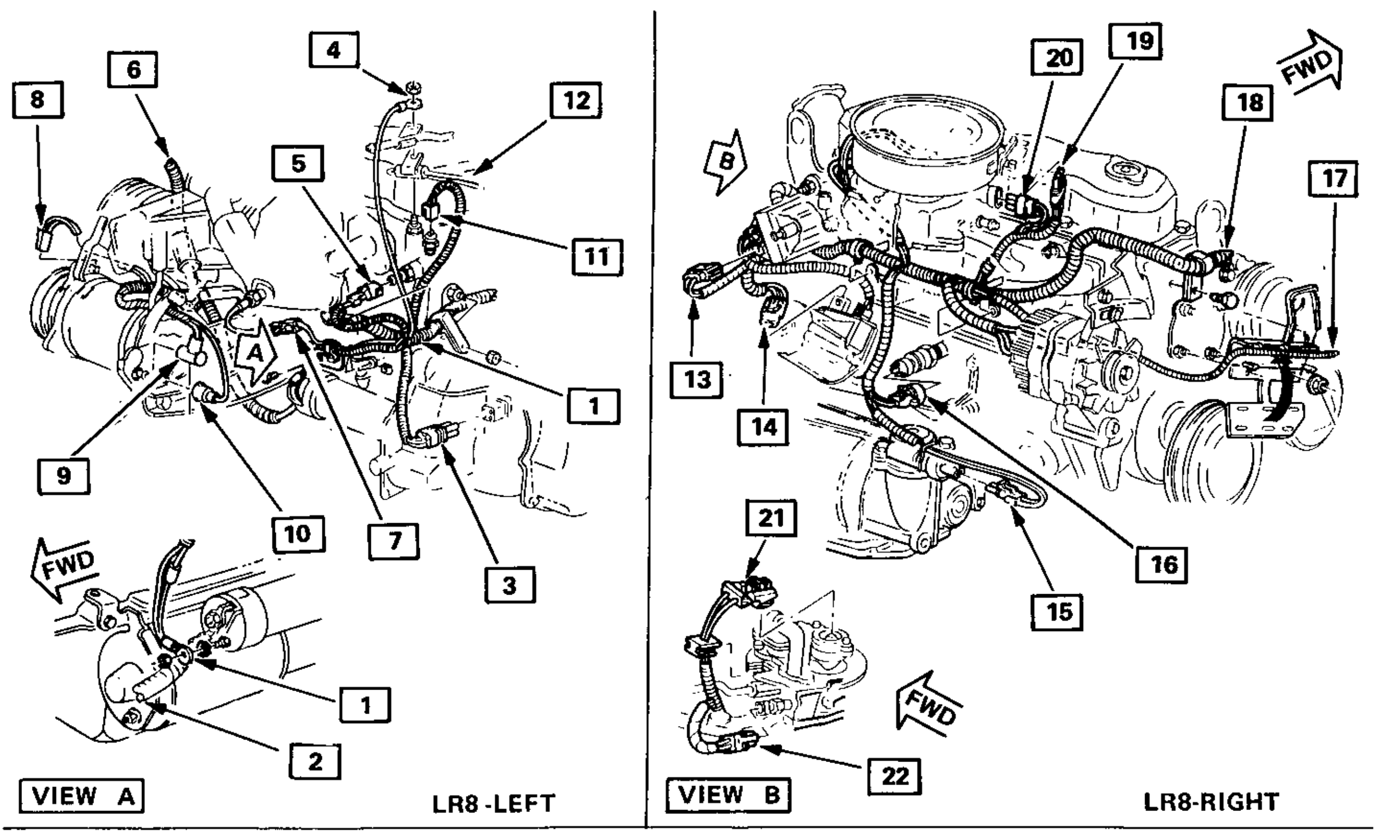
Fig. 801 Starter Motor Mounting



1–BATTERY
2–POSITIVE CABLE
3–NEGATIVE CABLE
4–BATTERY HEAT SHIELD
5–CABLE SHIELD
6–ENGINE HARNESS
7–GROUND STRAP

Fig. 802 Battery Cables (LR8 & L44)



1–ENGINE WIRING HARNESS
2–POSITIVE BATTERY CABLE
3–TRANSMISSION CLUTCH CONN.
4–SYSTEM GROUND
5–COOLING FAN TEMP. SW.
6–TO POSITIVE BATTERY TERMINAL
7–O2 SENSOR CONN.
8–A/C COMPRESSOR CONN.
9–HIGH PRESSURE SWITCH CONN.
10–COOLING FAN SWITCH CONN.
11–TEMP. SWITCH LEAD
12–TACH FILTER
13–COIL LEAD
14–DISTRIBUTOR CONN.
15–SPEED SENSOR LEAD
16–OIL PRESSURE SWITCH CONN.
17–TO AIR CONDENSOR
18 –TO JUNCTION BLOCK
19–MAP SENSOR CONN.
20–THROTTLE POSITION SENSOR CONN.
21–FUEL INJECTOR CONN.
22–IDLE AIR CONN.

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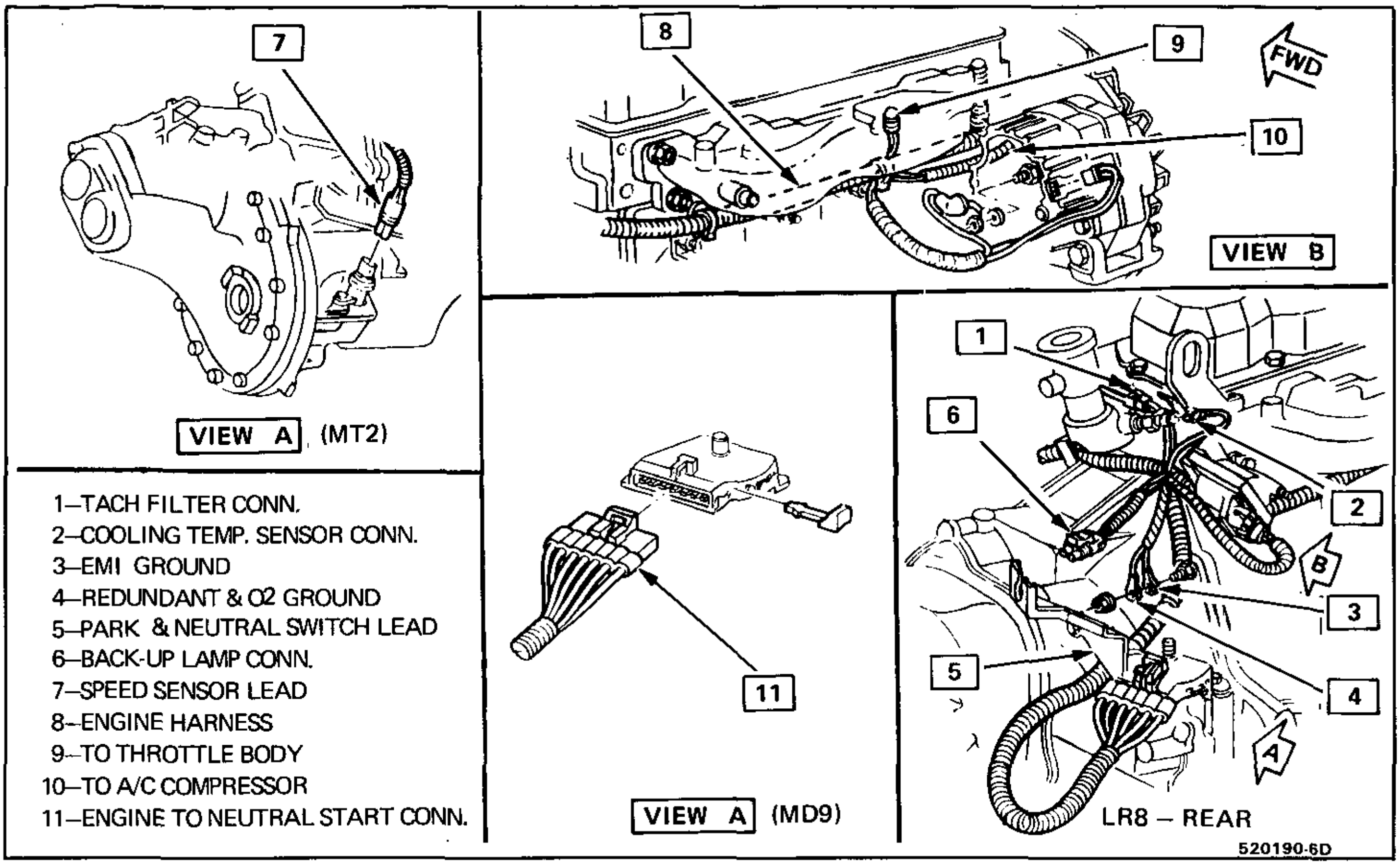
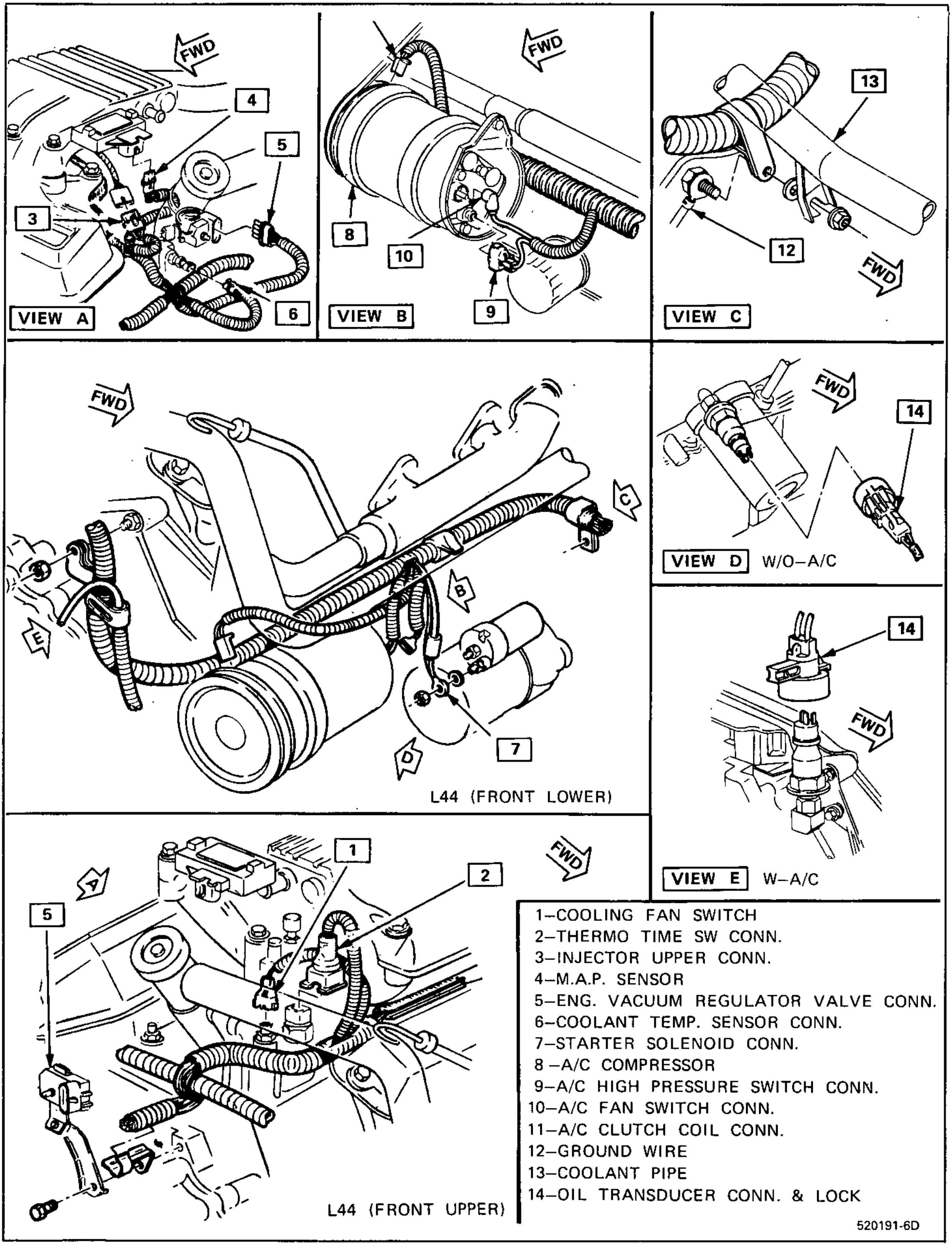
Fig. 803 Engine Wiring - Front (LR8)



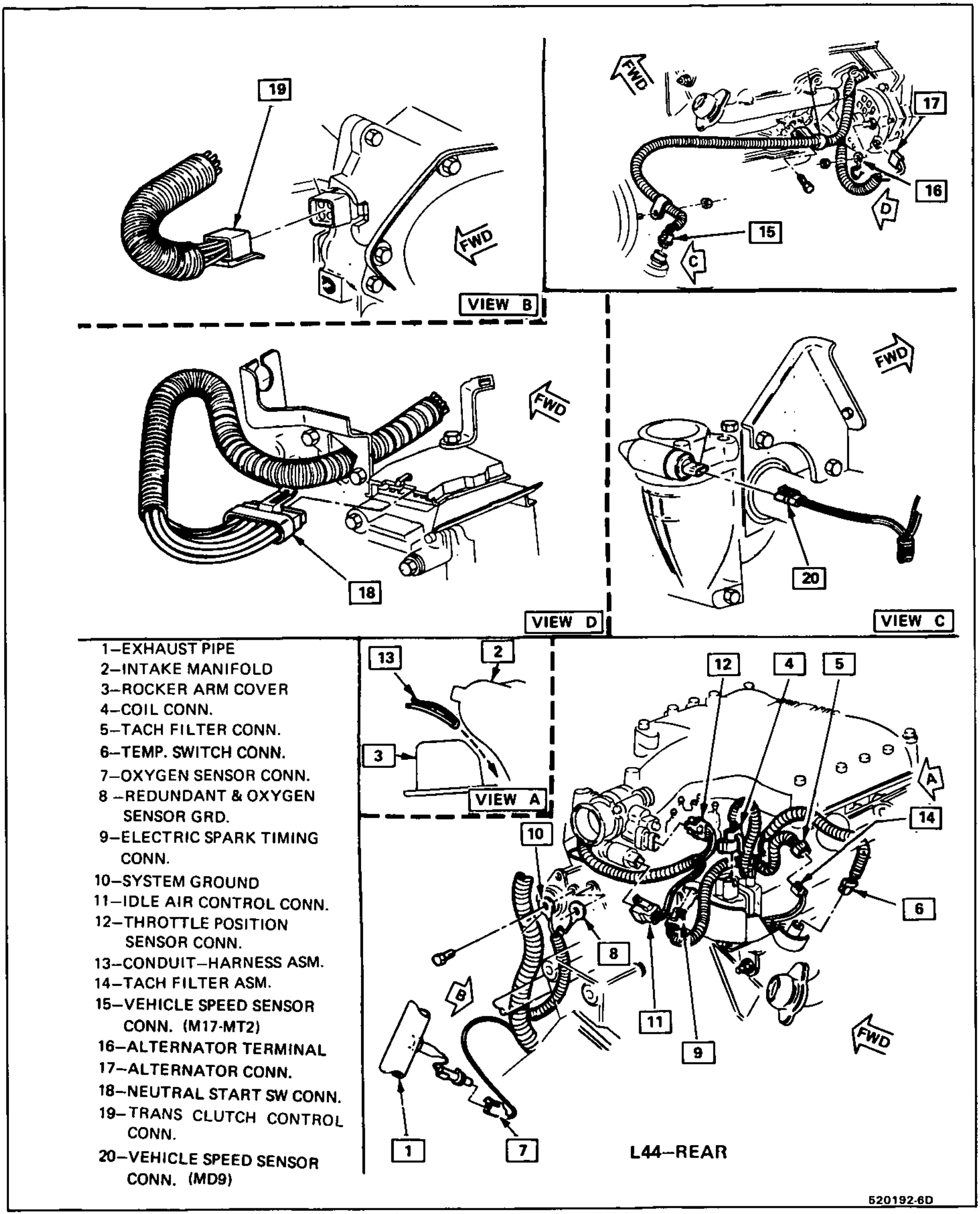
1–TACH FILTER CONN.
2–COOLING TEMP. SENSOR CONN.
3–EMI GROUND
4–REDUNDANT & O2 GROUND
5–PARK & NEUTRAL SWITCH LEAD
6–BACK-UP LAMP CONN.
7–SPEED SENSOR LEAD
8–ENGINE HARNESS
9–TO THROTTLE BODY
10–TO A/C COMPRESSOR
11–ENGINE TO NEUTRAL START CONN.

Fig. 804 Engine Wiring - Rear (LR8)



1–COOLING FAN SWITCH
2–THERMO TIME SW CONN.
3–INJECTOR UPPER CONN.
4–M.A.P. SENSOR
5–ENG. VACUUM REGULATOR VALVE CONN.
6–COOLANT TEMP. SENSOR CONN.
7–STARTER SOLENOID CONN.
8–A/C COMPRESSOR
9–A/C HIGH PRESSURE SWITCH CONN.
10–A/C FAN SWITCH CONN.
11–A/C CLUTCH COIL CONN.
12–GROUND WIRE
13–COOLANT PIPE
14–OIL TRANSDUCER CONN. & LOCK

Fig. 805 Engine Wiring - Front (L44)



1–EXHAUST PIPE
2–INTAKE MANIFOLD
3–ROCKER ARM COVER
4–COIL CONN.
5–TACH FILTER CONN.
6–TEMP. SWITCH CONN.
7–OXYGEN SENSOR CONN.
8–REDUNDANT & OXYGEN SENSOR GRD.
9–ELECTRIC SPARK TIMING CONN.
10–SYSTEM GROUND
11–IDLE AIR CONTROL CONN.
12–THROTTLE POSITION SENSOR CONN.
13–CONDUIT–HARNESS ASM.
14–TACH FILTER ASM.
15–VEHICLE SPEED SENSOR CONN. (M17-MT2)
16–ALTERNATOR TERMINAL
17–ALTERNATOR CONN.
18–NEUTRAL START SW CONN.
19–TRANS CLUTCH CONTROL CONN.
20–VEHICLE SPEED SENSOR CONN. (MD9)

Fig. 806 Engine Wiring - Rear (L44)

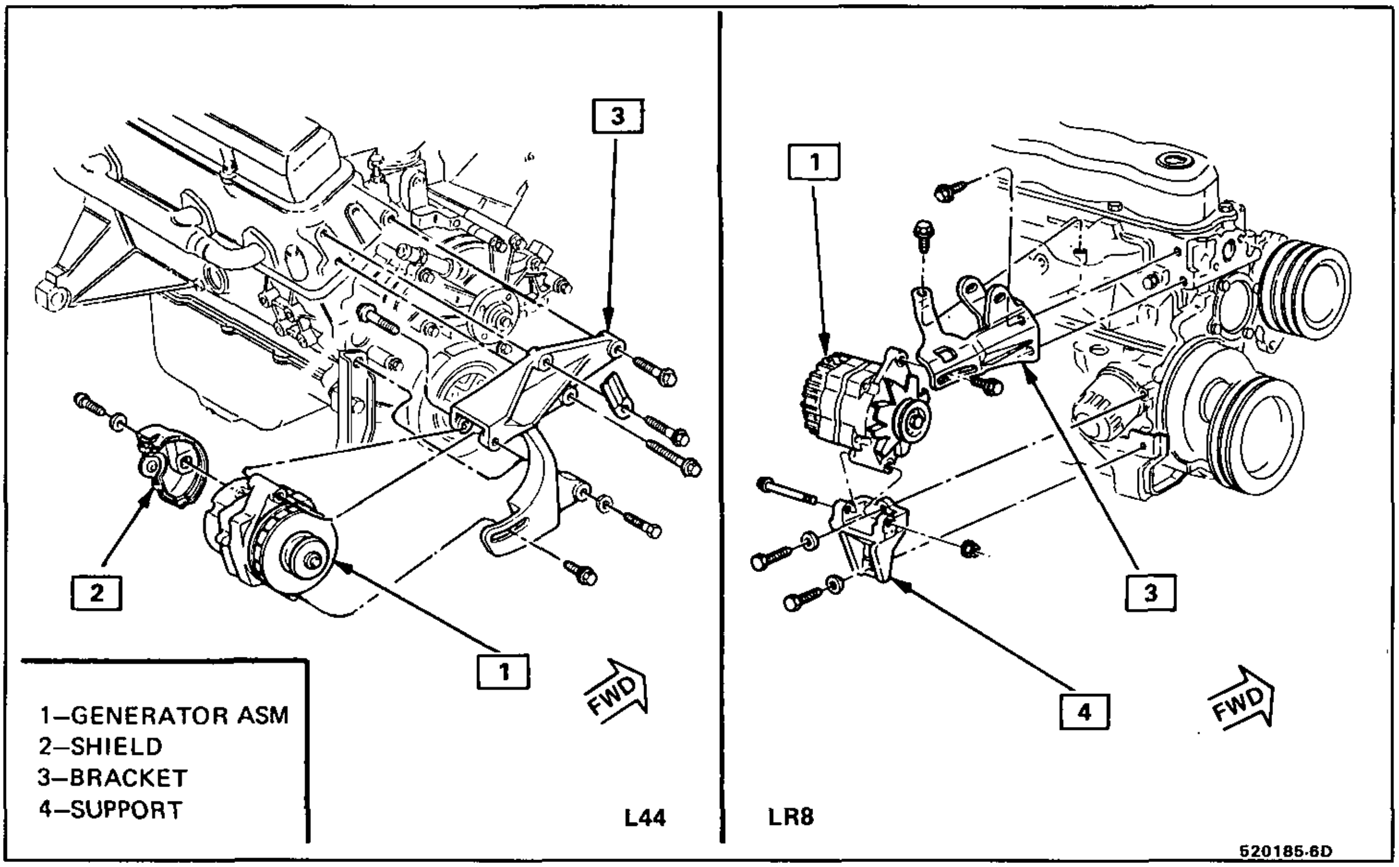


Fig. 807 Generator Mounting

SPECIFICATIONS

STARTER			NO LOAD TEST @ 10 VOLTS				SOLENOID	
	STARTER		AMPS		RPM		HOLD-IN WINDINGS	BOTH WINDINGS
ENGINE	PART NO.	SERIES	MIN.	MAX.	MIN.	MAX.	AMPS @ 10V	AMPS @ 5V
L4(LR8)	1998503	5MT	50	75	6000	11,900	13-19	23-30
V6(L44)	1998503	5MT	50	75	6000	11,900	13-19	23-30

GENERATOR USAGE

					HEAVY-DUTY	
ENGINE	STD	A/C	HBL	A/C & HBL	STD	A/C
L4(LR8)	66	94	–	–	–	–
V6(L44)	66	94	–	–	–	–

520189-6D

Fig. 808 Specifications

SECTION 6E
DRIVEABILITY AND EMISSIONS
CONTENTS

General Information - Section 6E
Driveability and Emissions - Carbureted - Section 6E1
Driveability and Emissions - Fuel Injected (TBI) - Section 6E2
Driveability and Emissions - Fuel Injected (PORTED) - Section 6E3

CONTENTS

GENERAL INFORMATION

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.

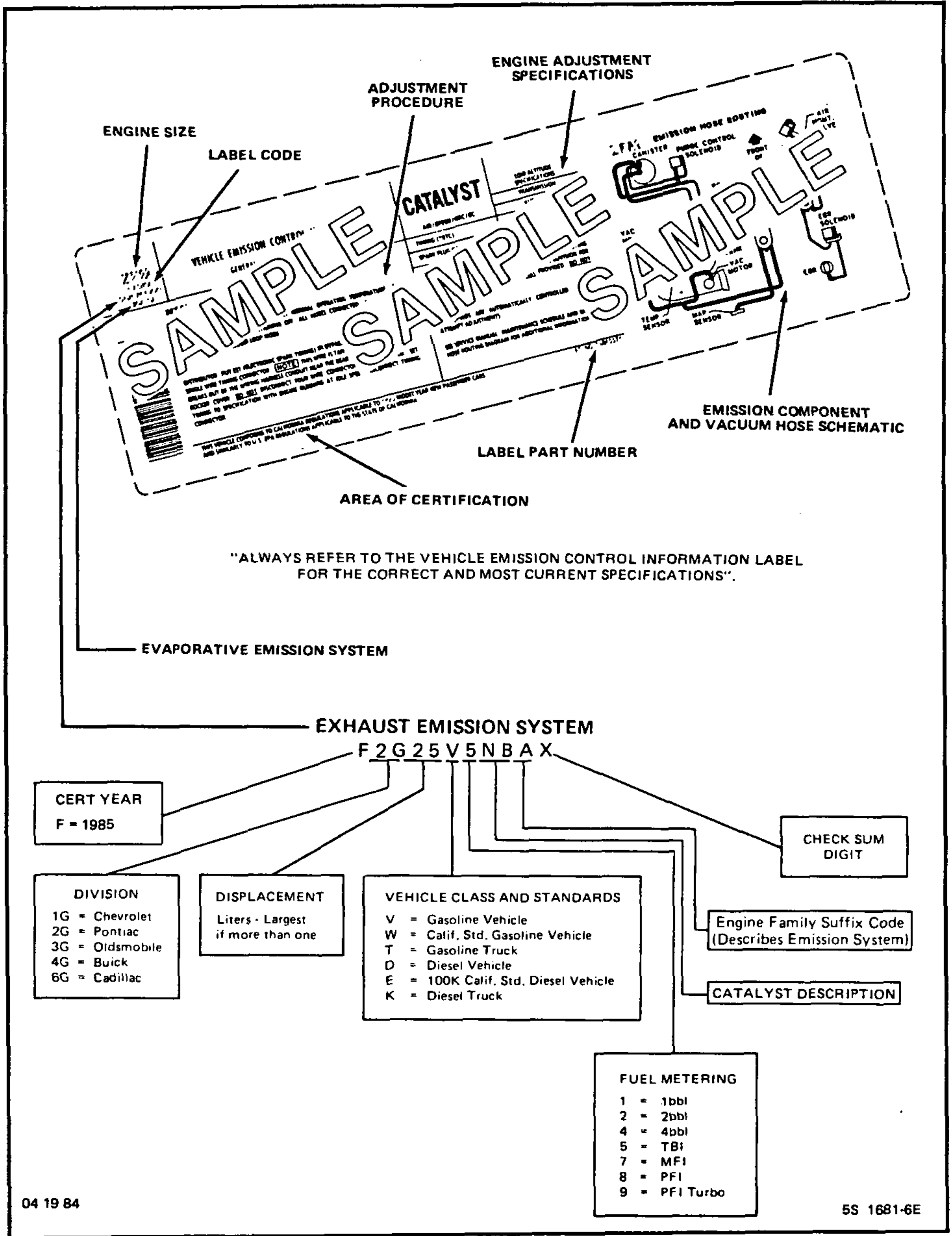
Any system disconnected during diagnosis should be reconnected. This includes wires, hoses, linkage, etc. When removing air cleaner, plug hose fittings that could cause an air leak.

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.



"ALWAYS REFER TO THE VEHICLE EMISSION CONTROL INFORMATION LABEL FOR THE CORRECT AND MOST CURRENT SPECIFICATIONS".

Figure 1 Vehicle Emission Control Information Label

VEHICLE EMISSION CONTROL INFORMATION LABEL

The Vehicle Emission Control Information label (Fig.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. This 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

GENERAL

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 for gasoline engines. The procedure starts with checking the Electronic Control Module for codes.

All engines have an Electronic Control Module (ECM) to control the fuel system. The ECM varies the air/fuel ratio depending on whether the fuel control is carbureted, fuel injected (TBI) or fuel injected (port).

In addition, the ECM controls the ignition timing system as well as other systems such as exhaust gas recirculation and canister purge.

It is important to review the component sections and wiring diagrams for a specific engine to determine what is controlled by the ECM and what systems are non-ECM controlled.

This Section has a brief description of systems used to control fuel and emissions.

- Abbreviations that are used in Driveability and Emissions are listed in this Section.
- Wiring harness service information for harnesses used with the ECM is also provided in this Section.
- Special tools used to diagnosis and repair a system.

The Driveability and Emissions Sections are subdivided into three sub sections:

A - Diagnostic Charts
B - Symptoms
C - Systems

SECTION A - DIAGNOSTIC CHARTS

This is the starting point for the diagnostic procedures. 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 diagnosis 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 2):

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 procedure, 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 vehicle will not start, see "Engine Cranks But Won't Run" in Chart A3. 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. Or, if the "SCAN" tool diagnostic Circuit Check is performed, see the code definition immediately following the chart. This will determine if the fault is still present. If no trouble code is stored, the third step is:

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.

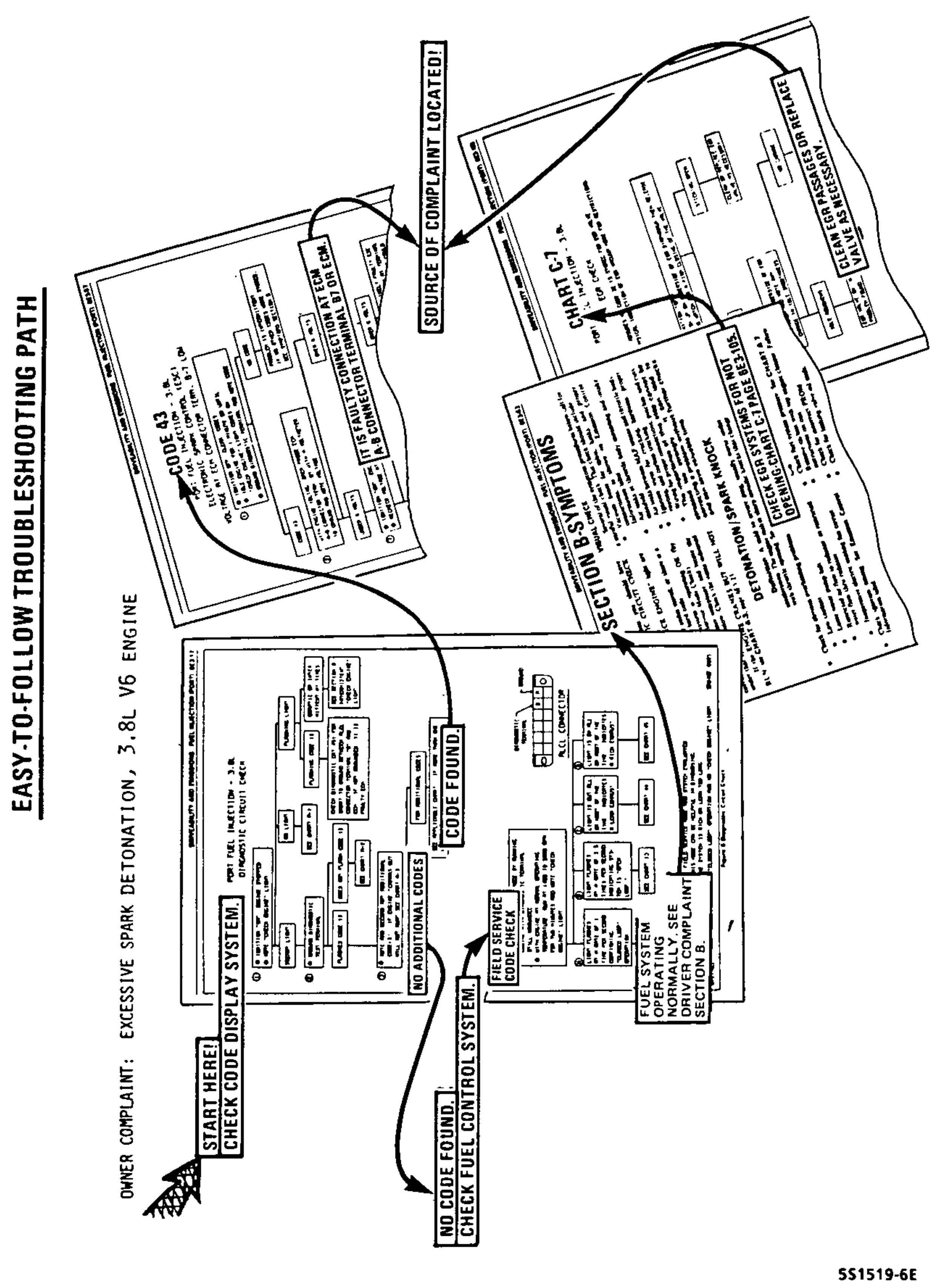


Figure 2 Diagnostic Procedure

3. Is the Fuel System controlling correctly? We find this out in the "System Performance Check" on carbureted engines and the "Field Service Mode" portion of the Diagnostic Circuit Check on fuel injected systems. If the *fuel system is not controlling correctly*, a chart in Section A will be used to correct the problem. If the fuel system goes closed loop and operates normally, go to the Driveability Symptoms in Section B. Section B lists various driveability symptoms which may be found, and suggests checks of related components, many of which are found in Section "C".

This procedure, which takes only a short time, will help lead you to repair the problem in the least amount of time.

Before checking the system, observe the following information:

Blocking Drive Wheels

The vehicle drive wheels should always 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 procedure 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 chaffed 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, 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.

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 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 on fuel injected *systems can also indicate an open 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 diagnosis 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 reset itself, and is not present while you are working on the vehicle. This is often caused by a loose connection. If a chart leads you to an intermittent condition, go to "INTERMITTENTS in Section B.

A "hard" code is one which is present when you are working on the vehicle and repeats itself in the Chart Procedures. The chart with the stored trouble code number will lead you to the cause of the problem.

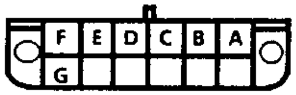
Trouble Codes

The Electronic 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 a 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 Communication Link (ALCL) connector.

ALCL Connector

The Assembly Line Communication Link (ALCL) is a diagnostic connector located in the passenger compartment (Figure 3). 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 on fuel injection.



TERMINAL IDENTIFICATION

A	GROUND
B	DIAGNOSTIC TERMINAL
C	A.I.R. (IF USED)
D	SERVICE ENGINE SOON LAMP
E	SERIAL DATA (SEE SPECIAL TOOLS)
F	T.C.C. (IF USED)
G	FUEL PUMP (NOT USED ON ALL SERIES)

3-26-85 *6S 2615-6E

Figure 3 ALCL Connector

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 are stored, code 12 will continue to flash until the Diagnostic terminal is ungrounded:

   On a carbureted engine, the engine should not be started with the Diagnostic terminal grounded, because it may continue to flash a Code 12 with the engine running. Also, on carbureted engines if the test terminal is grounded after the engine is running, any stored codes will flash, but Code 12 will flash only if there is a problem with the distributor reference signal.

   On fuel injected engines, 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.

   On a carbureted engine 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. <u>If it is an intermittent failure, the charts are not used.</u> A physical inspection of the applicable system is made.

   On a fuel injected engine, if a trouble code is displayed, a Diagnostic Code Chart is to be used to find a problem.

3. Energize all ECM controlled relays and solenoids (with some exceptions, as noted in "Component Systems").

   On a carbureted engine, the ISC motor (if equipped) also moves back and forth, and the Mixture Control Solenoid is pulsed for 25 seconds or until the engine is started whichever occurs first.

   On a fuel injected engine, the IAC valve also moves back and forth or is fully extended depending on the engine family.

Field Service Mode - Fuel Injection

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. In either case, the Field Service Mode Check, which is part of the Diagnostic Circuit Check, will lead you to the proper chart.

While the system is in Field Service Mode, the ECM will be in the following mode:

1. The distributor will have a fixed spark advance.
2. New trouble codes can not be stored in the ECM.
3. 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 after 10 seconds, when 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 10 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. 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.

SECTION B - DRIVEABILITY SYMPTOMS

Always start with Section A "Diagnostic Circuit Check" before proceeding to the driveability symptoms. Section A checks the ECM which may be the driveability problem. A definition of each symptom is described for that condition. 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. Included in each system is diagnosis and on- vehicle service.

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.

Fuel Control System

The ECM controls the air/fuel delivery to the combustion chamber.

On a carbureted engine, fuel delivery is controlled by a mixture control solenoid in the carburetor. On fuel injected engines, the fuel delivery is controlled in one of two ways:

Throttle Body Injection (TBI) - The ECM controls the delivery of the fuel to the injector(s) in the throttle body injection assembly.

Port Fuel Injection - The ECM controls the delivery of the fuel to each intake port injector.

The ECM, on some engines, controls the idle speed. It may also control the rear vacuum break on carbureted engines

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 engine is cranking or running.

DIAGNOSIS with "SCAN" TOOL

SECTION "A"

Trouble Tree Charts incorporate diagnosis procedures using an ALCL "SCAN" tool where possible. This manual will also contain a "NON-SCAN DIAGNOSTIC CIRCUIT CHECK" and one designed to be used when using the "SCAN" tool.

Both SCAN and NON-SCAN diagnostics must begin with their respective "Diagnostic Circuit Check", which represents an organized approach for identifying system problems. In addition, the "SCAN Diagnostic Circuit Check" includes code definitions to confirm a "hard failure" prior to using the Charts. Unless instructed otherwise, charts should not be used for diagnosis unless the fault is still present (hard failure).

The following information will describe each of the three modes and the affects it may cause.

NORMAL OR 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 and the "open" mode must be selected when it is available.

10K MODE, SPECIAL MODE OR ALCL MODE

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.
- On some engines, canister purge solenoid will be enabled
- P/N restrict functions will be disabled

FACTORY TEST MODE, BACK-UP OR 3.9 K MODE

When in this mode, the ECM is operating on the fuel back-up logic and calibrated by the Calpak. The Calpak is 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 USES

The "SCAN" tool allows a quick check of sensors and switches which are inputs to the ECM. The data however only updates every 1.25 seconds which makes the tool not as effective as a voltmeter when trying to detect an intermittent which lasts less than the 1.25 second period. 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.

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 technicians 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 operating manual to become familiar with the tool. 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 which will be indicated when the position is selected.

Mode

Check with the manufacture 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

This position will indicate whether the engine control system is operating in open or closed loop. Most systems go closed loop after a certain amount of run time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Exhaust (Rich/Lean Indicator)

Indicates whether the oxygen sensor is sensing a rich or lean exhaust and usually displayed as RH or LN.

Trouble Codes

Will display any trouble codes stored in the ECM memory.

TPS (Throttle Position Sensor)

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).

Oxygen

The reading will be read out in millivolts (mv) with a range from 100 to 999 mv. If the reading is consistently below 35 (35° mv), the fuel system is running lean as seen by the ECM and if the reading is consistently above 55 (55° 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

Displays engine RPM. 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 too close to ignition secondary wires on open distributor ground circuits.

MPH

Displays vehicle speed. Useful in Checking TCC lock up speed or speedometer accuracy.

Airflow

Displays the amount of air passing the MASS AIRFLOW SENSOR (MAF) in grams per second. Useful when comparing the airflow between a problem vehicle and a known good one. Normal readings at idle are about 5 to 8 grams. This system is used on some Port fuel Injected Engines.

Coolant Temperature

Displays engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90° C then stabilize when thermostat opens.

Manifold Air Temperature (MAT) Sensor

Displays temperature of the intake manifold air. Should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperature increases. This system is used on some Fuel Injected Engines.

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 operators manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from neutral to drive.

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

The EGR system uses a valve to feed a small amount of exhaust gas back into the intake manifold to control formation of NOx. On most Port fuel engines, the Duty Cycle that the ECM is commanding to the EGR solenoid will be displayed in this mode. 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.

Integrator and Block Learn

On Fuel Injected Engines, normal readings in these modes are around 128, if higher then it indicates that the ECM is adding fuel to the base fuel calculation and if the numbers are below 128 the ECM is taking out fuel from the base calculation. The integrator is short term corrective action while the block learn portion (long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

IAC (Idle Air Control)

This system is used on some Fuel Injected Engines to control engine idle speeds. In this mode, the numbers will indicate what position the ECM thinks the valve is in. The ECM moves the IAC in counts and these counts are are what is displayed on a "SCAN" tool.

Cross Counts

In this mode, on Fuel Injected Engines, the activity of the oxygen sensor is displayed by how many times the voltage of the sensor has passed by the midpoint in the cast 1.25 second period. The number will add up to 255 then start over.

A/C Request

Displays the state of the A/C signal line to the ECM. Should read " ON" whenever the A/C is requested and the pressure cycling switch is closed.

Power Steering Pressure Switch

Displays the state of switch. This reading 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.

OPERATING CONDITIONS SENSED AND SYSTEMS CONTROLLED BY THE ECM.

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 distributor 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.

Air Injection Reaction (AIR)

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 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 NOx. This system is used on most engines and may or may not be controlled by the ECM.

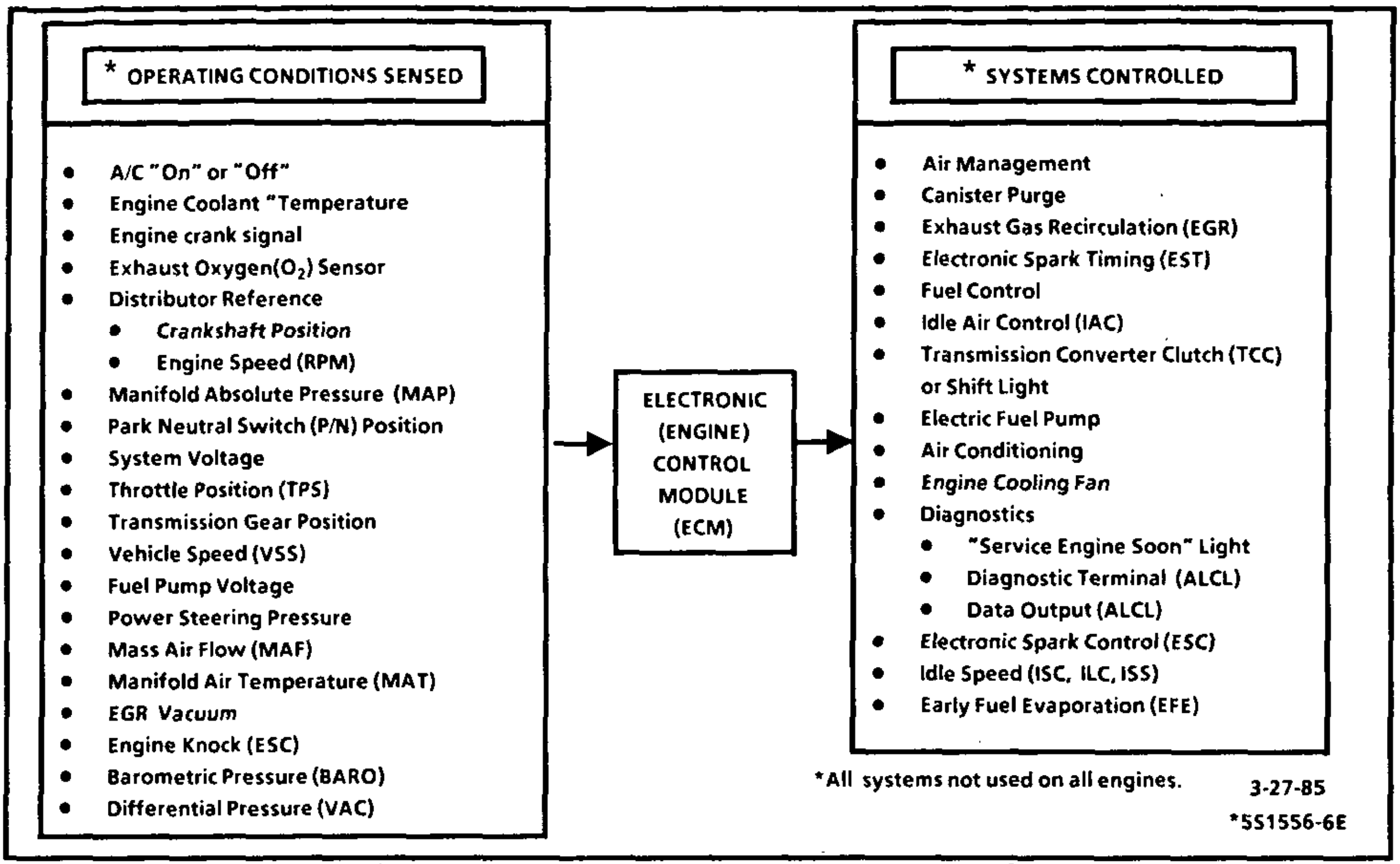


Figure 4 ECM Operating Conditions Sensed and Systems Controlled

Early Fuel Evaporation (EFE)

The EFE system heats the engine induction system electrically or with exhaust gas during cold driveaway. This system is not used on all engines and may or may not be controlled by the ECM.

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 convertor by coupling the engine flywheel to the output shaft of the transmission.

Shift Light Control

The ECM controls the shift light on a manual transmission 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.

A/C Wide Open Throttle (WOT) Control

The ECM controls the A/C compressor clutch to disengage clutch during hard acceleration. On some engines, the ECM disengages the clutch during engine start-up on a warm engine. This control is not on all engines.

A/C Constant Run Control

The ECM controls a relay to keep the A/C compressor clutch from cycling at idle for three minutes. 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 most transverse engine front wheel drive vehicles.

Positive Crankcase Ventilation (PCV)

The PCV system passes crankcase vapors into the intake manifold. This system is not controlled by the ECM and is used on most 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 and is used on all engines except port fuel injection.

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)

AIR - AIR INJECTOR REACTION SYSTEM - Air flow from pump is directed into engine exhaust manifold and/or converter to reduce exhaust emissions.

ALCL - Assembly Line Communication Link - Used at assembly to evaluate Computer Command Control and for service to flash the "SERVICE ENGINE SOON" light if there are trouble codes.

ATS - Air Temperature Sensor. Measures temperature of ambient air.

BARO - BAROMETRIC ABSOLUTE PRESSURE SENSOR - Reads atmospheric pressure.

Bat + - Battery Positive Terminal (12 Volts)

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 which can be specifically programmed to meet engine operating requirements for each 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.

. C^{3}I - 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

C LOOP - Closed Loop

CLCC - CLOSED LOOP CARBURETOR CONTROL - Used to describe oxygen sensor to ECM to M/C solenoid circuit operation.

COOLANT TEMPERATURE SENSOR - Device that senses the engine coolant temperature, and passes that information to the electronic 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 NOx.

CO - CARBON MONOXIDE - One of the pollutants found in engine exhaust.

DIS - Direct Ignition System. Produces the ignition spark without the aid of an ignition distributor.

DIAGNOSTIC CODE - Pair of numbers obtained from flashing "SERVICE ENGINE SOON" light. This code can be used to determine the system malfunction.

DIAGNOSTIC TERM. - Lead of ALCL Connector which is grounded to get a Trouble Code. On EFI it is grounded with the engine running to enter the "Field Service Mode".

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 AIR System to direct air flow to Air Switching valve or air cleaner.

EAS - Electric Air Switching - used to direct air flow to catalytic converter or exhaust ports of the engine.

ECM - ELECTRONIC (ENGINE) CONTROL MODULE - A metal cased box (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 is Computer Command Control using throttle body Fuel injection.

EGR - EXHAUST GAS RECIRCULATION - Method of reducing NOx emission levels.

OIL PAN

Remove or Disconnect

Fig. 806

Tool Required:
J28467 - Support Fixture.

1. Battery cables.
2. Engine compartment lid and side panels.
3. Raise car.
4. Engine oil.
5. Nuts - front engine mount to cradle.
6. Starter and flywheel cover.
7. Starter.
8. Splash shield.
9. Generator.
10. Lower car.
11. Engine strut.
12. Support engine with J28467.
13. Raise car.
14. Engine front support bracket.
15. Retaining bolts.
16. Oil pan.

Clean

- Sealing surfaces on oil pan and cylinder block.

Install or Connect

1. RTV, see Fig. 806.
2. Oil pan and retaining bolts.
3. Engine front support bracket.
4. Lower car.
5. Lower engine onto mounts.
6. Remove J28467.
7. Raise car.
8. Nuts - front engine mount to cradle.
9. Generator.
10. Splash shield.
11. Starter.
12. Starter and flywheel cover.
13. Lower car.
14. Engine oil.
15. Battery cables.

TIMING GEAR COVER

Remove or Disconnect

Tools Required:
J28467 Engine Support Fixture.
J34995 Front Cover Seal Installer.

1. Pulley and hub.
2. Support engine with J28467.
3. Engine mount and bracket as an assembly.
4. Timing gear cover screws.
5. Timing gear cover.

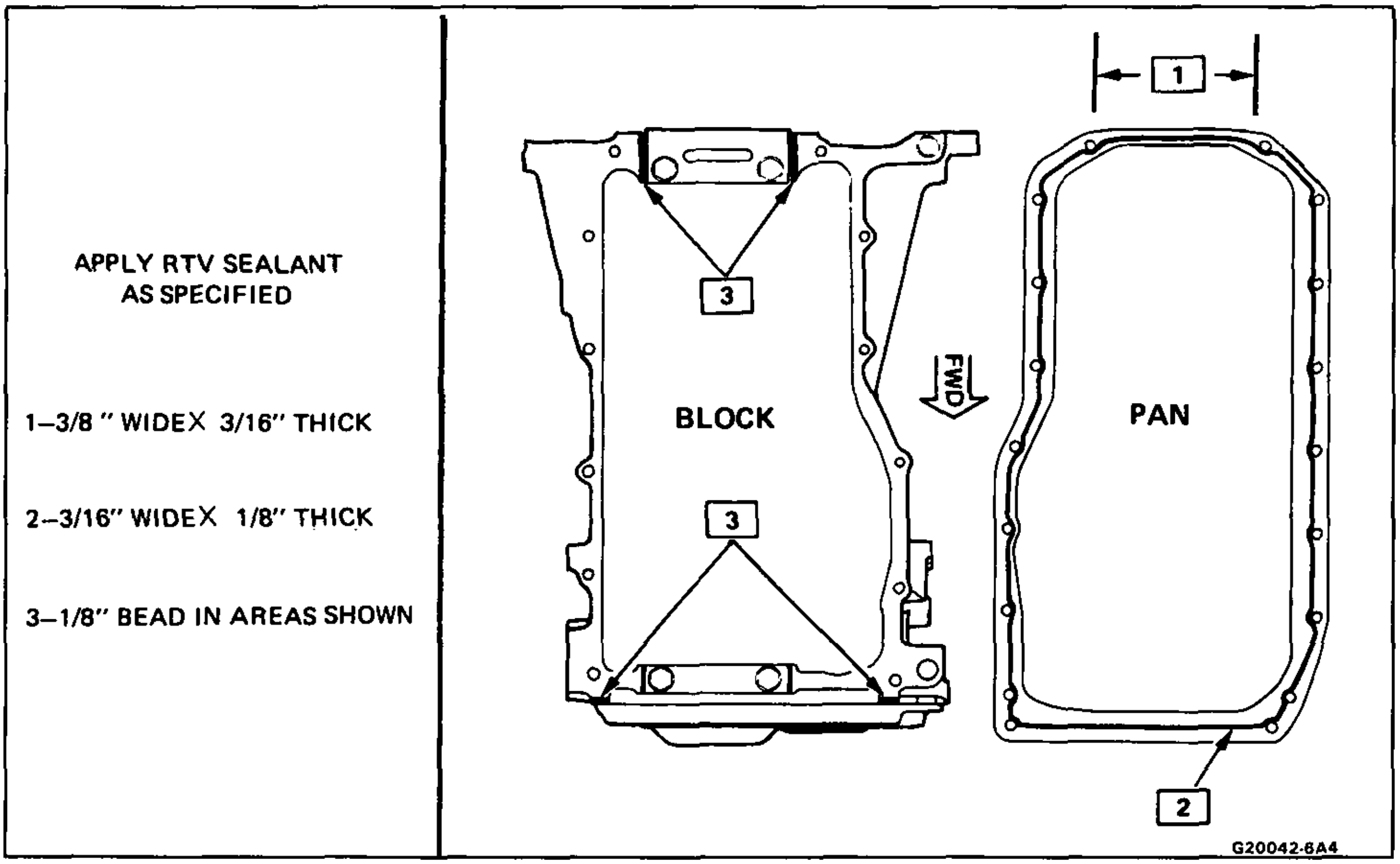


Fig. 806 Oil Pan Sealer Application

EECS - EVAPORATIVE EMISSIONS CONTROL SYSTEM - Used to prevent gasoline vapors in the fuel tank and carburetor from entering the atmosphere.

EFE - EARLY FUEL EVAPORATION (EFE) - 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 such as the M/C solenoid, the metering control armature is pulled into the solenoid (energized). When the voltage to the solenoid is turned off, a spring raises the metering control armature (de- energized).

ESC - Electronic Spark Control - Used to modify 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 - A Wire shorted to ground.

HC - HYDROCARBONS (HC) - 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 - is 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 - 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 14.7/1.

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 - is used to control throttle angle during long deceleration such as coasting down a long grade and extends at wide open throttle position or to prevent engine stalls at idle.

INPUTS - Information from sources (coolant temperature sensors, exhaust oxygen sensor, etc.) that tells the ECM how the engine is 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, is controlled by the ECM.

KM/HR - KILOMETER PER HOUR - A metric unit measuring distance (1000 meters) in one hour.

L - LITER - A metric unit of capacity.

L4 - Four Cylinder In-Line 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 - Reads pressure changes in intake manifold in relation to barometric pressure. May be called a differential pressure sensor.

MAP - MANIFOLD ABSOLUTE PRESSURE SENSOR - Reads pressure changes in intake manifold with reference to zero or absolute vacuum.

MAF - MASS AIR FLOW

MAT - Manifold Air Temperature Sensor. Measures air temperature in the intake manifold.

M/C - MIXTURE CONTROL

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, which regulates the air/fuel ratio.

MODE - A particular state of operation.

MPH - MILES PER HOUR - A unit measuring distance (5280 feet) in one hour.

N.C. - NORMALLY CLOSED. State of relay contacts or solenoid plunger when no voltage is applied.

N•m - NEWTON METERS (Torque) - A metric unit which measures force.

N.O. - NORMALLY OPEN. State of relay contacts or solenoid plunger when no voltage is applied.

NOx - NITROGEN, OXIDES OF (NOx) - 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.

OPEN LOOP - Describes ECM fuel control without use of oxygen sensor information.

OUTPUT - Functions, typically solenoids, that are controlled by the ECM.

OXYGEN SENSOR, EXHAUST - Device that detects the amount of oxygen (0_2) in the exhaust stream.

PAIR - 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.

SERVICE ENGINE SOON Light - Lights when a malfunction occurs in Computer Command Control system.

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. This code will indicate the area of the malfunction.

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 - Arranged in a "V".

V-8 - EIGHT CYLINDER ENGINE - 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 (VSS) - Sensor in speedometer cluster which sends vehicle speed information to the ECM.

WOT - WIDE OPEN THROTTLE.

WIRING HARNESS SERVICE

GENERAL DESCRIPTION

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. As shown in Figure 5, the connectors have a lock which secures the male and female terminals together. A secondary lock holds the seal and terminal into the connector.

ON-VEHICLE SERVICE

GENERAL

Molded-on connectors (like metro pack) require complete replacement of the connector. This means splicing a new connector assembly into the harness. Figure 7 has instructions on splicing wires.

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.

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. These connectors can be identified by the rubber seal at the rear of the connector. Figure 5 shows a Weather-Pack terminal and the tool (J-28742) 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.

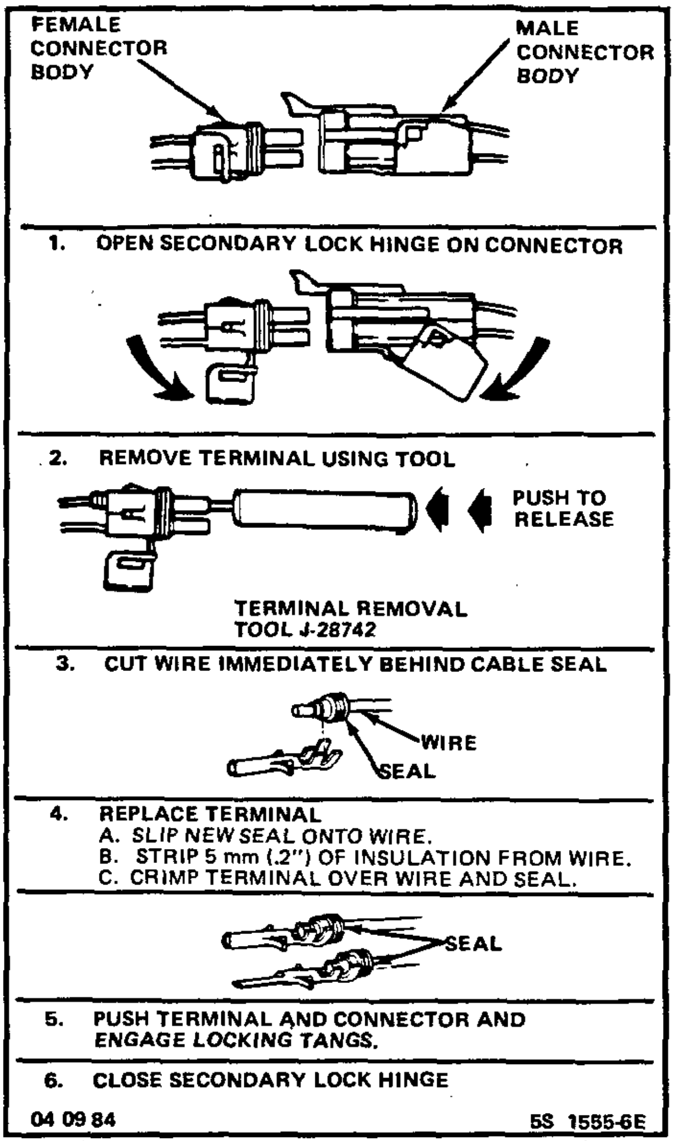
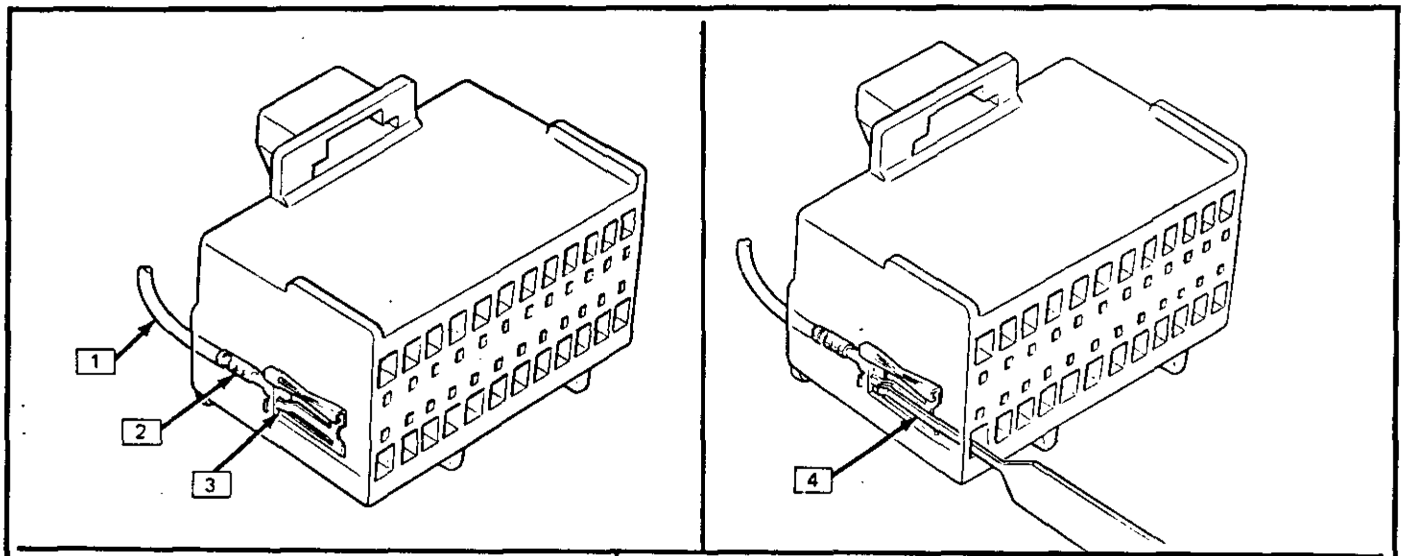


Figure 5 Weather-Pack Terminal Repair

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.



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.

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Figure 6 Micro Pack Terminal Replacement

COMPACT THREE

The Compact Three connector which looks similar to a Weather-Pack connector 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.

MICRO-PACK

Some connectors used on harness to connect to the ECM are called Micro-Pack. Terminal replacement requires the use of a special tool. Refer to Figure 6 for Micro-Pack terminal replacement.

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.

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 in Figure 7.

SPECIAL TOOLS

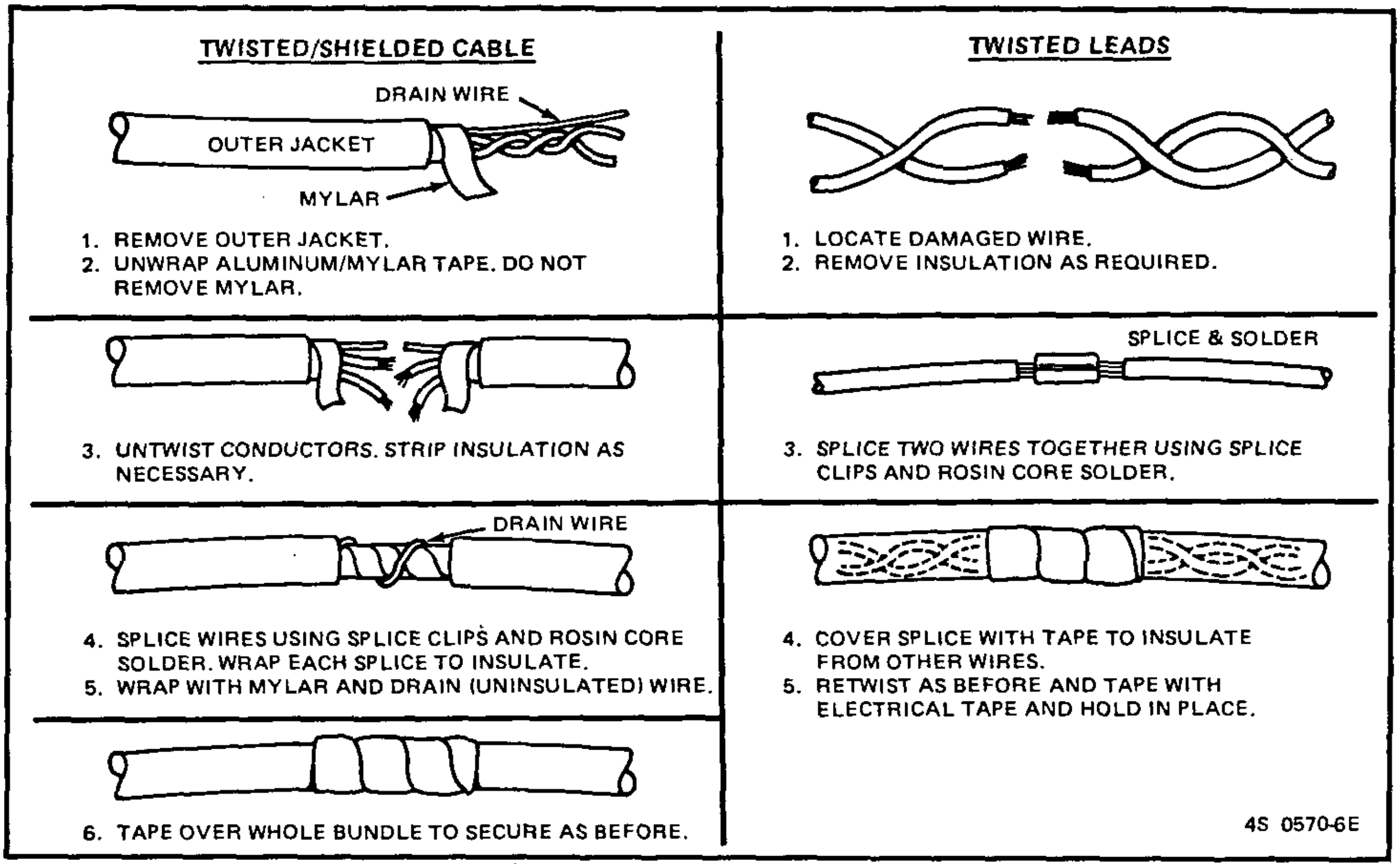
TOOLS NEEDED TO SERVICE THE SYSTEM

The system does not require special testers for diagnosis. A tachometer, test light, ohmmeter, digital voltmeter with 10 megohms impedance (J-29125A), vacuum gage and jumper wires are required for diagnosis. A test light or voltmeter must be used when specified in the procedures. They must NOT be interchanged. See Figures 8 through 11 for Special Tools needed to diagnosis or repair a system.

ALCL "SCAN" Tools

The ALCL connector under the dash has a variety of information available on terminal "E" (called Serial Data) on EFI engines and terminal "D" on carbureted engines.. 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.



1. REMOVE OUTER JACKET.
2. UNWRAP ALUMINUM/MYLAR TAPE. DO NOT REMOVE MYLAR.
3. UNTWIST CONDUCTORS. STRIP INSULATION AS NECESSARY.
4. SPLICE WIRES USING SPLICE CLIPS AND ROSIN CORE SOLDER. WRAP EACH SPLICE TO INSULATE.
5. WRAP WITH MYLAR AND DRAIN (UNINSULATED) WIRE.
6. TAPE OVER WHOLE BUNDLE TO SECURE AS BEFORE.

1. LOCATE DAMAGED WIRE.
2. REMOVE INSULATION AS REQUIRED.
3. SPLICE TWO WIRES TOGETHER USING SPLICE CLIPS AND ROSIN CORE SOLDER.
4. COVER SPLICE WITH TAPE TO INSULATE FROM OTHER WIRES.
5. RETWIST AS BEFORE AND TAPE WITH ELECTRICAL TAPE AND HOLD IN PLACE.

Figure 7 Wire Harness Repair

In some cases, "SCAN" Tools will provide information that is either extremely difficult or impossible to get with other equipment.

When a chart calls for a sensor reading, the "SCAN" tool can be used to read the following directly:

- Park/Neutral
- Throttle Position Sensor in volts
- Vacuum Sensor in volts
- Manifold Absolute Pressure Sensor in volts
- Barometric Pressure Sensor in volts
- Coolant Temperature Sensor in ° C
- Vehicle Speed Sensor in MPH
- Oxygen Sensor Voltage
- M/C Solenoid dwell.

When the "SCAN" tool is plugged in, the "SERVICE ENGINE SOON" light will flash rapidly on a carbureted engine. This indicates that information is being transmitted to the tool.

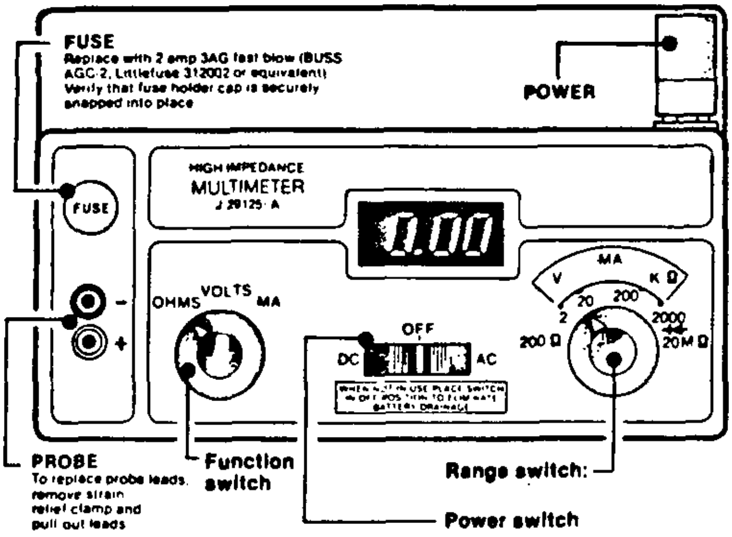
When the tool is plugged in on every system, it takes out the timer that keeps the system in open loop for a certain period of time. Therefore, it will go closed loop as soon as the vehicle is started, if all other closed loop conditions are met. This means that if, for example, the air management operation were checked with the "SCAN" tool plugged in, the air management system would not function normally because the air would go to the converter as soon as the vehicle was started and would not go to ports for a period of time. Also, when the tool is connected on some Fuel Injected engines, the idle increases to a controlled 1000 RPM. On some vehicles with ESC, it will advance the spark 8 to 10 degrees.

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.

For more complete information on the operation of these tools, see the manufacturer's instructions.

SPECIAL TOOLS



HIGH IMPEDANCE MULTIMETER
(DIGITAL VOLTMETER–DVM)
J29125-A or J34029

VOLTMETER–Voltage Position Measures amount of voltage. Connected parallel to exiting circuit. A digital voltmeter with a 10 meg ohm input impedence is used because some circuits require accurate low voltage readings, and some circuits have a very high resistance in the ECM. This meter also accurately measures extremely low current flow. Refer to meter for more information.

- Both function and range switch must be set properly, and the DC or AC position selected. DC is used for most measurements.

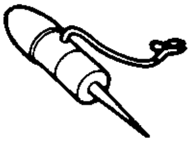
OHMMETER–Resistance Position Measures resistance of circuit directly in ohms. Refer to meter for more information.

- $\boxed{1.\ }$ 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
  - 2, 20, 200, 2,000Ω – Reads ohms in thousands
  - 20MΩ – Reads ohms in millions
  - Amps – Reads in thousandths of an amp.
  - Volts – Reads directly

J23738

VACUUM PUMP (20 IN. HG. MINIMUM)

Use gage to monitor manifold engine vacuum. Check vacuum sensors, solenoids and valves with hand pump.

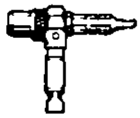


UNPOWERED TEST LIGHT

Used to check wiring for complete circuit. Connect lead wire to good ground. Probe with test prod to connector or component terminal. Bulb will light if voltage is present.

TACHOMETER

Use either a crankshaft harmonic balance pickup type or electronic coil trigger signal pickup type



J26792/BT7220-1

HEI SPARK TESTER

Use to check HEI spark voltage. Also called ST125.

DWELL METER (SET ON 6 CYL. SCALE)

Used to monitor the carburetor fuel control delivery determined by the ECM command.

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Figure 8 Special Tools (1 of 4)

SPECIAL TOOLS

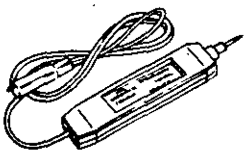
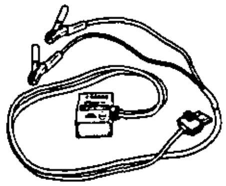
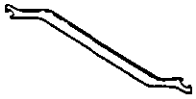
	JUMPER WIRES (#16, 18 OR 20 GAGE WIRE) ● Clip jumper wire used to complete a circuit by bypassing an open. ● Set of jumper wires used to insert between Weather Pack connectors to permit access to the connector terminals for circuit checking. Six wires approximately 6" long. Use terminals 12014836 and 12014837. One set - female terminals both ends, one set - male at both ends and four sets - male terminals at one end and female terminals at the opposite end.
 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 SWITCH WRENCH** Used to remove or install oil pressure gage switch on engine.
 J28742/BT8234-A	**WEATHER PACK TERMINAL REMOVER** Used to remove terminals from Weather Pack connectors. Refer to wiring harness service for removal procedure.
 J22727/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Use to extract a terminal from edgeboard connectors at the ECM.
 J33095/BT8234-A	**ECM CONNECTOR TERMINAL REMOVER** Used to remove terminal from Micro-Pack connectors. Refer to wiring harness service for removal procedure.
 J29533A/BT8127	**OXYGEN SENSOR WRENCH** Used to remove or install the oxygen sensor.
 J34025/BT8256A	**ISC MOTOR TESTER** Used to test operation of ISC motor on carburetor in either direction and condition of the internal switch.
 J29607/BT8022 05 24 84	**ISC ADJUSTING WRENCH** Used to adjust ISC plunger on carburetor to obtain maximum specification RPM speed. 5S 1470-6E

Figure 9 Special Tools (2 of 4)

SPECIAL TOOLS

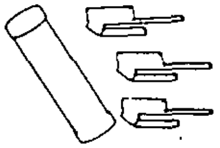
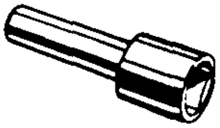
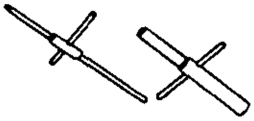
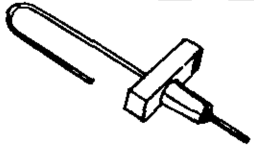
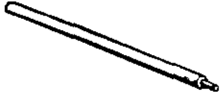
 J9789-135/BT8104	**FLOAT LEVEL GAGE SET** Used to check float level on 2SE or E2SE carburetor.
 J34935/BT8420A	**FLOAT LEVEL GAGE** Used to check float level or M/C solenoid plunger travel on E2ME or E4ME carburetor.
 J29030-B/BT7610B	**IDLE MIXTURE SOCKET** Used to adjust idle mixture needle on a E2SE carburetor.
 J28696-B/BT7928	**MIXTURE ADJUSTMENT TOOL** Used to adjust lean mixture and rich mixture stop screws on E2SE, E2ME or E4ME carburetor.
 J22646-02	**CARBURETOR ADJUSTMENT WRENCH** Used to remote adjust idle mixture needle on carburetor.
 J33815-1/BT8253-A	**M/C SOLENOID GAGING TOOL** Used to adjust the mixture control solenoid plunger on E2ME or E4ME carburetor.
 J33815-2/BT8253-A	**AIR BLEED VALVE GAGING TOOL** Used to adjust idle air bleed valve on E2ME or E4ME carburetor.
 J25322/BT7523	**PUMP LEVER PIN PUNCH** Used to drive pump lever pin inward to allow removal of the pump lever on E2ME carburetor.
 J34062	**BANJO BOLT WRENCH** Used to disconnect or connect fuel inlet on 2.0L TBI engine.

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Figure 10 Special Tools (3 of 4)

SPECIAL TOOLS

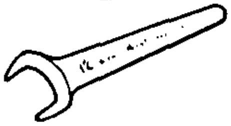
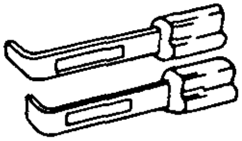
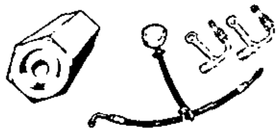
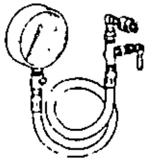
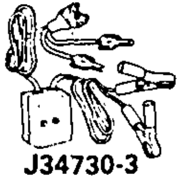
 J29698-A/BT8251	**FUEL LINE WRENCH** Used to connect or disconnect fuel lines at TBI unit by holding fuel nut at throttle body.
 J33031/BT8130	**IDLE AIR CONTROL WRENCH** Used to remove or install IAC valve on throttle body.
 J33047/BT8207-A	**IDLE AIR PASSAGE PLUGS** Used to block idle air passages when adjusting minimum idle speed on TBI unit. Also may be used to check ECM idle control.
 J33179-20	**MINIMUM AIR RATE ADJUSTING WRENCH** Used to adjust throttle stop screw on TBI unit.
 J29658/BT8205	**FUEL PRESSURE GAGE** Used to check fuel pressure on TBI engines.
 J34730-A	**PORT FUEL INJECTION DIAGNOSTIC KIT** Used to diagnosis and service port fuel injection systems. The kit includes: • Fuel Pressure Gage — to check fuel pump pressure and compare injectors for equal fuel distribution. • Test Light — to check electrical impulses to an injector. • Injector Tester — to evaluate an injector.
 J34730-1	**FUEL PRESSURE GAGE** Used to check and monitor fuel line pressure of port fuel system.
 J34730-2	**INJECTOR TEST LIGHT** Used to check port fuel injector signal from ECM.
 05 24 84 J34730-3	**INJECTOR TESTER** Used to perform injector balance test in CHART C-2A. 5S 1472-6E

Figure 11 Special Tools (4 of 4)

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.

Carburetor specifications can be found in the appropriate 6C Section of this Service Manual.

SPECIFICATION	LOCATION OF INFORMATION
Engine Timing	Vehicle Emission Control information label.
Idle Speed, ECM Controlled	Not adjustable. ECM controls idle.
Idle Speed, Non-ECM Controlled-Carbureted	Vehicle Emission Control Information label.
Idle Speed, Minimum-Carbureted	Vehicle Emission Control Information Label.
Fast Idle Speed-Carbureted	Vehicle Emission Control Information label.
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 0A. 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 6E2

DRIVEABILITY AND EMISSIONS FUEL INJECTION (TBI)

THIS SECTION APPLIES TO:
2.5L LR8 (P SERIES) VIN CODE "R"

CONTENTS

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SECTION A - DIAGNOSTIC CHARTS

SECTION B - SYMPTOMS

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS

SECTION C - COMPONENT SYSTEMS

SECTION C1
ELECTRONIC CONTROL MODULE AND SENSORS

SECTION C2
FUEL CONTROL SYSTEM

SECTION C3
EVAPORATIVE EMISSION CONTROL

SECTION C4
IGNITION SYSTEM/EST

SECTION C7
EXHAUST GAS RECIRCULATION SYSTEM

SECTION C8
TRANSMISSION/TRANSAXLE CONVERTER CLUTCH

SECTION C10
A/C CLUTCH CONTROL

SECTION C13
POSITIVE CRANKCASE VENTILATION

SECTION C14

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

The engine used in this vehicle has 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 get 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. 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

Trouble Tree Charts incorporate diagnosis procedures using an ALCL "SCAN" tool where possible. This manual will also contain a "NON-SCAN DIAGNOSTIC CIRCUIT CHECK" and one designed to be used when using the "SCAN" tool.

Both SCAN and NON-SCAN diagnostics must begin with their respective "Diagnostic Circuit Check", which represents an organized approach for identifing system problems. In addition, the "SCAN Diagnostic Circuit Check" includes code definitions to confirm a "hard failure" prior to using the Charts. Unless instructed otherwise, charts should not be used for diagnosis unless the fault is still present (hard failure).

The ALCL connector is used by the assembly plants to perform end of line tests. This connector can also be used by service to monitor certain inputs and outputs as seen by the ECM. The "SCAN" tool uses the information supplied to the ALCL connector.

The ECM can be commanded to transmit ALCL data in three different modes:

1. Normal or open mode - 0 resistance across ALCL connector terminal A to B.
2. Assembly line diagnostic mode - 10,000 ohms resistance across A & B. (May also be referred to as 10K mode, special mode, or ALCL mode.
3. Factory test or back-up mode - 3.9 K resistance across ALCL connector terminals A & B.

The following information will describe each of the three modes and the affects it may cause.

NORMAL OR 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 and the "open" mode must be selected when it is available.

10K MODE, SPECIAL MODE OR ALCL MODE

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
- On some engines, canister purge solenoid will be enabled
- P/N restrict functions will be disabeled

FACTORY TEST MODE, BACK-UP OR 3.9 K MODE

When in this mode, the ECM is operating on the fuel back-up logic and calibrated by the Calpak. The Calpak is 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 USES

The "SCAN" tool allows a quick check of sensors and switches which are inputs to the ECM. The data however only updates every 1.25 seconds which makes the tool not as effective as a voltmeter when trying to detect an intermittent which lasts less than the 1.25 second period. 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.

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 technicians 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 operating manual to become familiar with the tool. 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 which will be indicated when the position is selected.

Mode

Check with the manufacture to determine what the function of this mode is. In most cases it allows the user to place the ECM in different operating modes.

Closed Loop

This position will indicate whether the engine control system is operating in open or closed loop. Most systems go closed loop after a certain amount of run time, when coolant temperature is high enough, and the oxygen sensor becomes active.

Exhaust (Rich/Lean Indicator)

Indicates whether the oxygen sensor is sensing a rich or lean exhaust and usually displayed as RH or LN.

Trouble Codes

Will display any trouble codes stored in the ECM memory.

Manifold Absolute Pressure (MAP)

The MAP Sensor produces a low signal voltage when manifold pressure is low (high vacuum) and a high voltage when pressure is high (low vacuum).

With ignition on and engine stoppped, the manifold pressure is equal to atomospheric 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 (400 mv).

**MAP Sensors have a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector should also be the same as the insert color.

TPS (Throttle Position Sensor)

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).

Oxygen

The reading will be read out in millivolts (mv) with a range from 100 to 999 mv. If the reading is consistantly below 35 (35° mv), the fuel system is running lean as seen by the ECM and if the reading is consistently above 55 (55° mv), the system is running rich.

PROM ID

In this position, information is used for assembly verification only. PROM ID is usefull only when the vehicle is equipped with the original ECM and PROM or Mem-Cal.

RPM

Displays engine RPM. 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 wiring too close to ignition secondary wires or open distributor ground circuits.

MPH

Displays vehicle speed. Useful in Checking TCC lock up speed or speedometer accuracy.

Coolant Temperature

Displays engine temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90° C then stabilize when thermostat opens.

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 operators manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from neutral to drive.

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".

Integrator and Block Learn

Normal readings in these modes are around 128, if higher then it indicates that the ECM is adding fuel to the base fuel calculation and if the numbers are below 128 the ECM is taking out fuel from the base calculation. The integrator is short term corrective action while the block learn portion (long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

IAC (Idle Air Control)

In this mode, the numbers will indicate what position the ECM thinks the valve is in. The ECM moves the IAC in counts and these counts are are what is displayed on a "SCAN" tool.

Cross Counts

In this mode, the activity of the oxygen sensor is displayed by how many times the voltage of the sensor has passed by the midpoint in the last 1.25 second period. The number will begin at 0, then add up to 255, then start over.

A/C Request

Displays the state of the A/C signal line to the ECM. Should read "ON" whenever the A/C is requested and the pressure cycling switch is closed.

Power Steering Pressure Switch

Displays the state of switch. This reading 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.

ENGINE EMISSION COMPONENTS

View showing the location of emission components for this engine are as shown:

- *Component Location* - 2.5L "P" Series, Figure A1

Wiring schematic diagrams for the ECM are as shown:

- ECM Wiring Diagram (White Conn.), Figure A2
- ECM Wiring Diagram (Black Conn.), Figure A3

Refer to the following figure for ECM terminal end view of connector showing circuit and voltages.

- 2.5L .... Figure A4

BLANK

SECTION A
2.5L 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

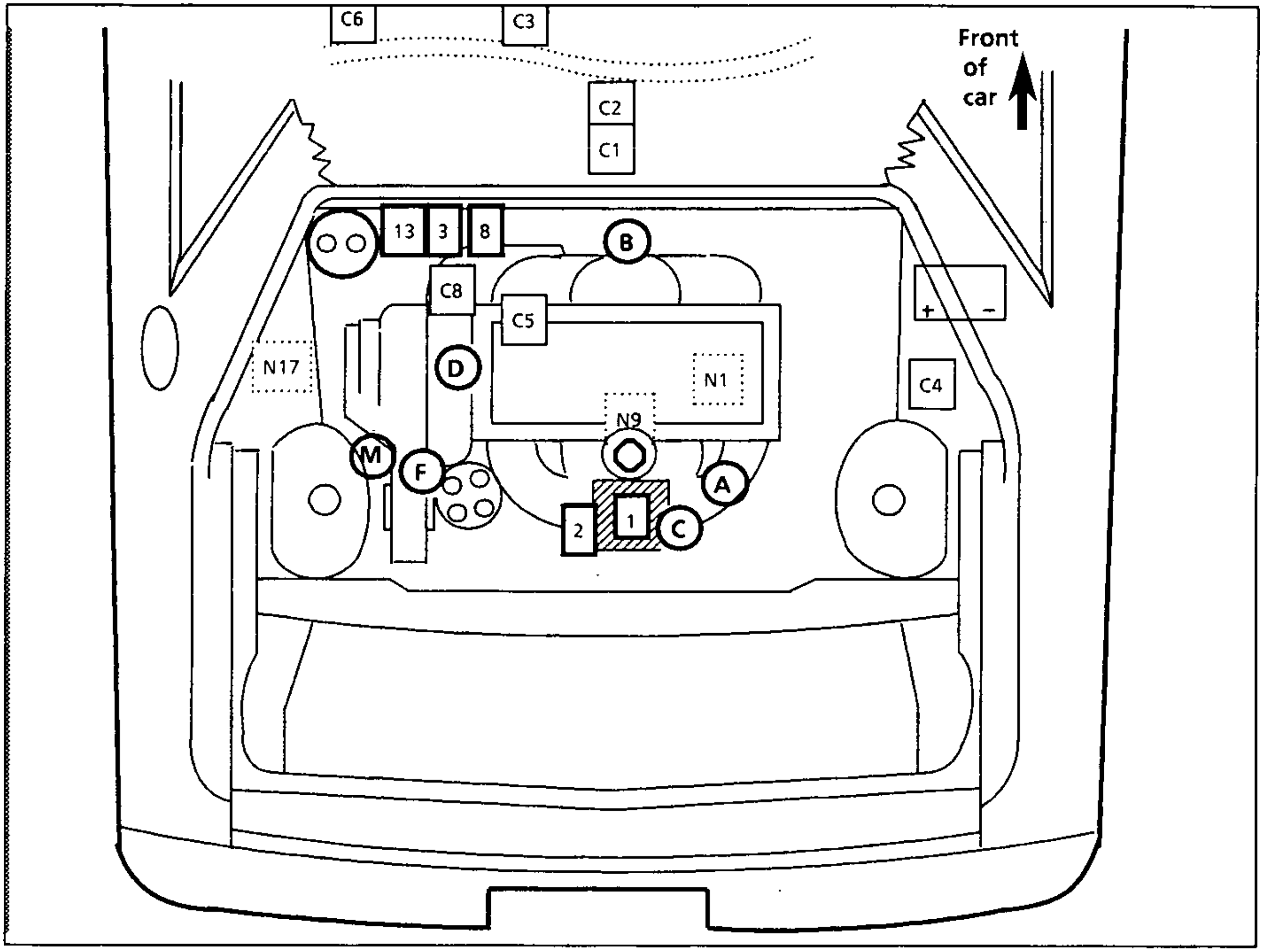
On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop." To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

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

'P' SERIES RPO: LR8 VIN CODE: R 2.5L L4 TBI



☐ COMPUTER HARNESS

C1 Electronic Control Module (ECM)
C2 ALCL diagnostic connector
C3 "SERVICE ENGINE SOON" light
C4 ECM power
C5 ECM harness ground
C6 Fuse panel
C8 Fuel pump test connector

⬚ NOT ECM CONNECTED

N1 Crankcase vent valve (PCV)
N9 Exhaust Gas Recirculation valve
N17 Fuel vapor canister

■ CONTROLLED DEVICES

1 Fuel injector
2 Idle air control valve
3 Fuel pump relay
8 Engine fan relay
13 A/C compressor relay

⬡ Exhaust Gas Recirculation valve

○ INFORMATION SENSORS

A Manifold differential pressure
B Exhaust oxygen
C Throttle position
D Coolant temperature
F Vehicle speed
M P/N switch

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*5S 2122-6E

Figure A-1 Component Locations (2.5L)

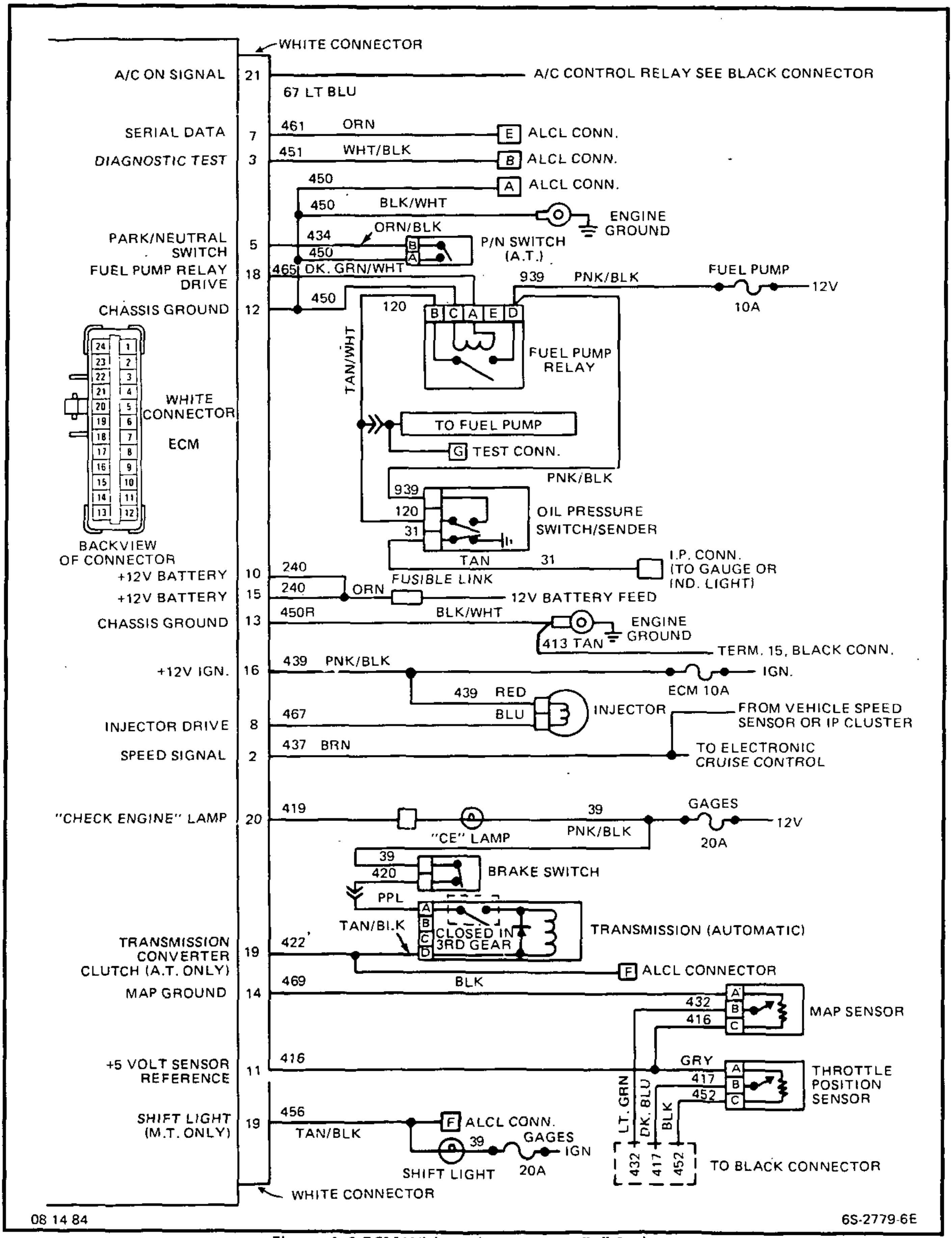


Figure A-2 ECM Wiring Diagram 2.5L "P" Series

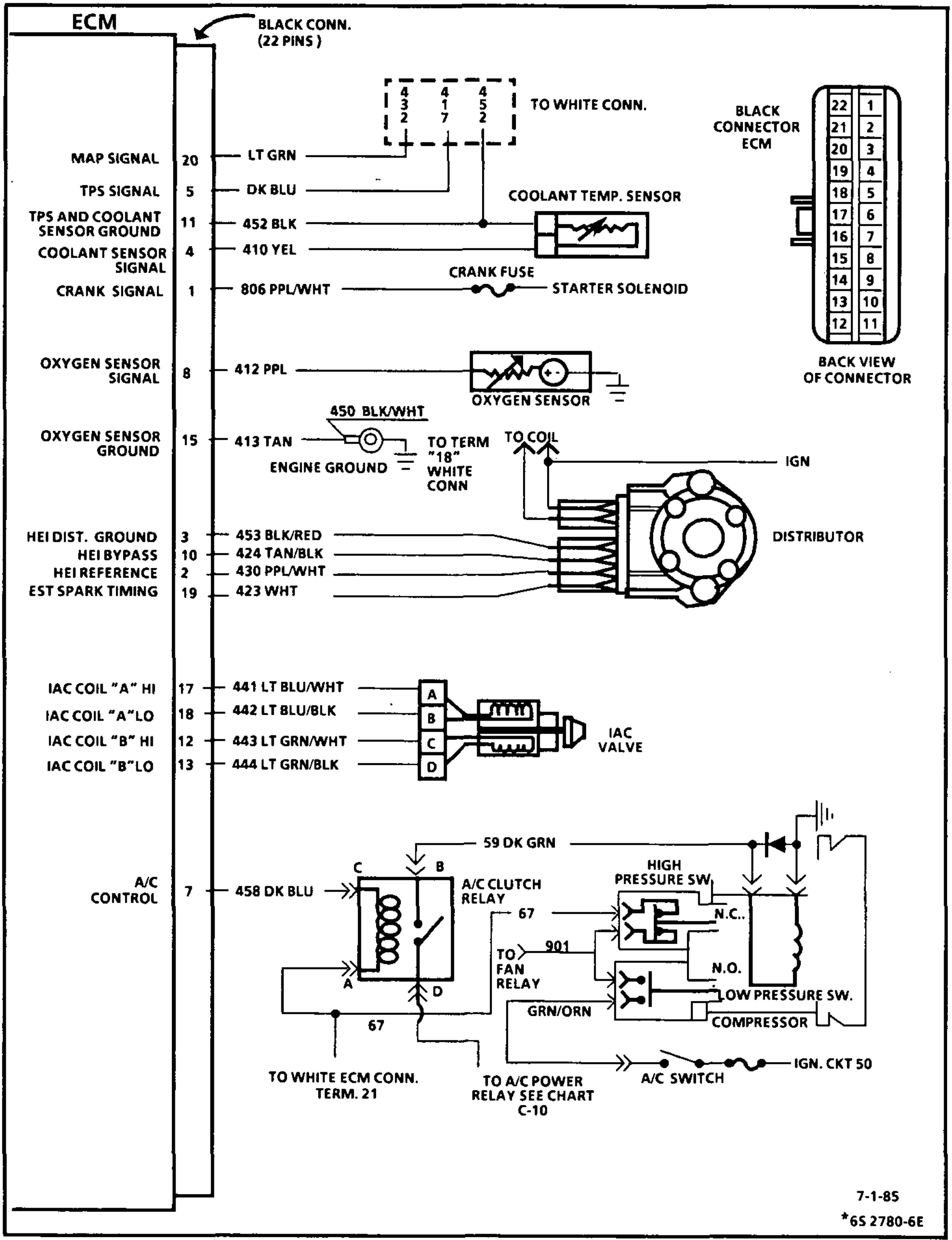


Figure A-3 ECM Wiring Diagram - 2.5L "P" Series "Black" Conn.

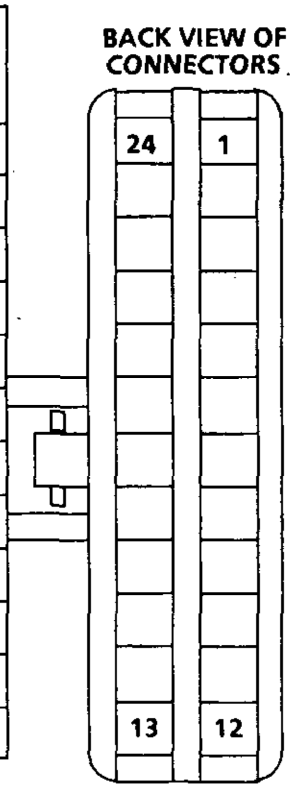
FUEL INJECTION ECM CONNECTOR IDENTIFICATION

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.

<u>THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:</u>

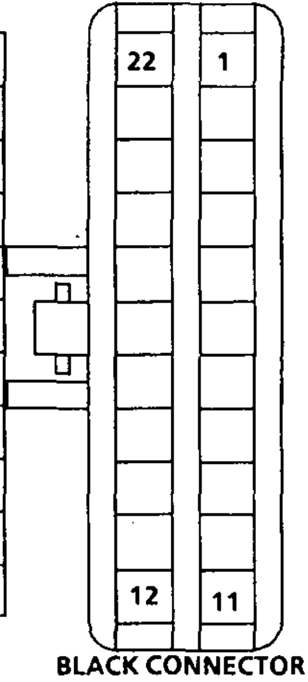
- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALCL tool not installed

VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	WIRE COLOR	
			NOT USED
			NOT USED
			NOT USED
0	0	DK.GRN	A/C CLUTCH ①
0	14.1	BRN WHT	"SERVICE ENGINE SOON" LIGHT
0	0	TAN BLK	TCC OR SHIFT LIGHT
0	14.0	DK.GRN /WHT	FUEL PUMP RELAY DRIVE
			NOT USED
12.3	14.3	PNK/ ORN	SWITCHED IGNITION
12.3	14.3	ORN	BATTERY
0	0	BLK/ ORN	MAP GROUND
0	0	BLK/ WHT	ECM GROUND



	VOLTAGE KEY "ON"	VOLTAGE ENG. RUN	WIRE COLOR
NOT USED			
VEHICLE SPEED SENSOR ④	11.6	13.4	BRN
DIAGNOSTIC TEST ALCL	5.2	5.3	WHT BLK
NOT USED			
PARK/NEUTRAL SWITCH ③	0	0	ORN BLK
NOT USED			
SERIAL DATA	5.0	4.6	ORN
INJECTOR	12.3	14.2	BLU
NOT USED			
BATTERY	12.3	14.3	ORN
5 VOLT REFERENCE	5.3	5.3	GRY
ECM GROUND	0	0	BLK. WHT.

			NOT USED
			NOT USED
5.1	1.5	LT.GRN	MANIFOLD PRESSURE SIGNAL
0	1.8	WHT	EST SIGNAL
②	②	LT.BLU BLK	I.A.C. COIL "A" LO
②	②	LT.BLU WHT	I.A.C. COIL "A" HI
			NOT USED
0	0	TAN	OXYGEN SENSOR GROUND
			NOT USED
②	②	LT.GRN BLK	I.A.C. COIL "B" LO
②	②	LT.GRN WHT.	I.A.C. COIL "B" HI



CRANK SIGNAL	0	0	PPL/WHT
HEI REFERENCE	0		PPL/ WHT
HEI DIST.GROUND	0	0	BLK RED
COOLANT SENSOR SIGNAL	1.3	.6	YEL
T.P.S. SIGNAL	.81	.81	DK.BLU
NOT USED			
AC CLUTCH RELAY ①	12.3	14.3	DK.BLU
OXYGEN SENSOR SIGNAL	.3	VARIES .3TO.7	PPL
NOT USED			
EST BYPASS	0	4.2	TAN/ BLK
COOLANT & TPS GROUND	0	0	BLK

① A/C off.
② Not useable.
③ Reads battery voltage in drive. (A.T. only.)
④ Voltage varies from 0 to 12 volts depending on position of drive wheels

ENGINE 2.5L
CARLINE "P"

*5S 1932-6E
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Figure A-4 ECM Connector Terminal End View - 2.5L "P"

"NON-SCAN" DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit Check is an organized approach for identifying a problem caused by the Fuel Injection System.

Driver comments normally fall into one of the following areas:

- Steady "SERVICE ENGINE SOON" light
- Driveability Problem
- Engine "Cranks But Will Not Run"

Understanding the chart and using it correctly will reduce diagnosis time and prevent the unnecessary replacement of parts. Many Charts have been changed to include "Scan" diagnostic procedures which are shown in large type. "Non-Scan" is the smaller type and always begins at the top of each Chart.

1. A steady "SERVICE ENGINE SOON" light with the ignition "ON" and engine stopped confirms battery and ignition voltage to the Electronic Control Module (ECM).

2. Ground diagnosis terminal by jumpering terminal "A" to "B" in the ALCL connector located below the instrument panel.
   The ECM will cause the "SERVICE ENGINE SOON" light to flash Code 12, indicating that the ECM diagnostics are working. Code 12 will flash three (3) times, followed by any other trouble codes stored in the memory. Each additional code will flash three (3) times, starting with the lowest code,and then start over again with Code 12. If there are no other codes, Code 12 will flash until the diagnostic "test" terminal jumper is disconnected or the engine is started.

3. Record all stored codes except for Code 12. If the problem is "Engine Cranks But Will Not Run", go to Chart A-3.

4. If no additional codes were recorded, see Section B for driveability symptoms and recommended service procedures. Depending on the severity of the problem, the "Field Service Mode" may be helpful in diagnosis.
   With the engine running and the diagnostic terminal grounded, the ECM will respond to the oxygen sensor signal voltage and use the "SERVICE ENGINE SOON" light to display this information as follows:

A. "Closed loop" confirms that the oxygen sensor signal is being used by the ECM to control fuel delivery and that the system is working normally. Signal voltage will swing quickly from below .35 to above .55 volts.

B. "Open loop" indicates that oxygen sensor voltage signal is not usable to the ECM. Signal voltage is at a constant value between .35 and .55 volts.

System will flash "open loop" from 30 seconds to 2 minutes after engine starts or until sensor reaches normal operating temperature. If system fails to go "closed loop", see Code 13 chart.

C. "SERVICE ENGINE SOON" light "OUT" indicates that exhaust is lean. O_2 sensor signal voltage will be less than .35 volts and steady. See Code 44 chart.

D. "SERVICE ENGINE SOON" light "on" steady indicates that exhaust is rich. Sensor signal voltage will be above .55 volts and steady. See Code 45. chart.

5. Road test of the system using the "Field Service Mode" should be done only at steady road speeds. Because the vehicle operates differently in the "Field Service Mode", the following conditions may be observed and should be considered normal.

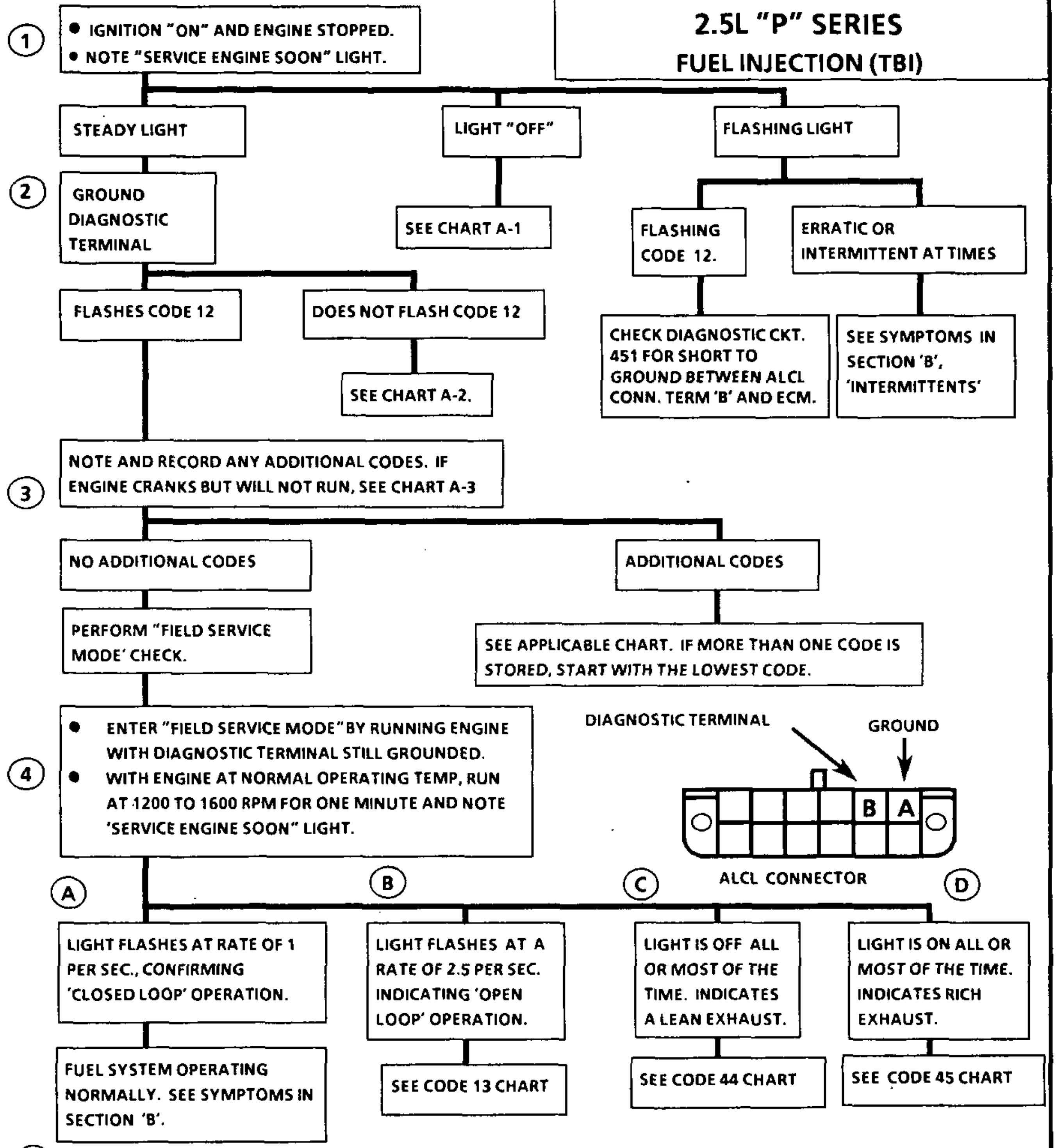
- Acceleration - Light may be "ON" too long due to acceleration enrichment.
- Deceleration - Light may be "OFF" too long due to decel enleanment or fuel cut-off.
- Idle - Light may be "ON" too long with idle below 1200 RPM.

6. Clearing codes. Ignition off. Disconnect battery pigtail for ten seconds.

"NON-SCAN" DIAGNOSTIC CIRCUIT CHECK

2.5L "P" SERIES

FUEL INJECTION (TBI)



①
- IGNITION "ON" AND ENGINE STOPPED.
- NOTE "SERVICE ENGINE SOON" LIGHT.

STEADY LIGHT

② GROUND DIAGNOSTIC TERMINAL

FLASHES CODE 12

DOES NOT FLASH CODE 12

SEE CHART A-2.

LIGHT "OFF"

SEE CHART A-1

FLASHING LIGHT

FLASHING CODE 12.

CHECK DIAGNOSTIC CKT. 451 FOR SHORT TO GROUND BETWEEN ALCL CONN. TERM 'B' AND ECM.

ERRATIC OR INTERMITTENT AT TIMES

SEE SYMPTOMS IN SECTION 'B', 'INTERMITTENTS'

③ NOTE AND RECORD ANY ADDITIONAL CODES. IF ENGINE CRANKS BUT WILL NOT RUN, SEE CHART A-3

NO ADDITIONAL CODES

PERFORM "FIELD SERVICE MODE' CHECK.

ADDITIONAL CODES

SEE APPLICABLE CHART. IF MORE THAN ONE CODE IS STORED, START WITH THE LOWEST CODE.

④
- ENTER "FIELD SERVICE MODE" BY RUNNING ENGINE WITH DIAGNOSTIC TERMINAL STILL GROUNDED.
- WITH ENGINE AT NORMAL OPERATING TEMP, RUN AT 1200 TO 1600 RPM FOR ONE MINUTE AND NOTE 'SERVICE ENGINE SOON" LIGHT.

Ⓐ LIGHT FLASHES AT RATE OF 1 PER SEC., CONFIRMING 'CLOSED LOOP' OPERATION.

FUEL SYSTEM OPERATING NORMALLY. SEE SYMPTOMS IN SECTION 'B'.

Ⓑ LIGHT FLASHES AT A RATE OF 2.5 PER SEC. INDICATING 'OPEN LOOP' OPERATION.

SEE CODE 13 CHART

Ⓒ LIGHT IS OFF ALL OR MOST OF THE TIME. INDICATES A LEAN EXHAUST.

SEE CODE 44 CHART

Ⓓ LIGHT IS ON ALL OR MOST OF THE TIME. INDICATES RICH EXHAUST.

SEE CODE 45 CHART

⑤ *VEHICLE MAY BE DRIVEN IN THE FIELD SERVICE MODE AND EVALUATED AT ANY STEADY SPEED. THIS CAN BE HELPFUL IN* DIAGNOSING DRIVEABILITY PROBLEMS WHERE THE SYSTEM IS RICH OR LEAN TOO LONG.

⑥ CLEAR CODES AND CONFIRM 'CLOSED LOOP' OPERATION AND NO 'LIGHT'.

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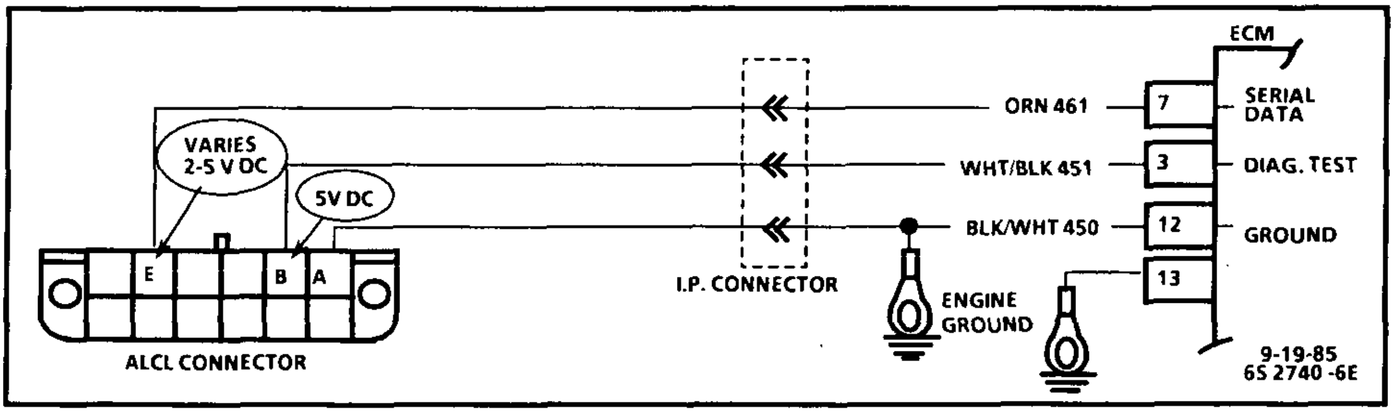


"SCAN" DIAGNOSTIC CIRCUIT CHECK

2.5L "P" SERIES

FUEL INJECTION (TBI)

The "SCAN" Diagnostic Circuit Check is an organized approach for identifying fuel injection problems using an assembly line communication link (ALCL)*. This communication link can provide diagnostic information for display on any "SCAN" device or tool designed for this purpose.

The use of a "SCAN" device requires a good understanding of its operation as well as its limitation. A complete review of the instruction manual furnished with the tool as well as the Introduction and General Description in this section is very important.

The tool plugs into the ALCL connector located below the instrument panel. If a stored code is displayed, the code definitions beginning on page two will aid in determining if the fault is still present (hard failure) or the result of an intermittent condition not normally diagnosed using the code charts.

A hard failure will be diagnosed using charts. That have been developed for both "SCAN" and "NON-SCAN" diagnosis, "SCAN" steps start with the arrow marked "Start Scan" and are identified by the larger type. The actual repair procedures, however, are the smaller type and apply to both methods of diagnosis.

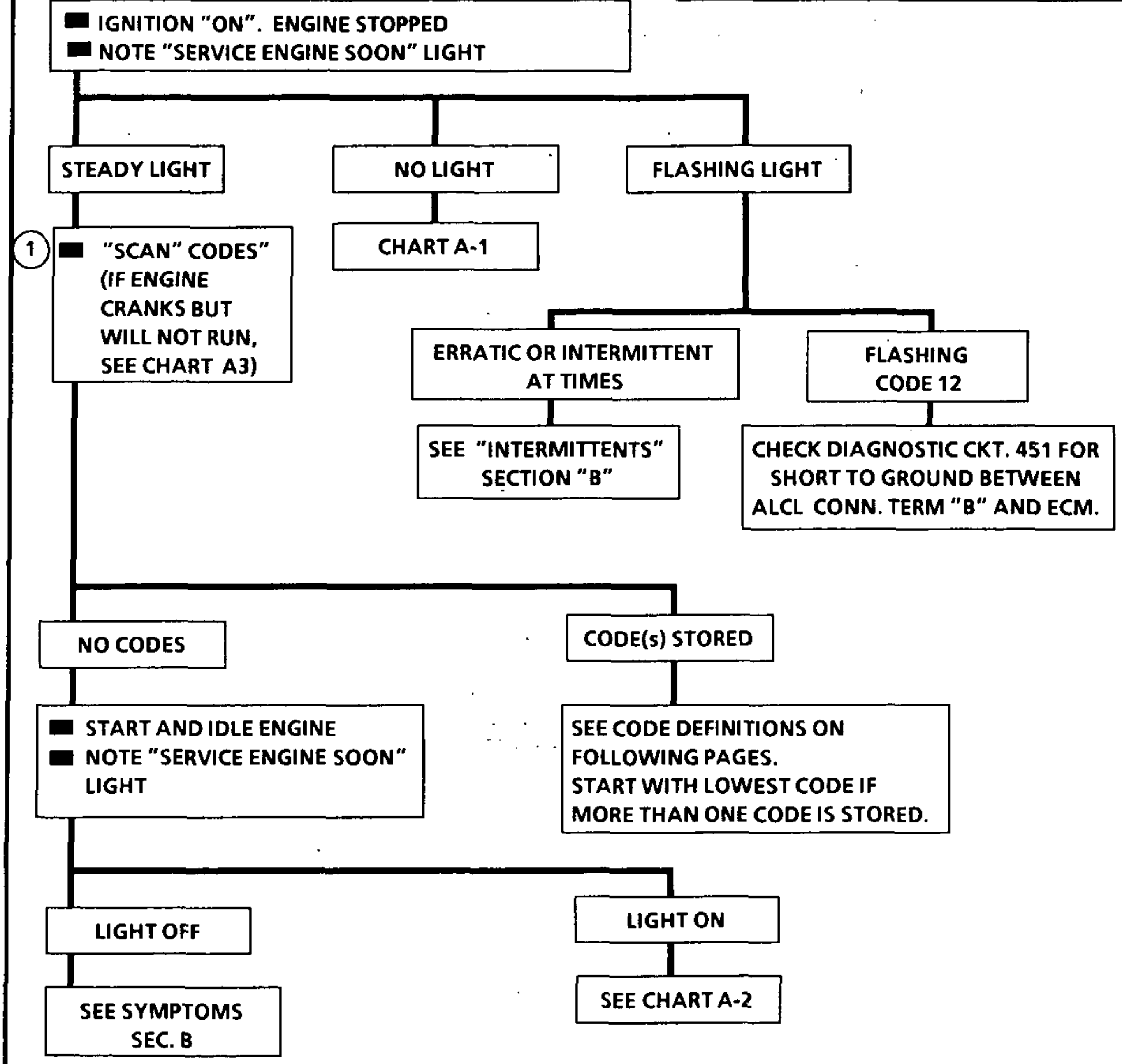
The facing page of each chart will provide a general circuit description and in some instances, alternate diagnostic steps or other diagnostic aids specific to that chart.

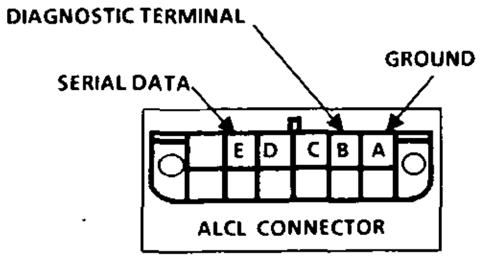
1. If the "SCAN" tool is not operating, check on another vehicle. If OK, the cigar lighter socket should be checked for 12 volts and a good ground. If the "SCAN" tool reads "no data" or "no ALCL", with the ignition "on", check the serial data wire for an open or short to ground between ALCL terminal "E" and the ECM. Also, check for an open diagnostic test terminal from ALCL terminal "B" and ECM. With ignition on, the serial data line (ALCL terminal "E") should have a varying 2-5 volts and the diagnostic line (ALCL terminal "B") about 5 volts.

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 1 of 6)
2.5L "P" Series
FUEL INJECTION (PORT)

■ "SCAN" STEP ONLY





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"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 2 of 6)

(CODE DEFINITIONS)

NOTICE

THE 'DIAGNOSTIC CIRCUIT CHECK' SCAN DATA IS TYPICAL OF THAT DISPLAYED BY A PROPERLY DESIGNED AND CALIBRATED ALCL SCAN DEVICE.

A SCAN DEVICE THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM REPORTED TO THE DEVICE MANUFACTURER. THE USE OF A FAULTY SCAN DEVICE CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

CODES	DEFINITIONS
■ **CODE 13** • "SCAN" IN ALCL "SPECIAL" MODE • ENGINE IDLING AT 1000 RPM FOR 2 MINUTES. • COOLANT 75° TO 95° C. • "SCAN" OXYGEN SENSOR VOLTAGE	**HARD FAILURE -** "SCAN" DISPLAY FIXED BETWEEN .35 TO .55 V. OPEN CIRCUIT CONDITION. SEE CODE CHART 13. **INTERMITTENT CODE -** NORMAL"SCAN" VOLTAGE WILL VARY BETWEEN 100MV TO 999 MV (.1 AND 1.0 VOLT). SEE "INTERMITTENTS" SECTION B.
■ **CODE 14** • IGNITION ON. • ENGINE STOPPED. • SCAN" COOLANT TEMPERATURE.	**HARD FAILURE -** "SCAN" DISPLAY FIXED ABOVE 135°C. CIRCUIT SHORTED TO GROUND OR FAULTY SENSOR. SEE CODE CHART 14. **INTERMITTENT CODE -** "SCAN" DISPLAY READS ENGINE TEMP. IN DEGREES CENTIGRADE. AFTER ENGINE IS STARTED, THE TEMPERATURE SHOULD RISE STEADILY TO ABOUT 90°C THEN STABILIZE WHEN THERMOSTAT OPENS. SEE "INTERMITTENTS" SECTION B.
■ **CODE 15** • IGNITION ON. • ENGINE STOPPED. • "SCAN" COOLANT TEMPERATURE.	**HARD FAILURE -** "SCAN" DISPLAY FIXED BELOW -30°C. CIRCUIT OPEN OR FAULTY SENSOR. SEE CODE CHART 15. **INTERMITTENT CODE -** "SCAN" TOOL DISPLAYS ENGINE COOLANT TEMPERATURE IN DEGREES CENTIGRADE. AFTER ENGINE IS STARTED, THE TEMPERATURE SHOULD RISE STEADILY TO ABOUT 90°C, THEN STABILIZE WHEN THERMOSTAT OPENS. SEE "INTERMITTENTS" SECTION B.

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 3 of 6)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 21** ● IGNITION "ON". ● THROTTLE CLOSED. ● ENGINE STOPPED. ● "SCAN" TPS	**HARD FAILURE -** "SCAN" TOOL DISPLAYS A CLOSED THROTTLE VOLTAGE OVER 2.5 VOLTS. SIGNAL VOLTAGE TOO HIGH, GROUND WIRE OPEN, SIGNAL LINE SHORTED TO SENSOR REF. LINE OR FAULTY SENSOR. SEE CODE CHART 21. **INTERMITTENT CODE -** "SCAN" TOOL DISPLAYS THROTTLE POSITION IN VOLTS. SHOULD READ BETWEEN 020-125 (200 mv AND 1.25 V). WITH THROTTLE CLOSED AND IGNITION ON OR AT IDLE, VOLTAGE SHOULD INCREASE AT A STEADY RATE AS THROTTLE IS MOVED TOWARD A WIDE OPEN POSITION. SEE "INTERMITTENTS" SECTION B.
■ **CODE 22** ● IGNITION "ON" ● ENGINE STOPPED. ● THROTTLE CLOSED. ● "SCAN" TPS	**HARD FAILURE -** "SCAN" TOOL DISPLAYS BELOW 020V (200 MV). OPEN OR SHORT TO GROUND IN 5V REFERENCE OR SIGNAL CIRCUIT, OR FAULTY SENSOR. SEE CODE CHART 22. **INTERMITTENT CODE -** "SCAN"TOOL DISPLAYS THROTTLE POSITION IN VOLTS. SHOULD READ BETWEEN 020-125 (200 mv AND 1.25 V). WITH THROTTLE CLOSED AND IGNITION ON OR AT IDLE, VOLTAGE SHOULD INCREASE AT A STEADY RATE AS THROTTLE IS MOVED TOWARD A WIDE OPEN POSITION. SEE "INTERMITTENTS" SECTION B.
■ **CODE 24** ● ENGINE RUNNING. ● DRIVE WHEELS TURNING. ● "SCAN" MPH.	**HARD FAILURE -** "SCAN" TOOL DISPLAYS 0 MPH. IF SPEEDOMETER IS WORKING OK, THEN THE VSS SIGNAL INPUT IS OPEN, SHORTED TO GROUND, OR THE BUFFER IS DEFECTIVE. SEE CODE CHART 24. **INTERMITTENT CODE -** "SCAN" TOOL DISPLAY SHOULD CLOSELY MATCH WITH SPEEDOMETER READING WITH DRIVE WHEELS TURNING. SEE 'INTERMITTENTS' SECTION B. "SCAN" DISPLAY INDICATES THAT PARK/NEUTRAL SWITCH DID NOT "SWITCH" WHEN SHIFTING NEUTRAL TO DRIVE (A.T. ONLY). SEE CHART C-1A. DISREGARD CODE 24 IF SET WITH DRIVE WHEELS NOT TURNING.

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"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 4 of 6)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 33** • ENGINE IDLING. • "SCAN" MAP.	**HARD FAILURE -** "SCAN" TOOL DISPLAYS ABOVE 2.5 VOLTS. SENSOR GROUND CIRCUIT OPEN, LEAKING VACUUM HOSE OR FAULTY SENSOR. SEE CODE CHART 33. **INTERMITTENT CODE -** "SCAN" TOOL DISPLAYS MANIFOLD PRESSURE IN VOLTS. LOW PRESSURE (HIGH VACUUM) DISPLAYS AS A LOW VOLTAGE WHILE A HIGH PRESSURE (LOW VACUUM) DISPLAYS AS A HIGH VOLTAGE. IF ENGINE IDLE IS LOW AND UNSTABLE IT MAY SET CODE 33. SEE "INTERMITTENTS" SECTION B.
■ **CODE 34** • IGNITION "ON" • SCAN" MAP.	**HARD FAILURE -** "SCAN" TOOL DISPLAYS BELOW (200 mv) .2 VOLTS. SIGNAL WIRE OR 5V REFERENCE OPEN OR SHORTED TO GROUND OR FAULTY SENSOR. SEE CODE CHART 34. **INTERMITTENT CODE -** "SCAN"TOOL DISPLAYS MANIFOLD PRESSURE IN VOLTS. LOW PRESSURE (HIGH VACUUM) READS A LOW VOLTAGE WHILE A HIGH PRESSURE (LOW VACUUM) READS A HIGH VOLTAGE. SEE "INTERMITTENTS" SECTION B.

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"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 5 of 6)

(CODE DEFINITIONS)

CODES / DEFINITIONS

CODE 35

- A/C OFF.
- ENGINE IDLING IN NEUTRAL
- COOLANT TEMP 70° TO 90°C
- "SCAN" IN "SPECIAL" MODE.
- INCREASE ENGINE RPM TO 2500 TO RESET IAC. CLOSE THROTTLE AND ALLOW IDLE AND IAC COUNTS STABILIZE.

HARD FAILURE -

"SCAN" TOOL DISPLAYS IDLE SPEED 950 RPM OR ABOVE . IAC COUNTS "0"- THIS CONDITION IS USUALLY A SMALL VACUUM LEAK SUCH AS THERMAC OR CRUISE CONTROL HOSE DISCONNECTED,

OR

ENGINE SPEED 950 RPM OR BELOW.
IAC COUNTS ABOVE 80.
SEE CODE 35 CHART.

INTERMITTENT CODE -

FOLLOWING AN IAC RESET, RPM SHOULD STABLIZE AT 1000 ± 50 RPM IN SPECIAL MODE.
DISCONNECTING "SCAN" TOOL WILL RESTORE NORMAL IDLE.

CODE 42

- CLEAR CODES, START AND IDLE ENGINE FOR 1 MINUTE.

HARD FAILURE -

SERVICE ENGINE SOON" ON, SCAN TOOL DISPLAYS CODE 42. SEE CODE CHART 42.

INTERMITTENT CODE -

THE SCAN TOOL DOES NOT HAVE THE ABILITY TO HELP DIAGNOSE A CODE 42 PROBLEM. IF NO "SERVICE ENGINE SOON "LIGHT, REFER TO INTERMITTENTS IN SECTION "B".

CODE 44

- "SCAN" TOOL IN "SPECIAL" MODE.
- COOLANT TEMP 75° to 95° C AND CLOSED LOOP
- ENGINE IDLING AT 1000 RPM.

HARD FAILURE -

"SCAN" TOOL DISPLAYED 0_2 VOLTAGE CONSISTENTLY BELOW .35V. CAUSED BY A LEAN EXHAUST OR SIGNAL CIRCUIT SHORTED TO GROUND. SEE CODE CHART 44.

INTERMITTENT CODE -

NORMAL "SCAN" DISPLAY WILL VARY BETWEEN 100 MV AND 999MV. (.1 to 1.0V). ALSO SEE CROSSCOUNTS, RICH - LEAN INDICATION, 0_2 VOLTAGE. SEE "SCAN" INFORMATION IN INTRODUCTION.

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 6 of 6)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 45** ● 'SCAN" TOOL IN "SPECIAL" MODE ● ENGINE IDLING AT 1000 RPM ● COOLANT TEMP 75° to 95° C AND IN CLOSED LOOP ● "SCAN" OXYGEN SENSOR VOLTAGE	**HARD FAILURE -** "SCAN" 0_2 VOLTAGE CONSISTENTLY ABOVE .65V. RICH EXHAUST CAUSING A HIGH 02 VOLTAGE. SEE CODE CHART 45. **INTERMITTENT CODE -** NORMAL "SCAN" VOLTAGE WILL VARY BETWEEN 100 MV AND 999MV. (.1 to 1.0V) ALSO SEE CROSSCOUNTS, RICH - LEAN INDICATION, 0_2 VOLTAGE. SEE "SCAN" INFORMATION IN INTRODUCTION.
■ **CODE 51** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 51 RESETS WHICH INDICATES A FAULTY PROM. SEE CODE CHART 51.
■ **CODE 55** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 55 RESETS WHICH INDICATES THE ECM IS FAULTY. REPLACE ECM.

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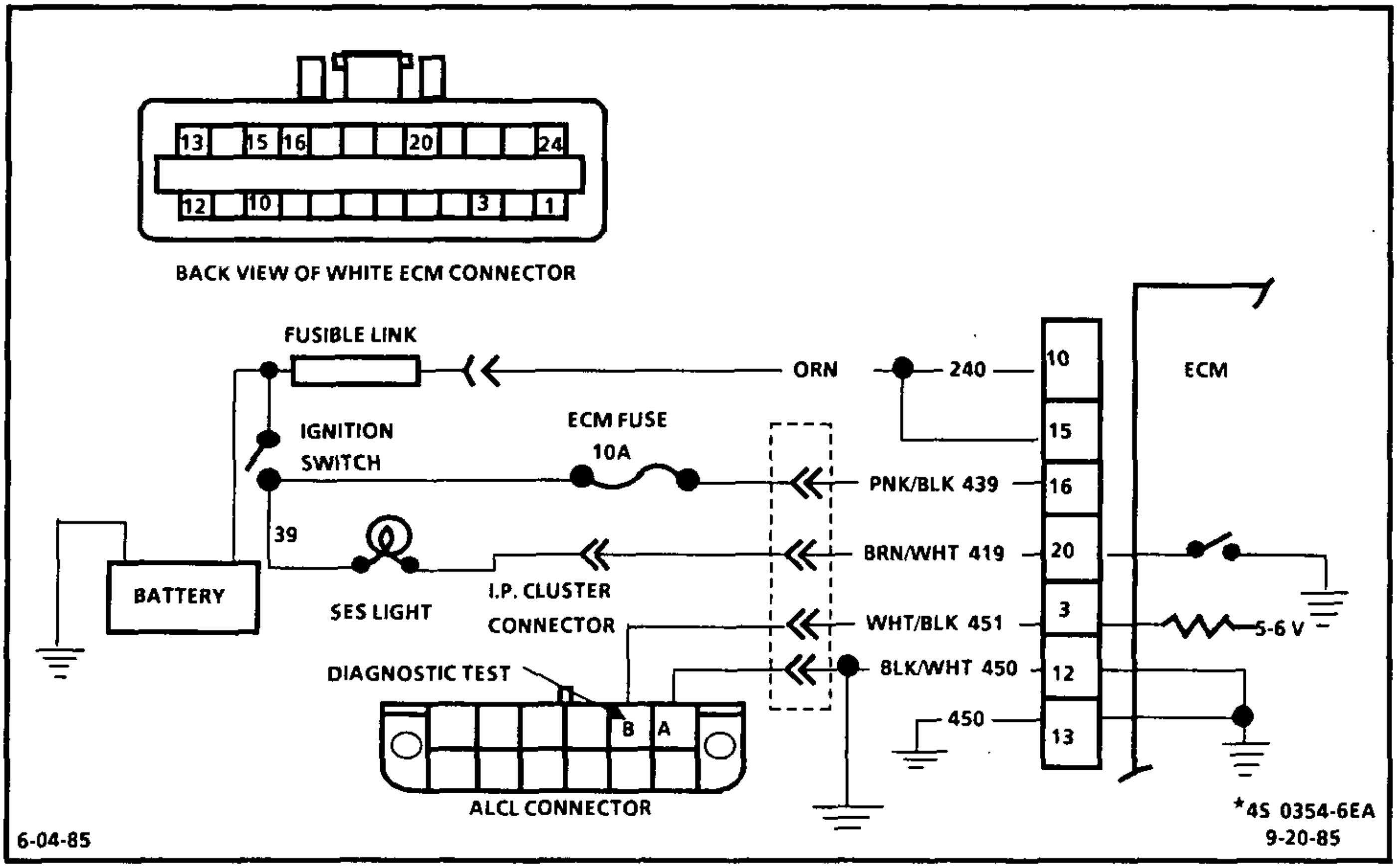


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT

2.5L "P" SERIES

FUEL INJECTION (TBI)

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 circuit 419 to the ECM.

Engine runs ok, check:

- Faulty light bulb.
- CKT 419 open.
- Gage fuse blown. This will result in no stop lights, 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.

1. 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. Solenoid and relay coil resistance must measure more than20 ohms. Less resistance will cause early failure of the ECM "driver".

Before replacing the ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoids and relays and the coil terminal identification.

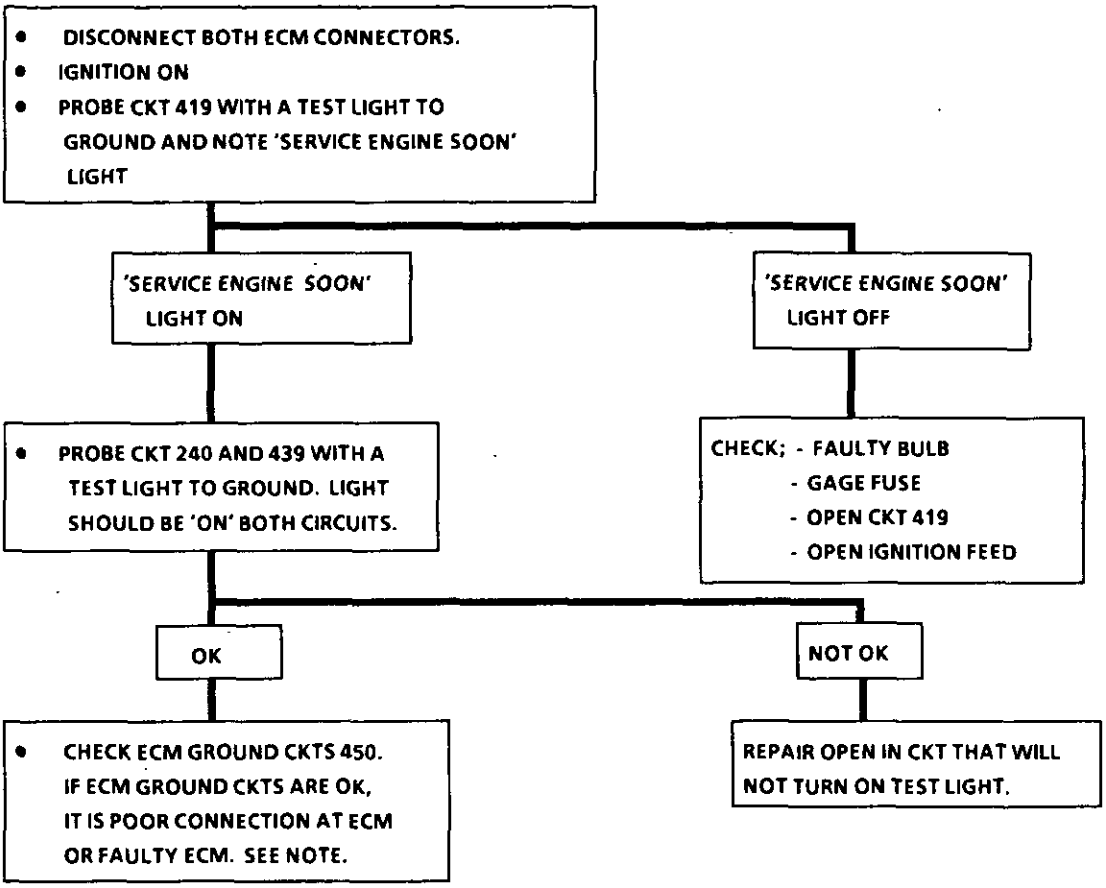
When checking TCC solenoid, be sure to raise drive wheels and run above 30 MPH to close third gear apply switch, if used.

CHART A-1

NO "SERVICE ENGINE SOON" LIGHT

2.5L "P" SERIES

FUEL INJECTION (TBI)



- DISCONNECT BOTH ECM CONNECTORS.
- IGNITION ON
- PROBE CKT 419 WITH A TEST LIGHT TO GROUND AND NOTE 'SERVICE ENGINE SOON' LIGHT

'SERVICE ENGINE SOON' LIGHT ON

- PROBE CKT 240 AND 439 WITH A TEST LIGHT TO GROUND. LIGHT SHOULD BE 'ON' BOTH CIRCUITS.

OK

- CHECK ECM GROUND CKTS 450. IF ECM GROUND CKTS ARE OK, IT IS POOR CONNECTION AT ECM OR FAULTY ECM. SEE NOTE.

NOT OK

REPAIR OPEN IN CKT THAT WILL NOT TURN ON TEST LIGHT.

'SERVICE ENGINE SOON' LIGHT OFF

CHECK; - FAULTY BULB
- GAGE FUSE
- OPEN CKT 419
- OPEN IGNITION FEED

NOTE:
BEFORE REPLACING ECM, USE AN OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-25-85

* 5S 1748-6EA

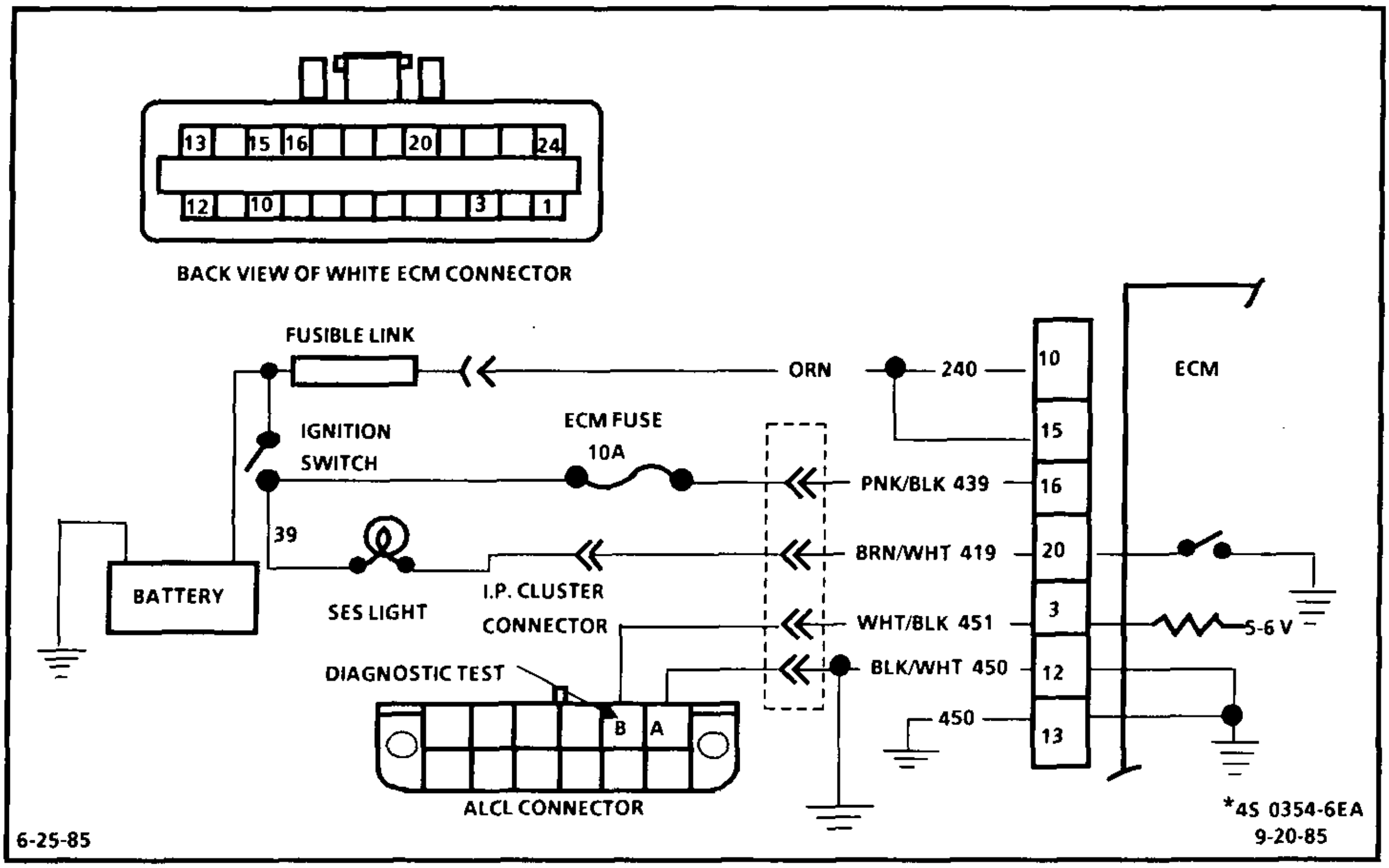


CHART A-2

WON"T FLASH CODE 12

("SERVICE ENGINE SOON" LIGHT ON STEADY)

2.5L "P" SERIES

FUEL INJECTION (TBI)

There should always be a steady "SERVICE ENGINE SOON" Light when the ignition is "on" and engine stopped. Battery ignition voltage is supplied directly to the light bulb. The Electronic Control Module (ECM) will turn the light on by grounding circuit 419 to 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 circuit 419, or an open in diagnostic circuit 451. A steady, but dim light would indicate a failed Quad-driver. The Chart will confirm and suggest the cause.

1. If the light goes off, when the ECM connector is disconnected, then circuit 419 is not shorted to ground. Take this opportunity to physically check the connector terminals for proper contact.
2. This step will check for an open diagnostic circuit 451.
3. At this point the "SERVICE ENGINE SOON" light wiring is okay. The problem is a faulty ECM or PROM. The ECM is OK, if a Code 51 is stored when the PROM is removed. Replace the PROM.
4. 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. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early Failure of the ECM "DRIVER".

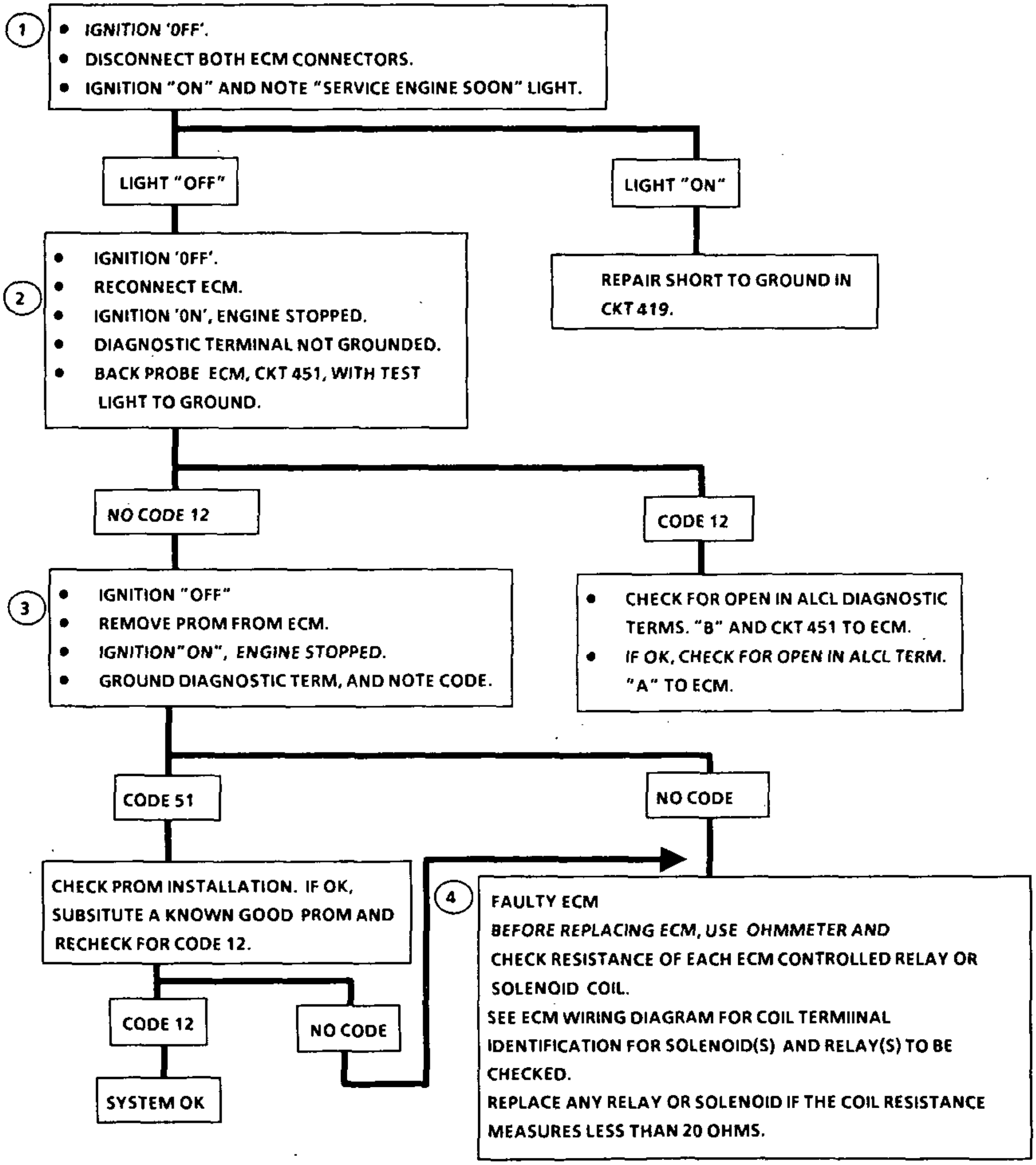
   Before replacing ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoids and relays and the coil terminal identification.

   When checking TCC solenoid, be sure to raise drive wheels and run above 30 MPH to close third gear apply switch.

CHART A-2

WON'T FLASH CODE 12
"SERVICE ENGINE SOON"LIGHT ON STEADY

2.5L "P" SERIES
FUEL INJECTION (TBI)



①
- *IGNITION 'OFF'.*
- DISCONNECT BOTH ECM CONNECTORS.
- IGNITION "ON" AND NOTE "SERVICE ENGINE SOON" LIGHT.

LIGHT "OFF"

②
- IGNITION 'OFF'.
- RECONNECT ECM.
- IGNITION 'ON', ENGINE STOPPED.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- BACK PROBE ECM, CKT 451, WITH TEST LIGHT TO GROUND.

LIGHT "ON"

REPAIR SHORT TO GROUND IN CKT 419.

NO CODE 12

③
- IGNITION "OFF"
- REMOVE PROM FROM ECM.
- *IGNITION"ON", ENGINE STOPPED.*
- GROUND DIAGNOSTIC TERM, AND NOTE CODE.

CODE 12

- CHECK FOR OPEN IN ALCL DIAGNOSTIC TERMS. "B" AND CKT 451 TO ECM.
- *IF OK, CHECK FOR OPEN IN ALCL TERM.* "A" TO ECM.

CODE 51

CHECK PROM INSTALLATION. IF OK, SUBSITUTE A KNOWN GOOD PROM AND RECHECK FOR CODE 12.

CODE 12

SYSTEM OK

NO CODE

NO CODE

④ FAULTY ECM

BEFORE REPLACING ECM, USE OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY OR SOLENOID COIL.

SEE ECM WIRING DIAGRAM FOR COIL TERMIINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.

REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-28-85
4S 0801-6EC

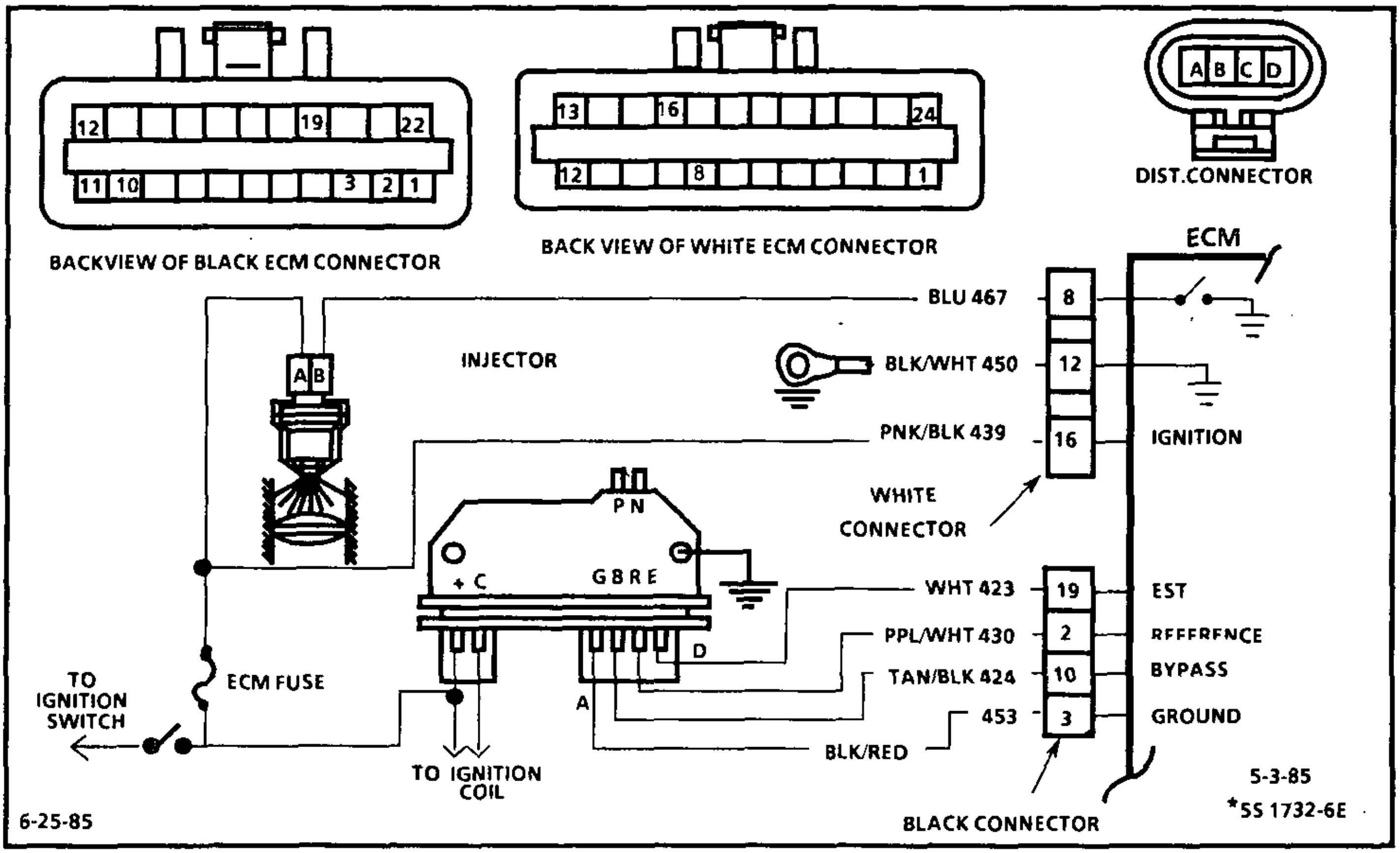


CHART A-3

ENGINE CRANKS BUT WON'T RUN

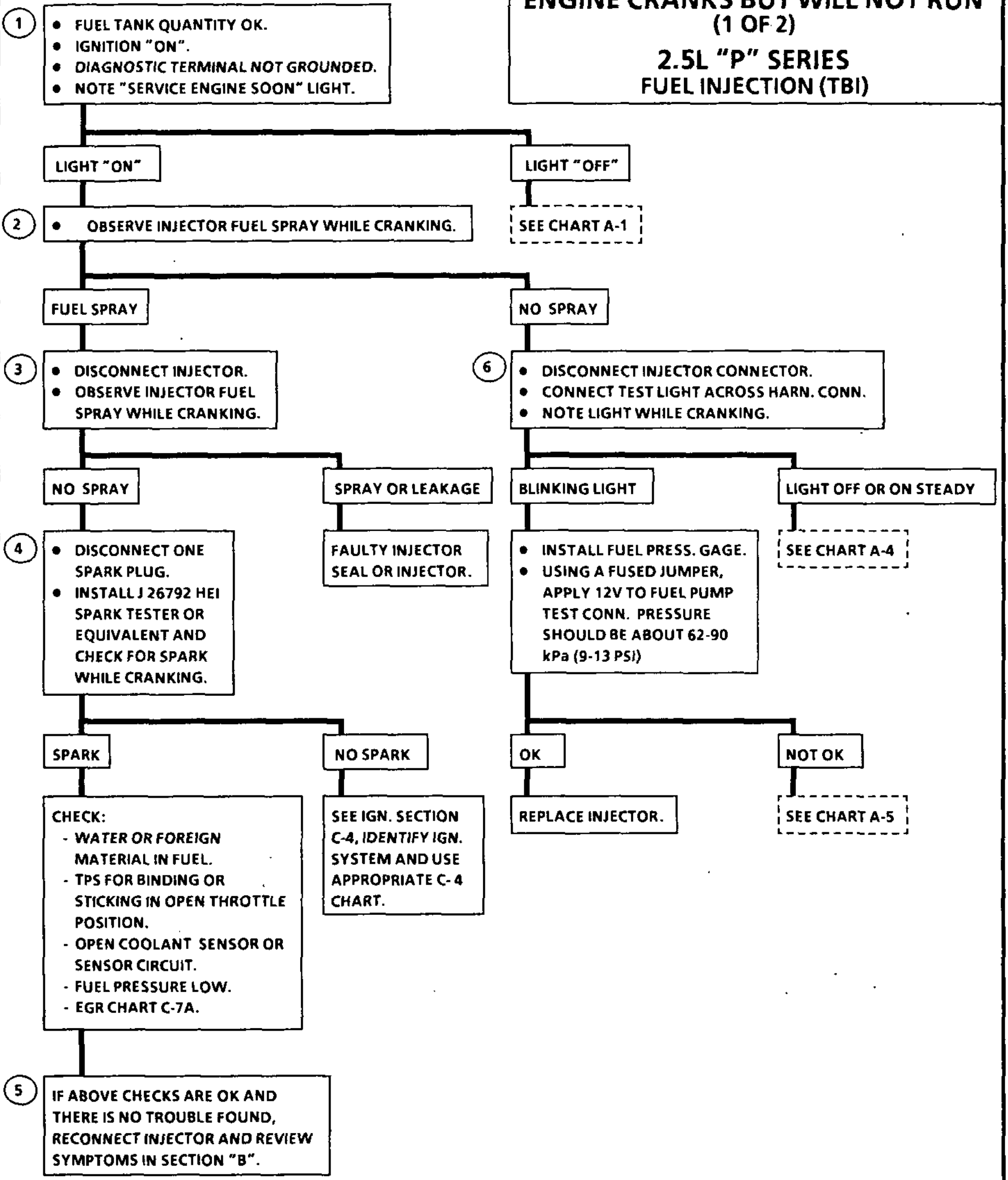
2.5L "P" SERIES FUEL INJECTION (TBI)

1. A "SERVICE ENGINE SOON" light "on" is a basic check for ignition and battery supply to the Electronic Control Module (ECM).
2. Fuel Spray from the injector indicates that fuel is available.However, the engine could be severely flooded due too much fuel.
3. While cranking engine there should be no fuel spray with injector disconnected. Replace the injector if it sprays fuel or drips like a leaking water faucet.
4. At this point the fuel system appears to be operating normally. Voltage at the spark plugs is checked using a ST-125 Spark Gap Tool.No spark indicates a basic HEI problem. If spark is OK the following checks should be made.
   - Throttle Position Sensor (TPS): If the sensor is sticking or binding in the wide open throttle position, the ECM will be in the 'Clear Flood' mode. The air/fuel ratio will be 18:1 to 20:1, and this may be too lean to start a cold engine.
   - Coolant Sensor: If the sensor signal circuit "opens" with ignition off, the ECM will think the coolant temperature is -40°F,(-40°C) and provide fuel for this,extremely cold temperature. The engine will be severely flooded because the ECM cannot recognize an open coolant circuit until the engine has been running for 1 minute or more.
   - Water or foreign material can cause a no start during freezing weather. The engine may start after 5 or 6 minutes in a heated shop. The problem may not reoccur until an overnight park in freezing temperatures.
   - An EGR sticking open can cause a high 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.
   - Fuel pressure: Low fuel pressure or volume can result in a very lean air/fuel ratio. See Chart A-5.
5. The system should be considered OK if no trouble was found. Reconnect injector and review Symptoms in section B for possible mechanical problems
6. No fuel spray from injector indicates a faulty fuel system 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 bulb should be an 1847 (6.3V) or equivalent.

CHART A-3

ENGINE CRANKS BUT WILL NOT RUN
(1 OF 2)

2.5L "P" SERIES
FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

9-19-85
4S 0802-6EA

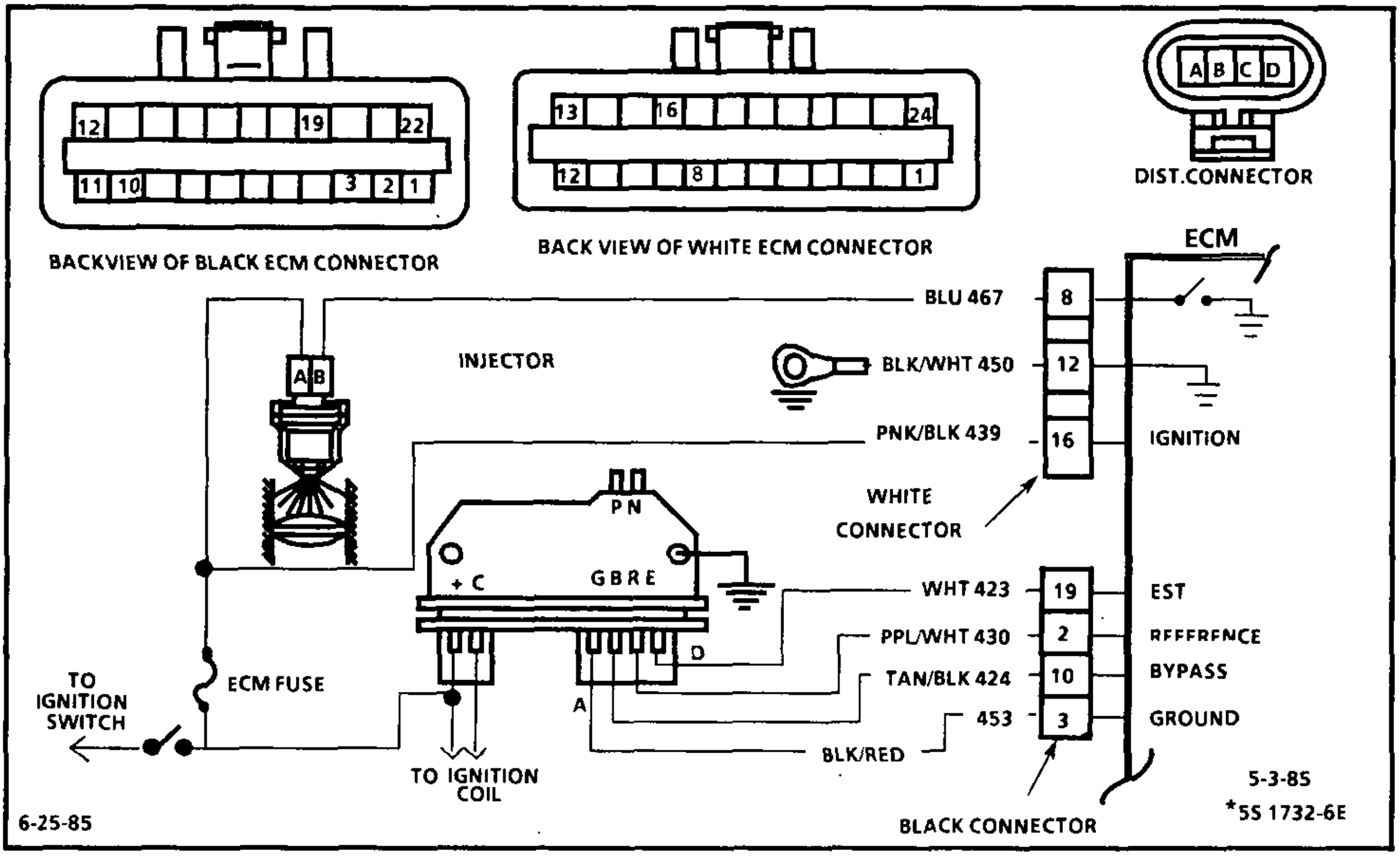


CHART A-4

ENGINE CRANKS BUT WON'T RUN

2.5L "P" SERIES

FUEL INJECTION (TBI)

7. Circuit 439 supplies ignition voltage to the injector. Probe each connector terminal with a test light to ground. There should be a light on one terminal, confirming ignition voltage at the connector. The ECM injector control circuit 467 may be open. Reconnect the injector, and using a light connected to ground, check for a light at the white ECM connector terminal "8". A light at this point indicates that the injector drive circuit is OK.

8. No blinking light indicates no ECM control of injector. With the voltmeter selector switch in the "AC" Volts position, and voltage scale switch in the 2 volts range, voltage should be greater than .7 volt AC normally reads about 1.4 volts AC. If the voltage is less than .7 volts AC there is an open or short to ground in HEI reference circuit 430. If the circuit is OK, there is a basic HEI problem. See Section 6D.

8A. Alternate procedure. Disconnect distributor connector. Momentarily touch ECM side of connector, reference CKT 430, with a test light to 12 volts. Note injector as contact is made. Each time test light momentarily contacts CKT 430, the injector should "turn on". If injector "turns on", the ECM injector control circuit is OK. Connect spark tester J-26792 (ST-125) or equivalent and check for "spark". If spark is OK, it is a faulty HEI module, no spark indicates a basic HEI problem. See Chart C4-B.

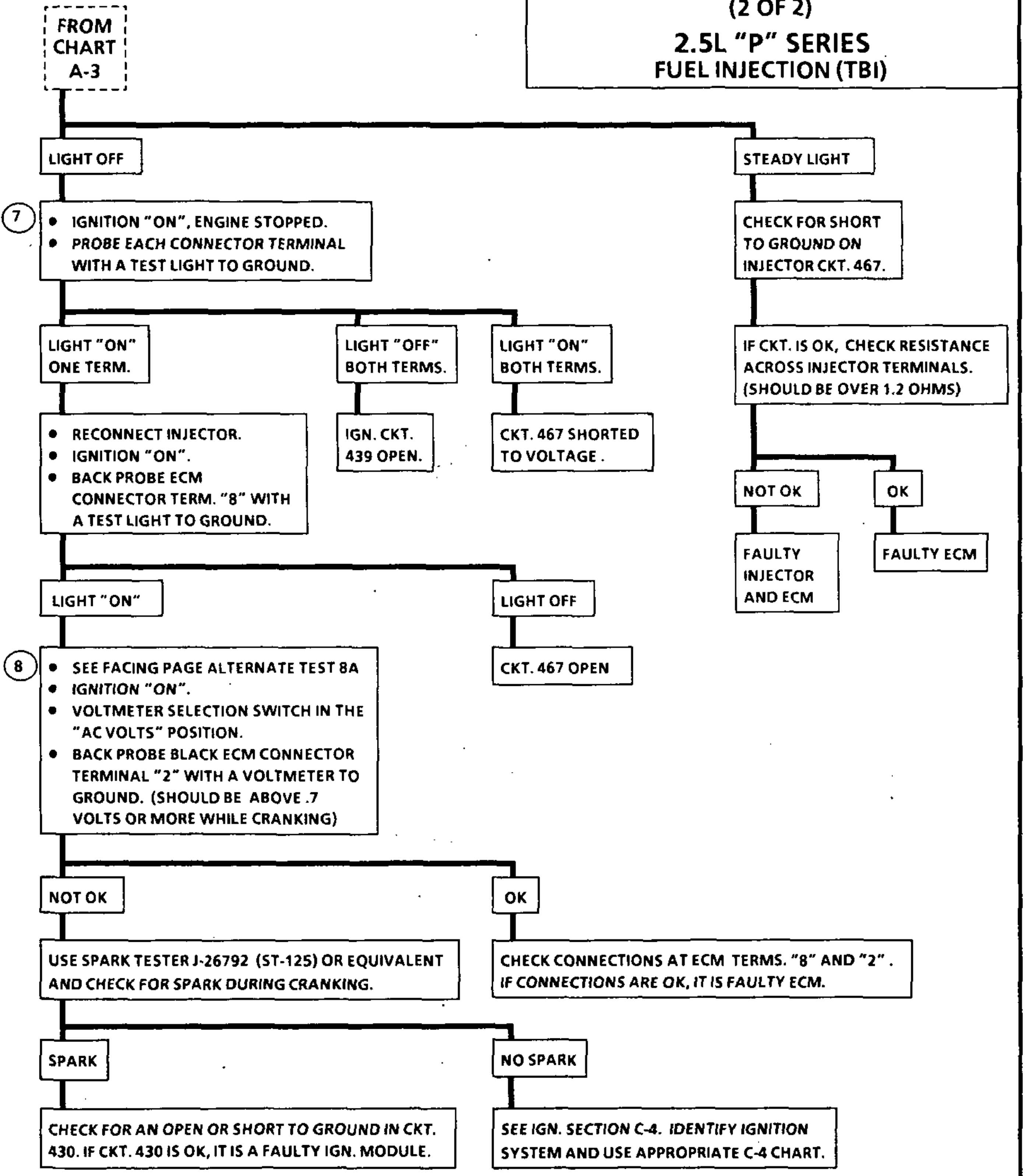
CHART A-4

ENGINE CRANKS BUT WILL NOT RUN

(2 OF 2)

2.5L "P" SERIES

FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

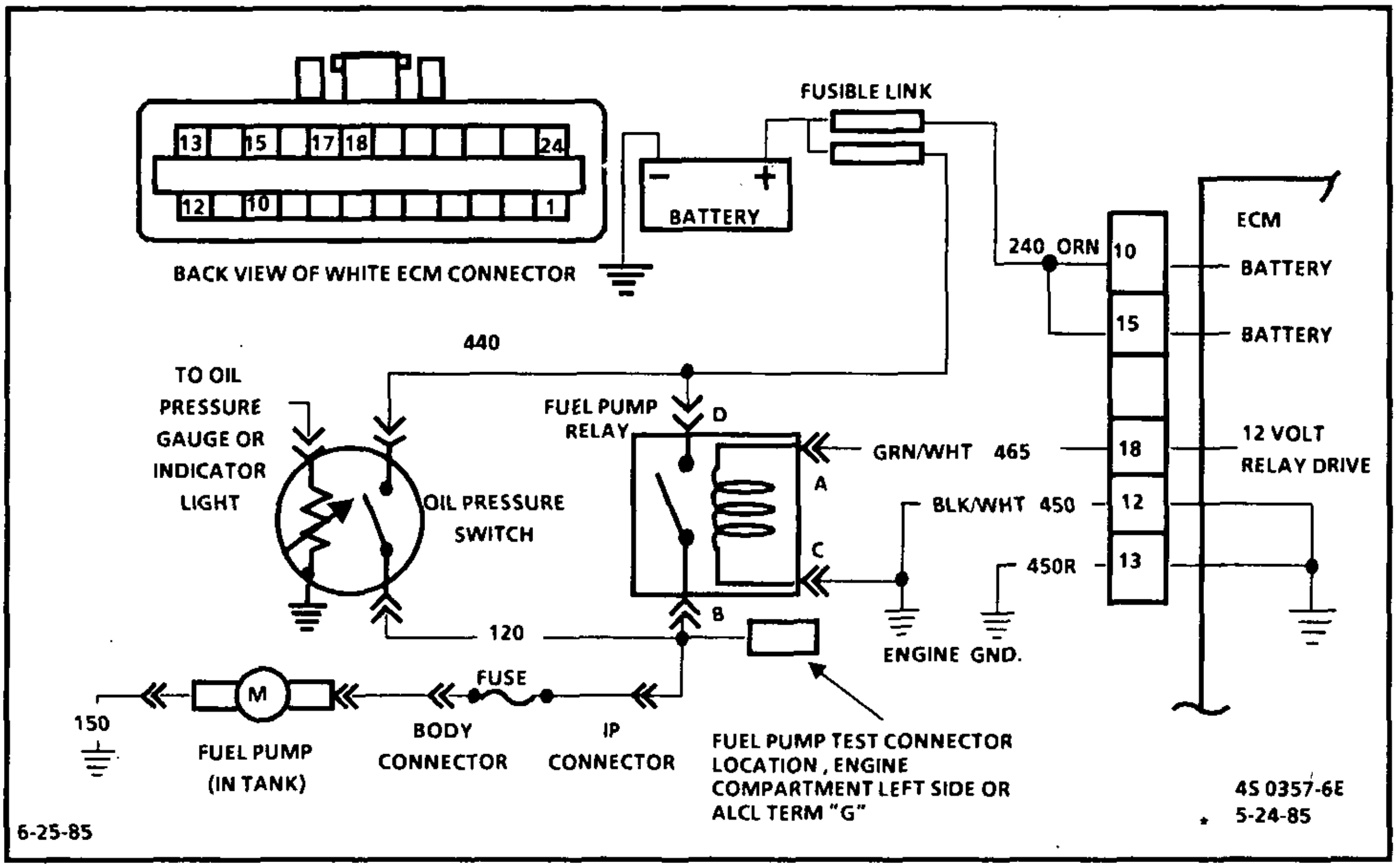


CHART A-5

FUEL SYSTEM DIAGNOSIS

2.5L "P" SERIES

FUEL INJECTION (TBI)

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 recieving HEI distributor 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.

Improper fuel system pressure will result in one or all 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.

1. Determines if the pump circuit is ECM controlled. The ECM will turn "ON" the pump relay. Engine is not cranking or running so the ECM will turn OFF" the relay within 2 seconds after ignition is turned "ON".
2. If the fuse is blown, this test will confirm a short to ground on circuit 120. To prevent misdiagnosis, be sure fuel pump is disconnected before test.
3. Turns "ON" the fuel pump if circuit 120 wiring is OK. If the pump runs, it is a basic fuel delivery problem which the following steps will locate.
4. Checks for battery voltage at the pump relay.

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.*

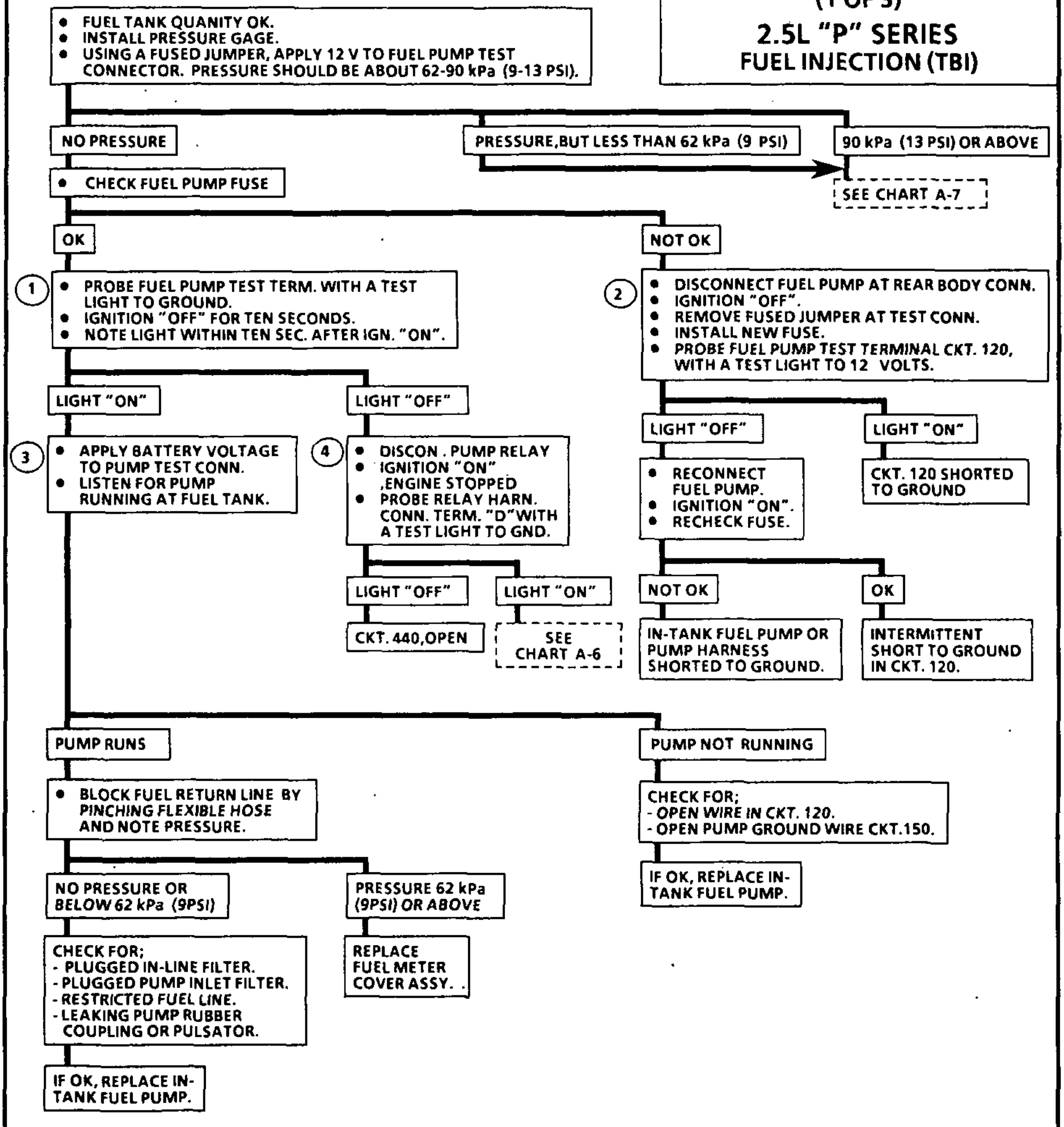
CHART A-5

FUEL SYSTEM DIAGNOSIS

(1 OF 3)

2.5L "P" SERIES

FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

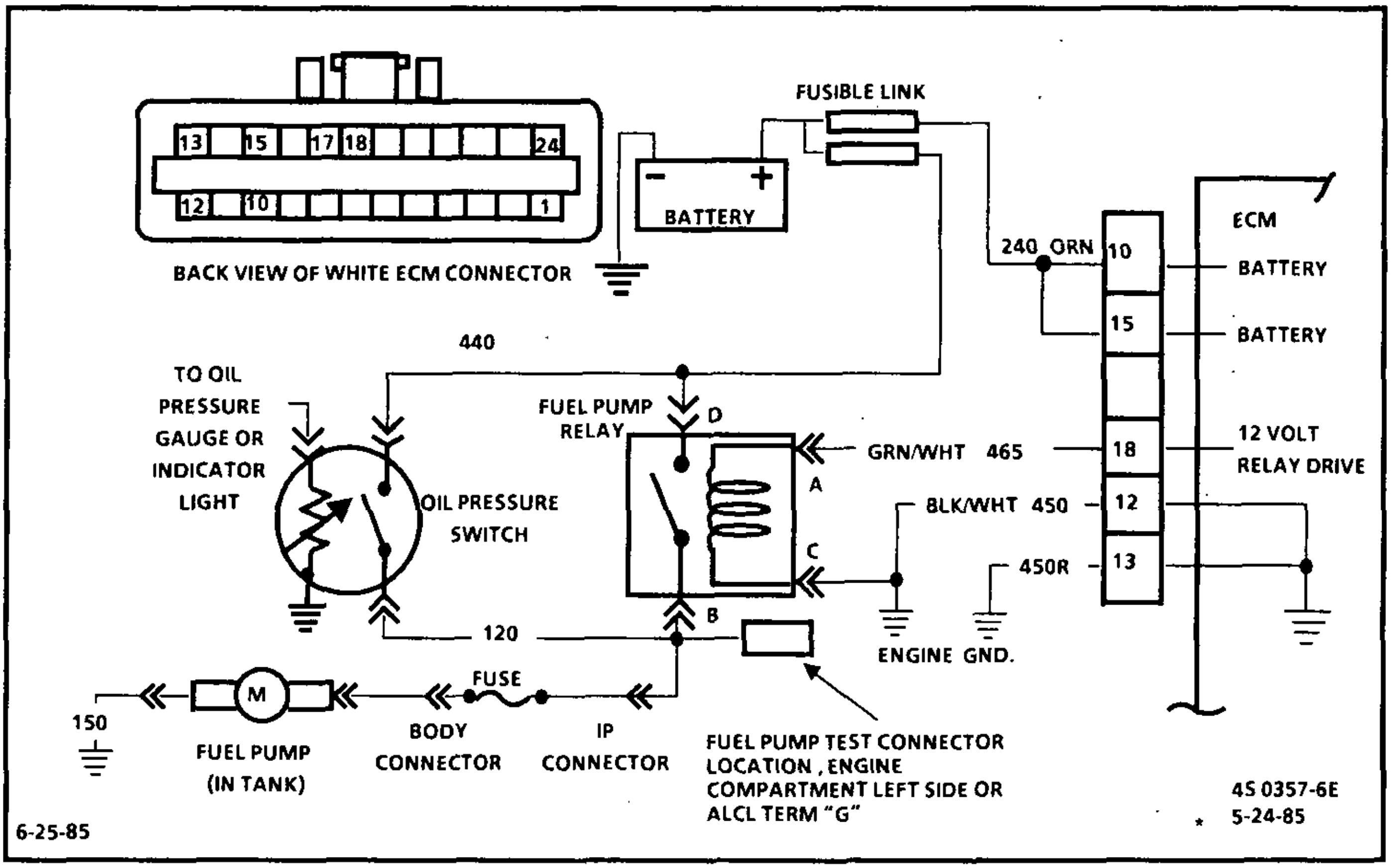


CHART A-6

FUEL SYSTEM DIAGNOSIS

2.5L "P" SERIES

FUEL INJECTION (TBI)

5. Checks relay ground CKT 450.
6. Checks for ECM control of relay through CKT 465.
7. The fuel pump voltage control circuit includes an engine oil pressure switch with a seperate set of normally open contacts. The switch closes at about (4 lbs) 27 kPa of oil pressure and provides a second battery feed path to the fuel pump. If the relay fails, the pump will continue to run using the battery feed supplied by the closed oil pressure switch.

   A failed pump relay will result in extended engine crank time, because of the time required to build enough oil pressure to close the oil pressure switch and turn "ON" the fuel pump.There may be instances when the relay has failed but the engine will not crank fast enough to build enough oil pressure to close the switch. This or a faulty oil pressure switch can result in "Engine Cranks But Will Not Run".
8. Checks the oil pressure switch to be sure it provides battery feed to the fuel pump should the pump relay fail.
9. Checks for open oil pressure switch with ignition "OFF". Should the switch stick closed, the fuel pump will continue to run and discharge the battery.

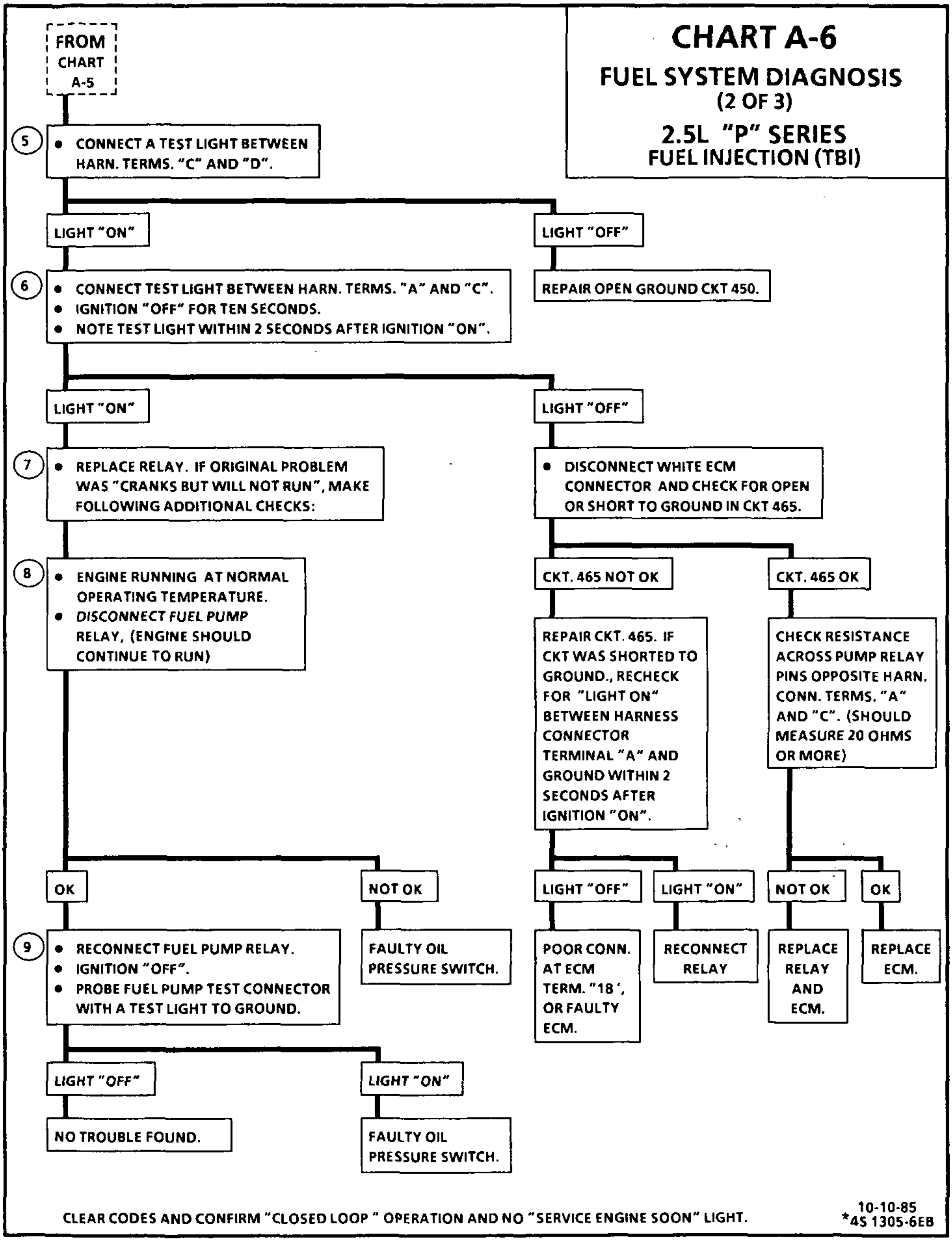


CHART A-6
FUEL SYSTEM DIAGNOSIS
(2 OF 3)
2.5L "P" SERIES FUEL INJECTION (TBI)

FROM CHART A-5

⑤
- CONNECT A TEST LIGHT BETWEEN HARN. TERMS. "C" AND "D".

LIGHT "ON"

⑥
- CONNECT TEST LIGHT BETWEEN HARN. TERMS. "A" AND "C".
- IGNITION "OFF" FOR TEN SECONDS.
- NOTE TEST LIGHT WITHIN 2 SECONDS AFTER IGNITION "ON".

LIGHT "OFF"

REPAIR OPEN GROUND CKT 450.

LIGHT "ON"

⑦
- REPLACE RELAY. IF ORIGINAL PROBLEM WAS "CRANKS BUT WILL NOT RUN", MAKE FOLLOWING ADDITIONAL CHECKS:

⑧
- ENGINE RUNNING AT NORMAL OPERATING TEMPERATURE.
- *DISCONNECT FUEL PUMP RELAY,* (ENGINE SHOULD CONTINUE TO RUN)

OK

⑨
- RECONNECT FUEL PUMP RELAY.
- IGNITION "OFF".
- PROBE FUEL PUMP TEST CONNECTOR WITH A TEST LIGHT TO GROUND.

LIGHT "OFF"

NO TROUBLE FOUND.

LIGHT "ON"

FAULTY OIL PRESSURE SWITCH.

NOT OK

FAULTY OIL PRESSURE SWITCH.

LIGHT "OFF"

- DISCONNECT WHITE ECM CONNECTOR AND CHECK FOR OPEN OR SHORT TO GROUND IN CKT 465.

CKT. 465 NOT OK

REPAIR CKT. 465. IF CKT WAS SHORTED TO GROUND., RECHECK FOR "LIGHT ON" BETWEEN HARNESS CONNECTOR TERMINAL "A" AND GROUND WITHIN 2 SECONDS AFTER IGNITION "ON".

LIGHT "OFF"

POOR CONN. AT ECM TERM. "18', OR FAULTY ECM.

LIGHT "ON"

RECONNECT RELAY

CKT. 465 OK

CHECK RESISTANCE ACROSS PUMP RELAY PINS OPPOSITE HARN. CONN. TERMS. "A" AND "C". (SHOULD MEASURE 20 OHMS OR MORE)

NOT OK

REPLACE RELAY AND ECM.

OK

REPLACE ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-10-85
*4S 1305-6EB

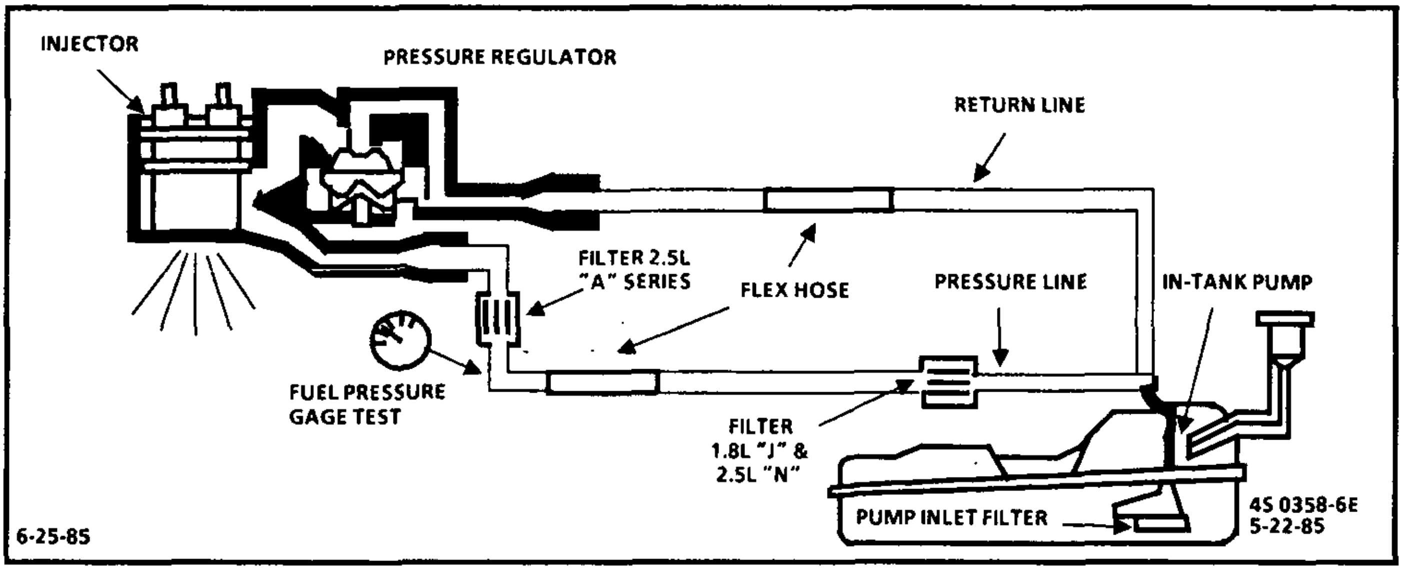


CHART A-7

FUEL SYSTEM DIAGNOSIS

(3 OF 3)

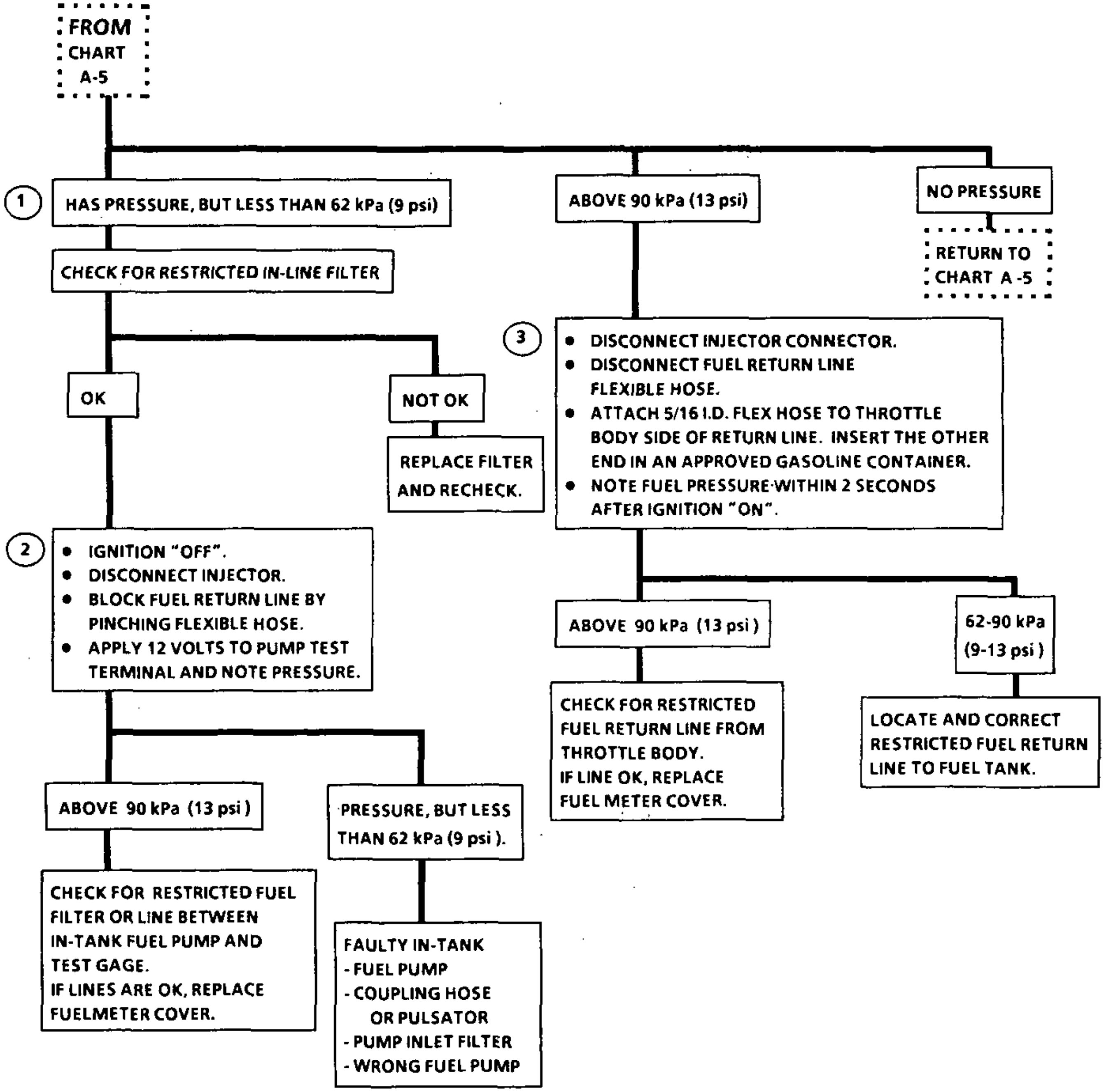
2.5L "P" SERIES

FUEL INJECTION (TBI)

1. Pressure but, less than 62 kPa (9 psi) falls into two areas:
    - Regulated pressure but less than 62 kPa (9 psi)- Amount of fuel to injector OK but, pressure is too low. System will be lean running 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.
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
FUEL SYSTEM DIAGNOSIS
(3 OF 3)
2.5L "P" SERIES
FUEL INJECTION (TBI)

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-5

① HAS PRESSURE, BUT LESS THAN 62 kPa (9 psi)

CHECK FOR RESTRICTED IN-LINE FILTER

OK

NOT OK

REPLACE FILTER AND RECHECK.

②
- IGNITION "OFF".
- DISCONNECT INJECTOR.
- BLOCK FUEL RETURN LINE BY PINCHING FLEXIBLE HOSE.
- APPLY 12 VOLTS TO PUMP TEST TERMINAL AND NOTE PRESSURE.

ABOVE 90 kPa (13 psi)

CHECK FOR RESTRICTED FUEL FILTER OR LINE BETWEEN IN-TANK FUEL PUMP AND TEST GAGE. IF LINES ARE OK, REPLACE FUELMETER COVER.

PRESSURE, BUT LESS THAN 62 kPa (9 psi).

FAULTY IN-TANK
- FUEL PUMP
- COUPLING HOSE OR PULSATOR
- PUMP INLET FILTER
- WRONG FUEL PUMP

ABOVE 90 kPa (13 psi)

③
- DISCONNECT INJECTOR CONNECTOR.
- DISCONNECT FUEL RETURN LINE FLEXIBLE HOSE.
- ATTACH 5/16 I.D. FLEX HOSE TO THROTTLE BODY SIDE OF RETURN LINE. INSERT THE OTHER END IN AN APPROVED GASOLINE CONTAINER.
- NOTE FUEL PRESSURE WITHIN 2 SECONDS AFTER IGNITION "ON".

ABOVE 90 kPa (13 psi)

CHECK FOR RESTRICTED FUEL RETURN LINE FROM THROTTLE BODY. IF LINE OK, REPLACE FUEL METER COVER.

62-90 kPa (9-13 psi)

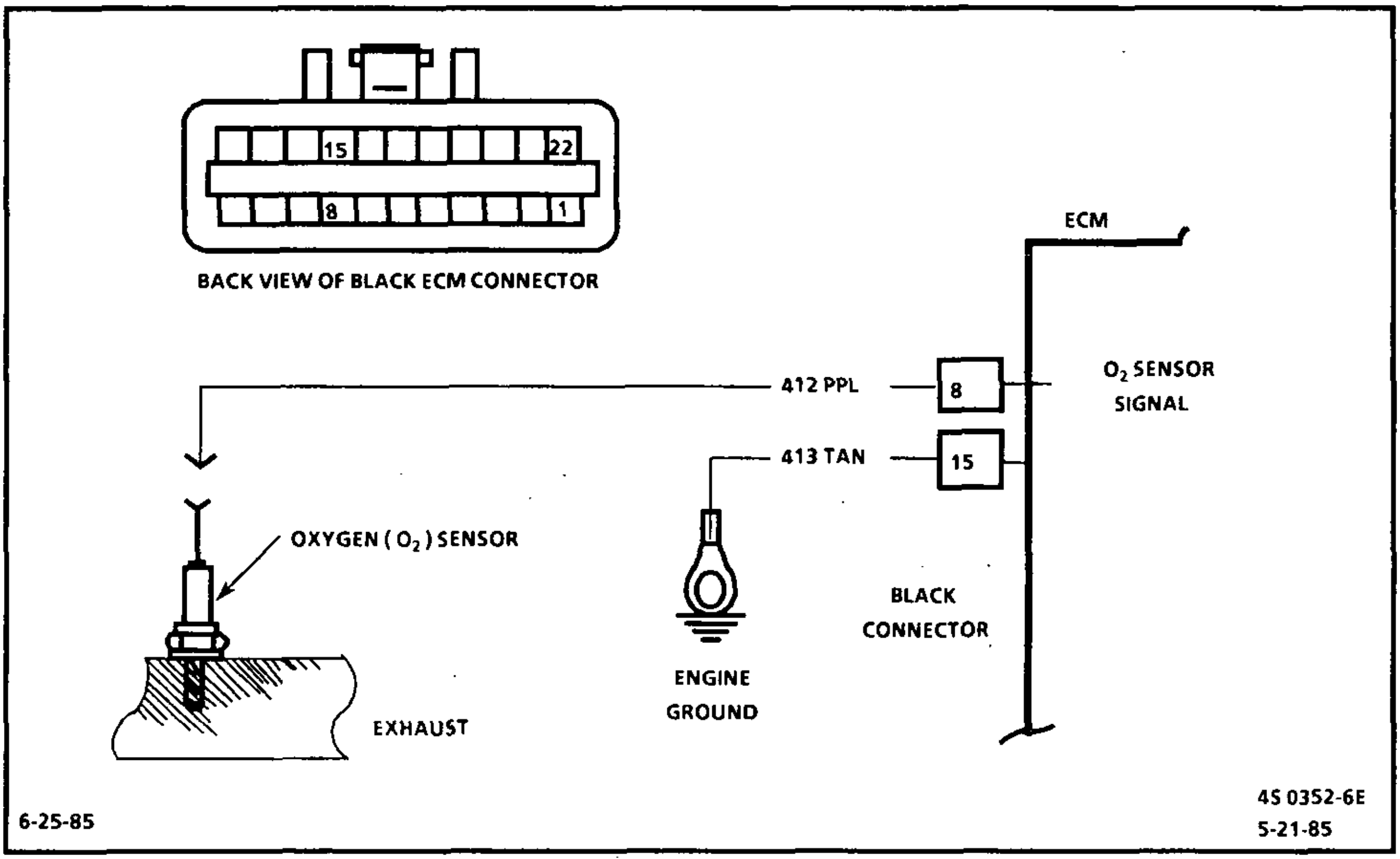
LOCATE AND CORRECT RESTRICTED FUEL RETURN LINE TO FUEL TANK.

NO PRESSURE

RETURN TO CHART A-5

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 1306-6EA
6-04-85



CODE 13

OXYGEN SENSOR CIRCUIT

2.5L "P" SERIES

FUEL INJECTION (TBI)

Code 13 WILL SET:

- At least two minutes engine time after start.
- O_2 signal voltage steady between .35 and .55 volts for more than one minute.
- Throttle position sensor signal above 6% (About 1600 RPM).

The ECM supplies a voltage of about .45 volt between terminals "8" and "15". (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The 0_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 310°C (600°F). An open sensor circuit or cold sensor causes open loop operation.

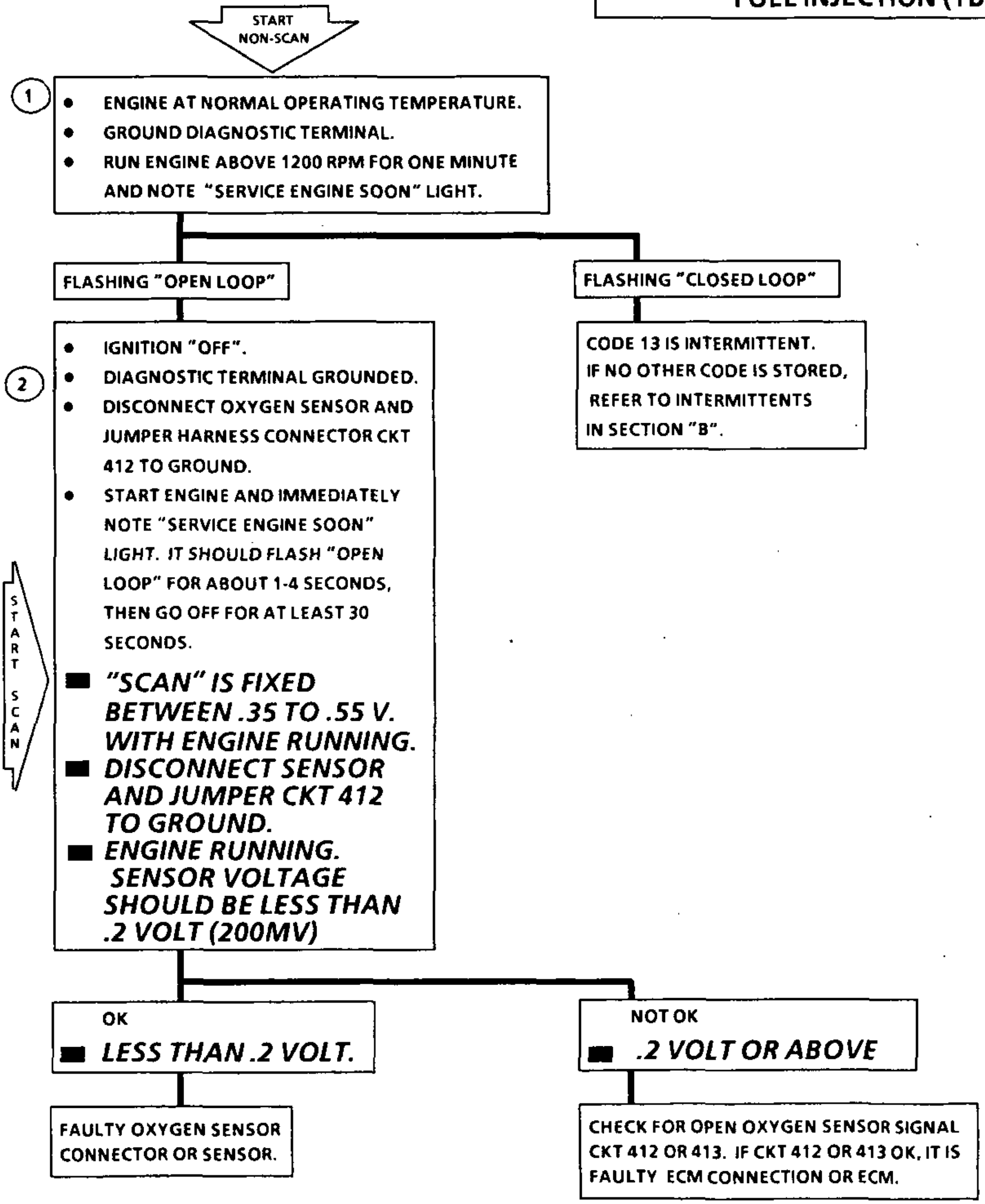
1. Grounding the diagnostic terminal with the engine running enables the "Field Service Mode", which allows the ECM to confirm either open or closed loop operation using the "SERVICE ENGINE SOON" light.
2. This step simulates a lean exhaust. If the ECM and wiring are OK the ECM will see the lean condition and turn the "SERVICE ENGINE SOON" light off for at least 30 seconds after engine start, and then flash "open loop". It should be considered normal if the light remains off for a longer period of time before flashing open loop.

"SCAN" STEP ONLY ■

CODE 13

OPEN OXYGEN SENSOR CIRCUIT

2.5L "P" SERIES
FUEL INJECTION (TBI)



START NON-SCAN

①
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- GROUND DIAGNOSTIC TERMINAL.
- RUN ENGINE ABOVE 1200 RPM FOR ONE MINUTE AND NOTE "SERVICE ENGINE SOON" LIGHT.

FLASHING "OPEN LOOP"

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR AND JUMPER HARNESS CONNECTOR CKT 412 TO GROUND.
- START ENGINE AND IMMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT. IT SHOULD FLASH "OPEN LOOP" FOR ABOUT 1-4 SECONDS, THEN GO OFF FOR AT LEAST 30 SECONDS.

START SCAN

■ *"SCAN" IS FIXED BETWEEN .35 TO .55 V. WITH ENGINE RUNNING.*

■ *DISCONNECT SENSOR AND JUMPER CKT 412 TO GROUND.*

■ *ENGINE RUNNING. SENSOR VOLTAGE SHOULD BE LESS THAN .2 VOLT (200MV)*

OK

■ *LESS THAN .2 VOLT.*

FAULTY OXYGEN SENSOR CONNECTOR OR SENSOR.

NOT OK

■ *.2 VOLT OR ABOVE*

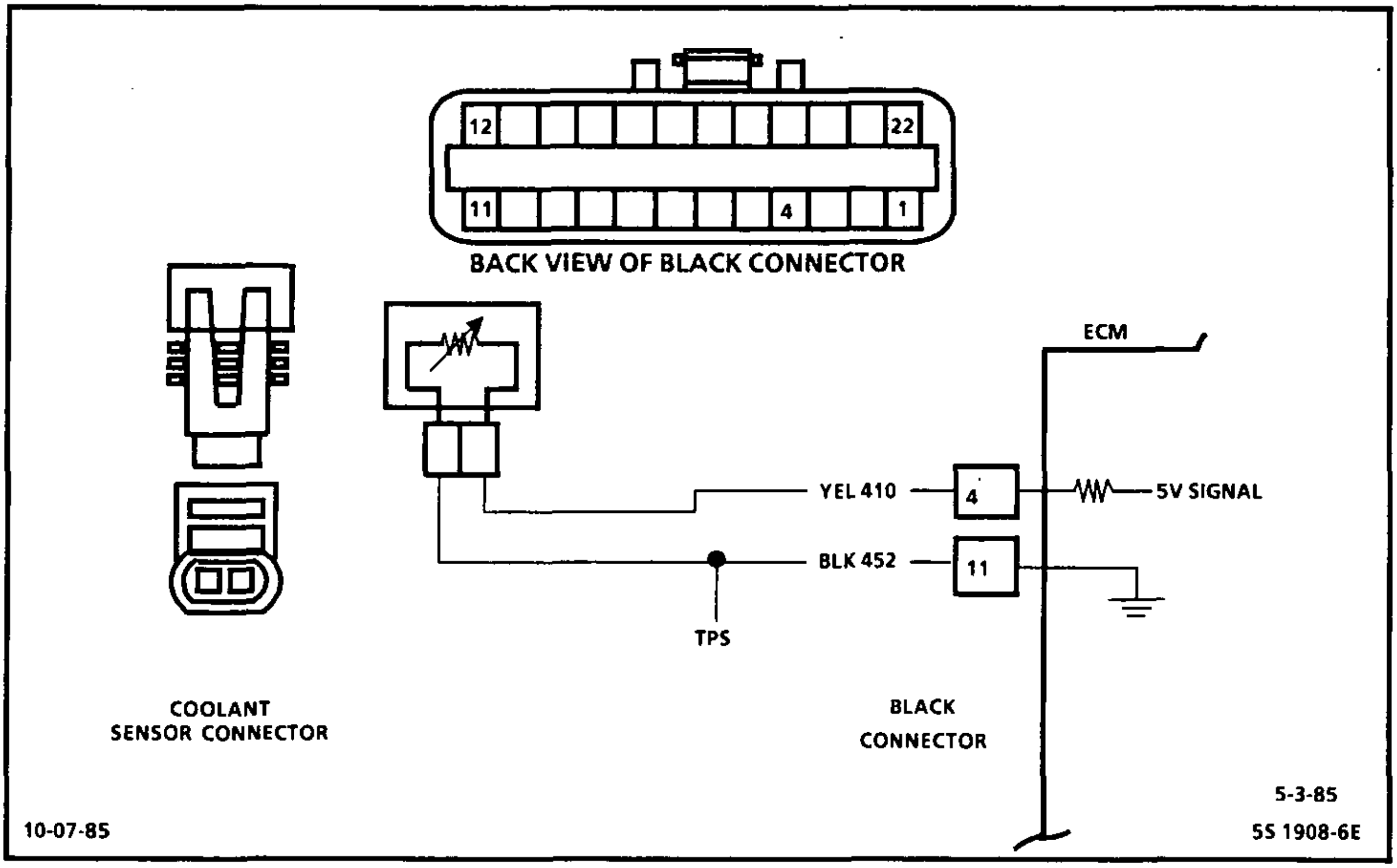
CHECK FOR OPEN OXYGEN SENSOR SIGNAL CKT 412 OR 413. IF CKT 412 OR 413 OK, IT IS FAULTY ECM CONNECTION OR ECM.

FLASHING "CLOSED LOOP"

CODE 13 IS INTERMITTENT. IF NO OTHER CODE IS STORED, REFER TO INTERMITTENTS IN SECTION "B".

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 0839-6E
9-20-85



CODE 14

COOLANT SENSOR CIRCUIT

(SIGNAL VOLTAGE LOW)

2.5L "P" SERIES

FUEL INJECTION (TBI)

The Coolant 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 will measure about 1 to 1.5 volts at the ECM terminal 4.

Code 14 will set if signal voltage indicates a coolant temperature above 135°C (275°F) for more than four seconds.

Coolant temperature is one of the inputs used to control:

- Fuel delivery
- Engine Timing (EST)
- Idle (IAC)
- Convertor Clutch (TCC)

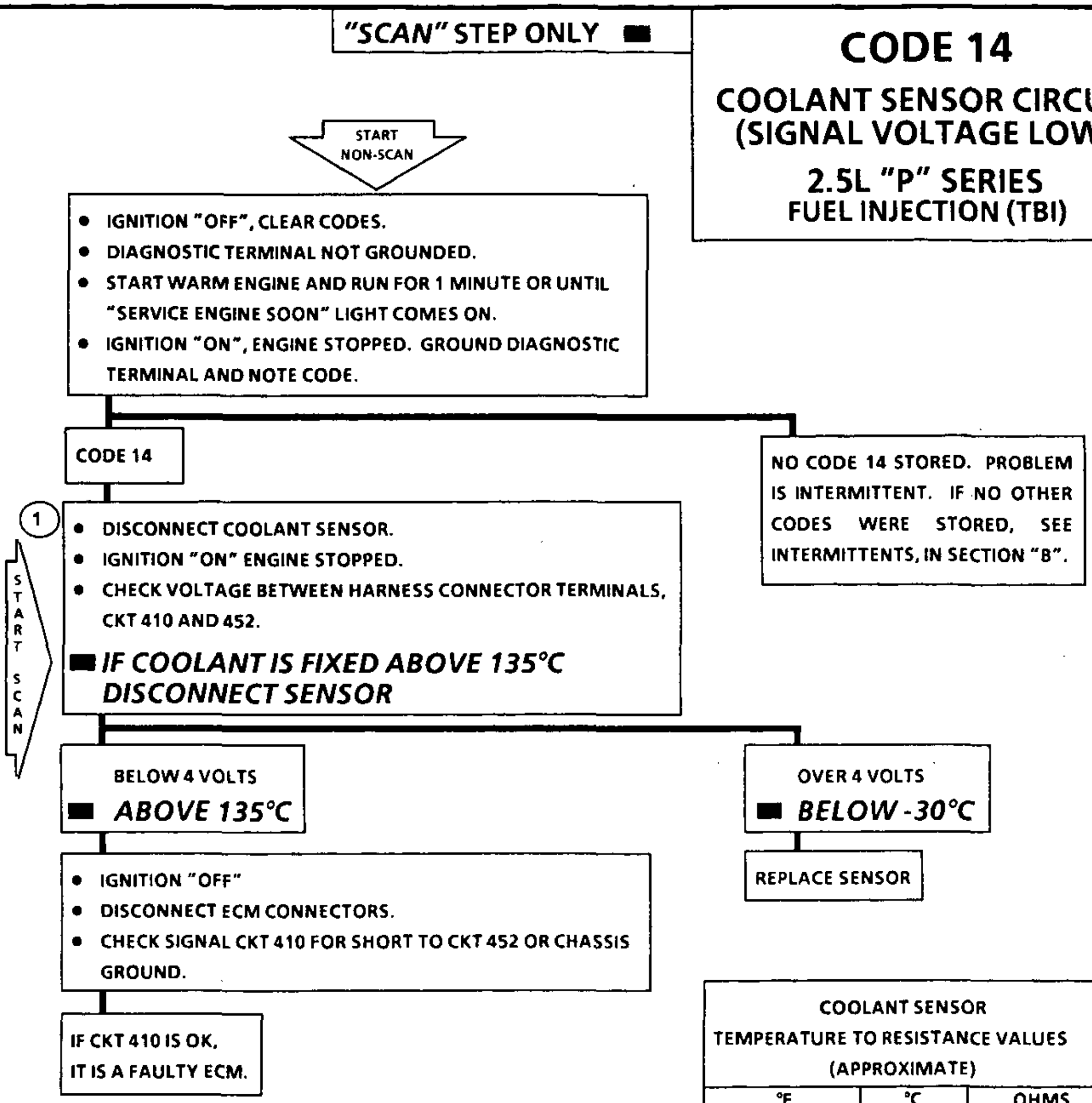
1. If voltage is above 4 volts, the ECM and wiring are OK.

   If checking resistance at the coolant sensor is difficult because of sensor location, disconnect the black ECM connector and check resistance between harness connector terminals 4 and 11.

CODE 14

COOLANT SENSOR CIRCUIT (SIGNAL VOLTAGE LOW)

2.5L "P" SERIES
FUEL INJECTION (TBI)



"SCAN" STEP ONLY ■

START NON-SCAN

- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START WARM ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED. GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 14

NO CODE 14 STORED. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE INTERMITTENTS, IN SECTION "B".

①

START SCAN

- DISCONNECT COOLANT SENSOR.
- IGNITION "ON" ENGINE STOPPED.
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINALS, CKT 410 AND 452.

■ *IF COOLANT IS FIXED ABOVE 135°C DISCONNECT SENSOR*

BELOW 4 VOLTS
■ *ABOVE 135°C*

OVER 4 VOLTS
■ *BELOW -30°C*

REPLACE SENSOR

- IGNITION "OFF"
- DISCONNECT ECM CONNECTORS.
- CHECK SIGNAL CKT 410 FOR SHORT TO CKT 452 OR CHASSIS GROUND.

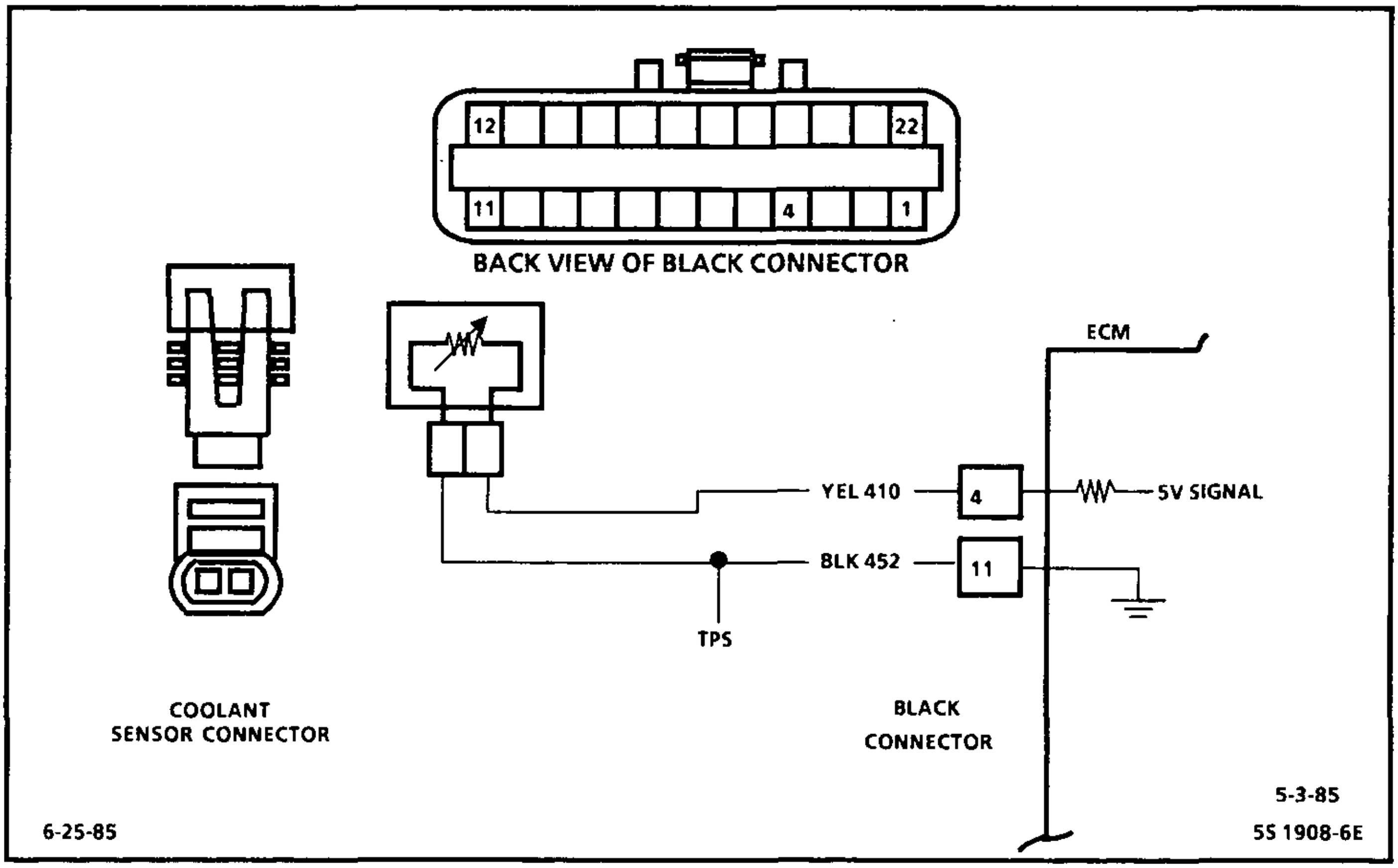
IF CKT 410 IS OK,
IT IS A FAULTY ECM.

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.

* 4S 0808-6E
4-19-85



CODE 15

COOLANT SENSOR CIRCUIT

(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES

FUEL INJECTION (TBI)

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 the voltage will measure about 1 to 1.5 volts at the ECM terminal 4.

Code 15 will set if:

- Signal voltage indicates a coolant temperature less than -30°C (-24°F) for 4 seconds.
- Time since engine start is more than 1 minute.

Coolant temperature is one of the inputs used to control:

- Fuel delivery.
- Engine Timing (EST)
- Idle (IAC)
- Convertor Clutch (TCC)

If the coolant CKT 410 opens with the ignition off, the ECM will see -40°C (-40°F) and deliver fuel for this temperature. If the actual temperature is above approx. -7°C (20°F) the engine will not start due to the rich mixture unless "Clear Flood" is used by fully depressing the accelerator. Engine will start using "Clear Flood" (which is Wide Open Throttle). However, "SERVICE ENGINE SOON" light will not come on, and code will not be stored, until engine has run for one minute.

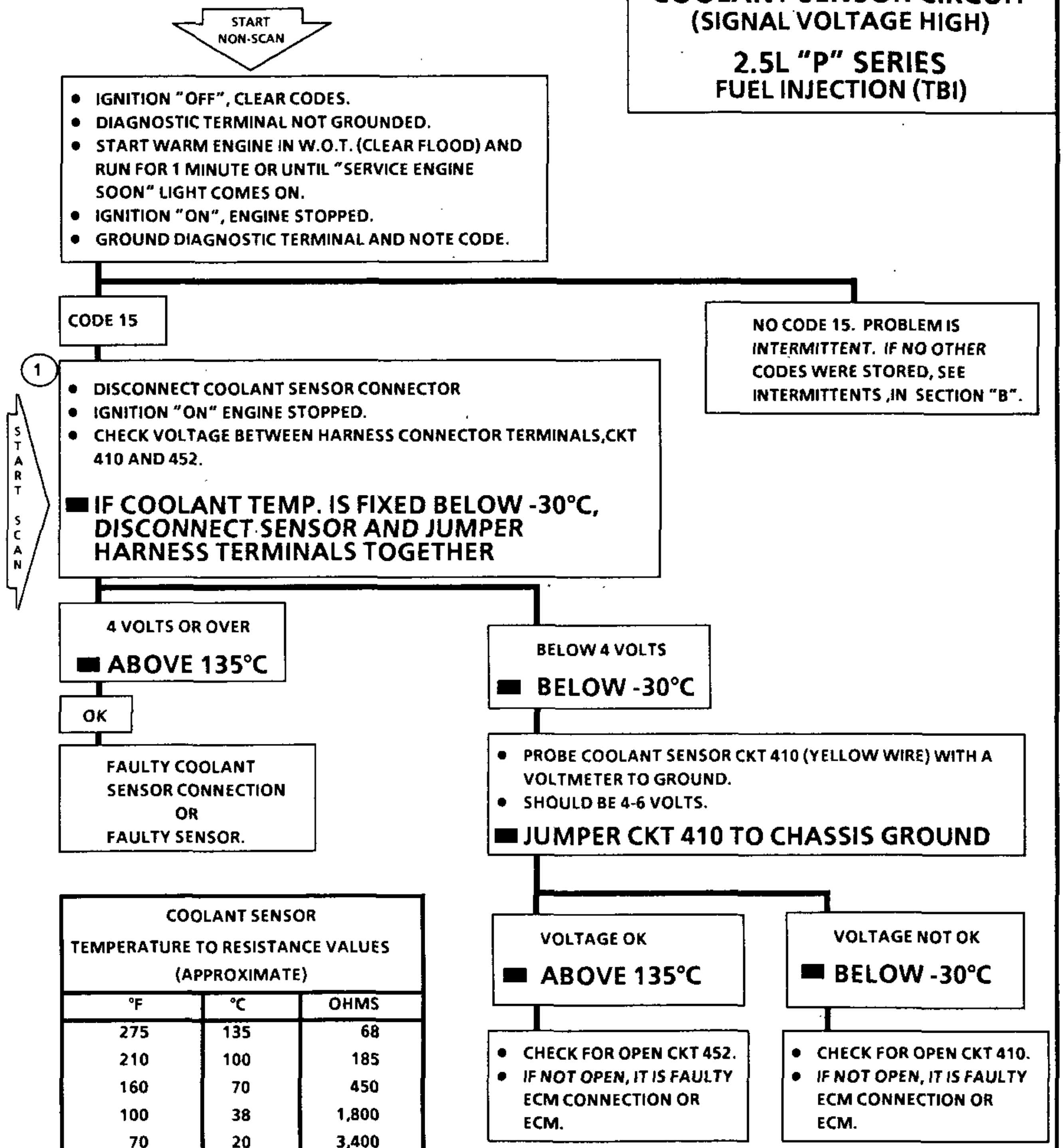
1. If voltage is above 4 volts, the ECM and wiring are OK. If checking resistance at the coolant sensor is difficult because of sensor location, disconnect black ECM connector and check resistance between connector terminals 4 and 11.

"SCAN" STEP ONLY ■

CODE 15

COOLANT SENSOR CIRCUIT
(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES
FUEL INJECTION (TBI)



- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START WARM ENGINE IN W.O.T. (CLEAR FLOOD) AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 15

NO CODE 15. PROBLEM IS *INTERMITTENT. IF NO OTHER* CODES WERE STORED, SEE INTERMITTENTS ,IN SECTION "B".

①
- DISCONNECT COOLANT SENSOR CONNECTOR
- IGNITION "ON" ENGINE STOPPED.
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINALS,CKT 410 AND 452.

■ IF COOLANT TEMP. IS FIXED BELOW -30°C, DISCONNECT SENSOR AND JUMPER HARNESS TERMINALS TOGETHER

4 VOLTS OR OVER

■ ABOVE 135°C

OK

FAULTY COOLANT SENSOR CONNECTION OR FAULTY SENSOR.

BELOW 4 VOLTS

■ BELOW -30°C

- PROBE COOLANT SENSOR CKT 410 (YELLOW WIRE) WITH A VOLTMETER TO GROUND.
- SHOULD BE 4-6 VOLTS.

■ JUMPER CKT 410 TO CHASSIS GROUND

VOLTAGE OK

■ ABOVE 135°C

- CHECK FOR OPEN CKT 452.
- *IF NOT OPEN, IT IS FAULTY* ECM CONNECTION OR ECM.

VOLTAGE NOT OK

■ BELOW -30°C

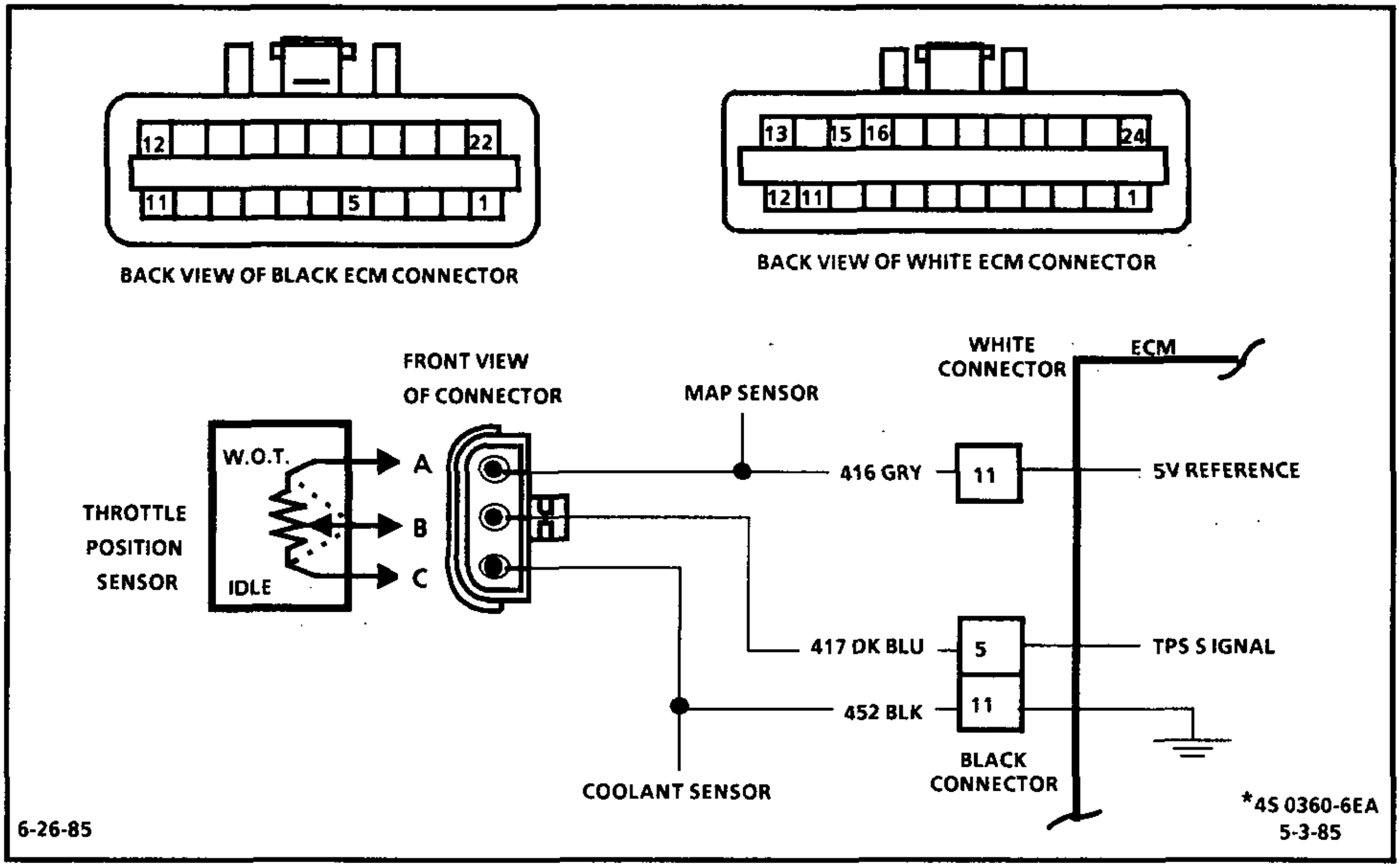
- CHECK FOR OPEN CKT 410.
- *IF NOT OPEN, IT IS FAULTY* ECM CONNECTION OR ECM.

COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
275	135	68
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
-22	-30	53,000
-40	-40	100,700

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 4S 0809-6EA
6-13-85



CODE 21

THROTTLE POSITION SENSOR

(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES

FUEL INJECTION (TBI)

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to the throttle valve. Signal voltage will vary from less than 1.25 volts at idle to 4.5 volts at wide open throttle and is non-adjustable.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Code 21 will set if:

- Engine RPM less than 1,000 A/T or 2,000 M/T.
- TPS signal voltage is greater than 2.5 volts for 2 seconds.
- MAP is less than 60 kPa (9 psi) or equal to a no load condition.

1. Confirms Code 21, and that fault is present.
2. Simulates Code 22: If the ECM recognizes the low signal voltage and sets Code 22 the ECM and wiring are OK.

CODE 21

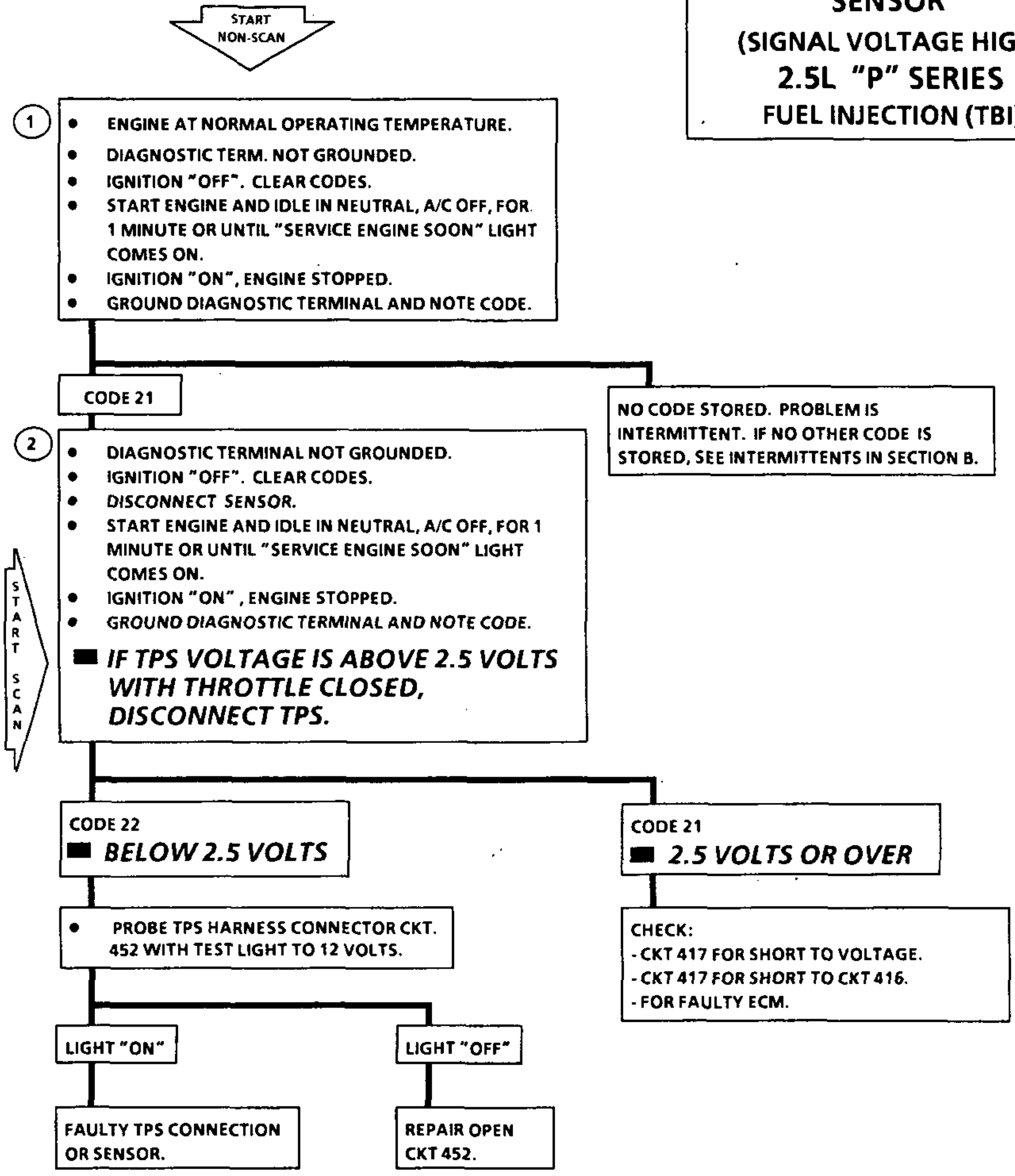
THROTTLE POSITION SENSOR

(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES

FUEL INJECTION (TBI)

"SCAN" STEP ONLY ■



START NON-SCAN

①
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- DIAGNOSTIC TERM. NOT GROUNDED.
- IGNITION "OFF". CLEAR CODES.
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 21

NO CODE STORED. PROBLEM IS INTERMITTENT. IF NO OTHER CODE IS STORED, SEE INTERMITTENTS IN SECTION B.

START SCAN

②
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF". CLEAR CODES.
- *DISCONNECT SENSOR.*
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- *GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.*

■ ***IF TPS VOLTAGE IS ABOVE 2.5 VOLTS WITH THROTTLE CLOSED, DISCONNECT TPS.***

CODE 22
■ ***BELOW 2.5 VOLTS***

CODE 21
■ ***2.5 VOLTS OR OVER***

- PROBE TPS HARNESS CONNECTOR CKT. 452 WITH TEST LIGHT TO 12 VOLTS.

CHECK:
- CKT 417 FOR SHORT TO VOLTAGE.
- CKT 417 FOR SHORT TO CKT 416.
- FOR FAULTY ECM.

LIGHT "ON"

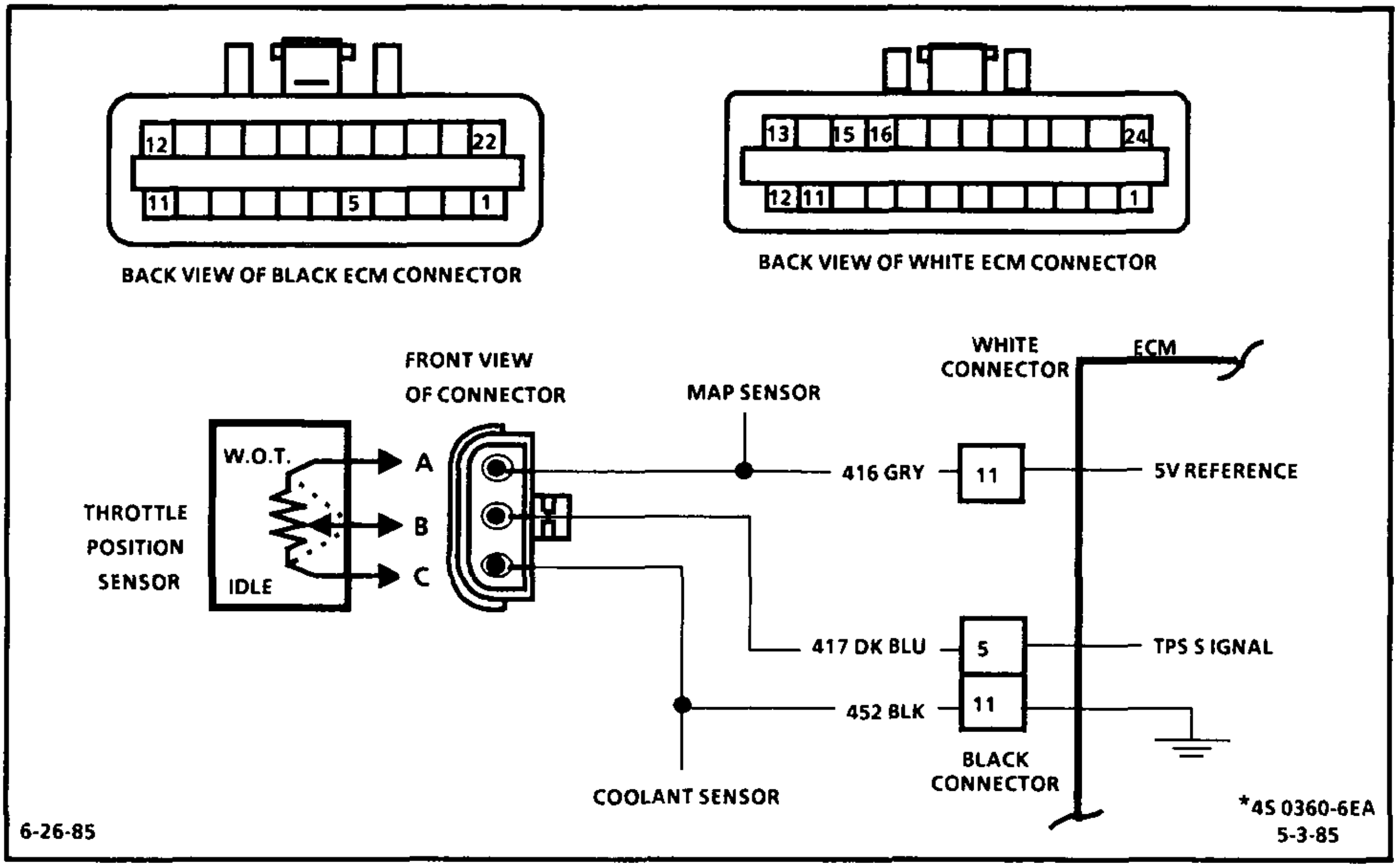
LIGHT "OFF"

FAULTY TPS CONNECTION OR SENSOR.

REPAIR OPEN CKT 452.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-29-85
*4S 0880-6E



CODE 22

THROTTLE POSITION SENSOR

(SIGNAL VOLTAGE LOW)

2.5L "P" SERIES

FUEL INJECTION (TBI)

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to the throttle valve. Signal voltage will vary from less than 1.25 volts at idle to about 4.5 volts at wide open throttle, and is non-adjustable.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Code 22 will set if:

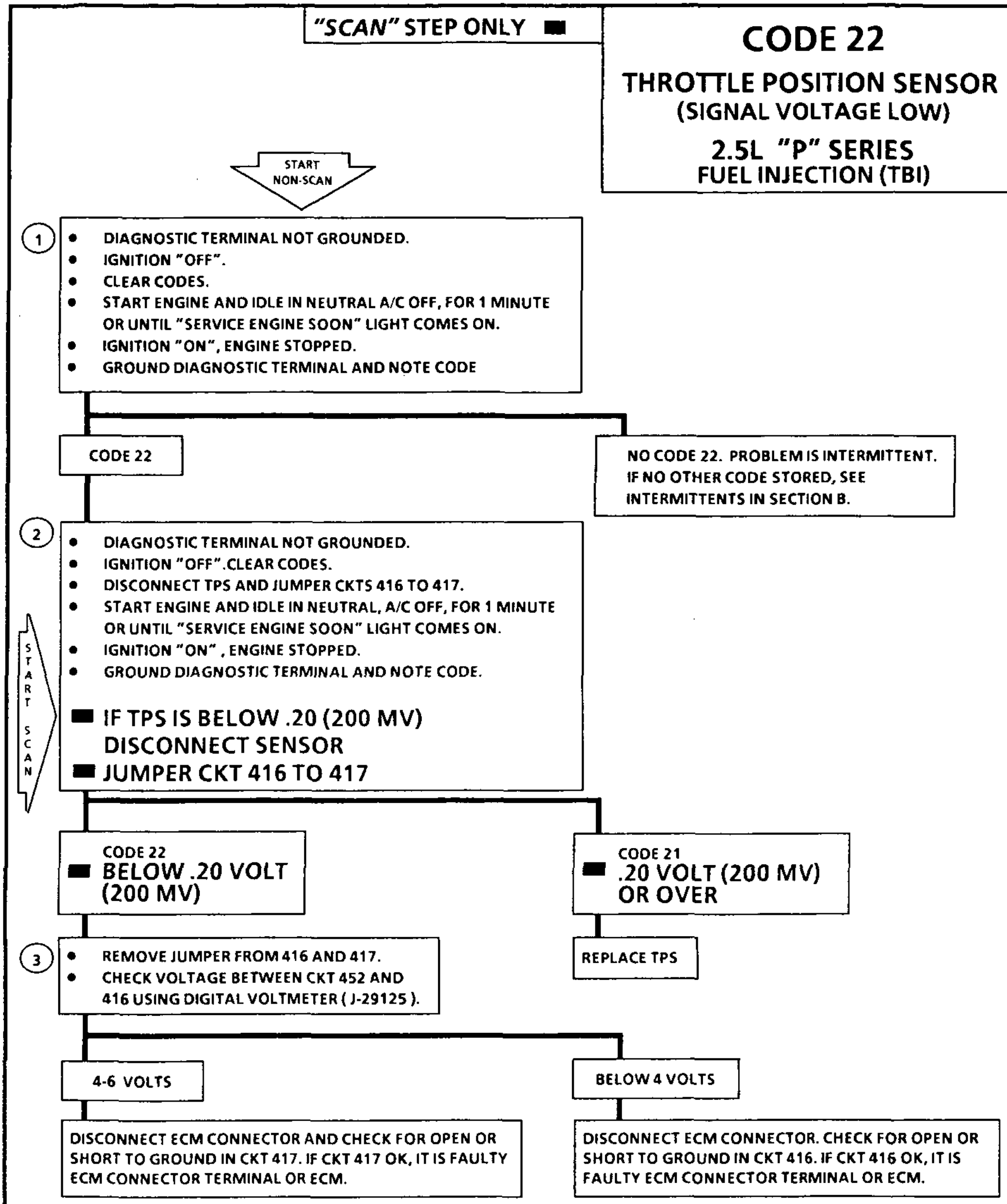
- Engine is running
- TPS signal voltage is less than .2 volts for 4 seconds

1. Confirms Code 22, and that fault is present.
2. Simulates Code 21: If the ECM recognizes the high signal voltage and sets Code 21 the ECM and wiring are OK.
3. Checks for reference voltage from the ECM. To prevent damage to ECM, be sure to disconnect ECM connector when checking circuit wiring for open or shorts to ground.

CODE 22

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE LOW)

2.5L "P" SERIES
FUEL INJECTION (TBI)



①
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF".
- CLEAR CODES.
- START ENGINE AND IDLE IN NEUTRAL A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE

CODE 22

NO CODE 22. PROBLEM IS INTERMITTENT. IF NO OTHER CODE STORED, SEE INTERMITTENTS IN SECTION B.

②
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF".CLEAR CODES.
- DISCONNECT TPS AND JUMPER CKTS 416 TO 417.
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF TPS IS BELOW .20 (200 MV) DISCONNECT SENSOR

■ JUMPER CKT 416 TO 417

CODE 22
■ BELOW .20 VOLT (200 MV)

CODE 21
■ .20 VOLT (200 MV) OR OVER

REPLACE TPS

③
- REMOVE JUMPER FROM 416 AND 417.
- CHECK VOLTAGE BETWEEN CKT 452 AND 416 USING DIGITAL VOLTMETER (J-29125).

4-6 VOLTS

DISCONNECT ECM CONNECTOR AND CHECK FOR OPEN OR SHORT TO GROUND IN CKT 417. IF CKT 417 OK, IT IS FAULTY ECM CONNECTOR TERMINAL OR ECM.

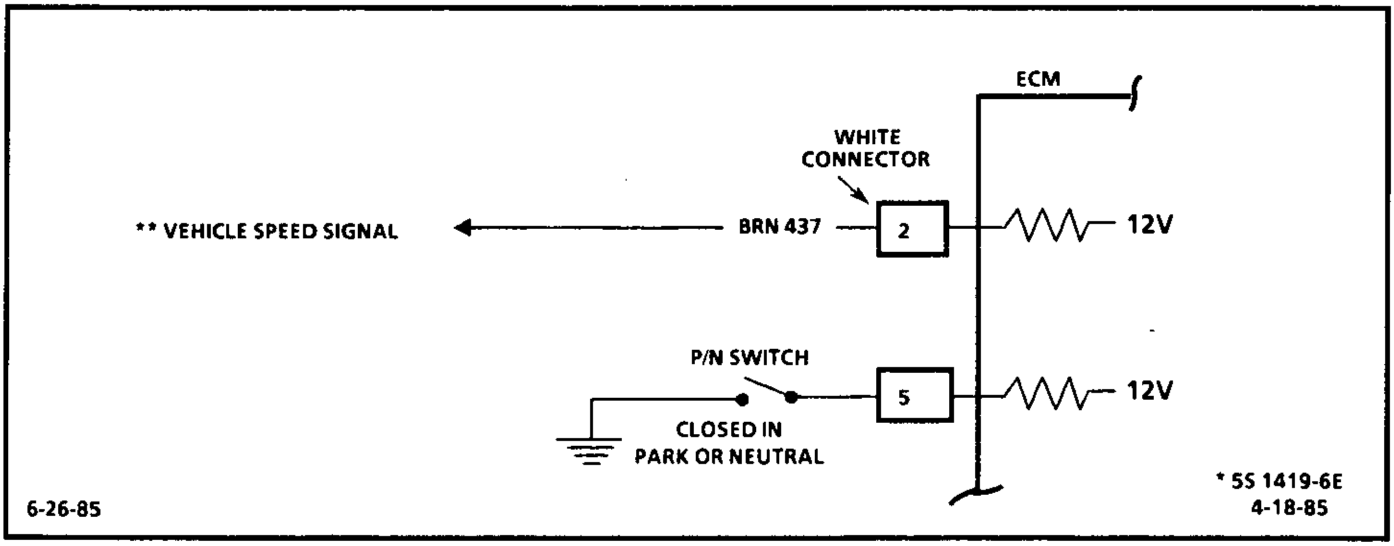
BELOW 4 VOLTS

DISCONNECT ECM CONNECTOR. CHECK FOR OPEN OR SHORT TO GROUND IN CKT 416. IF CKT 416 OK, IT IS FAULTY ECM CONNECTOR TERMINAL OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-10 85

*4S 0811-6E



CODE 24

VEHICLE SPEED SENSOR

2.5L "P" SERIES

FUEL INJECTION (TBI)

****NOTICE;**

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 a Code 24 set when drive wheels are not turning.

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".

1. This test monitors the ECM voltage on CKT 437. With the wheels turning, the pulsing action will result in a varying voltage.The variation will be greater at low wheel speeds to an average of 4-6 volts at about 20 mph.
2. A voltage of less than 1 volt at the ECM connector indicates that the CKT 437 wire is shorted to ground. Disconnect CKT 437 at the Vehicle Speed Sensor. If voltage now reads above 10 volts, the Vehicle Speed Sensor is faulty. Be sure that cruise control is "OFF" or disconnected. Some installations have a"splice" for the cruise control, which may supply a voltage to CKT 437. If voltage remains less than 10 volt, then CKT 437 wire is grounded. If 437 is not grounded, check for a faulty ECM connector or ECM.
3. A steady 8-12 volts at the ECM connector indicates CKT 437 is open or a faulty Vehicle Speed Sensor.
4. This normal voltage condition and indicates a possible intermittent condition - See "Intermittents" Section B.
5. If "Scan" displays vehicle speed, check park/neutral switch Chart C-1A on vehicle with automatic transmission. If switch is ok, check for intermittents.

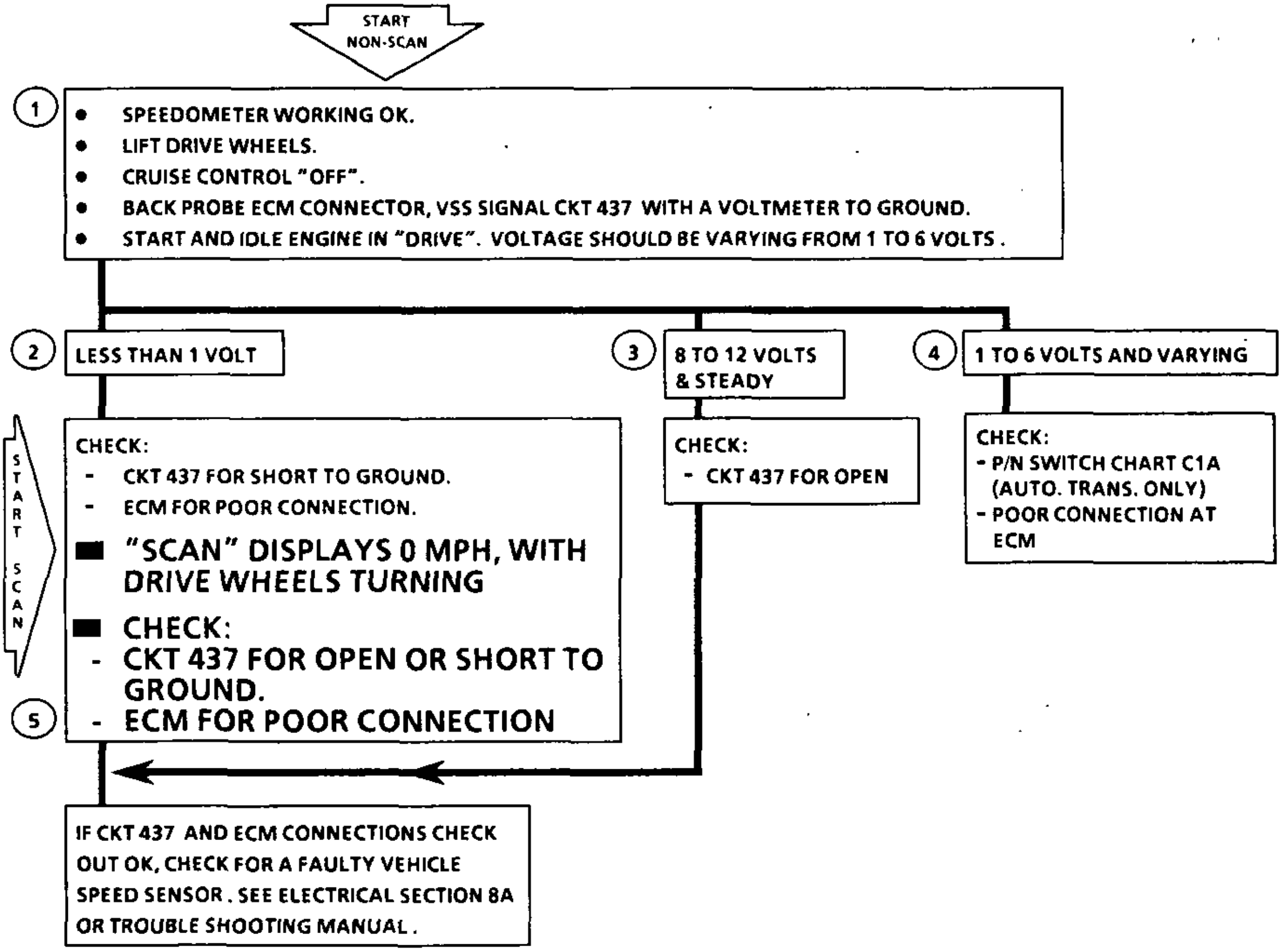
"SCAN" STEP ONLY ■

CODE 24

VEHICLE SPEED SENSOR (VSS)

2.5L "P" SERIES
FUEL INJECTION (TBI)

<u>NOTE</u>; 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.



START NON-SCAN

①
- SPEEDOMETER WORKING OK.
- LIFT DRIVE WHEELS.
- CRUISE CONTROL "OFF".
- BACK PROBE ECM CONNECTOR, VSS SIGNAL CKT 437 WITH A VOLTMETER TO GROUND.
- START AND IDLE ENGINE IN "DRIVE". VOLTAGE SHOULD BE VARYING FROM 1 TO 6 VOLTS.

② LESS THAN 1 VOLT

CHECK:
- CKT 437 FOR SHORT TO GROUND.
- ECM FOR POOR CONNECTION.

START SCAN

■ "SCAN" DISPLAYS 0 MPH, WITH DRIVE WHEELS TURNING

■ CHECK:
- CKT 437 FOR OPEN OR SHORT TO GROUND.
- ⑤ ECM FOR POOR CONNECTION

③ 8 TO 12 VOLTS & STEADY

CHECK:
- CKT 437 FOR OPEN

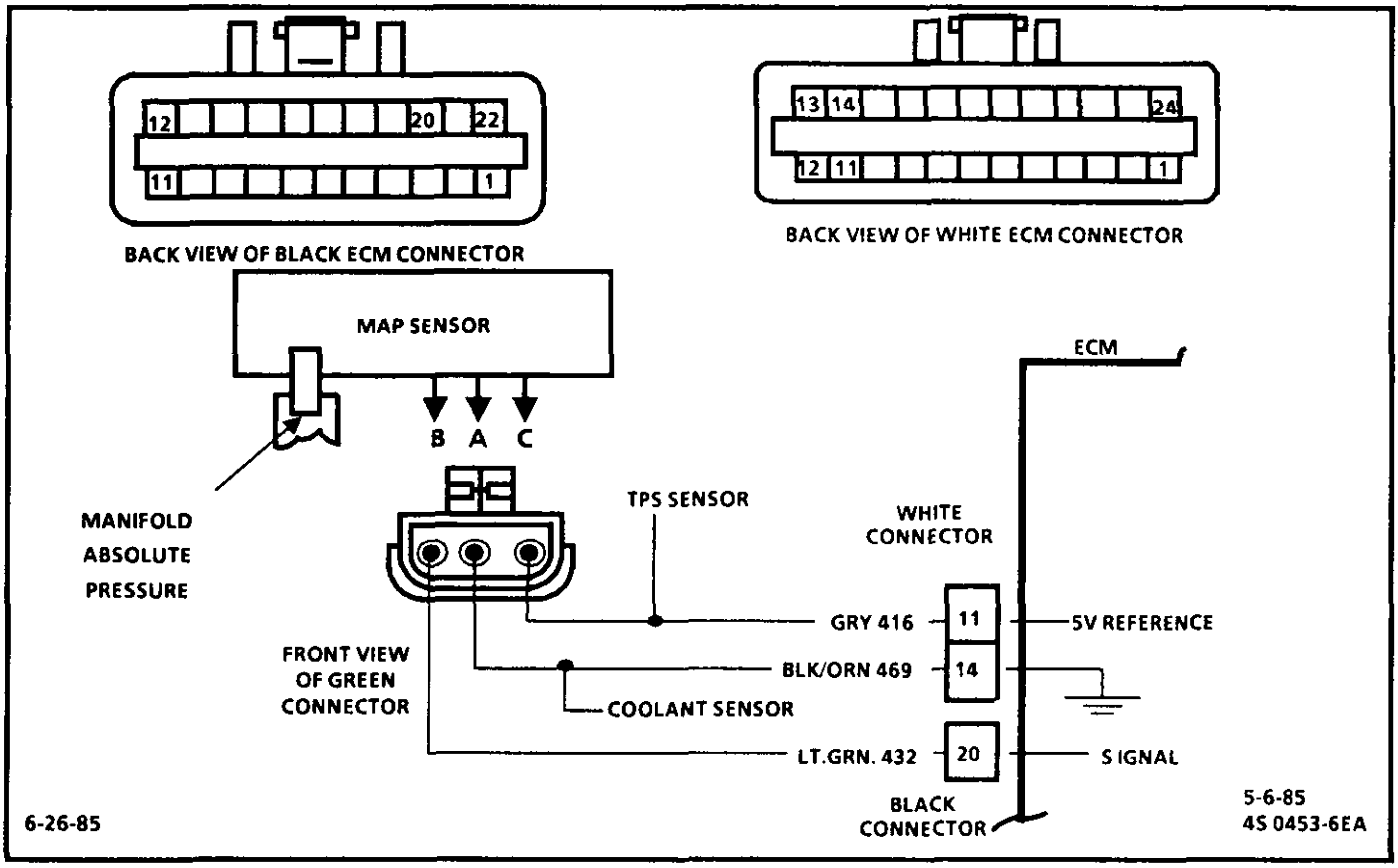
④ 1 TO 6 VOLTS AND VARYING

CHECK:
- P/N SWITCH CHART C1A (AUTO. TRANS. ONLY)
- POOR CONNECTION AT ECM

IF CKT 437 AND ECM CONNECTIONS CHECK OUT OK, CHECK FOR A FAULTY VEHICLE SPEED SENSOR. SEE ELECTRICAL SECTION 8A OR TROUBLE SHOOTING MANUAL.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-3-85
*5S 1420-6E



CODE 33

MAP SENSOR

(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES

FUEL INJECTION (TBI)

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 to 1.5 volts at idle to 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.

Code 33 will set when:

- Signal is too high for a time greater than 6.8 seconds
- TPS voltage indicates throttle is closed.

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, before using this chart.

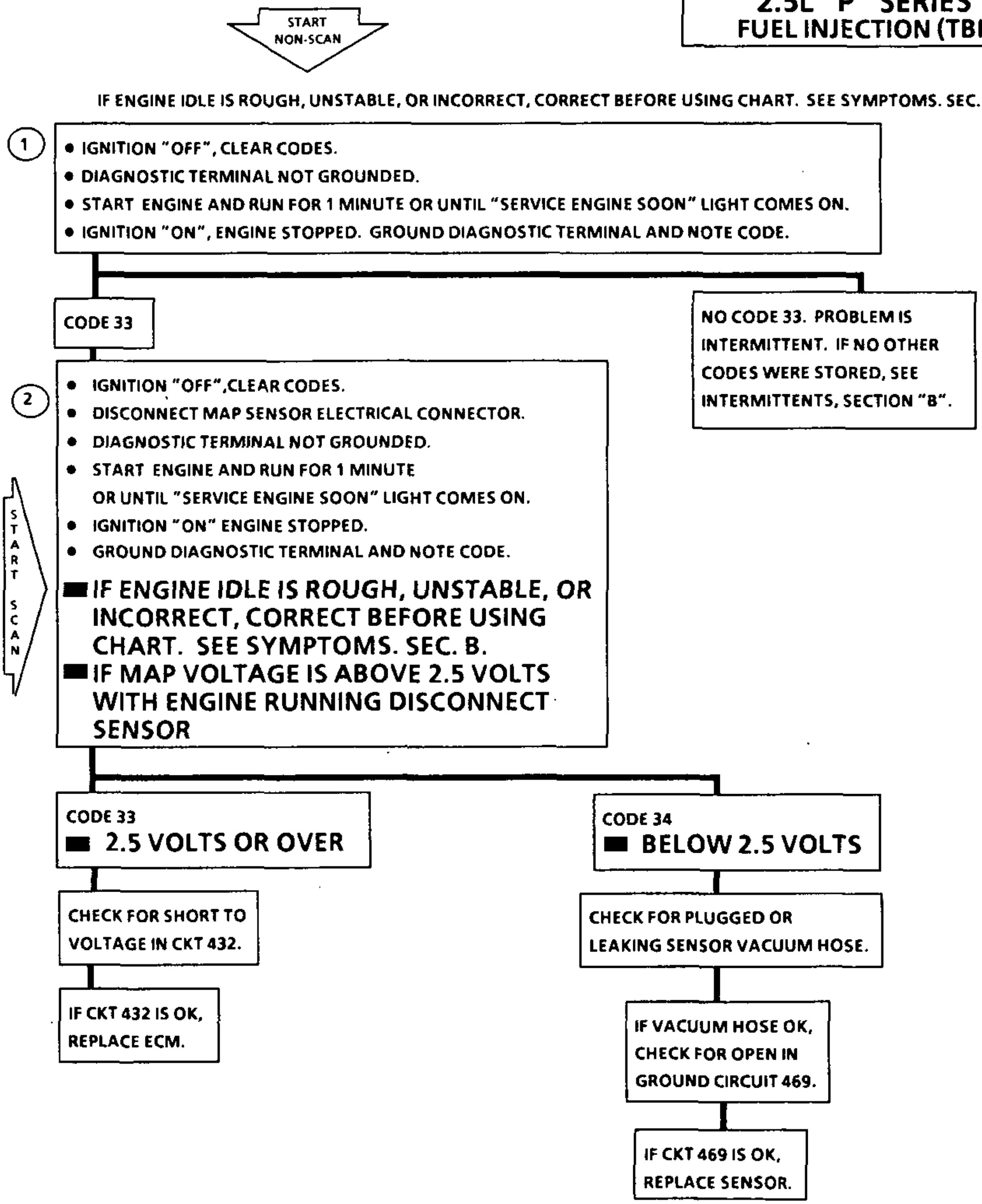
1. Confirms Code 33 and that fault is present.
2. If the ECM recognizes and sets Code 34, or the MAP signal voltage is below 2.5V, the Code 33 was caused by inadequate vacuum, open CKT. 469 or faulty MAP sensor.

"SCAN" STEP ONLY ■

CODE 33

MAP SENSOR
(SIGNAL VOLTAGE HIGH)

2.5L "P" SERIES
FUEL INJECTION (TBI)



IF ENGINE IDLE IS ROUGH, UNSTABLE, OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS. SEC. B.

①
- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED. GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 33

NO CODE 33. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE INTERMITTENTS, SECTION "B".

②
- IGNITION "OFF",CLEAR CODES.
- DISCONNECT MAP SENSOR ELECTRICAL CONNECTOR.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON" ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF ENGINE IDLE IS ROUGH, UNSTABLE, OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS. SEC. B.

■ IF MAP VOLTAGE IS ABOVE 2.5 VOLTS WITH ENGINE RUNNING DISCONNECT SENSOR

CODE 33
■ 2.5 VOLTS OR OVER

CHECK FOR SHORT TO VOLTAGE IN CKT 432.

IF CKT 432 IS OK, REPLACE ECM.

CODE 34
■ BELOW 2.5 VOLTS

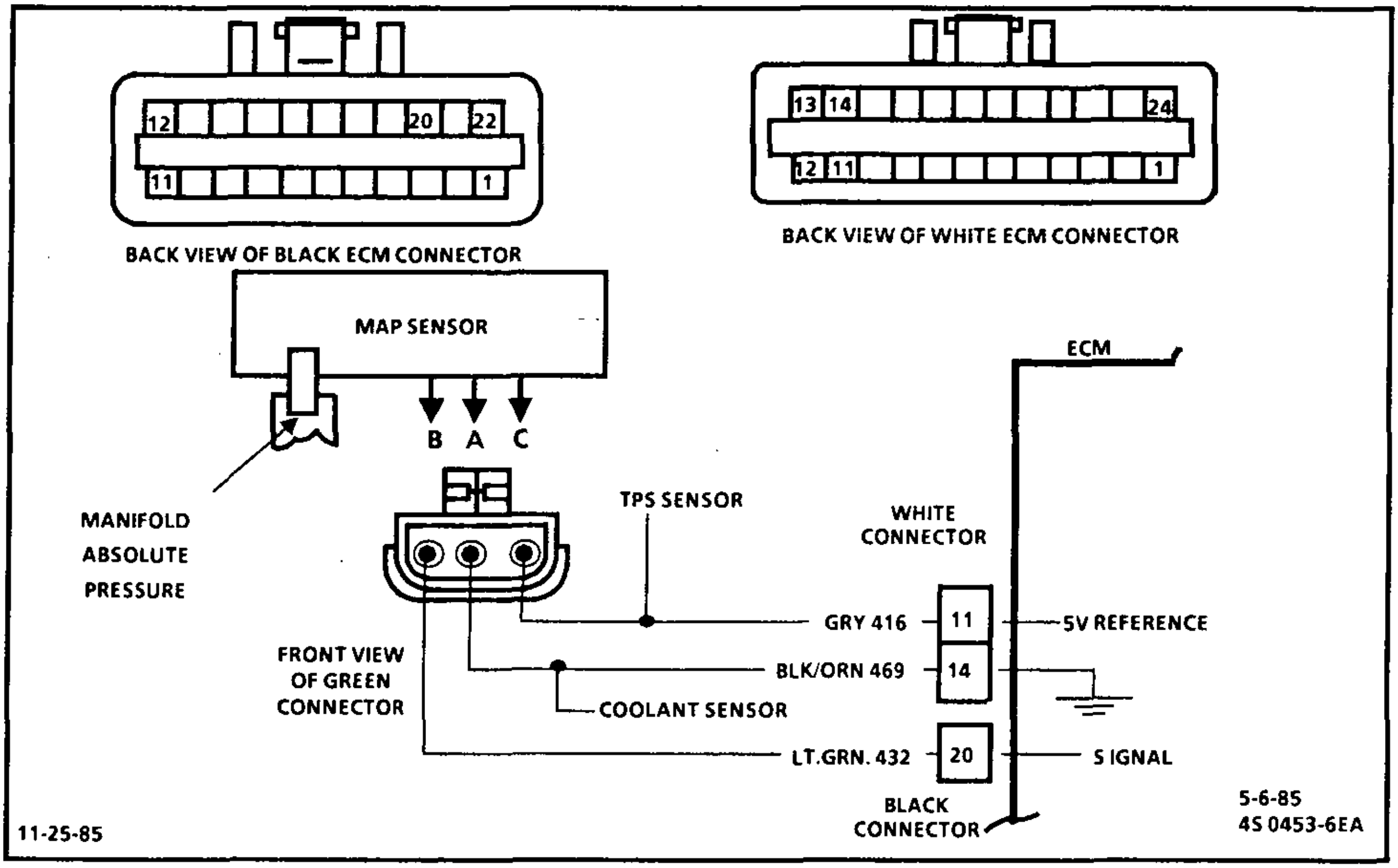
CHECK FOR PLUGGED OR LEAKING SENSOR VACUUM HOSE.

IF VACUUM HOSE OK, CHECK FOR OPEN IN GROUND CIRCUIT 469.

IF CKT 469 IS OK, REPLACE SENSOR.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 1315 -6E
7-01-85



CODE 34

MAP SENSOR

(SIGNAL VOLTAGE LOW)

2.5L "P" SERIES

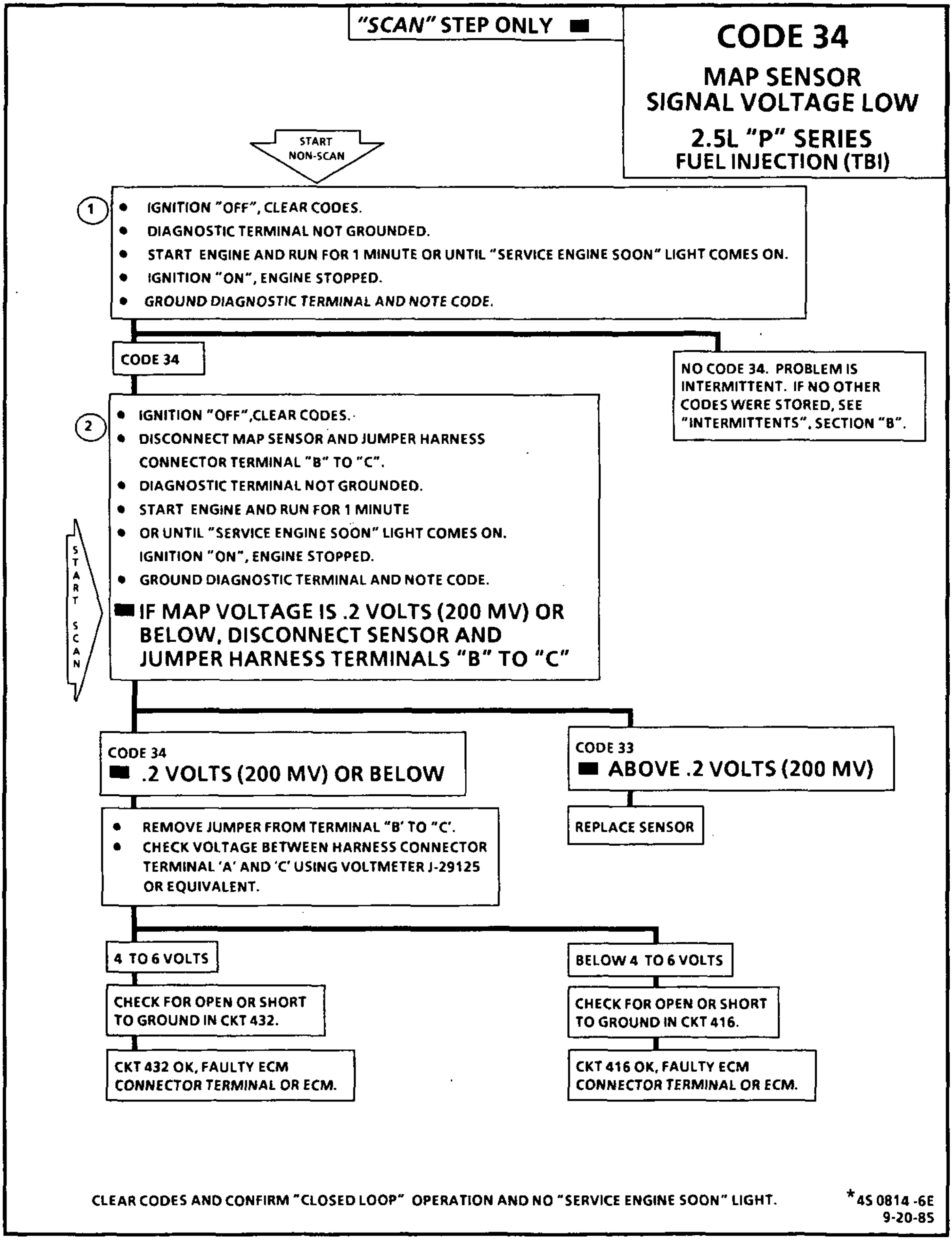
FUEL INJECTION (TBI)

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 to 1.5 volts at idle to 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.

Code 34 will set when signal is to low and ignition is turned on.

1. Confirms Code 34 and that fault is present.
2. If the ECM recognizes and sets Code 33 high, or the MAP signal voltage is above .2 volts, the ECM and wiring are OK.



CODE 34

MAP SENSOR SIGNAL VOLTAGE LOW

2.5L "P" SERIES

FUEL INJECTION (TBI)

"SCAN" STEP ONLY ■

START NON-SCAN

①
- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- *GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.*

CODE 34

NO CODE 34. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE "INTERMITTENTS", SECTION "B".

START SCAN

②
- IGNITION "OFF", CLEAR CODES.
- DISCONNECT MAP SENSOR AND JUMPER HARNESS CONNECTOR TERMINAL "B" TO "C".
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE
- OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON. IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF MAP VOLTAGE IS .2 VOLTS (200 MV) OR BELOW, DISCONNECT SENSOR AND JUMPER HARNESS TERMINALS "B" TO "C"

CODE 34
■ .2 VOLTS (200 MV) OR BELOW

- REMOVE JUMPER FROM TERMINAL "B" TO "C".
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINAL 'A' AND 'C' USING VOLTMETER J-29125 OR EQUIVALENT.

4 TO 6 VOLTS

CHECK FOR OPEN OR SHORT TO GROUND IN CKT 432.

CKT 432 OK, FAULTY ECM CONNECTOR TERMINAL OR ECM.

BELOW 4 TO 6 VOLTS

CHECK FOR OPEN OR SHORT TO GROUND IN CKT 416.

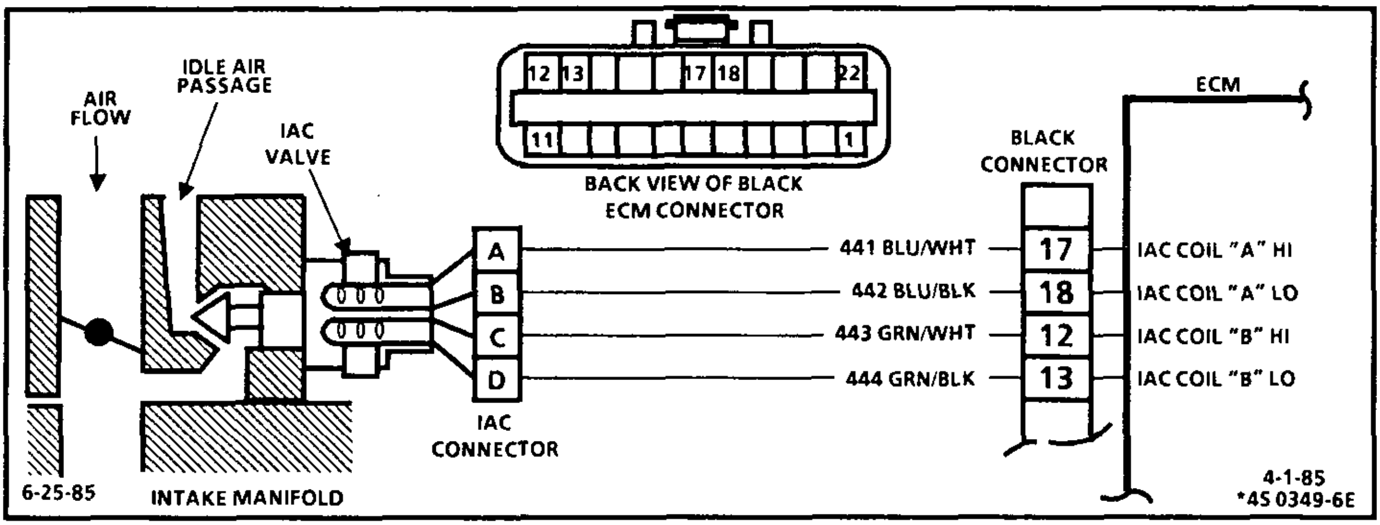
CKT 416 OK, FAULTY ECM CONNECTOR TERMINAL OR ECM.

CODE 33
■ ABOVE .2 VOLTS (200 MV)

REPLACE SENSOR

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 0814 -6E
9-20-85



6-25-85

4-1-85
*4S 0349-6E

CODE 35
IDLE AIR CONTROL
2.5L FUEL INJECTION (TBI) "P" SERIES

Code 35 will set when the closed throttle engine speed is 50 RPM above or below the correct idle speed for 30 seconds. Review general discription in Section "C".

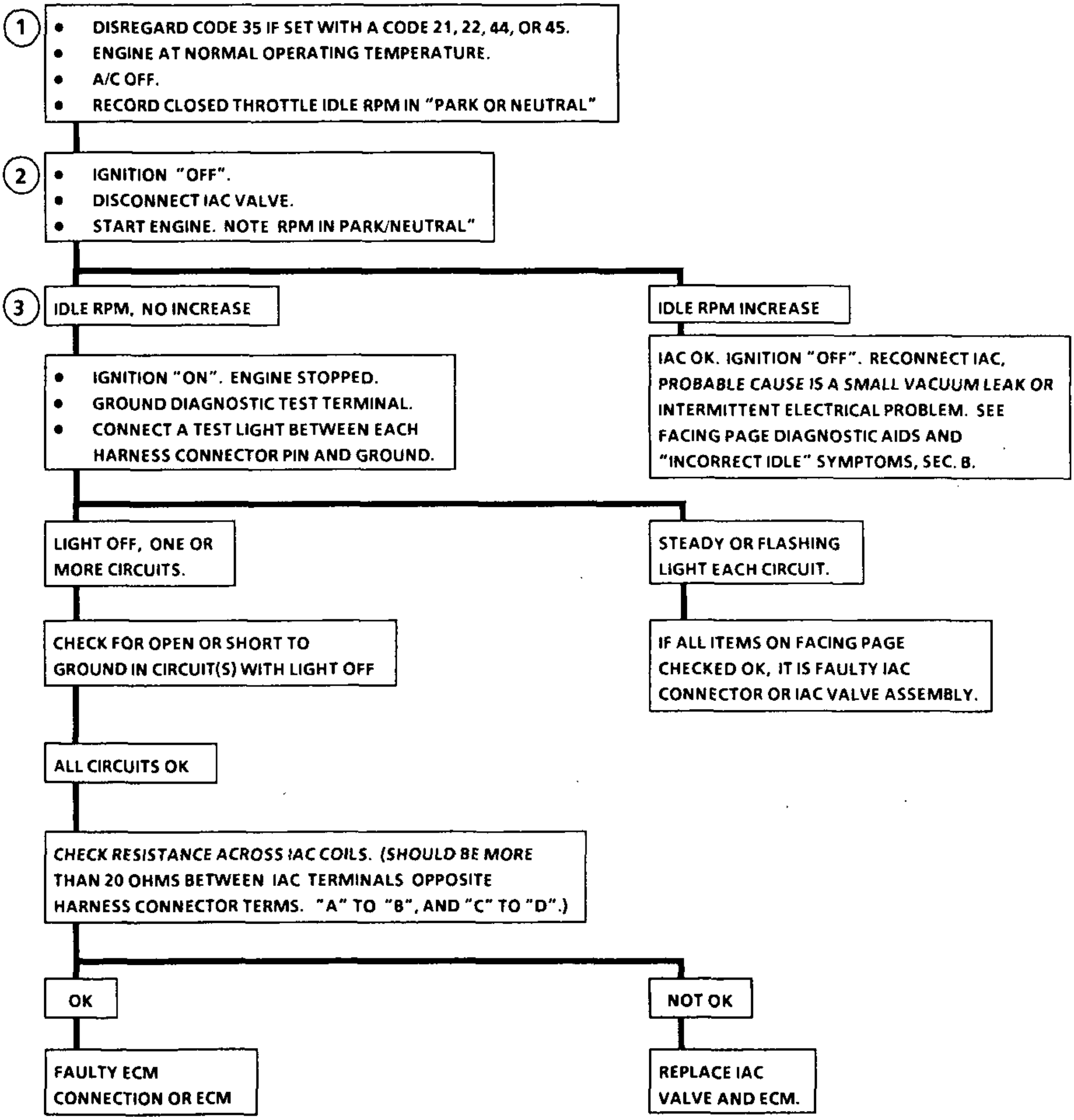
Following are nominal warm engine idle speeds:

	AUTO	MANUAL	ALCL
Neutral	950 ± 50	950 ± 50	1000 ± 50
Drive	725 ± 50		1000 ± 50

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 and a visual check of the idle air passage shows a seated valve, locate and correct a vacuum leak.
   If the idle is very high, usually above 1400 RPM and the IAC valve is not visible in the air passage, follow the left side of chart.
   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 paragraph three below.
2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position to provide increased air flow during the next engine start. A "Scan" will display 95 or more counts and the valve should not be visible in the idle air passage.
   Disconnecting the IAC will hold the valve in a retracted or open position and cause a closed throttle idle speed above 1500 RPM.
   A "Scan" will now display "0" counts because the ECM has tried to reduce the idle speed by extending the valve. The IAC is OK. The code 35 is likely a thermac or cruise control vacuum hose disconnect.
3. A slow unstable idle may be caused by a system problem that cannot be overcome by the IAC. If the IAC is visible in the air passage the chart should locate the problem. If the valve is not visible the IAC is probably OK.In both cases the "Scan" counts will be above 60 counts.

- 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 fixed at less than 300MV(.3V). Check for low regulated fuel pressure, water in fuel or lean injector. A lean exhaust with an oxygen sensor output fixed above 800 mV (.8mv) 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. IAC valve not visible in idle air passage and "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(.8V).
  Check:
  - High fuel pressure
  - Leaking TBI injector "O" rings or injector. Ignition on, engine stopped. Using a fused jumper, connect 12 volts to fuel pump "test" terminal to pressurize system. Visually check for fuel dripping into manifold.
  - Rich injector
- Throttle body. Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.
- Additional checks, see "Incorrect Idle" symptoms in Section "B".
- Code 35 with A/C "on"; Check A/C compressor or relay diagnostic Chart C-10.

CODE 35
IDLE AIR CONTROL
2.5L "P" SERIES
FUEL INJECTION (TBI)



①
- DISREGARD CODE 35 IF SET WITH A CODE 21, 22, 44, OR 45.
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- A/C OFF.
- RECORD CLOSED THROTTLE IDLE RPM IN "PARK OR NEUTRAL"

②
- IGNITION "OFF".
- DISCONNECT IAC VALVE.
- START ENGINE. NOTE RPM IN PARK/NEUTRAL"

③ IDLE RPM, NO INCREASE

- IGNITION "ON". ENGINE STOPPED.
- GROUND DIAGNOSTIC TEST TERMINAL.
- CONNECT A TEST LIGHT BETWEEN EACH HARNESS CONNECTOR PIN AND GROUND.

LIGHT OFF, ONE OR MORE CIRCUITS.

CHECK FOR OPEN OR SHORT TO GROUND IN CIRCUIT(S) WITH LIGHT OFF

ALL CIRCUITS OK

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 CONNECTION OR ECM

NOT OK

REPLACE IAC VALVE AND ECM.

STEADY OR FLASHING LIGHT EACH CIRCUIT.

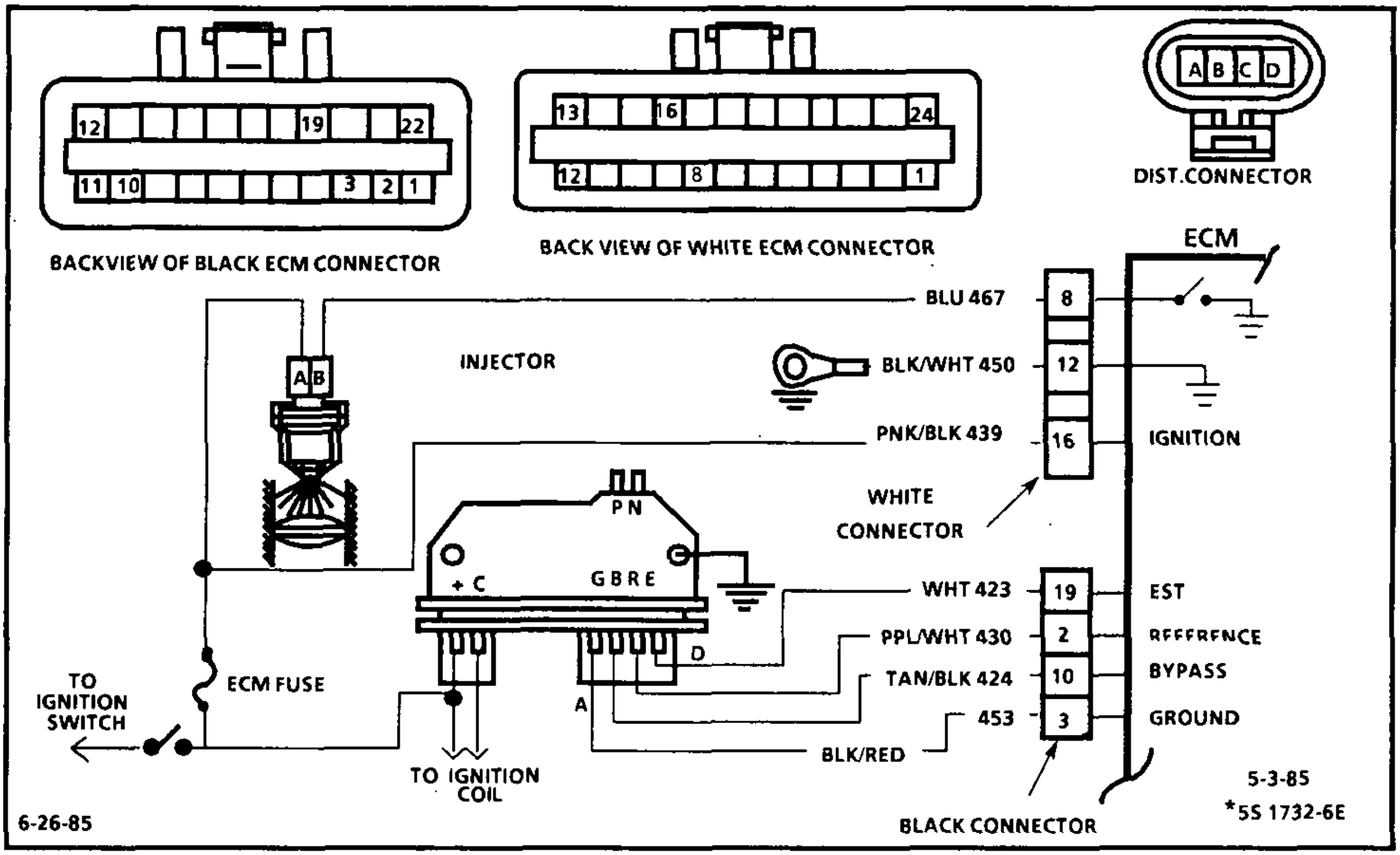
IF ALL ITEMS ON FACING PAGE CHECKED OK, IT IS FAULTY IAC CONNECTOR OR IAC VALVE ASSEMBLY.

IDLE RPM INCREASE

IAC OK. IGNITION "OFF". RECONNECT IAC. *PROBABLE CAUSE IS A SMALL VACUUM LEAK OR* INTERMITTENT ELECTRICAL PROBLEM. SEE FACING PAGE DIAGNOSTIC AIDS AND "INCORRECT IDLE" SYMPTOMS, SEC. B.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-22-85
5S 1733-6E



CODE 42

ELECTRONIC SPARK TIMING (EST)
2.5L "P" SERIES

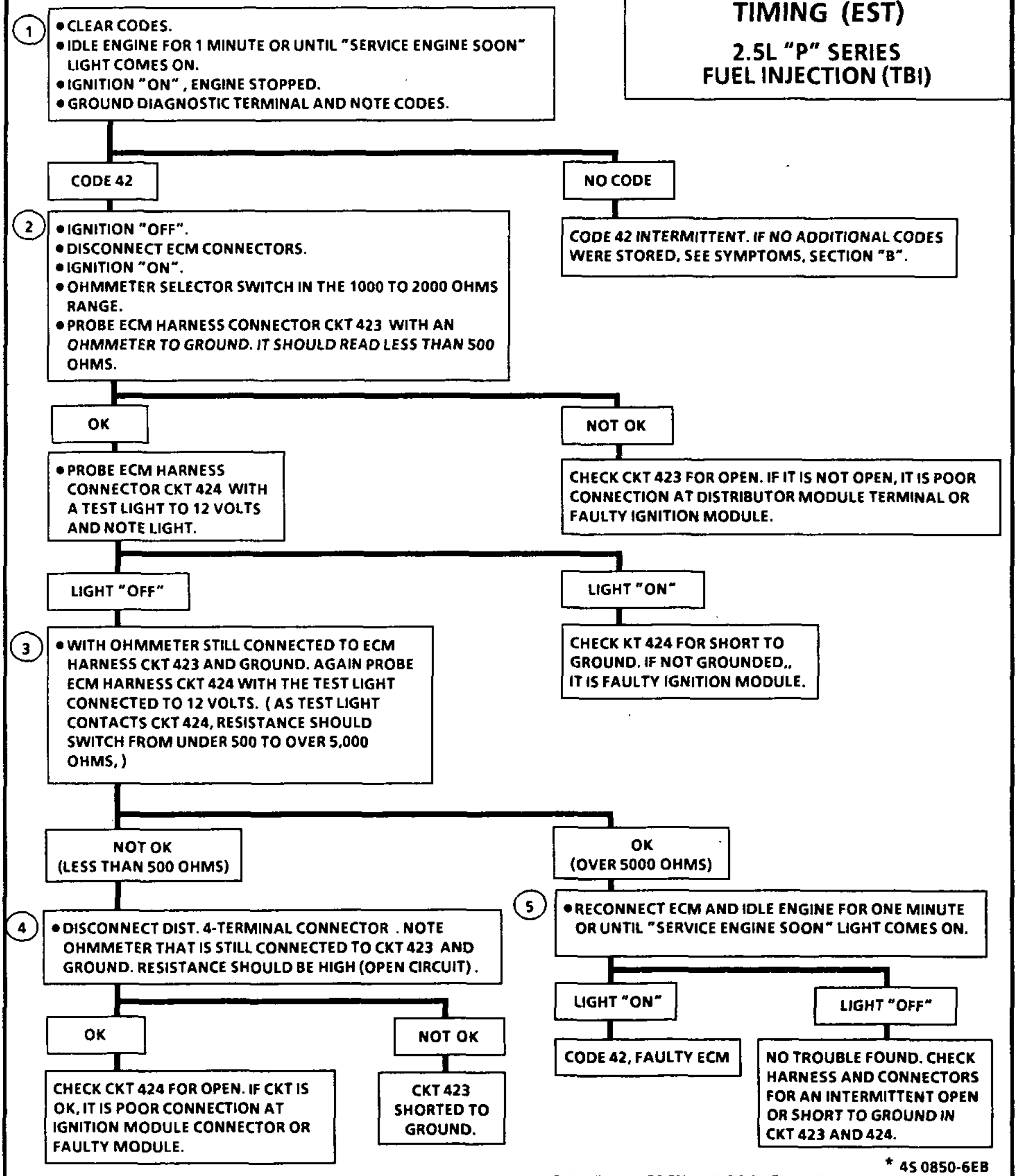
Code 42 means the ECM has seen an open or short to ground in the EST or bypass circuits.

1. 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.

CODE 42

ELECTRONIC SPARK TIMING (EST)

2.5L "P" SERIES FUEL INJECTION (TBI)



①
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODES.

CODE 42

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.

OK

- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

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.)

NOT OK (LESS THAN 500 OHMS)

④
- DISCONNECT DIST. 4-TERMINAL CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND GROUND. RESISTANCE SHOULD BE HIGH (OPEN CIRCUIT).

OK

CHECK CKT 424 FOR OPEN. IF CKT IS OK, IT IS POOR CONNECTION AT IGNITION MODULE CONNECTOR OR FAULTY MODULE.

NOT OK

CKT 423 SHORTED TO GROUND.

NO CODE

CODE 42 INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, SEE SYMPTOMS, SECTION "B".

NOT OK

CHECK CKT 423 FOR OPEN. IF IT IS NOT OPEN, IT IS POOR CONNECTION AT DISTRIBUTOR MODULE TERMINAL OR FAULTY IGNITION MODULE.

LIGHT "ON"

CHECK KT 424 FOR SHORT TO GROUND. IF NOT GROUNDED,, IT IS FAULTY IGNITION MODULE.

OK (OVER 5000 OHMS)

⑤
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.

LIGHT "ON"

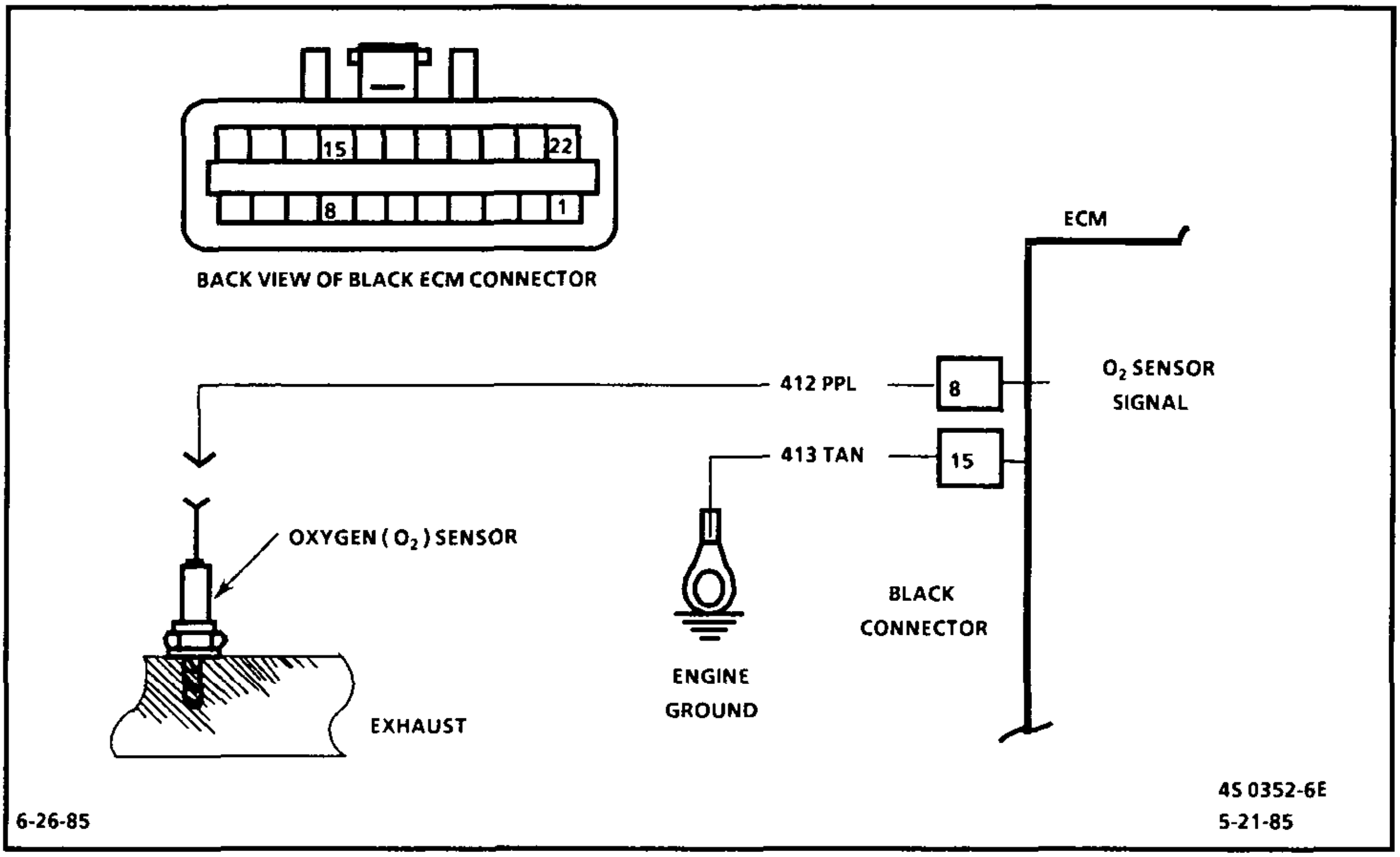
CODE 42, FAULTY ECM

LIGHT "OFF"

NO TROUBLE FOUND. CHECK HARNESS AND CONNECTORS FOR AN INTERMITTENT OPEN OR SHORT TO GROUND IN CKT 423 AND 424.

84-85 CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 4S 0850-6EB
12-9-85



CODE 44

LEAN EXHAUST INDICATION

2.5L "P" SERIES

FUEL INJECTION (TBI)

The ECM supplies a voltage of about .45 volt between Circuits 412 and 413. (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 310°C (600°F) An open sensor circuit or cold sensor causes open loop operation.

Code 44 is set when the O_2 sensor signal voltage at the ECM Circuit 412:

- Remains below .2 volt for 50 seconds idling or more;
- Time since engine start is 1 minutes or longer

Diagnostic Aids:

1. Grounding the diagnostic terminal with the engine running, enables the "Field Service Mode" and allows the ECM to confirm either open or closed loop operation.
2. A light out or "Open Loop" indicates the fault is present. Disconnecting the O_2 sensor will raise the signal voltage above .2 volt. If the ECM and wiring are OK, the ECM should recognize the higher voltage, .35 to .55, and flash open loop when the engine is started.
3. The Code 44 or lean exhaust is most likely caused by one of the following:

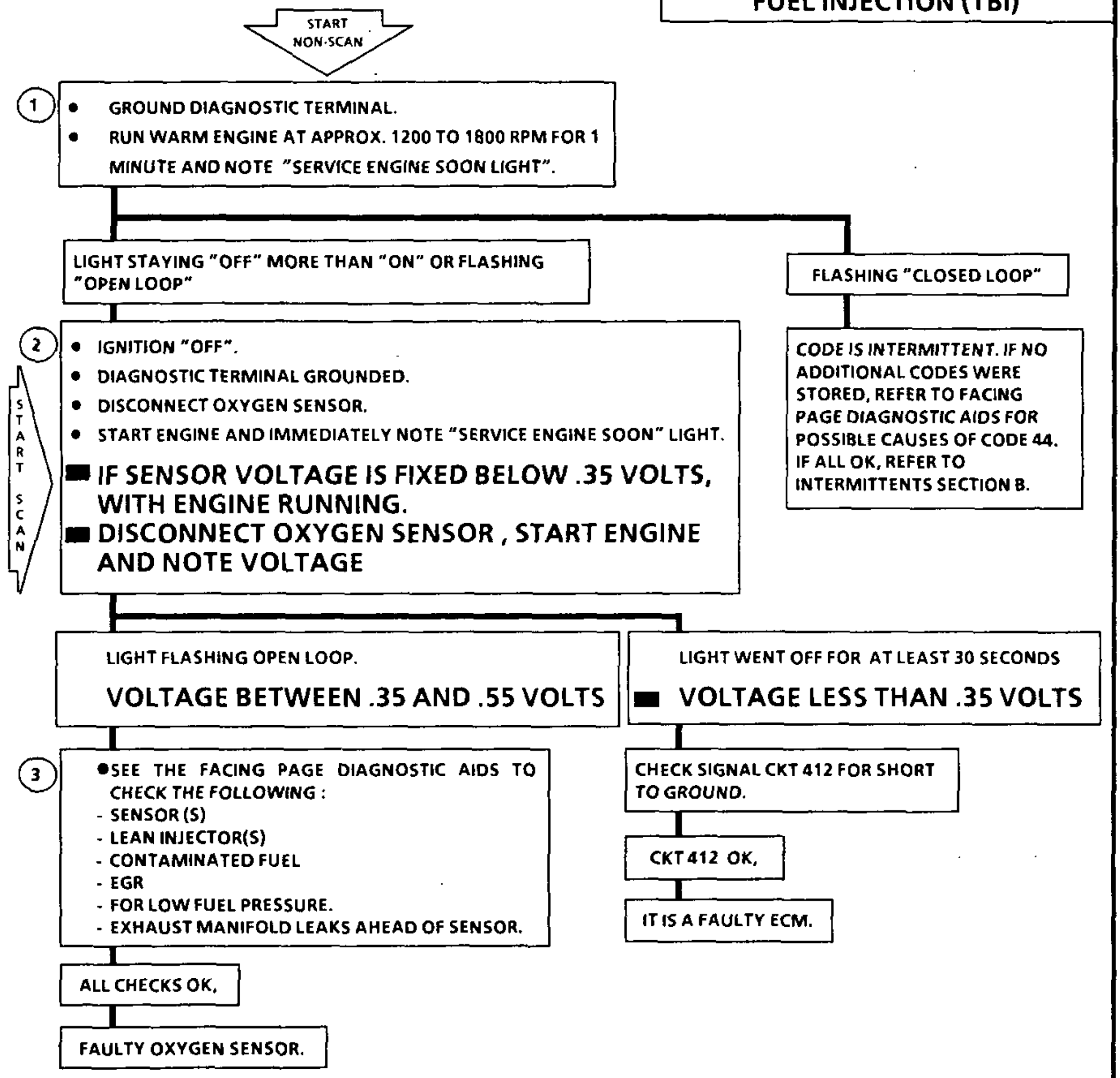
- Fuel Pressure. System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/ or loads to confirm.
- Fuel contamination. Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injector. The water causes a lean exhaust and can set a Code 44.
- MAP sensor. An output that causes the ECM to sense a lower than normal manifold pressure (high vacuum) can cause the system to go lean. Disconnecting the MAP sensor will allow the ECM to substitute a fixed (default) value for the MAP sensor. If the rich condition is gone when the sensor is disconnected, substitute a known good sensor and recheck.
- If the above are OK, and the instructions at the top of the chart will still set a Code 44, or "SERVICE ENGINE SOON" light is "OFF" more than "ON", or flashing "OPEN LOOP", it is a faulty Oxygen Sensor.

"*SCAN*" STEP ONLY ■

CODE 44

LEAN EXHAUST INDICATION

2.5L "P" SERIES
FUEL INJECTION (TBI)



①
- GROUND DIAGNOSTIC TERMINAL.
- RUN WARM ENGINE AT APPROX. 1200 TO 1800 RPM FOR 1 MINUTE AND NOTE "SERVICE ENGINE SOON LIGHT".

LIGHT STAYING "OFF" MORE THAN "ON" OR FLASHING "OPEN LOOP"

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR.
- START ENGINE AND IMMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT.

■ IF SENSOR VOLTAGE IS FIXED BELOW .35 VOLTS, WITH ENGINE RUNNING.

■ DISCONNECT OXYGEN SENSOR , START ENGINE AND NOTE VOLTAGE

FLASHING "CLOSED LOOP"

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO FACING PAGE DIAGNOSTIC AIDS FOR POSSIBLE CAUSES OF CODE 44. IF ALL OK, REFER TO INTERMITTENTS SECTION B.

LIGHT FLASHING OPEN LOOP.

VOLTAGE BETWEEN .35 AND .55 VOLTS

③
- SEE THE FACING PAGE DIAGNOSTIC AIDS TO *CHECK THE FOLLOWING* :
  - SENSOR (S)
  - LEAN INJECTOR(S)
  - CONTAMINATED FUEL
  - EGR
  - FOR LOW FUEL PRESSURE.
  - EXHAUST MANIFOLD LEAKS AHEAD OF SENSOR.

ALL CHECKS OK,

FAULTY OXYGEN SENSOR.

LIGHT WENT OFF FOR AT LEAST 30 SECONDS

■ VOLTAGE LESS THAN .35 VOLTS

CHECK SIGNAL CKT 412 FOR SHORT *TO GROUND.*

CKT 412 OK,

IT IS A FAULTY ECM.

•FIELD SERVICE MODE :

ENGINE RUNNING , DIAGNOSTIC TERMINAL GROUNDED .

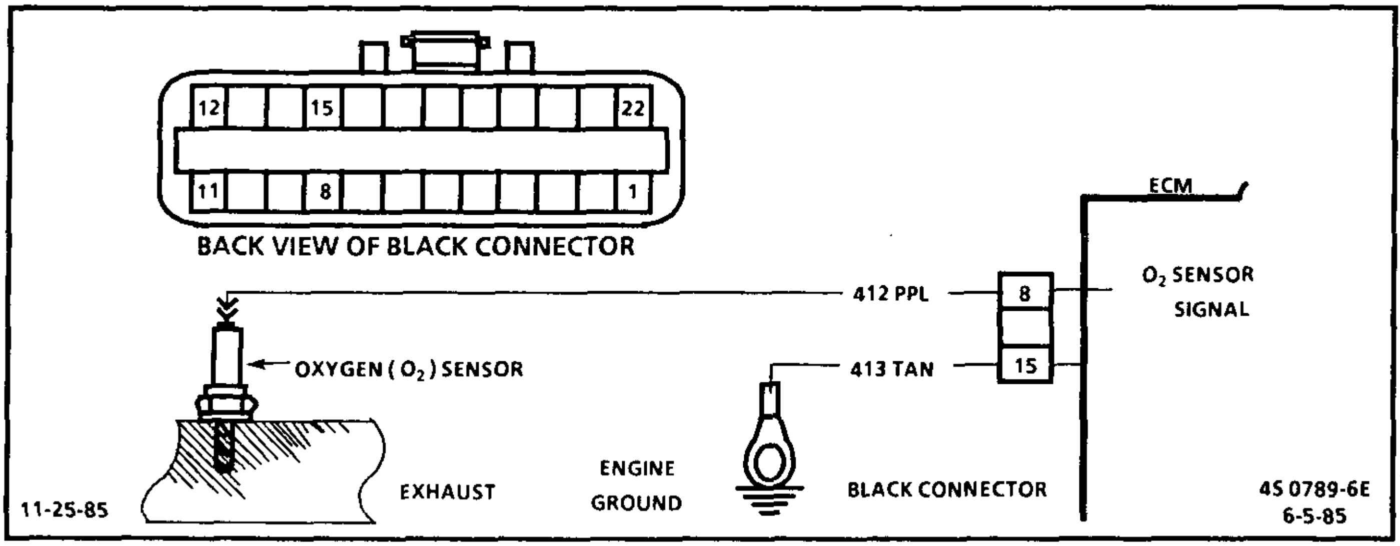
OPEN - LOOP , " SERVICE ENGINE SOON " LIGHT FLASHES AT A RATE OF 2 TIMES PER SECOND .

CLOSED - LOOP , " SERVICE ENGINE SOON " LIGHT FLASHES AT A RATE OF 1 TIME PER SECOND .

84 - 85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 0894-6EA
10-08-85



CODE 45

RICH EXHAUST INDICATION

2.5L "P" SERIES

FUEL INJECTION (TBI)

The ECM supplies a voltage of about .45 volt between CKT 412 and CKT 413. (If measured with a 10 megohm digital voltmeter, this may read as low as .32 volts.) The O2 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 310°C (600°F) An open sensor circuit or cold sensor causes open loop operation..

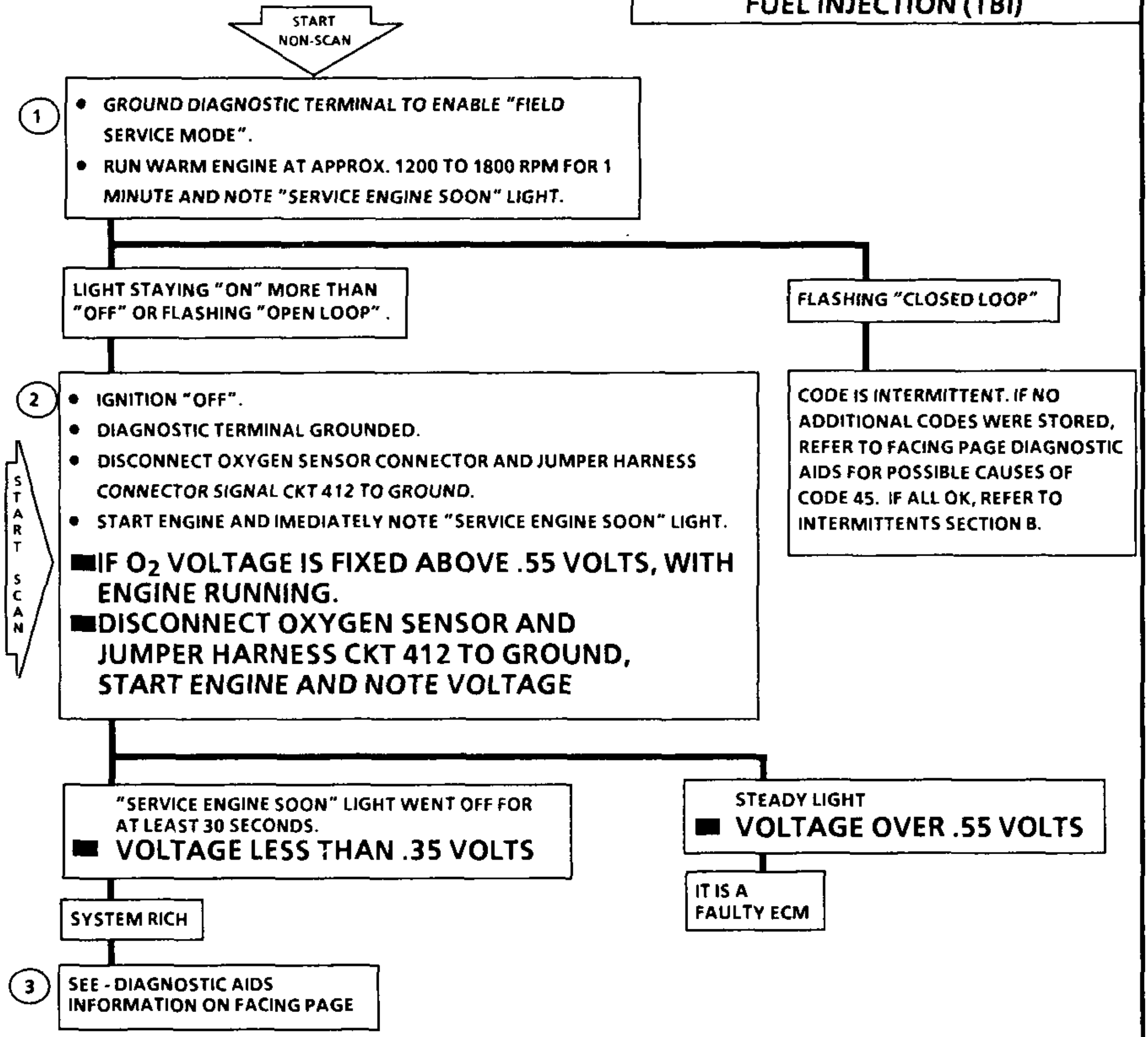
Code 45 is set when the O_2 sensor signal voltage at the ECM CKT 412.

- Remains above .48 volts for 50 seconds; and
- Engine time after start is 1 minute or more.

1. Grounding the diagnostic terminal with the engine running, enables the "Field Service Mode" and allows the ECM to confirm either open or closed loop operation using the "SERVICE ENGINE SOON" light.
2. A steady light or "Open Loop" indicates the fault is present. Grounding CKT 412 causes a low O_2 signal voltage.If the ECM and wiring are OK, the ECM should recognize the low voltage and confirm the lean signal by turning off the "SERVICE ENGINE SOON" light for at least 30 seconds.
3. A Code 45 will not be caused by a faulty O_2 sensor. Code 45 indicates a rich exhaust and diagnosis should begin with the items listed:
   - 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 will be set. System may exhibit black exhaust smoke.
   - Leaking injector. Symptoms will be similiar to high fuel pressure. Disconnect injector electrical connector and check for dripping fuel from injector while cranking. The leak may be from the injector/or injector "O" ring.
   - HEI Shielding. An open ground CKT 453 may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as distributor 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, and can help in diagnosing this problem.
   - Canister purge. Check for fuel saturation. If full of fuel, check canister control and hoses.
   - Coolant Sensor Intermittent Open. If the sensor circuit is intermittently open, fuel delivery will be heavy during the "open" time period. The coolant sensor code cannot set until sensor is open for 1 minute or longer.
   - MAP sensor. An output that causes the ECM to sense a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to substitute a fixed (default) value for the MAP sensor. If the the rich condition is gone while the sensor is disconnected, substitute a known good sensor and recheck.
   - TPS. An intermittent TPS output will cause the system to go rich, due to a false indication of the engine accelerating.
   - EGR. A leaking EGR valve could result in a rich O_2 signal at idle, due to a dilution of the air/fuel ratio oxygen poor exhaust gasses.

"SCAN" STEP ONLY ■

CODE 45
RICH EXHAUST INDICATION
2.5L "P" SERIES
FUEL INJECTION (TBI)



①
- *GROUND DIAGNOSTIC TERMINAL TO ENABLE "FIELD SERVICE MODE".*
- RUN WARM ENGINE AT APPROX. 1200 TO 1800 RPM FOR 1 *MINUTE AND NOTE "SERVICE ENGINE SOON" LIGHT.*

LIGHT STAYING "ON" MORE THAN "OFF" OR FLASHING "OPEN LOOP".

FLASHING "CLOSED LOOP"

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO FACING PAGE DIAGNOSTIC AIDS FOR POSSIBLE CAUSES OF CODE 45. IF ALL OK, REFER TO INTERMITTENTS SECTION B.

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR CONNECTOR AND JUMPER HARNESS *CONNECTOR SIGNAL CKT 412 TO GROUND.*
- START ENGINE AND IMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT.

■ IF O_2 VOLTAGE IS FIXED ABOVE .55 VOLTS, WITH ENGINE RUNNING.

■ DISCONNECT OXYGEN SENSOR AND JUMPER HARNESS CKT 412 TO GROUND, START ENGINE AND NOTE VOLTAGE

"SERVICE ENGINE SOON" LIGHT WENT OFF FOR AT LEAST 30 SECONDS.
■ VOLTAGE LESS THAN .35 VOLTS

STEADY LIGHT
■ VOLTAGE OVER .55 VOLTS

IT IS A FAULTY ECM

SYSTEM RICH

③ SEE - DIAGNOSTIC AIDS INFORMATION ON FACING PAGE

FIELD SERVICE MODE;

- ENGINE RUNNING, DIAGNOSTIC TERMINAL GROUNDED.
- OPEN - LOOP, "SERVICE ENGINE SOON" LIGHT FLASHES AT A RATE OF 2.5 TIMES PER SECOND.
- CLOSED LOOP, "SERVICE ENGINE SOON" LIGHT FLASHES AT A RATE OF 1 TIME PER SECOND.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

84-85
*4S 0895-6EA
10-9-85

CODE 51
CODE 55
2.5L "P" SERIES
FUEL INJECTION (TBI)

CODE 51

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 55

REPLACE ELECTRONIC CONTROL MODULE (ECM)

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-18-84

*4S 0816-6E
9-11-84

SECTION B
SYMPTOMS

SECTION B - SYMPTOMS

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. 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.

<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>

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. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit.
- 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.
- CHECK:
  - 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 kept away from spark plug wires, distributor wires, distributor housing, coil, and generator. Wire from circuit 453 to distributor should be a good ground.
  - Ignition secondary shorted to ground.
  - Circuits 419 and 451 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 pressure CHART A-5.
  - TPS for sticking or binding.
  - EGR operation. CHART C-7A.
  - Fuel pump relay - Connect test light between pump test terminal and ground. Light should be on for 2 seconds following ignition "ON".
  - 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 ground.
  - 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 by-pass line. If engine then starts and runs OK, replace distributor pickup coil.

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.

- If a tool is available which plugs in to the ALCL connector, 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-5.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - TCC Operation.
- 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.

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.
- CHECK:
  - Ignition timing. See Emission Control Information label.
  - For restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-5.
  - 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.
- Check Exhaust system for restriction:
  1. With engine at normal operating temperature, connect a vacuum gage to any convenient vacuum port on intake manifold.
  2. Disconnect EGR solenoid electrical connector or connect EGR valve directly to vacuum source bypassing any switches or solenoids.
  3. Run engine at 1000 RPM and record vacuum reading.
  4. Increase RPM slowly to 2500 RPM. Note vacuum reading at steady 2500 RPM.
  5. If vacuum at 2500 RPM decreases more than 3" from reading at 1000 RPM, the exhaust system should be inspected for restrictions.
  6. Disconnect exhaust pipe from engine and repeat steps 3 & 4. If vacuum still drops more than 3" with exhaust disconnected, check valve timing.

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.
  - Inoperative electric cooling fan circuit. See CHART C-12.
- CHECK:
  - For poor fuel quality, proper octane rating.
  - For correct PROM. (See Service Bulletins).
  - THERMAC for staying closed.
  - Ignition timing. See Vehicle Emission Control Information label.
  - Fuel system for low pressure. See CHART A-5.
  - Check EGR system for not opening - CHART C-7.
  - For proper transmission/transaxle shift points and TCC operation.
  - For incorrect basic engine parts such as cam, heads, pistons, etc.
- Remove carbon with top engine cleaner. Follow instructions on can.

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-5.
  - 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 HEI ground, circuit 453.
  - Canister purge system for proper operation. See table of contents for page .
  - EGR valve operation CHART C-7.
  - Thermac operation.

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.

- *Check for missing cylinder by:*
  1. Disconnecting 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, 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 Gap Tool or equivalent. If no spark, see Ignition Section C-4. If there is spark, *remove spark plug(s) in those cylinders* and check for:
     - Cracks
     - Wear
     - Improper Gap
     - Burned Electrodes
     - Heavy Deposits
- CHECK:
  - Spark plug wires by connecting ohmmeter to ends of each wire in question. If meter reads over 30,000 ohms, replace wire(s).
  - Ignition coil and secondary voltage using spark tester J-26792 (ST-125), or equivalent.
  - For restricted fuel filter. Also check fuel tank for water.
  - For low fuel pressure. See CHART A-5.
  - Check for proper valve timing.
- Perform compression check on questionable cylinder(s) found above. If compression is low, repair as necessary. See Section 6.
- Visually check distributor cap and rotor for moisture, dust, cracks, burns, etc. Spray cap and plug wires with fine water mist to check for shorts.
- Remove rocker covers. Check for bent pushrods, worn rocker arms, broken valve springs, worn camshaft lobes. Repair as necessary. See Section 6A.

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-5.
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. See CHART C-8.

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 leaking. Check Fuel Pressure CHART A-5.
  - Injectors - Too rich or lean.
- If ROUGH IDLE only occurs HOT, perform these additional checks:
  - Vacuum Leaks - Block idle air passage using J-33047 plug or equivalent. If closed throttle engine speed is above 650 RPM, locate and correct vacuum leak such as a disconnected thermac or cruise control hose.
  - Park/Neutral Switch (Automatic Transmission/Transaxle Only) See Chart C-1A.
  - 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.
  - EGR "on" while idling will cause roughness, stoppage 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.
  - Power Steering - Chart C-1E. ECM should compensate for Power Steering loads. Loss of this signal would be most noticable when parking and steering loads are high.
  - 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 compressor or relay. If inoperative, refer to Chart C-10.
  - A/C Refrigerant Pressure too high. Check for overcharge or faulty cycling switch.
  - Check 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.

ABOVE NORMAL EMISSIONS (ODORS)

- If test shows higher than normal CO and HC, (also has excessive odors), check items that will cause engine to run rich:
- CHECK:
  - For high fuel pressure. See CHART A-5.
  - For incorrect timing. See Vehicle Emission Control Information Label.
  - Canister for fuel loading. CHART C-3.
  - For stuck PCV valve or blocked PCV hose.
  - Condition of spark plugs, plug wires, and distributor cap. See Section 6D.
  - For lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).

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. 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, or in exhaust system, 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).
  - For intermittent condition in primary ignition system.
  - Engine timing - See Emission Control Information label.
  - For faulty spark plugs and/or plug wires or boots.
  - For proper valve timing.
- Perform a compression check - look for sticking or leaking valves.

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:

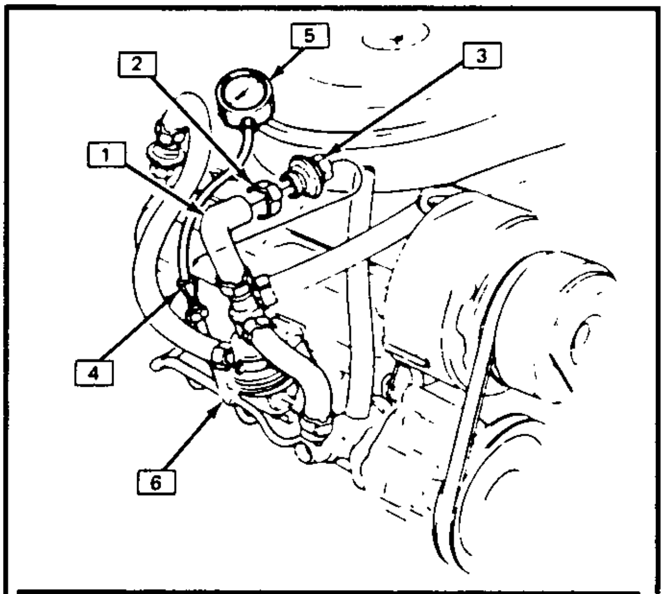
CHECK AT A. I. R. PIPE:

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

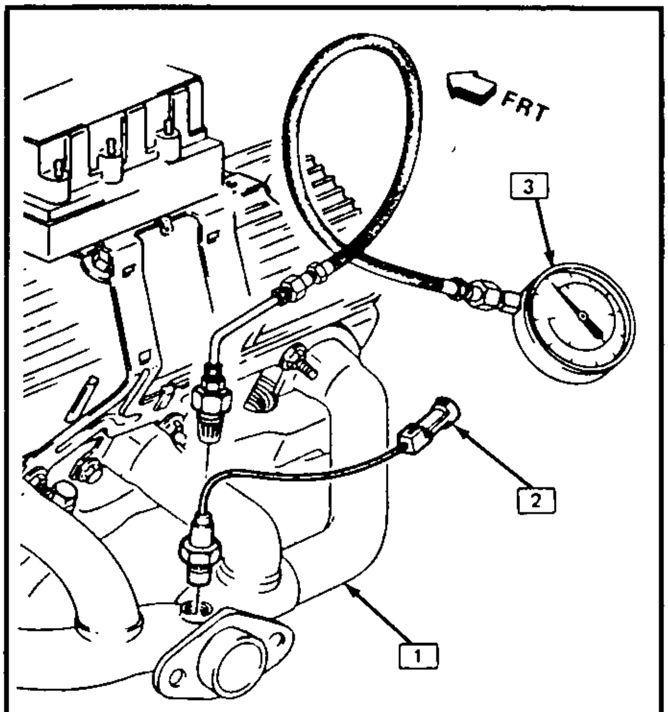
CHECK AT O_2 SENSOR:

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	CHECK VALVE HOSE
2	CHECK VALVE HOSE CLAMP
3	CHECK VALVE
4	HOSE & NIPPLE FROM PROPANE ENRICHMENT DEVICE J-26911
5	FUEL PUMP PRESSURE GAGE
6	RIGHT A.I.R. MANIFOLD

6S 2921-6E



1	EXHAUST MANIFOLD
2	O SENSOR
3	BACK PRESSURE TESTER

6S 2922-6E

DIAGNOSIS:

1. **With the engine at normal operating temperature and running at 2500 rpm, observe the exhaust system backpressure reading on the gauge.**
2. **If the backpressure exceeds 1 1/4 psi (8.62 kPa), a restricted exhaust system is indicated.**
3. **Inspect the entire exhaust system for a collapsed pipe, heat distress, or possible internal muffler failure.**
4. **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 of 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 sercvice and parts information at the back of each section. Following are the charts found in this section.

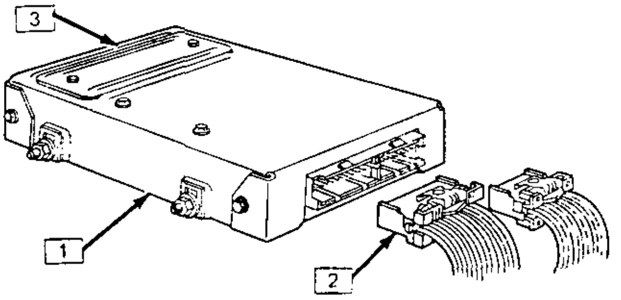
SECTION C1

ELECTRONIC CONTROL MODULE (ECM) AND SENSORS

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.



1 ECM

2 ECM HARNESS CONNECTORS TO ECM

3 PROM ACCESS COVER

4S 1196-6E

Figure C1-1 - Electronic Control Module (ECM)

PROM

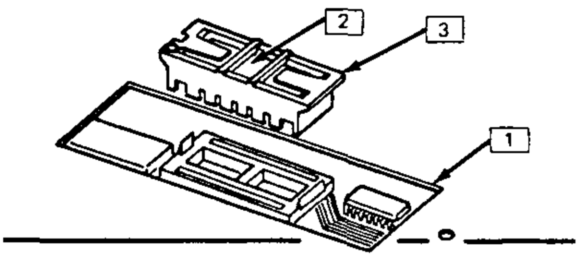
To allow one model of ECM to be used for many different cars, a device called a Calibrator (or PROM) (Programmable Read Only Memory) is used (see Figure C1-2). The PROM is located inside the ECM and has information on the vehicle's weight, engine, transmission, axle ratio, and several others. While one 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).

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.



1 ECM

2 PROM ENGINE CALIBRATOR

3 PROM CARRIER

4S 1190-6E

Figure C1-2 - PROM (Calibrator) (2.5L)

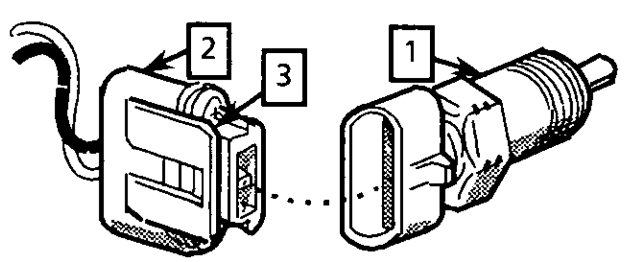
INFORMATION SENSORS

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).

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.



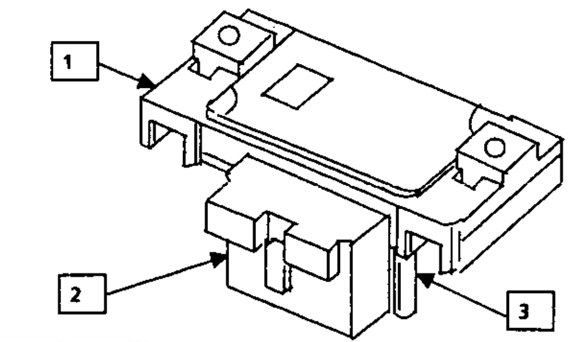
1 ENGINE COOLANT TEMPERATURE SENSOR
2 HARNESS CONNECTOR TO ECM
3 LOCKING TAB

4-2-85 *5S 1640-6EA

Figure C1-3 - Engine Coolant Temperature Sensor

MAP Sensor (Fig.C1-4)

The Manifold Absolute Pressure (MAP) sensor measures the changes in the intake manifold pressure which result from engine load and speed changes, and converts this to a voltage output.



1 SENSOR
2 ELECTRICAL CONNECTOR
3 MANIFOLD VACUUM TUBE

4-3-85 *6S 2648-6E

Figure C1-4 - MAP Sensor

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. 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 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.

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.

Oxygen (O_2) Sensor (Fig. C1-5)

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.

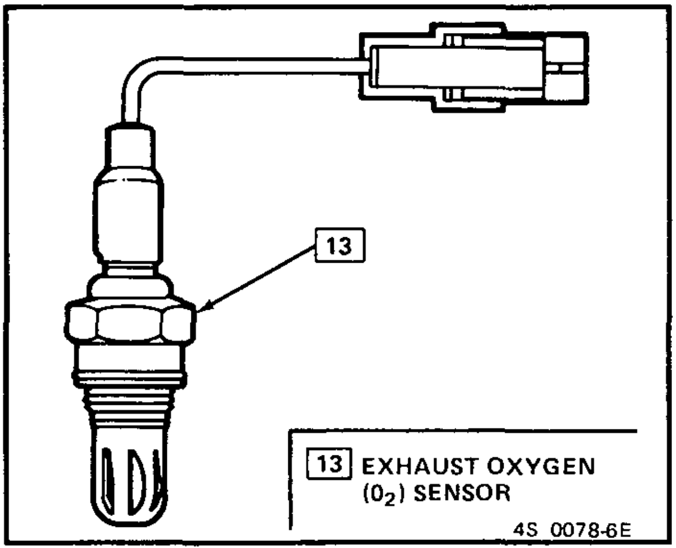


Figure C1-5 - Exhaust Oxygen (O_2) Sensor

Throttle Position Sensor (TPS) (Fig. C1-6)

The Throttle Position Sensor (TPS) is connected to the throttle shaft on the TBI unit. 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 below 1.25. 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.

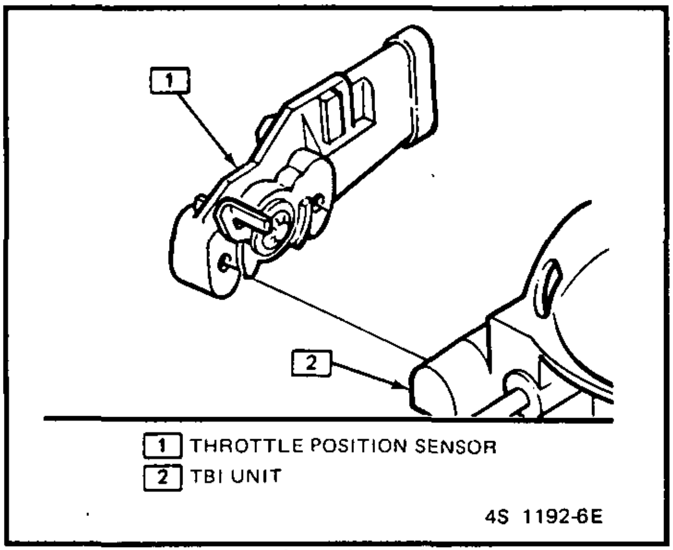


Figure C1-6 - Throttle Position Sensor

The TPS is not adjustable. The ECM uses the reading at idle for the zero reading, so no adjustment is necessary.

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 is connected to the starter solenoid to determine when the engine is cranking.

A/C "On" Signal

This signal tells the ECM that the A/C selector switch is turned on, and that the high side low pressure switch is closed. The ECM uses this to turn on A/C and adjust the idle speed when the air conditioning is working.

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.

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, 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
- Open pigtail connector at battery.

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.

The components or circuits and the codes or Charts, related to them are:

- Code 55 indicates a failure of the ECM.
- PROM (calibrator) - CHART 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.
- A/C "ON" Signal - CHART C-10.

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 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. 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

Remove or Disconnect.

1. Negative battery cable.
2. Right hand hush panel.
3. Connectors to ECM.
4. ECM.
5. PROM from ECM. (Fig. C1-7)

Install or Connect

1. Old PROM in ECM.
2. ECM into vehicle.
3. Connectors.
4. Hush panel.
5. Negative battery cable.

PROM

Code 51 indicates a faulty PROM bent pins, or incorrect installation.

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.

THE IGNITION SHOULD ALWAYS BE OFF WHEN INSTALLING OR REMOVING THE ECM CONNECTORS.

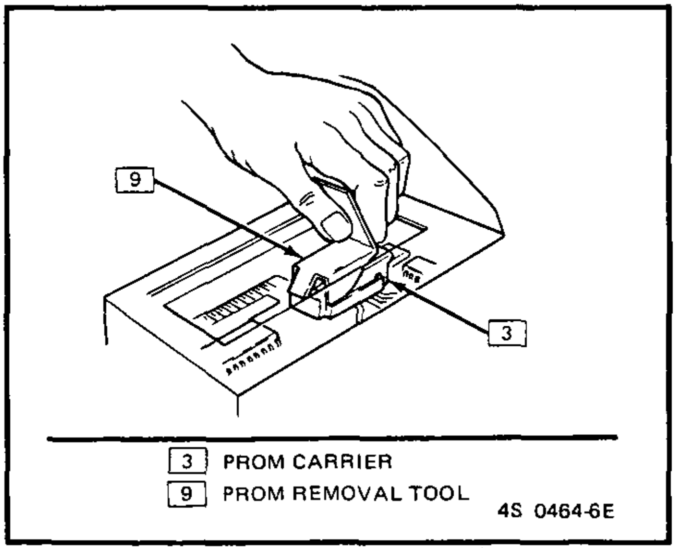


Figure C1-7 - PROM Removal Tool

Remove or Disconnect

1. Connectors from ECM.
2. ECM mounting hardware. (Fig. C1-8)
3. ECM from passenger compartment.
4. ECM access cover (see Figure C1-9).
5. 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 C1-7). 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.

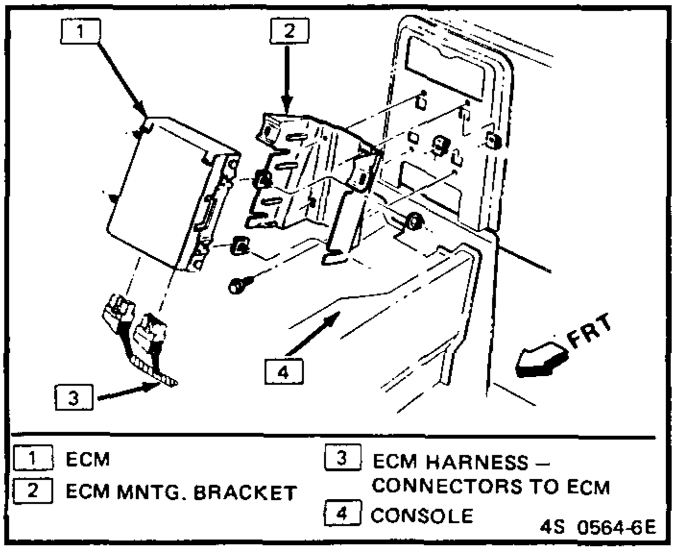


Figure C1-8 - ECM Mounting - P- Series - with A/C

Inspect

1. New PROM for same part number as old.

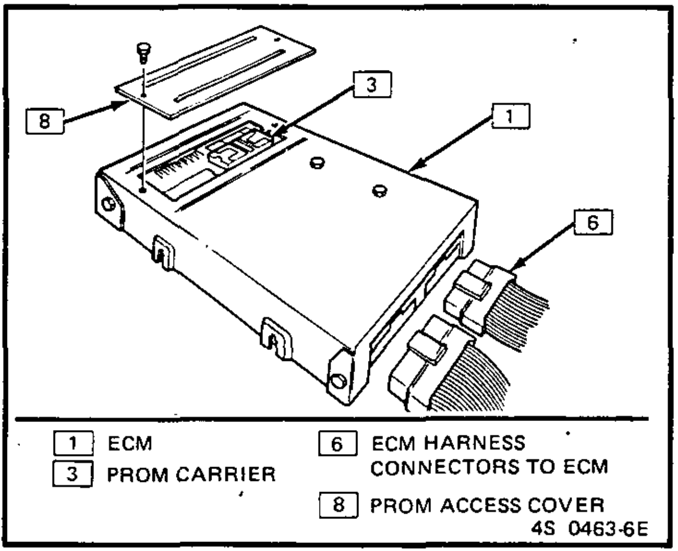


Figure C1-9 - PROM Access Cover P Series

Important

Do not remove PROM from carrier to check PROM number.

2. For correct reference of PROM in carrier, see Figure C1-10.

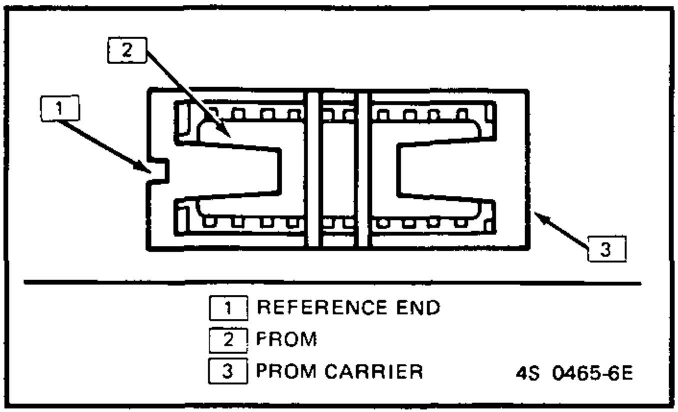


Figure C1-10 - PROM in PROM Carrier

Install or Connect

1. New PROM carrier in PROM 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.

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. Code 12 should flash at least four times. (No other codes 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.

Important

Any time the PROM is installed backward and the ignition switch turned on, the PROM is destroyed.

COOLANT SENSOR

Important

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.

MAP SENSOR (Fig. C1-11)

Other than checking for loose hoses and electrical connections the only service possible is unit replacement if diagnosis shows sensor to be faulty.

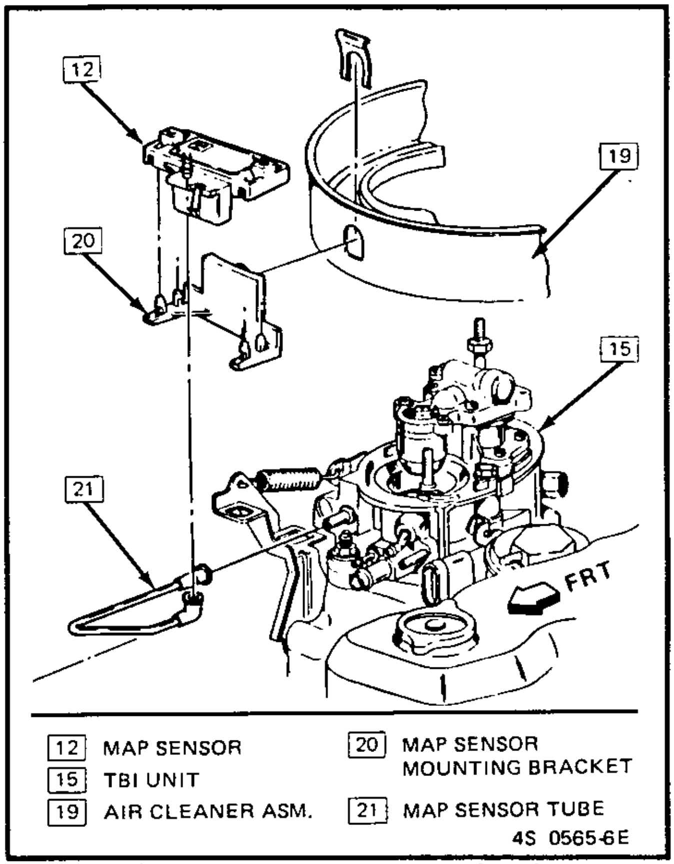


Figure C1-11 - MAP Sensor (2.5L)

OXYGEN SENSOR (Fig. C1-12)

Important

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.

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.

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.

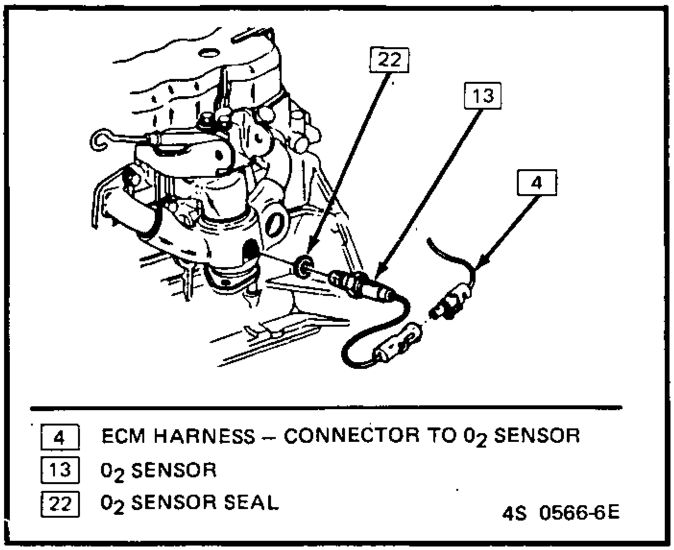


Figure C1-12 - Oxygen Sensor Typical

Remove or Disconnect

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 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. Air cleaner.
2. Electrical connector.
3. Two TPS attaching screws, lockwashers and cover.
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. cover and two TPS screws and lockwashers. 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 in Section 3B4.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
Sensor, Coolant Temp.	3.670
Sensor, Exhaust Oxygen	3.670
Sensor, MAP	3.670
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Switch, NeuSaf and Backing LP	2.698

BLANK

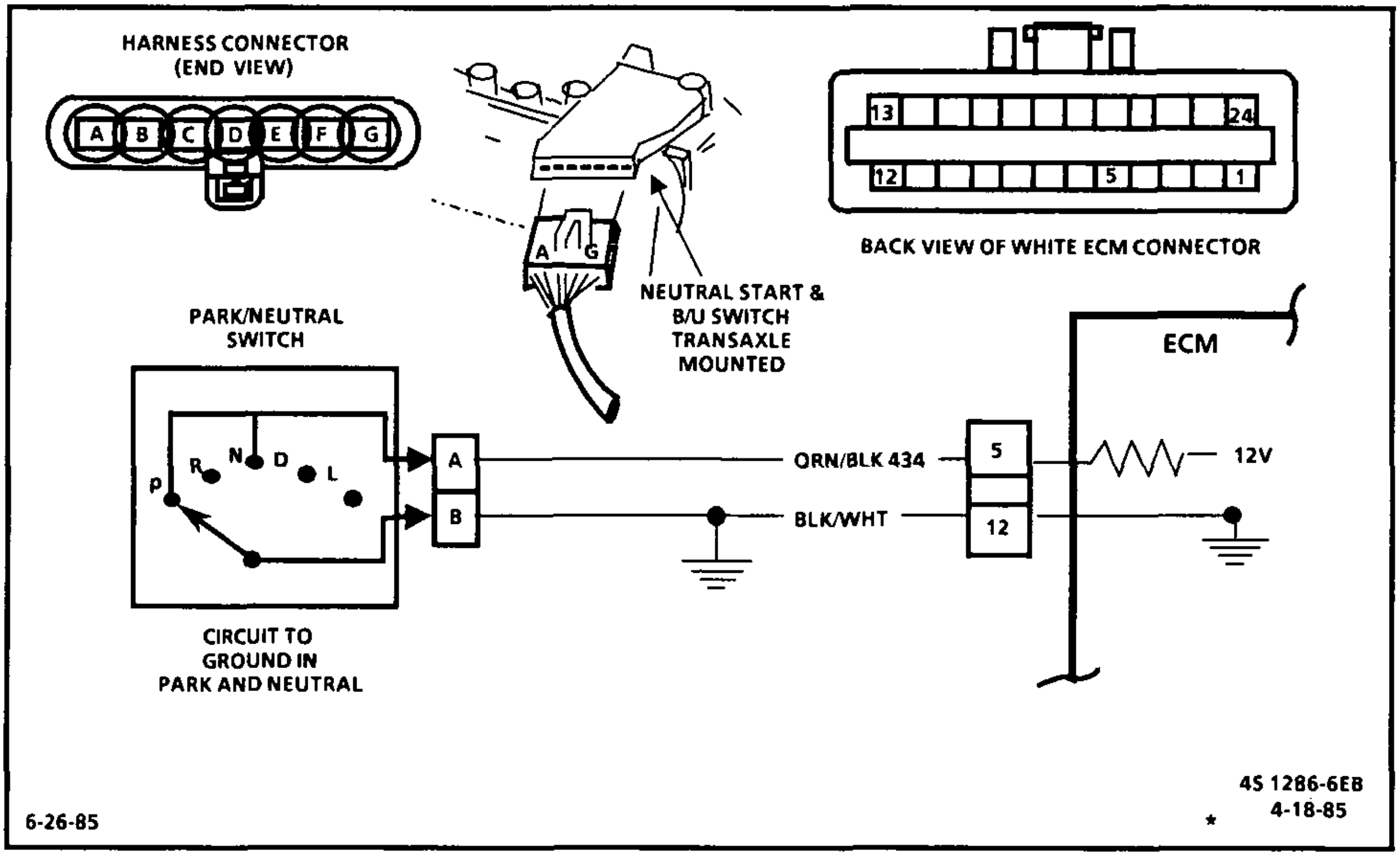


CHART C-1A

PARK/NEUTRAL SWITCH

2.5L "P" SERIES

FUEL INJECTION (TBI)

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;

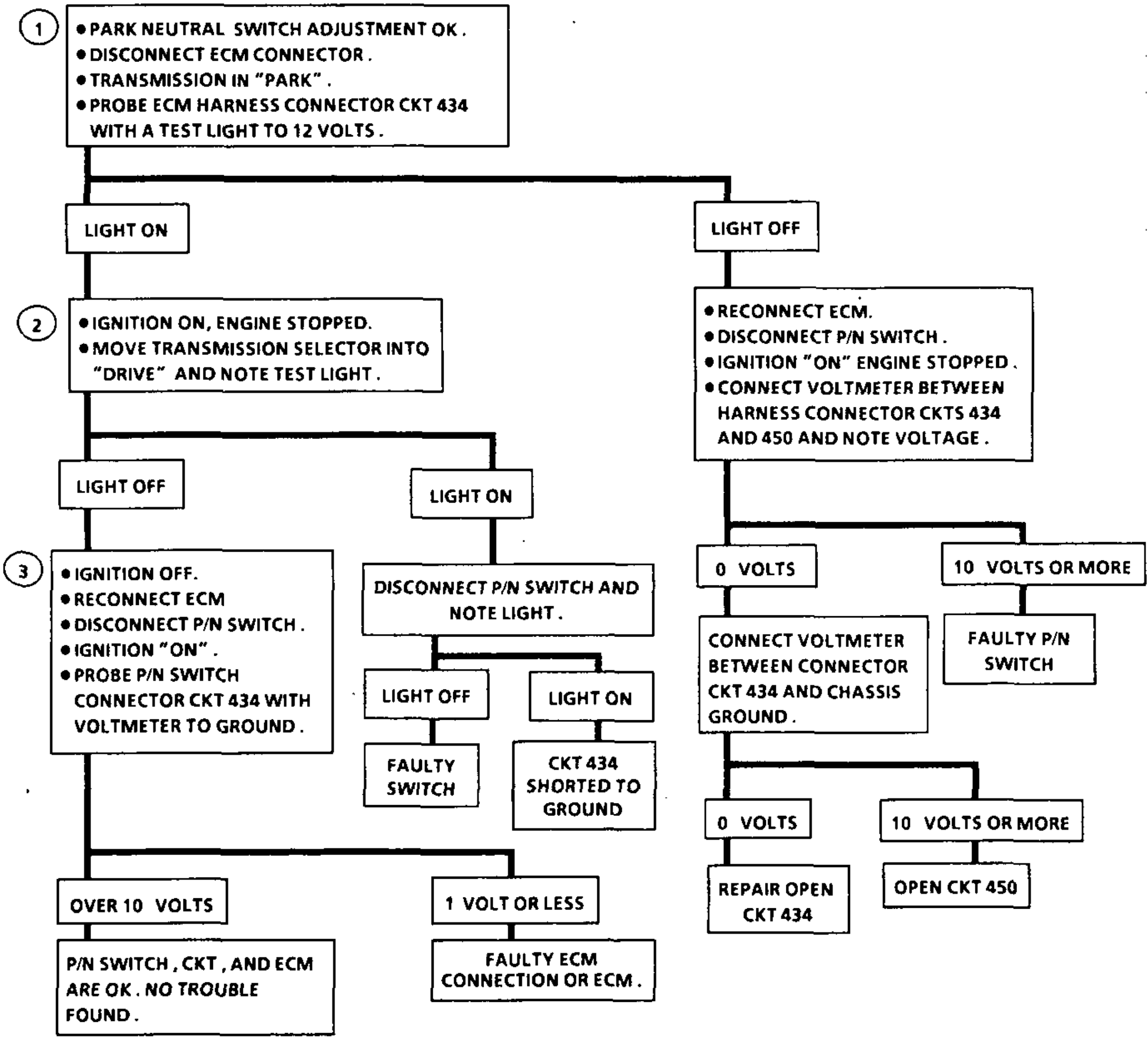
- Idle Air Control (IAC)
- VSS Diagnostics

1. Checks for a closed switch to gnd in park position. Use of an ohmmeter instead of a test light to 12 volts, the resistance will be low indicating continuity to ground.
2. Checks for an open switch in drive range. Use of an ohmmeter instead of a test light to 12 volts, the resistance will be high or infinity, indicating an open switch.
3. Checks to this point indicate the P/N switch and wiring are OK, however, the ECM signal voltage on ckt. 434 may be missing. To check, reconnect ECM. Either back probe ECM connector circuit 434 with selector in drive or disconnect P/N switch and probe harness connector ckt 434 with a voltmeter to ground.

CHART C-1A

PARK NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSAXLE ONLY)

2.5L "P" SERIES
FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

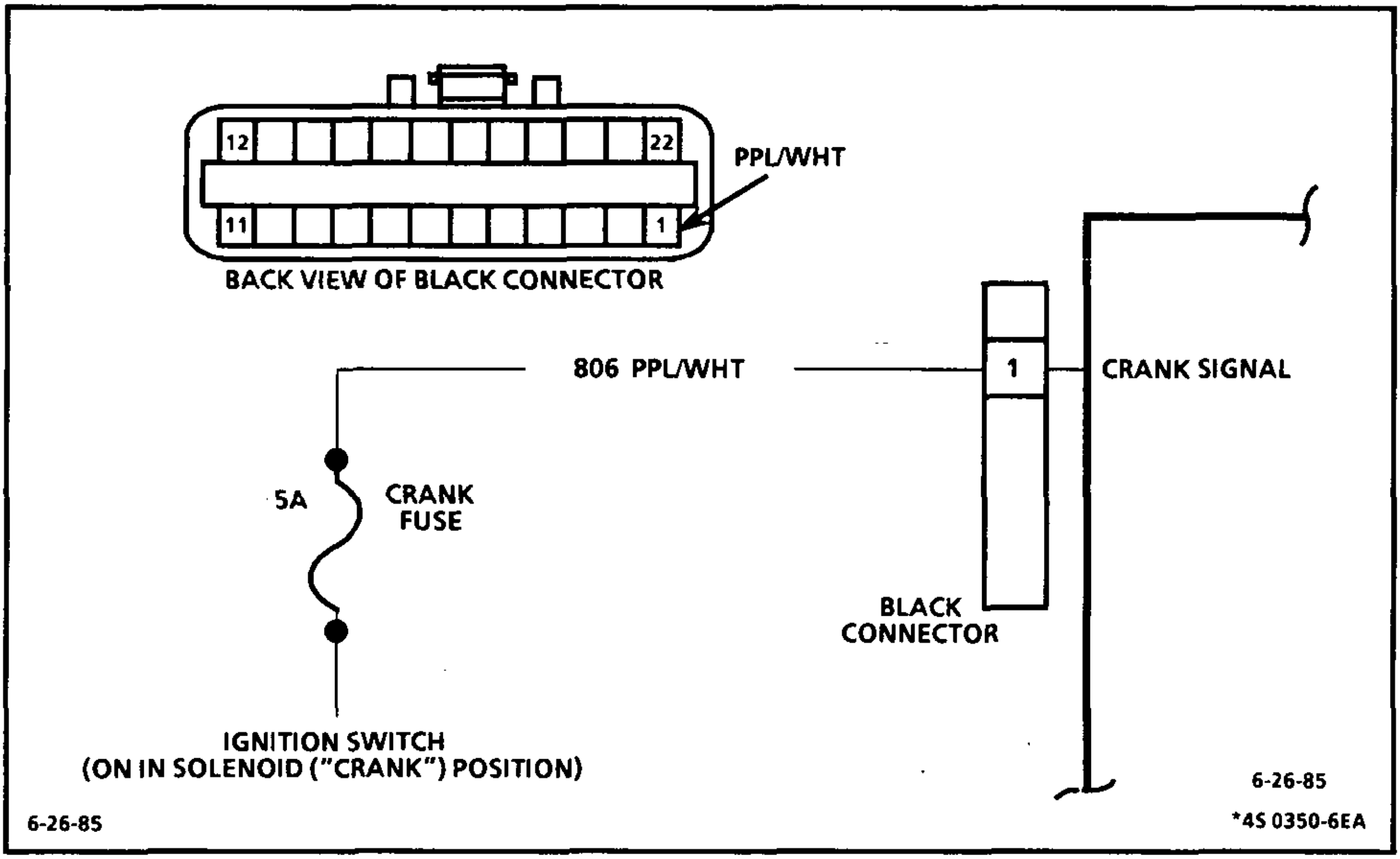


CHART C-1B

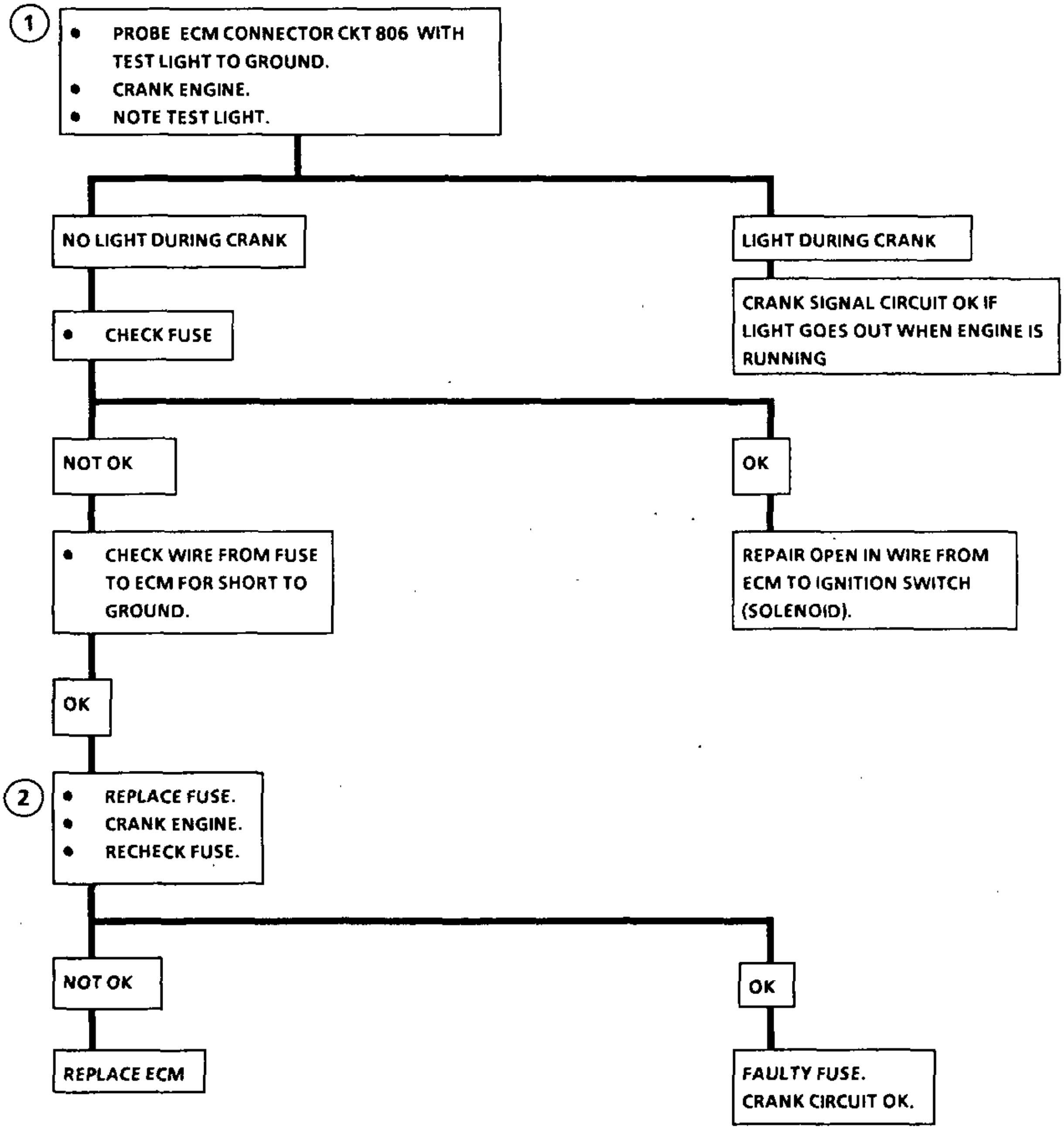
CRANK SIGNAL

2.5L "P" SERIES FUEL INJECTION (TBI)

Crank signal is a 12V signal to the ECM during cranking to allow enrichment and cancel diagnostics until engne is running or 12V is no longer on circuit.

1. Checks for normal (cranking) voltage to terminal "1" 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
2.5L "P" SERIES
FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-1-85

4S 1321-6E

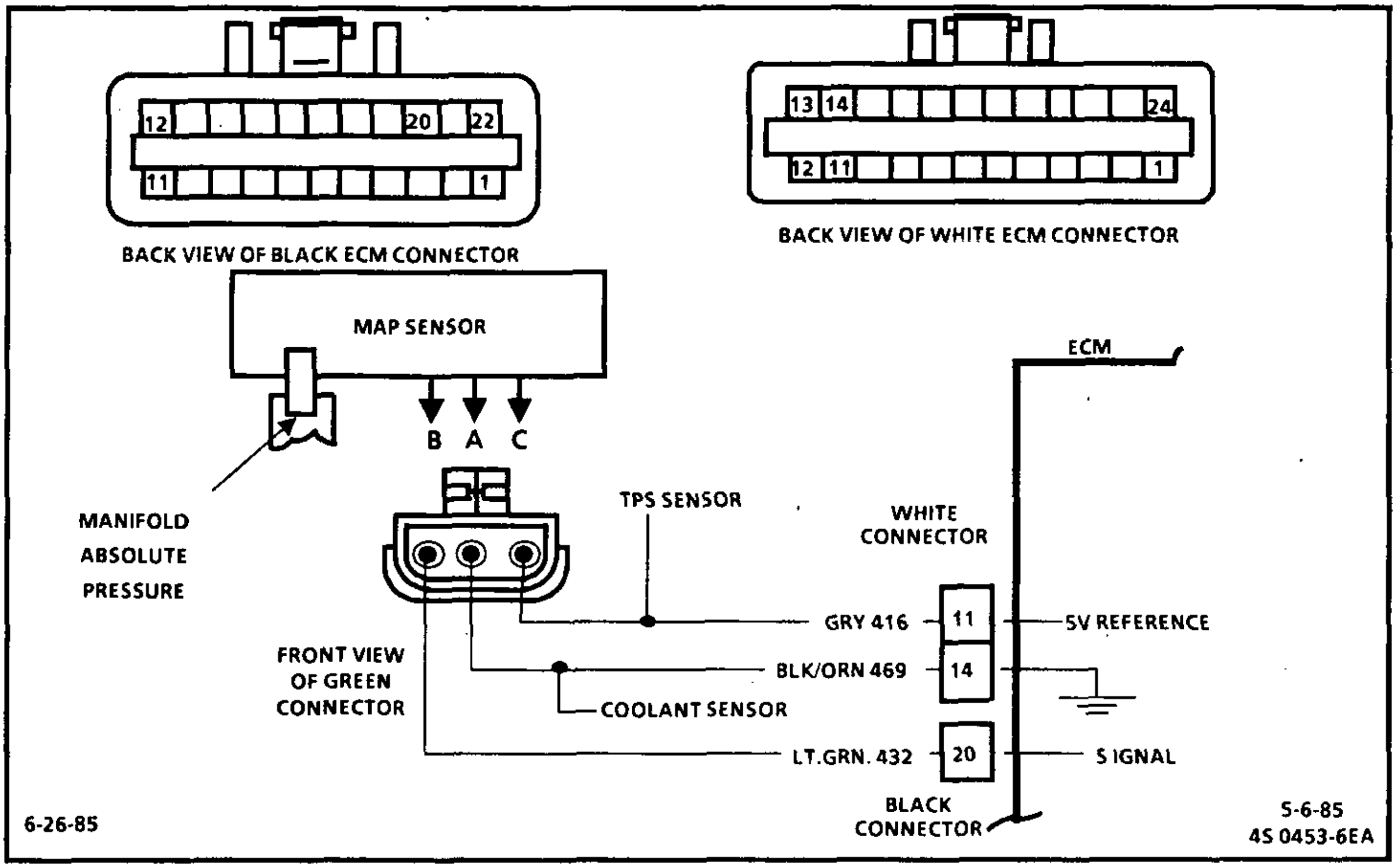


CHART C-1D

MAP OUTPUT CHECK
2.5L "P" SERIES
FUEL INJECTION (TBI)

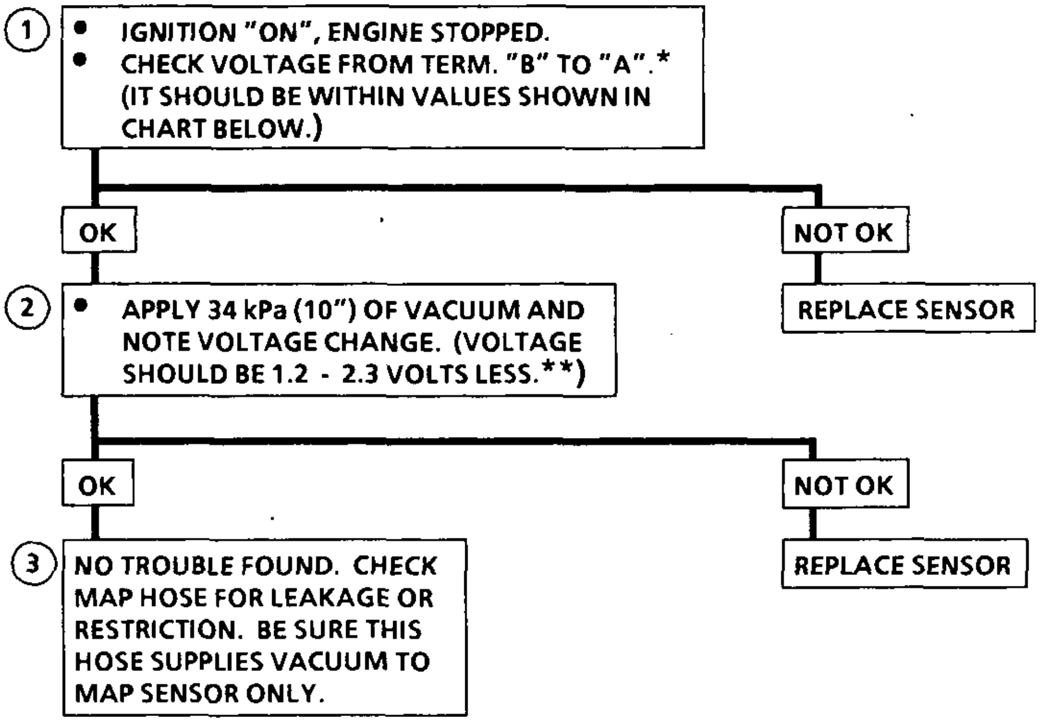
The Manifold Absolute Pressure Sensor (MAP) measures manifold pressure (vacuum) and sends that signal to the ECM. The ECM uses this information for fuel and spark control.

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 applyng 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.

CHART C–1D

MAP OUTPUT CHECK

2.5L "P" SERIES
FUEL INJECTION (TBI)



① • IGNITION "ON", ENGINE STOPPED.
• CHECK VOLTAGE FROM TERM. "B" TO "A".* (IT SHOULD BE WITHIN VALUES SHOWN IN CHART BELOW.)

REPLACE SENSOR

② • APPLY 34 kPa (10") OF VACUUM AND NOTE VOLTAGE CHANGE. (VOLTAGE SHOULD BE 1.2 - 2.3 VOLTS LESS.**)

REPLACE SENSOR

③ NO TROUBLE FOUND. CHECK MAP HOSE FOR LEAKAGE OR RESTRICTION. BE SURE THIS HOSE SUPPLIES VACUUM TO MAP SENSOR ONLY.

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

* THIS REQUIRES THE USE OF THREE JUMPERS WHICH CAN BE MADE USING TERMINALS 12014836 AND 12014837.

** IF VOLTAGE DOES NOT IMMEDIATELY FOLLOW VACUUM CHANGE, SENSOR IS FAULTY.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-21-85
*4S 0821-6EA

BLANK

SECTION C2

FUEL CONTROL SYSTEM

GENERAL DESCRIPTION

PURPOSE

The basic function of the fuel control system is control fuel delivery to the engine.

Fuel is delivered to the engine by a Throttle Body Injection (TBI) unit.

The main control sensor is the Oxygen (O_2) Sensor, which is located in the exhaust manifold. The O_2 sensor tells the ECM the ratio of oxygen in the exhaust gas, and the ECM changes the Air/Fuel ratio to the engine by controlling the fuel injector. The most efficient mixture to minimize exhaust emission is 14.7 to 1, which allows the Catalytic Converter to operate at maximum efficiency. 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).

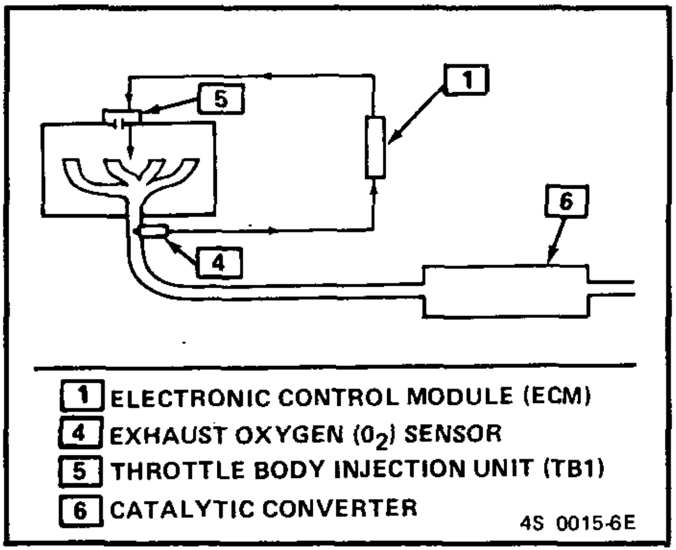


Figure C2-1 - Closed Loop System.

MODES OF OPERATION

The ECM looks at voltages from several sensors to detemine 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 key is first turned "on", the ECM will turn on the fuel pump relay for two seconds, and the fuel pump will build up pressure to the TBI unit. The ECM then checks the coolant temperature sensor, throttle position sensor, and crank signal, and determines the proper air/fuel ratio for starting.

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 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.

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, 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 MAP 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.
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. 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 as well as other sensor inputs. 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 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 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 CONTROL SYSTEM COMPONENTS

The Fuel Control System is made up of the following parts:

- Throttle Body Injection (TBI) Unit
  - Fuel Injector
  - Fuel Pressure Regulator
  - Idle Air Control (IAC) Valve
- Fuel pump
- Fuel pump relay

BASIC SYSTEM OPERATION

The fuel control system (Figure C2-2) starts with the fuel in the fuel tank. An electric fuel pump (7), located in the fuel tank with the gage sending unit, pumps fuel to the TBI (5) thru the fuel supply line (8), then thru an in-line fuel filter (9). 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 injector at a constant pressure between 62 and 90 kPa (9 and 13 psi). Fuel in excess of injector needs is returned to the fuel tank by a separate line (10). For further information on the fuel tank, in-line filter, and fuel lines, see Section 6C.

The injector, located in the TBI, is controlled by the ECM. It delivers 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 (Fuel Pump Electrical Circuit is shown in Code 54 Wiring Diagram).

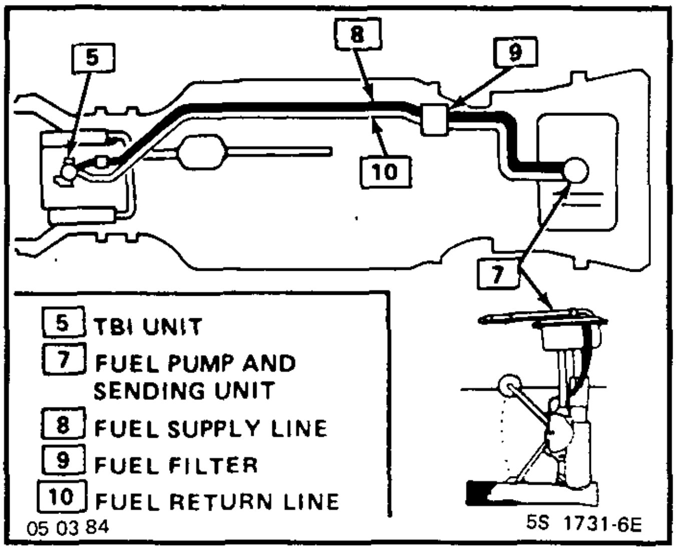


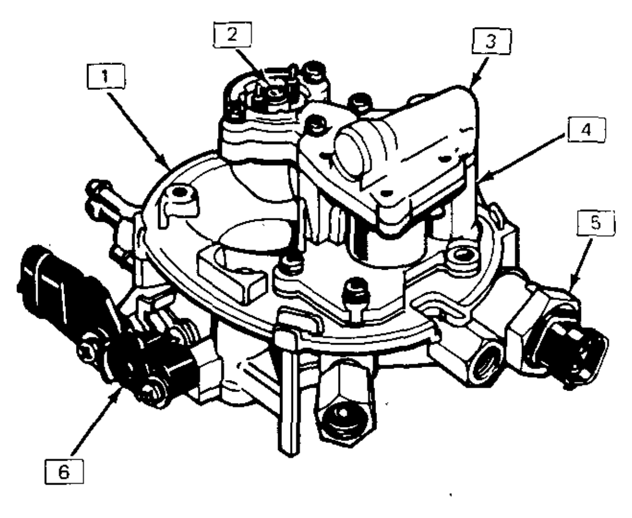
Figure C2-2 - Fuel Supply System (2.5L Typical)

THROTTLE BODY INJECTION (TBI) UNIT

The basic TBI unit (shown in Figure C2-3) is made up of two major casting assemblies:

1) A throttle body (11) with:
   - An Idle Air Control (IAC) Valve (14) to control air flow, and
   - A Throttle Position Sensor (15).
2) A fuel body (12) with:
   - A fuel meter cover with built in pressure regulator (13).
   - A fuel injector (16) to supply fuel to the engine.

The throttle body portion of the TBI unit may contain ports located at, above, or below the throttle valve. These ports generate the vacuum signals for the EGR valve, MAP sensor, and the canister purge system.



1 THROTTLE BODY
2 FUEL INJECTOR
3 FUEL METER COVER
(WITH PRESSURE REGULATOR BUILT-IN)
4 FUEL BODY ASM.
5 IDLE AIR CONTROL (IAC) VALVE
6 THROTTLE POSITION SENSOR (TPS)

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Figure C2-3 - TBI Unit (Typical)

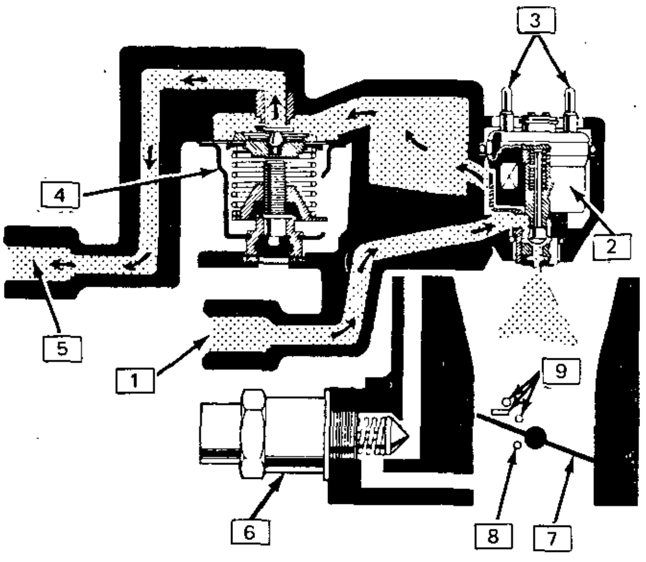
FUEL INJECTOR

The fuel injector is a solenoid operated device controlled by the ECM (See Figure C2-3). The ECM turns on the solenoid, which lifts a normally closed ball valve off a seat. The 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 injector passes through the pressure regulator before being returned to the fuel tank.

A fuel injector which does not open causes a no-start condition. An injector which is stuck partly open could cause dieseling because some fuel could 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 injector at all times, by controlling the flow in the return line (i.e., a calibrated bypass). The pressure regulator is serviced as part of the fuel meter cover.



1 FUEL SUPPLY LINE
2 FUEL INJECTOR
3 FUEL INJECTOR TERMINALS
4 PRESSURE REGULATOR (PART OF
FUEL METER COVER)
5 FUEL RETURN LINE
6 IDLE AIR CONTROL (IAC)
VALVE (SHOWN OPEN)
7 THROTTLE VALVE
8 MANIFOLD VACUUM SOURCE*
(BELOW THROTTLE VALVE)
9 PORTED VACUUM SOURCES*
(ABOVE THROTTLE VALVE)

*May be different on some models.

4S 0057-6E

Figure C2-4 - TBI Operation

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 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", which can be measured by some test equipment which plugs into the ALCL.

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 valve position to prevent stalls based on barometric pressure.

If the IAC Valve is disconnected or connected with the engine running, the IAC counts may be wrong. In this case, the IAC will reset when the vehicle speed is over 35 MPH (56 KPH).

Two different designs are used for the conical valve (see Figure C2-5). The first design, used on 2.5L, 1.8L, and 2.0L engines with automatic transmissions, is a dual taper. The second design, used on 2.0L engines with manual transmissions, is a blunt 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 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.

FUEL PUMP ELECTRICAL CIRCUIT

When the key 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 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 acts as a back-up to the relay and will turn on the fuel pump as soon as oil pressure reaches about 4psi (28 kPa).

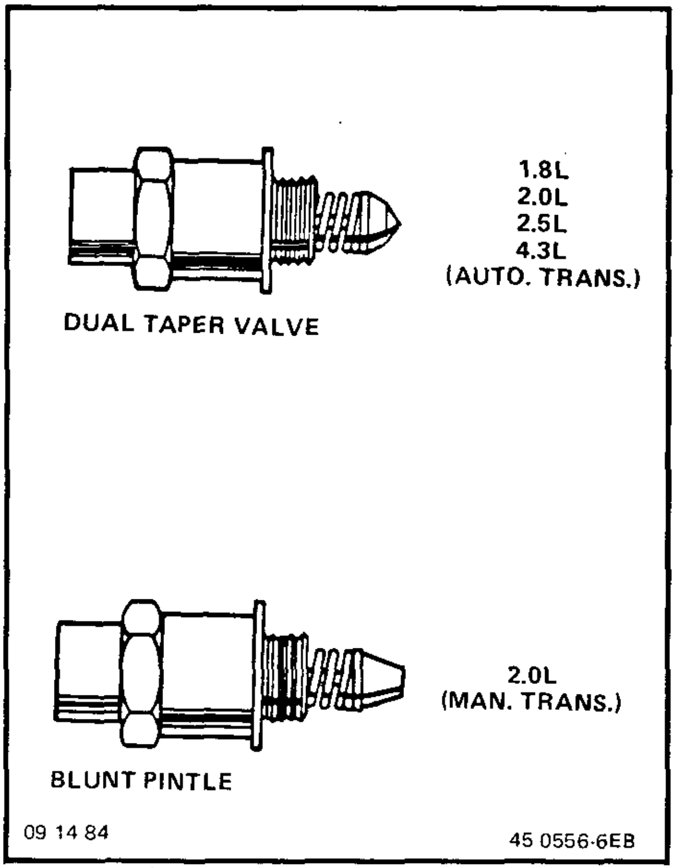


Figure C2-5 - IAC Valve Designs

DIAGNOSIS

The diagnosis of the fuel control system is covered in the CHARTS A-5 and A-7 called "Fuel System Diagnosis". This includes the fuel injectors, the pressure regulator, and the fuel pump and fuel pump relay.

> CAUTION: *Before servicing a TBI unit on 2.5L engines, 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").*

FUEL PRESSURE RELIEF PROCEDURE

1. Remove fuse marked "Fuel Pump" from fuse block in passenger compartment.
2. Crank engine - engine will start and run until fuel supply remaining in fuel lines is exhausted. When engine stops, engage starter again for 3.0 seconds to assure dissipation of any remaining pressure.
3. With ignition "OFF", replace "Fuel Pump" fuse. Unless this procedure is followed before servicing fuel lines or connections, fuel spray could occur.

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:

> **CAUTION:** *To reduce the risk of fire or personal injury, it is necessary to relieve the fuel system pressure before performing this test. See "Fuel Pressure Relief Procedure" above.*

1. Turn ignition off and relieve fuel pressure..
2. Install fuel pressure gage J29658/BT8205 or equivalent in the pressure line, at the connector, near the left engine compartment frame rail.

Measure

3. Start car and observe fuel pressure reading. It should be 62-90 kPa (9-13 psi); if not, refer to CHARTS A-5 or A-6.
4. Relieve fuel pressure.
5. Remove fuel pressure gage.
6. Reinstall fuel line.
7. Start car and check for fuel leaks.
8. Remove plug covering THERMAC vacuum port on TBI and install air cleaner.

ON-CAR SERVICE

TBI UNIT

> **CAUTION:** *Before servicing a TBI unit on 2.5L engines, 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" above).*

FUEL INJECTOR

Important

Use care in removing injector to prevent damage to the electrical connector terminals on top of the injector, the injector fuel filter, and the nozzle. The fuel injector is serviced as a complete assembly only. The fuel injector is an electrical component and should not be immersed in any type of cleaner.

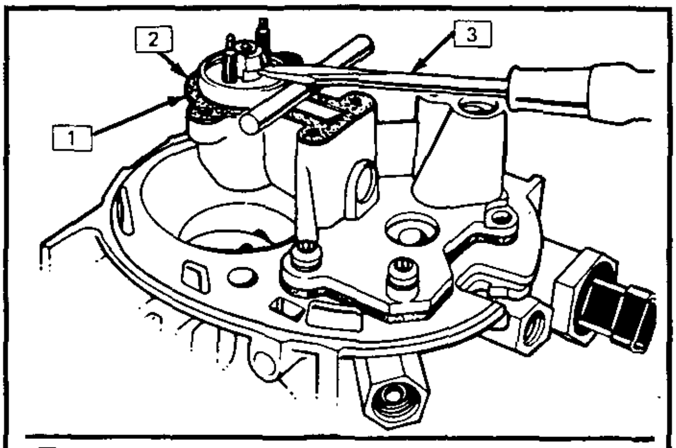


Figure C2-6 - Removing Injector

Remove or Disconnect

1. Air cleaner.
2. Injector connector (squeeze two tabs together and pull straight up).
3. Fuel meter cover (see Fuel Meter Cover procedure, and Figure C2-9).
4. With the fuel meter cover gasket in place to prevent damage to the casting, use a screwdriver, as shown, to lift the injector carefully until it is free from the fuel meter body (Figure C2-6). Tool J-26868 or equivalent can also be used.
5. Small "O" ring from nozzle end of injector. Carefully rotate the injector fuel filter back and forth, and remove filter from base of injector.
6. Remove and discard fuel meter cover gasket.
7. Remove large "O" ring and steel back-up washer from the top counterbore of the fuel meter body injector cavity, (Figure C2-7).

Install or Connect

1. Fuel injector nozzle filter on nozzle end of fuel injector, with larger end of filter facing injector, so that filter covers raised rib at base of injector. Use a twisting motion to position filter against base of injector.

2. Lubricate a new small O-ring with automatic transmission fluid. Push O-ring on nozzle end of injector until it presses against the injector fuel filter.

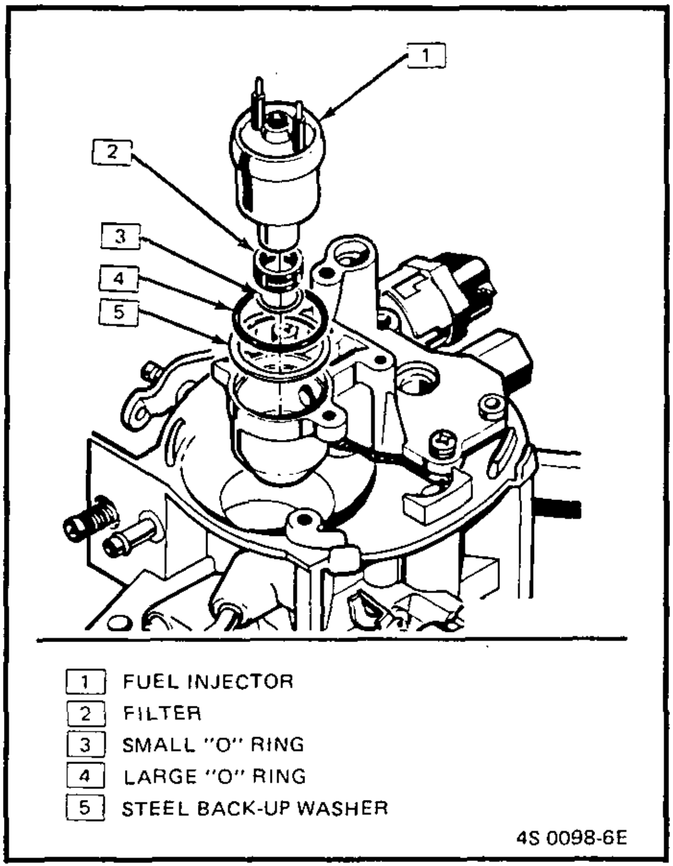


Figure C2-7 - Fuel Injector Components

3. Steel backup washer in top counterbore of fuel meter body injector cavity.
4. Lubricate a new large O-ring with automatic transmission fluid and install it directly over the backup washer. Be sure O-ring is seated properly in cavity and is flush with top of fuel meter body casting surface.

Important

Back-up washer and large O-ring must be installed before the injector, or improper seating of the large O-ring could cause fuel to leak.

5. Install injector in cavity, aligning raised lug on injector base with cast-in notch in the fuel meter body cavity. Push down on injector, as shown, (Figure C2-7), until it is fully seated in cavity, (Electrical terminals of injector will be approximately parallel to throttle shaft).
6. Fuel Meter Cover (see Fuel Meter Cover procedure). Thread locking compound must be used on screws.
7. Injector electrical connector.
8. Air cleaner.

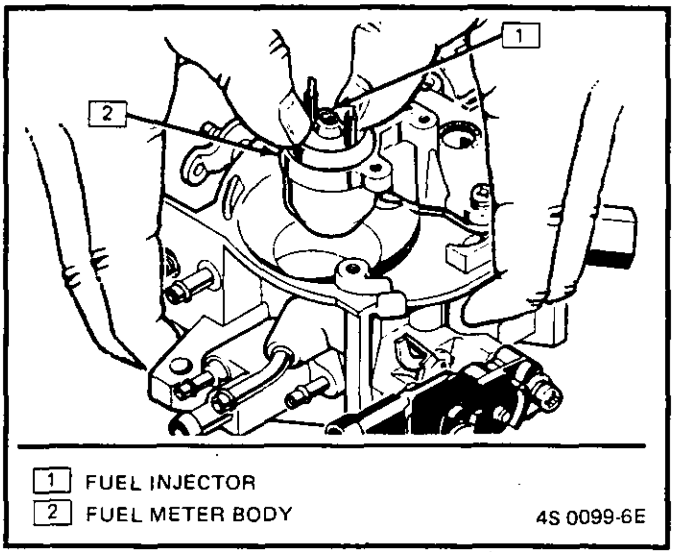


Figure C2-8 - Installing Fuel Injector

FUEL METER COVER

The fuel meter cover contains the pressure regulator and is only serviced as a complete preset assembly. The fuel pressure regulator is pre-set and plugged at the factory.

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 cause a fuel leak between the diaphragm and the regulator container.*

Remove or Disconnect

1. Air cleaner.
2. Electrical connector to fuel injector.
3. Five screws and lockwashers securing fuel meter cover to fuel meter body. Notice location of two short screws (Figure C2-9).
4. Fuel meter cover.

NOTICE: *DO NOT immerse the fuel meter cover (with pressure regulator) in cleaner, as damage to regulator diaphragms and gaskets could occur.*

Install or Connect

1. New dust seal (Figure C2-9, 13C), into recess on fuel meter body.
2. New fuel outlet passage gasket (Figure C2-10, 13E), on fuel meter cover.
3. New fuel meter cover gasket (Figure C2-10, 13D), on fuel meter body.

4. Fuel meter cover, making sure pressure regulator dust seal and cover gaskets are in place; then, apply a thread locking compound *to threads on the fuel meter cover attaching* screws (five). Install fuel meter cover attaching screws and lockwashers and torque to 3.0 N.m (28 in. lbs.). Two short screws go next to the fuel injector (Figure C2-9).

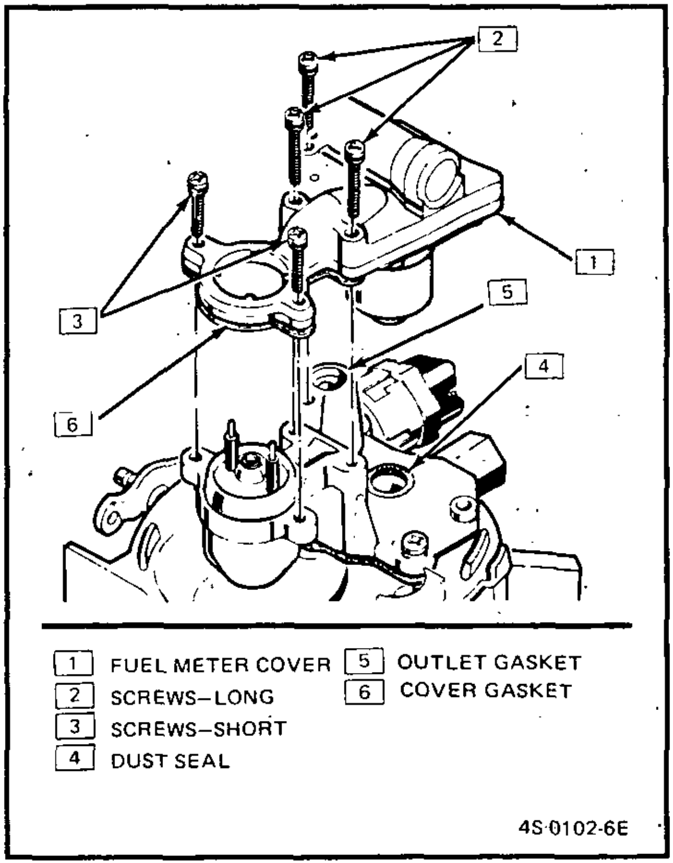


Figure C2-9 - Fuel Meter Cover Removal

Important

Service repair kits include a small vial of thread locking compound with directions for use. If material is not available, use Loctite 262, or GM part number 1052624, or equivalent. Do not use a higher strength locking compound than recommended, as this may prevent attaching screw removal or breakage of the screwhead if removal is again required.

5. Electrical connector to fuel injector.
6. Air cleaner.

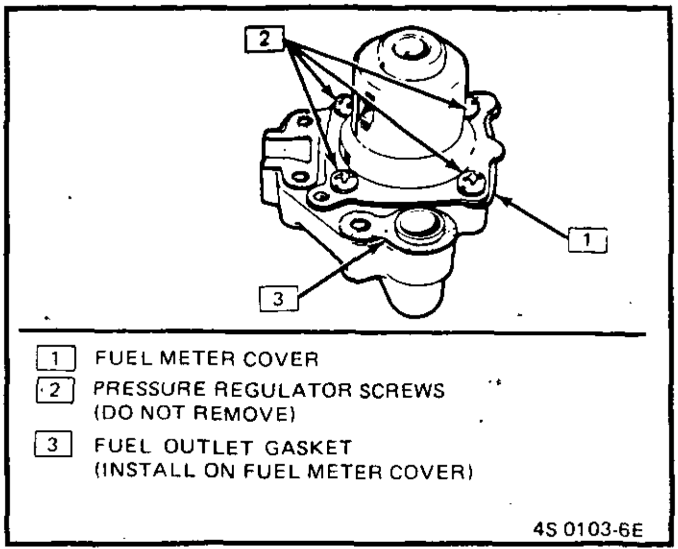


Figure C2-10 - Installing Fuel Meter Cover

Idle Air Control Valve

Remove or Disconnect

1. Air cleaner.
2. Electrical connector from idle air control valve.
3. Idle air control valve, using a 32mm (1-1/4") wrench (J-33031 or equivalent), on hex surface only.

Install or Connect

Important

Before installing new idle air control valve, measure the distance that the valve is extended (see Figure C2-11). Measurement should be made from motor housing to end of cone. Distance *should be no greater than 28mm (1-1/8 in). If the* cone is extended too far, damage may occur to the valve when installed.

Identify replacement IAC valve (Figure C2-11) as being either Type I (having collar at electric terminal end) or Type II (without collar). If measured dimension "A" is greater than 28mm (1-1/8"), distance must be reduced as follows:

TYPE I - Exert firm pressure on valve to retract it. (A slight side-to-side movement may be helpful).

TYPE II- Compress retaining spring of valve while turning valve "in" with a clockwise motion. Return spring to original position with straight portion of spring end aligned with flat surface of valve.

1. New idle air control valve to throttle body. Use new gasket supplied with assembly. Tighten valve to 18 N•m(13 lb. ft.).
2. Electrical connector to idle air control valve.
3. Air cleaner.
4. Start engine and allow engine to reach operating temperature.
5. ECM will reset idle speed when vehicle is driven above 35 MPH (56 kph)

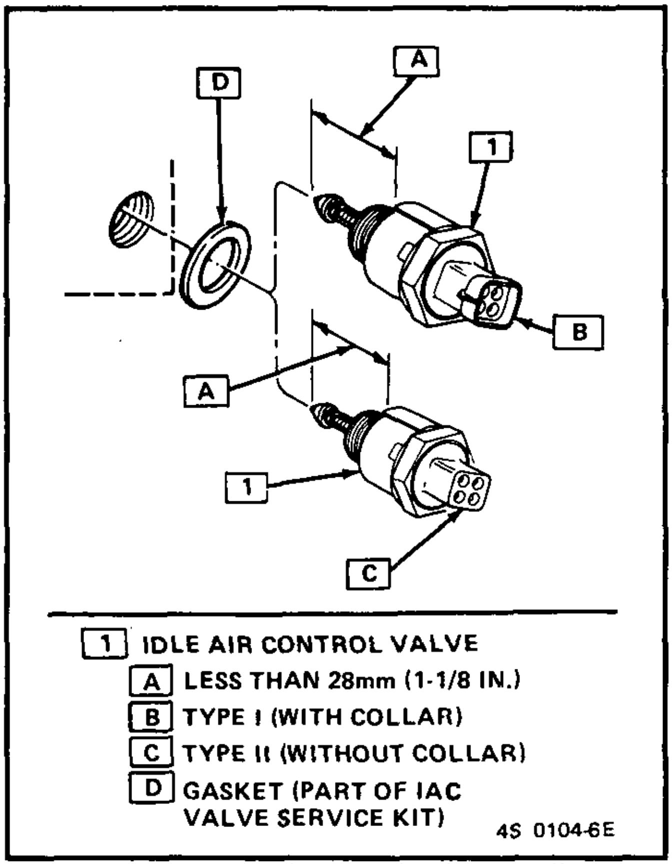


Figure C2-11 - Idle Air Control Valve Installation

MINIMUM IDLE SPEED (2.5L)

The Throttle Stop Screw, which is used in regulating minimum idle speed of the vehicle, is adjusted at the factory.

<u>This adjustment should be performed only when the throttle body has been replaced. Complete TBI assemblies are Factory adjusted and should not be reset in the field.</u>

Adjust

1. Air cleaner and air cleaner to TBI gasket. Plug vacuum port on TBI unit for THERMAC.
2. T.V. cable from throttle control bracket to allow access to minimum air adjustment screw.
3. Connect a tachometer to engine.
4. Idle Air Control (IAC) connector.
5. Start engine, transmission in Park (Neutral on manual transmission) and allow engine RPM to stabilize.
6. Install tool J-33047 in idle air passage of throttle body. Be certain that tool seats fully in passage and no air leaks exist (see Figure C2-12).
7. Using appropriate tool (No. 20 Torx Bit), turn throttle stop screw until engine RPM is 500 ± 25 for 2.5L in park or neutral with automatic transaxle, and 775 ± 25 for 2.5L in neutral with manual transaxle.
8. Stop engine and remove tool J-33047 from throttle body.

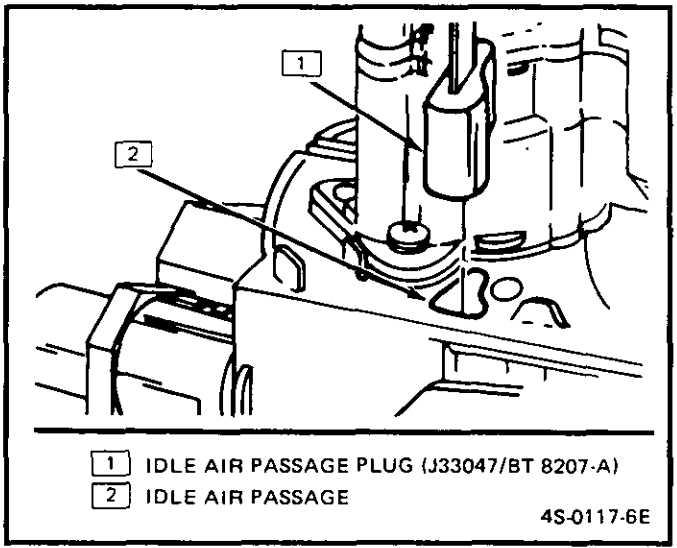


Figure C2-12 - Installing Tool J-33047

9. T.V. cable into throttle control bracket.
10. Idle Air Control (IAC) connector.
11. Use silicone sealant or equivalent to cover throttle stop screw.
12. Air cleaner gasket and air cleaner to engine.

Adjust

1. Remove air cleaner and plug THERMAC vacuum port.
2. S et parking brake and block drive wheels.
3. Connect a tachometer to engine.
4. Start engine, put transmission in Park (*Neutral on manual transmission*) and allow engine RPM to stabilize.
5. Disconnect Idle Air Control connector.
6. Install tool J-33047 in idle air passage of throttle body. Seat tool in air passage until bottomed and no air leaks exist. (See Figure C2-9).

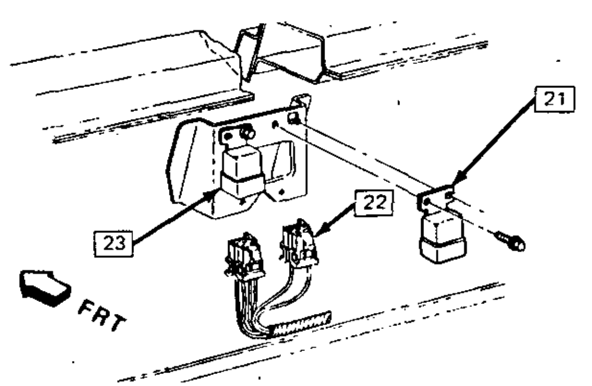
   If necessary, the air cleaner isolator can be removed to install J-33047 as follows:
   a. Remove two bolts and isolator.
   b. Reinstall bolts with 2 mm (or thicker) washers under each bolt head.
   c. After adjustment is complete, reinstall isolator without washers and torque bolts to 23 N•m (17 ft. lbs.).
7. On vehicles with automatic transaxle, place selector lever in D (Drive) before making *adjustment.*
8. Using a No. 20 Torx Bit, turn throttle stop screw until engine RPM is 650 +/- 25 RPM.
9. Stop engine and remove tool from throttle body.
10. Reconnect Idle Air Control connector.
11. Seal hole drilled through throttle body casting with silicone sealant.
12. Install air cleaner.

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment (See Figure C2-13). Other than checking for loose connectors, the only service possible is replacement.

OIL PRESSURE SWITCH

The oil pressure switch is mounted on the rear of the engine as shown in Figure C2-14.



21 FUEL PUMP RELAY
22 ECM HARNESS – CONNECTOR TO FUEL PUMP
23 A/C CONTROL RELAY

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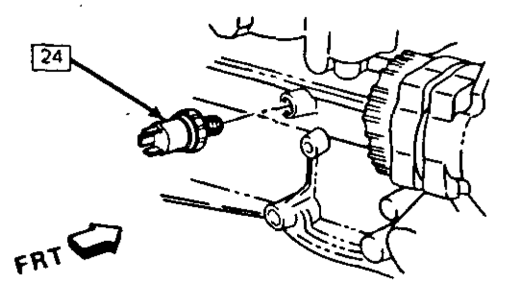
Figure C2-13 - Fuel Pump Relay



24 OIL PRESSURE SWITCH

4S 0560-6E

Figure C2-14 - Oil Pressure Switch (2.5L)

TBI REPLACEMENT

Removal

1. Disconnect THERMAC hose from engine fitting.
2. Remove air cleaner
3. Disconnect electrical connectors from idle air control, throttle position sensor and injector.
4. Disconnect throttle cable, return spring, transmission control cable and cruise control cable if equipped.
5. Disconnect vacuum hoses from throttle body noting positions for proper installation.

6. Disconnect fuel feed and return lines from throttle body unit. Use a backup wrench on return line.
7. Remove injector harness and grommet.
8. Remove three long throttle body bolts and remove unit from manifold.

INSTALLATION

1. Be sure throttle body to manifold surface is clean.
2. Install new throttle body to manifold gasket.
3. Install throttle body unit on intake manifold.
4. Install air cleaner isolator gasket on TBI unit (2.0L only).
5. Install injector harness and grommet.
6. Install three throttle body attaching bolts. Torque alternately to 17 N•m (12 ft. lbs.).
7. Install fuel return line to throttle body and torque to 23 N•m (17 ft. lbs.).
   Before installing return line, inspect "O" ring on end of return line. Replace "O" ring if it shows signs of being cut or frayed.
8. Fuel Feed Line Installation:
   Inspect "O" ring. Replace "O" ring if it shows signs of being cut or frayed. Assemble to throttle body and torque to 23 N•m (17 ft. lbs.).
9. Connect electrical connectors to idle air control, TPS and injector.
10. Connect throttle cable return spring, transmission control cable, and cruise control cable if removed.
11. Install air cleaner.
12. Start engine and check for fuel leaks.

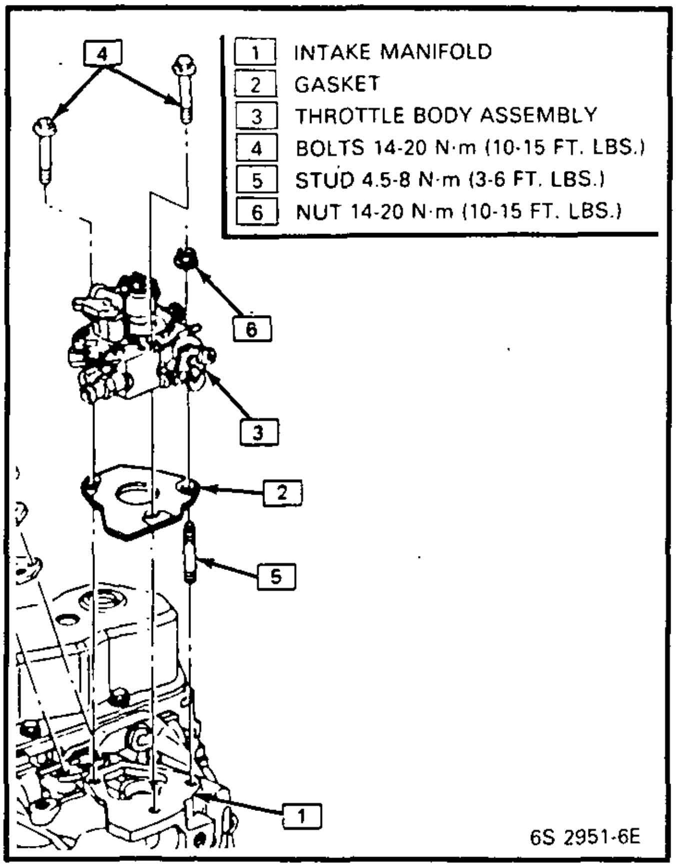


Figure C2-15 Throttle Body 2.5L

PARTS INFORMATION

PART NAME	GROUP
Cover, w/Regulator, Fuel Meter: Part of Meter Kit, Fuel	3.734
Injector, Fuel: Part of 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
Valve Asm, Idle Air Control: Part of Control Kit, Idle Air Valve	3.820

SECTION C3

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

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.

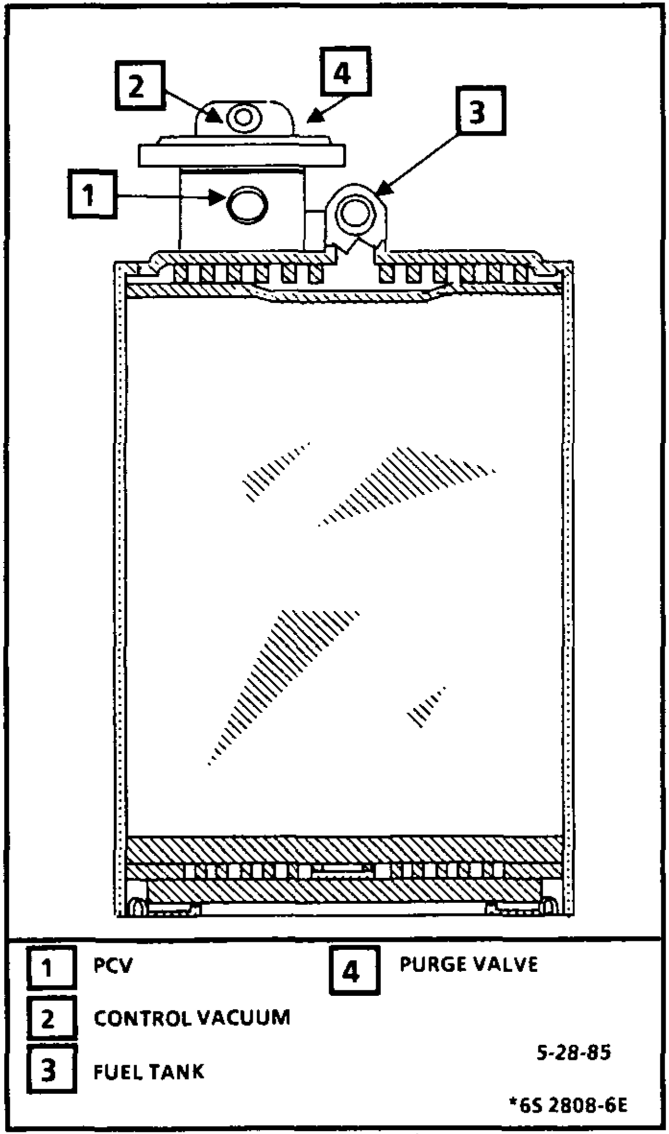


Figure C3-1 - Vapor Canister - 2.5L

PURGE VALVE OPERATION - 2.5L

The purge valve is an integral part of the canister. When the engine is running, manifold vacuum is supplied to the top tube of the purge valve (Control Vacuum Signal) which lifts the valve diaphragm and opens the valve. The lower tube on the purge valve (PCV Tube) is connected to a timed port above the TBI throttle valve. The rate of purge is controlled through this port by throttle position.

FUNCTIONAL TESTING - CANISTER WITH DIAPHRAGM OPERATED PURGE VALVE

2.5L

- Apply a short length of hose to the PCV tube of purge valve assembly (lower tube), and attempt 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 a hand vacuum pump, apply vacuum (15" Hg or 51 kPa) through the control vacuum signal tube to the purge valve diaphragm. If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking, and the canister must be replaced.
- If the diaphragm holds vacuum, again try to blow through the hose connected to the PCV tube while vacuum is still being applied. An increase flow of air should be observed. If not, the canister must be replaced.

RESULTS OF INCORRECT OPERATION

- Poor idle, stalling and poor driveability can be caused by:
  - Inoperative purge valve - 2.5L
  - 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 front fuel lines, fuel pump or TBI
  - Cracked or damaged canister
  - Inoperative bowl vent valve
  - Inoperative purge valve - 2.5L
  - Disconnected, misrouted, kinked, deteriorated or damaged vapor hoses, or control hoses
  - Air cleaner or air cleaner gasket improperly seated.

VISUAL CHECK OF CANISTER

- Cracked or damaged, replace canister.
- Fuel leaking from bottom of canister, replace canister and check hoses and hose routing.
- Check filter at bottom of canister. If dirty, plugged, or damaged, replace filter.

ON-CAR SERVICE

FUEL VAPOR CANISTER

←→ Remove or Disconnect

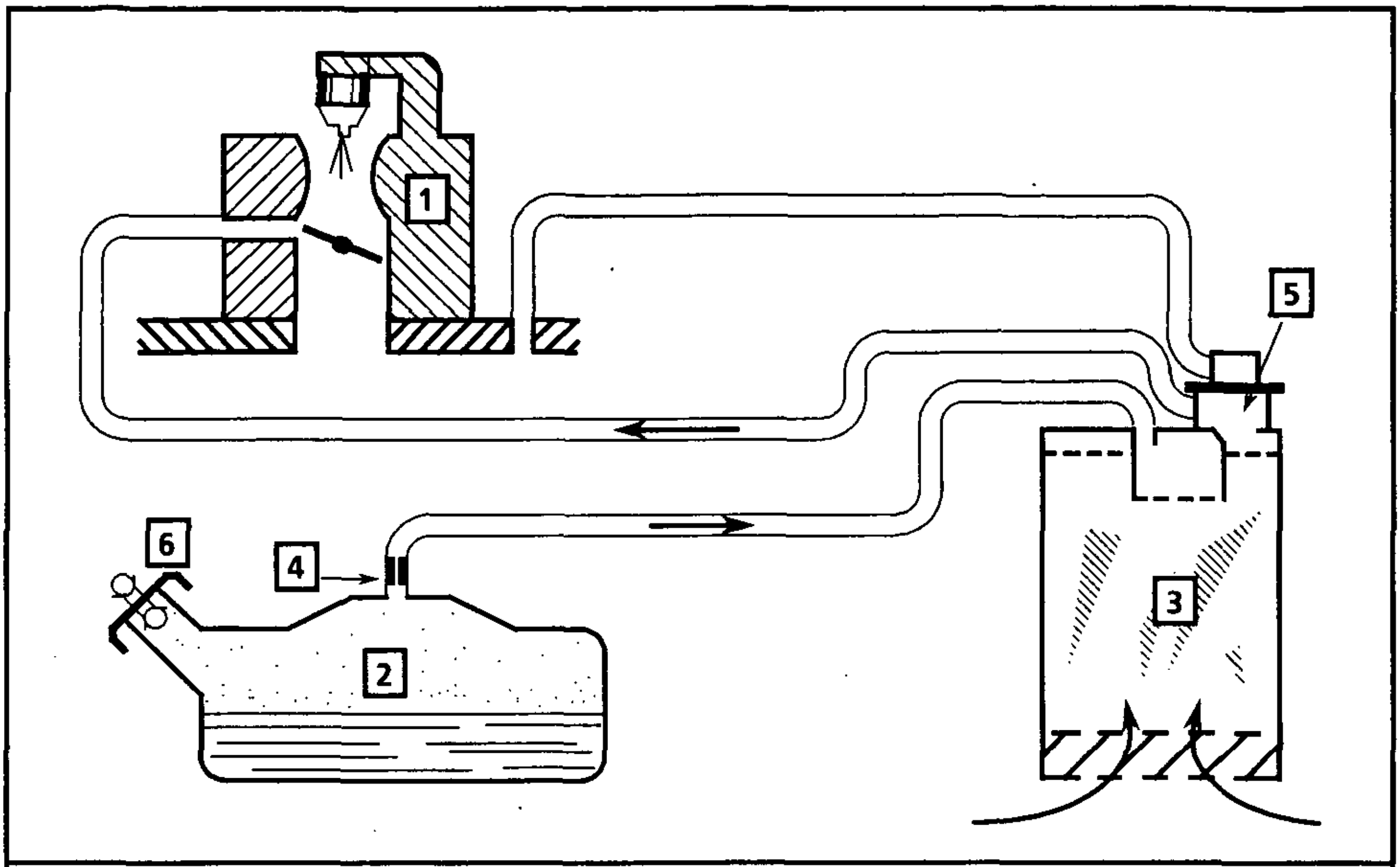
1. Hoses from canister. Mark hoses to install on new canister.
2. Canister.

→← Install or Connect

1. Canister.
2. Hoses. Make sure connections are correct.

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130



1	TBI
2	Fuel Tank
3	Canister
4	Vapor Restriction
5	Purge Control Valve
6	Pressure / Vacuum Relief Vented Fuel Filler Cap

6S 2961-6E

Figure C3-2 Evaporative Emissions Control System Schematic - 2.5L

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SECTION C4

IGNITION SYSTEM / EST

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

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 connector terminals are lettered as shown in Figure C4-1.

These circuits perform the following functions:

- Distributor reference - CKT. 430.
  This provides the ECM with RPM and crankshaft position information.
- 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. 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.

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.

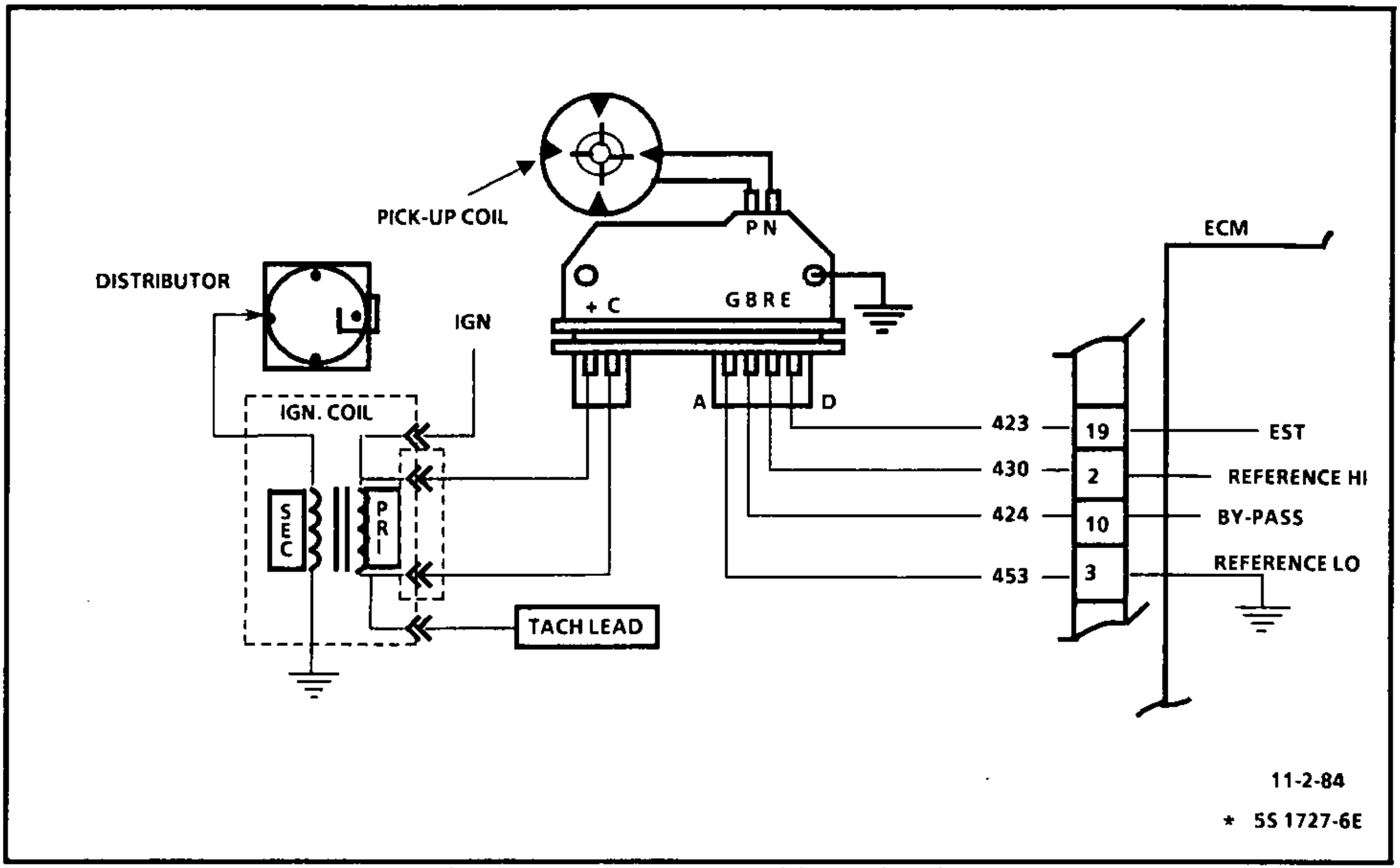
How Code 42 Is Determined

When the system is running on the HEI module, that is, no voltage on the by-pass 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 by-pass line and the EST *should no longer be grounded in the* HEI module so the EST voltage should be varying.

If the by-pass 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.

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. A Code 42 will be set.



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* 5S 1727-6E

Figure C4-1 - HEI System With EST (2.5L)

DIAGNOSIS

The description and operation of the HEI system are found in Section 6D of this manual. Diagnosis is covered in the C4 Chart at the end of this section.

- CHART C-4B, Ignition System Check - 2.5L

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 timing is set by following the procedures on the Vehicle Emission Control Information label and in Section 6D.

CHECKING EST PERFORMANCE

The ECM will set timing at a specified value when the diagnostic "Test" terminal in the ALCL connector is grounded. To check for EST operation, the timing should be checked at 2000 RPM with the terminal ungrounded. Then, ground the "Test" temninal. If the timing changes at 2000 RPM, the EST is operating. A fault in the EST system will set a trouble Code 42. Use that chart to diagnose the system.

PARTS INFORMATION

PART NAME	GROUP
Module, Distr	2.383
Coil, Distr	2.170

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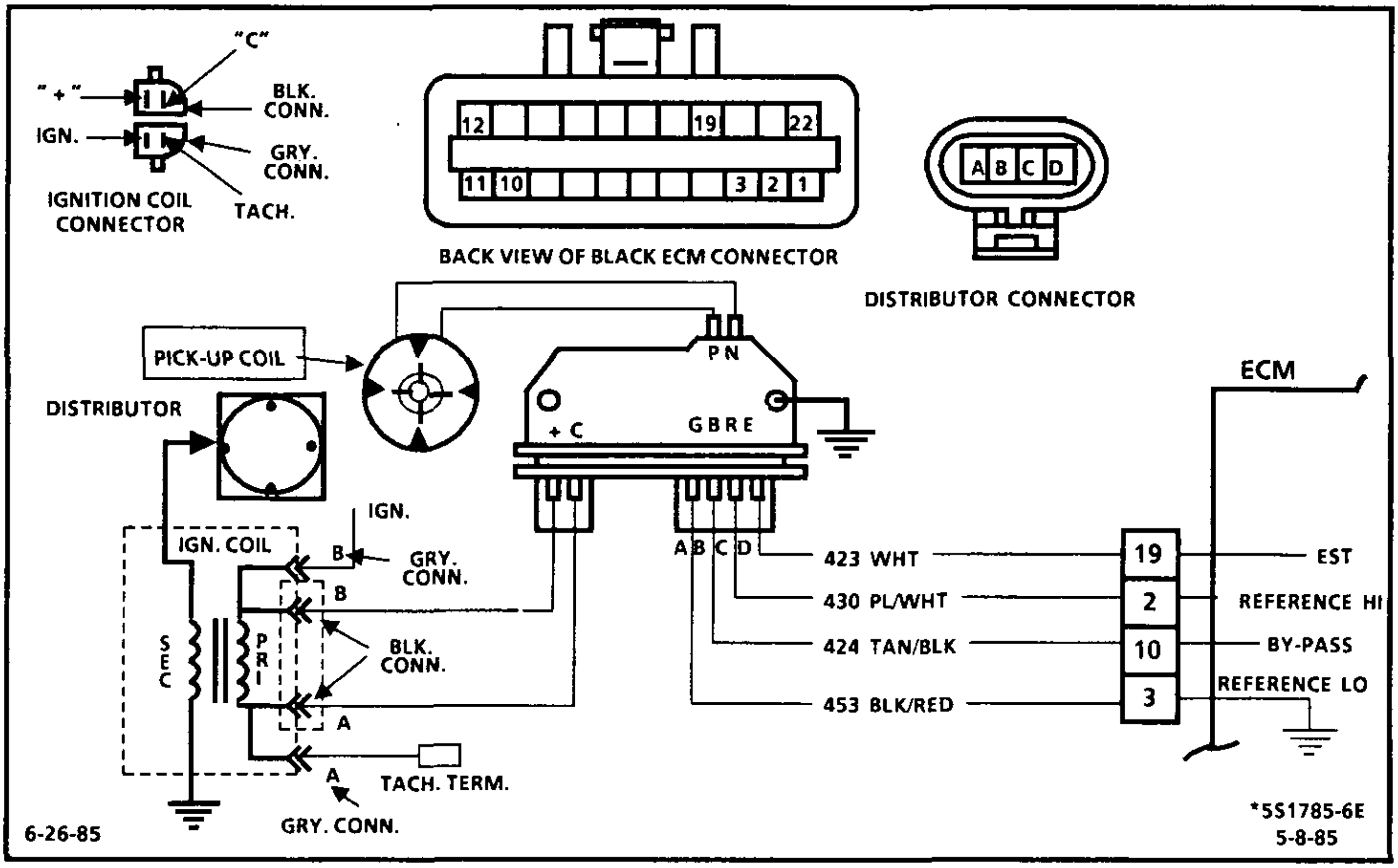

CHART C-4B

IGNITION SYSTEM CHECK

(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)

2.5L "P" SERIES

FUEL INJECTION (TBI)

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with 4 terminal distributor 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 dist. 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 ign. 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 its 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 (J24642) could determine which is at fault.

CHART C-4B
IGNITION SYSTEM CHECK
(REMOTE COIL / SEALED MODULE CONNECTOR DIST.) FUEL INJECTION (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.

  Bad → Replace module

Spark → Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).

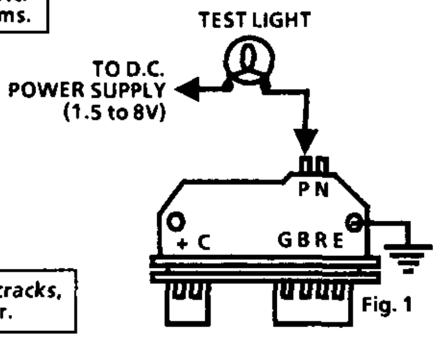

Fig. 1

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM

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.

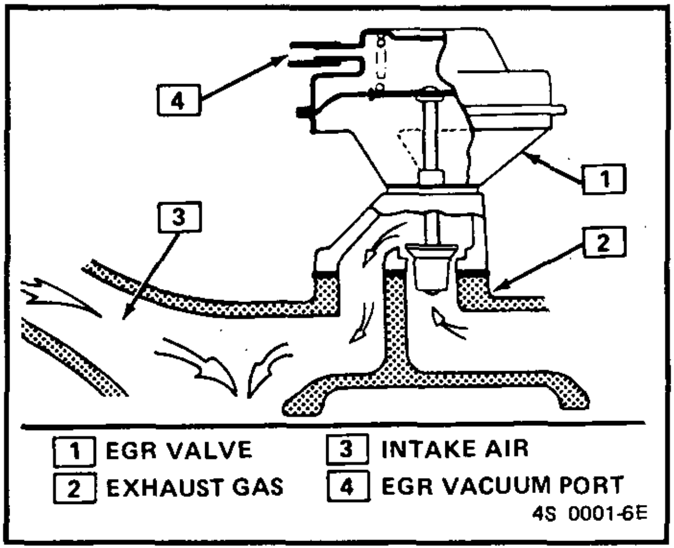


Figure C7-1 - Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by either ported manifold or full manifold 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 under the following conditions:

- Warm engine operation
- *Above idle speed*

The amount of exhaust gas recirculated is controlled by variations in vacuum and exhaust back pressure.

Two sources of vacuum are used:

- Vacuum port above the throttle valve. (Ported Manifold Vacuum)
- Intake manifold vacuum port. (Full Manifold Vacuum)

TYPES OF EGR VALVES

- Ported
- Positive Backpressure
- Negative Backpressure EGR Valve (2.5L)

Positive back pressure valve has an air bleed, located inside the EGR valve assembly, acts as a vacuum regulator. This bleed valve controls the amount of vacuum in the vacuum chamber by bleeding vacuum to atmosphere during the open phase of the cycle. When the bleed valve recieves sufficient exhaust backpressure through the hollow shaft, it closes the bleed. At this oint, maximum available vacuum is applied to the diaphragm and the EGR valve opens.

If there is little or no vacuum in the vacuum *chamber such as at idle or wide open throttle, or* if there is little or no pressure in the exhaust manifold, the EGR valve will not open. This type of valve will not open if vacuum is applied to it with the engine stopped or idling.

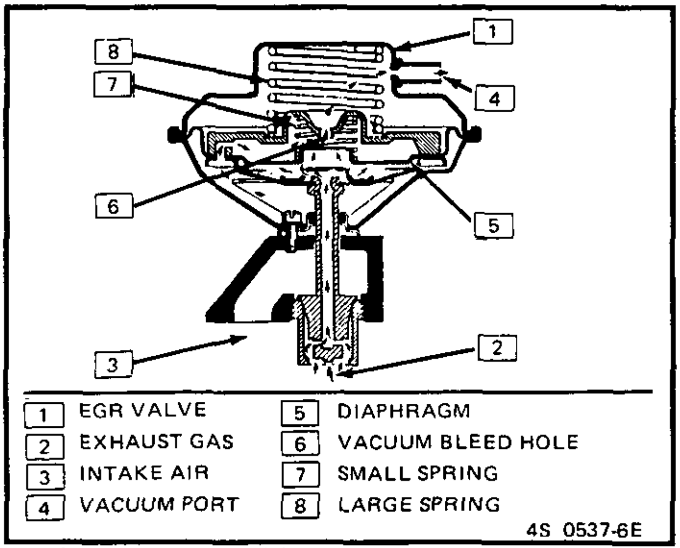


Figure C7-2 - Positive Backpressure EGR Valve

The negative backpressure EGR valve is similar to the positive backpressure EGR valve except that the bleed valve spring is moved from above the valve to below, and the valve is normally closed. The negative backpressure valve 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 C7-3) has an internal air bleed hole which is held closed by a small spring when there is no exhaust backpressure.

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.

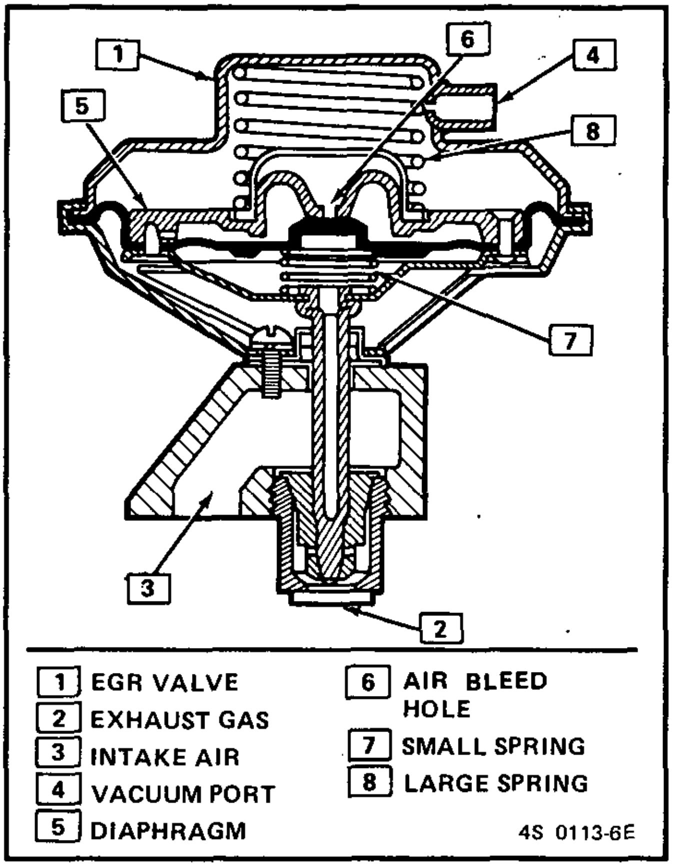


Figure C7-3 - Negative Backpressure EGR Valve (2.5L)

EGR VALVE IDENTIFICATION FIGURE C7-4

- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve after the part number.
- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number.
- Port EGR valves have no identification stamped after the part number.

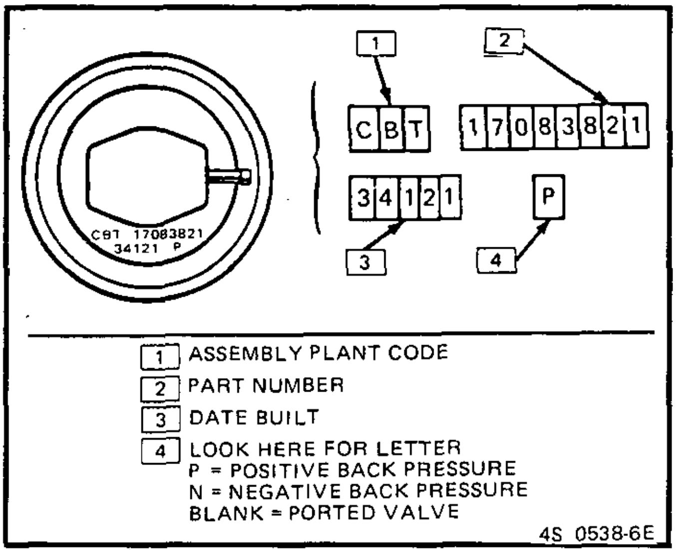


Figure C7-4 - EGR Valve Identification

EGR CONTROL

A variety of methods are used to control EGR valves.

Ported Vacuum, Figure C7-5 (2.5L)

This system uses ported vacuum connected direct to the EGR valve. The amount of EGR is controlled by the amount of manifold vacuum and throttle opening.

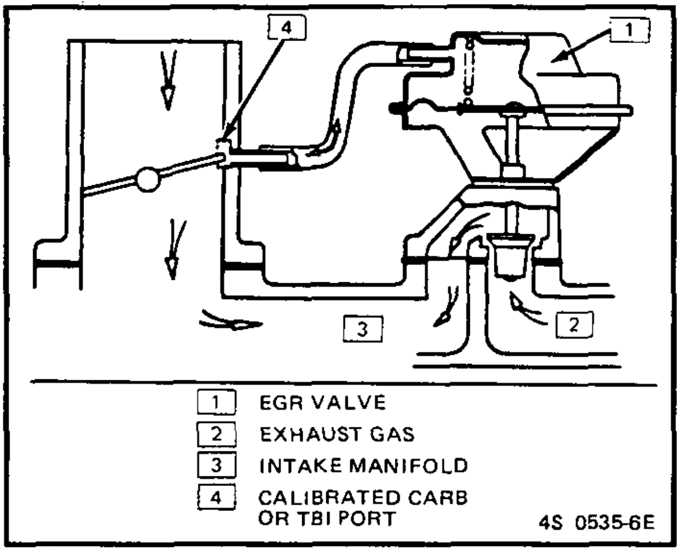


Figure C7-5 - Ported Vacuum EGR Control (2.5L)

Results of Incorrect EGR System 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

CHART C-7A *is used for the non-ECM controlled* EGR on 2.5L engines.

ON-CAR SERVICE

EGR VALVE

Remove or Disconnect

1. Air cleaner.
2. EGR valve vacuum tube at valve. (Figure C7-4)
3. Bolts.
4. EGR valve from manifold.

Install or Connect

1. EGR valve to manifold.
2. Bolts.
3. Vacuum tube.
4. Air cleaner.

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.

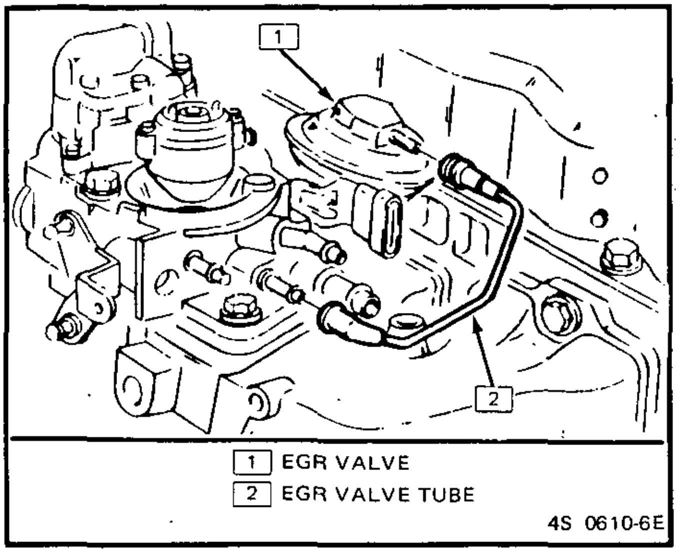


Figure C7-6 - EGR Valve (2.5L)

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. Cleaned or replacement EGR valve on intake manifold using new gasket (15).
2. Bolts and tighten to 18 Nm (14 ft.lbs.).
3. Vacuum hose to valve.
4. Air cleaner.

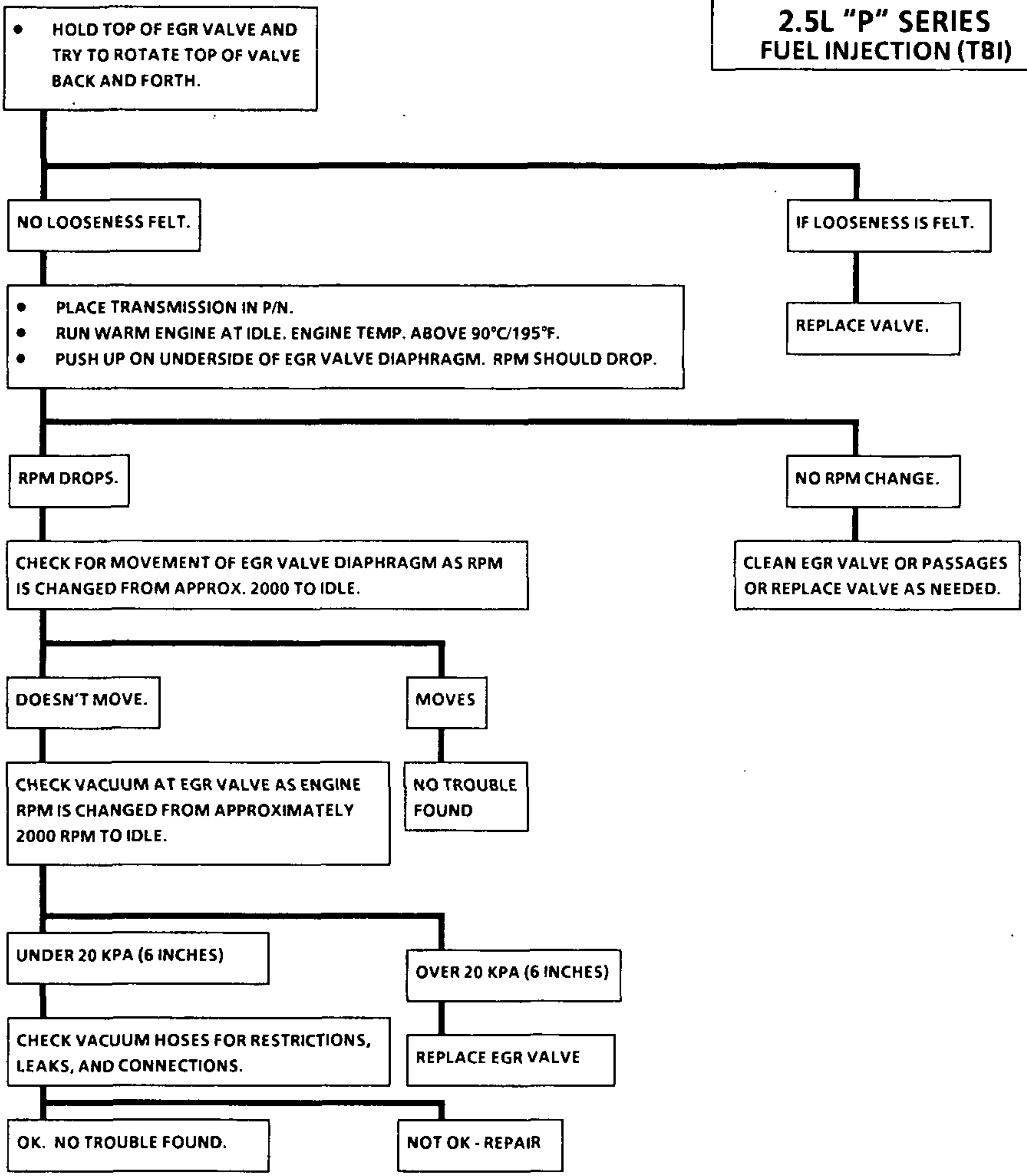
PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Gasket, EGR Valve	3.680

CHART C–7A

EGR VALVE CHECK
NON-ECM CONTROLLED

2.5L "P" SERIES
FUEL INJECTION (TBI)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

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SECTION C8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC) SYSTEM

GENERAL DESCRIPTION

PURPOSE

The Transmission/Transaxle Converter Clutch (TCC) System uses a solenoid operated valve (Figure C8-1) in the automatic transmission/ transaxle 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/transaxle fluid pressure must be correct. For information on internal transmission operation, see Section 7A. This section (6E) will cover only the electrical operation of the TCC system.
- The ECM grounds a switch internally to turn on a solenoid in the transmission/transaxle. This moves a check ball, which will allow the converter clutch to apply, if the hydraulic pressure is correct, as described above.

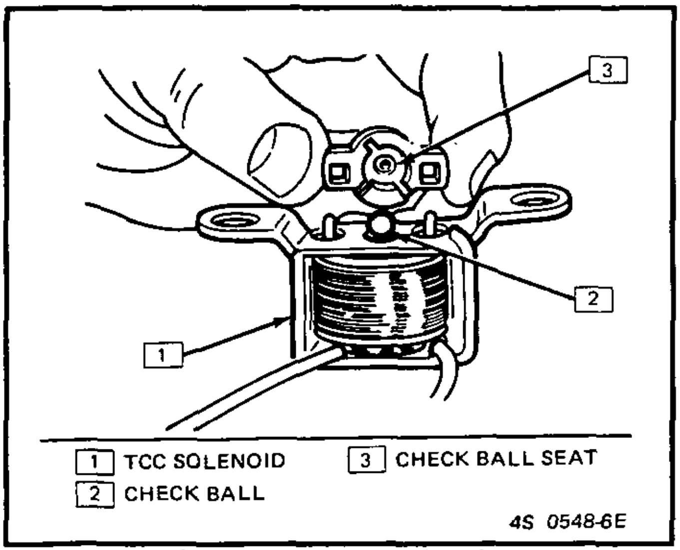

Figure C8-1 - TCC Solenoid

The ECM controls the TCC apply solenoid by looking at several sensors:

- 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.
- 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.
- Another switch used in the TCC circuit is a brake switch which opens the 12 volt supply to the TCC solenoid when the brake is depressed.
- On 125C transmissions/transaxles a third gear switch (normally open) is placed in series on the battery side of the TCC solenoid. This switch prevents TCC application until the transmission is in third gear. Then the switch closes, completing the circuit to the ECM. For applications of this switch see Section 7A.

Results of Incorrect Operation

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 3rd or 4th gear select switch does not operate, the TCC will not apply at the right time.

The Transmission/Transaxle Converter Clutch (TCC) system has different operating characteristics than an automatic transmission/ transaxle 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 be clutch disengagement rather than a downshift, 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 it should, but the ECM will turn on when the "test" terminal is grounded with ignition "on" and engine stopped, sensors such as coolant, speed, and throttle position should be checked. For diagnosis of the manual transmission shift light, see Chart C-8B.

ON-CAR SERVICE

- **See Section 7A for TCC Solenoid.**
- **See Section 8C for VSS (IP mounted) and brake switch.**

PARTS INFORMATION

PART NAME	GROUP
Sensor, Vehicle Speed	9.761
Retainer, Speedo Sen	9.761
Solenoid, TCC	4.122
Valve, Clutch and Cruise Vac. Switch	3.885

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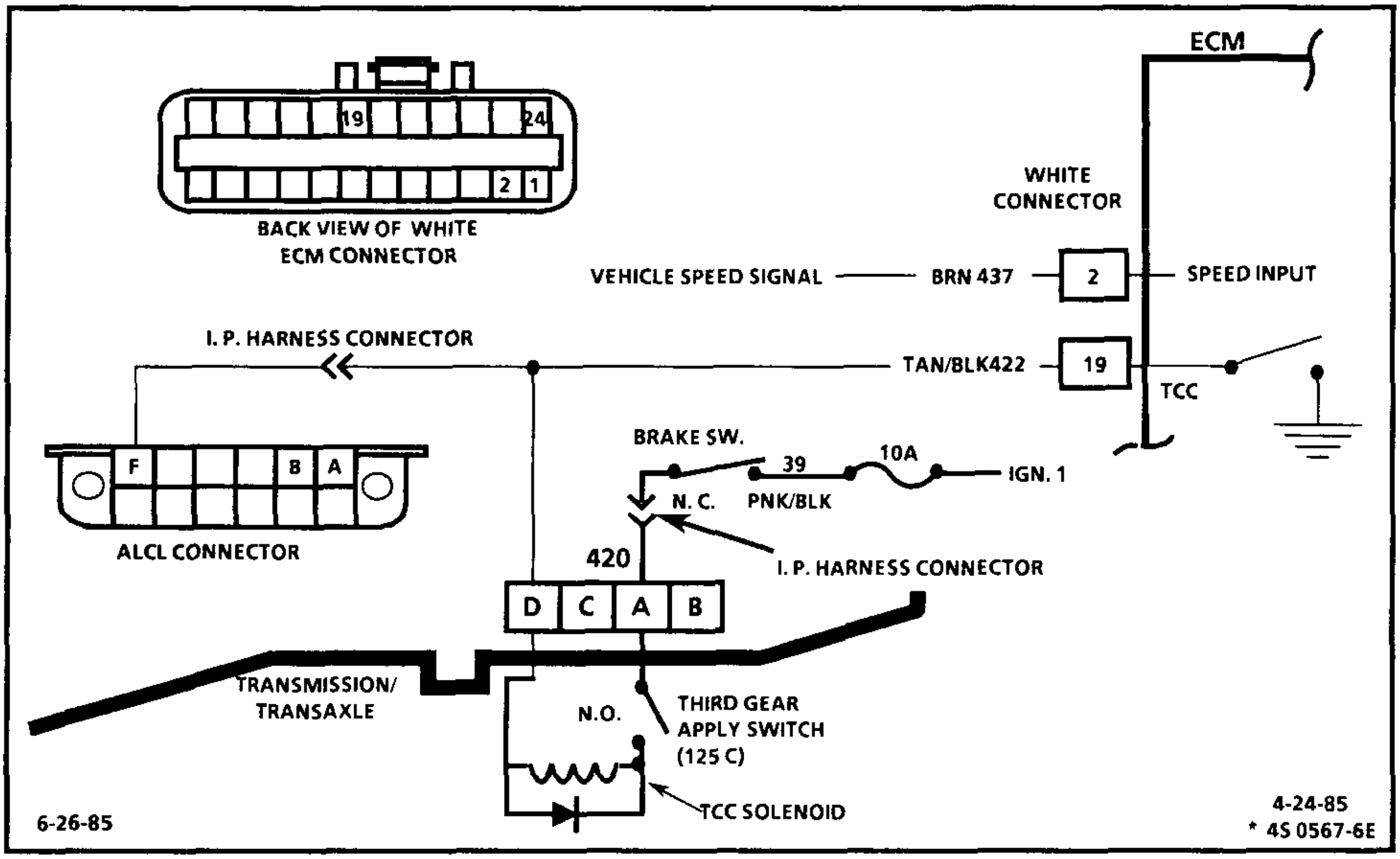


CHART C-8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC)

2.5L "P" SERIES
FUEL INJECTION (TBI)

The purpose of the automatic transmission/transaxle 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/transaxle and the fuel economy of a manual transmission.

Fused battery ignition is supplied to the TCC solenoid through the brake switch, and transmission third gear apply switch. The ECM will engage TCC by grounding CKT 422 to energize the solenoid.

TCC will engage when:

- Vehicle Speed above 45 MPH (72 km/h)
- Engine at normal operating temperature (above 70°C, 158°F).
- Throttle position sensor output not changing, indicating a steady road speed.
- Transmission third gear switch closed
- Brake switch closed

1. Light "OFF" off confirms transmission third gear apply switch is open.
2. At 48 km/h (30 MPH) the transmission/transaxle third gear switch should close. Test light will come on and confirm battery supply and closed brake switch.
3. Grounding the diagnostic terminal with engine "OFF" should energize the TCC solenoid. This test checks the capability of the ECM to control the solenoid.
4. Solenoids are turned "ON" or "OFF" by the ECM internal electronic switches called "drivers". Each driver is part of a group of four called "Quad-Drivers". Failure of one can damage any other driver within the set. 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 the following before installing a replacement ECM.

Check TCC solenoid resistance as follows:

1. Disconnect TCC at transmission.
2. Connect ohmmeter between transmission connector opposite harness connector Terminal "A" and "D".
3. Raise drive wheels.
4. Run engine in drive about 48 km/h (30 MPH) to close third gear apply switch.
5. Replace the TCC solenoid and ECM if resistance measures less than 20 ohms when switch is closed.

CHART C-8

125C TRANSMISSION/TRANSAXLE CONVERTER CLUTCH

ELECTRICAL DIAGNOSIS

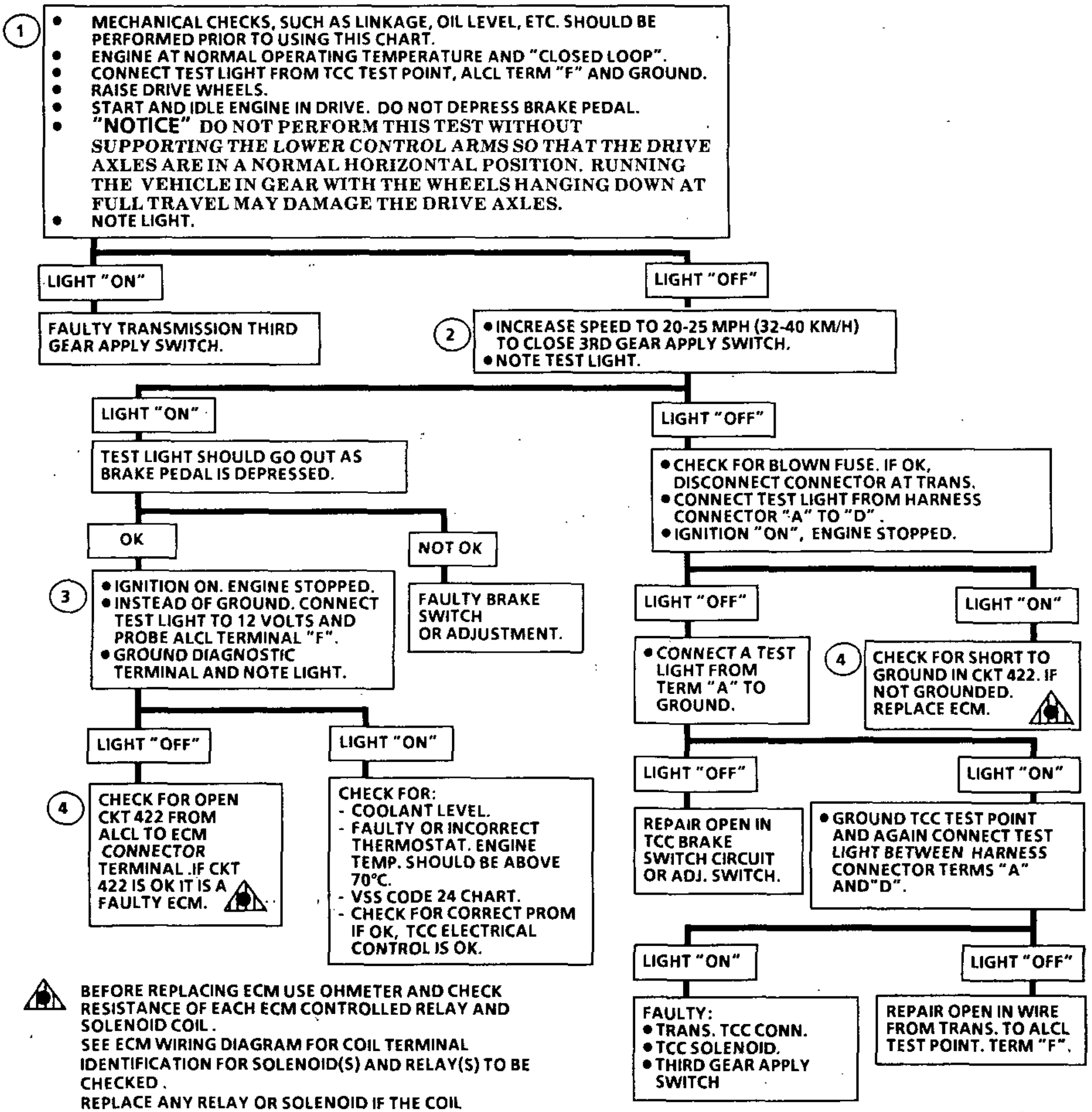
2.5L "P" SERIES

FUEL INJECTION (TBI)

START SCAN

■ **IF USING A "SCAN" TOOL, CHECK THE FOLLOWING AND CORRECT IF NECESSARY:**

- COOLANT TEMPERATURE
- TPS
- VSS
- CODES - IF 24 IS PRESENT, SEE CODE CHART 24. ALSO, PERFORM MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., BEFORE USING THIS CHART.



①
- MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
- ENGINE AT NORMAL OPERATING TEMPERATURE AND "CLOSED LOOP".
- CONNECT TEST LIGHT FROM TCC TEST POINT, ALCL TERM "F" AND GROUND.
- RAISE DRIVE WHEELS.
- START AND IDLE ENGINE IN DRIVE. DO NOT DEPRESS BRAKE PEDAL.
- "NOTICE" *DO NOT PERFORM THIS TEST WITHOUT SUPPORTING THE LOWER CONTROL ARMS SO THAT THE DRIVE AXLES ARE IN A NORMAL HORIZONTAL POSITION. RUNNING THE VEHICLE IN GEAR WITH THE WHEELS HANGING DOWN AT FULL TRAVEL MAY DAMAGE THE DRIVE AXLES.*
- NOTE LIGHT.

LIGHT "ON"

FAULTY TRANSMISSION THIRD GEAR APPLY SWITCH.

LIGHT "OFF"

②
- INCREASE SPEED TO 20-25 MPH (32-40 KM/H) TO CLOSE 3RD GEAR APPLY SWITCH.
- NOTE TEST LIGHT.

LIGHT "ON"

TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED.

OK

③
- IGNITION ON. ENGINE STOPPED.
- INSTEAD OF GROUND. CONNECT TEST LIGHT TO 12 VOLTS AND PROBE ALCL TERMINAL "F".
- GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "OFF"

④ CHECK FOR OPEN CKT 422 FROM ALCL TO ECM CONNECTOR TERMINAL .IF CKT 422 IS OK IT IS A FAULTY ECM. ⚠

LIGHT "ON"

CHECK FOR:
- COOLANT LEVEL.
- FAULTY OR INCORRECT THERMOSTAT. ENGINE TEMP. SHOULD BE ABOVE 70°C.
- VSS CODE 24 CHART.
- CHECK FOR CORRECT PROM IF OK, TCC ELECTRICAL CONTROL IS OK.

NOT OK

FAULTY BRAKE SWITCH OR ADJUSTMENT.

LIGHT "OFF"

- CHECK FOR BLOWN FUSE. IF OK, DISCONNECT CONNECTOR AT TRANS.
- CONNECT TEST LIGHT FROM HARNESS CONNECTOR "A" TO "D".
- IGNITION "ON", ENGINE STOPPED.

LIGHT "OFF"

- CONNECT A TEST LIGHT FROM TERM "A" TO GROUND.

LIGHT "OFF"

REPAIR OPEN IN TCC BRAKE SWITCH CIRCUIT OR ADJ. SWITCH.

LIGHT "ON"

- GROUND TCC TEST POINT AND AGAIN CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMS "A" AND "D".

LIGHT "ON"

FAULTY:
- TRANS. TCC CONN.
- TCC SOLENOID.
- THIRD GEAR APPLY SWITCH

LIGHT "OFF"

REPAIR OPEN IN WIRE FROM TRANS. TO ALCL TEST POINT. TERM "F".

LIGHT "ON"

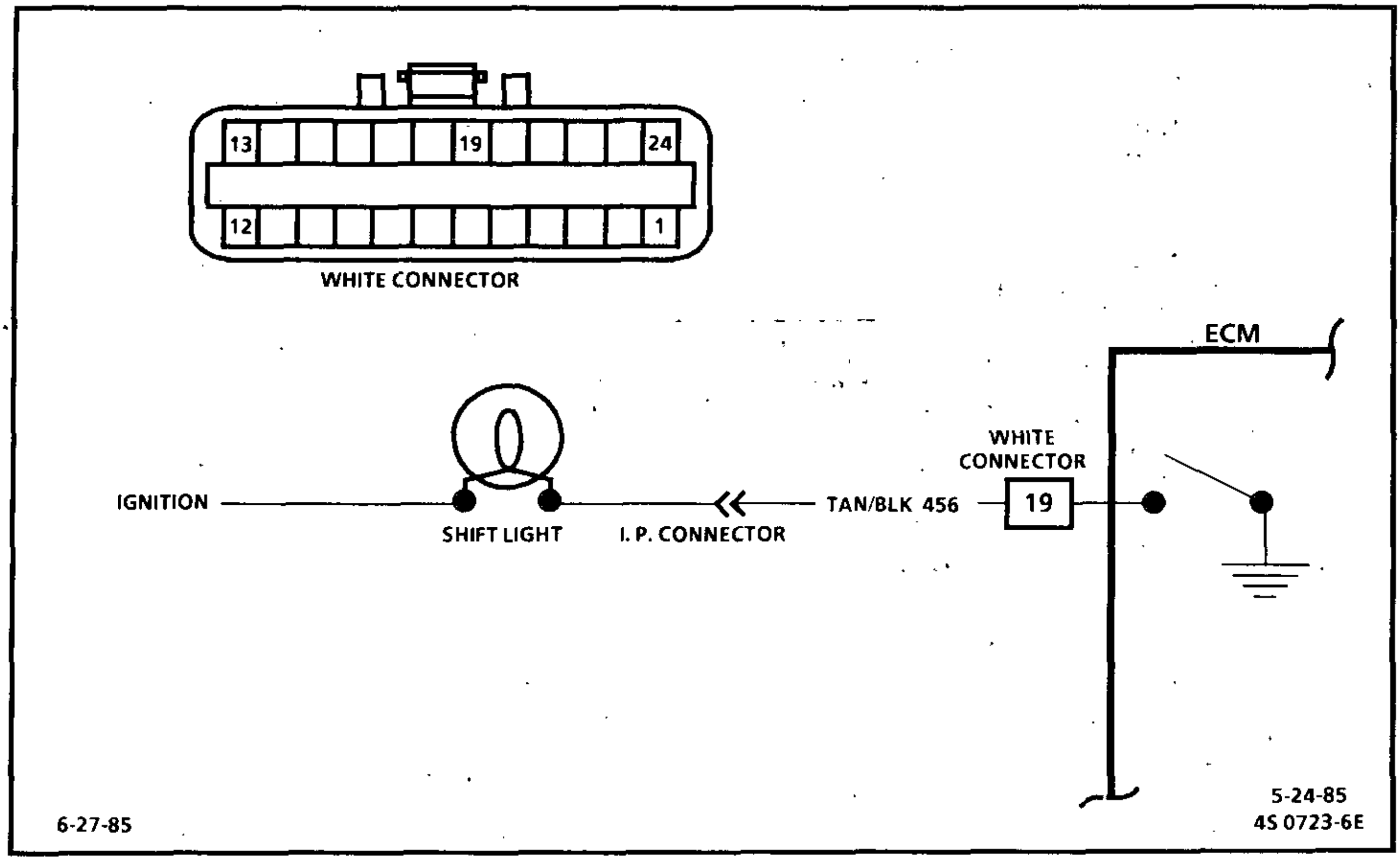
④ CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED. REPLACE ECM. ⚠

⚠ BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

84-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 6S 2872-6E
7-16-85



6-27-85

5-24-85
4S 0723-6E

CHART C-8B

MANUAL TRANSAXLE SHIFT LIGHT

2.5L "P" SERIES

FUEL INJECTION (TBI)

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 Terminal 19, CKT 456.

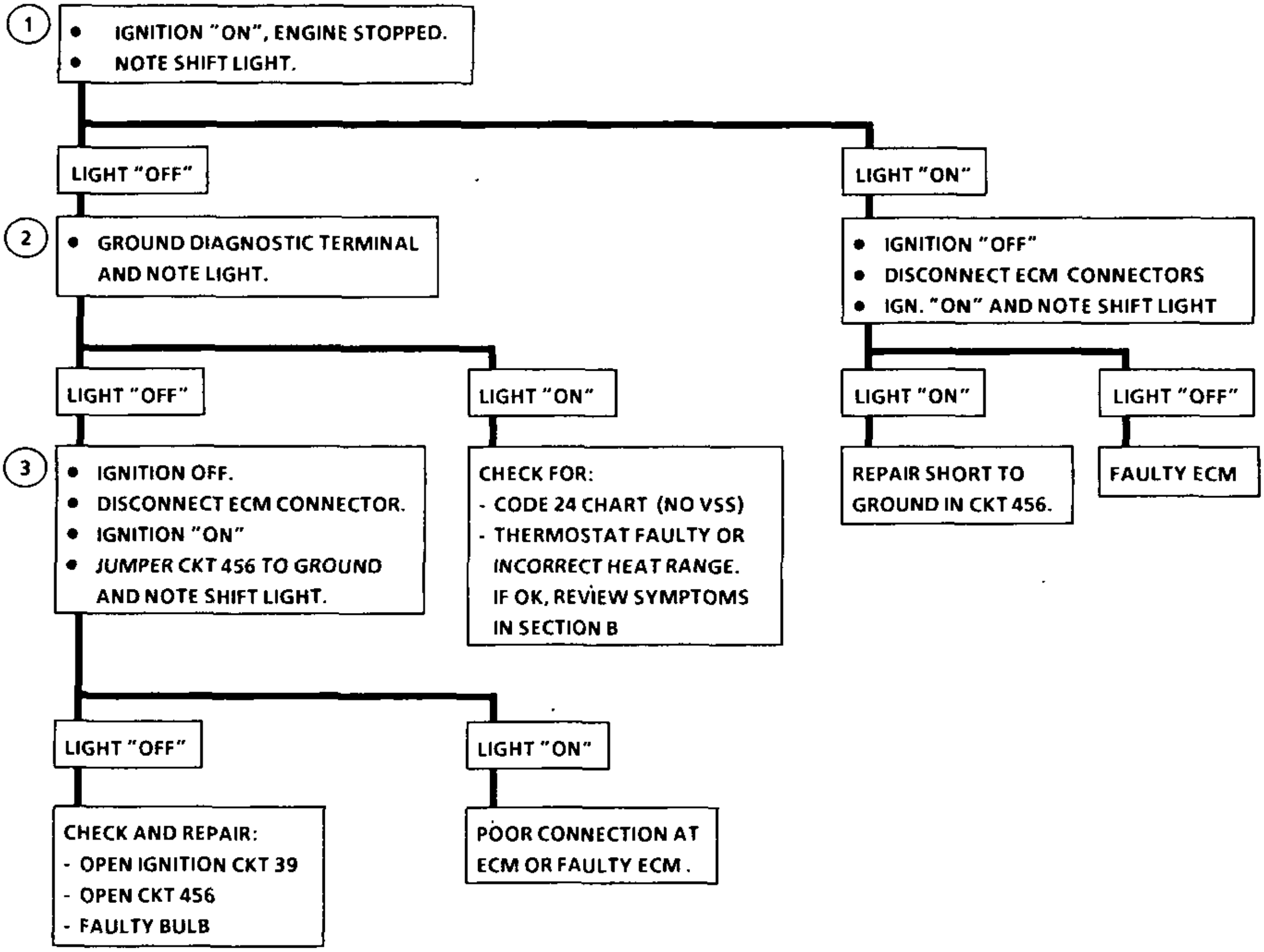
The ECM uses information from the following inputs to control the shift light:

- 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.

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
2.5L "P" SERIES
FUEL INJECTION (TBI)



① • IGNITION "ON", ENGINE STOPPED.
• NOTE SHIFT LIGHT.

LIGHT "OFF"

② • GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "OFF"

③ • IGNITION OFF.
• DISCONNECT ECM CONNECTOR.
• IGNITION "ON"
• JUMPER CKT 456 TO GROUND AND NOTE SHIFT LIGHT.

LIGHT "OFF"

CHECK AND REPAIR:
- OPEN IGNITION CKT 39
- OPEN CKT 456
- FAULTY BULB

LIGHT "ON"

POOR CONNECTION AT ECM OR FAULTY ECM.

LIGHT "ON"

CHECK FOR:
- CODE 24 CHART (NO VSS)
- THERMOSTAT FAULTY OR INCORRECT HEAT RANGE.
IF OK, REVIEW SYMPTOMS IN SECTION B

LIGHT "ON"

• IGNITION "OFF"
• DISCONNECT ECM CONNECTORS
• IGN. "ON" AND NOTE SHIFT LIGHT

LIGHT "ON"

REPAIR SHORT TO GROUND IN CKT 456.

LIGHT "OFF"

FAULTY ECM

* 6S 2736-6EA
5-29-85

BLANK

SECTION C10

A/C CLUTCH CONTROL

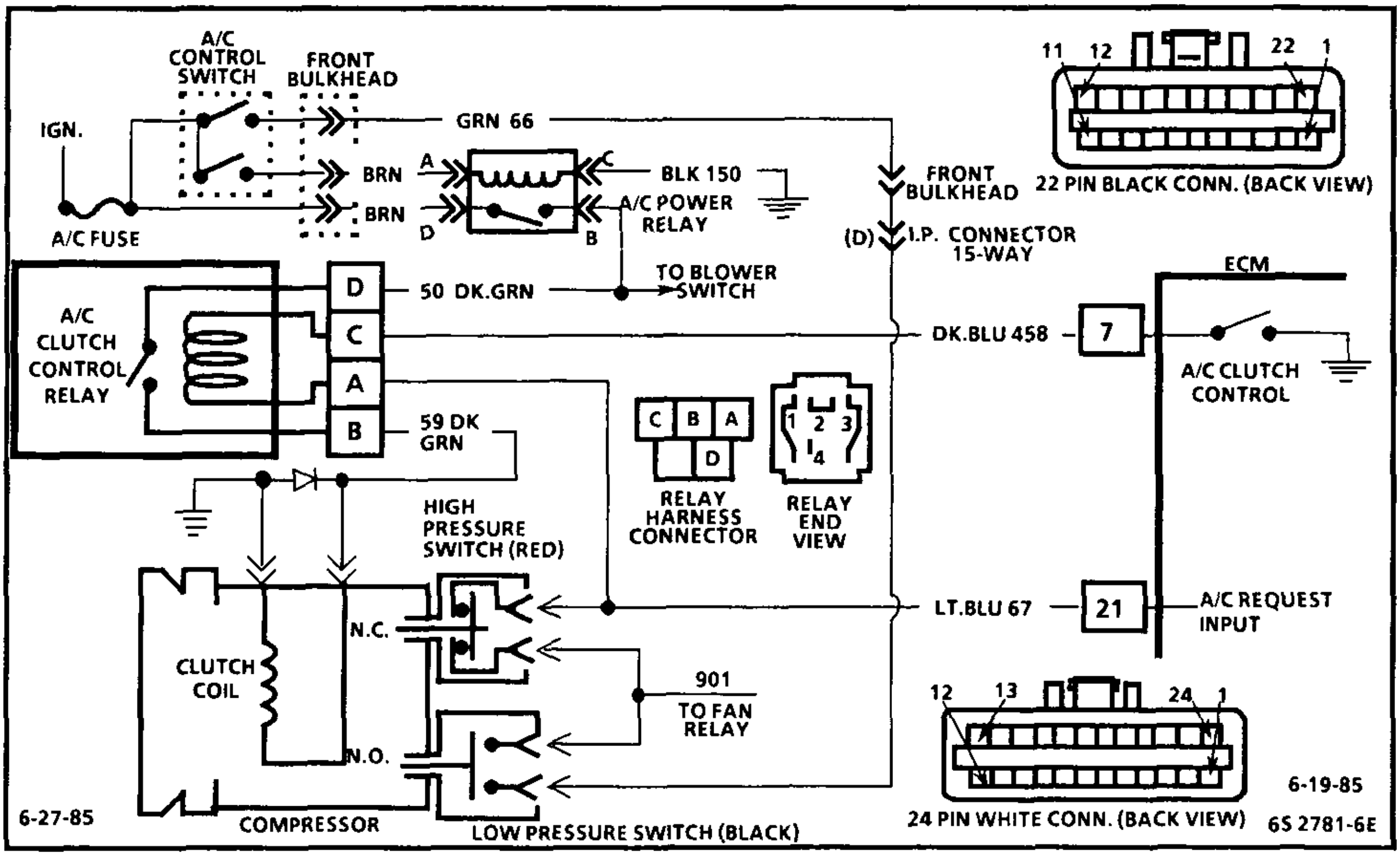


CHART C-10
A/C CLUTCH CONTROL
2.5L "P" SERIES
FUEL INJECTION (TBI)

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.
- 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 50 as the A/C power relay is energized by the A/C control switch. At the same time, voltage is supplied to the A/C relay coil on CKT 67 and as a signal to ECM pin "21" (white connector). After a time delay of about 1/2 second, the ECM will ground terminal 7 of the black connector, CKT 458, and close the A/C relay.

When relay is energized, battery voltage from CKT 50 is supplied to the A/C clutch through the relay and CKT 59.

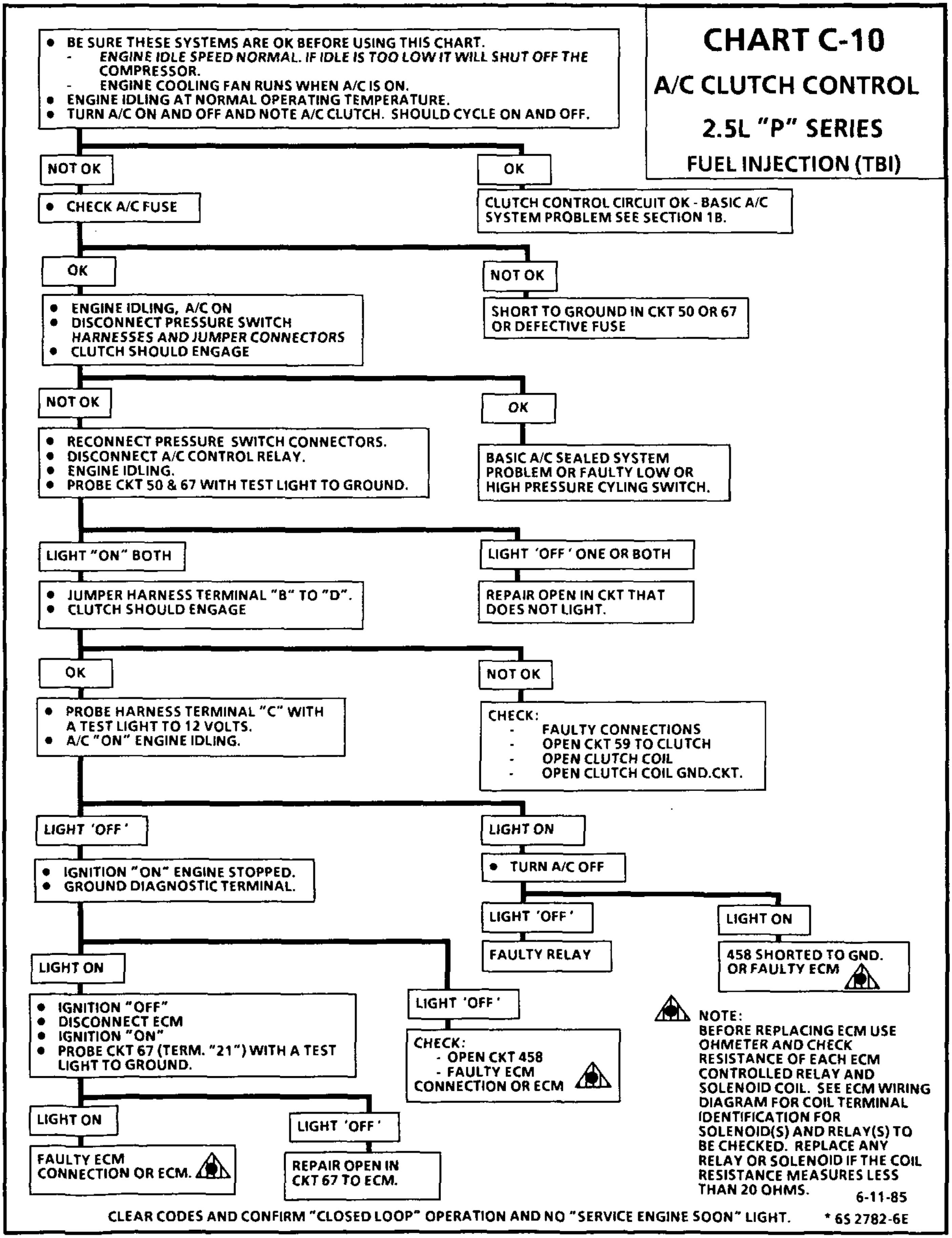


CHART C-10
A/C CLUTCH CONTROL
2.5L "P" SERIES
FUEL INJECTION (TBI)

NOTE:
BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL. SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED. REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

6-11-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 6S 2782-6E

BLANK

SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

GENERAL DESCRIPTION

A Positive 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 air cleaner 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.
  - Oil in air cleaner.
  - 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 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.

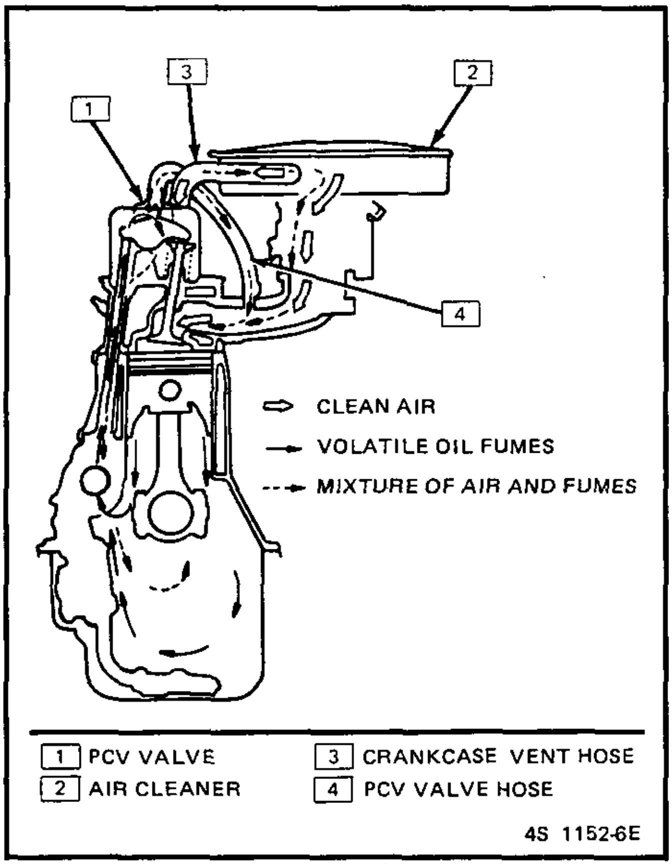


Figure C13-1 - PCV Flow - Typical

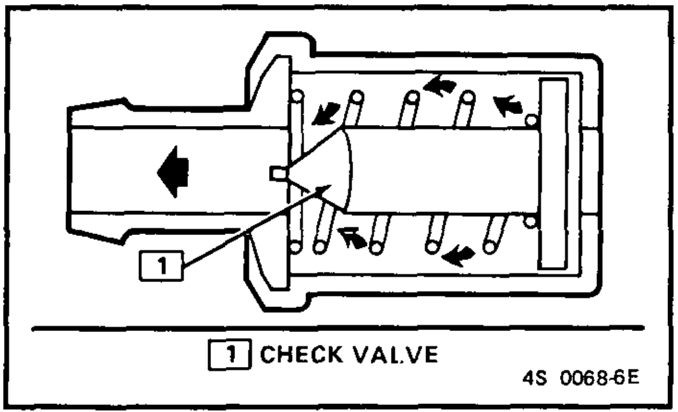


Figure C13-2 - PCV Valve Cross Section

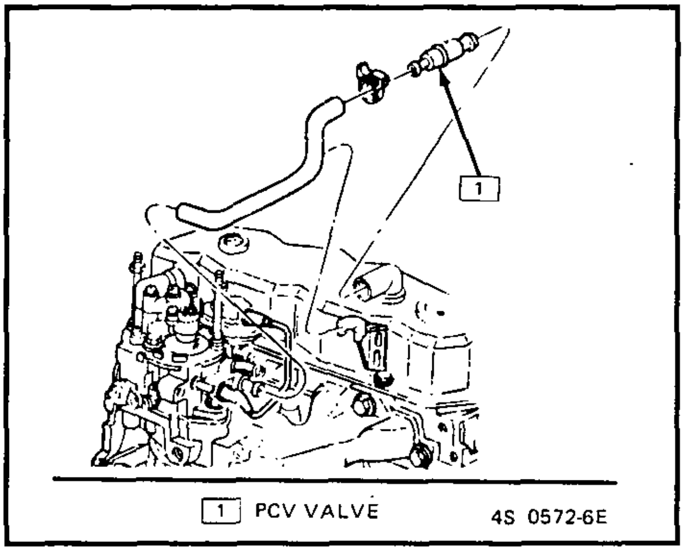


Figure C13-3 - PCV System - 2.5L

ON-CAR SERVICE

See Figure C13-3 for 2.5L replacement of PCV system components.

An engine which is operated without any crankcase ventilation can be damaged. Therefore, it is important to replace the PCV valve and air inlet filter/separator (where used) 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 Valve	1.162

SECTION C14

THERMOSTATIC AIR CLEANER (THERMAC)

GENERAL DESCRIPTION

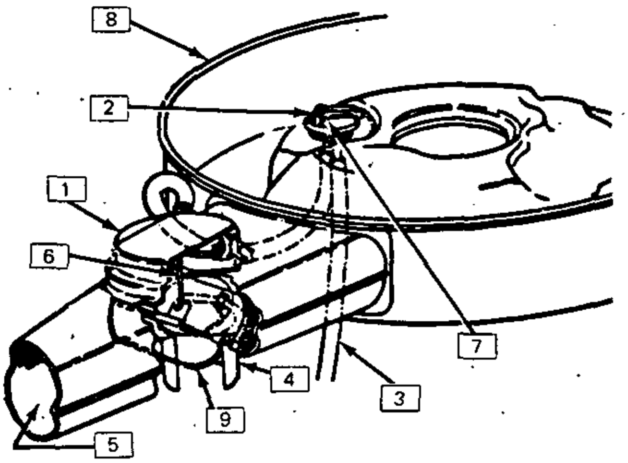
PURPOSE

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.

- 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, shutting 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 131°F (55°C), the damper door drops down and only outside air enters the air cleaner.
- Regulating Mode. Between 86°F (30°C) and 131°F (55°C) 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

08 14 84

4S 0648-6E

Figure C14-1 - THERMAC Air Cleaner - Typical

Results of Incorrect Operation

- 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 TBI seal.
  - Missing air cleaner cover seal or loose cover.
  - Loose air cleaner.
- Lack of power, sluggish, pinging, 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.

DIAGNOSIS

THERMAC AIR CLEANER FUNCTIONAL 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 TBI gasket and cover 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 FUNCTIONAL CHECK

1. With engine off, disconnect vacuum hose at vacuum diaphragm motor.
2. Apply at least 23 kPa (7 in. Hg.) of vacuum to the vacuum diaphragm motor. Damper door should completely block off 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.

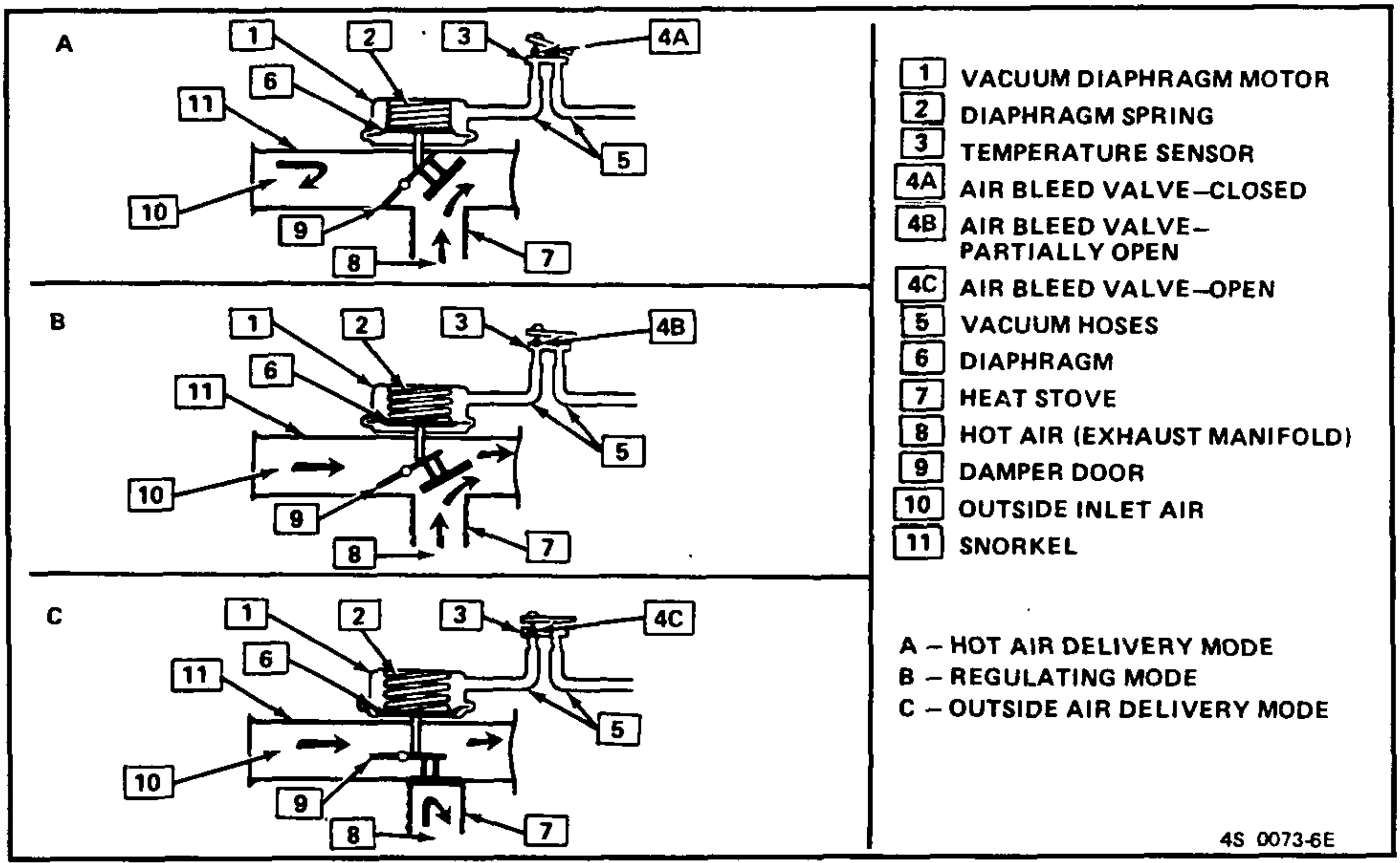


Figure C14-2 - THERMAC Operation

TEMPERATURE SENSOR FUNCTIONAL 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.
3. Clean Housing.

→← Install or Connect

1. New element.
2. Air cleaner cover. Do not over-torque nuts (install finger-tight).

AIR CLEANER

Refer to Figure C14-3 for the 2.5L, for repair or replacement of air cleaner, hoses, intake duct, and heat tube.

VACUUM DIAPHRAGM MOTOR

↔ Remove or Disconnect

1. Air cleaner.
2. Vacuum hose from motor.
3. Drill out the two spot welds 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.

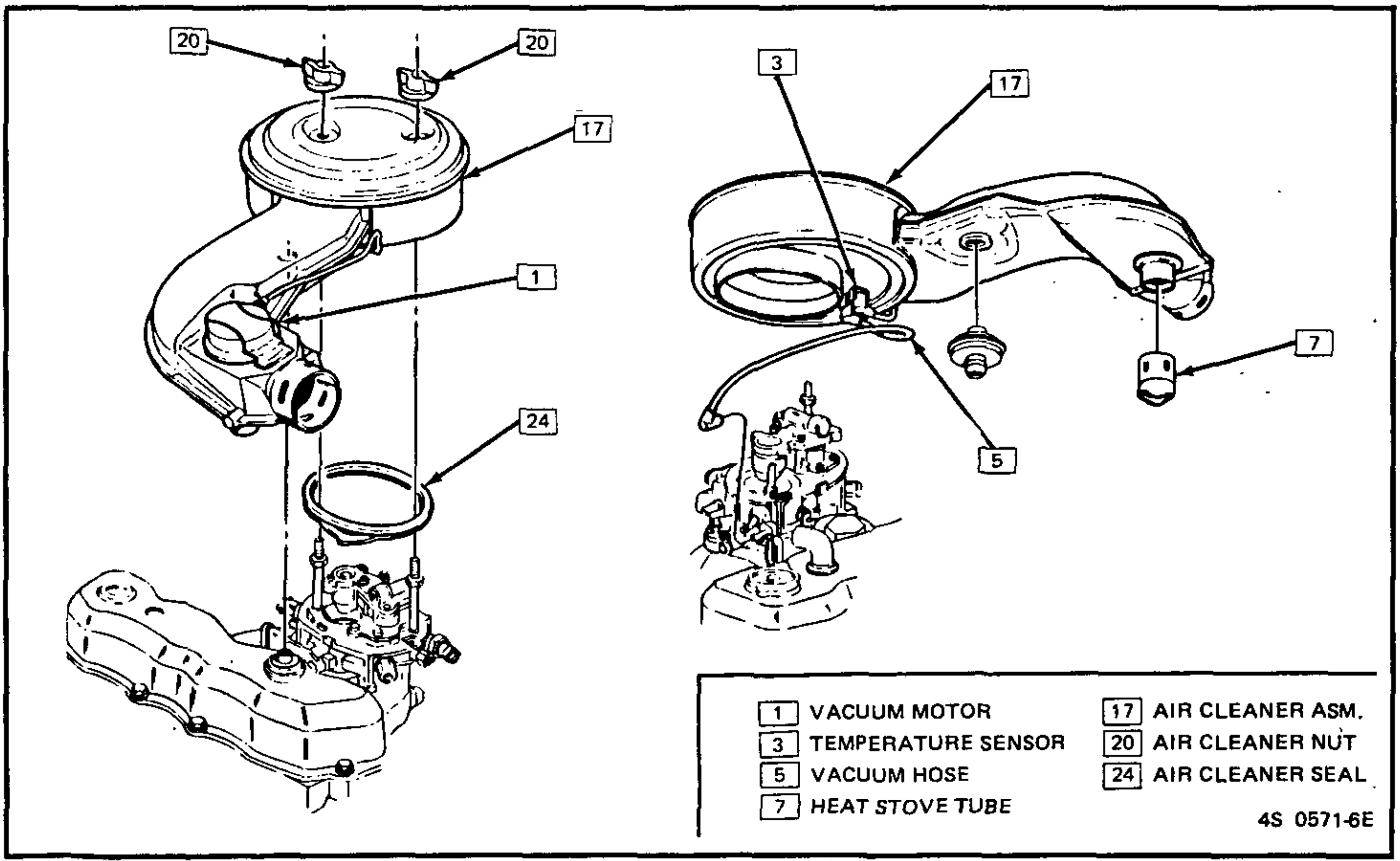


Figure C14-3 - Air Cleaner Service (2.5L)

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

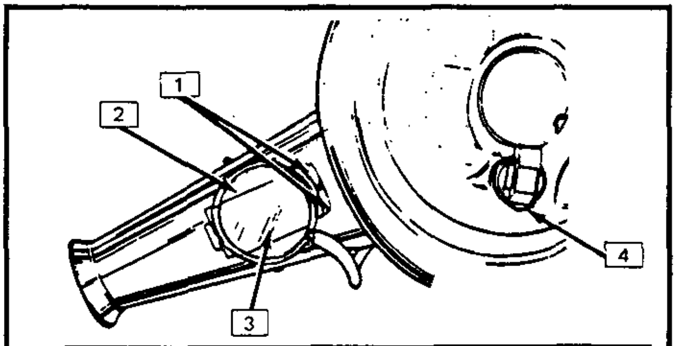
1. Air cleaner.
2. Hoses at sensor.
3. Pry up tabs on sensor retaining clip. Remove clip and sensor from air cleaner. Note position of sensor for installation.

Install or Connect

1 Sensor and gasket assembly in original position.

2 Retainer clip on hose connectors.

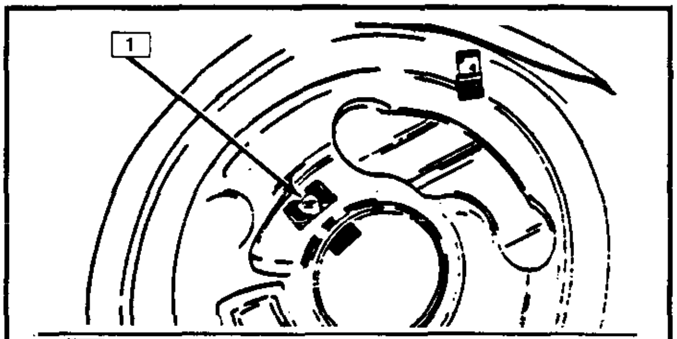
3 Vacuum hoses and air cleaner on engine.



1 SPOT WELDS
2 MOTOR ASM.
3 RETAINING STRAP
4 INSTALL REPLACEMENT SENSOR ASM. IN SAME POSITION AS ORIGINAL ASM.

08 14 84 4S 0649-6E

Figure C14-4 - Replacing THERMAC Vacuum Motor

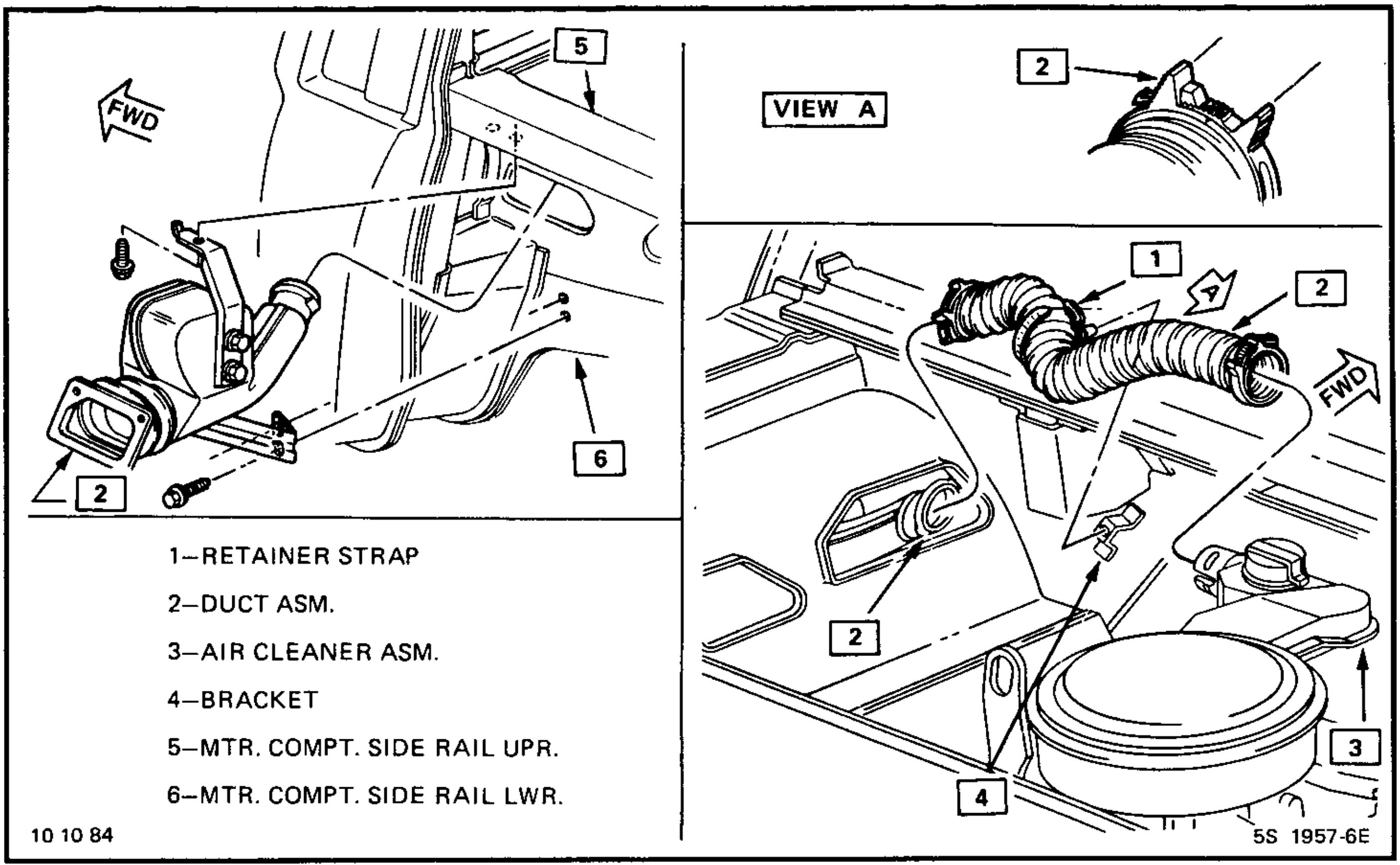


1 SENSOR RETAINING CLIP 4S 0650-6E
08 14 84

Figure C14-5 - Replacing THERMAC Sensor

PARTS INFORMATION

PART NAME	GROUP
Air Cleaner	3.402
Element (Paper)	3.410
Nut, A/Cl	3.403
Seal, Air Cleaner	3.403
Sensor, A/Cl	3.415
Motor, A/Cl Vac Diaph	3.415
Tube, Eng Air Heat Stove	3.417
Stove, Eng Air Heat	3.417



1—RETAINER STRAP
2—DUCT ASM.
3—AIR CLEANER ASM.
4—BRACKET
5—MTR. COMPT. SIDE RAIL UPR.
6—MTR. COMPT. SIDE RAIL LWR.

Figure C14-6 - Air Intake System

SECTION 6E3

DRIVEABILITY AND EMISSIONS FUEL INJECTION (PORT)

THIS SECTION APPLIES TO:
2.8L L44 (P SERIES) VIN CODE "9"

CONTENTS

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SECTION A - DIAGNOSTIC CHARTS

SECTION B - SYMPTOMS

FUNCTIONAL CHECKS/ DIAGNOSTIC CHARTS

SECTION C - COMPONENT SYSTEMS

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ELECTRONIC CONTROL MODULE AND SENSORS

SECTION C2
FUEL CONTROL SYSTEM

SECTION C3
EVAPORATIVE EMISSION CONTROL

SECTION C4
IGNITION SYSTEM/EST

SECTION C7
EXHAUST GAS RECIRCULATION SYSTEM

SECTION C8
TRANSMISSION/TRANSAXLE CONVERTER CLUTCH

SECTION C10
A/C CLUTCH CONTROL

SECTION C13
POSITIVE CRANKCASE VENTILATION

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

The engine used in this vehicle has 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 get 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. 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

Trouble Tree Charts incorporate diagnosis procedures using an ALCL "SCAN" tool where possible. This manual will also contain a "NON-SCAN DIAGNOSTIC CIRCUIT CHECK" and one designed to be used when using the "SCAN" tool.

Both SCAN and NON-SCAN diagnostics must begin with their respective "Diagnostic Circuit Check", which represents an organized approach for identifing system problems. In addition, the "SCAN Diagnostic Circuit Check" includes code definitions to confirm a "hard failure" prior to using the Charts. Unless instructed otherwise, charts should not be used for diagnosis unless the fault is still present (hard failure).

The ALCL connector is used by the assembly plants to perform end of line tests. This connector can also be used by service to monitor certain inputs and outputs as seen by the ECM. The "SCAN" tool uses the information supplied to the ALCL connector.

The ECM can be commanded to transmit ALCL data in three different modes:

1. Normal or open mode - 0 resistance across ALCL connector terminal A to B.
2. Assembly line diagnostic mode - 10,000 ohms resistance across A & B. (May also be referred to as 10K mode, special mode, or ALCL mode.
3. Factory test or back-up mode - 3.9 K resistance across ALCL connector terminals A & B.

The following information will describe each of the three modes and the affects it may cause.

NORMAL OR 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 and the "open" mode must be selected when it is available.

10K MODE, SPECIAL MODE OR ALCL MODE

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
- On some engines, canister purge solenoid will be enabled
- P/N restrict functions will be disabled

FACTORY TEST MODE, BACK-UP OR 3.9 K MODE

When in this mode, the ECM is operating on the fuel back-up logic and calibrated by the Calpak. The Calpak is 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 USES

The "SCAN" tool allows a quick check of sensors and switches which are inputs to the ECM. The data however only updates every 1.25 seconds which makes the tool not as effective as a voltmeter when trying to detect an intermittent which lasts less than the 1.25 second period. 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.

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 technicians 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 operating manual to become familiar with the tool. 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 which will be indicated when the position is selected.

Mode

Check with the manufacture to determine what the function of this mode is. In most cases it allows the user to place the ECM into one of the three operating modes.

Closed Loop / Open Loop

This position will indicate whether the engine control system is operating in open or closed loop. Most systems go closed loop after a certain amount of run time, when coolant temperature is high enough, and the oxygen sensor becomes active. In open loop the ECM is calculating fuel using all sensors except the O_2 sensor.

Exhaust (Rich/Lean Indicator)

Indicates whether the oxygen sensor is sensing a rich or lean exhaust and usually displayed as RH or LN.

Trouble Codes

Will display any trouble codes stored in the ECM memory.

Manifold Absolute Pressure (MAP)

The MAP Sensor produces a low signal voltage when manifold pressure is low (high vacuum) and a high voltage when pressure is high (low vacuum).

With ignition on and engine stoppped, the manifold pressure is equal to atomospheric 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.

**MAP Sensors have a colored plastic insert visible in the connector cavity. Sensors with the same insert color are identical in calibration. The harness electrical connector color should also be the same as the sensor insert color.

Injector Base Pulse Width

The display will be the actual injector pulse width (BPW) calculated by the ECM. It represents the injector "ON" time in Milliseconds.

Battery Volts

Displays actual battery voltage at the ECM.

TPS (Throttle Position Sensor)

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).

Oxygen

The reading will be read out in millivolts (mv) with a range from 100 to 999 mv. If the reading is consistantly below 350, the fuel system is running lean as seen by the ECM and if the reading is consistently above 550, the system is running rich.

"SCAN"

O2 readings can be mis-leading due to the slow up-date rate of the display (1.25 Sec).

For example, a constant low reading may be displayed because each time the ECM up-dates the information it missed the voltage changes to the higher readings.

The "Scan" tool can also be used to check for Distributor reference pulses while cranking. This may be helpful in diagnosing a no-start condition.

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.

RPM

Displays engine RPM. 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 wiring too close to ignition secondary wires or open distributor ground circuits.

MPH

Displays vehicle speed. Useful in Checking TCC lock up speed or speedometer accuracy.

Coolant Temperature

Displays engine temperature in degrees centigrade. After engine is started the temperature should rise steadily to about 90° C then stabilize when thermostat opens.

Manifold Air Temperature (MAT) Sensor

Displays temperature of the intake manifold air. Should read close to ambient air temperature when the engine is cold, and rise as underhood and engine temperature increases.

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 operators manual. The important thing is that the the reading changes state (switches) when the gear selector is moved from neutral to drive.

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

On most Port fuel engines, the Duty Cycle that the ECM is commanding to the EGR solenoid will be displayed in this mode. 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.

Integrator and Block Learn

Normal readings in these modes are around 128, if higher, then it indicates that the ECM is adding fuel to the base fuel calculation and if the numbers are below 128 the ECM is taking out fuel from the base calculation. The integrator is short term corrective action while the block learn portion (long term correction) will only change if the integrator has seen a condition which lasts for a calibrated period of time.

IAC (Idle Air Control)

In this mode, the numbers will indicate what position the ECM thinks the valve is in. The ECM moves the IAC in counts and these counts are are what is displayed on a "SCAN" tool.

Cross Counts

In this mode, the activity of the oxygen sensor is displayed by how many times the voltage of the sensor has passed by the midpoint in the last 1.25 second period. This checks how active the O_2 sensor is.

A/C Request

Displays the state of the A/C signal line to the ECM. Should read " ON" whenever the A/C is requested and the pressure cycling switch is closed.

BLANK

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

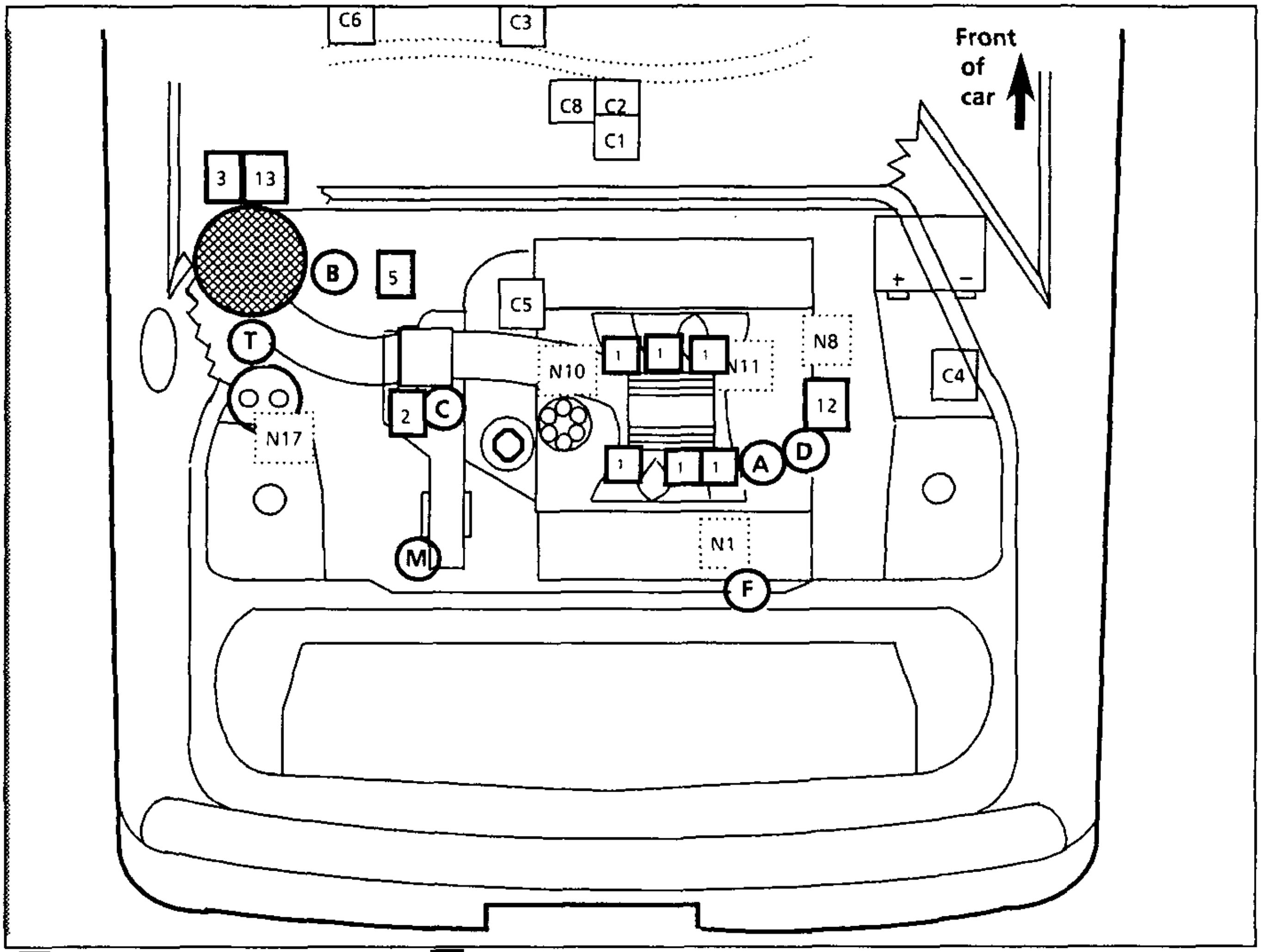
On some engines, the Oxygen Sensor will cool off after only a short period of operation at idle. This will put the system into "Open Loop." To restore "Closed Loop" operation, run the engine at part throttle several minutes and accelerate from idle to part throttle a few times.

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 - DIAGNOSTIC CHARTS

'P' SERIES RPO: L44 VIN CODE: 9 2.8L V6 PFI



☐ COMPUTER HARNESS

C1 · Electronic Control Module (ECM)
C2 ALCL diagnostic connector
C3 "SERVICE ENGINE SOON" light
C4 ECM power
C5 ECM harness ground
C6 Fuse panel
C8 Fuel pump test connector (ALCL connector terminal G)

⬚ NOT ECM CONNECTED

N1 Crankcase vent valve (PCV)
N8 Oil press. switch (fuel pump)
N10 Cold start valve
N11 Cold start fuel injection switch
N17 Fuel vapor canister

☐ CONTROLLED DEVICES

1 Fuel injector
2 Idle air control valve
3 Fuel pump relay
5 Trans. Converter Clutch connector
12 Exh. Gas Recirc. vacuum solenoid
13 A/C compressor relay

◎ Exhaust Gas Recirculation valve

○ INFORMATION SENSORS

A Manifold pressure (M.A.P.)
B Exhaust oxygen
C Throttle position
D Coolant temperature
F Vehicle speed
M P/N switch
T Manifold Air Temperature

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5S 2126-6E

Figure A1 Component Locations - (2.8L)

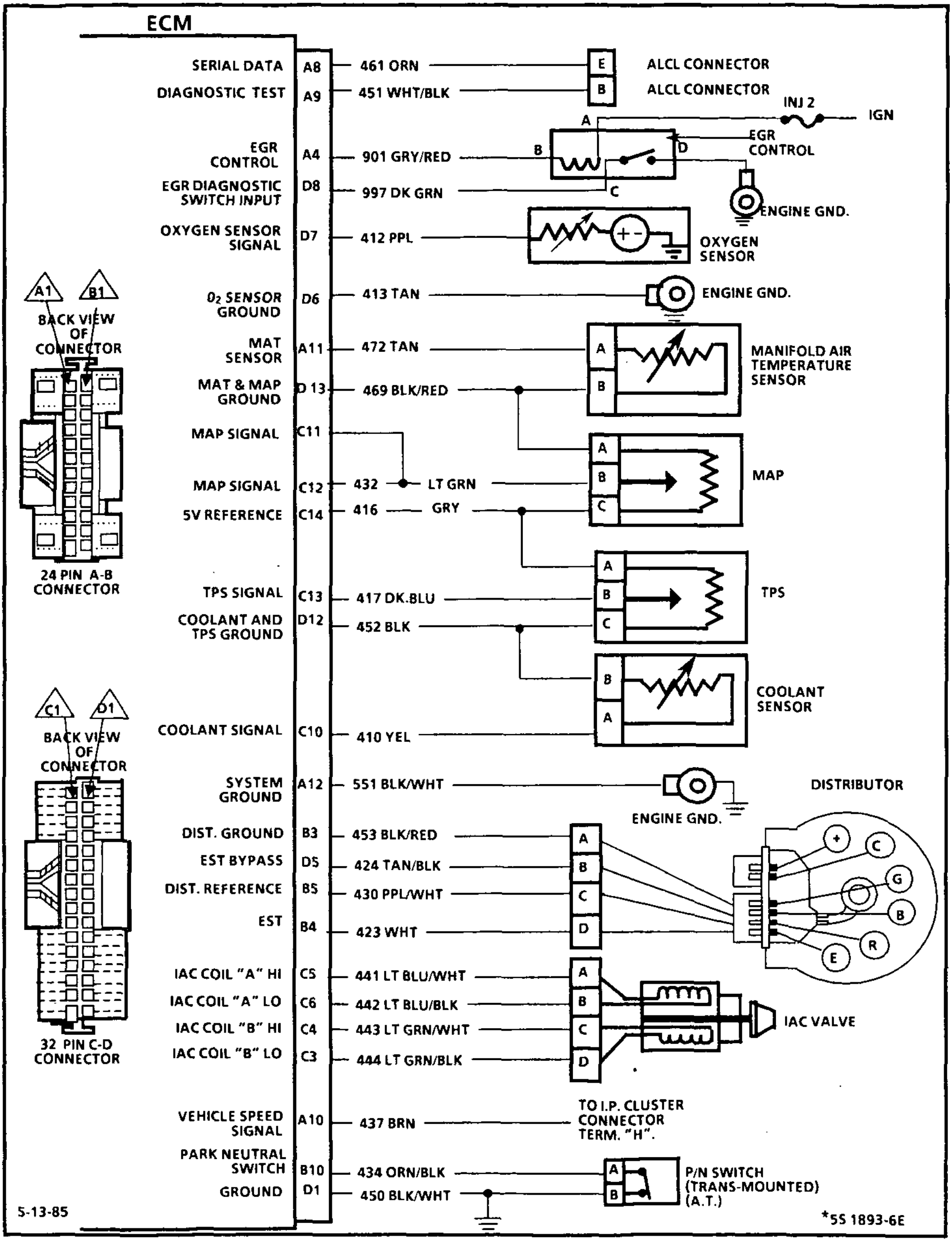


Figure A2 - 2.8L ECM Wiring Diagram

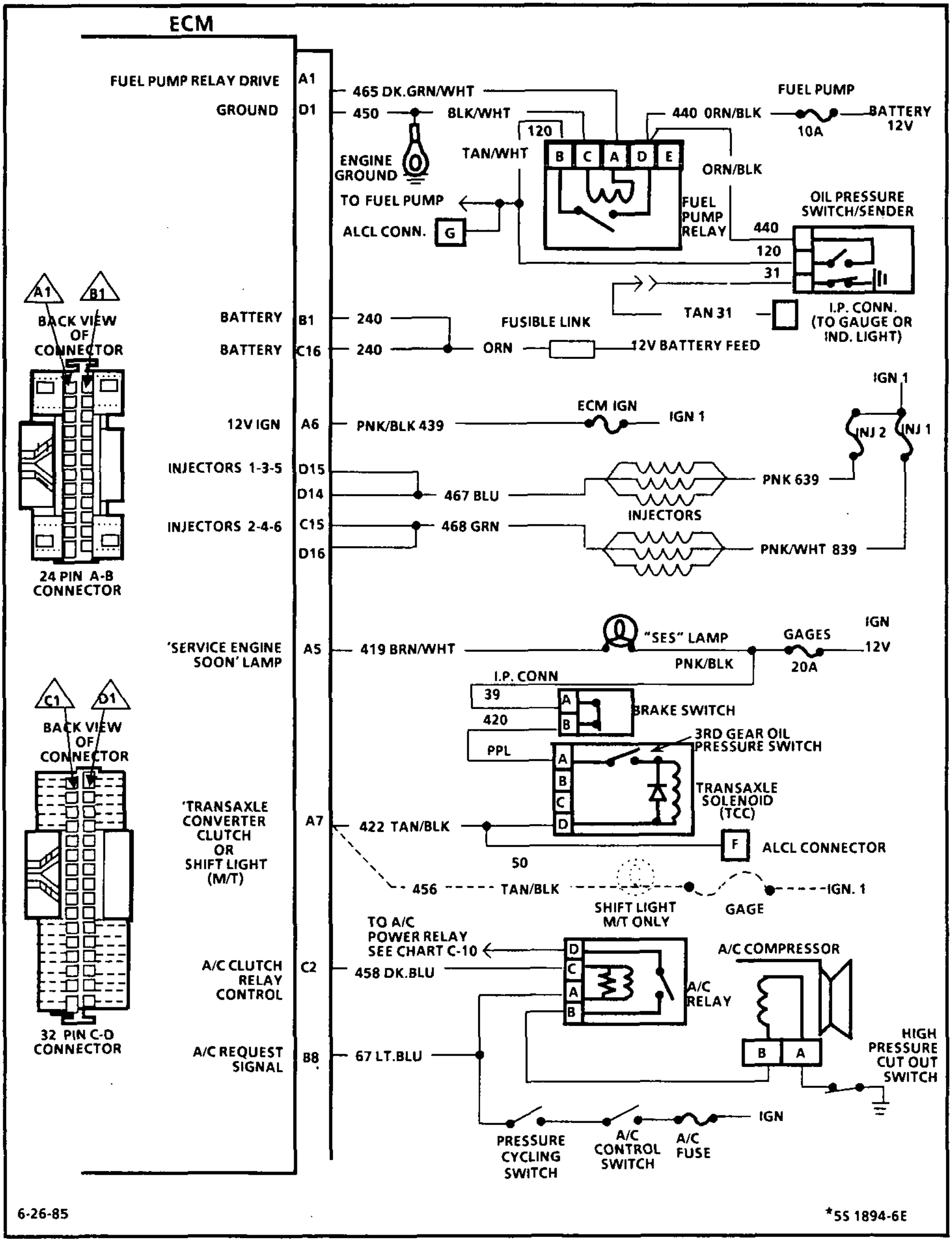


Figure A3 - 2.8L ECM Wiring Diagram

PORT FUEL INJECTION ECM CONNECTOR IDENTIFICATION

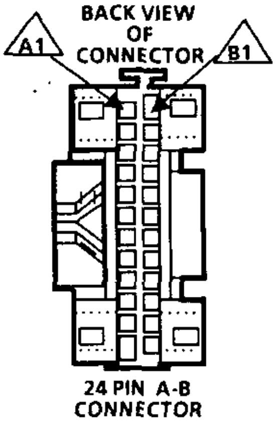
This ECM voltage chart is for use with a digital voltmeter to further aid in diagnosis. The voltages you get may vary due to low battery charge or other reasons, but they should be very close.

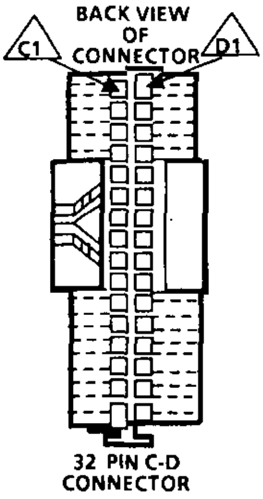
THE FOLLOWING CONDITIONS MUST BE MET BEFORE TESTING:

- Engine at operating temperature
- Engine idling in closed loop (for "Engine Run" column)
- Test terminal not grounded
- ALCL tool not installed

	VOLTAGE			
	KEY ON"	① ENG. RUN	CIRCUIT	PIN
④	0	14	FUEL PUMP RELAY	A1
			NOT USED	
			NOT USED	
	12	14	EGR VALVE	A4
	0	14	"SERVICE ENGINE SOON LIGHT"	A5
	12	14	IGN .-ECM FUSE	A6
	12 *0*	14 *0*	SHIFT LIGHT M/T *TCC CONTROL A/T*	A7
	2-5	2-5	SERIAL DATA	A8
	5	5	DIAG. TERM.	A9
①			SENSOR SIGNAL VEHICLE SPEED	A10
②			MAT SIGNAL	A11
	0	0	GROUND	A12

			NOT USED	C1
	12	14	A/C RELAY CTRL	C2
	NOT USEABLE		IAC "B" LO	C3
	NOT USEABLE		IAC "B" HI	C4
	NOT USEABLE		IAC "A" HI	C5
	NOT USEABLE		IAC "A" LO	C6
			NOT USED	C7
			NOT USED	C8
			NOT USED	C9
②	1.9	1.7	COOLANT SIGNAL	C10
	4.8	③	MAP SIGNAL	C11
	4.8	③	MAP SIGNAL	C12
			TPS SIGNAL	C13
	5	5	5 VOLT REFERENCE	C14
	12	14	'B 'INJ. 2.4.6	C15
	12	14	BATT. 12 VOLTS	C16





		VOLTAGE		
PIN	CIRCUIT	KEY "ON"	① ENG. RUN	
B1	BATT. 12 VOLTS	12	14	
B2	NOT USED			
B3	EST REF. LOW	0	0	
B4	EST CONTROL	0	1.3	
B5	DIST. REFERENCE	0	1.6	
B6	NOT USED			
B7	NOT USED			
B8	A/C CLUTCH SIGNAL	0	0	
B9	NOT USED			
B10	P/N SWITCH SIGNAL	0	0	
B11	NOT USED			
B12	NOT USED			

D1	SYSTEM GROUND	0	0	
D2	NOT USED			
D3	NOT USED			
D4	NOT USED			
D5	EST BYPASS	0	4.75	
D6	OXYGEN SENSOR GROUND	0	0	
D7	OXYGEN SENSOR SIGNAL			③
D8	EGR DIAG. SWITCH	12	12	
D9	NOT USED			
D10	NOT USED			
D11	NOT USED			
D12	CLTS-TPS GND.	0	0	
D13	MAT-MAP SENSOR GRD	*0*	*0*	
D14	INJ. 1, 3,-5 "A"	12	14	
D15	INJ. 1, 3,-5 "A"	12	14	
D16	INJ. 2,4,6 "B"	12	14	

ENGINE 2.8 L44

CARLINE "P"

1 Varies from .60 to battery voltage depending on position of drive wheels.
2 Varies with temperature.
3 Varies
4 12V first two seconds.

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*5S 1892-6EA

Figure A-4 ECM Connector Terminal End View - 2.8L

"NON-SCAN" DIAGNOSTIC CIRCUIT CHECK

The Diagnostic Circuit check is an organized approach for identifying a problem caused by the Fuel Injection System.

Driver comments normally fall into one of the following areas:

- Steady "SERVICE ENGINE SOON" light
- Driveability Problem
- Engine "Cranks But Will Not Run"

Understanding the chart and using it correctly will reduce diagnosis time and prevent the unnecessary replacement of parts.

1. A steady 'SERVICE ENGINE SOON' light with the ignition "ON" and the engine stopped confirms battery and ignition voltage to the Electronic Control Module (ECM).

2. Ground diagnostic "test" terminal by jumpering terminal "A" to "B" in the ALCL connector located below the instrument panel.

The ECM will cause the 'SERVICE ENGINE SOON' light to flash Code 12, indicating that the ECM diagnostics are working. Code 12 will flash three (3) times, followed by any other trouble codes stored in the memory. Each additional code will flash three (3) times, starting with the lowest code and then start over again with code 12. If there are no other codes, Code 12 will flash until the diagnostic 'test' terminal jumper is disconnected or the engine is started.

3. Record all stored codes except for Code 12. If the problem is "Engine Cranks But Will Not Run", proceed to Chart A-3.

4. If no additional codes were recorded, see Section B for driveability symptoms and recommended service procedures. Depending on the severity of the problem, the 'Field Service Mode' may be helpful in diagnosis.

With the engine running and the diagnostic terminal grounded, the ECM will respond to the Oxygen sensor signal voltage and use the 'SERVICE ENGINE SOON' light to display this information as follows:

A. Closed loop confirms that the Oxygen sensor signal is being used by the ECM to control fuel delivery, and that the system is working normally. Signal voltage will swing quickly from below .35 to above .55 volts.

B. Open loop indicates that the oxygen sensor voltage signal is not usable to the ECM. Signal voltage is at a constant value between .35 and .55 volts.

System will flash "open loop" from 30 seconds to 2 minutes after engine starts or until sensor reaches normal operating temperature. If system fails to go 'closed loop', see Code 13.

C. 'SERVICE ENGINE SOON' light "OUT" indicates that exhaust is lean. O_2 sensor signal voltage will be less than .35 volts and steady. See Code 44.

D. "SERVICE ENGINE SOON" light on steady indicates that exhaust is rich. Sensor signal voltage will be above .55 volts and steady. See Code 45.

5. Road test of the system using the field service mode should be done only at steady road speeds.Because the vehicle operates differently in the field service mode, the following conditions may be observed and should be considered normal.

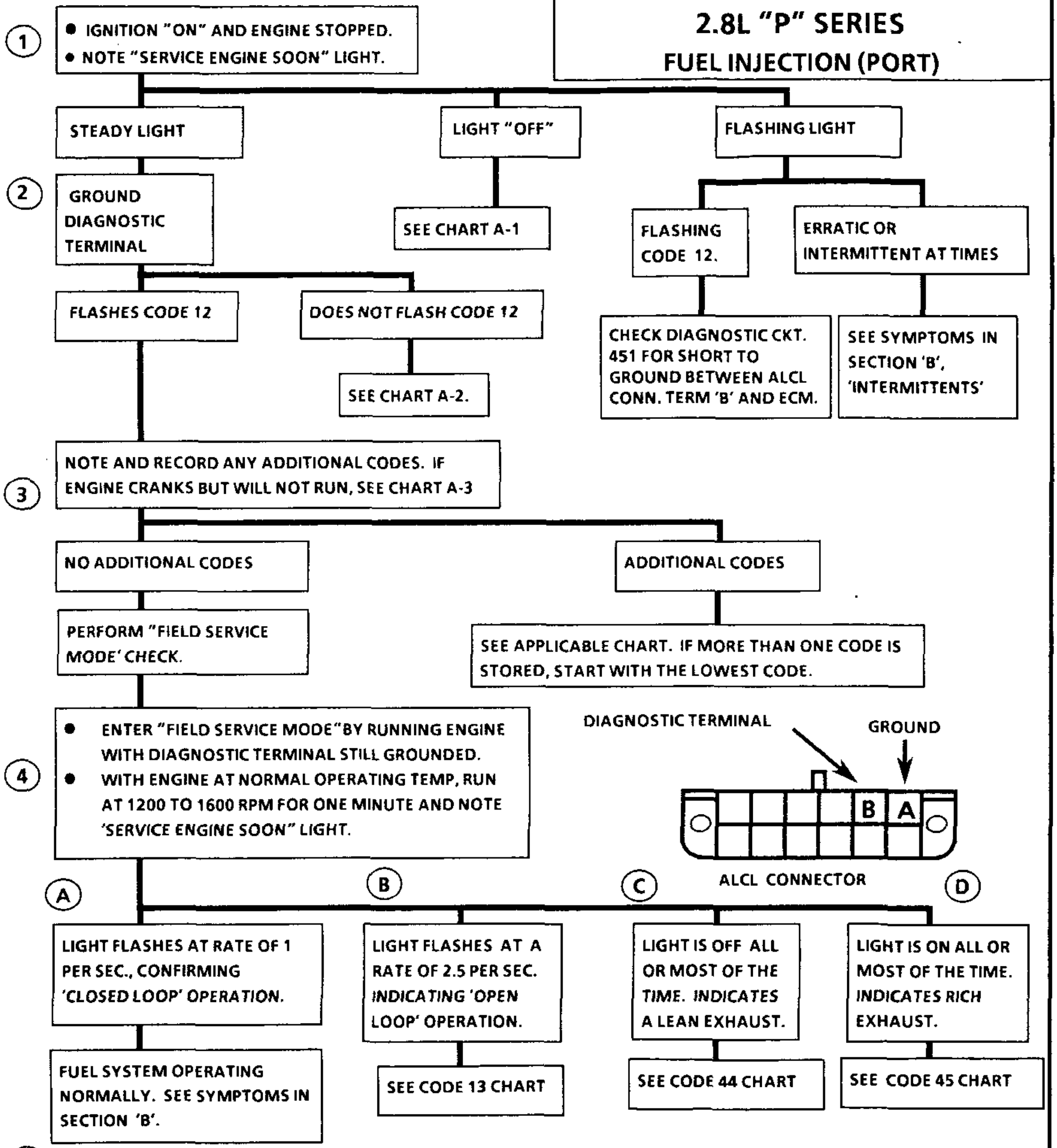
- Acceleration - Light may be "ON" too long due to acceleration enrichment.
- Deceleration - Light may be "OFF" too long due to decel enleanment or fuel cut-off.
- Idle-Light may be "ON" too long with idle below 1200 RPM.
- Surge 35 MPH - timing changes from 10° to normal spark advance at 1600 - 1800 RPM.

6. The codes are cleared by disconnecting the ECM battery pigtail in the engine compartment for at least 10 seconds.

"NON-SCAN" DIAGNOSTIC CIRCUIT CHECK

2.8L "P" SERIES

FUEL INJECTION (PORT)



⑤ VEHICLE MAY BE DRIVEN IN THE FIELD SERVICE MODE AND EVALUATED AT ANY STEADY SPEED. THIS CAN BE HELPFUL IN DIAGNOSING DRIVEABILITY PROBLEMS WHERE THE SYSTEM IS RICH OR LEAN TOO LONG.

⑥ CLEAR CODES AND CONFIRM 'CLOSED LOOP' OPERATION AND NO 'LIGHT'.

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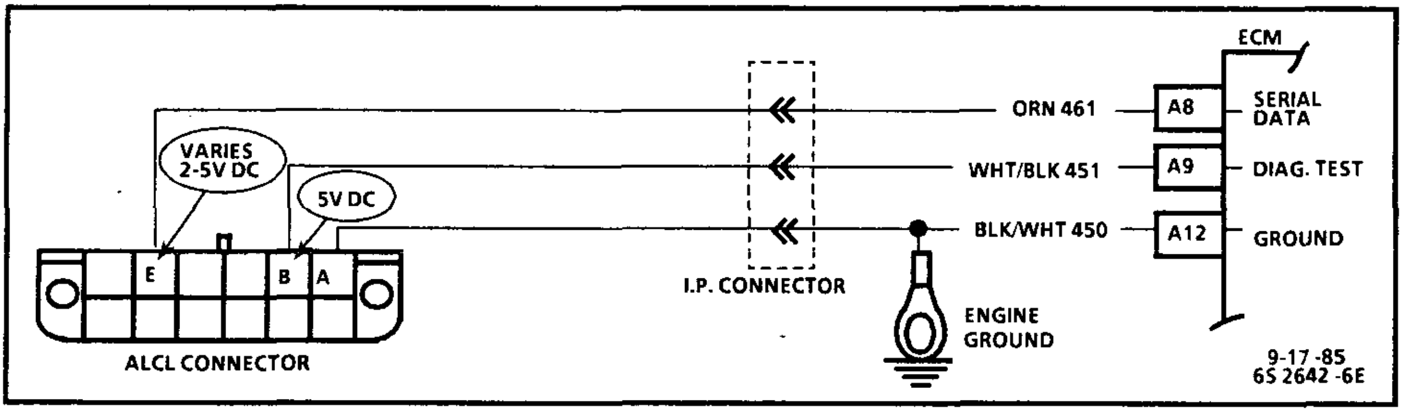
* 5S 1350-6EA



"SCAN" DIAGNOSTIC CIRCUIT CHECK

2.8L "P" SERIES

FUEL INJECTION (PORT)

The "SCAN" Diagnostic Circuit Check is an organized approach for identifying fuel injection problems using an assembly line communication link (ALCL). This communication link can provide diagnostic information for display on any "SCAN" device or tool designed for this purpose.
The use of a "SCAN" device requires a good understanding of its operation as well as its limitation. A complete review of the instruction manual furnished with the tool as well as the Introduction and General Description in this section is very important.

The tool plugs into the ALCL connector located below the instrument panel. If a stored code is displayed, the code definitions beginning on page two will aid in determining if the fault is still present (hard failure) or the result of an intermittent condition not normally diagnosed using the code charts.

A hard failure will be diagnosed using charts that have been developed for both "SCAN" and "NON-SCAN" diagnosis. "SCAN" steps start with the arrow marked "Start Scan"and are identified by the larger type. The actual repair procedures, however, are the smaller type and apply to both methods of diagnosis.

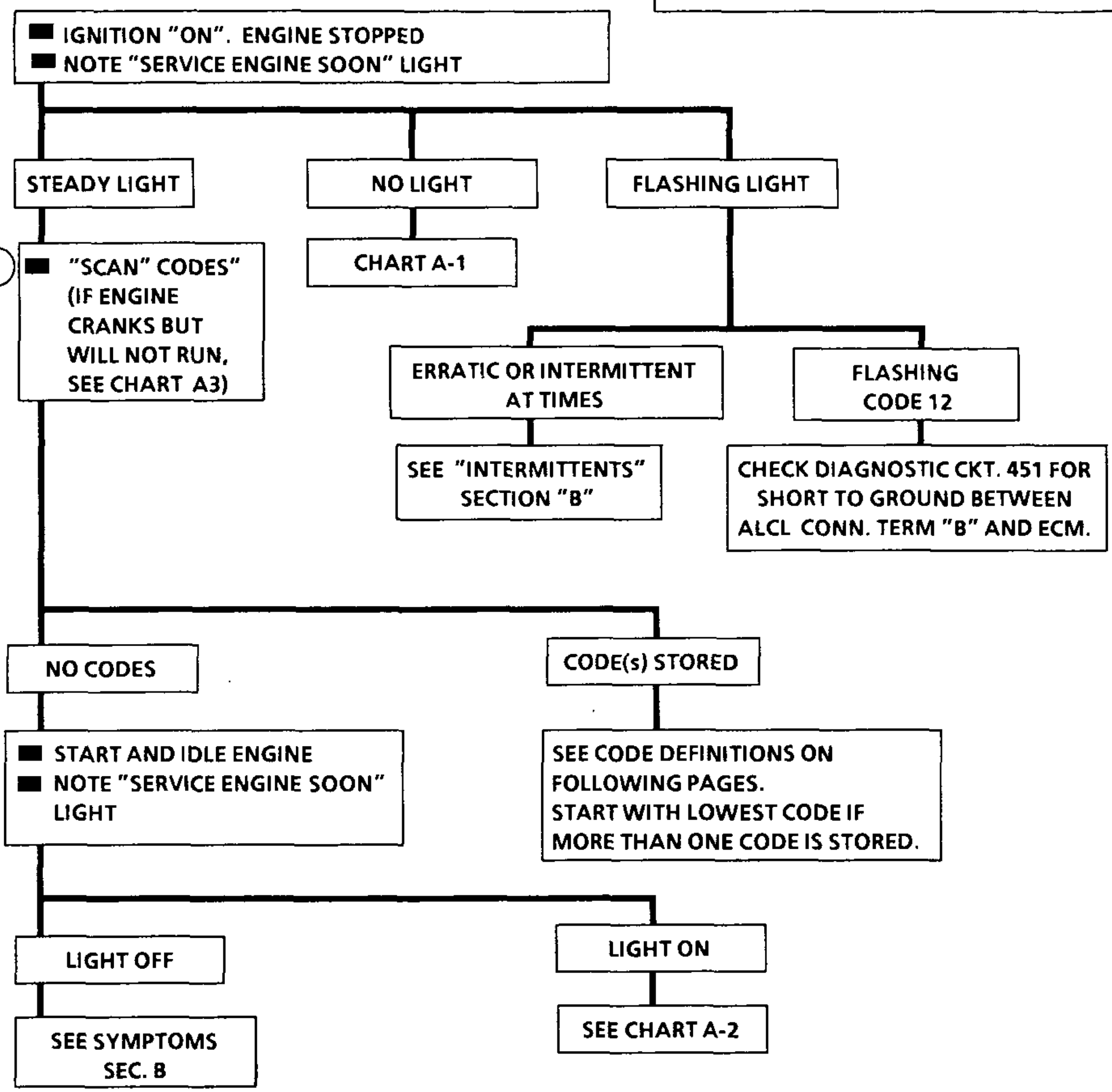
The facing page of each chart will provide a general circuit description and in some instances, alternate diagnostic steps or other diagnostic aids specific to that chart.

1. If the "SCAN" tool is not operating, check on another vehicle. If OK, the cigar lighter socket should be checked for 12 volts and a good ground. If the "SCAN" tool reads "no data" or "no ALCL", with the ignition "on", check the serial data wire for an open or short to ground between ALCL terminal "E" and the ECM. Also, check for an open diagnostic test terminal from ALCL terminal "B" and ECM. With ignition on, the serial data line (ALCL terminal "E") should have a varying 2-5 volts and the diagnostic line (ALCL terminal "B") about 5 volts.

■ "SCAN" STEP ONLY

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 1 of 7)
FUEL INJECTION (PORT)



■ IGNITION "ON". ENGINE STOPPED
■ NOTE "SERVICE ENGINE SOON" LIGHT

STEADY LIGHT

① ■ "SCAN" CODES" (IF ENGINE CRANKS BUT WILL NOT RUN, SEE CHART A3)

NO LIGHT

CHART A-1

FLASHING LIGHT

ERRATIC OR INTERMITTENT AT TIMES

SEE "INTERMITTENTS" SECTION "B"

FLASHING CODE 12

CHECK DIAGNOSTIC CKT. 451 FOR SHORT TO GROUND BETWEEN ALCL CONN. TERM "B" AND ECM.

NO CODES

■ START AND IDLE ENGINE
■ NOTE "SERVICE ENGINE SOON" LIGHT

LIGHT OFF

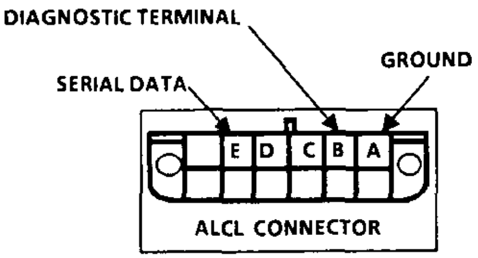
SEE SYMPTOMS SEC. B

LIGHT ON

SEE CHART A-2

CODE(s) STORED

SEE CODE DEFINITIONS ON FOLLOWING PAGES.
START WITH LOWEST CODE IF MORE THAN ONE CODE IS STORED.



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"SCAN" DIAGNOSTIC CIRCUIT CHECK
(Page 2 of 7)
(CODE DEFINITIONS)

THE DIAGNOSTIC CIRCUIT CHECK' SCAN DATA IS TYPICAL OF THAT DISPLAYED BY A PROPERLY DESIGNED AND CALIBRATED ALCL SCAN DEVICE.

A SCAN DEVICE THAT DISPLAYS FAULTY DATA SHOULD NOT BE USED AND THE PROBLEM REPORTED TO THE DEVICE MANUFACTURER. THE USE OF A FAULTY SCAN DEVICE CAN RESULT IN MISDIAGNOSIS AND UNNECESSARY PARTS REPLACEMENT.

CODES	DEFINITIONS
■ **CODE 13** • "SCAN" IN ALCL "SPECIAL" MODE • ENGINE IDLING AT 1000 ± 50 RPM FOR 2 MINUTES. • COOLANT 75° TO 95° C. • "SCAN" OXYGEN SENSOR VOLTAGE	**HARD FAILURE -** "SCAN" DISPLAY FIXED BETWEEN .35 TO .55 V. OPEN CIRCUIT CONDITION. SEE CODE CHART 13. **INTERMITTENT CODE -** NORMAL"SCAN" VOLTAGE WILL VARY BETWEEN 100MV TO 999 MV (.1 AND 1.0 VOLT). SEE "INTERMITTENTS" SECTION "B".
■ **CODE 14** • IGNITION ON. • ENGINE STOPPED. • SCAN" COOLANT TEMPERATURE.	**HARD FAILURE -** "SCAN" DISPLAY FIXED ABOVE 135° C. CIRCUIT SHORTED TO GROUND OR FAULTY SENSOR. SEE CODE CHART 14. **INTERMITTENT CODE -** "SCAN" DISPLAY READS ENGINE TEMP. IN DEGREES CENTIGRADE. AFTER ENGINE IS STARTED, THE TEMPERATURE SHOULD RISE STEADILY TO ABOUT 90° C THEN STABILIZE WHEN THERMOSTAT OPENS. SEE "INTERMITTENTS" SECTION "B".
■ **CODE 15** • IGNITION ON. • ENGINE STOPPED. • "SCAN" COOLANT TEMPERATURE.	**HARD FAILURE -** "SCAN" DISPLAY FIXED BELOW -30° C. CIRCUIT OPEN OR FAULTY SENSOR. SEE CODE CHART 15. **INTERMITTENT CODE -** "SCAN" DISPLAYS ENGINE COOLANT TEMPERATURE IN DEGREES CENTIGRADE. AFTER ENGINE IS STARTED, THE TEMPERATURE SHOULD RISE STEADILY TO ABOUT 90° C, THEN STABILIZE WHEN THERMOSTAT OPENS. SEE "INTERMITTENTS" SECTION "B".

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"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 3 of 7)

(CODE DEFINITIONS)

CODES

DEFINITIONS

■ CODE 21

- IGNITION "ON".
- THROTTLE CLOSED.
- ENGINE STOPPED.
- "SCAN" TPS

HARD FAILURE -

"SCAN" DISPLAYS A CLOSED THROTTLE VOLTAGE OVER 2.5 VOLTS. SIGNAL VOLTAGE TOO HIGH, GROUND WIRE OPEN, SIGNAL LINE SHORTED TO SENSOR REF. LINE OR FAULTY SENSOR. SEE CODE CHART 21.

INTERMITTENT CODE -

"SCAN" DISPLAYS THROTTLE POSITION IN VOLTS. SHOULD READ BETWEEN 020-125 (200 MV AND 1.25 V). WITH THROTTLE CLOSED AND IGNITION ON OR AT IDLE. VOLTAGE SHOULD INCREASE AT A STEADY RATE AS THROTTLE IS MOVED TOWARD A WIDE OPEN POSITION. SEE "INTERMITTENTS" SECTION "B".

■ CODE 22

- IGNITION "ON"
- ENGINE STOPPED.
- THROTTLE CLOSED.
- "SCAN" TPS

HARD FAILURE -

"SCAN" DISPLAYS BELOW 020V (200 MV). OPEN OR SHORT TO GROUND IN 5V REFERENCE OR SIGNAL CIRCUIT, OR FAULTY SENSOR. SEE CODE CHART 22.

INTERMITTENT CODE -

"SCAN" DISPLAYS THROTTLE POSITION IN VOLTS. SHOULD READ BETWEEN 020-125 (200 MV AND 1.25 V). WITH THROTTLE CLOSED AND IGNITION ON OR AT IDLE. VOLTAGE SHOULD INCREASE AT A STEADY RATE AS THROTTLE IS MOVED TOWARD A WIDE OPEN POSITION: SEE "INTERMITTENTS" SECTION "B".

■ CODE 23

- IGNITION "ON"
- ENGINE STOPPED.
- "SCAN" MAT TEMPERATURE

HARD FAILURE -

"SCAN" DISPLAY FIXED BELOW -25° C. CIRCUIT OPEN OR FAULTY SENSOR. SEE CODE CHART 23.

INTERMITTENT CODE -

"SCAN" TOOL READS TEMPERATURE OF THE AIR ENTERING THE ENGINE. SHOULD READ CLOSE TO AMBIENT AIR TEMPERATURE WHEN ENGINE IS COLD, AND RISE AS UNDERHOOD & ENGINE TEMPERATURE INCREASES. SEE "INTERMITTENTS" SECTION "B".

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 4 of 7)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 24** ● ENGINE RUNNING. ● DRIVE WHEELS TURNING. ● "SCAN" MPH	**HARD FAILURE -** "SCAN" DISPLAYS "0" MPH. IF SPEEDOMETER IS WORKING OK, THEN THE VSS SIGNAL INPUT IS OPEN, SHORTED TO GROUND, OR THE BUFFER IS DEFECTIVE. SEE CODE CHART 24. **INTERMITTENT CODE -** "SCAN" DISPLAY SHOULD CLOSELY MATCH SPEEDOMETER WITH DRIVE WHEELS TURNING. SEE "INTERMITTENTS", SECTION "B". "SCAN" DISPLAYS THAT PARK/NEUTRAL SWITCH DID NOT "SWITCH" WHEN SHIFTING NEUTRAL TO DRIVE (A.T. ONLY). SEE CHART C-1A DISREGARD CODE 24 IF SET WITH DRIVE WHEELS NOT TURNING.
■ **CODE 25** ● IGNITION "ON" ● ENGINE STOPPED. ● "SCAN" MAT TEMPERATURE	**HARD FAILURE -** "SCAN" DISPLAYS ABOVE 130° C. CIRCUIT SHORTED TO GND. OR FAULTY SENSOR. SEE CODE CHART 25. **INTERMITTENT CODE -** "SCAN" TOOL READS TEMPERATURE OF THE AIR IN THE INTAKE MANIFOLD . SHOULD READ CLOSE TO AMBIENT AIR TEMPERATURE WHEN ENGINE IS COLD, AND RISE AS UNDERHOOD & ENGINE TEMPERATURE INCREASES. SEE "INTERMITTENTS" SECTION "B".
■ **CODE 32**	**HARD FAILURE -** THE "SCAN" TOOL IS NOT USEFUL IN DIAGNOSING CODE 32 PROBLEMS. SEE CODE CHART 32 IF CODE WAS STORED IN MEMORY.

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 5 of7)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 33** • ENGINE IDLING. • "SCAN" MAP.	**HARD FAILURE -** "SCAN" DISPLAYS ABOVE 2.5 VOLTS. SENSOR GROUND CIRCUIT OPEN, LEAKING VACUUM HOSE OR FAULTY SENSOR. SEE CODE CHART 33. **INTERMITTENT CODE -** "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 ENGINE IDLE IS LOW AND UNSTABLE IT MAY SET CODE 33. SEE "INTERMITTENTS" SECTION "B".
■ **CODE 34** • IGNITION "ON" • SCAN" MAP.	**HARD FAILURE -** "SCAN" DISPLAYS BELOW 200 MV (.2 VOLTS). SIGNAL WIRE OR 5V REFERENCE OPEN OR SHORTED TO GROUND OR FAULTY SENSOR. SEE CODE CHART 34. **INTERMITTENT CODE -** "SCAN" DISPLAYS MANIFOLD PRESSURE IN VOLTS. LOW PRESSURE (HIGH VACUUM) READS A LOW VOLTAGE WHILE A HIGH PRESSURE (LOW VACUUM) READS A HIGH VOLTAGE. SEE "INTERMITTENTS" SECTION "B".
■ **CODE 35** • A/C OFF. • ENGINE IDLING IN NEUTRAL • COOLANT TEMP 70° TO 90°. • "SCAN" IN "SPECIAL"MODE. • INCREASE ENGINE RPM TO 2500 TO RESET IAC. CLOSE THROTTLE AND ALLOW ENGINE IDLE AND IAC COUNTS STABILIZE.	**HARD FAILURE -** "SCAN" DISPLAYS IDLE SPEED ABOVE 1000 ± 50 RPM. IAC COUNTS "0" - THIS CONDITION USUALLY A SMALL VACUUM LEAK SUCH AS CCP OR CRUISE CONTROL HOSE DISCONNECTED. OR ENGINE IDLE SPEED TOO LOW IAC COUNTS ABOVE 80. SEE CODE 35 CHART. **INTERMITTENT CODE -** FOLLOWING AN IAC RESET RPM SHOULD STABLIZE AT 1000 ± 50 RPM IN "SPECIAL" MODE. DISCONNECTING "SCAN" TOOL WILL RESTORE NORMAL IDLE..

7-01-85
*6S 2721-6E

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 6 of 7)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 42** • CLEAR CODES, START AND IDLE ENGINE FOR 1 MINUTE.	**HARD FAILURE -** SERVICE ENGINE SOON" LIGHT ON AND SCAN DISPLAYS CODE 42. SEE CODE CHART 42 **INTERMITTENT CODE -** THE SCAN TOOL CAN NOT HELP IN THE DIAGNOSIS OF A CODE 42 PROBLEM. IF NO "SERVICE ENGINE SOON "LIGHT, REFER TO INTERMITTENTS IN SECTION "B".
■ **CODE 44** • "SCAN" TOOL IN "SPECIAL" MODE. • COOLANT TEMP 75° to 95° C. • ENGINE IDLING AT 1000 RPM.	**HARD FAILURE -** "SCAN" DISPLAYS 0_2 VOLTAGE FIXED BELOW .35V IS CAUSED BY A LEAN EXHAUST OR SIGNAL CIRCUIT SHORTED TO GROUND. SEE CODE CHART 44. **INTERMITTENT CODE -** NORMAL "SCAN" VOLTAGE WILL VARY BETWEEN 100 MV AND 999 MV. (.1 to 1.0V) ALSO SEE CROSSCOUNTS, RICH - LEAN INDICATION, 0_2 VOLTAGE. REFER TO "SCAN" INFORMATION IN INTRODUCTION.
■ **CODE 45** • 'SCAN" TOOL IN "SPECIAL" MODE • ENGINE IDLING AT 1000 RPM • COOLANT TEMP 75° to 95° C. • "SCAN" OXYGEN SENSOR VOLTAGE	**HARD FAILURE -** "SCAN" 0_2 VOLTAGE FIXED ABOVE .65V. RICH EXHAUST CAUSING A HIGH 02 VOLTAGE. SEE CODE CHART 45. **INTERMITTENT CODE -** NORMAL "SCAN" VOLTAGE WILL VARY BETWEEN 100 MV AND 999 MV. (.1 to 1.0V) ALSO SEE CROSSCOUNTS, RICH - LEAN INDICATION, 0_2 VOLTAGE. REFER TO "SCAN" INFORMATION IN INTRODUCTION.

7-01-85
6S 2721-6E

"SCAN" DIAGNOSTIC CIRCUIT CHECK

(Page 7 of 7)

(CODE DEFINITIONS)

CODES	DEFINITIONS
■ **CODE 51** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 51 RESETS WHICH INDICATES A FAULTY PROM. SEE CODE CHART 51.
■ **CODE 52** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 52 RESETS WHICH INDICATES FAULTY OR MISSING CALPAK.
■ **CODE 53** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 53 RESETS WHICH INDICATES GENERATOR VOLTAGE EXCEEDED 17.1 VOLTS. REPAIR GENERATOR **INTERMITTENT CODE** THE BATTERY VOLTAGE CAN BE MONITORED BY THE "SCAN" TOOL AND WILL INDICATE THE SYSTEM VOLTAGE AS SEEN BY THE ECM - SEE INTERMITTENTS IN SECTION B.
■ **CODE 55** ● CLEAR CODES ● START ENGINE ● CHECK FOR CODE	**HARD FAILURE -** CODE 55 RESETS WHICH INDICATES THE ECM IS FAULTY. REPLACE ECM.

7-01-85
6S 2721-6E

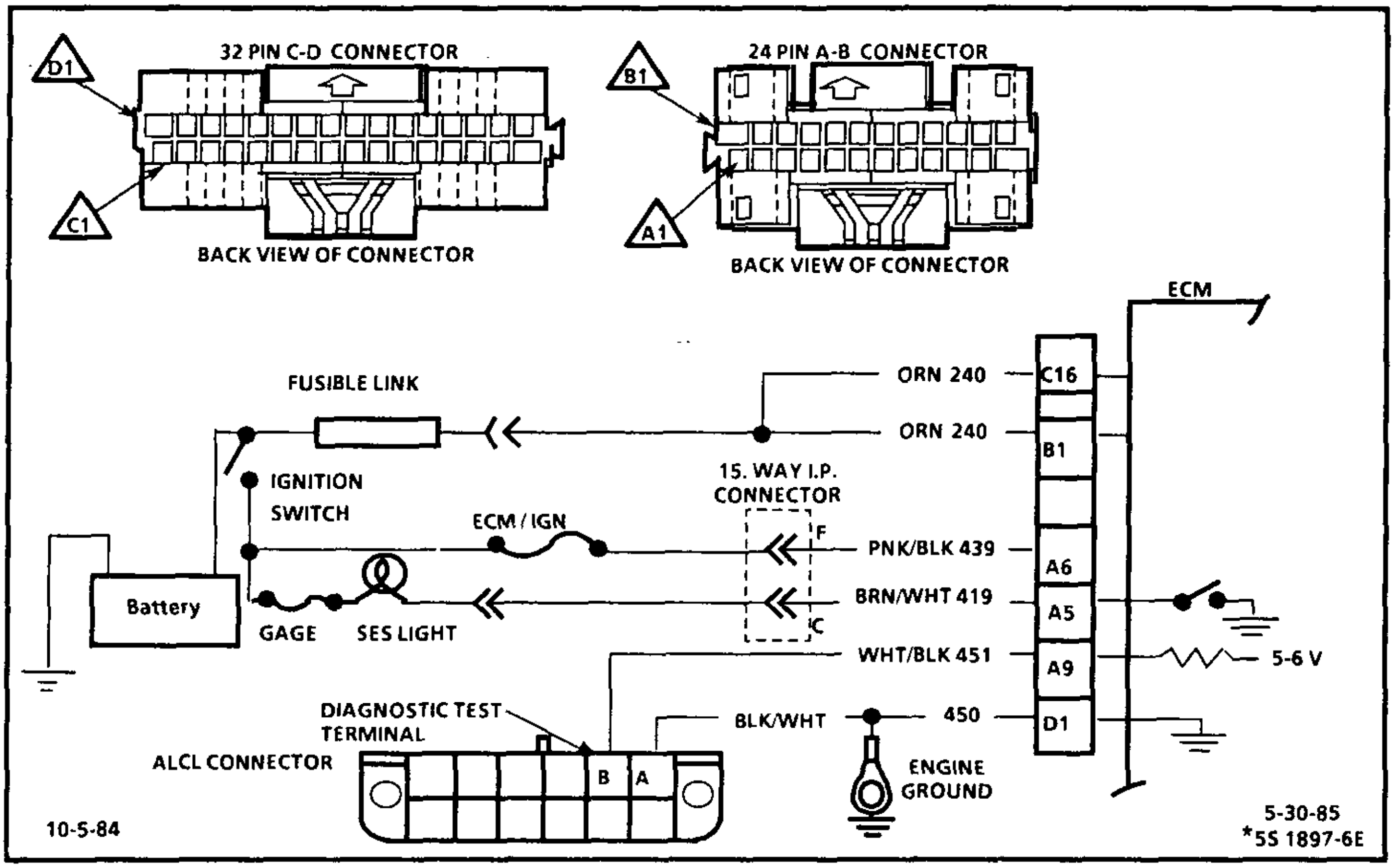


CHART A-1

NO "SERVICE ENGINE SOON" LIGHT

2.8L "P" SERIES

FUEL INJECTION (PORT)

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 circuit 419 to the ECM.

Engine runs ok, check:
- Faulty light bulb.
- CKT 419 open.
- Gage fuse blown. this will result in no stop lights, 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 240 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.

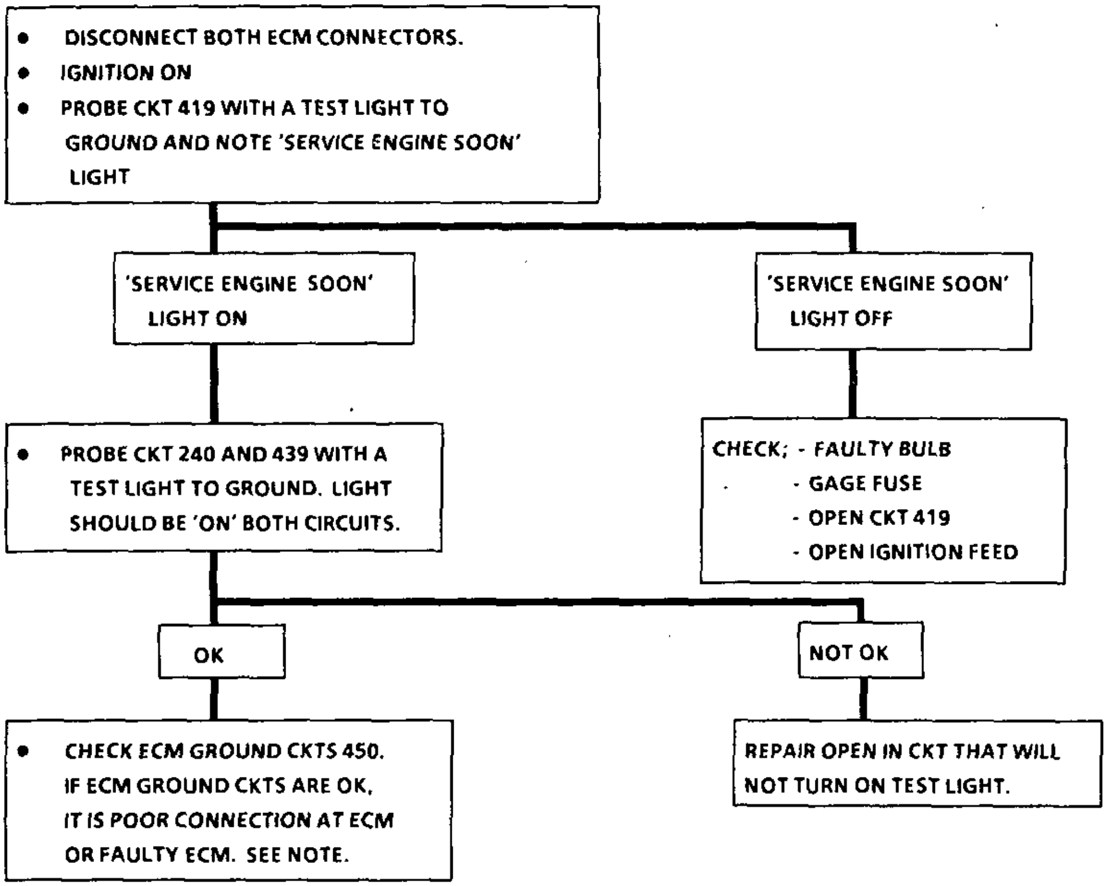
When checking 125C TCC solenoid, be sure to raise drive wheels and run above 30 MPH to close third gear apply switch.

CHART A-1

NO 'SERVICE ENGINE SOON' LIGHT

2.8L "P" SERIES

FUEL INJECTION (PORT)



- DISCONNECT BOTH ECM CONNECTORS.
- IGNITION ON
- PROBE CKT 419 WITH A TEST LIGHT TO GROUND AND NOTE 'SERVICE ENGINE SOON' LIGHT

'SERVICE ENGINE SOON' LIGHT ON

- PROBE CKT 240 AND 439 WITH A TEST LIGHT TO GROUND. LIGHT SHOULD BE 'ON' BOTH CIRCUITS.

OK

- CHECK ECM GROUND CKTS 450. IF ECM GROUND CKTS ARE OK, IT IS POOR CONNECTION AT ECM OR FAULTY ECM. SEE NOTE.

NOT OK

REPAIR OPEN IN CKT THAT WILL NOT TURN ON TEST LIGHT.

'SERVICE ENGINE SOON' LIGHT OFF

CHECK; - FAULTY BULB
- GAGE FUSE
- OPEN CKT 419
- OPEN IGNITION FEED

NOTE:

BEFORE REPLACING ECM, USE AN OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-25-85

5S 1748-6EA

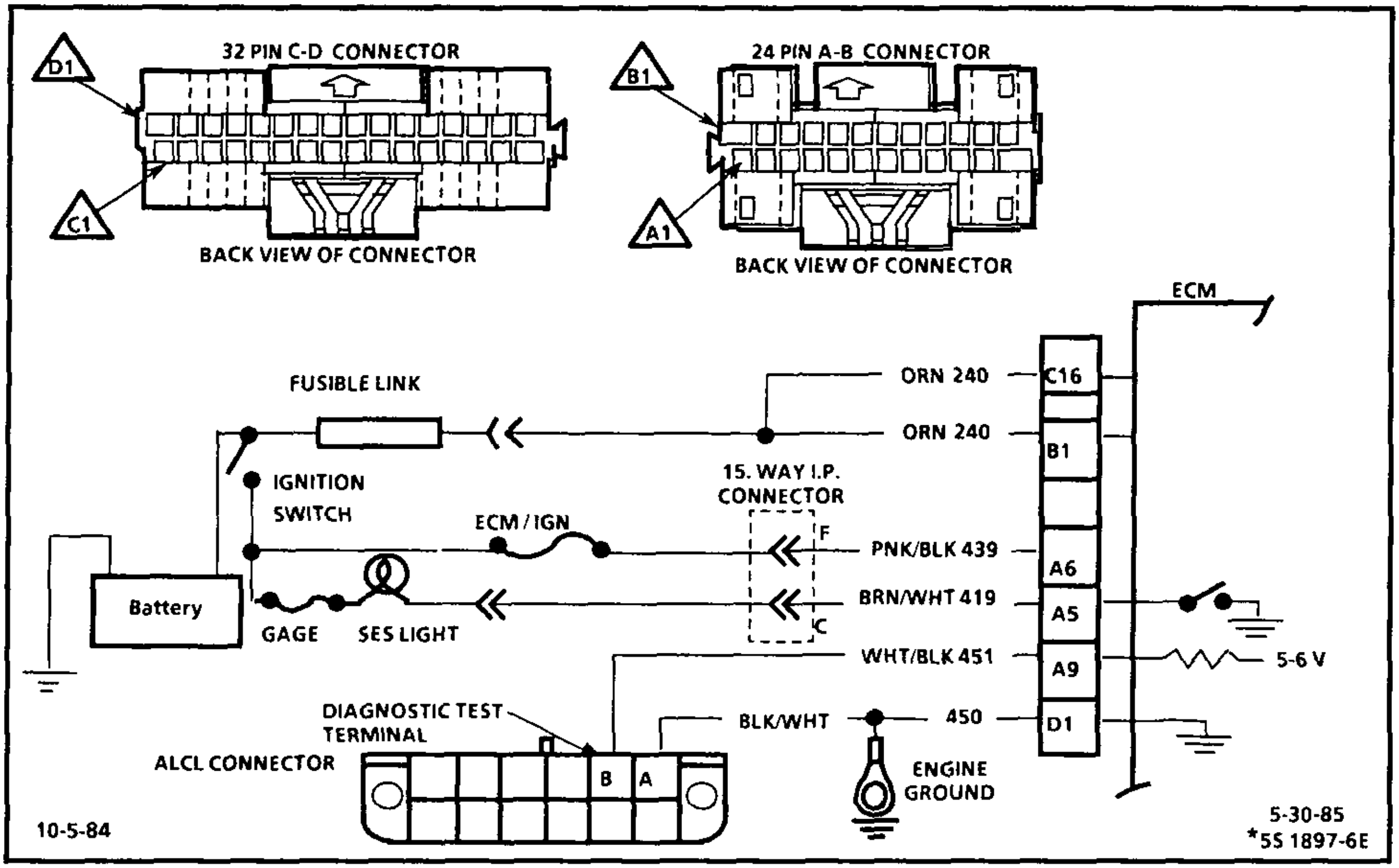


CHART A-2

WON'T FLASH CODE 12

"SERVICE ENGINE SOON" LIGHT ON STEADY

2.8L "P" SERIES

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 circuit 419 to 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 circuit 419, or an open in diagnostic circuit 451.

1. If the light goes off, when the ECM connector is disconnected, then circuit 419 is not shorted to ground. Also, check the connector terminals physically for proper contact at this time.
2. This step will check for an open diagnostic circuit 451.
3. At this point, the "SERVICE ENGINE SOON" light wiring is okay. The problem is a faulty ECM or PROM. The ECM is OK, if a Code 51 is stored when the PROM is removed. Replace the PROM.
4. 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. Solenoid and relay coil resistance must measure more than 20 ohms. Less resistance will cause early Failure of the ECM "driver".

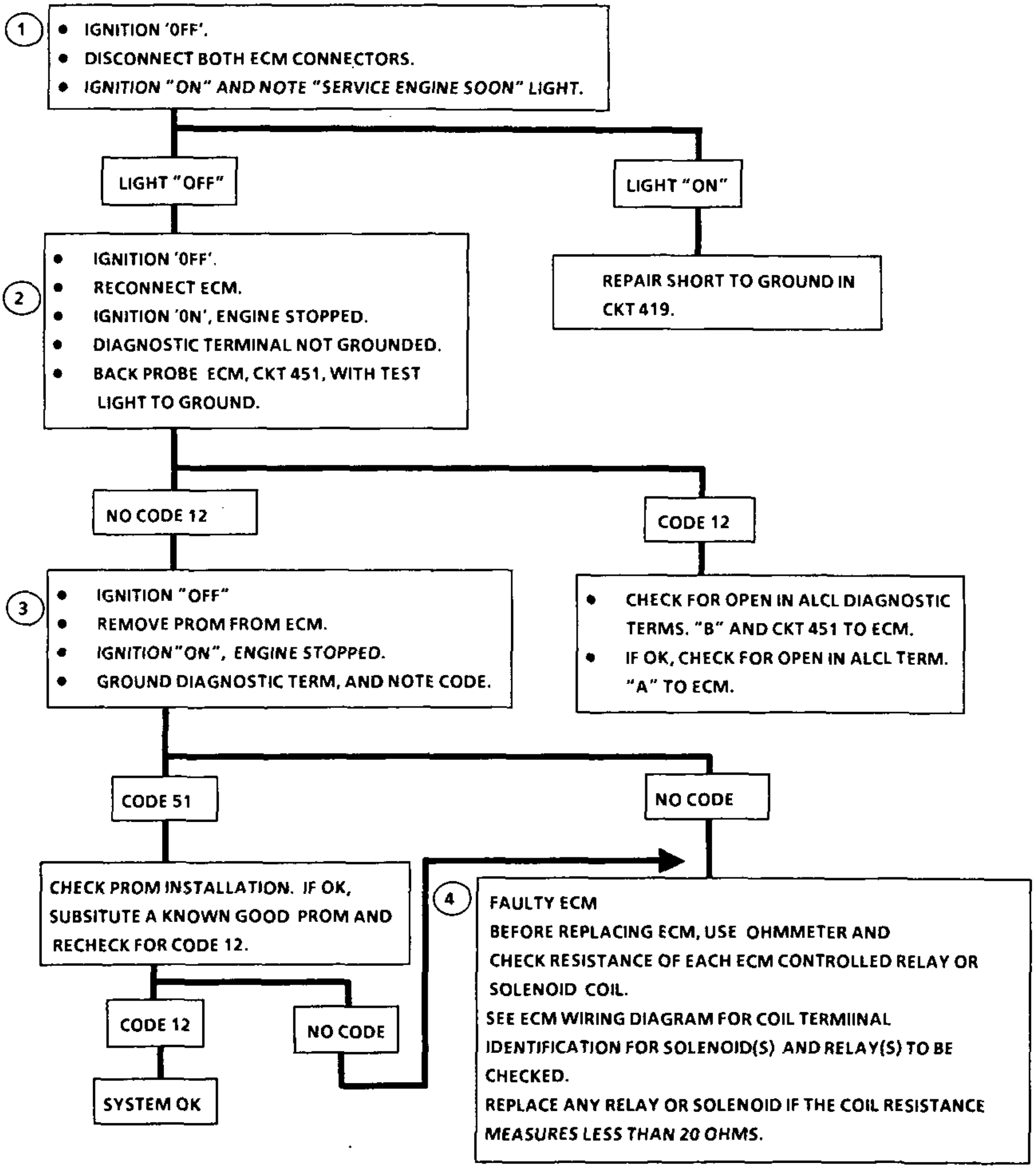
   Before replacing ECM, be sure to check the coil resistance of all solenoids and relays controlled by the ECM. See ECM wiring diagram for the solenoidsand relays and the coil terminal identification.

   When checking TCC solenoid, be sure to raise drive wheels and run above 30 MPH to close third gear apply switch, if used.

CHART A-2

WON'T FLASH CODE 12
"SERVICE ENGINE SOON" LIGHT ON STEADY

2.8L "" SERIES
FUEL INJECTION (PORT)



①
- IGNITION 'OFF'.
- DISCONNECT BOTH ECM CONNECTORS.
- *IGNITION "ON" AND NOTE "SERVICE ENGINE SOON" LIGHT.*

REPAIR SHORT TO GROUND IN CKT 419.

②
- IGNITION 'OFF'.
- RECONNECT ECM.
- IGNITION 'ON', ENGINE STOPPED.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- BACK PROBE ECM, CKT 451, WITH TEST LIGHT TO GROUND.

- CHECK FOR OPEN IN ALCL DIAGNOSTIC TERMS. "B" AND CKT 451 TO ECM.
- IF OK, CHECK FOR OPEN IN ALCL TERM. "A" TO ECM.

③
- IGNITION "OFF"
- REMOVE PROM FROM ECM.
- *IGNITION "ON", ENGINE STOPPED.*
- GROUND DIAGNOSTIC TERM, AND NOTE CODE.

CHECK PROM INSTALLATION. IF OK, SUBSITUTE A KNOWN GOOD PROM AND RECHECK FOR CODE 12.

④
FAULTY ECM
BEFORE REPLACING ECM, USE OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY OR SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMIINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE *MEASURES LESS THAN 20 OHMS.*

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-28-85
4S 0801-6EC

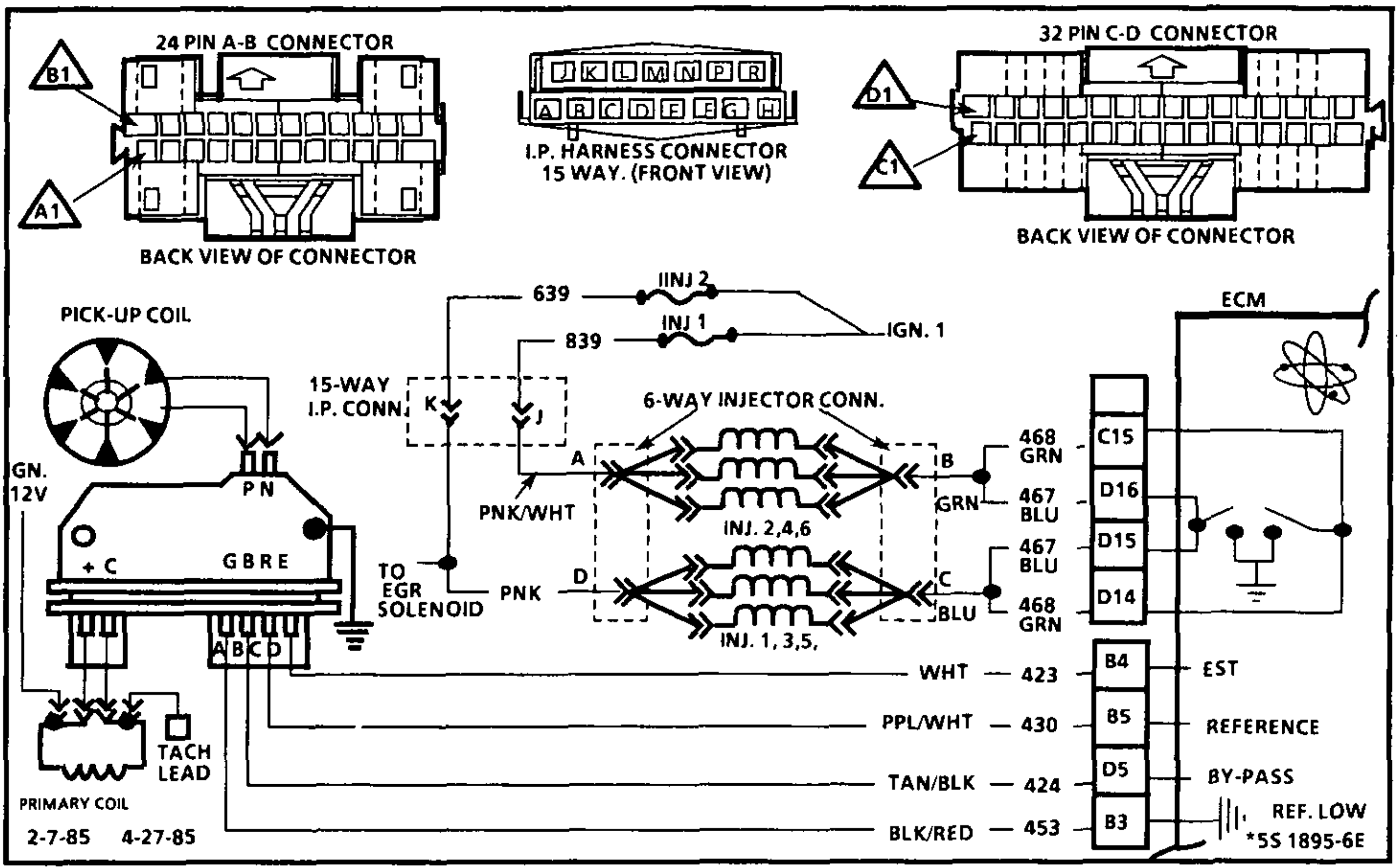


CHART A-3A

ENGINE CRANKS BUT WON'T RUN

(1 OF 2)

2.8L "P" SERIES

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).

1. 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.

   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. (6.3V Bulb)
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.
5. 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:

- Disconnect distributor 4-way connector or, remove both injector fuses.
- Engine temperature below 30°C (86°F).
- Fuel pressure gage installed.
- IGN. "on".
- Crank engine for 2 seconds and note gage.
- If the cold start valve is functioning properly the pressure should drop at least 5 psi (34 kpa).

If not OK, see Chart A-9.

- Also check injector fuses and that the injectors on both sides of engine will cause a test light to "blink".

If above are all OK, refer to Symptoms in Section B "Hard Start".

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

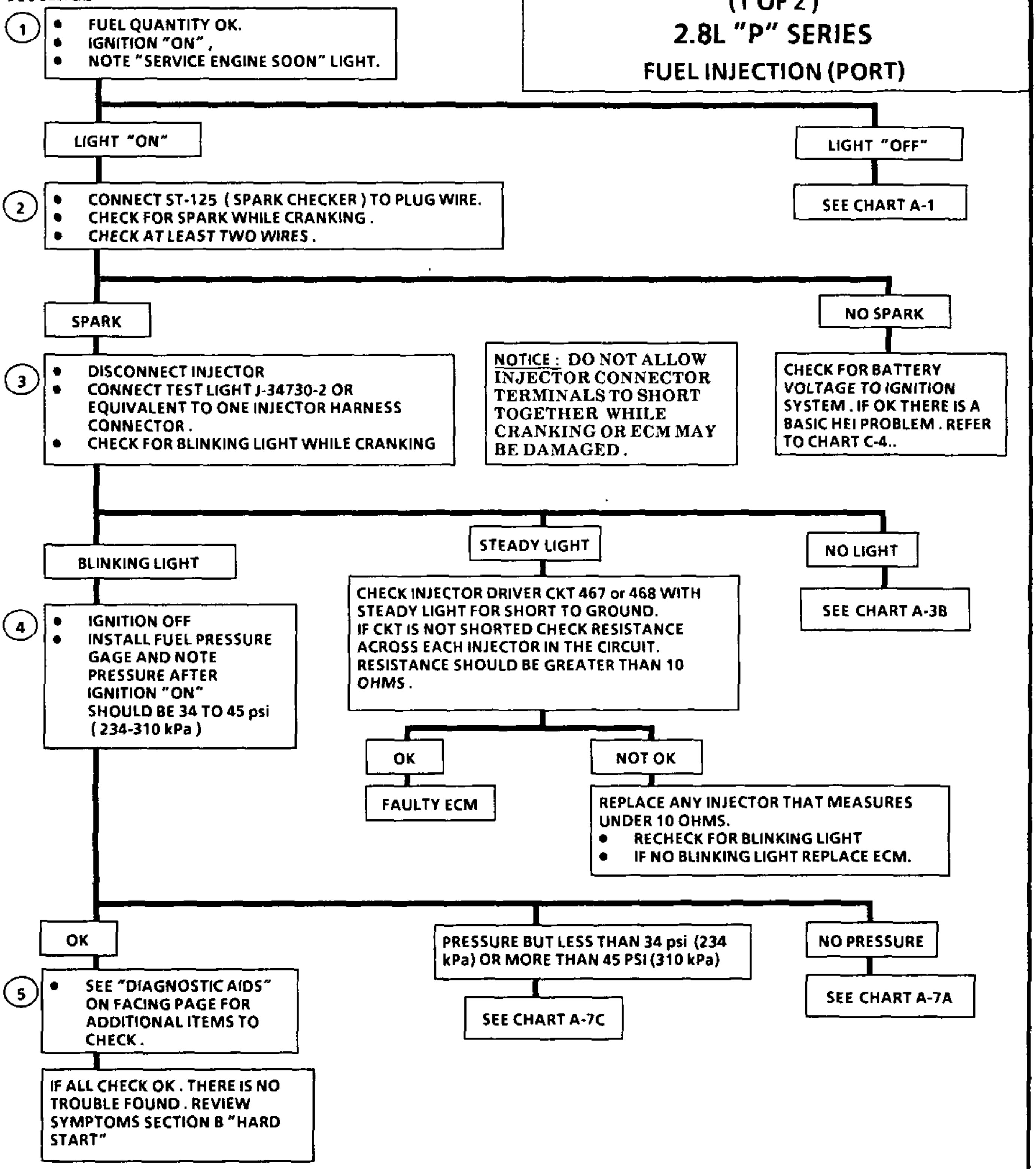
CHART A-3A

ENGINE CRANKS BUT WILL NOT RUN

(1 OF 2)

2.8L "P" SERIES

FUEL INJECTION (PORT)



①
- FUEL QUANTITY OK.
- IGNITION "ON",
- NOTE "SERVICE ENGINE SOON" LIGHT.

LIGHT "ON"

LIGHT "OFF"

SEE CHART A-1

②
- CONNECT ST-125 (SPARK CHECKER) TO PLUG WIRE.
- CHECK FOR SPARK WHILE CRANKING.
- CHECK AT LEAST TWO WIRES.

SPARK

NO SPARK

CHECK FOR BATTERY VOLTAGE TO IGNITION SYSTEM. IF OK THERE IS A BASIC HEI PROBLEM. REFER TO CHART C-4..

③
- DISCONNECT INJECTOR
- CONNECT TEST LIGHT J-34730-2 OR EQUIVALENT TO ONE INJECTOR HARNESS CONNECTOR.
- CHECK FOR BLINKING LIGHT WHILE CRANKING

NOTICE: DO NOT ALLOW INJECTOR CONNECTOR TERMINALS TO SHORT TOGETHER WHILE CRANKING OR ECM MAY BE DAMAGED.

BLINKING LIGHT

STEADY LIGHT

NO LIGHT

SEE CHART A-3B

CHECK INJECTOR DRIVER CKT 467 or 468 WITH STEADY LIGHT FOR SHORT TO GROUND. IF CKT IS NOT SHORTED CHECK RESISTANCE ACROSS EACH INJECTOR IN THE CIRCUIT. RESISTANCE SHOULD BE GREATER THAN 10 OHMS.

OK

FAULTY ECM

NOT OK

REPLACE ANY INJECTOR THAT MEASURES UNDER 10 OHMS.
- RECHECK FOR BLINKING LIGHT
- IF NO BLINKING LIGHT REPLACE ECM.

④
- IGNITION OFF
- INSTALL FUEL PRESSURE GAGE AND NOTE PRESSURE AFTER IGNITION "ON" SHOULD BE 34 TO 45 psi (234-310 kPa)

OK

PRESSURE BUT LESS THAN 34 psi (234 kPa) OR MORE THAN 45 PSI (310 kPa)

SEE CHART A-7C

NO PRESSURE

SEE CHART A-7A

⑤
- 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"

* CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

6-28-85
* 5S 1900-6E

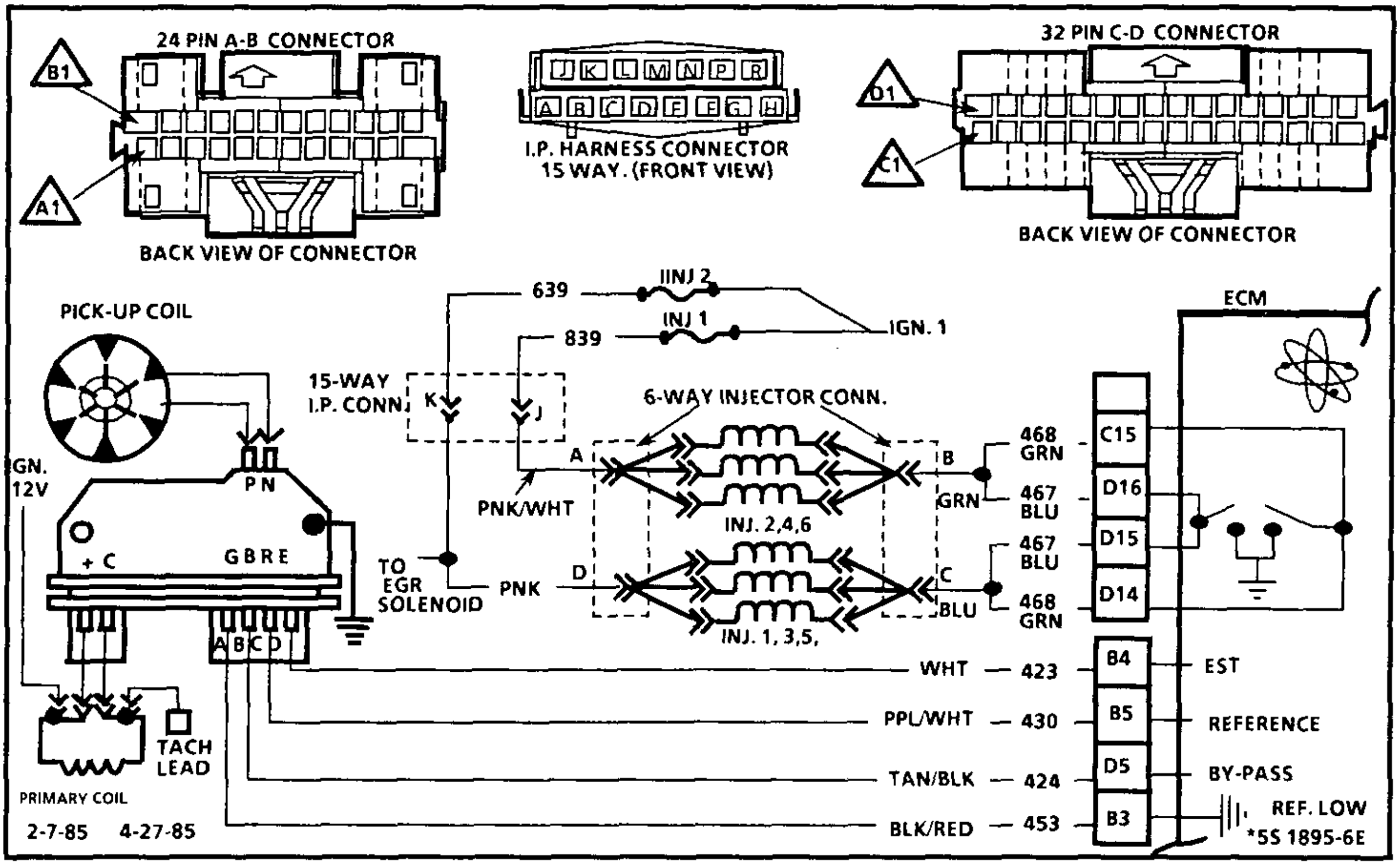


CHART A-3B

ENGINE CRANKS BUT WILL NOT RUN

(2 OF 2)

2.8L "P" SERIES

FUEL INJECTION (PORT)

6. Checks for 12 volt supply to injectors.
7. This test will determine if the distributor module is not generating the reference pulse or if the wiring or ECM are at fault. By momentarily touching CKT 430 with a test light, a pulse or reference signal is being generated. If the test light (J34730-2) blinks at the injector, then the ECM and wiring are OK.

7A. Alternate Test - If a "SCAN" tool is available, it can be used to monitor the reference pulses during crank.

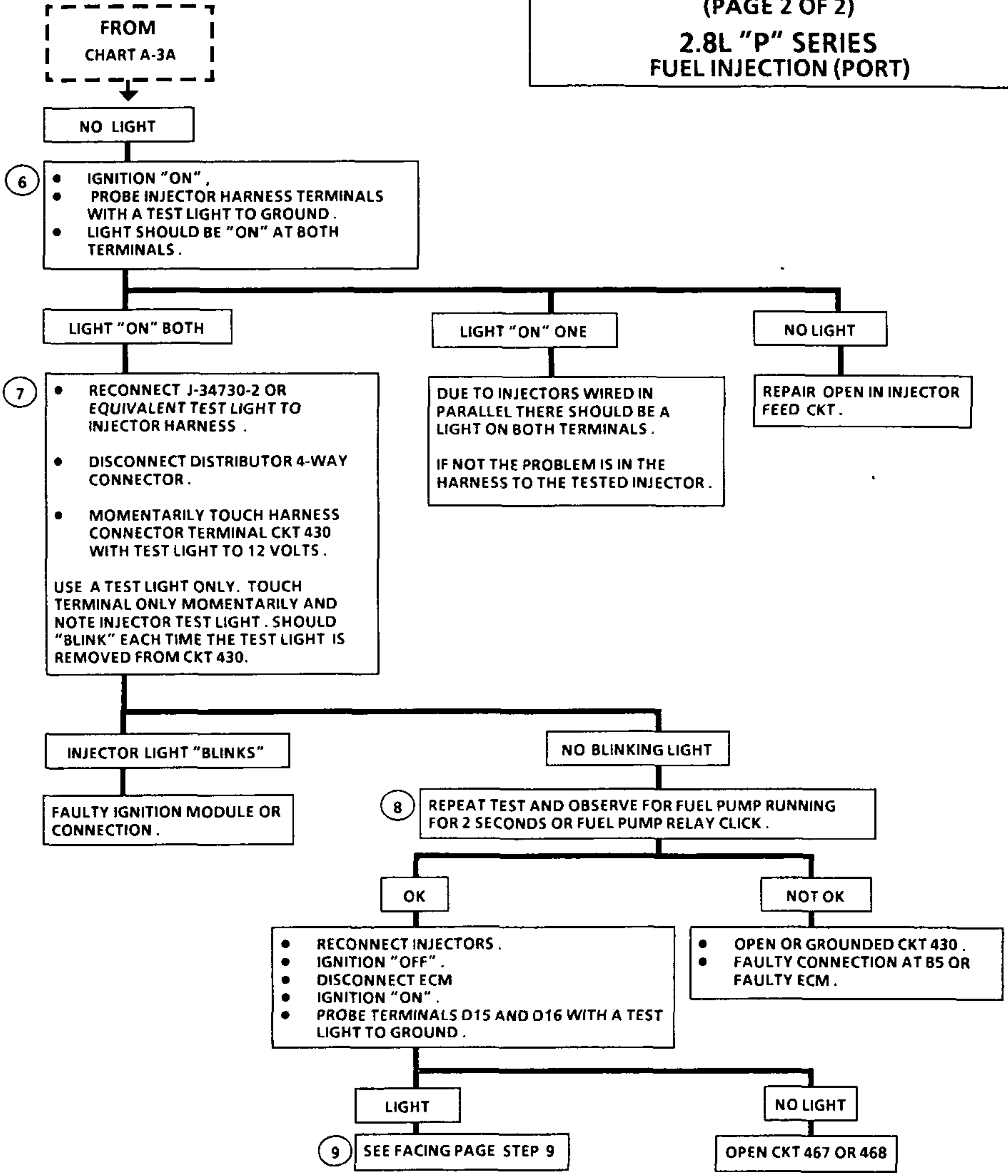
8. Each time the test light touches CKT 430, the ECM should turn on the fuel pump for 2 seconds.
9. - All checks made, to this point, would indicate that the ECM is at fault. However, there is a possibility of CKT 467, or 468, being shorted to a voltage source, either in the engine harness or in the injector harness.
   - To test for this condition:
     - Disconnect the injector 6-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 B & A, B & D, C & A, and C & D.
     - 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; *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-3B

ENGINE CRANKS BUT WILL NOT RUN
(PAGE 2 OF 2)

2.8L "P" SERIES
FUEL INJECTION (PORT)



FROM CHART A-3A

NO LIGHT

⑥
- IGNITION "ON",
- PROBE INJECTOR HARNESS TERMINALS WITH A TEST LIGHT TO GROUND.
- LIGHT SHOULD BE "ON" AT BOTH TERMINALS.

LIGHT "ON" BOTH

⑦
- 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.

INJECTOR LIGHT "BLINKS"

FAULTY IGNITION MODULE OR CONNECTION.

NO BLINKING LIGHT

⑧ REPEAT TEST AND OBSERVE FOR FUEL PUMP RUNNING FOR 2 SECONDS OR FUEL PUMP RELAY CLICK.

OK

- RECONNECT INJECTORS.
- IGNITION "OFF".
- DISCONNECT ECM
- IGNITION "ON".
- PROBE TERMINALS D15 AND D16 WITH A TEST LIGHT TO GROUND.

LIGHT

⑨ SEE FACING PAGE STEP 9

NO LIGHT

OPEN CKT 467 OR 468

NOT OK

- OPEN OR GROUNDED CKT 430.
- FAULTY CONNECTION AT B5 OR FAULTY ECM.

LIGHT "ON" ONE

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.

NO LIGHT

REPAIR OPEN IN INJECTOR FEED CKT.

6-28-85

* CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 5S 2021-6E

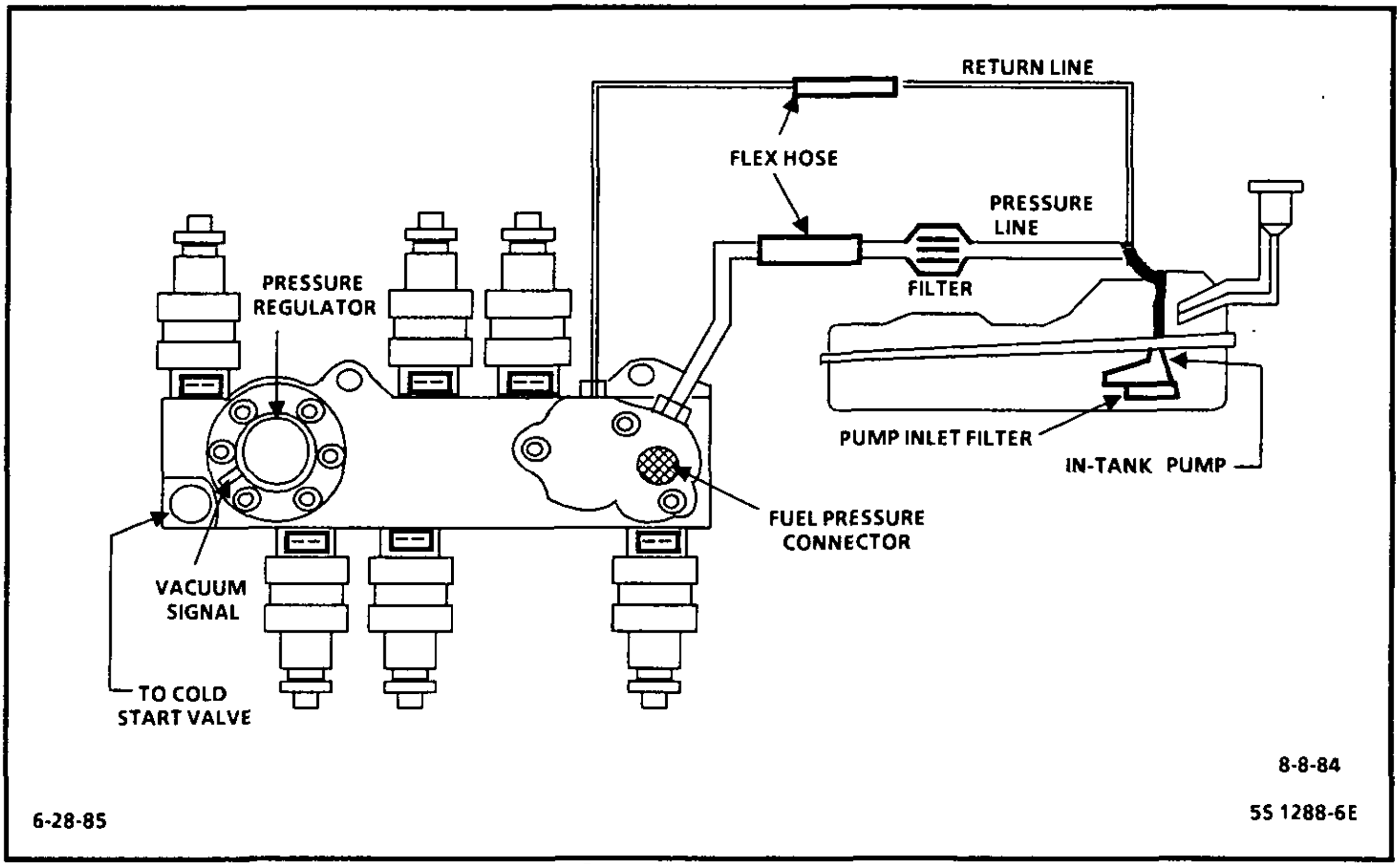


CHART A-7

FUEL SYSTEM DIAGNOSIS

2.8L "P" SERIES

FUEL INJECTION (PORT)

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.

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.

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.

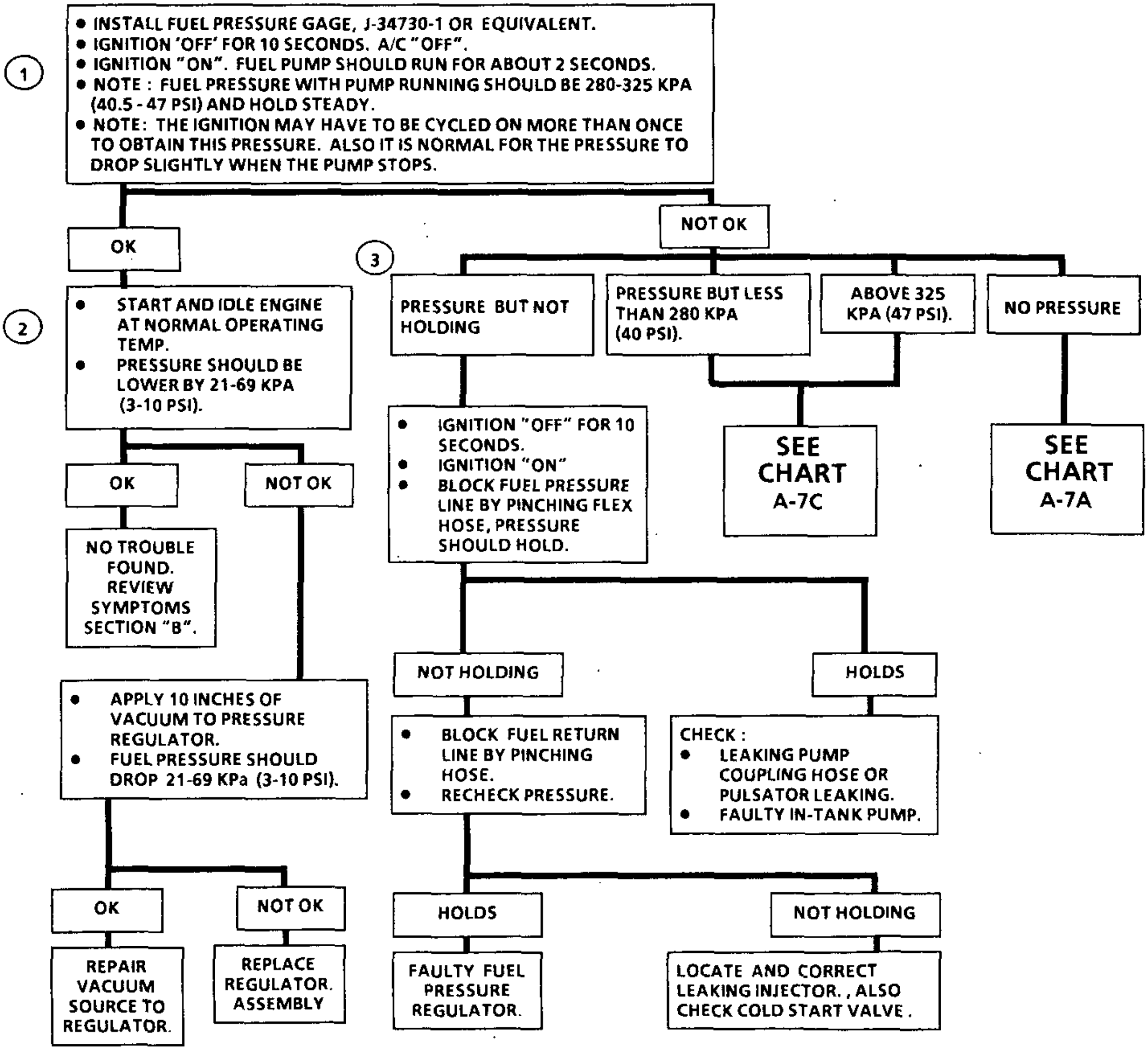
NOTICE- EFI SYSTEM UNDER PRESSURE. TO AVOID FUEL SPILLAGE, REFER TO FIELD SERVIICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.

CHART A-7

FUEL SYSTEM DIAGNOSIS
(1 of 4)

2.8L "P" SERIES

FUEL INJECTION (PORT)



①
- INSTALL FUEL PRESSURE GAGE, J-34730-1 OR EQUIVALENT.
- IGNITION 'OFF' FOR 10 SECONDS. A/C "OFF".
- IGNITION "ON". FUEL PUMP SHOULD RUN FOR ABOUT 2 SECONDS.
- NOTE : FUEL PRESSURE WITH PUMP RUNNING SHOULD BE 280-325 KPA (40.5 - 47 PSI) AND HOLD STEADY.
- NOTE: THE IGNITION MAY HAVE TO BE CYCLED ON MORE THAN ONCE TO OBTAIN THIS PRESSURE. ALSO IT IS NORMAL FOR THE PRESSURE TO DROP SLIGHTLY WHEN THE PUMP STOPS.

OK

②
- START AND IDLE ENGINE AT NORMAL OPERATING TEMP.
- PRESSURE SHOULD BE LOWER BY 21-69 KPA (3-10 PSI).

OK: NO TROUBLE FOUND. REVIEW SYMPTOMS SECTION "B".

NOT OK:
- APPLY 10 INCHES OF VACUUM TO PRESSURE REGULATOR.
- FUEL PRESSURE SHOULD DROP 21-69 KPa (3-10 PSI).

OK: REPAIR VACUUM SOURCE TO REGULATOR.

NOT OK: REPLACE REGULATOR. ASSEMBLY

NOT OK

③

PRESSURE BUT NOT HOLDING
- IGNITION "OFF" FOR 10 SECONDS.
- IGNITION "ON"
- BLOCK FUEL PRESSURE LINE BY PINCHING FLEX HOSE, PRESSURE SHOULD HOLD.

NOT HOLDING:
- BLOCK FUEL RETURN LINE BY PINCHING HOSE.
- RECHECK PRESSURE.

HOLDS: FAULTY FUEL PRESSURE REGULATOR.

NOT HOLDING: LOCATE AND CORRECT LEAKING INJECTOR. , ALSO CHECK COLD START VALVE .

HOLDS: CHECK :
- LEAKING PUMP COUPLING HOSE OR PULSATOR LEAKING.
- FAULTY IN-TANK PUMP.

PRESSURE BUT LESS THAN 280 KPA (40 PSI). / ABOVE 325 KPA (47 PSI).: SEE CHART A-7C

NO PRESSURE: SEE CHART A-7A

6-28-85

* 5S 1901-6E

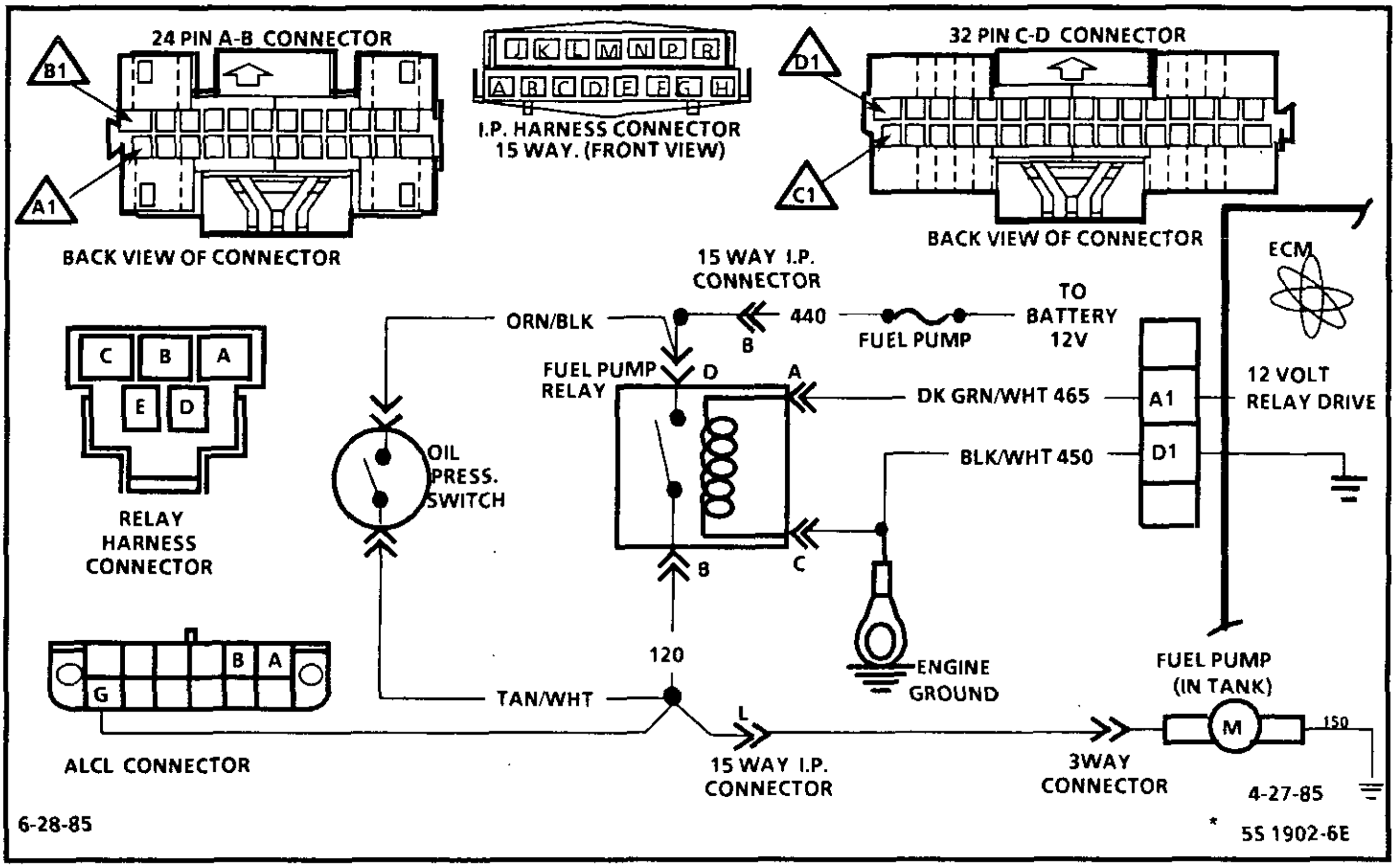


CHART A-7A

FUEL SYSTEM DIAGNOSIS
(2 of 4)

2.8L "P" SERIES

FUEL INJECTION (PORT)

1. If the fuse is blown, this test will confirm a short to ground on circuit 120. To prevent misdiagnosis, be sure fuel pump is disconnected before test.

2. Determines if the pump circuit is ECM controlled. The ECM will turn "ON" the pump relay. Engine is not cranking or running so the ECM will turn "OFF" the relay within 2 seconds after ignition is turned "ON".

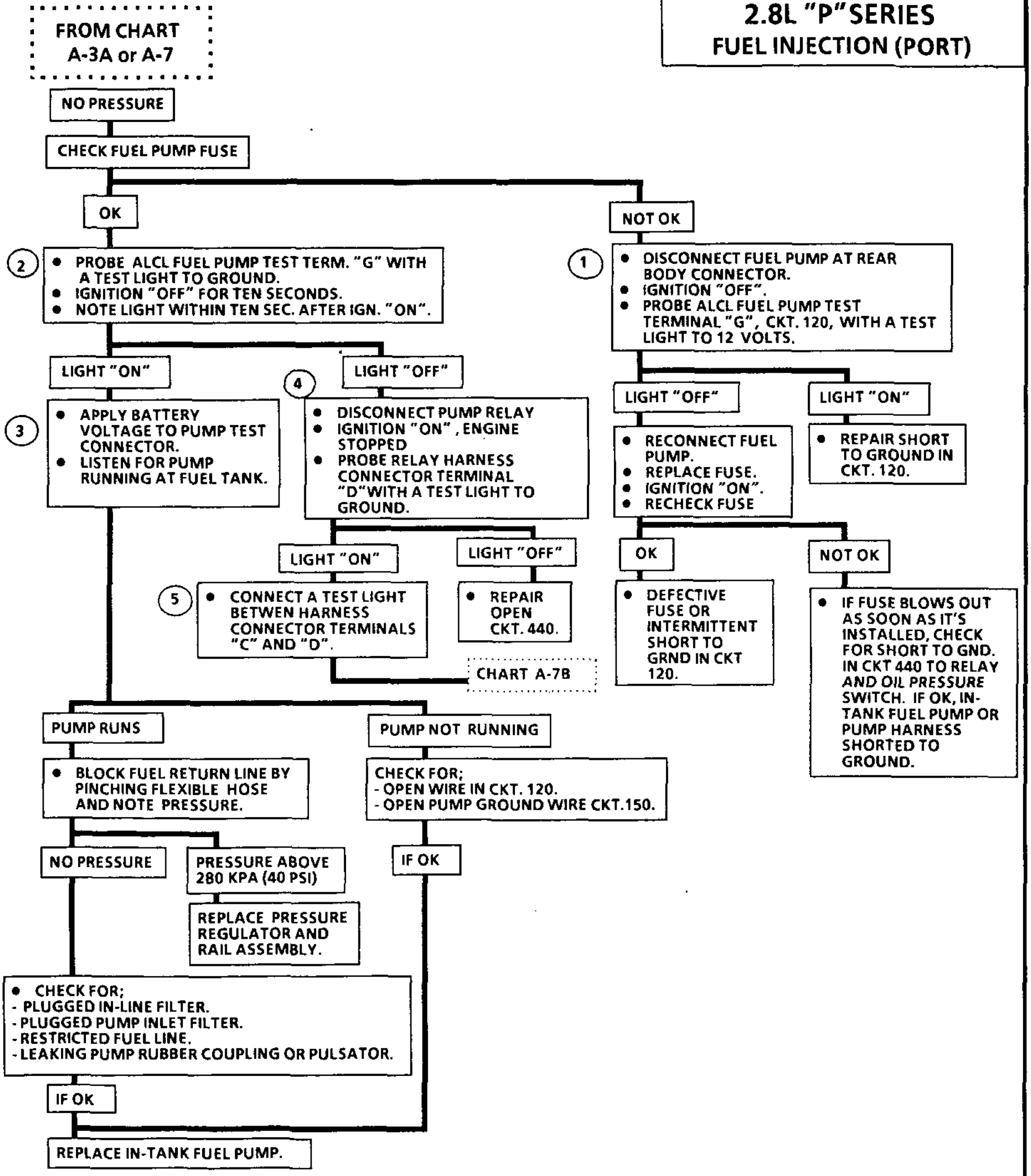
3. Turns "ON" the fuel pump if circuit 120 wiring is OK. If the pump runs, it is a basic fuel delivery problem which the following steps will locate.

4. Checks for battery voltage at the pump relay.

5. Checks relay ground CKT 450.

NOTICE- *EFI SYSTEM UNDER PRESSURE. TO AVOIDFUEL SPILLAGE, rEFER TO FIELD SERVICE PROCEDURES FOR TESTING OR MAKING REPAIRS REQUIRING DISASSEMBLY OF FUEL LINES OR FITTINGS.*

CHART A-7A
FUEL SYSTEM DIAGNOSIS
(2 OF 4)
2.8L "P" SERIES
FUEL INJECTION (PORT)



FROM CHART A-3A or A-7

NO PRESSURE

CHECK FUEL PUMP FUSE

OK

②
- PROBE ALCL FUEL PUMP TEST TERM. "G" WITH A TEST LIGHT TO GROUND.
- IGNITION "OFF" FOR TEN SECONDS.
- NOTE LIGHT WITHIN TEN SEC. AFTER IGN. "ON".

LIGHT "ON"

③
- APPLY BATTERY VOLTAGE TO PUMP TEST CONNECTOR.
- LISTEN FOR PUMP RUNNING AT FUEL TANK.

LIGHT "OFF"

④
- DISCONNECT PUMP RELAY
- IGNITION "ON", ENGINE STOPPED
- PROBE RELAY HARNESS CONNECTOR TERMINAL "D" WITH A TEST LIGHT TO GROUND.

LIGHT "ON"

⑤
- CONNECT A TEST LIGHT BETWEN HARNESS CONNECTOR TERMINALS "C" AND "D".

CHART A-7B

LIGHT "OFF"

- REPAIR OPEN CKT. 440.

PUMP RUNS

- BLOCK FUEL RETURN LINE BY PINCHING FLEXIBLE HOSE AND NOTE PRESSURE.

NO PRESSURE

- CHECK FOR;
- PLUGGED IN-LINE FILTER.
- PLUGGED PUMP INLET FILTER.
- RESTRICTED FUEL LINE.
- LEAKING PUMP RUBBER COUPLING OR PULSATOR.

IF OK

REPLACE IN-TANK FUEL PUMP.

PRESSURE ABOVE 280 KPA (40 PSI)

REPLACE PRESSURE REGULATOR AND RAIL ASSEMBLY.

PUMP NOT RUNNING

CHECK FOR;
- OPEN WIRE IN CKT. 120.
- OPEN PUMP GROUND WIRE CKT.150.

IF OK

NOT OK

①
- DISCONNECT FUEL PUMP AT REAR BODY CONNECTOR.
- IGNITION "OFF".
- PROBE ALCL FUEL PUMP TEST TERMINAL "G", CKT. 120, WITH A TEST LIGHT TO 12 VOLTS.

LIGHT "OFF"

- RECONNECT FUEL PUMP.
- REPLACE FUSE.
- IGNITION "ON".
- RECHECK FUSE

OK

- DEFECTIVE FUSE OR INTERMITTENT SHORT TO GRND IN CKT 120.

NOT OK

- IF FUSE BLOWS OUT AS SOON AS IT'S INSTALLED, CHECK FOR SHORT TO GND. IN CKT 440 TO RELAY AND OIL PRESSURE SWITCH. IF OK, IN-TANK FUEL PUMP OR PUMP HARNESS SHORTED TO GROUND.

LIGHT "ON"

- REPAIR SHORT TO GROUND IN CKT. 120.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

12-09-85
*5S 1903-6E

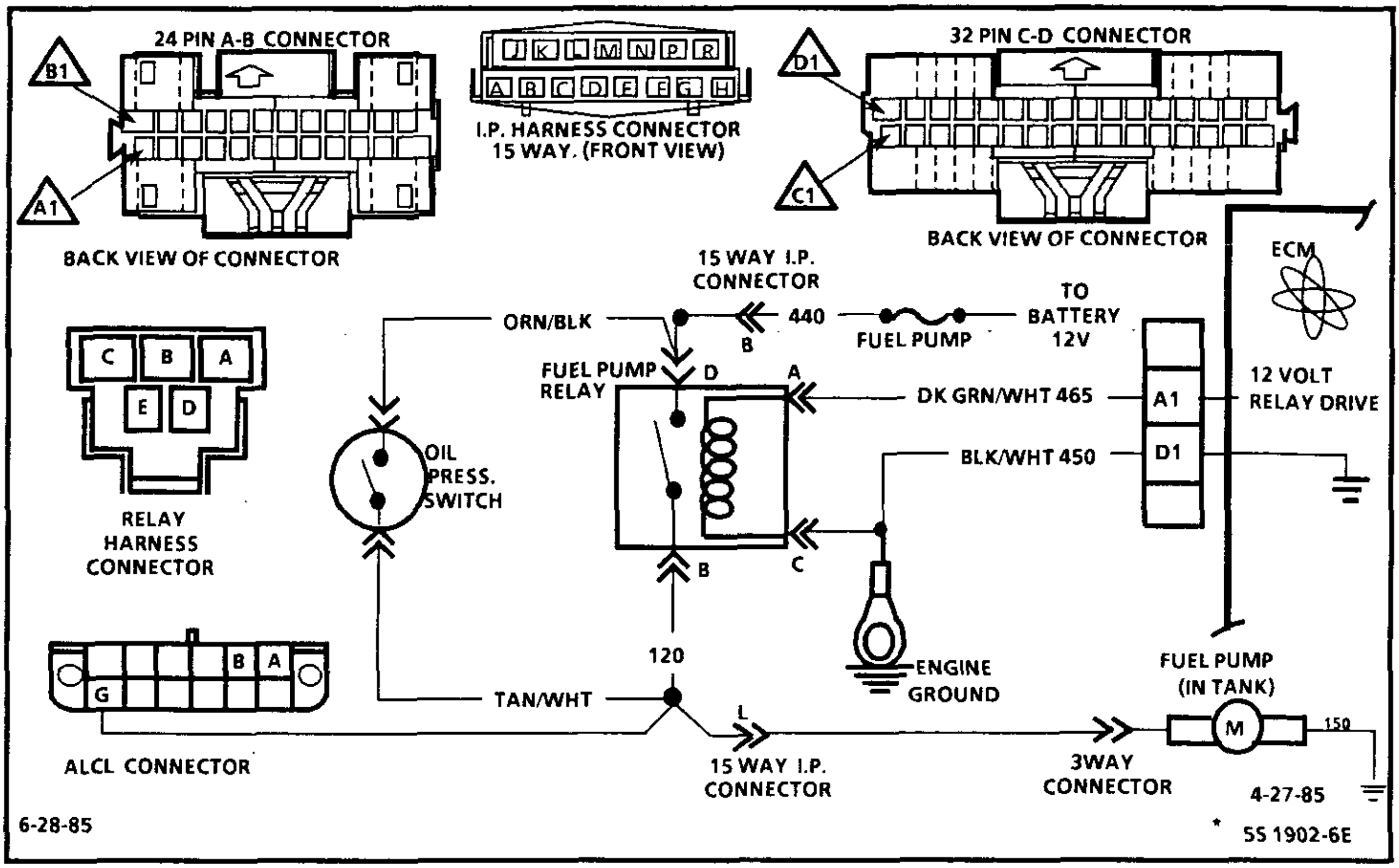


CHART A-7B

FUEL SYSTEM DIAGNOSIS

(3 of 4)

2.8L "P" SERIES

FUEL INJECTION (PORT)

6. Checks for ECM control of relay through CKT 465.
7. The fuel pump voltage control circuit includes an engine oil pressure switch with a seperate set of normally open contacts. The switch closes at about (4 lbs) 27 Kpa of oil pressure and provides a second battery feed path to the fuel pump. If the relay fails, the pump will continue to run using the battery feed supplied by the closed oil pressure switch.

   A failed pump relay will result in extended engine crank time, because of the time required to build enough oil pressure to close the oil pressure switch and turn "ON" the fuel pump. There may be instances when the relay has failed but the engine will not crank fast enough to build enough oil pressure to close the switch. This or a faulty oil pressure switch can result in "Engine Cranks But Will Not Run".
8. Checks the oil pressure switch to be sure it provides battery feed to the fuel pump should the pump relay fail.
9. Checks for open oil pressure switch with ignition "OFF". Should the switch stick closed, the fuel pump will continue to run and discharge the battery.

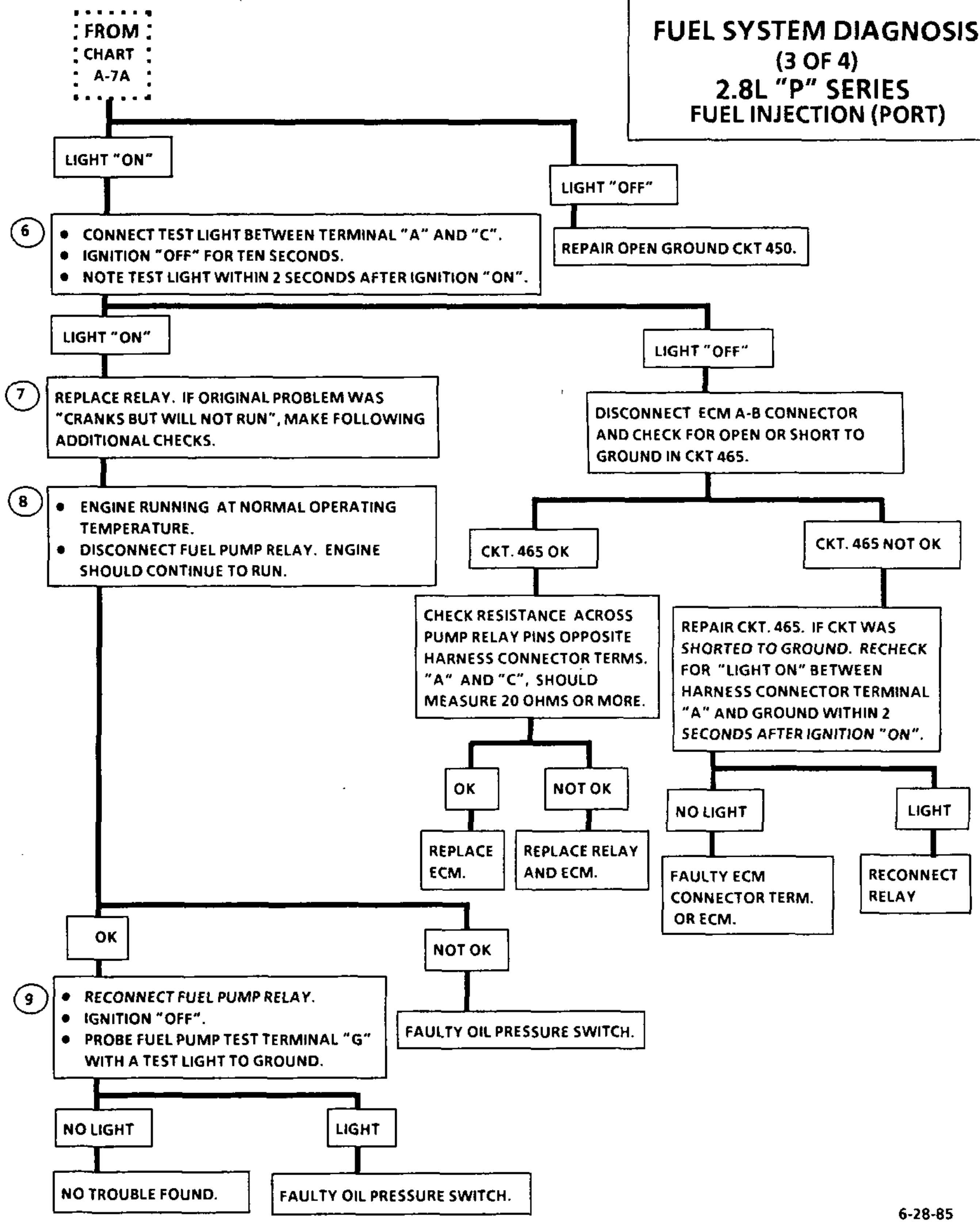
CHART A-7B

FUEL SYSTEM DIAGNOSIS

(3 OF 4)

2.8L "P" SERIES

FUEL INJECTION (PORT)



6-28-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 5S 1904-6E

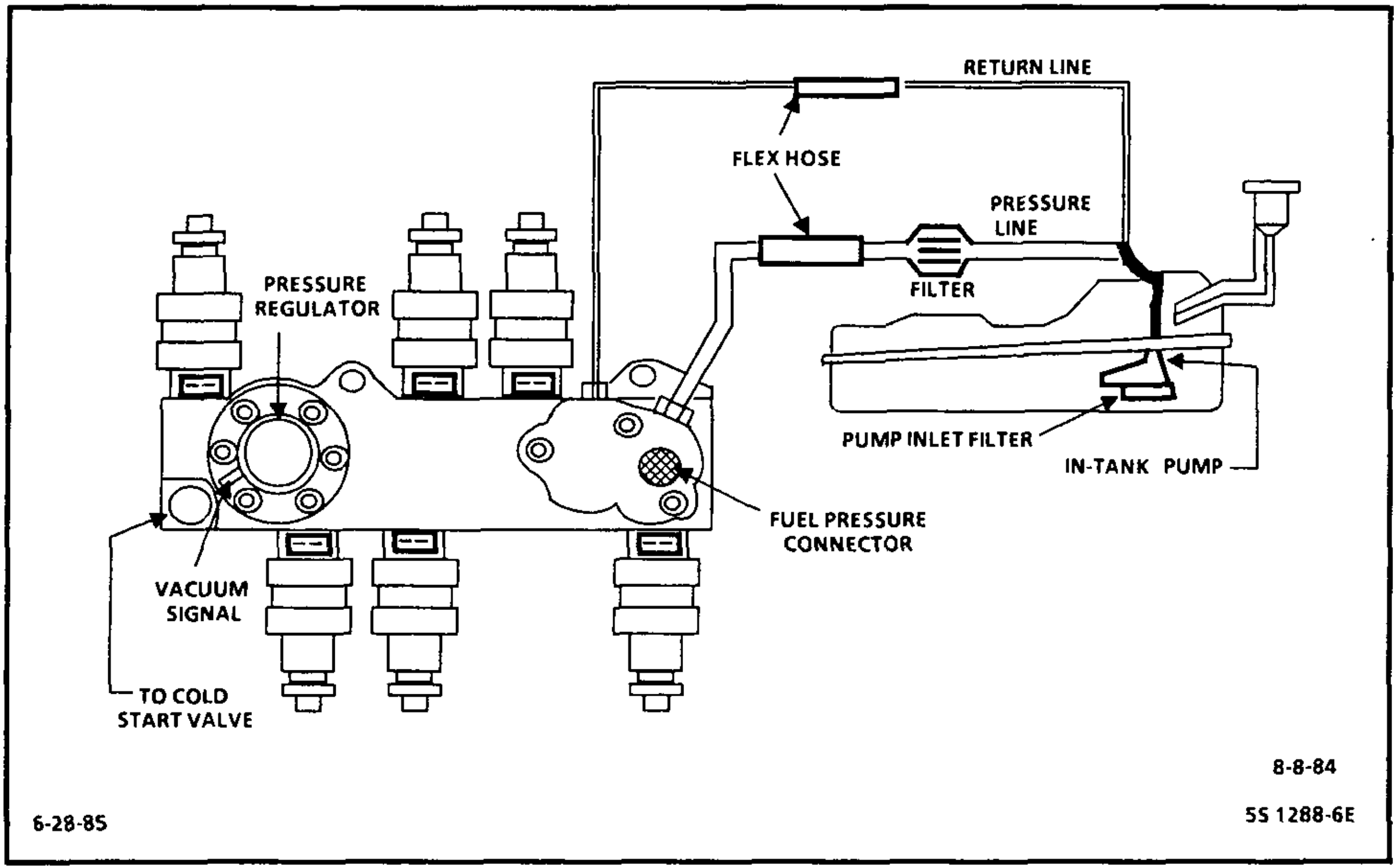


CHART A-7C

FUEL SYSTEM DIAGNOSIS

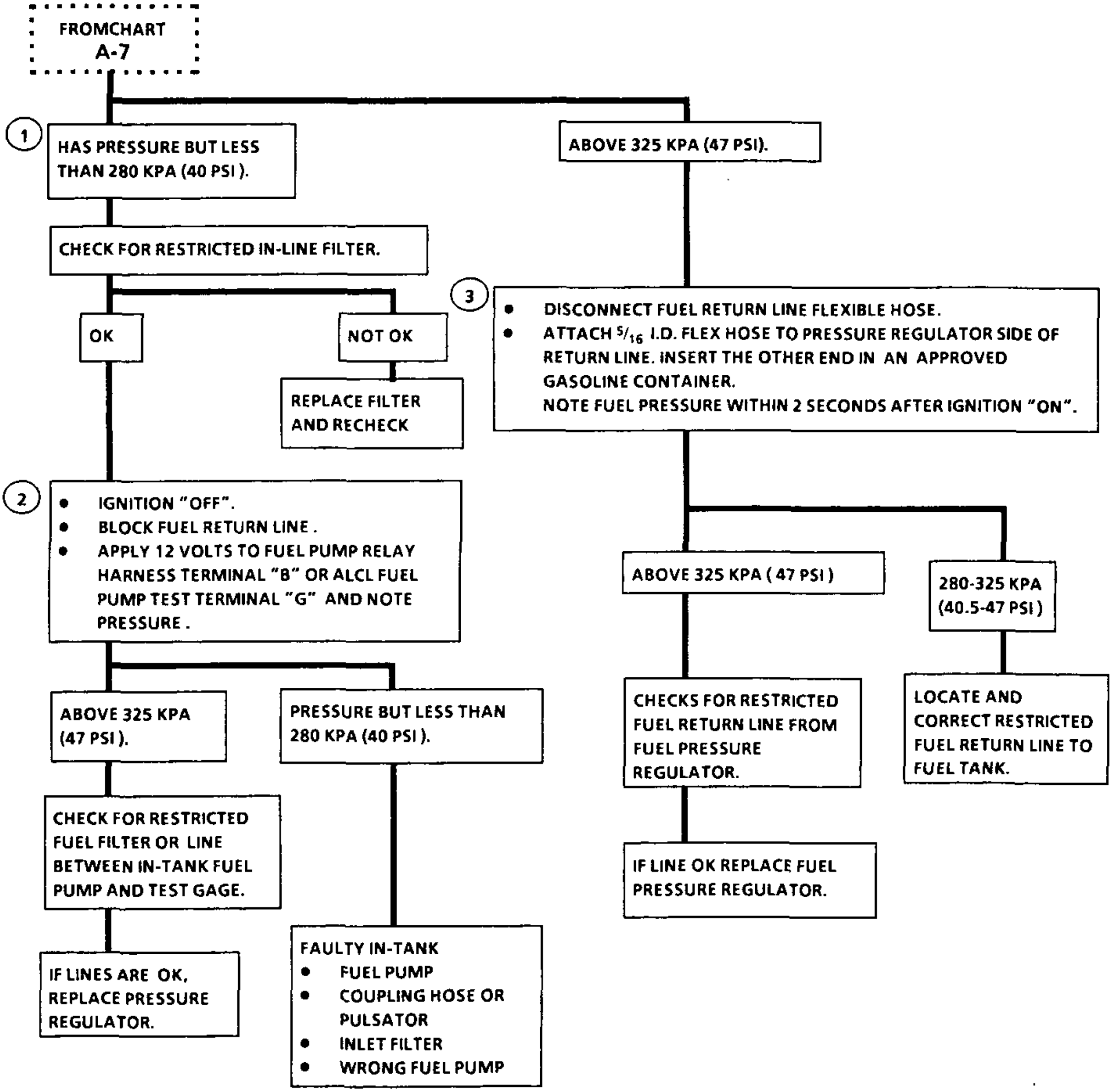
2.8L "P" SERIES

FUEL INJECTION (PORT)

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-7C
FUEL SYSTEM DIAGNOSIS
(4 OF 4)
2.8L "P" SERIES
FUEL INJECTION (PORT)

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.


FROMCHART A-7

① HAS PRESSURE BUT LESS THAN 280 KPA (40 PSI).

CHECK FOR RESTRICTED IN-LINE FILTER.

OK

NOT OK

REPLACE FILTER AND RECHECK

②
- IGNITION "OFF".
- BLOCK FUEL RETURN LINE .
- APPLY 12 VOLTS TO FUEL PUMP RELAY HARNESS TERMINAL "B" OR ALCL FUEL PUMP TEST TERMINAL "G" AND NOTE PRESSURE .

ABOVE 325 KPA (47 PSI).

CHECK FOR RESTRICTED FUEL FILTER OR LINE BETWEEN IN-TANK FUEL PUMP AND TEST GAGE.

IF LINES ARE OK, REPLACE PRESSURE REGULATOR.

PRESSURE BUT LESS THAN 280 KPA (40 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)

CHECKS FOR RESTRICTED FUEL RETURN LINE FROM FUEL PRESSURE REGULATOR.

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.

12-2-85

* 5S 1905-6E

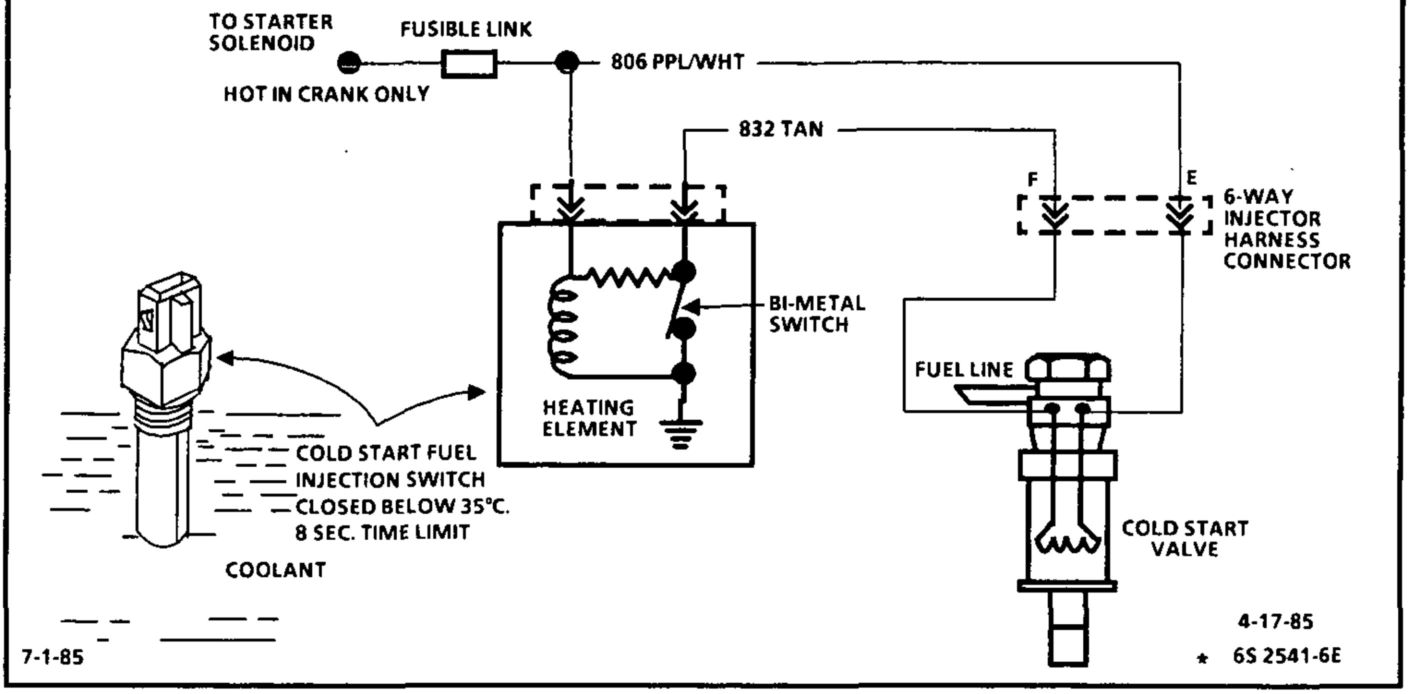


CHART A-9

COLD START VALVE

2.8L "P" SERIES

FUEL INJECTION (PORT)

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 controlled by a cold start switch, which provides a ground path for the valve during cranking, when engine coolant is below 95°F(35°C).

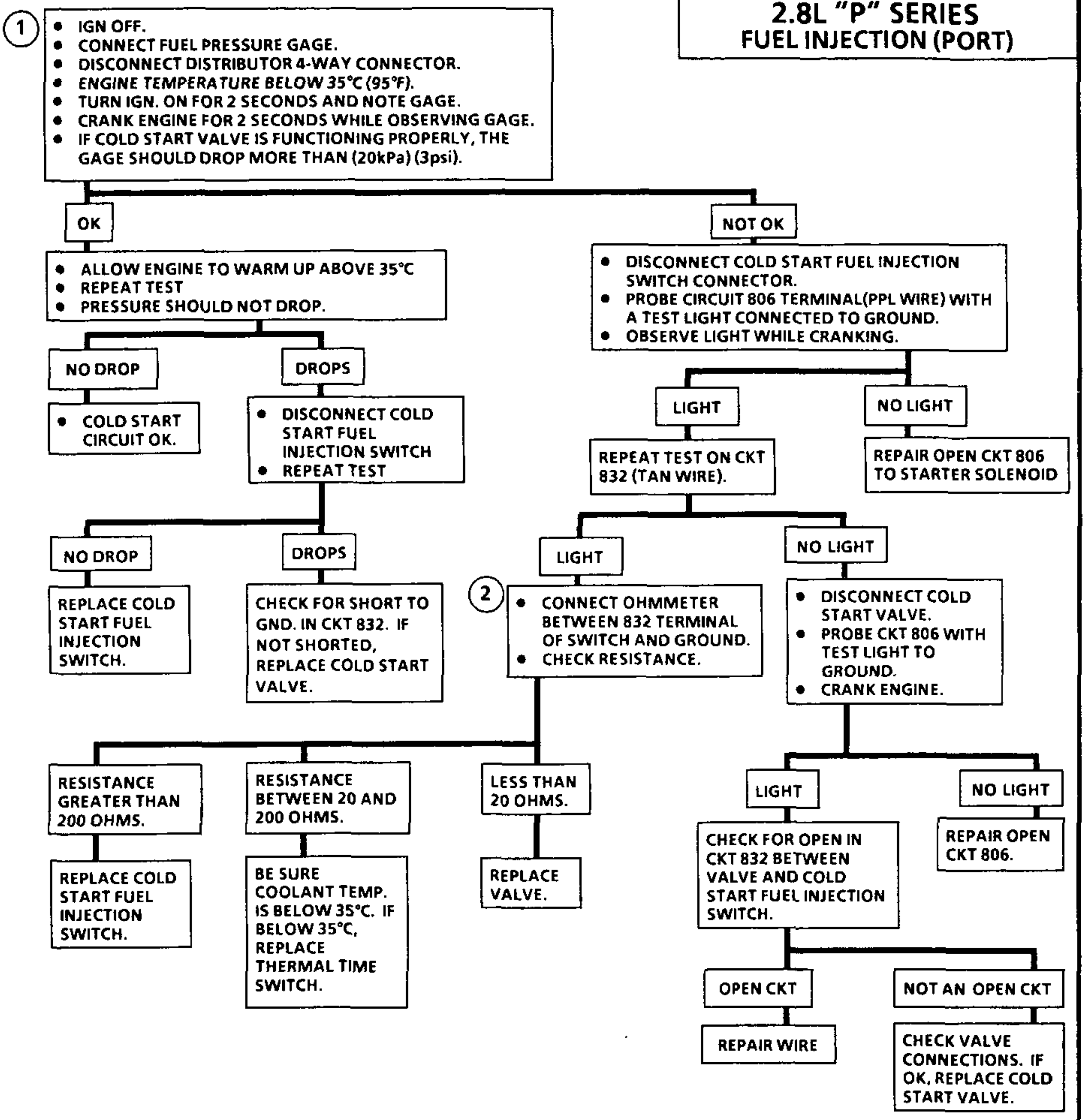
The cold start fuel injection switch contains a bimetal switch, which opens at a specified coolant temperature. This bimetal is also heated by the winding in the cold start fuel injection switch, which allows the valve to stay "ON" for 8 seconds at -20°C (-5°F) coolant. The time the switch will stay closed varies inversely with coolant temperature. In other words, as the coolant temperature goes up, the cold start valve "ON" time goes down.

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 TEST

2.8L "P" SERIES
FUEL INJECTION (PORT)



①
- IGN OFF.
- CONNECT FUEL PRESSURE GAGE.
- DISCONNECT DISTRIBUTOR 4-WAY CONNECTOR.
- *ENGINE TEMPERATURE BELOW 35°C (95°F).*
- TURN IGN. ON FOR 2 SECONDS AND NOTE GAGE.
- CRANK ENGINE FOR 2 SECONDS WHILE OBSERVING GAGE.
- IF COLD START VALVE IS FUNCTIONING PROPERLY, THE GAGE 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 FUEL INJECTION SWITCH
- REPEAT TEST

NO DROP

REPLACE COLD START FUEL INJECTION SWITCH.

DROPS

CHECK FOR SHORT TO GND. IN CKT 832. IF NOT SHORTED, REPLACE COLD START VALVE.

NOT OK

- DISCONNECT COLD START FUEL INJECTION SWITCH CONNECTOR.
- PROBE CIRCUIT 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 FUEL INJECTION SWITCH.

RESISTANCE BETWEEN 20 AND 200 OHMS.

BE SURE COOLANT TEMP. IS BELOW 35°C. IF BELOW 35°C, REPLACE THERMAL TIME SWITCH.

LESS THAN 20 OHMS.

REPLACE 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 COLD START FUEL INJECTION SWITCH.

OPEN CKT

REPAIR WIRE

NOT AN OPEN CKT

CHECK VALVE CONNECTIONS. IF OK, REPLACE COLD START VALVE.

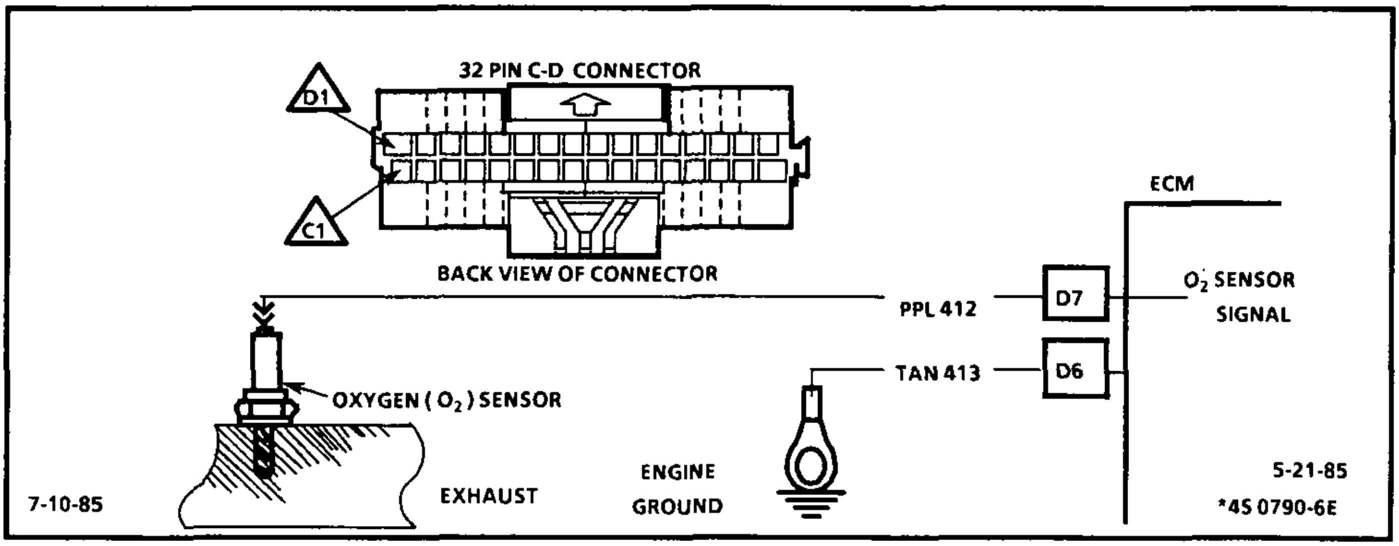
NO LIGHT

REPAIR OPEN CKT 806.

NO LIGHT

REPAIR OPEN CKT 806 TO STARTER SOLENOID

12-09-85
*5S 1789-6E



CODE 13

OXYGEN SENSOR CIRCUIT
2.8L "P" SERIES
FUEL INJECTION (PORT)

Code 13 is set when the voltage at terminal D7 of the ECM:

- Stays within a range of .35 to .55 volts for 20 seconds;
- The TPS is above a specified value about .5v above idle voltage;
- The engine has run for about one minute;
- Coolant greater than 85° C; and
- RPM greater than 1600.

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 360°C (600°F). An open sensor circuit, or cold sensor, causes open loop operation.

Normal "SCAN" voltage will vary between 100 mv and 999 mv (.1v to 1.0v).

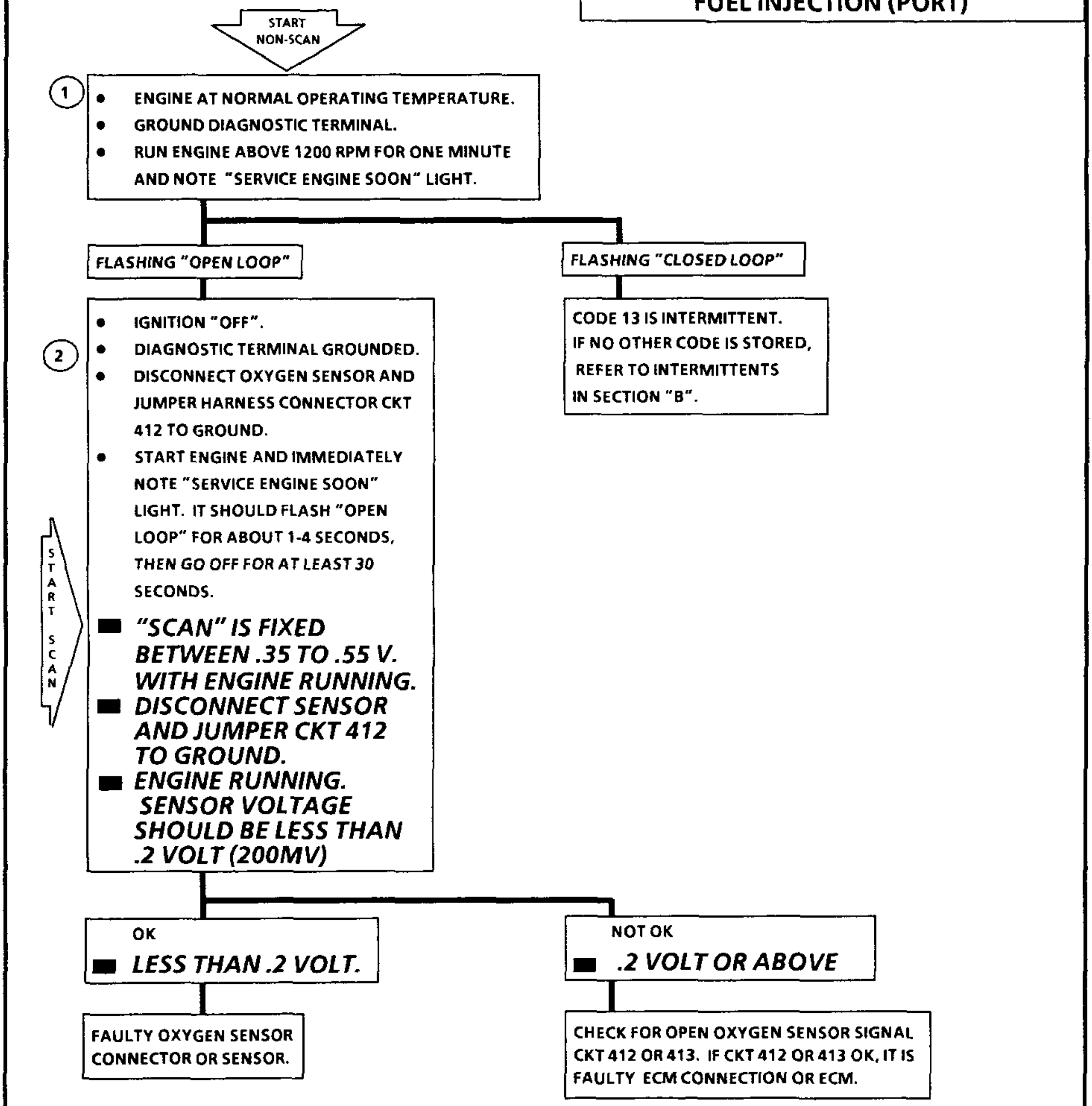
1. Grounding the diagnostic terminal with the engine running enables the "Field Service Mode ", which allows the ECM to confirm either open or closed loop operation using the "SERVICE ENGINE SOON" light.

   If the conditions for a Code 13 are present, the voltage will be fixed between 350 mv and 550 mv, and the system will stay open loop.

2. This step simulates a lean exhaust. If the ECM and wiring are OK the ECM will see the lean condition and turn the "SERVICE ENGINE SOON" light off for at least 15 seconds after engine start.

CODE 13
OPEN OXYGEN SENSOR CIRCUIT
2.8L "P" SERIES
FUEL INJECTION (PORT)

"SCAN" STEP ONLY ■



①
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- GROUND DIAGNOSTIC TERMINAL.
- RUN ENGINE ABOVE 1200 RPM FOR ONE MINUTE AND NOTE "SERVICE ENGINE SOON" LIGHT.

FLASHING "OPEN LOOP"

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR AND JUMPER HARNESS CONNECTOR CKT 412 TO GROUND.
- START ENGINE AND IMMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT. IT SHOULD FLASH "OPEN LOOP" FOR ABOUT 1-4 SECONDS, *THEN GO OFF FOR AT LEAST 30* SECONDS.

■ ***"SCAN" IS FIXED BETWEEN .35 TO .55 V. WITH ENGINE RUNNING.***

■ ***DISCONNECT SENSOR AND JUMPER CKT 412 TO GROUND.***

■ ***ENGINE RUNNING. SENSOR VOLTAGE SHOULD BE LESS THAN .2 VOLT (200MV)***

OK

■ ***LESS THAN .2 VOLT.***

FAULTY OXYGEN SENSOR CONNECTOR OR SENSOR.

NOT OK

■ ***.2 VOLT OR ABOVE***

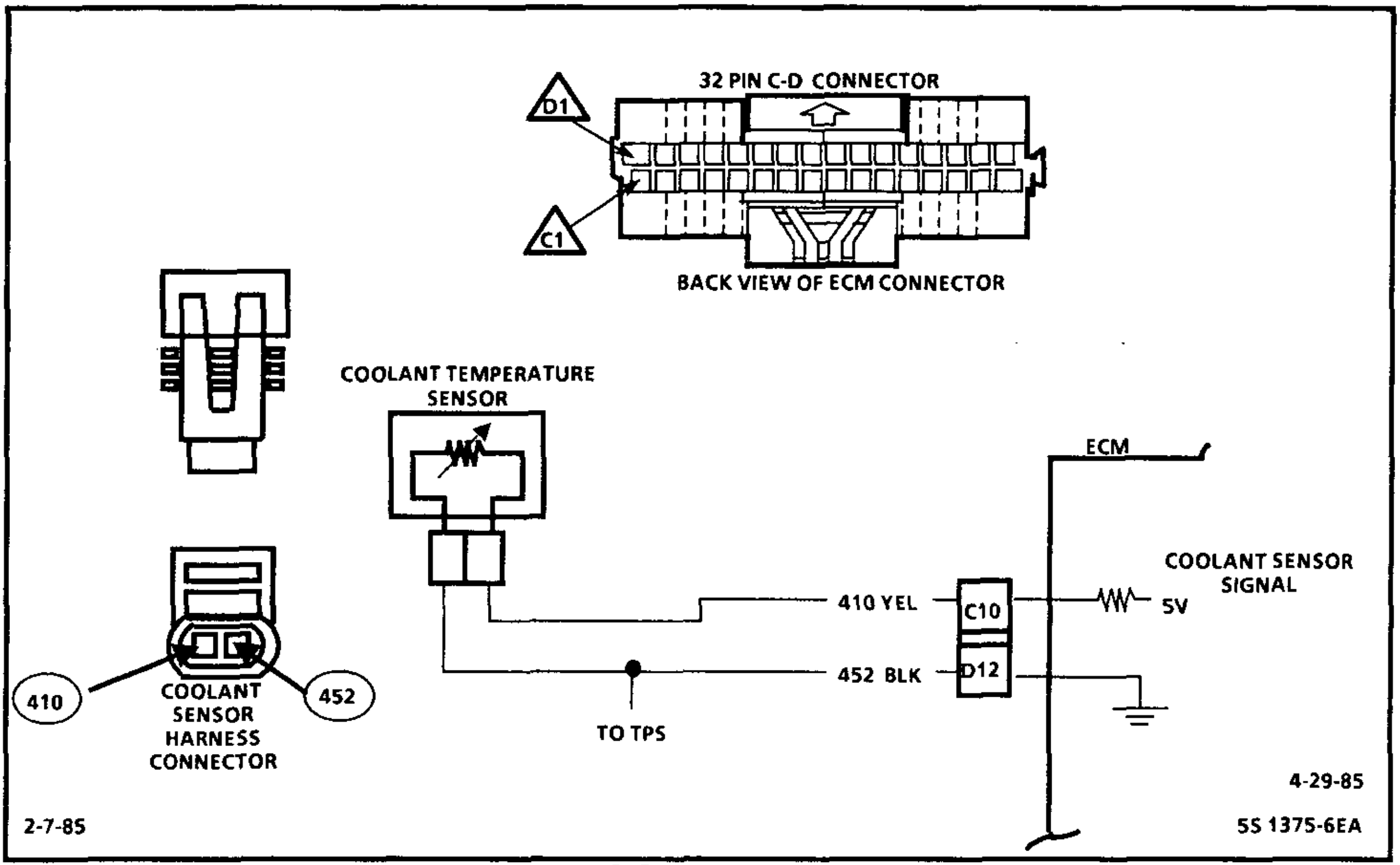
CHECK FOR OPEN OXYGEN SENSOR SIGNAL CKT 412 OR 413. IF CKT 412 OR 413 OK, IT IS FAULTY ECM CONNECTION OR ECM.

FLASHING "CLOSED LOOP"

CODE 13 IS INTERMITTENT. IF NO OTHER CODE IS STORED, REFER TO INTERMITTENTS IN SECTION "B".

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 0839-6E
9-20-85



CODE 14

COOLANT SENSOR (SIGNAL VOLTAGE LOW)

2.8L "P" SERIES

FUEL INJECTION (PORT)

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 the voltage will measure about 1.5 to 2.0 volts at the ECM terminal C10.

A "SCAN" display reads engine temp. in degrees centigrade. After engine is started, the temperature should rise steadily to about 90° C, then stabilize, when themostat opens.

Coolant temperature is one of the inputs used to control:

- Fuel delivery.
- Engine Spark Timing (EST)
- Idle (IAC)
- Convertor Clutch (TCC)
- EGR

Code 14 will set if:

- Signal voltage indicates a coolant temperature above 135°C (275°F) for 3 seconds.
- Engine run time is greater than 20 seconds.

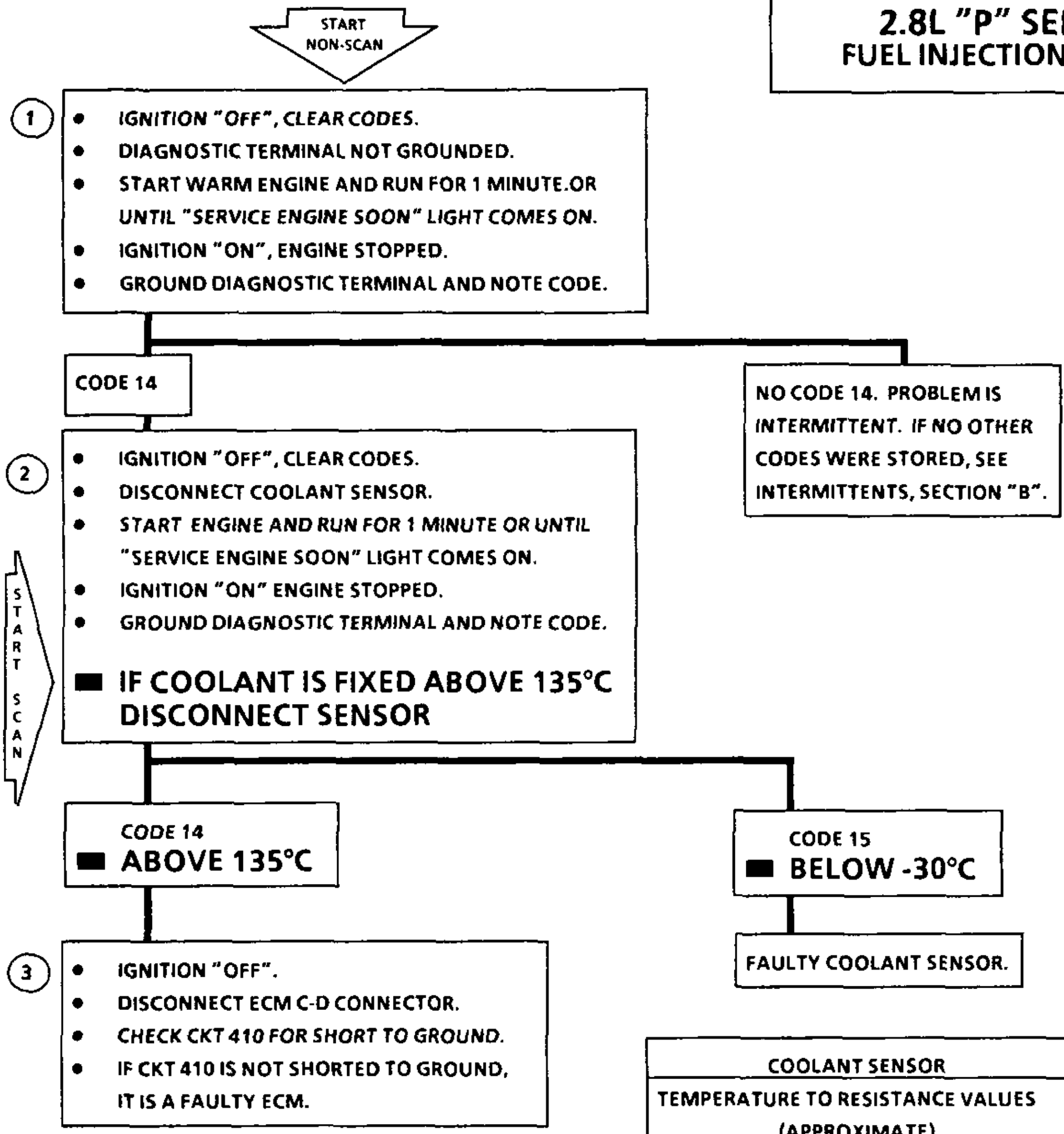
1. Checks to see if code was set as result of hard failure or intermittent condition.
2. This test simulates a code 15. If the ECM recognizes the open circuit (high voltage) and sets a code 15, the ECM and wiring are OK.
3. If code 14 repeats, CKT 410, is shorted to ground or the ECM is faulty.

"SCAN" STEP ONLY ■

CODE 14

COOLANT SENSOR CIRCUIT (SIGNAL VOLTAGE LOW)

2.8L "P" SERIES
FUEL INJECTION (PORT)



①
- *IGNITION "OFF", CLEAR CODES.*
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START WARM ENGINE AND RUN FOR 1 MINUTE.OR *UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.*
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 14

NO CODE 14. PROBLEM IS *INTERMITTENT.* IF NO OTHER CODES WERE STORED, SEE INTERMITTENTS, SECTION "B".

②
- IGNITION "OFF", CLEAR CODES.
- DISCONNECT COOLANT SENSOR.
- *START ENGINE AND RUN FOR 1 MINUTE OR UNTIL* "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON" ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF COOLANT IS FIXED ABOVE 135°C DISCONNECT SENSOR

CODE 14
■ ABOVE 135°C

CODE 15
■ BELOW -30°C

FAULTY COOLANT SENSOR.

③
- IGNITION "OFF".
- DISCONNECT ECM C-D CONNECTOR.
- *CHECK CKT 410 FOR SHORT TO GROUND.*
- IF CKT 410 IS NOT SHORTED TO GROUND, IT IS A FAULTY ECM.

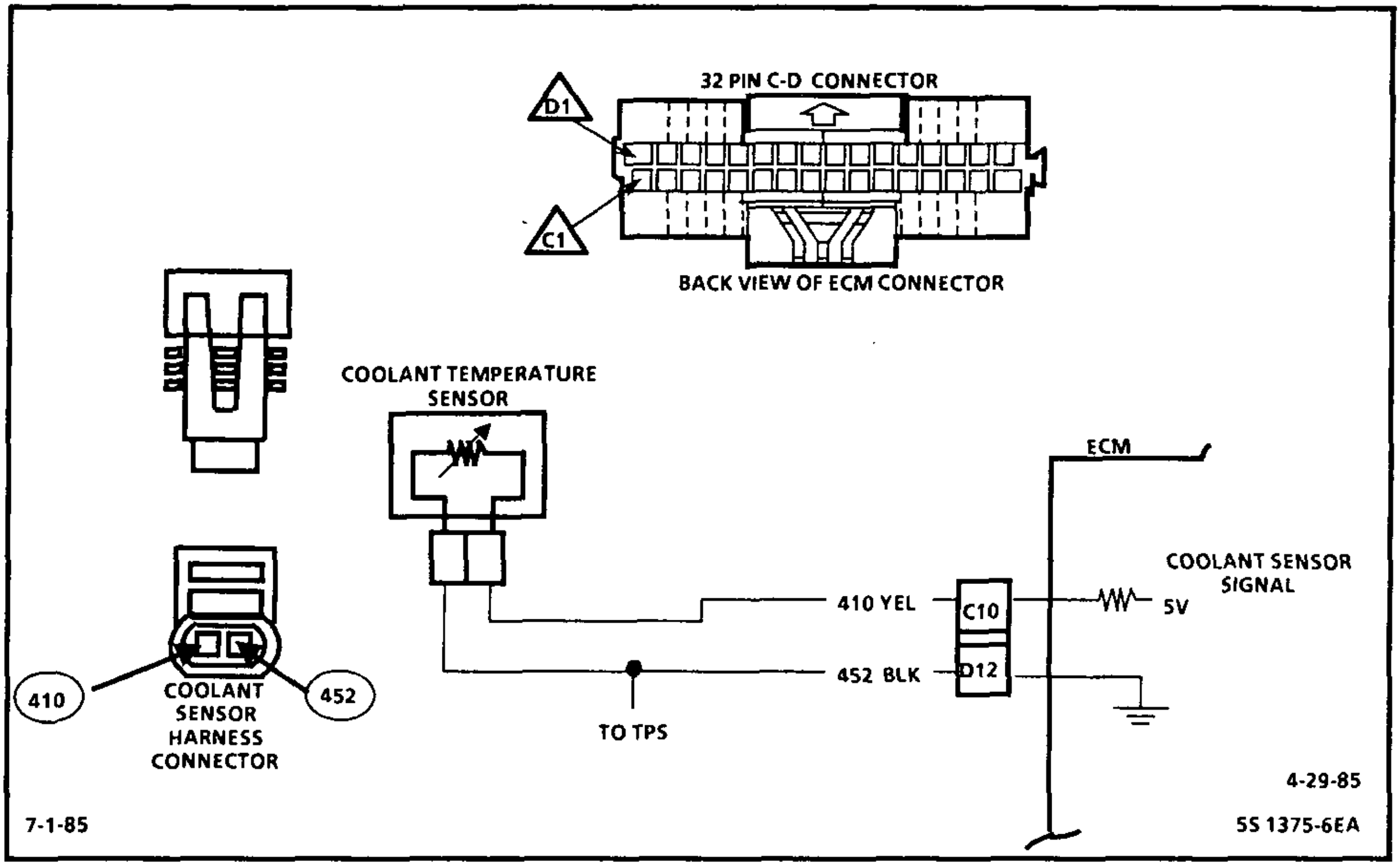
COOLANT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°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

3-6-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 45 0840 -6EA



CODE 15

COOLANT SENSOR (SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES

FUEL INJECTION (PORT)

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 the voltage will measure about 1.5 to 2.0 volts at the ECM terminal C10.

A "Scan" displays engine coolant temperature in degrees centigrade. After engine is started, the temperature should rise steadily to about 90°C, then stabilize when thermostat opens.

Coolant temperature is one of the inputs used to control:

- Fuel delivery.
- Engine Spark Timing (EST)
- Idle (IAC)
- Convertor Clutch (TCC)
- EGR

Code 15 will set if:

- signal voltage indicates a coolant temperature less than -30°C (-23°F) for 3 seconds.
- Engine running for about 1 minute.

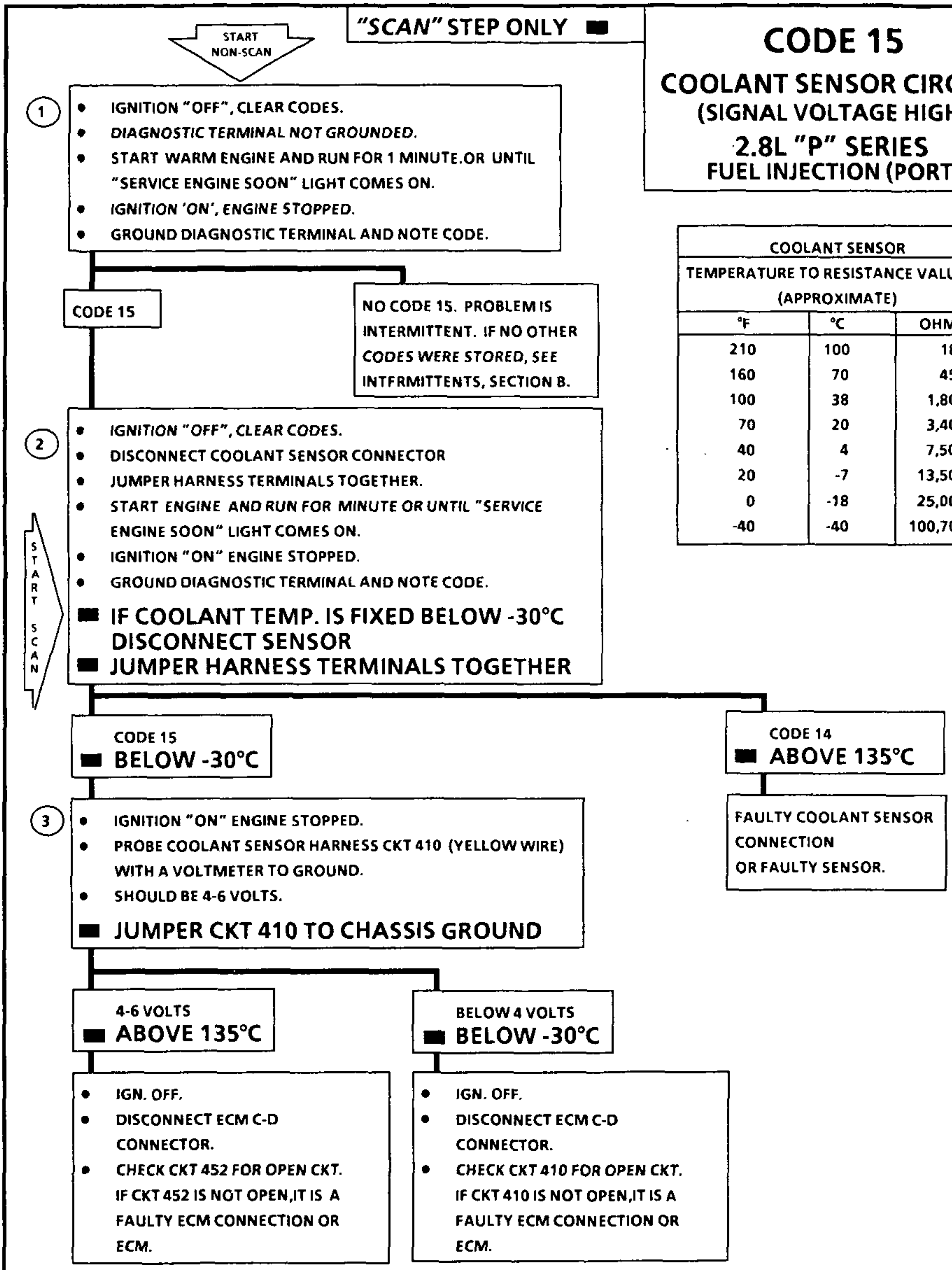
1. Checks to see if code was set as result of hard failure or intermittent condition.
2. This test simulates a code 14. If the ECM recognizes the low signal voltage and sets a code 14, the ECM and wiring are OK.

If code 15 repeats, the problem is an open CKT 410, 452, a poor connection at the ECM or sensor, or a faulty ECM.

CODE 15

COOLANT SENSOR CIRCUIT
(SIGNAL VOLTAGE HIGH)
2.8L "P" SERIES
FUEL INJECTION (PORT)

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



①
- IGNITION "OFF", CLEAR CODES.
- *DIAGNOSTIC TERMINAL NOT GROUNDED.*
- START WARM ENGINE AND RUN FOR 1 MINUTE.OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- *IGNITION 'ON', ENGINE STOPPED.*
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 15

NO CODE 15. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE INTERMITTENTS, SECTION B.

②
- *IGNITION "OFF", CLEAR CODES.*
- DISCONNECT COOLANT SENSOR CONNECTOR
- JUMPER HARNESS TERMINALS TOGETHER.
- START ENGINE AND RUN FOR MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON" ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF COOLANT TEMP. IS FIXED BELOW -30°C DISCONNECT SENSOR

■ JUMPER HARNESS TERMINALS TOGETHER

CODE 15
■ BELOW -30°C

CODE 14
■ ABOVE 135°C

FAULTY COOLANT SENSOR CONNECTION OR FAULTY SENSOR.

③
- IGNITION "ON" ENGINE STOPPED.
- PROBE COOLANT SENSOR HARNESS CKT 410 (YELLOW WIRE) WITH A VOLTMETER TO GROUND.
- SHOULD BE 4-6 VOLTS.

■ JUMPER CKT 410 TO CHASSIS GROUND

4-6 VOLTS
■ ABOVE 135°C

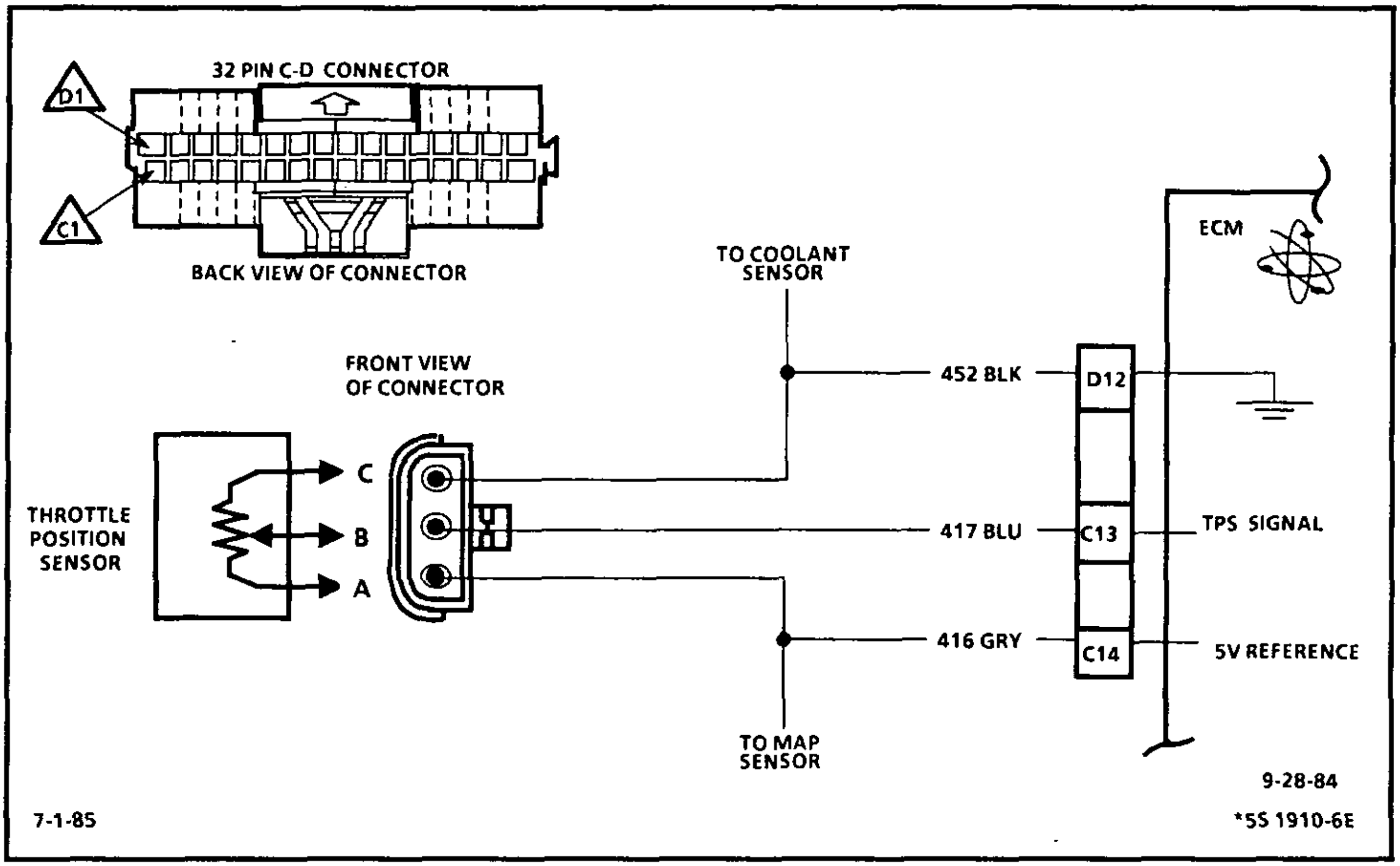
- IGN. OFF.
- DISCONNECT ECM C-D CONNECTOR.
- CHECK CKT 452 FOR OPEN CKT. IF CKT 452 IS NOT OPEN,IT IS A FAULTY ECM CONNECTION OR ECM.

BELOW 4 VOLTS
■ BELOW -30°C

- IGN. OFF.
- DISCONNECT ECM C-D CONNECTOR.
- CHECK CKT 410 FOR OPEN CKT. IF CKT 410 IS NOT OPEN,IT IS A FAULTY ECM CONNECTION OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-2-85
4S 0841-6EA



CODE 21

THROTTLE POSITION SENSOR (SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES

FUEL INJECTION (PORT)

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to the throttle valve. Signal voltage will vary from less than 1.25 volts at idle to 4.5 volts at wide open throttle.

A "Scan" displays throttle position in volts. Should read between 020-125 (200 MV and 1.25 V). With throttle closed and ignition on or at idle. Voltage should increase at a steady rate as throttle is moved toward a wide open position.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Code 21 will set if:

- TPS signal voltage is greater than 2.5 volts for 2 seconds
- Engine running less than 1600 RPM.
- MAP indicating engine is not in a high load condition.

1. Confirms code 21, and that fault is present.

2. Simulates Code 22: If the ECM recognizes the high signal voltage and sets Code 22 the ECM and wiring are OK

CODE 21

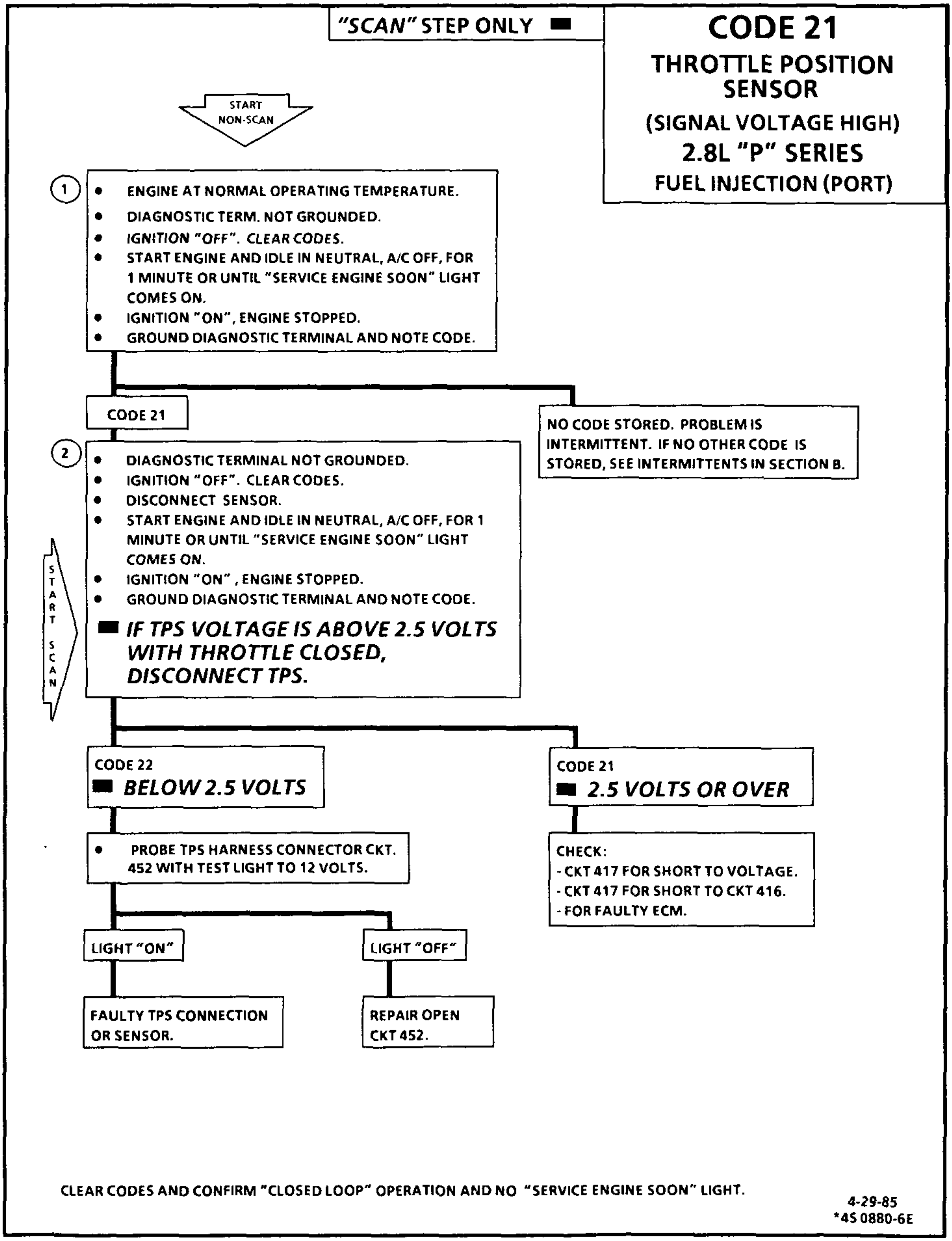
THROTTLE POSITION SENSOR

(SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES

FUEL INJECTION (PORT)

"SCAN" STEP ONLY ■



①
- ENGINE AT NORMAL OPERATING TEMPERATURE.
- DIAGNOSTIC TERM. NOT GROUNDED.
- IGNITION "OFF". CLEAR CODES.
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 21

NO CODE STORED. PROBLEM IS INTERMITTENT. IF NO OTHER CODE IS STORED, SEE INTERMITTENTS IN SECTION B.

②
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF". CLEAR CODES.
- DISCONNECT SENSOR.
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ ***IF TPS VOLTAGE IS ABOVE 2.5 VOLTS WITH THROTTLE CLOSED, DISCONNECT TPS.***

CODE 22
■ ***BELOW 2.5 VOLTS***

- PROBE TPS HARNESS CONNECTOR CKT. 452 WITH TEST LIGHT TO 12 VOLTS.

LIGHT "ON"

FAULTY TPS CONNECTION OR SENSOR.

LIGHT "OFF"

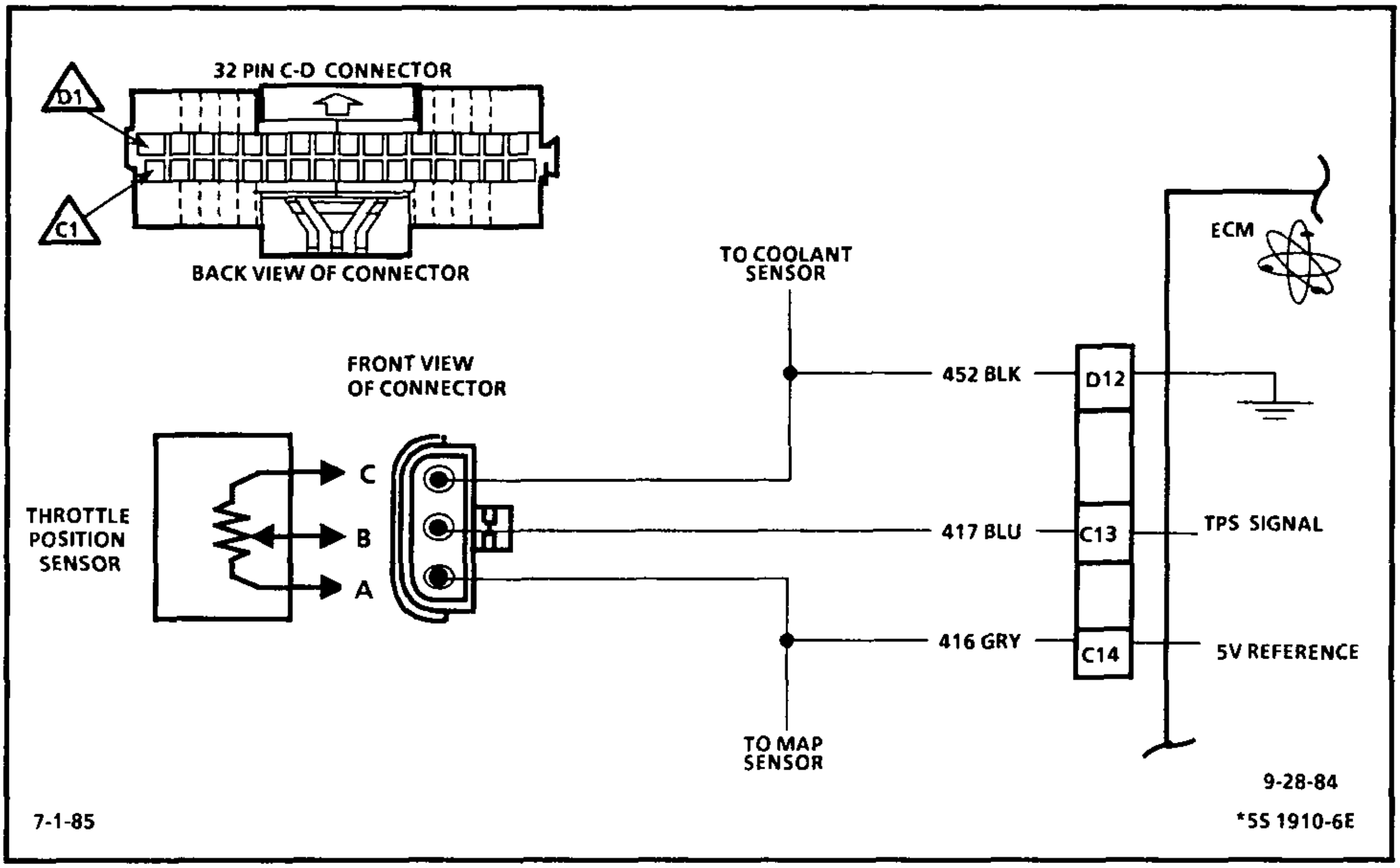
REPAIR OPEN CKT 452.

CODE 21
■ ***2.5 VOLTS OR OVER***

CHECK:
- CKT 417 FOR SHORT TO VOLTAGE.
- CKT 417 FOR SHORT TO CKT 416.
- FOR FAULTY ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

4-29-85
*4S 0880-6E



CODE 22

TPS (SIGNAL VOLTAGE LOW)

2.8L "P" SERIES

FUEL INJECTION (PORT)

The Throttle Position Sensor (TPS) provides a voltage signal that changes relative to the throttle blade. Signal voltage will vary from less than 1.25 volts at idle to 4.5 volts at wide open throttle.

A "Scan" displays throttle position in volts. Should read between 020-125 (200 MV and 1.25 V). With throttle closed and ignition on or at idle. Voltage should increase at a steady rate as throttle is moved toward a wide open position.

The TPS signal is one of the most important inputs used by the ECM for fuel control and for most of the ECM controlled outputs.

Code 22 will set if:

- TPS signal voltage is less than about .2 volt for 2 seconds with engine running.

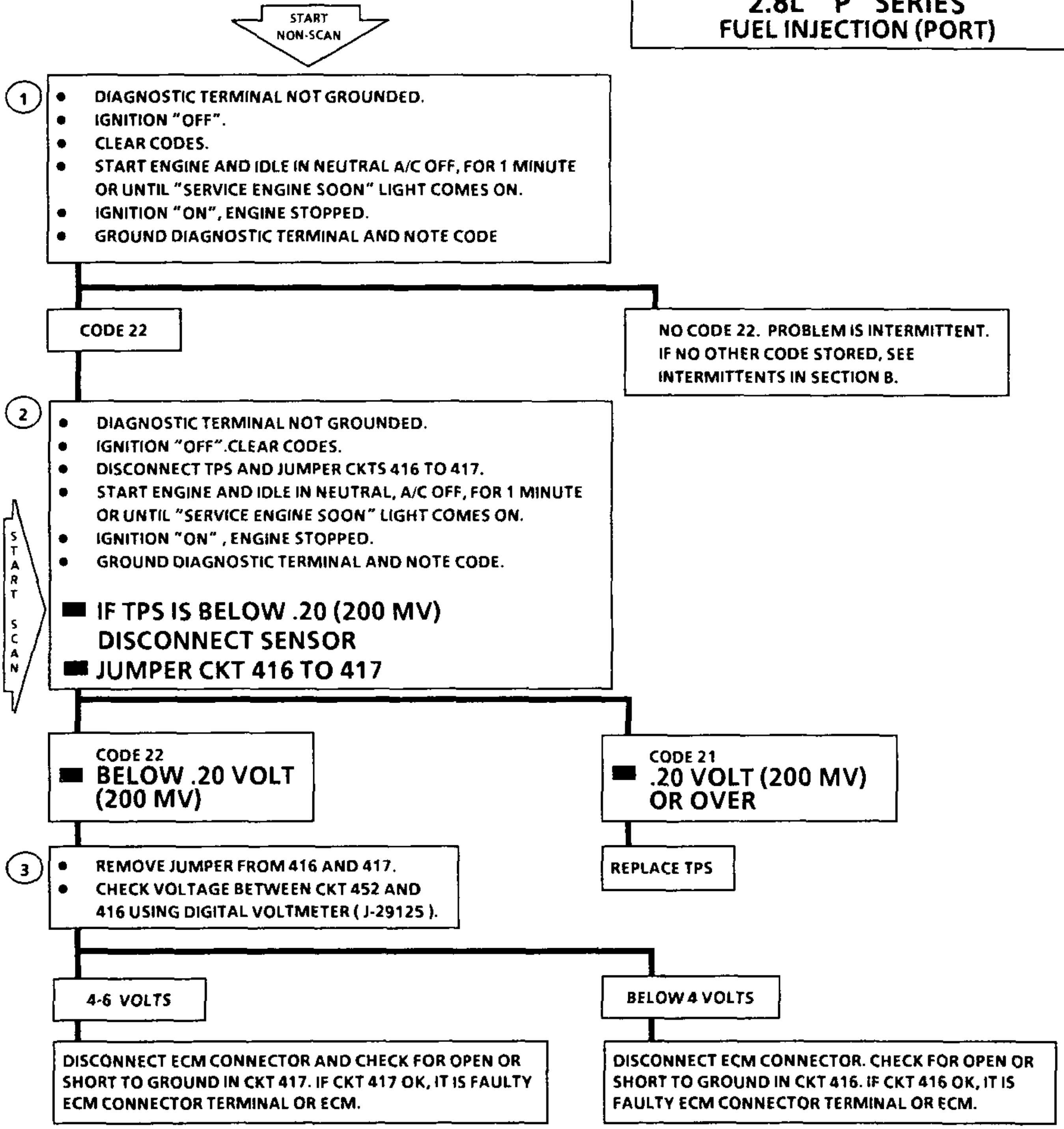
1. Confirms code 22, and that fault is present.
2. Simulates Code 21: If the ECM recognizes the high signal voltage and sets Code 21 the ECM and wiring are OK
3. Checks for reference voltage from the ECM. To prevent damage to ECM, be sure to disconnect C-D connector when checking circuit wiring for open or shorts to ground.

"SCAN" STEP ONLY ■

CODE 22

THROTTLE POSITION SENSOR
(SIGNAL VOLTAGE LOW)

2.8L "P" SERIES
FUEL INJECTION (PORT)



START NON-SCAN

①
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF".
- CLEAR CODES.
- START ENGINE AND IDLE IN NEUTRAL A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE

CODE 22

NO CODE 22. PROBLEM IS INTERMITTENT. IF NO OTHER CODE STORED, SEE INTERMITTENTS IN SECTION B.

START SCAN

②
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- IGNITION "OFF".CLEAR CODES.
- DISCONNECT TPS AND JUMPER CKTS 416 TO 417.
- START ENGINE AND IDLE IN NEUTRAL, A/C OFF, FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF TPS IS BELOW .20 (200 MV) DISCONNECT SENSOR

■ JUMPER CKT 416 TO 417

CODE 22
■ BELOW .20 VOLT (200 MV)

CODE 21
■ .20 VOLT (200 MV) OR OVER

REPLACE TPS

③
- REMOVE JUMPER FROM 416 AND 417.
- CHECK VOLTAGE BETWEEN CKT 452 AND 416 USING DIGITAL VOLTMETER (J-29125).

4-6 VOLTS

DISCONNECT ECM CONNECTOR AND CHECK FOR OPEN OR SHORT TO GROUND IN CKT 417. IF CKT 417 OK, IT IS FAULTY ECM CONNECTOR TERMINAL OR ECM.

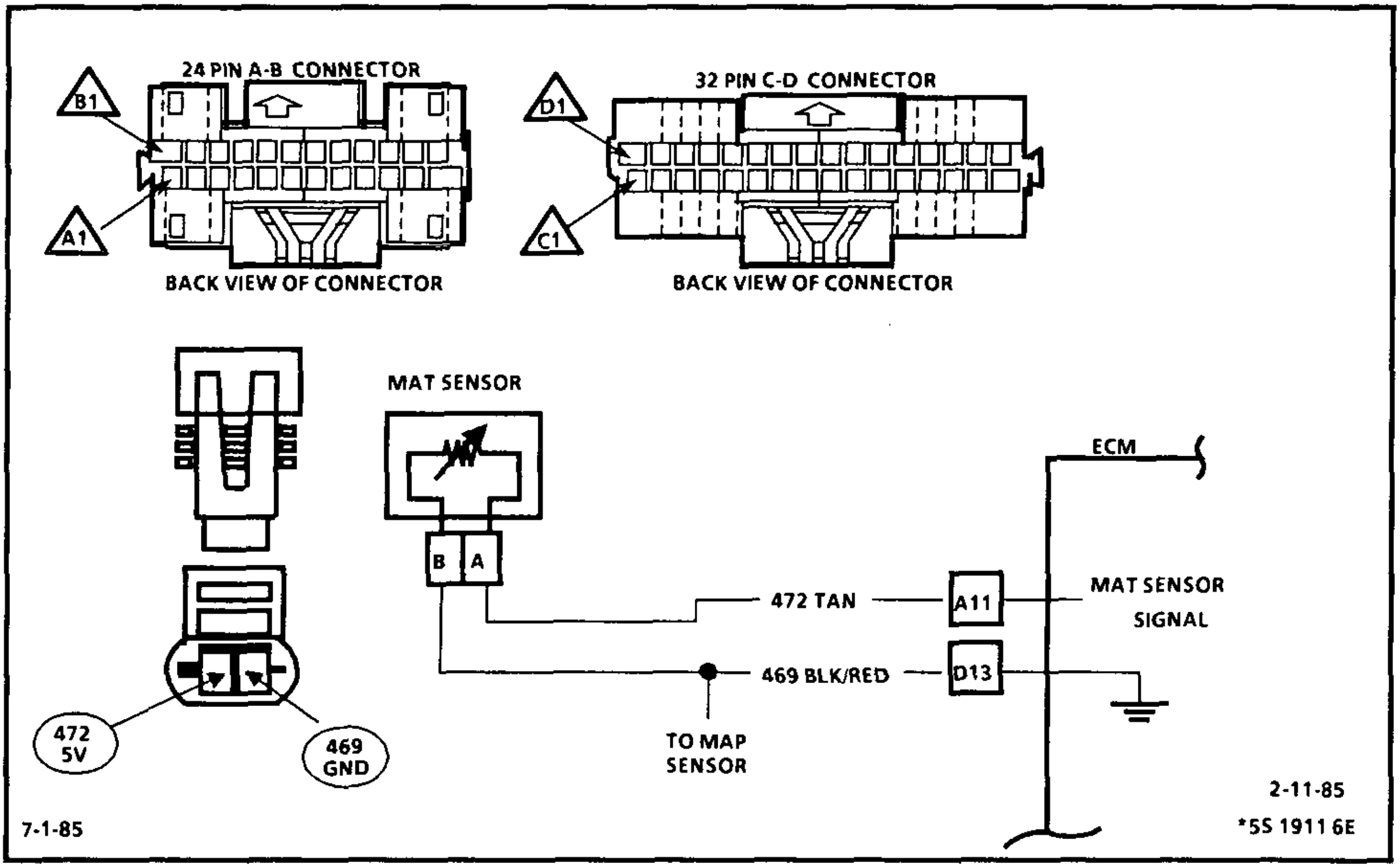
BELOW 4 VOLTS

DISCONNECT ECM CONNECTOR. CHECK FOR OPEN OR SHORT TO GROUND IN CKT 416. IF CKT 416 OK, IT IS FAULTY ECM CONNECTOR TERMINAL OR ECM.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

7-10 85

*4S 0811-6E



CODE 23

MANIFOLD AIR TEMPERATURE(MAT) SENSOR
(SIGNAL VOLTAGE HIGH)
2.8L "P" SERIES
FUEL INJECTION (PORT)

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.

A "Scan" tool reads temperature of the air entering the engine. Should read close to ambient air temperature when engine is cold, and rise as underhood & engine temperature increases.

Code 23 will set if:

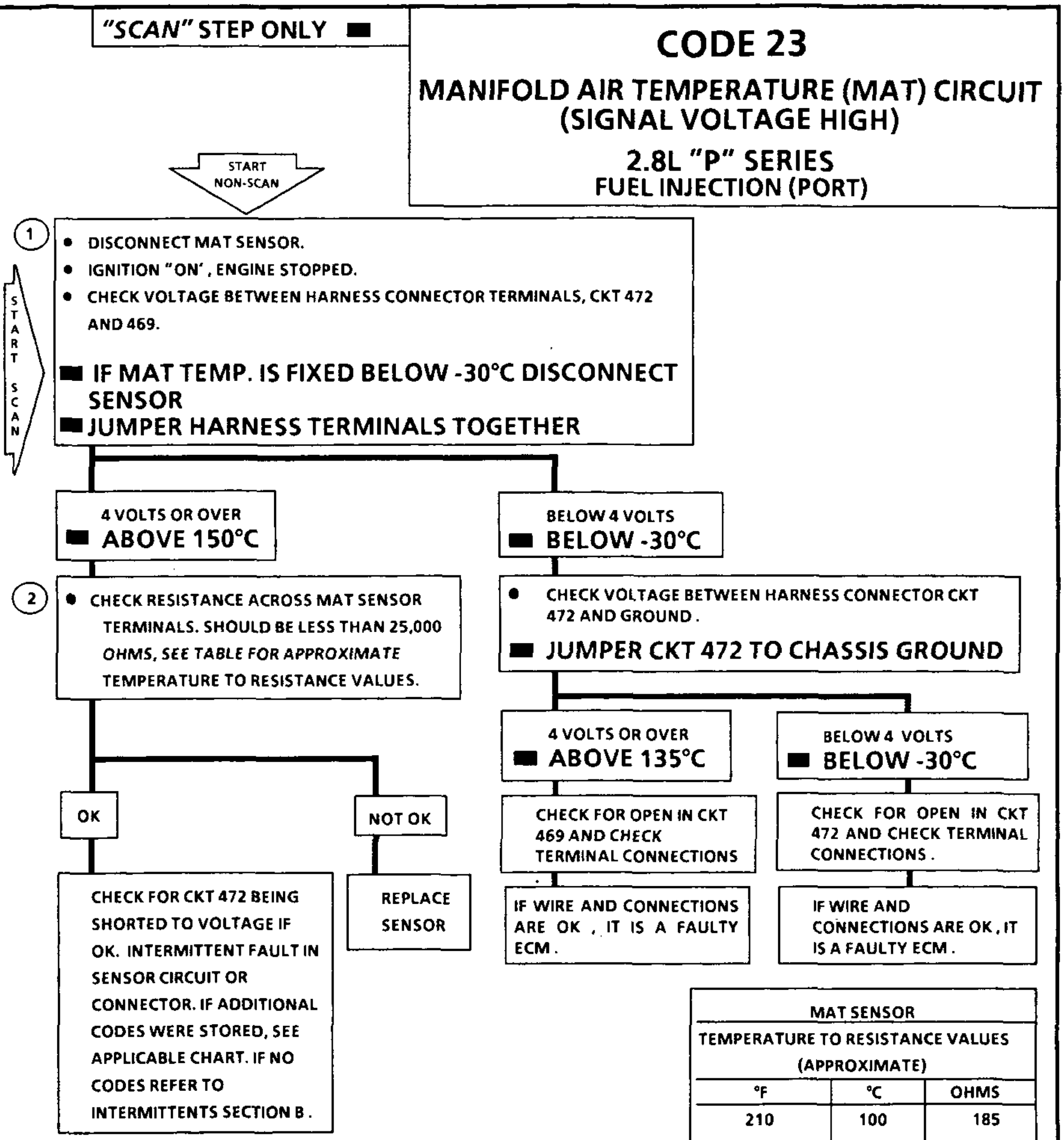
- A signal voltage indicates a manifold air temperature below -30°C for 3 seconds.
- Time since engine start is 58 seconds or longer.

1. A Code 23 will set due to an open sensor, wire, or connection. This test will determine if the wiring and ECM are OK.
2. If the resistance is greater than 25,000 ohms replace the sensor.

CODE 23

MANIFOLD AIR TEMPERATURE (MAT) CIRCUIT (SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES
FUEL INJECTION (PORT)



①
- DISCONNECT MAT SENSOR.
- IGNITION "ON", ENGINE STOPPED.
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINALS, CKT 472 AND 469.

■ IF MAT TEMP. IS FIXED BELOW -30°C DISCONNECT SENSOR
■ JUMPER HARNESS TERMINALS TOGETHER

4 VOLTS OR OVER
■ ABOVE 150°C

②
- CHECK RESISTANCE ACROSS MAT SENSOR TERMINALS. SHOULD BE LESS THAN 25,000 *OHMS, SEE TABLE FOR APPROXIMATE* TEMPERATURE TO RESISTANCE VALUES.

OK

CHECK FOR CKT 472 BEING SHORTED TO VOLTAGE IF OK. INTERMITTENT FAULT IN SENSOR CIRCUIT OR CONNECTOR. IF ADDITIONAL CODES WERE STORED, SEE APPLICABLE CHART. IF NO CODES REFER TO INTERMITTENTS SECTION B.

NOT OK

REPLACE SENSOR

BELOW 4 VOLTS
■ BELOW -30°C

- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR CKT 472 AND GROUND.

■ JUMPER CKT 472 TO CHASSIS GROUND

4 VOLTS OR OVER
■ ABOVE 135°C

CHECK FOR OPEN IN CKT 469 AND CHECK TERMINAL CONNECTIONS

IF WIRE AND CONNECTIONS ARE OK, IT IS A FAULTY ECM.

BELOW 4 VOLTS
■ BELOW -30°C

CHECK FOR OPEN IN CKT 472 AND CHECK TERMINAL CONNECTIONS.

IF WIRE AND CONNECTIONS ARE OK, IT IS A FAULTY ECM.

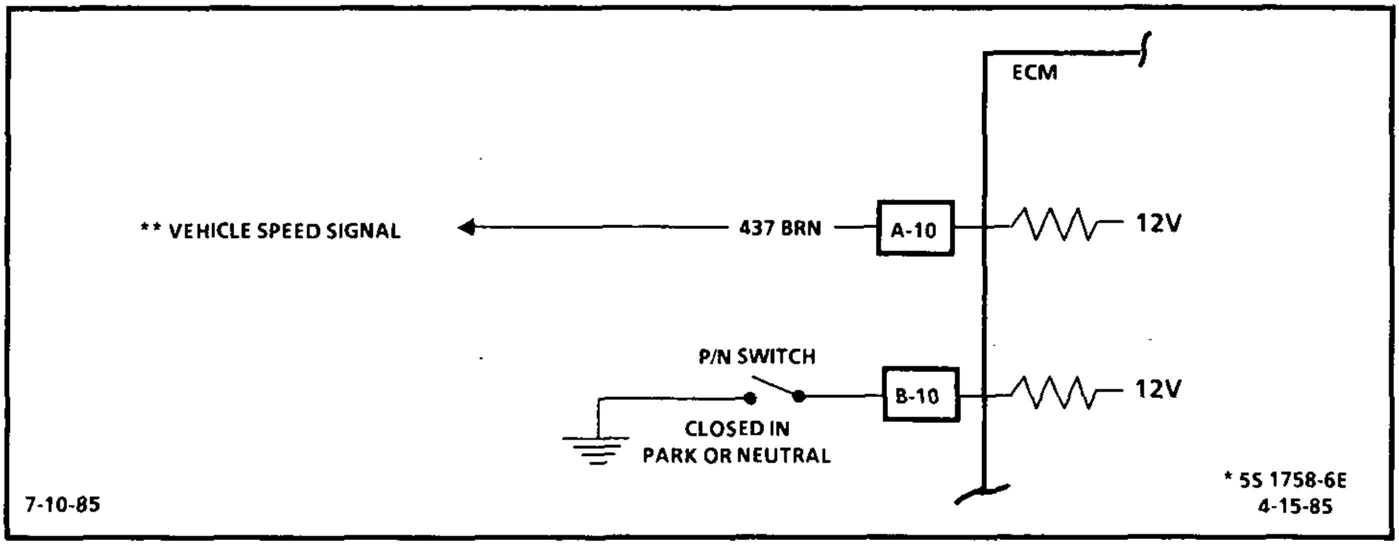
MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°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

4-25-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 5S 1912-6E



CODE 24

VEHICLE SPEED SENSOR
2.8L "P" SERIES
FUEL INJECTION (PORT)

***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 a Code 24 set when drive wheels are not turning.*

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 (high vacuum).
- Not in park or neutral.
- All conditions must be met for 4 seconds.

A "Scan" display should closely match speedometer with drive wheels turning.

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".

1. This test monitors the ECM voltage on CKT 437. With the wheels turning, the pulsing action will result in a varying voltage.The variation will be greater at low wheel speeds to an average of 4-6 volts at about 20 mph (32 km/h).
2. A voltage of less than 1 volt at the ECM connector indicates that the CKT 437 wire is shorted to ground. Disconnect CKT 437 at the Vehicle Speed Sensor. If voltage now reads above 10 volts, the Vehicle Speed Sensor is faulty. If voltage remains less than 10 volt, then CKT 437 wire is grounded. If 437 is not grounded, check for a faulty ECM connector or ECM.
3. A steady 8-12 volts at the ECM connector indicates CKT 437 is open or a faulty Vehicle Speed Sensor.
4. This is normal voltage which indicates a possible intermittent condition - See "Intermittents" Section B.
5. If "SCAN" displays vehicle speed, check park/neutral switch Chart C-1A or vehicle with auto trans. If switch is ok, check for intermittents.

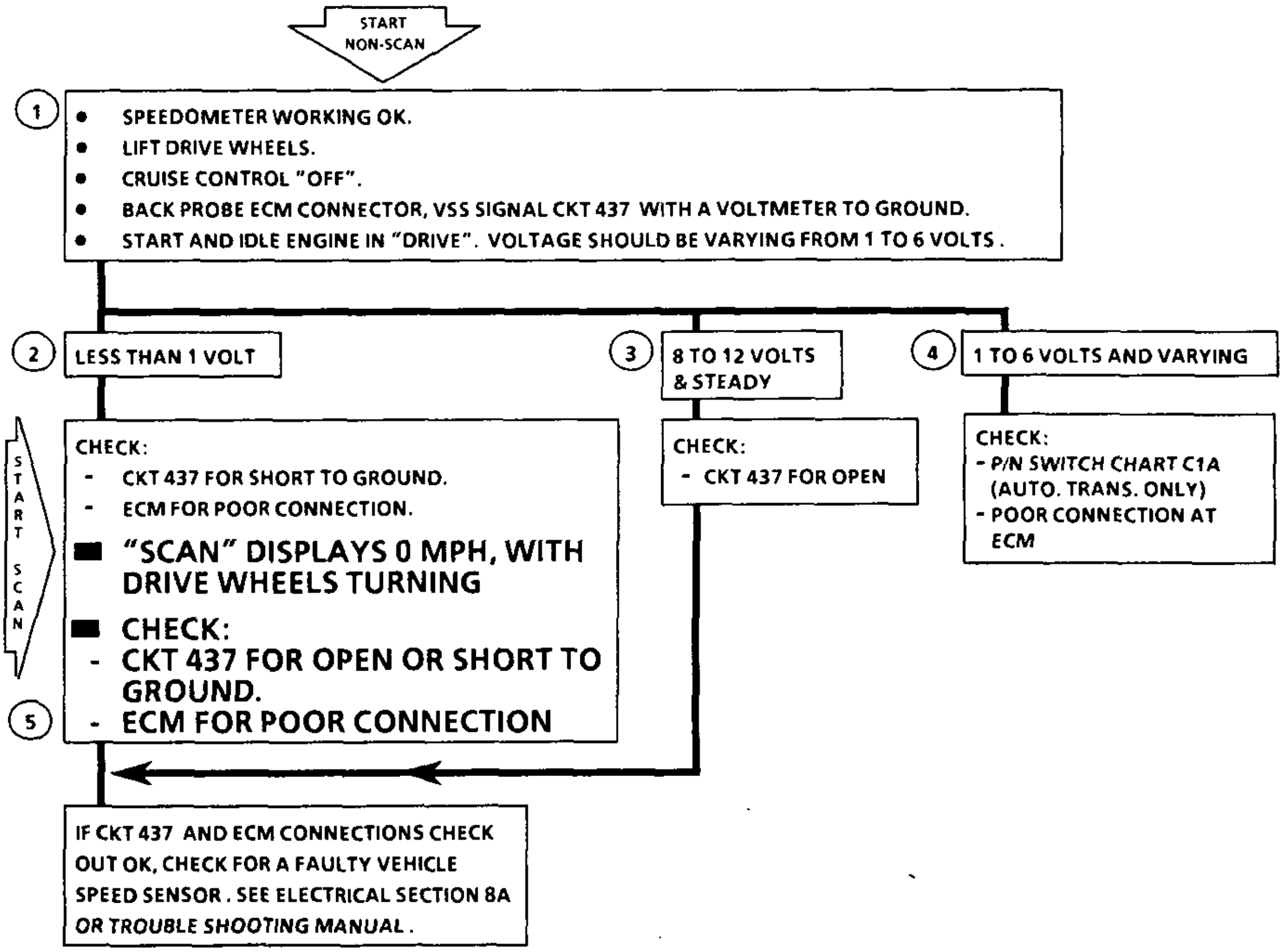
"SCAN" STEP ONLY ■

CODE 24

VEHICLE SPEED SENSOR (VSS)

2.8L "P" SERIES
FUEL INJECTION (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
- SPEEDOMETER WORKING OK.
- LIFT DRIVE WHEELS.
- CRUISE CONTROL "OFF".
- BACK PROBE ECM CONNECTOR, VSS SIGNAL CKT 437 WITH A VOLTMETER TO GROUND.
- START AND IDLE ENGINE IN "DRIVE". VOLTAGE SHOULD BE VARYING FROM 1 TO 6 VOLTS.

② LESS THAN 1 VOLT

CHECK:
- CKT 437 FOR SHORT TO GROUND.
- ECM FOR POOR CONNECTION.

■ "SCAN" DISPLAYS 0 MPH, WITH DRIVE WHEELS TURNING

■ CHECK:
- CKT 437 FOR OPEN OR SHORT TO GROUND.
- ⑤ ECM FOR POOR CONNECTION

③ 8 TO 12 VOLTS & STEADY

CHECK:
- CKT 437 FOR OPEN

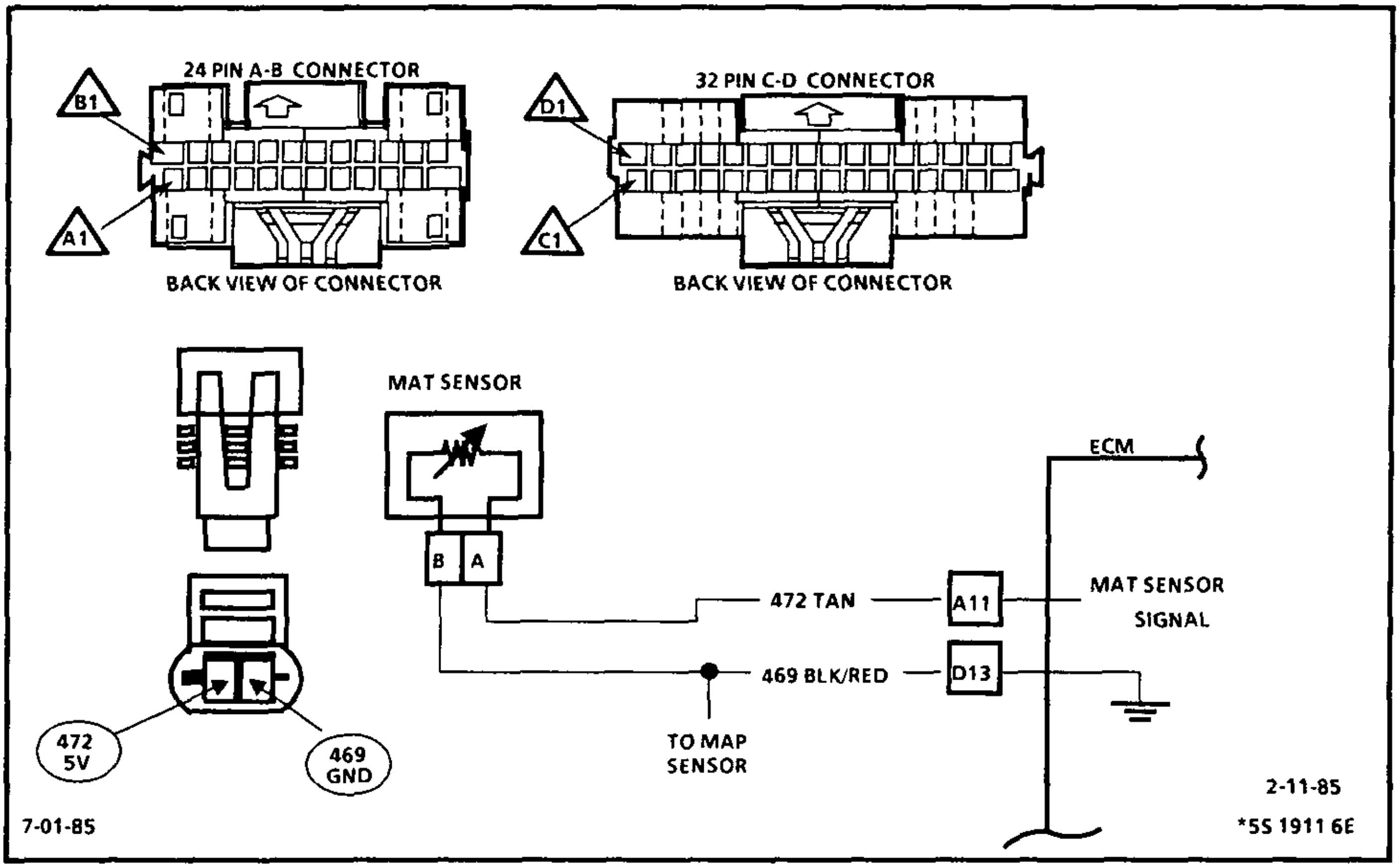
④ 1 TO 6 VOLTS AND VARYING

CHECK:
- *P/N SWITCH CHART C1A* (AUTO. TRANS. ONLY)
- POOR CONNECTION AT *ECM*

IF CKT 437 AND ECM CONNECTIONS CHECK OUT OK, CHECK FOR A FAULTY VEHICLE SPEED SENSOR. SEE ELECTRICAL SECTION 8A *OR TROUBLE SHOOTING MANUAL.*

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

10-11-85
*5S 1420-6E



CODE 25

MANIFOLD AIR TEMPERATURE(MAT) SENSOR

(SIGNAL VOLTAGE LOW)

2.8L "P" SERIES

FUEL INJECTION (PORT)

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.

A "Scan" tool reads temperature of the air in the intake manifold. Should read close to ambient air temperature when engine is cold, and rise as underhood & engine temperature increases.

Code 25 will set if:

- Signal voltage indicates a manifold air temperature greater than 135°C (275° F) for 3 seconds.
- Time since engine start is 20 seconds or longer.

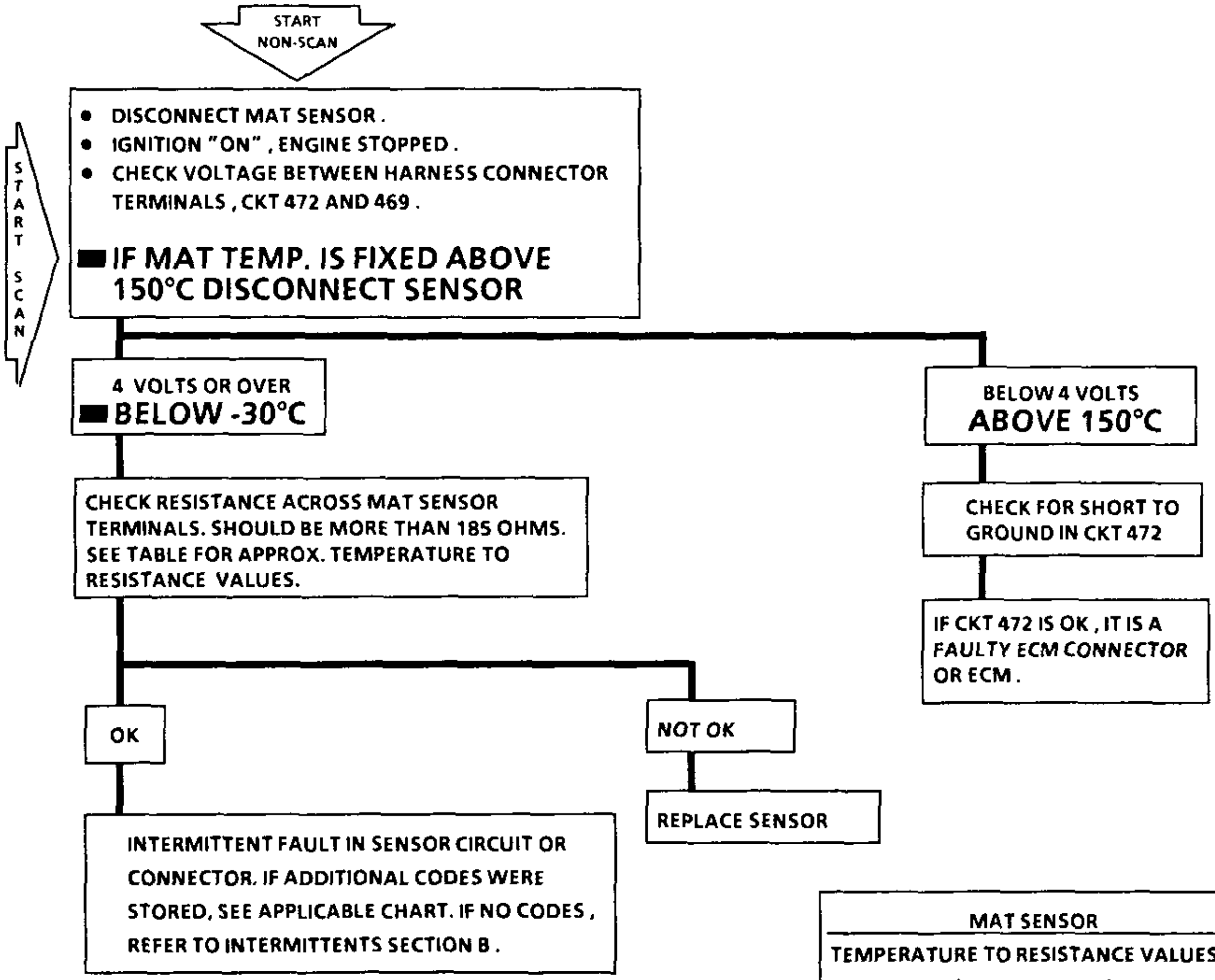
1. If voltage is above 4 volts, the ECM and wiring are OK.
2. If the resistance is less than 185 ohms replace the sensor.

"SCAN" STEP ONLY ■

CODE 25

MANIFOLD AIR TEMPERATURE (MAT) CIRCUIT (SIGNAL VOLTAGE LOW)

2.8L "P" SERIES
FUEL INJECTION (PORT)



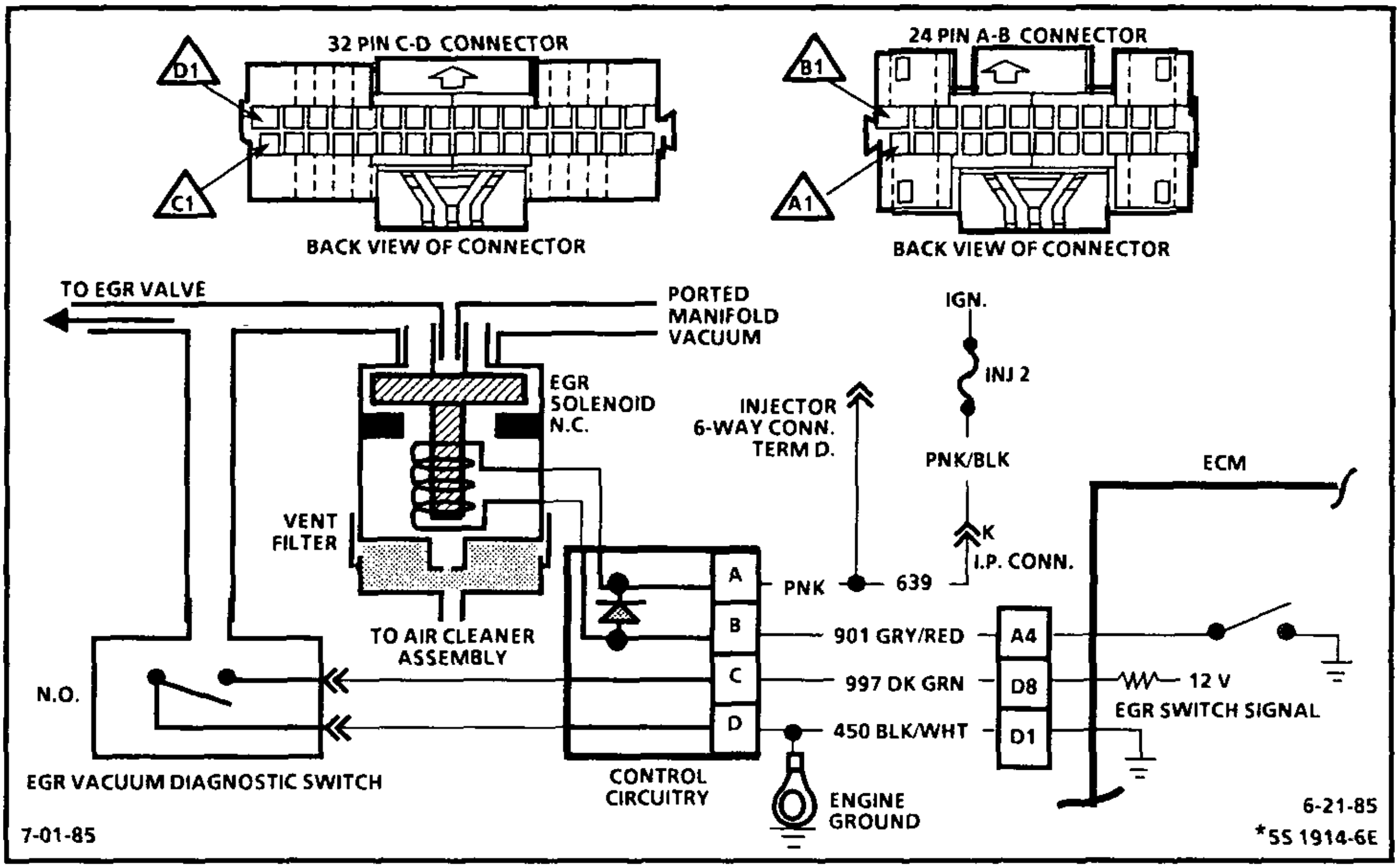
MAT SENSOR
TEMPERATURE TO RESISTANCE VALUES
(APPROXIMATE)

°F	°C	OHMS
210	100	185
160	70	450
100	38	1,600
70	20	3,400
40	4	7,500
20	-7	13,500
0	-18	25,000
-40	-40	100,700

4-11-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 4S 0846-6E



CODE 32
EXHAUST GAS RECIRCULATION (EGR) VACUUM CONTROL
2.8L "P" SERIES
FUEL INJECTION (PORT)

Code 32 means that the EGR diagnostic 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 50%.
- Manifold pressure less than 25 kPa, (7" vacuum)
- All conditions above must be met for 8 seconds.

If the switch is detected closed the "Service Engine Soon" light will remain "ON" unless the switch changes state.

The EGR vacuum control uses an ECM controlled EGR valve. The valve 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 901. The duty cycle is calculated by the ECM based on information from the coolant and MAP sensor and engine RPM. The duty cycle should be 0% (no EGR) when 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.

1. With the ignition on, the solenoid should not be energized and vacuum should not pass to the EGR valve.
2. To this point the EGR solenoid and valve are OK and the following check will check the diagnostic vacuum switch portion of the system.
3. The diagnostic switch should close at about 2" of vacuum. With vacuum applied, the switch should close and resistance go to near zero Ohms.

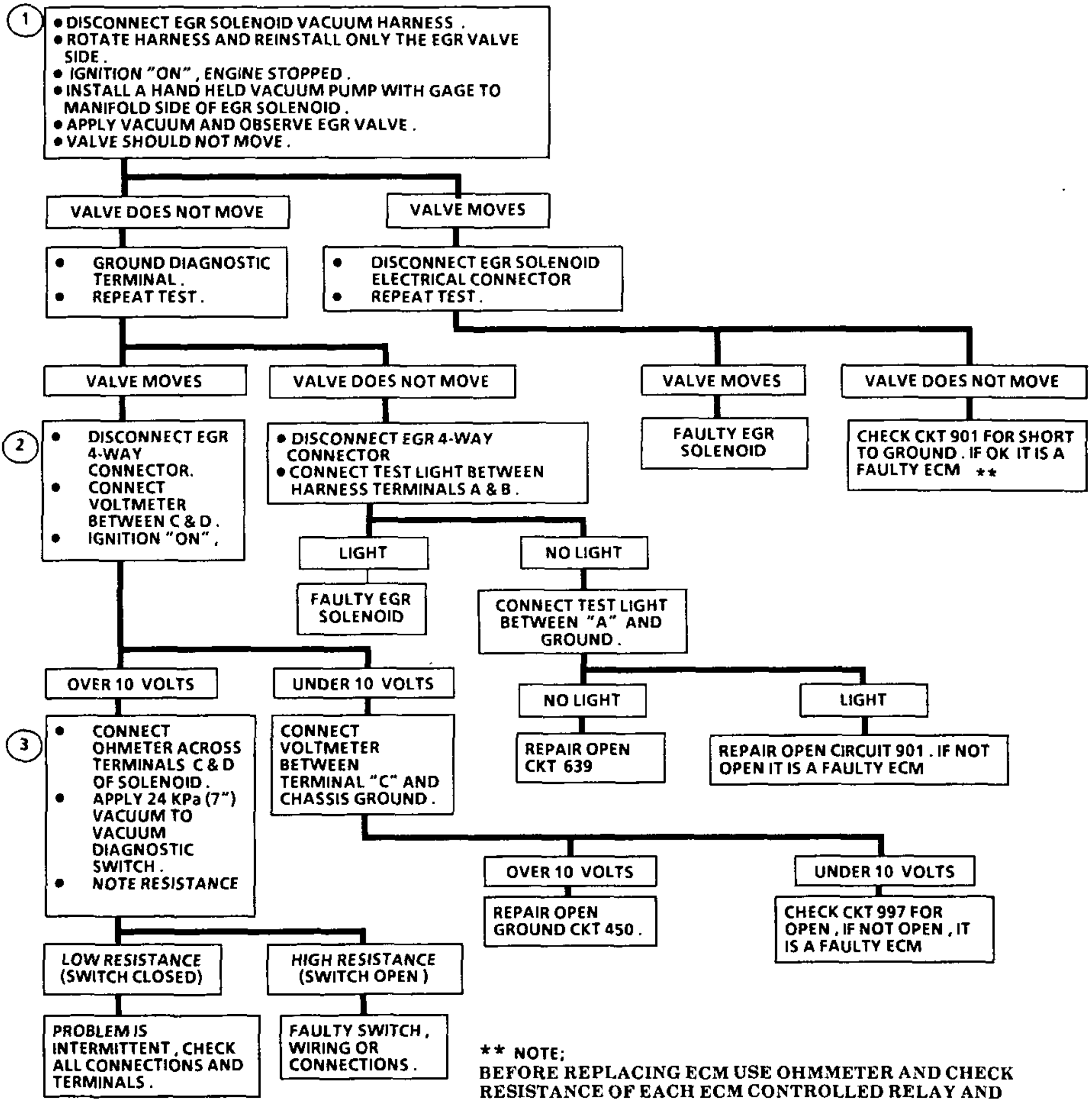
CODE 32

EGR SYSTEM FAILURE

2.8L "P" SERIES

FUEL INJECTION (PORT)

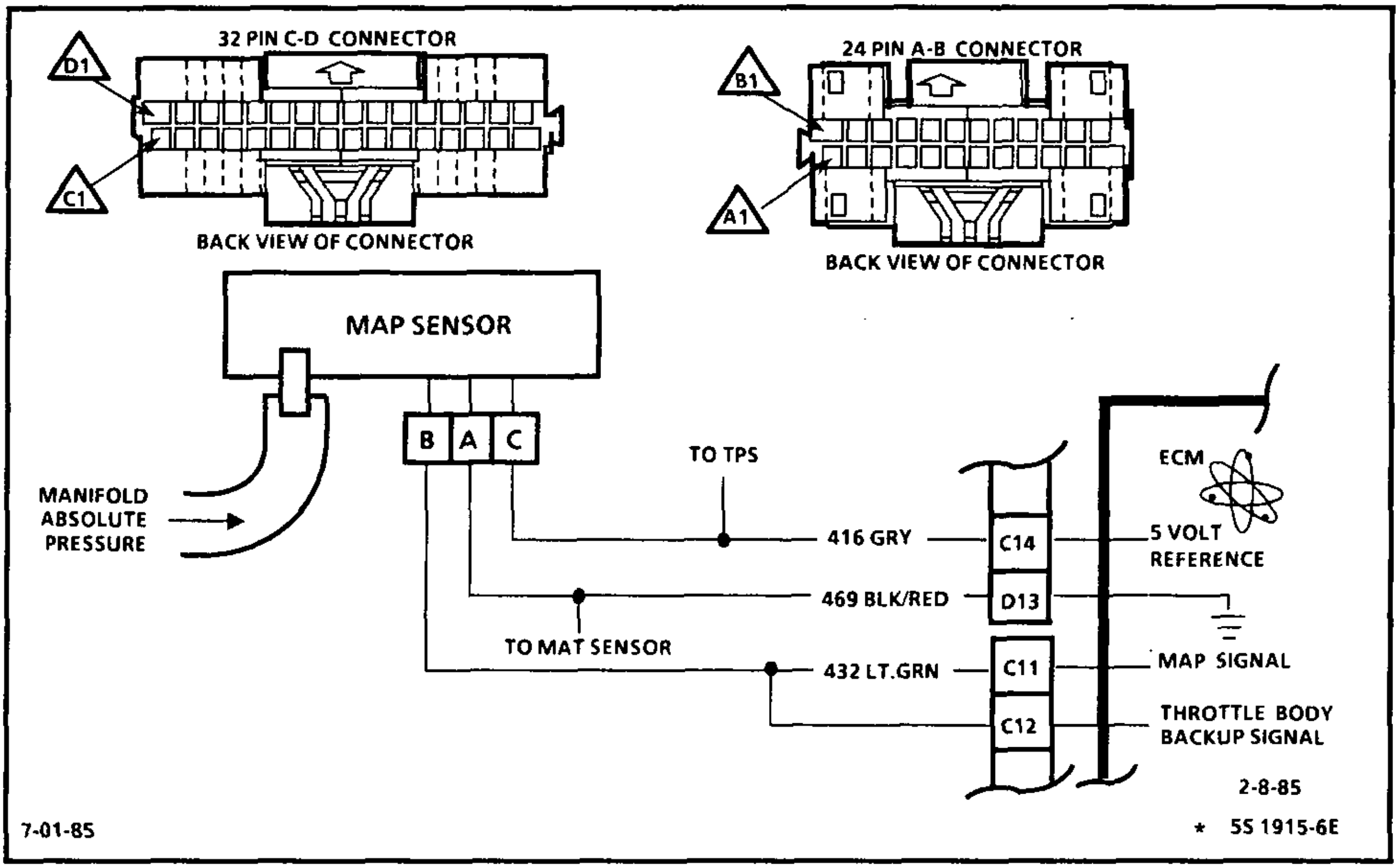
BEFORE USING THIS CHART, CHECK FOR PORTED VACUUM TO EGR SOLENOID, ALSO CHECK HOSES FOR LEAKS OR RESTRICTIONS. SHOULD BE AT LEAST 7" HG VACUUM AT 2000 RPM.



** NOTE;
BEFORE REPLACING ECM USE OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

7-01-85

*5S 1913-6E



CODE 33

MAP SENSOR

(SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES

FUEL INJECTION (PORT)

The Manifold Absolute Pressure Sensor (MAP)responds to changes in manifold pressure (vacuum). The ECM recieves this information as a signal voltage that will vary from about 1 to 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 engine idle is low and unstable it may set code 33.

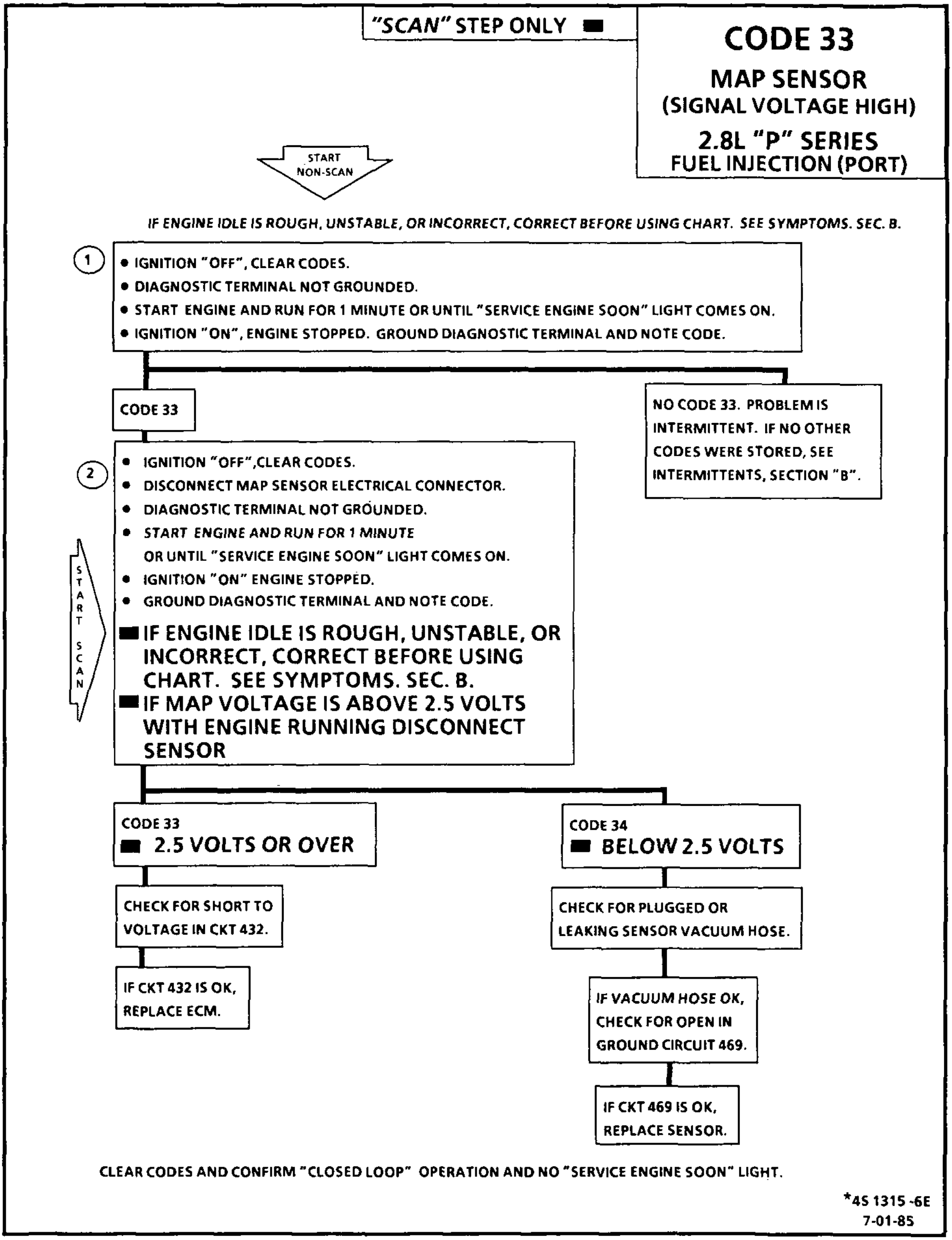
If the MAP sensor fails the ECM will substitute a fixed MAP value and use the Throttle Position Sensor (TPS) to control fuel delivery.

Code 33 will set when:

- Signal is too high for a time greater than 6 seconds

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.

1. Confirms Code 33 and that fault is present.
2. If the ECM recognizes this condition and sets Code 34, low MAP signal, the ECM and wiring are OK.



"SCAN" STEP ONLY ■

CODE 33

MAP SENSOR
(SIGNAL VOLTAGE HIGH)

2.8L "P" SERIES
FUEL INJECTION (PORT)

START NON-SCAN

IF ENGINE IDLE IS ROUGH, UNSTABLE, OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS. SEC. B.

①
- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED. GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 33

NO CODE 33. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE INTERMITTENTS, SECTION "B".

START SCAN

②
- IGNITION "OFF",CLEAR CODES.
- DISCONNECT MAP SENSOR ELECTRICAL CONNECTOR.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- *START ENGINE AND RUN FOR 1 MINUTE* OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON" ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF ENGINE IDLE IS ROUGH, UNSTABLE, OR INCORRECT, CORRECT BEFORE USING CHART. SEE SYMPTOMS. SEC. B.

■ IF MAP VOLTAGE IS ABOVE 2.5 VOLTS WITH ENGINE RUNNING DISCONNECT SENSOR

CODE 33
■ 2.5 VOLTS OR OVER

CHECK FOR SHORT TO VOLTAGE IN CKT 432.

IF CKT 432 IS OK, REPLACE ECM.

CODE 34
■ BELOW 2.5 VOLTS

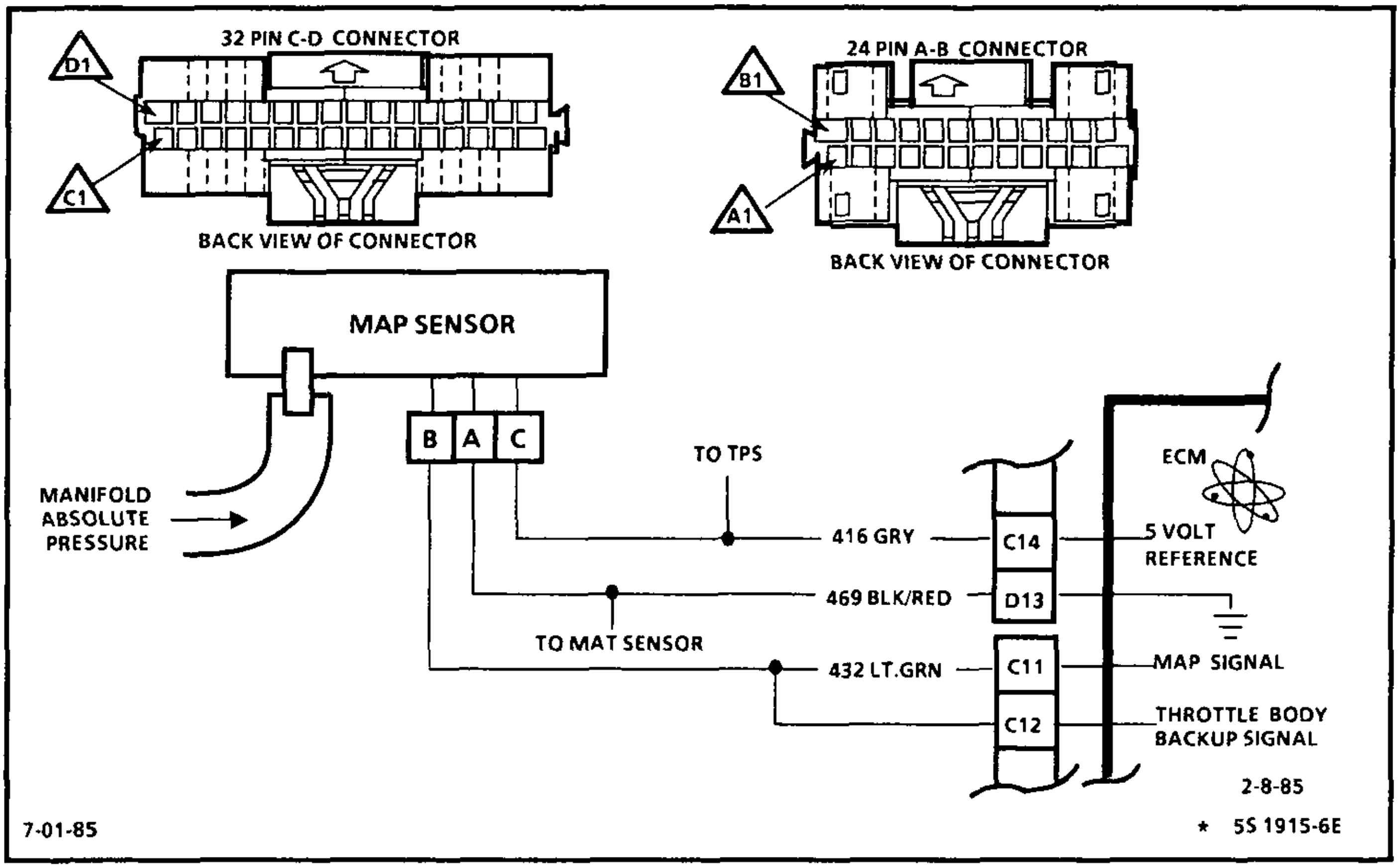
CHECK FOR PLUGGED OR LEAKING SENSOR VACUUM HOSE.

IF VACUUM HOSE OK, CHECK FOR OPEN IN GROUND CIRCUIT 469.

IF CKT 469 IS OK, REPLACE SENSOR.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 1315 -6E
7-01-85



CODE 34

MAP SENSOR

(SIGNAL VOLTAGE LOW)

2.8L "P" SERIES

FUEL INJECTION (PORT)

The Manifold Absolute Pressure Sensor (MAP)responds to changes in manifold pressure (vacuum). The ECM recieves this information as a signal voltage that will vary from about 1 to 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.

Code 34 will set whensignal is too low and ignition is turned on.

1. Confirms Code 34 and that fault is present.

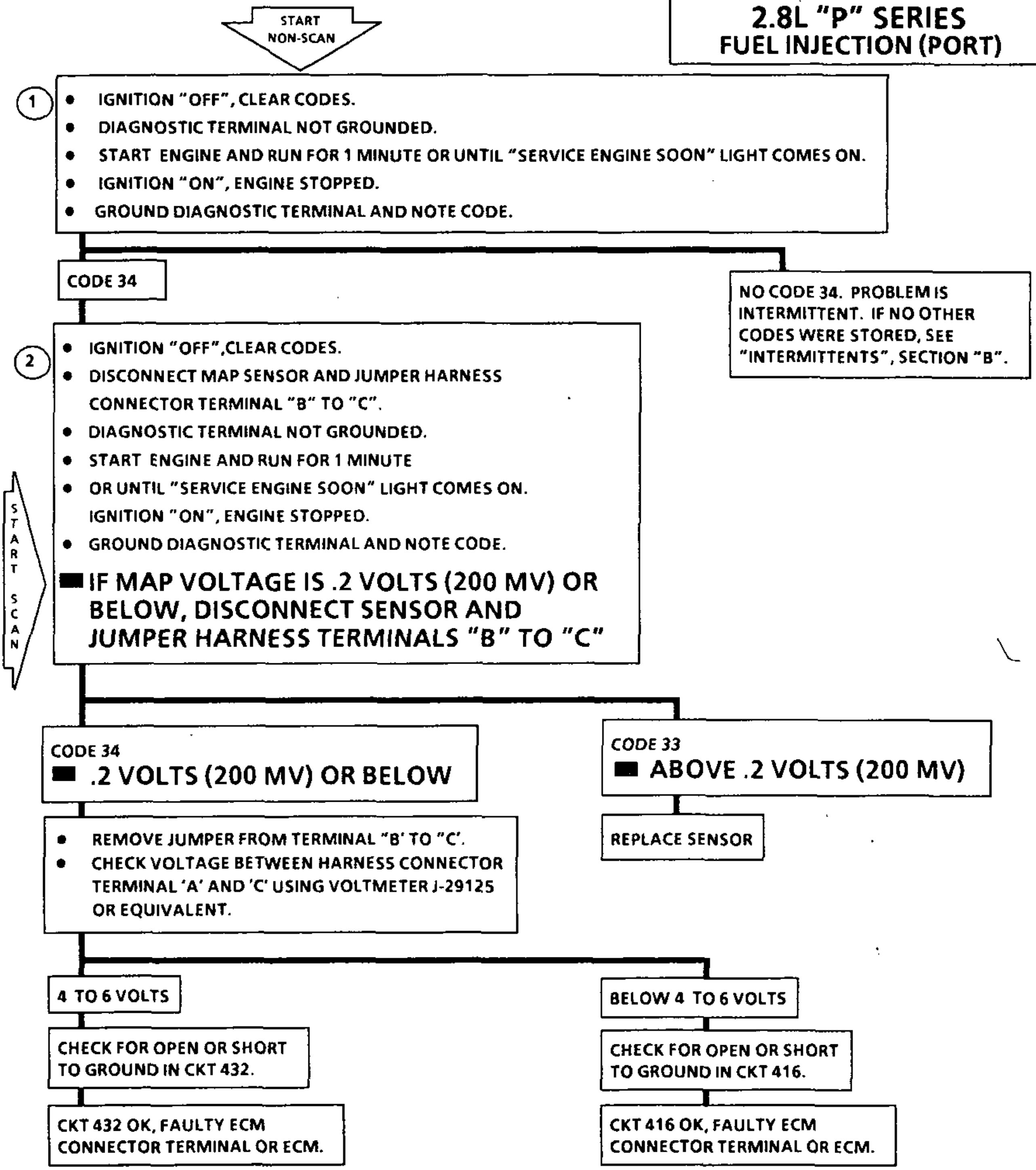
2. If the ECM recognizes this condition and sets Code 33, high MAP signal, the ECM and wiring are OK.

"*SCAN*" STEP ONLY ■

CODE 34

MAP SENSOR
(SIGNAL VOLTAGE LOW)

2.8L "P" SERIES
FUEL INJECTION (PORT)



START NON-SCAN

①
- IGNITION "OFF", CLEAR CODES.
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

CODE 34

NO CODE 34. PROBLEM IS INTERMITTENT. IF NO OTHER CODES WERE STORED, SEE "INTERMITTENTS", SECTION "B".

START SCAN

②
- IGNITION "OFF",CLEAR CODES.
- DISCONNECT MAP SENSOR AND JUMPER HARNESS CONNECTOR TERMINAL "B" TO "C".
- DIAGNOSTIC TERMINAL NOT GROUNDED.
- START ENGINE AND RUN FOR 1 MINUTE
- OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON. IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODE.

■ IF MAP VOLTAGE IS .2 VOLTS (200 MV) OR BELOW, DISCONNECT SENSOR AND JUMPER HARNESS TERMINALS "B" TO "C"

CODE 34
■ .2 VOLTS (200 MV) OR BELOW

- REMOVE JUMPER FROM TERMINAL "B' TO "C'.
- CHECK VOLTAGE BETWEEN HARNESS CONNECTOR TERMINAL 'A' AND 'C' USING VOLTMETER J-29125 OR EQUIVALENT.

4 TO 6 VOLTS

CHECK FOR OPEN OR SHORT TO GROUND IN CKT 432.

CKT 432 OK, FAULTY ECM CONNECTOR TERMINAL OR ECM.

BELOW 4 TO 6 VOLTS

CHECK FOR OPEN OR SHORT TO GROUND IN CKT 416.

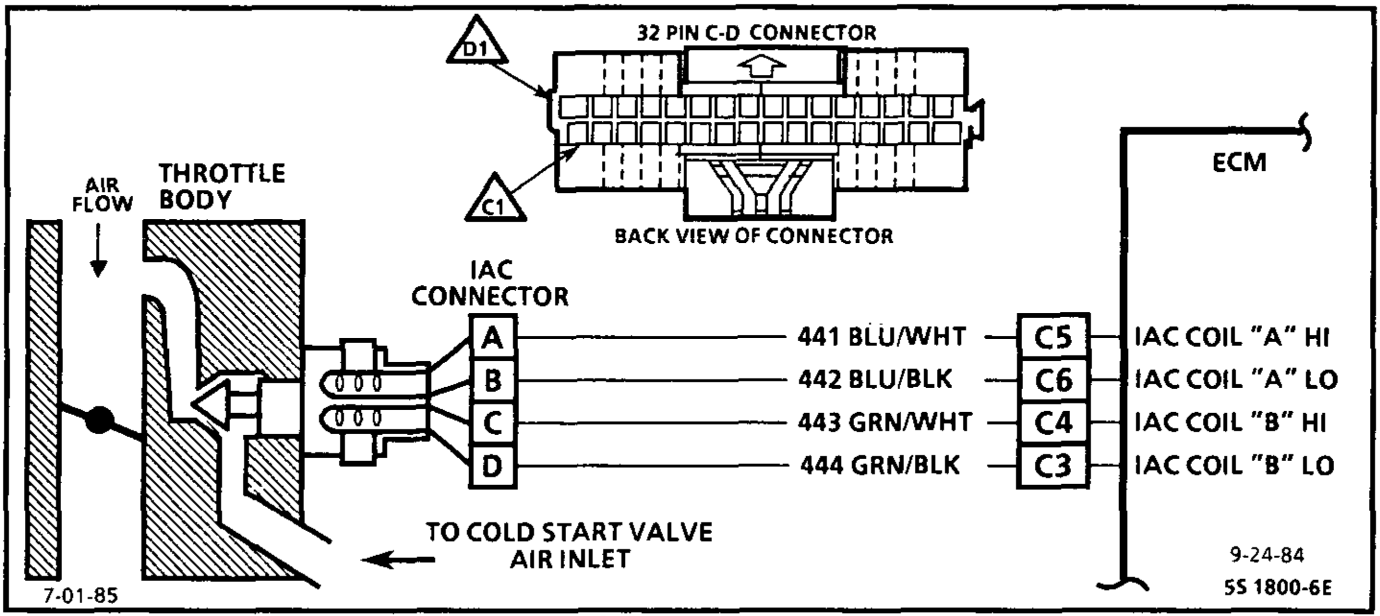
CKT 416 OK, FAULTY ECM CONNECTOR TERMINAL OR ECM.

CODE 33
■ ABOVE .2 VOLTS (200 MV)

REPLACE SENSOR

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*4S 0814 -6E
9-20-85



CODE 35
IDLE AIR CONTROL
2.8L "P" SERIES

Code 35 will set when the closed throttle engine speed is 75 RPM above or below the correct idle speed for 45 seconds. Review general discription in Section "C". Following are nominal warm engine idle speeds:

	AUTO	MANUAL	ALCL
Neutral	900 ± 50	900 ± 58	1000 ± 50
Drive	800 ± 50		1000 ± 50

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 "O" 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 paragraph three below.

2. When the engine was stopped, the IAC Valve retracted (more air) to a fixed "Park" position for increased air flow during the next engine start. A "Scan" will display 95 or more counts.

   Disconnecting the IAC will hold the valve in a retracted or open position and cause a closed throttle idle speed above 1500 RPM.

   A "Scan" will now display "0" counts because the ECM has tried to reduce the idle speed by extending the valve. The IAC is OK. The code 35 is likely a CCP or cruise control vacuum hose disconnected.

3. 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 "O" counts if too high.

   If idle is too high, stop engine. Ignition on. Ground diagnostic terminal. Wait a few seconds for IAC to seat then disconnect IAC. Start engine. If idle speed is above 800 ±50 RPM, locate and correct vacuum leak.

- 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 300MV(.3V). Check for low regulated fuel pressure or water in fuel. A lean exhaust with an oxygen sensor output fixed above 800 mV (.8mv) 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(.8V). Check:
  - High fuel pressure
  - Injector leaking or sticking.

- Map Sensor. Ignition on , engine stopped. Compare MAP Signal voltage with a known good vehicle with the same sensor. Voltage should be the same ± 400 MV (.4V.) Also, disconnect MAP Sensor electrical connector. If idle improves, substitute a known good sensor and recheck.

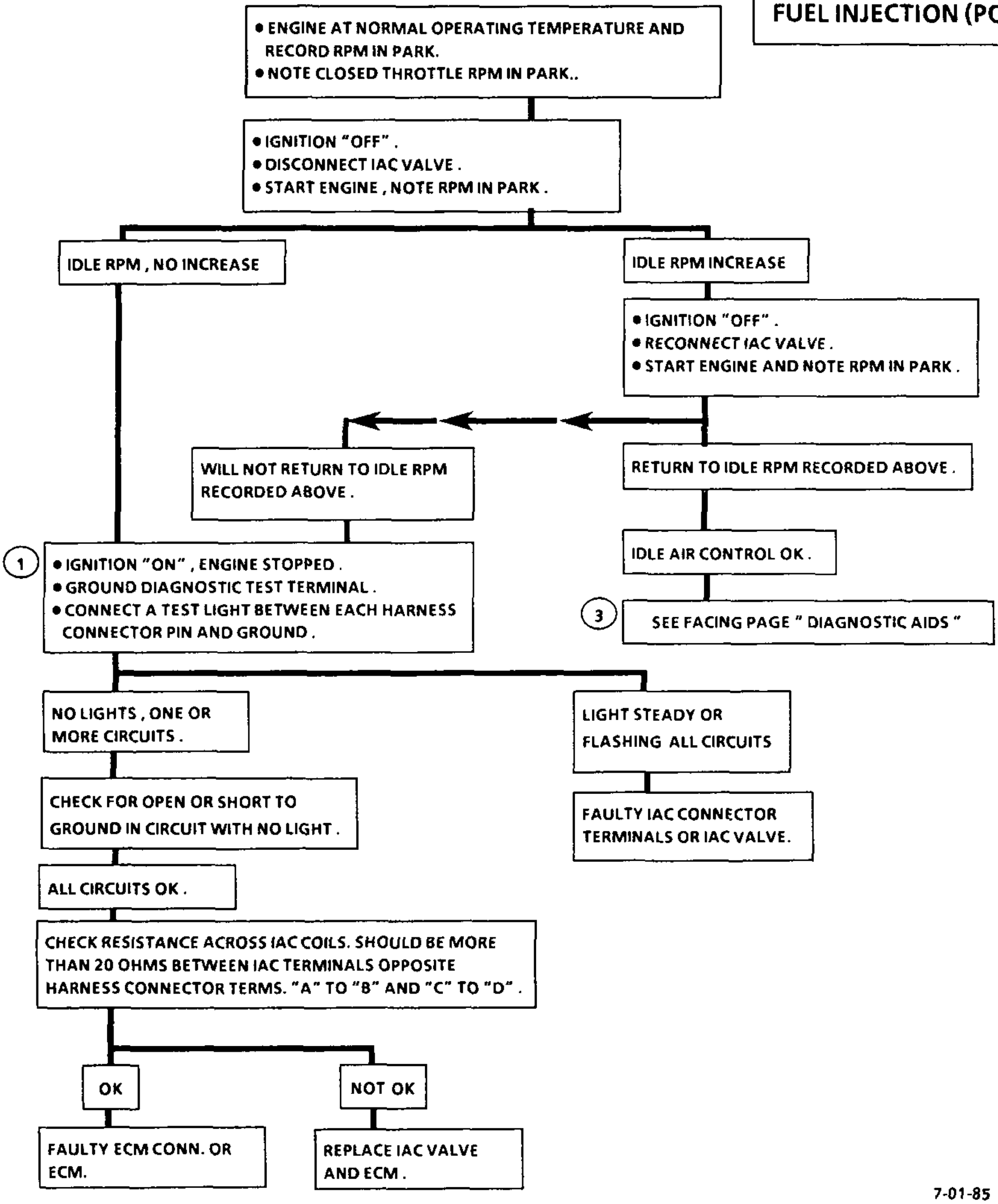
- Throttle body. Remove IAC and inspect bore for foreign material or evidence of IAC valve dragging the bore.

- A/C Compressor or Relay failure. See Chart C-10.

- Refer to Rough, Unstable, Incorrect Idle or Stalling in Symptoms in Section B.

CODE 35

IDLE AIR CONTROL
2.8L "P" SERIES
FUEL INJECTION (PORT)



- ENGINE AT NORMAL OPERATING TEMPERATURE AND RECORD RPM IN PARK.
- NOTE CLOSED THROTTLE RPM IN PARK..

- IGNITION "OFF".
- DISCONNECT IAC VALVE.
- START ENGINE, NOTE RPM IN PARK.

IDLE RPM, NO INCREASE

IDLE RPM INCREASE

- IGNITION "OFF".
- RECONNECT IAC VALVE.
- START ENGINE AND NOTE RPM IN PARK.

WILL NOT RETURN TO IDLE RPM RECORDED ABOVE.

RETURN TO IDLE RPM RECORDED ABOVE.

IDLE AIR CONTROL OK.

③ SEE FACING PAGE " DIAGNOSTIC AIDS "

①
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TEST TERMINAL.
- CONNECT A TEST LIGHT BETWEEN EACH HARNESS CONNECTOR PIN AND GROUND.

NO LIGHTS, ONE OR MORE CIRCUITS.

LIGHT STEADY OR FLASHING ALL CIRCUITS

FAULTY IAC CONNECTOR TERMINALS OR IAC VALVE.

CHECK FOR OPEN OR SHORT TO GROUND IN CIRCUIT WITH NO LIGHT.

ALL CIRCUITS OK.

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

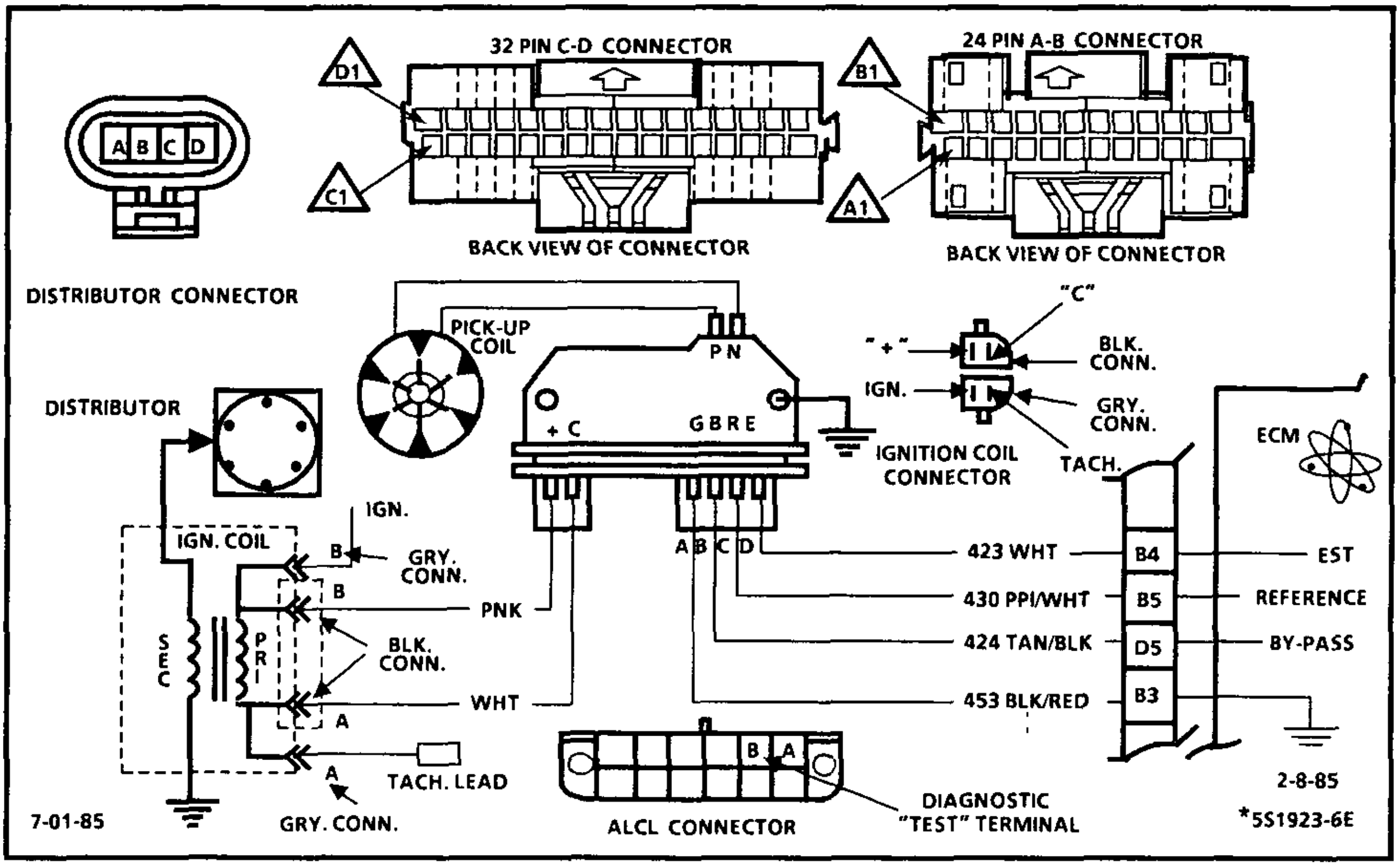
FAULTY ECM CONN. OR ECM.

REPLACE IAC VALVE AND ECM.

7-01-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 5S 1922-6E



CODE 42

ELECTRONIC SPARK TIMING (EST)

2.8L "P" SERIES

FUEL INJECTION (PORT)

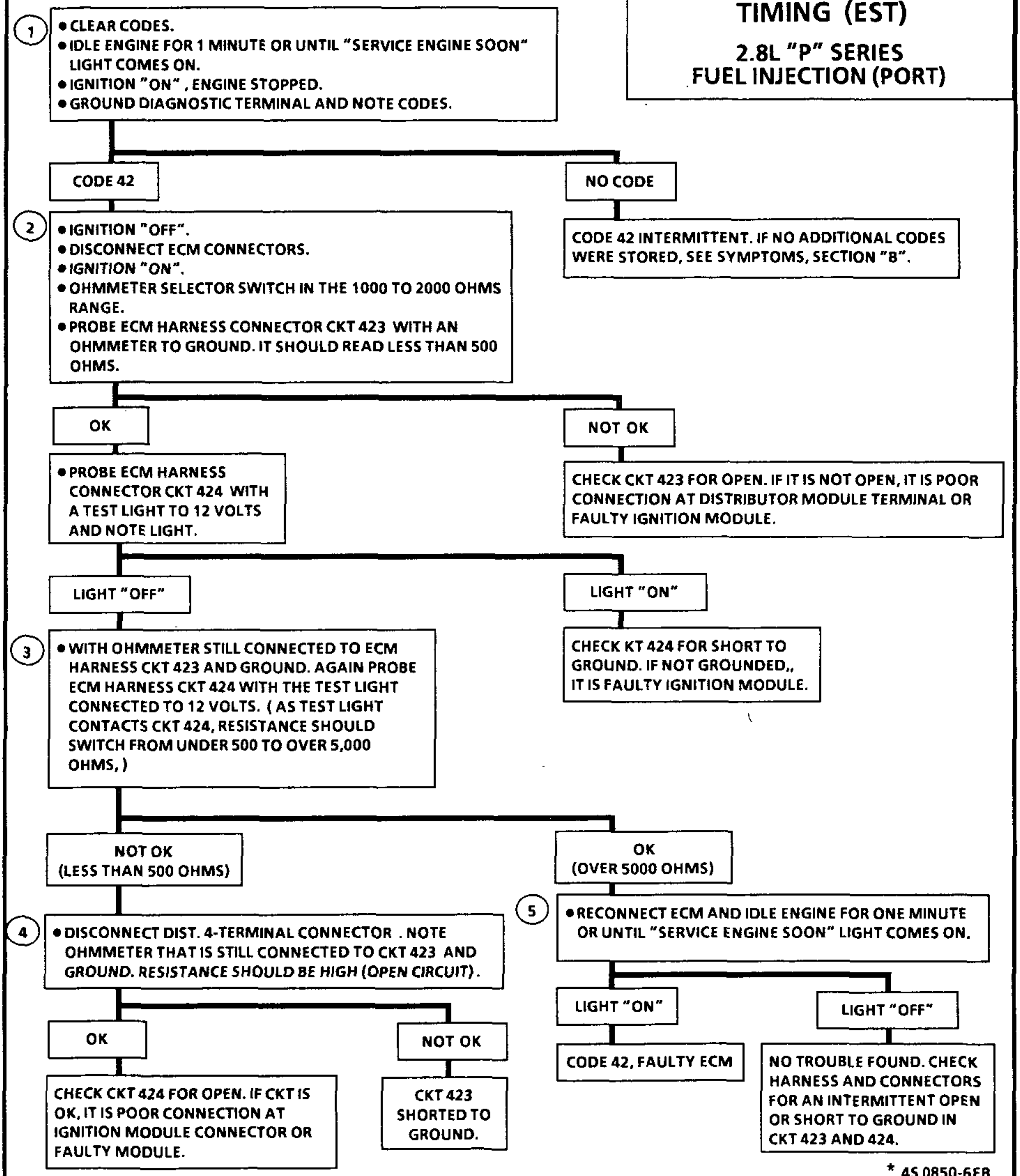
Code 42 means the ECM has seen an open or short to ground in the EST or by-pass circuits.

1. 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.

CODE 42

ELECTRONIC SPARK TIMING (EST)

2.8L "P" SERIES FUEL INJECTION (PORT)



①
- CLEAR CODES.
- IDLE ENGINE FOR 1 MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.
- IGNITION "ON", ENGINE STOPPED.
- GROUND DIAGNOSTIC TERMINAL AND NOTE CODES.

CODE 42

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.

OK

- PROBE ECM HARNESS CONNECTOR CKT 424 WITH A TEST LIGHT TO 12 VOLTS AND NOTE LIGHT.

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,)

NOT OK (LESS THAN 500 OHMS)

④
- DISCONNECT DIST. 4-TERMINAL CONNECTOR . NOTE OHMMETER THAT IS STILL CONNECTED TO CKT 423 AND *GROUND. RESISTANCE SHOULD BE HIGH (OPEN CIRCUIT).*

OK

CHECK CKT 424 FOR OPEN. IF CKT IS OK, IT IS POOR CONNECTION AT IGNITION MODULE CONNECTOR OR FAULTY MODULE.

NOT OK

CKT 423 SHORTED TO GROUND.

OK (OVER 5000 OHMS)

⑤
- RECONNECT ECM AND IDLE ENGINE FOR ONE MINUTE OR UNTIL "SERVICE ENGINE SOON" LIGHT COMES ON.

LIGHT "ON"

CODE 42, FAULTY ECM

LIGHT "OFF"

NO TROUBLE FOUND. CHECK HARNESS AND CONNECTORS FOR AN INTERMITTENT OPEN OR SHORT TO GROUND IN CKT 423 AND 424.

LIGHT "ON"

CHECK KT 424 FOR SHORT TO GROUND. IF NOT GROUNDED,, IT IS FAULTY IGNITION MODULE.

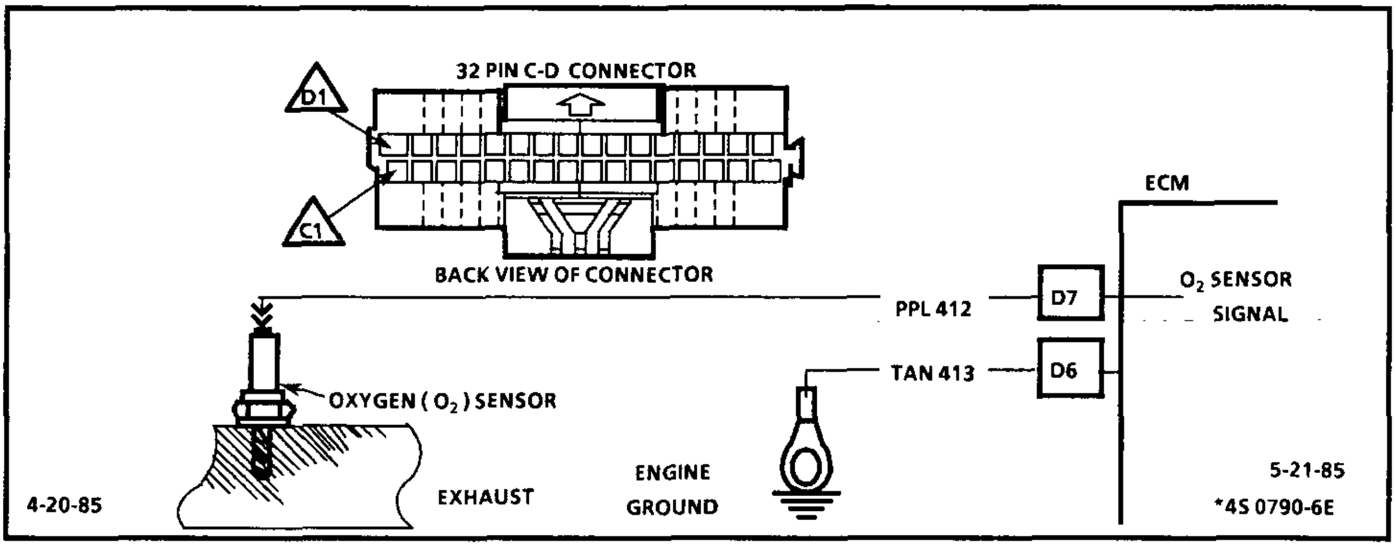
NOT OK

CHECK CKT 423 FOR OPEN. IF IT IS NOT OPEN, IT IS POOR CONNECTION AT DISTRIBUTOR MODULE TERMINAL OR FAULTY IGNITION MODULE.

NO CODE

CODE 42 INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, SEE SYMPTOMS, SECTION "B".

84-85 CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 44

LEAN EXHAUST INDICATION

2.8L "P" SERIES

FUEL INJECTION (TBI)

The ECM supplies a voltage of about .45 volt between Circuits 412 and 413. (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.

Code 44 is set when the O_2 sensor signal voltage at the ECM Circuit 412:

- Remains below 2 volt for 50 seconds or more;
- Time since engine start is 1 minute or longer

1. Grounding the diagnostic terminal with the engine running, enables the "Field Service Mode" and allows the ECM to confirm either open or closed loop operation.
2. A light out or "Open Loop" indicates the fault is present. Disconnecting the O_2 sensor will raise the signal voltage above .2 volt. If the ECM and wiring are OK, the ECM should recognize the higher voltage, .35 to .55, and flash open loop when the engine is started.

DIAGNOSTIC AIDS:

3. The Code 44 or lean exhaust is most likely caused by one of the following:

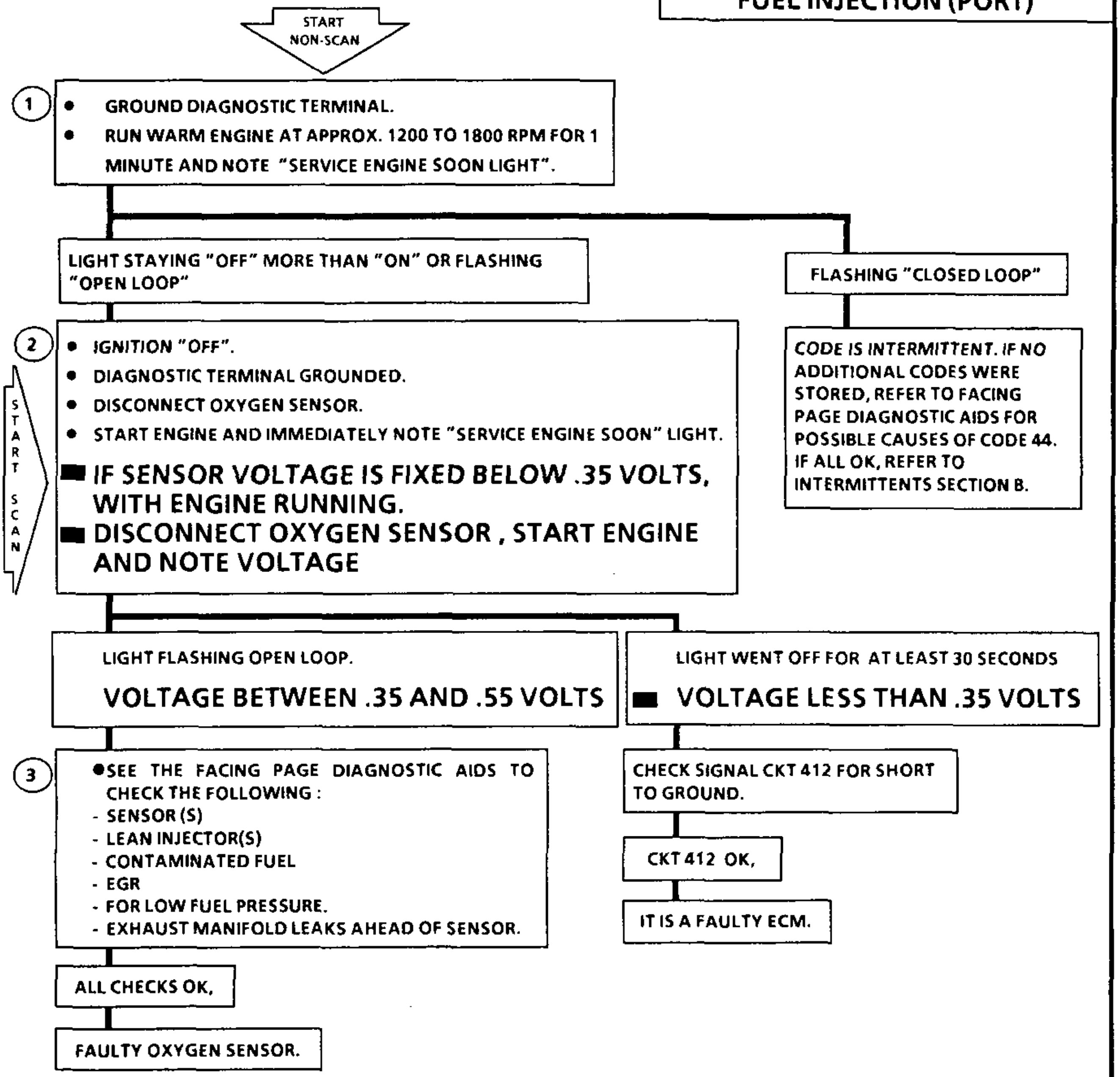
- Lean injectors. Perform injector balance test Chart C-2A.
- Fuel Pressure. System will be lean if pressure is too low. It may be necessary to monitor fuel pressure while driving the car at various road speeds and/ or loads to confirm.
- Fuel contamination. Water, even in small amounts, near the in-tank fuel pump inlet can be delivered to the injector. The water causes a lean exhaust and can set a Code 44.
- EGR. In normal operation, the ECM delivers less fuel and advances spark when EGR comes in. If the EGR does not open, the system will go lean and may have slight spark knock.
- O^2 Sensor Wire. Sensor pigtail may be mispositioned and contacting the exhaust manifold.
- Check for ground in wire between connector and sensor.
- MAP sensor. An output that causes the ECM to sense a lower than normal manifold pressure (high vacuum) will cause the system to go lean.
- Exhaust Leaks. If there is an exhaust leak, the engine can cause outside air to be pulled into the exhaust and past the sensor.
- If the above are OK, and the instructions at the top of the chart will still set a Code 44, or "SERVICE ENGINE SOON" light is "OFF" more than "ON", or flashing "OPEN LOOP", it is a faulty Oxygen Sensor.

"SCAN" STEP ONLY ■

CODE 44

LEAN EXHAUST INDICATION

2.8L "P" SERIES
FUEL INJECTION (PORT)



START NON-SCAN

①
- GROUND DIAGNOSTIC TERMINAL.
- RUN WARM ENGINE AT APPROX. 1200 TO 1800 RPM FOR 1 MINUTE AND NOTE "SERVICE ENGINE SOON LIGHT".

LIGHT STAYING "OFF" MORE THAN "ON" OR FLASHING "OPEN LOOP"

FLASHING "CLOSED LOOP"

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO FACING PAGE DIAGNOSTIC AIDS FOR POSSIBLE CAUSES OF CODE 44. IF ALL OK, REFER TO INTERMITTENTS SECTION B.

START SCAN

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR.
- START ENGINE AND IMMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT.

■ IF SENSOR VOLTAGE IS FIXED BELOW .35 VOLTS, WITH ENGINE RUNNING.

■ DISCONNECT OXYGEN SENSOR, START ENGINE AND NOTE VOLTAGE

LIGHT FLASHING OPEN LOOP.

VOLTAGE BETWEEN .35 AND .55 VOLTS

LIGHT WENT OFF FOR AT LEAST 30 SECONDS

■ VOLTAGE LESS THAN .35 VOLTS

③
- SEE THE FACING PAGE DIAGNOSTIC AIDS TO CHECK THE FOLLOWING :
  - SENSOR (S)
  - LEAN INJECTOR(S)
  - CONTAMINATED FUEL
  - EGR
  - FOR LOW FUEL PRESSURE.
  - EXHAUST MANIFOLD LEAKS AHEAD OF SENSOR.

ALL CHECKS OK,

FAULTY OXYGEN SENSOR.

CHECK SIGNAL CKT 412 FOR SHORT TO GROUND.

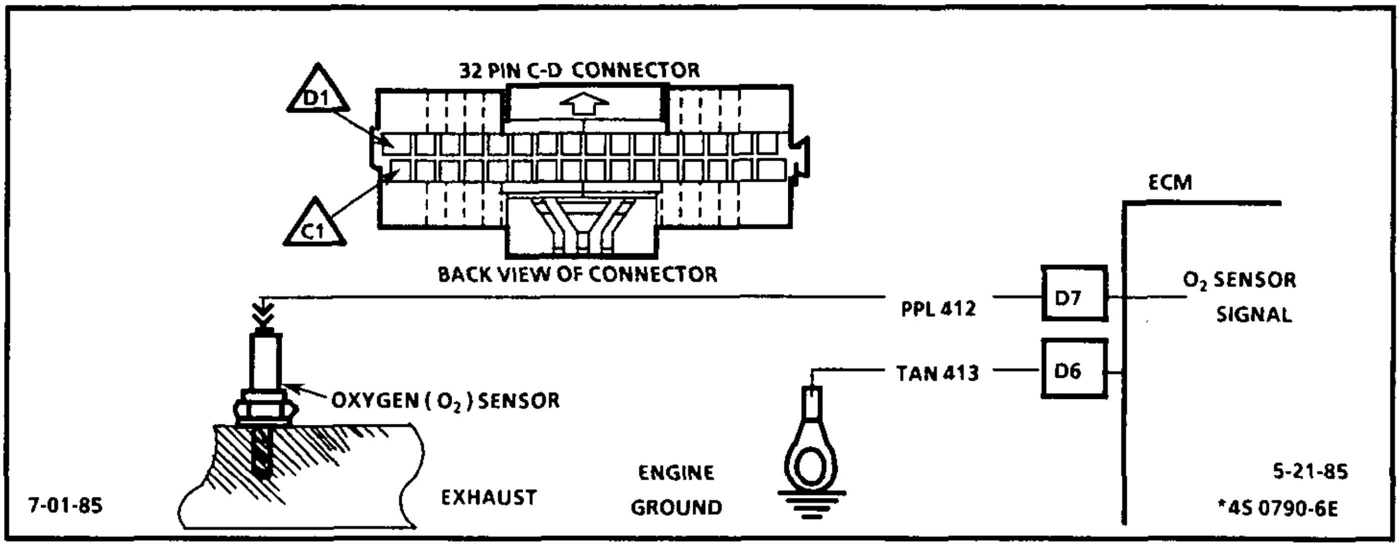
CKT 412 OK,

IT IS A FAULTY ECM.

FIELD SERVICE MODE :
ENGINE RUNNING, DIAGNOSTIC TERMINAL GROUNDED.
OPEN - LOOP, " SERVICE ENGINE SOON " LIGHT FLASHES AT A RATE OF 2 TIMES PER SECOND.
CLOSED - LOOP, " SERVICE ENGINE SOON " LIGHT FLASHES AT A RATE OF 1 TIME PER SECOND.

84 - 85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.



CODE 45

RICH EXHAUST INDICATION

2.8L "P" SERIES

FUEL INJECTION (PORT)

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 O2 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..

Code 45 is set when the O2 sensor signal voltage at the ECM C-D connector terminal D-7

- Remains above .7 volt for 30 seconds; and
- Engine time after start is 1 minute or more.

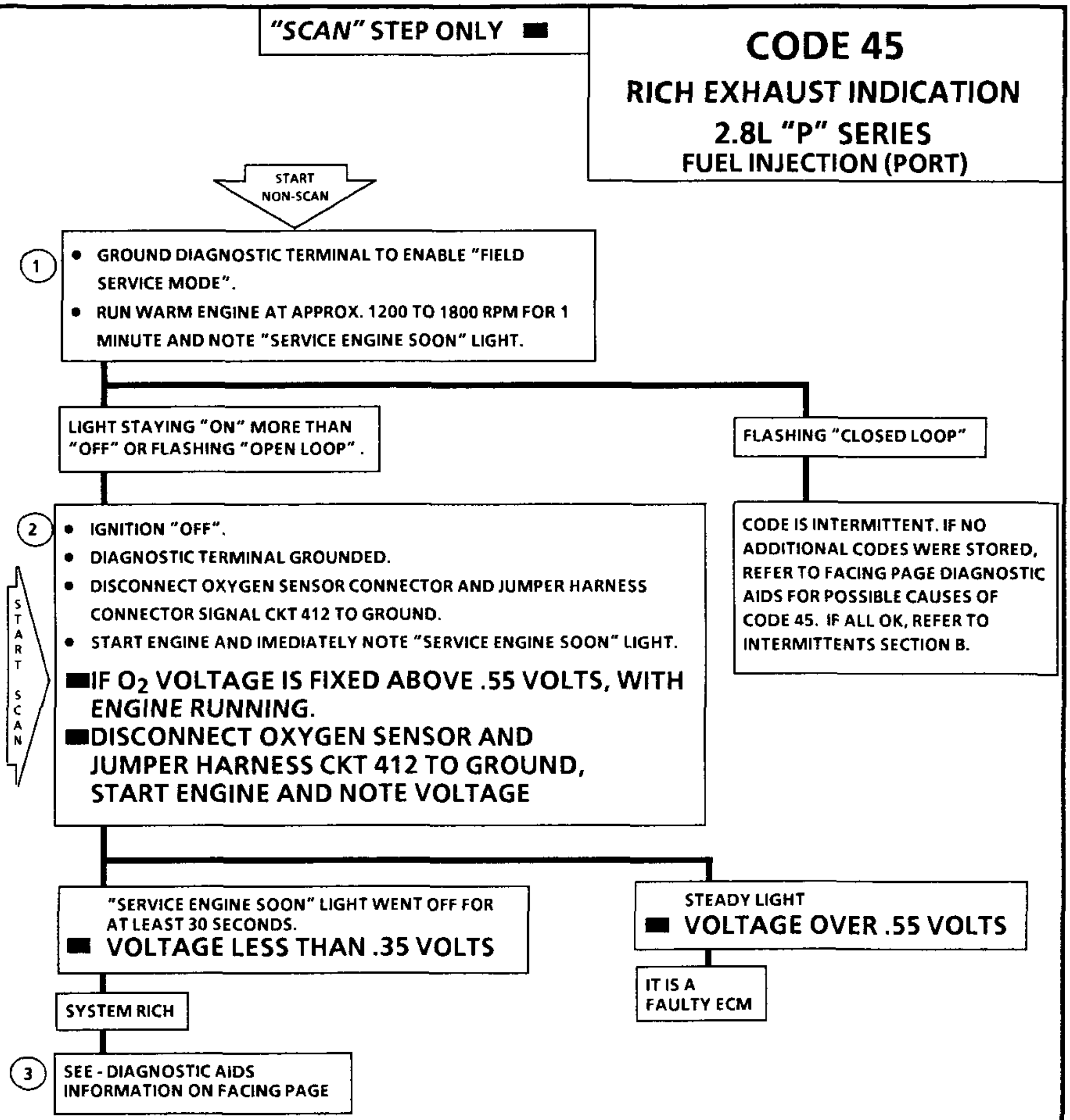
1. Grounding the diagnostic terminal with the engine running, enables the "Field Service Mode" and allows the ECM to confirm either open or closed loop operation.using the "SERVICE ENGINE SOON" light.
2. A steady light or "Open Loop" indicates the fault is present. Grounding CKT 412 causes a low O2 signal voltage.If the ECM and wiring are OK, The ECM should recognize the low voltage and confirm the lean signal by turning off the "SERVICE ENGINE SOON" light for at least 15 seconds.
3. **DIAGNOSTIC AIDS:**
   - 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 will be set.

   See Fuel System diagnosis Chart A-7.
   - Rich injector. Perform injector balance test Chart C-2A.
   - An EGR sticking open may result in a code 45 at idle.
   - Leaking injector(s). See Chart A-7A.
   - HEI Shielding. An open ground CKT 453 may result in EMI, or induced electrical "noise". The ECM looks at this "noise" as distributor 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.
   - MAP sensor. An output that causes the ECM to sense a higher than normal manifold pressure (low vacuum) can cause the system to go rich. Disconnecting the MAP sensor will allow the ECM to set a fixed value for the MAP sensor. Substitute a different MAP sensor if the 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.
   - 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 delievered to the engine, causing a severe driveability problem.

CODE 45

RICH EXHAUST INDICATION

2.8L "P" SERIES
FUEL INJECTION (PORT)



①
- GROUND DIAGNOSTIC TERMINAL TO ENABLE "FIELD SERVICE MODE".
- RUN WARM ENGINE AT APPROX. 1200 TO 1800 RPM FOR 1 MINUTE AND NOTE "SERVICE ENGINE SOON" LIGHT.

LIGHT STAYING "ON" MORE THAN "OFF" OR FLASHING "OPEN LOOP".

FLASHING "CLOSED LOOP"

CODE IS INTERMITTENT. IF NO ADDITIONAL CODES WERE STORED, REFER TO FACING PAGE DIAGNOSTIC AIDS FOR POSSIBLE CAUSES OF CODE 45. IF ALL OK, REFER TO INTERMITTENTS SECTION B.

②
- IGNITION "OFF".
- DIAGNOSTIC TERMINAL GROUNDED.
- DISCONNECT OXYGEN SENSOR CONNECTOR AND JUMPER HARNESS CONNECTOR SIGNAL CKT 412 TO GROUND.
- START ENGINE AND IMEDIATELY NOTE "SERVICE ENGINE SOON" LIGHT.

■ IF O_2 VOLTAGE IS FIXED ABOVE .55 VOLTS, WITH ENGINE RUNNING.

■ DISCONNECT OXYGEN SENSOR AND JUMPER HARNESS CKT 412 TO GROUND, START ENGINE AND NOTE VOLTAGE

"SERVICE ENGINE SOON" LIGHT WENT OFF FOR AT LEAST 30 SECONDS.
■ VOLTAGE LESS THAN .35 VOLTS

STEADY LIGHT
■ VOLTAGE OVER .55 VOLTS

IT IS A FAULTY ECM

SYSTEM RICH

③ SEE - DIAGNOSTIC AIDS INFORMATION ON FACING PAGE

FIELD SERVICE MODE;
- ENGINE RUNNING, DIAGNOSTIC TERMINAL GROUNDED.
- OPEN - LOOP, "SERVICE ENGINE SOON" LIGHT FLASHES AT A RATE OF 2.5 TIMES PER SECOND.
- CLOSED LOOP, "SERVICE ENGINE SOON" LIGHT FLASHES AT A RATE OF 1 TIME PER SECOND.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

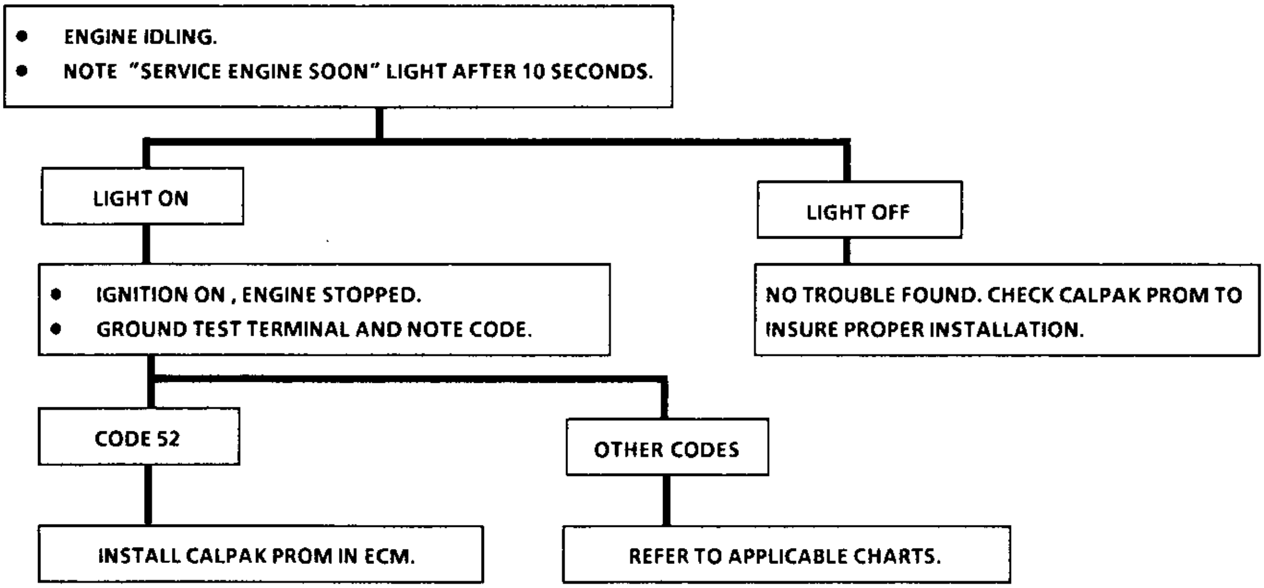
CODE 51
CODE 52
CODE 53
CODE 55
2.8L "P" SERIES
FUEL INJECTION (PORT)

CODE 51

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

FUEL CALPAK MISSING



- ENGINE IDLING.
- NOTE "SERVICE ENGINE SOON" LIGHT AFTER 10 SECONDS.

LIGHT ON

- IGNITION ON , ENGINE STOPPED.
- GROUND TEST TERMINAL AND NOTE CODE.

CODE 52

INSTALL CALPAK PROM IN ECM.

OTHER CODES

REFER TO APPLICABLE CHARTS.

LIGHT OFF

NO TROUBLE FOUND. CHECK CALPAK PROM TO INSURE PROPER INSTALLATION.

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 .

CODE 55

BE SURE ECM GROUNDS ARE OK. IF OK REPLACE ELECTRONIC CONTROL MODULE (ECM)

3-30-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

*5S 1516-6E

SECTION B
SYMPTOMS

SECTION B
SYMPTOMS

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.
3. The fuel control system is operating OK (by performing Field Service Mode 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 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.
- 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. An abnormal voltage reading when the problem occurs indicates the problem may be in that circuit. If the wiring and connections 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.
- ■ A "SCAN" tool can also be used by selecting the position of the suspected problem circuit and moving related wiring and connectors. See Introduction to this Section on how each "SCAN" tool position can be used.

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.

- <u>Loss of trouble code memory.</u> 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 circuit 453 to distributor should be a good ground.
- 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.
  - 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.
  - Fuel pump relay - See Chart A-7A step 2.
  - 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.

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.
  - Spark plugs for being fouled or faulty wiring.
  - PROM number. Also check Service Bulletins for latest PROM.
  - TPS *for binding or sticking.* Voltage should increase at a steady rate as throttle is moved toward W.O.T.
  - MAP Sensor - Chart C-1F.
  - Ignition timing. See Emission Control Information label.
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
  - HEI ground, circuit 453.
  - Canister purge system for proper operation. See CHART C-3.
  - EGR - See CHART C-7.
  - Engine Thermostat - functioning correctly and proper heat range.
- 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:
  - Generator output voltage. Repair if less than 9 or more than 16 volts.
- ■ If a "SCAN" tool is available which plugs in to the ALCL connector, make sure reading of VSS matches vehicle speedometer. See Introduction explaining "SCAN" tool positions.
  - EGR - There should be no EGR at idle. See CHART C-7.
  - EGR filter for being plugged.
  - 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.

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:
  - Ignition timing. See Emission Control Information label.
  - Restricted fuel filter, contaminated fuel or improper fuel pressure. See CHART A-7.
  - ECM power grounds - See wiring diagrams.
  - EGR operation for being open or partly open all the time - CHART C-7.
  - Exhaust system for possible restriction:
    - 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.
- 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 - 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.

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 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, 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 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).
  - 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.
  - 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.
- 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:
  - 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.

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.
  - Ignition timing. See Emission Control Information label.
  - TCC for proper operation. See CHART C-8.
  - Induction system and crankcase for air leaks.

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.
  - IAC system. See Code 35 facing page.
  - 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. Section C3.
  - Power Steering Pressure switch input. See CHART C-1E or use "SCAN" tool.
  - 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.
  - 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 of faulty cycling switch.
  - 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 proper operation of A/C system. See Chart C-10.

EXCESSIVE EXHAUST EMISSIONS (ODORS)

- If test shows higher than normal CO and HC, (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.
  - Injector balance. See CHART C-2A.
  - PCV valve for being plugged, stuck, or blocked PCV hose.
  - Spark plugs, plug wires, and distributor cap. See Section 6D.
  - Check for lead contamination of catalytic converter (look for removal of fuel filler neck restrictor).
- 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.
    - Remove carbon with top engine cleaner. Follow instructions on can.
    - Check ignition timing for excessive base advance. See Emission Control Information label.

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.

Following are the sub-section identification and the system covered:

DIAGNOSTIC CHARTS

The Diagnostic Charts for each system are found after the on-car sercvice 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

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 various systems that affect vehicle performance. For service, the ECM has three parts: a seperate Controller (the ECM without the PROM), a separate calibrator (PROM), and a CALPAK .

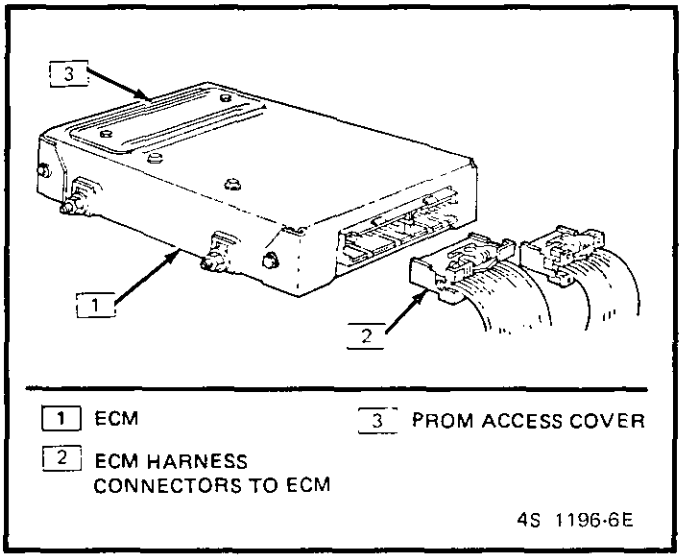


Figure C1-1 Electronic Control Module (ECM)

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 voltmeter is required to assure accurate voltage readings.

The ECM controls output circuits such as the Injectors, IAC, AC Control Relay, etc., by controlling the ground circuit through transistors in the ECM.

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 other components. 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.

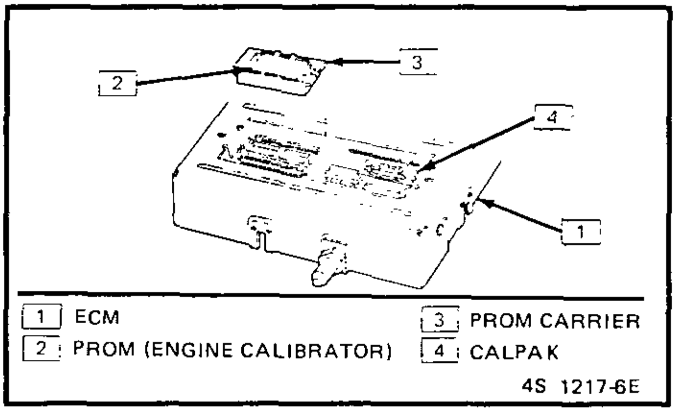


Figure C1-2 PROM (Calibrator) and CALPAK

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

A device called a CALPAK is used to allow fuel delivery if certain parts of the ECM should fail. 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, a Code 52 will be set.

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).

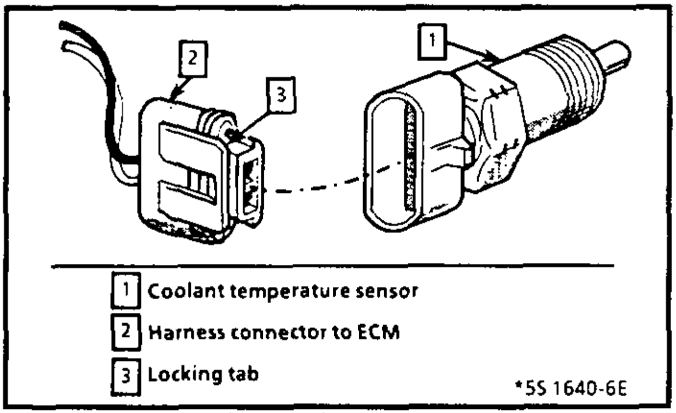


Figure C1-3 Engine Coolant Temperature Sensor

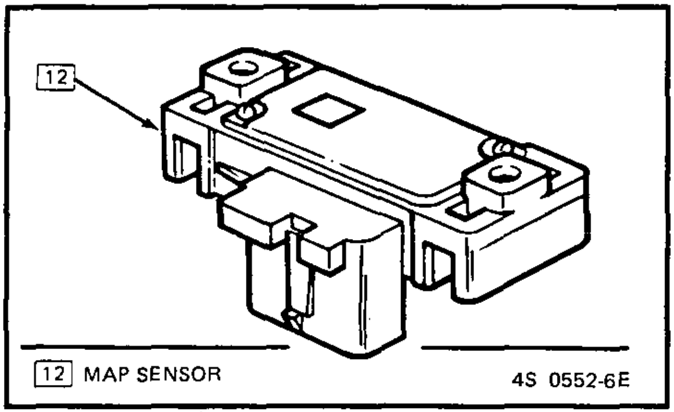


Figure C1-4 MAP Sensor

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.

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 Assy. 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 incoming air is cold, and low when the air is hot.

A failure in the MAT sensor circuit should set either a Code 23 or Code 25.

Manifold Absolute Pressure (MAP) Sensor

The Manifold Absolute Pressure (MAP) sensor (see 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. Manifold Absolute Pressure (MAP) is the OPPOSITE of what you would measure on a vacuum gage. 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.

A failure in the MAP sensor circuit should set a Code 33 or Code 34.

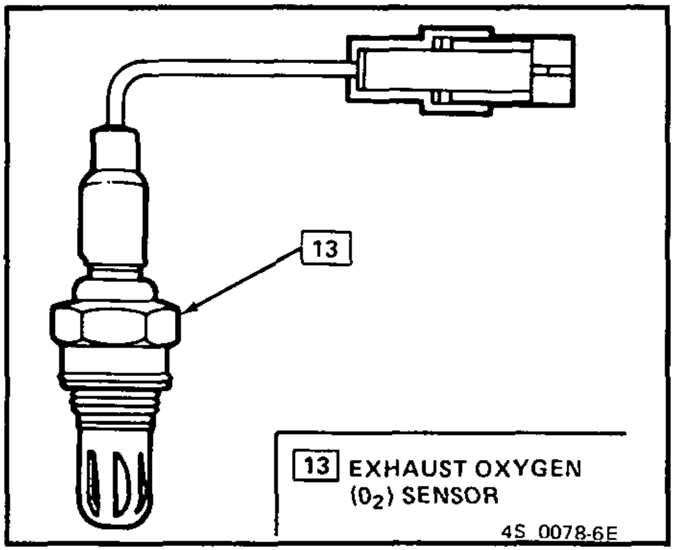


Figure C1-5 Exhaust Oxygen (0_2) Sensor

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. The oxygen content in the exhaust reacts with the oxygen sensor to produce a voltage output. This voltage ranges from approximately .1 volts (high 0_2 - lean mixture) to .9 volts (low 0_2 - rich mixture).

By monitoring the voltage output of the 0_2 sensor, the ECM will know what fuel mixture command to give to the injectors (lean mixture-low voltage-rich command, rich mixture-high voltage-lean command).

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 throttle body (see Figure C1-6) 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. As the throttle valve opens, the output increases so that, at wide-open throttle, the output voltage should be approximately 5 volts.

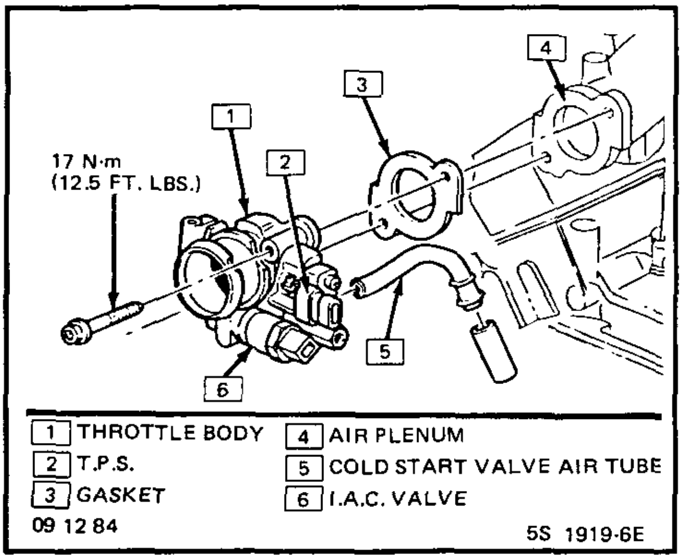


Figure C1-6Throttle Position Sensor

By monitoring the output voltage from the TPS, the ECM can determine fuel delivery based on throttle valve angle (driver demand).

Failure in the TPS circuit will set a Code 22 (low voltage) or Code 21 (Voltage too high)

Park/Neutral Switch (Auto Trans. 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 system, IAC valve operation, and EGR control.

NOTICE: *Vehicle should not be driven with ParklNeutral switch disconnected as idle quality may be affected.*

An inoperative P/N switch could cause improper idle speed or TCC operation. See Section 8A for more information on the P/N switch.

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 before turning on the A/C relay and to determine when A/C is requested. The ECM has total control of the A/C clutch.

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 Section C8 "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 Section C4 "EST System" for further information.

DIAGNOSIS

To read the codes, 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 12V pigtail connector located near the battery.

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 indicated 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". 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 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 the PROM rarely fails, it operates as part of the ECM. Therefore, it could be the cause of the problem.

- 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 failure - Chart 51.
- Coolant Temperature Sensor - Charts 14 and 15 .
- MAT Sensor - Charts 23 and 25.
- VSS - Chart 24.
- TPS - Charts 21 or 22.
- MAP - Charts 33 and 34.
- P/N switch - Chart C-1A.
- O_2 Sensor - Chart 13, 44, and 45.
- A/C "ON" signal - Chart C-10. If the A/C "ON" signal is not reaching the ECM, it can cause rough idle, loss of A/C, or other symptoms. These symptoms are covered in Section B.

ON-CAR SERVICE

ELECTONIC 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 and CALPAK from the faulty ECM and install them 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 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.

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.).*

See Section 8C for console removal and installation procedures. Section 8A or Figure C1-7. also shows the location of the ECM.

Remove or Disconnect

1. Negative battery cable.
2. Refer to Section C8 for removal of console cover.
3. ECM from bracket.
4. ECM connectors.

Install or Connect

1. Connector on ECM.
2. ECM on bracket.
3. Console cover.
4. Negative battery cable.

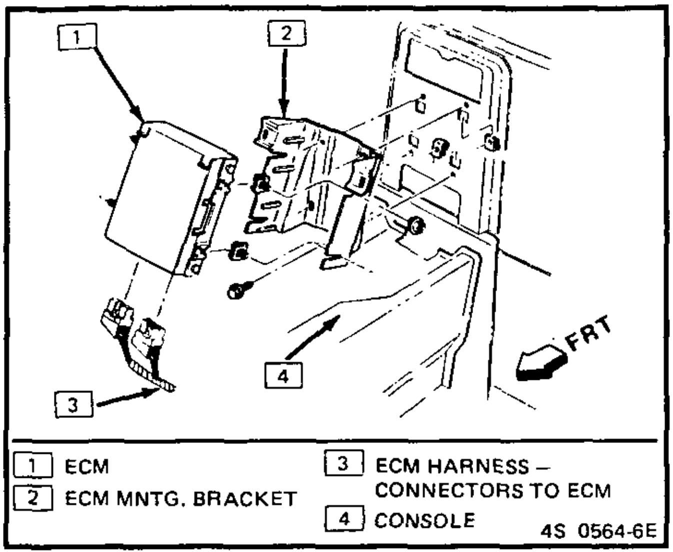


Figure C1-7 ECM Mounting P Series

PROM

Code 51 indicates a faulty PROM, 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.

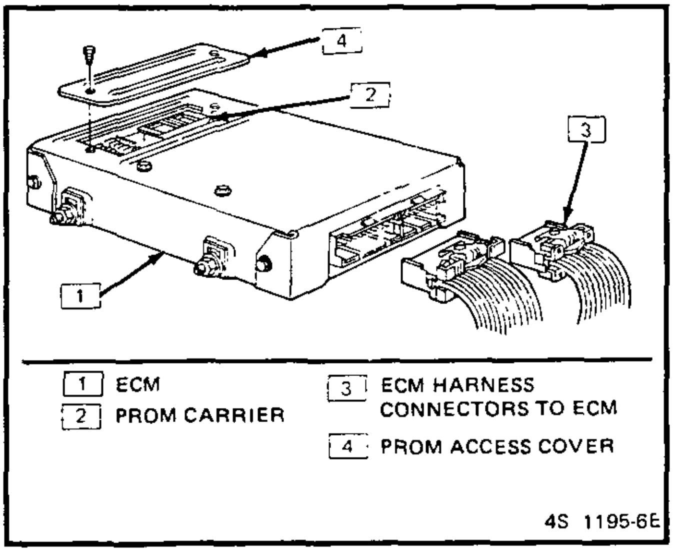


Figure C1-8 PROM Access Cover

Remove or Disconnect

1. Connectors from ECM.
2. ECM mounting hardware.
3. ECM from passenger compartment.
4. ECM access cover (see Figure C1-8).
5. 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 C1-9). 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.

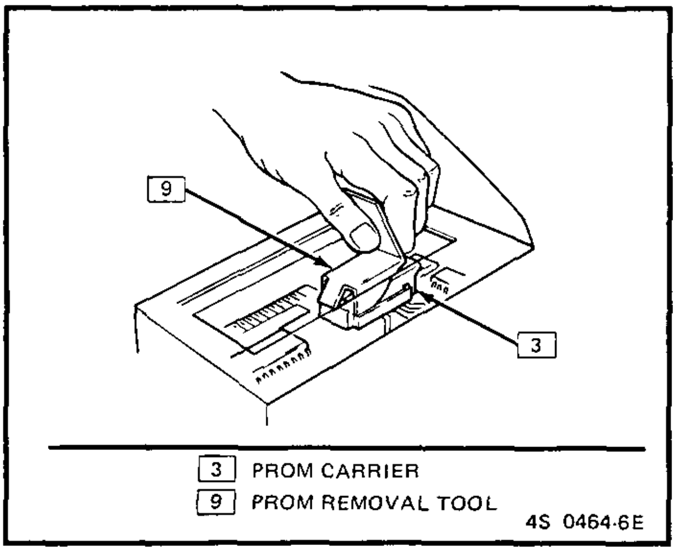


Figure C1-9 PROM Removal Tool

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 C1-10
3. Using the removal tool, pictured in Figure C1-11 grasp the CALPAK 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.

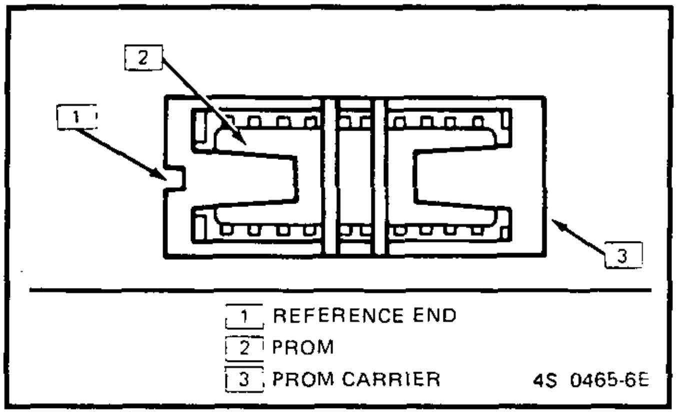


Figure C1-10 PROM in PROM Carrier

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.

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 are 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, had bent pins, or is defective.

- If not fully seated, press firmly on PROM or CALPAK carrier.
- If it is necessary to remove the PROM, follow instructions.
- 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 IS INSTALLED BACKWARDS AND THE IGNITION SWITCH TURNED ON, THE PROM IS DESTROYED.

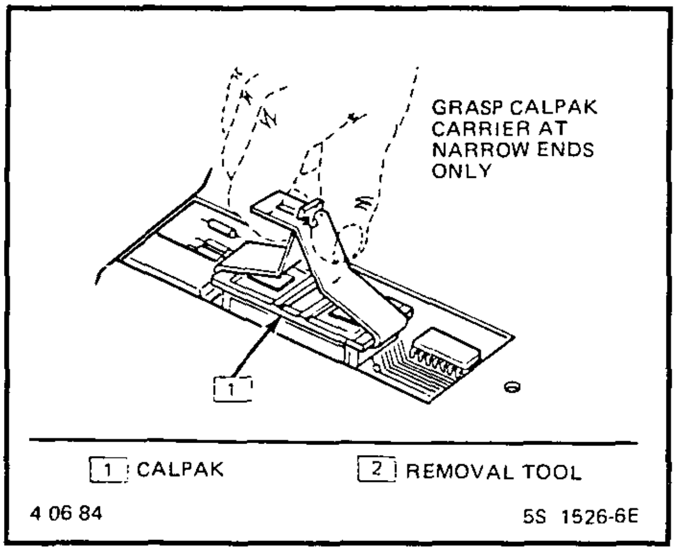


Figure C1-11 Removing CALPAK

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. EGR Solenoid bracket.
3. Electrical connector.
4. Carefully back out coolant sensor.

Install or Connect

1. Sensor in engine.
2. Electrical connector.
3. EGR Solenoid bracket.
4. Negative battery cable.

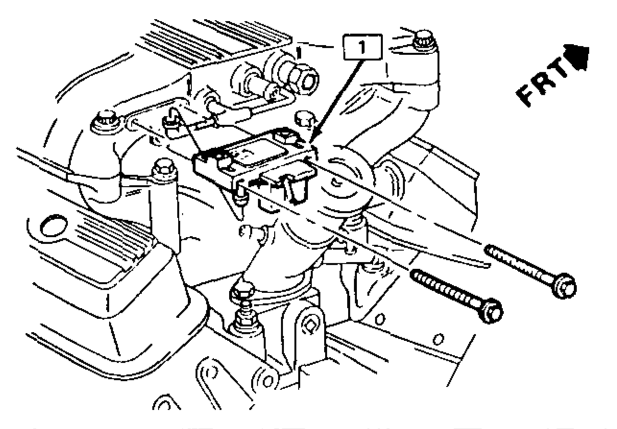


Figure C1-12 MAP Sensor Service

MAP SENSOR

Other than checking for loose vacuum hose and electrical connection the only service possible is unit replacement if diagnosis shows sensor to be faulty. Figure C1-12 shows location and replacement of MAP sensor.

MAT SENSOR

Replacement of the MAT Sensor, mounted in the air cleaner assembly, uses the same procedure as for the coolant sensor.

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.

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.

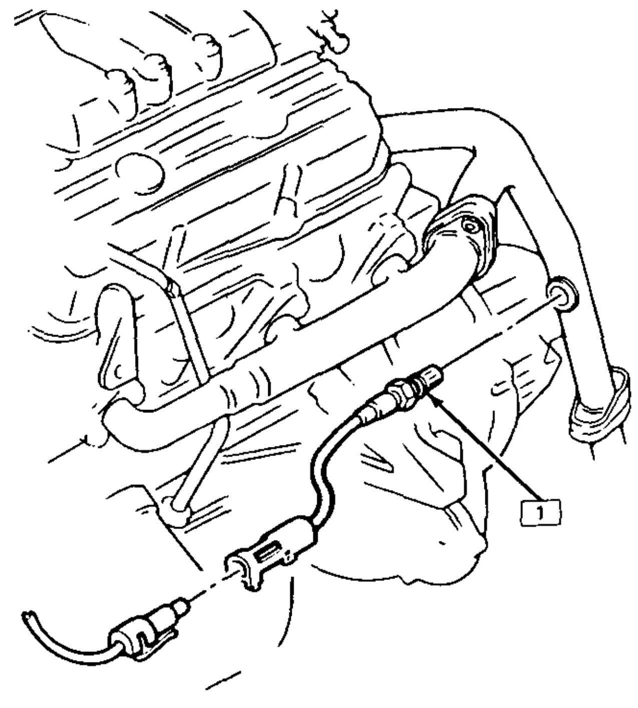


Figure C1-13 Oxygen Sensor

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 lockwashers.

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.
3. Tighten screws to 2.0 N.m (18 in. lbs.)
4. Electrical Connector

PARK/NEUTRAL SWITCH

This switch is mounted on the transaxle. On-Car Service and Adjustment Procedures are listed in Section 3B 4 or 7A. Also Section 8A contains information on the P/N switch.

PARTS INFORMATION

PART NAME	GROUP
Controller, ECM	3.670
Calibrator, PROM	3.670
CALPAK	3.670
Sensor, Coolant Temp.	3.682
Sensor, Exhaust Oxygen	3.682
Sensor, Manif Absolute Sensor (MAP)	3.682
Sensor, Manif Air Temp (MAT)	3.682
Sensor, Throttle Position: Part of Sensor Kit, Throttle Position	3.440
Sensor, Vehicle Speed	3.682

BLANK

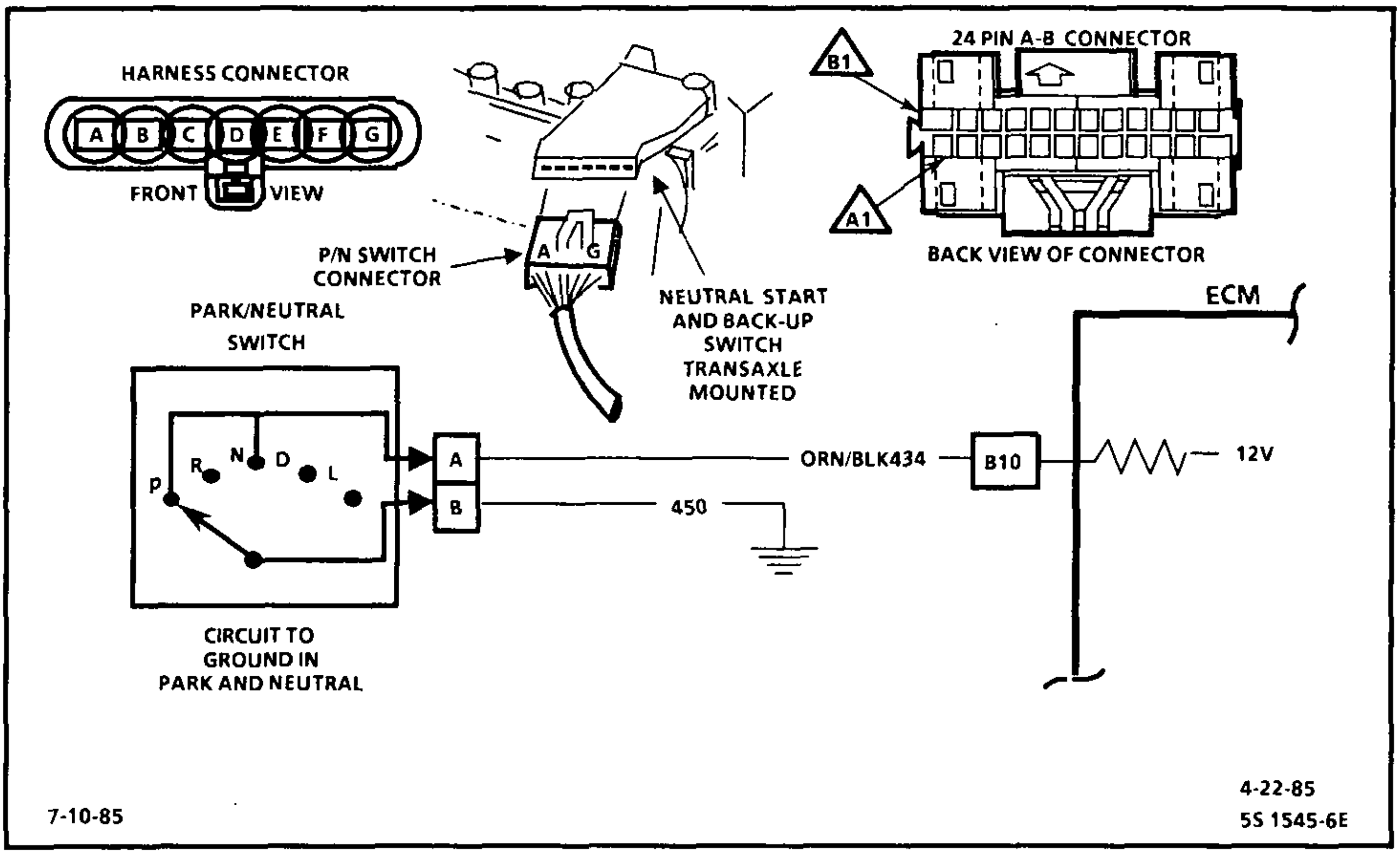


CHART C-1A

PARK/NEUTRAL SWITCH
2.8L "P" SERIES

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.

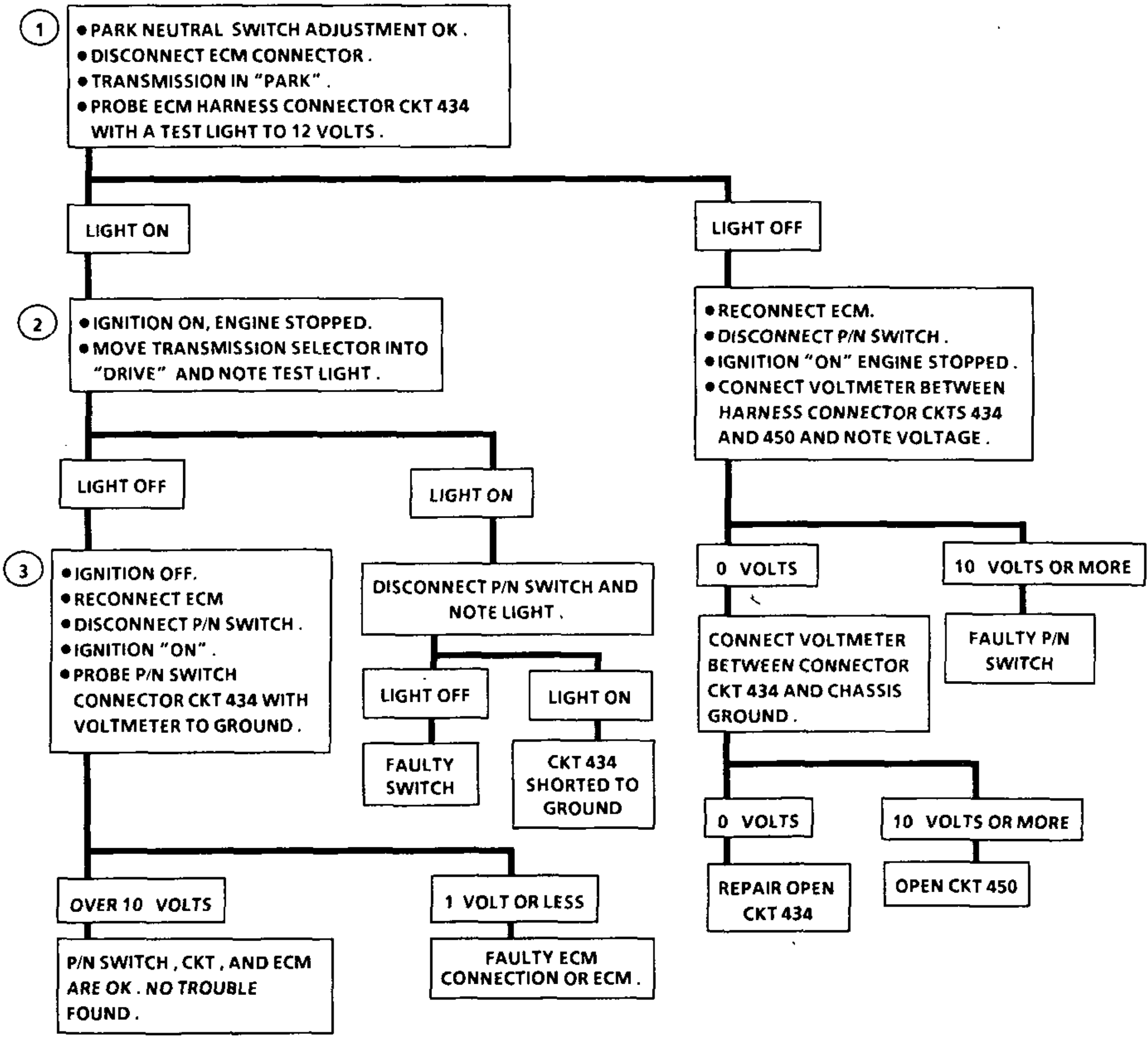
The ECM uses the P/N signal as one of the inputs to control;
Idle Air Control
VSS Diagnostics

1. Checks for a closed switch to ground in park position. If using an ohmmeter instead of a test light the resistance will be low, indicating continuity to gnd.
2. Checks for an open switch in drive range. If using an ohmmeter instead of a test light to 12 volts, the resistance will be high or infinity, indicating an open switch.
3. Checks to this point indicate the P/N switch and wiring are OK, however, the ECM signal voltage on ckt. 434 may be missing. To check, reconnect ECM. Either back probe ECM connector circuit 434 with selector in drive or disconnect P/N switch and probe harness connector ckt 434 with a voltmeter to ground.

CHART C-1A

PARK NEUTRAL SWITCH DIAGNOSIS
(AUTO TRANSAXLE ONLY)

2.8L "P" SERIES
FUEL INJECTION (PORT)



CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

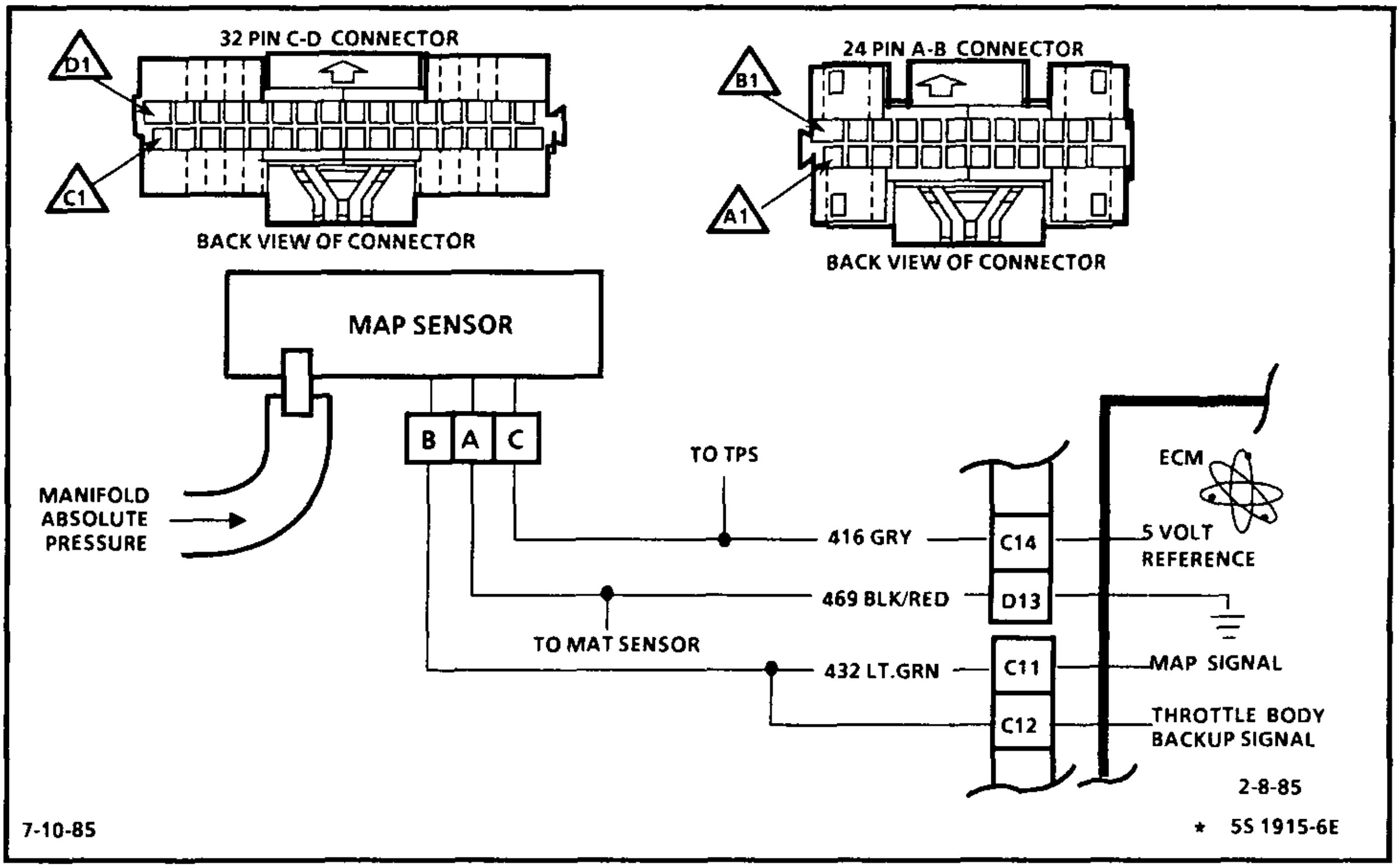


CHART C-1D

MAP OUTPUT CHECK
2.8L "P" SERIES

FUEL INJECTION (PORT)

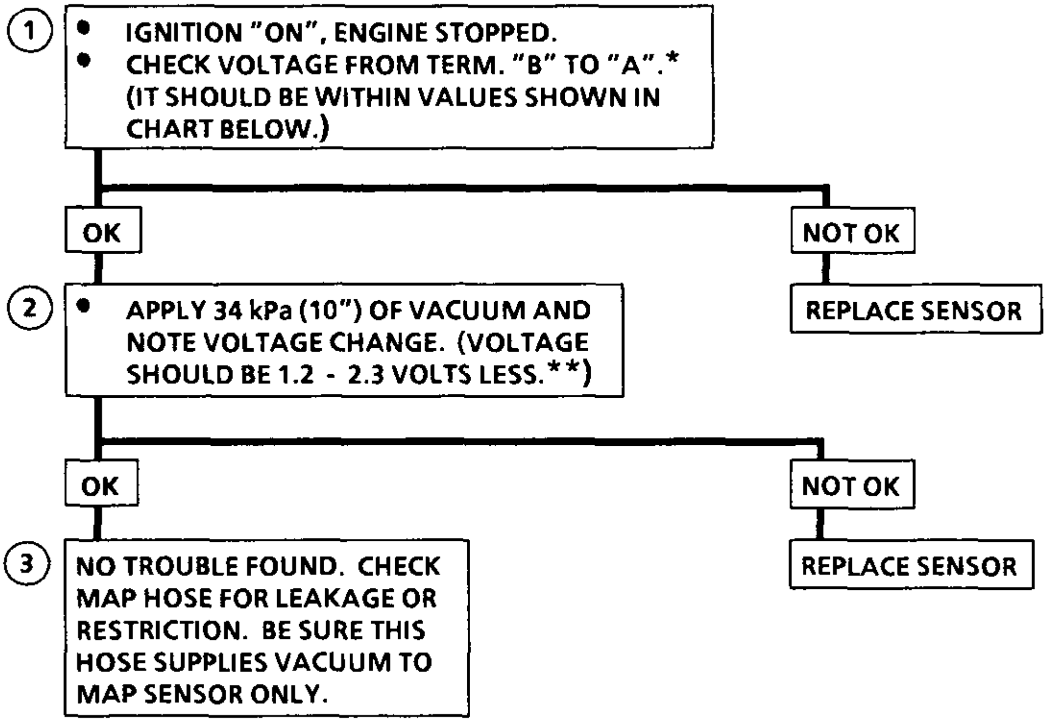
The Manifold Absolute Pressure Sensor (MAP) measures manifold pressure (vacuum) and sends that signal to the ECM. The ECM uses this information for fuel and spark control.

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 applyng 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.

CHART C-1D

MAP OUTPUT CHECK

2.8L "P" SERIES
FUEL INJECTION (PORT)



①
- IGNITION "ON", ENGINE STOPPED.
- CHECK VOLTAGE FROM TERM. "B" TO "A".* (IT SHOULD BE WITHIN VALUES SHOWN IN CHART BELOW.)

OK

②
- APPLY 34 kPa (10") OF VACUUM AND NOTE VOLTAGE CHANGE. (VOLTAGE SHOULD BE 1.2 - 2.3 VOLTS LESS.**)

OK

③ NO TROUBLE FOUND. CHECK MAP HOSE FOR LEAKAGE OR RESTRICTION. BE SURE THIS HOSE SUPPLIES VACUUM TO MAP SENSOR ONLY.

NOT OK

REPLACE SENSOR

NOT OK

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

* THIS REQUIRES THE USE OF THREE JUMPERS WHICH CAN BE MADE USING TERMINALS *12014836* AND *12014837*.

** IF VOLTAGE DOES NOT IMMEDIATELY FOLLOW VACUUM CHANGE, SENSOR IS FAULTY.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-21-85
*4S 0821-6EA

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SECTION C2

FUEL CONTROL SYSTEM

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 (0_2) Sensor, which is located in the exhaust manifold. The 0_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).

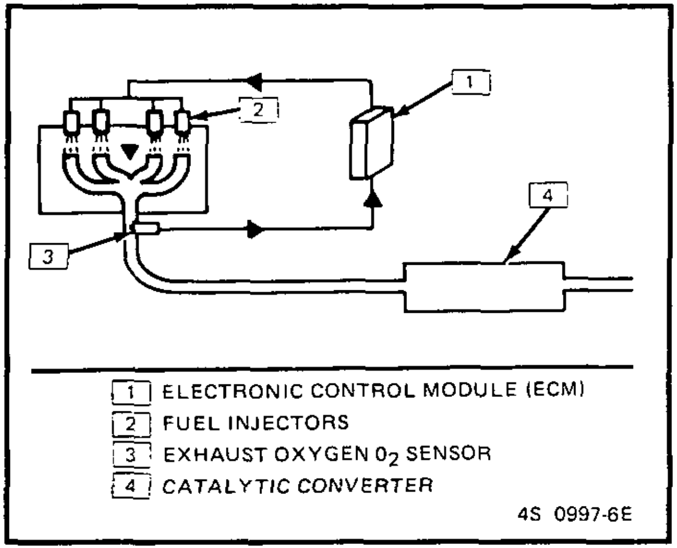


Figure C2-1 Closed Loop System

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 fuel 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 turned on and off. This is done by "pulsing" the injectors for very short times and is referred to as injector pulse width.

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 engine coolant temperature is very low because the other six 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 combustionable mixture.

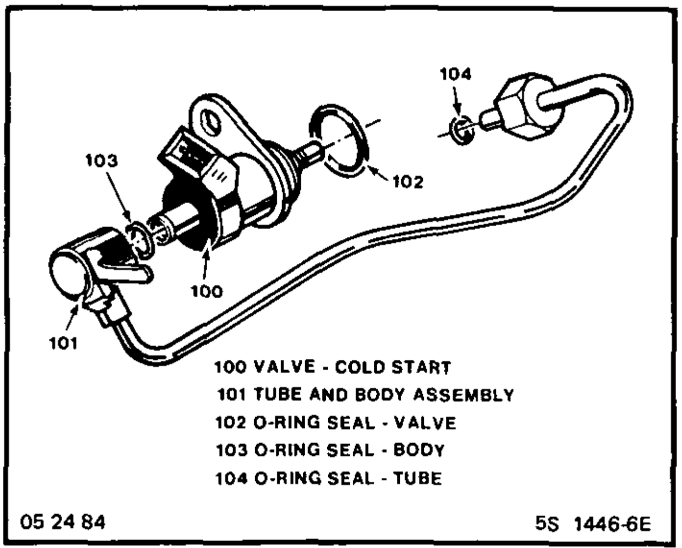


Figure C2-2 Cold Start Valve

The Circuit is activated only in the crank mode. The power is supplied directly from the starter solenoid and only hot in the crank mode. 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 consists of a bimetal material which opens circuit at specified coolant temperature. This bimetal is also heated by the winding in the switch which would allow the cold start valve to stay "ON" 8 seconds at -20°C (-4° F) or below. Above (-20°C), the maximum time the switch will stay closed is proportional to the coolant remperature. In other words, as the coolant temperature goes up the maximum cold start valve "ON" time goes down.

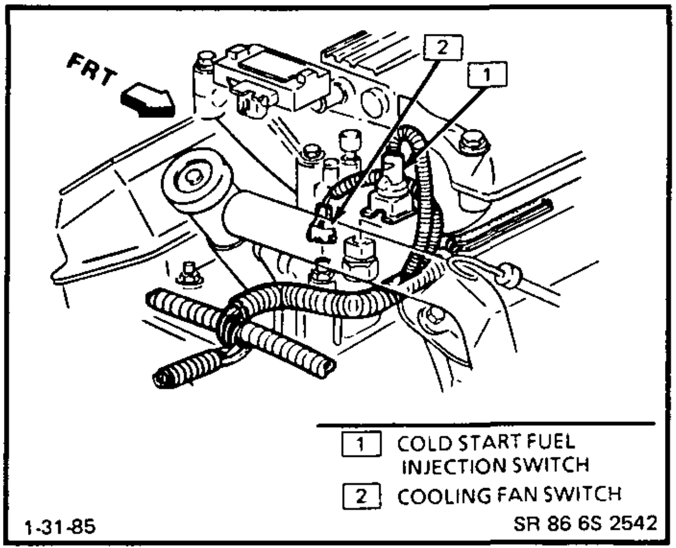


Figure C2-3 Cold Start Fuel Injection Switch

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 400. 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 (02) sensor, and calculate the air/fuel ratio based on inputs from the Coolant and MAP sensors.

The system will stay in open loop until the following conditions are met:

1. The 02 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.
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. 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 O2 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 (vacuum) and provides extra fuel.

DECELERATION MODE

When deceleration occurs, the fuel remaining in the intake port 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 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 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. This prevents flooding.

FUEL CONTROL SYSTEM COMPONENTS

The Fuel Control System is made up of the following parts:

- Fuel Injectors
- Throttle Body
- Fuel Rail and Pressure Regulator Assembly
- Idle Air Control (IAC) Valve
- Fuel pump
- Fuel pump relay

BASIC SYSTEM OPERATION

The fuel control system (Figure C2-4) 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 seperate 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).

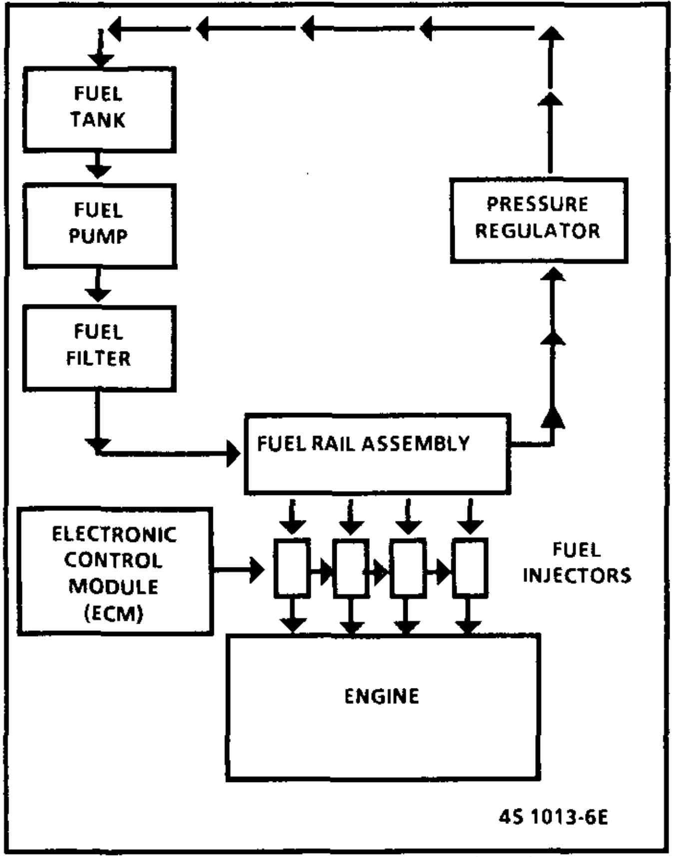


Figure C2-4 Fuel Supply System (Typical)

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.

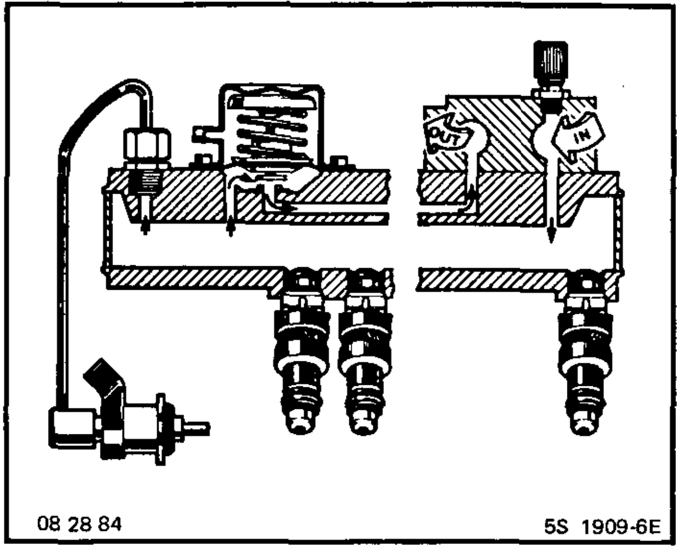


Figure C2-5 Fuel Rail

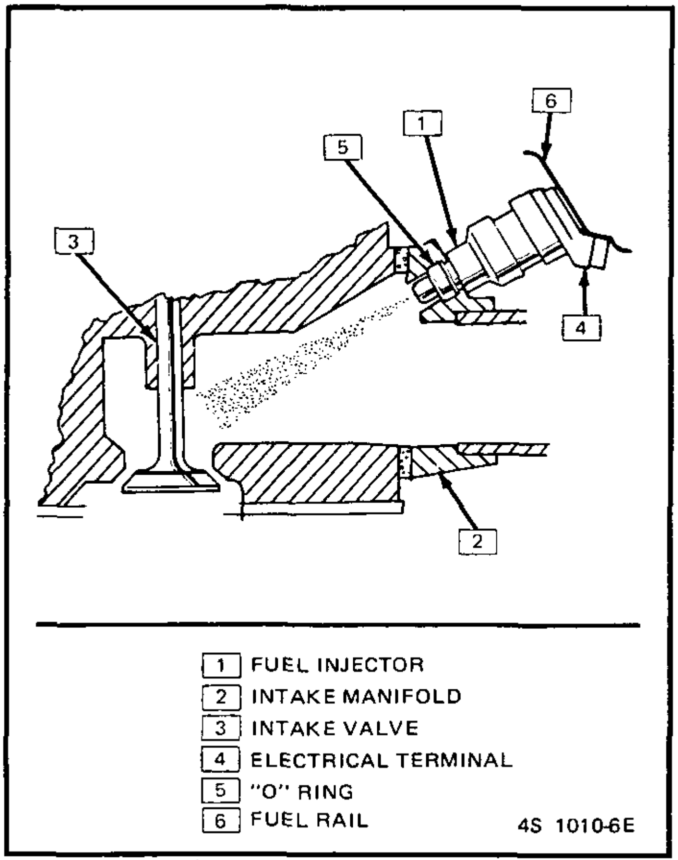


Figure C2-6 Fuel Injector

FUEL RAIL

The fuel rail (Figure C2-5) 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. The regulator keeps the pressure to the injectors at a constant pressure. Remaining fuel is then returned to the fuel tank.

FUEL INJECTOR

The fuel injector is a solenoid operated device controlled by the ECM (See Figure C2-6). 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..

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 differential across the injectors at all times, by controlling the flow in the return line (i.e., a calibrated leak).

The pressure regulator is mounted to 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 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 C2-7), 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 ALCL.

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.

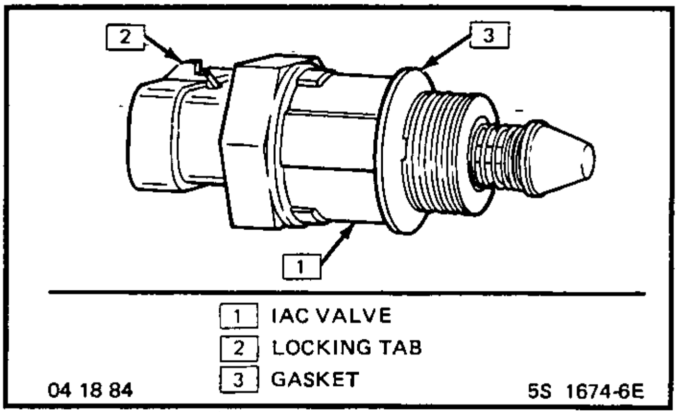


Figure C2-7 IAC Valve

FUEL PUMP ELECTRICAL CIRCUIT

When the key 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 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 acts as a back-up to the relay and will turn on the fuel pump as soon as oil pressure reaches about 4 psi.

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

The diagnosis of the fuel control system is covered in CHART A-3 "Engine Cranks But Won't Run". The electrical portion is covered in CHARTS A-7, called "Fuel system Diagnosis". This includes the fuel injectors, the pressure regulator,and the fuel pump.

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 on the page opposite 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 fuel spillage, cover the fuel line with a shop cloth to collect the fuel, and then place the cloth in an approved container. After servicing the fuel system, cycle the ignition "on" and "off" several times (wait 10 seconds between cycles) and check system for leaks.*

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.

THROTTLE BODY SERVICE

Remove or Disconnect

1. Negative battery cable
2. TPS and IAC electrical connectors.
3. Coolant lines.
4. Throttle linkages.
5. Air inlet duct.
6. Throttle body bolts.

Install or Connect

1. Reverse removal procedures.
2. See FigureC2-8

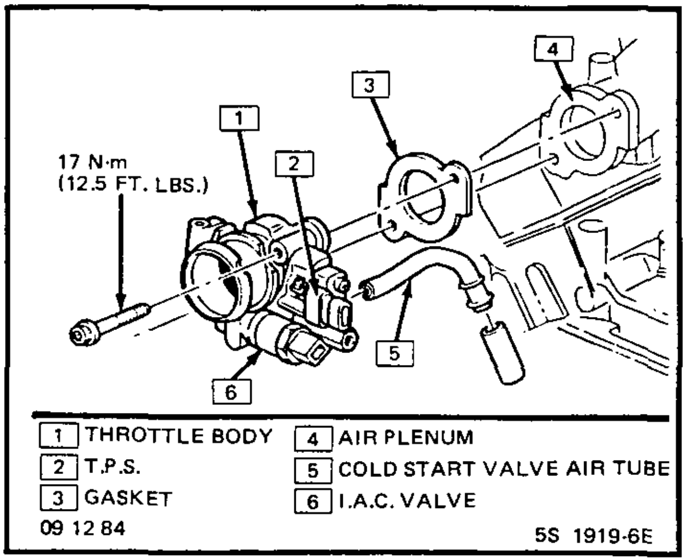


Figure C2-8 Throttle Body Service

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

Remove or Disconnect

1. Electrical connector from idle air control (IAC) valve assembly . (70)
2. IAC valve assembly from idle air/vacuum signal housing assembly. (60)

- Do not remove any thread locking compound from threads.

3. IAC valve assembly gasket (71), and discard.

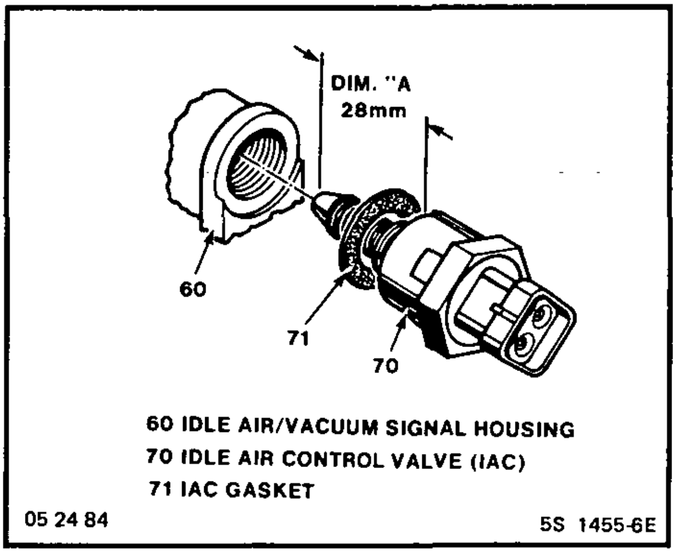


Figure C2-9 Idle Air Control Valve Assembly

NOTICE: *The IAC valve assembly is an electrical component, and must not be soaked in any liquid cleaner or solvent, as damage may result.*

Clean

- Gasket mounting surface of idle air/vacuum signal housing assembly to ensure a good seal.

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.*

Measure

- Distance from gasket mounting surface of IAC valve assembly (70) to tip of pintle, Dimension :"A" in Figure C2-9.

Adjust if necessary

If distance is greater than 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 (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 28 mm(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 18 N·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 controlled by ECM action when the vehicle is operated.

Plenum

Remove or Disconnect

1. Negative battery cable.
2. Vacuum lines.
3. EGR Pipe to EGR valve base bolts (2)
4. Throttle body bolts (2)
5. Plenum bolts (10).
6. Plenum and gaskets.

Install or Connect

1. Gaskets.
2. Plenum bolts.
3. Throttle body bolts.
4. EGR pipe.
5. Throttle cable bracket bolts.
6. Vacuum lines.
7. Negative battery cable.

Important

Use care in removing injectors to prevent damage to the electrical connector pins on the injector and the nozzle. The fuel injector is serviced as a complete assembly only. The fuel injector is an electrical component and should not be immersed in any type of cleaner.

Fuel Rail

Remove or Disconnect

1. Negative battery cable.
2. Plenum.
3. Cold start valve line at rail.
4. Fuel lines at rail.
5. Vacuum line at regulator.
6. Injector electrical connectors.
7. Rail retaining bolts (2).
8. Rail and injectors.

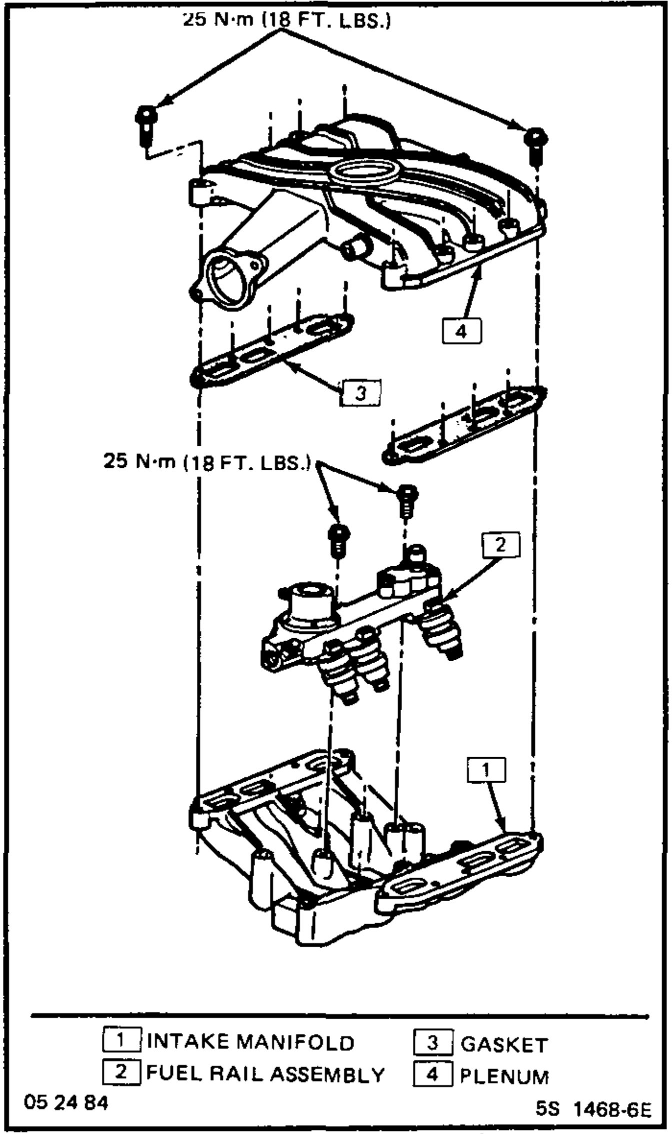


Figure C2-10 Fuel Rail Service

Clean

- Fuel rail and pressure regulator assembly and adjacent fuel lines with AC-Delco X-30A or equivalent.

Important

Use care when handling fuel rail assembly to avoid damaging injectors.

Install or Connect

- Lubricate all injector O-ring seals with engine oil.
- Reverse removal procedure.
- See Figure C2-10

FUEL RAIL SERVICE

Names of component parts will be found on the numbered list that accompanies the exploded view (Figure C2-12). 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 C2-11. Refer to this number if servicing or part replacement is required.

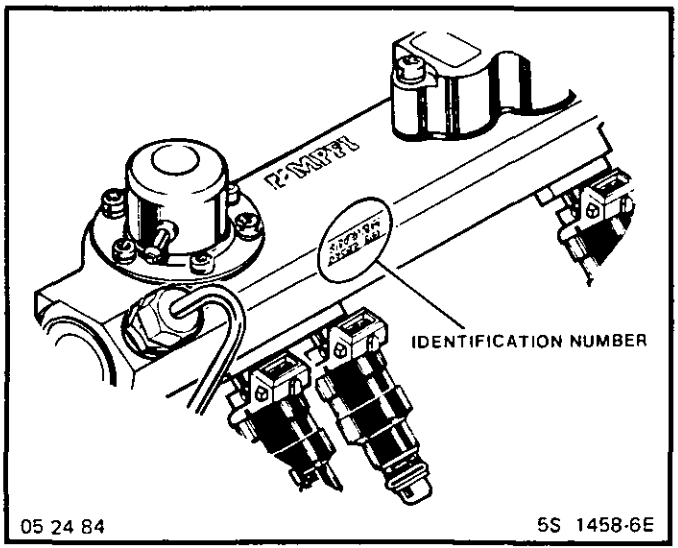


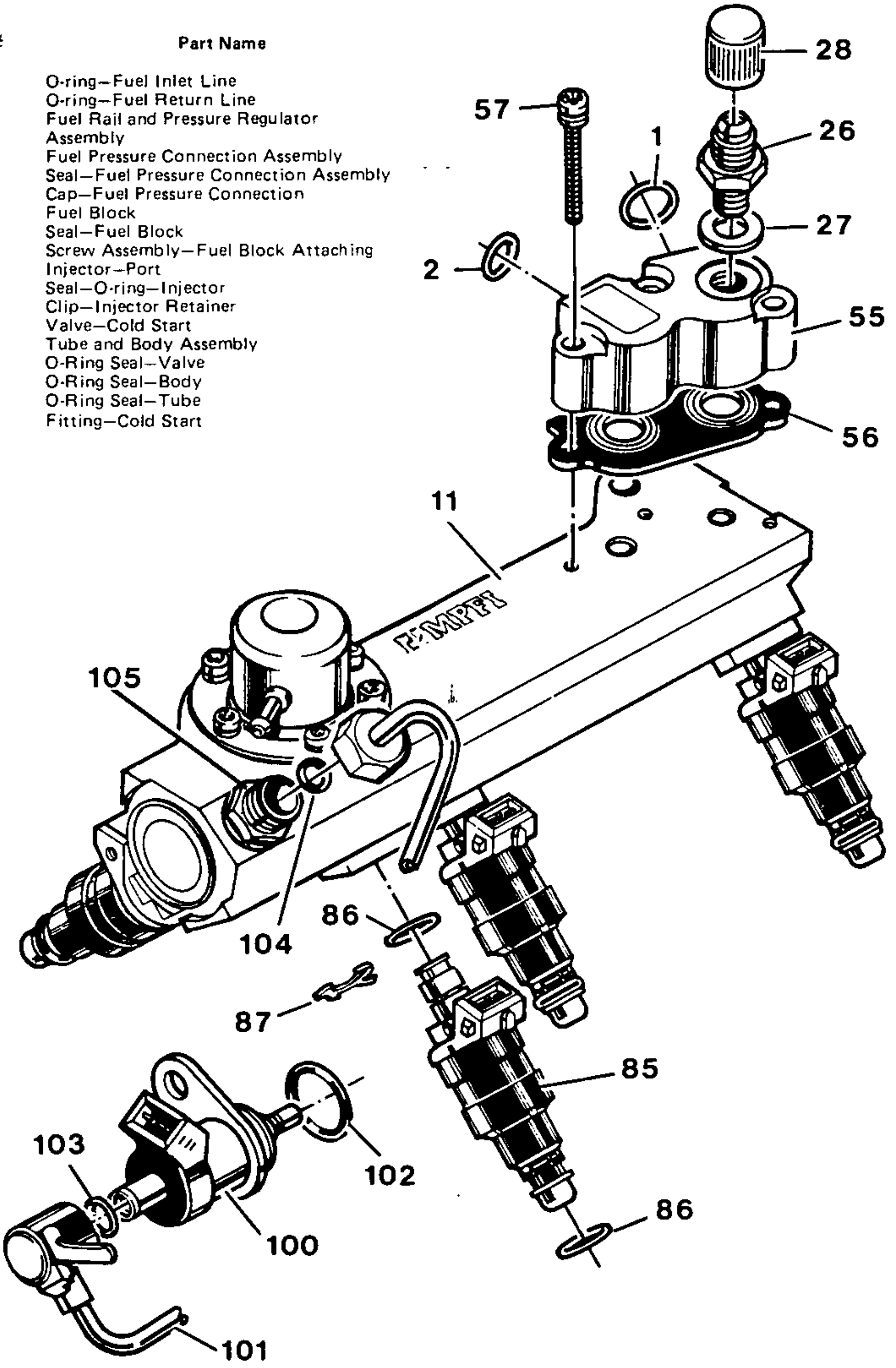
Figure C2-11 Fuel Rail Assembly Identififcation

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.

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



05 24 84

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Figure C2-12 Fuel Rail 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.

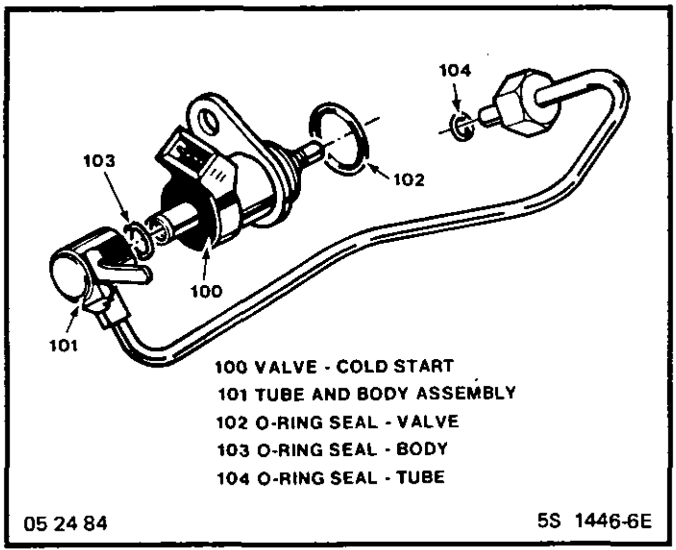


Figure C2-13 Cold Start Valve Assembly

COLD START TUBE AND VALVE ASSEMBLY (FIGURE C2-13)

Remove or Disconnect

1. Negative battery cable.
2. Fuel line at rail.
3. Valve electrical connector.
4. Valve retaining bolt.

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 unsrewing of valve.

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.

Adjust

1. Turn valve completely into body.assembly (101)
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.
4. Before re-installing into engine, coat o-ring seals with engine oil.)

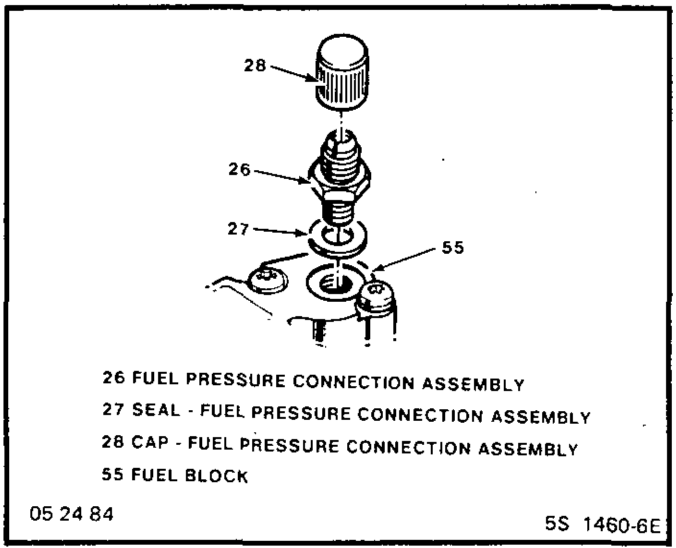


Figure C2-14 Fuel Pressure Connection Assembly

FUEL PRESSURE CONNECTION ASSEMBLY (Figure C2-14)

Remove or Disconnect

1. Negative battery terminal.

Clean

- Area around valve and connection with AA-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 assemly 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.

FUEL BLOCK AND SEAL

Figure C2-15

Remove or Disconnect

1. Negative battery terminal.
2. Plenum.

Clean

- Fuel block (55) and adjacent fuel line connections with AC-Delco Xd30A 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 seals (56). Discard seal.

Clean

- Sealing surfaces of fuel block and fuel rail assembly to ensure a good seal.

Install or Connect

1. New-O-ring seals (1) and (2) on fuel inlet and return lines.
2. Fuel block (55) on seal.
3. Fuel block attaching screw assemblies (57).
   - Tighten Attaching screw assemblies to 5.0 N·m (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.

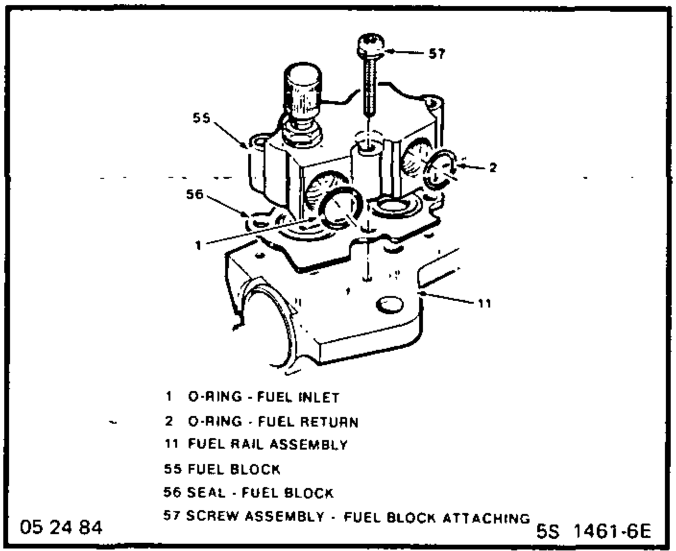


Figure C2-15 Fuel Block Assembly

FUEL INJECTORS

NOTICE: *To prevent dirt from entering the engine the area around the injectors should be clean before servicing.*

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 C2-16.

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 injectors (85).

Install or Connect

1. Lubricate all injector -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 C2-16).

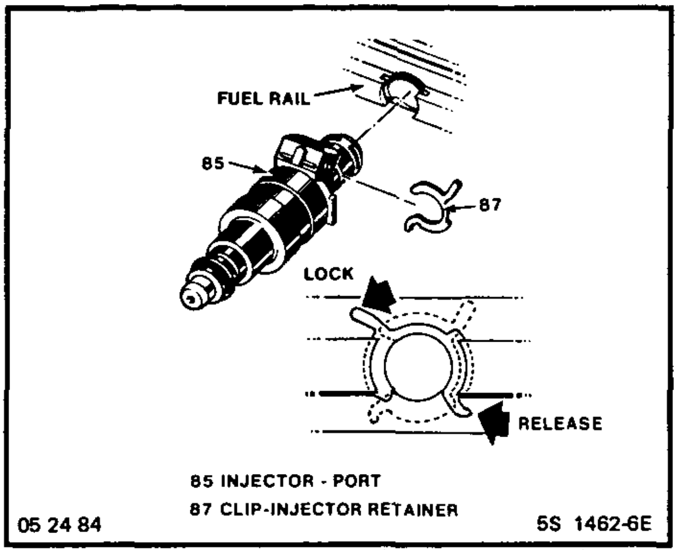


Figure C2-16 Port Injectors with Injector Retaining Clips

PRESSURE REGULATOR

Important

The Pressure Regulator is factory adjusted and is not serviceable. Do not attempt to remove the regulator from the Fuel Rail.

COLD START FUEL INJECTION SWITCH

Remove or Disconnect

1. Negative battery cable.
2. Connector.
3. Switch

Install or Connect

1. Coat threads with pipe sealant.
2. Switch.
3. Connector.
4. Negative battery cable.

FUEL PUMP RELAY

The fuel pump relay is mounted in the engine compartment in front of the air cleaner assembly. Other than checking for loose connectors, the only service possible is replacement.

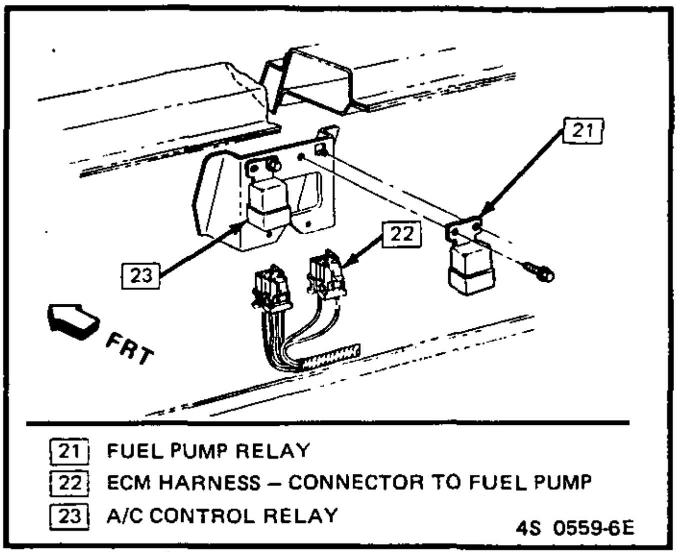


Figure C2-17 Fuel Pump Relay

PARTS INFORMATION

PART NAME	GROUP
Injector, fuel	3.330
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*
Fuel feed rail and regulator kit	3.330

CHART C-2A

INJECTOR BALANCE TEST

The injector tester is a timer used to turn each injector on for a precise amount of time. This time allows a measured amount of fuel to be sprayed into the intake manifold thereby reducing the pressure in the fuel rail. All injectors in the engine should measure about the same pressure drop (± 10 kPa).

STEP 1

Connect fuel gage 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. 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 gage and hose to insure accurate gage operation.

STEP 2

Turn ignition off for 10 seconds and then on again to get fuel pressure to its maximum. This insures that fuel pressure is precisely the same for each injector tested. Energize tester one time and note pressure drop the instant the gage needle stops. The pressure may increase for a few seconds after the initial pressure drop. This increase should not be considered in the test, because it may vary depending on temperature.

NOTE: *The entire test should not be repeated more than once to prevent flooding.*

STEP 3

This example shows how faulty injectors would appear, as compared to good ones. Usually, good injectors will have virtually the same drop. Retest any injector that has a pressure difference of 10 kPa, 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 10 kPa of this average, the injectors appear to be flowing properly. Reconnect them and review Symptoms, Section B.

CHART C-2A

INJECTOR BALANCE TEST

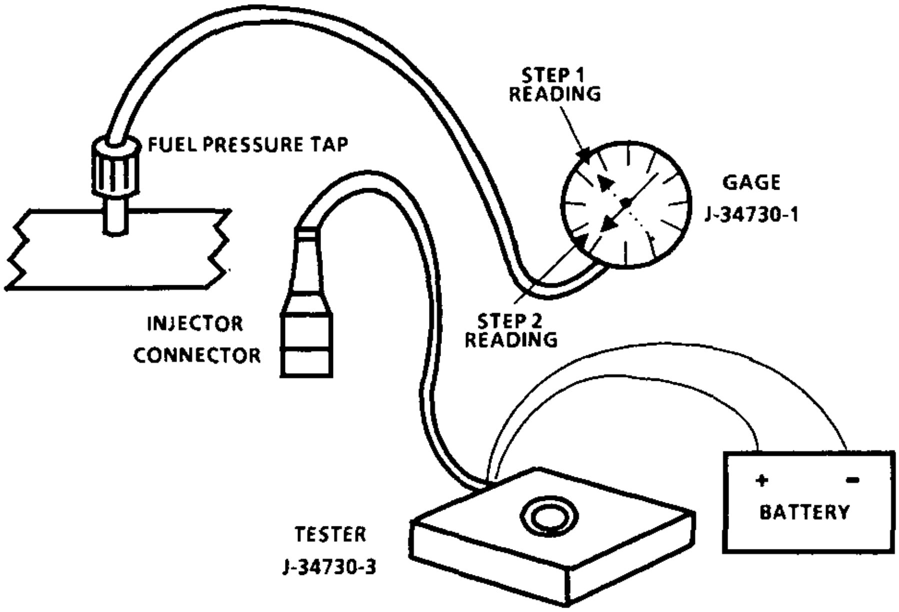
2.8L "P" SERIES
FUEL INJECTION (PORT)

Before performing test, perform
the fuel pressure test in Section A.

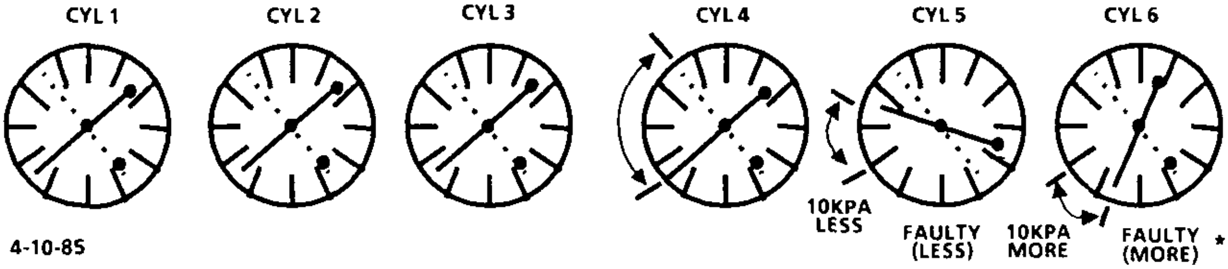
Step 1. Connect fuel pressure gage and injector tester.
1. Ignition "OFF".
2. Connect fuel pressure gage and injector tester.
3. Ignition "ON".
4. Bleed off air in gage.

Step 2. Run test.
1. Ignition "OFF" for 10 sec.
2. Ignition "ON".
3. Turn injector on by depressing button on injector tester and note *pressure at the instant the gage needle stops.*

Step 3.
1. Repeat step 2 on all injectors and record pressure drop on each. Retest injectors that appear faulty. Replace any injectors that have a 10 KPA difference (either more or less) in pressure. If no problem is found, review symptoms in Section B.



— EXAMPLE —



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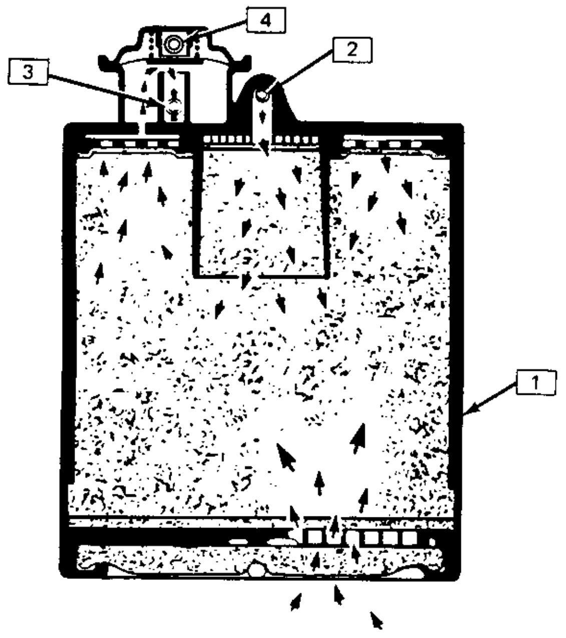
SECTION C3

EVAPORATIVE EMISSION CONTROL SYSTEM (EECS)

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.



1 CHARCOAL CANISTER
2 TO FUEL TANK
3 PURGE VALVE (TO PORTED VACUUM)
4 CONTROL VALVE (TO MANIFOLD VACUUM)

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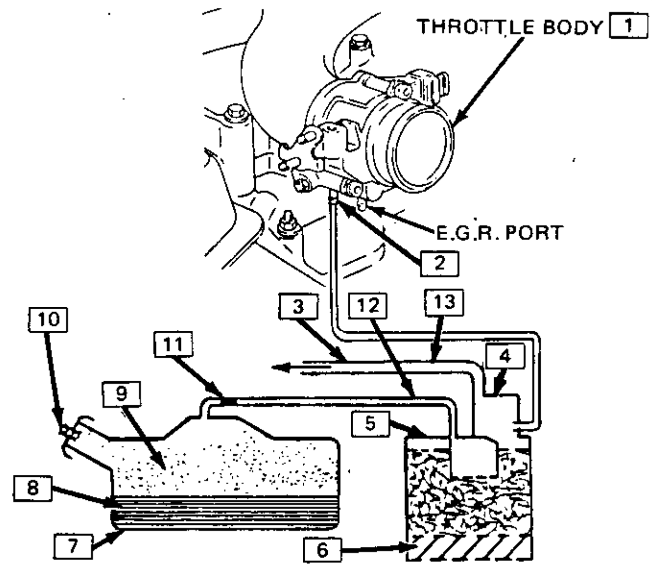
Figure C3-1 Charcoal Canister- Purge Valve 2.8L

2.8L EVAPORATIVE SYSTEM

Purging of the canister is controlled by a canister-mounted purge valve, and throttle valve position. Manifold vacuum opens the purge valve, allowing vapors to purge through the purge line whenever the engine is running above idle.



1 THROTTLE BODY
2 CANISTER PURGE
3 VACUUM
4 PURGE VALVE
5 VAPOR STORAGE CANISTER
6 PURGE AIR
7 FUEL TANK
8 FUEL
9 VAPOR
10 PRESSURE—VACUUM RELIEF GAS CAP
11 VENT RESTRICTER
12 FUEL TANK VENT
13 PURGE LINE

09 18 85
5S 1924-6E

Figure C3-2 Evaporative System-2.8L

FUNCTIONAL TEST OF FUEL VAPOR CANISTER

Apply a short length of hose to the lower tube of purge valve, and attempt to blow through it. Little or no air should pass into the canister.

With hand vacuum pump, apply vacuum (15"Hg. or 51 kPa) through the control valve tube (upper tube). If the diaphragm does not hold vacuum for at least 20 seconds, the diaphragm is leaking, and 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.

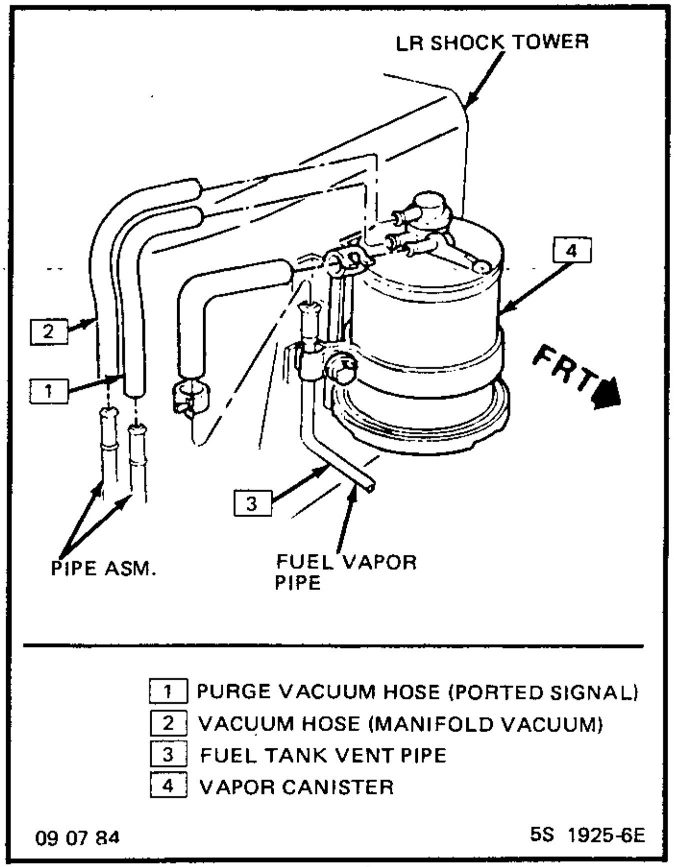


Figure C3-3 Evaporative System-2.8L

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.**
2. **Hoses. Make sure connections are correct**

PARTS INFORMATION

PART NAME	GROUP
Canister, Fuel Vapor	3.130

SECTION C4

IGNITION SYSTEM (EST)

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)
- Manifold pressure
- Engine temperature

The EST system consists of the distributor module, ECM, and connecting wires. The distributor has module terminals which are connected directly to the engine harness connectors. 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.
- Reference ground (CKT 453).
  This wire is grounded in the distributor and makes sure the ground circuit has no voltage drop, between the distributor and ECM, which could affect performance.
- By-Pass (CKT 424).
  At about 400 RPM, and ECM applies 5 volts to this circuit to switch spark timing control from the HEI module to the ECM. An open or grounded bypsss 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 or bypass 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.

How Code 42 is Determined

When the system is running on the HEI module, that is , no voltage on the by-pass 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 by-pass line and the EST should no longer be grounded in the HEI module so the EST voltage should be varying.

If the by-pass line is open or grounded, the HEI module will not switch to EST and Code 42 will be set.

DIAGNOSIS

The description, operation, and diagnosis of the HEI system are found in Section 6D of this manual. CHART C-4 should be used for diagnosing a no spark condition.

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.

CHECKING EST PERFORMANCE

The ECM will set timing at a specified value when the diagnostic "Test" terminal in the ALCL connector is grounded. To check for EST operation, the timing should be checked at 1500 RPM *with the terminal ungrounded. Then* ground the "Test" terminal. If the timing changes at 1500 RPM, the EST is operating.

A fault in the EST system will usually set a trouble code 42. Use that chart to diagnose the system.

ON-CAR SERVICE

SETTING TIMING

The timing is set by following the procedures on the Vehicle Emission Control Information label.

PARTS INFORMATION

PART NAME	GROUP
Module, Distr	2.383
Coil, Distr	2.170

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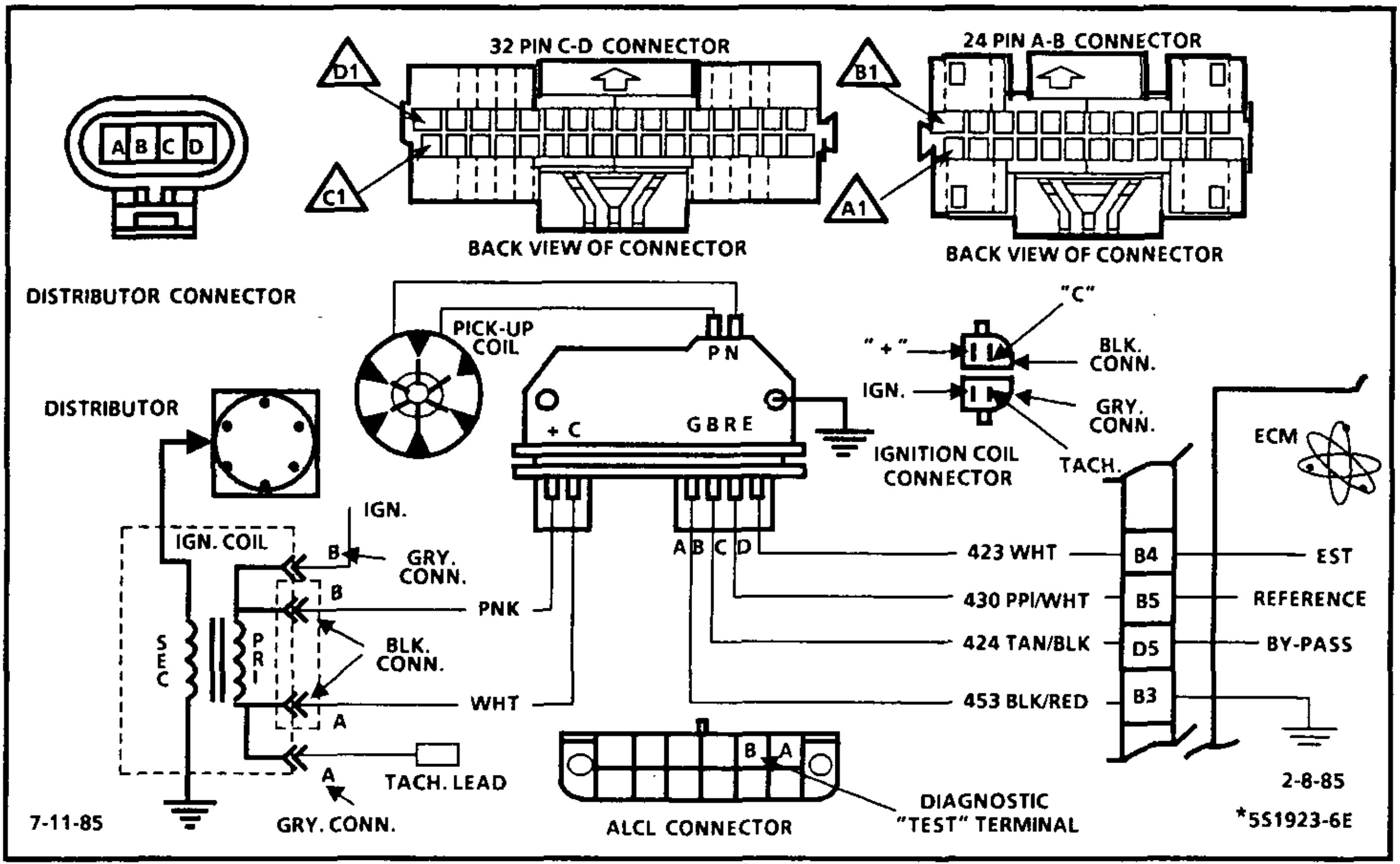

CHART C-4B

IGNITION SYSTEM CHECK

(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)

2.8L "P" SERIES FUEL INJECTION (PORT)

1. Two wires are checked, to ensure that an open is not present in a spark plug wire.

1A. If spark occurs with 4 terminal distributor 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 (J24642) could determine which is at fault.

CHART C-4B

IGNITION SYSTEM CHECK

(REMOTE COIL / SEALED MODULE CONNECTOR DISTRIBUTOR)

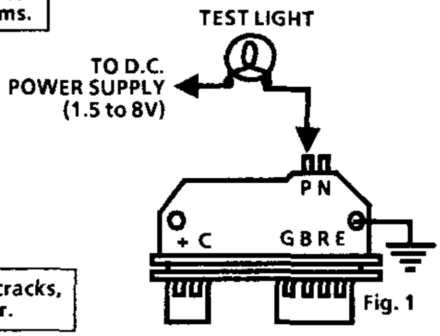

Fig. 1

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.
                                - **Bad** — Replace module
                            - **Spark** — Check pick-up coil or conns. (Coil resistance should be 500-1500 ohms and not grounded).
                        - **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.

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SECTION C7

EXHAUST GAS RECIRCULATION (EGR) SYSTEM)

GENERAL DESCRIPTION

PURPOSE

The EGR system is used to lower NOx (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 exhaust manifold.

The EGR valve feeds small amounts of exhaust gas back into the combustion chamber as shown in Figure C7-1.

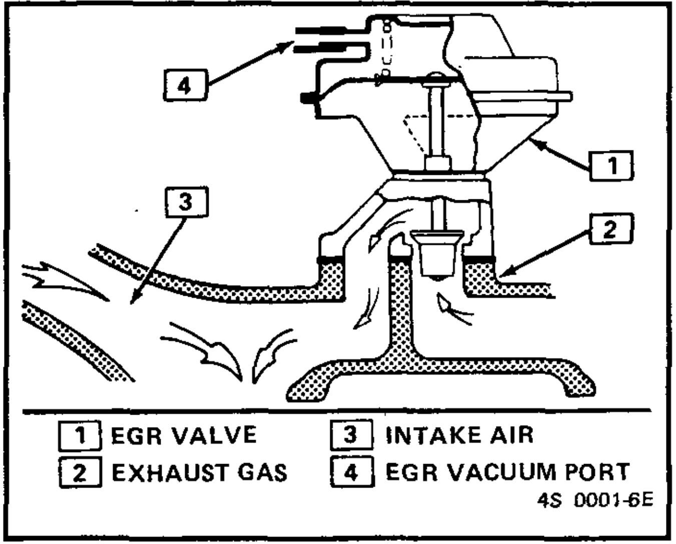


Figure C7-1 Exhaust Gas Recirculation

OPERATION

The EGR valve is opened by manifold 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 under the following conditions:

- Warm engine operation
- Above idle speed

To more closely regulate EGR flow, an ECM controlled solenoid is used in the vacuum line (see Figure C7-4). The ECM uses information from the following sensors to regulate the vacuum solenoid:

- Coolant Temperature
- Throttle Position (TPS)
- Manifold absolute pressure (MAP)

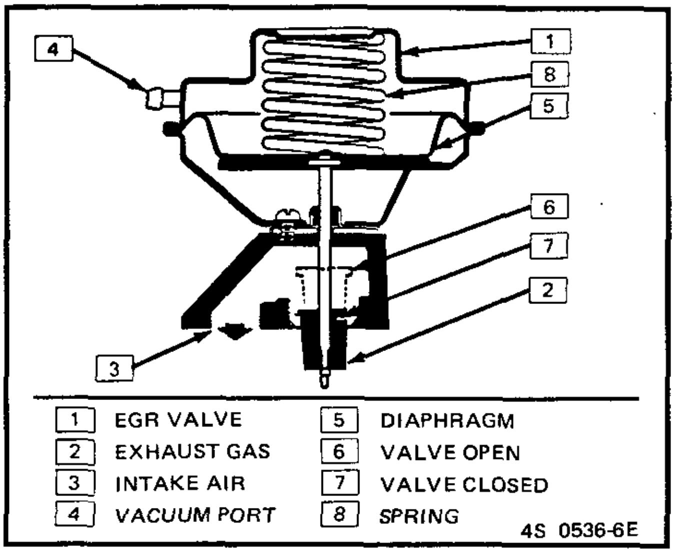


Figure C7-2 Port EGR Valve

EGR VALVE IDENTIFICATION, FIG. C7-2

- Positive backpressure EGR valves will have a "P" stamped on the top side of the valve after the part number.
- Negative backpressure EGR valves will have an "N" stamped on the top side of the valve after the part number.
- Port EGR valves have no identification stamped after the part number.

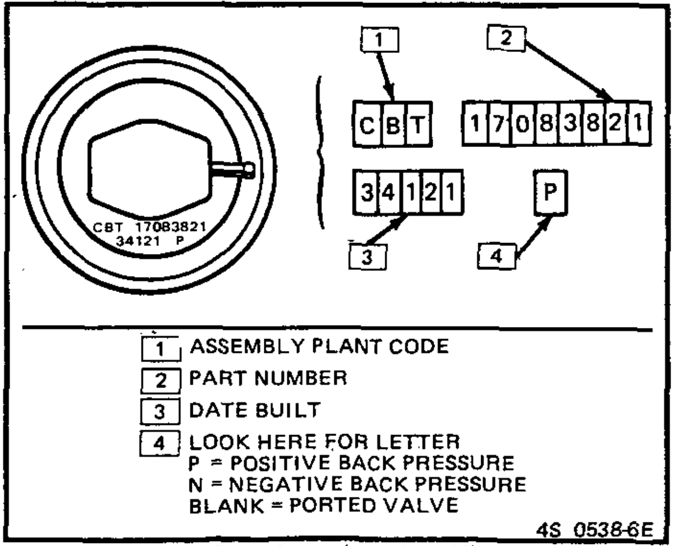


Figure C7-3 EGR Valve Identification

PORT EGR VALVE (2.8L)

This valve 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.

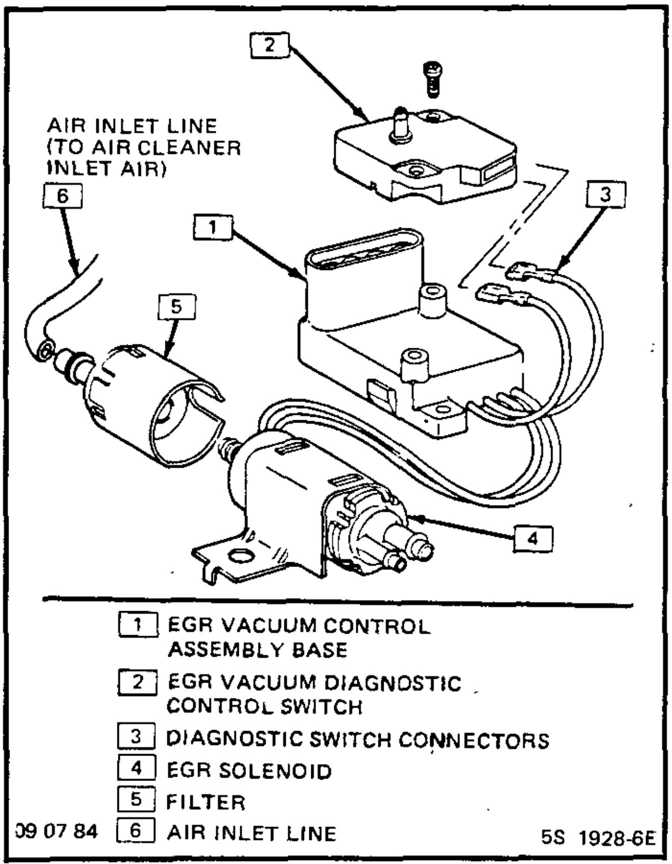


Figure C7-4 EGR Vacuum Control Solenoid

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.

Results of Incorrect EGR System 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.

ON-CAR SERVICE

EGR VALVE

↔ Remove or Disconnect

1. Vacuum line.
2. Bolts.
3. Valve

→← Install or Connect

1. Valve
2. Bolts.
3. Vacuum line.

If EGR passages to the 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.

EGR Manifold Passage

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

Install or Connect

1. Reinstall valve or replacement EGR valve using new gasket.
2. Bolts and tighten to 18 N.m (14 ft.lbs.).
3. Vacuum hose to valve.

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 ft.lbs.).
2. Vacuum hoses.
3. Electrical connector.
4. Negative battery cable.

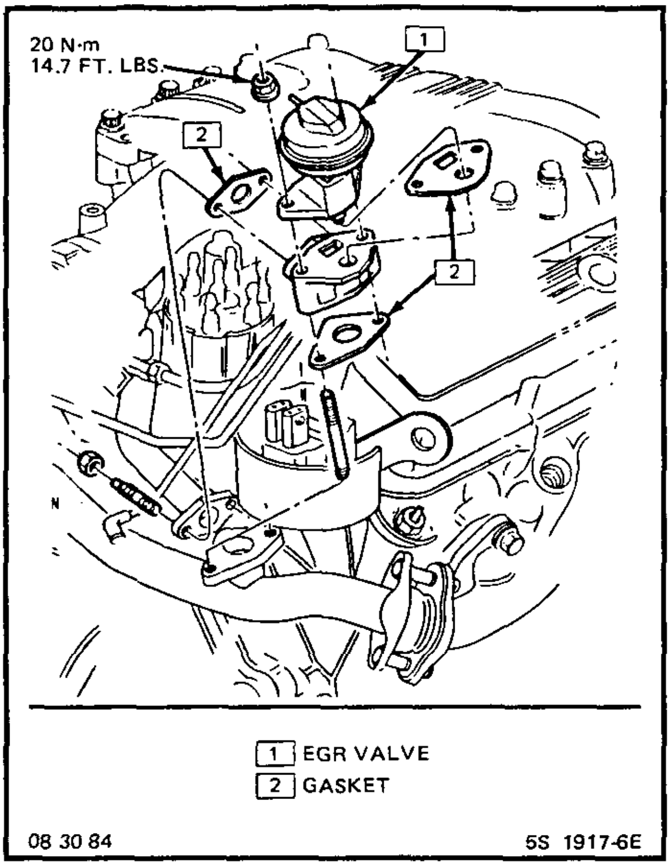


Figure C7-5 EGR

PARTS INFORMATION

PARTS NAME	GROUP
Valve, EGR	3.670
Control, EGR Vacuum	3.670
Solenoid, EGR Cont VLV	3.670
Gasket, EGR Valve	3.680

EGR Valve Identification.

When replacing an EGR valve, always check for correct part number in the parts catalog or supplemental bulletin.

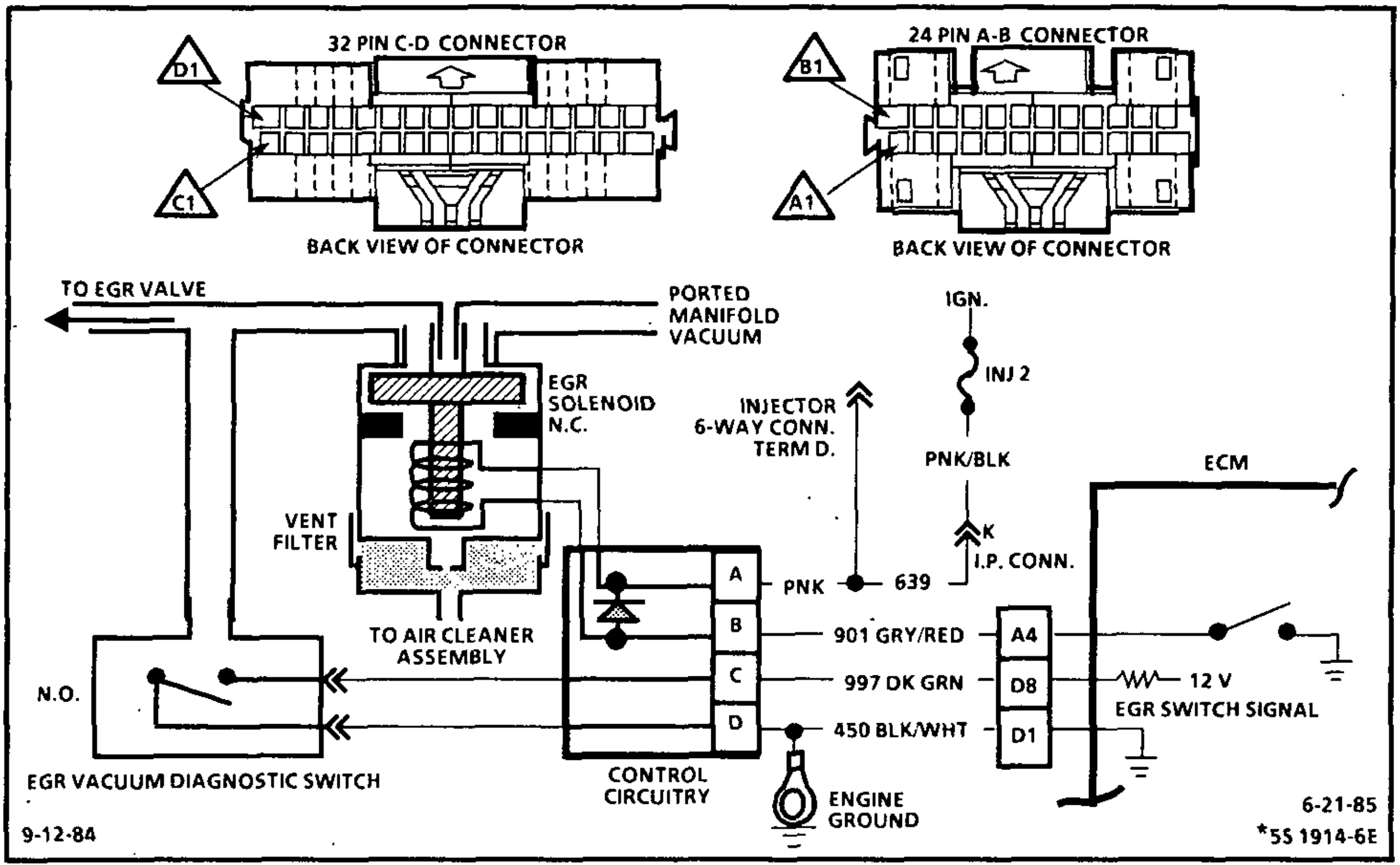


CHART C-7

EXHAUST GAS RECIRCULATION CHECK

2.8L "P" SERIES

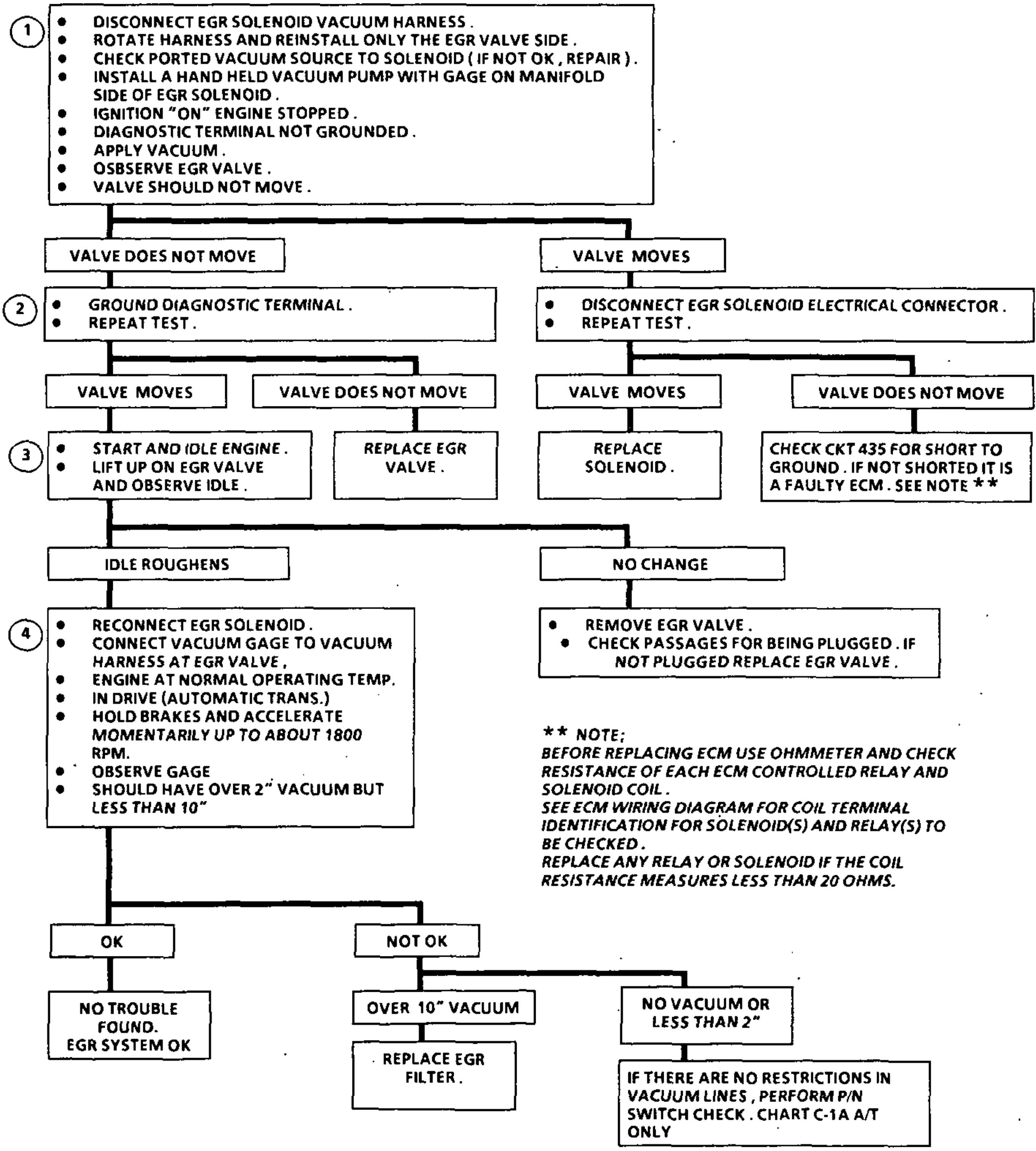
FUEL INJECTION (PORT)

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.

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 plugged 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 recieved by the ECM.

CHART C-7
EGR CHECK
2.8L "P" SERIES
FUEL INJECTION (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 NOTE **

** *NOTE;*

BEFORE REPLACING ECM USE OHMMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.

SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.

REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

5-23-85
* 5S 1676-6E

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SECTION C8

TRANSMISSION/TRANSAXLE CONVERTER CLUTCH (TCC) AND MANUAL TRANSMISSION SHIFT LIGHT

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.

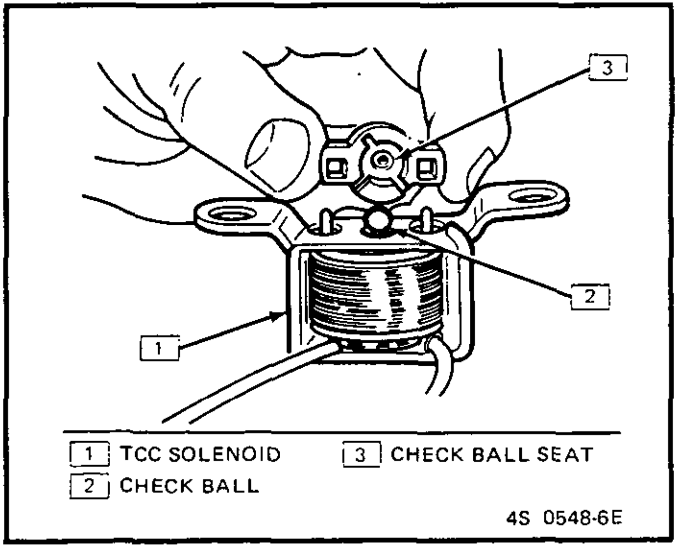

Figure C8-1 TCC Solenoid

The ECM controls the TCC apply solenoid by looking at several sensors:

- 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.
- 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.
- Another switch used in the TCC circuit is a brake switch which opens the 12 volt supply to the TCC solenoid when the brake is depressed.
- On 125C transmissions a third gear switch (normally open) is placed in series on the battery side of the TCC solenoid. This switch prevents TCC application until the transmission is in third gear. Then the switch closes, completing the circuit to the ECM.

Results of Incorrect Operation

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.

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 be clutch disengagement rather than a downshift, due to the change in TPS to maintain cruising speed.

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 it should,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.

SHIFT LIGHT

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 6C if ECM is to be replaced.

PARTS INFORMATION

PART NAME	GROUP
Sensor, Vehicle Speed	9.761
Solenoid, TCC	4.122

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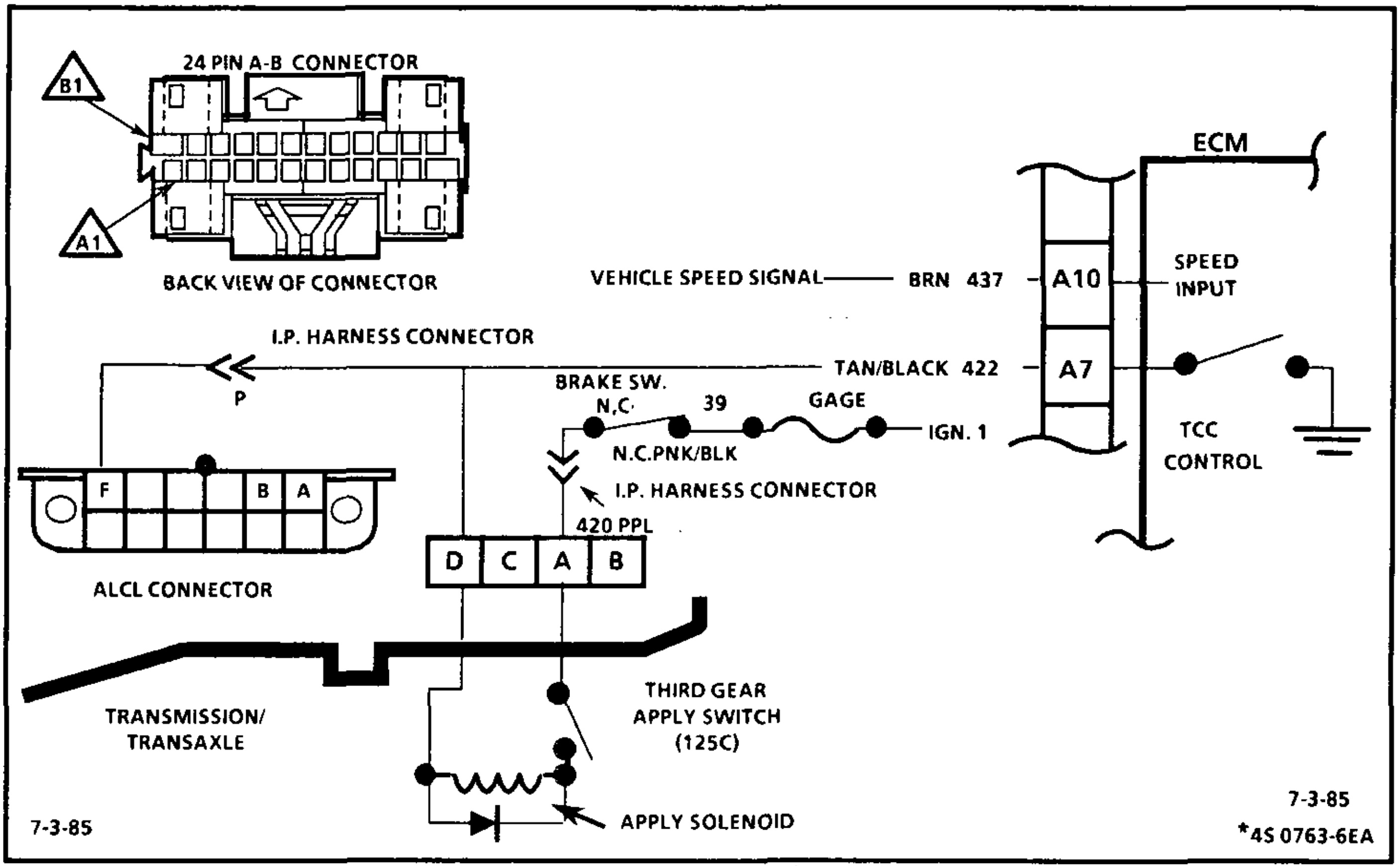


CHART C-8

TRANSAXLE CONVERTER CLUTCH (TCC)

2.8L "P" SERIES

FUEL INJECTION (PORT)

The purpose of the 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.

Fused battery ignition is supplied to the TCC solenoid through the brake switch, and transmission third gear apply switch. The ECM will engage TCC by grounding CKT 422 to energize the solenoid.

TCC will engage when:

- Engine warmed up
- Vehicle speed above a calibrated value.
- Throttle position sensor output not changing, indicating a steady road speed.
- Transmission third gear switch closed
- Brake switch closed

1. Light off confirms transmission third gear apply switch is open.
2. At about 25 mph the transmission third gear switch should close. Test light will come on and confirm battery supply and closed brake switch.
3. Grounding the diagnostic terminal with ignition "ON", engine "OFF" should energize the TCC solenoid. This test checks the capability of the ECM to ground CKT 422.
4. Solenoids and relay's are turned "ON" or "OFF" by the ECM internal electronic switches called "drivers". Each driver is part of a group of four called "Quad-Drivers". Failure of one can damage any other driver within 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.

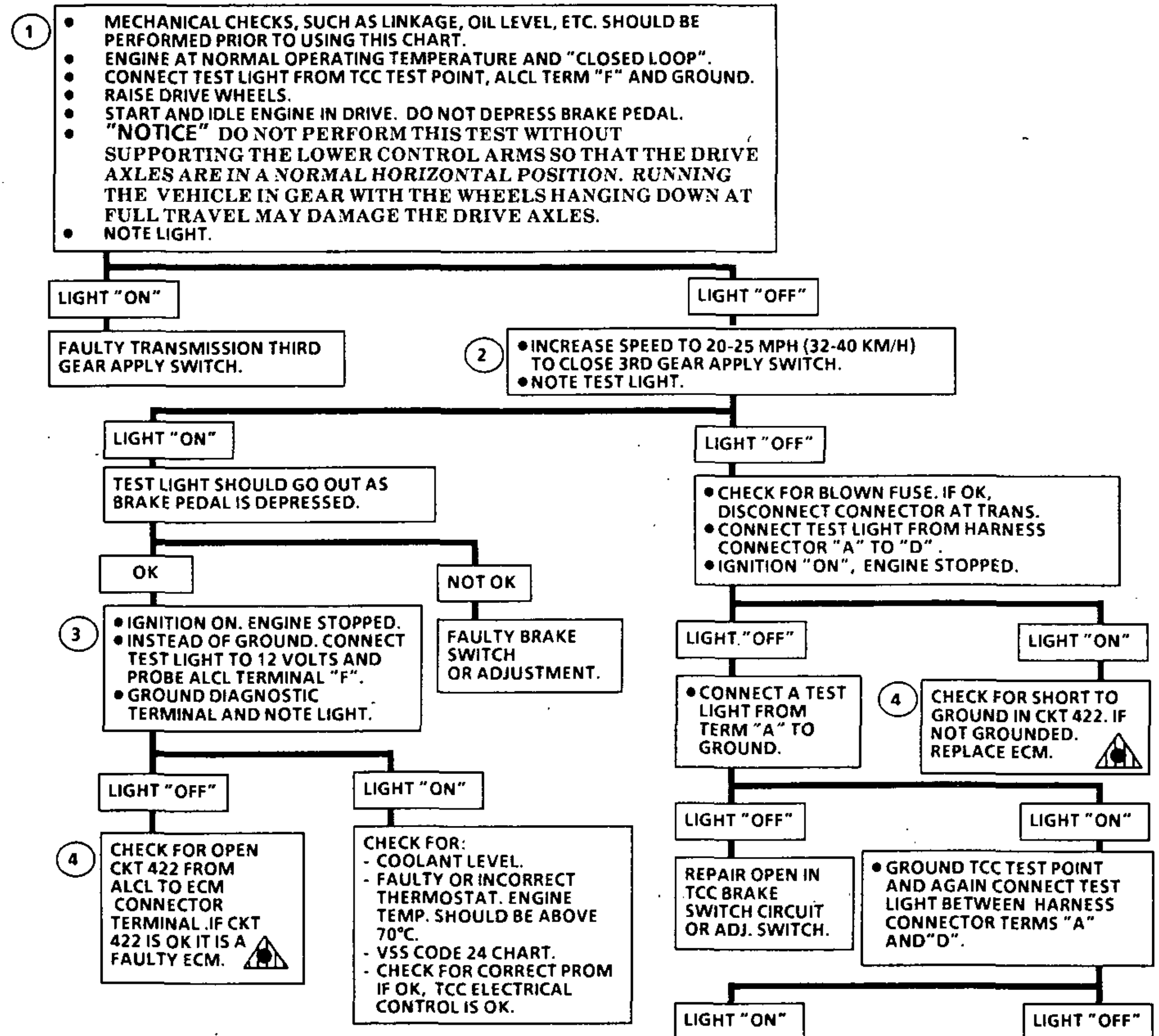
When checking TCC solenoid be sure to raise drive wheels and run about 30 MPH to close third gear apply switch.

CHART C–8

125C TRANSMISSION/TRANSAXLE CONVERTER CLUTCH
ELECTRICAL DIAGNOSIS
2.8L "P" SERIES
FUEL INJECTION (PORT)

START SCAN

■ IF USING A "SCAN" TOOL, CHECK THE FOLLOWING AND CORRECT IF NECESSARY:
- COOLANT TEMPERATURE
- TPS
- VSS
- CODES - IF 24 IS PRESENT, SEE CODE CHART 24. ALSO, PERFORM MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC., BEFORE USING THIS CHART.



①
- MECHANICAL CHECKS, SUCH AS LINKAGE, OIL LEVEL, ETC. SHOULD BE PERFORMED PRIOR TO USING THIS CHART.
- ENGINE AT NORMAL OPERATING TEMPERATURE AND "CLOSED LOOP".
- CONNECT TEST LIGHT FROM TCC TEST POINT, ALCL TERM "F" AND GROUND.
- RAISE DRIVE WHEELS.
- START AND IDLE ENGINE IN DRIVE. DO NOT DEPRESS BRAKE PEDAL.
- "NOTICE" DO NOT PERFORM THIS TEST WITHOUT SUPPORTING THE LOWER CONTROL ARMS SO THAT THE DRIVE AXLES ARE IN A NORMAL HORIZONTAL POSITION. RUNNING THE VEHICLE IN GEAR WITH THE WHEELS HANGING DOWN AT FULL TRAVEL MAY DAMAGE THE DRIVE AXLES.
- NOTE LIGHT.

LIGHT "ON": FAULTY TRANSMISSION THIRD GEAR APPLY SWITCH.

LIGHT "OFF": ②
- INCREASE SPEED TO 20-25 MPH (32-40 KM/H) TO CLOSE 3RD GEAR APPLY SWITCH.
- NOTE TEST LIGHT.

LIGHT "ON": TEST LIGHT SHOULD GO OUT AS BRAKE PEDAL IS DEPRESSED.

OK: ③
- IGNITION ON. ENGINE STOPPED.
- INSTEAD OF GROUND. CONNECT TEST LIGHT TO 12 VOLTS AND PROBE ALCL TERMINAL "F".
- GROUND DIAGNOSTIC TERMINAL AND NOTE LIGHT.

LIGHT "OFF": ④ CHECK FOR OPEN CKT 422 FROM ALCL TO ECM CONNECTOR TERMINAL .IF CKT 422 IS OK IT IS A FAULTY ECM. ⚠

LIGHT "ON": CHECK FOR:
- COOLANT LEVEL.
- FAULTY OR INCORRECT THERMOSTAT. ENGINE TEMP. SHOULD BE ABOVE 70°C.
- VSS CODE 24 CHART.
- CHECK FOR CORRECT PROM IF OK, TCC ELECTRICAL CONTROL IS OK.

NOT OK: FAULTY BRAKE SWITCH OR ADJUSTMENT.

LIGHT "OFF":
- CHECK FOR BLOWN FUSE. IF OK, DISCONNECT CONNECTOR AT TRANS.
- CONNECT TEST LIGHT FROM HARNESS CONNECTOR "A" TO "D".
- IGNITION "ON", ENGINE STOPPED.

LIGHT "OFF":
- CONNECT A TEST LIGHT FROM TERM "A" TO GROUND.

LIGHT "OFF": REPAIR OPEN IN TCC BRAKE SWITCH CIRCUIT OR ADJ. SWITCH.

LIGHT "ON":
- GROUND TCC TEST POINT AND AGAIN CONNECT TEST LIGHT BETWEEN HARNESS CONNECTOR TERMS "A" AND "D".

LIGHT "ON": FAULTY:
- TRANS. TCC CONN.
- TCC SOLENOID.
- THIRD GEAR APPLY SWITCH

LIGHT "OFF": REPAIR OPEN IN WIRE FROM TRANS. TO ALCL TEST POINT. TERM "F".

LIGHT "ON": ④ CHECK FOR SHORT TO GROUND IN CKT 422. IF NOT GROUNDED. REPLACE ECM. ⚠

⚠ BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND SOLENOID COIL.
SEE ECM WIRING DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED.
REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

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CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 6S 2872-6E
7-16-85

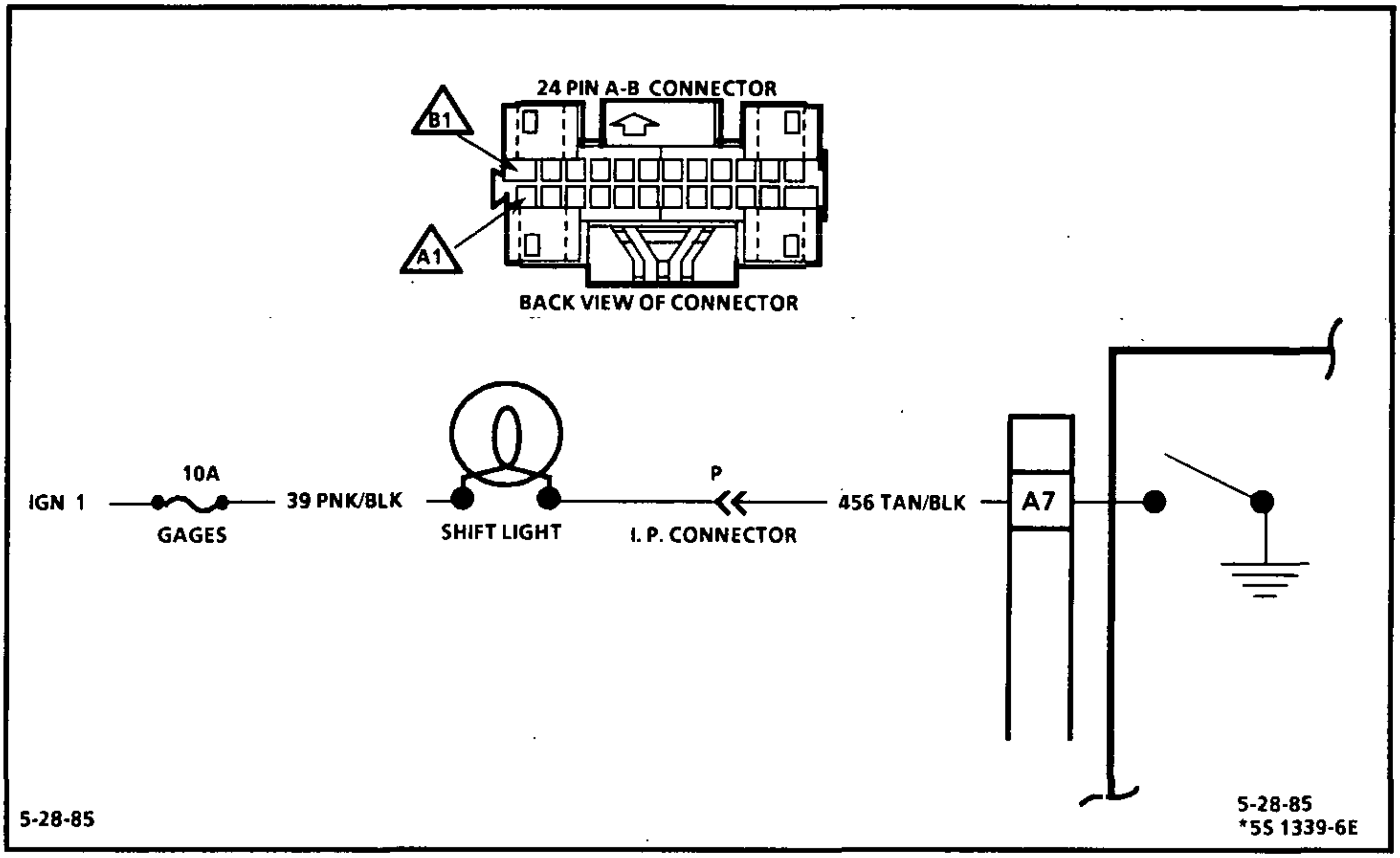


CHART C-8B
SHIFT LIGHT
2.8L "P" SERIES
FUEL INJECTION (PORT)

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

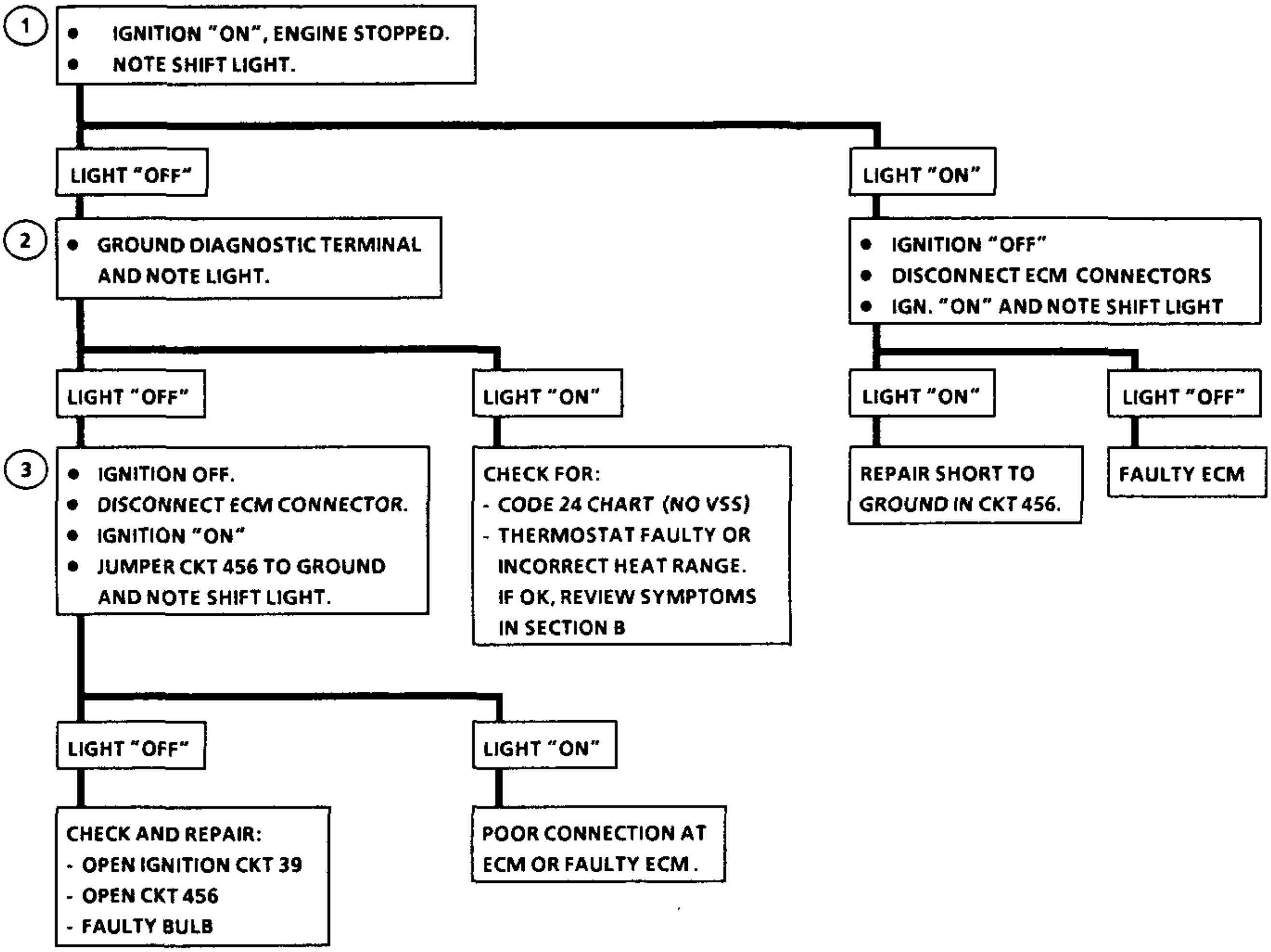
The ECM uses the measured RPM and the vehicle speed to calculate what gear the vehicle is in. It's this calculation that determines when the shift light should be turned on.

1. This should not turn "ON" the shift light. If the light is "ON", there is a short to ground in CKT 456 wiringj 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
2.8L "P" SERIES
FUEL INJECTION (PORT)



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SECTION C10

A/C CLUTCH CONTROL

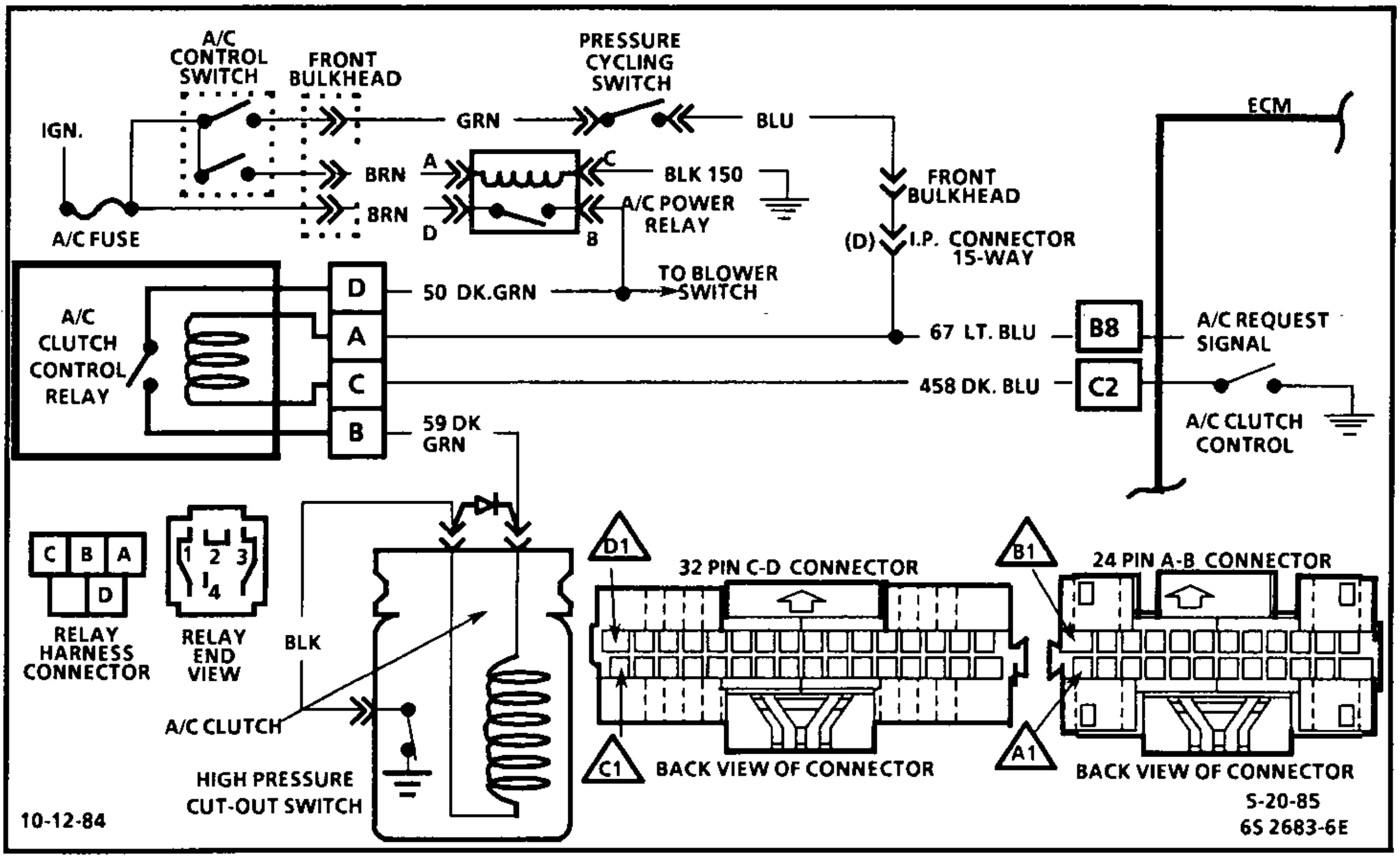


CHART C-10
A/C CLUTCH CONTROL
2.8L "P" SERIES
FUEL INJECTION (PORT)

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.
- 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 50 when the A/C power relay is energized by the A/C Control Switch. Also, when the A/C is turned on, voltage is supplied to the A/C relay coil on CKT 67 through the closed pressure cycling 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 C2, CKT 458, and close the A/C relay.

When relay is energized battery voltage from CKT 50 is supplied to the A/C clutch through the relay and CKT 59.

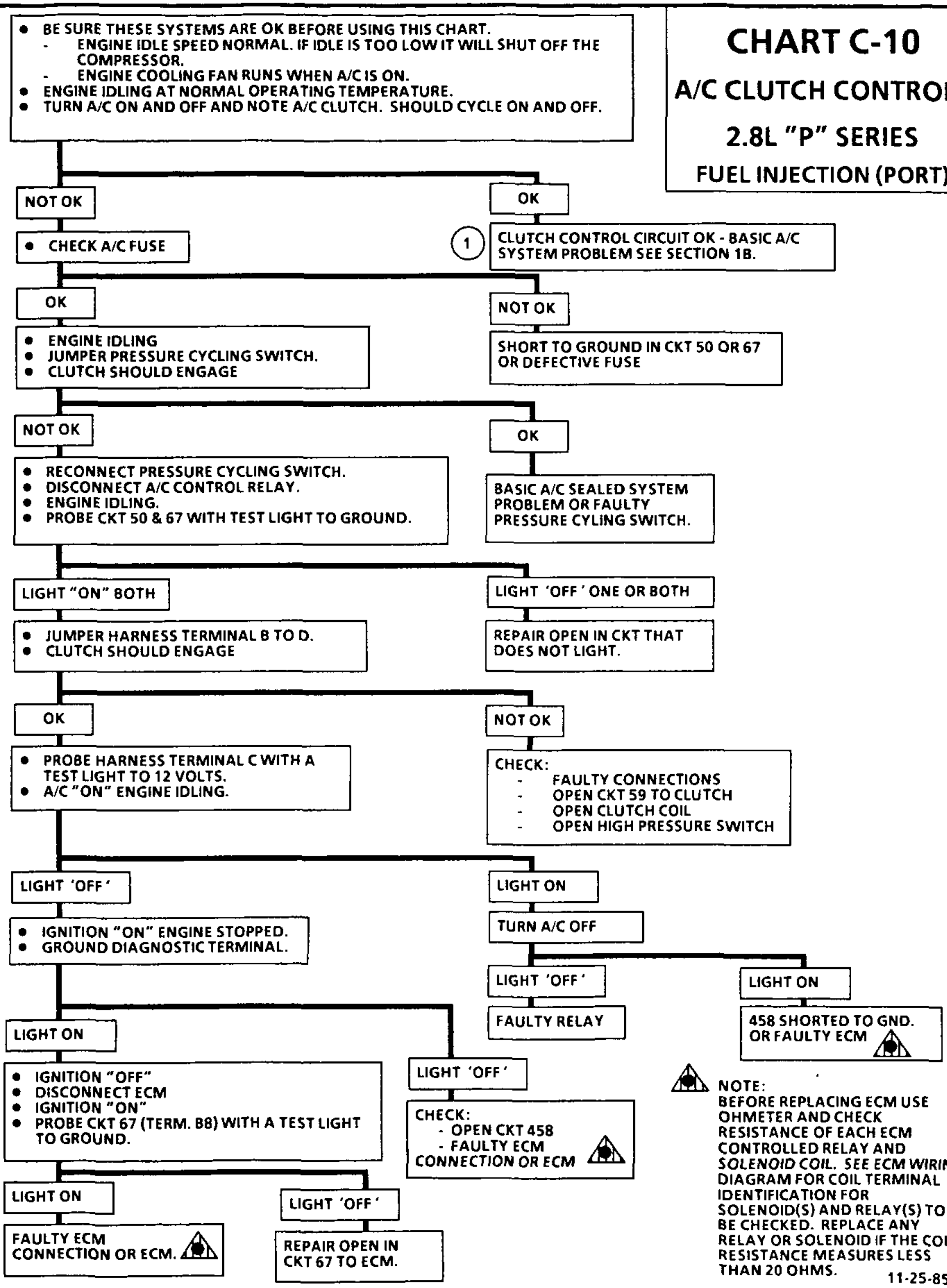
1. If there is no delay when switch is cycled from off to on, CKT 458 may be shorted to ground or the relay contacts are stuck closed.

CHART C-10

A/C CLUTCH CONTROL

2.8L "P" SERIES

FUEL INJECTION (PORT)



⚠ NOTE:
BEFORE REPLACING ECM USE OHMETER AND CHECK RESISTANCE OF EACH ECM CONTROLLED RELAY AND *SOLENOID COIL. SEE ECM WIRING* DIAGRAM FOR COIL TERMINAL IDENTIFICATION FOR SOLENOID(S) AND RELAY(S) TO BE CHECKED. REPLACE ANY RELAY OR SOLENOID IF THE COIL RESISTANCE MEASURES LESS THAN 20 OHMS.

11-25-85

CLEAR CODES AND CONFIRM "CLOSED LOOP" OPERATION AND NO "SERVICE ENGINE SOON" LIGHT.

* 6S 2758-6E

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SECTION C13

POSITIVE CRANKCASE VENTILATION (PCV)

GENERAL DESCRIPTION

A Positive Crankcase Ventilation (PCV) system is used to provide more complete scavenging of crankcase vapors. Fresh air from the air intake duct is supplied to the crankcase, mixed with blow-by gases and then passed through a positive crankcase ventilation (PCV) valve into the Air Plenum (Figure C13-1).

The primary control is through the PCV valve (Figure C13-1) 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 air cleaner 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.
    - Oil in air cleaner.
    - 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.

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.

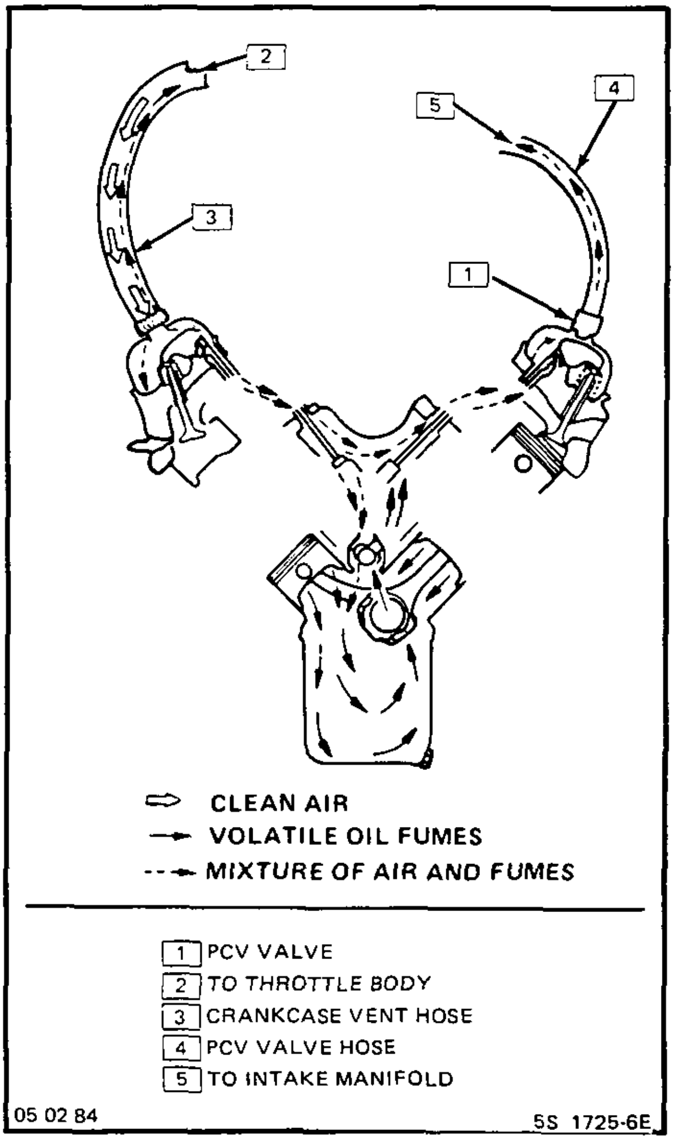


Figure C13-1 PCV Flow (Typical)

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 OB.

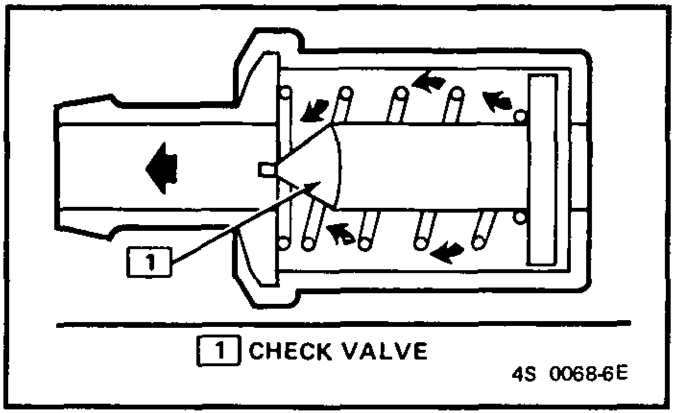


Figure C13-2 PCV Valve Cross Section

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 Valve	1L.162

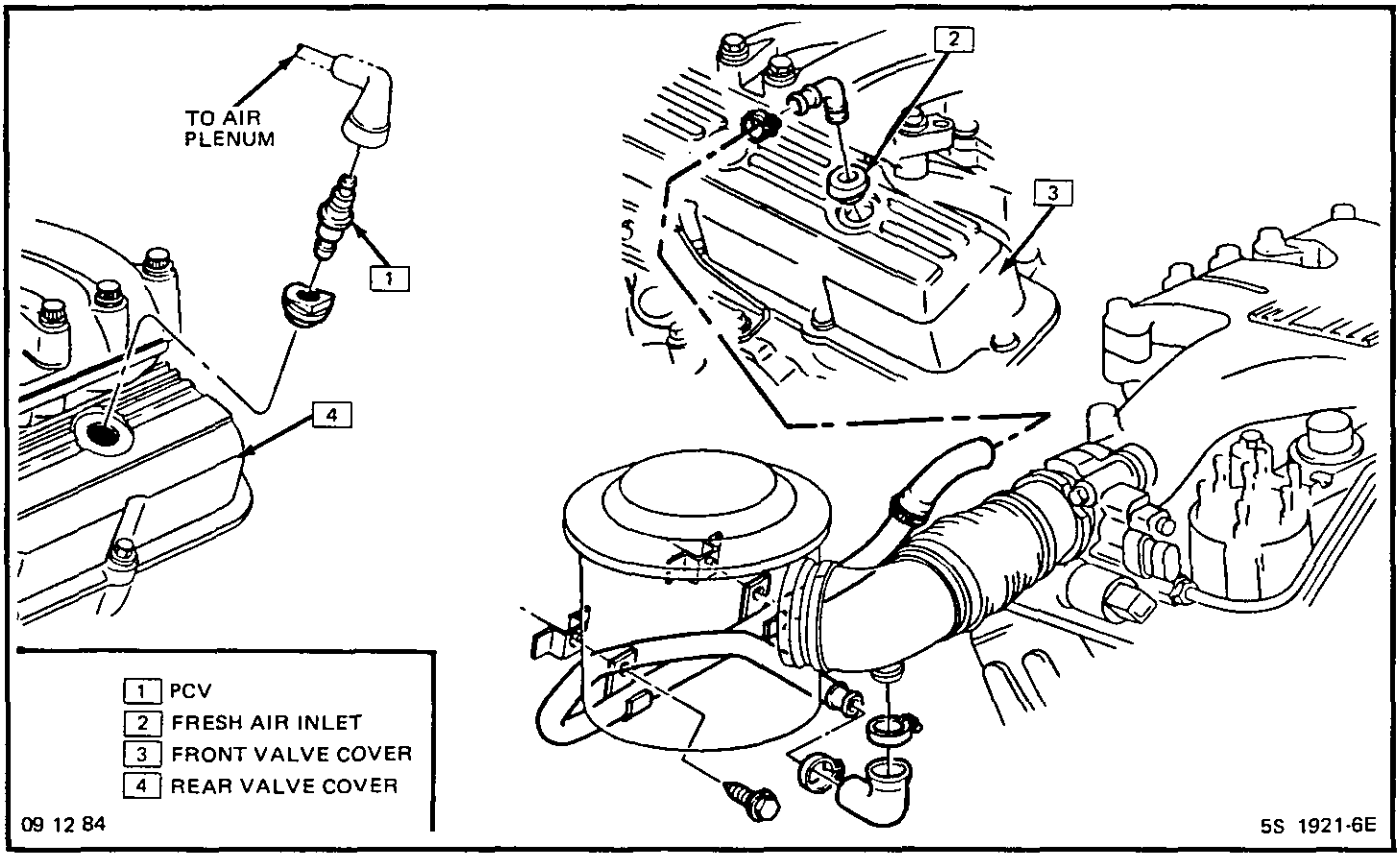


Figure C13-3 PCV System Service

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 for broken, damaged, missing or mispositioned parts, open seams, holes, loose connections, or other deterioration which could permit ex Dust or water in the passenger compartment may be an indication of a problem in one of these areas. Any defects should be correcte

EXHAUST PIPE

The exhaust manifold to exhaust pipe connection is of the flex joint type, and requires a graphoil seal.

MUFFLER

The muffler is a tri-flow design, located at the rear of the vehicle, mounted transversely. The complete exhaust system is a one piece design constructed of stainless steel.

HANGER

Spring type hangers are used to support the complete exhaust system.

The installation of exhaust system supports is very important, as improperly installed supports can cause annoying vibrations which are difficult to diagnose.

CLAMP

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).

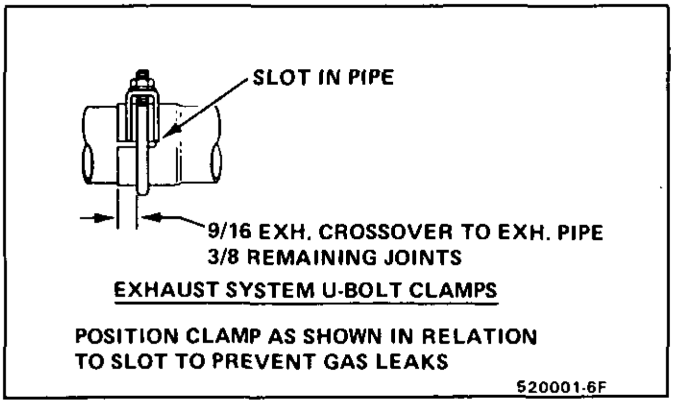


Fig. 1 Installation of Exhaust System Clamp

CATALYTIC CONVERTER

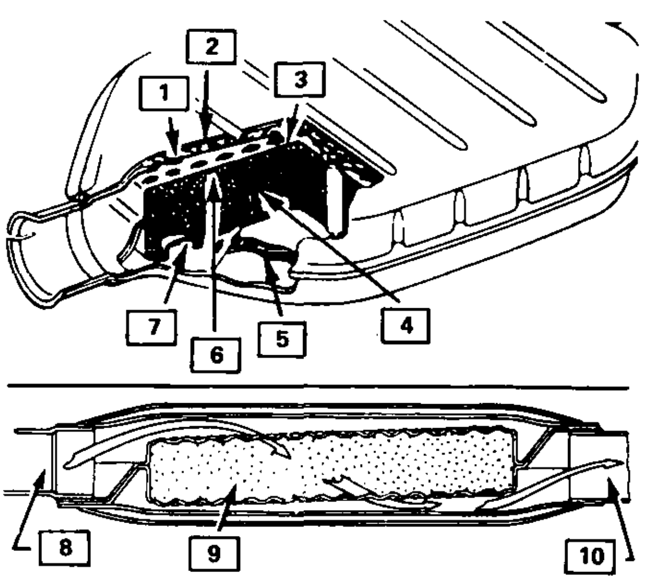
The catalytic converter is an emission control device added to the exhaust system to reduce pollutants from the exhaust gas stream.

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 converter, pipes and muffler.

A single bed converter design is used in combination with a three-way (reduction) catalyst.

The catalytic coating on the three-way (reduction) catalyst contains platinum and rhodium, which lower levels of oxide of nitrogen (NOX) as well as hydrocarbons (HC) and carbon monoxide (CO).



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

Fig. 2 Single Bed Pellet Converter

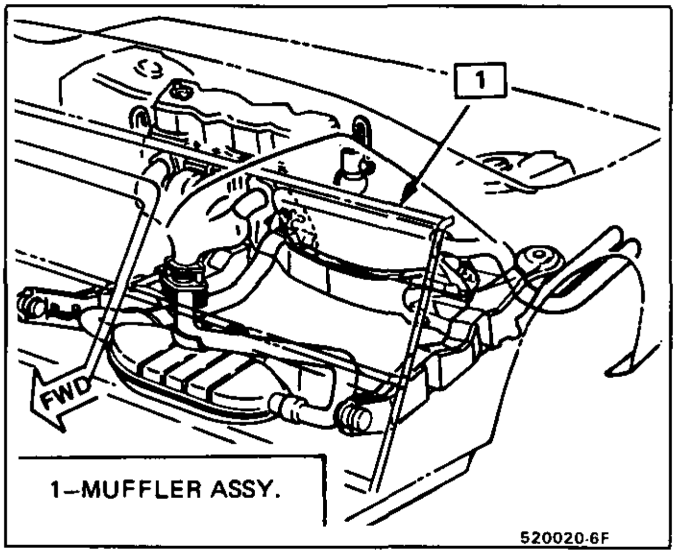


Fig. 3 Exhaust System (LR8)

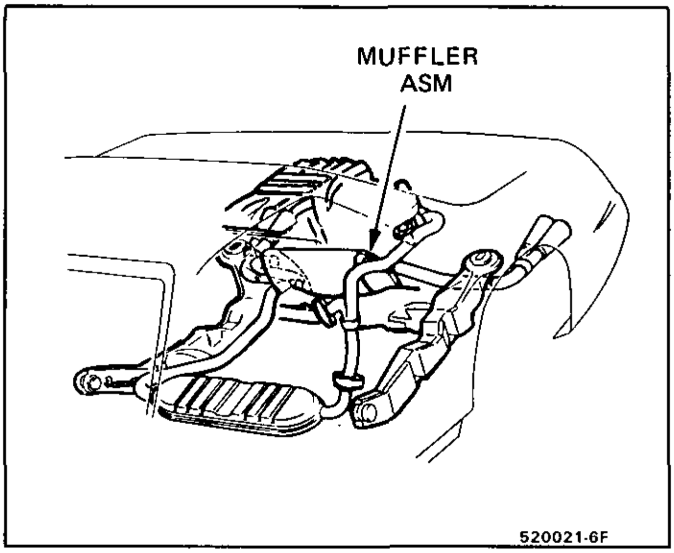
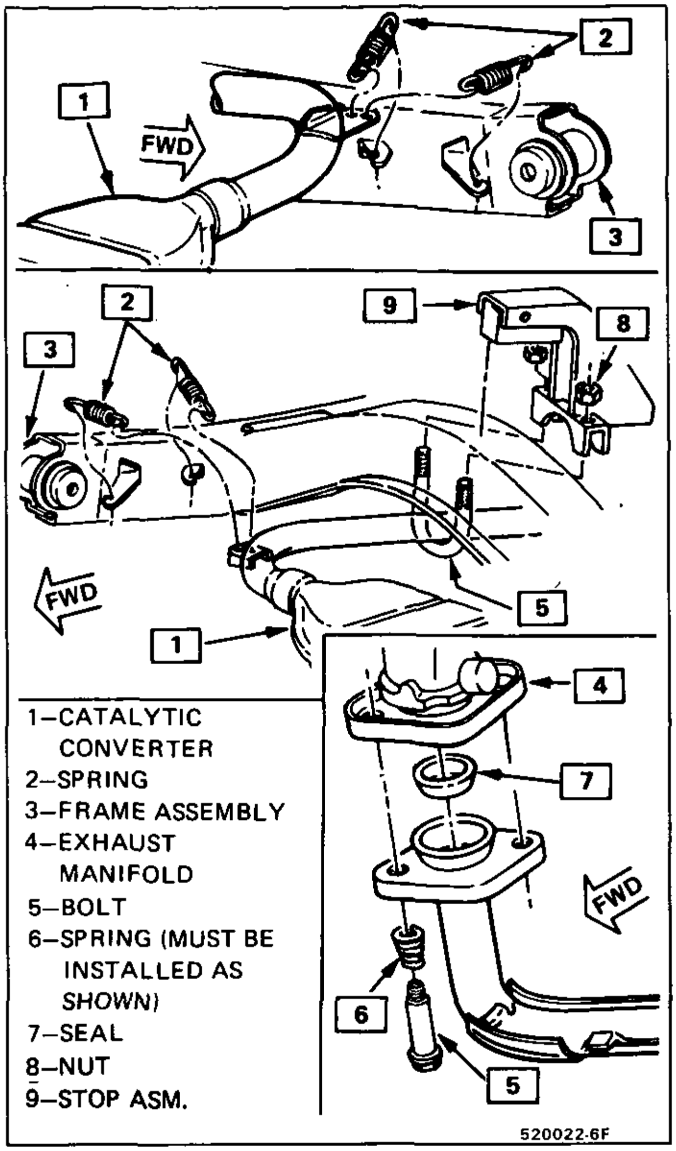


Fig. 4 Exhaust System (L44)



1–CATALYTIC CONVERTER
2–SPRING
3–FRAME ASSEMBLY
4–EXHAUST MANIFOLD
5–BOLT
6–SPRING (MUST BE INSTALLED AS SHOWN)
7–SEAL
8–NUT
9–STOP ASM.

Fig. 5 Exhaust Pipe Connection

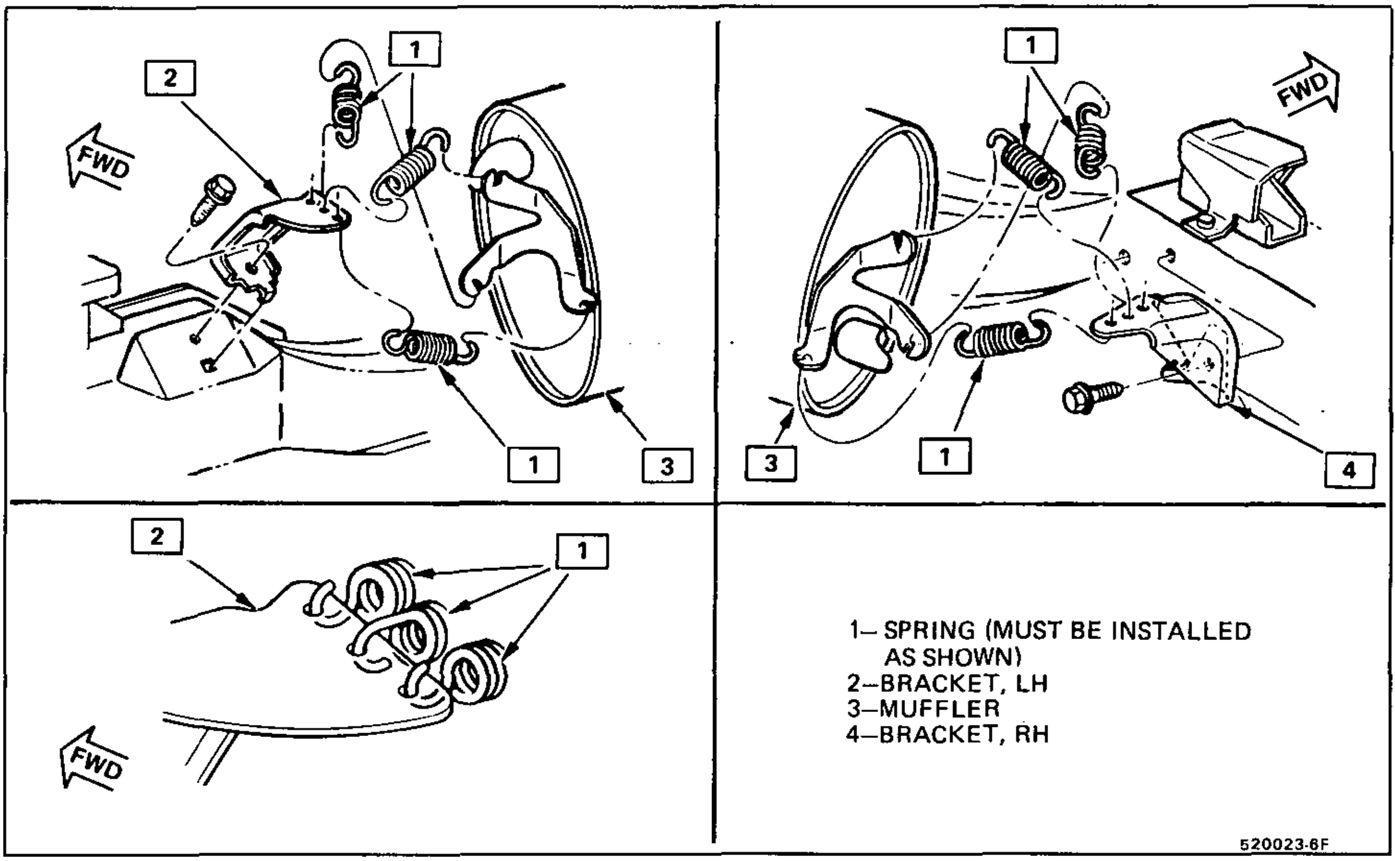


Fig. 6 Muffler Spring Installation

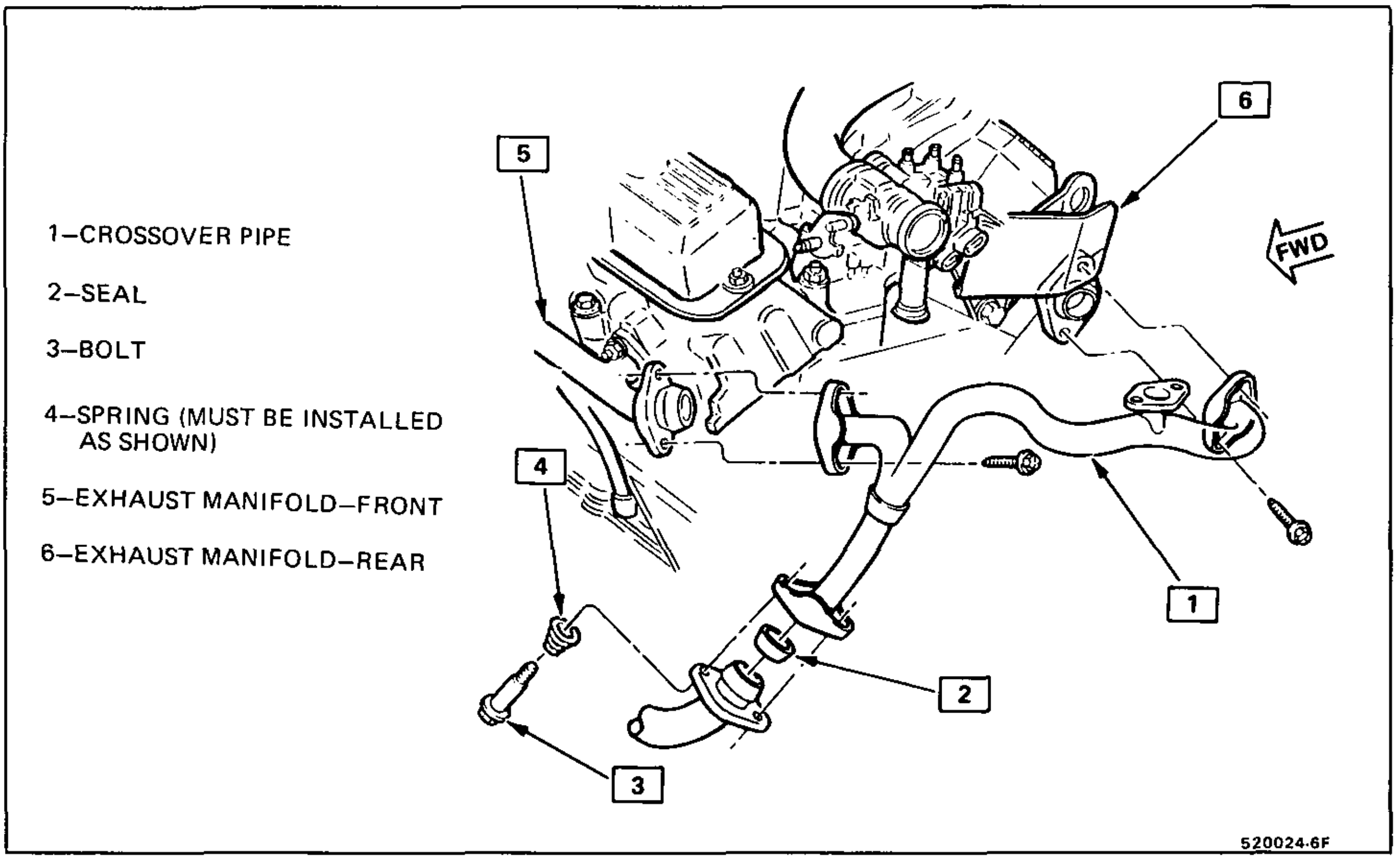


Fig. 7 Exhaust Crossover Pipe

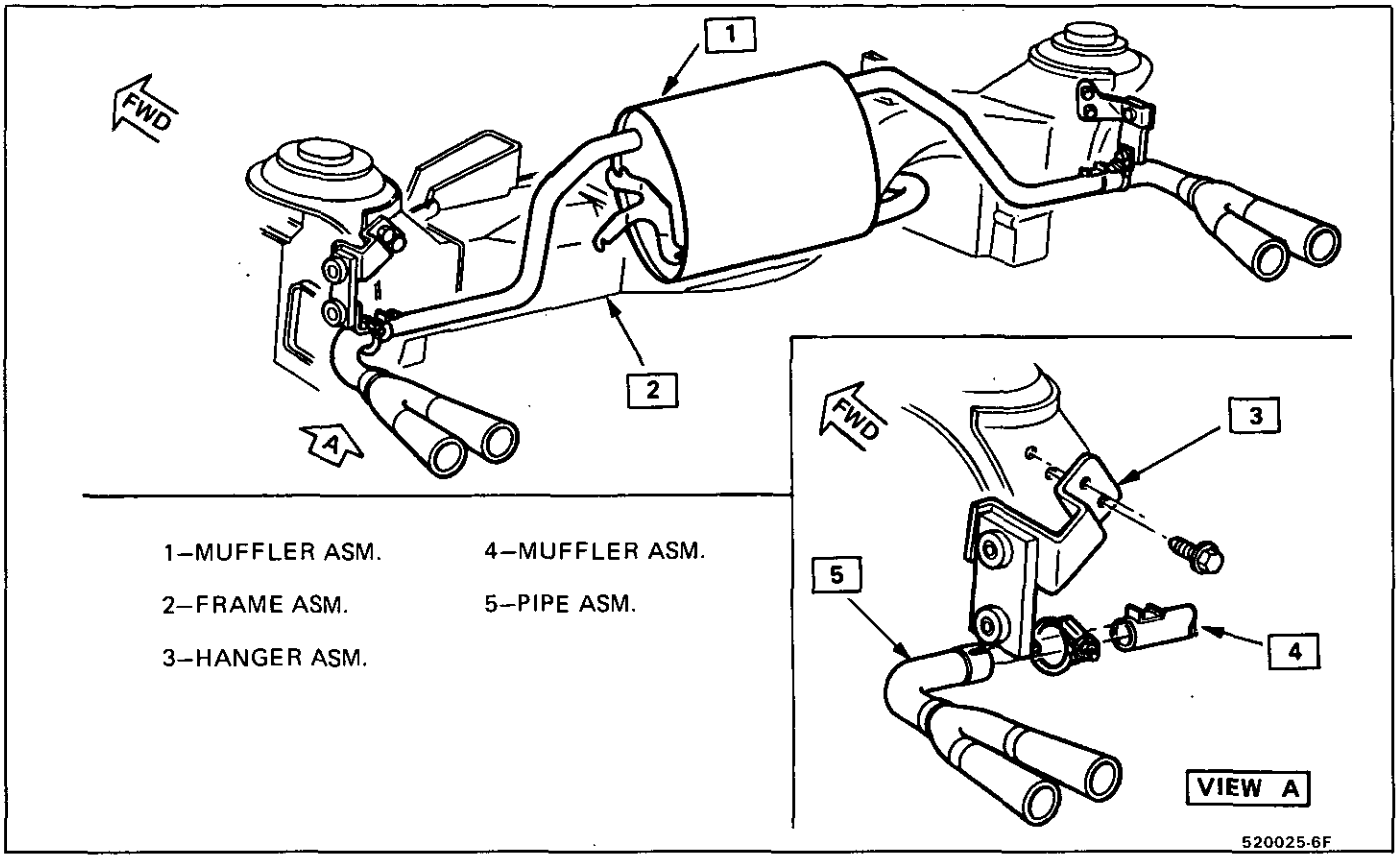


Fig. 8 Muffler Assembly and Tailpipe Extension (LR8)

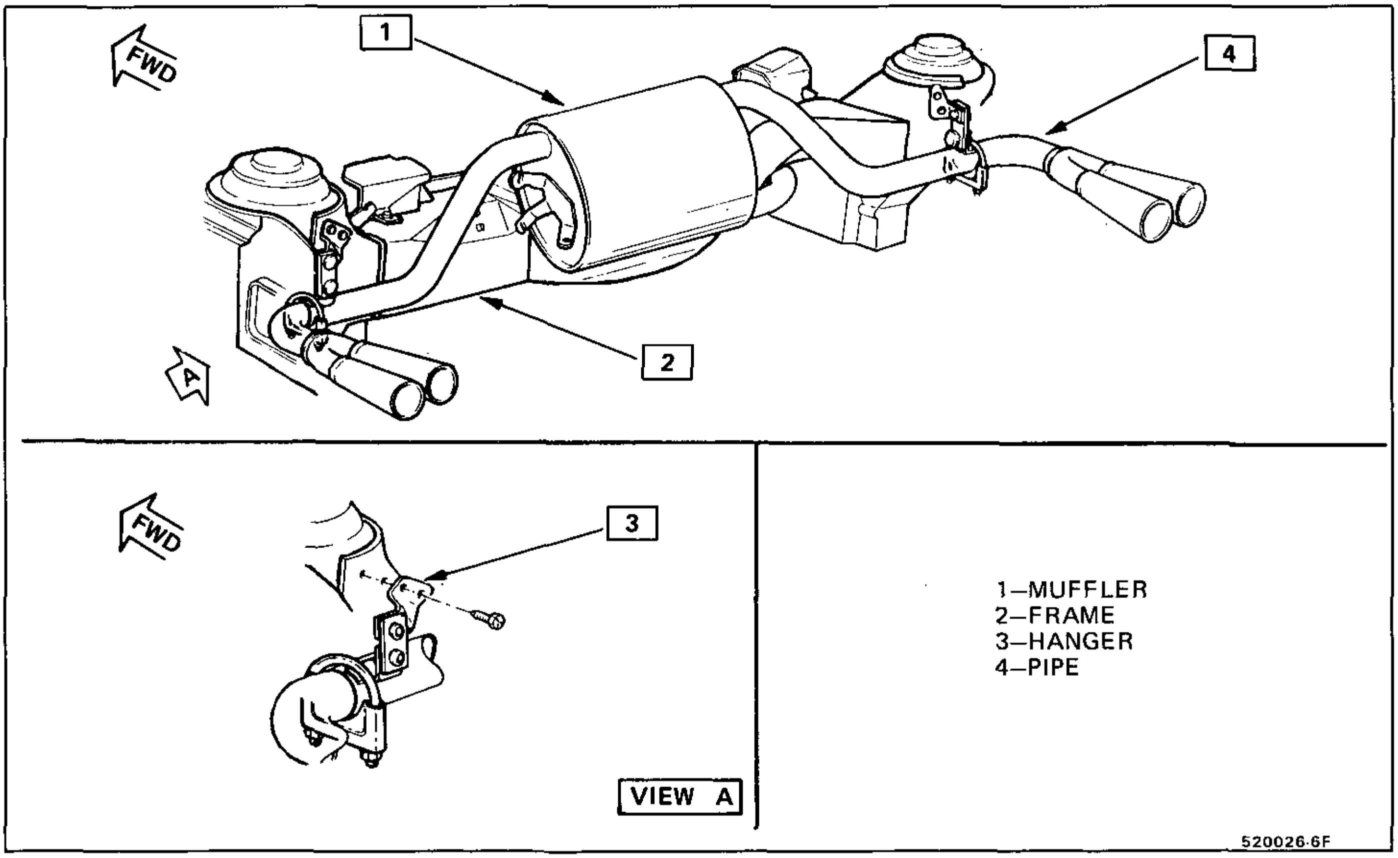


Fig. 9 Muffler Assembly and Tailpipe Extension (L44)

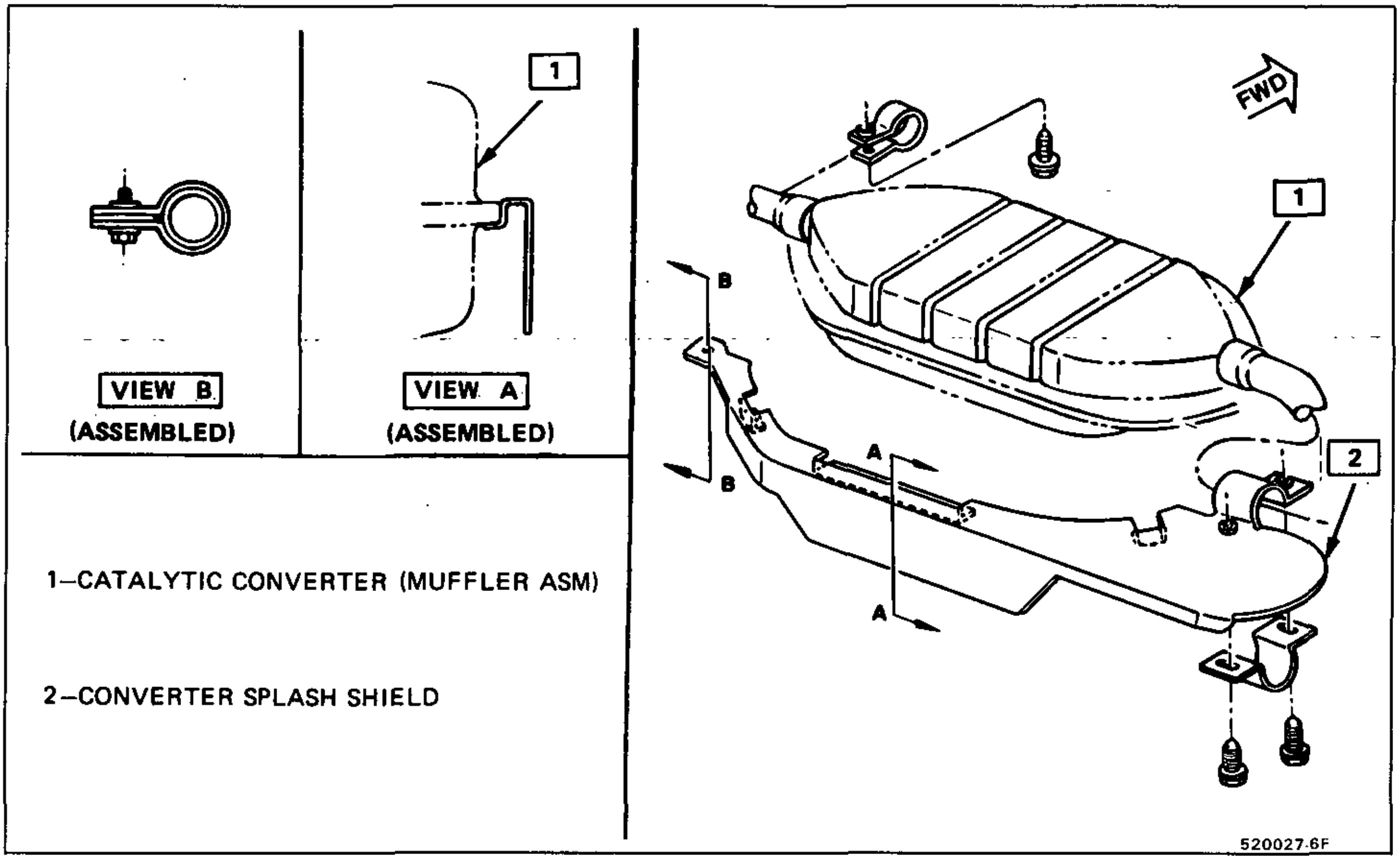


Fig. 10 Converter Splash Shield

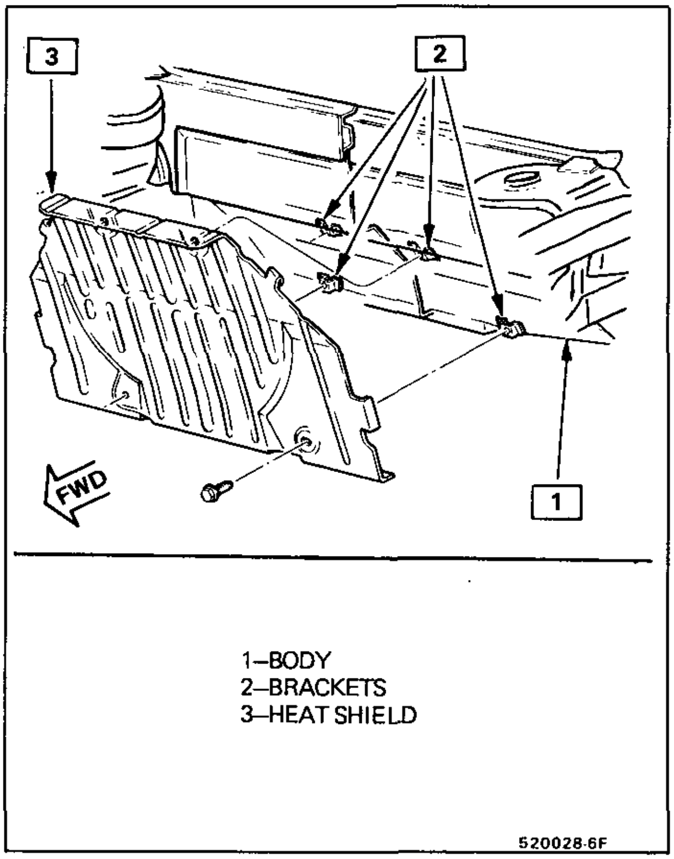


Fig. 11 Muffler Heat Shield

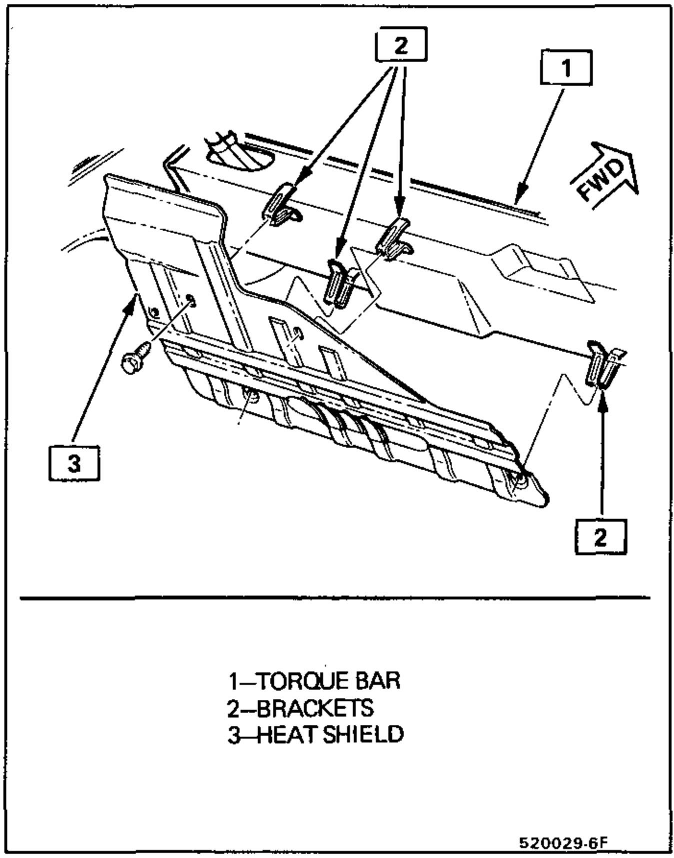


Fig. 12 Converter Heat Shield

SECTION 7A

AUTOMATIC TRANSAXLE/TRANSMISSION

DIAGNOSIS AND GENERAL SERVICE

The service procedures in this section are common to all automatic transaxles and automatic transmissions. For on-car service and overhaul procedures, refer to the specific sections.

For vehicles sold in Canada and equipped with non-closed loop engines, also refer to the appropriate Canadian service manual supplement.

CONTENTS

DIAGNOSIS

Automatic transaxle/transmission malfunctions are caused by one, or a combination, of the following:

- Improper fluid level
- Low engine performance
- T.V. cable misadjustment
- Manual linkage misadjustment
- Internal fluid leaks
- Electrical failure
- Mechanical failure

PRELIMINARY CHECKING PROCEDURE

Figure 1

Most of the automatic transaxle/transmission problems are caused by improper external adjustments. Before attempting to service a transmission or transaxle, the fluid level and external adjustments should be checked and corrected as necessary.

Inspect

1. Warm up engine and transmission to operating temperature.
2. Fluid level. Refer to "Fluid Level Checking Procedure".
3. Engine idle speed

   Important

   - Do not attempt to proceed with the Preliminary Checking Procedure if the engine does not perform properly. Correct any engine malfunction first.
4. T.V. cable for freedom of movement and returnability at cable activating lever. Check to be sure that the T.V. cable is adjusted to the proper length.

   The T.V. cable may function properly with the engine shut off and cold but may malfunction when hot. Check both cold and at operating temperature.
5. Shift control linkage. Make sure the linkage does not bind and is properly adjusted.

6. Test drive car.

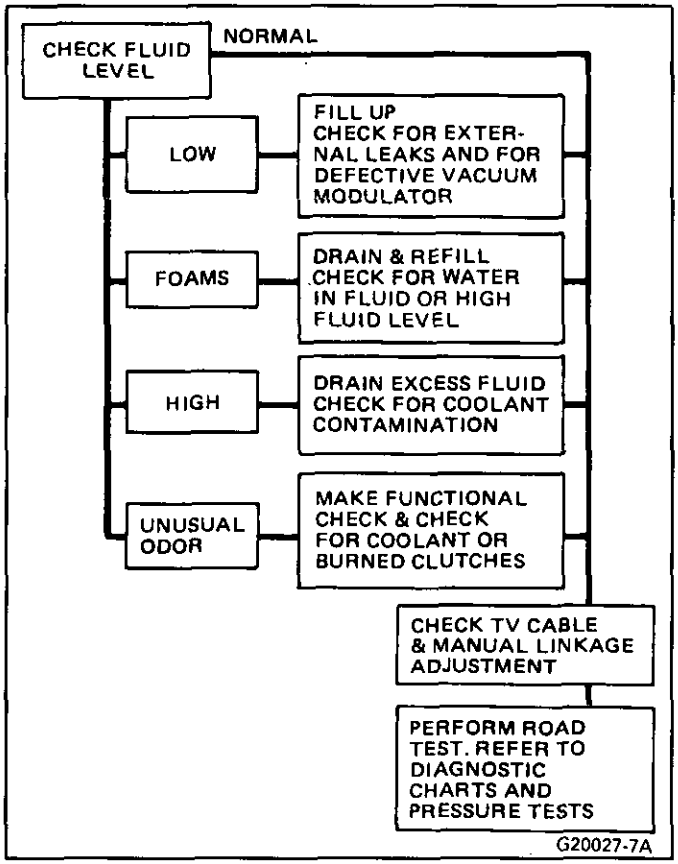


Fig. 1 Preliminary Check Procedure

ROAD TEST PROCEDURE

Important

- Perform the road test in an organized manner. Carry out **all** steps in the sequence shown. Note the results of each step for later evaluation with the aid of the Diagnostic Charts in the Specific Automatic Transaxle/Transmission Section.

Inspect

1. "DRIVE" range
   a. Place gear selector into "DRIVE" (D) and accelerate car.
   b. Observe the 1-2 and 2-3 shift. Shift points will vary with throttle pressure.
   c. Observe Torque Converter Clutch (TCC) engagement. This should occur between 35-50 mph (57-80 km/h). Refer to "TCC Diagnosis".

      Important

      - TCC will not engage if the engine is not at operating temperature.

   d. Observe 3-2 downshift
      - Part Throttle Downshift
        - At a speed of 25-30 mph (40-50 km/h) quickly open throttle approximately 3/4.
      - Full Throttle Downshift
        - At a speed of 50 mph (80 km/h) open throttle fully.
2. "INTERMEDIATE" range (I or 2) - 3rd gear is inoperative at this setting.
   a. Place gear selector into "2".
   b. Accelerate car and observe 1-2 shift. The shift point will vary with the throttle opening. The 1-2 shift will be firmer than in the "D" range.
   c. Observe 2-1 downshift.
      - Accelerate car to 20 mph (32 km/h).
      - Quickly open the throttle to wide open and observe downshift.
      - Place gear selector into "D".
      - Accelerate car to 50 mph (80 km/h).
      - Close throttle, move gear selector to "2" and observe downshift.
3. "LOW" range (L or 1) - 2nd and 3rd gear should be inoperative at this setting. Do not overspeed engine.
   a. Observe 2-1 downshift.
   b. Place gear selector into "2" and accelerate to 40 mph (64 km/h).
   c. Close throttle and move gear selector into "1". The 2-1 downshift should occur between 25-45 mph (40-72 km/h).
4. "REVERSE" (R)
   - Place gear selector into "R" and observe reverse.
   - Do not place gear selector into "R" while vehicle is moving.

FLUID PRESSURE TEST PROCEDURE

1. Install pressure gage J-21867 or J-5907-A. See specific transmission section.
2. Note transmission model code and refer to the appropriate chart in the specific transmission section for the correct pressure range and engine speeds.

   CAUTION: To avoid possible personal injury and/or damage to the car, brakes must be applied at all times during the test.

Causes of Low Oil Pressure

1. Low oil level
2. T.V. system (pressure low in "NEUTRAL", "DRIVE" and low to normal in "INTERMEDIATE" and "REVERSE")
   - T.V. cable misadjusted, sticking or broken. Refer to T.V. Cable Diagnosis.
   - T.V. linkage binding or incorrect cable.
   - Throttle valve stuck.
   - Shift T.V. valve stuck.
3. Oil strainer plugged or damaged.
4. Oil strainer seal leaking.
5. Control valve and pump assembly bolts loose.

6. Control Valve Assembly:
   - Check ball missing or off location.
   - Stuck or damaged valves:
     - T.V. valve and plunger.
     - Shift T.V. valve.
     - Pressure regulator valve.
     - T.V. boost valve.
     - Pressure relief valve.
     - Modulator valve.
   - 1-2 accumulator piston and/or seal leaking or missing.
   - Internal leaks.
7. (“LOW” only) Low blow off valve damaged, check ball missing or off location.
8. (“REVERSE” only) Low-Reverse clutch housing to case cup plug assembly leaking (Low-Reverse oil pipe leaking-where applicable).
9. Pump vane seals cut or missing.
10. Intermediate oil passages to pressure regulator blocked.
11. Driven sprocket support to case cover leaking.

Causes of High Oil Pressure

1. T.V. system (pressure high in “NEUTRAL” and “DRIVE” and normal to high in “INTERMEDIATE” and ““REVERSE”)
   - T.V. cable misadjusted, sticking or broken. Refer to T.V. Cable Diagnosis.
   - T.V. linkage binding or incorrect cable.
   - Throttle valve stuck
   - Shift T.V. valve stuck
   - T.V. lifter bent, damaged or too short
2. Control Valve and Pump Assembly:
   - T.V. valve and plunger
   - Shift T.V. valve
   - Pressure regulator valve
   - T.V. boost valve
   - Pump slide stuck
3. (“LOW” only) Low blow-off valve stuck closed
4. Internal pump or case cover leaking

On the basis of the results of the road test and the oil pressure test, consult the Diagnostic Charts for the appropriate model and determine the probable cause.

Important

- A number of sub-assemblies and systems can be repaired without removing the Automatic Transaxle/Transmission. Refer to the appropriate chart in the specific on-car service section.

FLUID LEAK DIAGNOSIS

Most fluid oil leaks are easily located and repaired by visually finding the leak and replacing or repairing the necessary parts. On some occasions a fluid leak may be difficult to locate or repair. The following procedure may help in locating and repairing most leaks.

FINDING THE LEAK

1. Identify the fluid, determine whether it is engine oil, automatic transmission fluid, power steering fluid, etc.
2. At what point is the fluid leaking from? After running the vehicle at normal operating temperature, park the vehicle over a large sheet of paper. After a few minutes, you should be able to find the approximate location of the leak by the drippings on the paper.
3. Visually check around the suspected component. Check around the suspected component. Check around all gasket mating surfaces for leaks. A mirror is useful for finding leaks in areas that are hard to reach.
4 If the leak still cannot be found, it may be necessary to clean the suspected area with a degreaser, steam or spray solvent. Clean the area well, then dry the area. Operate the vehicle for several miles at normal operating temperature and varying speeds. After operating the vehicle, visually check the suspected component. If you still cannot locate the leak, try using the powder or black light and dye method.

Powder Method

1. Clean the suspected area.
2. Apply an aerosol-type powder (such as foot powder) to the suspected area.
3. Operate the vehicle under normal operating conditions.
4. Visually inspect the suspected component. You should be able to trace the leak path over the white powder surface to the source.

Black Light and Dye Method

A dye and light kit is available for finding leaks. Refer to the manufacturers directions when using the kit.

1. Pour specified amount of dye into leaking component.
2. Operate the vehicle under normal operating conditions as directed in the kit.
3. Direct the light toward the suspected area. The dyed fluid will appear as a brightly colored path leading to the source.
   - See kit directions for the color of the fluid and dye mix.

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

1. Fluid level/pressure is too high.

2. Plugged vent.
3. Improperly torqued fasteners or dirty/damaged threads.
4. Warped flanges or sealing surface.
5. Scratches, burrs or other damage to the sealing surface.
6. Damaged or worn gasket.
7. Cracking or porosity of the component.
8. Improper sealant used (where applicable).

Seals

1. Fluid level/pressure is too high.
2. Plugged vent.
3. Damaged seal bore (scratched, burred or nicked).
4. Damaged or worn seal.
5. Improper installation.
6. Cracks in component.
7. Shaft surface scratched, nicked or damaged.
8. Loose or worn bearing causing excess seal wear.

Possible Points of Oil Leak

1. **Transaxle/Transmission pan or valve body cover:**
    - Attaching bolts not correctly torqued
    - Improperly installed or damaged gasket
    - Oil pan or valve body cover 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 and "O" rings damaged or missing
    - Speedometer driven gear/speed sensor seal damaged
    - Manual valve bore plug loose
    - Oil cooler connector fittings loose or damaged
    - Axle oil seals worn or damaged
    - Parking pawl shaft cup plug loose
    - Governor pressure pickup plug loose
    - Line pressure pickup pipe plug loose
    - Case to case cover gasket damaged
    - 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 drive sprocket support)
    - Turbine shaft oil seal worn or damaged
4. **Fluid comes out vent pipe or fill tube:**
    - Over-filled
    - Water in fluid
    - Case porous
    - Incorrect dipstick
    - Plugged vent
    - Drain back holes plugged

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

The TCC is applied by fluid pressure which is controlled by a solenoid located inside the Automatic Transaxle/Transmission assembly. The solenoid is energized or released by making or breaking ground contact thru a combination of external switches and sensors.

TCC Diagnosis

- For electrical diagnosis of TCC, refer to the specific carline 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 specific Transmission 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. 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 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. Refer to "General Service Procedures" for individual component test procedures.

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 ground path. Remember, a completed ground does not indicate that the circuit carries current.
- Do not bench test using an automotive type battery. Accidentally crossed wires will destroy the internal diodes of the TCC solenoid.

External Controls

Inspect

- Connect voltmeter between transmission connector and ground.
- Turn key "ON"
- If 12 volts are present at the connector, refer to the specific transmission section for TCC internal diagnosis.
- If 0 or low voltage is found, refer to Sections 6E and 8A for electrical diagnosis.

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 line 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".
7. Increase engine speed to 1400 RPM. If oil pressure does not increase, adjust T.V. cable. Refer to "T.V. Cable Adjustment".

SPEEDOMETER SYSTEM DIAGNOSIS

Figures 2 and 3

Refer to Figure 2 for diagnosis of speedometer complaints.

For verification of axle ratio/tire size/speedometer gear combinations, refer to Figure 3.

NOISE AND VIBRATION DIAGNOSIS

1. Vibration with the car in motion.

   Inspect

   - Engine and transmission mounts, damaged or loose. Refer to Sections 6A, 7A1 and 7A2.
   - Tires out of balance or unevenly worn. Snow tires, mixed sizes or mixed radial and bias ply. Refer to Section 3.
   - Drive shaft bearings worn. Refer to Section 4A.
   - Shock absorbers worn or loose. Refer to Section 3.
   - Front suspension worn, loose or misaligned. Refer to Section 3.
2. Vibration in "PARK" and "NEUTRAL". Worse at idle, tends to disappear as engine speed is increased.

   Inspect

   - Engine Performance
     - Spark plugs and wires
     - Timing
     - Compression. Refer to Section 6A.
   - Engine/Torque Converter Balance
     - Flywheel balance weights loose or missing. Refer to Section 6A.
     - Torque converter out of balance. Refer to "On Car Service, Torque Converter Vibration Test Procedure".

GENERAL SERVICE PROCEDURES

Important

- Keep work area and tools clean.
- Always clean the exterior of the transaxle/transmission before removing any parts.
- Do not use wiping cloths or rags.
- Do not use solvent on:
  - Neoprene seals
  - Composition faced clutch plates
  - Thrust washers
- Blow out all passages with compressed air. Probe small passages with tag wire.
- Handle parts with care to avoid nicks and scratches.

Inspect

- Linkage and pivot points for wear.
- Bearing and thrust surfaces for wear and scoring.
- Broken seal rings and damaged ring lands.
- Gaskets, mating surfaces, seals and "O" rings for damage. Investigige and correct cause of damage.
- Do not remove Teflon oil seal rings unless damaged.
- Case for porosity. Refer to Case Porosity Repair Procedure.

Important

- Expand internal snap rings and compress external snap rings to assure proper seating.
- Lubricate all internal parts as they are being installed.
- When installing cap screws into aluminum parts:
  - Always use a torque wrench.
  - Always dip screw threads in transmission fluid or engine oil.
  - Stripped or damaged aluminum threads may be reconditioned with thread inserts. Refer to Section 6A.
- Replace all gaskets, seals and "O" rings.
  - Always use seal protectors.
  - Do not use gasket cement or sealers, except where noted.

DIAGNOSIS SPEEDOMETER SYSTEM

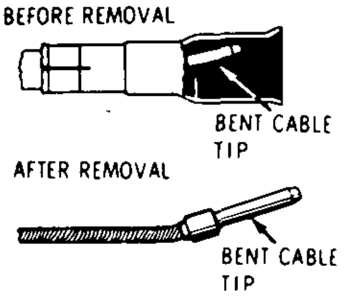
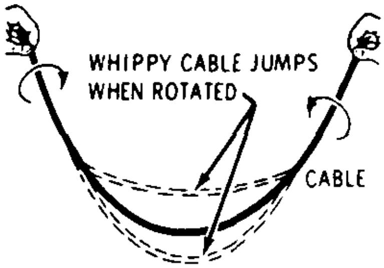
COMPLAINT	CAUSE	PROCEDURE
NOISY	LOOSE FERRULE AT SPEEDO HEAD.	PUSH FERRULE AGAINST SPEEDO HEAD AND RECHECK FOR NOISE.
	BEND CABLE TIP AT SPEEDO HEAD. 	REPLACE CABLE. LUBRICATE LOWER TWO-THIRDS OF CABLE WITH A THIN COAT OF SPEEDOMETER CABLE LUBRICANT.
	CABLE IS "WHIPPY." 	HOLD CABLE IN POSITION SHOWN AND ROTATE. A "WHIPPY" CABLE DOES NOT TURN SMOOTHLY, BUT JUMPS. IF THIS CONDITION EXISTS, REPLACE WITH A NEW CABLE. LUBRICATE LOWER TWO-THIRDS OF CABLE WITH A THIN COAT OF SPEEDOMETER CABLE LUBRICANT AND RECHECK FOR NOISE.
	CAUSE	PROCEDURE
	NOT PART OF SPEEDOMETER SYSTEM.	WITH CABLE REMOVED FROM CASING, RECONNECT FERRULE AND RECHECK FOR NOISE. IF NOISE STILL EXISTS, GEARS THAT DRIVE THE CABLE AT THE TRANSMISSION MAY BE AT FAULT.
	FAULTY DRIVEN GEAR IN TRANSMISSION	REMOVE DRIVEN GEAR FROM TRANSMISSION. CHECK FOR FREE ROTATION OF GEAR IN SLEEVE. CHECK FOR BURRS, FLASH, OR UNUSUAL WORN SPOTS. IF GEAR APPEARS FAULTY, REPLACE WITH NEW PART AND RECHECK FOR NOISE.
	FAULTY SPEEDOMETER HEAD.	IF NOISE STILL EXISTS AFTER PERFORMING THE ABOVE PROCEDURES, REMOVE SPEEDOMETER FOR REPAIR.
SPEEDO POINTER FLUTTERS	CABLE AND/OR CASING IS KINKED.	REFER TO NOISY CABLE AND/OR CASING KINKED.
	CABLE IS WEAK.	IF EXAMINATION DOES NOT REVEAL A KINKED CABLE AND/OR CASING, REPLACE WITH A NEW AND PROPERLY LUBRICATED CABLE AND RECHECK FOR POINTER FLUTTER.
STICKY SPEEDO POINTER BINDS OR HANGS UP	SPEEDO POINTER IS BENT AND RUBS.	REMOVE SPEEDOMETER CLUSTER FROM PANEL AND INSPECT FOR A RUBBING POINTER. STRAIGHTEN POINTER UNTIL IT IS FREE TO MOVE, REPLACE SPEEDOMETER CLUSTER IN PANEL AND RECHECK SPEEDO OPERATION.
	FAULTY SPEEDOMETER.	REMOVE HEAD FOR REPAIR.
SPEEDO DOESN'T WORK	BROKEN OR DISCONNECTED CABLE.	IF NEITHER THE SPEEDOMETER POINTER NOR ODOMETER OPERATES, CHECK TO SEE THAT CABLE IS IN PLACE AND TIGHT AT TRANSMISSION AND SPEEDOMETER. IF STILL INOPERATIVE, REPLACE CABLE.
	FAULTY SPEEDOMETER HEAD.	IF ONLY THE ODOMETER IS INOPERATIVE, OR IF THE ABOVE PROCEDURE IS NOT SATISFACTORY, REMOVE THE SPEEDOMETER FOR REPAIR.
INCORRECT CALIBRATION	WRONG TRANSMISSION ADAPTER, DRIVEN GEAR OR SLEEVE.	CHECK SPEEDOMETER GEAR REFERENCE CHART FOR CORRECT APPLICATION AND REPLACE IF NECESSARY.
	OVERSIZE OR UNDERSIZE TIRES.	CHECK CALIBRATION USING CORRECT TIRE SIZE.
	FAULTY SPEEDOMETER HEAD.	REMOVE SPEEDOMETER FOR REPAIR.

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Fig. 2 Speedometer System Diagnosis

AXLE RATIO (RPO)	TRANSMISSION		TIRE SIZE	DRIVE GEAR REFERENCE		SPEED GEAR REFERENCE	
	TYPE (RPO)	IDENTIFICATION CODE		COLOR TEETH	NO. OF TEETH	NO. OF	COLOR
3.060	THM125 (MD9)	CD	P185/75R14 P195/70R14 P215/60R15	GREEN	10	30	BLUE
3.180	THM125 (MD9)	PF	P185/75R14 P195/70R14	GREEN	10	30	BLUE
3.350	5 spd (MT2)	ZH	P185/75R14 P195/70R14	BLUE	35	29	RED
3.610	5 spd (MG2)	ZN	P185/75R14 P195/70R14 P215/60R15	NATURAL	35	29	RED
3.650	4 spd (M17)	UA	P185/75R14 P195/70R14 P215/60R15	NATURAL	35	29	RED

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Fig. 3 Speedometer Gear Chart

CHECKING AUTOMATIC TRANSAXLE/TRANSMISSION FLUID LEVEL

Important

- Fluid level should be checked with the Transaxle/Transmission at operating temperature - 150-200°F (83-93°C). This temperature is reached after at least 15 miles (24 km) of highway driving.
- An accurate fluid level reading cannot be obtained if the car has recently been operated under the following conditions:
  - In high ambient temperature - above 90°F (32°C)
  - At sustained high speed
  - In heavy city traffic in hot weather
  - Pulling a trailer
  - In commercial service (taxi, police, etc.)

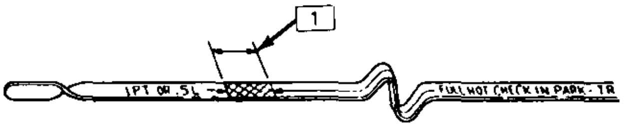
Fluid Level Checking Procedure

Figure 4

1. Park car on level ground.
2. Apply parking brake.
3. Run engine at slow idle.
4. Move gear selector through all gear positions. Move selector to "PARK" and read fluid level.
5. Maintain fluid level between "ADD" and "FULL". Refer to Figure 4 for Automatic Transaxle. Low fluid level may cause slipping when cold, on a hill, when accelerating or when turning.

NOTICE: Do not overfill. Overfilling causes foaming and loss of fluid through the vent and may damage the Automatic Transaxle/ Transmission.

6. Refer to Figure 1 if unusually low or high fluid level is found, if fluid foams excessively or has an unusual odor.



1 LEVEL TO BE IN CROSS-HATCHED AREA ON FLUID LEVEL INDICATOR BLADE. CHECK AT OPERATING TEMPERATURE

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Fig. 4 Fluid Level Indicator-125C Transaxle

CHANGING FLUID AND FILTER

1. Raise vehicle and suitably support.
2. Place drain pan under Transaxle/Transmission oil pan.
3. Oil pan bolts from front and sides
4. Loosen rear oil pan bolts approximately 4 turns.
5. Pry oil pan loose with a screwdriver and allow fluid to drain.
6. Remaining oil pan bolts, pan and gasket.
7. Screen/filter and seal.

Inspect

- Oil pan and screen for foreign material:
  - Metal particles
  - Clutch facing material
  - Rubber particles
  - Engine coolant
- Determine and correct source of contamination.

Clean

- Gasket mating surfaces
- Remove all traces of old gasket
- Oil pan in solvent and blow dry.

Install or Connect

1. Screen, using a new filter and seal. Coat seal with petroleum jelly. Torque screen to specification.
2. Oil pan, using a new gasket. Torque bolts to specification.
3. Lower vehicle
4. Fill Transaxle/Transmission with the proper quantity of Dextron ® II or equivalent. Refer to specific section for quantity.
5. Place gear selector into "PARK".
6. Start engine and run at slow idle. Do not race the engine.
7. Check fluid level. Correct as required.

T.V. CABLE

Figures 5 and 6

Adjustment Procedure

Important

- Adjustment of the T.V. cable must be made by rotating the throttle lever at the carburetor or throttle body. Do not use the accelerator pedal to rotate the throttle lever. On Diesel engines, the throttle link assembly must be correctly adjusted **Before** making the T.V. cable adjustment.

Adjust

1. Stop engine.
2. Depress and hold down metal readjust tab at engine end of T.V. cable.
3. Move slider until it stops against the fitting.
4. Release readjustment tab.
5. Rotate the throttle lever to its "full travel position."
6. The slider must move (Ratchet) toward the lever when the lever is rotated to its "full travel position.".

Inspect

- Check that cable moves freely. The cable may appear to function properly with the engine stopped and cold. Recheck after the engine is hot.
- Road Test Vehicle.

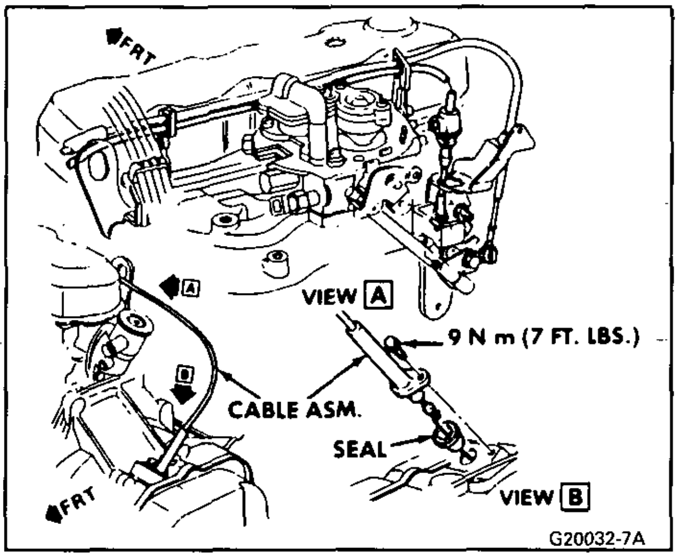
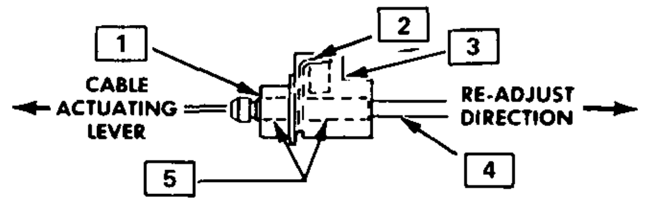


Fig. 5 T.V. Cable System



1. SLIDER AGAINST FITTING (ZERO OR READJUST POSITION)
2. READJUST TAB
3. FITTING
4. CABLE
5. SLIDER

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Fig. 6 T.V. Cable Adjuster

ENGINE COOLANT IN TRANSMISSION

NOTICE: Antifreeze will attack the rubber seals on the selective spacer and the glue used to bond the clutch material to the pressure plate, which may cause transmission damage.

If the transmission oil cooler has developed a leak allowing engine coolant to enter the transmission:

- Disassemble transmission and replace all rubber type seals.
- Replace composition-faced clutch plate assemblies.
- Replace all Nylon parts (washers, speedometers gears and governor gear).
- Replace the Torque Converter.
- Thoroughly clean and rebuild transmission, using new gaskets and oil filter.
- Flush the cooler lines and cooler after the transmission cooler has been properly repaired or replaced.

OIL COOLER AND COOLER LINE FLUSHING

Oil cooler and lines must be flushed if the transmission fluid has been contaminated by engine coolant or if metal, rubber or clutch facing particles have become suspended in the fluid as the result of mechanical failure.

Clean

1. Disconnect both cooler lines from the transmission.
2. Place a hose over the end of the cooler inlet line (from the bottom of the cooler) and insert the hose into an empty container.
3. Flush clean Oleum Solvent or equivalent through the return line (from the top of the cooler) using an oil suction gun until clean solvent comes out of the hose.
4. Remove the hose from the inlet cooler line and place it on the return line.
5. Flush clean Oleum Solvent or equivalent through the inlet line until clean solvent comes out the return line. Remove remaining solvent from cooler with compressed air applied to the return line and flush with transmission fluid.
6. Reconnect oil cooler lines and torque nuts to 17 N·m (12 ft. lbs.). Steel tubing should be double flared.

TORQUE CONVERTER CLUTCH (TCC) DIAGNOSIS

- See TCC Diagnosis in this section.

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

The car 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 transaxle 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. Driving the vehicle in "REVERSE" (R) and checking for poor performance will help determine if the stator is freewheeling at all times.

Condition B

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.

Do not use such items as the driven sprocket support or shafts to turn the race, as the results may be misleading.

TORQUE CONVERTER VIBRATION TEST PROCEDURE

Inspect

1. For missing or loose converter-to-flywheel bolts. Tighten or replace as necessary.
2. Converter for damage or missing balance weights. If the converter is damaged or balance weights are missing, replace the converter.
3. Change position of converter to flywheel by 120 degrees at a time to cancel out engine and converter unbalance. Recheck in each position for improvement.
4. If the unbalance persists, leave converter in the best balanced position. Imbalance can be corrected by the use of balance weights clipped to the flexplate or install longer flywheel-to-converter bolts adding and removing washers until optimal balance is achieved.

   Important! Some engine/transmission combinations cannot be balanced in this manner due to close clearances between the torque converter bolts and engine.

NOTICE: Be sure the bolts are not bottoming in the lug nuts. If bolts bottom, cover could be dented causing internal clutch facing damage. Always rotate the converter by hand after adding washers to check for clearance. See flexplate balance in Section 6A, General Engine Mechanical.

CONVERTER FLUSHING PROCEDURE

Figures 7 thru 10

Tool Required:
J-21369 Leak Tester

1. Drill a 11/32" (8.5 mm) hole in the converter between two vane extrusions and adjacent to the converter weld seam edge. Figure 7.
   - Drill the hole to approximate completion.
   - Remove the drill bit from the started hole and coat it with grease to retain any metal chips.
   - Complete drilling the hole at low speed.

NOTICE: To prevent converter damage, drill at right angles to the surface and sleeve the drill bit so it can enter no deeper than 1/4" (6.25 mm).

2. Apply grease to a 1/8 x 27 NPSF tap and thread the hole.
3. Drain fluid by propping converter in a drain pan with the drilled hole at the bottom, Figure 8. Drain approximately 15 minutes.
4. Charge converter hub with air to remove as much contaminated transmission fluid as possible. Set converter on pilot, pour in two quarts of cleaning solvent and agitate. Drain converter and to blow dry.
5. Coat a 1/8 x 27 NPTF pipe plug GM 9427802 or equivalent with Teflon pipe sealant or equivalent and install.

6. Torque to 96 in. lbs.

Inspect

- For leaks at 80 psi using Tool J-21369. Put liquid soap or leak-detecting solution on the pipe plug and watch for bubbles.

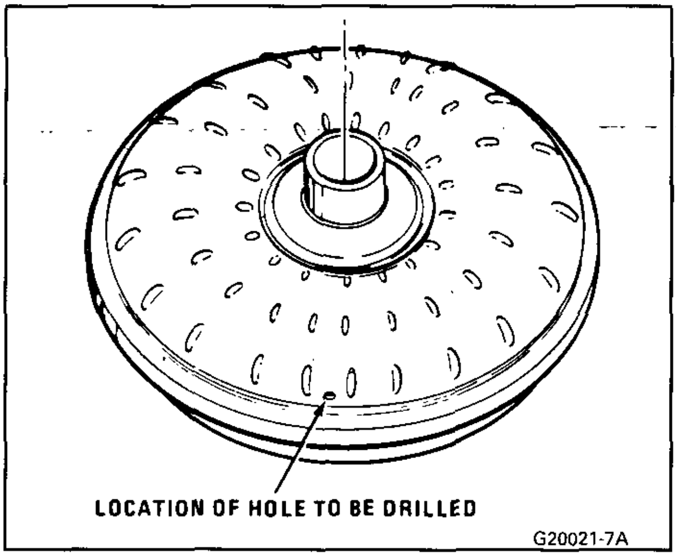


Fig. 7 Location of Hole to be Drilled

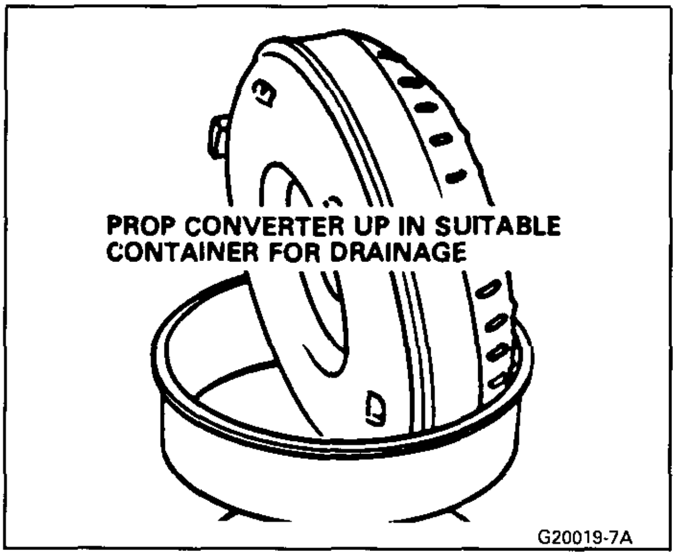


Fig. 8 Draining Torque Converter

TORQUE CONVERTER EVALUATION

Figures 9, 10 and 11

Tools Required:

J-21369-D Torque Converter Leak Test Fixture

J-21369-40 125C Leak Test Adapter

J-29060 End Play Checking Tool 200C, 200-4R

J-21371 End Play Checking Tool 325-4L

J-29830 End Play Checking Tool 125C, 440-T4

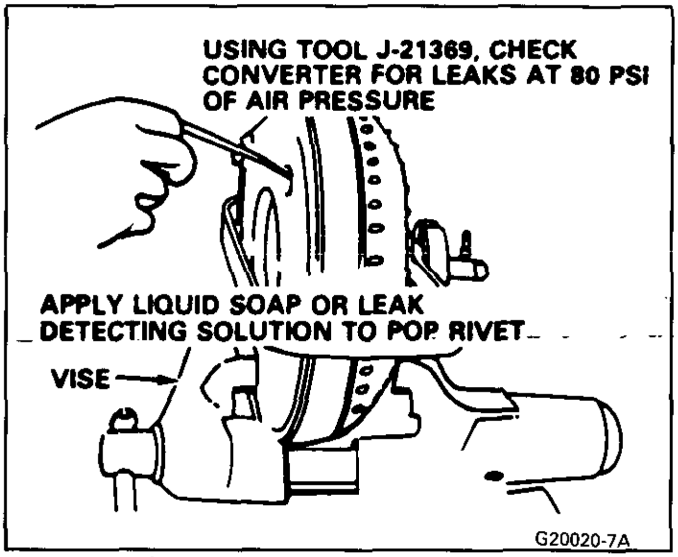


Fig. 9 Pressure Testing Torque Converter

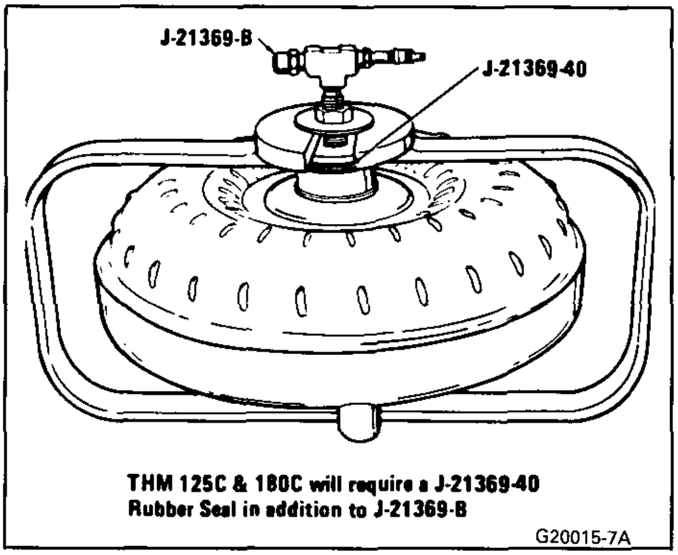


Fig. 10 Pressure Testing Torque Converter

The converter should be replaced if:

- Either the auxiliary valve body cover or pump pocket are badly scored.
- Internal converter failure, such as the stator overrun clutch not locking, thrust bearing failure, etc.. Such failures are also normally associated with "aluminized" oil in the converter.
- End play in the converter exceeds .020" to .024" (0.5mm). This measurement cannot be estimated, but must be made with tool J-29830.
- Leaks externally, such as at the hub weld area.
- Hub scored or otherwise damaged, which could cause a front seal failure or front pump bushing failure.
- A broken, damaged or illfitting converter pilot, which could cause the converter to either not fit into the crankshaft bore properly or not be correctly aligned with the crankshaft.
- If the converter has an imbalance which cannot be corrected, the converter should be replaced. Refer to Converter Vibration Test Procedure.

- Converter 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. There is no indication that there is internal damage, nor any pump damage. Dump out as much oil as possible from the converter and replace only the oil filter in the pan.
- The threads in one or more of the three converter bolt holes are damaged. Correct with thread insert. Refer to Section 6A.

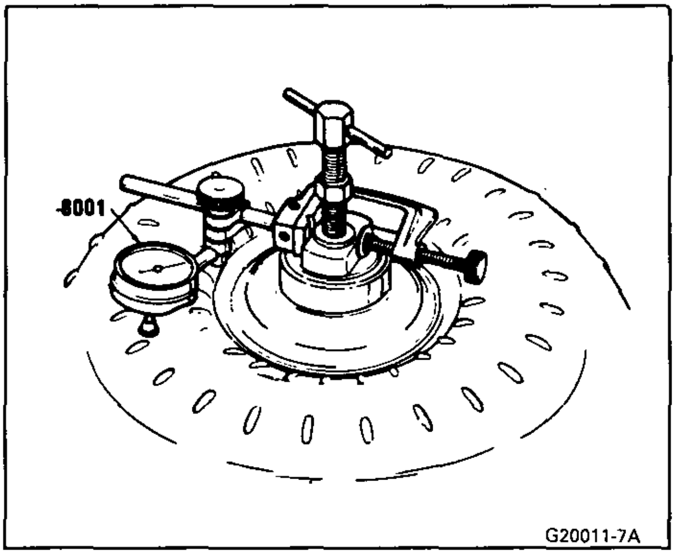


Fig. 11 Checking Torque Converter End Play

CLUTCH PLATE DIAGNOSIS

Composition Plates

Inspect

- Dry plates and inspect for pitting, flaking, wear, glazing, cracking, charring, and chips or metal particles imbedded in lining.

  If a composition plate shows any of the above conditions replacement is required.

Steel Plates

- Wipe plates dry and check for heat discoloration. If the surfaces are smooth, even if color smear is indicated, the plate should be reused. If severe heat spot discoloration or surface scuffing is indicated, the plate must be replaced.

Important

- If there is evidence of extreme heat or burning in the area of the clutch, the springs should be replaced.

Causes of Burned Clutch Plates

Burned clutch plates can be caused by incorrect usage of clutch plates. Engine coolant in the transmission fluid can cause severe damage, such as large pieces of composition clutch plate material peeling off.

Inspect

1. Forward Clutch
   - Check ball in clutch housing damaged, stuck or missing
   - Clutch piston cracked, seals damaged or missing
   - Low line pressure
   - Pump cover oil seal rings missing, broken or undersize; ring groove oversize
   - Case valve body face not flat or porosity between channels
2. Intermediate Clutch or Band.
   - Intermediate clutch piston seals damaged or missing
   - Intermediate band servo piston seals damaged or missing
   - Low line pressure
   - Case valve body face not flat or porosity between channels
3. Direct Clutch
   - Clutch piston seals damaged or missing
   - Case valve body face not flat or porosity between channels
   - (Transaxles) driven sprocket support internal leakage

CASE POROSITY REPAIR PROCEDURE

External leaks caused by case porosity can be repaired with the transmission in the car:

1. Road test and bring the transmission to operating temperature, approximately 93°C. (200°F.)
2. Raise and support car with the engine running. Check for leaks in all operating positions. A mirror may be helpful in finding leaks.
3. Shut engine off and thoroughly clean area to be repaired with a cleaning solvent and air dry.
4. Using instructions of the manufacturer, mix a sufficient amount of epoxy, GM. 1360016 or equivalent to make repair.

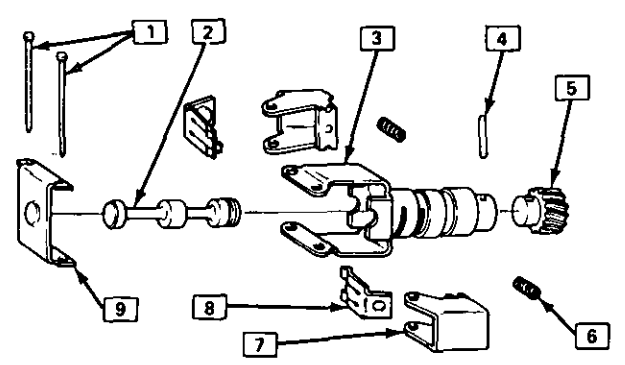
   CAUTION: EPOXY MAY IRRITATE THE SKIN AND CAUSE EYE DAMAGE. OBSERVE THE MANUFACTURER'S HANDLING INSTRUCTIONS. READ THE LABEL ON THE CONTAINERI
5. While the transmission case is still HOT apply epoxy. A clean, dry soldering acid brush can be used to clean the area and also to apply the epoxy cement. Make certain the area to be repaired is fully covered.
6. Allow epoxy cement to cure for three hours before starting engine.
7. Road test and check for leaks.

GOVERNOR

Figure 12

Refer to specific section for removal and replacement procedure.

All parts of the governor assembly, with the exception of the driven gear, are a select fit and each assembly is calibrated. The governor, including the driven gear, is serviced as a complete assembly. The driven gear can also be serviced separately.



1 PINS	5 DRIVEN GEAR
2 VALVE	6 SPRINGS (2)
3 SLEEVE AND CARRIER ASM.	7 PRIMARY WEIGHT (2)
4 GEAR RETAINING PIN	8 SECONDARY WEIGHT (2)
	9 THRUST CAP

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Fig. 12 Governor Assembly (Typical)

Inspect

1. The governor cover "O" ring seal for damage.
2. Governor for missing exhaust check balls.
3. Governor cover for damage or wear in its bore.
4. Speedometer drive gear and thrust washer for excessive wear.
5. Governor driven gear teeth for excessive wear or damage. If excessively worn or damaged, closely inspect the governor drive gear on the output shaft for nicks or damage.
6. The governor secondary weight may be bent and cause the governor weights to bind and not have free motion. (The secondary weight is thinner and lighter than the primary weight.) There must be more clearance between the weights. If no clearance exists, carefully place a small screwdriver between the weights at the pin and pry to create enough clearance to provide free motion of the weights. At the same time, make sure to maintain some clearance between the secondary weight and the governor shaft.
7. The primary and secondary springs must stand straight and not be mis-positioned or tilted. If improperly positioned or tilted, position it properly using a small screwdriver.

Governor Driven Gear

Figure 12

Disassemble

1. Remove retaining ring.
2. Remove washer
3. Remove gear from shaft.
   - Do not attempt to disassemble the governor any further.

Clean

- Wash govenror assembly in solvent. Dry and lubricate with transmission fluid.

Assemble

1. Place gear on shaft.
2. Place washer on shaft. of hole.
3. Replace retaining ring.

DRIVE LINK ASSEMBLY (CHAIN)

When disassembling any 125/125C, inspect the drive link assembly (chain) for wear.

Inspect

1. Remove the case side cover to expose the drive link (chain)
2. Midway between the sprockets and at right angles to the chain, push the slack strand (bottom strand) of the chain until all slack is removed and mark with crayon on the bottom side of the chain link. See Figure 13.
3. Push up in the same manner and put a second mark on the case, making sure that both marks are made from the same point on the chain.

Measure

- The distance between the two marks. If the distance exceeds 27.4 mm (1 1/16 inches), replace the drive link (chain).

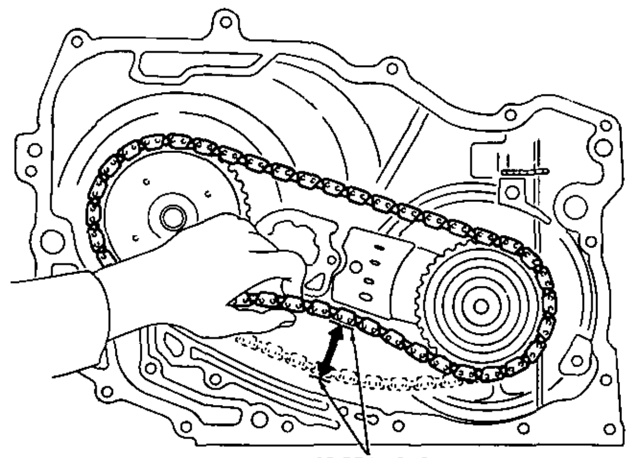

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Fig. 13 Checking Drive Link (Chain) Wear

SECTION 7A1

ON-CAR SERVICE 125C AUTOMATIC TRANSAXLE

Before diagnosis of any transmission complaint is attempted, there must be understanding of oil checking procedure and what appearance the oil should have. Many times a transmission malfunction can be traced to low oil level or improper reading of dipstick. Due to the transmission fluid that is now being used, it may appear to be darker and have a stronger odor. This is normal, and not a positive sign of required maintenance or transmission failure. Also when the dipstick is removed, it should be noted whether the oil is devoid of air bubbles or not. Oil with air bubbles gives an indication of an air leak in the suction lines, which can cause erratic operation and slippage. Water in the oil imparts a milky, pink cast to the oil and can cause spewing.

CONTENTS

GENERAL DESCRIPTION

Refer to the 125C transaxle section for overhaul procedures.

MAINTENANCE AND ADJUSTMENTS

DRAIN INTERVALS

The transaxle operating temperature resulting from the type of driving conditions under which the car is used is the main consideration in establishing the proper frequency of transaxle fluid changes.

Change the transaxle fluid and replace strainer every 15,000 miles if the car is usually driven under one or more of the following severe transaxle service conditions.

a. In heavy city traffic.
b. Where the outside temperature regularly reaches 90°F (32°C).
c. In very hilly or mountainous areas.
d. Frequent trailer pulling.
e. Commercial use, such as taxi, police car, or delivery service.
f. Operating in dusty areas.

If you do not use your car under any of these conditions, change the fluid and replace strainer as suggested in Section 0B

NOTICE: DO NOT OVERFILL. It takes only one pint to raise level from "ADD" to "FULL" with a hot transaxle. Overfilling can cause damage to transaxle.

FLUID CAPACITIES

Pan removal - 3.8 liters (4 qts.)

Overhaul - without converter drain - 5.7 liters (6 qts.)

Overhaul - with converter drain - 8.5 liters (9 qts.)

SERVICE PROCEDURES

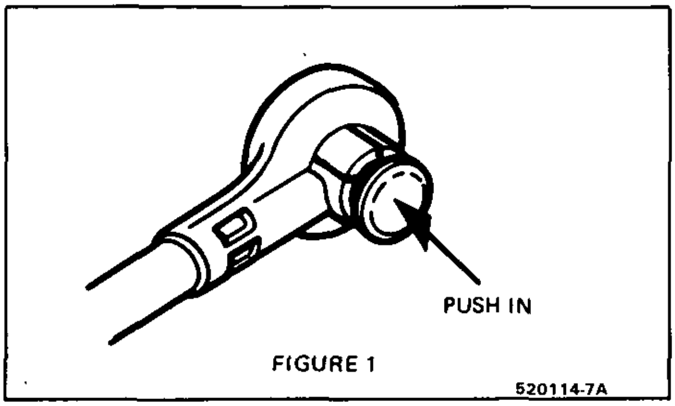

Fig. 7A1-1 Cable Removal (Plug Type)

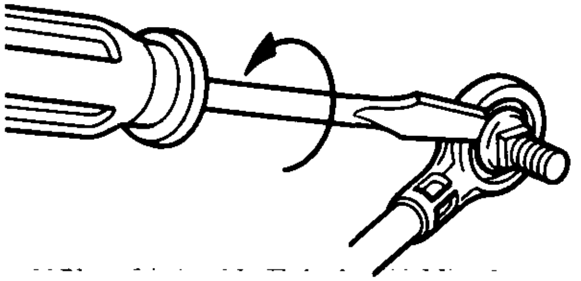

FIGURE 2

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Fig. 7A1-2 Cable Removal (Without Plug)

SHIFT SYSTEM CABLE REMOVAL

Removal procedure for automatic shift linkage cables (shift and park lock) with nylon ends.

- If cable end has a plug (reference Figure 1), push on plug to spread tangs then remove cable end from lever pin (shifter, transmission, etc.).
- If cable end does not have a plug, use a screwdriver or flat tool as shown in Figure 2.
  - Insert tool between lever and nylon end at the pin center line. Rotate tool and cable end will snap off pin.

ADJUSTMENTS

MANUAL LINKAGE

The transaxle manual linkage must be adjusted so that the indicator quadrant and stops correspond with the transaxle detent. If the linkage is not adjusted properly, an internal leak could occur which could cause a clutch or band to slip.

CAUTION: If a manual linkage adjustment is made with the selector lever in the "PARK" position, the parking pawl should freely engage the reaction internal gear to prevent the car from rolling. Transmission, vehicle or personal injury may occur if not properly adjusted.

TRANSMISSION CONTROL CABLE

Adjust

Figure 7A1-4 and 7A1-6

1. Place shift lever in "N" (neutral) position.
2. Place transmission lever in "neutral" position. Obtain "neutral" position by rotating transmission lever clockwise from "park" thru "R" into "N" (neutral).
3. Insert threaded pin (part of shift cable asm) upward through slotted hole in lever and hand start nut. Lever must be held out of park when torquing nut. Impact type tools must not be used.

Tighten

Nut to 20-34 N·m (15-25 lb.ft.)

PARK/LOCK CONTROL CABLE

Park Lock Cable

Remove or Disconnect

Figure 7A1-4 and 7A1-5

Remove console covers, hush panel and lower steering column as necessary for access to park lock cable.

1. Negative (-) battery cable.
2. Shift lever in "park" position.
3. Ignition key to "run" position.
4. Cable from inhibitor.

NOTICE: To release cable from inhibitor insert screwdriver blade into inhibitor slot, depress cable latch and pull cable from inhibitor.

5. Cable from park lock lever pin.
6. Cable from shifter base.
7. Cable.

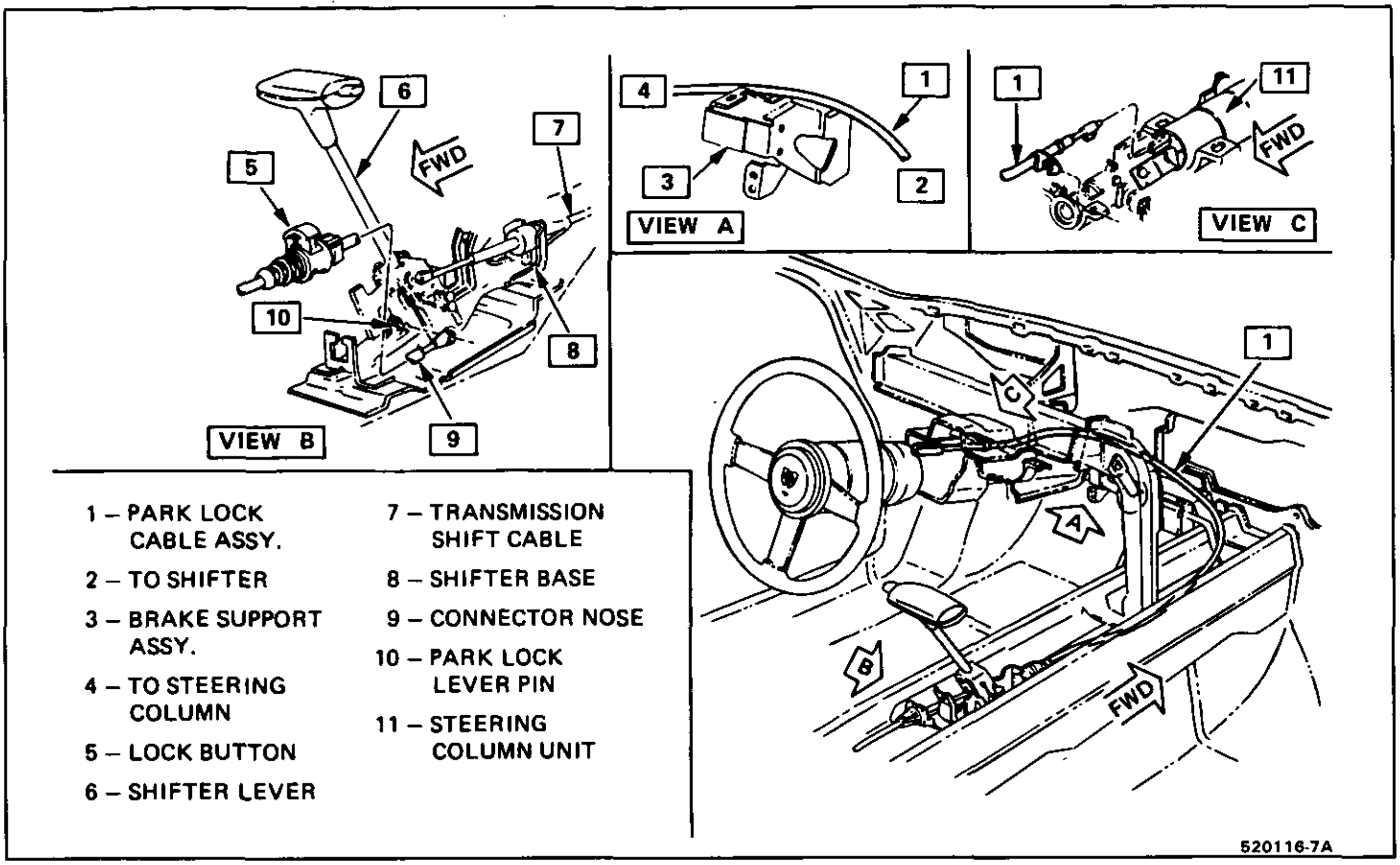
Install or Connect

1. Shift lever in "park" position.
2. Snap cable connector lock button to up position.
3. Snap cable connector to base.
4. Ignition key to "OFF" position.
5. Snap cable into inhibitor housing.
6. Ignition key to "lock" position.
7. Snap cable to park lock lever pin.
8. Push cable connector nose forward toward connector to remove slack.
9. With no load applied to nose, snap cable connector lock button down.

Tighten

1. Shift lever in "park" position.
2. Ignition key to "lock" position.
3. Shift lever should not be able to move to another position. Ignition key should be removable from column.
4. Ignition key to "run" position.
5. With shift lever in "Neutral", ignition key should not be removable from column.

NOTICE: If the above functional checks were met adjustment is complete. If key can be removed in "Neutral" snap connector lock button to up position and repeat Steps 8 and 9. 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. Snap connector lock button down.



1 – PARK LOCK CABLE ASSY.
2 – TO SHIFTER
3 – BRAKE SUPPORT ASSY.
4 – TO STEERING COLUMN
5 – LOCK BUTTON
6 – SHIFTER LEVER
7 – TRANSMISSION SHIFT CABLE
8 – SHIFTER BASE
9 – CONNECTOR NOSE
10 – PARK LOCK LEVER PIN
11 – STEERING COLUMN UNIT

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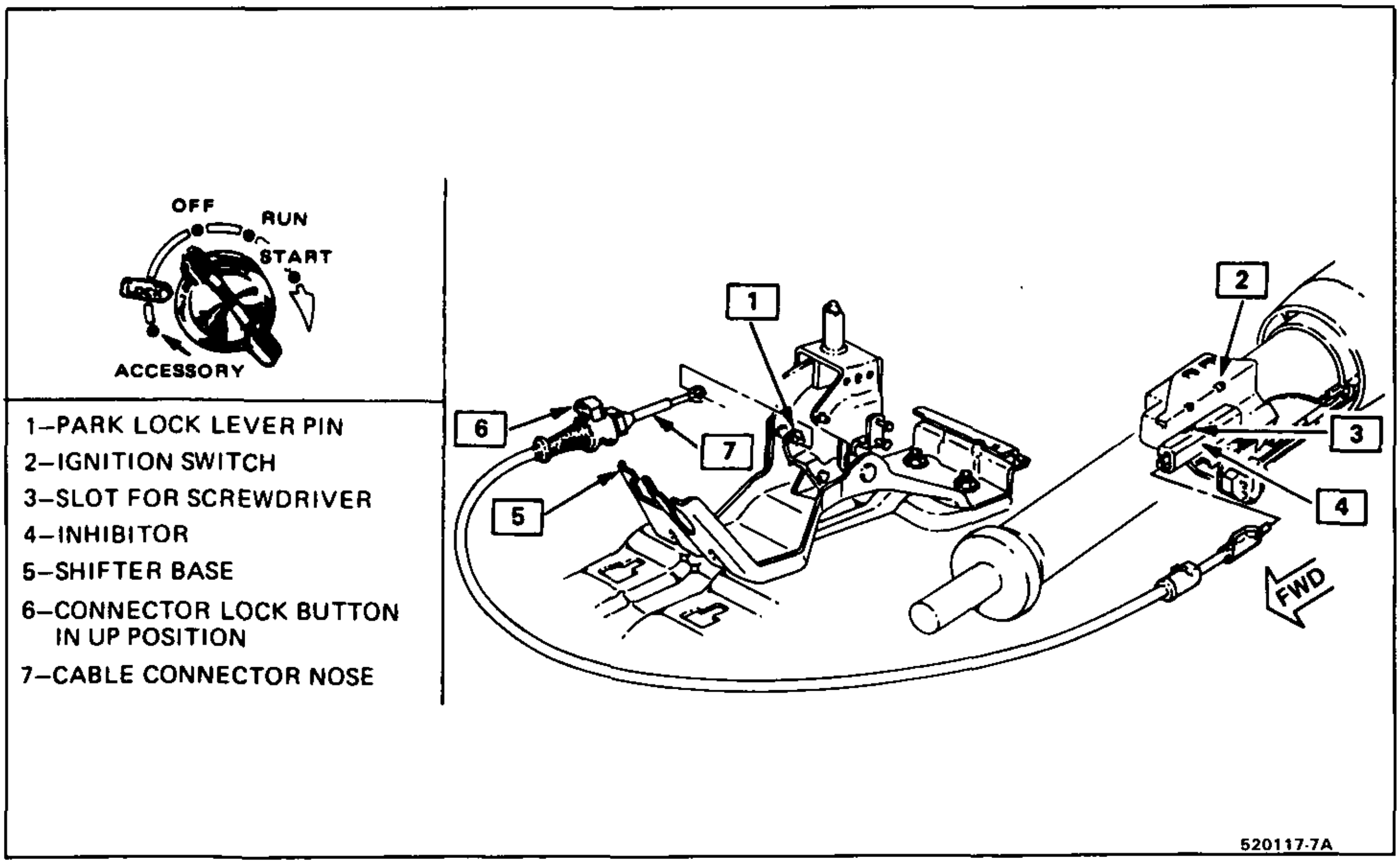
Fig. 7A1-3 Park Lock Cable Routing



1–PARK LOCK LEVER PIN
2–IGNITION SWITCH
3–SLOT FOR SCREWDRIVER
4–INHIBITOR
5–SHIFTER BASE
6–CONNECTOR LOCK BUTTON IN UP POSITION
7–CABLE CONNECTOR NOSE

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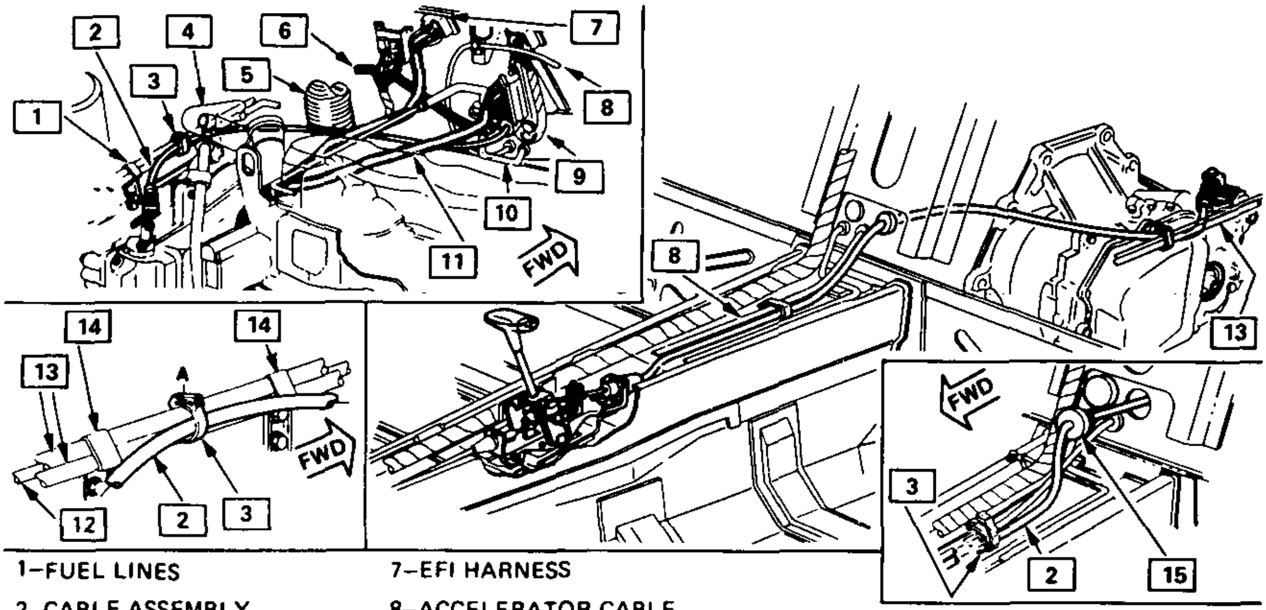
Fig. 7A1-4 Park Lock Cable Adjustment Illustration



1–FUEL LINES
2–CABLE ASSEMBLY
3–CLIP
4–RADIATOR HOSE
5–AIR INTAKE DUCT
6–REAR BODY HARNESS
7–EFI HARNESS
8–ACCELERATOR CABLE
9–MAIN HARNESS
10–VACUUM HOSE
11–ENGINE HARNESS
12–EMISSION PIPE
13–FUEL LINES
14–FUEL LINE CLIPS
15–GROMMET
A–INSTALL CLIP MIDWAY BETWEEN FUEL LINE CLIPS

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Fig. 7A1-5 Transaxle Control Cable Routing

Neutral Safety and Backup Lamp Switch

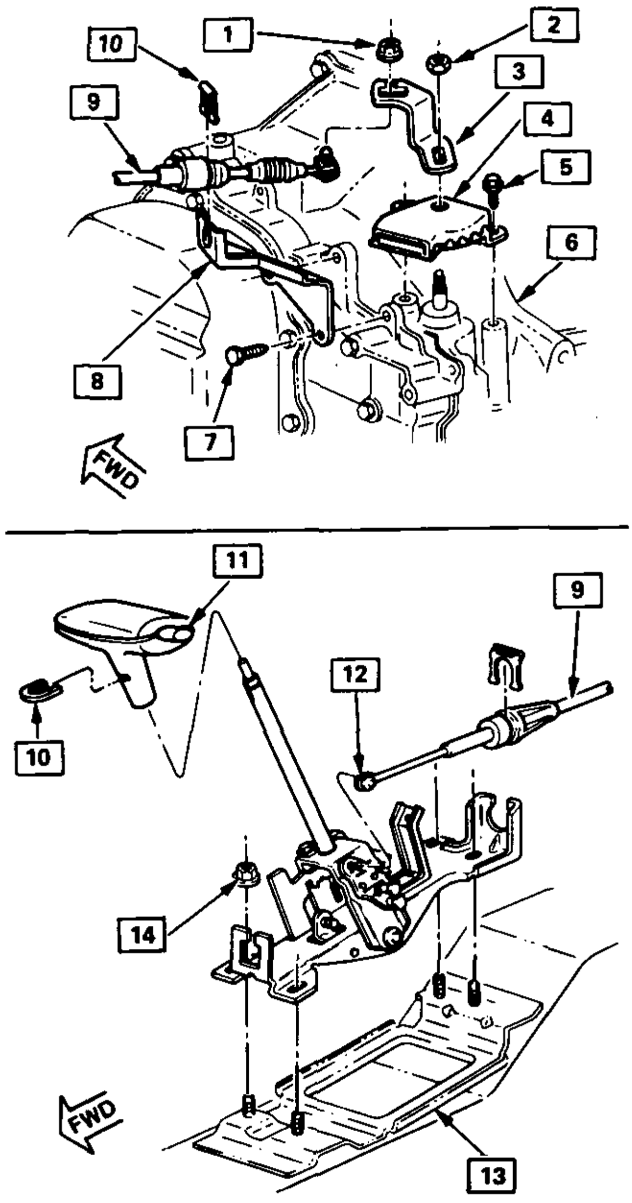
Adjust

Figure 7A1-6

1. Place transmission shaft in "NEUTRAL" position.
2. Align flats in switch insert with flats on transmission shaft and push switch over shaft.
3. Lossely assemble bolts to transmission case.
4. Insert 2.34 dia. gage pin (or rounded shank end and a 3/32 inch drill bit) into service adjustment hole. Rotate the switch until the gage pin drops to a depth of 9mm.
5. Tighten attaching bolts to recommended torque.
6. Remove gage pin.

GENERAL SERVICE PRECAUTIONS

- When servicing the transaxle, it is recommended that upon disassembly of a unit, all parts should be cleaned and inspected.
- The unit should be reassembled before disassembly of other units to avoid confusion and interchanging of parts.
- Before disassembly of the unit, thoroughly clean the exterior.
- Disassembly and reassembly of the unit and the subassemblies must be made on a clean work bench. As in repairing any hydraulically operated unit, cleanliness is of the utmost importance; therefore, the bench tools, and parts must be kept clean at all times.
- Before installing cap screws into aluminum parts, ALWAYS DIP SCREWS INTO TRANSMISSION OIL to present cap screws from galling the aluminum threads and also to prevent the screws from seizing.
- Always use a torque wrench when installing cap screws into aluminum parts to prevent the possibility of stripping the threads.
- If tapped threads in aluminum parts are stripped or damaged, the part can be made serviceable by the use of Heli-coils or equivalent.
- Seal-protecting tools must be used when assembling the units to prevent damage to the seals. The slightest flaw in the sealing surface of the seal can cause an oil leak.
- The aluminum castings and the valve parts are very susceptible to nicks, burrs, etc., and care should be exercised when handling them.
- The internal snap rings should be expanded and the external snap rings compressed if they are to be reused. This will ensure proper seating when installed.
- Replace all "O" rings, gaskets and oil seals that are removed. Teflon oil seal rings should not be removed unless damaged.
- During assembly of each unit, all internal parts must be lubricated with oil.



1 – NUT/CABLE ASSY.
2 – NUT/SHIFTING LEVER
3 – LEVER/SHIFTING
4 – SWITCH/NEUTRAL START AND BACK-UP
5 – BOLT/NEUTRAL START SWITCH (2)
6 – TRANSAXLE
7 – BOLT/BRACKET
8 – BRACKET
9 – CABLE ASSY.
10 – RETAINER ASSY.
11 – T HANDLE
12 – SNAP SECURELY ONTO PIN
13 – GEAR SHIFT SUPPORT
14 – NUT 23 N·M (17 FT. LB.)

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Fig. 7A1-6 Transaxle Controls, Cable Attachment and Neutral Start Switch

ON-CAR SERVICE

SERVICEABLE COMPONENTS

The following parts can be serviced with the transaxle in the car. For part removal and installation procedures not listed in this section, refer to the disassembly and reassembly sections.

1. Throttle valve control cable and/or sleeve seal.
2. Filler pipe and/or sleeve seal.
3. Governor assembly and speedometer gear assembly.
4. Intermediate servo assembly and direct clutch accumulator check valve.
5. Valve body assembly, spacer plate, gaskets, throttle lever and bracket assembly, pump shaft, valve body cover and gasket, TCC solenoid, switch and wiring.
6. Converter to flexplate bolts.
7. Oil pan and/or gasket, strainer assembly and "O" ring.
8. Lo and Reverse pipe, "O" ring seal and oil seal.
9. Dip-stick stop bracket, parking pawl and return spring.
10. Output shaft, axle joint retaining ring, snap ring (shaft) and axle oil seals.
11. Cooler fittings, manual valve, and electrical connector. spring and seal, thermostatic element assembly, manual detent spring and roller assembly, sprockets, drive link and thrust washers.
12. 3rd clutch pressure switch, solenoid, auxiliary valve body, cover and gasket.
13. Park/Neutral and back-up lamp switch.

Speedometer Driven Gear

1 – SENSOR ASSEMBLY
2 – SEAL, 'O' RING
3 – SPEEDOMETER DRIVEN GEAR
4 – COVER, GOVERNOR
5 – SCREW, GOVERNOR COVER TO CASE
6 – SEAL, 'O' RING
7 – WASHER, SPEEDO GEAR THRUST
8 – GEAR, SPEEDOMETER DRIVE
9 – GOVERNOR ASSEMBLY
10 – RING OIL SEAL
11 – RETAINER

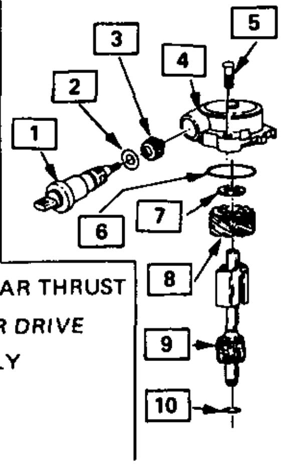

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Fig. 7A1-7 Governor and Speedometer Sensor Assembly

←→ Remove or Disconnect

Figure 7A-8

1. Negative (-) battery cable.

2. Electrical connector at sensor assembly.
3. Sensor assembly retainer.
4. Sensor assembly.
5. Speedometer drive gear from sensor assembly.

Important

Reassemble using new O-rings.

Install or Connect

1. Speedometer drive gear to sensor.
2. Sensor assembly.
3. Sensor assembly retainer.
4. Electrical connector at sensor assembly.
5. Negative (-) battery cable.

Inspect

Speedometer for proper operation.

SPEEDOMETER DRIVE GEAR

Remove or Disconnect

Figure 7A1-7

1. Negative (-) battery cable.
2. Electrical connection at sensor.
3. Sensor assembly retainer.
4. Sensor assembly and gear.
5. Governor cover screw.
6. Governor cover.
7. O-ring.
8. Speedometer thrust washer.
9. Speedometer drive gear.

Important

Reassemble using new O-rings.

Install or Connect

1. Speedometer drive gear.
2. Speedometer thrust washer.
3. O-ring.
4. Governor cover.
5. Governor cover screw.
6. Sensor assembly and gear.
7. Sensor assembly retainer.
8. Electrical connection at sensor.
9. Negative (-) battery cable.

Inspect

Speedometer for proper operation.

T.V. CABLE

Remove or Disconnect

1. Air cleaner assembly.
2. T.V. cable at injector.
3. Bolt securing T.V. cable at transaxle.

Important

Pull up on cable cover at transaxle until cable is seen. Disconnect cable from transaxle rod.

Remove or Disconnect

1. Clip securing T.V. cable at valve cover.

Install or Connect

1. T.V. cable at transaxle.

Tighten

Torque T.V. cable bolt to 7-10 N·m (6-7 lb. ft.).

Install or Connect

1. T.V. cable at injector.
2. Clip securing T.V. cable to valve cover.
3. Air cleaner assembly.

Adjust

Make all necessary adjustments to T.V. cable as outlined above.

AUTOMATIC (SHIFT CABLE)

Remove or Disconnect

1. Negative (-) battery cable.
2. Front trim plate and shift knob.
3. Shift trim plate rear console pad assembly and front pad assembly.
4. E.C.M. electrical connection.
5. E.C.M.
6. Front carrier to I.P. reinforcement.
7. Carrier reinforcement.
8. Carpet clips and rivits at console.
9. Heater control.
10. Radio.
11. Carrier.
12. Shift cable from shifter control assembly.
13. Cable from shift lever at transaxle.
14. Yoke clip securing shift cable to transaxle mounting bracket.
15. Pull cable through body into the passenger compartment.

Install or Connect

1. Pilot cable from passenger side through body into engine compartment.
2. Clip cable to transaxle mounting bracket.
3. Snap cable to shift lever.
4. Clip cable in place at, fuel line.
5. Cable to shifter bracket.
6. Cable end to shift lever pin.
7. Carrier assembly, console.
8. Radio.
9. Heater control.
10. Carpet clips and rivits at console.

11. Carrier reinforcements.
12. E.C.M.
13. E.C.M. Electrical connections.
14. Front pad assembly.
15. Front pad trim plate.
16. Rear console pad assembly.
17. Shift trim plate, and shift knob.
18. Negative (-) battery cable.

SECTION 125C

AUTOMATIC TRANSAXLE DIAGNOSIS AND UNIT REPAIR

CONTENTS

GENERAL DESCRIPTION

The 125C automatic transaxle is a fully automatic unit consisting primarily of a 4-element hydraulic torque converter, compound planetary gear set and dual sprocket and drive link assembly. In addition, this transaxle incorporates a differential and final drive gear set.

The 4-element torque converter contains a pump, a turbine, a pressure plate splined to the turbine, and a stator assembly. The pressure plate, when applied, provides a mechanical direct drive coupling of the engine to the planetary gears.

Three multiple-disc clutches, a roller clutch and a band provide the friction elements required to obtain the desired function of the planetary gear sets.

A hydraulic system pressurized by a vane type pump provides the working pressure required to operate the friction elements and automatic controls.

DIAGNOSIS

ROAD TEST PROCEDURE

Drive Range:

Position the selector lever in DRIVE RANGE and accelerate the vehicle. A 1-2 and 2-3 shift should occur at these throttle openings. (The shift points will vary with the throttle openings). Check the part throttle 3-2 downshift at 30 m.p.h. (50 km/h) by quickly opening the throttle approximately three-fourths. At 50 m.p.h. (80 km/h) the transmission should downshift 3-2 by depressing the accelerator fully.

Intermediate Range:

Position the selector lever in INTERMEDIATE RANGE and accelerate the vehicle. A 1-2 shift should occur at all the throttle openings. (No 2-3 shift can be obtained in this range.) The 1-2 shift point will vary with the throttle opening. Check the detent 2-1 downshift at 20 m.p.h. (32 km/h). The transaxle should downshift 2-1. The 1-2 shift in INTERMEDIATE RANGE is somewhat firmer than in DRIVE RANGE. This is normal.

Position the selector lever in DRIVE RANGE. With the vehicle speed at approximately 50 m.p.h. (80 km/h) and closed or 0 throttle, move the selector lever to INTERMEDIATE RANGE. The transaxle should downshift into 2nd. An increase in engine r.p.m. and an engine braking effect should be noticed.

Lo Range:

Position the selector lever in LO RANGE and accelerate the vehicle. No upshift should occur in this range.

At 40 m.p.h. (64 km/h), with throttle closed, move the selector lever to Lo. A 2-1 downshift should occur in the speed range of approximately 45 to 25 m.p.h. (72 to 40 km/h), depending on valve body calibration. The 2-1 downshift at closed throttle will be accompanied by increased engine r.p.m. and an engine braking effect should be noticed. Stop vehicle.

Reverse Range:

Position the selector lever in REVERSE POSITION and check for reverse operation.

Converter Clutch

Install an engine tachometer. **Engine must be at normal operating temperature.**

Position the selector lever in drive range. With vehicle speed between 40-45 mph (64-72 km/h), in third gear, the converter clutch will apply. Observe the tachometer. A drop of about 200 rpm's will occur.

PRELIMINARY CHECK PROCEDURE

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 PRESSURES IN THE FOLLOWING MANNER:

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.

*For line pressure tap location see Fig. A-10, Item 405.

CAUTION Brakes must be applied at all times.

NOTICE Total running time for this combination not to exceed 2 minutes.

MODEL	RANGE	MINIMUM T.V.		MAXIMUM T.V.	
		kPa	P.S.I.	kPa	P.S.I.
BA,BC,BD,BP,CA,CJ,PD,CB,CC,JS,CM,PH,JP,PF,PR,PK,PN,PW,HX,PA	Park @ 1000 RPM	455-510	65-75	No T.V. pressure in Park. Line pressure is the same as Park at Minimum T.V.	
CD, CF, CH, CK, CL, CT, CU, CX, HL, HN, HS, HU		510-585	75-85		
JB, JD, JF, JJ, JK, JM, JN, JR, JW, RD		395-440	55-65		
JD, JM	Reverse @ 1000 RPM	690-765	100-112	1400-1590	203-230
JF, JK		690-765	100-112	1600-1785	230-260
JN		690-765	100-112	1185-1320	170-190
JW		690-765	100-112	1510-1720	220-250
JR		760-840	110-122	1510-1680	220-245
JJ		760-840	110-122	1635-1815	235-265
RD		760-840	110-122	1635-1815	235-265
JB		760-840	110-122	1760-1955	255-285
PA		780-860	113-125	1810-2057	262-300
JP		805-890	117-130	1487-1655	215-240
BA, BC, BD, BP, CA, CB, CC, CM, JS, PH, PK, PN, PW		805-890	117-130	1510-1710	220-248
CJ		805-890	117-130	1630-1850	235-270
HX		805-890	117-130	1715-1910	250-277
PD, PF		805-890	117-130	1750-1985	255-290
CD		895-1020	130-148	1692-1912	245-277
CT, CX		895-1020	130-148	1720-1980	250-287
CF, CK, CL, CU, HL, HN, HS, HU		895-1020	130-148	1840-2115	267-307
JB, JF, JK	Neutral/ Drive @ 1000 RPM	395-437	55-65	915-1020	132-148
JD, JM		395-437	55-65	800-906	116-132
JN		395-437	55-65	675-753	98-110
JR		395-437	55-65	785-875	114-127
JJ, RD		395-437	55-65	850-950	125-138
JW		395-437	55-65	863-981	125-143
JP		459-507	67-74	849-944	123-137
BA, BC, BD, BP, CA, CC, CB, CM, JS, PH, PR, PK, PN, PW		459-507	67-74	863-977	125-142
CJ		459-507	67-74	930-1055	135-153
HX		459-507	67-74	979-1090	142-158
PD, PF		459-507	67-74	998-1133	145-165
PA		459-507	67-74	1065-1211	155-176
CD		510-582	74-85	966-1091	140-158
CX, CT		510-582	74-85	982-1130	142-164
CF, CK, CL, CU, HL, HN, HS, HU		510-582	74-85	1050-1208	152-175
JD, JF, JK, JM, JN, JW	Intermediate/ LO @ 1000 RPM	680-750	99-109	No T.V. pressure in Intermediate or Lo. Line pressure is the same as Intermediate/ Lo at Minimum T.V.	
BA,BC,BD,BP,CA,CB,CC,CM,CJ,HX,JP,JS,PD,PF,PH,PR,PK,PN,PW		787-870	114-126		
JB, JJ, JR, RD		826-910	120-132		
CD, CF, CK, CL, CT, CU, CX, HL, HN, HS, HU		877-998	127-145		
PA		957-1057	139-154		

Line pressure is basically controlled by pump output and the pressure regulator valve. In addition, line pressure is boosted in Reverse, Intermediate and Lo by the reverse boost valve.

Also, in the Neutral, Drive and Reverse positions of the selector lever, the line pressure should increase with throttle opening because of the T.V. system. The T.V. system is controlled by the T.V. cable, the throttle lever and bracket assembly and the T.V. link, as well as the control valve pump assembly.

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Figure A-1 Preliminary Checking Procedure

CAUSES OF BURNED CLUTCH PLATES OR BAND

A burned clutch or band is generally caused by some condition such as low pressure and/or leaks that prevent proper application. During diagnosis or inspection, this cause must be found.

A cut or damaged seal may be the cause of a clutch problem or may be the result of a burned clutch. If a clutch is burned, excessive piston travel may result and allow one or more of the piston seals to come out of the bore and become cut or folded. When looking for the cause of the problem, the condition of the piston seals should be considered; but further inspection should be made to determine if some other area is the cause of the problem, to prevent a repeat problem.

EXAMPLE: A leak at an intermediate servo piston seal may be the cause of a burned direct clutch and/or intermediate band because the oil pressure that applies the direct clutch also releases the servo piston.

In All Cases of Burned Clutch Plates or Band - Check for

1. The Driven Sprocket Support
   a. The drive sprocket support seal rings may be leaking.
   b. The case cover gaskets are not sealing. Case cover gasket leaking.
   c. The driven sprocket support sleeve may be loose or mispositioned.
   d. Loose attaching bolts. Torque to 24 N·m (18 ft. lbs.)
2. The Case Cover and Case
   a. Blocked or interconnected oil channels.
   b. The sealing surfaces may be damaged or leaking.
   c. The check balls may be missing or out of location.
   d. Porosity.
3. The Control Valve Pump Assembly
   a. The control valve pump assembly to case cover bolts may be loose.
   b. The sealing surfaces on the control valve pump assembly, spacer plate, and/or gaskets are damaged or leaking.
   c. The valves may be leaking, binding, or sticking.
   d. The channels may be blocked or interconnected.

If low line pressure is present, refer to the possible causes.

NOTICE: Burned clutch plates can be caused by incorrect usage of clutch plates. Engine coolant in the transmission fluid can cause severe damage to clutch plate material and result in pieces of composition material peeling off.

Burned Direct Clutch Only*

1. The Direct Clutch Assembly
   a. The seals may be cut, missing or rolled out of groove.
   b. The exhaust ball capsule in the housing may be damaged and not sealing.
   c. The piston or the housing may be damaged, leaking.
   d. The snap ring may not be fully seated.
2. The Intermediate Servo Assembly
   a. The wrong servo pin - check selectivity.
   b. The seals may be missing or damaged.
   c. The servo bore is scored or damaged.
   d. The servo orifice bleed plug may be missing.
   e. The band apply pin could be tight in the case bore.
3. The Case Cover and Case
   a. The #5 check ball missing or off location may be the case cover.
   b. The accumulator exhaust check valve may be missing or not sealing in the case.

Burned Forward Clutch Only*

1. The Forward Clutch Assembly
   a. The seal rings on the input shaft could be damaged or missing.
   b. The Input shaft feed passage or the orifice are restricted.
   c. Holes not drilled in piston or waved steel clutch plate not installed next to piston.
   d. The selective backing plate or snap ring may be incorrectly installed, or incorrect selective backing plate.
   e. The piston seals may be missing or damaged.
   f. The piston insert may be missing.
   g. The piston, housing, or shaft could be damaged, leaking.
2. The Control Valve Pump Assembly
   a. The valve body pipe is loose or leaking.
   b. Pressure regulator valve roll pin damaged or worn.

Burned Lo and Reverse Clutch Only*

1. The Lo and Reverse Clutch Assembly
   a. The housing seals are damaged.
   b. The piston or seals are damaged.
   c. Wrong number of clutch plates.
2. The Control Valve Pump Assembly
   a. The reverse boost valve is sticking.
3. The Case Cover and Case
   a. The #4 or #5 check ball is missing or off location in the case cover.
   b. The Lo and Reverse pipe is leaking in the case bore.
   c. The Lo and Reverse clutch housing to case cup plug assembly is restricted, damaged, or not seated properly.
   d. The Lo and Reverse pipe to case "O" ring and/or seal backup ring is damaged or missing.

Burned Intermediate Band Only*

1. The Intermediate Band
   a. The band is not properly installed and aligned in the case.
   b. The apply pin is not engaged.
2. The Intermediate Servo Assembly
   a. The wrong servo pin - check the selectivity.
   b. The seals are missing or damaged.
   c. The servo bore is scored or damaged.
   d. The band apply pin is tight or undersize in the case bore.
3. The Case Cover and the Case
   a. The accumulator check valve and/or spring is missing or not sealing properly.
   b. The direct clutch accumulator cup plug is missing.

   c. The #1 or #2 check balls are missing or off location.
   d. The 1-2 accumulator piston is missing or the seal is leaking.
4. The Control Valve Pump Assembly
   a. The 1-2 accumulator valve is sticking.
      * See also above section labeled "IN ALL CASES OF BURNED CLUTCH PLATES OR BAND."

THE CAUSES OF LOW OIL PRESSURE

1. Low oil level.
2. The T.V. system (the pressure is low in Neutral, Drive, and low to normal in Intermediate and Reverse.)
   a. The T.V. cable is misadjusted or sticking.
   b. The T.V. linkage may be binding, incorrect cable.
   c. The throttle valve may be stuck in the bore.
   d. The shift T.V. valve is stuck.
3. The oil strainer is plugged.
4. The oil strainer "O" ring seal is leaking or damaged.
5. The control valve and pump assembly bolts are loose.
6. The control Valve Assembly.
   a. The #5 or #6 check ball is missing or off location.
   b. The below listed valves may be stuck or damaged.
      1) The T.V. valve and plunger.
      2) The Shift T.V. valve.
      3) The pressure regulator valve.
      4) The T.V. boost valve.
      5) The pressure relief valve.
   c. The 1-2 accumulator piston and/or seal is leaking or missing.
   d. Internal leaks.
7. (Lo only) The Lo blow off valve is damaged, #4 check ball is missing or off location.
8. (Reverse only) The Lo-Reverse clutch housing to case cup plug assembly is leaking.
9. The pump vane seals are cut or missing.
10. The intermediate oil passages to pressure regulator is blocked.
11. The driven sprocket support to case cover is leaking.

CAUSES OF HIGH OIL PRESSURE

1. The T.V. system (the pressure is high in the Neutral, Drive and normal to high in intermediate and Reverse).
   a. The T.V. cable is misadjusted, sticking or broken.
   b. The T.V. linkage is binding or incorrect cable.
   c. The throttle valve is stuck.
   d. The shift T.V. valve is stuck.
   e. The T.V. lifter is bent, damaged or too short.
2. The control Valve and Pump Assembly valves may be sticking or damaged.
   a. The T.V. valve and plunger.
   b. The shift T.V. valve.
   c. The pressure regulator valve.
   d. The T.V. boost valve.
   e. The pump slide stuck.
3. (Lo only) The Lo blow off valve may be stuck closed.
4. The internal pump or case cover may be leaking.

RANGE REFERENCE CHART

RANGE	GEAR	DIRECT CLUTCH	INTERMEDIATE BAND	FORWARD CLUTCH	ROLLER CLUTCH	LO - REVERSE CLUTCH
PARK - NEUT.						
DRIVE	FIRST			APPLIED	HOLDING	
	SECOND		APPLIED	APPLIED		
	THIRD	APPLIED		APPLIED		
INTERMEDIATE	FIRST			APPLIED	HOLDING	
	SECOND		APPLIED	APPLIED		
LO	FIRST			APPLIED	HOLDING	APPLIED
REVERSE		APPLIED				APPLIED

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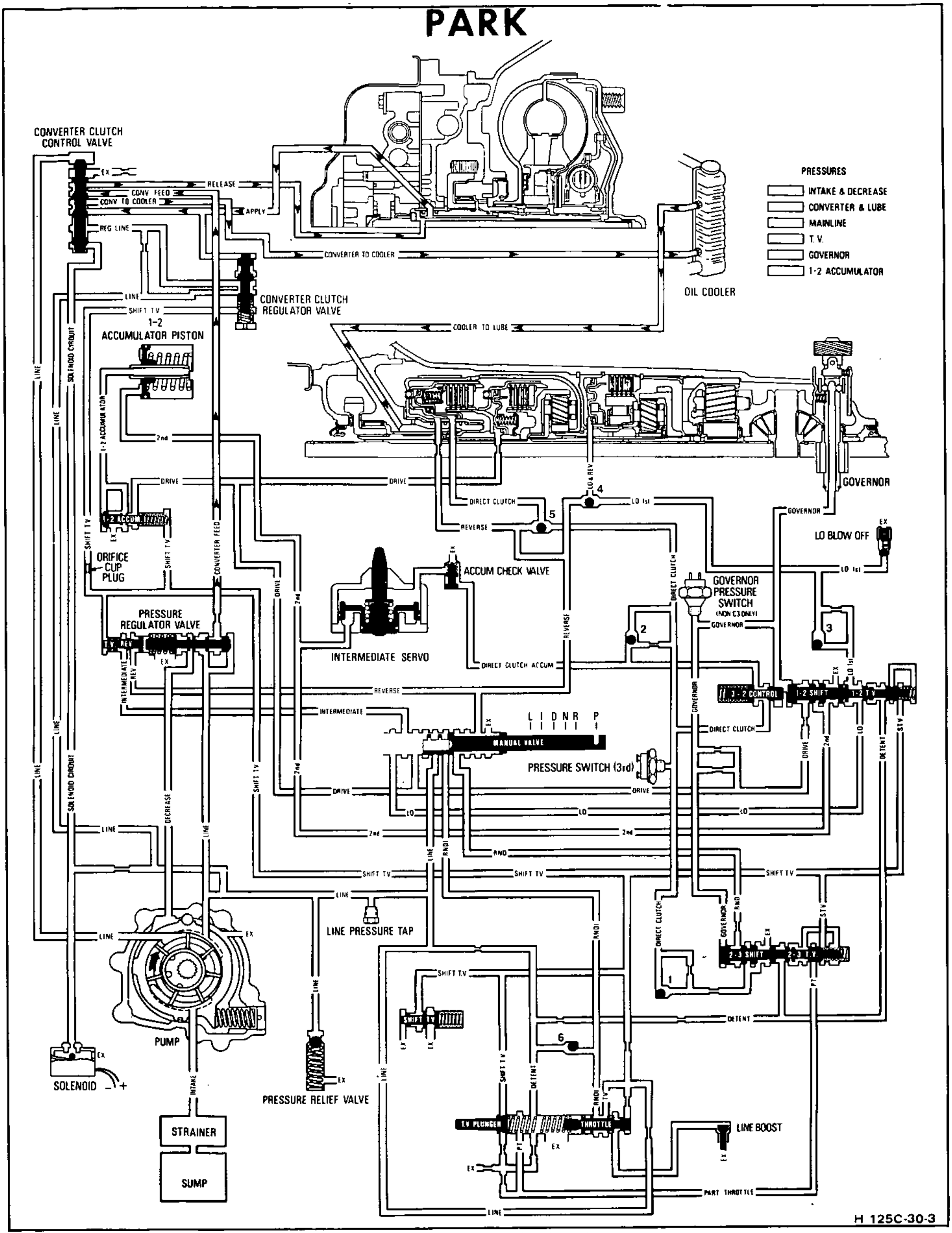
Figure A-2 Range Reference Chart



PARK

Figure A-3 Hydraulic Oil Circuit

1	VALVE, LINE BOOST
2	LINE
3	CONVERTER FEED
4	APPLY
5	SHIFT TV EXHAUST
6	SHIFT TV (ORIFICE CUP PLUG)
7	VALVE BODY PIPE (DRIVE)
8	SLIDE COVER SEAL & SEAL SUPPORT
9	LO BLOW OFF
10	GOVERNOR
11	3RD CLUTCH
12	SLIDE SEAL & SEAL SUPPORT
13	VANE RING
14	SPRING, PRIMING
15	ROTOR
16	VANE
17	SLIDE
18	TO COOLER
19	RELEASE
20	EXHAUST
21	DECREASE

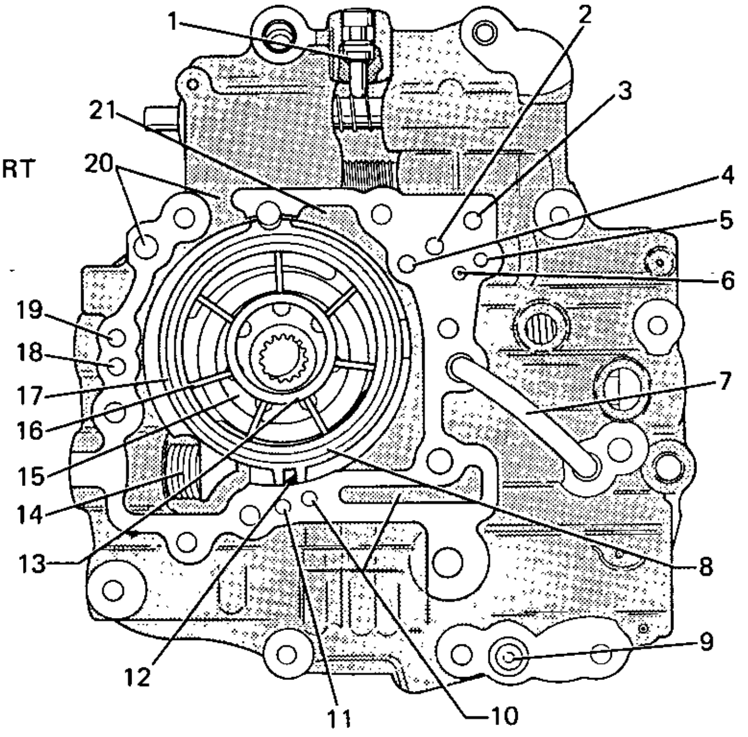


Figure A-4 Variable Capacity Vane Oil Pump

A	SLEEVE, STEEL
B	CONVERTER, FEED (T.C.C. APPLY)
C	CONVERTER SEAL, DRAINBACK
D	CONVERTER TO COOLER (T.C.C. RELEASE)
18	SHAFT, OIL PUMP DRIVE
103	SPROCKET, DRIVE
104	WASHER, THRUST
105	RING, OIL SEAL (GREEN)
106	SHAFT, TURBINE
107	SEAL, "O" RING
108	BEARING ASSEMBLY
109	SUPPORT, DRIVE SPROCKET
110	BUSHING
148	RING, OIL SEAL (YELLOW)

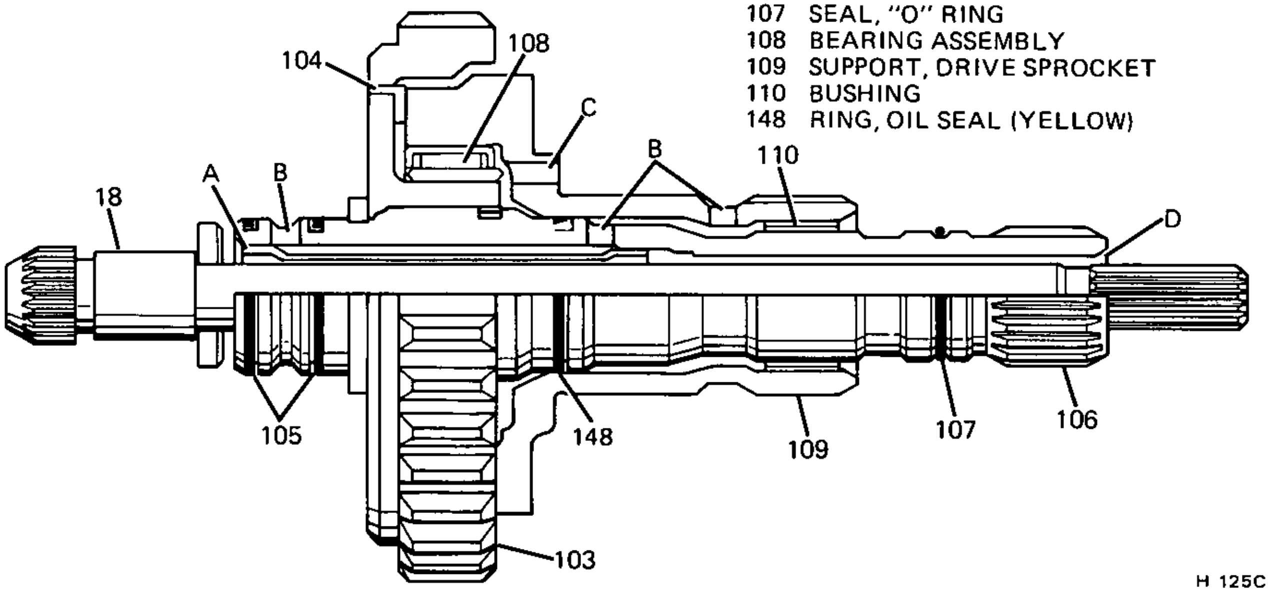


Figure A-5 Converter Oil Passages - Parts Cut-Away View

1 #1 CHECK BALL
2 GOVERNOR
3 RND
4 DRIVE
5 2ND
6 LO - 1ST
7 DIRECT CLUTCH (3RD)
8 LO
9 DETENT
10 SHIFT TV
11 PART THROTTLE
12 LUBE
13 1-2 ACCUMULATOR
14 EXHAUST
15 APPLY
16 CONVERTER FEED
17 TV
18 TV EXHAUST
19 DECREASE
20 RNDI
21 REVERSE
22 VOID
23 INTERMEDIATE
24 LINE
25 RELEASE
26 TO COOLER
27 INTAKE
28 DRILLED HOLE
29 DIRECT CLUTCH ACCUMULATOR

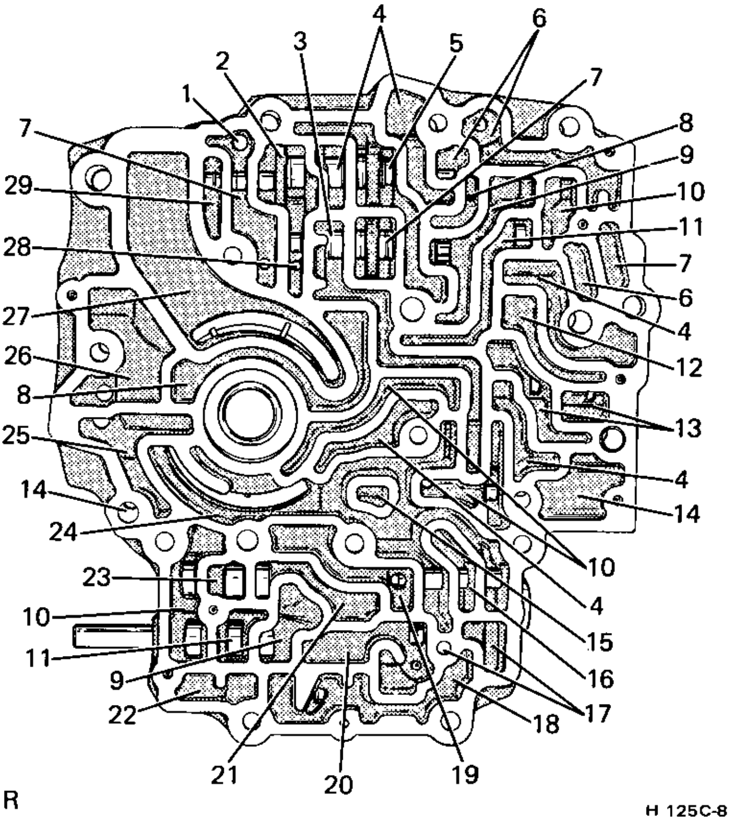
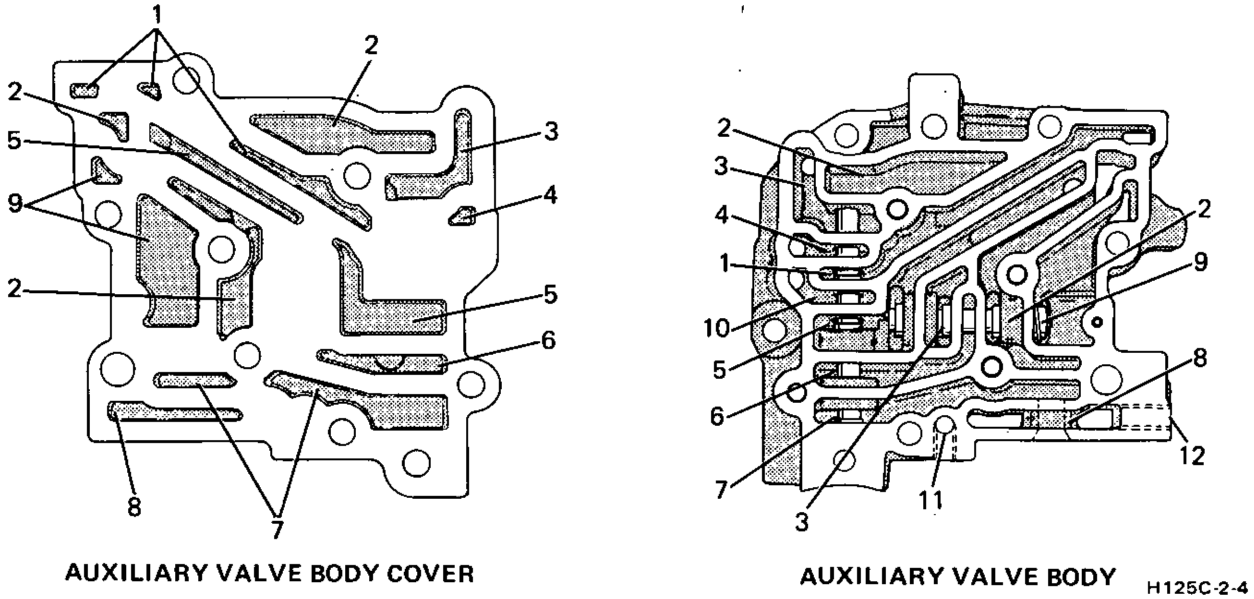


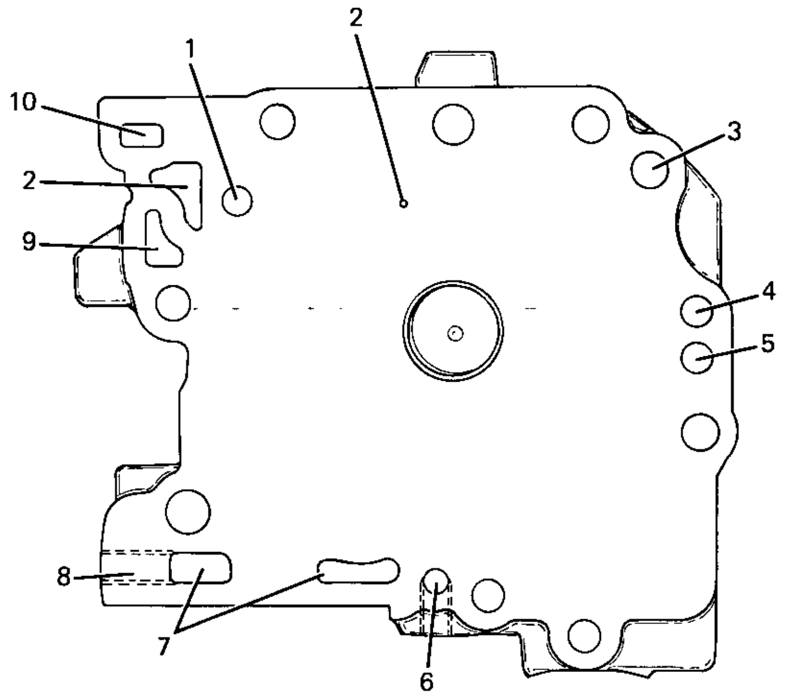
Figure A-6 Valve Body Passages

1 CONVERTER FEED
2 LINE
3 EXHAUST
4 RELEASE
5 APPLY
6 REGULATED LINE
7 SOLENOID CIRCUIT
8 GOVERNOR
9 SHIFT TV
10 TO COOLER
11 3RD CLUTCH
12 DRILLED & TAPPED HOLE (NON C3 ONLY)


AUXILIARY VALVE BODY COVER

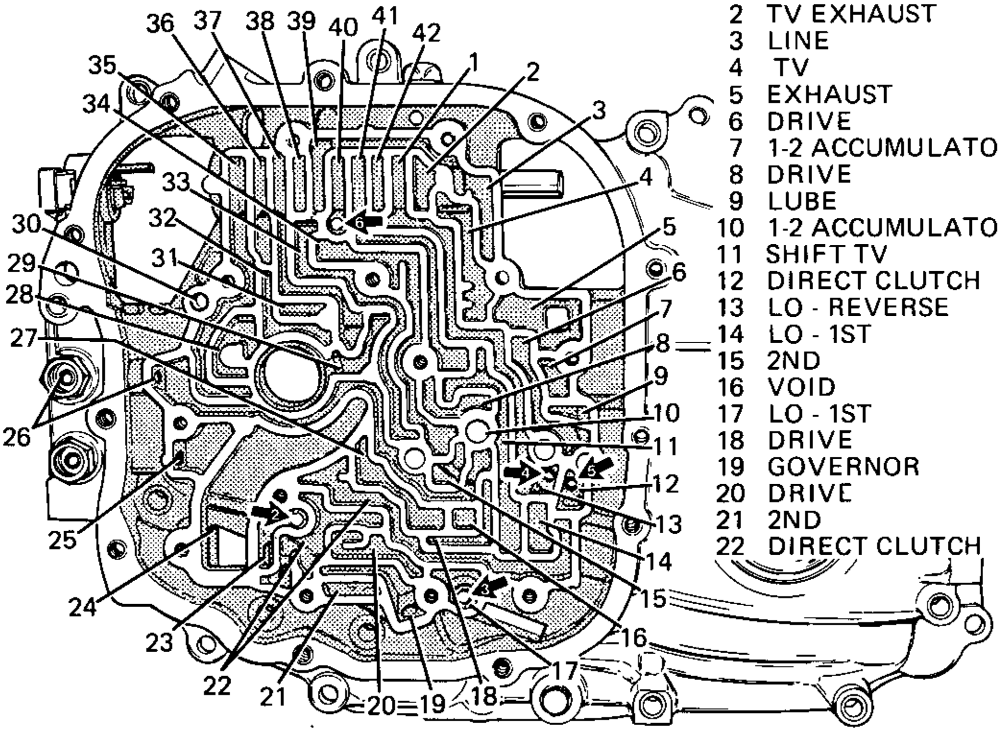
AUXILIARY VALVE BODY

Figure A-7 Auxiliary Valve Body and Cover



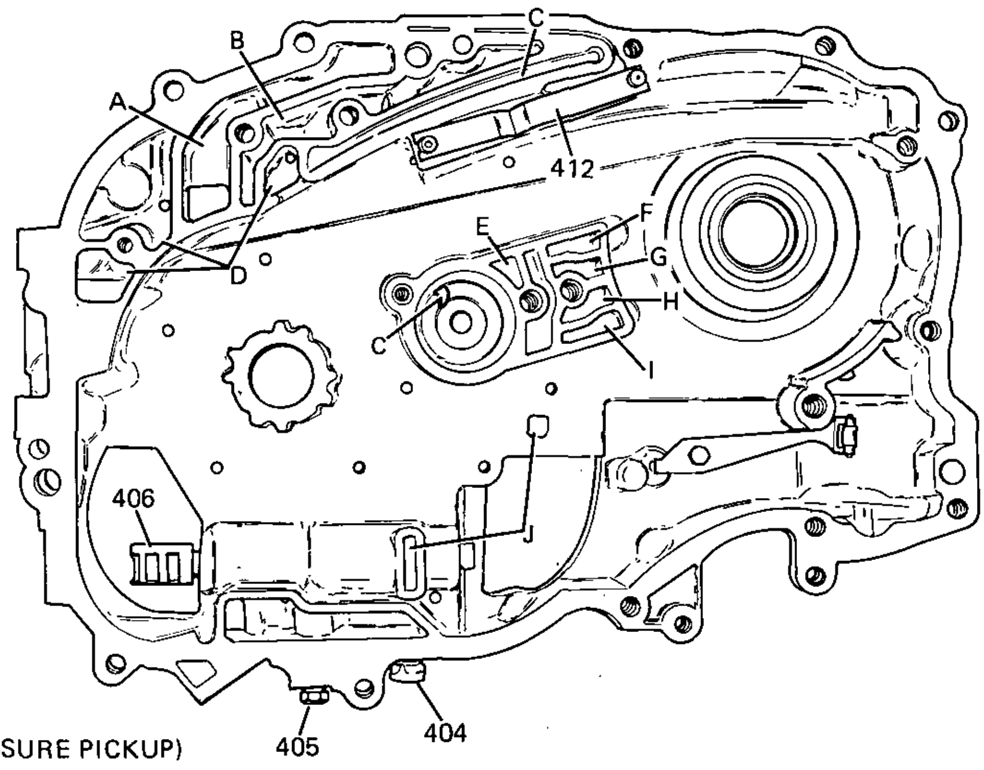
1 APPLY
2 LINE
3 EXHAUST
4 RELEASE
5 TO COOLER
6 DIRECT CLUTCH (3RD)
7 GOVERNOR
8 DRILLED & TAPPED HOLE (NON C3 ONLY)
9 SHIFT TV
10 CONVERTER FEED

Figure A-8 Auxiliary Valve Body - Pump Side



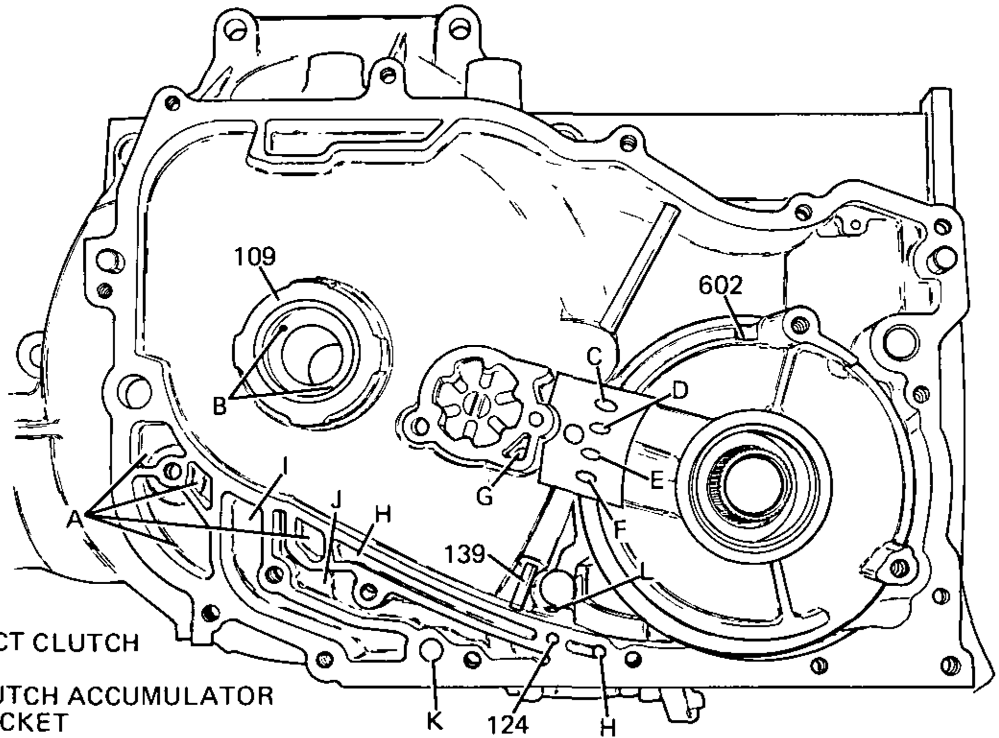
1 REVERSE
2 TV EXHAUST
3 LINE
4 TV
5 EXHAUST
6 DRIVE
7 1-2 ACCUMULATOR
8 DRIVE
9 LUBE
10 1-2 ACCUMULATOR
11 SHIFT TV
12 DIRECT CLUTCH
13 LO - REVERSE
14 LO - 1ST
15 2ND
16 VOID
17 LO - 1ST
18 DRIVE
19 GOVERNOR
20 DRIVE
21 2ND
22 DIRECT CLUTCH
23 DIRECT CLUTCH ACCUMULATOR
24 INTAKE
25 TO COOLER
26 COOLER TO LUBE
27 LO
28 VOID
29 CONVERTER FEED
30 EXHAUST
31 VOID
32 SHIFT TV
33 PART THROTTLE
34 DETENT
35 LO
36 INTERMEDIATE
37 DRIVE
38 VOID
39 LINE
40 RNDI
41 RND
42 VOID
➡ CHECK BALLS

Figure A-9 Case Cover - Valve Body Side



A	INTAKE
B	ACCUMULATOR, DIRECT CLUTCH
C	2ND
D	VOID
E	LO - REVERSE
F	DIRECT CLUTCH
G	REVERSE
H	DRIVE
I	LUBE
J	EXHAUST
404	VENT ASSEMBLY
405	PLUG, PIPE (LINE PRESSURE PICKUP)
406	VALVE, MANUAL
412	THERMO-ELEMENT

Figure A-10 Case Cover - Case Side



A	VOID
B	DRAINBACK, SEAL
C	LUBE
D	DRIVE
E	REVERSE
F	DIRECT CLUTCH
G	LO - REVERSE
H	2ND
I	INTAKE
J	ACCUMULATOR, DIRECT CLUTCH
K	GOVERNOR
L	EXHAUST, DIRECT CLUTCH ACCUMULATOR
109	SUPPORT, DRIVE SPROCKET
124	ACCUMULATOR, DIRECT CLUTCH (CUP PLUG)
139	PIPE, LO - REVERSE
602	SUPPORT, DRIVEN SPROCKET

Figure A-11 Case - Case Cover Side

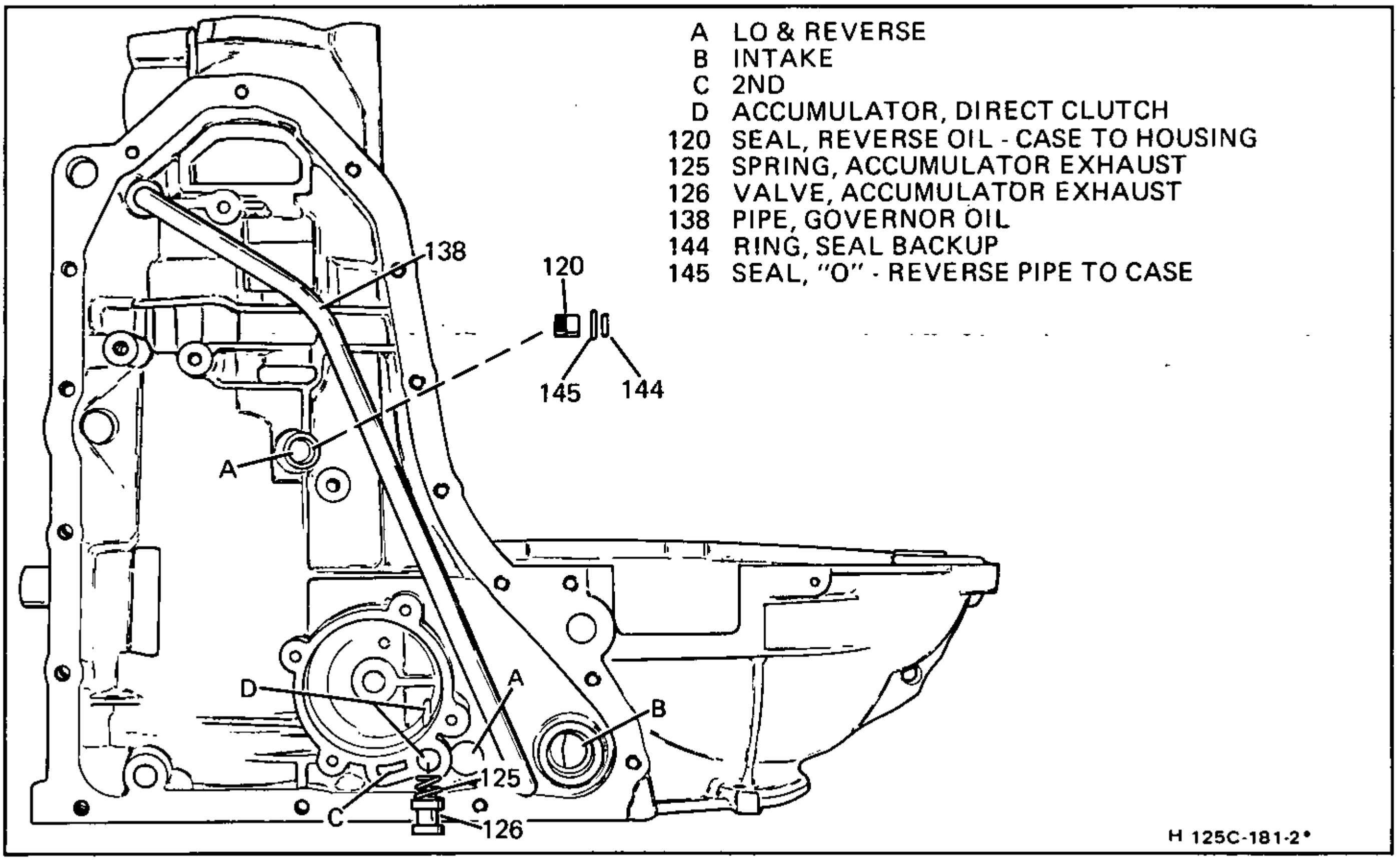


Figure A-12 Case - Oil Pan Side

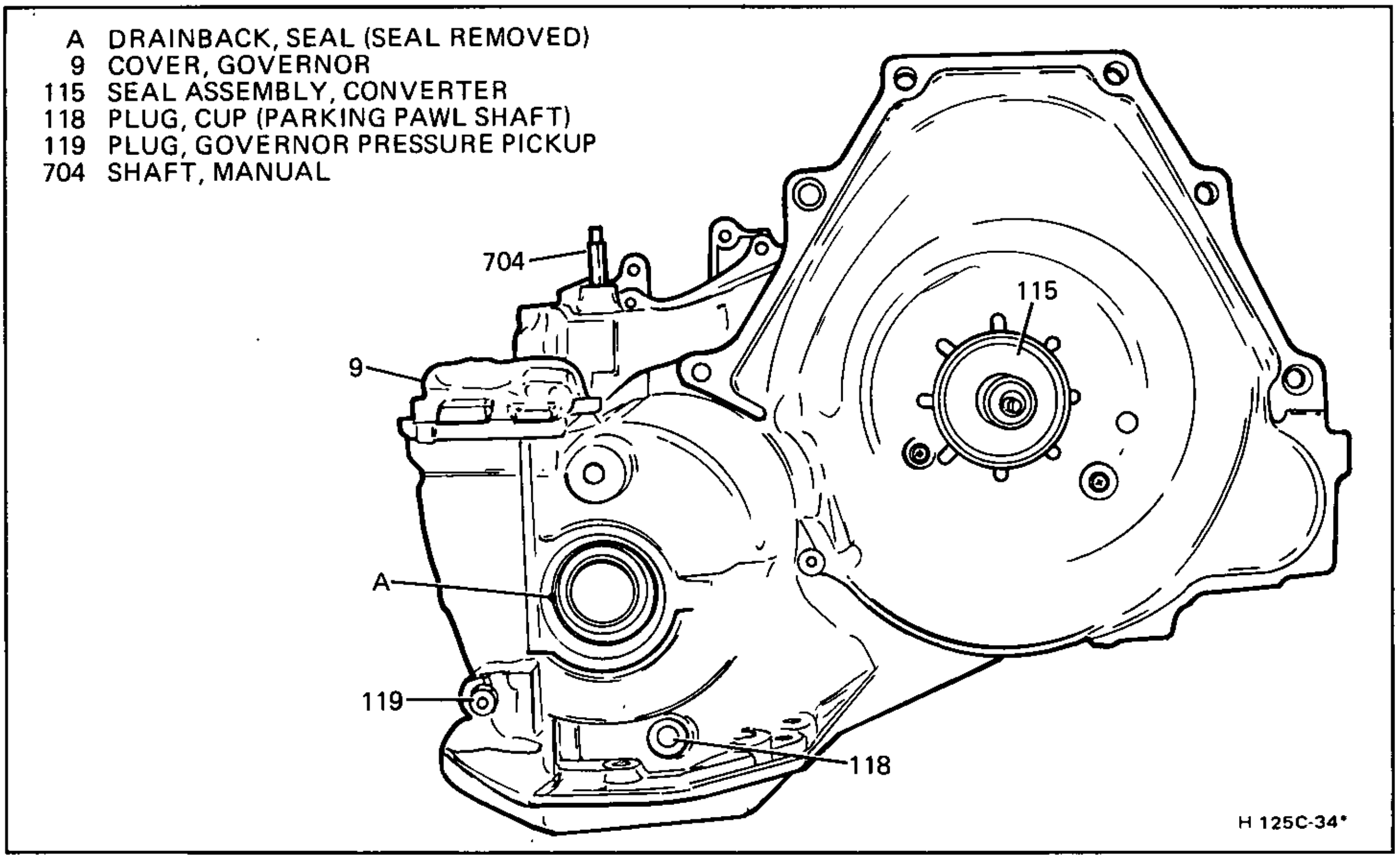


Figure A-13 Case - Right Hand Axle End

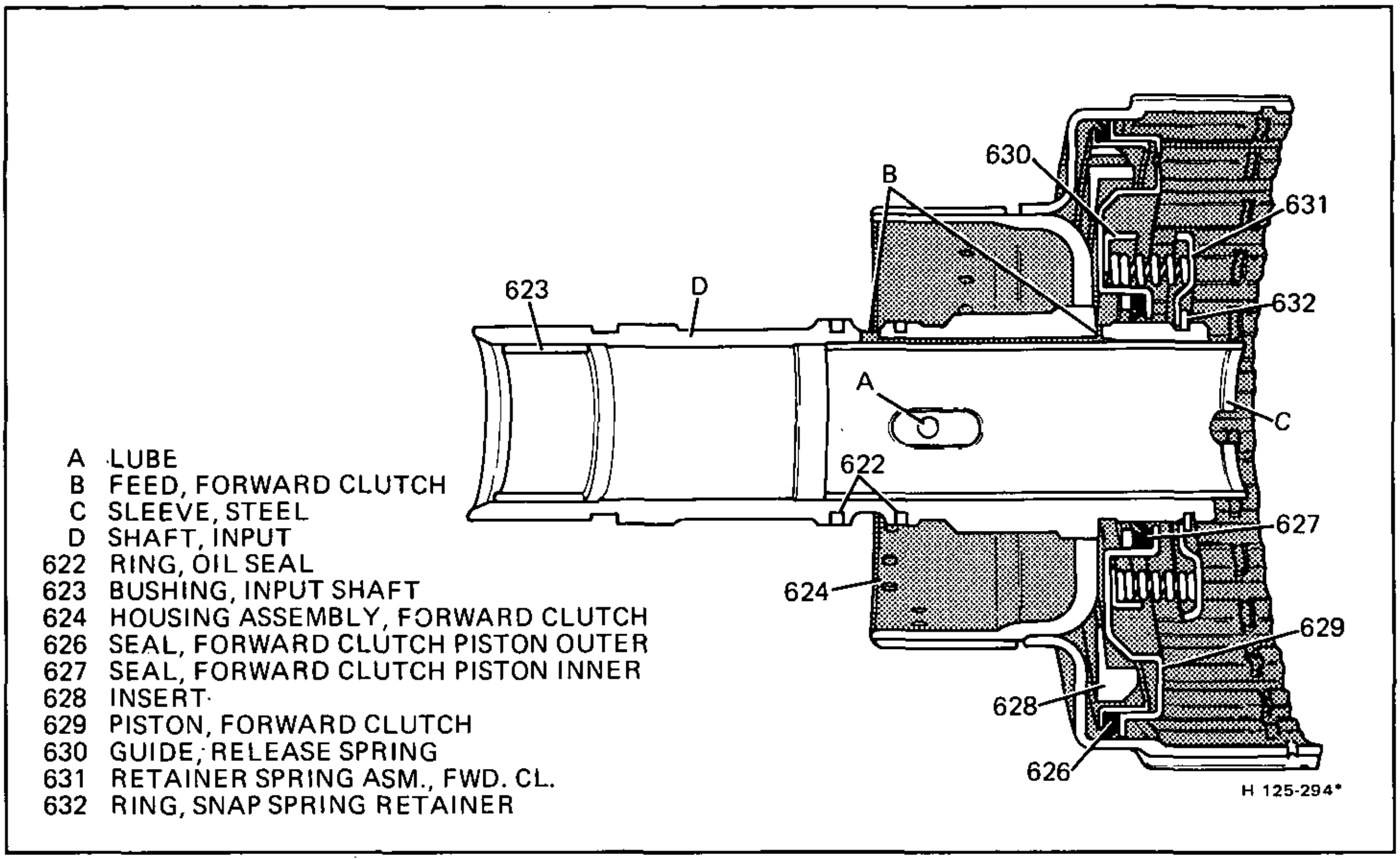


Figure A-14 Forward Clutch Assembly - Cut-Away View

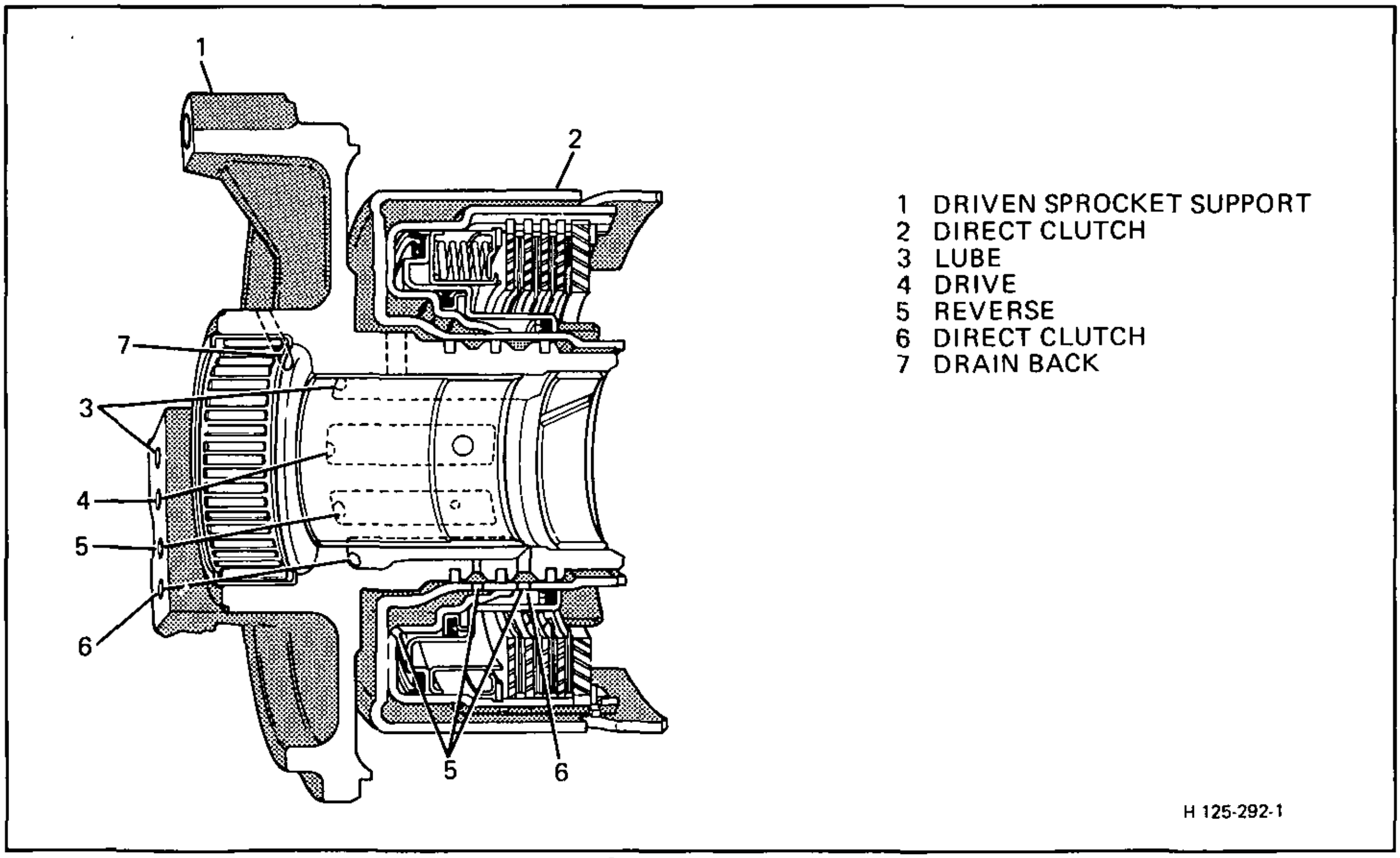
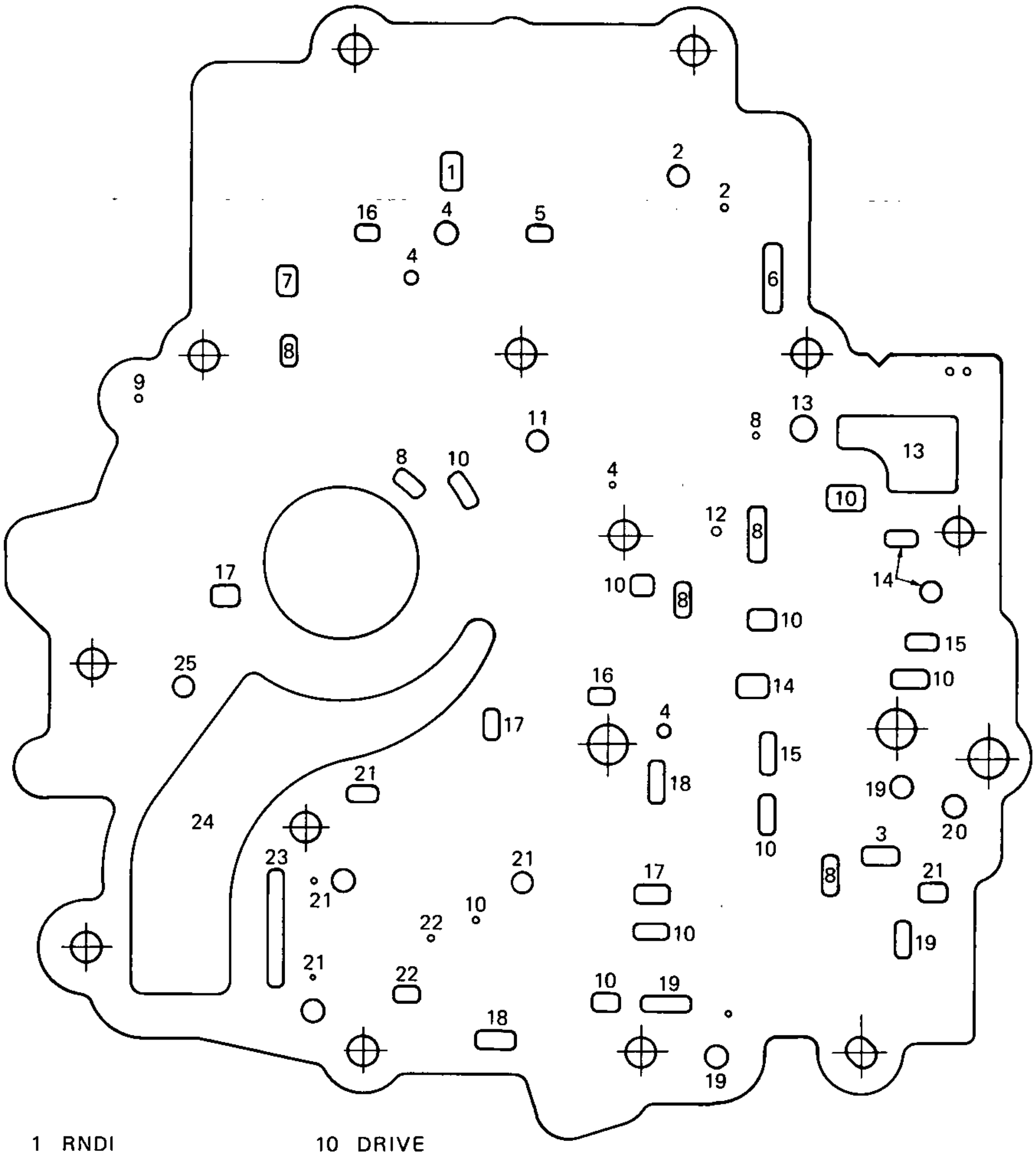


Figure A-15 Driven Sprocket Support - Cut-Away View



1 RNDI
2 T.V.
3 LO - 1ST
4 DETENT
5 REVERSE
6 LINE
7 INTERMEDIATE
8 S.T.V.
9 T.C.C. EXHAUST
10 DRIVE
11 T.C.C. APPLY
12 RND
13 S.T.V. EXH.
14 1-2 ACCUM.
15 LUBE
16 P.T.V.
17 LO
18 2ND
19 LO - 1ST OR REV.
20 3RD CL. (DIRECT) OR REV.
21 3RD CL. (DIRECT)
22 GOVERNOR
23 3RD CL. (DIRECT) ACCUM.
24 SUCTION
25 TO COOLER

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Figure A-16 Valve Body Spacer Plate - Typical

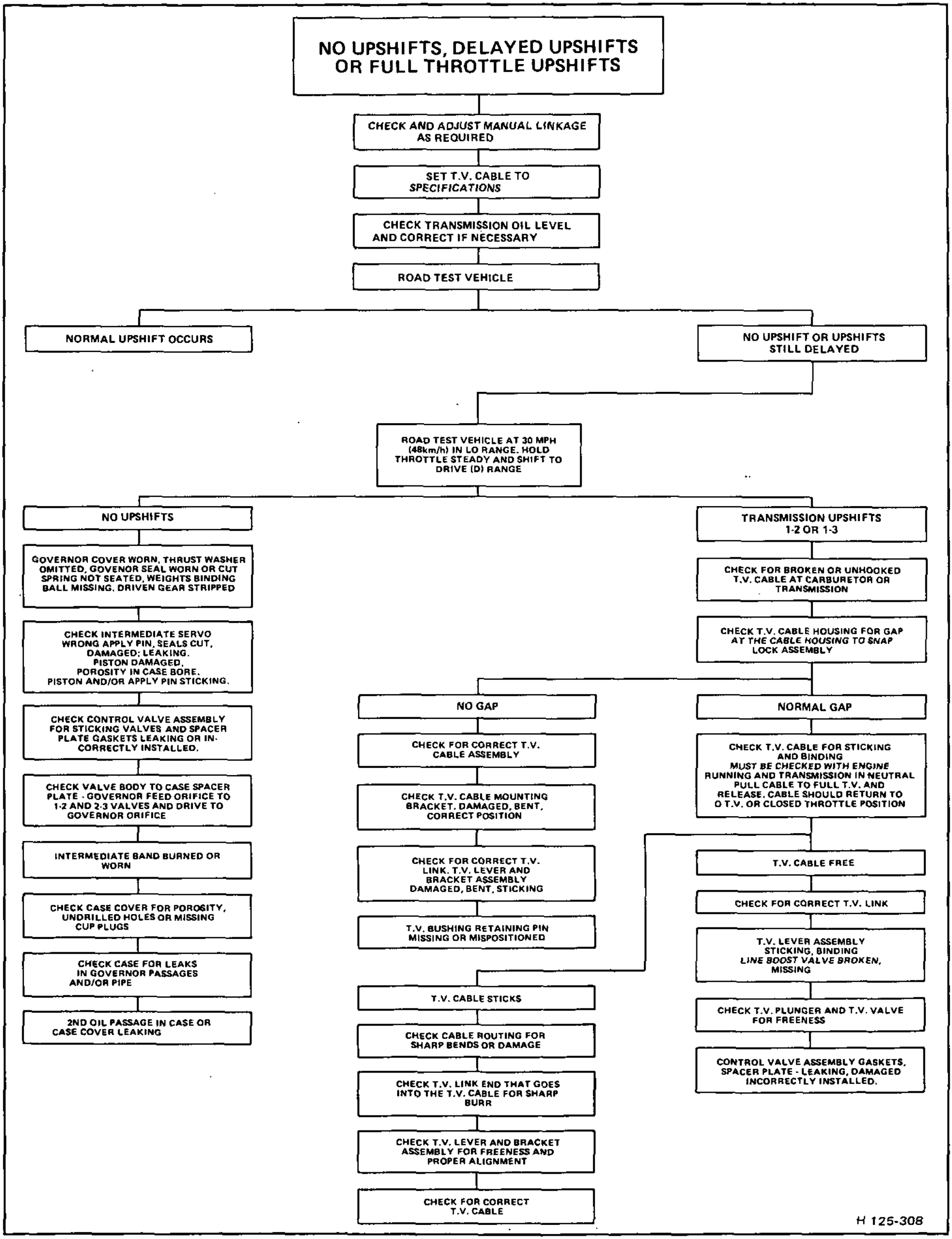

Figure A-17 Upshift Complaint

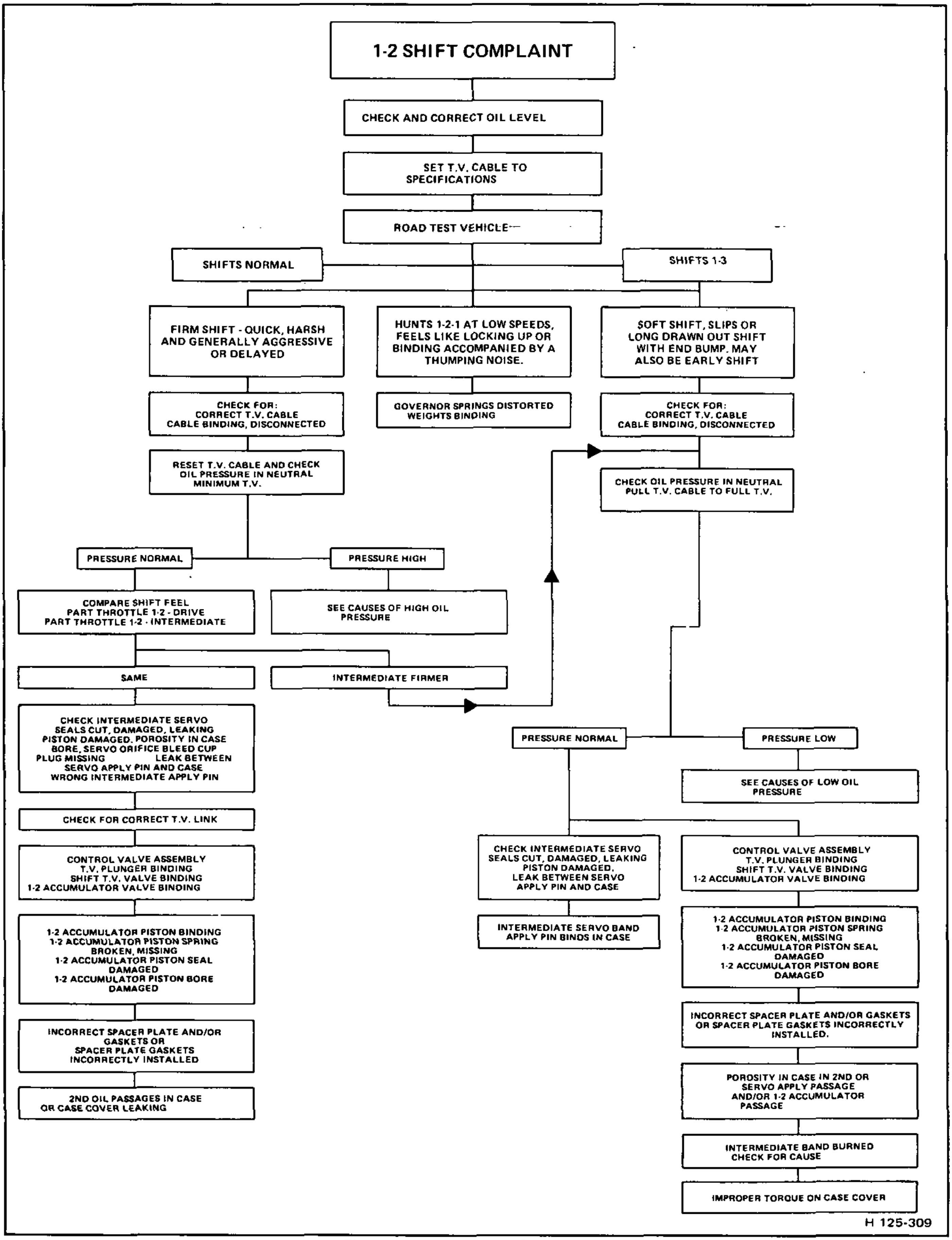

Figure A-18 1-2 Shift Complaint

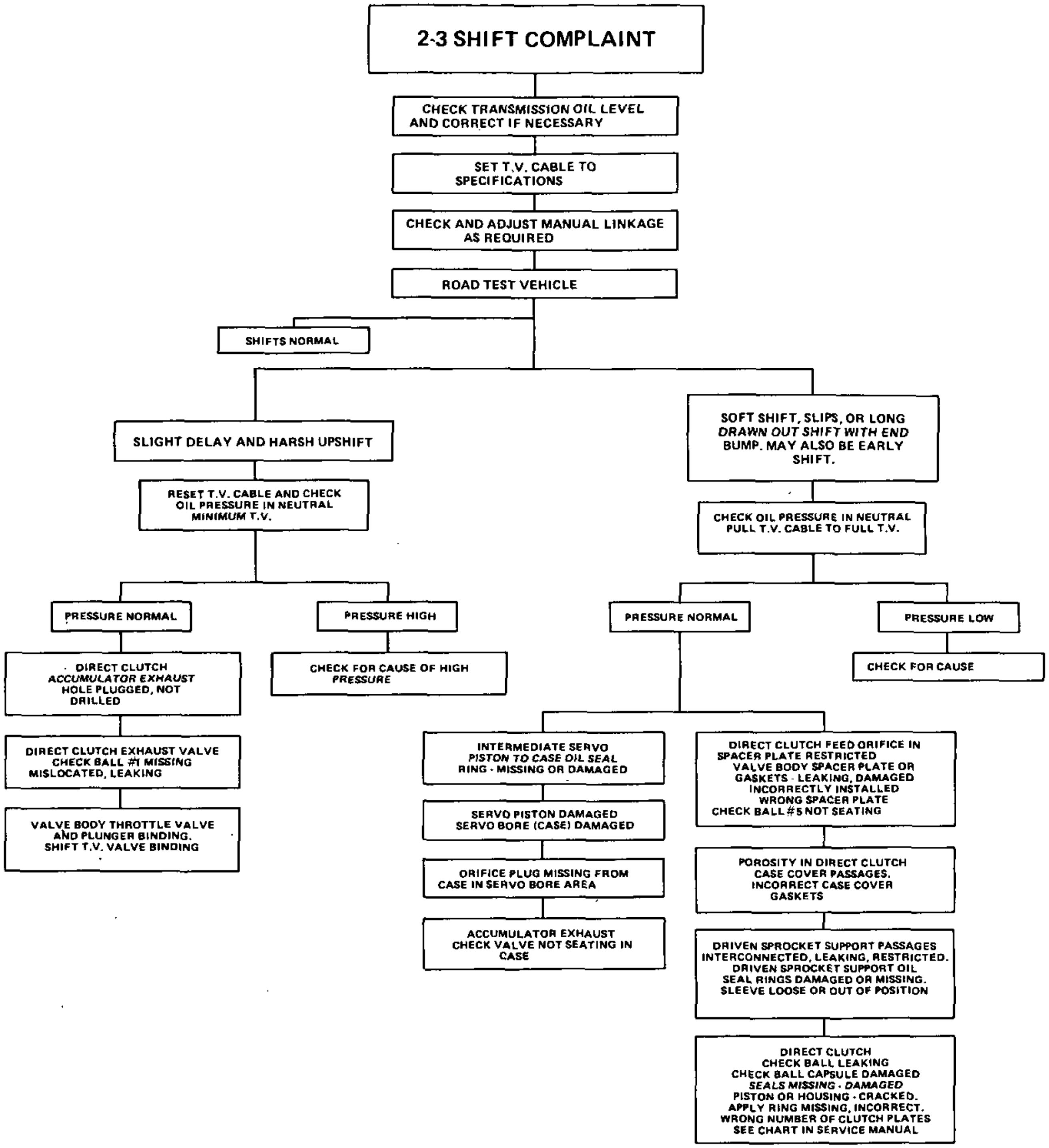

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Figure A-19 2-3 Shift Complaint

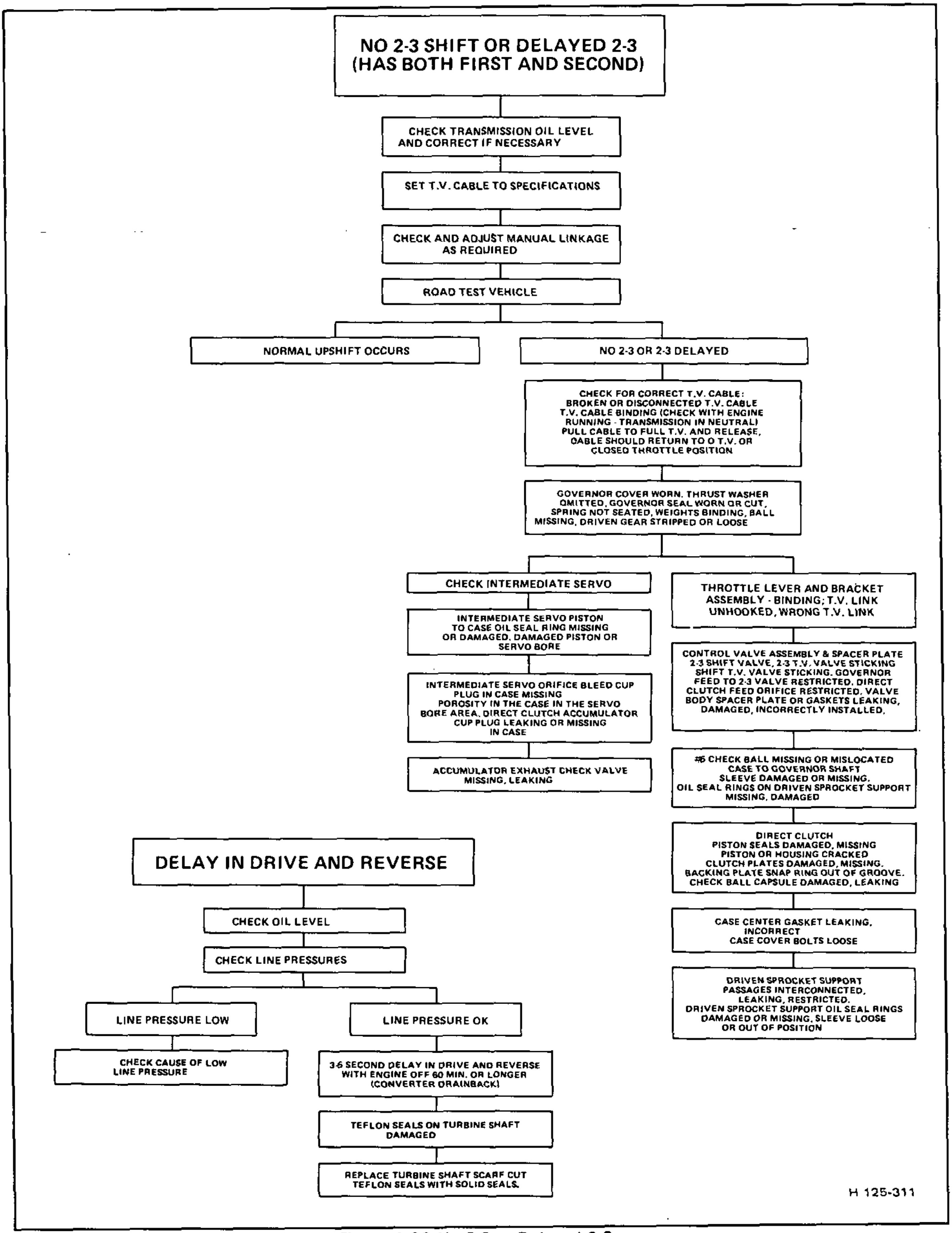


Figure A-20 No 2-3 or Delayed 2-3

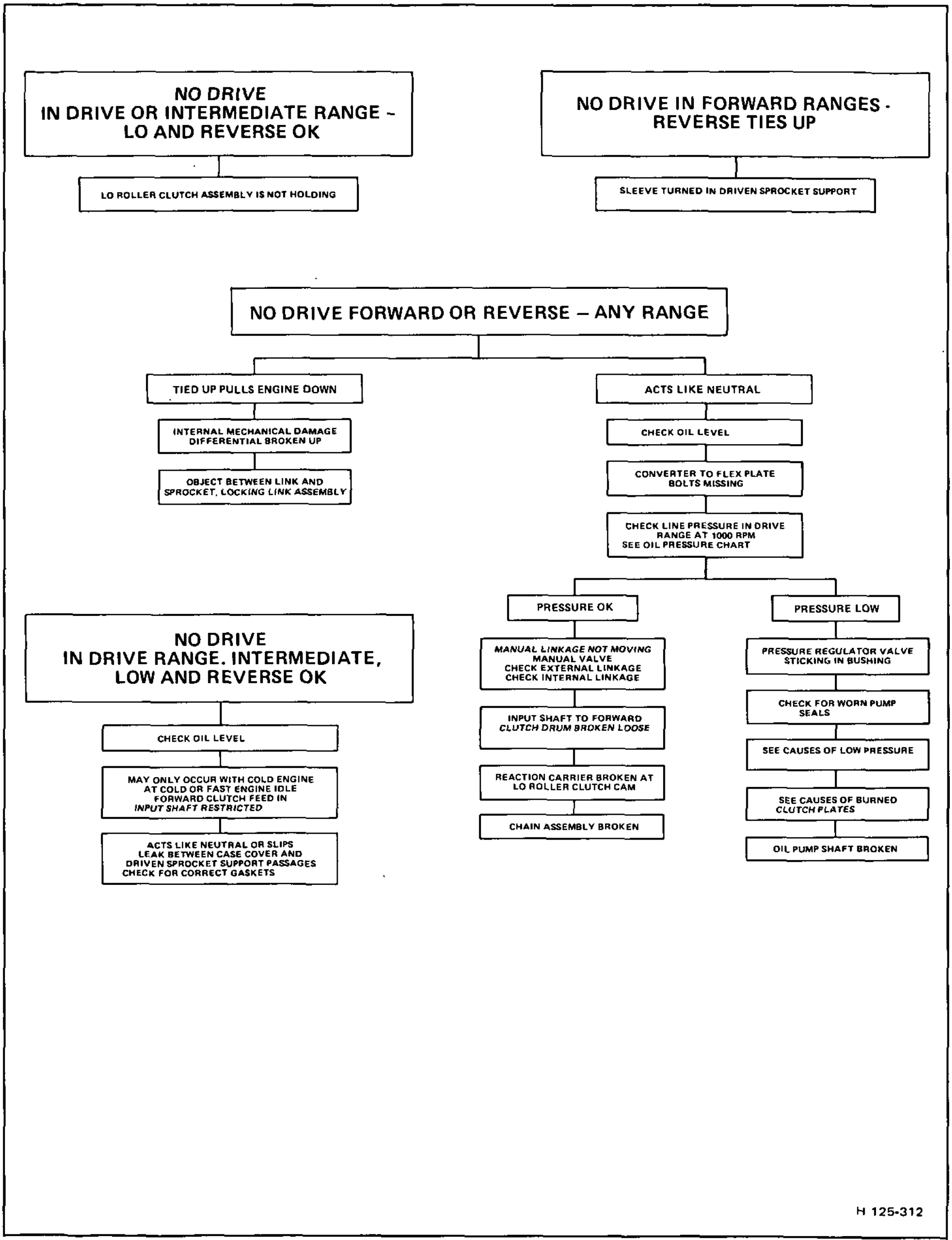


Figure A-21 No Drive

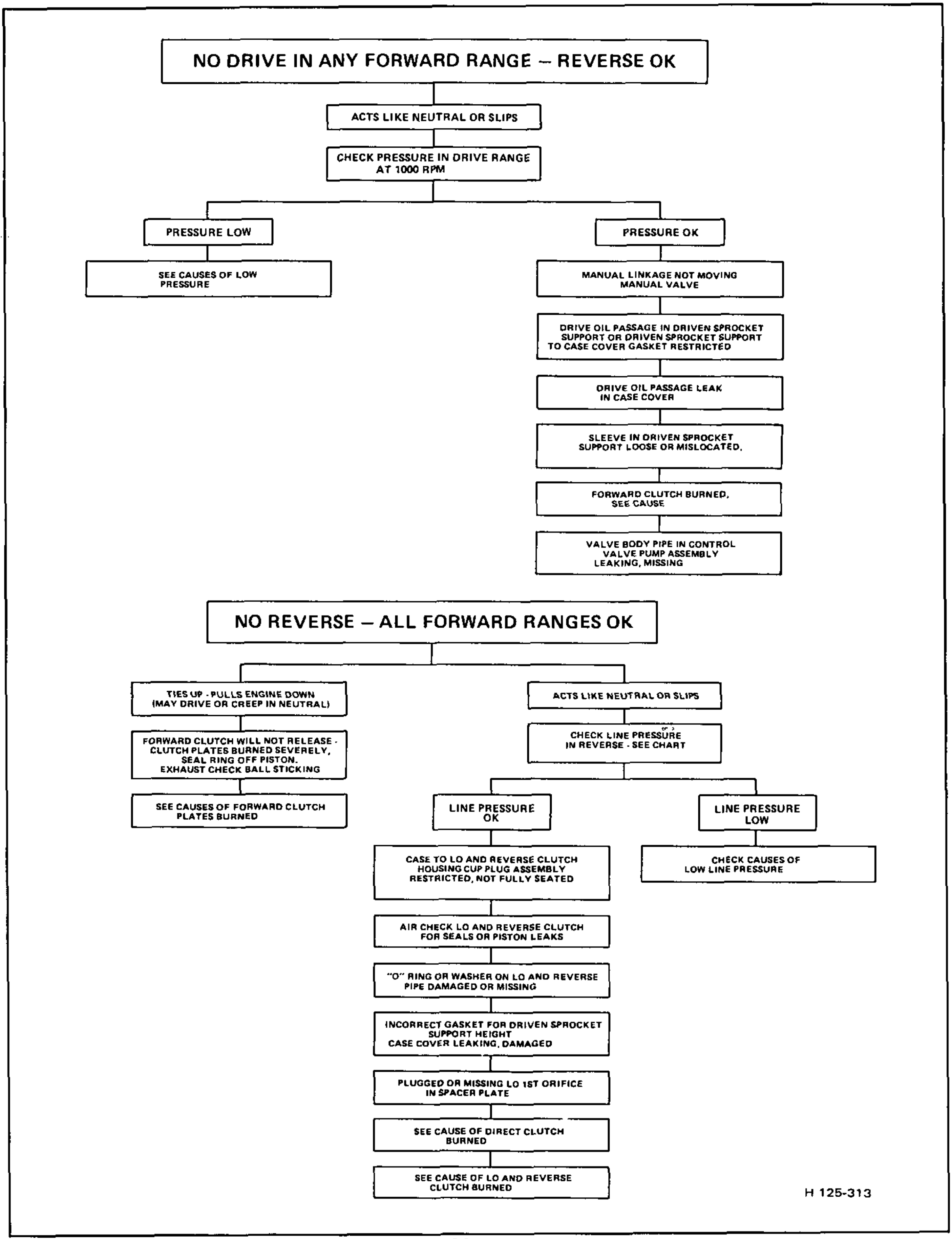


Figure A-22 No Reverse

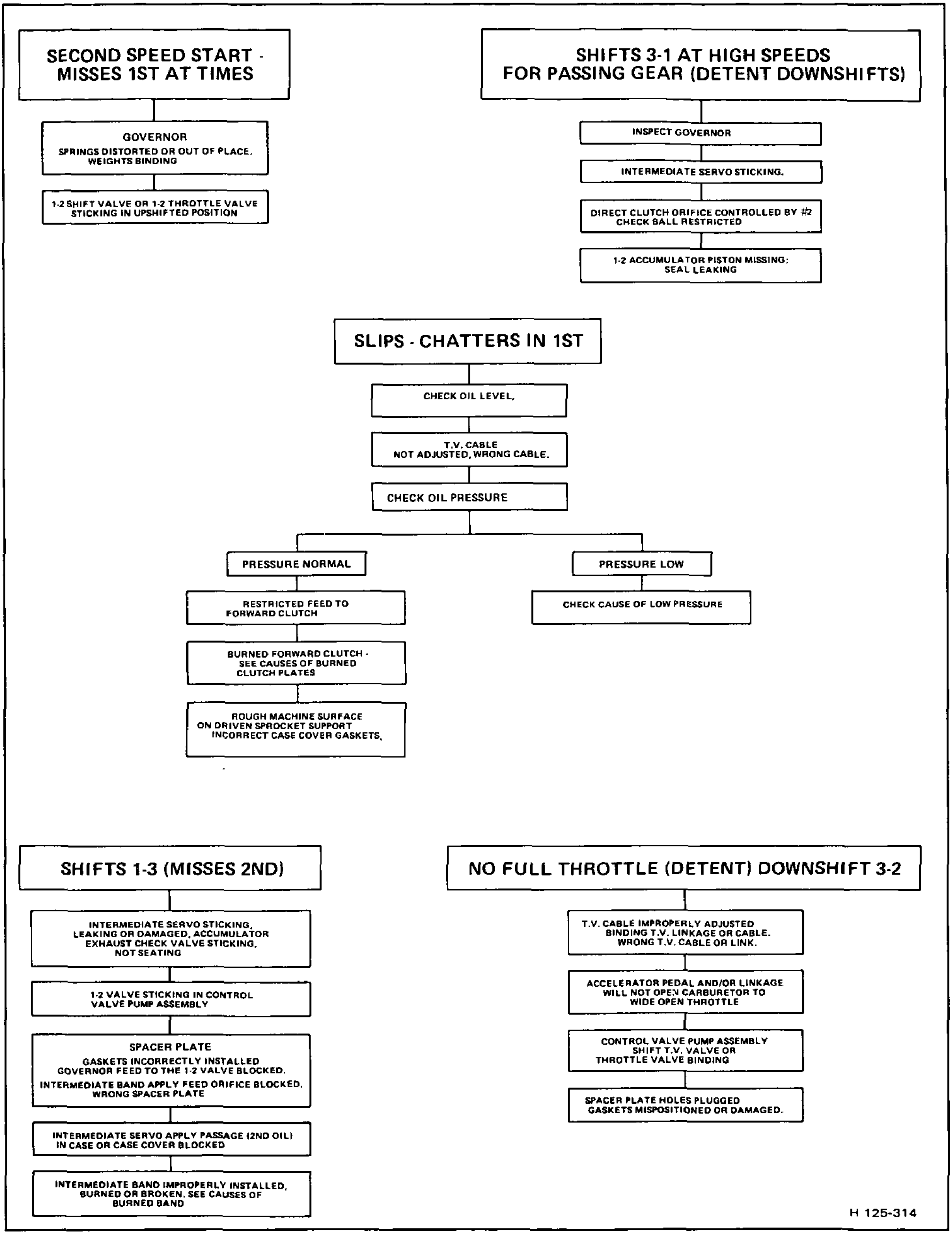


Figure A-23 Shift Complaint

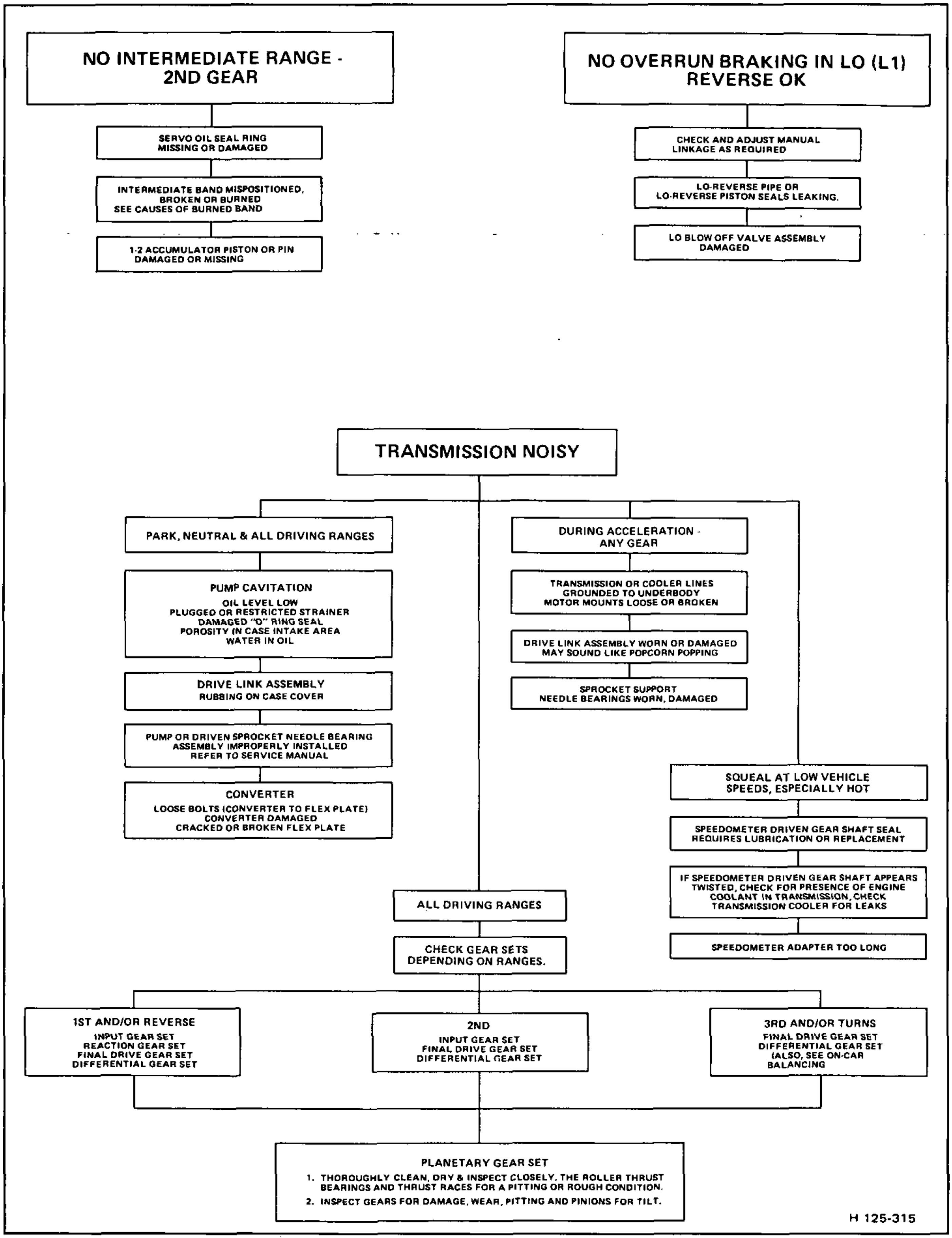


Figure A-24 Transmission Noisy

DISASSEMBLY

Remove or Disconnect

1. J-21366 Converter holding strap
2. Converter (1)

Install or Connect (Figure 1)

Tools Required:

J-28664 - Transaxle Holding Fixture
J-3289-20 - Fixture Base

CAUTION: To reduce the possibility of personal injury or transaxle damage, make sure, when doing the next step, that all the bolts for the support fixture J-28664 are installed as shown and torqued to 11 N·m (8 ft.-lbs.).

1. J-28664 fixture
2. Fixture into J-3289-20 base
3. Drain the transmission fluid.

Governor Assembly

Remove or Disconnect (Figure 2)

1. Bolt (14 and retainer (13)
2. Speedo sleeve (12) and gear (10)
3. Screws (8)
4. Governor cover (9) and "O" ring (7)
5. Bearing (6)
6. Gear (5)
7. Governor assembly (4)

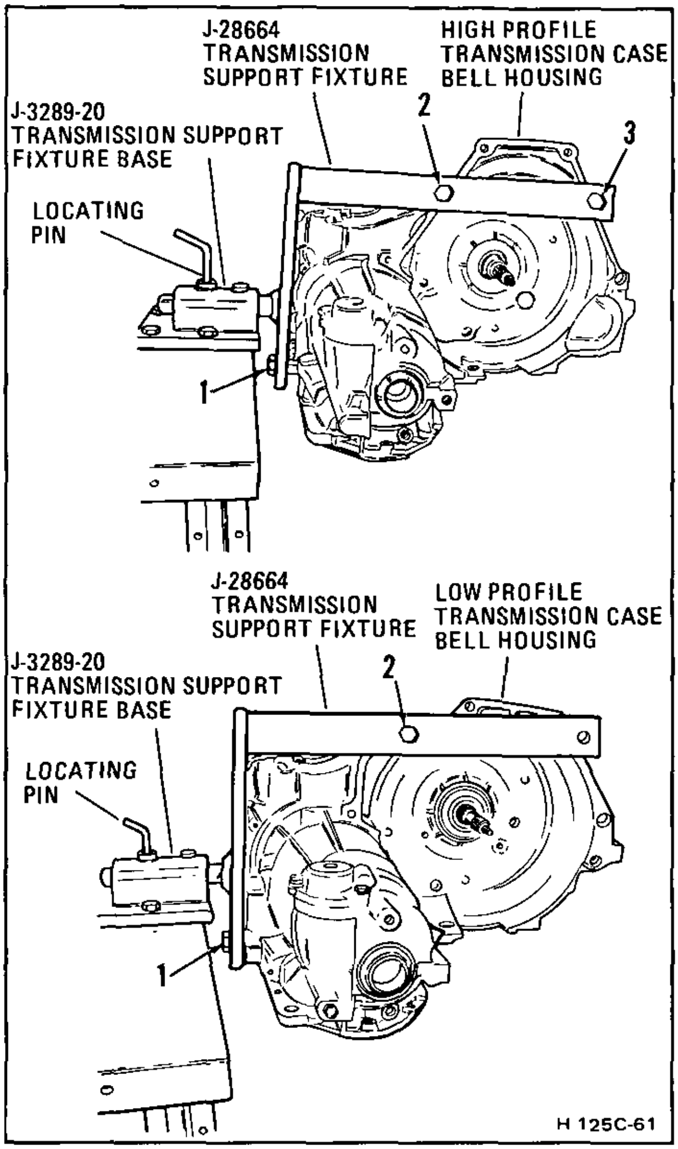


Figure 1 Transaxle in Holding Fixture

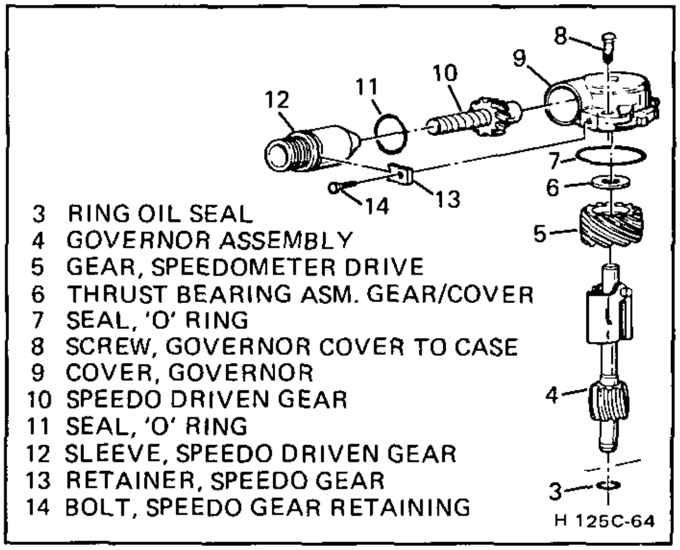
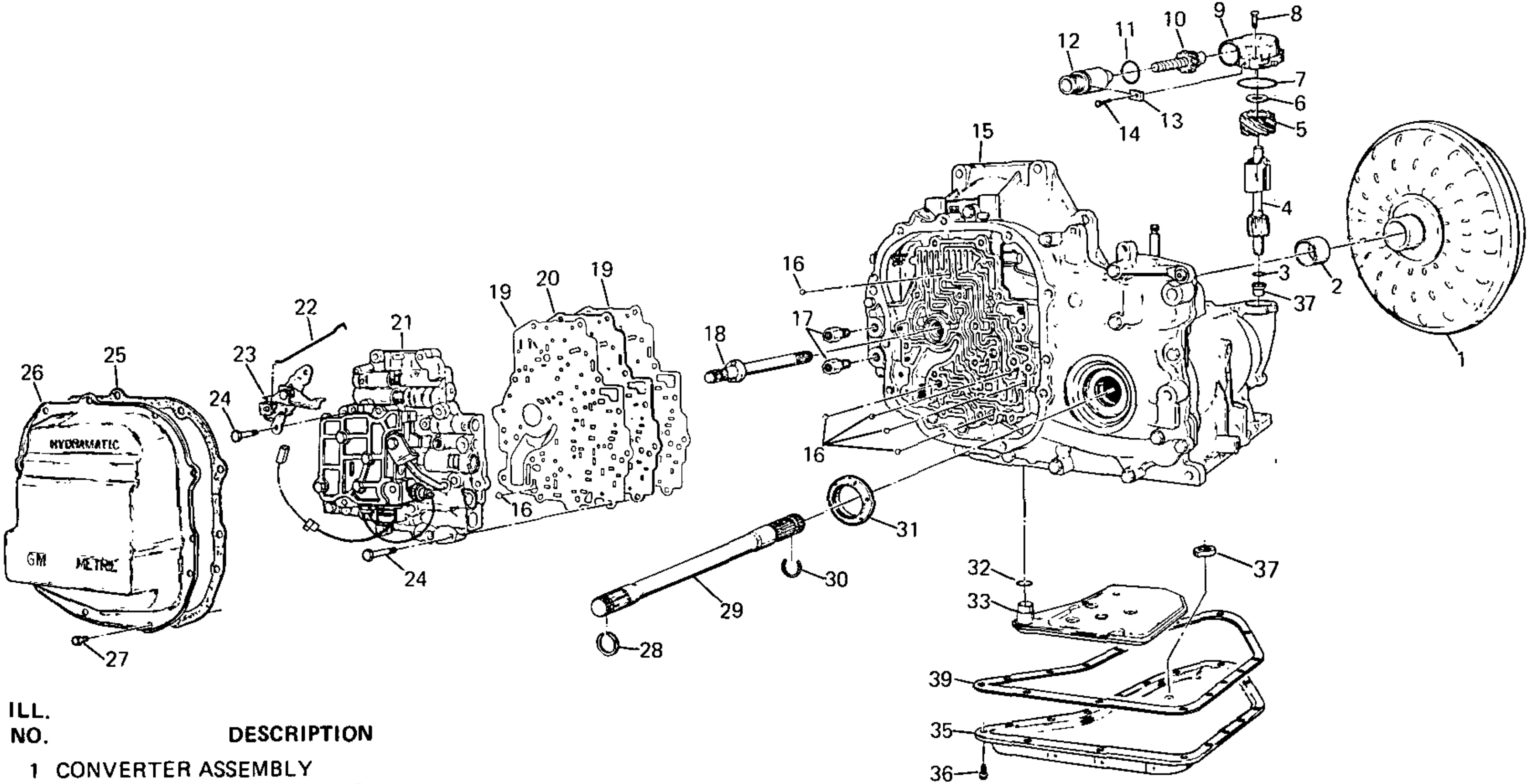
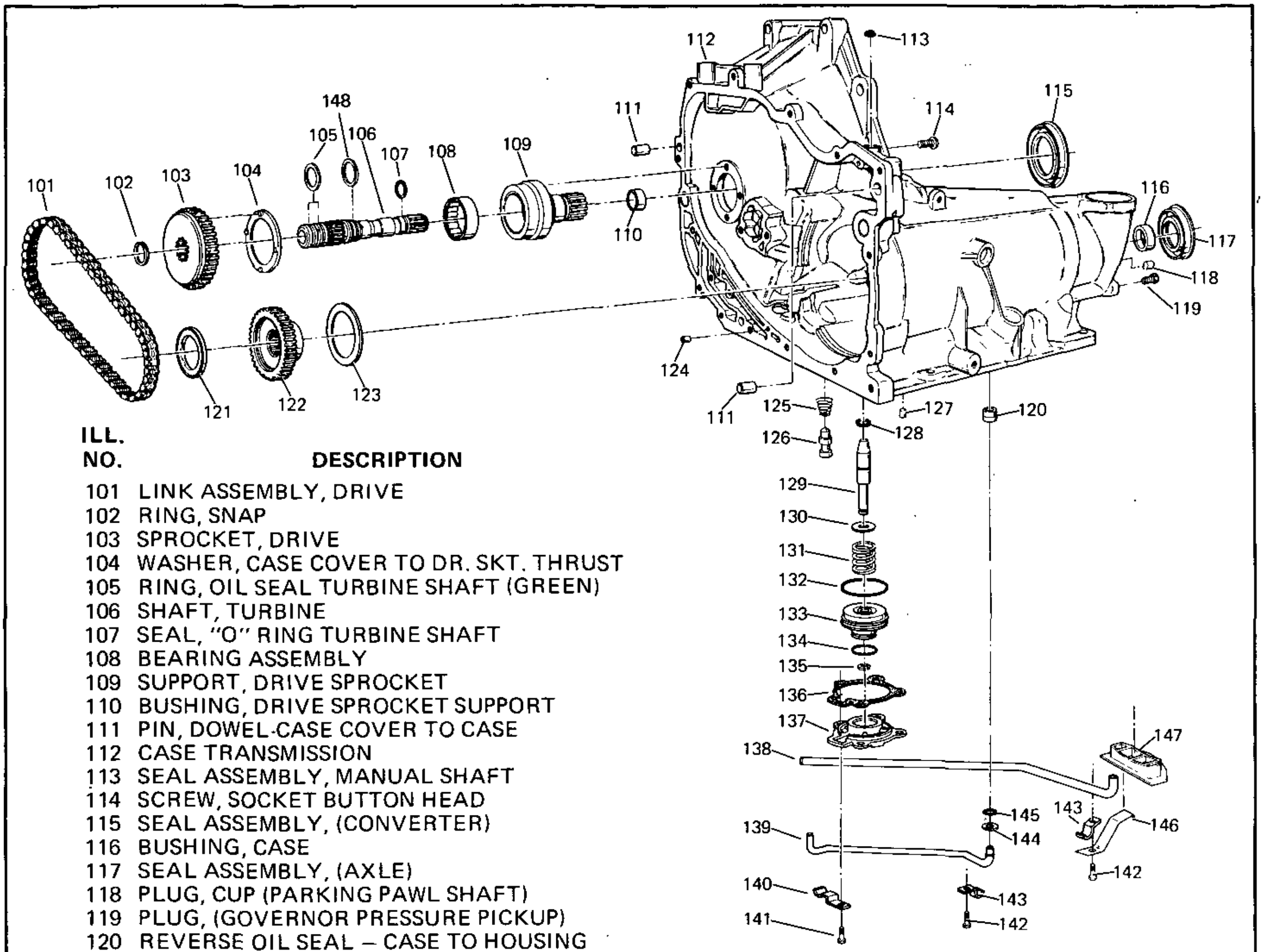


Figure 2 Governor Assembly



ILL. NO.	DESCRIPTION
1	CONVERTER ASSEMBLY
2	BUSHING, CONVERTER PUMP
3	RING, OIL SEAL
4	GOVERNOR ASSEMBLY, COMPLETE
5	GEAR, SPEEDOMETER DRIVE
6	THRUST BEARING ASSEMBLY, GEAR/COVER
7	SEAL, "O" RING
8	SCREW, GOVERNOR COVER TO CASE
9	COVER, GOVERNOR
10	SPEEDO DRIVEN GEAR
11	SEAL, "O" RING
12	SLEEVE SPEEDO DRIVEN GEAR
13	RETAINER, SPEEDO GEAR
14	BOLT, SPEEDO GEAR RETAINING
15	CASE, ASSEMBLY
16	BALL (6.3 DIA.)
17	CONNECTOR, COOLER FITTING
18	SHAFT, OIL PUMP DRIVE
19	GASKET, SPACER PLATE
20	PLATE, VALVE BODY SPACER
21	CONTROL VALVE & OIL PUMP ASSEMBLY
22	LINK, THROTTLE LEVER TO CABLE
23	LEVER & BRACKET ASSEMBLY, THROTTLE
24	BOLT, VALVE BODY/CASE
25	GASKET, VALVE BODY COVER
26	COVER, VALVE BODY
27	SCREW, VALVE BODY COVER
28	RING, RETAINING – AXLE JOINT
29	SHAFT, OUTPUT
30	RING, SNAP
31	SEAL ASSEMBLY, AXLE OIL
32	SEAL, "O" RING
33	STRAINER ASSEMBLY, TRANSMISSION OIL
35	PAN, TRANSMISSION OIL
36	SCREW, TRANSMISSION OIL PAN
37	MAGNET, CHIP COLLECTOR

Figure 3 External Components



ILL. NO.	DESCRIPTION
101	LINK ASSEMBLY, DRIVE
102	RING, SNAP
103	SPROCKET, DRIVE
104	WASHER, CASE COVER TO DR. SKT. THRUST
105	RING, OIL SEAL TURBINE SHAFT (GREEN)
106	SHAFT, TURBINE
107	SEAL, "O" RING TURBINE SHAFT
108	BEARING ASSEMBLY
109	SUPPORT, DRIVE SPROCKET
110	BUSHING, DRIVE SPROCKET SUPPORT
111	PIN, DOWEL-CASE COVER TO CASE
112	CASE TRANSMISSION
113	SEAL ASSEMBLY, MANUAL SHAFT
114	SCREW, SOCKET BUTTON HEAD
115	SEAL ASSEMBLY, (CONVERTER)
116	BUSHING, CASE
117	SEAL ASSEMBLY, (AXLE)
118	PLUG, CUP (PARKING PAWL SHAFT)
119	PLUG, (GOVERNOR PRESSURE PICKUP)
120	REVERSE OIL SEAL – CASE TO HOUSING
121	BEARING ASM., DRIVEN SPROCKET THRUST
122	SPROCKET, DRIVEN
123	WASHER, DR. SKT./SUPPORT THRUST
124	PLUG, CUP (3RD OIL)
125	SPRING, ACCUMULATOR EXHAUST
126	VALVE, ACCUMULATOR EXHAUST
127	PLUG, ORIFICE
128	RING, OIL SEAL INTER. BAND APPLY PIN
129	PIN, INTERMEDIATE BAND APPLY
130	RETAINER, INTERMEDIATE SERVO SPRING
131	SPRING, INTERMEDIATE SERVO CUSHION
132	RING, OIL SEAL OUTER, INT. SERVO
133	PISTON, INTERMEDIATE SERVO
134	RING, OIL SEAL – INNER INT. SERVO
135	RING, SNAP
136	GASKET, *INTERMEDIATE SERVO COVER*
137	COVER, INTERMEDIATE SERVO
138	PIPE, GOVERNOR OIL
139	PIPE, REVERSE OIL
140	RETAINER, REVERSE OIL PIPE
141	BOLT, INTERMEDIATE SERVO COVER
142	BOLT, PIPE RETAINER/CASE
143	RETAINER, GOVERNOR & REVERSE OIL PIPE
144	RING – SEAL BACKUP
145	SEAL, "O" REVERSE PIPE TO CASE
146	RETAINER, OIL WEIR
147	OIL WEIR
148	RING, OIL SEAL TURBINE SHAFT (YELLOW)

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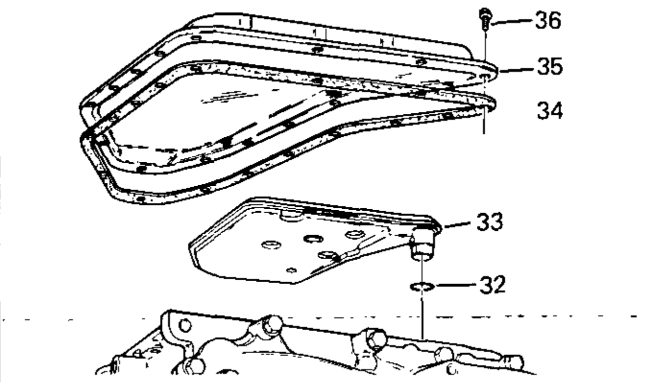
Figure 4 Drive Link Assembly, Servo, Oil Pipes



32	SEAL, 'O' RING
33	STRAINER ASM., TRANSMISSION OIL
34	GASKET, OIL PAN
35	PAN, TRANSMISSION OIL
36	SCREW, TRANSMISSION OIL PAN

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Figure 5 Bottom Pan & Oil Strainer

Bottom Pan, Oil Strainer, Oil Pipes

Remove or Disconnect (Figures 3 and 5)

1. Bolts (36)
2. Pan (35) — Leave two bolts in place finger tight — tap with a rubber mallet to break the R.T.V. sealant bead or gasket set.
3. Strainer (33) and "O" ring (32)

Remove or Disconnect (Figures 4 and 6)

1. Bolts (141) and (142)
2. Brackets (140) and retainers (143)
3. Servo cover (137) and gasket (136)
4. Servo assembly (129 - 135)
5. "E" ring (135) from pin (129)
6. Pin (129) from piston (133)

Measure (Figures 7 and 8)

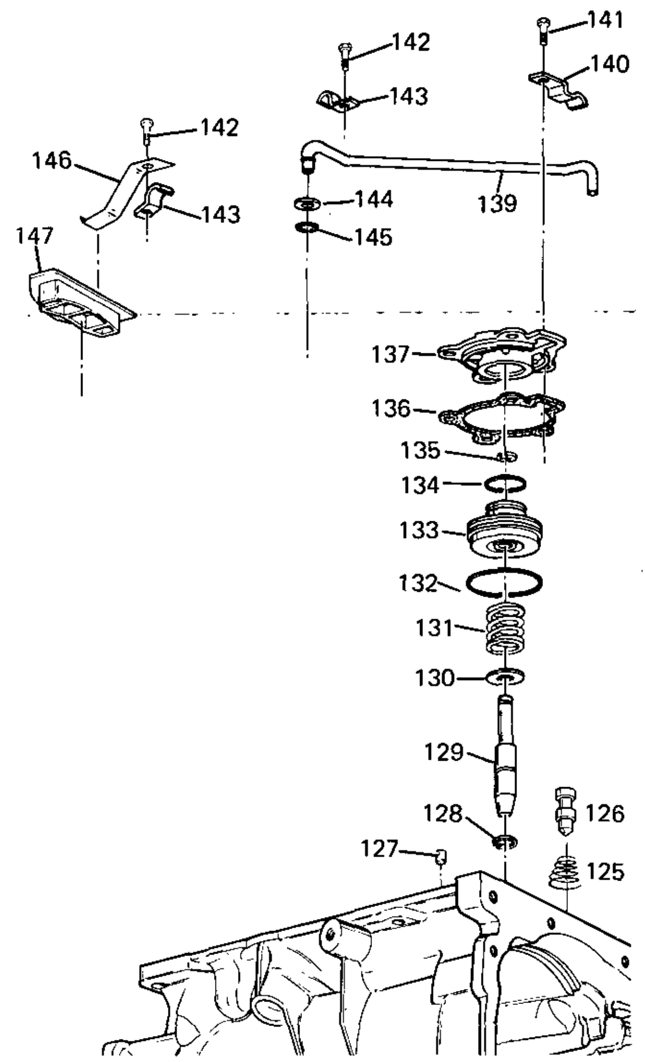
Tool Required:

J-28535 Intermediate band apply pin gage

1. Install J-28535 on case (112) and pin (129) into the gage.
2. With a torque wrench apply 11.2 N·m (100 inch pounds) of torque.
3. If the white line appears in the window the pin length is correct.
   - If the white line does not appear, select another length pin. (Figure 6) Repeat procedure.
4. Remove pin gage.

Remove or Disconnect (Figures 9 & 10)

1. Bolt (712)
2. Stop bracket (711)
3. Bracket (710)
4. Bolts (146)
5. Weir (147)
6. Check valve (126) and spring (125)
7. Pipe (139), backup ring (144) and "O" Ring (145)



125	SPRING, ACCUMULATOR EXHAUST
126	VALVE, ACCUMULATOR EXHAUST
127	PLUG, ORIFICE
128	RING, OIL SEAL INTER. BAND APP. PIN
129	PIN, INTERMEDIATE, BAND APPLY
130	RETAINER, INTER. SERVO SPRING
131	SPRING, INTER. SERVO CUSHION
132	RING, OIL SEAL (OUTER) INTER. SERVO
133	PISTON, INTERMEDIATE SERVO
134	RING, OIL SEAL (INNER) INT. SERVO
135	RING, SNAP
136	GASKET, INTERMEDIATE SERVO COVER
137	COVER, INTERMEDIATE SERVO
139	PIPE, REVERSE OIL
140	RETAINER, REVERSE OIL PIPE
141	BOLT, INT. SERVO COVER
142	BOLT, PIPE RET/CASE
143	RETAINER, GOVERNOR AND REV. OIL PIPE
144	RING-SEAL BACKUP
145	SEAL, 'O' REVERSE PIPE TO CASE
146	RETAINER, OIL WEIR
147	OIL WEIR

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Figure 6 Oil Pipes & Servo Assembly

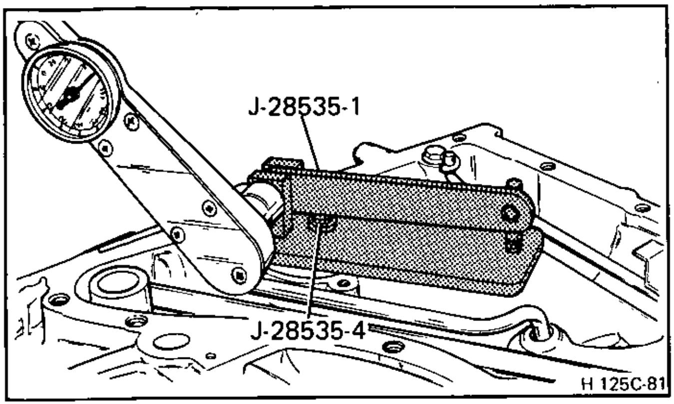

Figure 7 Checking for Proper Apply Pin

INTERMEDIATE BAND
APPLY PIN

LENGTH	IDENTIFICATION
Short	2 Grooves
Medium	1 Groove
Long	No Grooves

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Figure 8 Apply Pin Chart

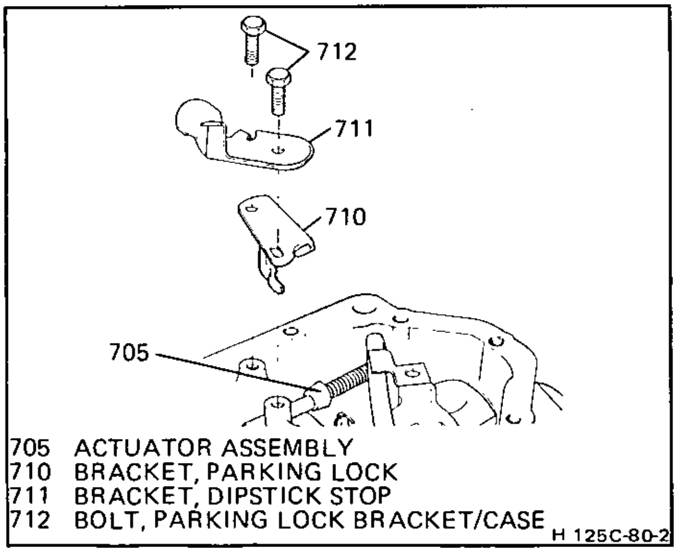


Figure 9 Dip Stick Stop & Brackets

LOW AND REVERSE SEAL AND OUTPUT SHAFT

↔ Remove or Disconnect (Figure 11 & 12)

Tool Required:
J-28583 - "C" ring remover, output shaft
Modified No. 4 screw extractor

1. Lo and reverse seal (120)
   - Use a modified No. 4 screw extractor
2. Output shaft "C" ring (30) with J-28583
   - Push ring with remover – rotate shaft (29) – pull the ring with needle nose pliers
3. Output shaft (29) from case

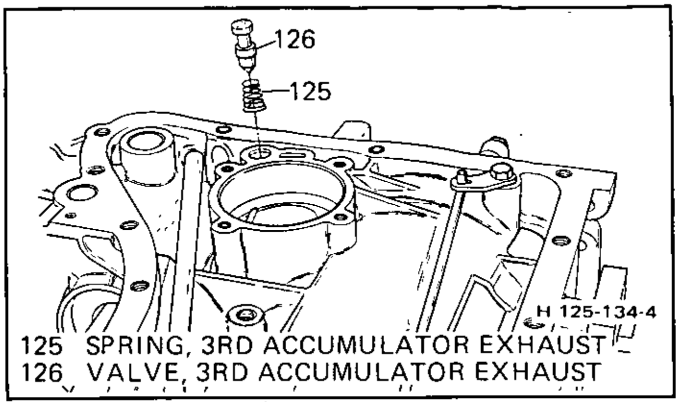


Figure 10 3rd Accumulator Exhaust Valve & Spring

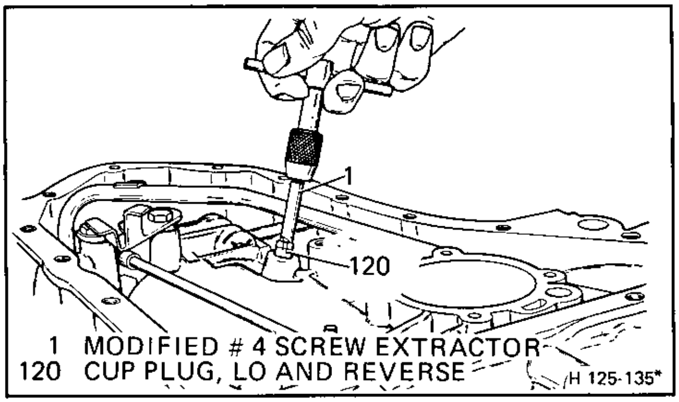


Figure 11 Lo & Reverse Cup Plug

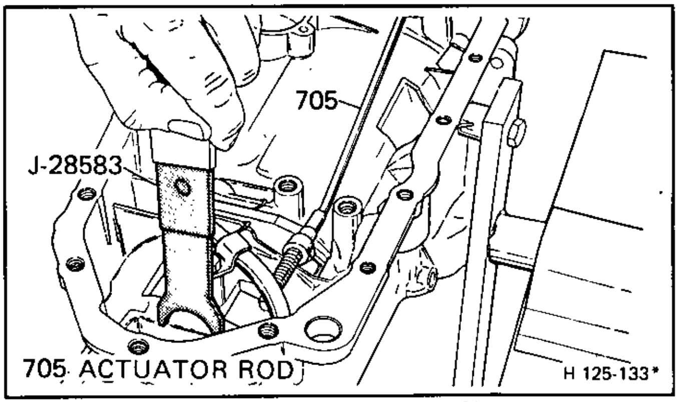
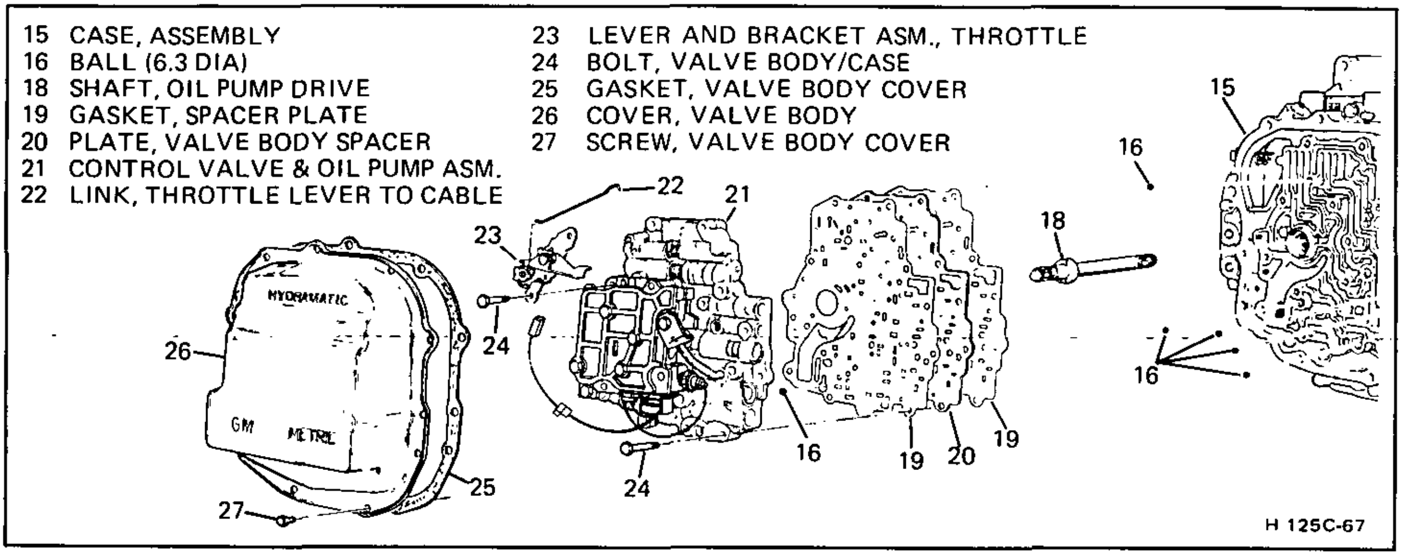


Figure 12 Expanding "C" Ring

SIDE COVER AND CONTROL VALVE PUMP ASSEMBLY

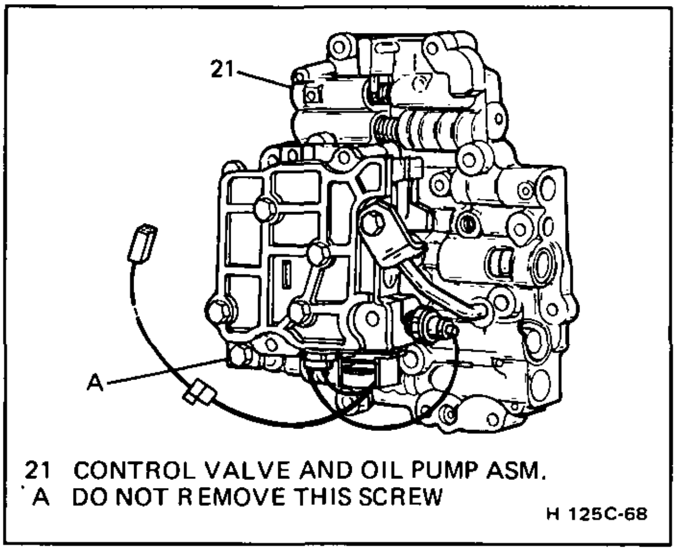
↔ Remove or Disconnect (Figures 13 and 14)

1. Screws (27) (Leave two screws finger tight – tap the cover (26) with rubber mallet.)
2. Cover (26)
3. Bolts (24) – Do not remove the screw marked "A" (Figure 14)
4. Bracket assembly (23) and T.V. cable link (22)
5. Valve body (21) – Do not place the machined side on the bench
6. Number one check ball (16)
7. Pump shaft (18)
8. Spacer plate (20) and gaskets (19)
9. Five check balls (Figure 15)



15	CASE, ASSEMBLY	23	LEVER AND BRACKET ASM., THROTTLE
16	BALL (6.3 DIA)	24	BOLT, VALVE BODY/CASE
18	SHAFT, OIL PUMP DRIVE	25	GASKET, VALVE BODY COVER
19	GASKET, SPACER PLATE	26	COVER, VALVE BODY
20	PLATE, VALVE BODY SPACER	27	SCREW, VALVE BODY COVER
21	CONTROL VALVE & OIL PUMP ASM.		
22	LINK, THROTTLE LEVER TO CABLE		

Figure 13 Side Cover & the Control Valve, Pump Assembly



21 CONTROL VALVE AND OIL PUMP ASM.
A DO NOT REMOVE THIS SCREW

Figure 14 Control Valve/Pump Assembly

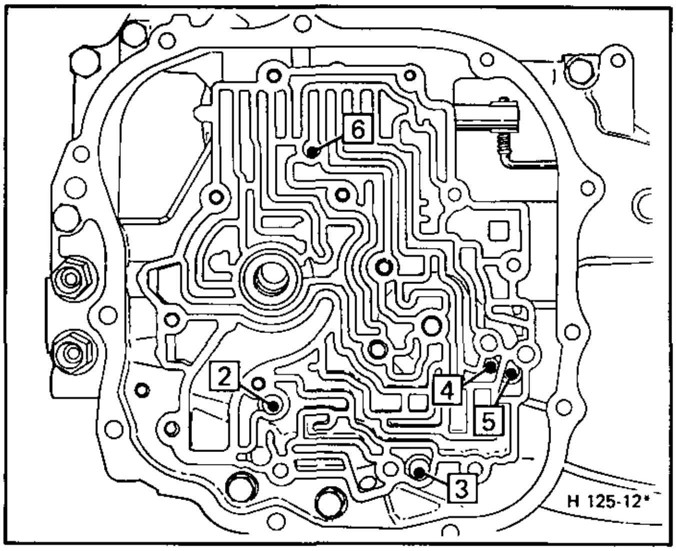


Figure 15 Check Ball Locations

Input Shaft to Case Cover Selective Snap Ring End Play Check

Measure (Figures 16, 17 and 18)

Tools required:

J-26958-10 Adapter Plug
J-26958 Loading tool
J-26958-11 Bracket
J-28544 Input shaft lifter
J-25025-7 Dial indicator post
(J-26900-12 or 58001 (M) dial indicator)

1. Install the adapter plug J-26958-10, loading tool J-26958 and bracket J-26958-11.
   Tighten the loading tool knob until tight.
2. Install the dial indicator set and lifter.
3. Push the lifter down then zero the dial indicator.
4. Pull the lifter up.
5. Reading should be 0.10-0.84 mm (.004"-0.33"). See Figure 18. For choice of selective snap rings for proper end play ranges - record the reading.
6. Remove the dial indicator set and the lifter.

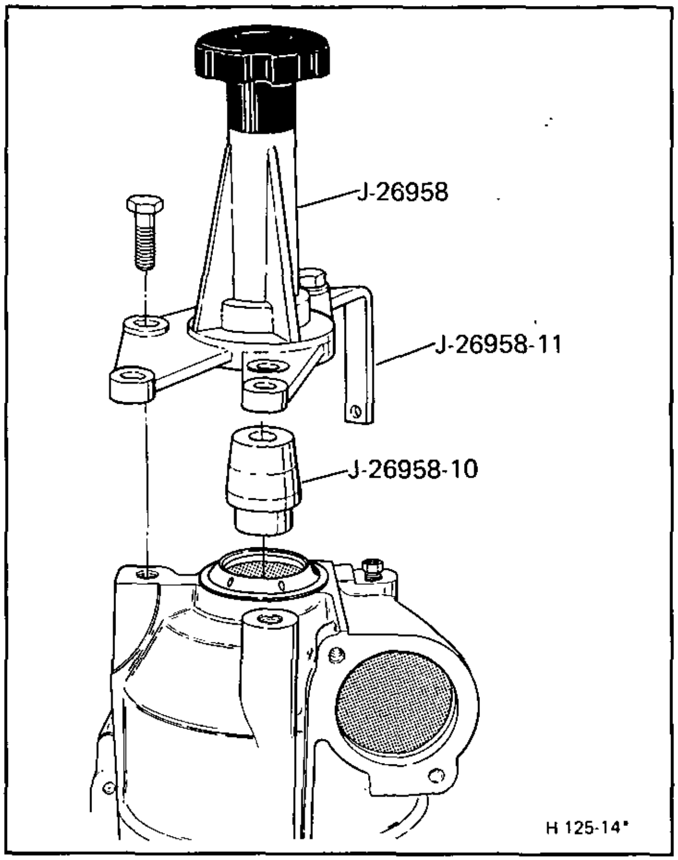


Figure 16 Output Shaft Loading Tool

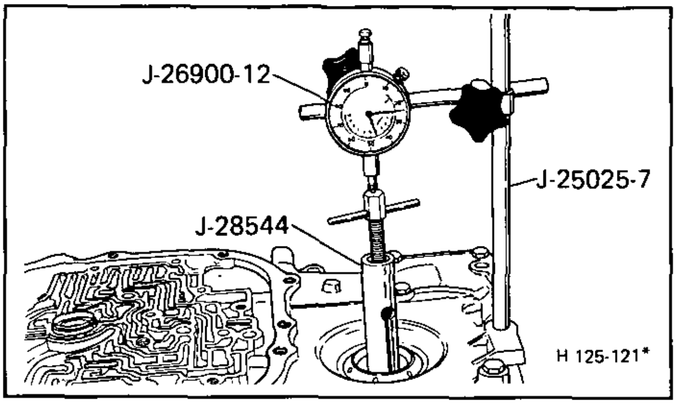


Figure 17 Input Shaft to Case Cover End Play

INPUT SHAFT SELECTIVE SNAP RING (621)

Thickness	Identification/Color
1.83 - 1.93mm (0.071" - 0.076")	White
2.03 - 2.13mm (0.078" - 0.084")	Blue
2.23 - 2.33mm (0.088" - 0.092")	Brown
2.43 - 2.53mm (0.095" - 0.099")	Yellow
2.63 - 2.73mm (0.103" - 0.107")	Green

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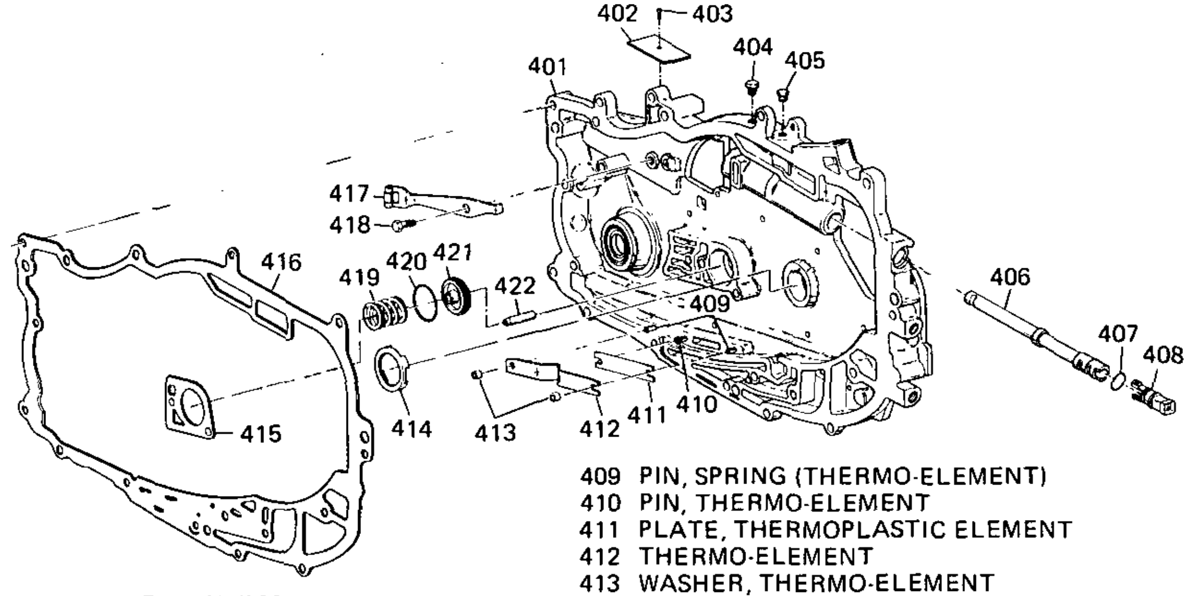
Figure 18 Selective Snap Ring Chart



ILL. NO.	DESCRIPTION
401	*COVER, TRANSMISSION CASE*
402	NAMEPLATE
403	SCREW – NAMEPLATE
404	VENT ASSEMBLY
405	PLUG, (LINE PRESSURE PICKUP) PIPE
406	VALVE, MANUAL
407	SEAL, "O" RING
408	ELECTRICAL CONNECTOR
409	PIN, SPRING (THERMO-ELEMENT)
410	PIN, THERMO-ELEMENT
411	PLATE, THERMOPLASTIC ELEMENT
412	THERMO-ELEMENT
413	WASHER, THERMO-ELEMENT
414	WASHER, THRUST CASE COVER TO DR. SKT.
415	*GASKET, CASE TO CASE COVER CENTER*
416	GASKET, CASE TO CASE COVER
417	SPRING AND ROLLER ASM., MANUAL DETENT
418	BOLT, MAN. DET. SPRING/CASE COVER
419	SPRING, 1-2 ACCUMULATOR PISTON
420	RING, OIL SEAL, 1-2 ACCUMULATOR PISTON
421	PISTON, 1-2 ACCUMULATOR
422	PIN, 1-2 ACCUMULATOR

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Figure 19 Case Cover - Case Side

Case Cover

↔ Remove or Disconnect (Figures 19, 20, 21, and 22)

Tools Required:
Two M12 bolts 50 mm (2″ long)

1. Rod (70) from manual valve (406)
2. All case cover attaching bolts including 2 TORX ® head bolts
   - Install two (2) M12 bolts 50 mm (2″) long into dowel pin holes. Bolts will: self tap, bottom and separate the case (112) and the cover(401). Alternate tightening of the bolts. DO NOT PRY CASE COVER (401).
   - Place the case cover (401) on the bench, 1-2 accumulator side up.
3. Accumulator spring (419)
4. Piston (421)
5. Gasket (415)
6. Drive sprocket thrust washer (414)
7. Driven sprocket thrust washer (121)
8. Turbine shaft "O" ring (Figure 21)
9. Link assembly (101), drive and driven sprockets (103) (122)
10. Drive sprocket support thrust washer (104)
11. Driven sprocket support thrust washer (123)

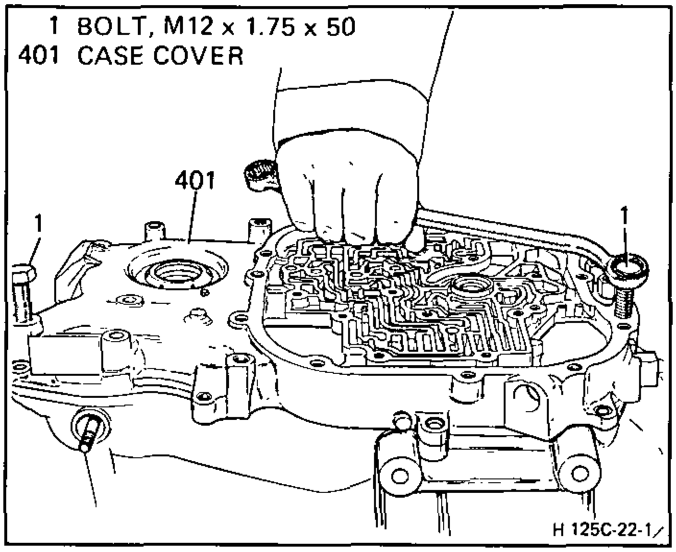


Figure 20 Case Cover Removal

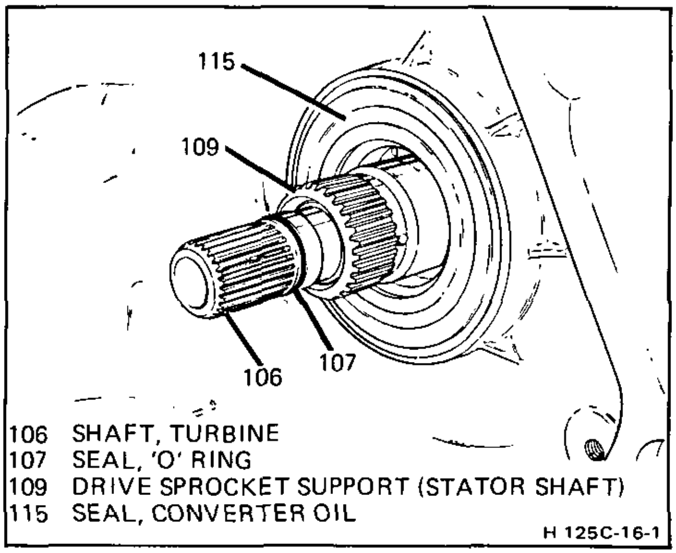


Figure 21 Turbine Shaft "O" Ring Seal

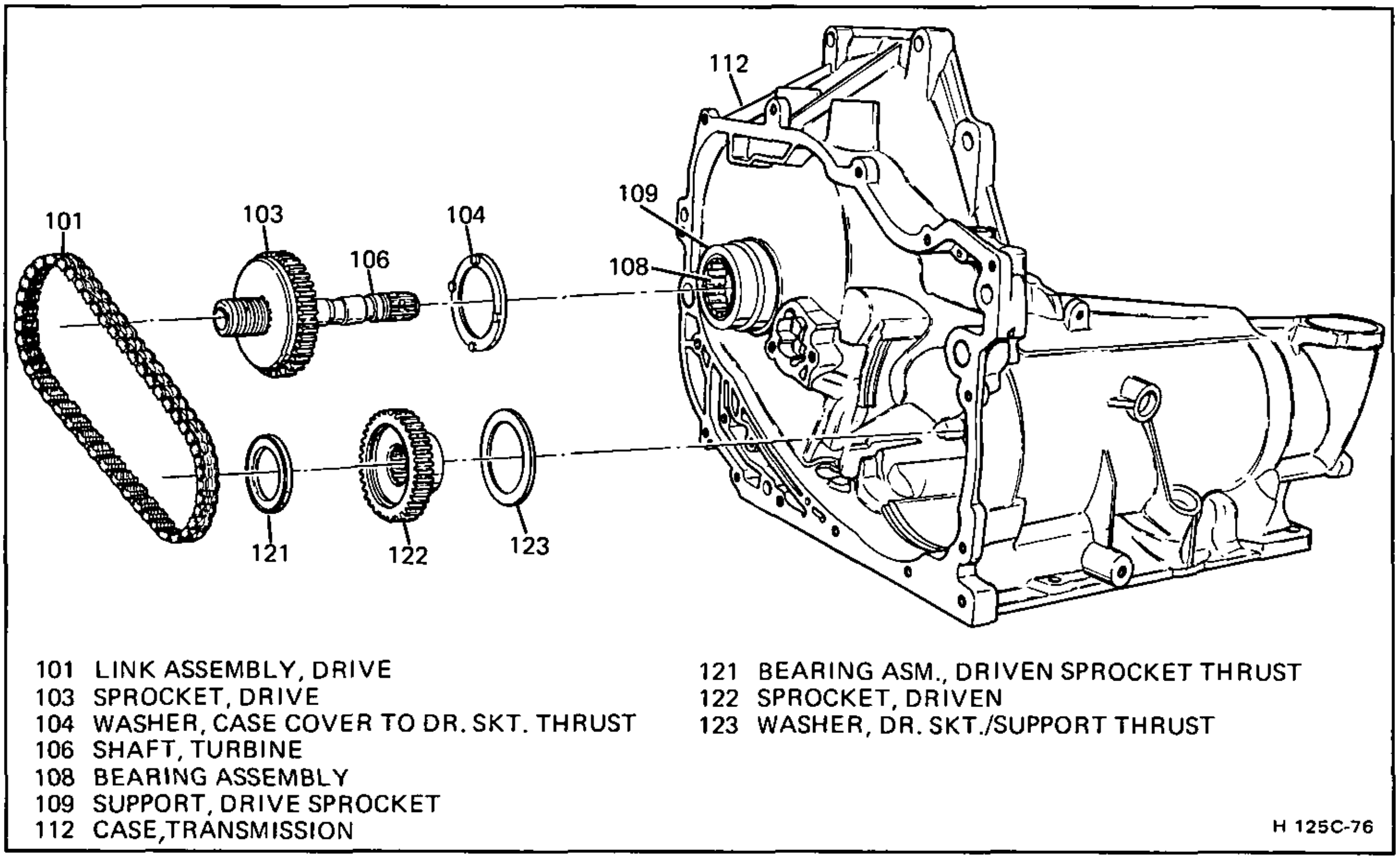
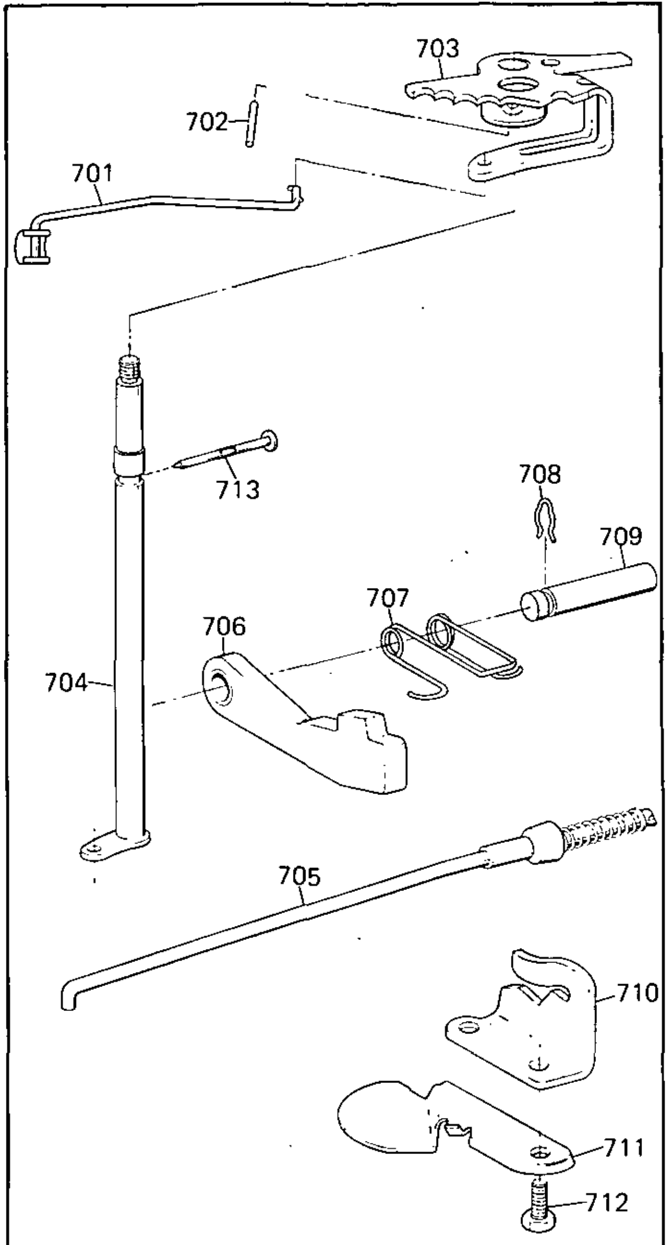
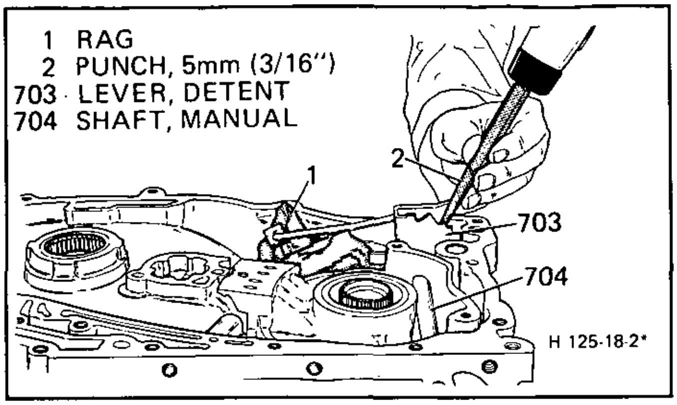


Figure 22 Drive Link Assembly



ILL. NO.	DESCRIPTION
701	ROD & RETAINER ASSEMBLY
702	PIN, SPRING – DETENT LEVER TO SHAFT
703	LEVER & HUB ASSEMBLY, MANUAL DETENT
704	SHAFT, MANUAL
705	ACTUATOR ASSEMBLY, PARKING LOCK
706	PAWL, PARKING LOCK
707	SPRING, PARKING PAWL RETURN
708	RETAINER, PARKING PAWL SHAFT
709	SHAFT, PARKING LOCK PAWL
710	BRACKET, PARKING LOCK
711	BRACKET, DIPSTICK STOP
712	BOLT, PARKING LOCK BRACKET/CASE
713	PIN, MANUAL SHAFT/CASE RETAINING

Figure 23 Manual Linkage



1	RAG
2	PUNCH, 5mm (3/16")
703	LEVER, DETENT
704	SHAFT, MANUAL

Figure 24 Retaining Pin Removal

INPUT UNIT PARTS

↔ Remove or Disconnect (Figures 23, 24, 25, 26, 27, and 28)

1.
   - Pin (702)
   - Pin (713)
   - Detent lever (703)
   - Manual shaft (704)
   - Actuator rod (705)
2.
   - Driven sprocket support (602)
   - Thrust washer (605) (from direct clutch side)
3.
   - Plug (607) (Figure 27)
   - Band (606)

602	SUPPORT, DRIVEN SPROCKET
605	WASHER, THRUST – DRIVEN SPROCKET SUPPORT TO DIRECT CLUTCH HOUSING
701	ROD AND LEVER ASSEMBLY
703	LEVER ASSEMBLY, DETENT
704	SHAFT, MANUAL
713	PIN, MANUAL SHAFT/CASE RETAINING

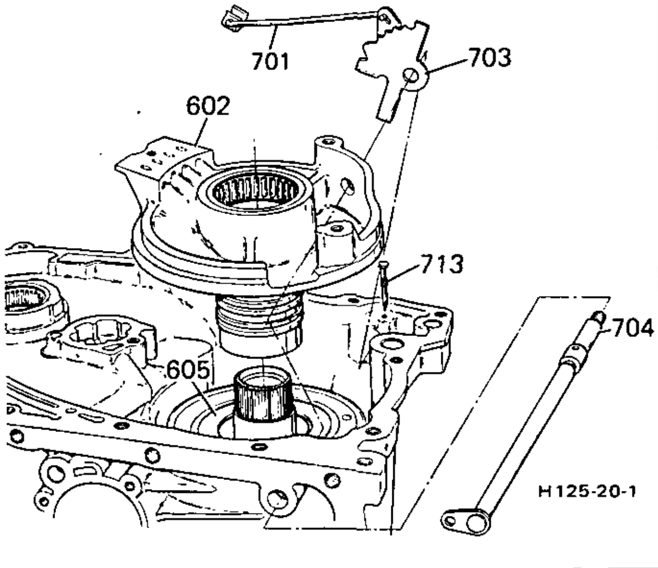
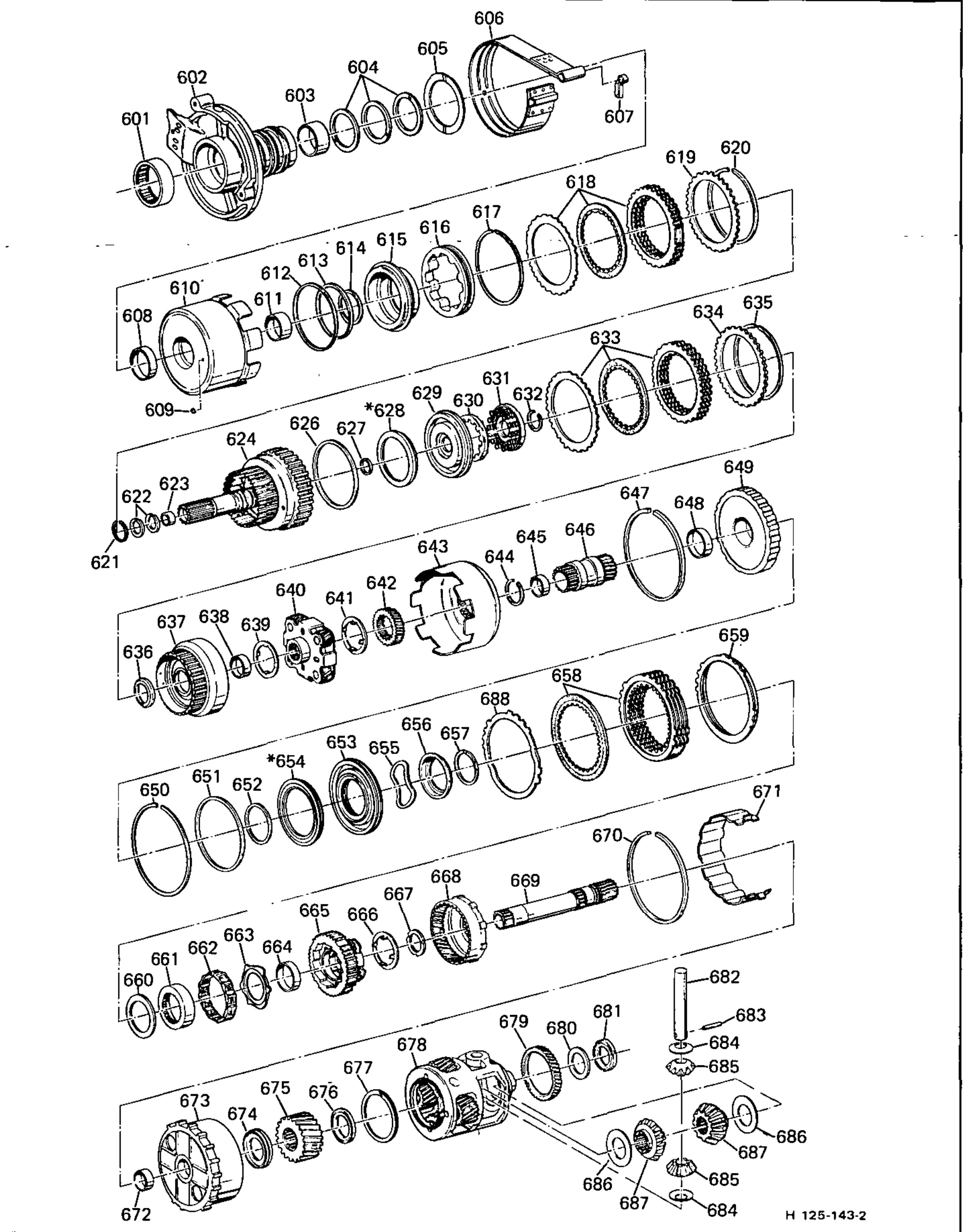


Figure 25 Removing Manual Linkage



*NOT REQUIRED WITH CAST ALUMINUM PISTON

Figure 26 Internal Components

ILL. NO.	DESCRIPTION
601	BEARING ASSEMBLY
602	SUPPORT ASSEMBLY, DRIVEN SPROCKET
603	BUSHING, DRIVEN SPROCKET SUPPORT
604	RING, OIL SEAL
605	WASHER, THRUST
606	BAND ASSEMBLY, INTERMEDIATE
607	PLUG, BAND ANCHOR HOLE
608	BUSHING, DIRECT CLUTCH
609	RETAINER & BALL ASM., CHECK VALVE
610	HOUSING & DRUM ASM., DIRECT CLUTCH
611	BUSHING, DIRECT CLUTCH DRUM
612	SEAL, DIRECT CLUTCH PISTON OUTER
613	SEAL, DIRECT CLUTCH CENTER
614	SEAL, DIRECT CLUTCH PISTON INNER
615	PISTON, DIRECT CLUTCH
616	APPLY RING & RELEASE SPRING ASM.
617	RING, SNAP
618	PLATE, DIRECT CLUTCH
619	PLATE, CLUTCH BACKING, DIRECT
620	RING, SNAP
621	SNAP RING, SELECTIVE
622	RING, OIL SEAL
623	BUSHING, INPUT SHAFT
624	HOUSING ASSEMBLY, FORWARD CLUTCH
626	SEAL, FORWARD CLUTCH PISTON OUTER
627	SEAL, FORWARD CLUTCH PISTON INNER
*628	INSERT
629	PISTON, FORWARD CLUTCH
630	GUIDE, RELEASE SPRING
631	RETAINER & SPRING ASM., FWD. CL.
632	RING, SNAP SPRING RETAINER
633	PLATE, FORWARD CLUTCH
634	PLATE, CLUTCH BACKING, FORWARD
635	RING, SNAP
636	WASHER, INPUT SHAFT THRUST
637	GEAR, AND INPUT INTERNAL
638	BUSHING, INPUT INTERNAL GEAR
639	WASHER, INPUT CARR./IP. INT. GR. THRUST
640	CARRIER ASSEMBLY, INPUT
641	WASHER, INPUT CARR./IP. SUN GR. THRUST
642	GEAR, INPUT SUN
643	DRUM, INPUT
644	RING, SNAP SELECT. INPUT DRUM/SUN GEAR
645	BUSHING, REACTION SUN GEAR
646	GEAR, REACTION SUN
647	RING, SNAP
648	BUSHING, LO & REVERSE CLUTCH HOUSING
649	HOUSING, LO AND REVERSE
650	RING, SNAP
651	SEAL, LO & REVERSE PISTON OUTER
652	SEAL, LO & REVERSE PISTON INNER
653	PISTON, LO AND REVERSE CLUTCH
*654	INSERT, LO & REVERSE CLUTCH PISTON
655	SPRING, LO & REVERSE CLUTCH RELEASE
656	RETAINER, LO & REVERSE CLUTCH SPRING
657	RING, SNAP
658	PLATE, LO & REVERSE CLUTCH
659	PLATE, LO & REVERSE CLUTCH BACKING
660	SPACER, REV. HOUSING/LO RACE SELECTIVE
661	RACE, LO ROLLER CLUTCH
662	ROLLER ASSEMBLY, LO CLUTCH
663	WASHER, REACTION CARR./INT. GR. THRUST
664	BUSHING, REACTION CARRIER
665	CARRIER ASSEMBLY, REACTION
666	WASHER, REACTION CARR./INT. GR. THRUST
667	BEARING, REACTION SUN/INT. GR. THRUST
668	GEAR, REACTION INTERNAL
669	SHAFT, FINAL DRIVE SUN GEAR
670	RING, SNAP
671	SPACER, FINAL DRIVE INTERNAL GEAR
672	BUSHING, FINAL DRIVE INTERNAL GEAR
673	GEAR, FINAL DRIVE INTERNAL
674	BEARING, THRUST SUN GEAR/INT. GEAR
675	GEAR, FINAL DRIVE SUN
676	BEARING, THRUST SUN GEAR/CARRIER
677	RING, SPIRAL RETAINING
678	DIFFERENTIAL, CARRIER
679	GEAR, GOVERNOR DRIVE
680	WASHER, DIFF. CARR./CASE SEL. THRUST
681	BEARING ASM., DIFF. CARR./CASE THRUST
682	SHAFT, DIFFERENTIAL PINION
683	PIN, DIFF. PINION SHAFT RETAINING
684	WASHER, PINION THRUST
685	PINION, DIFFERENTIAL
686	WASHER, DIFF. SIDE GEAR THRUST
687	GEAR, DIFFERENTIAL SIDE
688	PLATE, LO & REVERSE CLUTCH WAVED

*NOT REQUIRED WITH CAST ALUMINUM PISTON

LEGEND
H 125-143-2L

Figure 27L Legend

- Direct and forward clutch assemblies (610 - 624) by lifting input shaft

4. Thrust washer (636)
5.
   - Internal gear (637)
   - Carrier (640) thrust washer (641)
   - Input sun gear (642)
   - Input drum (643)

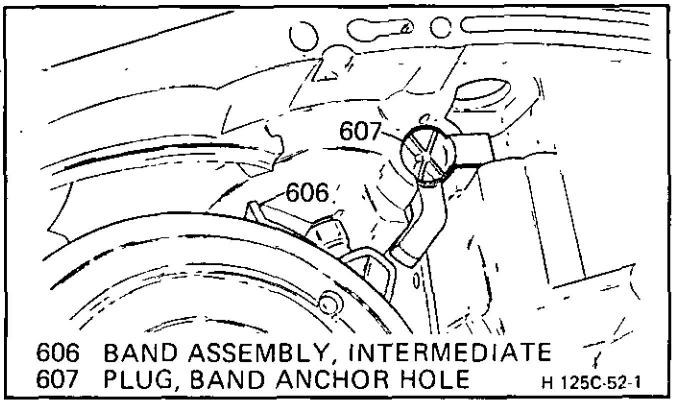


Figure 28 Band Anchor Hole Plug

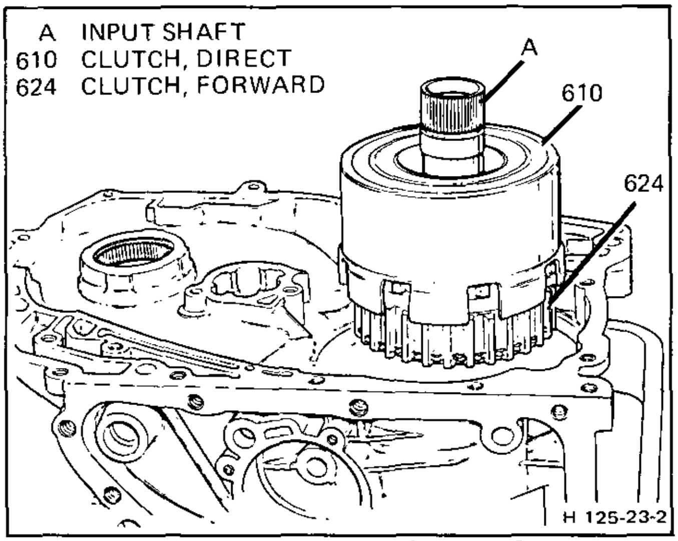


Figure 29 Removing Forward & Direct Clutches

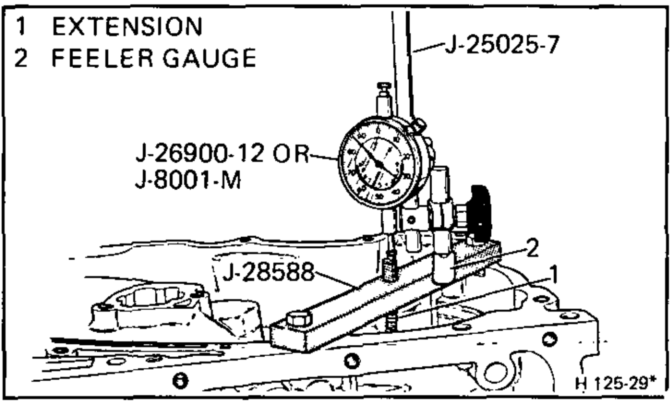


Figure 30 Selective Snap Ring End Play

REACTION SUN GEAR
TO INPUT DRUM
SELECTIVE SNAP RING
(644)

Thickness	Identification/Color
2.27 - 2.37mm (0.089" - 0.093")	Pink
2.44 - 2.54mm (0.096" - 0.100")	Brown
2.61 - 2.71mm (0.103" - 0.107")	Lt. Blue
2.78 - 2.88mm (0.109" - 0.113")	White
2.95 - 3.05mm (0.116" - 0.120")	Yellow
3.12 - 3.22mm (0.123" - 0.127")	Lt. Green
3.29 - 3.39mm (0.129" - 0.133")	Orange
3.46 - 3.56mm (0.136" - 0.140")	No Color

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Figure 31 Selective Snap Ring Chart

Reaction Sun Gear to Input Drum End Play

Measure (Figure 30 & 31)

Tools Required:
- J-26958 Loading tool
- J-26958-11 Bracket
- J-26958-10 Adapter plug
- J-28588 Gauge
- J-25025-7 Post
- J-26900-12 or J-8001M Dial indicator

1. Install tools as shown.
   - The loading tool should already be in place.
2. Position the gage extension between open ends of the snap ring (644). (Reaction sun gear (646) must be properly positioned.)
3. Swing the gage under the extension shoulder.
4. Zero the dial indicator.
5. Position the snap ring (644) under the extension.
6. Remove the gage from under the shoulder.
7. The dial indicator should read 0.33 to 0.13 mm (0.013" to 0.005"). – record the reading.

   For correct snap ring selection, See Figure 31. Measure washer thickness (new or old) with a micrometer.

Lo Roller Clutch Race Selective Spacer End Play

Measure (Figures 32 and 33)

1. Use tools from "Selective Snap Ring End Play Check".
2. Pry up on internal gear (668) with J-28585 – Do not pry against the spacer (671).
3. The dial indicator reading should be 0.08-1.17 mm (0. 003"-0.046"). Record reading.
   For correct washer selection see Figure 33.
4. Remove the dial indicator set and J-28588 gage.

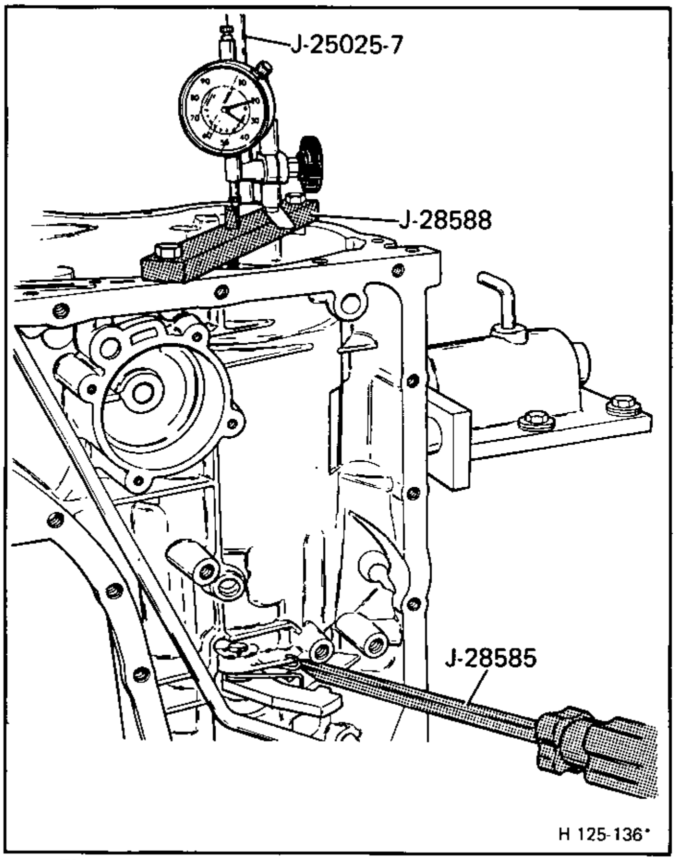

Figure 32 Lo Roller Clutch Race Selective Thrust Spacer

REACTION UNIT PARTS

Remove or Disconnect (Figures 25, 33, 34, 35 and 36)

Tool Required:
J-28542 Lo-Reverse Clutch Unit Remover and Installer

1. Sun gear (646)
2. Snap ring (644) – ring is 2.36 mm (0.092") thick
3. Lo reverse clutch housing (649) with J-28542
4. Snap ring (650)
5. Output carrier and roller clutch assemblies and lo reverse clutch plates (658 thru 668) by lifting shaft (669) (Figure 35).

REVERSE CLUTCH HOUSING
TO LO RACE SELECTIVE SPACER
(660)

Thickness	Identification
1.00 - 2.20mm (0.039" - 0.043")	1
1.42 - 1.52mm (0.056" - 0.060")	2
1.84 - 1.94mm (0.072" - 0.076")	3
2.26 - 2.36mm (0.089" - 0.093")	4
2.68 - 2.78mm (0.105" - 0.109")	5
3.10 - 3.20mm (0.122" - 0.126")	6

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Figure 33 Lo Race Selective Spacer Chart

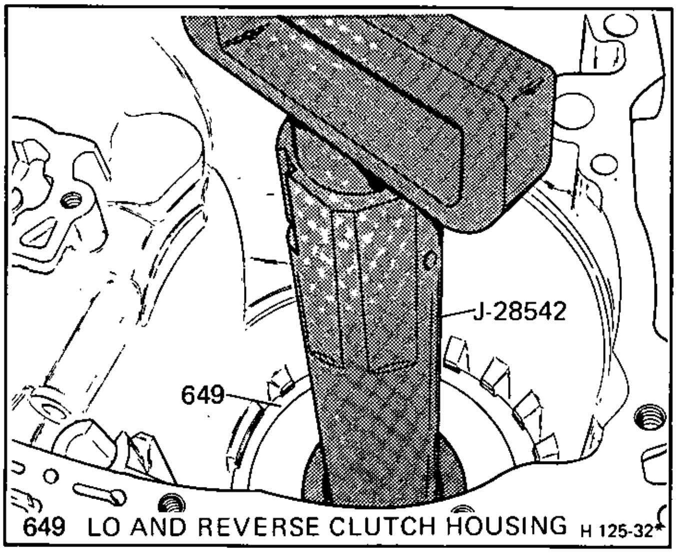


Figure 34 Removing the Lo & Reverse Clutch Housing

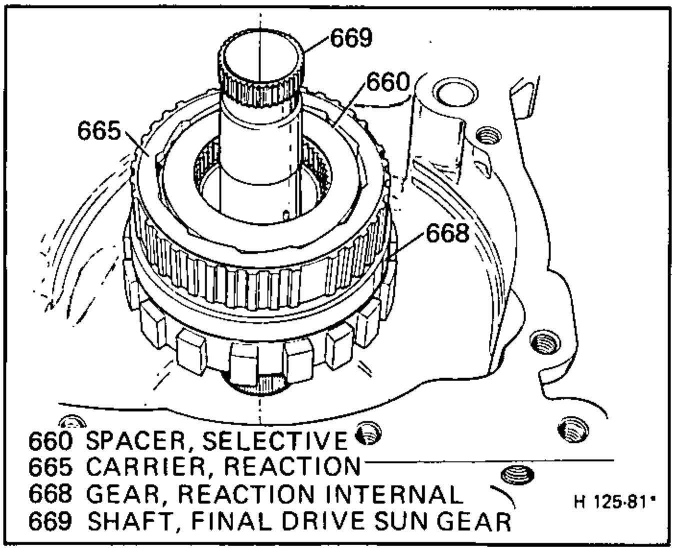
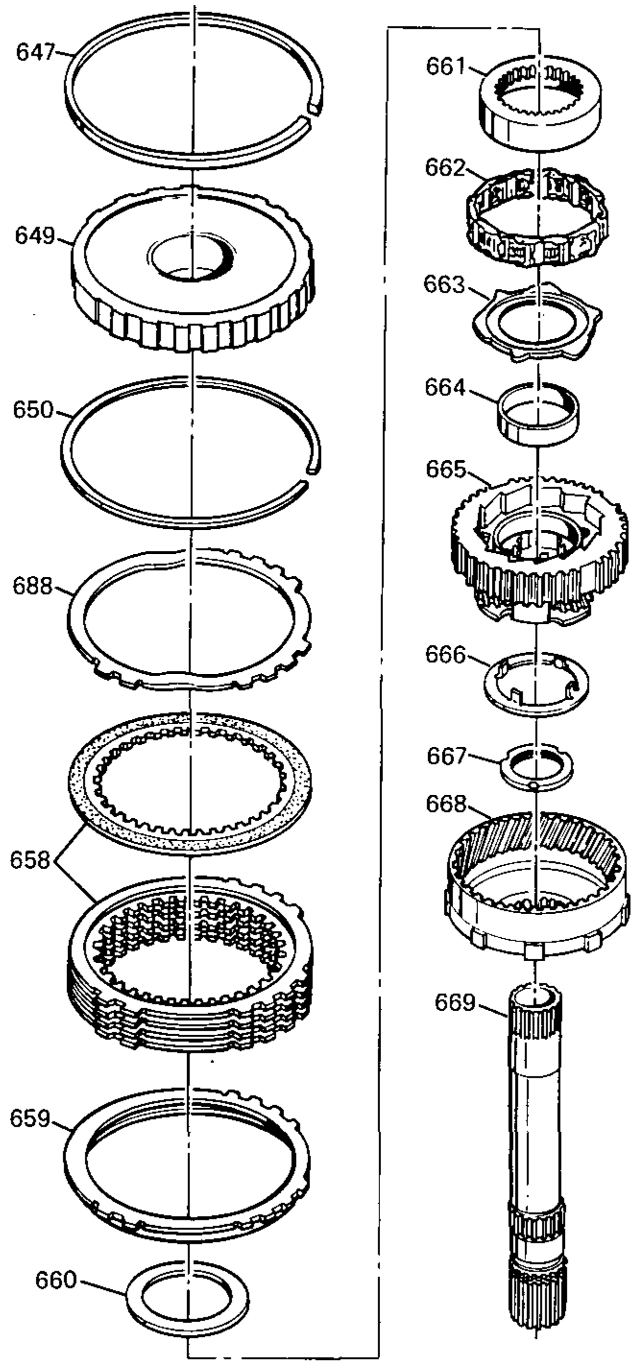


Figure 35 Removing Reaction Components



647	SNAP RING
649	HOUSING ASM., LO & REVERSE CLUTCH
650	RING, SNAP
658	PLATE, LO & REVERSE CLUTCH
659	PLATE, LO & REVERSE CLUTCH BACKING
660	SPACER, REV. HOUSING/LO RACE SELECTIVE
661	RACE, LO ROLLER CLUTCH
662	ROLLER ASSEMBLY, LO CLUTCH
663	WASHER, REACTION CARR./INT. GR. THRUST
664	BUSHING, REACTION CARRIER
665	CARRIER ASSEMBLY, REACTION
666	WASHER, REACTION CARR./INT. GR. THRUST
667	BEARING, REACTION SUN/INT. GR. THRUST
668	GEAR, REACTION INTERNAL
669	SHAFT, FINAL DRIVE SUN GEAR
688	PLATE, LO & REVERSE CLUTCH WAVED

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Figure 36 Reaction Components Disassembly

Disassemble (Figure 26 and 36)

- Clutch plates (658) & Backing plate (658)
- Roller clutch assembly (665)
- Internal gear (668)
- Shaft (669)

FINAL DRIVE ASSEMBLY

Measure (Figures 37, 38, 39 and 40)

Tools Required:

J-26958-10 Adapter
J-25025-7 Post
J-26900-12 or J-8001M Dial indiactor
J-28585 Snap ring remover

1. Remove J-26958 and J-26958-11. Leave J-26958-10 adapter in place.
2. Install the dial indicator set so that stem contacts the adapter.

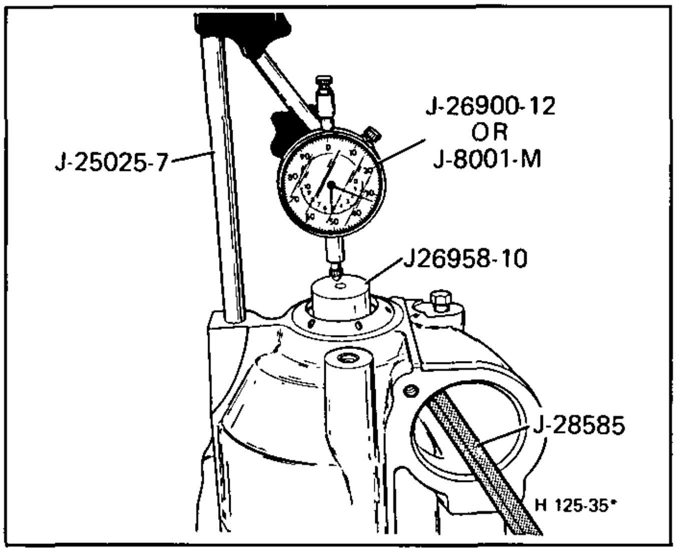

Figure 37 Final Drive End Play Selective Thrust Washer Measurement (680)

FINAL DRIVE TO CASE END PLAY
SELECTIVE THRUST WASHER (680)

THICKNESS	IDENTIFICATION NO./COLOR
1.40 - 1.50mm (0.055" - 0.059")	0/Orange
1.50 - 1.60mm (0.059" - 0.062")	1/White
1.60 - 1.70mm (0.062" - 0.066")	2/Blue
1.70 - 1.80mm (0.066" - 0.070")	3/Pink
1.80 - 1.90mm (0.070" - 0.074")	4/Brown
1.90 - 2.00mm (0.074" - 0.078")	5/Green
2.00 - 2.10mm (0.078" - 0.082")	6/Black
2.10 - 2.20mm (0.082" - 0.086")	7/Purple
2.20 - 2.30mm (0.086" - 0.091")	8/Purple & White
2.30 - 2.40mm (0.091" - 0.095")	9/Purple & Blue

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Figure 38 Final Drive End Play Chart

3. Lift up on the governor drive gear (679) with J-28585.
4. Reading on the dial indicator should be 0.12-0.82 mm (0.005"-0.032") – Record reading.
   For correct washer selection see Figure 37.
5. Remove the dial indicator set and the adpater.

Remove or Disconnect (Figures 26, 38, 39 and 48)

Tool Required:

J-28545 Final Drive Unit Remover and Installer

1. Snap ring (670) – Ring is 2.36 mm (0.092") thick.
2. Spacer (671)
3. Final drive assembly (673-688) with J-28545
4. Thrust bearing (681)
5. Selective washer (680)

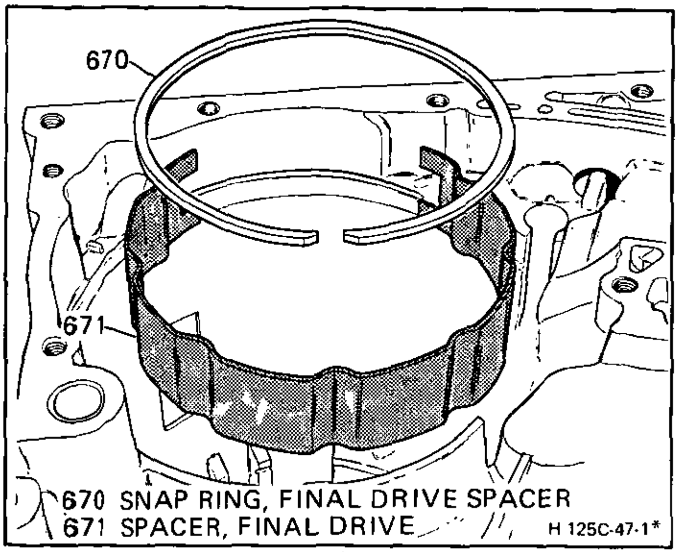


Figure 39 Final Drive Spacer & Snap Ring

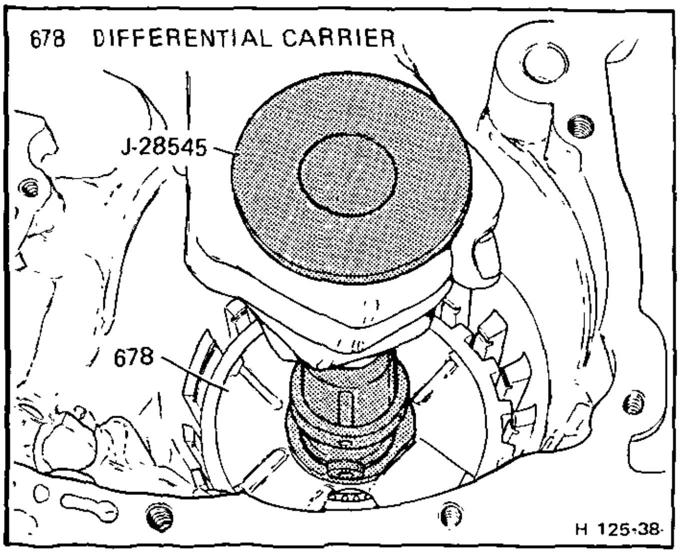


Figure 40 Removing Final Drive Assembly

CASE ASSEMBLY

Clean

- Case (112) thoroughly with solvent and air dry.

Inspect (Figure 40)

- Case – see Section 7A for Case Repair
  - Lug damage
  - Snap ring groove damage
  - Oil passage damage
  - Servo bore damage
  - Casting porosity
  - Stripped threads
- Case bushing (116) – for scoring
- Converter seal (115) – see drive sprocket support inspection replace
- Axle seal (117) – for damage

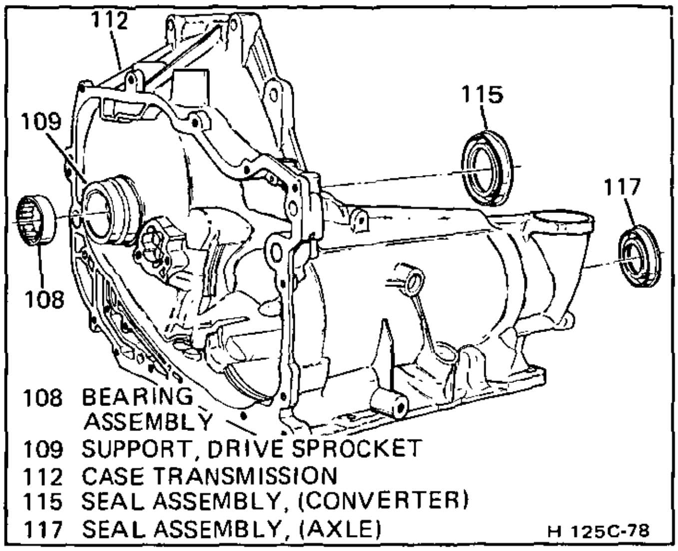


Figure 41 Axle Seals & Sprocket Bearing

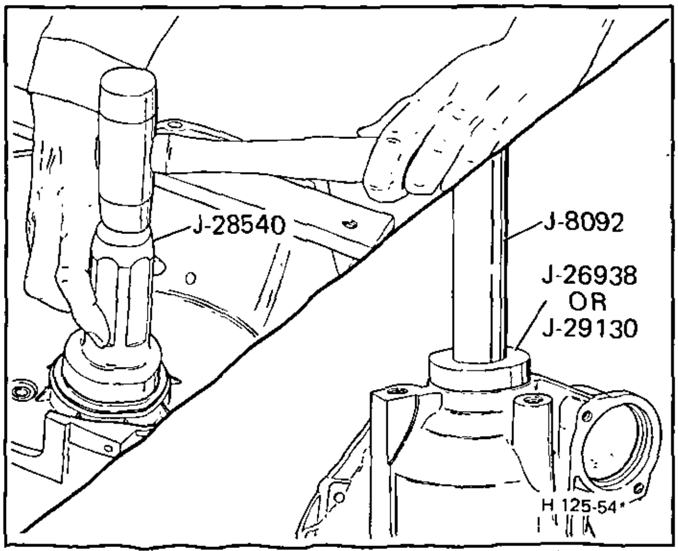


Figure 42 Converter Seal and Axle Seal Installation

Seal Replacement Procedure

Remove or Disconnect (Figure 41)

- Seal (115) or (117) – pry out

Install or Connect (Figure 42)

Tools Required:

J-26938 or J-29130 Axle Seal Installer
J-28540 Converter Seal Installer

- Seal (115) with J-28540
- Seal (117) with J-26938 or J-29130

Inspect (Figure 41)

- Drive sprocket support bearing (108)
  If new bearing is required be sure to inspect drive sprocket (106) race for damage or wear

Bearing Replacement Procedure

Remove or Disconnect (Figure 43)

Tools Required:

J-26941 Bearing puller
J-6125-1 or J-2619-01 Slide hammer
J-6471-8 Adapter

- Bearing (108) with J tools

Install or Connect (Figure 44)

Tools Required:

J-28677 Bearing Installer
J-8092 Handle

- Bearing (108) identification side up with J-28677 and J-8092

Inspect

- Drive sprocket support (109) for scoring

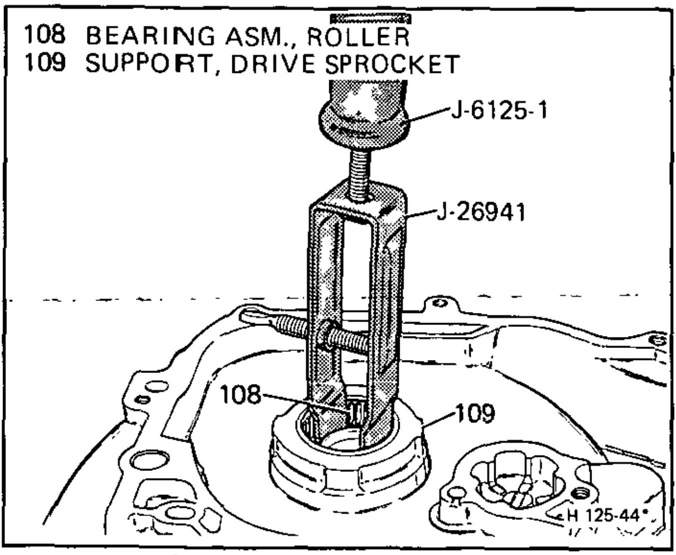


Figure 43 Removing Bearing

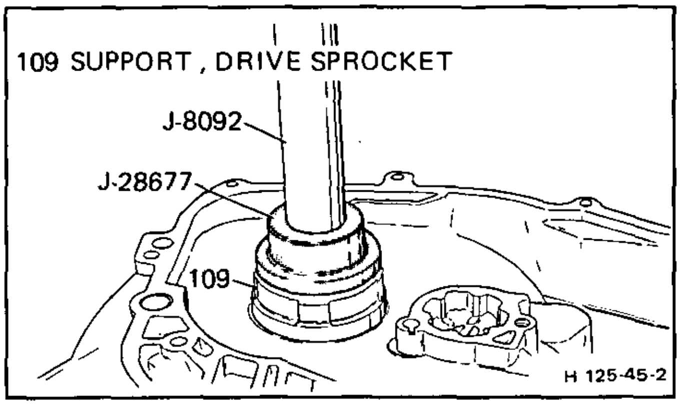


Figure 44 Installing Bearing

Support Replacement Procedure

Remove or Disconnect (Figure 45)

Tool Required:

J-25359-5 #40 Torx bit or equivalent

1. Converter oil seal (115)
2. Screws (114) with J-25359-5
3. Support (109) from case

Install or Connect (Figure 45)

1. Support (109) into case
2. Screws (114) – use thread locking compound

Tighten

Tools Required:

J-25259 #40 Torx bit or equivalent

- Screws (114) to 24 N·m (18 ft. lbs.) with J-25359-5

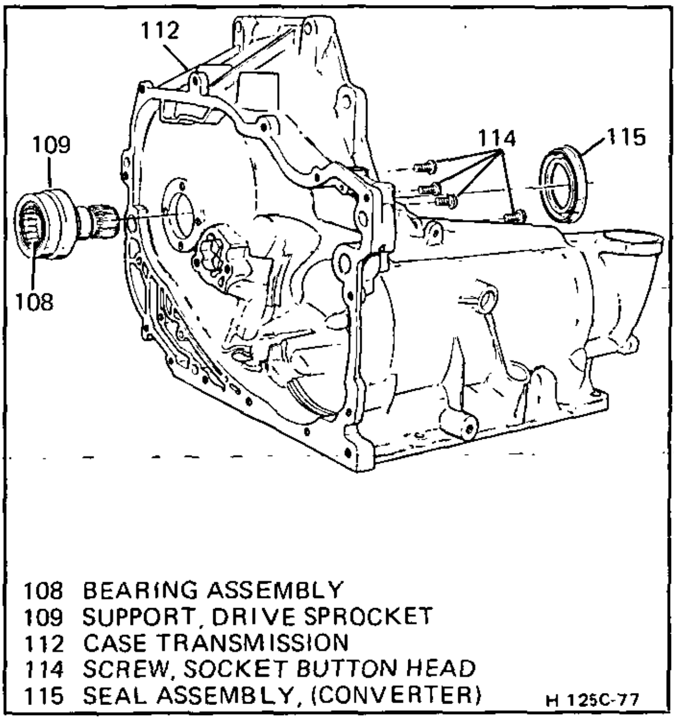


Figure 45 Sprocket Support Replacement

Inspect

- Parking pawl (706) for damage

Parking Pawl Replacement Procedure

Remove or Disconnect (Figure 46)

1. Cup plug with a screw extractor
2. Retainer (708)
3. Shaft (709)
4. Return spring (707)
5. Pawl (706)

Install or Connect

1. Return spring (707)
2. Pawl (706)
3. Shaft (709)
4. Retainer (708)
5. Cup Plug with a 9 mm (3/8″) rod

Inspect

- Governor pipe (138) for damage or cracks

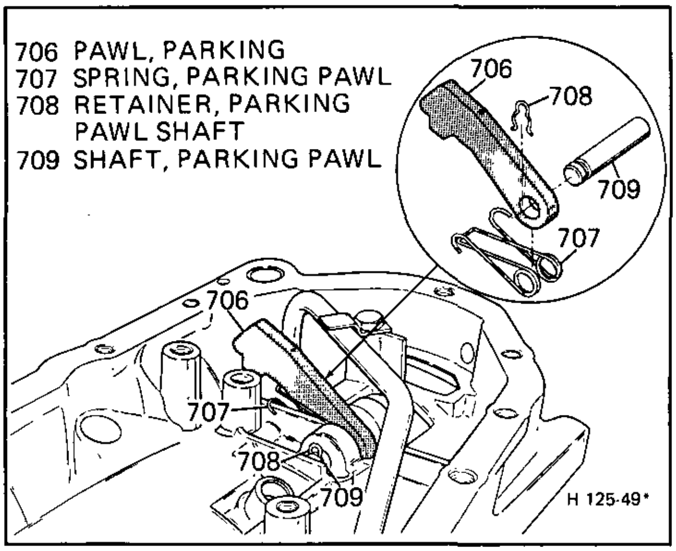


Figure 46 Parking Pawl

Governor Pipe Replacement Procedure

Remove or Disconnect (Figure 47)

Tool Required:
J-28585 Snap Ring Remover

- Pipe (138) with J-28585, pry out.
  Use particle board to protect case. Pipe is sealed in place.

Install or Connect

1. Coat both ends of the pipe (138) with loctite ® or equivalent.
2. Pipe (138) into case (112), tap gently with a soft mallet.
3. Retainer (143) and bolt (142) torque to 24 N·m (18 ft. lbs.)

Inspect

- 3rd oil cup plug (127) for cracks or loose fit

3rd Oil Cup Plug Replacement Procedure

Remove or Disconnect (Figure 48)

- Plug (127) – use #3 screw extractor with 13 mm (1/2″) ground off.

Install or Connect

- Plug (127) tap until seated in case – use a 6 mm (1/4″) rod.

Inspect

- Manual Shaft oil seal (113) for damage

Manual Shaft Replacement Procedure

Remove or Disconnect

- Seal (113) – pry out – check bore for burrs. Smooth with fine stone if necessary.

Install or Connect

- Seal (113) lip side up use 13 mm or 9/16″ socket – tap with mallet until seated.

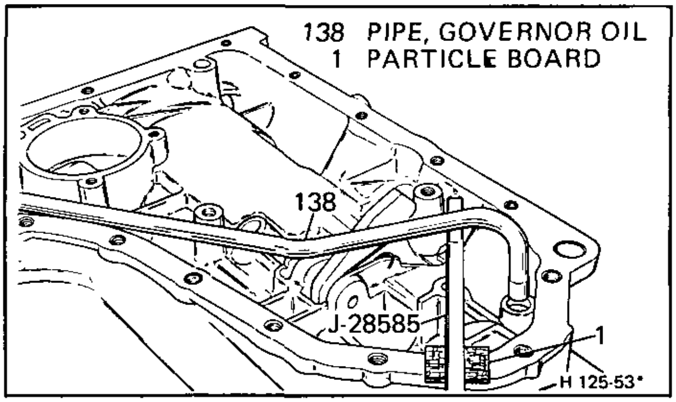


Figure 47 Governor Pipe Replacement

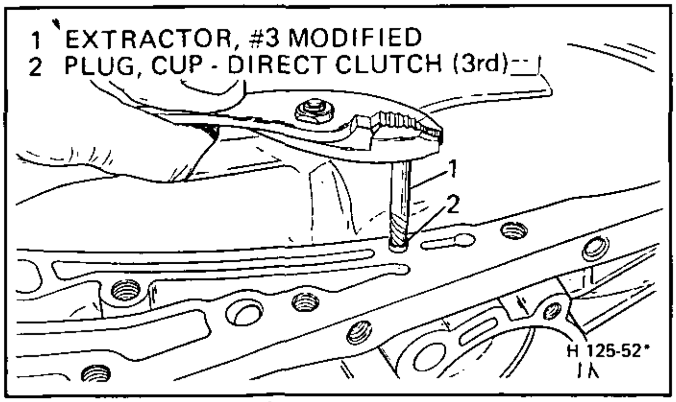
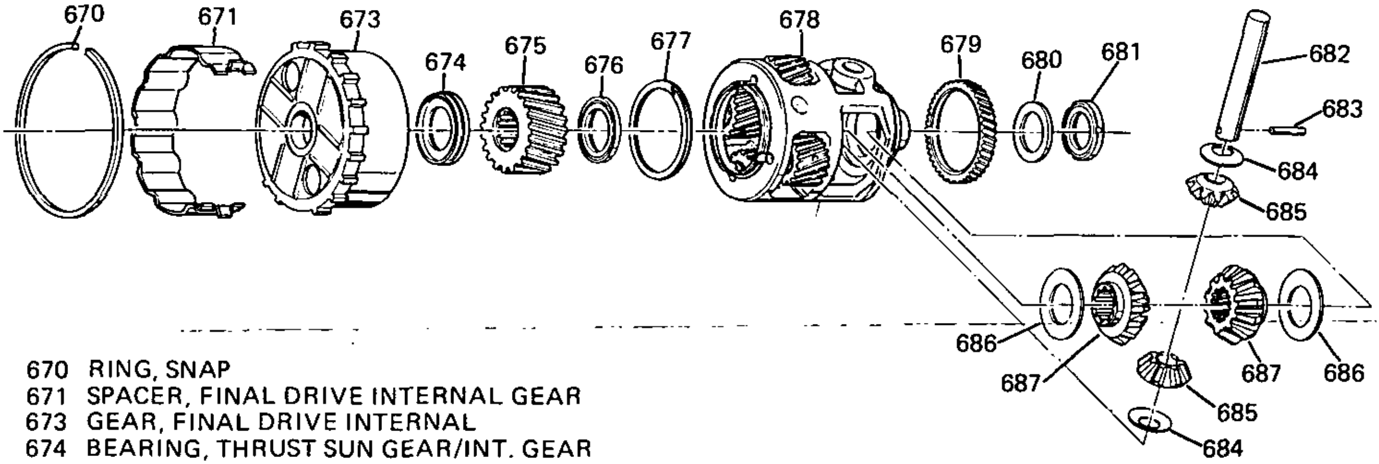


Figure 48 Cup Plug Removal



670 RING, SNAP
671 SPACER, FINAL DRIVE INTERNAL GEAR
673 GEAR, FINAL DRIVE INTERNAL
674 BEARING, THRUST SUN GEAR/INT. GEAR
675 GEAR, FINAL DRIVE SUN
676 BEARING, THRUST SUN GEAR/CARRIER
677 RING, SPIRAL RETAINING
678 DIFFERENTIAL, CARRIER
679 GEAR, GOVERNOR DRIVE
680 WASHER, DIFF. CARR./CASE SEL. THRUST
681 BEARING ASM., DIFF. CARR./CASE THRUST
682 SHAFT, DIFFERENTIAL PINION
683 PIN, DIFF. PINION SHAFT RETAINING
684 WASHER, PINION THRUST
685 PINION, DIFFERENTIAL
686 WASHER, DIFF. SIDE GEAR THRUST
687 GEAR, DIFFERENTIAL SIDE

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Figure 49 Final Drive Assembly

DIFFERENTIAL AND FINAL DRIVE

Disassemble (Figure 49)

1. Internal gear (673)
2. Thrust bearing (674)
3. Sun gear (675)
4. Thrust bearing (676)

1 FEELER GAGE
2 PINION, FINAL DRIVE
678 DIFFERENTIAL CARRIER

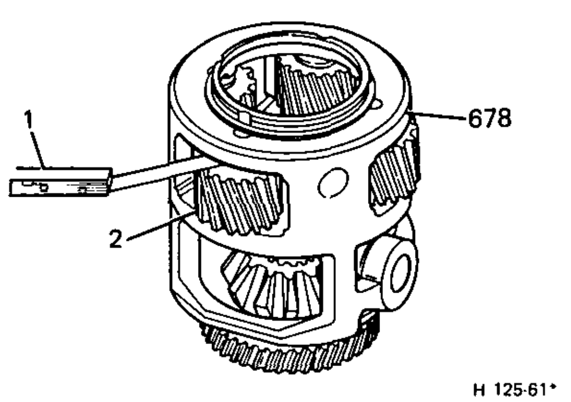

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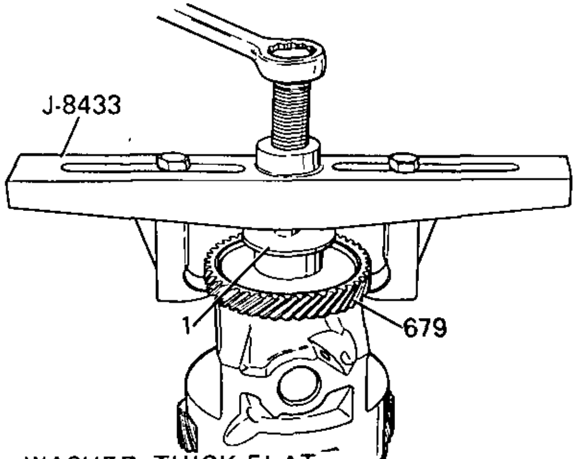
Figure 50 Final Drive Pinion End Play

Inspect (Figure 50)

- Final drive pinions (678) for damage
  - Excessive end play - with a feeler gage

End play range – 0.24 - 0.63 mm (0.009"-0.025")

- Internal gear (673) for damaged teeth or bearing surface
- Thrust bearing (674) for damage
- Sun gear (675) for damaged teeth or bearing surfaces
- Thrust bearing (676) for damage
- Governor drive gear (679) for wear



1 WASHER, THICK FLAT
679 GEAR, GOVERNOR DRIVE

H 125-56*

Figure 51 Governor Drive Gear Replacement

Governor Drive Gear Replacement

Remove or Disconnect (Figure 51)

Tool Required:
J-8433 Puller

- Governor drive gear (678) with J-8433 – place a thick flat washer or other protection on the hub to avoid damage

Install or Connect

- Drive gear – tap into position with a soft mallet.

Inspect (Figure 49)

- Pinions (685) and side gears (687) for damaged teeth

Pinion Gear Replacement Procedure

Disassemble (Figures 49 and 52)

- Retaining pin (683) use a pin punch as shown
- Pinion shaft (682)
- Pinions (685), side gears (687) and washers (684 and 686)

Inspect (Figure 49)

- Washers (684 and 686) and carrier for damage

Assemble (Figure 49)

1. Side gears (687) and washer (686) into carrier
2. Pinion thrust washer (684) to pinions (685), *retain with petrolatum*
3. Pinions and thrust washers into carrier
4. Pinion shaft (682), slide through both pinions for alignment, then remove.
5. Rotate pinions into position, then replace shaft (682)
6. Retaining pin (683)

Assemble (Figure 49)

1. Thrust bearing (676) into carrier
2. Sun gear (675) stepped side facing up
3. *Thrust bearing (674) outside race to internal gear*
4. Internal gear (673) onto carrier

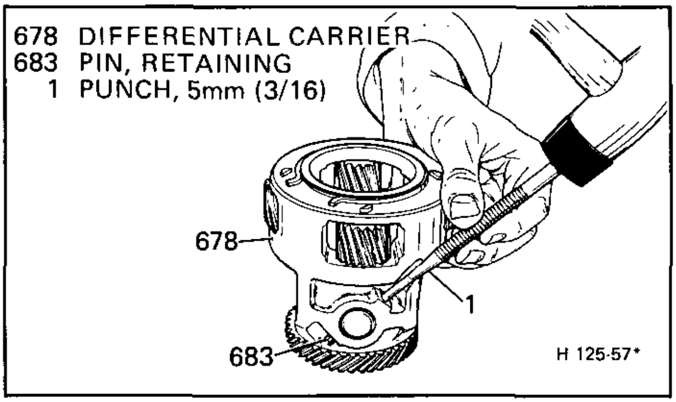


Figure 52 Pinion Shaft Retaining Pin

Install or Connect (Figure 52)

Tool Required:
J-28545 Final Drive Remover and Installer

1. Thrust washer (680) onto carrier assembly, retain with petrolatum

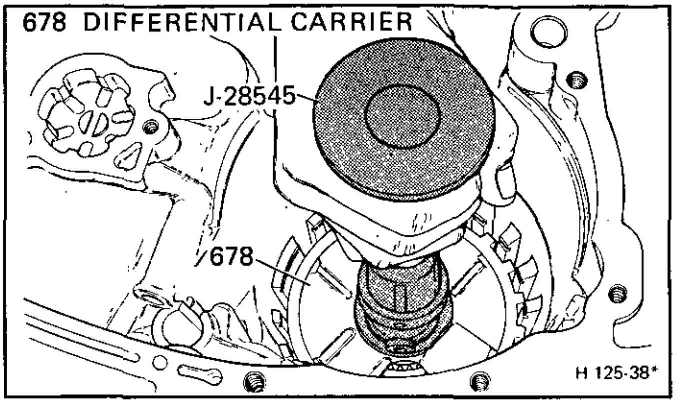


Figure 53 Installing the Final Drive Assembly

2. Thrust bearing (681) onto carrier assembly, inner race toward carrier, retain with petrolatum
3. Carrier assembly into case with J-28545

Inspect

- Spacer (671) for damage
- Snap ring (670) for damage

Install or Connect (Figure 49)

1. Spacer (671) into the transmission case

Important

The spacer (671) must fit into the case so that the parking pawl operates freely.

2. Snap ring into the snap ring groove.

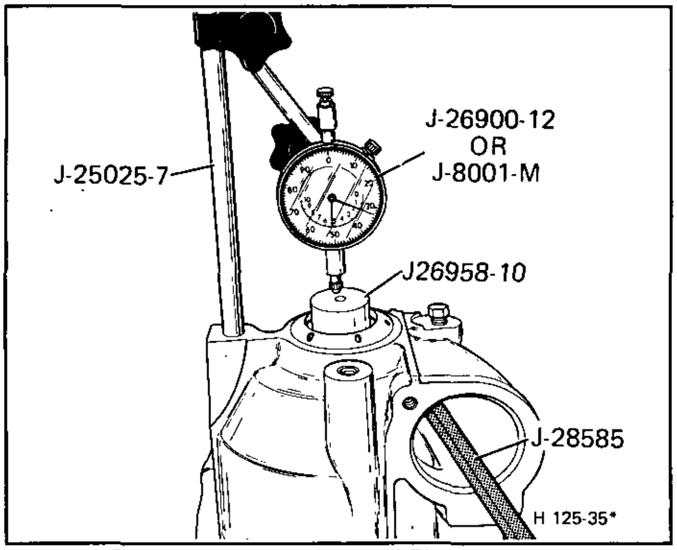


Figure 54 Final Drive End Play Selective Thrust Washer Measurement (680)

Final Drive to Case End Play

Measure (Figures 54 and 55)

Tools Required:
J-26958-10 Adapter
J-25025-7 Post
J-26900-12 or J-800/M Dial indicator
J-28585 Snap ring remover

1. Install the dial indicator set so that stem contacts the adapter.
2. With J-28585 through the governor bore, lift up on the governor drive gear (679).

FINAL DRIVE TO CASE END PLAY
SELECTIVE THRUST WASHER (680)

THICKNESS	IDENTIFICATION NO./COLOR
1.40 - 1.50mm (0.055" - 0.059")	0/Orange
1.50 - 1.60mm (0.059" - 0.062")	1/White
1.60 - 1.70mm (0.062" - 0.066")	2/Blue
1.70 - 1.80mm (0.066" - 0.070")	3/Pink
1.80 - 1.90mm (0.070" - 0.074")	4/Brown
1.90 - 2.00mm (0.074" - 0.078")	5/Green
2.00 - 2.10mm (0.078" - 0.082")	6/Black
2.10 - 2.20mm (0.082" - 0.086")	7/Purple
2.20 - 2.30mm (0.086" - 0.091")	8/Purple & White
2.30 - 2.40mm (0.091" - 0.095")	9/Purple & Blue

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Figure 55 Final Drive End Play Chart

3. Reading on the dial indicator should be 0.12-0.82 mm (0.005"-0.032") For correct washer selection, see Figure 54.
4. Remove the dial indicator set and the adapter. Leave the adapter in place.
5. Install J-26958 and J-26958-11 – turn knob until it bottoms.

REACTION CARRIER ASSEMBLY

Inspect (Figure 56 and Figure 26)

- Sun gear shaft (669) for damage or wear
- Internal gear (668) for damage or wear
- Thrust bearing (667) for damage or wear

Assemble

1. Internal gear (668) onto sun gear shaft (669)
2. Thrust bearing (667) – inner race against internal gear (668)

LO ROLLER CLUTCH ASSEMBLY

Disassemble (Figure 56)

1. Selective washer (660)
2. Race (661)
3. Clutch assembly (662)
4. Lo race thrust washer (663)
5. Reaction carrier thrust washer (666)

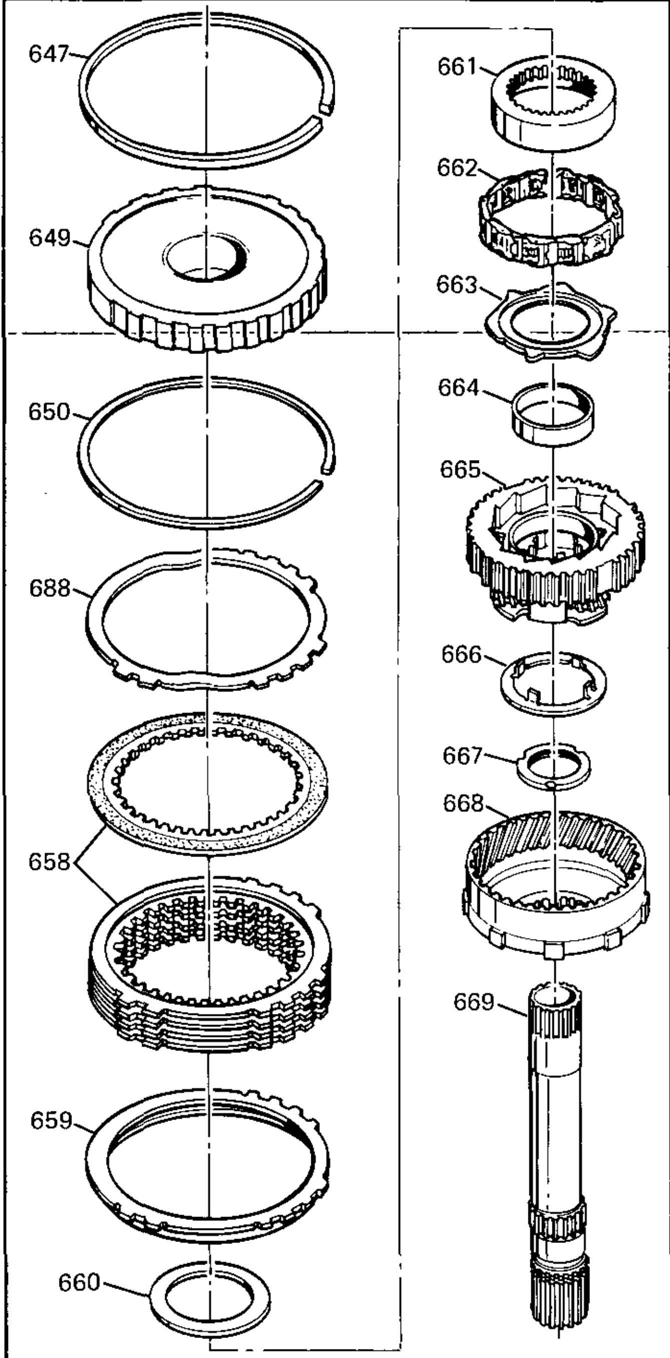
Inspect

- Selective spacer (660) for damage
- Lo roller clutch cam (665)
- Carrier bushing (664) for damage
- Reaction carrier pinions (665) for damage, rough bearings or tilt

Measure

- Pinions (665 – end play with feeler gage – end play range 0.24-0.69 mm (0.009"-0.027").

Inspect (Figure 56 and Figure 26)



647	SNAP RING
649	HOUSING ASM., LO & REVERSE CLUTCH
650	RING, SNAP
658	PLATE, LO & REVERSE CLUTCH
659	PLATE, LO & REVERSE CLUTCH BACKING
660	SPACER, REV. HOUSING/LO RACE SELECTIVE
661	RACE, LO ROLLER CLUTCH
662	ROLLER ASSEMBLY, LO CLUTCH
663	WASHER, REACTION CARR./INT. GR. THRUST
664	BUSHING, REACTION CARRIER
665	CARRIER ASSEMBLY, REACTION
666	WASHER, REACTION CARR./INT. GR. THRUST
667	BEARING, REACTION SUN/INT. GR. THRUST
668	GEAR, REACTION INTERNAL
669	SHAFT, FINAL DRIVE SUN GEAR
688	PLATE, LO & REVERSE CLUTCH WAVED

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Figure 56 Reaction Components

- Clutch race (661) for damage, cracks or wear

- Rollers, springs and cage (662) for damage or wear
- Carrier (4 tanged) thrust washer (665) for scoring or distortion

Assemble (Figure 56 and Figure 26)

1. Thrust washer (663) into carrier assembly (665)
2. Rollers, into cage (662)
3. Clutch assembly (662)
4. Clutch race (661) – rotate into place.
5. Tanged thrust washer (666) – use petrolatum to hold in position.
6. Carrier (665) and clutch assembly into internal gear (668)
7. Selective spacer (660)
8. Reaction gear set (660-669) into case
   Make sure gear set does not contact spacer (671).

LO AND REVERSE CLUTCH PLATES

Inspect (Figure 56)

- Backing plate (659) for damage or cracks
- Lo and reverse clutch composition and steel plates (658) for wear or burning

Install or Connect (Figure 56 and Figure 70)

1. Backing plate (659) stepped side down into case
2. Lubricant on composition plates (658) before installation
3. Alternate composition plate first, then steel plate (See Figure 70)
4. Waved steel plate
5. Spacer ring (650) – ring is 1.07 mm (0.042") thick

LO AND REVERSE CLUTCH HOUSING

Disassemble (Figure 57)

1. Snap ring (656) – push down on spring retainer (657).
2. Waved spring (655)
3. Clutch piston (653)
4. Inner (652) and outer (651) seals from piston (653)

Inspect (Figure 57)

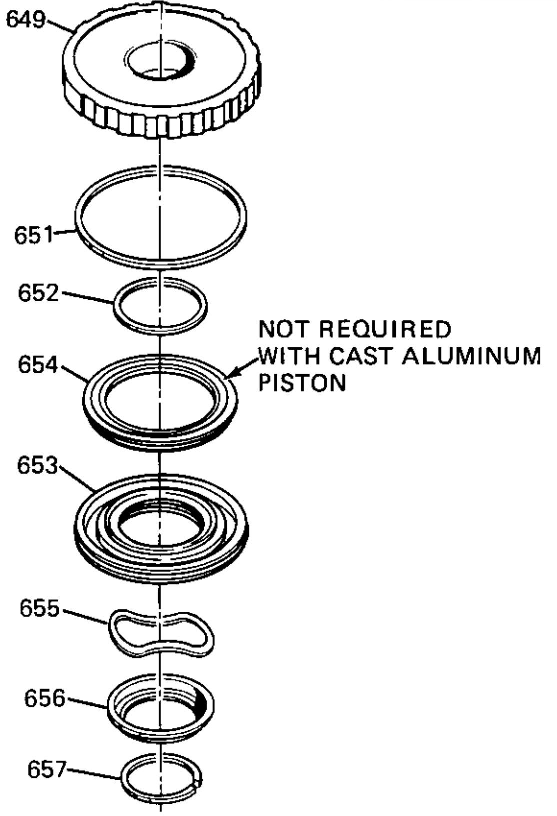
- Waved spring (655) for damage
- Inner (652) and outer (651) seals for nicks or rolling
- Clutch housing (649) for damage or plugged feed hole
- Clutch housing bushing for damage, cracks or scoring
- Clutch piston (653) for distortion, cracks or damage

Assemble (Figures 57, 58 and 59)

1. Seals (651 and 652) onto piston (653)
2. Piston (653) – with J-26744-A inner seal (652) first, then outer seal
3. Waved spring (655)
4. Retainer (656) – cupped side down
5. Snap ring (657) – push down on spring retainer (656).

FUNCTIONAL CHECK

Apply air (max 90 psi) to feed hole. Piston must apply and release when pressure is removed.



649	HOUSING, LO AND REVERSE
651	SEAL, LO AND REVERSE PISTON OUTER
652	SEAL, LO AND REVERSE PISTON INNER
653	PISTON, LO AND REVERSE CLUTCH
654	INSERT, OIL DISPLACEMENT
655	SPRING, LO & REVERSE CLUTCH RELEASE
656	RETAINER, LO & REVERSE CLUTCH SPRING
657	RING, SNAP

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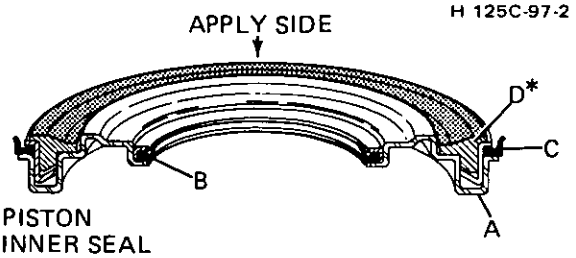
Figure 57 Lo & Reverse Clutch Assembly

Install or Connect (Figure 61)

1. Lo and reverse clutch housing (649) with J-28542 into case
   - Align the clutch housing oil feed hole with the case feed hole.

     If housing (649) does not go past snap ring groove – remove J-28542 and install sun gear (646). Rotate sun gear back and forth until the housing is properly positioned. Loosen J-26958 as needed.
2. Snap ring (647) – ring is 2.36 mm (0.092") thick.



A PISTON
B INNER SEAL
C OUTER SEAL
D OIL DISPLACEMENT INSERT*
*NOT REQUIRED WITH CAST ALUMINUM PISTON

Figure 58 Typical Lo & Rev. Clutch Apply Piston

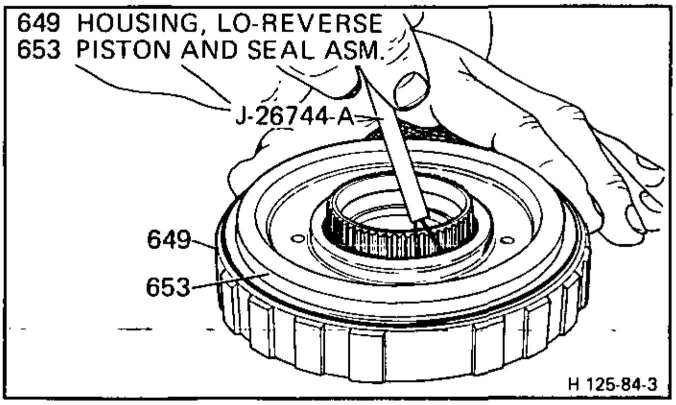


Figure 59 Installing the Lo & Reverse Piston

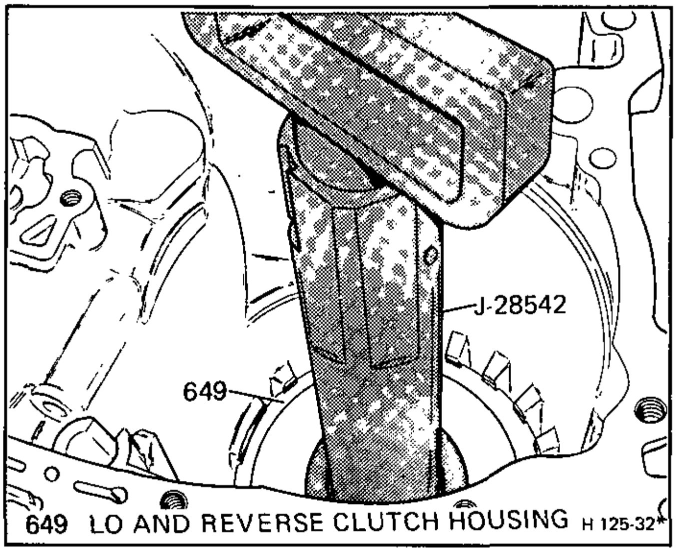


Figure 60 Installing the Lo & Reverse Clutch

REACTION SUN GEAR

Inspect (Figure 65)

- Reaction sun gear (646) for cracks, splits, damaged splines, worn gear or journal and plugged lubrication holes.

Install or Connect

- Sun gear (646) and selective snap ring (644).

Selective Snap Ring End Play

Measure (Figures 61 and 62)

Tools Required:
J-26958 Loading tool
J-26958-11 Bracket
J-26958-10 Adapter plug
J-28588 Gage
J-25025-7 Post
J-26900-12 or J-8001M Dial indicator

1. Install the tools as shown.
   - The loading tool should still be in place.
2. Seat sun gear (646).
3. Position the gage extension between open ends of snap ring (644).
4. Swing the gage under the extension shoulder.
5. Set the dial indicator at zero.
6. Position the snap ring (644) under extension shoulder.
7. Remove the gage from under the shoulder.
8. The dial indicator should read 0.33 to 0.13 mm (0.013" to 0.005"). If not within tolerances, for correct selection see Figure-62 (Measure-washer thickness (new or used) with micrometer).

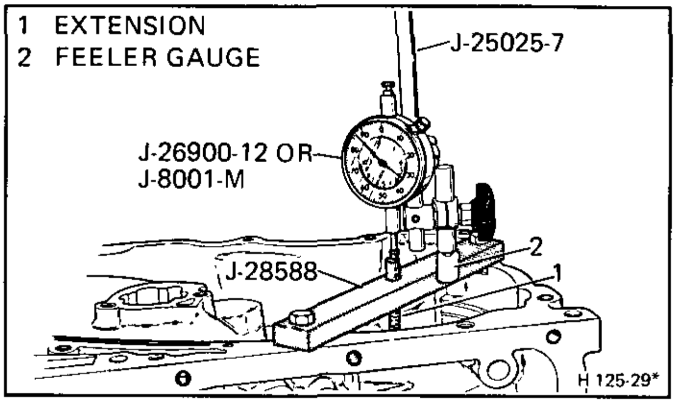


Figure 61 Selective Snap Ring End Play (Sun Gear/Input Drum)

REACTION SUN GEAR
TO INPUT DRUM
SELECTIVE SNAP RING
(644)

Thickness	Identification/Color
2.27 - 2.37mm (0.089" - 0.093")	Pink
2.44 - 2.54mm (0.096" - 0.100")	Brown
2.61 - 2.71mm (0.103" - 0.107")	Lt. Blue
2.78 - 2.88mm (0.109" - 0.113")	White
2.95 - 3.05mm (0.116" - 0.120")	Yellow
3.12 - 3.22mm (0.123" - 0.127")	Lt. Green
3.29 - 3.39mm (0.129" - 0.133")	Orange
3.46 - 3.56mm (0.136" - 0.140")	No Color

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Figure 62 Selective Snap Ring Chart

Lo Roller Clutch Race Selective Spacer End Play

Measure (Figures 63 and 64)

Tools Required:
Tools from previous measurement check
J-28585 Snap Ring Remover

1. Leave tools from "Selective Snap Ring End Play Check" in place.
2. Pry up on internal gear (668) with J-28585 – Do not pry against spacer (671).

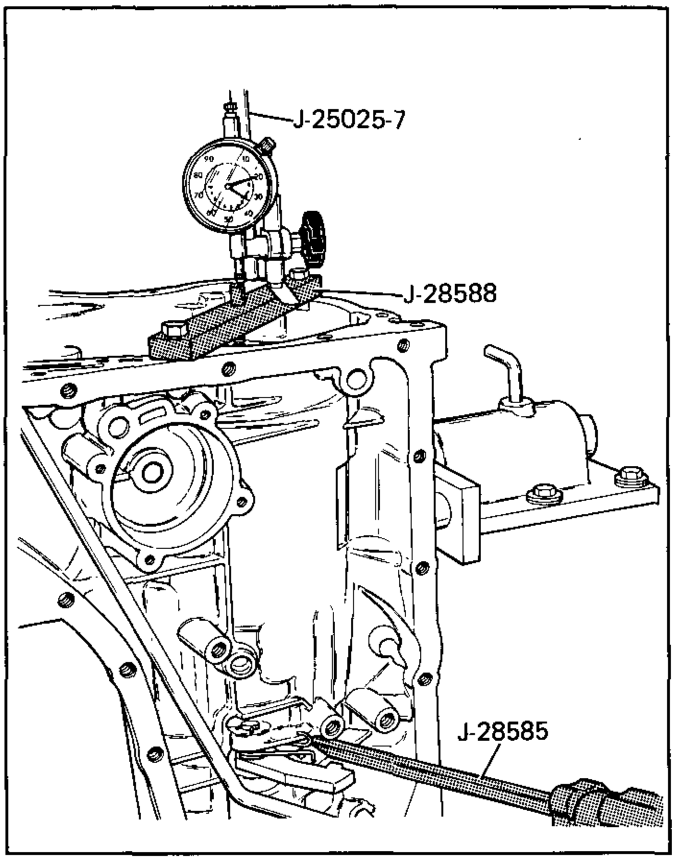

Figure 63 Lo Roller Clutch Race Selective Spacer

REVERSE CLUTCH HOUSING
TO LO RACE SELECTIVE SPACER
(660)

Thickness	Identification
1.00 - 2.20mm (0.039" - 0.043")	1
1.42 - 1.52mm (0.056" - 0.060")	2
1.84 - 1.94mm (0.072" - 0.076")	3
2.26 - 2.36mm (0.089" - 0.093")	4
2.68 - 2.78mm (0.105" - 0.109")	5
3.10 - 3.20mm (0.122" - 0.126")	6

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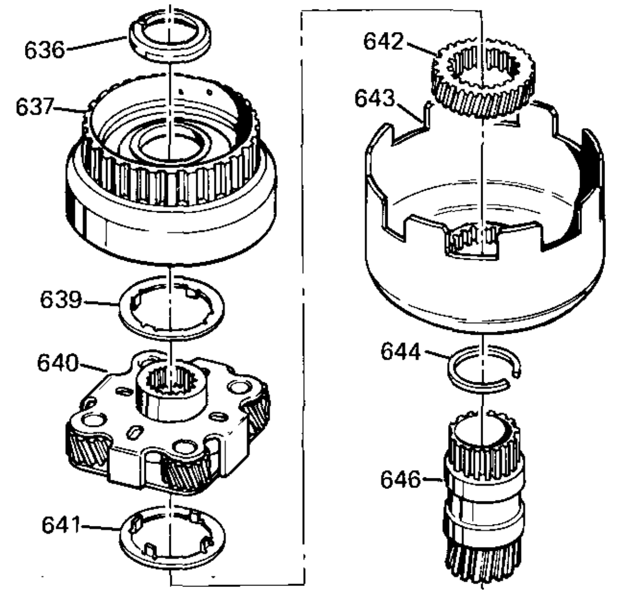
Figure 64 Lo Race Selective Spacer Chart

3. Dial indicator reading should be 0.08-1.17 mm (0. 003"-0.046"). For correct washer selection see Figure 64.
4. Remove the dial indicator set and J-28588.

INPUT UNIT PARTS

Inspect (Figure 65)

- Drum (643) for damage
- Thrust washer (641) for damage
- Carrier assembly (640) for
  - Pinion damage
  - Pinion tilt
  - Pinion end play – use the feeler gages – end play range 0.24-0.69 mm (0.009"-0.027")
- Thrust washer (639) for damage



636	WASHER, INPUT SHAFT THRUST
637	GEAR, INPUT INTERNAL
639	WASHER, INPUT CARR./IP. INT. GR. THRUST
640	CARRIER ASSEMBLY, INPUT
641	WASHER, INPUT CARR./IP. SUN GR. THRUST
642	GEAR, INPUT SUN
643	DRUM, INPUT
644	RING, SNAP SELECTIVE INPUT DRUM/SUN GR.
646	GEAR, REACTION SUN

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Figure 65 Input Components

- Internal gear (637) for gear tooth damage, clutch hub damage or scored bearing surfaces
- Sun gear (642) for damaged teeth or bearing surface

Assemble (Figure 65)

1. Drum (643) onto the reaction sun gear (646) in the case
2. Input sun gear (642) I.D. groove facing up onto the reaction sun gear (646)
3. Tanged thrust washer (641) onto the carrier assembly (640) – retain with petrolatum.
4. Carrier assembly (640) onto the sun gear (642) – sun gear must engage the pinions.
5. Thrust washer (639)
6. Internal gear (637)

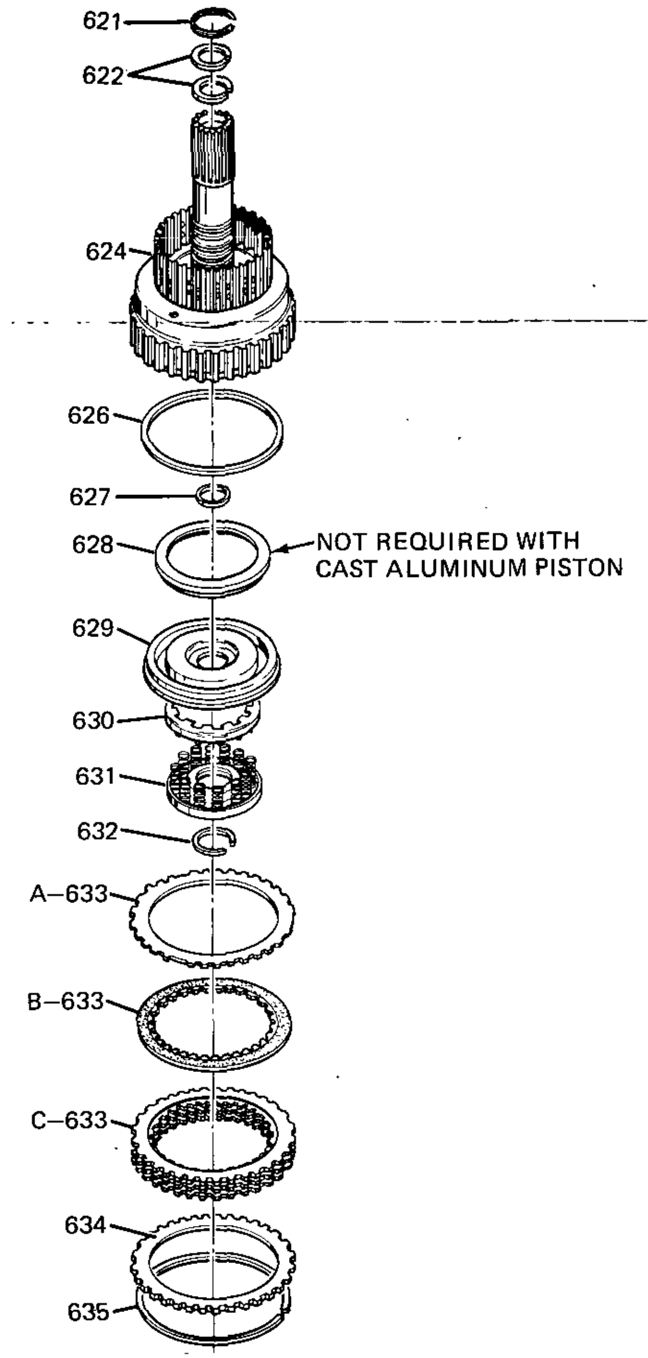
FORWARD CLUTCH ASSEMBLY

Disassemble (Figures 66 and 67)

Tools Required:
Arbor Press or J-23456 Clutch Pack Compressor

1. Snap ring (635) from clutch housing (624)
2. Backing plate (634)
3. Steel and composition clutch plates (633)
4. Snap ring (632) – use an arbor press or J-23456.
5. Retainer and spring assembly (631) and guide (630)
6. Piston (629)
7. Insert (628)
8. Piston seals (626 and 627)

Inspect (Figure 66)



621	SNAP RING, SELECTIVE
622	RING, OIL SEAL
624	HOUSING ASSEMBLY, FORWARD CLUTCH
626	SEAL, FORWARD CLUTCH PISTON OUTER
627	SEAL, FORWARD CLUTCH PISTON INNER
628	INSERT
629	PISTON, FORWARD CLUTCH
630	GUIDE, RELEASE SPRING
631	RETAINER & SPRING ASM., FWD. CL.
632	RING, SNAP SPRING RETAINER
A–633	WAVED STEEL PLATE
B–633	COMPOSITION FACED PLATE
C–633	ALTERNATING STEEL & COMP. PLATES
634	PLATE, CLUTCH BACKING, FORWARD
635	RING, SNAP

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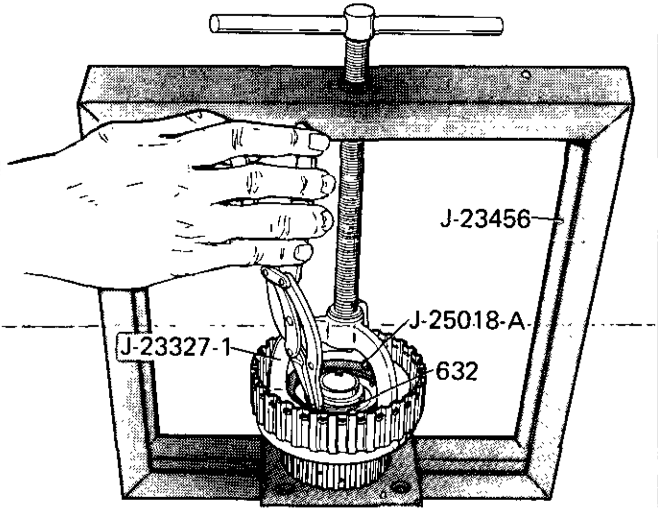
Figure 66 Forward Clutch Assembly



632 RING, SNAP- SPRING RETAINER

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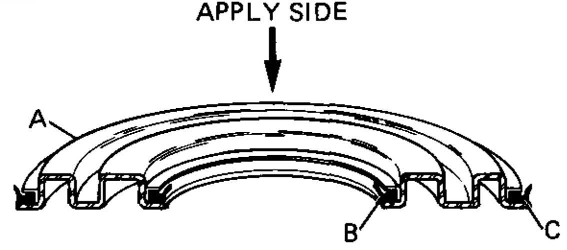
Figure 67 Forward Clutch Disassembly

- Forward clutch housing (624) for cracks, broken welds
- Input shaft (A) splines and journals for damage
- Input sleeve for damage, alignment and tightness – sleeve must not turn and slot must line up with input shaft hole.
- Seal rings (622) for damage – do not remove unless replacing.
- Piston (629) for damage or cracks
- Snap ring (621) for damage
- Insert (628) for damage
- Spring guide (630) for damage or distortion
- Retainer and spring assembly (631) for collapsed springs or bent retainer
- Composition and steel plates for wear or burning
- Waved steel plate (633) for wear or burning - flatness
- Backing plate (634) for damage or cracks



A PISTON
B INNER SEAL
C OUTER SEAL

H 125C-82

Figure 68 Typical Apply Piston

Assemble (Figures 66, 67, 68, 69, and 70)

Tools Required:

J-26744-A Seal Installer

J-23456 Clutch Pack Compressor

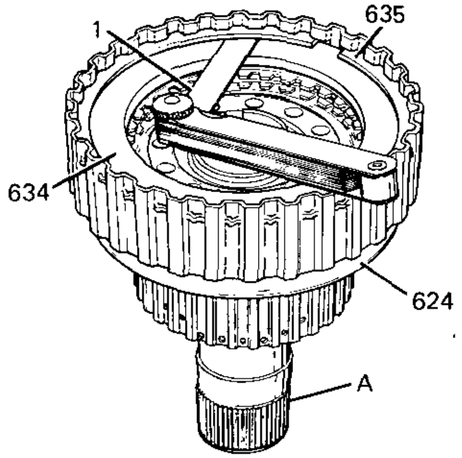
J-25018-A Adapter Forward Spring Compressor

1. Inner (627) and outer (626) seals – lips facing housing (624) (Figure 68)
2. Insert (628)

3. Piston assembly (629) with J-26744-A. Start inner seal (627) first.
   Do not cut the seals on the snap ring groove.
4. Spring guide (630)
5. Spring and retainer assembly (631)
6. Snap ring (632) – Use arbor press or J-23456 and J-25018-A.
7. Wave plate (633).
8. Lubricate composition plates (633).
9. Alternately composition and steel plates (633)
10. Backing plate (633) I.D. side up
11. Snap ring (632)
12. New seal rings (622) if required

Measure

- Snap ring (635) to backing plate (634) – end play range with a feeler gage must be 1.0-1.5 mm (.040"-.060"). For correct backing plate selection see Figure 69.



A INPUT SHAFT
1 FEELER GAGE 1.0-1.5mm (.04"-.06")
624 HOUSING ASSEMBLY, FORWARD CLUTCH
634 PLATE, FORWARD CLUTCH BACKING
635 RING, SNAP

BACKING PLATE THICKNESS		IDENTIFICATION CODE
MM	Inches	
6.1 - 6.0	0.24 - 0.23	1
5.4 - 5.3	0.21 - 0.20	2
4.7 - 4.6	0.19 - 0.18	3

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Figure 69 Forward Clutch Backing Plate Selection

DIRECT CLUTCH ASSEMBLY

Disassemble (Figure 70)

1. Snap ring (620)
2. Backing plate (619)
3. Composition and steel clutch plates (618)
4. Snap ring (617)
5. Apply ring and release spring assembly (616).
6. Piston (615)
   - Inner (614) and outer (612) seals
   - Center seal (613) from housing

125C CLUTCH PLATE AND APPLY RING USAGE CHART

CLUTCH	FLAT STEEL PLATE		COMP. FACED PLATE	WAVED PLATE		APPLY RING	
DIRECT	No.	Thickness	No.	No.	Thickness	I.D.	Thickness
CJ, CT, CD, CX, CF, PJ, PA, CU	5	2.3mm (0.09")	5	—	—	7	19.0mm (0.74")
ALL OTHERS	4	2.3mm (0.09")	4	—	—	1	23.1mm (0.90")
FORWARD ALL	3	1.9mm (0.08")	4	1	1.25mm (0.06")	—	—
LO & REVERSE ALL	4	2.2mm (.085")	5	1	1.94mm (0.08")	—	—

The direct and forward clutch flat steel clutch plates and the forward clutch waved steel plate should be identified by their thickness.

The direct and forward production installed composition-faced clutch plates must not be interchanged. For service, direct and forward clutch use the same compositioned-faced plates.

The forward clutch backing plate is selective. Refer to the Forward Clutch End Play Chart.

Measure the width of the clutch apply ring for positive identification.

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Figure 70 Clutch Plate Usage Chart

Inspect

- Housing (610) for
  - Bad welding
  - Band scoring
  - Heat damage
- Housing bushings for cracks, damage or scoring
- Piston (615) for damage or cracks
- Inner (614), outer (612) and center (613) seals for burrs, nicks or brittleness
- Apply ring and release spring assembly (616) for damage and collapsed springs
- Clutch plates (618) for wear or burning
- Backing plate (619) for damage, cracks or burning
- Snap rings (620), (617) for damage
- Check ball capsule for free operation

Check Ball Capsule Replacement Procedure

Remove or Disconnect

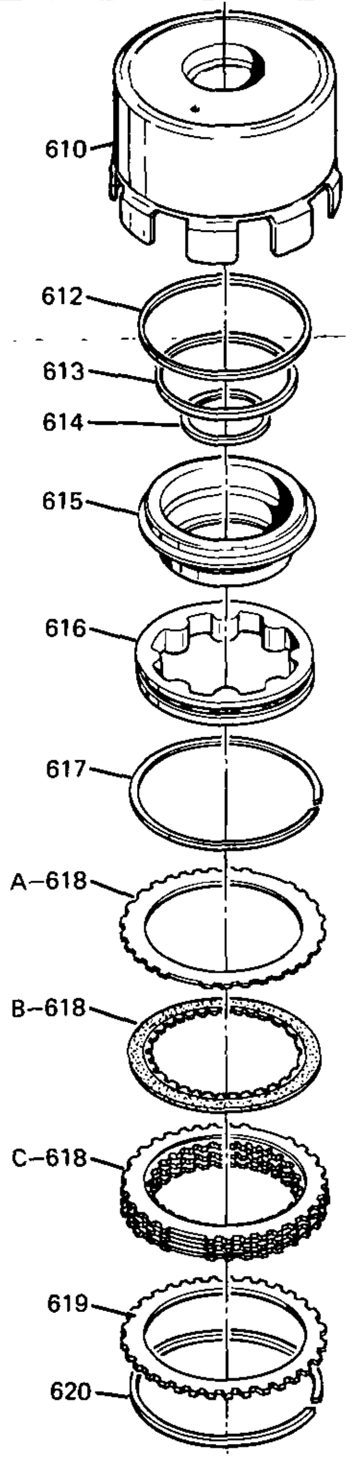
- Use a 9.5 mm (3/8") drift to drive out the ball capsule assembly.

Install or Connect

- Seat the new capsule with the 9.5 mm (3/8") drift.

Assemble (Figures 70, 71 and A-15)

1. Center seal (613) – lips facing away from capsule
2. Inner seal (614) – lips facing capsule
3. Outer seal (612) – lips facing capsule
4. Piston (615)



610	HOUSING & DRUM ASM., DIRECT CLUTCH
612	SEAL, DIRECT CLUTCH PISTON OUTER
613	SEAL, DIRECT CLUTCH CENTER
614	SEAL, DIRECT CLUTCH PISTON INNER
615	PISTON, DIRECT CLUTCH
616	APPLY RING & RELEASE SPRING ASM.
617	RING, SNAP
A–618	STEEL CLUTCH PLATE
B–618	COMPOSITION FACED PLATE
C–618	ALTERNATING STEEL & COMP. PLATES
619	PLATE, CLUTCH BACKING, DIRECT
620	RING, SNAP

H 125-146-3

Figure 71 Direct Clutch Assembly

5. Apply ring and release spring assembly (616)
6. Snap ring (617)
7. Lubricate composition plates (618)
8. Alternatel steel and composition plates (618)
9. Backing plate (619) (chamfered or highly polished side against composition plate)
10. Snap ring (620)

610 HOUSING, DIRECT CLUTCH
624 HOUSING, FORWARD CLUTCH
636 WASHER, THRUST (STEPPED SIDE OUT)

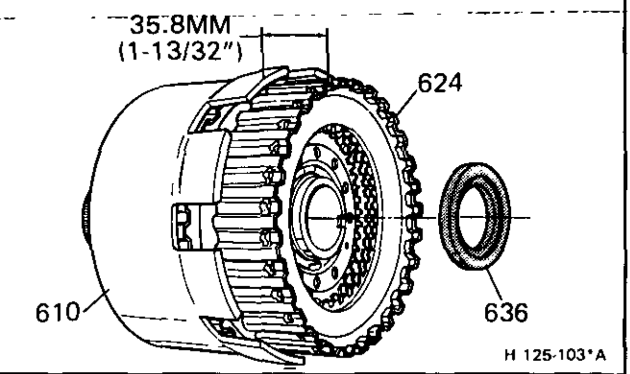


Figure 72 Assembled Height of Clutch Assemblies

FORWARD AND DIRECT CLUTCH

Assemble (Figures 72, 73 and 74)

- Direct clutch assembly onto the forward clutch assembly. Rotate the direct clutch so that all clutch plates engage the clutch hub.
- Thrust washer stepped side out (636) - use petrolatum

Measure (Figure 72)

- Assembled height 31 mm (1-7/32")

Install or Connect (Figures 73 and 74)

- Forward and direct clutch assemblies into case

Measure (Figure 74)

- Case face to housing - 42 mm (1-11/16")

A INPUT SHAFT
610 CLUTCH, DIRECT
624 CLUTCH, FORWARD

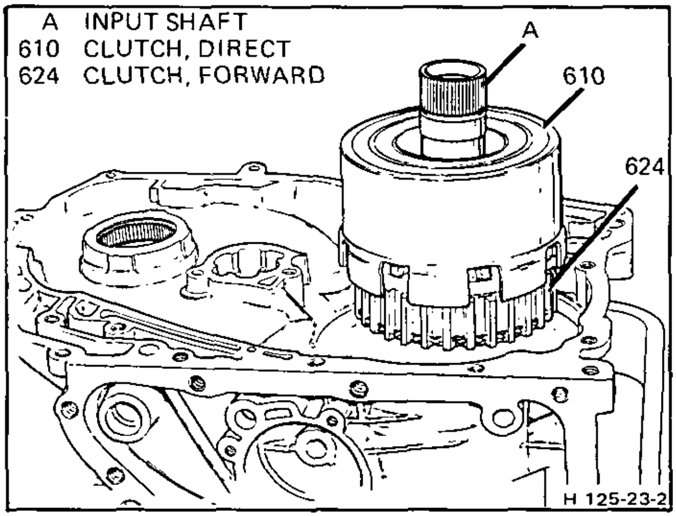


Figure 73 Installing the Clutch Assemblies

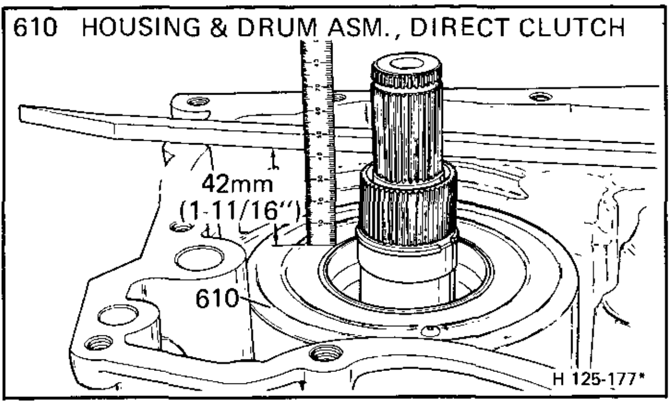


Figure 74 Proper Clutch Installation

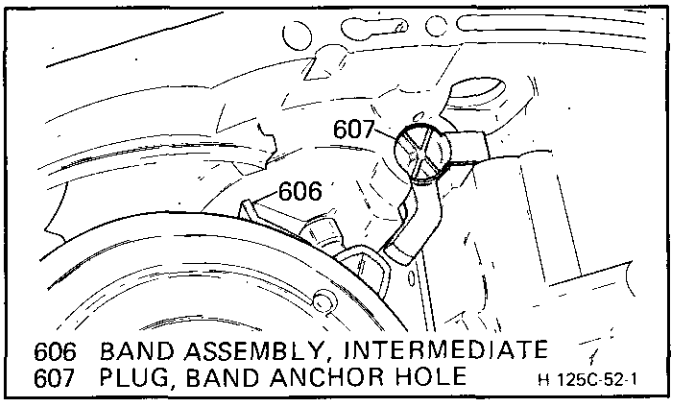


Figure 75 Intermediate Band Anchor Hole Plug

INTERMEDIATE BAND ASSEMBLY

Inspect

- Band (606) for burns, flaking or damage

Install or Connect (Figure 75)

1. Band (606) – must engage the case lug
2. Plug (607)

DRIVEN SPROCKET SUPPORT

Inspect (Figure 76 and 26)

- Support (602) for cracks, burrs or damage – oil *passage surface must be flat and smooth*
- Bushing (603) for damage
- Thrust washer (605) for damage
- Oil seal rings (604) for nicks, cuts or damage

Bearing Replacement Procedure

Remove or Disconnect (Figure 76)

Tools Required:

J-26941 Transmission Case Bearing Cup Remover

J-6125-1 Slide Hammer

- Bearing assembly (601) – use J-26941 and J-6125-1
- Inspect race for damage

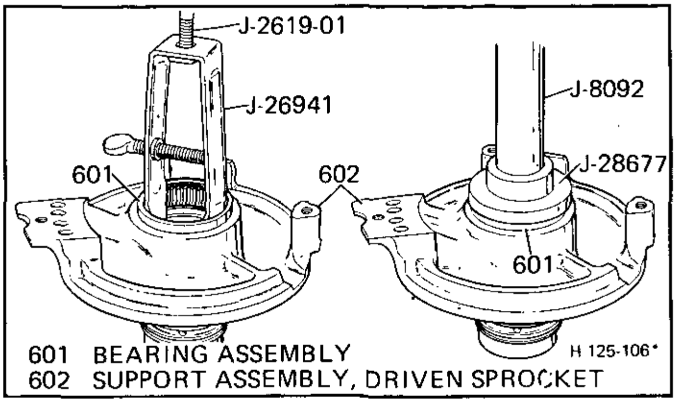


Figure 76 Bearing Replacement

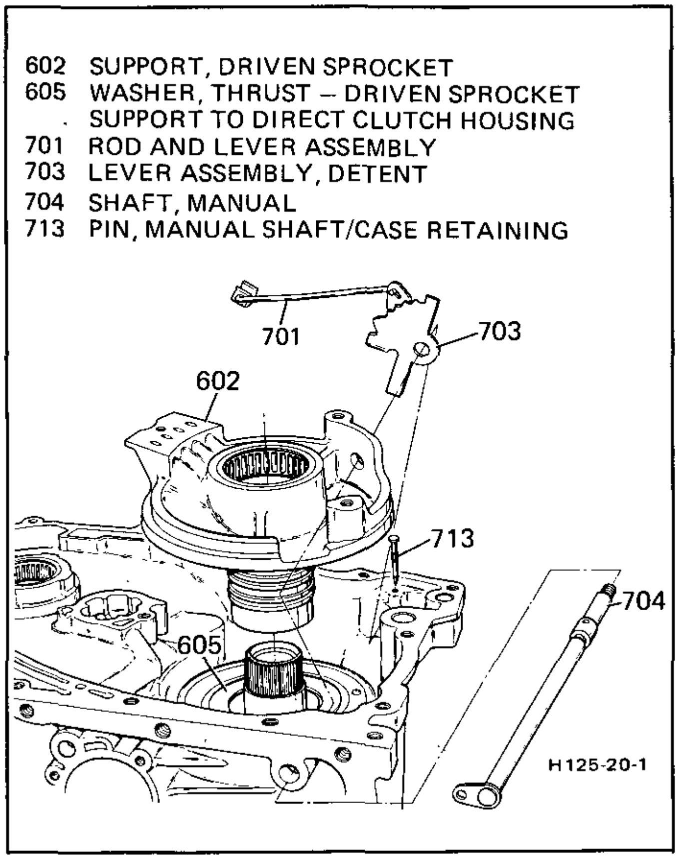


Figure 77 Driven Sprocket Support & Manual Linkage

Install or Connect

- New bearing – manufacturing identification faces up

Assemble (Figure 77 and Figure 26)

- Thrust washer (605) – retain with petrolatum.
- Support assembly (602) into the case. **(Do not allow the direct clutch bushing to cut the oil seals.)**

MANUAL SHAFT

Inspect (Figure 77)

- Rod and retainer assembly (701) for distortion or damage

- Detent lever (703) for damage
- Manual shaft (704) for damaged threads, raised edges on flats
- Parking lock actuator assembly (705) for damage or broken retainer lugs

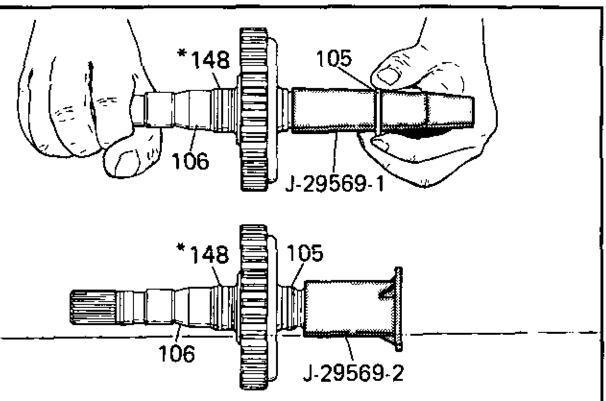
Assemble

1. Actuator (705) to manual shaft (704)
2. Detent lever (703) into case
3. Slide the manual shaft (704) into the case and engage the detent lever (703).
4. Tap the roll pin (702) into the detent lever with a 5 mm (3/16") drift.
5. Tap nail (703) into place.

DRIVE LINK ASSEMBLY

Inspect (Figure 78)

- Drive and driven sprockets (103) 122) teeth and splines for nicks, burrs, scoring or wear.
- Shaft (106) for damage, wear
- Seals (105) for damage
- Thrust washer (104) for damage or wear
- Link assembly (101) for damage or loose links



105	RING, SOLID SEAL, TURBINE SHAFT (GREEN)
106	SHAFT, TURBINE
*148	RING, SOLID SEAL, TURBINE SHAFT (YELLOW)

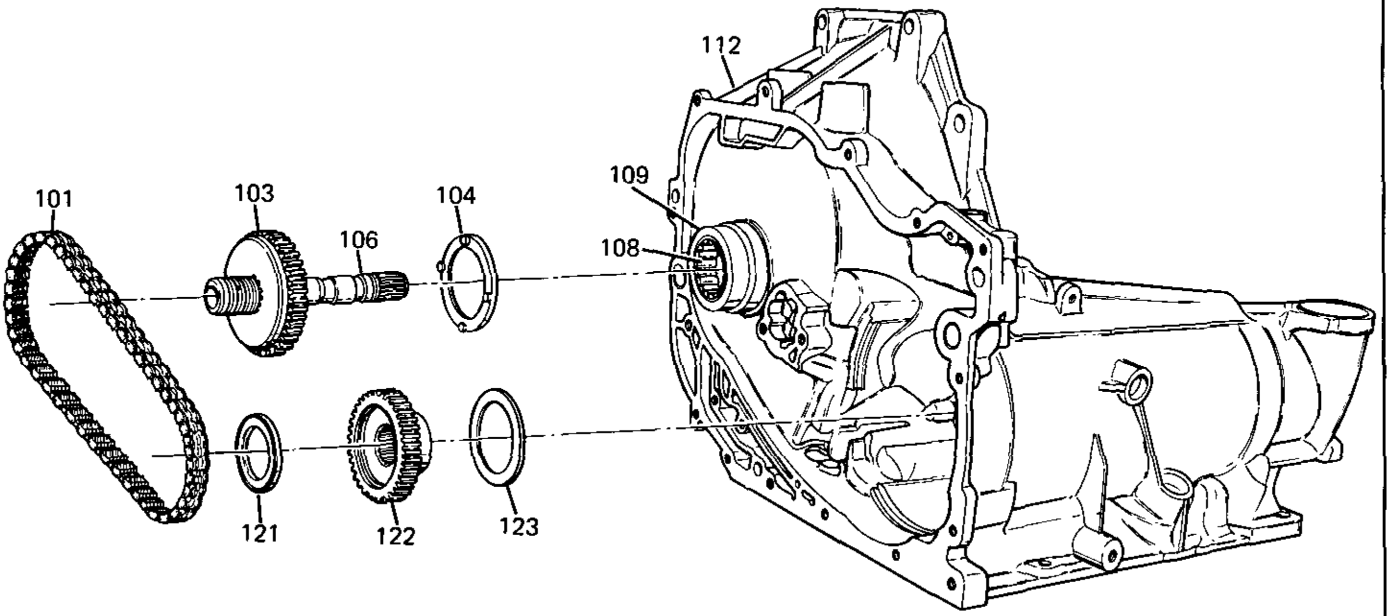
*REQUIRES USE OF J-29829

H125-324B

Figure 79 Turbine Shaft Seal Replacement

- Thrust bearing (121) for damage or wear
- Driven support thrust washer (123) for damage or wear

See drive link inspection in Section 7A.



101	LINK ASSEMBLY, DRIVE
103	SPROCKET, DRIVE
104	WASHER, CASE COVER TO DR. SKT. THRUST
106	SHAFT, TURBINE
108	BEARING ASSEMBLY
109	SUPPORT, DRIVE SPROCKET
112	CASE,TRANSMISSION
121	BEARING ASM., DRIVEN SPROCKET THRUST
122	SPROCKET, DRIVEN
123	WASHER, DR. SKT./SUPPORT THRUST

H 125C-76

Figure 78 Drive Link Assembly

Turbine Shaft Seal and Drive Sprocket Replacement Procedure

↔ Remove or Disconnect (Figure 4 and 79)

- Seals (105) from turbine shaft (cut with a knife)
- Snap ring (102) from turbine shaft
- Drive sprocket (103) from turbine shaft

→← Install or Connect (Figure 79)

Tools Required:
J-29569 Turbine Shaft Seal Installer
J-29829 Turbine Shaft Seal Installer

- Drive sprocket (103) onto turbine shaft
- Snap ring (102) onto turbine shaft
- Slide installer J-29569-1 over the turbine shaft and coat with petrolatum
- Guide new seals (105) over tool into seal ring grooves
- Size the seals with sizing tool J-29569-2
- Slide installer J-29829-1 over opposite end of turbine shaft and coat with petrolatum.
- Guide new seal (148) over tool into seal ring groove.
- Size the seal with sizing tool J-29829-2.

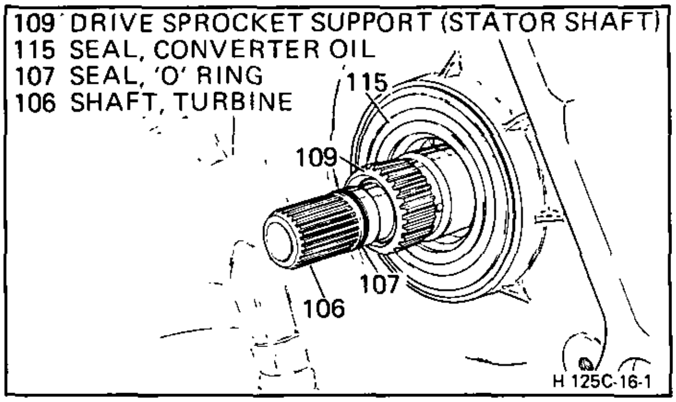
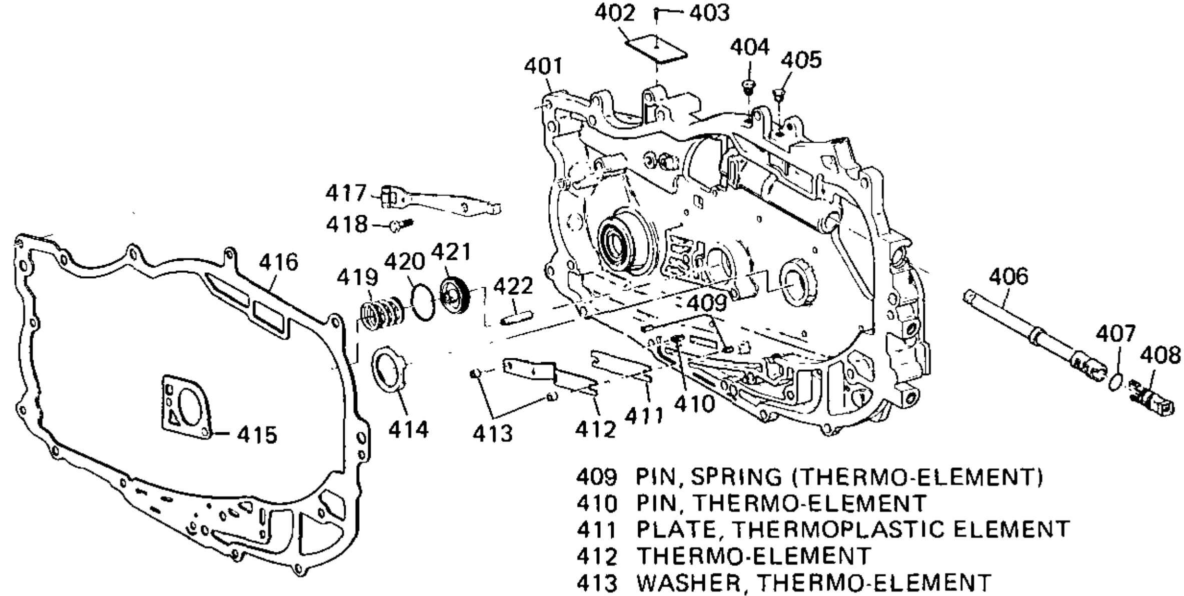


Figure 80 Turbine Shaft "O" Ring Seal

→← Install or Connect (Figures 78 and 80)

1. Thrust washer (123) onto sprocket (122) and retain with petrolatum
2. Thrust washer (104) onto sprocket (103) and retain with petrolatum
3. Drive (103) and driven (122) sprockets into link assembly (101) - colored guide link up
4. Link assembly (101) and sprockets (103) and (122) into case (112)
5. New "O" ring (107) onto the turbine shaft from the converter side of case (Figure 80)
6. Thrust bearing (121) onto sprocket (122)



ILL. NO.	DESCRIPTION
401	COVER, TRANSMISSION CASE
402	NAMEPLATE
403	SCREW – NAMEPLATE
404	VENT ASSEMBLY
405	PLUG, (LINE PRESSURE PICKUP) PIPE
406	VALVE, MANUAL
407	SEAL, "O" RING
408	ELECTRICAL CONNECTOR
409	PIN, SPRING (THERMO-ELEMENT)
410	PIN, THERMO-ELEMENT
411	PLATE, THERMOPLASTIC ELEMENT
412	THERMO-ELEMENT
413	WASHER, THERMO-ELEMENT
414	WASHER, THRUST CASE COVER TO DR. SKT.
415	GASKET, CASE TO CASE COVER CENTER
416	GASKET, CASE TO CASE COVER
417	SPRING AND ROLLER ASM., MANUAL DETENT
418	BOLT, MAN. DET. SPRING/CASE COVER
419	SPRING, 1-2 ACCUMULATOR PISTON
420	RING, OIL SEAL, 1-2 ACCUMULATOR PISTON
421	PISTON, 1-2 ACCUMULATOR
422	PIN, 1-2 ACCUMULATOR

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Figure 81 Case Cover - Case Side

CASE COVER ASSEMBLY

Clean (Figures 81 and 84)

- Apply gasket remover, then scrape the case cover gasket surface with a plastic scraper

Inspect

- Case cover (401) – see Section 7A for case cover repair
  - Casting porosity
  - Oil passage damage
  - 1-2 accumulator bore damage
- 1-2 accumulator piston (421), seal (420) and spring (419)
  - Cracked or damaged piston
  - Cut or nicked seal
  - Distorted spring
- Vent assembly (404) for damage

Vent Assembly Replacement Procedure

Remove or Disconnect

- Vent assembly with pliers

Install or Connect

- Apply thread sealant to the vent (404) vent.
- Tap the vent (404) into case cover with a soft mallet.

Inspect (Figure 81 and 84)

- Detent spring and roller (417) for damage – replace as necessary.
- Cooler fittings (17) for thread damage

Cooler Fitting Replacement Procedure

Disassemble (Figure 84)

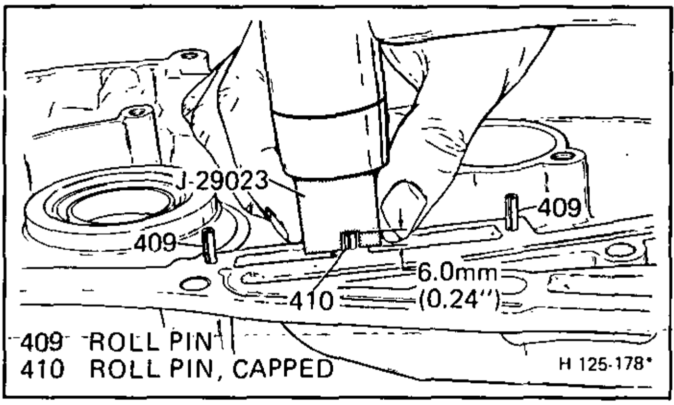
- Cooler fittings (17) from case cover

Assemble

- Apply thread sealer to cooler fittings
- Cooler fittings (17) into case cover – 38 N·m (23 ft. lbs.)

Inspect

- Electrical connector (408) for damage
- Case cover sleeve – for feed hole alignment
- Manual valve (406) for damage – must slide freely in the bore
- Thrust washer (414) for damage
- Thermostatic element (409-413) for damage



409 ROLL PIN
410 ROLL PIN, CAPPED

Figure 82 Setting Center Roll Pin Height

411 PLATE, THERMOPLASTIC ELEMENT
412 THERMO-ELEMENT
413 WASHER, THERMO-ELEMENT
414 WASHER, THRUST- CASE COVER/DR. SPRKT.

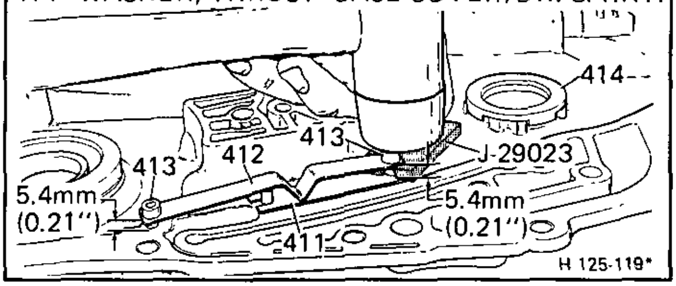
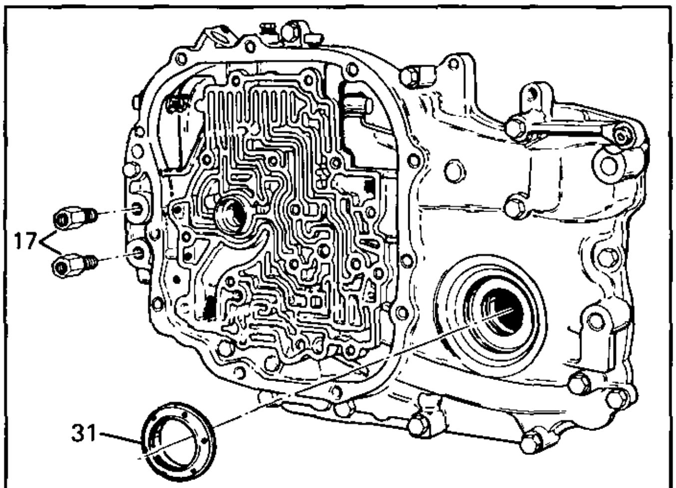


Figure 83 Setting Element Height



17 CONNECTOR, COOLER FITTING
31 SEAL ASSEMBLY, AXLE OIL

Figure 84 Left Hand Axle Seal & Cooler Fittings

Thermostatic Element Replacement Procedure

Disassemble (Figure 82)

Tool Required:
J-29023

- Washers (413)
- Element (412)
- Element plate (411)

Assemble (Figure 82 and 83)

- Set thermo pin height with J-29023
- Install the element plate (411)
- Install the element (412)
- Install the washers (413) – use J-29023 to set the washer height.

Inspect (Figure 84)

- Left hand axle seal (31) for damage

Seal Replacement Procedure

Remove or Disconnect

- Seal (31)

Install or Connect

- Seal (31) use J-26938 or J-29130

Assemble (Figure 81)

1. Case cover
2. Thrust washer (414) – use petrolatum to hold in place.
3. Pin (422), chamfered end first
4. Piston (421)
5. Spring (419)
6. Gasket (415) – use petrolatum to hold in place.

Install or Connect

- Loctite ® 515 or equivalent on both sides of gasket (416)
- Gasket (416) to case cover
- Case cover (401) to case
- Coat bolt (A) with thread sealer (Figure 84A).
- Retainer (701) to manual valve (406) (Figure 85)

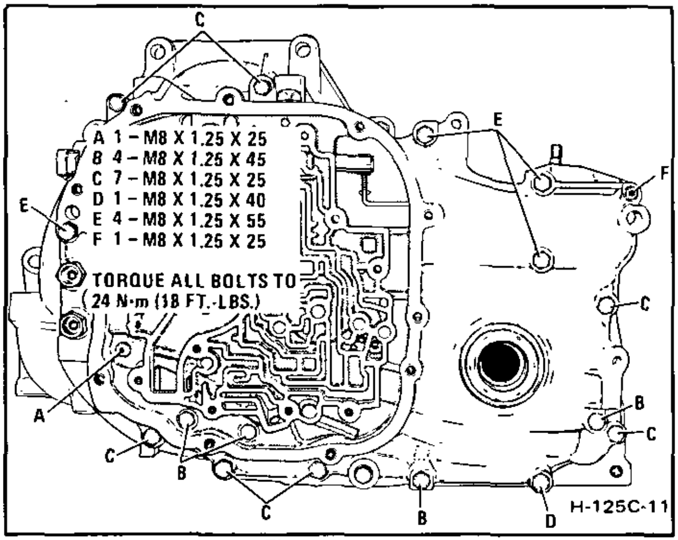


Figure 84A

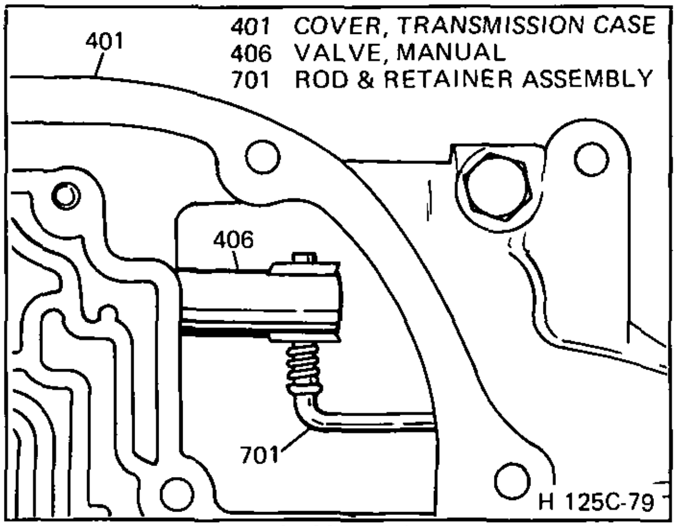


Figure 85 Manual Valve

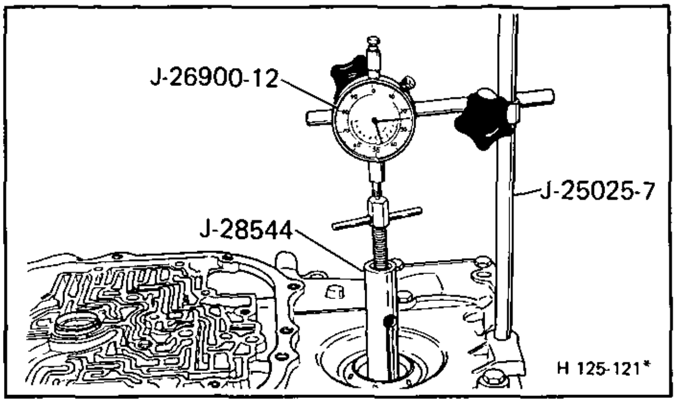


Figure 86 Input Shaft to Case Cover End Play

INPUT SHAFT TO CASE COVER
SELECTIVE SNAP RING
(621)

Thickness	Identification/Color
1.83 - 1.93mm (0.071" - 0.076")	White
2.03 - 2.13mm (0.078" - 0.084")	Blue
2.23 - 2.33mm (0.088" - 0.092")	Brown
2.43 - 2.53mm (0.095" - 0.099")	Yellow
2.63 - 2.73mm (0.103" - 0.107")	Green

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Figure 87 Selective Snap Ring Chart

Input Shaft End Play

Measure (Figures 86 and 87)

Tools required:
J-26958-10 Adapter plug
J-26958 Loading tool and J-26958-11 bracket
J-28544 Input shaft lifter
J-25025-7 Dial indicator post
J-26900-12 or J-8001 Dial indicator

1. Install essential tools
2. Push the lifter down and zero the dial indicator.
3. Pull the lifter up.
4. Dial indicator reading should be 0.10-0.84 mm (.004-.033").
   See (Figure 87) for snap ring selection – correct as necessary.
5. Remove tools.

CONTROL VALVE AND OIL PUMP ASSEMBLY

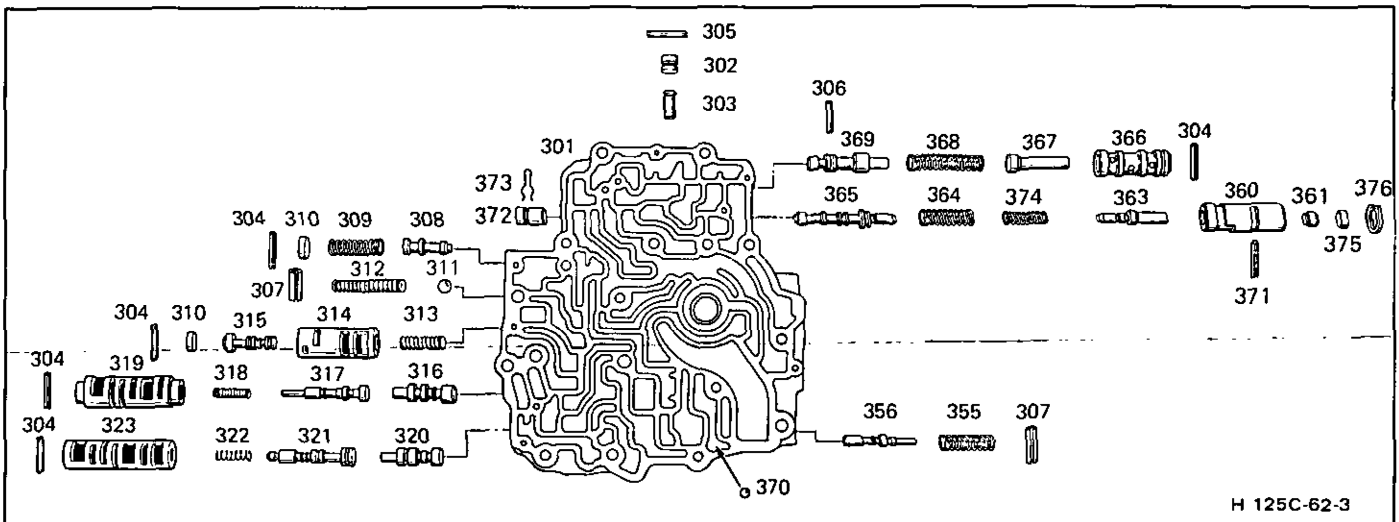
Disassemble (Figures 88, 89, and 90L)

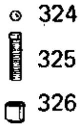
- Control Valve Assembly

Important

Valves and springs are **not** interchangeable. Keep them in the order shown.

- Position as shown.
- Start at the upper left and remove each valve train. Lay out the valve train as shown.





301	BODY, OIL PUMP AND CONTROL VALVE
302	PLUG, BORE LINE BOOST VALVE
303	VALVE, LINE BOOST
304	PIN – SPRING, VALVE RETAINING
305	PIN, COILED SPRING LINE BOOST PLUG
306	PIN, COILED SPRING
307	SLEEVE, SPRING RETAINING
308	VALVE, SHIFT T.V.
309	SPRING, SHIFT T.V.
310	PLUG, VALVE BORE
311	BALL, PRESSURE RELIEF (9.525 DIA.)
312	SPRING, PRESSURE RELIEF
313	SPRING, 1-2 ACCUMULATOR
314	BUSHING, 1-2 ACCUMULATOR
315	VALVE, 1-2 ACCUMULATOR
316	VALVE, 2-3 SHIFT
317	VALVE, 2-3 THROTTLE
318	SPRING, 2-3 THROTTLE VALVE
319	BUSHING, 2-3 THROTTLE VALVE
320	VALVE, 1-2 SHIFT
321	VALVE, 1-2 THROTTLE
322	SPRING, 1-2 THROTTLE VALVE
323	BUSHING, 1-2 THROTTLE VALVE
324	BALL, LO BLOW OFF
325	SPRING & PLUG ASSEMBLY – LO BLOW OFF
326	PLUG, LO BLOW OFF VALVE
355	SPRING, 3-2 VALVE
356	VALVE, 3-2 CONTROL
360	BUSHING, T.V. & REVERSE BOOST VALVE
361	VALVE, T.V. BOOST
362	BUSHING, REVERSE BOOST VALVE
363	VALVE, REVERSE BOOST
364	SPRING, PRESSURE REGULATOR
365	VALVE, PRESSURE REGULATOR
366	BUSHING, T.V. PLUNGER
367	PLUNGER, THROTTLE VALVE
368	SPRING, THROTTLE VALVE
369	VALVE, THROTTLE
370	CHECK BALL # 1
371	PIN, T.V. & REVERSE BOOST BUSHING
372	PLUG, BORE (PRESSURE REGULATOR)
373	RETAINER (PRESSURE REGULATOR)
374	SPRING, PRESSURE REGULATOR ISOLATOR
375	PLUG, VALVE BORE ISOLATOR
376	RING, VALVE RETAINING

Figure 88 Control Valve - Pump Assembly

  - Roll pins (307) – they are under pressure. Cover the bore when the pin is removed.
  - Blind hole pins must be removed with a #49 drill bit (1.85 mm or .073"). Grind the taper off the bit.
- Oil pump and auxiliary valve body assembly
  1. Screw (327)
  2. Cover (330) and gasket (331)
  3. Screw (334), solenoid assembly (333) and "O" ring seal (337)
  4. Switches (335 & 338)
  5. Auxiliary valve body (343)
     — Converter clutch regulator valve, pin, bore plug and spring (306, 340,41, 4.)
  6. C.C. Control valve (332) and plug (310)
  7. Pin (345) and slide (348)
  8. Vanes (352) and rotor (353)
  9. Pump vane ring (351)

Clean

- Valve body (301) and auxiliary valve body (340) with solvent - air dry. Lo blow off assembly - 326, 325, 324 must be replaced.
- All valves, bushings and springs with solvent, air dry

Inspect

- Valve body (301) and auxiliary valve body (343)
  - Oil passage damage
  - Casting porosity
  - Machine face damage
  - Scored valve bores
  - Pump pocket for damage
  - Auxiliary valve body sleeve for damage
- Valves, bushings and springs
  - Scored or cracked valves
  - Scored or cracked bushings
  - Collapsed springs
- Pump rotor and vanes
  - Rotor damage (353)
  - Vane damage (352)
  - Vane rings for damage (351)
  - Slide seals (350)
  - Slide "O" rings seals (346 & 347)
- Pump shaft bearing (354) for damage

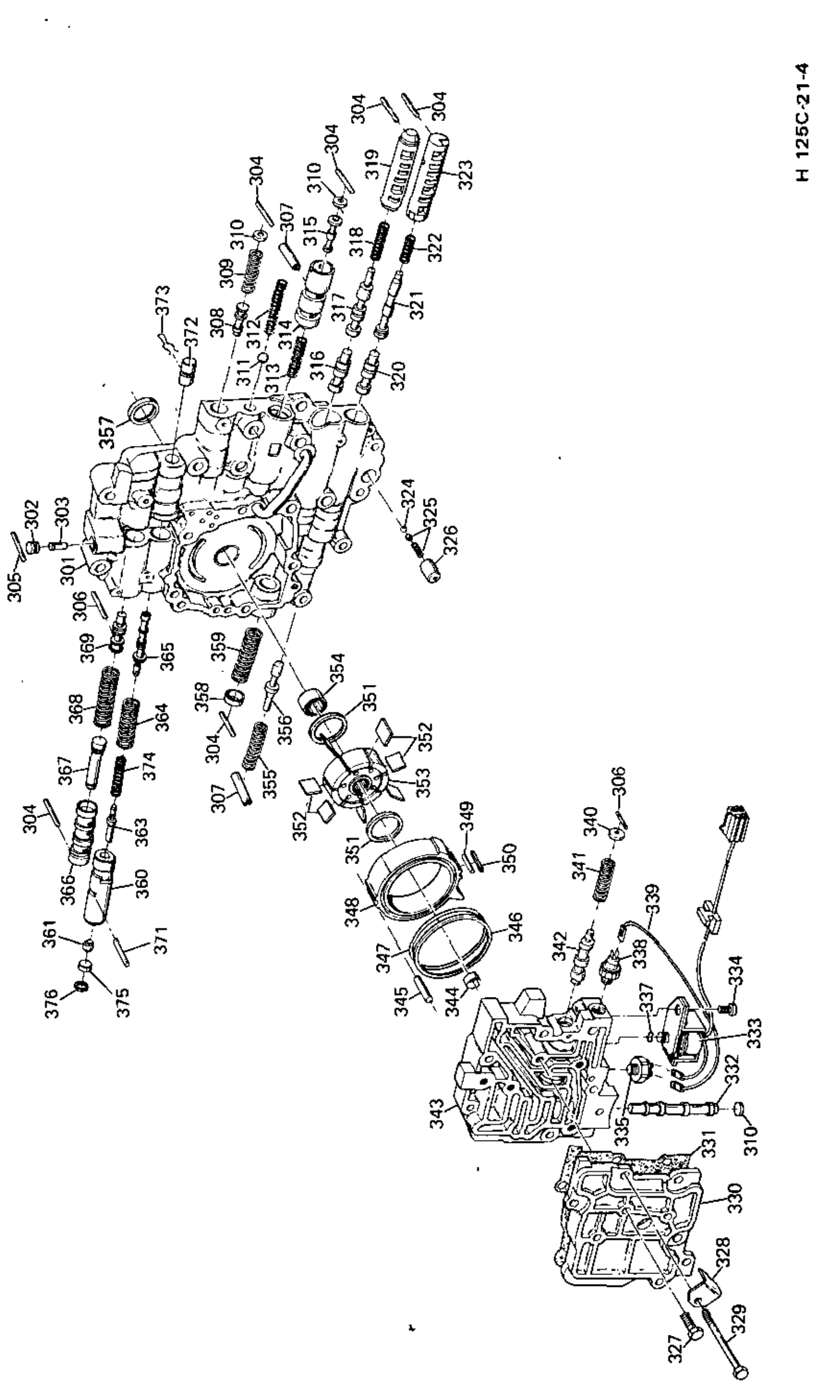


Figure 89 Control Valve & Oil Pump Assembly

301 BODY, OIL PUMP & CONTROL VALVE
302 PLUG, BORE LINE BOOST VALVE
303 VALVE, LINE BOOST
304 PIN, VALVE RETAINING SPRING
305 PIN, COILED SPRING LINE BOOST PLUG
306 PIN, COILED SPRING
307 SLEEVE, SPRING RETAINING
308 VALVE, SHIFT T.V.
309 SPRING, SHIFT T.V.
310 PLUG, VALVE BORE
311 BALL, PRESSURE RELIEF (9.525 DIA.)
312 SPRING, PRESSURE RELIEF
313 SPRING, 1-2 ACCUMULATOR
314 BUSHING, 1-2 ACCUMULATOR
315 VALVE, 1-2 ACCUMULATOR
316 VALVE, 2-3 SHIFT
317 VALVE, 2-3 THROTTLE
318 SPRING, 2-3 THROTTLE VALVE
319 BUSHING, 2-3 THROTTLE VALVE
320 VALVE, 1-2 SHIFT
321 VALVE, 1-2 THROTTLE
322 SPRING, 1-2 THROTTLE VALVE
323 BUSHING, 1-2 THROTTLE VALVE
324 BALL, LO BLOW OFF
325 SPRING & PLUG ASSEMBLY, LO BLOW OFF
326 PLUG, LO BLOW OFF VALVE
327 BOLT, AUXILIARY V.B./VALVE BODY
328 RETAINER, VALVE BODY PIPE
329 BOLT, AUXILIARY VALVE BODY TO CASE
330 COVER, AUXILIARY VALVE BODY
331 GASKET, AUXILIARY VALVE BODY COVER
332 VALVE, CONVERTER CLUTCH CONTROL
333 SOLENOID ASSEMBLY
334 BOLT, SOLENOID
335 SWITCH, PRESSURE
337 SEAL, "O" RING
338 SWITCH, GOVERNOR PRESSURE (DIESEL ONLY)
339 HARNESS, SOLENOID WIRE
340 PLUG, VALVE BORE
341 SPRING, CONVERTER CLUTCH REGULATOR
342 VALVE, CONVERTER CLUTCH REGULATOR
343 BODY, AUXILIARY VALVE
344 SLEEVE, AUXILIARY VALVE BODY
345 PIN, SLIDE PIVOT
346 RING, OIL SEAL (SLIDE TO COVER)
347 SEAL, "O" RING (SLIDE)
348 SLIDE, PUMP
349 SUPPORT, PUMP SLIDE SEAL
350 SEAL, PUMP SLIDE
351 RING, PUMP VANE
352 VANE, PUMP
353 ROTOR, OIL PUMP
354 BEARING ASSEMBLY, ROLLER PUMP SHAFT
355 SPRING, 3-2 VALVE
356 VALVE, 3-2 CONTROL
357 SEAL, PUMP SHAFT
358 PLUG, SPRING RETAINING
359 SPRING, PUMP PRIMING
360 BUSHING, T.V. & REVERSE BOOST VALVE
361 VALVE, T.V. BOOST
363 VALVE, REVERSE BOOST
364 SPRING, PRESSURE REGULATOR
365 VALVE, PRESSURE REGULATOR
366 BUSHING, T.V. PLUNGER
367 PLUNGER, THROTTLE VALVE
368 SPRING, THROTTLE VALVE
369 VALVE, THROTTLE
371 PIN, T.V. & REVERSE BOOST BUSHING
372 PLUG, BORE (PRESSURE REGULATOR)
373 RETAINER, PRESSURE REGULATOR
374 SPRING, PRESSURE REGULATOR ISOLATOR
375 PLUG, VALVE BORE ISOLATOR
376 RING, VALVE RETAINING

LEGEND
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Figure 90L Control Valve and Oil Pump Ass'y. Legend

Oil Pump Rotor and Slide Replacement

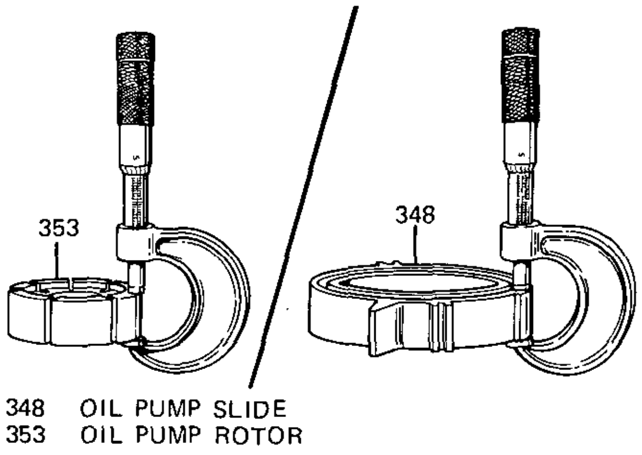
Measure (Figure 91)

Tool Required:
One Inch Micrometer

- Oil Pump Rotor (353) Thickness
- Oil Pump Slide (348) Thickness

Important

Measurement of rotor/slide must be made on undamaged surfaces. Select similar size replacements. (Figure 91) Lightly hone both sides of replacement rotor or slide to remove any nicks or burrs.



OIL PUMP ROTOR SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.917 - 17.929	0.7055 - 0.7059
17.930 - 17.942	0.7060 - 0.7064
17.943 - 17.955	0.7065 - 0.7069
17.956 - 17.968	0.7070 - 0.7074
17.969 - 17.981	0.7075 - 0.7079

OIL PUMP SLIDE SELECTION CHART

THICKNESS (mm)	THICKNESS (in.)
17.955 - 17.967	0.7070 - 0.7074
17.968 - 17.980	0.7075 - 0.7079
17.981 - 17.993	0.7080 - 0.7084
17.994 - 18.006	0.7085 - 0.7089
18.007 - 18.020	0.7090 - 0.7094

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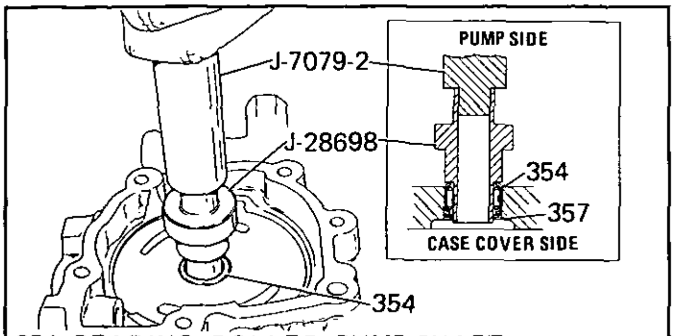
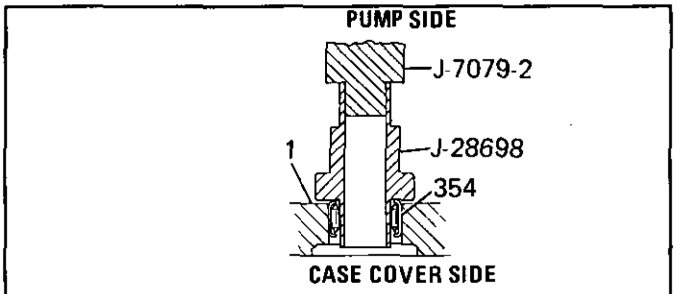
Figure 91 Oil Pump Rotor and Slide Selection



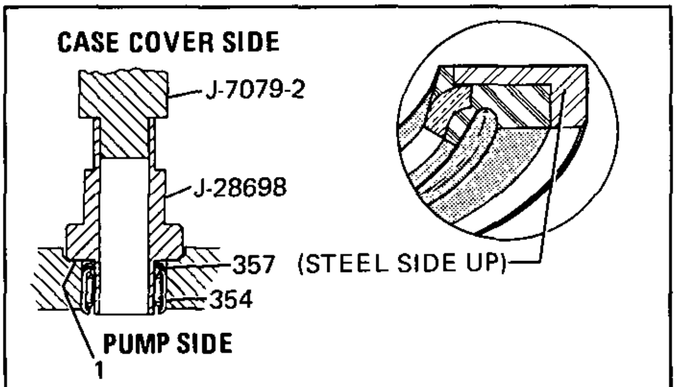
354 BEARING, ROLLER- PUMP SHAFT
357 SEAL, PUMP SHAFT

Figure 92 Pump Bearing Installation



1 PRESS BEARING 1.0mm TO 1.2mm (.040"- .047") ABOVE THIS SURFACE
354 BEARING, ROLLER- PUMP SHAFT

Figure 93 Bearing Dimension



1 PRESS SEAL FLUSH TO 0.5mm (0.020") ABOVE THIS SURFACE
354 BEARING, ROLLER- PUMP SHAFT
357 SEAL, PUMP SHAFT

Figure 94 Bearing Seal Dimension

Pump Shaft Bearing Replacement

Remove or Disconnect

Tools Required:

J-28698 Pump Bearing Remover and Installer

J-7079-2 Driver Handle

- Bearing with J-28698 and J-7079-2 (Drive toward pump pocket)

Install or Connect (Figures 92, 93, and 94)

Tools Required:

J-28698 Pump Bearing Remover and Installer

J-7079-2 Driver Handle

- New bearing, use J-28698 and J-7-79-2 – install from pump pocket side – bearing cup must be 0.45 - 0.15 mm (0.017"-0.005") below pump pocket

Assemble (Figures 88 and 89)

- Oil pump assembly
  1. Pump slide (348) into pump pocket
  2. Slide seal support (349) and seal (350 into slide (348)
  3. *Align side with pivot hole, then install pin (345)*
  4. Vane ring (351) into pump pocket (1 of 2 rings)
  5. Vanes (352) and rotor (353) pocket
  6. Vane ring (351) top of rotor
  7. "O" ring seal (349) on top of rotor
  8. "O" ring seal (346) (slide to cover)
- Auxiliary valve body
  - Converter clutch regulator valve (342), spring (341), bore plug (340) and roll pin (306)
  - Control valve (332) and plug (310)
  - Switches (335 & 338)
  - Solenoid (333) with oil seal (337) and bolt (334) - attach leads
- Auxiliary valve body to valve body
  - Position as shown.
  - Install gasket (331) and cover (330).

Tighten

Torque the bolts (327) to 11 N·m (8 ft. lbs.)

Assemble (Figures 88, 89, and 90L)

- Control valve assembly
- All valves, springs, bushings, bore plugs and roll pins as shown

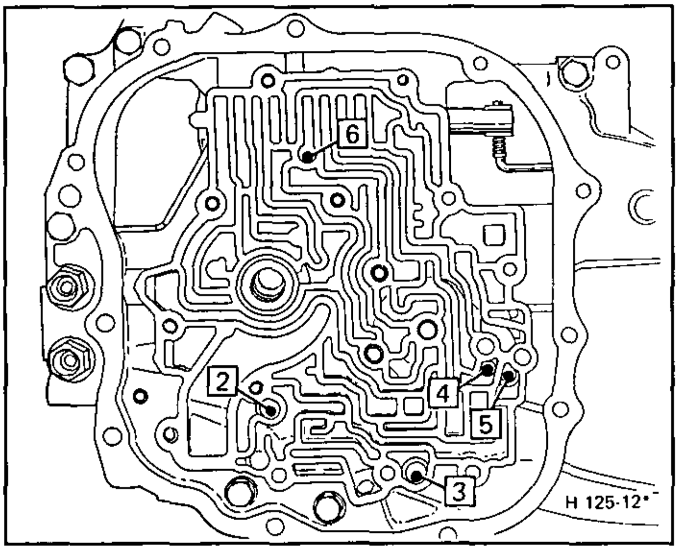
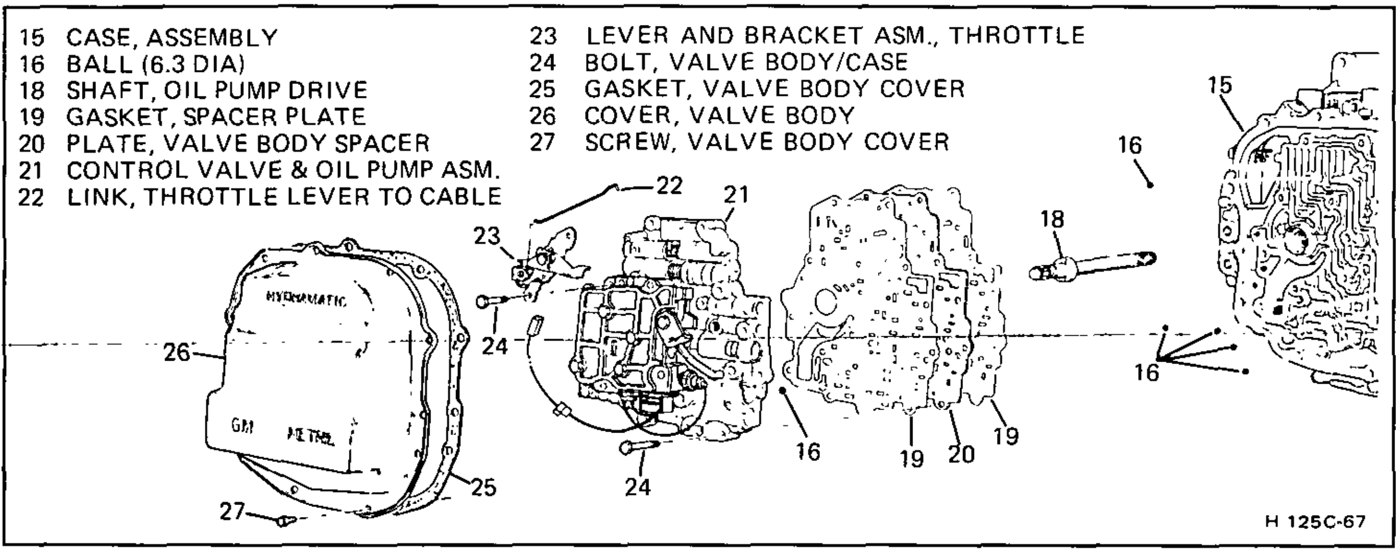


Figure 95 Check Ball Locations



15	CASE, ASSEMBLY
16	BALL (6.3 DIA)
18	SHAFT, OIL PUMP DRIVE
19	GASKET, SPACER PLATE
20	PLATE, VALVE BODY SPACER
21	CONTROL VALVE & OIL PUMP ASM.
22	LINK, THROTTLE LEVER TO CABLE
23	LEVER AND BRACKET ASM., THROTTLE
24	BOLT, VALVE BODY/CASE
25	GASKET, VALVE BODY COVER
26	COVER, VALVE BODY
27	SCREW, VALVE BODY COVER

Figure 96 Control Valve Pump Assembly, Oil Pump Shaft

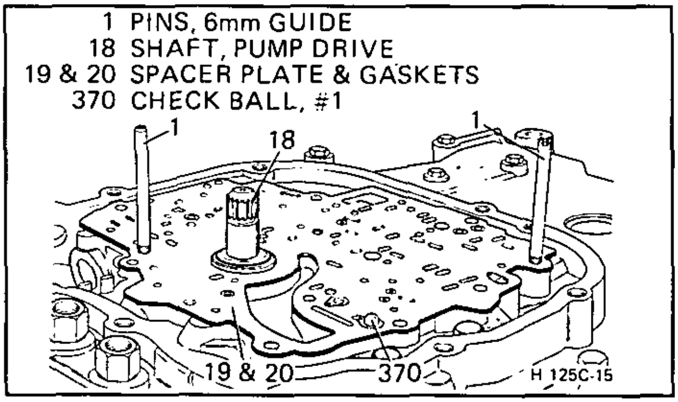
CONTROL VALVE AND OIL PUMP ASSEMBLY

Install or Connect (Figures 95, 96, 97, 98, 99 and 100)

1. Check balls (16), numbers 2, 3, 4 and 5
2. Gasket (19)
3. Plate (20)
4. Gasket (19)
5. Check ball (16) number one – on spacer plate
6. Shaft (18) – through case cover
7 6 mm guide pins
8. Body assembly (21) – onto case cover
9. Retainer (328)
10. Bolts (327). Refer to Figure 98.
11. Coat bolt "F" Figure 98 with thread sealer.
12. Wiring harness.
13. Link (22)
14. Bracket assembly (23) – engage link (22)
15. Remove 6 mm guide pins.
16. Remaining bolts (327)

Tighten

- Torque the bolts (327):
  M6 - 11 N·m (8 ft. lbs.).
  M8 - 24 N·m (18 ft. lbs.).

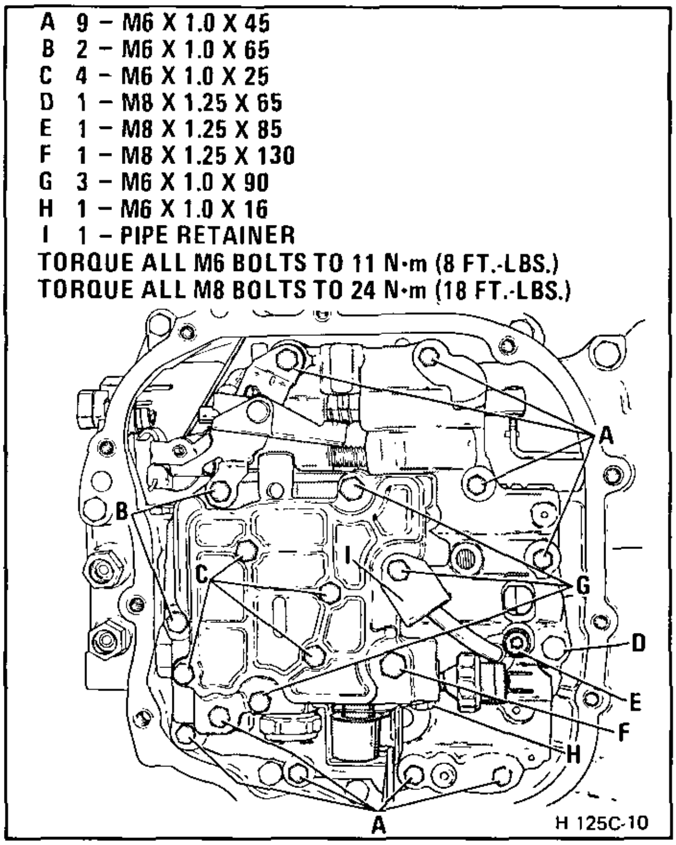


1	PINS, 6mm GUIDE
18	SHAFT, PUMP DRIVE
19 & 20	SPACER PLATE & GASKETS
370	CHECK BALL, #1

Figure 97 Spacer Plate & Gaskets

Install or Connect

1. Gasket (25) or apply R.T.V. silicon sealant



A	9 – M6 X 1.0 X 45
B	2 – M6 X 1.0 X 65
C	4 – M6 X 1.0 X 25
D	1 – M8 X 1.25 X 65
E	1 – M8 X 1.25 X 85
F	1 – M8 X 1.25 X 130
G	3 – M6 X 1.0 X 90
H	1 – M6 X 1.0 X 16
I	1 – PIPE RETAINER

TORQUE ALL M6 BOLTS TO 11 N·m (8 FT.-LBS.)
TORQUE ALL M8 BOLTS TO 24 N·m (18 FT.-LBS.)

Figure 98 Valve Body Bolt Location

2. Cover (26)
3. Screws (27)

Tighten

- Torque the screws (27) to 11 N·m (8 ft. lbs.).

Install or Connect (Figure 101)

1. Shaft (29) into case
2. "C" ring (30) position with needle nose pliers.
3. With J-28583 push on "C" ring (30)

MODEL USAGE — BA, BC, BD, BP, CA, CB, CC, CD, CF, CJ, CK, CL, CM, CT, CU, CX, HL, HU, PA, PD, PF, PH, PJ, PK, PN, PR, PW

1 CLIP IN CASE COVER PRONGS
2 RED
3 WHITE
4 BLACK
333 SOLENOID ASSEMBLY
335 SWITCH, 3RD CLUTCH PRESSURE (N.O.)
408 CONNECTOR, ELECTRICAL

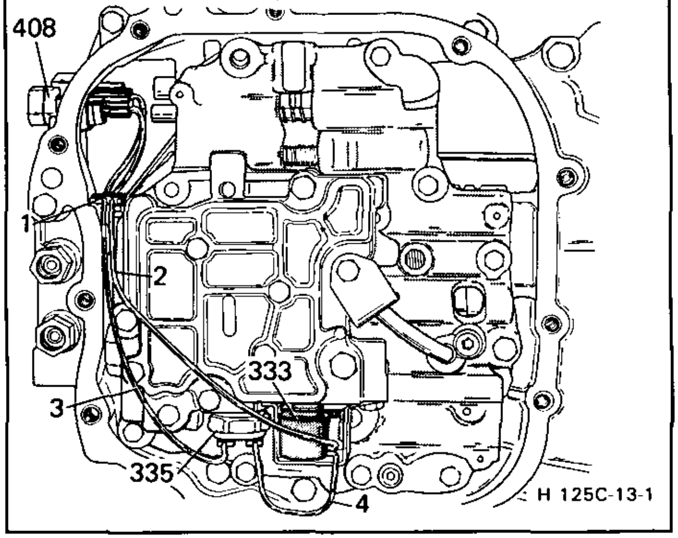
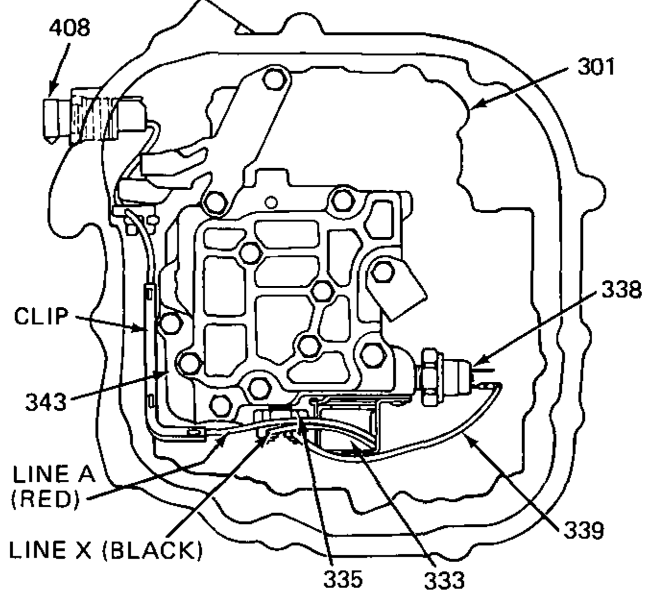


Figure 99 T.C.C. Wiring Diagram

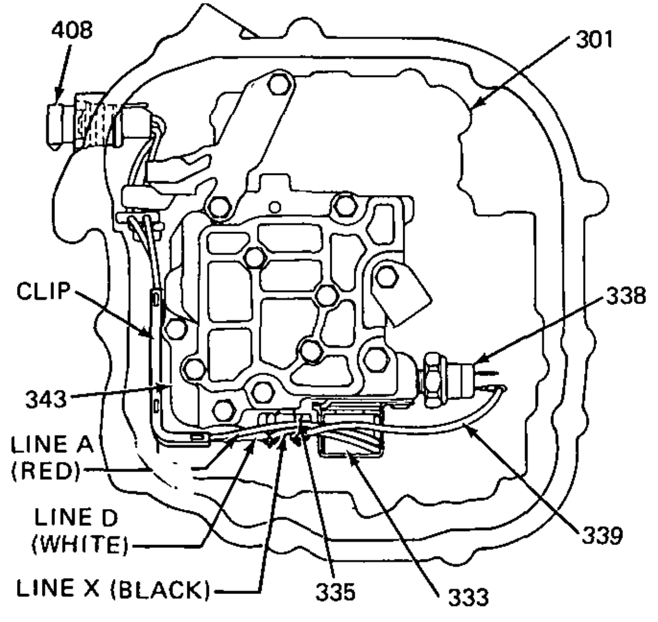
MODEL HS



301 BODY, OIL PUMP AND CONTROL VALVE
333 SOLENOID ASSEMBLY
335 SWITCH, 3RD CLUTCH PRESSURE (N.O.)
338 SWITCH, GOV. PRESSURE (N.O.)
339 WIRE ASSEMBLY (WHITE)
343 BODY, AUXILIARY VALVE
408 ELECTRICAL CONNECTOR

Figure 100A T.C.C. Wiring Diagram

MODELS JD, JM, JN, JS, JW



301 BODY, OIL PUMP AND CONTROL VALVE
333 SOLENOID ASSEMBLY
335 SWITCH, 3RD CLUTCH PRESSURE (N.O.)
338 SWITCH, GOV. PRESSURE (N.O.)
339 WIRE ASSEMBLY (WHITE)
343 BODY, AUXILIARY VALVE
408 ELECTRICAL CONNECTOR

Figure 100 T.C.C. Wiring Diagram

29 SHAFT, OUTPUT
30 RING, SNAP

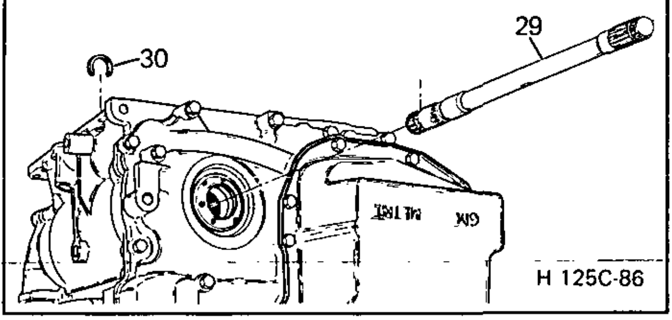
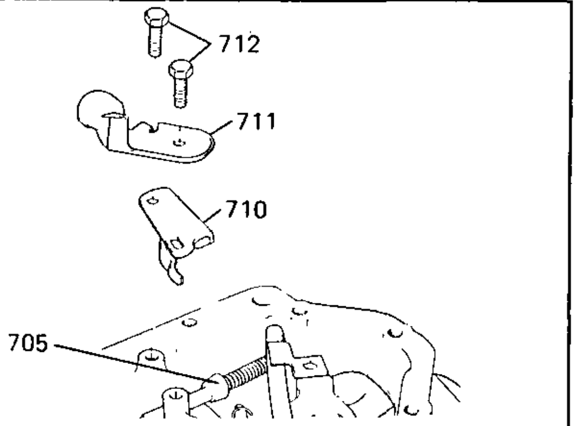


Figure 101 Output Shaft & "C" Ring



705 ACTUATOR ASSEMBLY
710 BRACKET, PARKING LOCK
711 BRACKET, DIPSTICK STOP
712 BOLT, PARKING LOCK BRACKET/CASE

Figure 102 Dipstick Stop & Parking Lock

Reverse Pipe and Parking Bracket

Install or Connect (Figures 102 and 103)

1. Weir (147)
2. Bracket (143)
3. Retainer (143)
4. Screw (142)
5. Bracket (710)
6. Stop (711)
7. Screw (712)

Inspect

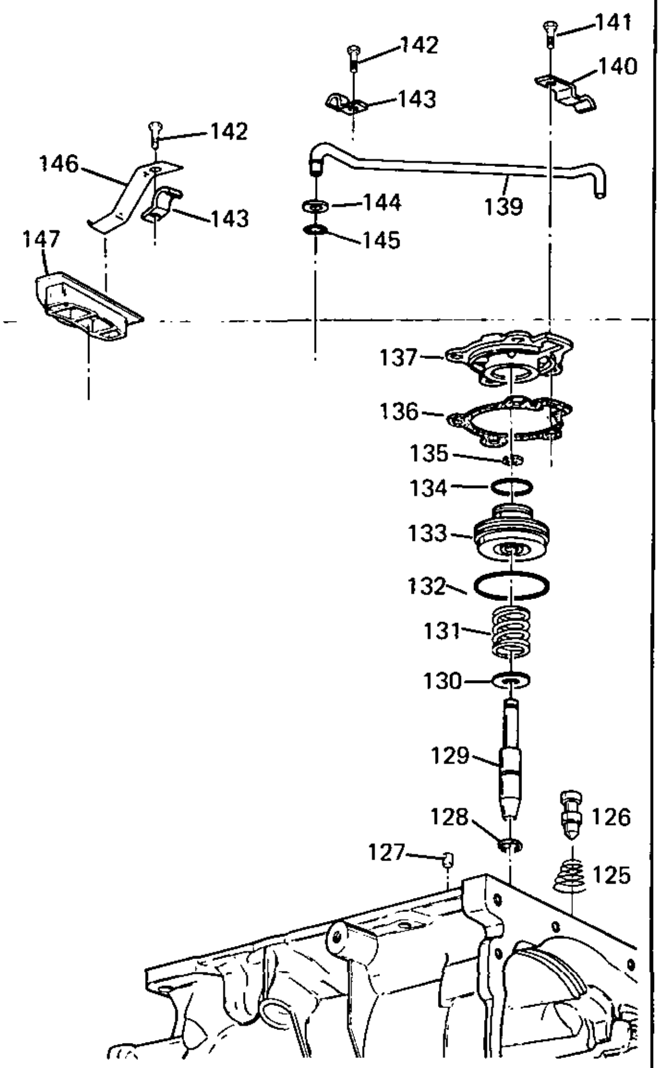
- Actuator Assembly (705) for proper action

Install or Connect (Figure 104)

- Cup plug (120) – use 9.5 mm (3/8") drift

Assemble (Figure 103)

1. Washer (144) onto pipe (139)
2. "O" ring (145) – retain with petrolatum
3. Pipe assembly (139)
4. Bracket (143)
5. Screw (142)



125 SPRING, ACCUMULATOR EXHAUST
126 VALVE, ACCUMULATOR EXHAUST
127 PLUG, ORIFICE
128 RING, OIL SEAL INTER. BAND APP. PIN
129 PIN, INTERMEDIATE, BAND APPLY
130 RETAINER, INTER. SERVO SPRING
131 SPRING, INTER. SERVO CUSHION
132 RING, OIL SEAL (OUTER) INTER. SERVO
133 PISTON, INTERMEDIATE SERVO
134 RING, OIL SEAL (INNER) INT. SERVO
135 RING, SNAP
136 GASKET, INTERMEDIATE SERVO COVER
137 COVER, INTERMEDIATE SERVO
139 PIPE, REVERSE OIL
140 RETAINER, REVERSE OIL PIPE
141 BOLT, INT. SERVO COVER
142 BOLT, PIPE RET/CASE
143 RETAINER, GOVERNOR AND REV. OIL PIPE
144 RING-SEAL BACKUP
145 SEAL, 'O' REVERSE PIPE TO CASE
146 RETAINER, OIL WEIR
147 OIL WEIR

H 125C-66

Figure 103 Oil Pipe & Servo

Tighten

- Torque the screws (142, 712, 142) to 24 N·m (18 ft. lbs.).

INTERMEDIATE SERVO

Disassemble (Figure 103)

1. "E" ring (135) from pin (129)
2. Piston (133) from pin (129)
3. Spring (131)
4. Retainer (130)

Inspect

- Pin (129) for damage
- Seals (134 and 132) for cuts or nicks – proper scarf cut alignment.

  Do not remove seals (132 and 134) unless replacement is necessary.
- Spring (131) for damage
- Retainer (130) for damage
- Cover (137) for damage, cracks, porosity
- Piston (133) for cracks, seal groove damage

Measure (Figures 105 and 106)

Tools Required:

J-28535 Intermediate Band apply pin gage

1. Install J-28535 on the case (112) and the pin (129) into the gage.
2. With a torque wrench apply 11.2 N·m (100 inch pounds of torque.

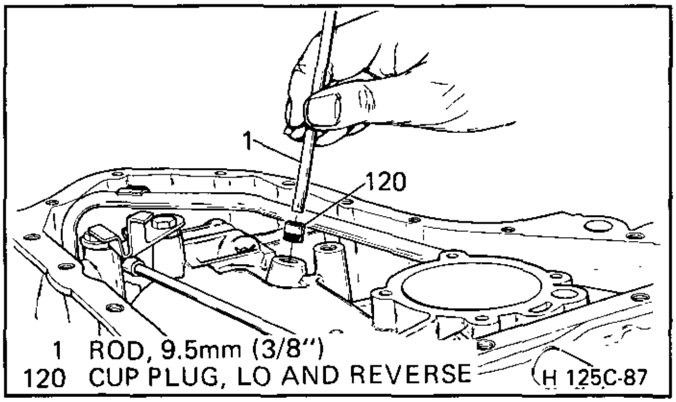


Figure 104 Lo & Reverse Cup Plug

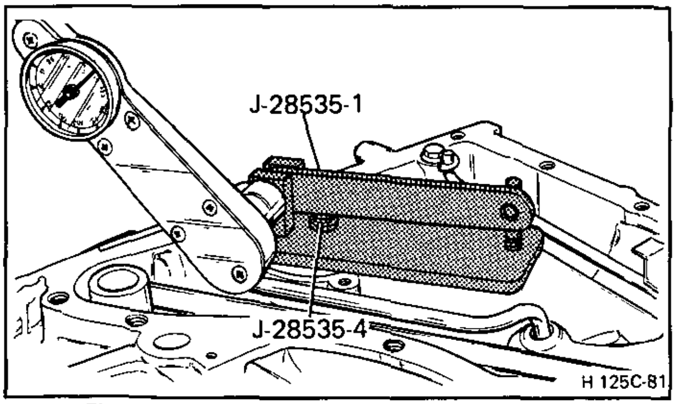


Figure 105 Checking for Proper Apply Pin

INTERMEDIATE BAND
APPLY PIN

LENGTH	IDENTIFICATION
Short	2 Grooves
Medium	1 Groove
Long	No Grooves

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Figure 106 Apply Pin Chart

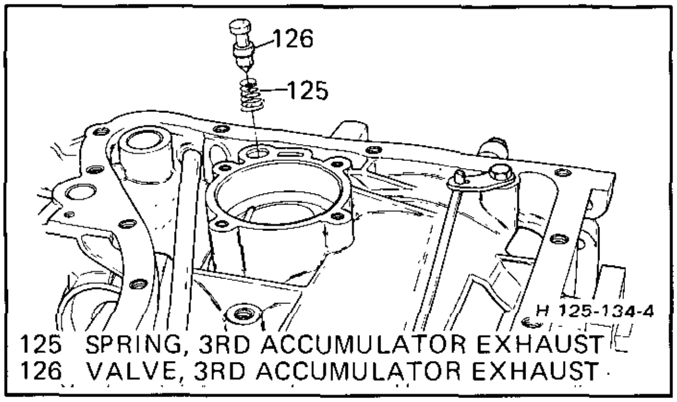


Figure 107 3rd Accumulator Exhaust Valve & Spring

3. If the white line appears in window the pin length is correct.
   - If the white line does not appear, select another length pin – Figure 106. Repeat procedure.
4. Remove pin gage.

Assemble (Figure 103)

1. Retainer (130) onto pin (129)
2. Spring (131) against spacer (13)
3. Piston (133) onto pin
4. "E" ring (135) onto pin

Install or Connect (Figures 107 and 103)

1. Spring (125) into bore
2. Check valve (126) into bore

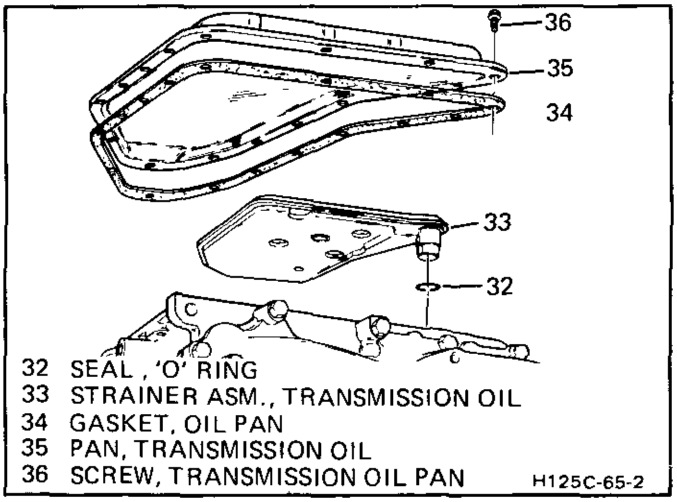


Figure 108 Bottom Pan & Oil Strainer

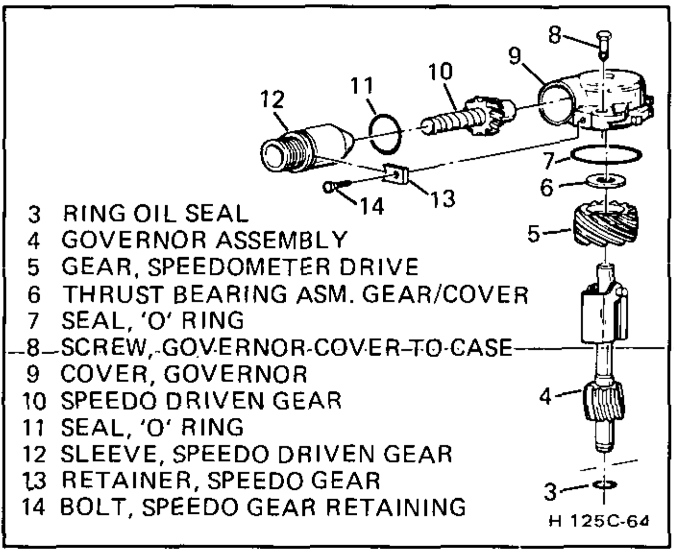


Figure 109 Governor Assembly

3. Servo assembly (133) into servo bore
4. Gasket (136)
5. Cover (137)
6. Bracket (140)
7. Screws (141)

Tighten

- Torque the screws (141) to 11 N·m (8 ft. lbs.).

OIL PAN AND STRAINER

Install or Connect (Figure 108)

1. "O" ring (32) onto the strainer tube
2. Strainer (33) into the case
3. Gasket (34) or apply R.T.V. silicon sealant.
4. Pan (35) onto the case
5. Bolts (36)

Tighten

- Torque the pan bolts (36) to 11 N·m (8 ft. lbs.).

GOVERNOR AND SPEEDOMETER GEAR ASSEMBLY

Clean

- Governor assembly (4)

Inspect (Figure 109)

- Governor
  - Oil passage blocked
  - Damaged springs
  - Missing check balls
  - Seal (3) damage
  - Binding weights

Seal Replacement Procedure

Remove or Disconnect

- Seal (3) – cut off

Install or Connect

- Seal (3) – use petrolatum

Inspect

- Gear (5) for wear
- Bearing (6) for damage
- Cover (9) for porosity or cracks
- Gear (10) for wear
- "O" ring (11) for nicks or cuts
- Sleeve (12) for scoring

Install or Connect (Figure 109)

1. Governor (4) assembly into case
2. Gear (5) onto governor
3. Bearing (6) onto gear
4. New "O" ring (7) into cover (9)
5. Cover (9)
   Make sure shaft (4) is piloted into cover.
6. Screw (8)

Tighten

- Torque the screw (8) to 11 N·m (8 ft. lbs.)

Assemble (Figure 109)

- "O" ring (11) onto sleeve (12)
- Gear (10) into sleeve (12)

Install or Connect

1. Sleeve (12) into cover (9)
2. Retainer (13)
3. Screw (14)

Tighten

- Torque the screw (14) to 9 N·m (75 inch pounds)

Install or Connect

- Transaxle into transmission jack

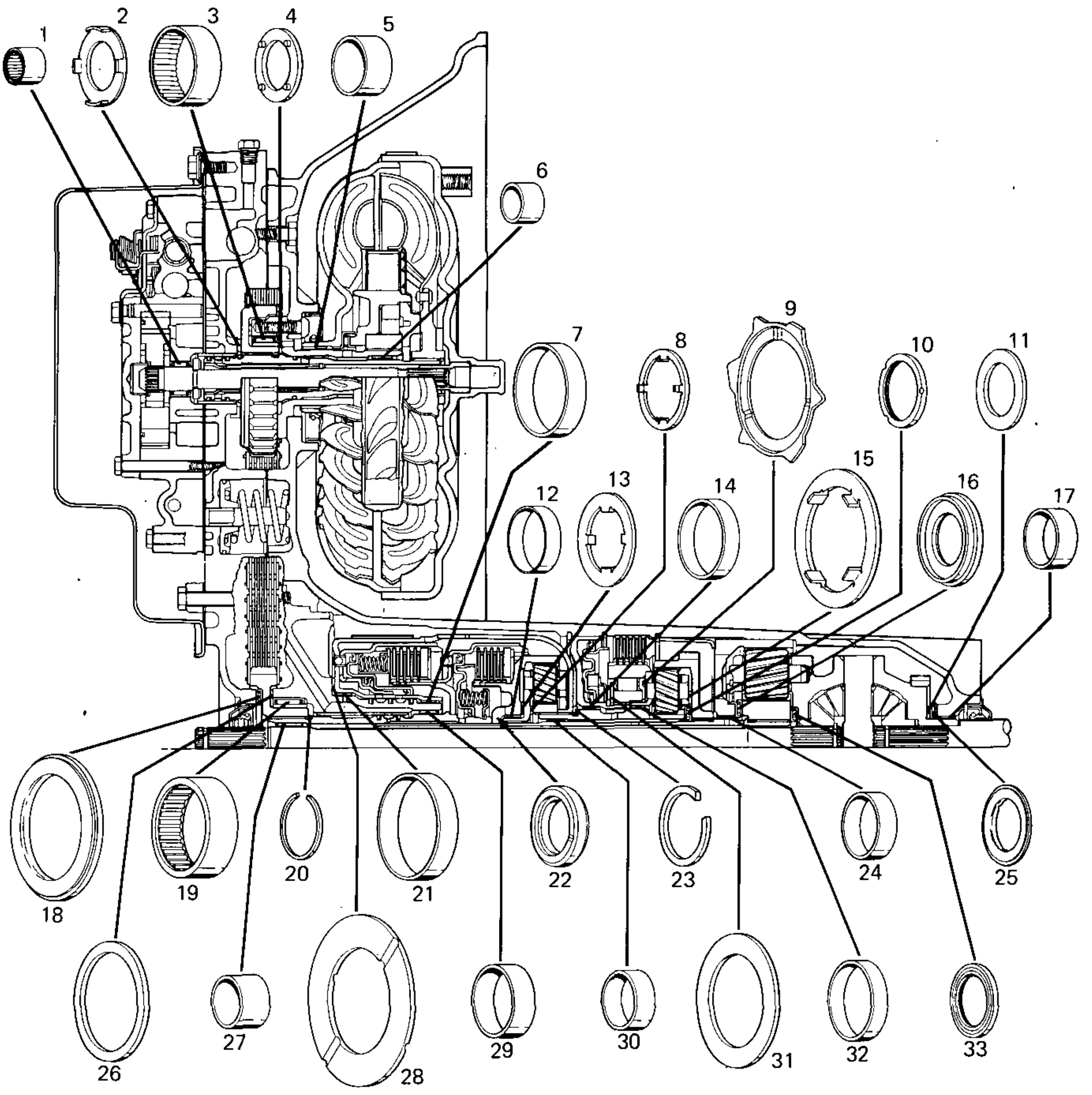
Remove or Disconnect

- J-28664

Install or Connect

Tool Required:
J-21366 Converter Holding Strap

1. Converter (1)
2. J-21366 Converter retaining strap



1. Pump Shaft Roller Bearing Assy. Group 4.226
2. Case Cover To Driven Sprocket Thrust Washer Group 4.131
3. Bearing Assembly Group 4.131
4. Case Cover To Drive Sprocket Thrust Washer Group 4.131
5. Converter Bushing Group 4.115
6. Drive Sprocket Support Bushing Group 4.226
7. Direct Clutch Drum Bushing Group 4.169
8. Input Carrier To Input Sun Gear Thrust Washer Group 4.159
9. Reaction Carrier To Lo Race Thrust Washer Group 4.180
10. Reaction Sun To Internal Gear Thrust Bearing Group 4.159
11. Differential Carrier To Case Sel. Thrust Washer Group 4.176
12. Input Internal Gear Bushing Group 4.158
13. Input Carrier To Input Int. Gear Thrust Washer Group 4.159
14. Lo And Reverse Clutch Housing Bushing Group 4.159
15. Reaction Carrier To Int. Gear Thrust Washer Group 4.180
16. Sun Gear To Internal Gear Thrust Bearing Group 4.178
17. Case Bushing Group 4.319
18. Driven Sprocket Thrust Bearing Assembly Group 4.131
19. Bearing Assembly Group 4.131
20. Selective Snap Ring Group 4.169
21. Direct Clutch Bushing Group 4.169
22. Input Shaft Thrust Washer Group 4.158
23. Selective Snap Ring Group 4.216
24. Final Drive Internal Gear Bushing Group 4.319
25. Differential Carrier To Case Thrust Brg. Assy. Group 4.176
26. Driven Sprocket Support Thrust Washer Group 4.131
27. Input Shaft Bushing Group 4.158
28. Thrust Washer Group 4.169
29. Driven Sprocket Support Bushing Group 4.226
30. Reaction Sun Gear Bushing Group 4.159
31. Reverse Housing To Lo Race Selective Washer Group 4.180
32. Reaction Carrier Bushing Group 4.159
33. Sun Gear To Carrier Thrust Bearing Group 4.159

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Figure 110 Bushing & Thrust Washer Locations

TORQUE SPECIFICATIONS

DESCRIPTION OF USAGE	QUANTITY	SIZE	TORQUE ASSEMBLY
Valve Body to Case Cover	2	M6 x 1.0 x 65.0	11 N·m (8 ft.-lbs.)
Pump Cover to Case Cover	1	M8 x 1.25 x 130.00	24 N·m (18 ft.-lbs.)
Pump Cover to Valve Body	4	M6 x 1.0 x 20.0	11 N·m (8 ft.-lbs.)
Pump Cover to Valve Body	3	M6 x 1.0 x 90	11 N·m (8 ft.-lbs.)
Solenoid to Valve Body	1	M6 x 1.0 x 16	11 N·m (8 ft.-lbs.)
Valve Body to Case Cover	9	M6 x 1.0 x 45.0	11 N·m (8 ft.-lbs.)
Valve Body to Case	1	M8 x 1.25 x 85.0	24 N·m (18 ft.-lbs.)
Valve Body to Driven Sprocket Support	1	M8 x 1.25 x 65.0	24 N·m (18 ft.-lbs.)
Case Cover to Case	4	M8 x 1.25 x 45.0	24 N·m (18 ft.-lbs.)
Case Cover to Case	4	M8 x 1.25 x 55.0	24 N·m (18 ft.-lbs.)
Case Cover to Case	1	M8 x 1.25 x 40.0	24 N·m (18 ft.-lbs.)
Case Cover to Case	7	M8 x 1.25 x 25.0	24 N·m (18 ft.-lbs.)
Case Cover to Case	2	M8 x 1.25 x 25.0	24 N·m (18 ft.-lbs.)
Case to Drive Sprocket Support	4	M8 x 1.25 x 23.5	24 N·m (18 ft.-lbs.)
Oil Pan and Valve Body Cover	27	M8 x 1.25 x 16.0	11 N·m (8 ft.-lbs.)
Manual Detent Spring Assembly to Case	1	M6 x 1.0 x 10.0	11 N·m (8 ft.-lbs.)
Cooler Connector	2	1/4 - 18 NPSF	38 N·m (23 ft.-lbs.)
Line Pressure Take-Off	1	1/8 - 27 NPTF	11 N·m (8 ft.-lbs.)
Intermediate Servo Cover	4	M6 x 1.0 x 20.0	11 N·m (8 ft.-lbs.)
Parking Lock Bracket to Case	2	M8 x 1.25 x 20.0	24 N·m (18 ft.-lbs.)
Pipe Retainer to Case	2	M8 x 1.25 x 14.0	24 N·m (18 ft.-lbs.)
Governor Cover to Case	2	M6 x 1.0 x 25.0	11 N·m (8 ft.-lbs.)
Speedometer Driven Gear to Governor Cover	1	M6 x 1.0 x 16.0	9 N·m (75 in.-lbs.)
T.V. Cable to Case	1	M6 x 1.0 x 16.0	9 N·m (75 in.-lbs.)
Pressure Switch	2	1/8 - 27 NPTF	11 N·m (8 ft.-lbs.)

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Figure 111 Torque Specifications

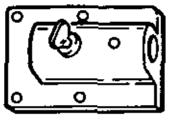
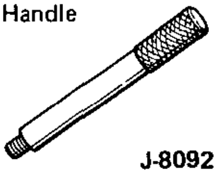
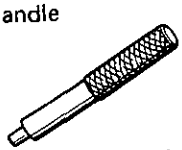
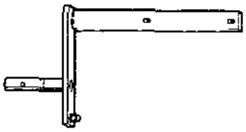
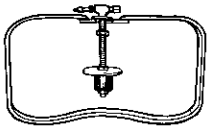
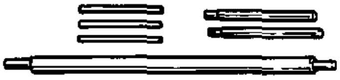
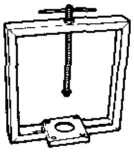
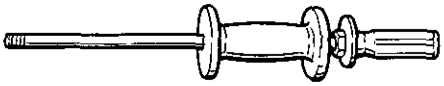
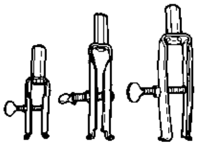
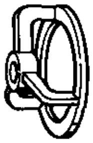
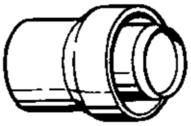
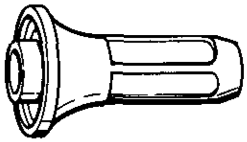
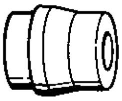
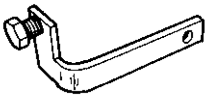
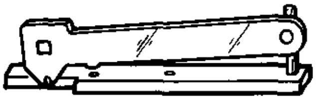
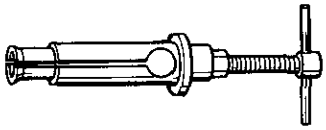
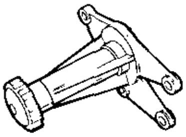
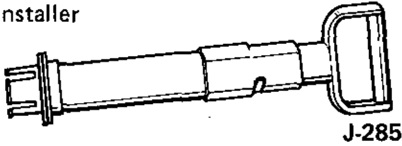
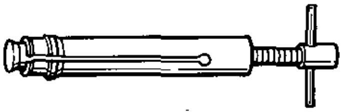
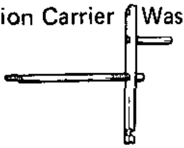
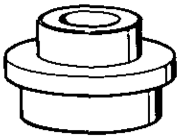
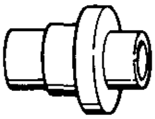
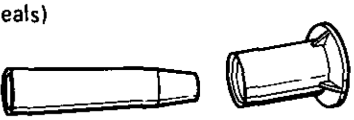
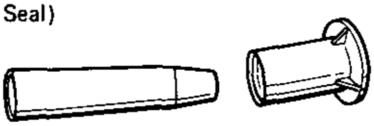
Transmission Support Fixture Base  J-3289-20	Handle  J-8092 Handle  J-7079-2	
Transmission Support Fixture  J-28664	Torque Converter Pressurization Kit  J-21369-B	Dial Indicator Stand and Guide Pin Set  J-25025-A
Compressor Screw and Frame  J-23456	Universal Remover  J-23907	Universal Bushing Remover Set  J-29369
Forward Clutch Spring Compressor  J-23327-1	#40 Torx Bit or Equivalent  J-25359-5	Axle Seal Installer  J-29130
Adapter - Forward Clutch Spring Compressor  J-25018-A		Converter Seal Installer  J-28540
Adapter Plug  J-26958-10 Adapter Bracket  J-26958-11	Intermediate Band Apply Pin Gauge  J-28535	Torque Converter End-Play Fixture  J-28538
Output Shaft Aligning and Loading Tool  J-26958	Lo-Reverse Clutch Housing Remover and Installer  J-28542	Input Shaft Lifter  J-28544
Final Drive Unit Remover and Installer  J-28545	"C" Ring Remover - Output Shaft  J-28583	Gauge - Reaction Sun Gear Snap Ring and Reaction Carrier Washer Selection  J-28588
Bearing Installer - Sprocket Supports  J-28677	Pump Bearing - Installer and Remover  J-28698	Thermo - Element Height Gauge  J-29023
Universal Bushing Installer Set  J-29369	Turbine Shaft Seal Installer and Sizer (2 Seals)  J-29569	Turbine Shaft Seal Installer and Sizer (1 Seal)  J-29829

Figure 112 Tool List

SECTION 7B

MANUAL TRANSAXLE ON-CAR SERVICE

CONTENTS

GENERAL DESCRIPTION

The on-car service procedures for both the 4-speed and 5-speed manual transaxle are the same. The components vary only in internal structure not externally. The shift lever, shift cables, clutch and housing are the same for both units. The units look the same and attach to the engine with similar procedures.

The shifter cables are called select and shift cables. When one cable moves the other cable should be stationary. Both transmissions have two cables. The *shifter cables attach to the shifter posts with pins.* The shifter cables are adjusted at the rear where the cables attach to the transmission. The shifter cables must be detached from the transmission to make shift cable adjustments. Shift cable adjustments are verified when 5/32″ drill rod or no. 22 drill bits inserted in shifter assembly.

The transmission and cradle removal and installation procedures are the same for the 4-speed and 5-speed transmission. The cradle has two forward and rear mounts bolted to the frame. The engine has two lower mounts with studs attaching to the cradle. The engine has one rear upper strut mount. When installing the motor and transmission mounts be certain the mounts are aligned to the center of the mounts. Alignment of mounts will keep the driveline centered in installation.

MAINTENANCE AND ADJUSTMENT

Checking Transaxle Mounts

Raise the vehicle on a hoist. Push up and pull down on the case while observing the mounts. If the rubber separates from the metal plate of the mount or if the case 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 case or crossmember.

Checking Fluid Level

Figure 1

See the Maintenance Schedule booklet to find out how often the lubricant level should be checked and what type of lubricant should be used.

Check the fluid level only when the engine is off, the vehicle is level and the transaxle is cool enough to let you rest your fingers on the transaxle case. To check the fluid level, remove the speedometer fitting on the driver's side of the case, above the axle shaft.

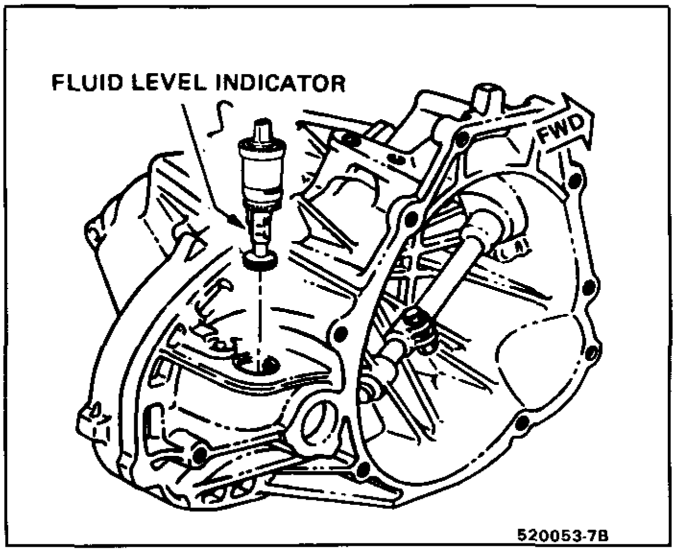


Fig. 1 Filling Procedure

Be sure the fluid level is between the "L" and "H" marks on this fitting.

If needed, add enough fluid to bring the level up to the "L" mark. Be sure to seat the speedometer fitting fully when reinstalling.

Shifter Shaft Selective Washer

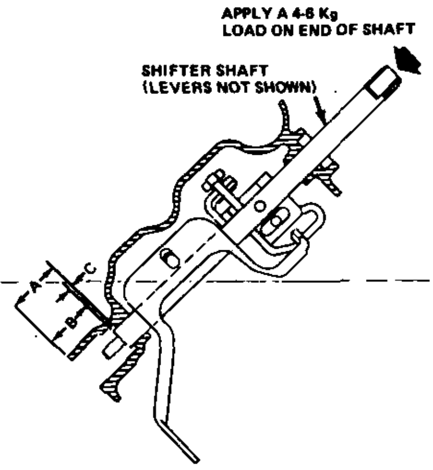
(Figure 2)

When "hang-up" is encountered in shifting in the 1-2 gear range, and the shift cables are properly adjusted, it may be necessary to check the washer shown in Figure 2. This washer helps position the shifter shaft for proper shifting characteristics. Follow the steps in Figure 2 to obtain correct washer thickness.

Cable Adjustment Procedure

Figure 5

1. Disconnect negative (-) battery cable.
2. Place transaxle in first gear.
3. Loosen shift cable attaching nuts (E) at transaxle levers (D) and (F) shown in Figure 5.
4. Remove console and trim plates as required for access to shifter.



1. Remove reverse inhibitor fitting spring and washer from end of housing.
2. Position shifter shaft in 2nd gear.
3. Measure Dimension A (End of housing to shoulder just behind end of shaft).
4. Apply a load of 4-6 Kg on opposite end of shaft. Then measure Dimension B (End of housing to end of shifter shaft major diameter).
5. Subtract: Dimension A minus Dimension B equals Distance C.
6. Compare result of step 5 with chart and choose the proper shim for use on reinstallation.

SHIM PART NO.	DIM C (MM)	COLOR & NO OF STRIPES
14008235	1.8	3 WHITE
476709	2.1	1 ORANGE
476710	2.4	2 ORANGE
476711	2.7	3 ORANGE
476712	3.0	1 BLUE
476713	3.3	2 BLUE
476714	3.6	3 BLUE
476715	3.9	1 WHITE
476716	4.2	2 WHITE

G20001-7B

Fig. 2 Selective Washer/Shifter Shaft

5. With shifter lever in first gear position (pulled to left and held against stop), insert alignment pins F and G as shown in view C.
6. Remove lash from transaxle by rotating lever (D) in direction of arrow while tightening nut (E) view A. Levers (D) and (F) should be kept from moving during this process. Similarly, tightening nut (E) on lever (F). (No biasing required). Again levers (D) and (F) must remain stationary. Nut (E) on levers (D) and (F) tightened to 27 N·m (20 lb.ft).
7. Ensure reverse inhibit cam is against roller and align if necessary.
8. Remove alignment pins F and G at shifter assembly.
9. Replace console trim plate.
10. Reconnect negative battery cable.

While cycling shifter from 1 to 2 and 2 to 1, the select cable B should not move.

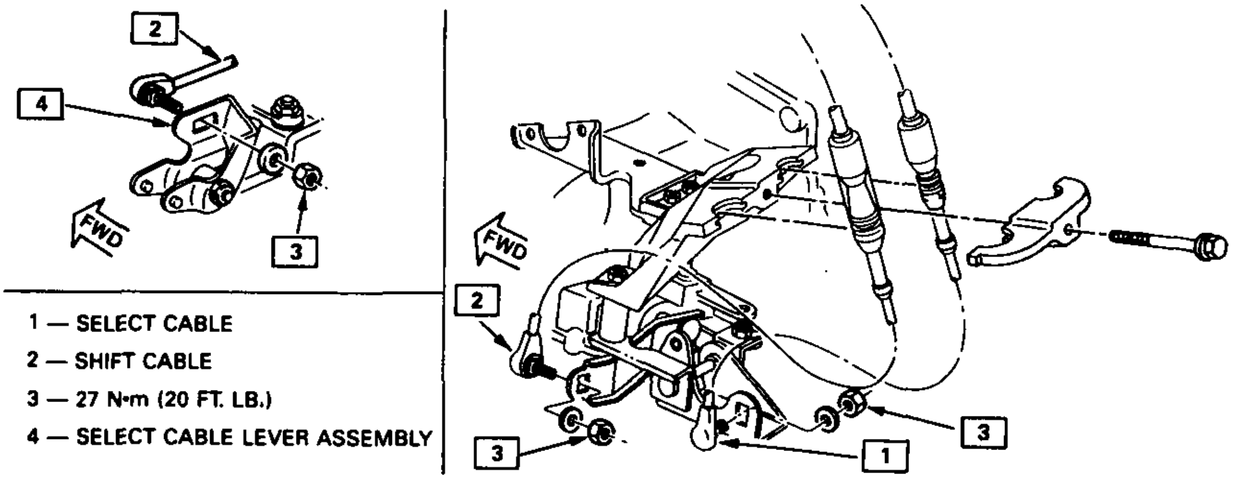
ON-CAR SERVICE

TRANSMISSION SHIFT CABLES

↔ Remove or Disconnect

Figures 3 and 4

1. Negative (-) battery cable.
2. Place shifter in first gear.
3. Shift knob.
4. Front trim plate.
5. Shifter trim plate.
6. Rear console pad assembly.
7. E.C.M.
8. E.C.M. electrical connections.
9. Front carrier to I.P. reinforcement.
10. Carrier reinforcment.
11. Carpet clips and rivits at console.
12. Heater control.
13. Radio.



1 — SELECT CABLE
2 — SHIFT CABLE
3 — 27 N·m (20 FT. LB.)
4 — SELECT CABLE LEVER ASSEMBLY

520050-7B

Fig. 3 Shift & Select Cable Routing & Attachment at Transaxle

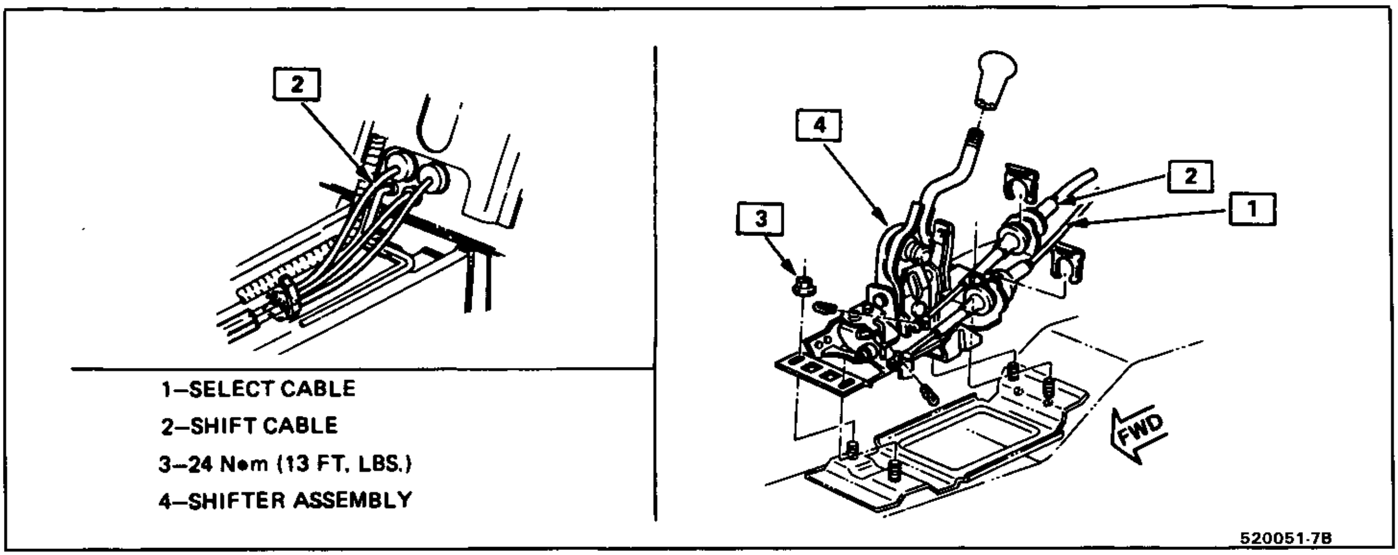


Fig. 4 Shift Cable & Select Cable Routing and Cable Attachment at Shifter

14. Carrier.
15. Shift cable and select cable from shifter.
16. Release rubber grommet on cable from body.
17. With transaxle in first gear, remove cables at gear select lever assembly.
18. Mount attaching shift cable and select cable assemblies to transaxle.
19. Shift and select cables from transaxle.
20. Pull cables through body into passenger compartment.

Install or Connect

1. Pilot cable from passenger side through body into engine compartment.
2. Cables to mounting bracket at transaxle.
3. Shift cables to transaxle.
4. With transmission lever assembly in first gear position, cables to lever assembly.
5. Shift cables to shifter assembly.
6. Rubber grommet on cable to body.
7. Carrier assembly, console.
8. Radio.
9. Heater control.
10. Carpet clips and rivits at console.
11. Carrier reinforcements.
12. E.C.M. electrical connection.
13. E.C.M.
14. Front pad assembly.
15. Front pad trim plate.
16. Rear console pad assembly.
17. Shift trim plate.
18. Shift knob.
19. Negative (-) battery cable.

SHIFTER ASSEMBLY

Remove or Disconnect

Figure 4

1. Steps 1 thru 14 as outlined in shift cable and select cable removal procedure.
2. Mark location of shifter assembly for reinstallation purposes.
3. Shifter assembly nuts.

Install or Connect

1. Shifter to body at location marked.

Tighten

- to 24 N·m (18 lb.ft.)

Install or Connect

1. Cables to shifter assembly.
2. Carrier and console components as outlined in shift cable and select cable installation procedure.

SHIFT CABLE AND SELECT CABLE LEVER ASSEMBLY

Remove or Disconnect

1. Cables from shift lever at transaxle.
2. Bolt from mount at transaxle.
3. Cotter key from crosshaft through rod at shift shaft.
4. Transaxle shift lever assembly.

Install or Connect

1. Shift lever assembly to shifter shaft.
2. Crosshaft through rod into shift lever assembly.
3. Cotter key into through rod.
4. Bolt through mount at transaxle.
5. Shift cables to shift levers at transaxle.

SHIFT CABLE BRACKET

Remove or Disconnect

1. Shift and select cables from transaxle shift levers.

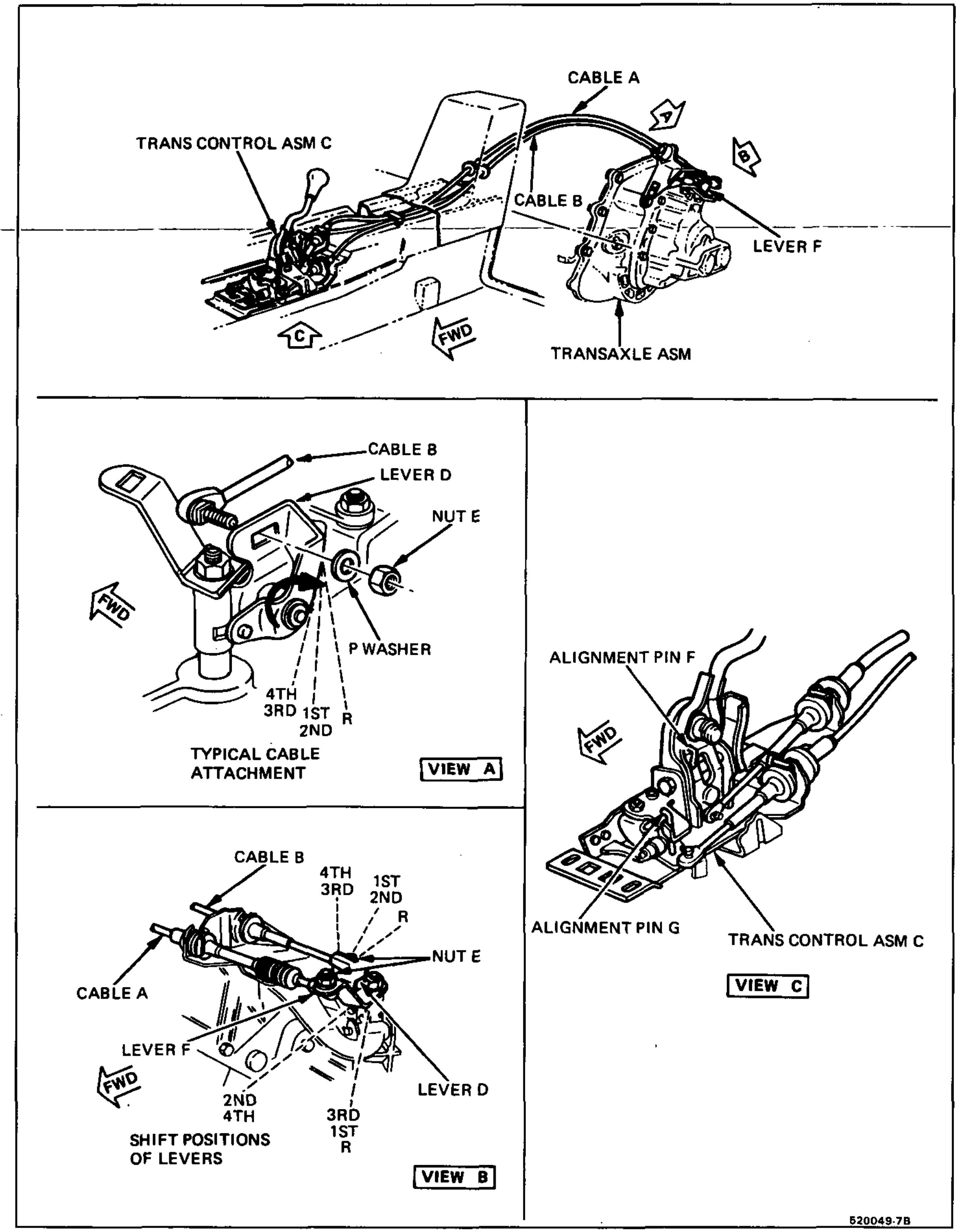


Fig. 5 Cable Adjustment

2. Bolt through transaxle cable bracket top half and separate cable bracket halfs.
3. Shift and select cables.
4. Bracket from transaxle.

Install or Connect

1. Bracket to transaxle.
2. Shift and select cable to bracket.
3. Bolt through transaxle cable bracket top half and join cable bracket halfs.
4. Shift and select cables to transaxle shift levers.

MANUAL TRANSAXLE

Remove or Disconnect

Figure 6

Tools required:

- J-28467 - Engine Support Fixture.

1. Negative (-) battery cable.
2. Deck lid.
3. Louvered panels.
4. Upper rear engine support bolt.

Install or Connect

1. Engine support fixture J-28467.

Remove or Disconnect

1. Hoist car.
2. Slave cylinder from clutch (do not disconnect hydraulic line).
3. Shift cables from transmission.
4. EGR valve ouput pipe from exhaust manifold.
5. Tires.
6. Parking brake cable from calipers.
7. Parking brake cable from body.
8. Lower ball joints.
9. Tie rods.
10. Axle shafts from transmission. See Section 7D.
11. Rubber skirts from splash shield cradle retainers.
12. Rear transmission bracket mount bolts.
13. Motor mount nuts from cradle and front engine mount shock.
14. Bolts from crossover pipe to converter.
15. Cradle bolts and cradle from engine and support cradle on adjustable stand.
16. Oxygen sensor wire.
17. Crossover pipe heat shields.
18. Exhaust crossover pipe.
19. Upper transmission bolts to engine.
20. Clutch inspection plate cover.
21. Lower engine bolt studs and coolant pipe from stud and nut.
22. Transaxle.

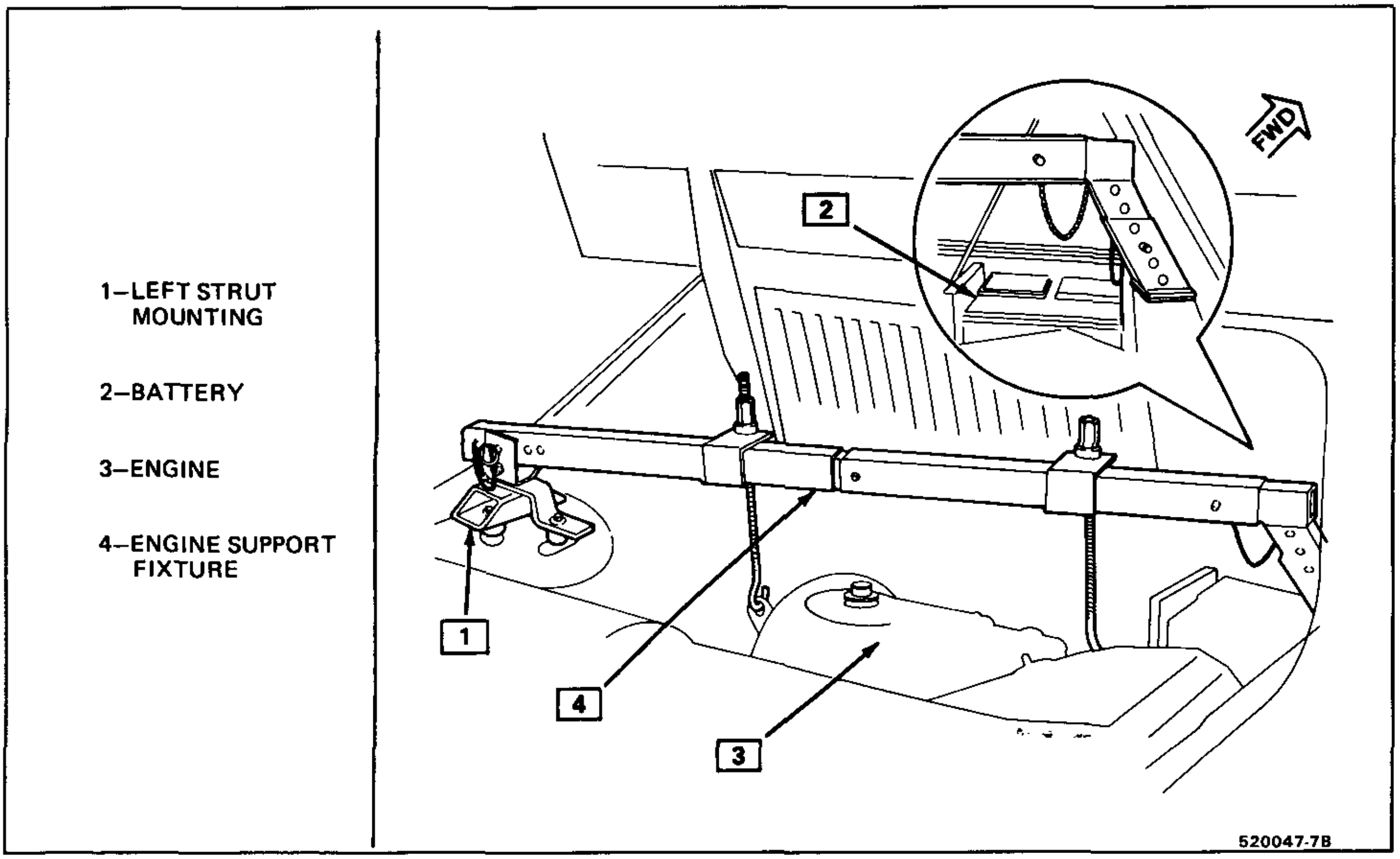


Fig. 6 Engine Support Fixture J-28467 Installed

Install or Connect

1. Hoist transaxle in place.
2. Position clutch inspection cover on starter motor.
3. Transmission on engine with upper bolts. 75 N·m (55 lb.ft.).

Remove or Disconnect

1. Transaxle jack stand.

Install or Connect

1. Wire harness and coolant pipe on transaxle stud.
2. Clutch inspection plate cover.
3. Speedometer wires.
4. Axle shafts. See Section 7D.
5. Cradle and four bolts front 90 N·m (67 lb.ft.) rear 103 N·m (76 lb.ft.).
6. Rear transmission bracket bolts and align bracket 54 N·m (40 lb.ft.).
7. Motor mount nuts and align mount 57 N·m (42 lb.ft.).
8. Engine shock.
9. Ball joints (45 N·m 33 lb.ft.).
10. Tie rods 47 N·m (34 lb.ft.).
11. Parking brake cables.
12. Splash shield retainers.
13. Tires.

Remove or Disconnect

1. Engine support fixture - J28467.

Install or Connect

1. Upper rear engine support bolt 58 N·m (43 lb.ft.).
2. Crossover pipe and wire on oxygen sensor.
3. Heat shields.
4. EGR valve output pipe to exhaust manifold.
5. Clutch slave cylinder to transmission 22 N·m (16 lb.ft.).
6. Transmission shift cables at transmission.
7. Intake duct at throttle body from intake elbow.
8. Fill transmission with fluid.
9. Deck lid.
10. Louvered panels.
11. Negative battery cable.

SECTION 7B1

4-SPEED 76MM MANUAL TRANSAXLE

CONTENTS

GENERAL DESCRIPTION

The four-speed transaxle assembly (Figure 1) is representative of the constant-mesh design transmission, combined with a differential unit and assembled in a single case. All forward gears are in constant mesh. For ease of shifting and selection of the desired gear range, synchronizers with blocker rings, controlled by shift forks are used. Reverse uses a sliding idler gear arrangement.

Fundamental components of these units are the aluminum transaxle case, aluminum clutch cover, input gear (shaft), output gear (shaft), and the differential assembly. The input gear, output gear and differential are all supported by preloaded tapered roller bearings. Selective shims are used beneath the right-hand bearing cups to establish the correct preload.

The final output gear (an integral part of the output shaft) turns the ring gear and differential assembly, thereby turning the drive axle shafts which are attached to the front wheels.

The differential is a conventional arrangement of gears that divides the torque between the drive axle shafts and allows them to rotate at different speeds. A basic differential consists of a set of four gears.

Two are called differential side gears, and two are differential pinion gears. Each side gear is splined to a drive axle shaft which must turn when its side gear rotates.

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case and is at right angles to the drive axle shafts.

GENERAL INFORMATION

Transaxle to engine attachment is accomplished with six (6) bolts, five passing through the transaxle bell housing and into engine bosses while one attachment on the back side of the engine screws into a transaxle boss.

Two cable assemblies are utilized to shift the gears, one being the trans-selector cable and the other a trans-shifter cable.

The routing of the control cables is forward through the front of the dash, where a grommet and retainer holds them in place, and they are anchored to the transaxle, either through the use of clips (M19) or by a clamp and bracket (MX6). The cables are attached to the trans-control levers with spring wire clips and stud combinations. The control mechanism bracket allows the cables to be retained by clips and slots.

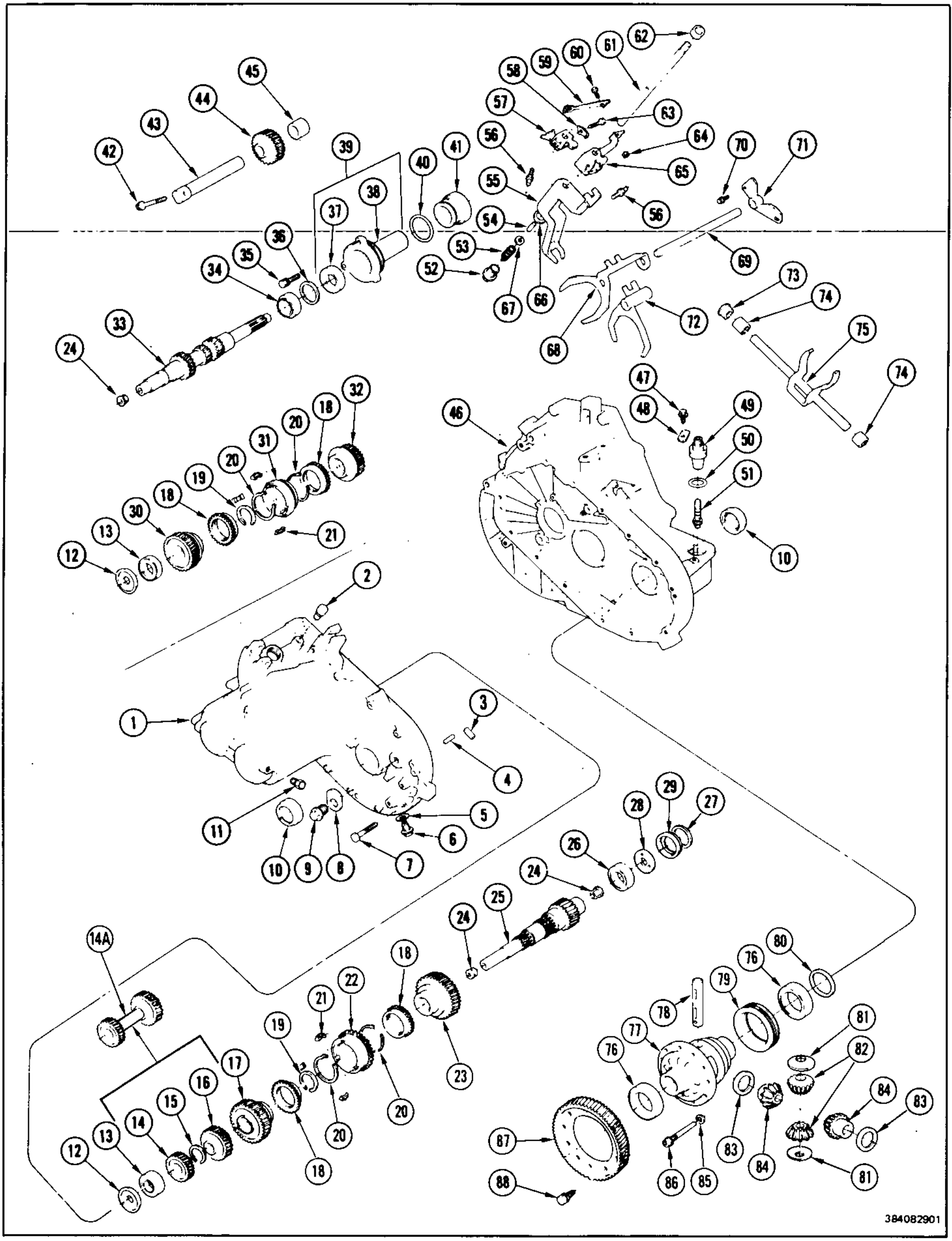


Figure 1 Manual Transaxle-Exploded View (1 of 2)

1. CASE ASSEMBLY
2. VENT ASSEMBLY
3. MAGNET
4. PIN
5. WASHER, Drain Screw
6. SCREW, Drain
7. BOLT
8. WASHER, Fill Plug
9. PLUG, Fill
10. SEAL ASSEMBLY, Axle Shaft
11. PLUG
12. SHIELD, Oil
13. BEARING ASSEMBLY
14. GEAR, 4th Speed Output
14A. GEAR, 3rd/4th Speed Output (One Pc. Gear for MX6)
15. RING, 3rd Speed Output Gear Retaining
16. GEAR, 3rd Speed Output
17. GEAR, 2nd Speed Output
18. RING, Synchronizer Blocking
19. RING, Synchronizer Retaining
20. SPRING, Synchronizer Key Retaining
21. KEY, Synchronizer
22. SYNCHRONIZER ASSEMBLY
23. GEAR, 1st Speed Output
24. SLEEVE, Oil Shield
25. GEAR, Output
26. BEARING ASSEMBLY, Output
27. SHIM, Output Gear Bearing Adjustment
28. SHIELD, Output Bearing Oil
29. RETAINER, Output Gear Bearing Oil Shield
30. GEAR, 4th Speed Input
31. SYNCHRONIZER ASSEMBLY
32. GEAR, 3rd Speed Input
33. GEAR, Input Cluster
34. BEARING ASSEMBLY, Input
35. SCREW
36. SHIM, Input Gear Bearing Adjustment
37. SEAL ASSEMBLY, Input Gear
38. RETAINER, Input Gear
39. RETAINER ASSEMBLY, Input Gear Bearing
40. SEAL, Input Gear Bearing Retainer
41. BEARING ASSEMBLY, Clutch Release
42. SCREW & WASHER, Reverse Idler
43. SHAFT, Reverse Idler
44. GEAR ASSEMBLY, Reverse Idler
45. SPACER, Reverse Idler Shaft
46. HOUSING ASSEMBLY, Clutch & Differential
47. SCREW
48. RETAINER, Speedo Gear Fitting
49. SLEEVE, Speedo Driven Gear
50. SEAL, Speedo Gear Sleeve
51. GEAR, Speedo Driven
52. SEAT, Reverse Inhibitor Spring
53. SPRING, Reverse Inhibitor
54. PIN
55. LEVER, Reverse Shift
56. STUD, Reverse Lever Locating
57. LEVER ASSEMBLY, Detent
58. WASHER, Lock Detent Lever
59. SPRING, Detent
60. BOLT
61. SHAFT, Shift
62. SEAL ASSEMBLY, Shift Shaft
63. BOLT
64. NUT
65. INTERLOCK, Shift
66. SHIM, Shift Shaft
67. WASHER, Reverse Inhibitor Spring
68. FORK, 3rd & 4th Shift
69. SHAFT, Shift Fork
70. SCREW
71. GUIDE, Oil
72. FORK, 1st & 2nd Shift
73. SEAL ASSEMBLY, Clutch Fork Shaft
74. BEARING, Clutch Fork Shaft
75. SHAFT ASSEMBLY, Clutch Fork
76. BEARING ASSEMBLY, Differential
77. CASE, Differential
78. SHAFT, Differential Pinion
79. GEAR, Speedo Drive
80. SHIM, Differential Bearing Adjustment
81. WASHER, Pinion Thrust
82. GEAR, Differential Pinion
83. WASHER, Side Gear Thrust
84. GEAR, Differential Side
85. LOCKWASHER
86. SCREW, Pinion Shaft
87. GEAR, Differential Ring
88. BOLT

Figure 2 Manual Transaxle-Exploded View (2 of 2)

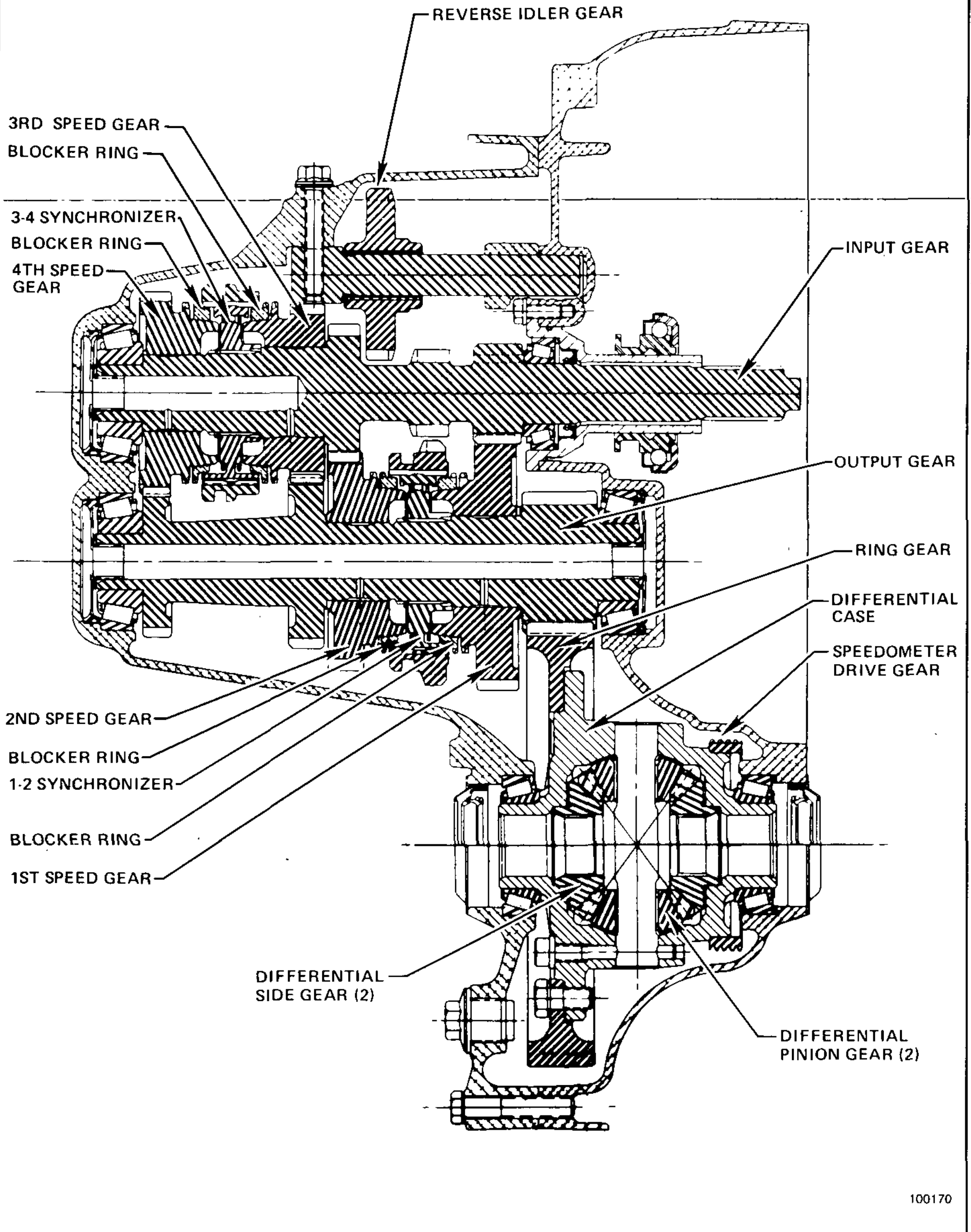


Figure 3 Manual Transaxle Cross-Section

MAINTENANCE AND ADJUSTMENT

CHECKING TRANSAXLE MOUNT

Pull up and push down on the transaxle case while observing the mount. If the rubber separates from the metal plate of the mount or if the case move up, but not down (mount bottomed out), replace the mount. If there is relative movement between the metal plate of the mount and its attaching point, tighten the bolts attaching the mount to the mount bracket or side frame.

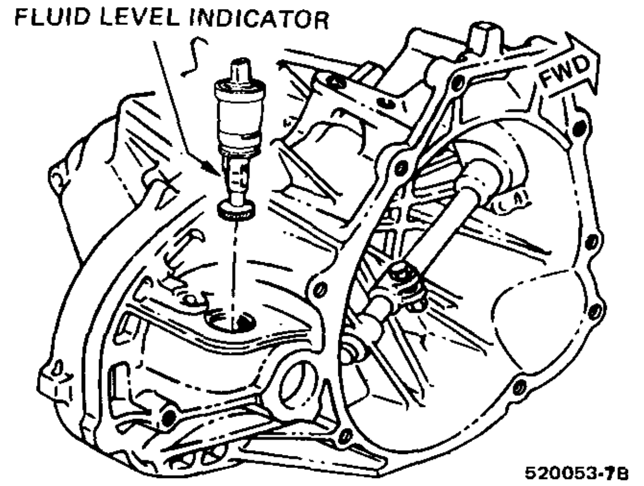


Figure 4 Oil Filling Procedure

CHECKING FLUID LEVEL (FIGURE 2)

See the Maintenance Schedule booklet to find out how often the lubricant level should be checked and what type of lubricant should be used.

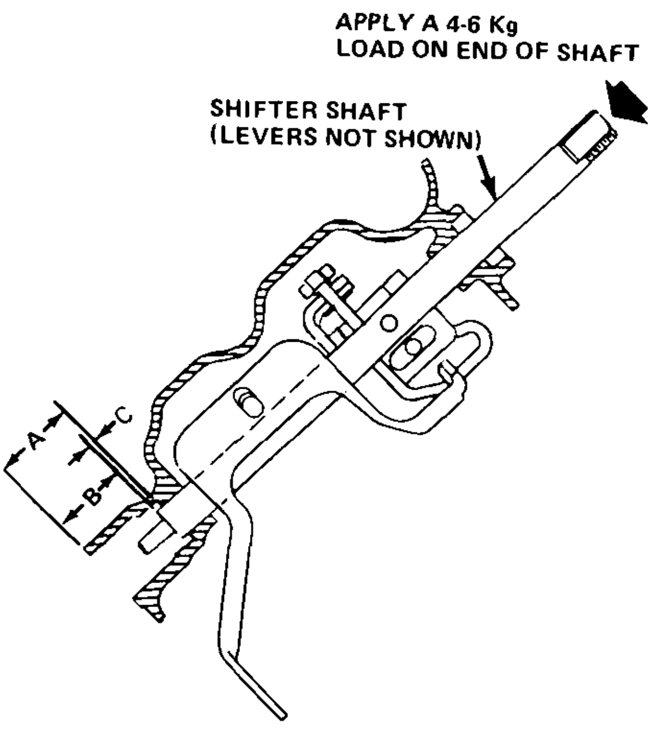
Check the fluid level only when the engine is off, the vehicle is level and the transaxle is cool enough to let you rest your fingers on the transaxle case. To check the fluid level, remove the speedometer fitting on the dri

Be sure the fluid level is between the "L" and "H" marks on this fitting.

If needed, add enough fluid to bring the level up to the "L" mark. Be sure to seat the speedometer fitting fully when reinstalling.

SHIFTER SHAFT SELECTIVE WASHER (FIGURE 5)

When "hang-up" is encountered in shifting in the 1-2 gear range, and the shift cables are properly adjusted, it may be necessary to check the washer shown in Figure 5. This washer helps position the shifter shaft for proper shifting characteristics. Follow the steps in Figure 5 to obtain correct washer thickness.



1. Remove reverse inhibitor fitting spring and washer from end of housing.
2. Position shifter shaft in 2nd gear.
3. Measure Dimension A (End of housing to shoulder just behind end of shaft).
4. Apply a load of 4-6 Kg on opposite end of shaft. Then measure Dimension B (End of housing to end of shifter shaft major diameter).
5. Subtract: Dimension A minus Dimension B equals Distance C.
6. Compare result of step 5 with chart and choose the proper shim for use on reinstallation.

SHIM PART NO.	DIM C (MM)	COLOR & NO OF STRIPES
14008235	1.8	3 WHITE
476709	2.1	1 ORANGE
476710	2.4	2 ORANGE
476711	2.7	3 ORANGE
476712	3.0	1 BLUE
476713	3.3	2 BLUE
476714	3.6	3 BLUE
476715	3.9	1 WHITE
476716	4.2	2 WHITE

Figure 5-Selective Washer/Shifter Shaft

DIAGNOSIS

Before attempting to repair the clutch, transaxle or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transaxle problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished, and the following checks and adjustments made before disassembling the clutch or transaxle for repairs.

Diagnosis of drivetrain noises may seem baffling because many noises believed to be coming from the trnasaxle may actually be originating from other sources, such as tires, road surfaces, wheel bearings, engine, and exhaust system.

These noises may vary by vehicle size, type and amount of body insulation used. Therefore, a thorough and careful check should be made to determine the source of the noise before disassembling the transaxle. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the transaxle.

It should also be remembered that transaxle gears, like any mechanical device, are not absolutely quiet and, will exhibit some normal operating noise.

The following is a suggested approach to verify suspected transxle noises.

1. Select a smooth, level asphalt road to reduce tire and resonant body noise.
2. Drive vehicle far enough to thoroughly warm up all lubricants.
3. Note speed at which noise occurs and, in which gear range the transmission is in at the time.
4. Check for noises with engine running and vehicle stopped.
5. Determine in which of the following drive conditions noise is occuring:
   - A. Drive - light acceleration or heavy pull.
   - B. Float - maintaining constant vehicle speed at light throttle on a level road.
   - C. Coast - partly or fully closed throttle with transaxle in gear.
   - D. All of above.
6. After road testing the vehicle, refer to the following conditions and probable causes along with the Diagnosis Chart (Figure 6).

BEARINGS

Bad bearings generally produce a rough "growl" or "grating" sound, rather than the "whine" which is typical of gear noise.

Before diagnosing a bearing problem, clean the cone assembly thoroughly in solvent and allow to dry completely.

Whenever a bearing is removed, a careful inspection must be made to determine the cause of the problem and whether any related parts have been damaged.

If bearing has become magnetized, removal of metal particles from inside cage cannot be accomplished unless bearing is demagnetized.

Bearings fail by lapping, spalling or locking.

LAPPING

Lapping is caused by fine particles of abrasive material such as scale, sand or emery which are circulated by oil and which cause wearing away of roller and race surfaces. Bearings which are worn loose, but remain smooth without spalling or pitting, are the result of dirty oil.

SPALLING

Spalling failure of bearings is caused by overload or faulty assembly. Bearings that fail by spalling have either flaked or pitted rollers or races. Faulty assembly consists of misalignment, cocking of bearings, or adjustments which are too tight.

LOCKING

Locking of bearings is caused by large particles of foreign material becoming wedged between rollers and race, usually causing one of the races to turn. Preloading of regular type taper roller bearings, higher than specified, can also cause locking of bearings.

BEARING NOISE

Since side bearings are preloaded, noise should not go away, or diminish appreciably, when the differential is run with wheels off the ground. Noise in this area can easily be confused with wheel bearing noise. Inspect and replace as required.

WHEEL BEARING NOISE

A rough bearing produces a vibration or "growl" which continues with the vehicle coasting and transmission in Neutral. Since wheel bearings are not preloaded, noise should diminish if differential is run with the wheels off ground. A brinnelled bearing causes a "knock" or "click" approximately every two revolutions of the wheels as the bearing rollers do not travel at the same speed as the wheel. With wheels jacked up, spin wheels by hand while listening at hubs for evidence of rough or brinnelled bearing noise.

Wheel bearings are not serviceable and must be replaced as an integral part of hub and spindle.

CONDITION	PROBABLE CAUSE
Noise is the same in drive or coast.	a. Road Noise. b. Tire noise. c. Front wheel bearing noise. d. Incorrect drive axle angle. (Standing Height)
Noise changes on a different type of road.	a. Road noise. b. Tire noise.
Noise tone lowers as car speed is lowered.	Tire noise.
Noise is produced with engine running vehicle stopped and/or driving.	a. Engine noise. b. Transaxle noise. c. Exhaust noise.
A knock at low speeds.	a. Worn drive axle joints. b. Worn side gear hub counterbore.
Noise most pronounced on turns.	Differential gear noise.
Clunk on acceleration or deceleration.	a. Loose engine mounts. b. Worn differential pinion shaft in case or side gear hub counterbore in case worn oversize. c. Worn or damaged drive axle inboard joints.
Clicking noise in turns.	Worn or damaged outboard joint.
Vibration	a. Rough wheel bearing. b. Damaged drive axle shaft. c. Out of round tires. d. Tire unbalance. e. Worn joint in drive axle shaft. f. Incorrect drive axle angle.
Noisy in Neutral with Engine Running	a. Damaged input gear bearings. b. Damaged clutch release bearing.
Noisy in First Only	a Damaged or worn first-speed constant mesh gears. b. Damaged or worn 1-2 synchronizer.
Noisy in Second Only	a. Damaged or worn second-speed constant mesh gears. b. Damaged or worn 1-2 synchronizer.
Rattle noise in 2nd gear while making left turn.	a. Bent reverse fork.
Noisy in Third Only	a. Damaged or worn third-speed constant mesh gears. b. Damaged or worn 3-4 synchronizer.
Noisy in High Gear	a. Damaged 3-4 synchronizer. b. Damaged 4th speed gear or output gear.
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing. b. Worn or damaged 1-2 synchronizer sleeve.
Noisy in All Gears	a. Insufficient lubricant. b. Damaged or worn bearings. c. Worn or damaged input gear (shaft) and/or output gear (shaft.)
Slips out of Gear	a. Worn or improperly adjusted linkage. b. Transmission loose on engine housing. c. Shift linkage does not work freely; binds. d. Bent or damaged cables. e. Input gear bearing retainer broken or loose. f. Dirt between clutch cover and engine housing. g. Stiff shift lever seal. h. Worn shift fork.
Leaks Lubricant	a. Dip stick not seated in filler tube , causing fluid leakage at vent plug. b. Axle shaft seals c. Excessive amount of lubricant in transmission. d. *Loose or broken input gear (shaft) bearing retainer.* e. Input gear bearing retainer "O" ring and/or lip seal damaged. f. Lack of sealant between case and clutch cover or loose clutch cover. g. Shift lever seal leaks. 103038

Figure 6 Diagnosis Chart

UNIT REPAIR-OVERHAUL

CASE

Disassembly

1. Place the transaxle assembly into a suitable work stand, such as J-28408. (Figure 1 illustrates a typical view of the general use of this stand).
2. Remove the (15) bolts securing the clutch cover to the transaxle case.
3. Use a plastic hammer to carefully tap the clutch cover from the transaxle case shown in Figure 8. Anaerobic sealant is used between the case and cover, instead of a gasket.
4. Remove the ring gear/differential assembly shown in Figure 9.

Removal of Internal Parts

1. Position the shifter shaft in the neutral position so that shifter moves freely and is not engaged in any drive gear.
2. Bend back tab on lock and remove bolt from shifter shaft. Remove the shifter shaft and the shift fork shaft from the synchronizer forks as shown in Figure 10.
3. Remove the reverse shift fork shown in Figure 11 by disengaging from the guide pin and interlock bracket.
4. Remove the lock bolt securing the reverse idler gear shaft. Remove the gear/shaft / spacer assembly as shown in Figure 12.
5. Remove the detent shift lever and interlock assembly. Leave shift forks engaged with the snychronizers as shown in Figure 13. Do not remove detent spring.

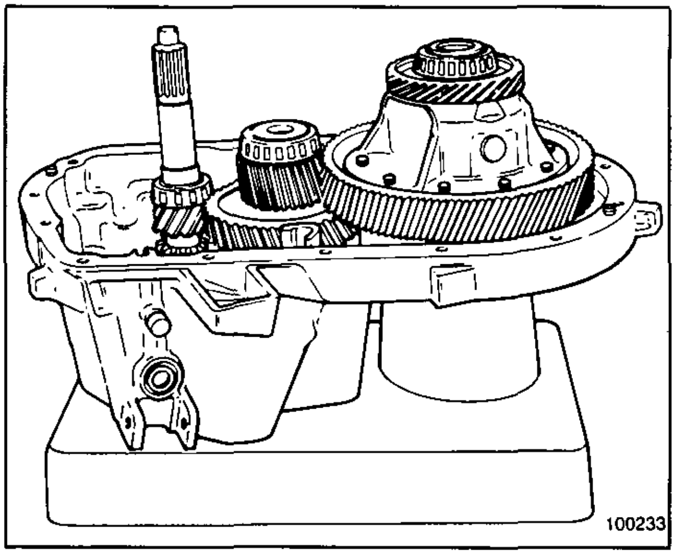


Figure 7 Transaxle in J-28408

6. Grasp the input and output shafts and then lift them as an assembly from the case. Note the position of the shift forks, shown in Figure 14, for aid when reinstalling later. Remove the shift forks.

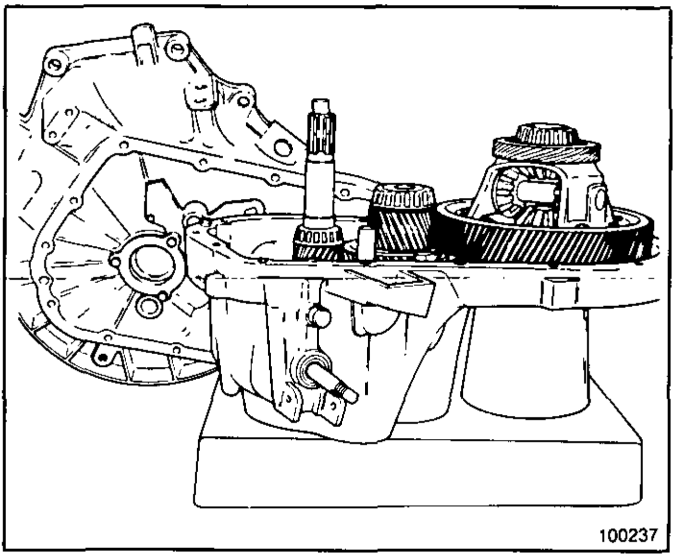


Figure 8 Clutch Cover Removed

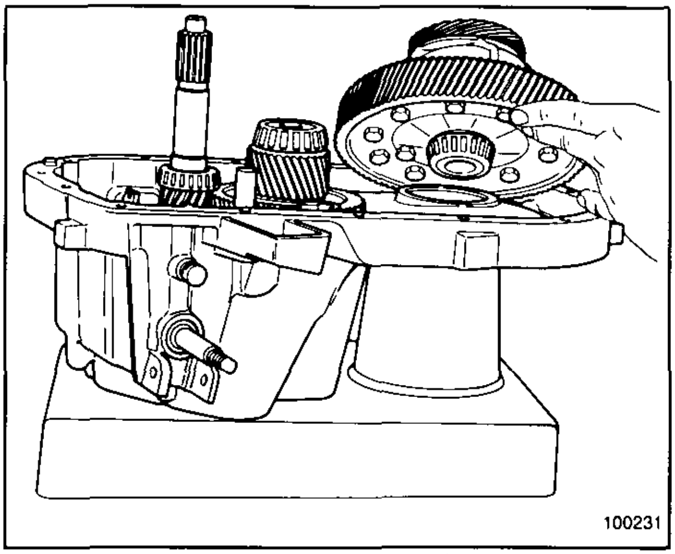


Figure 9 Removing Ring Gear/Differential

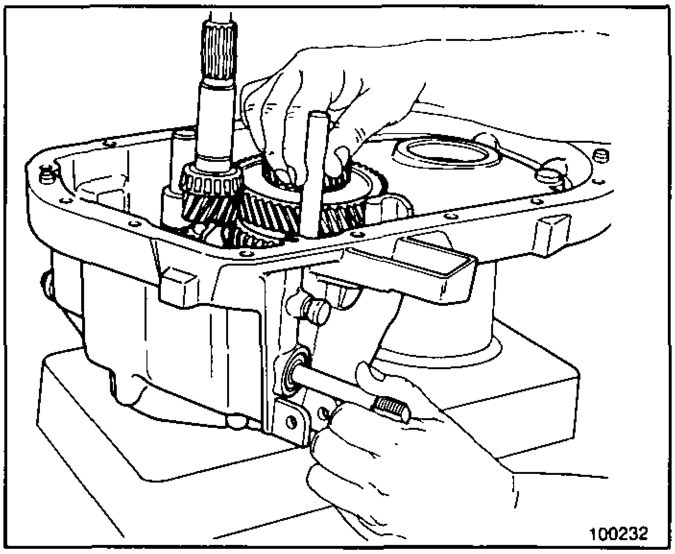


Figure 10 Removing Shifter Shaft

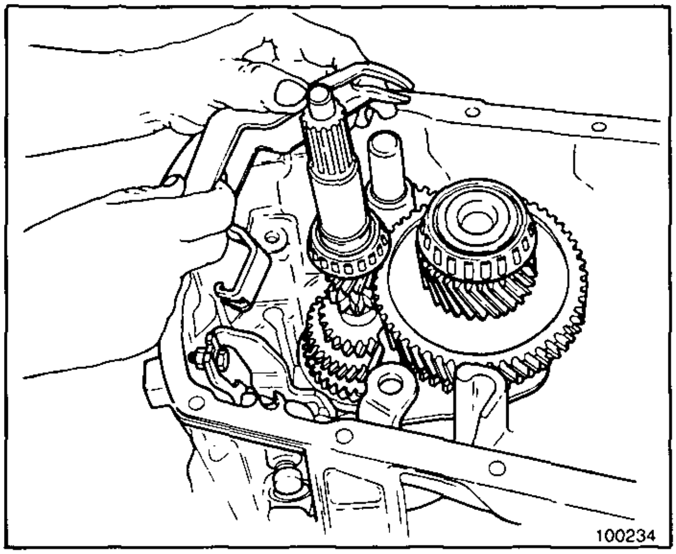


Figure 11 Removing Reverse Shift Fork

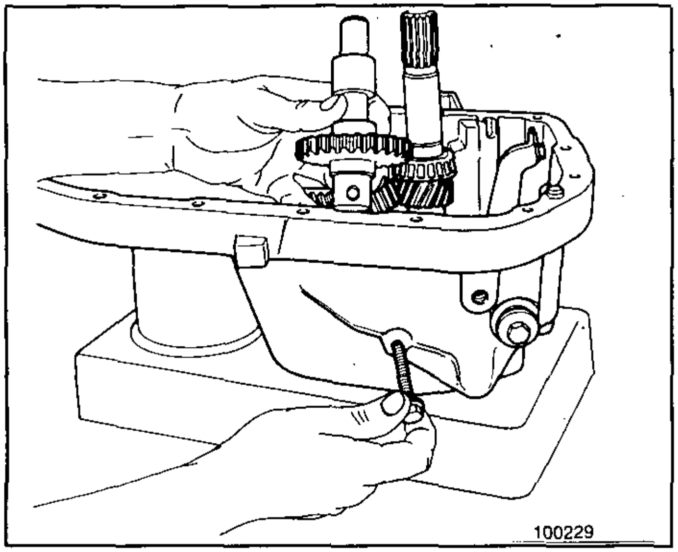


Figure 12 Removing Reverse Idler Gear

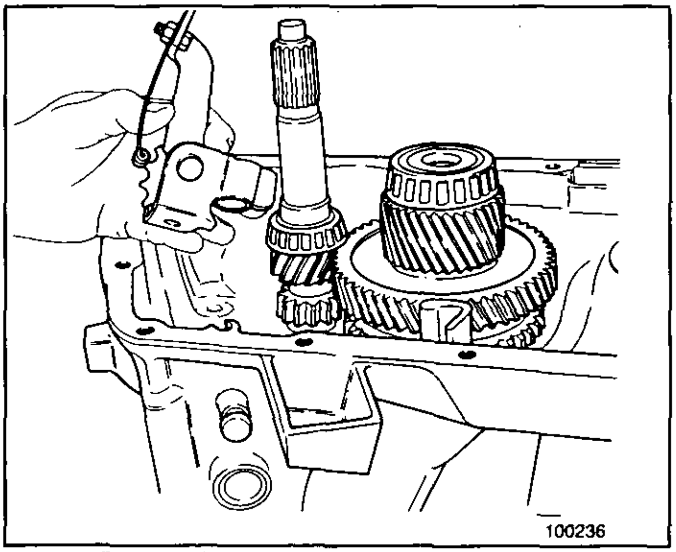


Figure 13 Removing Interlock Assembly

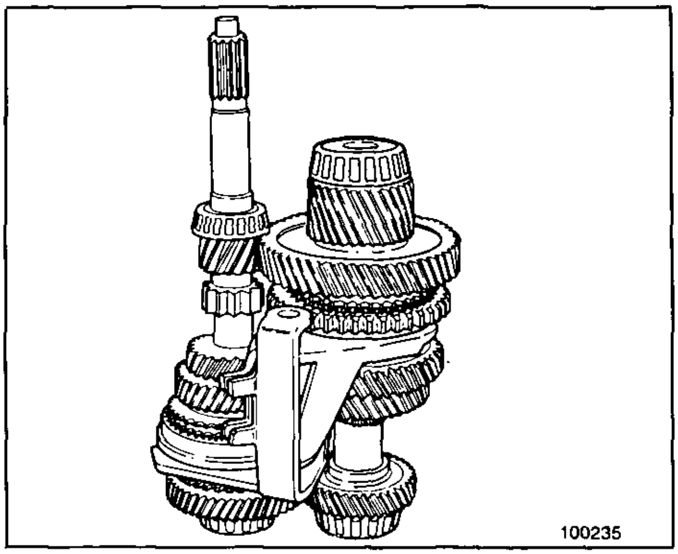


Figure 14 Shafts/Shift Forks

SHAFT DISASSEMBLY

Refer to Figure 15 for parts arrangement on the input and output shafts. The terms "R.H." and "L.H." refer to the installed position on vehicle. (R.H. refers *to the end nearest the clutch; L.H. refers to the end* farthest from the clutch.)

Input Shaft

1. Slide L.H. bearing and 4th gear from input shaft.
2. Remove brass blocker ring. Remove the snap ring from the 3-4 synchronizer.
3. Using support plates behind 3rd gear, press 3rd gear and 3-4 synchronizer from input shaft (Figure 16).
4. Remove R.H. bearing from shaft using J-26946 (Figure 17).

Output Shaft (Except MX6)

1. Using support plates behind 4th gear and J-26943, press on the end of the output shaft to remove 4th gear and the L.H. bearing (Figure 18).
2. Remove the snap ring retaining 3rd gear.
3. Slide the 1-2 synchronizer assembly into first gear position to allow press plates to support 2nd gear. Press 2nd speed gear and 3rd gear from the output shaft. Remove the brass blocker ring (Figure 20).
4. Remove the snap ring retaining the 1-2 synchronizer.
5. Using press plates behind 1st speed gear, press 1st gear and 1-2 synchronizer from the output shaft (Figure 21).
6. Install J-22227-A on the R.H. bearing and remove the bearing by pressing on J-26943 pilot (Figure 22).

Output Shaft (MX6)

1. Remove the retainer from the left hand end of the shaft. The retainer and shaft are designed with L.H. threads.
2. Using support plates behind 4th gear and J-26943, press on the end of the output shaft to

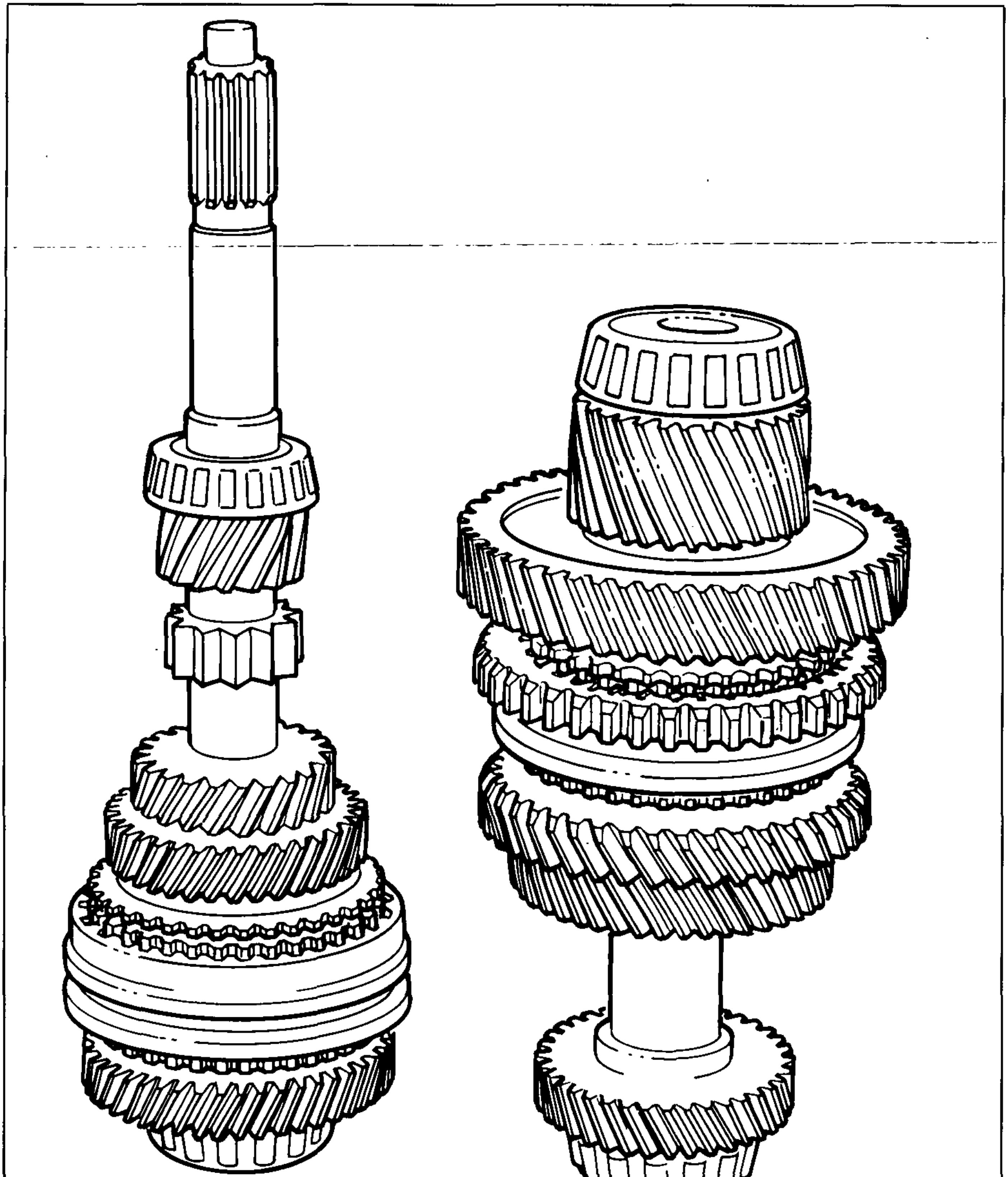


Figure 15 Input and Output Shaft Assemblies

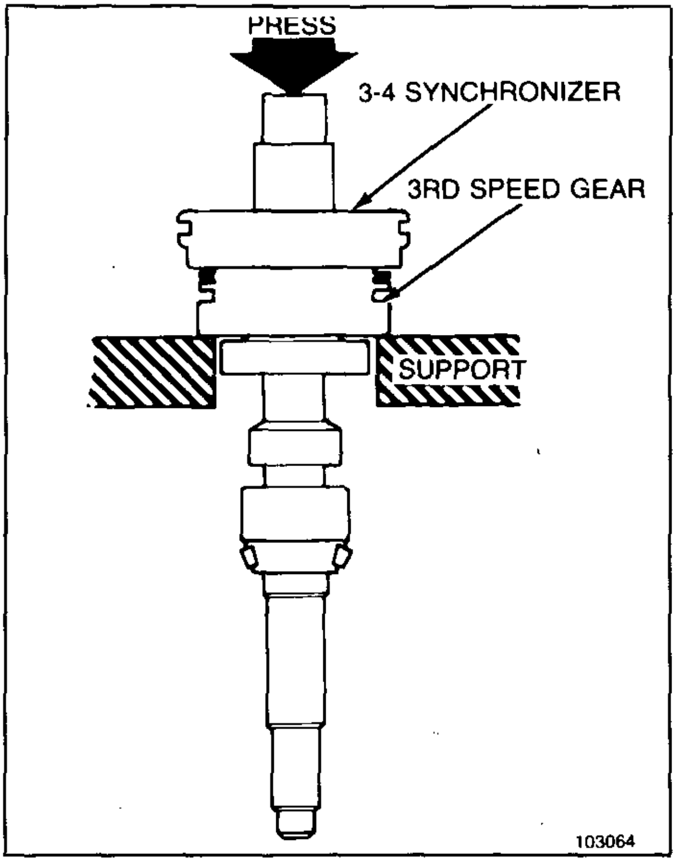


Figure 16 Removing 3-4 Synch. and 3rd Gear(Input)

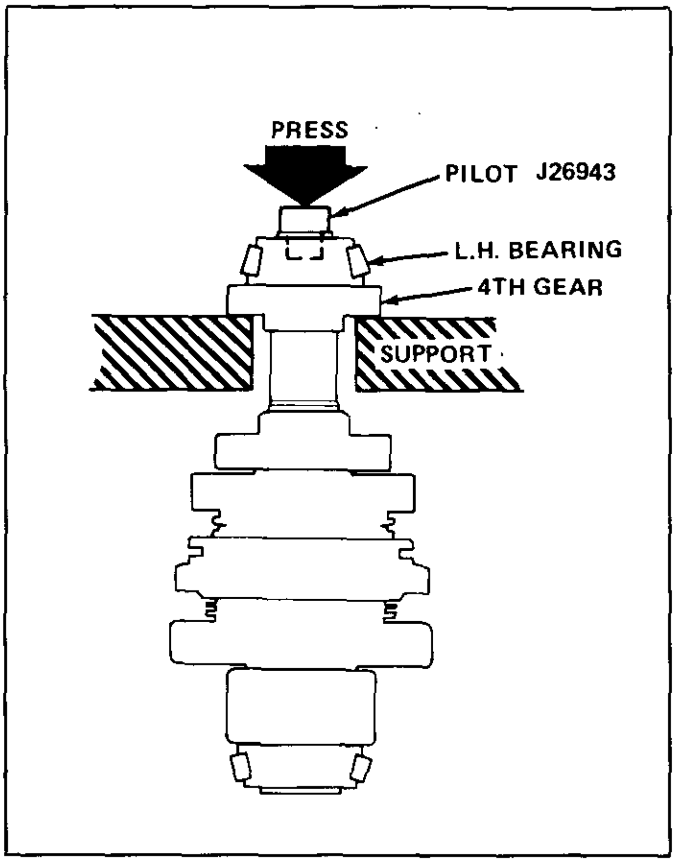


Figure 18 Removing L.H. Brg. and 4th Gear (Output)

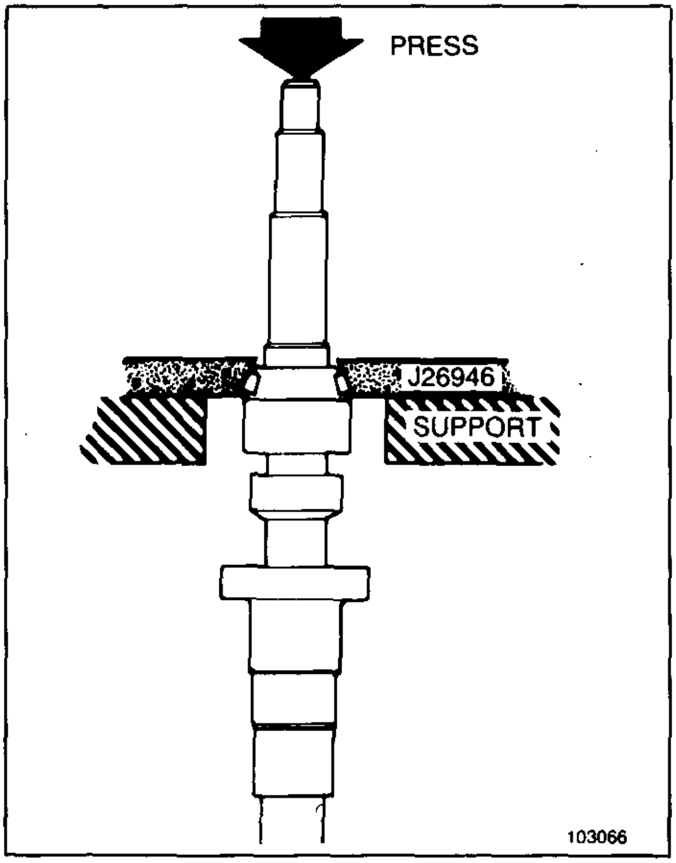


Figure 17 Removing R.H. Bearing (Input)

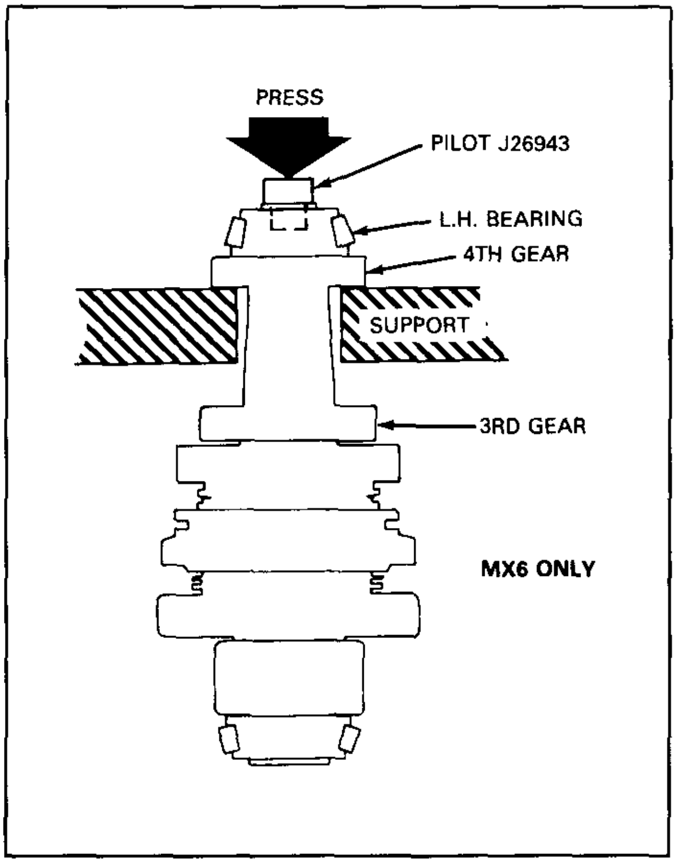


Figure 19 Removing L.H. Brg. and 3rd/4th Gear (Output)

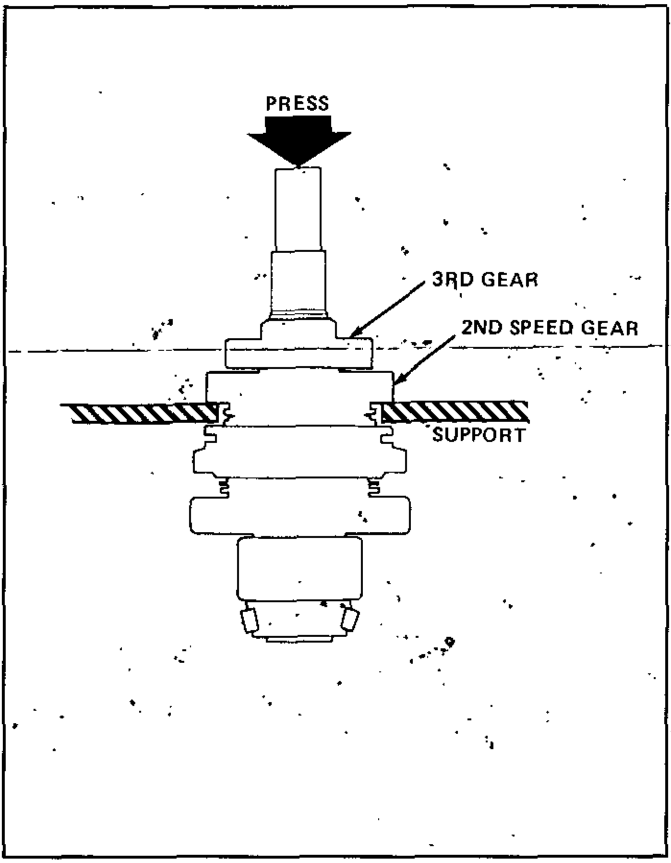


Figure 20 Removing 3rd Gear and 2nd Gear (Output)

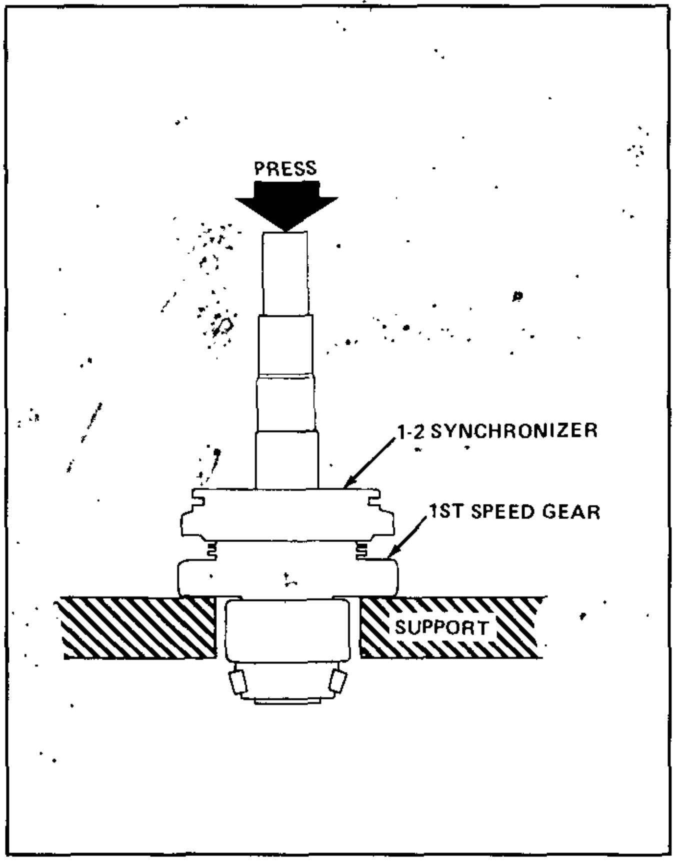


Figure 21 Removing 1-2 Synch. and 1st Gear (Output)

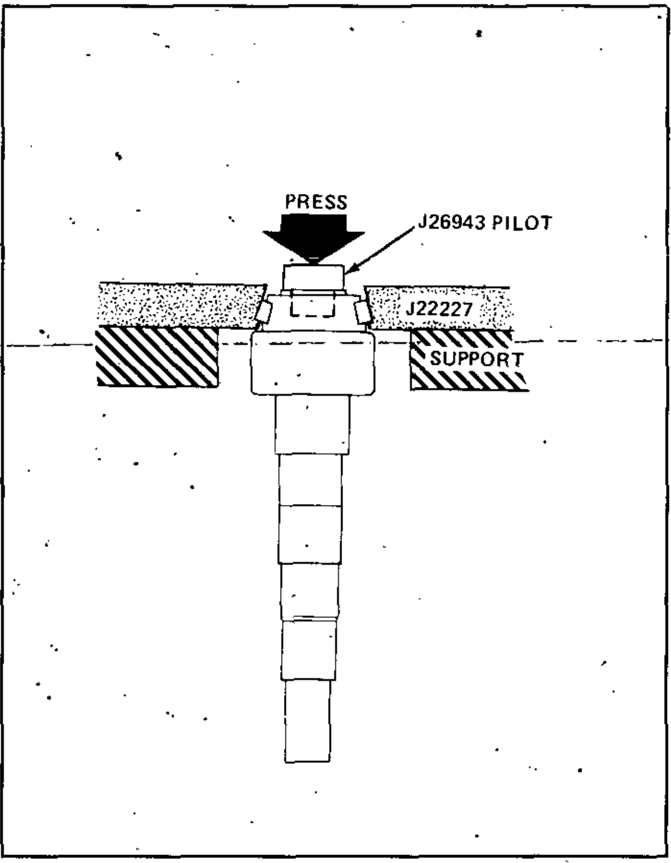


Figure 22 Removing R.H. Bearing (Output)

remove 3rd/4th gear and the L.H. bearing (Figure 19). Third and fourth gear is a one piece gear on the MX6 transaxle.

3. Slide 2nd speed gear from the output shaft. Remove the brass blocker ring.
4. Remove the snap ring retaining the 1-2 synchronizer.
5. Using press plates behind 1st speed gear, press 1st gear and 1-2 synchronizer from the output shaft (Figure 21).
6. Install J-22227-A on the R.H. bearing and remove the bearing by pressing on J-26943 pilot (Figure 22).

SYNCHRONIZER OVERHAUL

1. Carefully pry out both synchronizer key springs from each synchronizer.
2. Separate the hub, sleeve and (3) keys, noting their relative positions. Scribe the hub to the sleeve prior to separation.
3. Clean, inspect and replace parts as necessary.
4. Assemble the hub to the sleeve, with the extruded lip on the hub directed away from the shift fork groove in the sleeve and align previous scribed marks (Figure 23).
5. Carefully install one retaining ring, then carefully pry the ring back and insert keys one at a time, being sure to position the ring so it is "captured" by the keys.
6. Install the ring on the opposite side, with the open segment of the ring "out-of-phase" with the open segment on the other side.

SHAFT REASSEMBLY

Lubricate all parts prior to reassembly.

Input Shaft

1. Install R.H. bearing onto shaft, using J-28406 (Figure 24).
2. Place 3rd gear onto the shaft, oriented toward the 3-4 synchronizer. Install the brass blocker ring onto the gear cone, then install the 3-4 synchronizer, using an appropriate cylinder to contact the hub, near the shaft. Do not press on the sleeve portion (Figure 25). Both synchronizer hubs are a press fit to the shafts.
3. Install snap ring to retain 3-4 synchronizer. Be sure to position snap ring with beveled edges away from synchronizer for later access with snap ring pliers (Figure 26).
4. Install brass blocker ring.
5. Slide 4th speed gear onto shaft, oriented toward the 3-4 synchronizer and slide L.H. bearing onto the shaft.

Output Shaft (Except MX6)

1. Install R.H. bearing onto shaft using J-26943 (Figure 27).
2. Place 1st speed gear onto the shaft, oriented toward the 1-2 synchronizer. Place the brass blocker ring onto the gear cone, then install the 1-2 synchronizer, using an appropriate cylinder to press on the hub, near the shaft. Do not press on the sleeve (Figure 28).
3. Install the snap ring to retain the 1-2 synchronizer. Place the brass blocker ring into position.
4. Place 2nd speed gear onto the shaft, oriented toward the 1-2 synchronizer, then press 3rd gear onto the shaft, with its hub toward 4th gear. Use an appropriate cylinder to contact 3rd gear hub near the shaft (Figure 29).
5. Install snap ring to retain 3rd gear.
6. Press 4th gear onto the shaft, with its hub toward 3rd gear, using support plates and install L.H. bearing cone on the shaft, using J-26942 (Figure 30).

Output Shaft (MX6)

1. Install R.H. bearing onto the shaft using J-26943 (Figure 27).
2. Place 1st speed gear onto the shaft, oriented toward the 1-2 synchronizer. Place the brass blocker ring onto the gear cone, then install the 1-2 synchronizer, using an appropriate cylinder to press on the hub near the shaft (Figure 28). Do not press on the sleeve.
3. Install the snap ring to retain the 1-2 synchronizer. Place the brass blocker ring into position.
4. Place 2nd speed gear onto the shaft, oriented toward the 1-2 synchronizer.
5. Press 3rd/4th gear onto the shaft using support plates and J-26943 (Figure 31).
6. Press the L.H. bearing onto the shaft using J-26942 (Figure 31).
7. Install the L.H. retainer and torque to 50-75 N·m (37-55 ft. lbs.).

TRANSMISSION CASE OVERHAUL

NOTICE: When using an arbor press, DO NOT use holding stand J-28408 to press bearing cups into case, since the stand is not intended to support heavy loads.

1. Remove reverse inhibitor fitting from exterior of case. From inside of case, remove the spring and pilot/spacer (Figure 32).
2. Remove input and output shaft L.H. bearing cups, using J-26941. Turn set screw on J-26941 counterclockwise to insert tool below bearing cup. Turn set screw clockwise to grasp bearing cup. When installing cups, use J-26938 (Figure 33).
3. Remove oil slingers (Figure 34).
4. Remove differntial side bearing cup, using J-26941. Reinstall cup with J-23423A.
5. Check two guide pins for interlock bracket and reverse shift fork. Check magnet. Remove sealant from mating surface with J-28410 where the clutch cover contacts the case. Use care not to gouge or damage the aluminum surface, or leaks can result.
6. Clean all parts. Thoroughly inspect/replace parts as required.

CLUTCH COVER

Disassembly

1. Using J-26941, remove differential side bearing cup and shim.
2. Using J-26941, remove input shaft and output shaft R.H. bearing cups. Remove the shim from back of input bearing cup and remove oil shield, shim, and retainer from back of output shaft bearing cup.
3. Remove three bolts securing the input gear bearing retainer (release bearing sleeve). Remove the sleeve. Tap carefully as necessary (Figure 35).
4. Remove external oil ring, and internal oil seal from sleeve (Figure 36).
5. Remove plastic oil scoop (Figure 37).
6. If it's necessary to replace the clutch fork shaft or bushing, do not break the weld on the clutch fork to remove it. Use J-28412 (clutch shaft bushing installer/remover), and remove the shaft bushings first and then slide the clutch shaft out of the case at a slight angle (Figure 38). Always replace the clutch fork shaft seal after replacement of the shaft or bushing.
7. Remove bead of sealant from mating surfaces. Use care not to damage sealing surfaces.
8. Clean and inspect all parts. Replace parts as required.

Reassembly

1. Install plastic oil scoop.

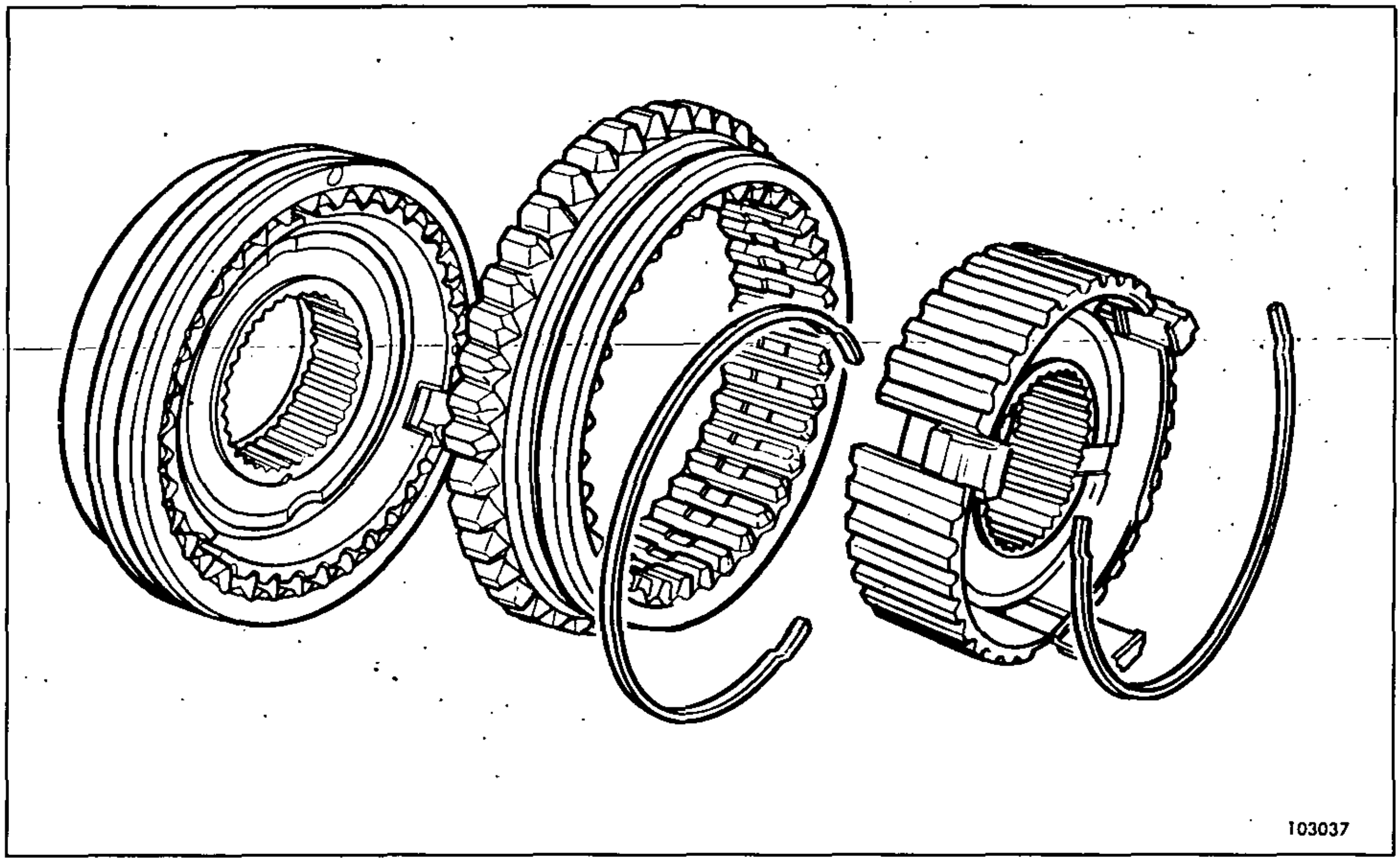


Figure 23 Synchronizer Explode

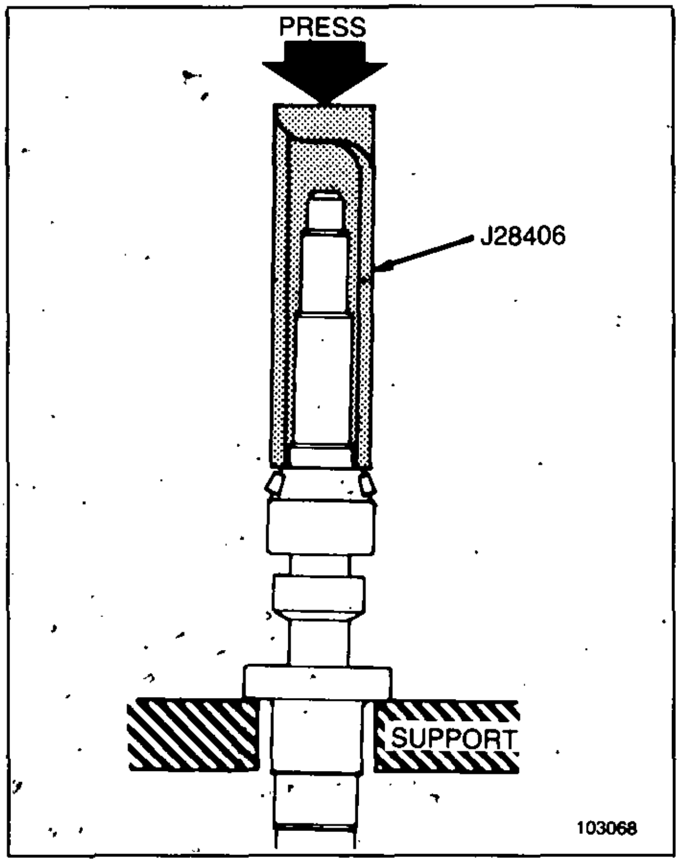


Figure 24 Installing R.H. Bearing (Input)

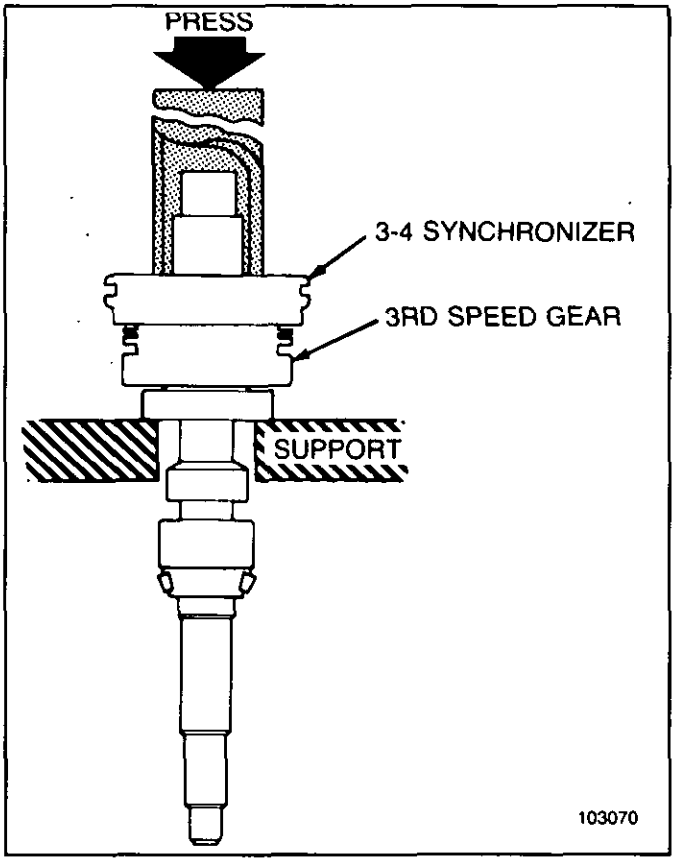


Figure 25 Installing 3rd Gear and 3-4 Synchronizer (Input)

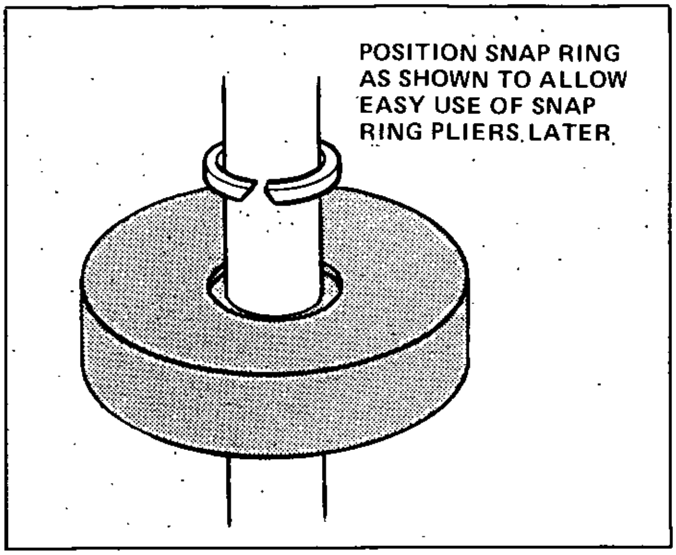


Figure 26 Installing Snap Ring

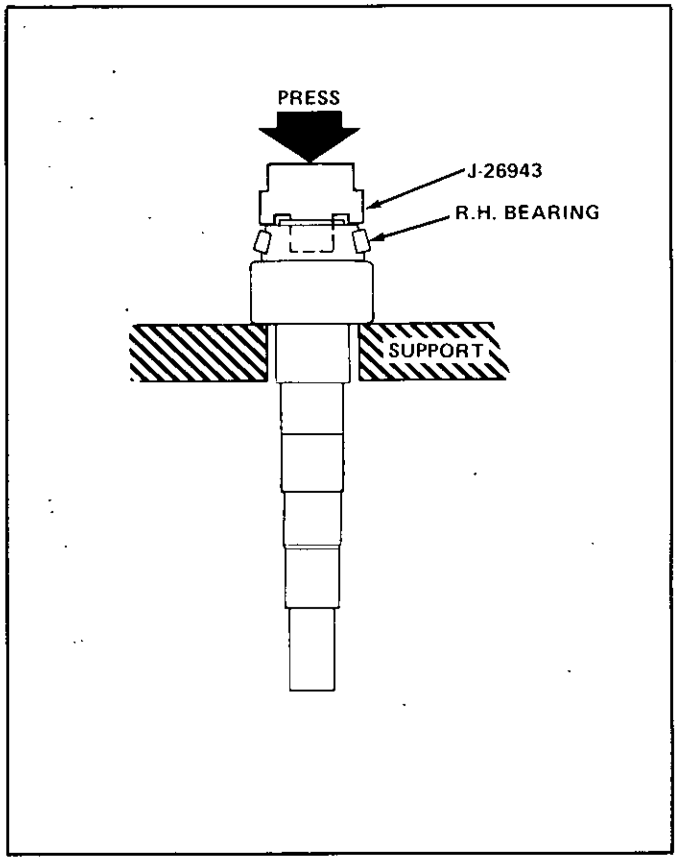


Figure 27 Installing R.H. Bearing(Output)

2. Replace external square-cut oil ring on sleeve. Install input bearing retainer, tightening three bolts to specifications.
3. Use J-26936 to install internal oil seal.

DIFFERENTIAL CASE/RING GEAR OVERHAUL

1. Separate ring gear from differential case.
2. Remove pinion shaft lock bolt, remove pinion shaft, then roll the gears and thrust washers out through the opening in the case.
3. If differential side bearings are to be replaced, use J-22888 puller and J-22888-30 (puller leg set) to

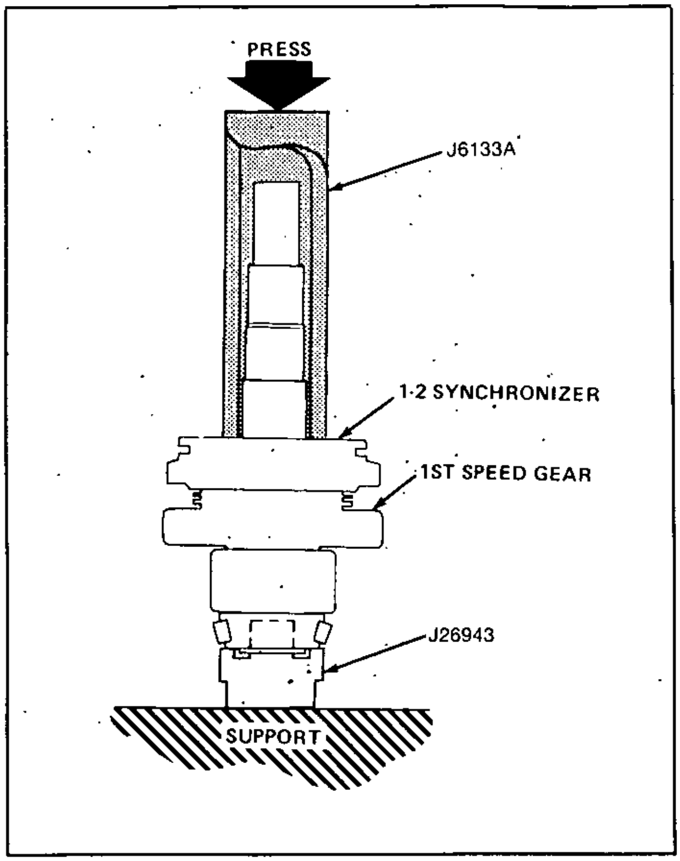


Figure 28 Installing 1st Speed Gear and 1-2 Synch. (Output)

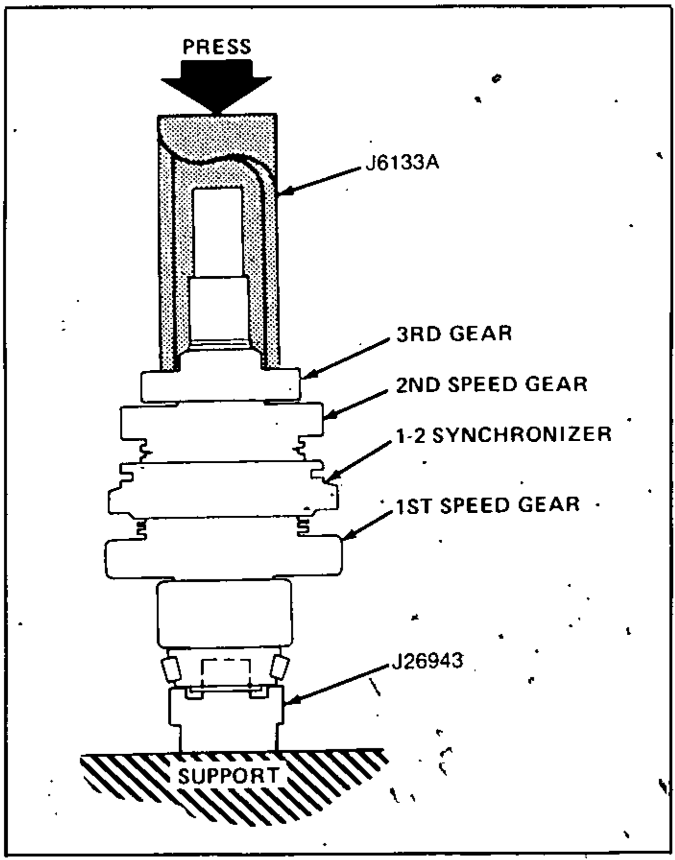


Figure 29 Installing 2nd and 3rd Speed Gears (Output)

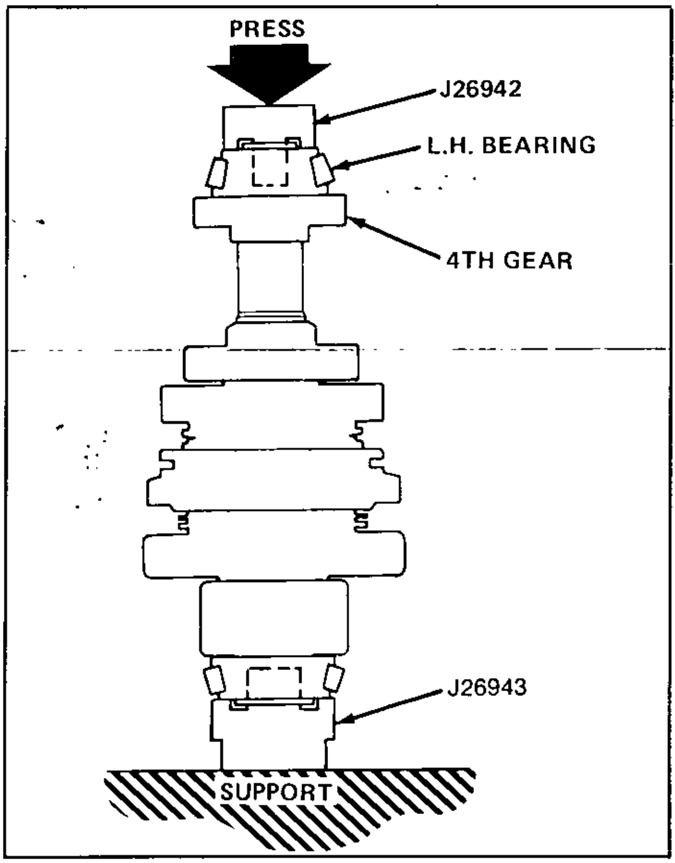


Figure 30 Installing 4th Gear and L.H. Brg. (Output)

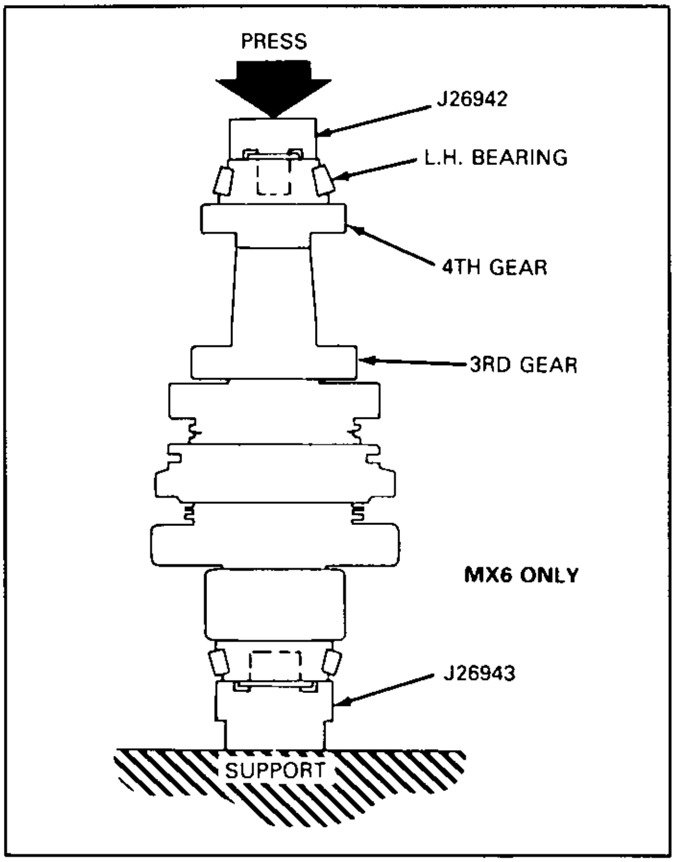


Figure 31 23B-Installing 3rd/4th Gear and L.H. Brg. (Output)

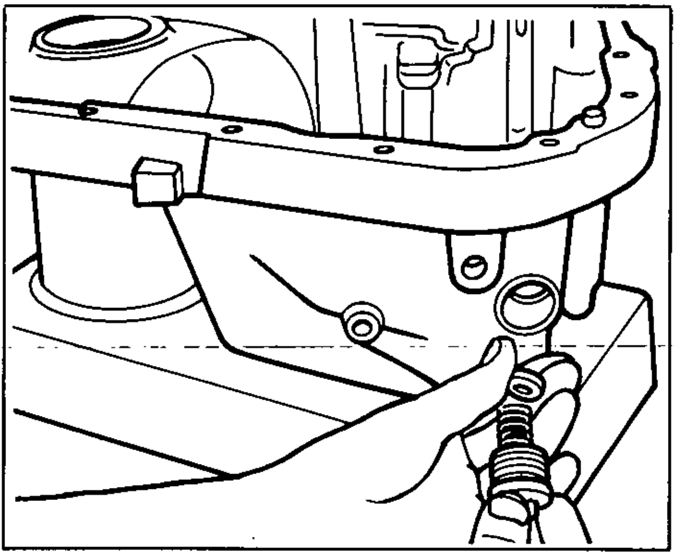


Figure 32 Remove Reverse Inhibitor Fitting

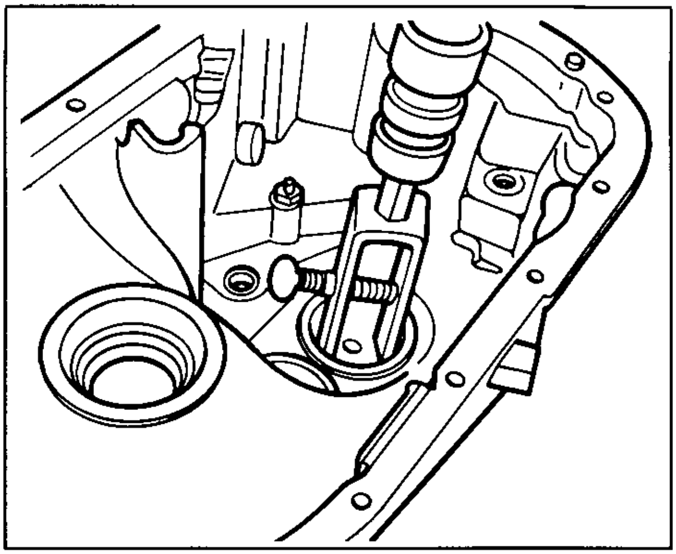


Figure 33 Removing Bearing Cups with J-26941

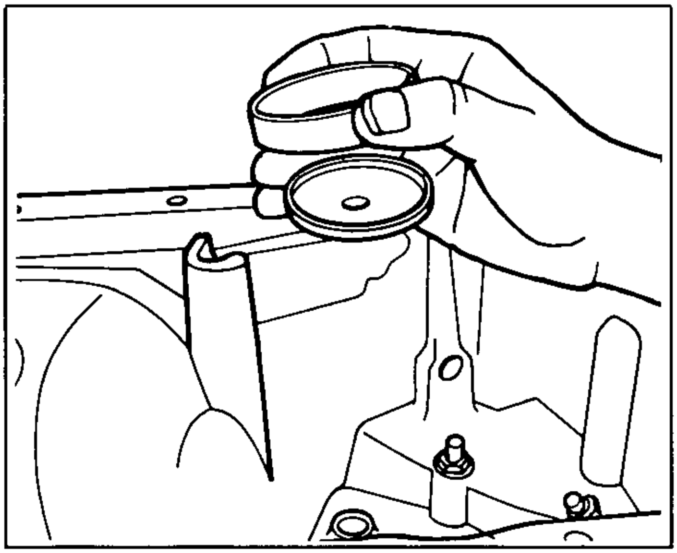


Figure 34 Removing Oil Slingers

remove the bearings. Use J-22919 cone installer for reinstallation of side bearings.

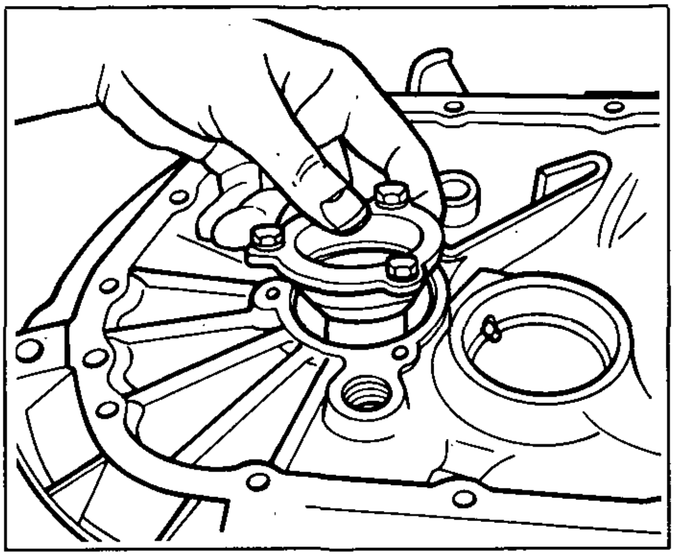


Figure 35 Removing Release Bearing Sleeve

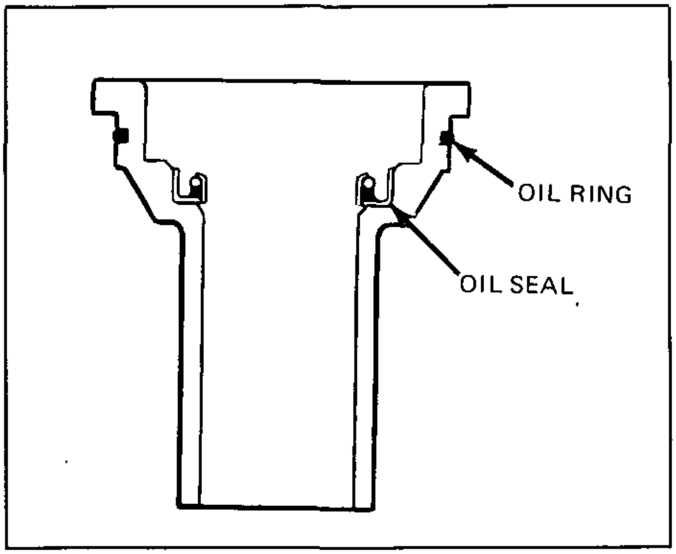


Figure 36 Oil Seal and Oil Ring

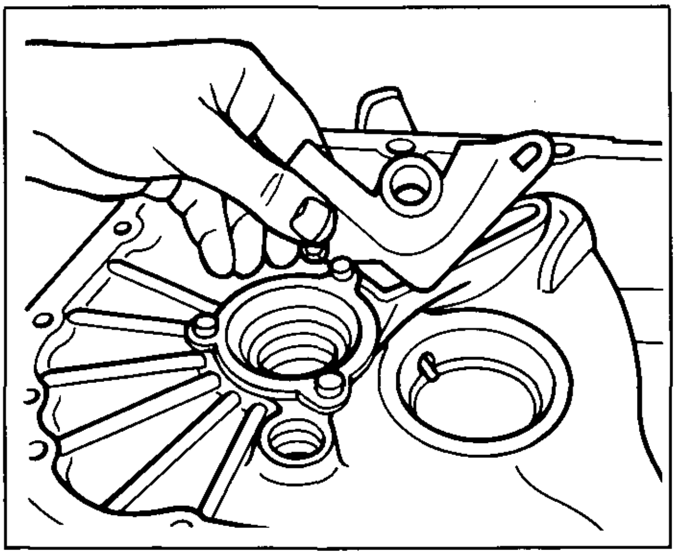


Figure 37 Removing Oil Scoop

4. Clean and inspect all parts. Replace parts as required.
5. Install gears and thrust washers into the case; install the pinion shaft and lock bolt. Tighten to specifications.
6. Position the ring gear to the differential case.
7. Apply P/N 1052624 or equivalent on ring gear bolts. Install bolts and torque to specifications.

SHIM SELECTION

Selection of the preload shims for reassembly can begin when the input and output shaft assemblies and the differential assembly are reassembled and ready to be installed into the transaxle case.

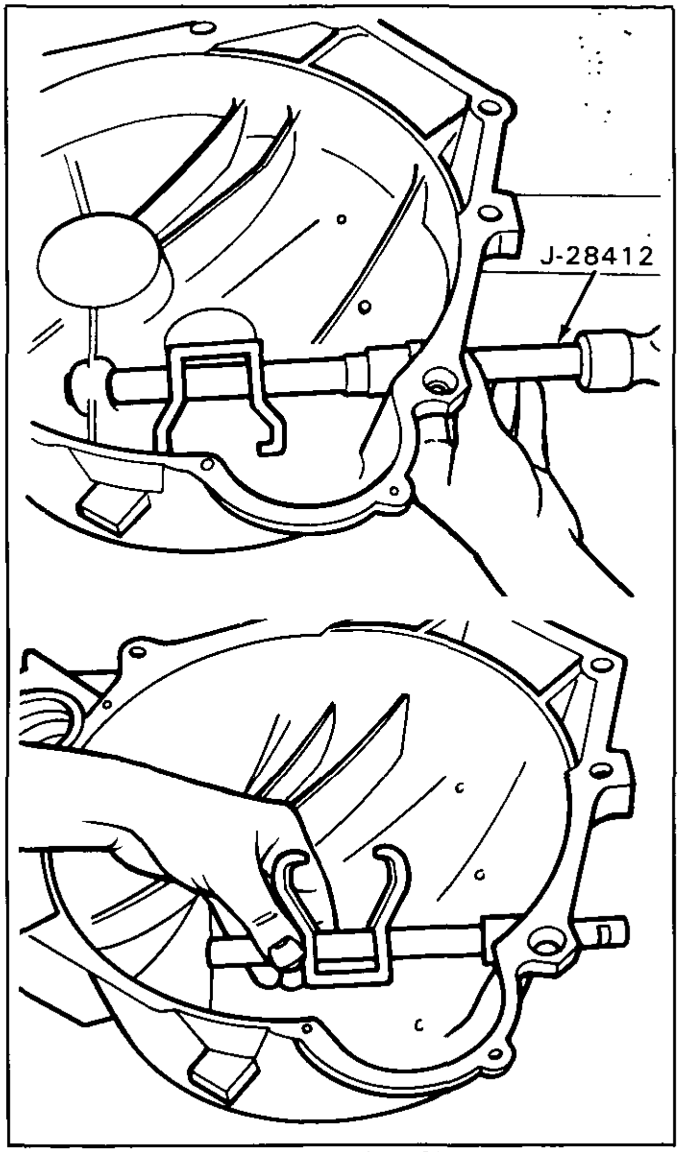


Figure 38 Replacing Clutch Fork Shaft and Bushings

1. Place the transaxle case into holding fixture J-28408.
2. With the (3) L.H. bearing races installed in the case, place the input and output shaft assemblies and the differential assembly into their installed positions. Place the (3) R.H. bearing races onto their respective bearings (Figure 39).
3. Position (3) gages; J-26935-2 on input bearing and J-26935-4 onto output bearing and J-26935-3 on the differential bearing. Be sure the bearing

races fit smoothly into the bores of the gage tools (Figure 40).

4. On J-26935-4, (output shaft), install oil shield retainer into bore on top of tool.
5. Carefully assemble the clutch cover over the (3) gages and onto the case, using (7) spacers placed evenly around the perimeter. Retain with bolts provided (Figure 41).

   Draw the cover to the case by tightening alternately and gradually. Torque bolts to 10 ft. lbs. (13 N·m). This will compress all three gage sleeves.
6. Rotate each gage to seat the bearings. Rotate the differential case through three revolutions in each direction.

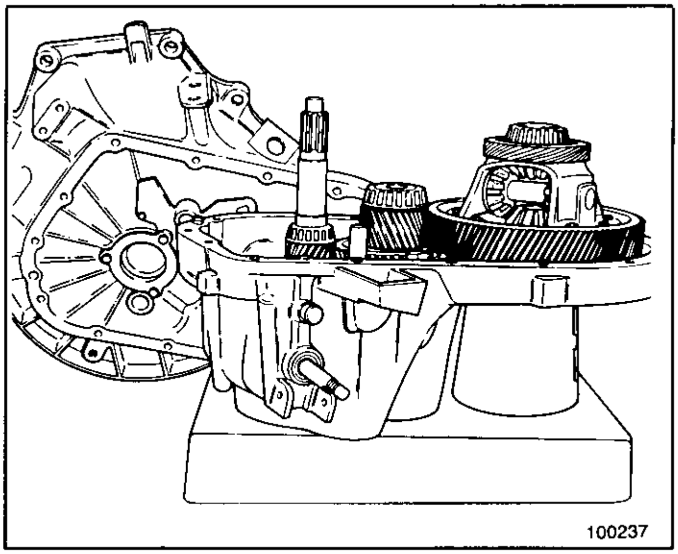


Figure 39 Assemblies in Case

7. With the three gages compressed, the gap between the outer sleeve and the base pad is larger than the correct preload shim at each location. Carefully compare the gap to the available shims. Determine the largest shim that can be placed into the gap and drawn through without binding. Then use the next shim size smaller on the output shaft and differential for reassembly. On the input shaft, use a shim 2 sizes smaller. If end play occurs, use the next larger shim sizes (Figure 42).
8. When each of the three shims has been selected, remove the clutch cover, (7) spacers and (3) gages.
9. Place the selected shims into their respective bore in the clutch cover, add the metal shield and then install the bearing cups using special Tools J-26936 on the input shaft cup and J-23423-A on output shaft cup and J-26938 on the differential side bearing cup.

CASE REASSEMBLY

1. Place input shaft and output shaft together, on a bench. Install the two shift forks (Figure 14).
2. Grasp the shafts as an assembly and carefully lower them into the transaxle case. Use care not to nick gears.
3. Place interlock bracket onto guide pin J-28411. Be sure that the bracket engages the fingers on the shift forks.
4. Use a straight edge on both sides of the interlock to determine if the detent is out of alignment with the interlock.

NOTICE: The straight edge should rest on both sides of the interlock without interference from the detent paddle. If interference is noted on either the left or right sides, perform the following:

   A. Place the detent and interlock assembly in a vise with light pressure (the alignment pin is still in position) on the detent paddle to push it into alignment.
   B. Loosen the nut securing the detent spring to the interlock. The detent spring is slotted beneath the nut and will seek a proper alignment.
   C. Tighten the nut (detent spring to interlock) while exerting light pressure on the spring with your thumb.
   D. Check the detent alignment with a straight edge as in Step 2.

5. Place detent shift lever into the interlock (Figure 13).
6. Install the shifter shaft through the interlock bracket and the detent shift lever. Do not extend further at this time.
7. Install reverse shift fork onto the guide pin. Be sure the reverse shift fork engages the interlock bracket.
8. Install the reverse idler gear and shaft into position. Be sure the long end of the shaft points upward, and the large chamfered ends of the gear tooth are facing up. Install the spacer onto the shaft (Figure 12).

   The flat on the reverse idler shaft faces the input gear (shaft).
9. Fully install the shifter shaft through the reverse shift fork, until it pilots into the inhibitor spring spacer. Remove dummy shaft. With the shaft in neutral position, install the bolt and lock through the detent shift lever. Bend tab of lock over bolt head.
10. Install fork shaft through the synchronizer forks and into the bore in the case.
11. Carefully install the ring gear-and-differential case assembly.
12. Install magnet.
13. Apply a thin bead of anaerobic sealant (Do not use RTV) to the clutch cover, then carefully install the cover onto the transaxle case, using the dowel pins to guide the cover into position. Tap clutch cover gently with a plastic hammer to insure that the parts are seated.
14. Install the (15) attaching bolts. Torque to specifications.
15. Torque idler shaft retaining bolt in case.
16. Shift through the gear ranges to test for freedom of movement of all internal parts.

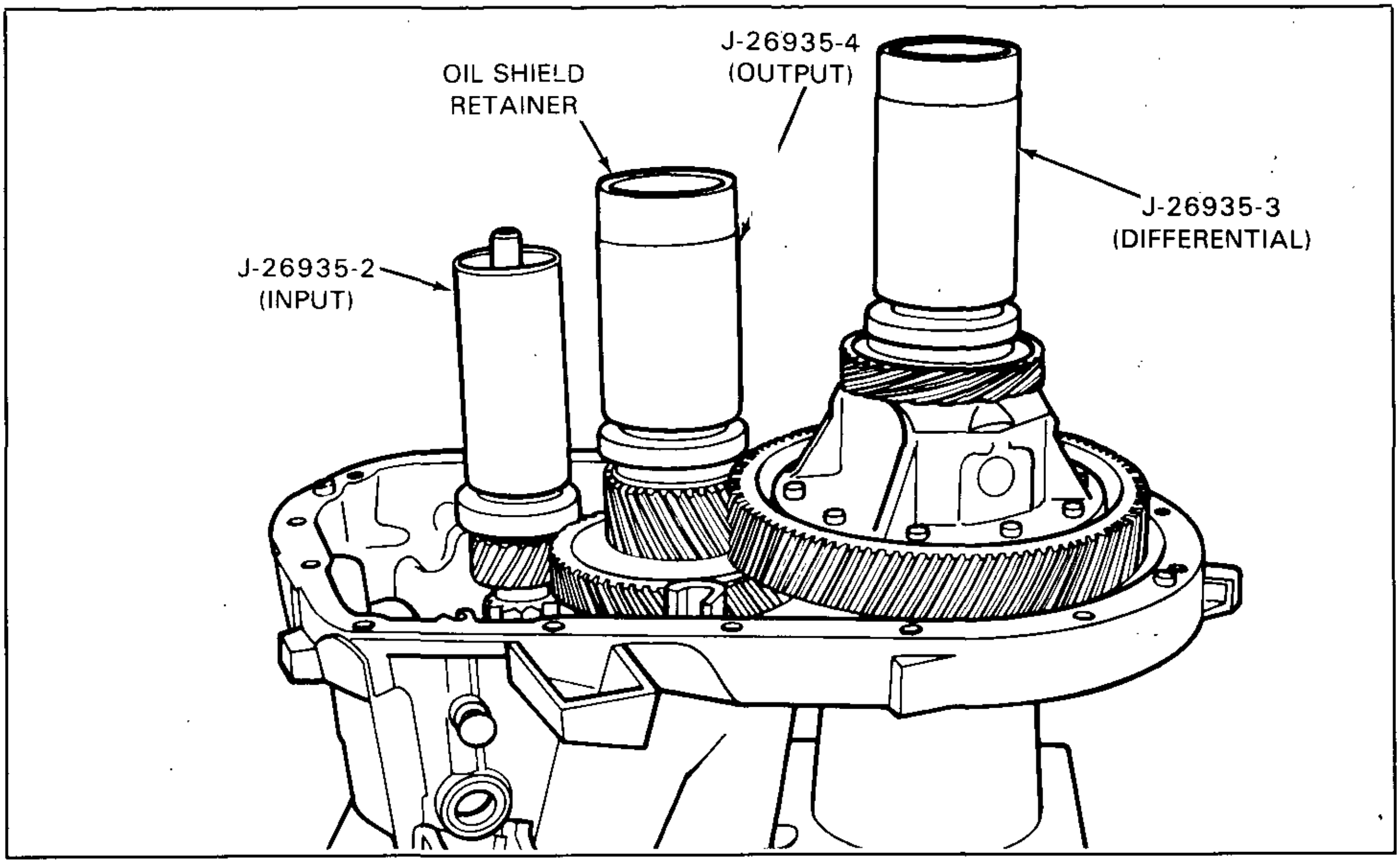


Figure 40 Gages in Position

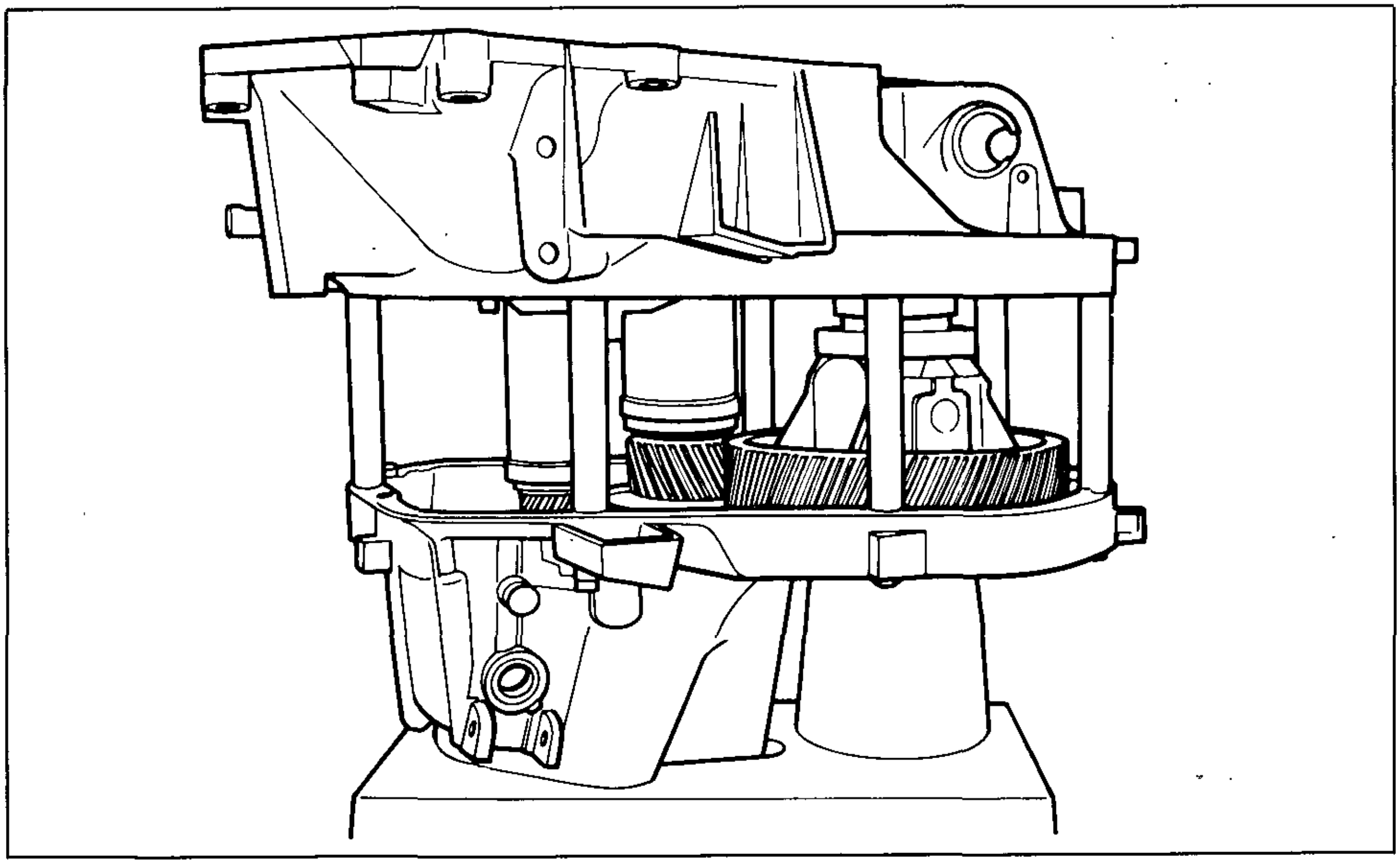


Figure 41 Compressing Gages

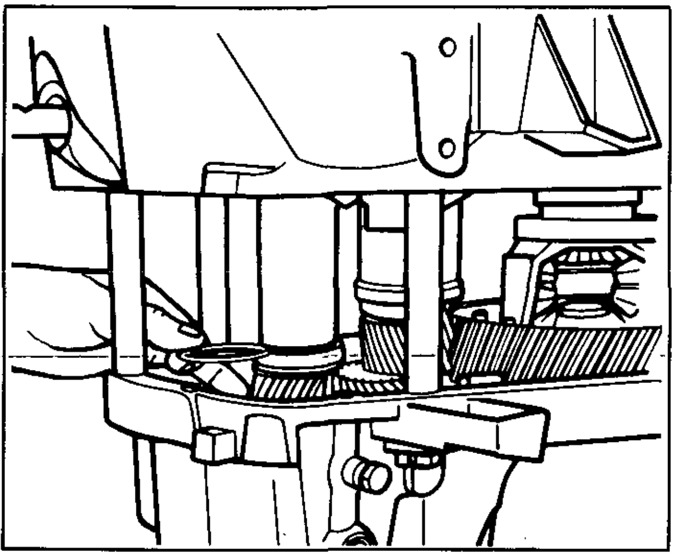


Figure 42 Measuring Gap

Input Shaft RH Bearing Retainer	9 N·m (7 FT. LBS.)
Output Shaft LH Bearing Retainer	65 N·m (45 FT. LBS.)
Reverse Idler Shaft Lock Bolt	21 N·m (16 FT. LBS.)
Reverse Inhibitor Fitting	35 N·m (26 FT. LBS.)
Case-to-Cover Bolts	21 N·m (16 FT. LBS.)
Ring Gear Bolts	73 N·m (54 FT. LBS.)
Pinion Shaft Lock Bolts	9 N·m (7 FT. LBS.)
Transaxle Strut	40 N·m (30 FT. LBS.)
Transaxle to Engine	75 N·m (55 FT. LBS.)
Control Assembly	25 N·m (20 FT. LBS.)

Lube Capacity	2.8 Litres (3 Qt.)
Lube Recommended	Engine Oil SAE 5W-30 SF

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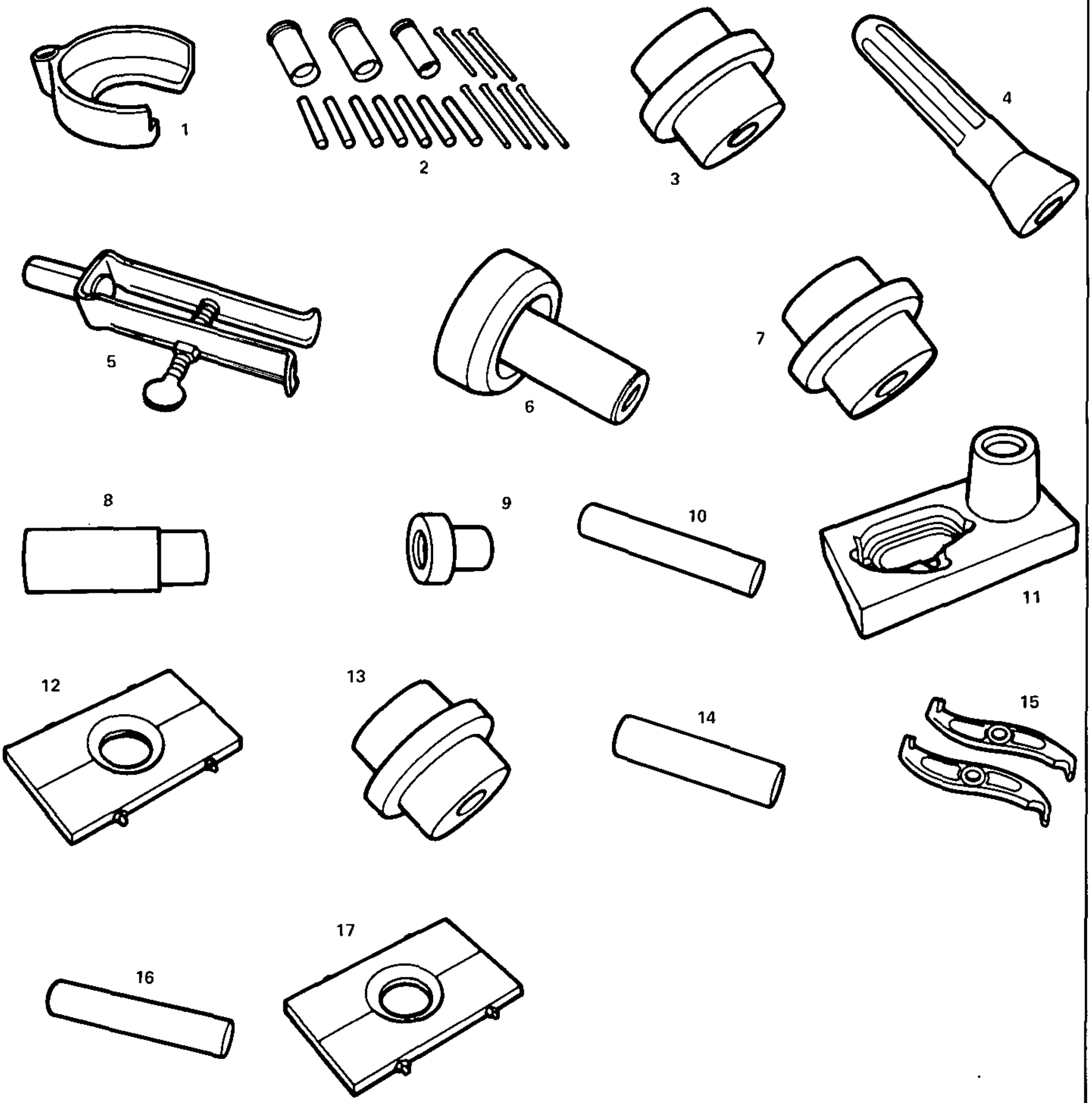
Figure 43 Specifications



1.	J28468	Axle Shaft Remover
2.	J26935	Shim Selector Set
3.	J26936	Installer, R.H. Input Shaft Seal and R.H. Bearing Cup
4.	J26937	Shifter Shaft Seal Installer
5.	J26941	Transaxle Case Bearing Cup Remover
6.	J26942	Input & Output Shaft, Inner Race Installer
7.	J26938	Axle Shaft Seal & Bearing Cup Installer
8.	J26943	Input & Output Shaft, Pilot For Bearing Removal
9.	J22919	Differential Inner Bearing Installer
10.	J28406	Input Shaft R.H. Bearing Installer
11.	J28408	Holding Fixture
12.	J26946	Input Shaft R.H. Bearing Remover
13.	J23423-A	Transaxle Case Bearing Cup Installer
14.	J28411	Shifter Shaft Alignment Pin
15.	J22888-20	Differential Side Bearing Puller Legs
16.	J28412	Clutch Shaft Bushing Installer/Remover
17.	J22912-01	Input Shaft L.H. Bearing Remover
	J22227-A	Output Shaft R.H. Bearing Remover (Not Shown)
	J28410	Gasket Remover (Not Shown)

Figure 44 Special Tools

SECTION 7B2

5-SPEED 76MM MANUAL TRANSAXLE

CONTENTS

GENERAL DESCRIPTION

The five-speed transaxle assembly (Figure 1) is representative of the constant-mesh design transmission, combined with a differential unit and assembled in a single case. All forward gears are in constant mesh. For ease of shifting and selection of the desired gear range, synchronizers with blocker rings, controlled by shift forks are used. Reverse uses a sliding idler gear arrangement.

Fundamental components of these units are the aluminum transaxle case, aluminum clutch housing, aluminium rear cover, input gear (shaft) output gear (shaft), and the differential assembly. The input gear, output gear and differential are all supported by tapered roller bearings. Selective shims are used behind the rear bearing outer races to establish the correct pre-load.

The final output gear (an integral part of the output shaft) turns the ring gear and differential assembly, thereby turning the drive axle shaft which are attached to the front wheels.

The differential is a conventional arrangement of gears that divides the torque between the drive axle shafts and allows them to rotate at different speeds. A basic differential consists of a set of four gears.

Two are called differential side gears, and two are differential pinion gears. Each side gear is splined to a drive axle shaft which must turn when its side gear rotates.

The differential pinion gears are mounted on a differential pinion shaft, and the gears are free to rotate on this shaft. The pinion shaft is fitted into a bore in the differential case is at right angles to the drive axle shafts.

GENERAL INFORMATION

Transaxle to engine attachment is accomplished with six (6) bolts, five passing through the transaxle bell housing and into engine bosses while one attachment on the back side of the engine screws into a transaxle boss.

The manual transaxle utilizes a cable to control the clutch and routes from the pedal and detent subassembly, forward through a bracket assembly where it is retained on the engine side of the dash and passes through a second bracket mounted on the transaxle. Again the cable is retained and then proceeds forward into the clutch lever and simply snaps in place. The clutch pedal and control system incorporates a constant "no lash" feature.

There is constant contact of release bearing to the fingers of the pressure plate but very little (if any) pressure on the pressure plate.

Two cable assemblies are utilized to shift the gears, one being the trans-selector cable and the other a trans-shifter cable.

The routing of the control cables is forward through the front of the dash, where a grommet and retainer holds them in place, and anchored to a bracket on the transaxle. The inner cables are attached to the trans control levers with a snap-together ball joint assembly. This permits the cables to be previously routed before the shifter mechanism is installed.

MAINTENANCE AND ADJUSTMENTS

CHECKING TRANSAXLE MOUNT

Pull up and push down on the transaxle case while observing the mount. If the rubber separates from the metal plate of the mount or if the case move up, but not down, (mount bottomed out), replace the mount. If there is relative movement between the metal plate of the mount and its attaching point, tighten the bolts attaching the mount to the mount bracket or side frame.

CHECKING FLUID LEVEL (FIGURE 5)

See the Maintenance Schedule booklet to find out how often the lubricant level should be checked and what type of lubricant should be used.

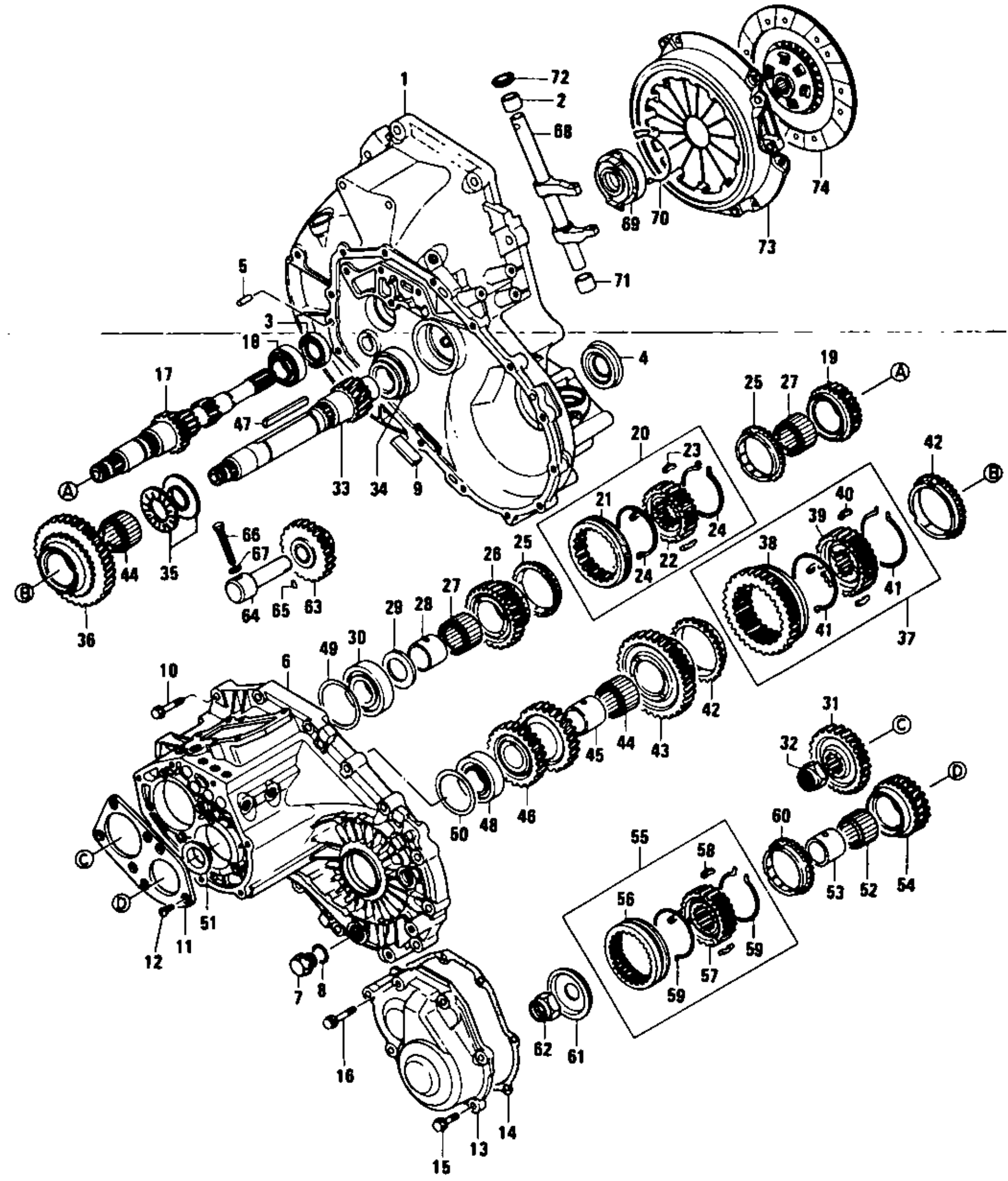
Check the fluid level only when the engine is off, the vehicle is level and the transaxle is cool enough to let you rest your fingers on the transaxle case. To check the fluid level, remove the speedometer fitting on the driver's side of the case, above the axle shaft.

Be sure the fluid level is between the "L" and "H" marks on this fitting.

If needed, add enough fluid to bring the level up to the "L" mark. Be sure to seat the speedometer fitting fully when reinstalling.

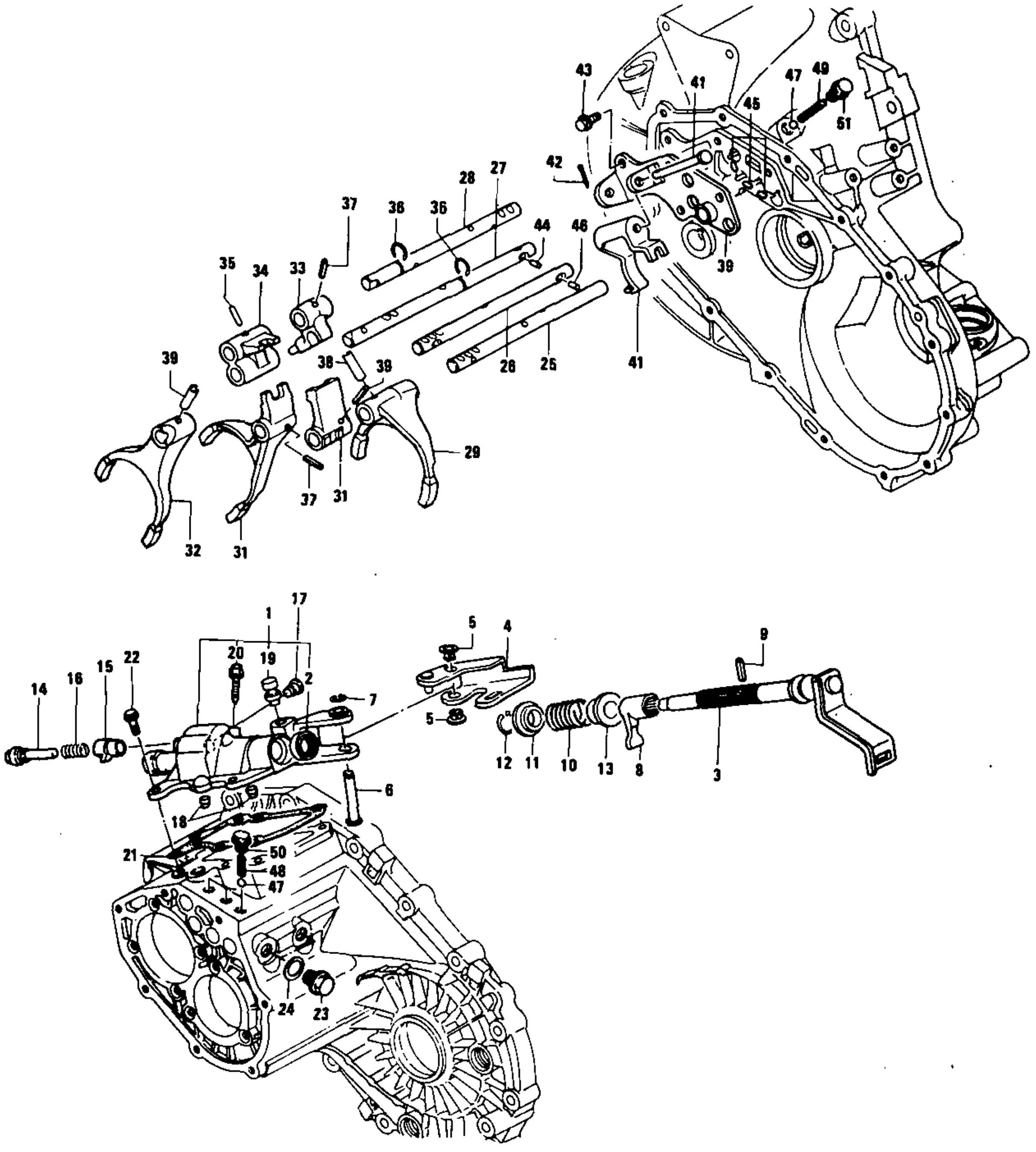
NOTICE: Fluid level must always be at the full mark. Some oil will appear on the dipstick even when the transaxle is only half full.

The dipstick must be fully seated in filler tube during vehicle operation or leakage will occur at the vent plug.



1. HOUSING, clutch and diff
2. BUSH, clutch shaft
3. SEAL, oil, input shaft
4. SEAL, oil, drive shaft
5. PIN, straight knock
6. CASE, transaxle
7. PLUG, drain
8. PACKING, o-ring, plug
9. MAGNET, case
10. BOLT, housing to case
11. RETAINER, bearing
12. SCREW, retainer to trans. case
13. COVER, rear
14. PACKING, case to rear cover
15: BOLT; rear cover to trans. case
16. BOLT, rear cover to trans. case
17. SHAFT, input
18. BEARING, input shaft, front
19. GEAR ASM., 3rd input
20. SYNCHRONIZER ASM., 3rd & 4th
21. SLEEVE, syn. 3rd & 4th. part of syn. asm.
22. HUB, clutch, 3rd & 4th, part of syn. asm.
23. INSERT, 3rd & 4th.
24. SPRING, insert, 3rd & 4th
25. RING, blocking, 3rd & 4th
26. GEAR ASM., 4th , input
27. BEARING, needle, 3rd & 4th
28. COLLAR, needle bearing, 4th gear
29. WASHER, thrust, 4th gear
30. BEARING, input, rear
31. GEAR, 5th., input
32. NUT, 5th, gear
33. SHAFT, output
34. BEARING, output shaft, front
35. BEARING, thrust needle, 1st (with thrust washer)
36. GEAR ASM. 1st, output
37. SYNCHRONIZER ASM., 1st & 2nd
38. Gear, rev. & sleeve, part of syn. asm.
39. HUB, clutch, rev. part of syn asm.
40. INSERT, 1st & 2nd
41. SPRING, insert, 1st & 2nd
42. RING, blocking, 1st & 2nd
43. GEAR ASM., 2nd., output
43. GEAR ASM., 2nd., output
44. BEARING, 1st & 2nd
45. COLLAR, needle bearing, 2nd gear
46. GEAR, output, 3rd & 4th
47. KEY, feather, 3rd & 4th
48. BEARING, output, rear
49. SHIM, bearing, input shaft
50. SHIM, bearing, output shaft
51. WASHER, thrust, 5th gear
52. BEARING, needle, 5th gear
53. COOLAR, needle brg., 5th gear
54. GEAR ASM., output, 5th.
55. SYNCHRONIZER ASM., 5th gear
56. SLEEVE, syn. 5th. part of sn. asm.
57. HUB, clutch, 5th gear, part of syn. asm.
58. INSERT, 5th
59. SPRING, insert, 5th
60. RING, blocking, 5th
61. PLATE, stopper, insert
62. NUT, sleeve & hub
63. GEAR ASM., idler, rev.
64. SHAFT, idler, rev.
65. PIN, straight
66. BOLT, idle shaft, rev.
67. GASKET, idle shaft
68. SHAFT ASM., clutch fork
69. BEARING, clutch release
70. SPRING, release bearing
71. BUSH, clutch shaft
72. SEAL, clutch shaft
73. PLATE ASM., clutch pressure
74. DISC ASM., clutch w/facing

Figure 1 5-Speed Transaxle Exploded View



1. BOX SUB ASM., quardrant, shift cont.
2. SEAL, oil quardrant box
3. LEVER ASM., shift, external
4. LEVER ASM., select, external
5. BUSH, select lever
6. PIN, select lever
7. RING, snap, select lever
8. LEVER, shift, internal
9. PIN, spring, internal lever
10. SPRING, select stop, 1st & 2nd
11. SEAT, spring select stop
12. RING, snap, spring seat
13. STOPPER, rev. inhibitor
14. BOLT, rev. inhibitor
15. CAM, stopper, rev. inhibitor
16. SPRING, stopper cam
17. BOLT, stopper cam
18. *PIN, knock, quardrant box*
19. VENTILATOR, *air quardrant box*
20. STUD, 3rd position set
21. GASKET, quardrant box
22. BOLT, quardrant box
23. PLUG, screw
24. GASKET, plug
25. *SHAFT, arm, gear shift, 1st & 2nd*
26. SHAFT, arm, gear shift, 3rd & 4th
27. SHAFT, arm, gear shift, 5th
28. SHAFT, arm, gear shift, rev.
29. FORK, shift, 1st & 2nd
30. BLOCK, shift, 1st & 2nd
31. FORK, shift, 3rd & 4th
32. FORK, shift, 5th
33. LEVER, shift, rev.
34. BLOCK, shift, rev. & 5th
35. PIN, lock, rev. & 5th
36. RING, snap
37. PIN, spr., shift arm
38. PIN, spr., shift arm
39. BRACKET, fulcrum, rev. lever
40. LEVER, shift rev.
41. PIN, fulcrum brkt., rev. shift
42. COTTER PIN, snap, fulcrum pin
43. BOLT, *fulcrum brkt*
44. PIN, lock, 5th shaft
45. PIN, inter lock
46. PIN, lock, 3rd & 4th shaft
47. BALL, detent, gear shift
48. SPRING, detent ball
49. *SPRING, detent ball*, rev.
50. PLUG, detent spring

Figure 2 5-Speed Transaxle Exploded View

1. RING GEAR
2. RING GEAR BOLT
3. DIFFERENTIAL CASE
4. DIFFERENTIAL PINION GEAR
5. DIFFERENTIAL SIDE GEAR
6. SIDE GEAR THRUST WASHER
7. PINION GEAR THRUST WASHER
8. CROSS PIN
9. LOCK PIN
10. SPEEDOMETER DRIVE GEAR
11. SIDE BEARING
12. SIDE BEARING SHIM

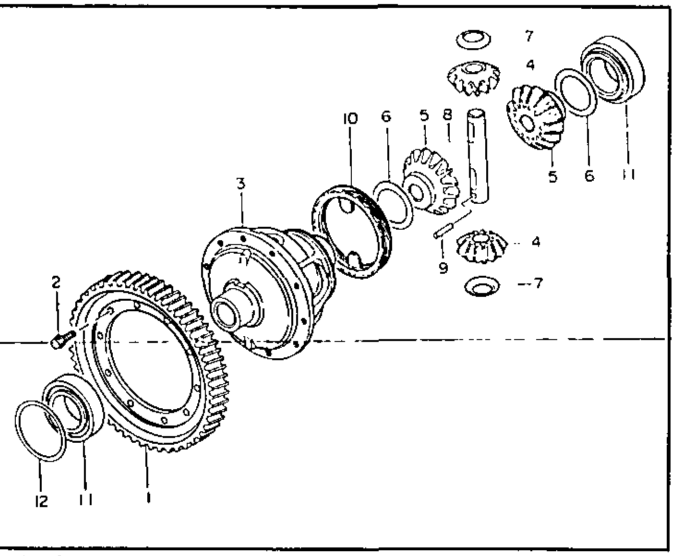


Figure 3 5-Speed Transaxle Exploded View

DIAGNOSIS

Before attempting to repair the clutch, transaxle or related linkages for any reason other than an obvious failure, the problem and probable cause should be identified. A large percentage of clutch and manual transaxle problems are manifested by shifting difficulties such as high shift effort, gear clash and grinding or blockout. When any of these problems occur, a careful analysis of these difficulties should be accomplished, and the following checks and adjustments made before disassembling the clutch or transaxle for repairs.

Diagnosis of drivetrain noises may seem baffling because many noise believed to be coming from the transaxle may actually be orignating from other sources, such as tires, road surfaces, wheel bearings, engine, and exhaust system.

These noises may vary by vehicle size, type and amount of body insulation used. Therefore, a thorough and careful check should be made to determine the source of the noise before disassembling the transaxle. Noise which originates in other places cannot be corrected by adjustment or replacement of parts in the transaxle.

It should also be remembered that transaxle gears, like any mechanical device, are not absolutely quiet and, will exhibit some normal operating noise.

The following is a suggested approach to verify suspected transaxle noises.

1. Select a smooth, level asphalt road to reduce tire and resonant body noise.
2. Drive vehicle far enough to thoroughly warm up all lubricants.
3. Note speed at which noise occurs and, in which gear range the transmission is in at the time.
4. Check for noises with engine running and vehicle stopped.
5. Determine in which of the following drive conditions noise is occurring:
   A. Drive-light acceleration or heavy pull.
   B. Float - maintaining constant vehicle speed at light throttle on a level road.
   C. Coast - partly or fully closed throttle with transaxle in gear.
   D. All of above.
6. After road testing the vehicle, refer to the following conditions and probable causes along with the Diagnosis Chart (Figure 6).

BEARINGS

Bad bearings generally produce a rough "growl" or "grating" sound, rather than the "whine" which is typical of gear noise.

Before diagnosing a bearing problem, clean the cone assembly thoroughly in solvent and allow to dry completely.

Whenever a bearing is removed, a careful inspection must be made to determine the cause of the problem and whether any related parts have been damaged.

If bearing has become magnetized, removal of metal particles from inside cage cannot be accomplished unless bearing is demagnetized.

Bearings fail by lapping, spalling or locking.

LAPPING

Lapping is caused by fine particles of abrasive material such as scale, sand or emery which are circulated by oil and which cause wearing away of roller and race surfaces. Bearings which are worn loose, but remain smooth without spalling or pitting, are the result of dirty oil.

SPALLING

Spalling of bearings is caused by overload or faulty assembly. Bearings that fail by spalling have either flaked or pitted rollers or races. Faulty assembly consists of misalignment, cocking or bearings, or adjustments which are too tight.

LOCKING

Locking of bearings is caused by large particles of foreign material becoming wedged between rollers and

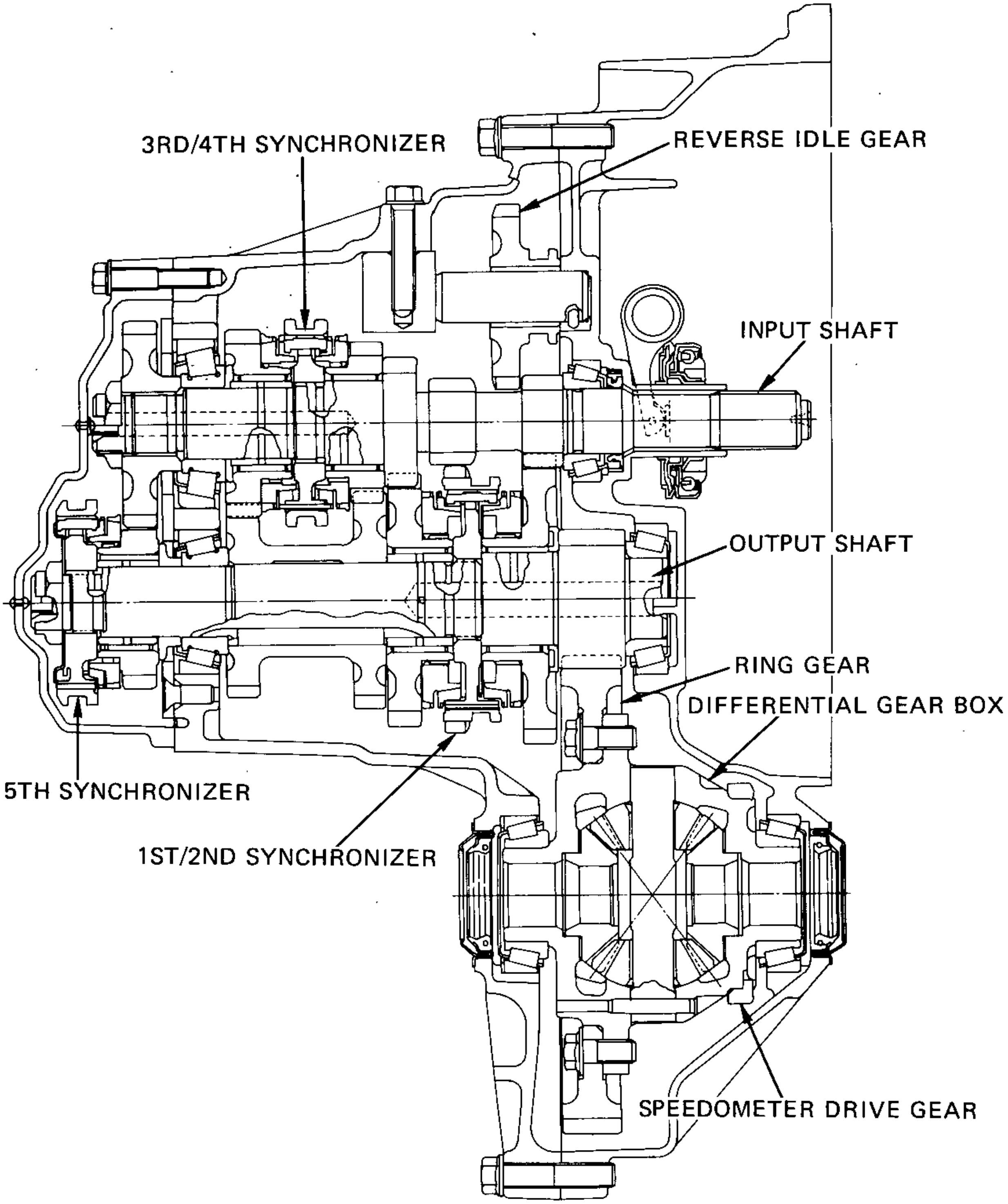


Figure 4 5-Speed Transaxle Cross Section

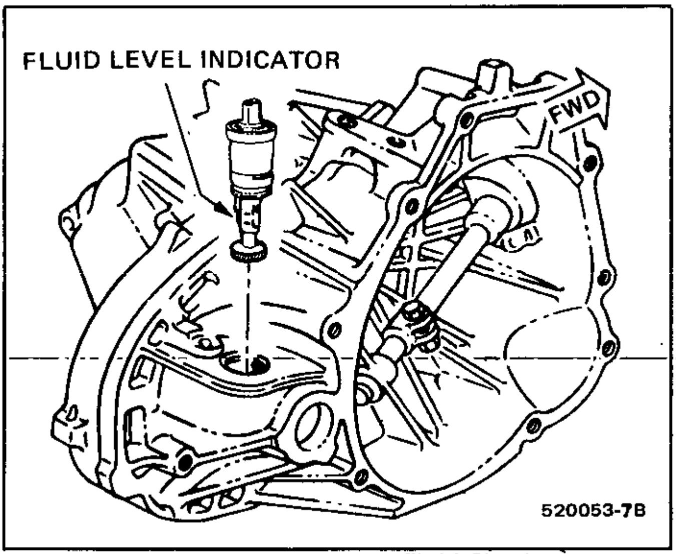


Figure 5-Transmission Fluid Check

race, usually causing one of the races to turn. Preloading of regular type taper roller bearings, higher than specified, can also cause locking of bearings.

BEARING NOISE

Since side bearings are preloaded, noise should not go away, or diminish appreciably, when the differential is run with wheels off the ground. Noise in this area can easily be confused with wheel bearing noise. Inspect and replace as required.

WHEEL BEARING NOISE

A rough bearing produces a vibration or "growl" which continues with the vehicle coasting and transmission in Neutral. Since wheel bearings are not preloaded, noise should diminish if differential is run with the wheels off ground. A brinnelled bearing causes a "knock" or "click" approximately every two revolutions of the wheels as the bearing rollers do not travel at the same speed as the wheel. With wheels jacked up, spin wheels by hand while listening at hubs for evidence of rough or brinnelled bearing noise.

Wheel bearings are not serviceable and must be replaced as an integral part of hub and spindle.

CONDITION	PROBABLE CAUSE
Noise is the same in drive or coast.	a. Road Noise. b. Tire noise. c. Front wheel bearing noise. d. Incorrect drive axle angle. (Standing Height)
Noise changes on a different type of road.	a. Road noise. b. Tire noise.
Noise tone lowers as car speed is lowered.	Tire noise.
Noise is produced with engine running vehicle stopped and/or driving.	a. Engine noise. b. Transaxle noise. c. Exhaust noise.
A knock at low speeds.	a. Worn drive axle joints. b. Worn side gear hub counterbore.
Noise most pronounced on turns.	Differential gear noise.
Clunk on acceleration or deceleration.	a. Loose engine mounts. b. Worn differential pinion shaft in case or side gear hub counterbore in case worn oversize. c. Worn or damaged drive axle inboard joints.
Clicking noise in turns.	Worn or damaged outboard joint.
Vibration	a. Rough wheel bearing. b. Damaged drive axle shaft. c. Out of round tires. d. Tire unbalance. e. Worn joint in drive axle shaft. f. Incorrect drive axle angle.
Noisy in Neutral with Engine Running	a. Damaged input gear bearings. b. Clutch release bearing.
Noisy in First Only.	a. Damaged or worn first-speed constant mesh gears. b. Damaged or worn 1-2 synchronizer.
Noisy in Second Only	a. Damaged or worn second-speed constant mesh gears. b. Damaged or worn 1-2 synchronizer.
Noisy in Third Only.	a. Damaged or worn third-speed constant mesh gears. b. Damaged or worn 3-4 synchronizer.
Noisy in Fourth Gear Only.	a. Damaged or worn 3-4 synchronizer. b. Damaged or worn 4th speed constant mesh gears
Noisy in Fifth Gear Only.	a. Damaged or worn 5th synchronizer. b. Damaged or worn 5th speed constant mesh gears
Noisy in Reverse Only	a. Worn or damaged reverse idler gear or idler bushing. b. Worn or damaged 1-2 synchronizer sleeve.
Noisy in All Gears.	a. Insufficient lubricant. b. Damaged or worn bearings. c. Worn or damaged input gear (shaft) and/or output gear (shaft).
Slips out of Gear.	a. Worn or improperly adjusted linkage. b. Transmission loose on engine housing. c. Shift linkage does not work freely; binds. d. Bent or damaged cables. e. Dirt between clutch housing and engine. f. Stiff shift lever seal .
Leaks Lubricant	a. Axle shaft seals and input shaft seal. b. Excessive amount of lubricant in transmission. c. Lack of sealant between case and clutch housing or loose clutch housing. d. Shift lever seal leaks. e. Loose rear cover. f. Dipstick not seated in tube.
Locked in Second Gear	a. Lock pin or interlock pin missing.

Figure 6 Diagnosis Chart

UNIT REPAIR

TRANSAXLE

Disassembly

1. Remove the clutch release bearing. Attach the transaxle assembly to the transaxle holding fixture (J-33366). Attach J-33366 to base plate J-3389-20 (Figure 7).
2. Remove seven bolts from the rear cover and remove cover (Figure 8).
3. Remove the control box assembly together with four bolts from the transaxle case (Figure 9).
4. Using a screwdriver, shift transaxle into gear. Remove fifth speed drive and driven gear retaining nuts from the input and output shaft (Figure 10) and discard the retaining nuts. Shift transaxle back into neutral, aligning the detents on the shift rails.
5. Remove the detent spring retaining bolts for 1st/2nd, 3rd/4th, reverse and 5th speeds, and remove the detent springs and detent balls (Figure 11). Remove reverse detent spring retaining bolts and remove spring and detent ball (Figure 12).
6. Place 5th speed synchronizer in neutral. Remove the roll pin at 5th gear shift fork and discard the roll pin. Remove 5th gear synchronizer hub, sleeve, roller bearing and gear with the shift fork as an assembly from the output shaft. Using J-35274, remove 5th speed gear from the input shaft (Figure 13).
7. Remove seven screws with torx (No. 45) from the bearing retainer. Remove the bearing retainer and shims from the input and output shafts. (Figure 14).
8. Remove the bolt used to retain the reverse idler shaft at the transaxle case (Figure 15).

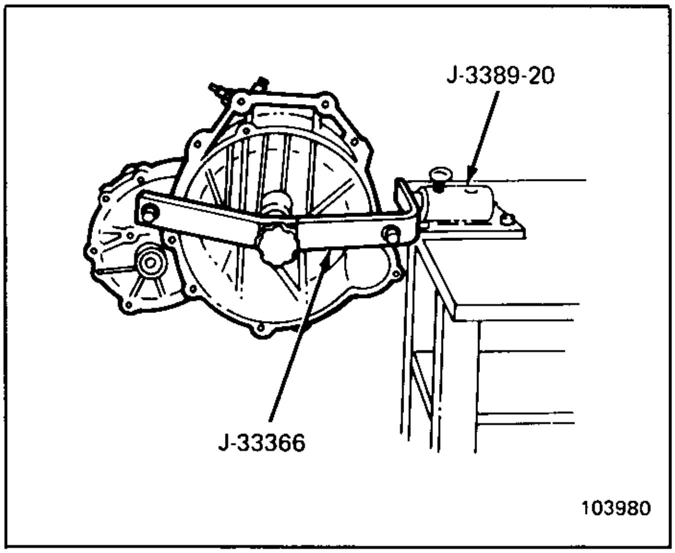


Figure 7 Transaxle Attached to J-33366

9. Remove the collar and thrust washer from the output shaft using J-22888 and J-22888-30 (Figure 16).

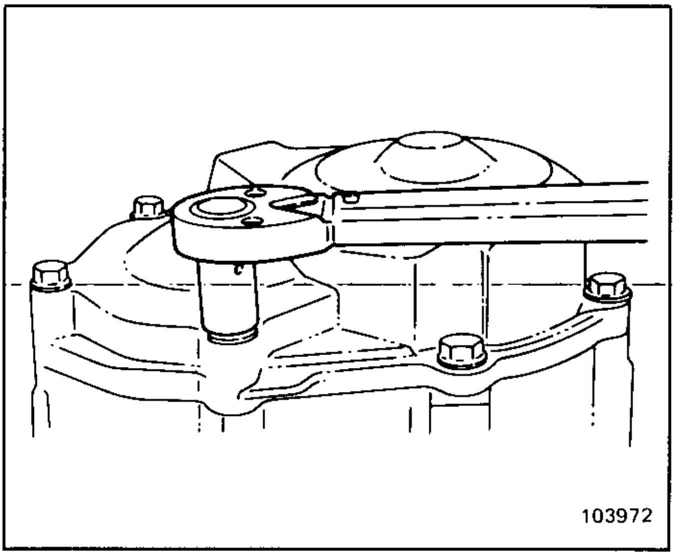


Figure 8 Rear Cover

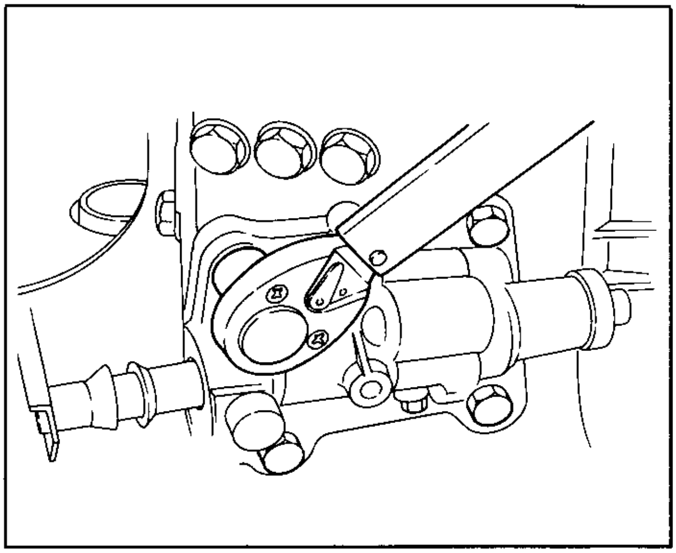


Figure 9 Control Box

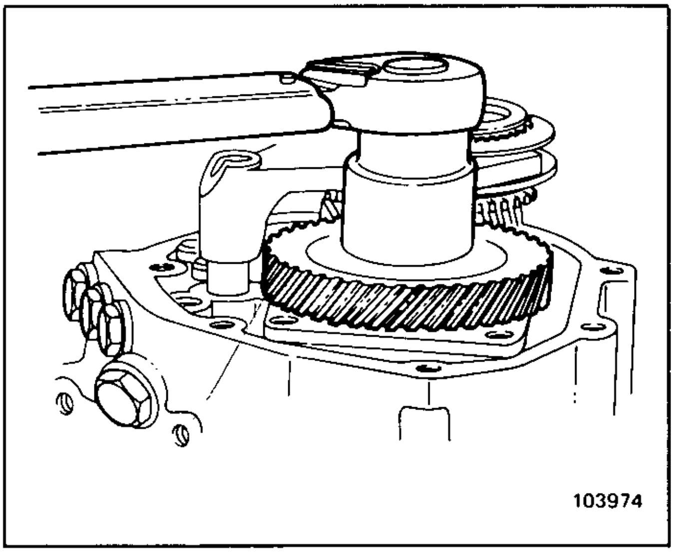


Figure 10 Fifth Gear Retaining Nuts

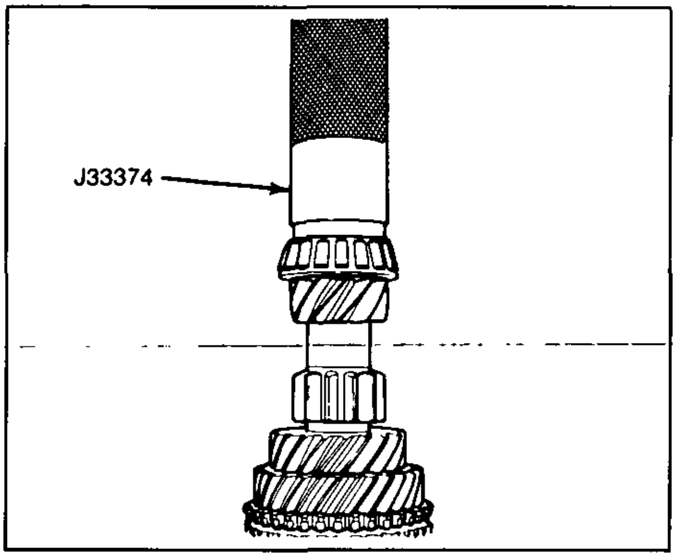


Figure 33 Front Brg. Input Shaft

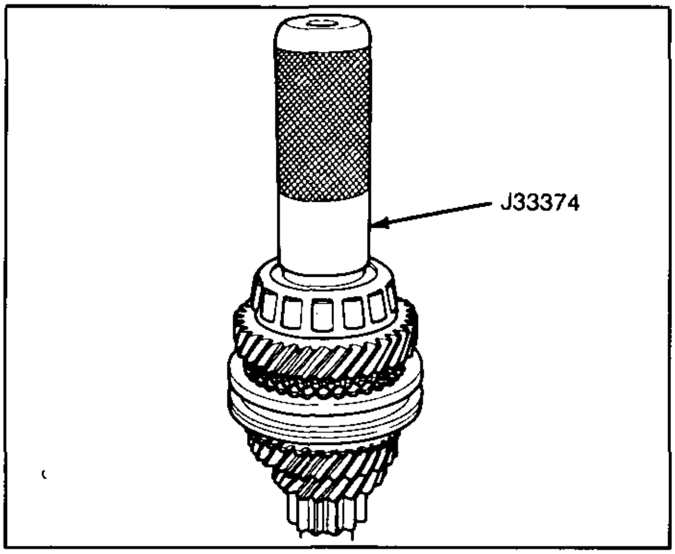


Figure 34 Rear Brg. Input Shaft

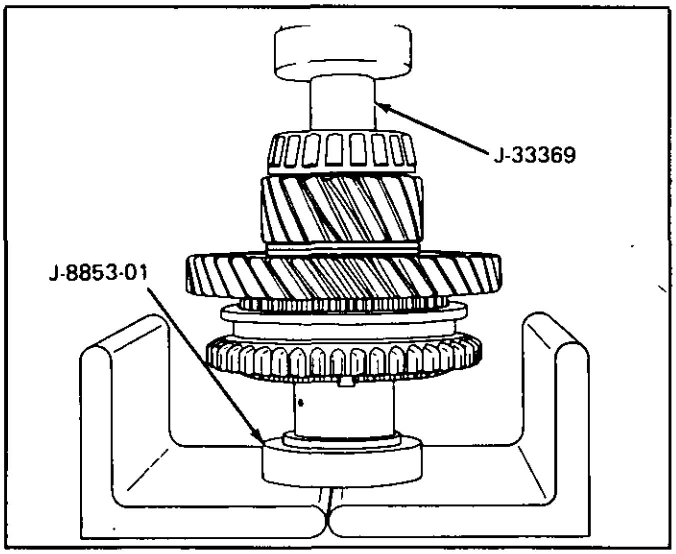


Figure 35 Collar Sleeve and Hub (1st)

two thrust washers and pinion gears opposite of each other, and install them in their positions by turning the side gear.

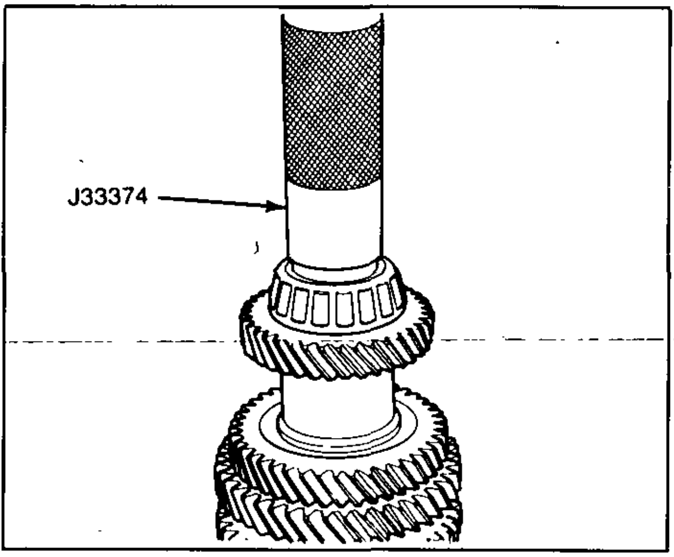


Figure 36 Rear Brg. Output Shaft

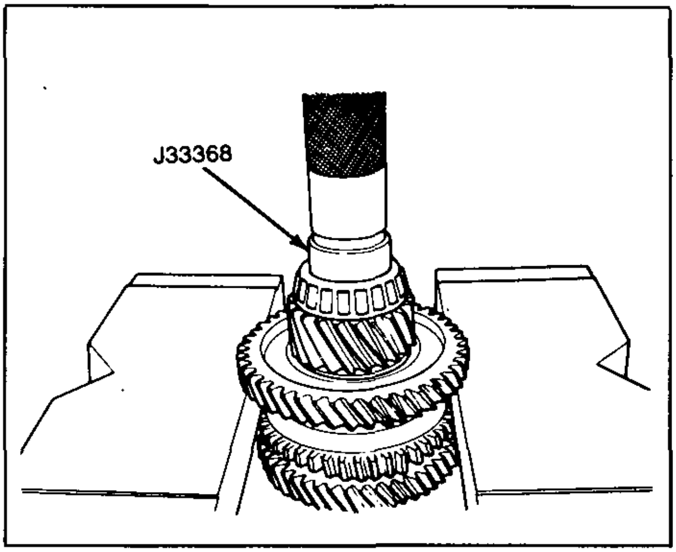


Figure 37 Front Brg. Output Shaft

2. Insert the cross pin, and make sure the backlash is within the rated range (0.03 to 0.08mm (0.0012 to 0.0031 in.).
3. Install the lock pin and stake it.
4. Heat the speedometer drive gear to about 95°C using a hot oil dryer (do not use hot water) and then install it on the differential.
5. Install the ring gear on the differential case. Next, install ten new bolts and then tighten them to the specified torque in a diagonal sequence.

   Apply oil only to the abrasive surfaces of the bolts. Do not apply oil to the threaded portions of the bolts. NOTE: Apply oil to the cross pin, differential gears, thrust portion, side gear shaft portion and side gear spline portion before installation.
6. Install the side bearings on the differential case. Using J-22919 and an arbor press, install bearings.

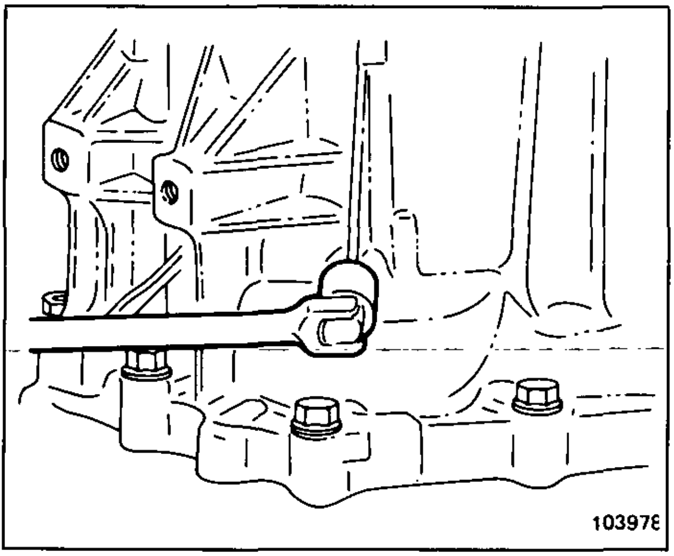


Figure 15 Reverse Idler Shaft Bolt

21. Drive out the bushing toward the inside by the use of J-28412 and discard the bushing. Remove the fork assembly only when replacing the clutch fork assembly.

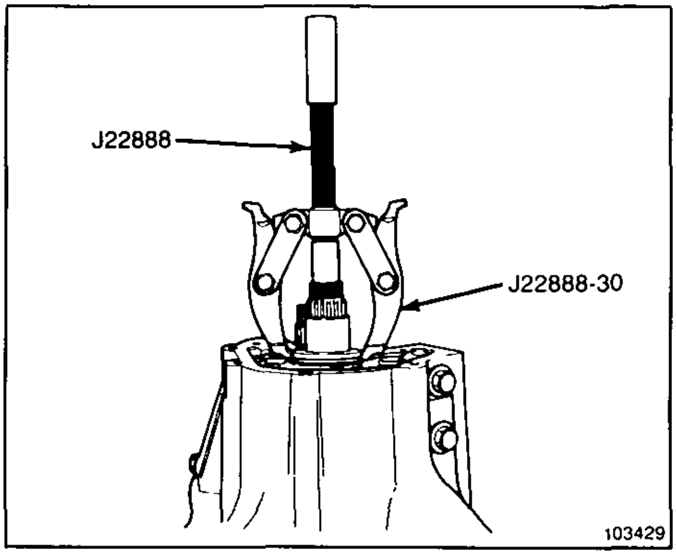


Figure 16 Collar and Thrust Washer

SHAFT DISASSEMBLY

Input Shaft

1. Remove the front bearing using J-22912-01 with a press (Figure 26).
2. Pull out the rear bearing 4th gear, 3rd/4th synchronizer assembly and 3rd gear all together, using J-22912-01 and a press (Figure 27).
3. Remove other parts from the input shaft.

Output Shaft

1. Remove the front bearing using J-22227-A with J-33369 and a press (Figure 28).
2. Remove the rear bearing and 3rd/4th gear simultaneously using J-22912-01 and a press (Figure 29).

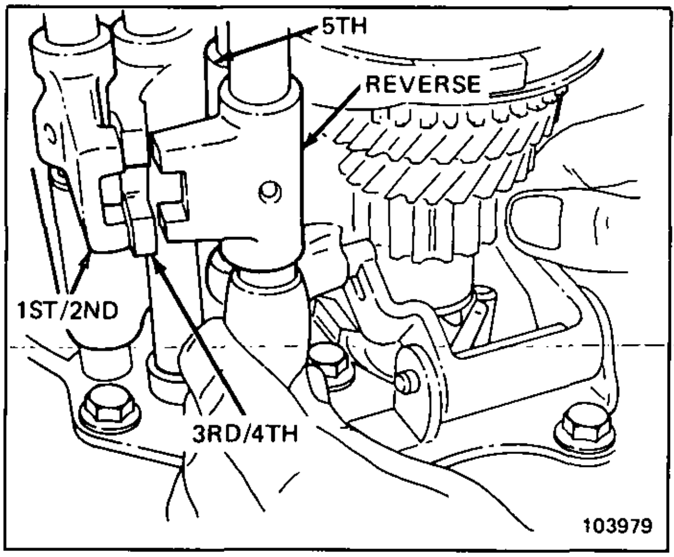


Figure 17 5th and Reverse Shifter Shafts

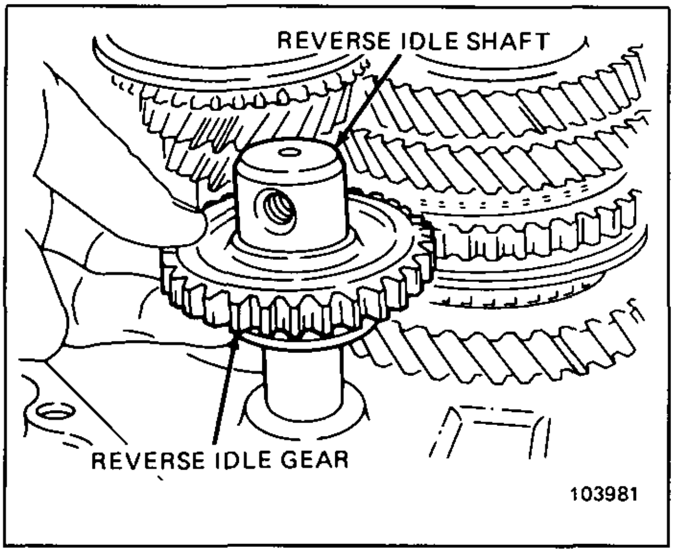


Figure 18 Reverse Idler Shaft and Gear

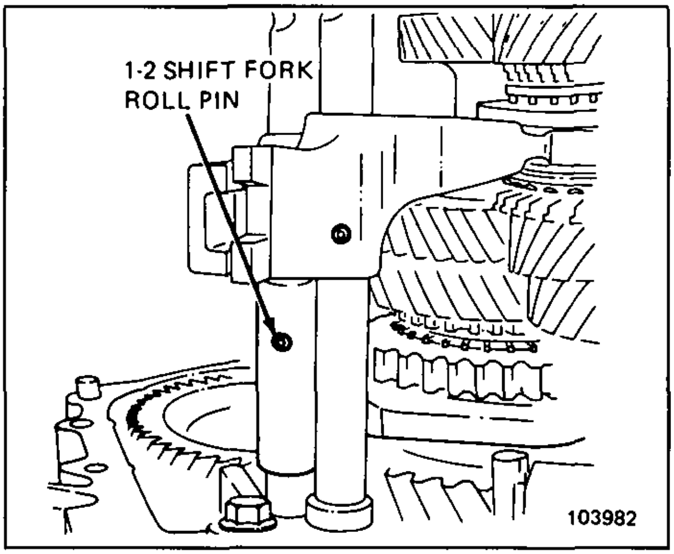


Figure 19 1st/2nd Shift Fork Roll Pin

3. Remove the key, 2nd gear, needle bearing and blocker ring.

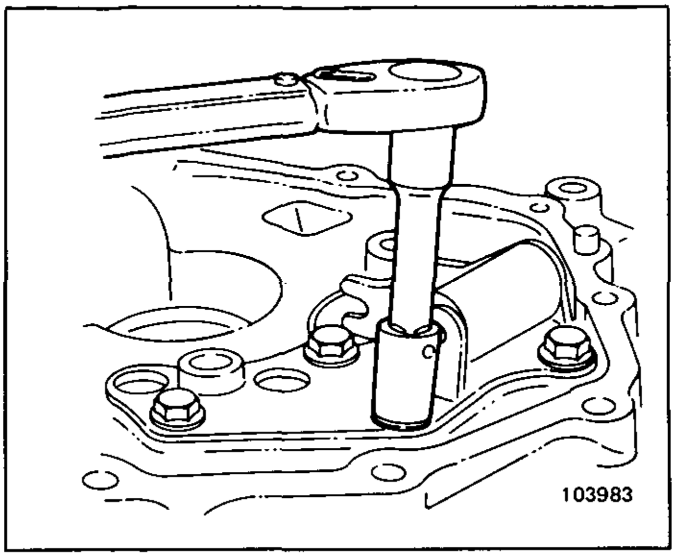


Figure 20 Reverse Shift Lever and Bracket

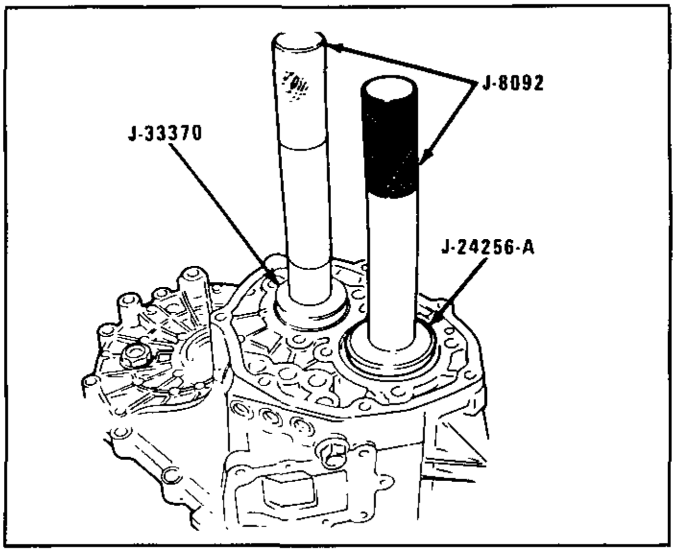


Figure 21 Input/Output Rear Brg. Races

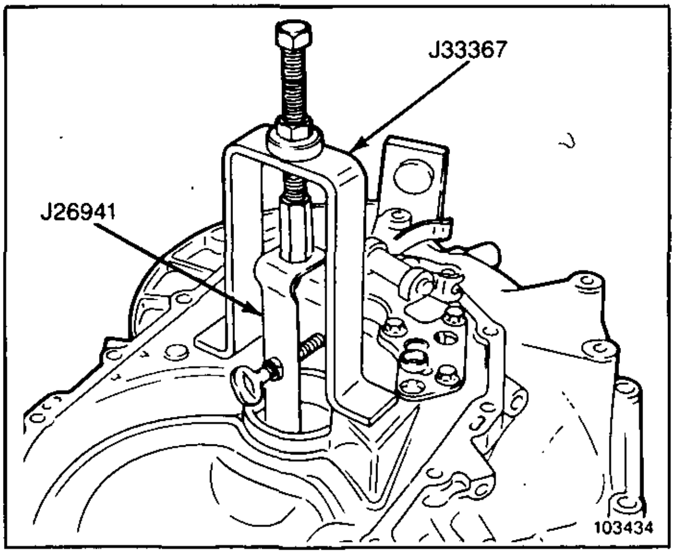


Figure 22 Input/Output Front Brg. Races

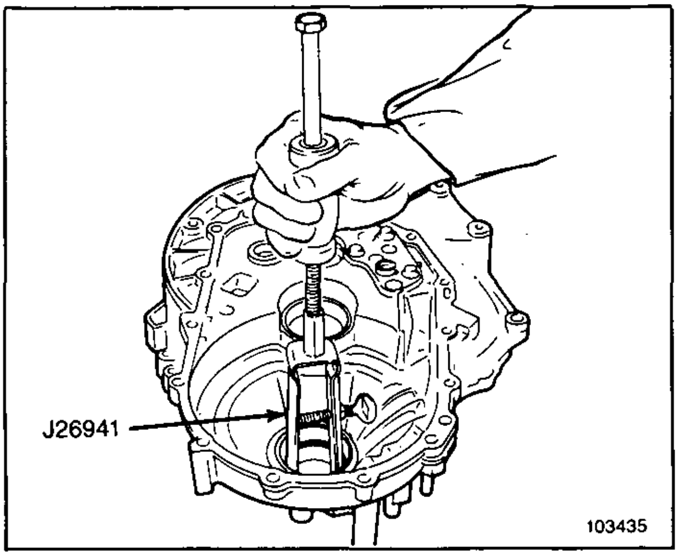


Figure 23 Differential Front Brg. Race

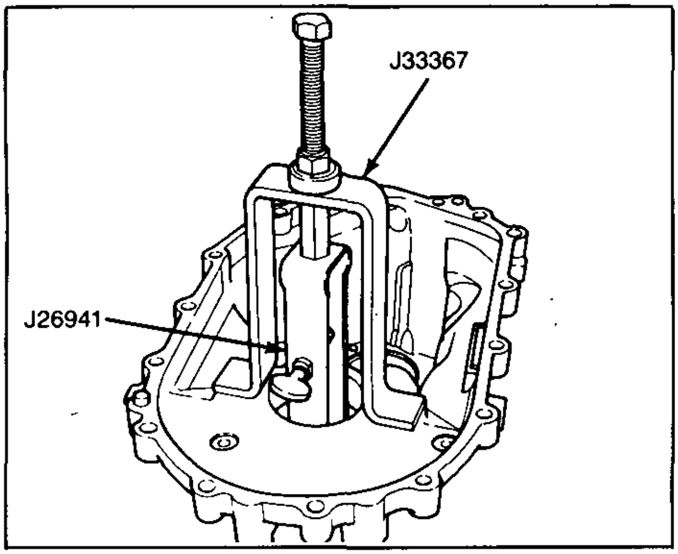


Figure 24 Differential Rear Brg. Race

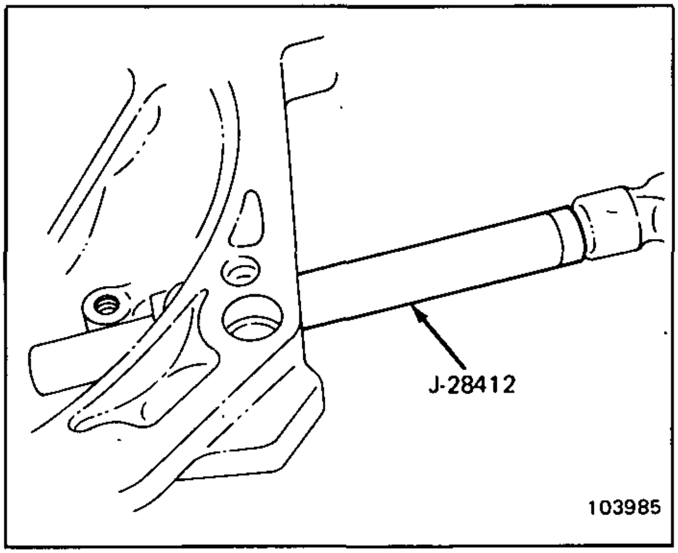


Figure 25 Clutch Shaft Bushing

4. Remove the collar, reverse gear assembly and 1st gear all together by the use of a press (Figure 30).

DIFFERENTIAL

Disassembly

1. Remove the side bearing using J-22888 with puller leg kit J-22888-30 and pilot J-2241-11 (Figure 31).
2. Remove ten bolts, and remove the ring gear. Discard the ring gear bolts.
3. Using a screwdriver, pry the speedometer drive gear from the differential case.

   Do not use the removed speedometer drive gear again.
4. Drive out the lockpin, and pull out the cross pin.
5. Remove the pinion gears and thrust washers, and remove the side gears and thrust washers.

CLEANING AND INSPECTION

Wash all parts thoroughly in clean solvent. Be sure all old lubricant, metallic particles, dirt, or foreign material are removed from the surfaces of every part. Apply compressed air to each oil feed port and channel in each case half to remove any obstructions or cleaning solvent residue.

Inspect all gear teeth for signs of excessive wear or damage and check all gear splines for burrs, nicks, wear or damage. Remove minor nicks or scratches on an oil stone. Replace any part exhibiting excessive wear or damage.

Inspect all thrust washers for evidence of excessive wear, distortion or damage. Replace any of these parts if they exhibit these conditions.

Inspect the two case halves for cracks, porosity, damaged mating surfaces, stripped bolt threads, or distortion. Replace any part that exhibits these conditions.

Inspect the condition of all needle, roller and thrust bearings. Wash bearings thoroughly in a cleaning solvent. Apply compressed air to bearings.

NOTICE: Do not allow the bearings to spin. Turn them slowly by hand. Spinning bearings may damage the rollers.

Lubricate bearings with a light oil and check them for roughness by slowly turning the race by hand.

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. When reassembling synchronizer assemblies note the following:

Each insert spring should support all three keys and each opening portion of the insert spring should face the opposite direction from the other.

SHAFT ASSEMBLY

Input Shaft

Before assembling, apply oil to the thrust surfaces on all gears and washers.

1. Install the needle bearing and 3rd gear, and install the block ring next.
2. Match the inserts of the 3rd/4th sleeve and hub assembly with the grooves of the blocker ring and press the sleeve and hub assembly and collar. Using J-33374 and a press (Figure 32).

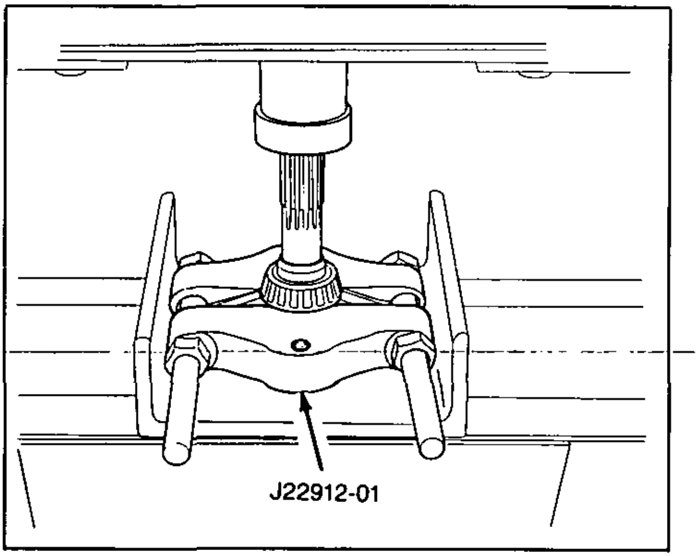


Figure 26 Front Input Bearing

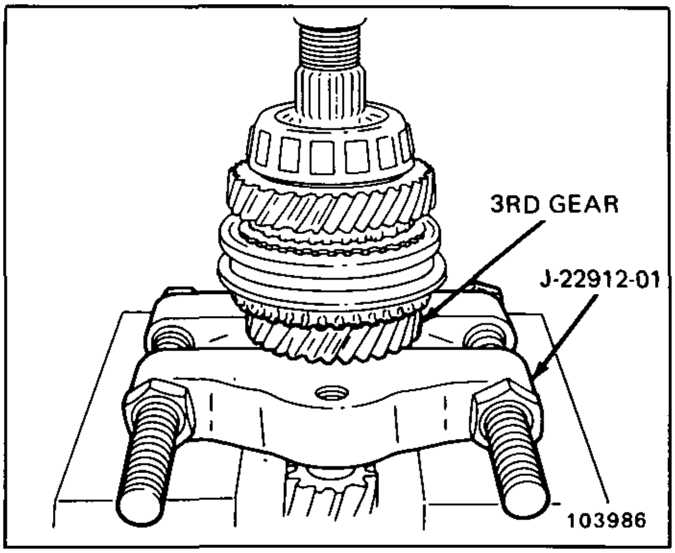


Figure 27 Rear Input Bearing

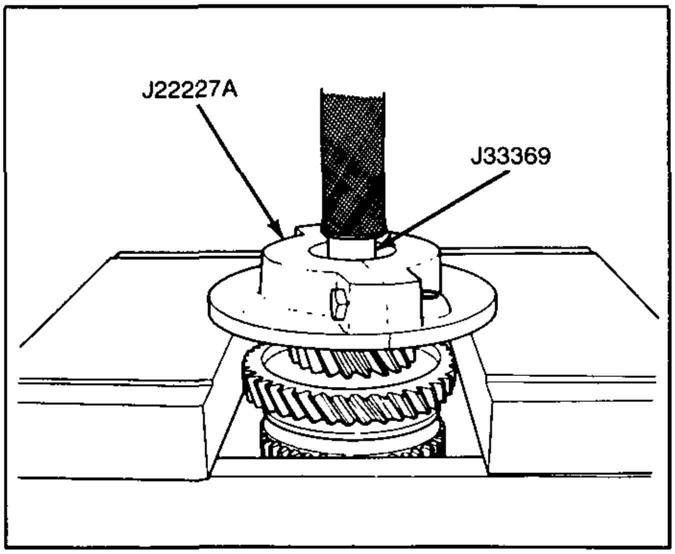


Figure 28 Front Output Bearing

Before installing, apply oil to the collar and hub interiors. After installation, apply oil to the circumference of the collar.

3. Install the blocker ring and needle bearing, and install the 4th gear and thrust washer next. Install the thrust washer with the recessed area facing 4th gear.
4. Install the front and rear bearings using J-33374 and a press (Figures 33 and 34).
   Before installing, apply oil to the bearing interior and race surfaces.

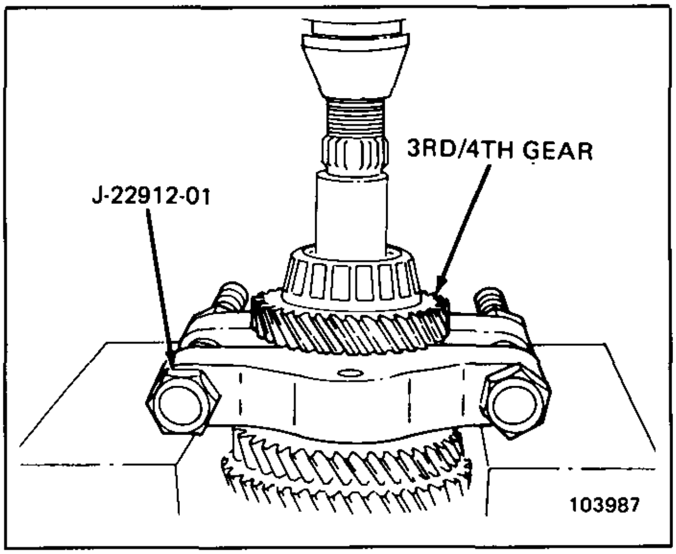


Figure 29 Rear Output Bearing

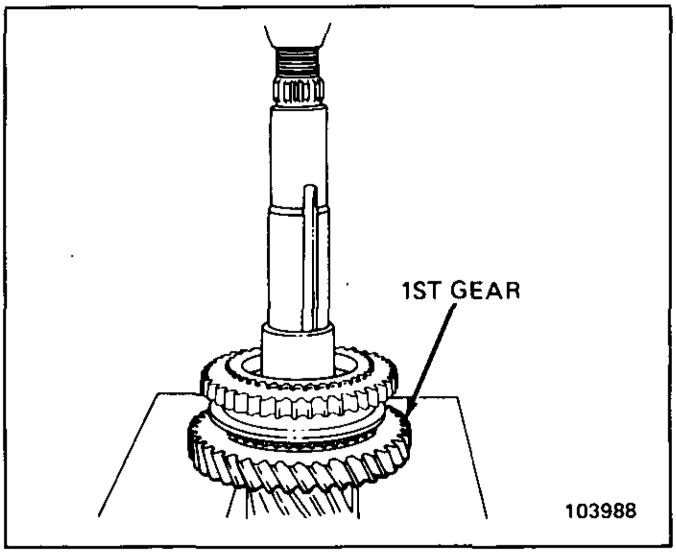


Figure 30 Collar,Reverse and 1st Gear

Output Shaft

Before assembling, apply oil to the thrust surfaces on all gears. Apply oil to all the bearing interiors and race surfaces.

1. Install the thrust washer, thrust needle bearing, 1st gear and blocker ring.
2. Match the inserts of the sleeve and hub assembly with the grooves of the blocker ring and press the sleeve and hub assembly together with the collar using J-8853-01, pilot J-33369 and a press (Figure 35).
   Before installing the sleeve and hub assembly, recommend oil be applied to the hub and collar interiors. After installation, apply oil to the collar exterior.

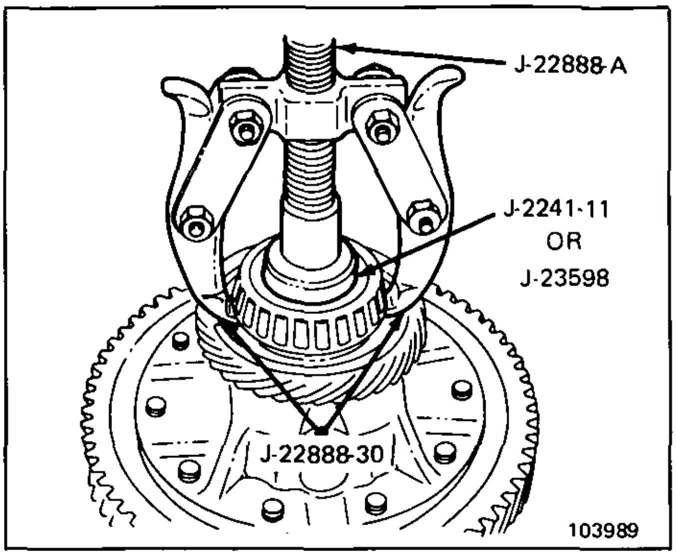


Figure 31 Differential Side Bearings

3. Install the blocker ring needle bearing and 2nd gear, and install the key on the key groove next.
4. Apply oil to the 3rd/4th gear interior, match the key with the key groove and fit the key together with the rear bearing. Using J-33374 and a press, press bearing on shaft (Figure 36).

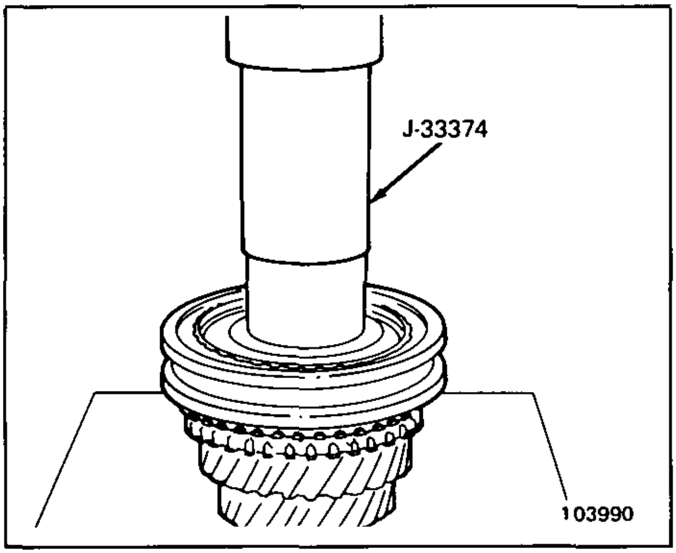


Figure 32 3rd/4th Sleeve/Hub and Collar

5. Press the front bearing on the shaft using J-33368 and a press (Figure 37).

DIFFERENTIAL

Assembly

Before assembling, apply oil to the bearing interiors and race surfaces.

1. Install two side gears on the differential case together with the thrust washers. Next, position

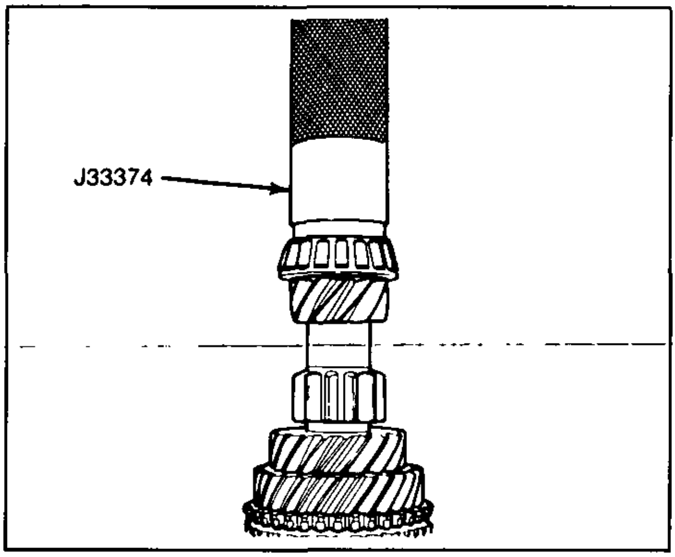


Figure 33 Front Brg. Input Shaft

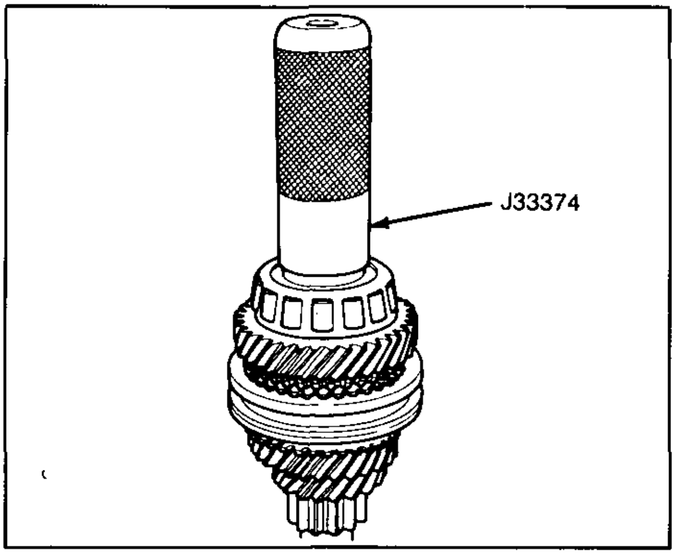


Figure 34 Rear Brg. Input Shaft

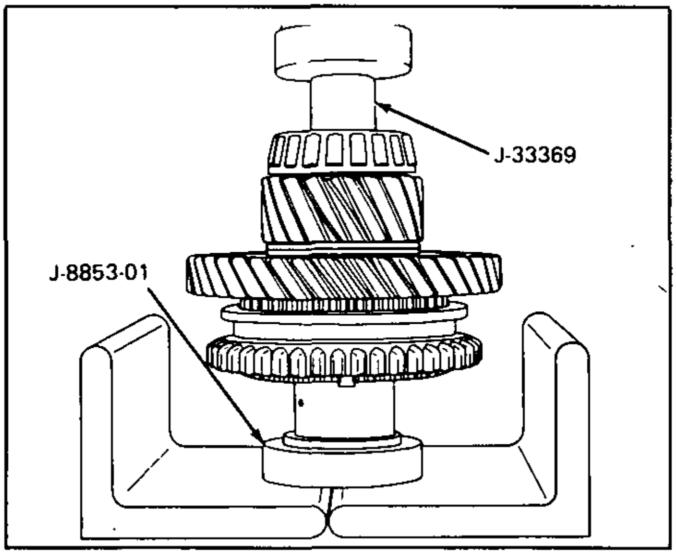


Figure 35 Collar Sleeve and Hub (1st)

two thrust washers and pinion gears opposite of each other, and install them in their positions by turning the side gear.

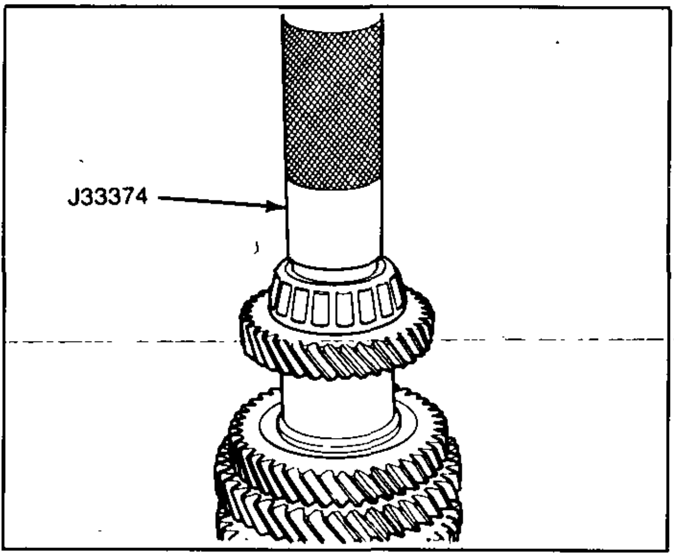


Figure 36 Rear Brg. Output Shaft

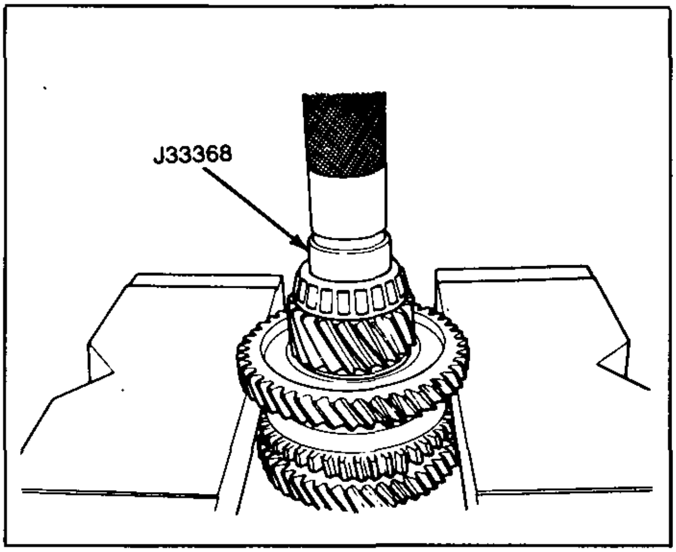


Figure 37 Front Brg. Output Shaft

2. Insert the cross pin, and make sure the backlash is within the rated range (0.03 to 0.08mm (0.0012 to 0.0031 in.).
3. Install the lock pin and stake it.
4. Heat the speedometer drive gear to about 95°C using a hot oil dryer (do not use hot water) and then install it on the differential.
5. Install the ring gear on the differential case. Next, install ten new bolts and then tighten them to the specified torque in a diagonal sequence.

   Apply oil only to the abrasive surfaces of the bolts. Do not apply oil to the threaded portions of the bolts. NOTE: Apply oil to the cross pin, differential gears, thrust portion, side gear shaft portion and side gear spline portion before installation.
6. Install the side bearings on the differential case. Using J-22919 and an arbor press, install bearings.

TRANSAXLE

Assembly

Before reassembly, attach the clutch housing to the transaxle holding fixture if removed.

1. Install a new input shaft seal using J-26540 (Figure 38).
2. Install the front outer bearing races for the input shaft, output shaft and differential into the clutch housing. Apply oil to the bearing races before installation. Using J-33371 with driver handle J-8092, press input race into housing (Figure 39). Using J-7817 with driver handle J-8092, press output race into housing (Figure 40). Using J-8611-01 with driver handle J-8092, press differential race into housing. (Figure 41).
3. Apply grease to three interlock pins, and install them on the clutch housing (Figure 42).
4. Install the reverse shift bracket on the clutch housing. Use 3rd/4th shift rod to align bracket to housing. Install retaining bolts and torque to specification. Make sure rod operates smoothly after installation (Figure 43).

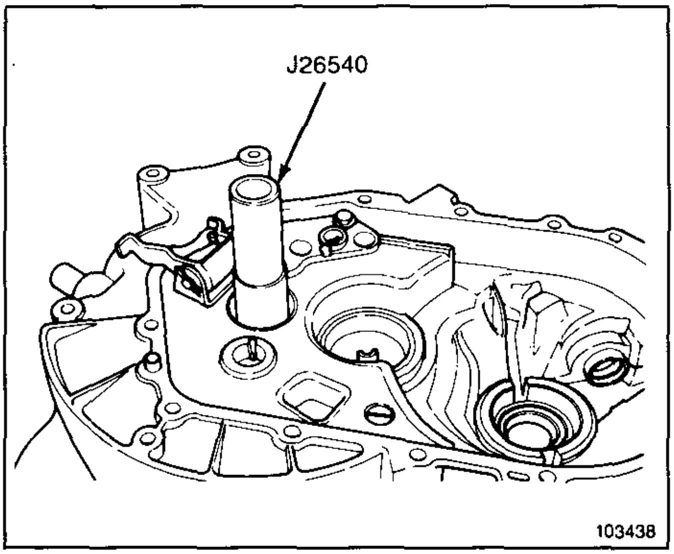


Figure 38 Input Shaft Seal

5. Install the differential assembly first, then install the input and output shaft with the 3rd/4th shift fork and shaft together as an assembly into the clutch housing. Make sure interlock pin is in the 3rd/4th shifter shaft before installing.

   The 3rd/4th shift shaft is installed into the raised collar of reverse shift lever bracket.

6. Install the 1-2 shift fork onto the synchronizer sleeve and insert the shifter shaft into the reverse shift lever bracket. Align hole in fork with the shaft and install a new roll pin. Stake the roll pin after installation.
7. Install reverse lever on shift bracket.
8. Install reverse and 5th gear shifter shaft and at the same time, engage reverse shaft with reverse shift lever. Make sure interlock pin is in the 5th gear shifter shaft before installing.

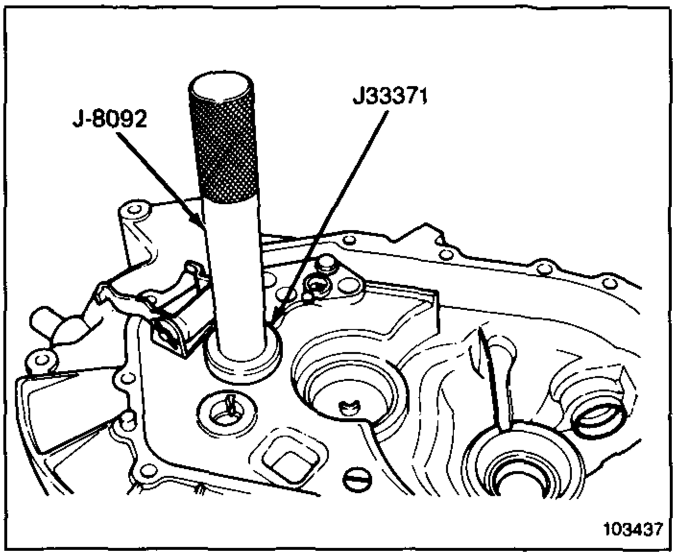


Figure 39 Frt. Input Shaft Brg. Race

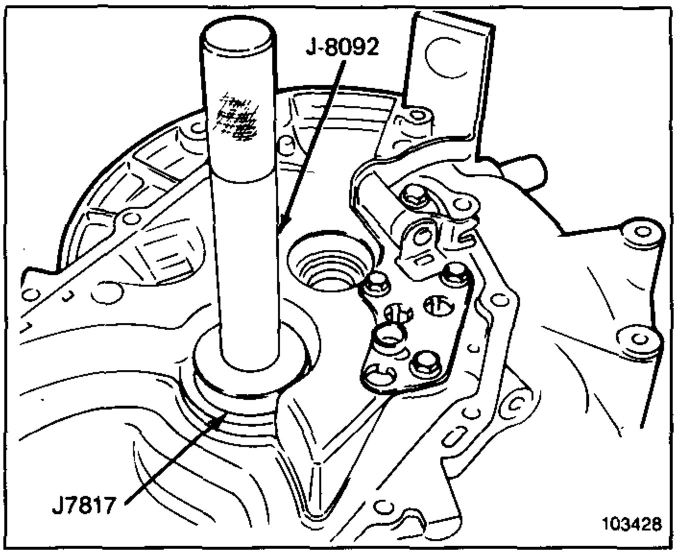


Figure 40 Frt. Output Shaft Brg. Race

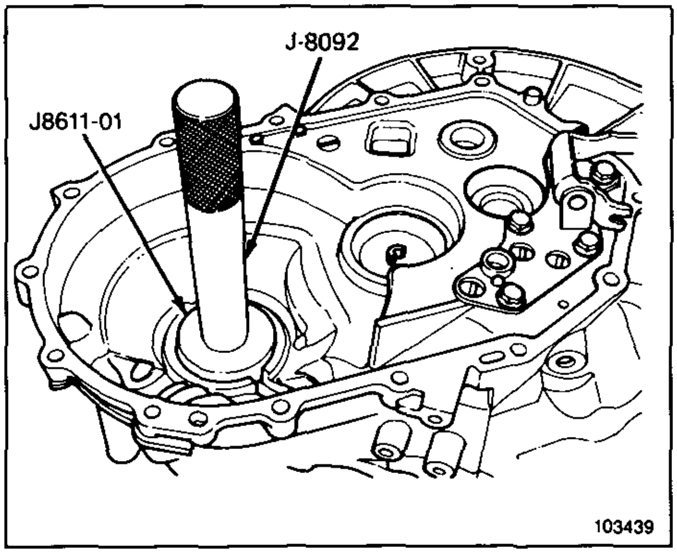


Figure 41 Frt. Differential Brg. Race

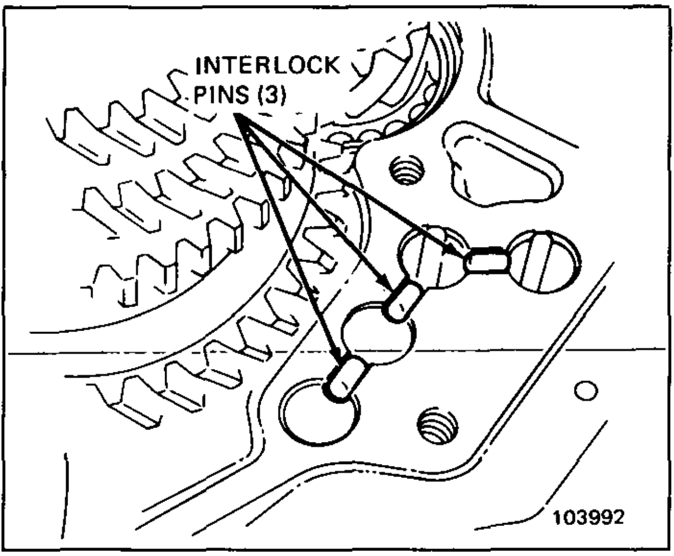


Figure 42 Interlock Pins

9. Install the reverse idler shaft together with the gear into the clutch housing. Make sure reverse lever is engaged in collar of gear.
10. Measure and determine shim size using J-33373:
    A. Position the outer bearing races on the input, output and differential bearings. Position the shim selection gages on the bearing races as shown in Figure 44. The 3 gages are identified: Input, Output and Differential.
    B. Place seven spacers provided with J-33373 evenly around the perimeter of the clutch housing (Figure 45).

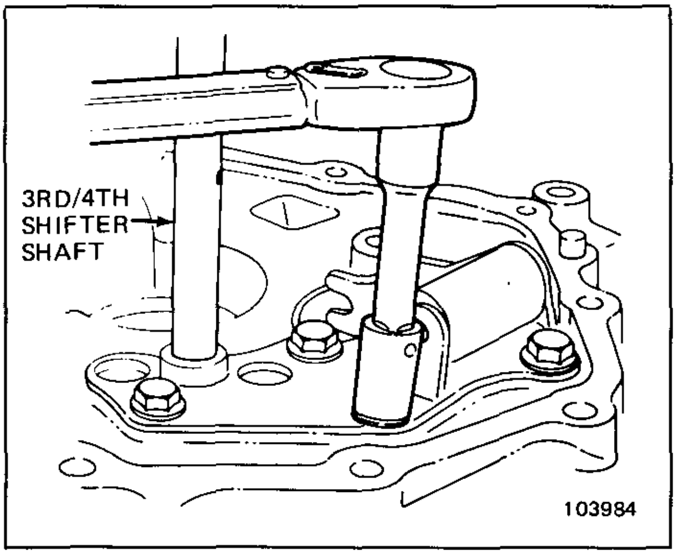


Figure 43 Reverse Shift Bracket

    C. Install bearing and shim retainer on transaxle case. Torque screws to 15-22 N·m (11-16 ft. lbs.). After final torque on screws, stake screws to the retaining plate.

    D. Carefully position the transaxle case over the gages and on the spacers. Install the seven bolts provided with the tool kit and

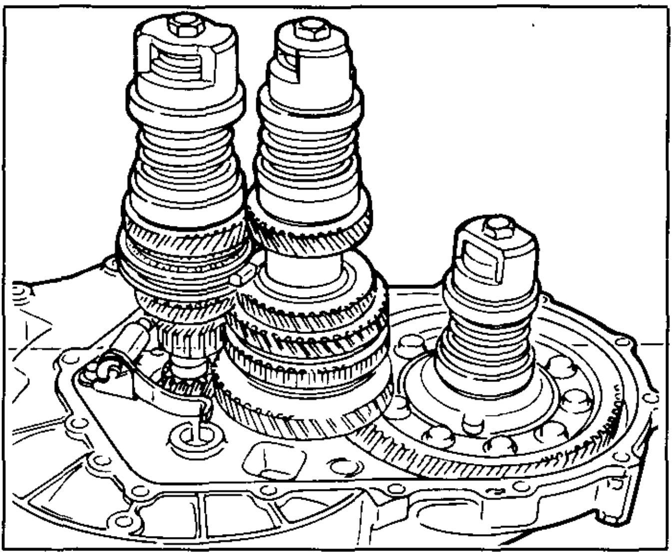


Figure 44 Gages in Position

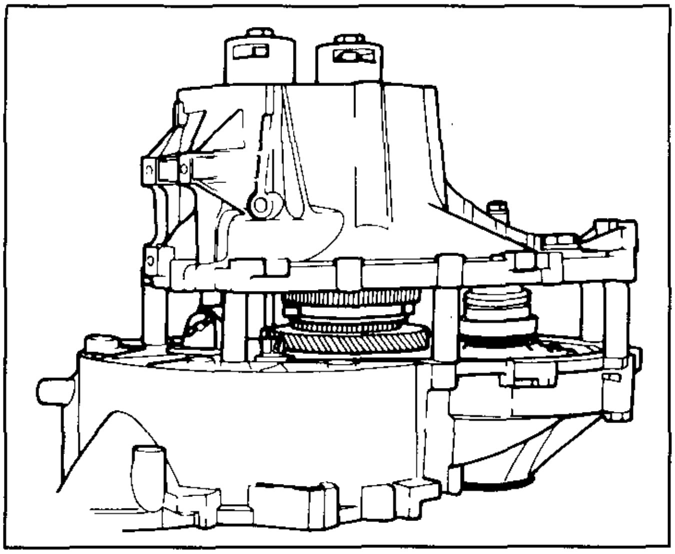


Figure 45 Gages and Spacers in Position

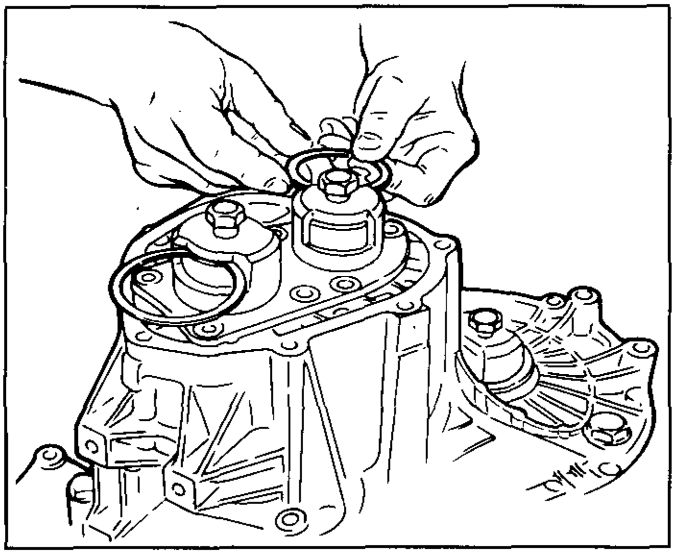


Figure 46 Checking Shim Size

tighten bolts alternately until case is seated on spacers. Torque bolts to 15 N·m (10 ft. lbs.).

E. Rotate each gage to seat the bearings. Rotate the differential case through three revolutions in each direction.

F. With the three gages compressed, measure the gap between the outer sleeve and the base pad using available shim sizes (Figure 47). The input shaft shim should be one size smaller than the largest shim that will fit in the gap. The differential should use a shim three sizes larger than that which will smoothly fit in the gap. The output shaft should use the largest shim that can be placed into the gap and drawn through without binding.

G. When each of the three shims have been selected, remove the transaxle case, seven spacers and three gages.

THICKNESS		AVAILABLE		
mm	(in.)	INPUT	OUTPUT	DIFF
1.00	0.0394	●		
1.04	0.0410	●		
1.08	0.0426	●		●
1.12	0.0441	●		●
1.16	0.0457	●	●	●
1.20	0.0473	●		●
1.24	0.0489	●	●	●
1.28	0.0504	●		●
1.32	0.0520	●	●	●
1.36	0.0536	●		●
1.40	0.0552	●	●	●
1.44	0.0567	●		●
1.48	0.0583	●	●	●
1.52	0.0599	●		●
1.56	0.0615	●	●	●
1.60	0.0630	●		●
1.64	0.0646	●	●	●
1.68	0.0662	●		●
1.72	0.0678	●	●	●
1.76	0.0693	●		●
1.80	0.0709	●	●	●
1.84	0.0725	●		●
1.88	0.0741	●	●	●
1.92	0.0756	●		●
1.96	0.0772	●	●	●
2.00	0.0788	●		●
2.04	0.0804	●	●	
2.08	0.0820	●		
2.12	0.0835	●	●	
2.16	0.0851	●		
2.20	0.0867	●	●	
2.24	0.0883	●		
2.28	0.0899	●	●	
2.32	0.0914	●		
2.36	0.0930	●	●	
2.40	0.0946	●		
2.44	0.0961	●	●	
2.48	0.0977	●		

Figure 47 Preload Shim Sizes Chart

11. Position the shim selected for the input, output and differential into the bearing race bores in the transaxle case.
12. Install the rear input shaft bearing race using J-24256-A with J-8092.
13. Install the rear output shaft bearing race using J-33370 with J-8092.
14. Install the rear differential case bearing race using J-8611-01 with J-8092 and a press. Apply oil to the bearing race before installation. Press bearing until seated in its bore.
15. Apply a 1/8″ bead of Loctite #514 or equivalent to the mating surfaces of the clutch housing and transaxle case.
16. Be sure magnet is installed in transaxle case.
17. Install the transaxle case on the clutch housing. Install the reverse idle shaft bolt into the transaxle case. Torque the bolt to 30-45 N·m (22-33 ft. lbs.).
18. Install 14 case bolts. Torque bolts to 30-45 N·m (22-33 ft. lbs.) in a diagonal sequence.

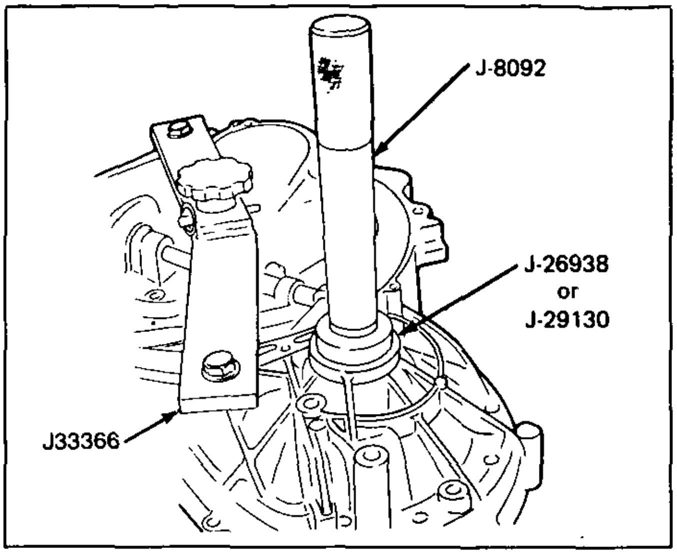


Figure 48 Drive Axle Seals

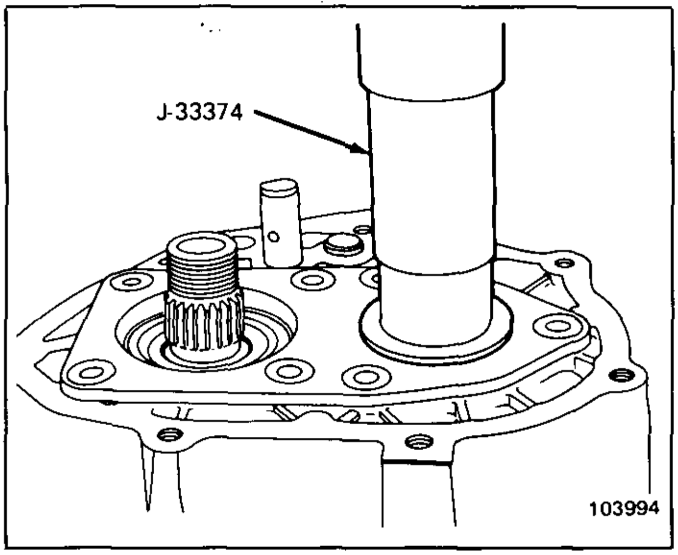


Figure 49 Fifth Gear Thrust Brg. and Collar

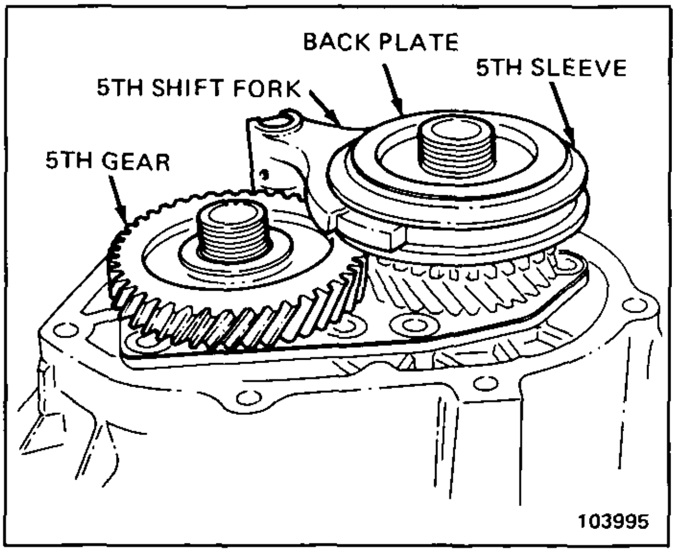


Figure 50 Fifth Gear and Shift Fork

19. Install drive axle seals using J-26938 or J-29130 with J-8092 (Figure 48).

20. Install the thrust washer and collar to the output shaft using J-33374 (Figure 49).
    Before installing, apply oil to the thrust surfaces and collar.
21. Install the 5th gear to the input shaft. Install the needle bearing, 5th gear, blocker ring, hub/sleeve assembly with shift fork in its groove and back plate on the output shaft. Align shift fork on shifter shaft and install a new roll pin (Figure 50).
    Before installing, apply oil to the output gear thrust surfaces.
22. Install the detent balls and detent springs for the reverse, 1st/2nd, 3rd/4th and 5th speeds. Install retaining bolts and torque to 21-29 N·m (15-21 ft. lbs.).
23. Apply Loctite No. 262 or equivalent to the threads of the input and output shafts. Carefully wipe any oil from the threads on the input and output shafts. Use care not to allow the loctite to flow into the splines of the 5th gear and input shaft. Install new retaining nuts and torque to 118-137 N·m (87-101 ft. lbs.). Stake nuts after reaching final torque.

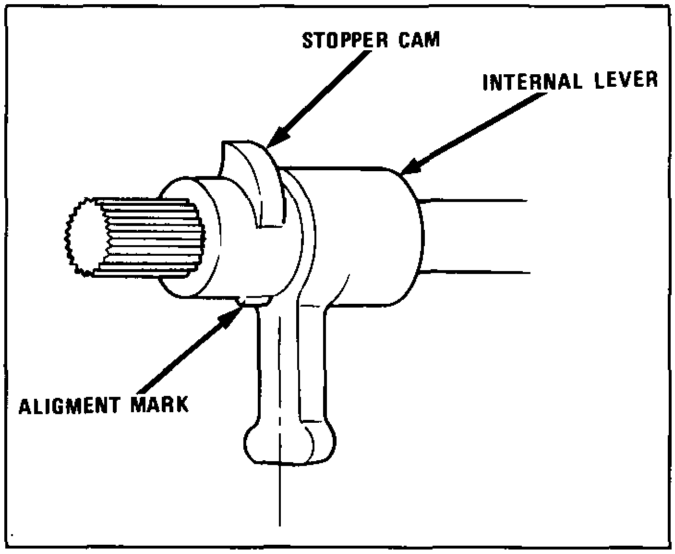


Figure 51 Stopper Cam Alignment Mark

24. Assemble the control box as follows:

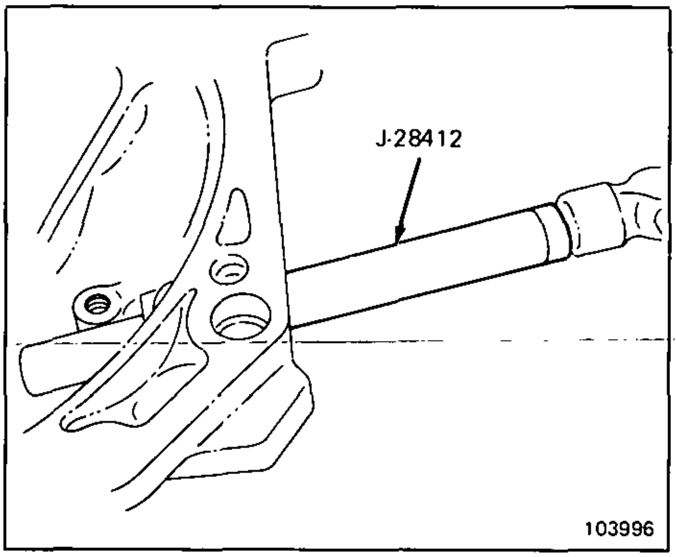


Figure 52 Clutch Shaft Bushing

- Assemble the stopper cam and the internal lever. Make sure that the serrations on the stopper cam and the internal lever are aligned .
- Install the stopper cam and internal lever to the shift lever.
- Align the stopper cam alignment mark with the center on the internal lever (Figure 51).
- Check to see that the reverse inhibitor mechanism operates properly.
- Use a new roll pin to attach the internal lever during assemble.

25. Install the gasket and control box assembly on the transaxle case, and torque four bolts to 15-22 N·m (11-16 ft. lbs.).
    Make sure transaxle shifts properly before installing rear cover.
26. Install the gasket and rear cover with seven bolts, and torque the bolts to 15-22 N·m (11-16 ft. lbs.).
27. Install the clutch fork assembly if it has been removed. Install the bushing into the upper hole using J-28412 (Figure 52). Install the oil seal next using J-28406.
    Before installing the bushing, apply grease to both the interior and exterior.
28. Install the clutch release bearing as outlined in the Clutch Section (7C).
    Measure the rotating torque on the input shaft as shown in Figure 53. When measuring, the input shaft should be to the upper side and the differential assembly to the lower side. The rotating torque should be less than 7 in. lbs.

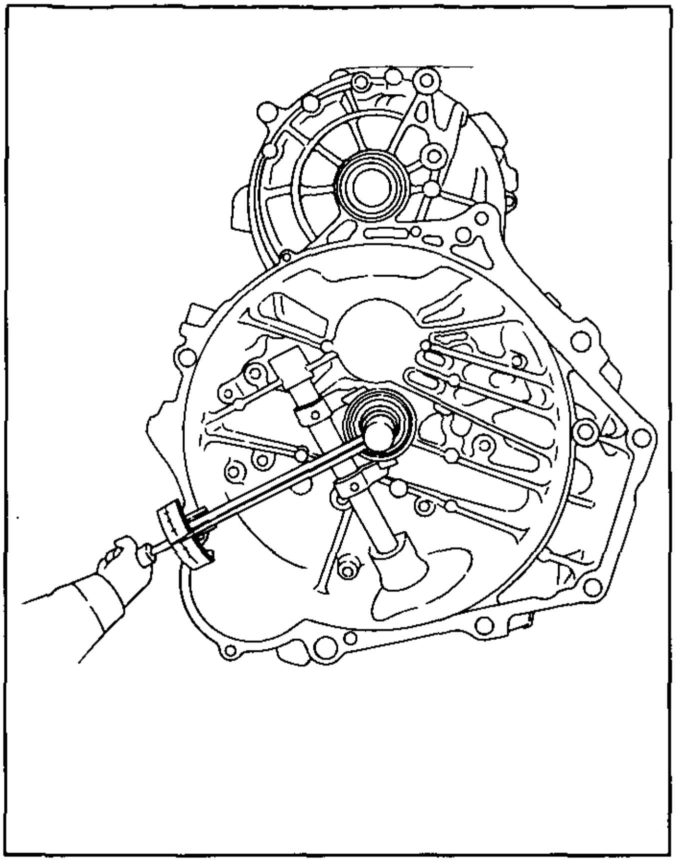


Figure 53 Checking Input Shaft Rotating Torque

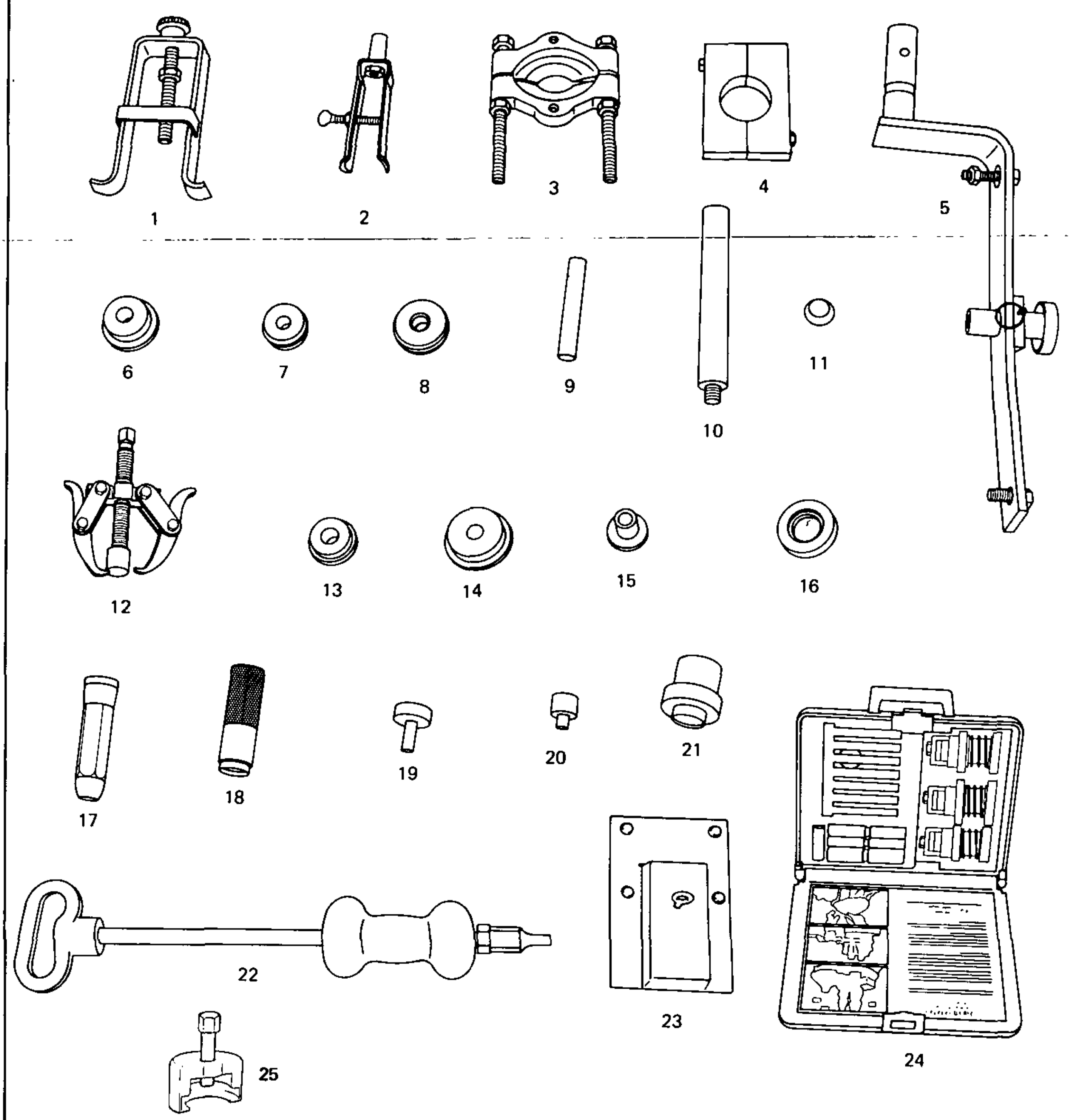
Reverse Shift Bracket	15-22 N·m	11-16 Ft. Lbs.
Ring Gear Bolts	98-107 N·m	73-79 Ft. Lbs.
Transaxle Case to Clutch Housing Bolts	30-45 N·m	22-33 Ft. Lbs.
Reverse Idler Shaft Bolt	30-45 N·m	22-33 Ft. Lbs.
Detent Spring Retaining Bolts	21-29 N·m	15-21 Ft. Lbs.
Input/Output Shaft Retaining Nuts	118-137 N·m	87-101 Ft. Lbs.
Control Box to Case Bolts	15-22 N·m	11-16 Ft. Lbs.
Rear Cover Bolts	15-22 N·m	11-16 Ft. Lbs.
Clutch Master Cyl. Retaining Nuts	20-34 N·m	15-25 Ft. Lbs.
Slave Cyl. Retaining Nuts	18-26 N·m	14-20 Ft. Lbs.
Clutch Shaft Release Lever Bolt	40-60 N·m	30-45 Ft. Lbs.

LUBE CAPACITY 2.55 Litres (2.7 Qt.)

LUBE RECOMMENDED SAE 5W-30 SF

103997

Figure 54 Specifications



1. J-33367
2. J-26941
3. J-22912-01
4. J-22227-A
5. J-33366
6. J-33370
7. J-8611-01
8. J-7817
9. J-28412
10. J-8092
11. J-23598 OR J-2241-11
12. J-22888 AND J-22888-30
13. J-33371
14. J-24256-A
15. J-22919
16. J-8853-01
17. J-26540
18. J-33374
19. J-33368
20. J-33369
21. J-29130 OR J-26938
22. J-2619
23. J-3389-20
24. J-33373
25. J-35274

Figure 55 Special Tools

SECTION 7C

HYDRAULIC CLUTCH

CONTENTS

GENERAL DESCRIPTION

PRINCIPAL COMPONENTS

(Fig. 7C-1 and 7C-2)

The principal parts of the clutch system are the driving members, the driven members and the operating members. Figure 7C-1 shows an exploded view of the clutch system. The clutch housing is part of the manual transaxle assembly.

Driving Members

The driving members consist of two flat surfaces machined to a smooth finish. One of these is the rear face of the engine flywheel, and the other is the pressure plate. The pressure plate is fitted into a steel cover, which is bolted to the flywheel.

Driven Members

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 assemby.

Operating Members

(Fig. 7C-4)

The clutch release system is operated by hydraulic pressure and consists of the clutch pedal, clutch master cylinder, clutch pipe and hose assembly, clutch slave cylinder. Clutch fork lever, transmission clutch shaft-and-fork assembly. The hydraulic clutch system locates the clutch pedal and provides automatic clutch adjustment. No adjustment of clutch linkage or pedal position is required.

When pressure is applied to the clutch pedal to release the clutch, hydraulic pressure is exerted against the outer end of the clutch fork lever. As the fork pivots on its shaft, the inner end pushes against the release bearing. The bearing then pushes against the diaphragm spring levers in the pressure plate assembly, thereby releasing the clutch.

MASTER CYLINDER

(Fig. 7C-3)

The fluid reservoir tank is an integral part of the cylinder. The operating principle is as follows:

When pressure is applied to the pedal, the push rod contacts the plunger and pushes it up the bore of the cylinder. In the first 1/32 in. of movement, the center valve seal closes the port to the fluid tank and as the plunger continues to move up the bore of the cylinder, the fluid is forced through the outlet line to the slave cylinder mounted on the clutch housing.

On the return stroke, the plunger moves back as a result of the return pressure of the clutch. Fluid returns to the master cylinder and the final movement of the plunger lifts the valve seal off the seat, allowing an unrestricted flow of fluid between system and tank.

SLAVE CYLINDER

(Fig. 7C-6)

The cylinder is made with a threaded inlet port which is connected to the master cylinder by a length of pipe.

As fluid is pushed along the pipe from the master cylinder to the slave cylinder, this in turn forces the slave cylinder piston outward, A push rod connects the slave cylinder and the clutch operating lever.

HYDRAULIC CLUTCH FLUID

CAUTION: Do not use mineral or parafin base oils in the Clutch Hydraulic System. These fluids will damage the rubber parts in the cylinders.

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.

ON-CAR SERVICE

NOTICE: Prior to any vehicle service that requires removal of the slave cylinder, the master cylinder push rod must be disconnected from the clutch pedal. If not disconnected, permanent

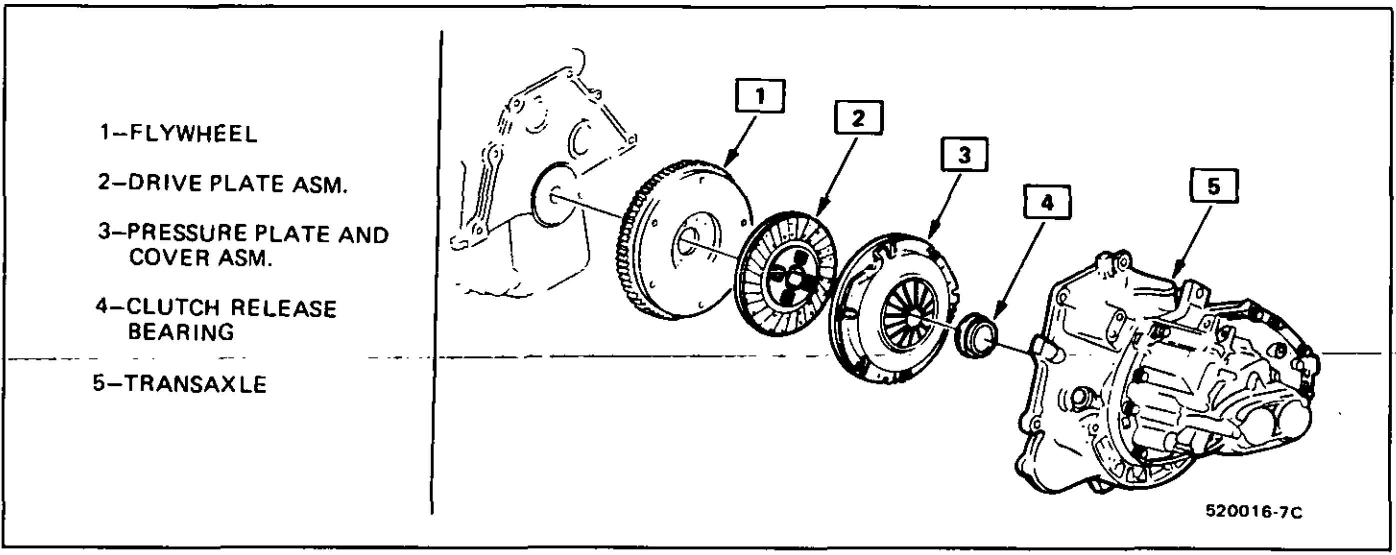


Fig. 7C-1 Clutch Exploded

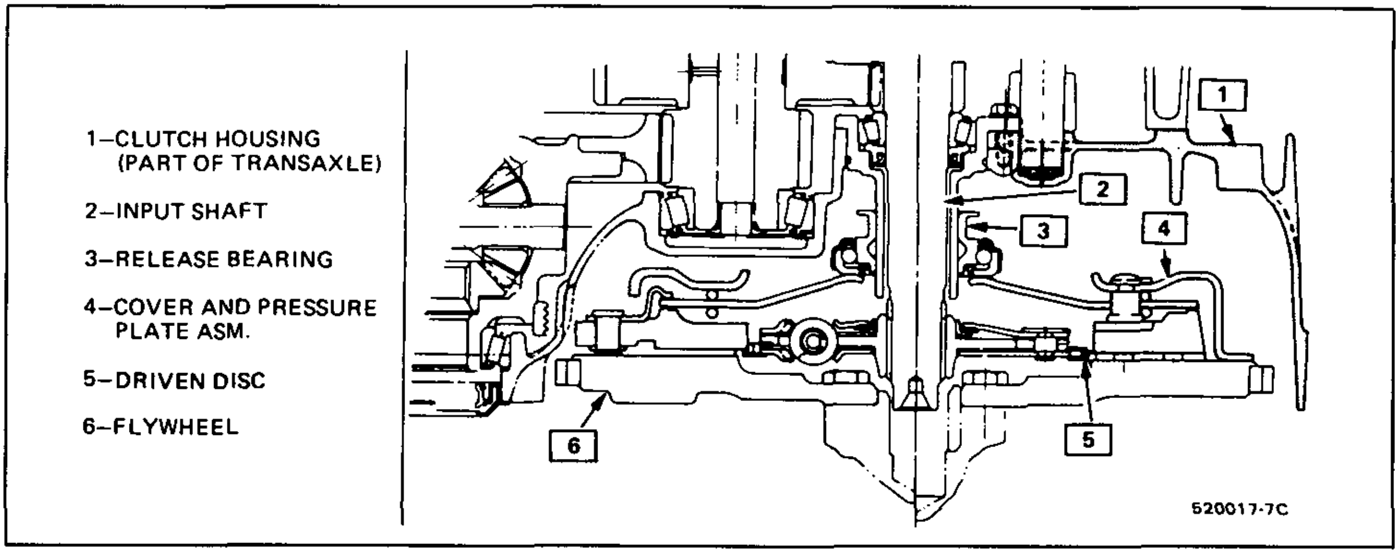


Fig. 7C-2 Clutch Cross Section

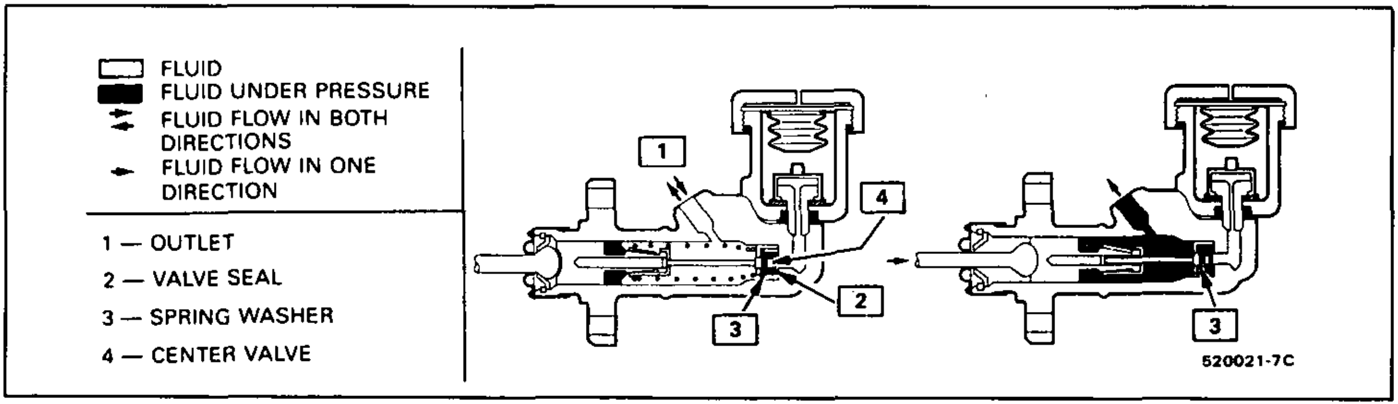


Fig. 7C-3 Master Cylinder Cross Section

damage to the slave cylinder will occur if the clutch pedal is depressed while the slave cylinder is disconnected.

CLUTCH MASTER CYLINDER

↔ Remove or Disconnect (Fig. 7C-5)

1. Cylinder push rod at clutch pedal.
2. Hydraulic line at master cylinder.
3. Nuts attaching cylinder to cowl, remove cylinder.

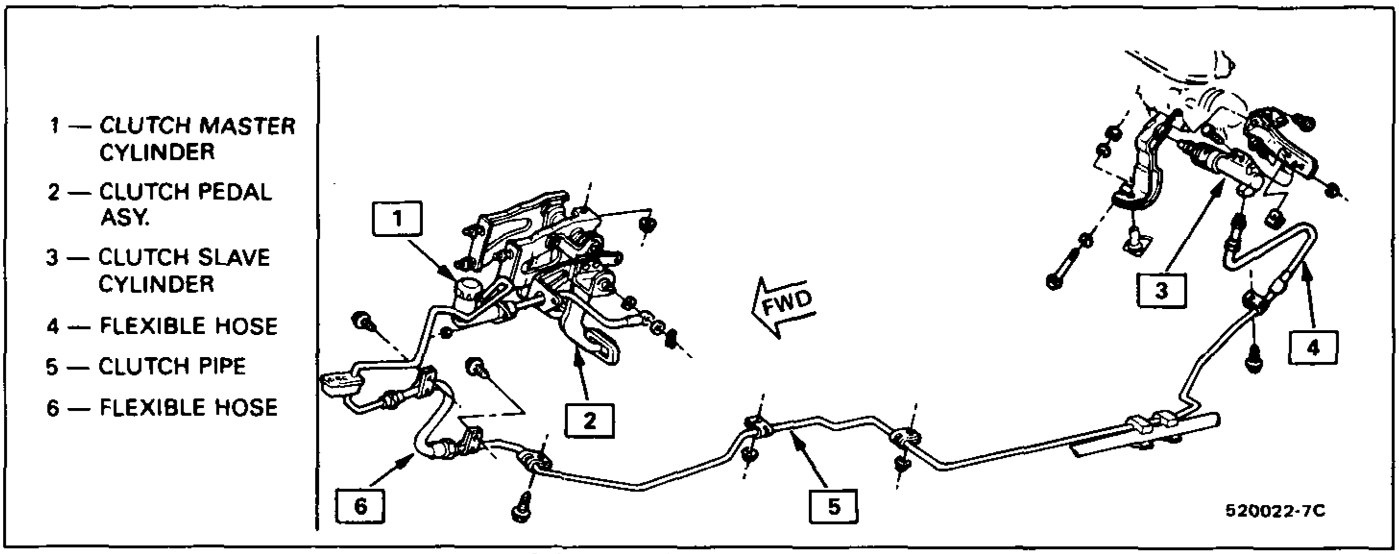

1 — CLUTCH MASTER CYLINDER
2 — CLUTCH PEDAL ASY.
3 — CLUTCH SLAVE CYLINDER
4 — FLEXIBLE HOSE
5 — CLUTCH PIPE
6 — FLEXIBLE HOSE

Fig. 7C-4 Hydraulic Clutch, Pipe Routing

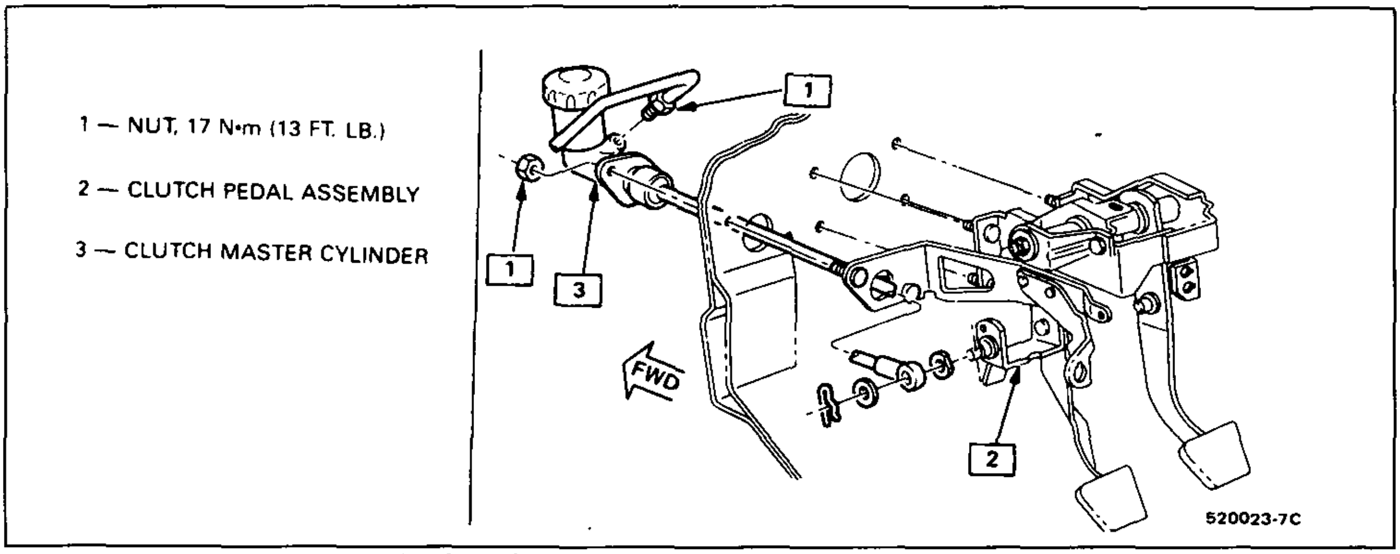

1 — NUT, 17 N•m (13 FT. LB.)
2 — CLUTCH PEDAL ASSEMBLY
3 — CLUTCH MASTER CYLINDER

Fig. 7C-5 Clutch Pedal & Master Cylinder Assembly

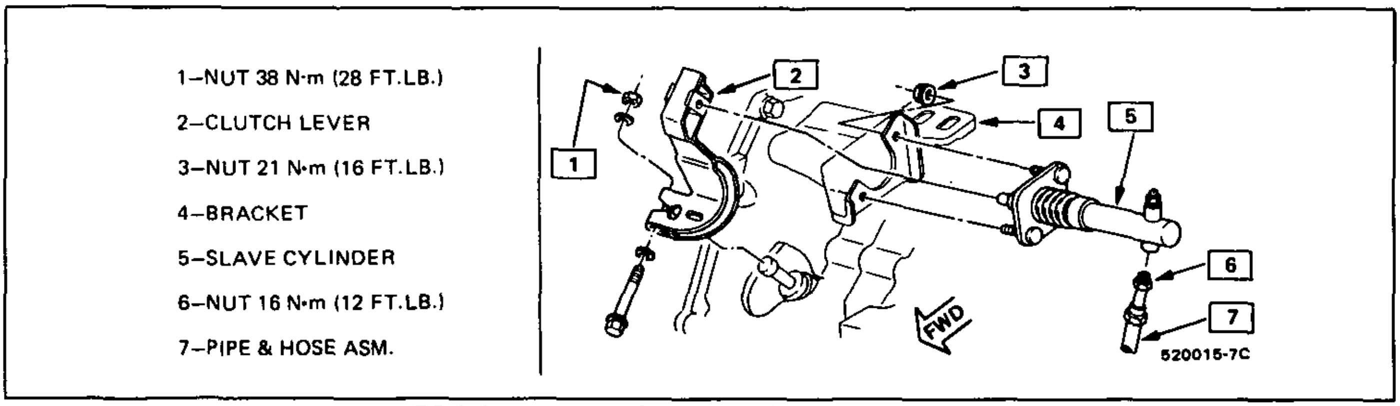

1–NUT 38 N·m (28 FT.LB.)
2–CLUTCH LEVER
3–NUT 21 N·m (16 FT.LB.)
4–BRACKET
5–SLAVE CYLINDER
6–NUT 16 N·m (12 FT.LB.)
7–PIPE & HOSE ASM.

Fig. 7C-6 Clutch Slave Cylinder & Clutch Lever Mounting

→← Install or Connect

1. Position cylinder push rod through cowl and loosely install cylinder to cowl nuts.
2. Cylinder push rod to clutch pedal with spring clip.

Tighten

Torque cylinder to cowl nuts to 17 N·m (13 lb.ft.).

CLUTCH HYDRAULIC DIAGNOSIS

FAULT	CAUSE	ACTION
Pedal travels to floor. No pressure or very little resistance.	Master or slave cylinder faulty. Hose/pipe burst or leaking. Connections leaking. No fluid in reservoir.	Check components and replace. Then bleed system.
Pedal travels to floor. No pressure or very little resistance. Fluid in master cylinder dust cover.	Rear seal failure in master cylinder.	Service or replace unit. Then bleed system.
Pedal travels to floor. No pressure or very little resistance. Fluid level in reservoir rises as pedal is depressed.	Master cylinder center valve seal faulty.	Service or replace unit. Then bleed system.
Fluid in area of master cylinder dust cover and on pedal.	Rear seal failure in master cylinder.	Service or replace unit. Then bleed system.
Fluid in slave cylinder and on cylinder body.	Slave cylinder plunger seal faulty.	Service or replace unit. Then bleed system.
Pedal feels "spongy" when depressed.	Air in system.	Check fluid level. Bleed system. Check and replace parts if symptom recurs.
Pedal effort high with long pedal travel.	Incorrect size master or slave cylinder fitted.	Check and fit correct unit. Then bleed system.
Unable to select gears. Pedal effort and travel normal.	Clutch mechanism faulty. Gearbox faulty.	Check and replace clutch or gearbox components.
Clutch slip.	Clutch plate worn. Master and/or slave cylinder seal worn or damaged. Overfilled reservoir.	Check and replace. Clean and service or replace units. Remove excess fluid.
Pedal effort and travel normal. Difficulty in selecting gears.	Clutch or gearbox mechanism faulty. Wear in clevis linkages.	Check and replace faulty or worn components.

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Fig. 7C-7 Clutch Hydraulic Diagnosis

Install or Connect

1. Hydraulic line to master cylinder and torque to 17 N·m (13 lb.ft.).
2. Fill clutch master cylinder with recommended fluid, bleed system.

CLUTCH SLAVE CYLINDER

Remove or Disconnect (Fig. 7C-6)

1. Hydraulic line at slave cylinder.
2. Slave cylinder to bracket bolts, remove slave cylinder.

Install or Connect

1. Position slave cylinder at mounting bracket and pilot cylinder push rod into clutch release lever.
2. Slave cylinder to bracket nuts.

Tighten

Torque nut to 22 N·m (16 lb.ft.)

Install or Connect

1. Hydraulic line to slave cylinder.

Tighten

Torque line nut to 17 N·m (13 lb.ft.).

Install or Connect

1. Fill clutch master cylinder with recommended fluid and bleed system.

CLUTCH SLAVE CYLINDER BRACKET

Remove or Disconnect (Fig. 7C-6)

1. Engine wire harness clamp at salve cylinder bracket and move wires for access.
2. Slave cylinder to bracket bolts, do not disconnect hydraulic pipe from slave cylinder.
3. Slave cylinder bracket to transaxle attaching bolt.
4. Slave cylinder bracket to shift cable bracket bolt, remove bracket.

Install or Connect

1. Slave cylinder bracket to transaxle.

Tighten

Torque bolt to 50 N·m (32 lb.ft.)

1. Slave cylinder bracket to shift cable bracket.

Tighten

Torque bolt to 50 N·m (32 lb.ft.)

Install or Connect

1. Position slave cylinder to mounting bracket and pilot slave cylinder push rod into clutch lever.
2. Slave cylinder to bracket nuts.

CLUTCH MECHANICAL DIAGNOSIS

CONDITION	PROBABLE CAUSE	CORRECTION
Fails to Release (pedal pressed to floor-shift lever does not move freely in and out of reverse gear without gear clash)	a. Faulty driven disc. b. Fork and bearing not assembled properly. c. Clutch disc hub binding on input shaft splines. d. Clutch disc warped or bent. e. Clutch-to-flywheel bolts loose.	a. Replace disc. b. Install properly and* lubricate fingers at release bearing with wheel bearing grease. c. Repair or replace. d. Replace disc. e. Torque bolts to specification. *Very lightly lubricate fingers.
Slipping	a. *Improper operation.* b. Oil soaked driven disc. c. Worn facing or facing torn from disc. d. Warped pressure plate or flywheel. e. Weak diaphragm spring. f. Driven plate not seated in. g. Driven plate overheated.	a. *Correct as required.* b. Install new disc and correct leak at its source. c. Replace disc. d. Replace pressure plate or flywheel. e. Replace pressure plate. f. Make 30 to 40 normal starts. CAUTION: Do not overheat. g. Allow to cool.
Grabbing (Chattering)	a. *Oil on facing. Burned or glazed facings.* b. Worn splines on input shaft. c. Loose engine mountings. d. Warped pressure plate or flywheel. e. Burned or smeared resin on flywheel or pressure plate.	a. *Install new disc and correct leak to engine or transaxle.* b. Replace input shaft. c. Tighten or replace mountings. d. Replace pressure plate or flywheel. e. Sand off if superficial, replaced burned or heat checked parts.
Rattling-Transmission Click	a. Release fork loose. b. Oil in driven plate damper. c. Driven plate damper spring failure. d. Low engine idle speed.	a. Install properly. b. Replace driven disc. c. Replace driven disc. d. Adjust idle speed.
Release Bearing Noise with Clutch Fully Engaged	a. Improper operation. b. *Release bearing binding.* c. Fork shaft improperly installed. d. Faulty bearing.	a. Correct as required. b. *Clean, relubricate, check for burrs, nicks, etc.* c. Install properly. d. Replace bearing.
Noisy	a. Worn release bearing. b. Fork shaft improperly installed.	a. Replace bearing. b. Install properly and lubricate fork fingers at bearing.
Pedal Stays on Floor	a. *Fork shaft binds in housing.*	a. *Free-up shaft and lubricate.*
Hard Pedal Effort	a. Driven plate worn. b. Fork shaft binds in housing.	a. Replace driven plate. b. Free-up shaft and lubricate.

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Fig. 7C-8 Clutch Mechanical Diagnosis

Tighten

Torque nuts to 22 N·m (16 lb.ft.).

CLUTCH RELEASE LEVER

Remove or Disconnect (Fig. 7C-6)

1. Slave cylinder to bracket bolts, do not disconnect hydraulic pipe from slave cylinder.
2. Clutch release lever attaching bolt and remove lever from transaxle clutch fork shaft.

Install or Connect

1. Clutch release lever on clutch fork shaft. Install attaching bolt.

Tighten

Torque to 27 N·m (20 lb.ft.).

Install or Connect

1. Position slave cylinder to mounting bracket and pilot slave cylinder push rod into clutch lever.
2. Install slave cylinder to slave cylinder bracket.

Tighten

Torque bolts to 22 N·m (16 lb.ft.).

CLUTCH PRESSURE PLATE & DISC

Remove or Disconnect (Fig. 7C-1)

1. Transaxle assembly as outlined in Section 7B of this manual.
2. Mark relationship of pressure plate assembly to flywheel, for reassembly in same position.
3. Loosen attaching bolts one turn at a time, until spring pressure is relieved.
4. Support pressure plate.
5. Pressure plate bolts.
6. Pressure plate and driven disc. Do not disassemble the pressure plate assembly. If defective, replace assembly.

Inspect

Clutch disc, pressure plate, flywheel, clutch-fork and pivot shaft assembly and release bearing. Replace parts as required. Also inspect the bearing retainer outer surface of the transaxle.

Clean

Pressure plate and flywheel mating surfaces and bearing retainer outer surface, of all oil, grease, metal deposits, etc.

Install or Connect

NOTICE: Pressure plate is replaced, align paint dab on new pressure plate as close as possible to "X" stamped in flywheel to maintain a balanced condition. The driven disc is installed with the damper springs offset toward the transaxle. Stamped on the driven disc identifying "Flywheel side".

1. Position clutch disc and pressure plate to flywheel, aligning marks previously made and support with J-29074.
2. Pressure plate assembly-to-flywheel bolts evenly and gradually. Remove J-29074.

Tighten

Torque bolts to 20 N·m (15 lb.ft.)

3. Lightly lubricate the O.D. groove and completely pack full the I.D. recess of the release bearing, as shown in Figure 7C-10 with p/n 1051344 or equivalent.
4. Transaxle as outline in Section 7B.

CLUTCH RELEASE BEARING

Remove or Disconnect (Fig. 7C-1)

1. Transaxle assembly as outlined in Section 7B.
2. Clutch release bearing from clutch fork shaft assembly.

Clean

Clean and inspect the release bearing.

NOTICE: Do not place bearing in degreaser or damage to the seals may result.

Install or Connect

1. Lightly lubricate the clutch fork ends that contact the bearing and complety pack full the I.D. recess or the release bearing, with p/n 105344 or equivalent.
2. Release bearing on the transaxle retainer with both fork tangs fitted into bearing O.D. groove.
3. Transaxle assembly as outlined in Section 7B of this manual.

NOTICE: Clutch lever must not be moved toward flywheel until transaxle is bolted to the engine or damage to the transaxle could occur.

FLYWHEEL

Remove or Disconnect (Fig. 7C-9)

1. Transaxle assembly as outlined in Section 7B.
2. Pressure plate and clutch disc assembly as previously outlined in this section.
3. Flywheel attaching bolts and flywheel assembly.

Install or Connect

1. Flywheel and attaching bolts.

Tighten

Torque bolts to 70 N·m (50 lb.ft.).

Install or Connect

1. Pressure plate, clutch disc assembly and release bearing as previously outline in this section.
2. Transaxle assembly as outlined in Section 7B.

UNIT REPAIR

CLUTCH MASTER CYLINDER

Remove or Disconnect (Fig. 7C-11)

1. Master cylinder as outlined in On-Car Service.
2. Unscrew filler cap and drain surplus fluid. NEVER RE-USE FLUID BLED OR DRAINED FROM A SYSTEM.
3. Pull back dust cover.
4. Circlip together with retaining washer and push rod.
5. Shake cylinder to eject plunger assembly.
6. Lift leaf of spring retainer and remove spring assembly from plunger.
7. Compress spring to free valve stem from keyhole of spring retainer, thus releasing tension of spring.
8. Spring, valve spacer, spring washer from valve stem.
9. Valve seal from valve head.

NOTICE: Remove seal carefully from plunger, ensuring no damage occurs to plunger surfaces.

Replace all serviceable seals and parts and clean the remaining parts thoroughly with denatured alcohol and place them on to a clean sheet of paper.

Examine the bore of the cylinder for visible scores and ridges and check that it is smooth to the touch. If there is the slightest doubt as to the condition of the bore or the plunger, a new cylinder assembly must be used.

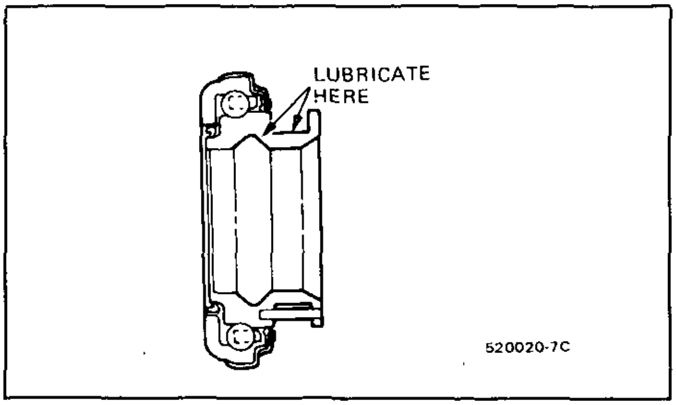


Fig. 7C-10 Release Bearing Lubrication

Install or Connect

1. Fit plunger seal to plunger.
2. Fit valve seal, smallest diameter leading, to valve head.
3. Position spring washer on valve stem so that it flares away from valve stem shoulder (see illustration) follow with valve spacer, legs first, and spring.
4. Fit spring retainer to spring and compress spring until valve stem passes through keyhole slot and engages in center.
5. Fit spring immediately to plunger and press home leaf of spring retainer to secure.

NOTICE: Liberally lubricate the seal and the plunger bore with unused Delco Supreme No. 11 Brake and Clutch Fluid or a fluid conforming to DOT 3.

6. Insert plunger assembly, valve end leading, into cylinder body, easing the entrance of the plunger seal.
7. Position push rod and retaining washer and fit circlip to secure.

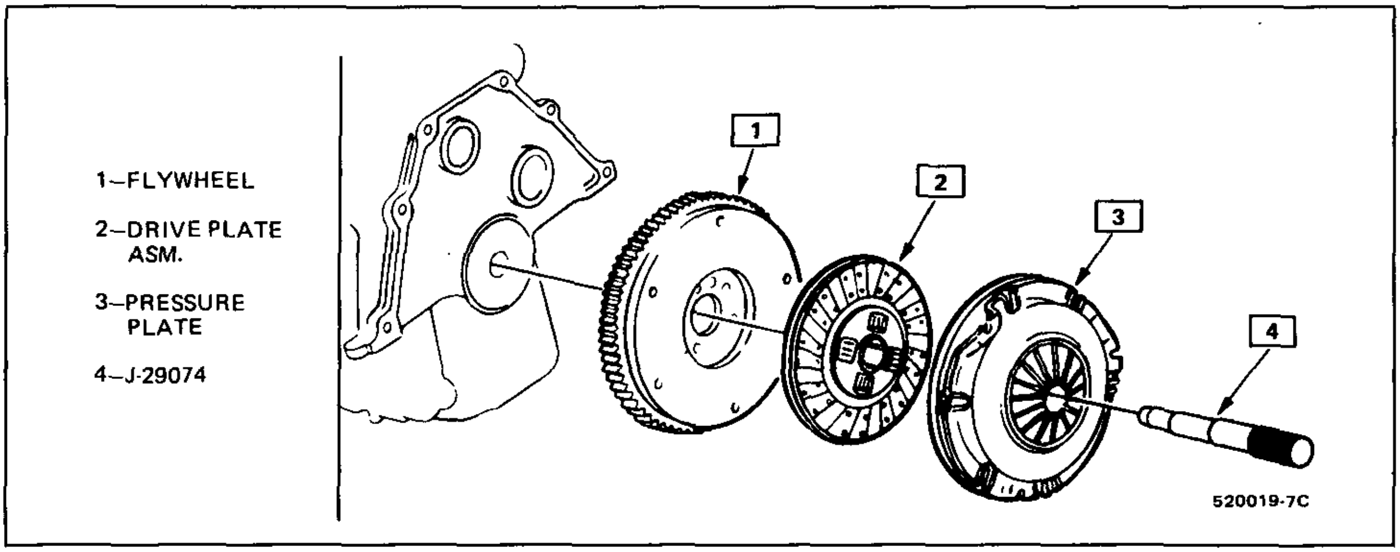


Fig. 7C-9 Clutch Pressure Plate & Disc

8. Smear inside of dust cover with Silicone Lubricant Part Number 5459912 or equivalent and fit.
9. Fit cap washer.
10. Screw filler cap on to cylinder.
11. Remount cylinder.

SLAVE CYLINDER

↔ Remove or Disconnect (Fig. 7C-12)

1. Slave cylinder as outlined in On-Car Service.
2. Pull back dust cover and remove circlip together with retaining ring and push rod.
3. Shake cylinder to remove piston and seal.

> **NOTICE:** Replace all serviceable seals and parts and clean the remaining parts throughly with denatured alcohol and place them on to a clean sheet of paper.

Examine the bore of the cylinder for visible scores and ridges and check that it is smooth to the touch. If there is the slightest doubt as to the condition of the bore or the plunger, a new cylinder assembly must be used.

→← Install or Connect

1. Liberally lubricate seal and piston bore with unused Delco Supreme No. 11 Brake and Clutch Fluid or a fluid conforming to DOT 3.
2. Insert seal and piston respectively.
3. Insert push rod and secure with circlip.
4. Smear inside of dust cover with Silicone Lubricant Part Number 5459912 or equivalent and fit.
5. Remount cylinder.

Bleeding the Clutch System

The process of removing air from the pipe line and cylinders is know as "bleeding" and is necessary whenever any part of the system has been disconnected, or the level of fluid in the supply tank has been allowed to fall so low that air has been drawn into the master cylinder.

When seals are worn, it is possible for air to enter the cylinders without any sign of leaking fluid, and cause a "spongy" pedal, which is the usual indication of air bubbles in the system.

> **NOTICE:** It is vital that extreme cleanliness is maintained throughout the entire bleeding operation. Never use a rag of linty texture and ensure that dirt and grit are not allowed to enter the system especially at the supply tank.

Preparing for Bleeding

Fill the supply tank directly from a can of unused Delco Supreme No. 11 Brake Fluid or a fluid conforming to DOT 3.

> **NOTICE:** Never, under any circumstances, use fluid which has been bled from a system to fill the supply tank as it may be aerated, have too much moisture content or may possibly be contaminated.

Ensure that the supply tank is kept full with fluid as it is essential that at no time during the bleeding operation should the fluid reservoir level be allowed to fall to a point where air may be admitted into the hydraulic system via the supply tank.

Procedure

> **NOTICE:** Always remove the floor mat or any other object which may obstruct the full stroke of the pedal.

1. Unscrew bleedscrew at slave cylinder enough to allow fluid to be pumped out (half a turn is normally sufficient).
2. Push pedal down through full stroke.
3. Allow pedal to return quickly to its stop by removing foot from the clutch pedal.
4. Repeat procedure until air is dispelled at bleedscrew.
5. Close bleedscrew immediately after last downward stroke of pedal when air bubbles no longer appear.

1 — RESERVE CAP
2 — BAFFLE*
3 — CYLINDER BODY AND RESERVOIR ASSEMBLY
4 — PLUNGER
5 — SEAL*
6 — SPRING
7 — VALVE SPACER
8 — CENTER VALVE SEAL*
9 — VALVE STEM
10 — SPRING
11 — SPRING RETAINER
12 — RETAINING WASHER
13 — CIRCLIP*
14 — PUSH ROD
15 — DUST COVER*
*PARTS INCLUDED IN SERVICE KIT

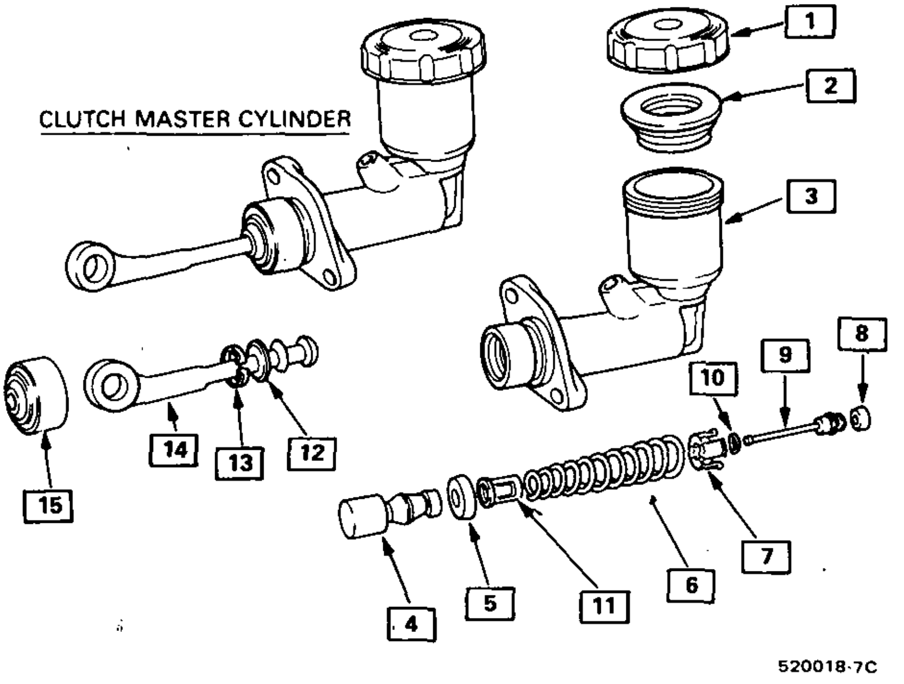
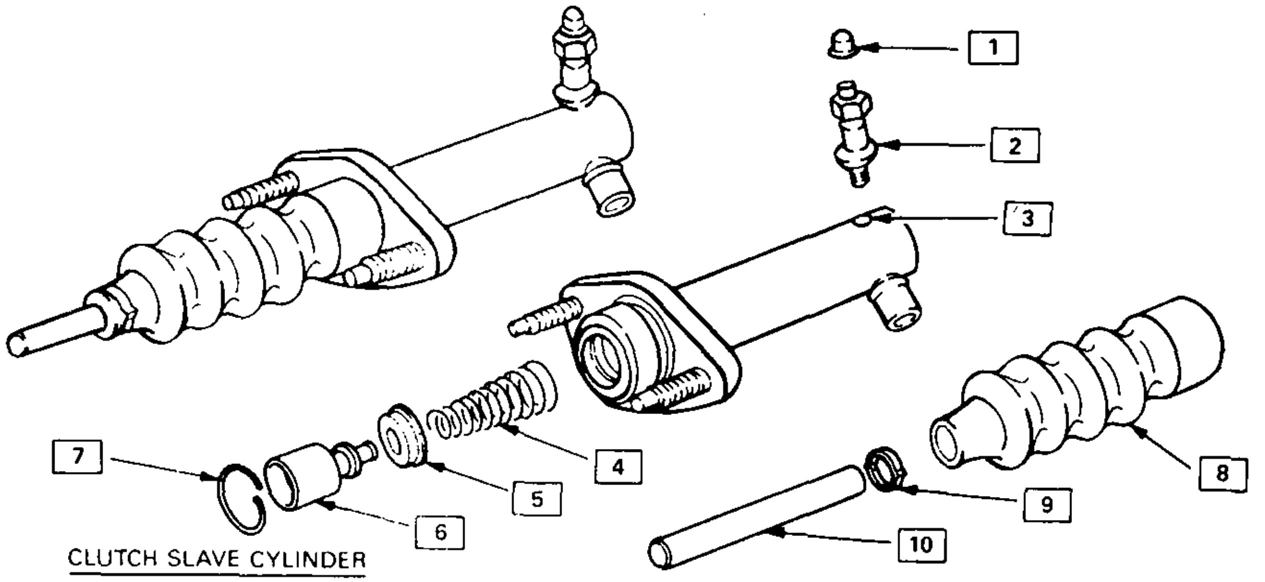


Fig. 7C-11 Clutch Master Cylinder



1 — BLEEDSCREW DUST COVER*
2 — BLEEDSCREW
3 — CYLINDER BOLT
4 — SPRING
5 — SEAL*
6 — PLUNGER
7 — RETAINING RING*
8 — DUST COVER*
9 — RETAINING BAND*
10 — PUSH ROD
*PARTS INCLUDED IN SERVICE KIT

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Fig. 7C-12 Clutch Slave Cylinder

SPECIFICATIONS

TORQUE SPECIFICATIONS

SPECIFICATIONS	N•M	LB.-FT.
• Clutch Flywheel To Crankshaft	70	50
• Clutch Pressure Plate To Flywheel	20	15
• Clutch Pedal Assembly To Cowl	17	13
• Hydraulic Pipe To Clutch Master Cylinder	17	13
• Hydraulic Pipe To Clutch Slave Cylinder	17	13
• Clutch Lever To Clutch Fork	27	20
• Clutch Slave Cylinder To Slave Cylinder Bracket	27	20
• Slave Cylinder Bracket To Transaxle	50	32

HYDRAULIC FLUID SPECIFICATIONS

Fluid type Delco Supreme No. 11 Hydraulic Brake Fluid or equivalent. Must meet DOT 3 requirement.

SECTION 8A

ELECTRICAL DIAGNOSIS

FIERO

CONTENTS

CELL NUMBER

WHAT'S NEW FOR 1986

- **Harness Routing Views** are found in section 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.

INTRODUCTION

DIAGNOSTIC INFORMATION

This manual contains the following kinds of diagnostic information:

- Electrical Schematics
- Component Location Lists and Views
- System Checks
- Troubleshooting Hints
- System Diagnoses
- Circuit Operation Descriptions
- Harness Connector Faces
- 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 ***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 section 201.

The **System Check** *gives* a quick 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 **Troubleshooting Hints** offer short-cuts or tests 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 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.

The final part of the text, the **Circuit Operation**, will help you understand the circuit. It describes the components and how the circuit works.

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. The socket half of the connector face is shown for in-line connectors.

Harness Routing Views are found in section 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 schematic will always be the first pages of cell 34. The other information *for Cruise Control* follows them and is paged 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.

INTRODUCTION

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.

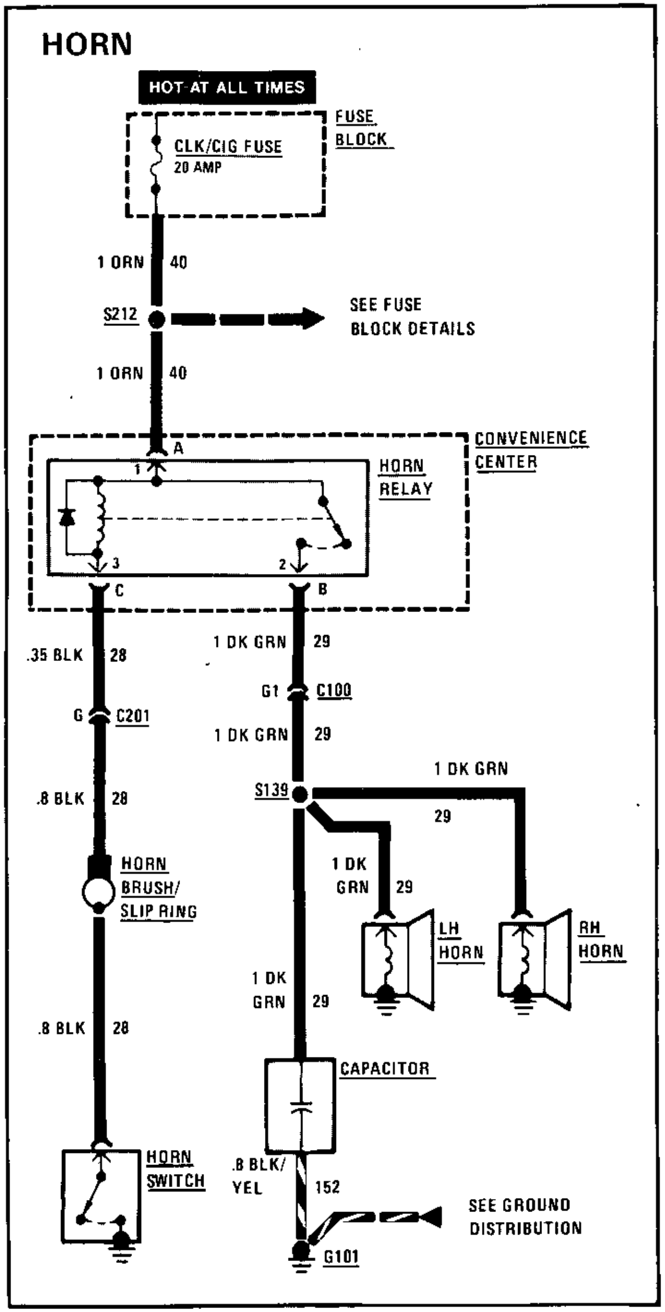


Figure 1 - Typical Horn Schematic

INTRODUCTION

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

INTRODUCTION

HARNESS CONNECTOR FACES

The connectors, see figure 3, are labeled with the component they are connected to, or the connector number, C224, from the schematic where they appear. In addition, the color and part number of the connector is given. For in-line connectors the half shown is usually the socket half. If both views are shown, the other is marked 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.

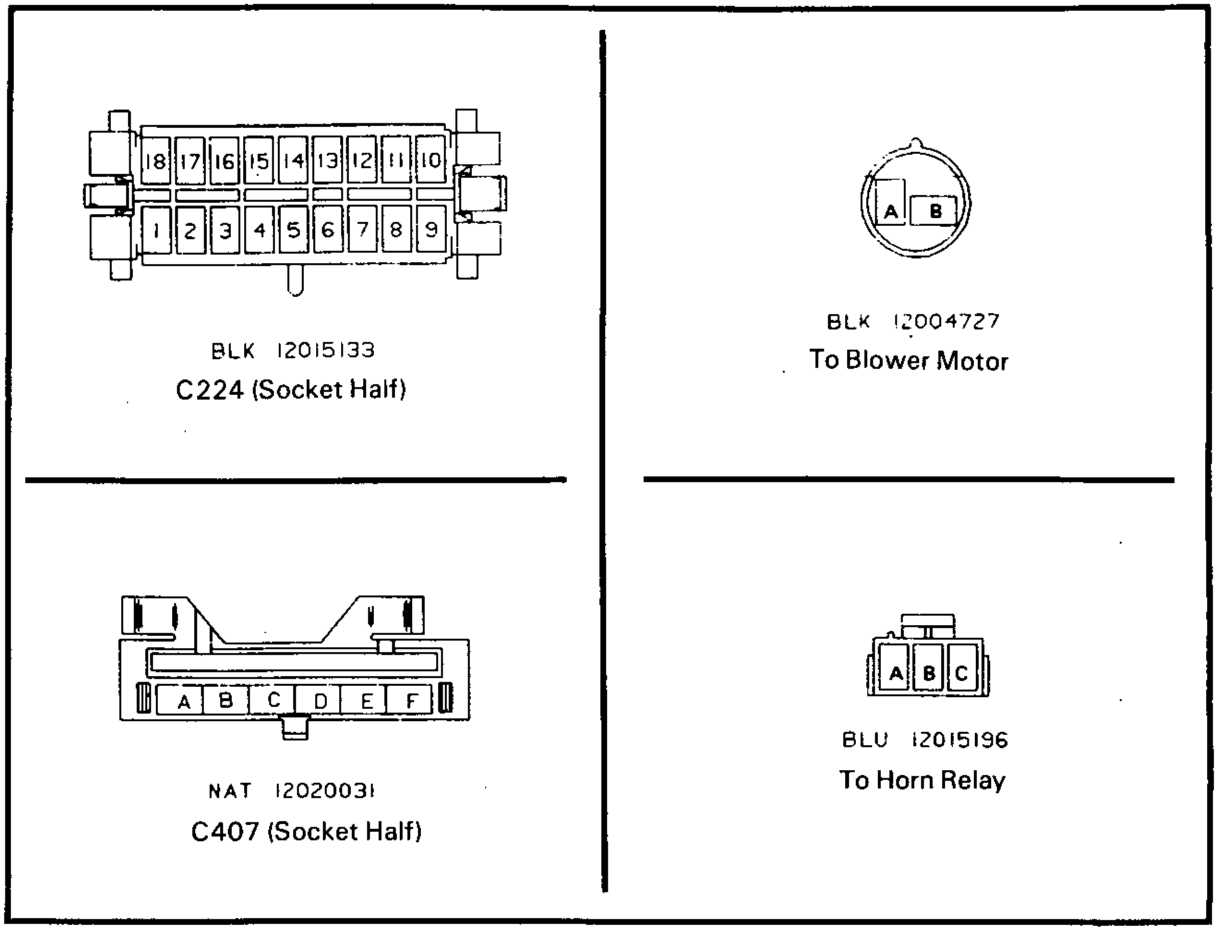


Figure 3 -Typical Harness Connector Faces

OTHER INFORMATION

Body Part Names

Refer to figure 4 for the correct body part names.

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.

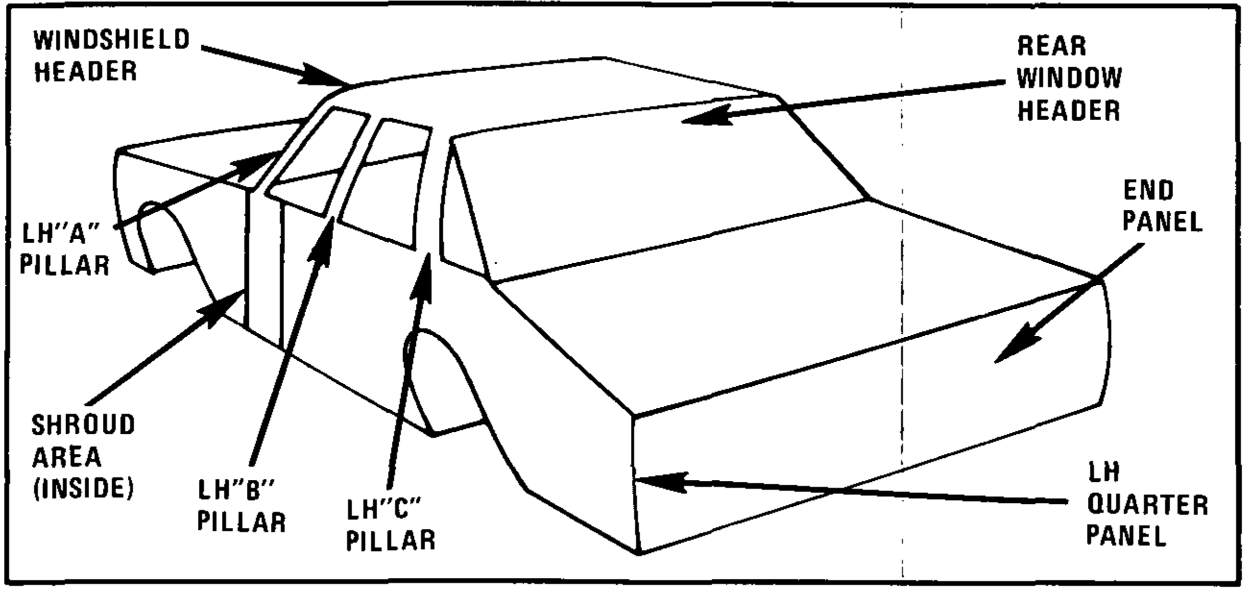


Figure 4 - Body Part Names

INTRODUCTION

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, the Fusible Link B, 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.

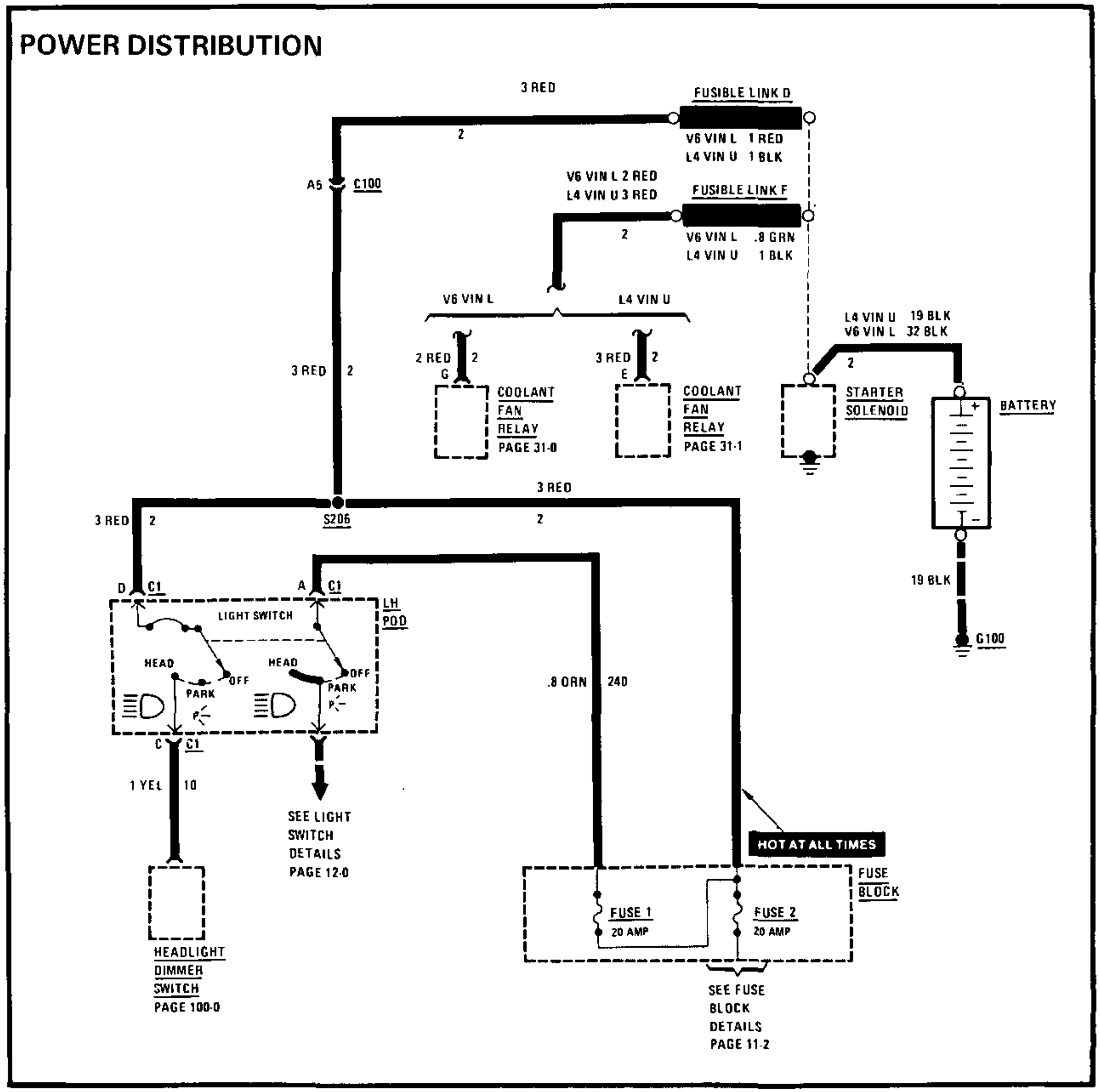


Figure 5 - Typical Power Distribution Schematic

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.

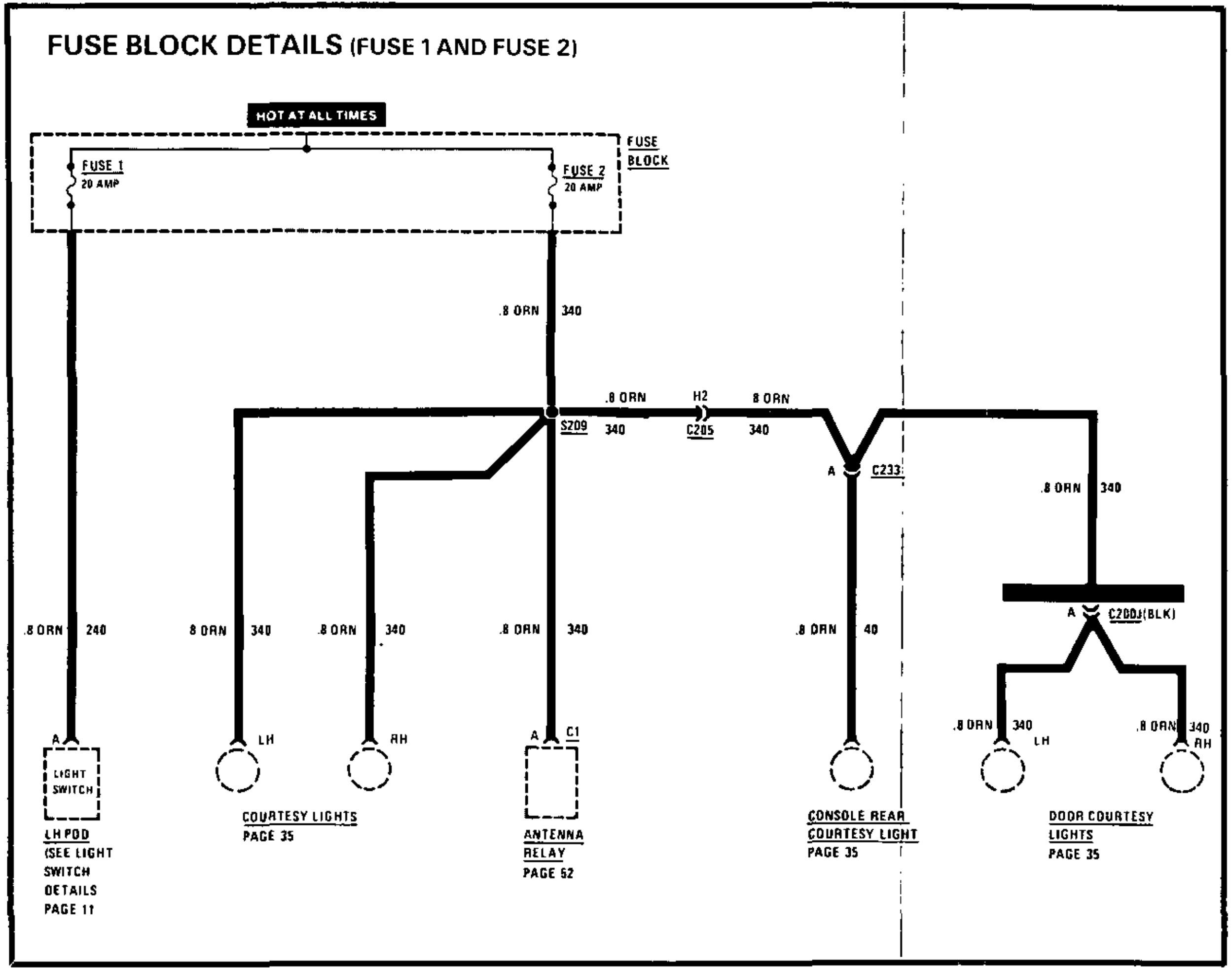


Figure 6 - Typical Fuse Block Details Schematic

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.

LIGHT SWITCH DETAILS

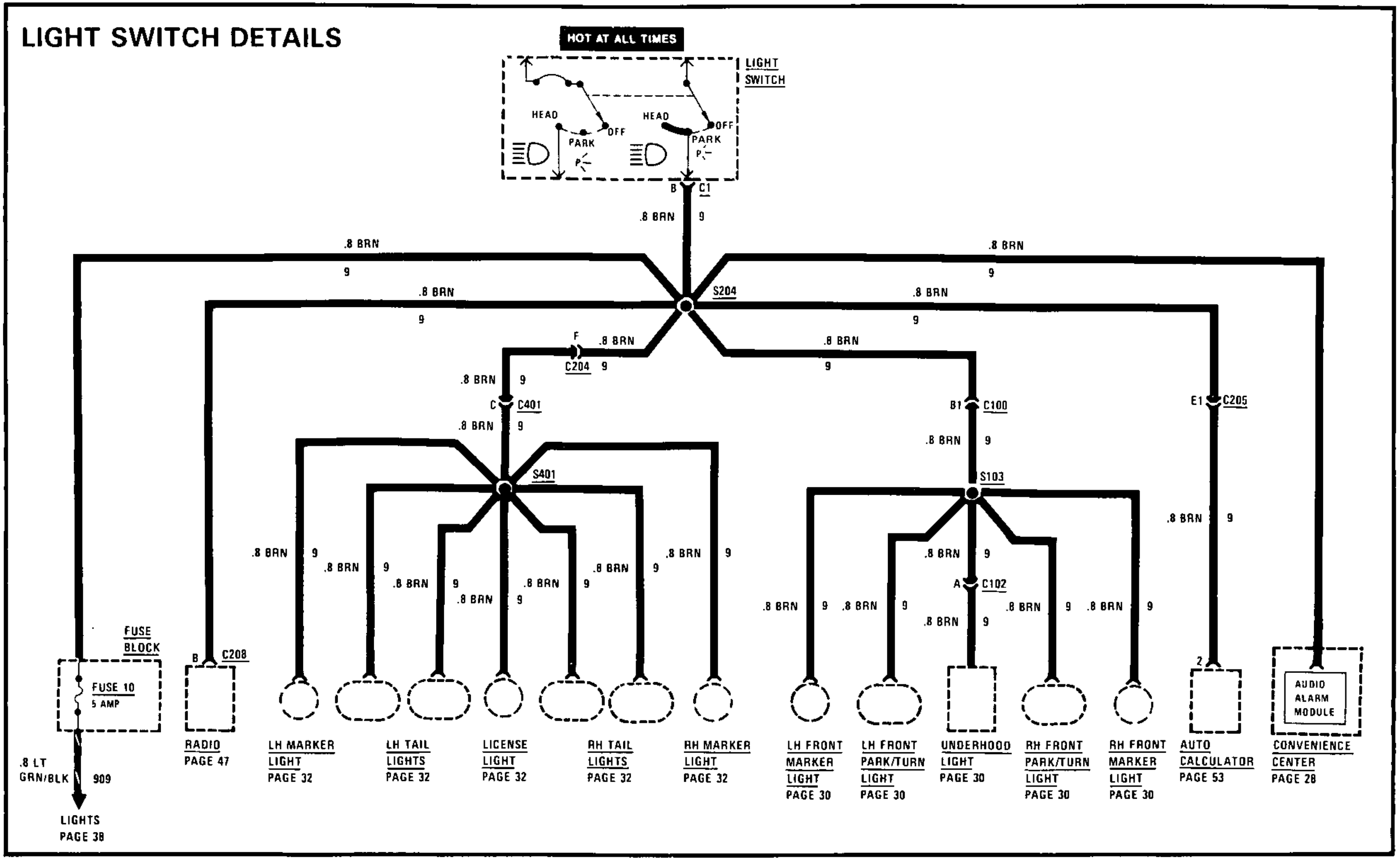


Figure 7 - Typical Light Switch Details Schematic

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.

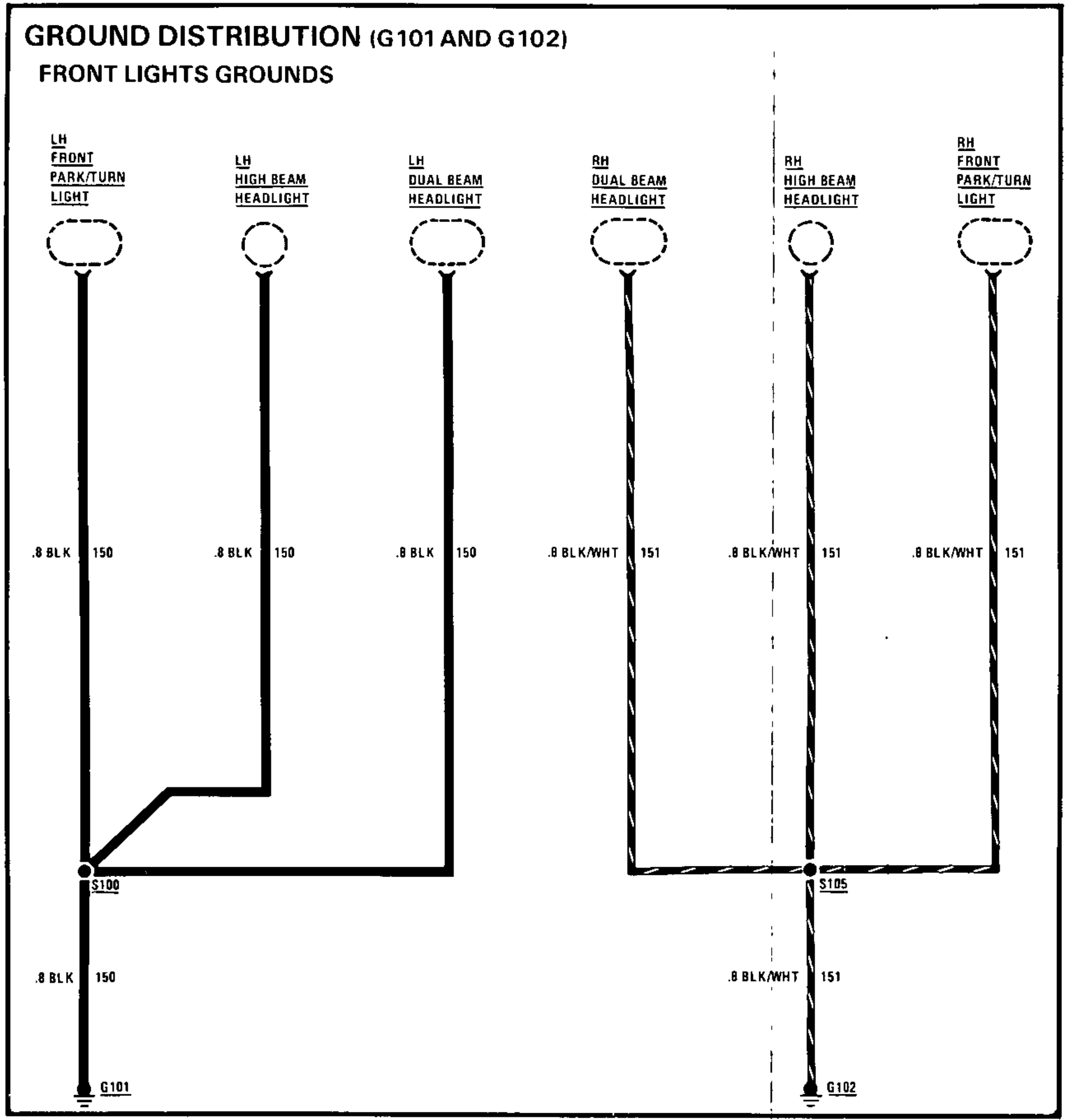
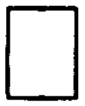


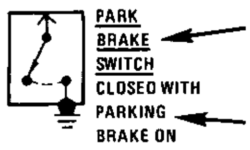
Figure 8 - Typical Ground Distribution Schematic

SYMBOLS



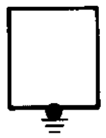
ENTIRE COMPONENT SHOWN

PART OF A COMPONENT SHOWN



NAME OF COMPONENT

DETAILS ABOUT COMPONENT OR ITS OPERATION



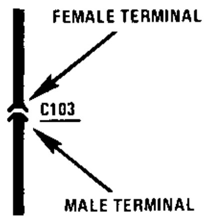
COMPONENT CASE IS DIRECTLY ATTACHED TO METAL PART OF CAR (GROUNDED)

WIRE IS ATTACHED TO METAL PART OF CAR (GROUNDED)

GROUND IS NUMBERED FOR REFERENCE ON COMPONENT LOCATION TABLE

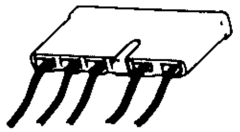
WIRE IS INDIRECTLY CONNECTED TO GROUND

WIRE MAY HAVE ONE OR MORE SPLICES BEFORE IT IS GROUNDED.



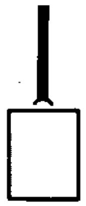
CONNECTOR REFERENCE NUMBER FOR COMPONENT LOCATION TABLE

TABLE ALSO SHOWS TOTAL NUMBER OF TERMINAL POSSIBLE: C103 (6 CAVITIES)



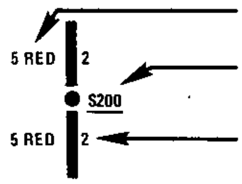
5 CAVITY CONNECTOR (5 OUT OF 5 CAVITIES ARE USED)

5 CAVITY CONNECTOR (4 OUT OF 5 CAVITIES ARE USED)



CONNECTOR ATTACHED TO COMPONENT

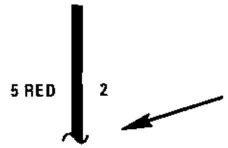
CONNECTOR ON COMPONENT LEAD (PIGTAIL)



INSULATION COLOR IS BOTH SHOWN AND LABELED

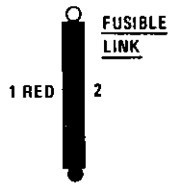
SPLICES ARE SHOWN AND NUMBERED

CIRCUIT NUMBER IS SHOWN TO HELP IN TRACING CIRCUITS

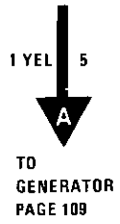


A WAVY LINE MEANS A WIRE IS TO BE CONTINUED

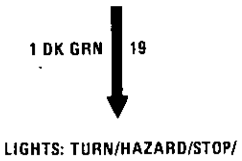
WIRE INSULATION IS ONE COLOR WITH ANOTHER COLOR STRIPE (RED WITH YELLOW)



WIRE SIZE AND INSULATION COLOR ARE LABELED



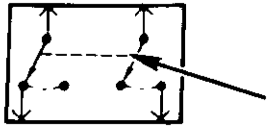
CURRENT PATH IS CONTINUED AS LABELED. THE ARROW SHOWS THE DIRECTION OF CURRENT FLOW AND IS REPEATED WHERE CURRENT PATH CONTINUES.



A WIRE WHICH CONNECTS TO ANOTHER CIRCUIT. THE WIRE IS SHOWN AGAIN ON THAT CIRCUIT.

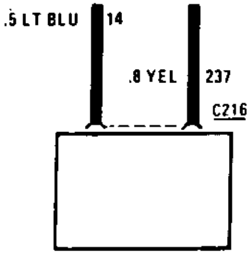
SYMBOLS

CIRCUIT BREAKER



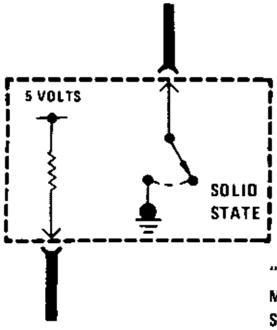
SWITCH CONTACTS THAT MOVE TOGETHER

DASHED LINE SHOWS A MECHANICAL CONNECTION BETWEEN SWITCH CONTACTS



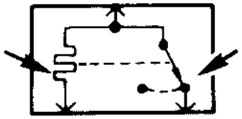
TWO TERMINALS IN THE SAME CONNECTORS

DASHED LINE SHOWS A PHYSICAL CONNECTION BETWEEN PARTS (SAME CONNECTOR)



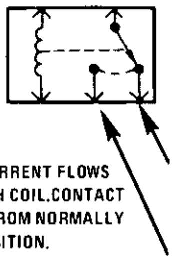
ELECTRONIC CONTROL MODULE (ECM) SOLID STATE

"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.



HEATING ELEMENT

HEAT-ACTUATED CONTACT

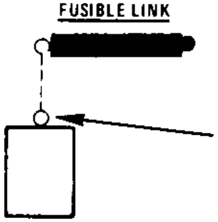


RELAY SHOWN WITH NO CURRENT FLOWING THROUGH COIL

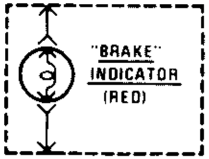
NORMALLY CLOSED CONTACT

NORMALLY OPEN CONTACT

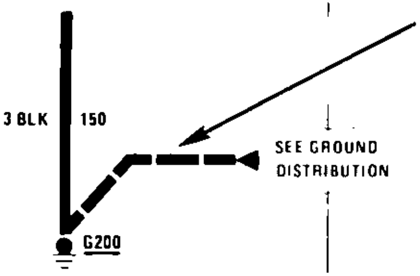
WHEN CURRENT FLOWS THROUGH COIL,CONTACT MOVES FROM NORMALLY OPEN POSITION.



FUSIBLE LINK CONNECTS TO SCREW TERMINAL, SHOWN SEPARATED

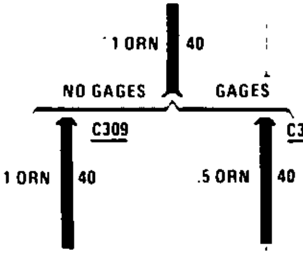


AN INDICATOR WHICH DISPLAYS THE LIGHTED WORD "BRAKE"

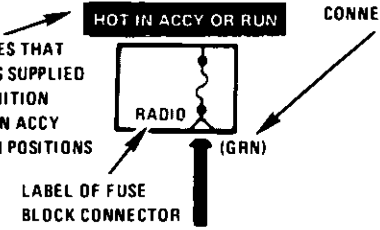


INDICATES THAT THE CIRCUITRY IS NOT SHOWN IN COMPLETE DETAIL BUT IS COMPLETE ON THE INDICATED PAGE

SEE GROUND DISTRIBUTION



WIRE CHOICES FOR OPTIONS OR DIFFERENT MODELS ARE SHOWN AND LABELED

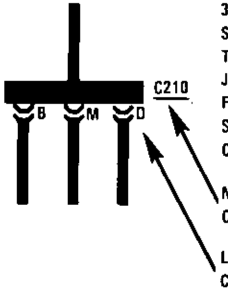


COLOR OF FUSE BLOCK CONNECTOR

INDICATES THAT POWER IS SUPPLIED WITH IGNITION SWITCH IN ACCY AND RUN POSITIONS

LABEL OF FUSE BLOCK CONNECTOR CAVITY

DIODE
CURRENT CAN FLOW ONLY IN THE DIRECTION OF THE ARROW

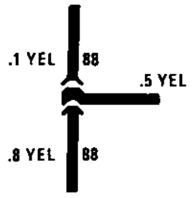


3 CONNECTORS ARE SHOWN CONNECTED TOGETHER AT A JUNCTION BLOCK. FOURTH WIRE IS SOLDER TO COMMON CONNECTION ON BLOCK.

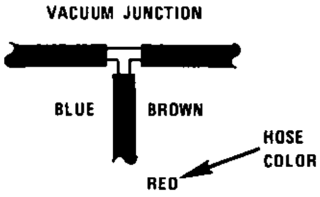
NUMBER FOR TOTAL CONNECTOR

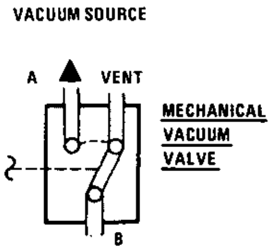
LETTERS FOR EACH CONNECTOR

SYMBOLS



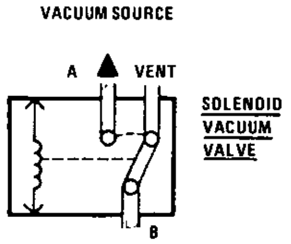
3 WIRES ARE SHOWN CONNECTED TOGETHER WITH A PIGGYBACK CONNECTOR





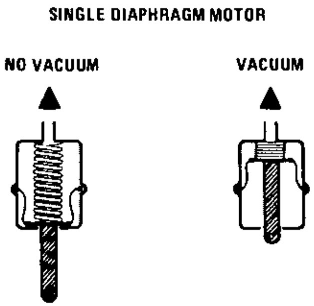
IN THE "AT REST" POSITION SHOWN, THE VALVE DOES THE FOLLOWING:
PORT A IS SEALED
PORT B IS VENTED TO THE ATMOSPHERE

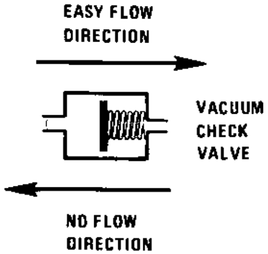
WHEN THE VALVE IS MOVED TO THE "OPERATED" POSITION VACUUM FROM PORT A IS CONNECTED TO PORT B

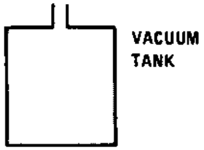


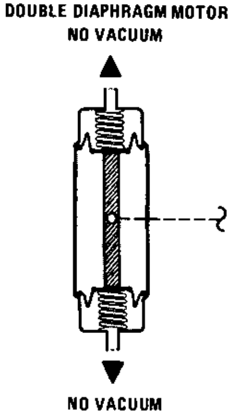
THE SOLENOID VACUUM VALVE USES THE SOLENOID TO MOVE THE VALVE

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.

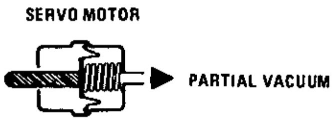








Double diaphragm motors can be operated by vacuum in two directions. When there is no vacuum, the motor is in the center "at rest" position.



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.

TROUBLESHOOTING PROCEDURES

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.
- Before you replace a component, check power, signal, and ground wires at the component harness connector. If these check 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.

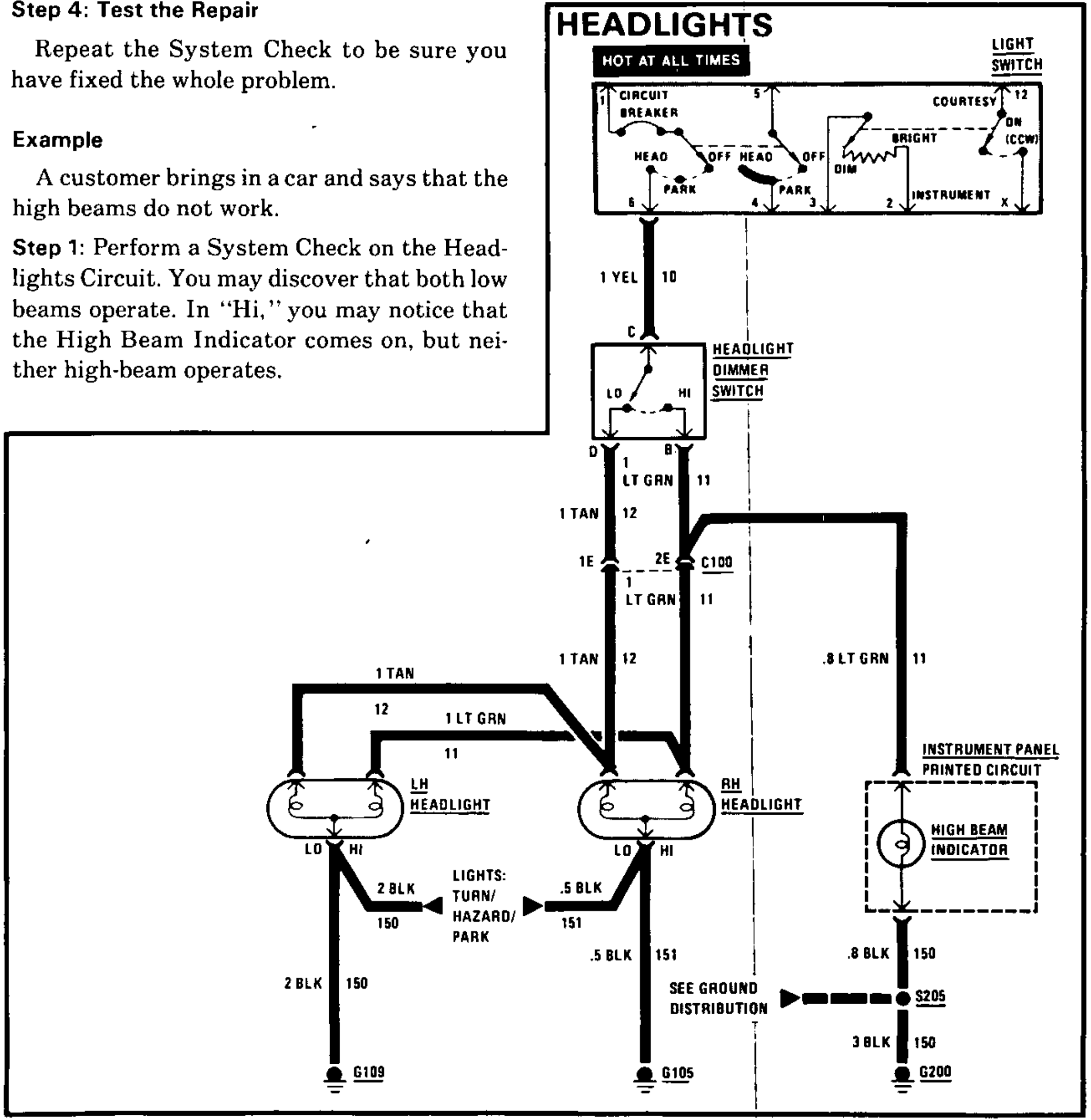


Figure 9 - Typical Headlights Schematic

TROUBLESHOOTING PROCEDURES

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.

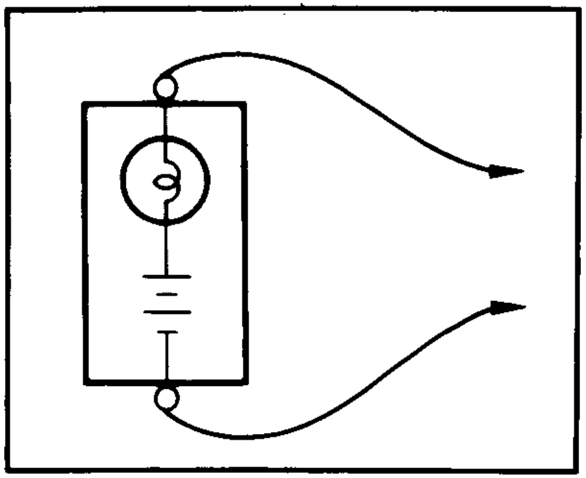
When testing for voltage or continuity at a connection, you do not have to separate the two halves of the connector. Unless you are testing a ''weather-pack'' connector, you should probe the connector from the back. Always check both sides of the connector. An accumulation of dirt and corrosion between contact surfaces is sometimes a cause of electrical problems.

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).

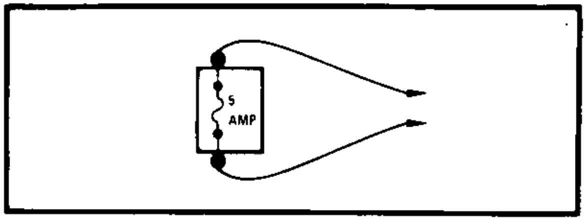
When measuring resistance with a digital multimeter, the vehicle Battery should be disconnected. This will prevent incorrect readings. Digital meters apply such a small voltage to measure resistance that the presence of voltages can upset a resistance reading.

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.

TROUBLESHOOTING TOOLS • TROUBLESHOOTING TESTS

FUSED JUMPER WIRE

A jumper wire is made up of an in-line fuse holder connected to a set of test leads. It should have a five ampere fuse. Use it for bypassing open circuits. Never use a jumper wire across any load (motors, etc.). This direct battery short will blow the fuse.



Fused Jumper Wire

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.

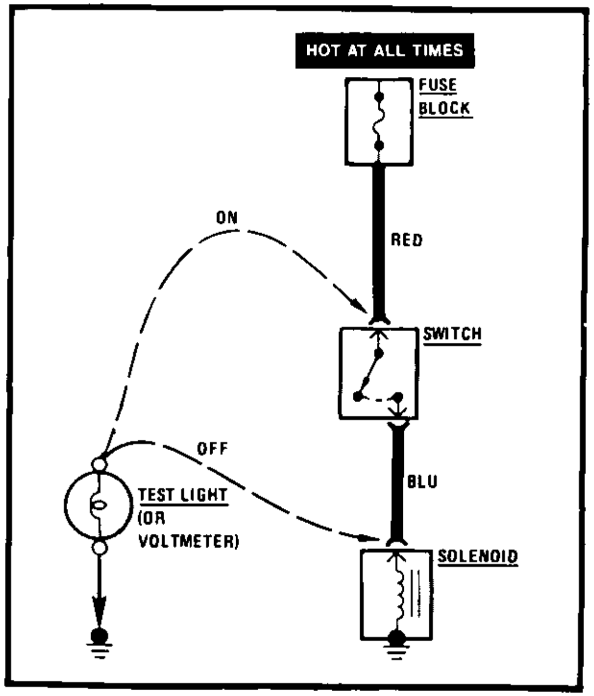
FUSE TESTER

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, either 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

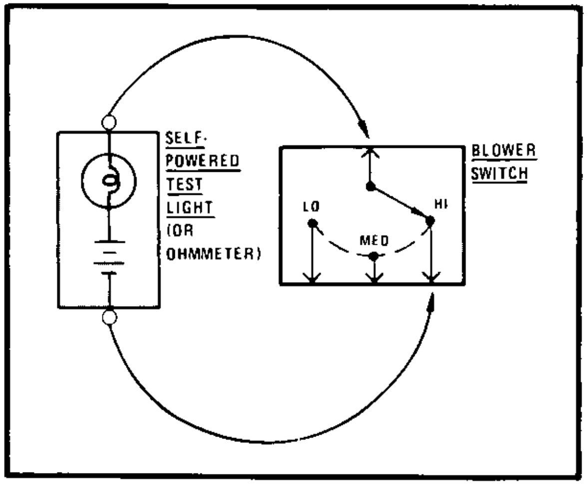
1. Connect one lead of a test light to a known good ground. If you are using a voltmeter, be sure it is the voltmeter's negative lead that you have connected to ground.
2. Connect the other lead of the test light or voltmeter to a selected test point (connector or terminal).
3. If the test light glows, 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.



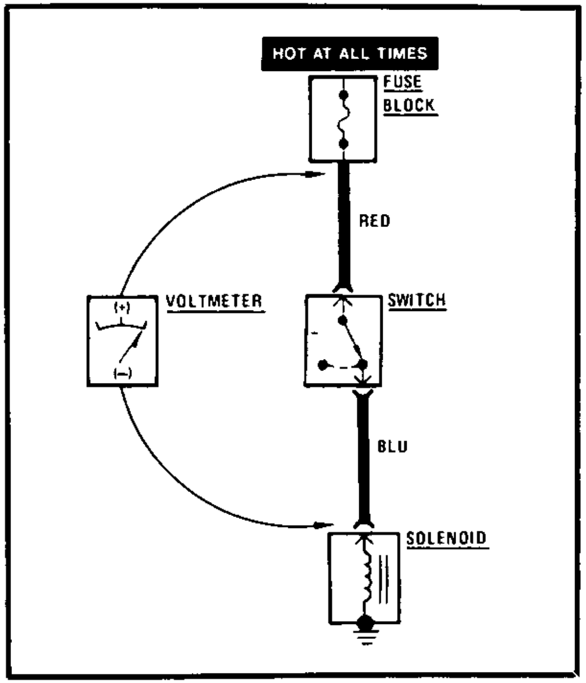
Continuity Check Through A Switch

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.

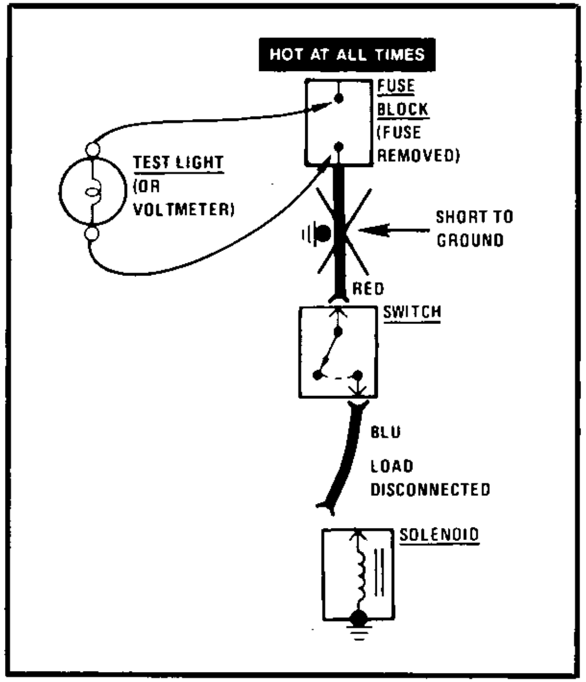


Voltage Drop Test

TESTING FOR SHORT TO GROUND

With a Test Light or Voltmeter

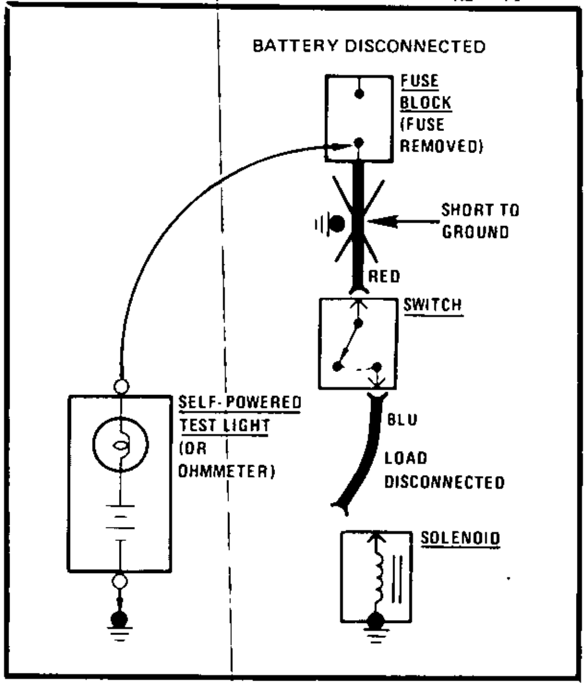
1. Remove the blown fuse and disconnect the load.
2. Connect a test light or voltmeter across the fuse terminals (be sure that the fuse is powered).
3. Beginning near the fuse block, wiggle the harness from side to side. Continue this at convenient points (about 6 inches apart) while watching the test 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 six 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.

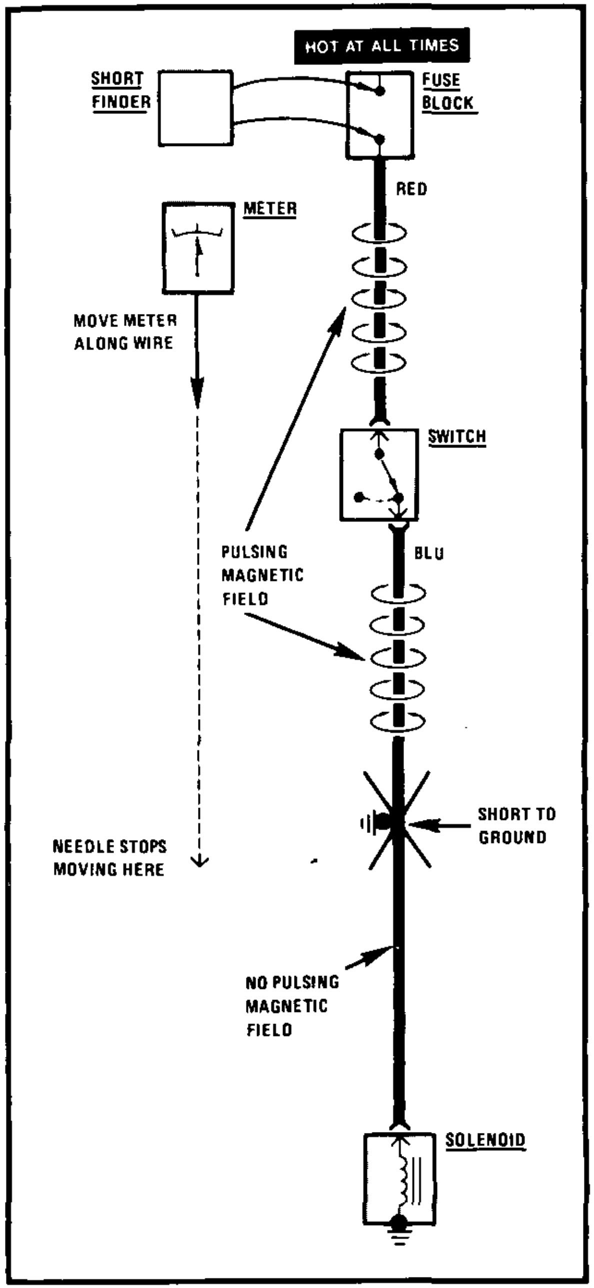


Testing For Short With Self-Powered Test Light or Ohmmeter

TROUBLESHOOTING TESTS

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.



Finding Short With Short Finder

REPAIR PROCEDURES

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).

REPAIR PROCEDURES

REPLACING A WIRE

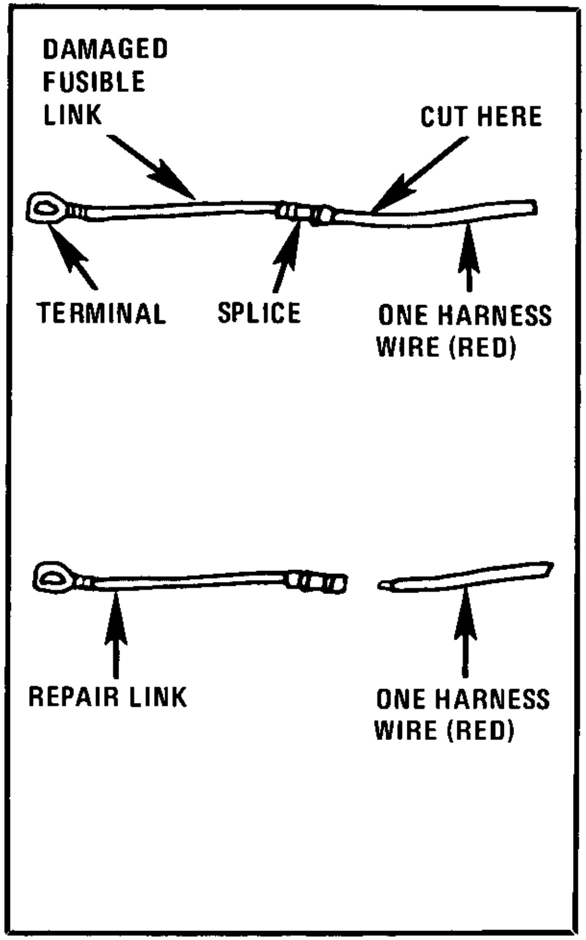
When replacing a wire, use a wire of the same size as the original wire, or larger. The schematics list wire size in metric units. The following table shows the commercial (AWG) wire sizes which will replace each metric wire size. Each AWG size is equal to or larger than the metric size.

METRIC SIZE	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

Wire Size Conversion Table

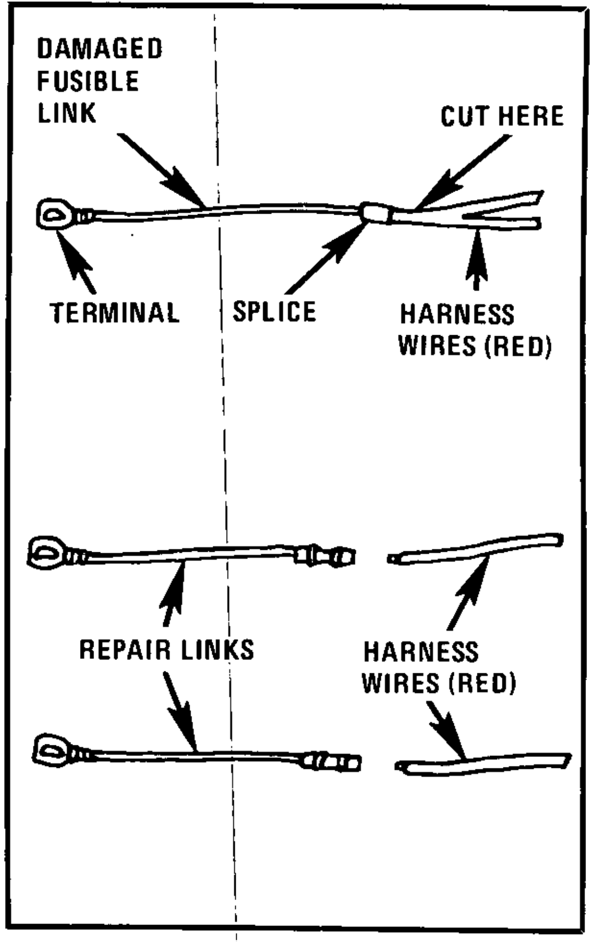
REPLACING A FUSIBLE LINK

Original Link with One Wire



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.

Original Link With Two Wires



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.

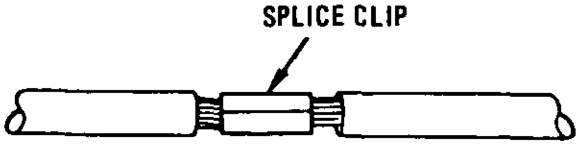
REPAIR PROCEDURES

Splicing Wire

Splices must be done carefully using both a crimped clip and solder as shown below. The finished splice must be taped. Insulation piercing splice clips should not be used.

- Strip about 1/2″ of insulation from the ends to be joined.

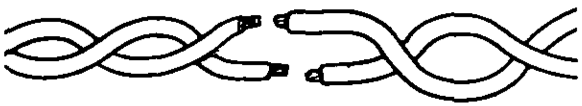
- Insert the bare wires into the splice clip and crimp tightly with a crimping tool. The wires should not slip out of the splice clip after crimping.



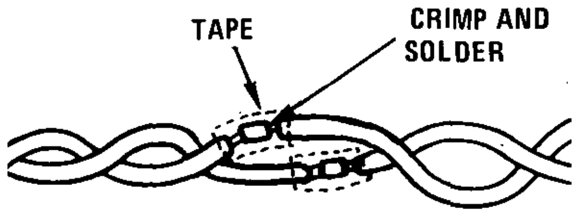
- Solder the wires and splice clip using 60/40 (tin/lead) rosin core solder.
- Wrap several layers of electrical tape around the splice for insulation.

When splicing two leads that are twisted together, the two clips should be staggered so that they are not next to each other when the splices are finished.

- Cut the wires off so that the ends are different lengths, as shown below. Strip about 1/2″ of insulation from each end.



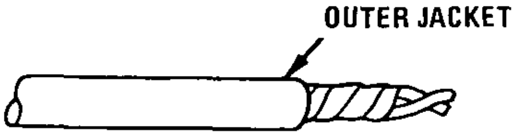
- Splice the ends together with splice clips as shown below. Crimp the clips to the wires and solder them.



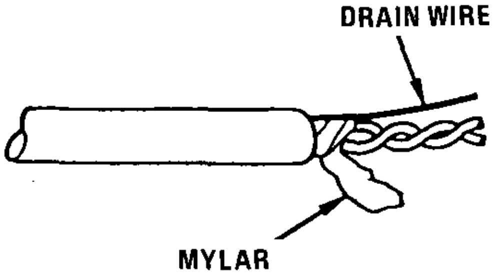
- Wrap each splice separately with electrical tape, as indicated by the dotted lines above.
- Twist the wires together and wrap the entire connection with electrical tape.

SPLICING SHIELDED CABLE

- Carefully cut away about two inches of the plastic outer jacket. Try not to cut the aluminum/mylar tape shield.



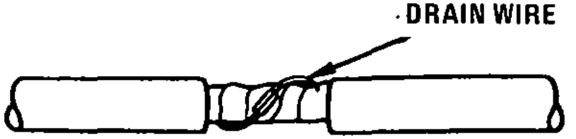
- Unwind the aluminum/mylar tape but do not cut it off. It will be wrapped around the splice when finished.



- Untwist the two insulated wires. Cut them so that their lengths are not equal. The splice will be staggered so that they do not touch. Strip about 1/2″ of insulation from their ends.
- Splice the ends together with splice clips, crimp, and solder. Wrap each splice with electrical tape.

REPAIR PROCEDURES

- Wrap the aluminum/mylar tape around the wire and splices. Splice the drain (ground) wire ends together with a splice clip, crimp and solder.



- Wrap the entire splice with electrical tape.

SPLICING ALUMINUM WIRE

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 to crimp on new terminals.

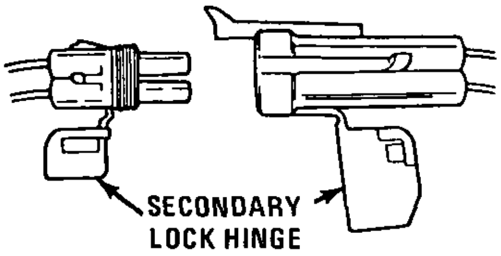
Splices in aluminum wire must be at least 1-1/2″ (40mm) from other splices.

- Strip approximately 1/4″ of insulation from the ends of the wires to be joined.
- Pick the proper-sized splice clips from the kit and crimp then to the ends of the aluminum wire. Crimp with large pliers.
- Assemble the mating connectors together and coat them and the wires with petroleum jelly. This protects against corrosion.
- Wrap the entire splice with electrical tape.

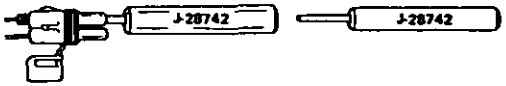
WEATHERPROOF CONNECTORS

The weatherproof connection system is used to provide weather protection on certain electrical circuits. Substitute connectors and terminals cannot be used to replace the weatherproof system, nor can cable or connector seals be left off from the repair method. If a weatherproof connection is damaged or requires repair for any reason, the following procedure should be used:

1. Open secondary lock hinge on connector.

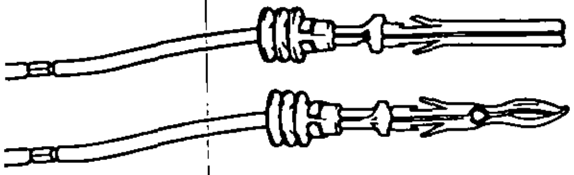


2. Remove terminals using special tool J-28742.



TERMINAL REMOVAL TOOL

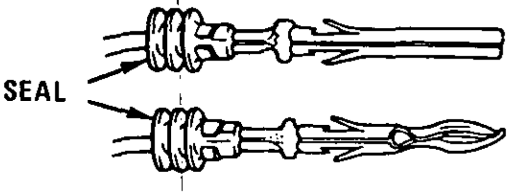
3. a. Cut wire, crimp and solder on weatherproof lead assembly using rosin core solder.



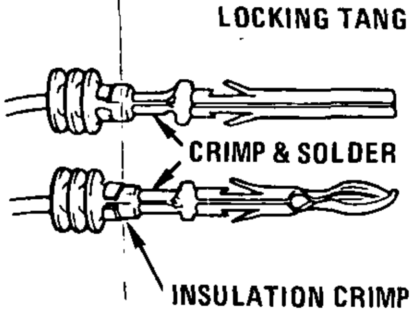
If weatherproof lead assemblies are not available:

b. Cut wire immediately behind cable seal.

Slip new cable seal onto wire and strip 5.0mm (3/16″) of insulation from wire. Position cable seal as shown.



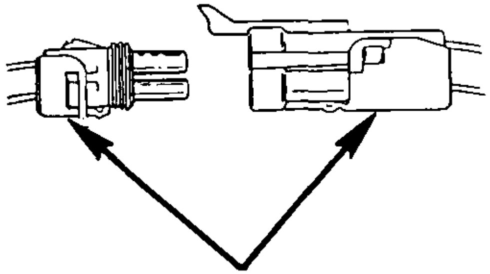
Crimp new terminal onto wire using standard crimping tool.



REPAIR PROCEDURES

Then solder the crimp to the wire with rosin core solder. Insulation crimp must grip the cable seal as shown. Only slight pressure should be applied for this crimp. Bend each locking tang back to its original position so *that the terminals will lock into the connector.*

4. Insert new terminals into connector. Terminals will "click" and lock into place. Be sure to maintain indexing by placing wires into *the same cavities as in the original connector.*
5. Close secondary lock hinge on connector body.



SECONDARY LOCK HINGES
CLOSED ON CONNECTOR BODY

MOLDED CONNECTORS

If a molded connector is damaged, it must be removed from the harness. It can be replaced by a similar connector. The new connector must be spliced back into the harness following recommended splicing procedures.

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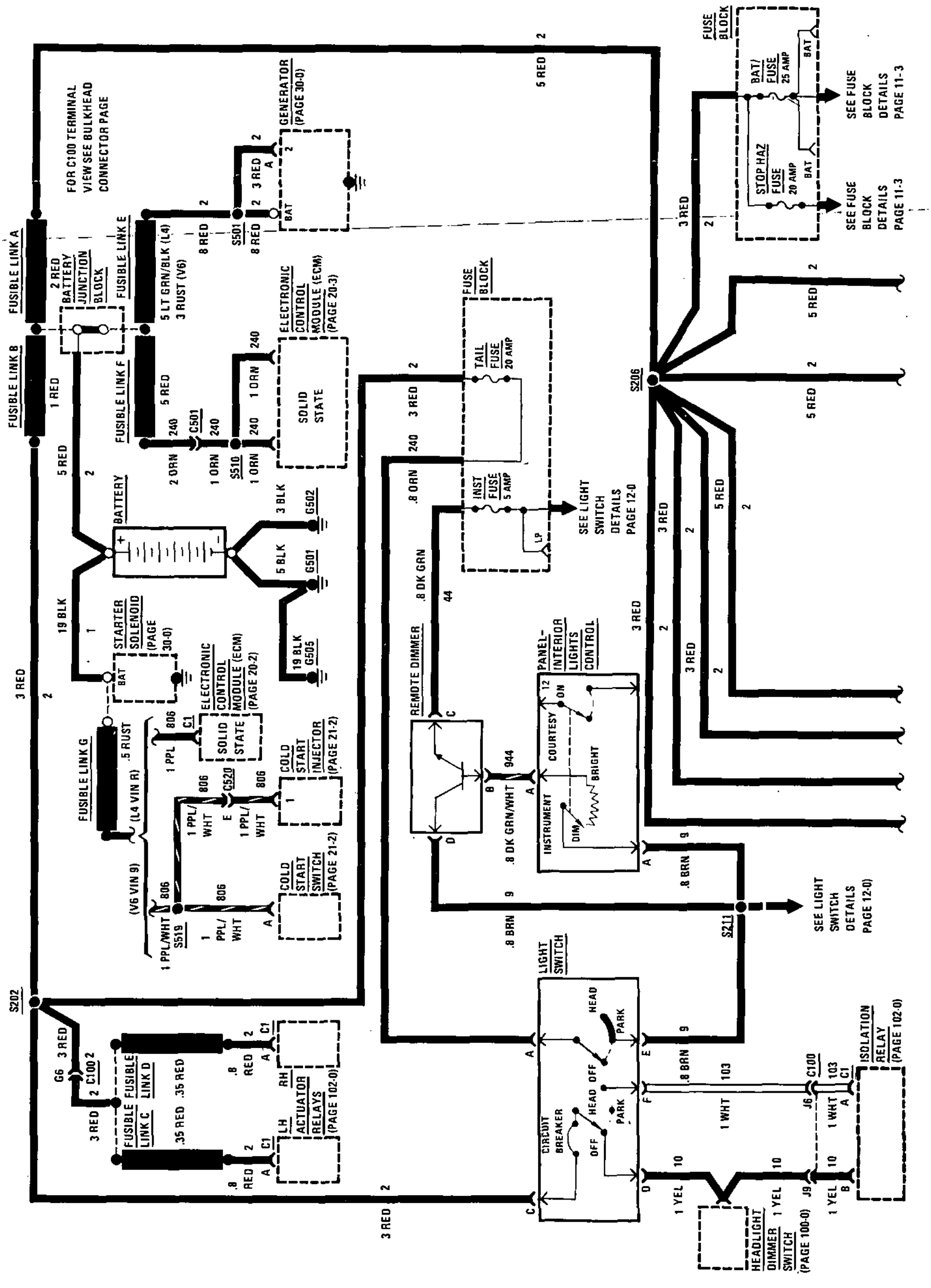
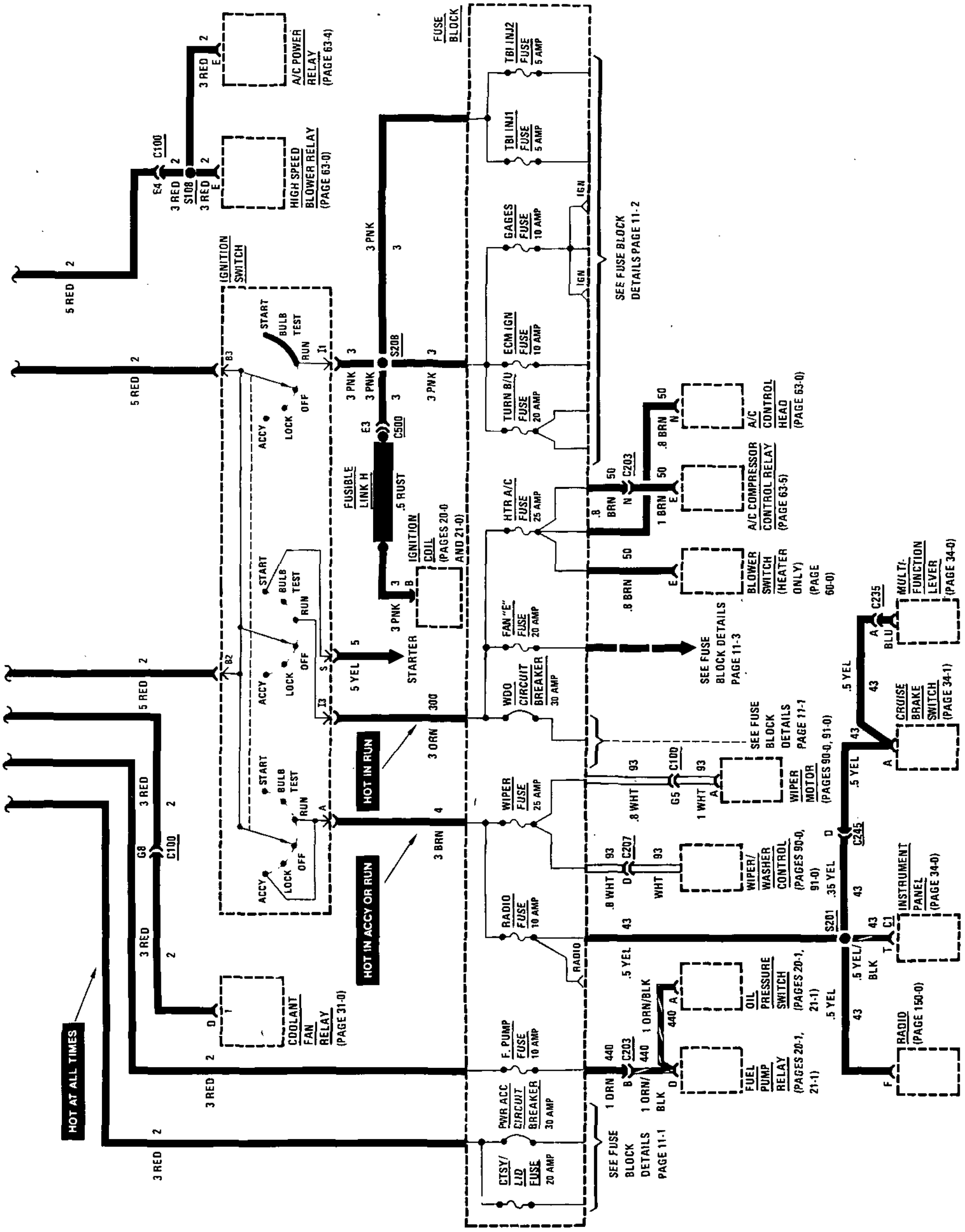
POWER DISTRIBUTION

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HTR A/C FUSE 25 AMP
FAN "E" FUSE 20 AMP
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WIPER FUSE 25 AMP
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COMPONENT LOCATION

Component	Location	Page-Figure
A/C Compressor Control Relay	On rear bulkhead, left of center	201- 9-C
A/C Power Relay	Front compartment, on RH side of heater-A/C plenum	201-10-C
Actuator Relays	Front compartment, next to each headlamp	201-10-F
Battery Junction Block (VIN 9)	RH front of engine compartment, near battery	201- 0-B
Battery Junction Block (VIN R)	RH front of engine compartment, near battery	201- 0-A
Cold Start Injector	Top of engine, on throttle body	
Cold Start Switch	Top RH side of engine	
Coolant Fan Relay	LH front corner of front compartment	201- 9-C
Cruise Brake Switch	On brake pedal support	201- 8-A
Electronic Control Module	Between seats, on rear bulkhead	201- 6-A
Fuel Pump Relay	On rear bulkhead, left of center	201- 9-C
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link B	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link C	In front lights harness, to right of brake master cylinder	201- 9-D
Fusible Link D	In front lights harness, to right of brake master cylinder	201- 9-D
Fusible Link E	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link F	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link G	LH front of engine, at starter solenoid	201- 1-C
Fusible Link H (VIN 9)	Above starter solenoid	
Generator	Rear RH side of engine	201- 2-A
Headlight Dimmer Switch	At base of steering column, LH side	201- 5-B
High Speed Blower Relay	On RH side of heater-A/C plenum	201- 9-A
Ignition Coil (VIN 9)	Top of engine, near distributor	
Ignition Coil (VIN R)	Rear engine, left of intake manifold	201- 1-B
Ignition Switch	At base of steering column	201- 5-A
Isolation Relay	LH side of front compartment, to rear of side	201-10-E
Multi-Function Lever	Top of steering column, LH side	201- 7-C
Oil Pressure Switch	Rear of engine, center of engine block	201- 2-A
Radio	Behind center of dash	201- 9-E

COMPONENT LOCATION

		Page-Figure
Remote Dimmer	*Right of RH steering column support*	201- 5-C
Starter Solenoid (VIN 9)	Front right side of engine	
Starter Solenoid (VIN R)	Lower front LH side of engine	201- 1-A
Wiper Motor	Front of dash, in center	201-16-A
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C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A
C207 *(7 cavities)*	Behind dash, near windshield wiper switch	201-10-B
C235 (4 cavities)	Middle of steering column, LH side	201- 7-C
C245 (9 cavities)	Below right steering column support	201- 8-B
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C501 (1 cavity)	RH side of engine, near battery junction block	
C520 (6 cavities)	Top RH of engine	
G501 (VIN 9)	RH front of engine, near dipstick	201- 0-E
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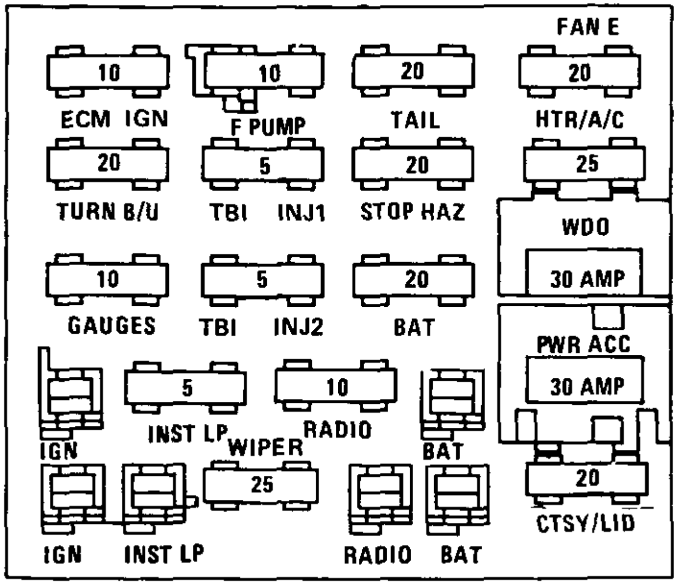
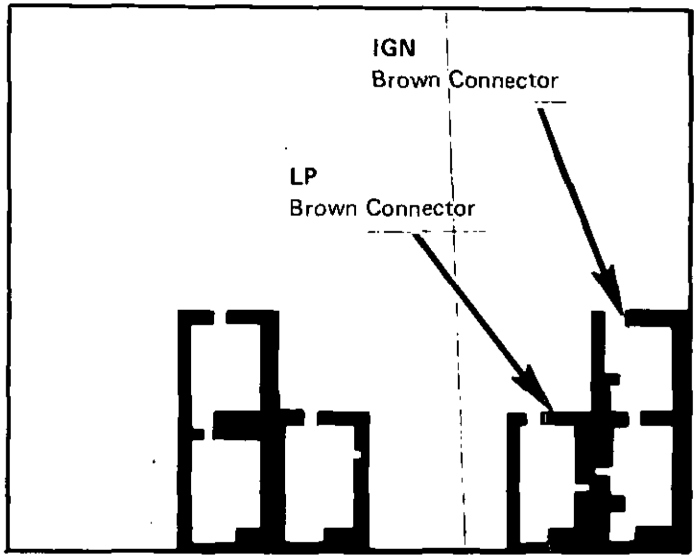
S206	Main harness, above LH side of steering column	201- 5-A
S208	Main harness, right of steering column	201- 3-D
S211	Main harness, behind RH side of cluster	201- 3-D
S501	Engine harness, under intake manifold	201- 2-A
S510	TBI harness, in front of rear bulkhead	201- 6-A
S519	Engine harness, near starter	

FUSE BLOCK DETAILS

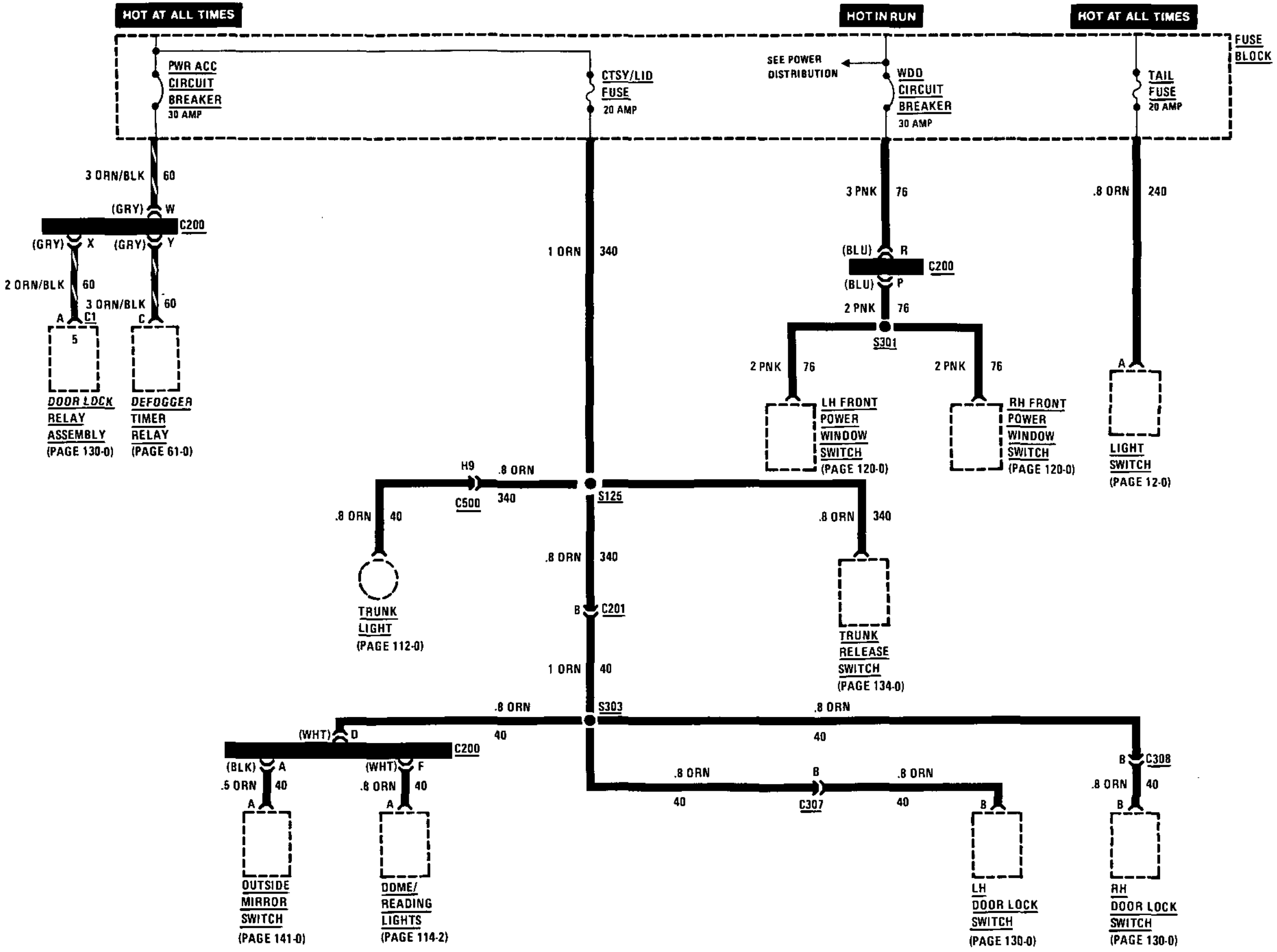


FRONT VIEW OF FUSE BLOCK

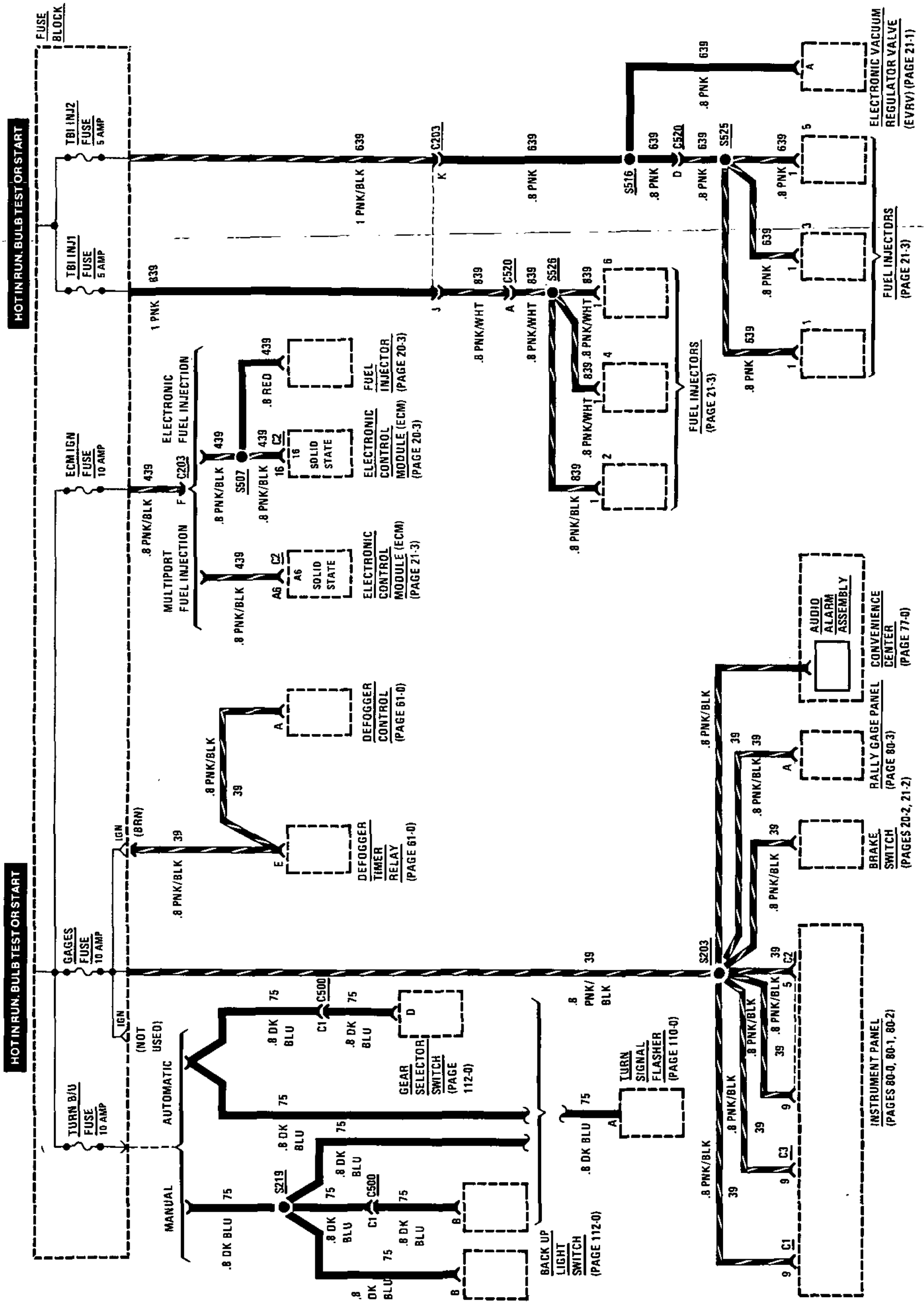


REAR VIEW OF FUSE BLOCK
Connector Cavity Locations

FUSE BLOCK DETAILS



FUSE BLOCK DETAILS



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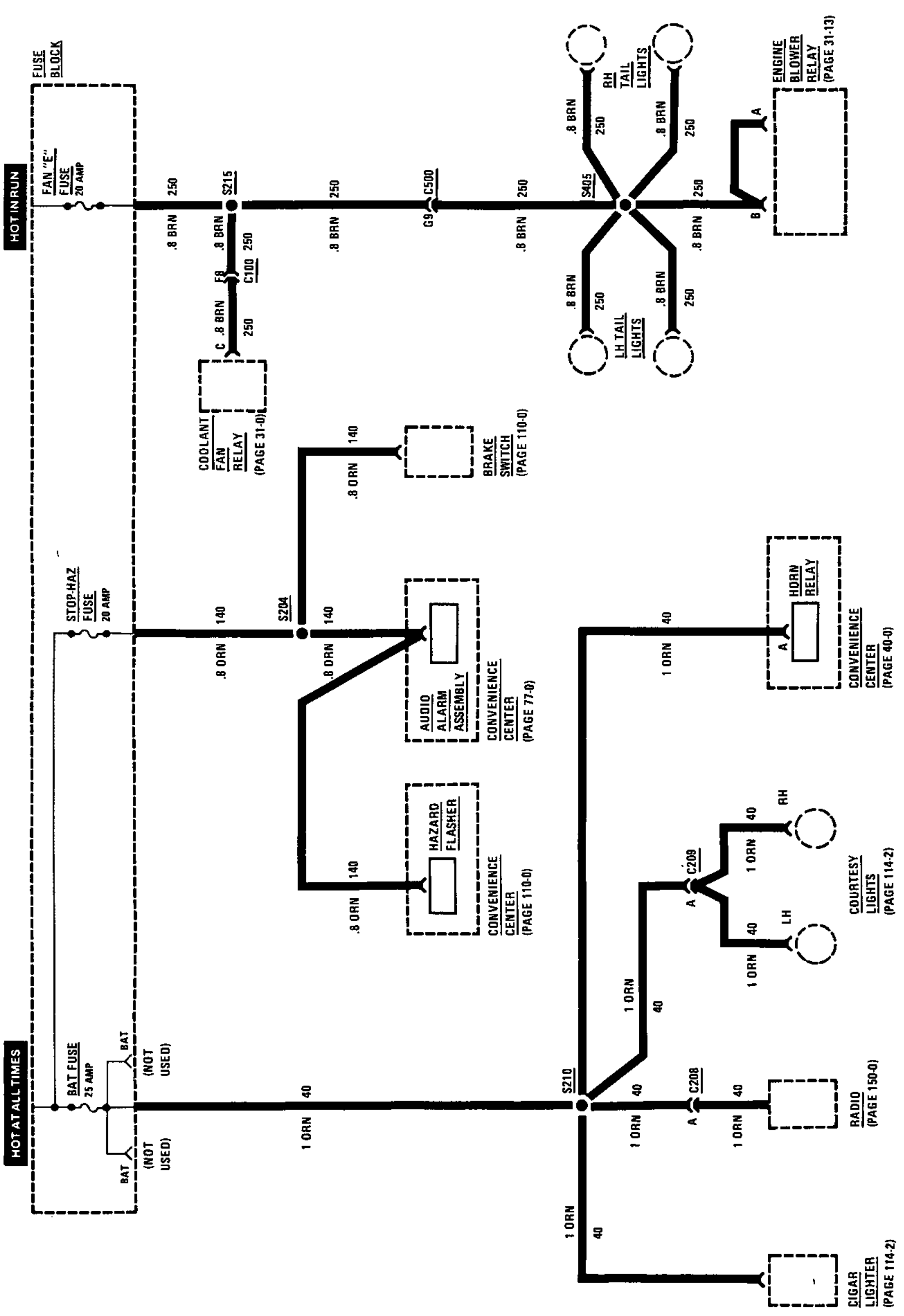
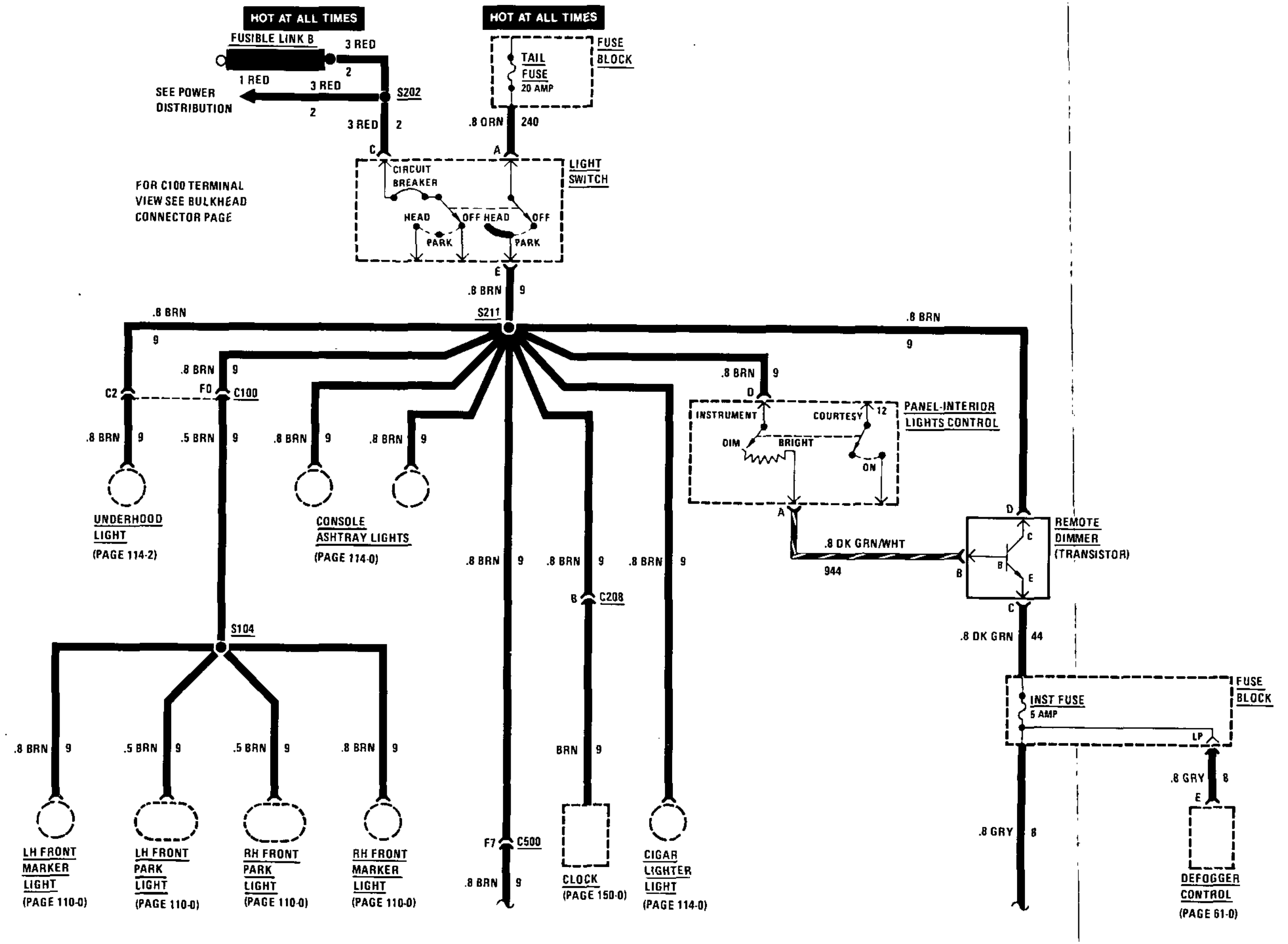
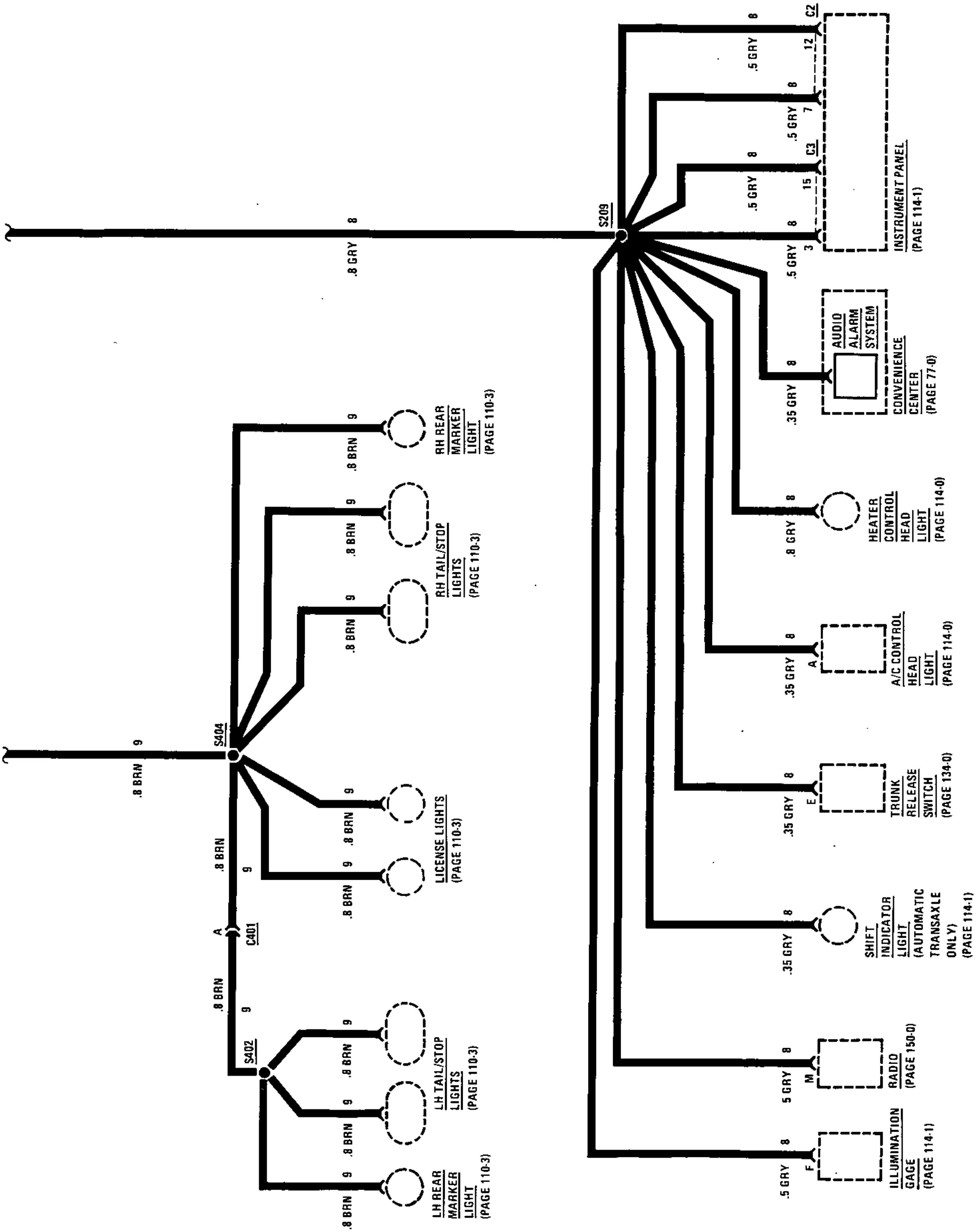
FUSE BLOCK DETAILS



LIGHT SWITCH DETAILS



FOR C100 TERMINAL VIEW SEE BULKHEAD CONNECTOR PAGE



8 .8 GRY
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8 .5 GRY M
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A C401
.8 BRN 9
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9 .8 BRN
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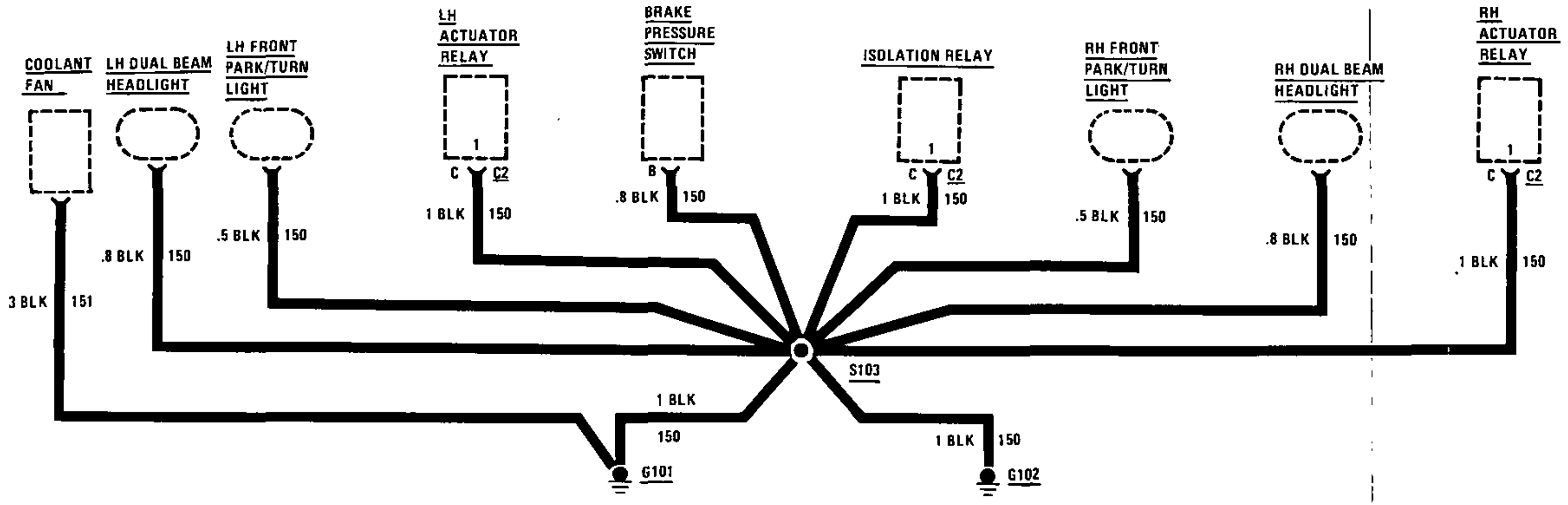
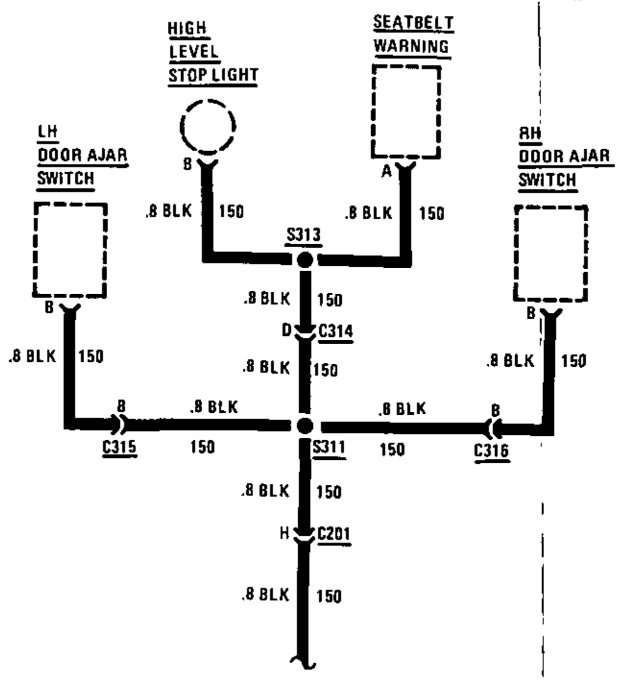
9 .8 BRN
LH REAR MARKER LIGHT (PAGE 110-3)

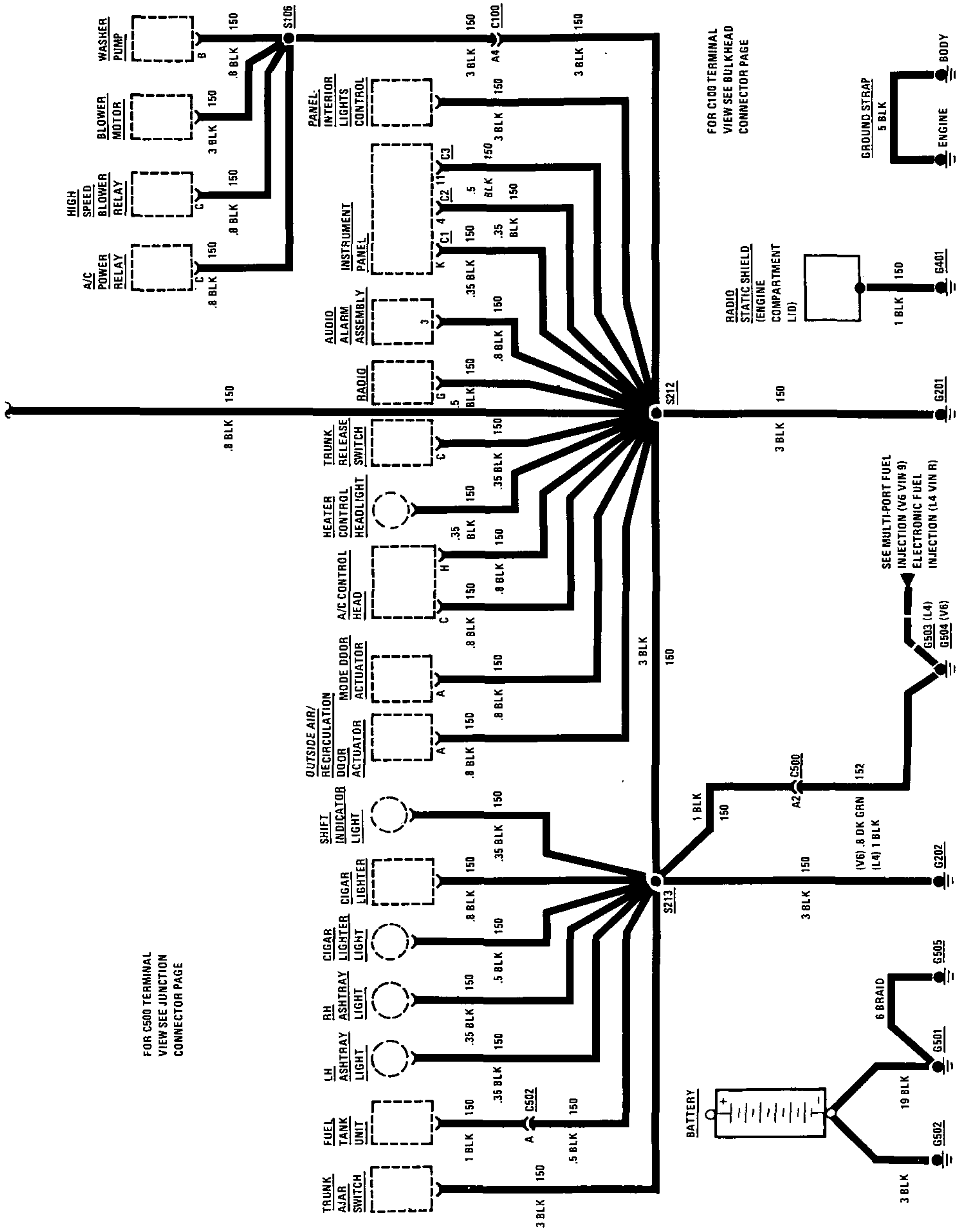
P

GROUND DISTRIBUTION (G101, G102, G201, G202, G401, G501, G502, G503, G504, AND G505)

INSTRUMENT PANEL, FRONT AND LIGHTS GROUNDS







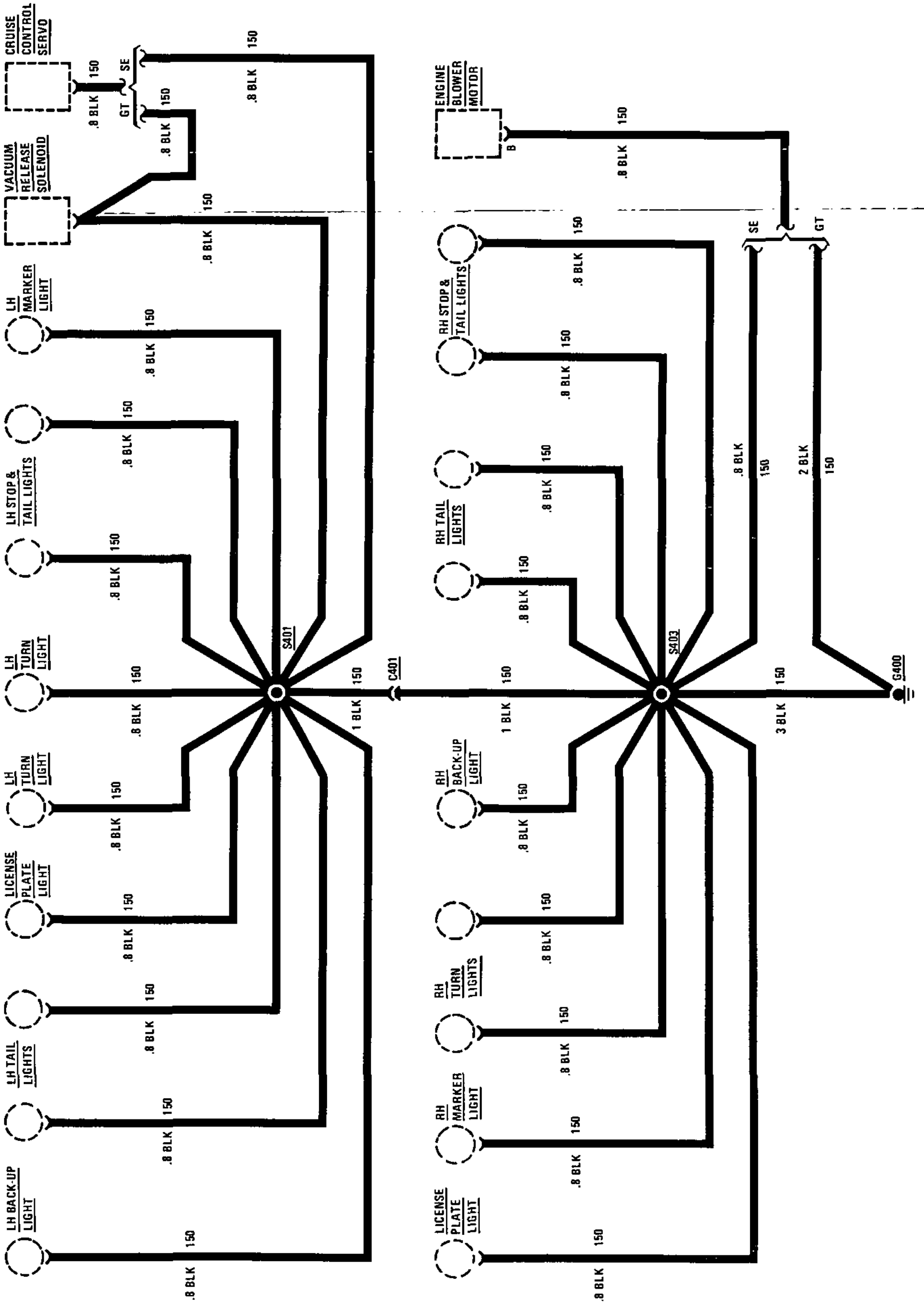
FOR C100 TERMINAL VIEW SEE BULKHEAD CONNECTOR PAGE

SEE MULTI-PORT FUEL INJECTION (V6 VIN 9) ELECTRONIC FUEL INJECTION (L4 VIN R)

FOR C500 TERMINAL VIEW SEE JUNCTION CONNECTOR PAGE

GROUND DISTRIBUTION (G400)

REAR LIGHTS GROUNDS



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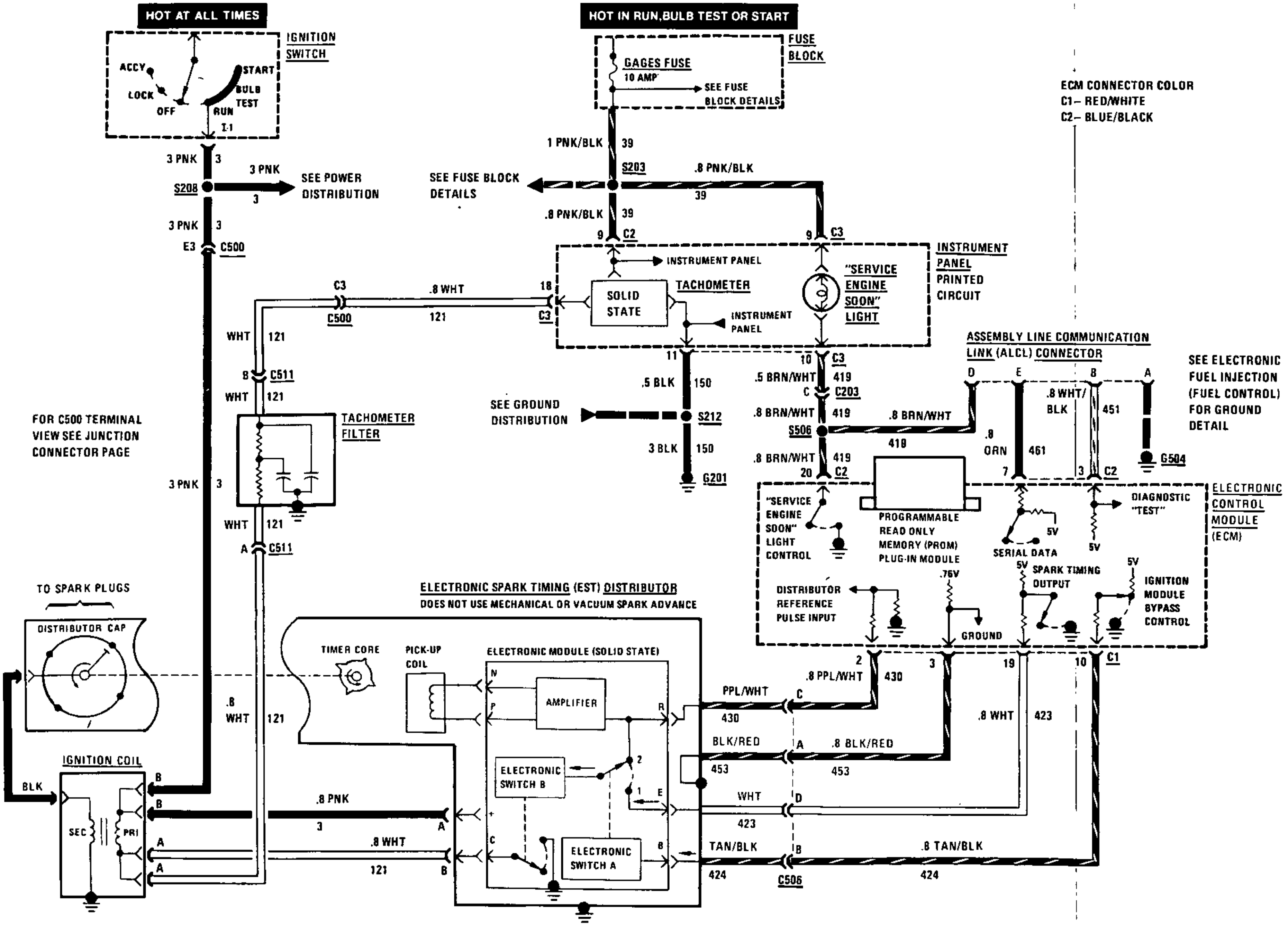
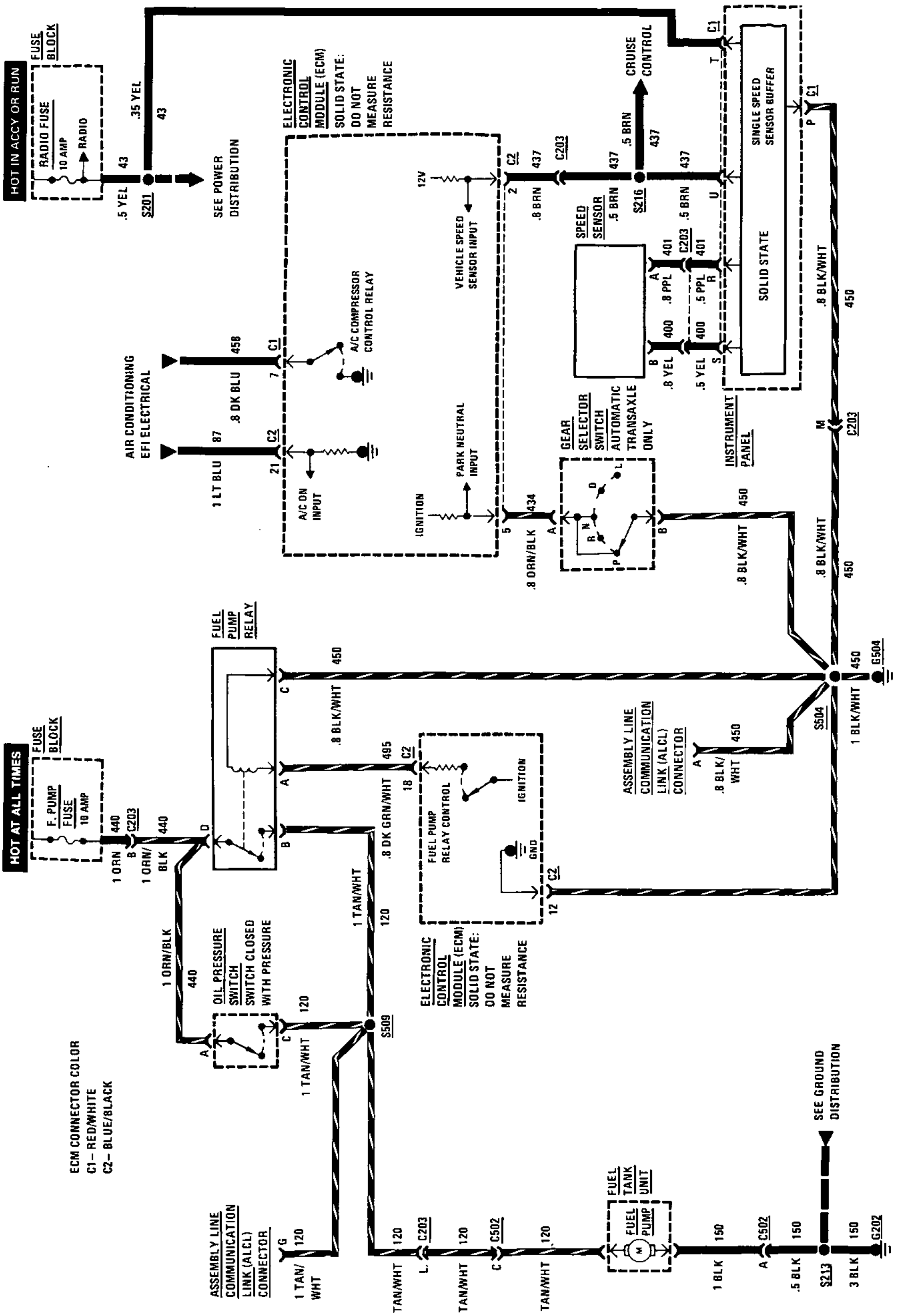
ELECTRONIC FUEL INJECTION (L4 VIN R)

IGNITION, SERVICE ENGINE SOON LIGHT AND TACHOMETER



ELECTRONIC FUEL INJECTION (L4 VIN R)

FUEL CONTROL

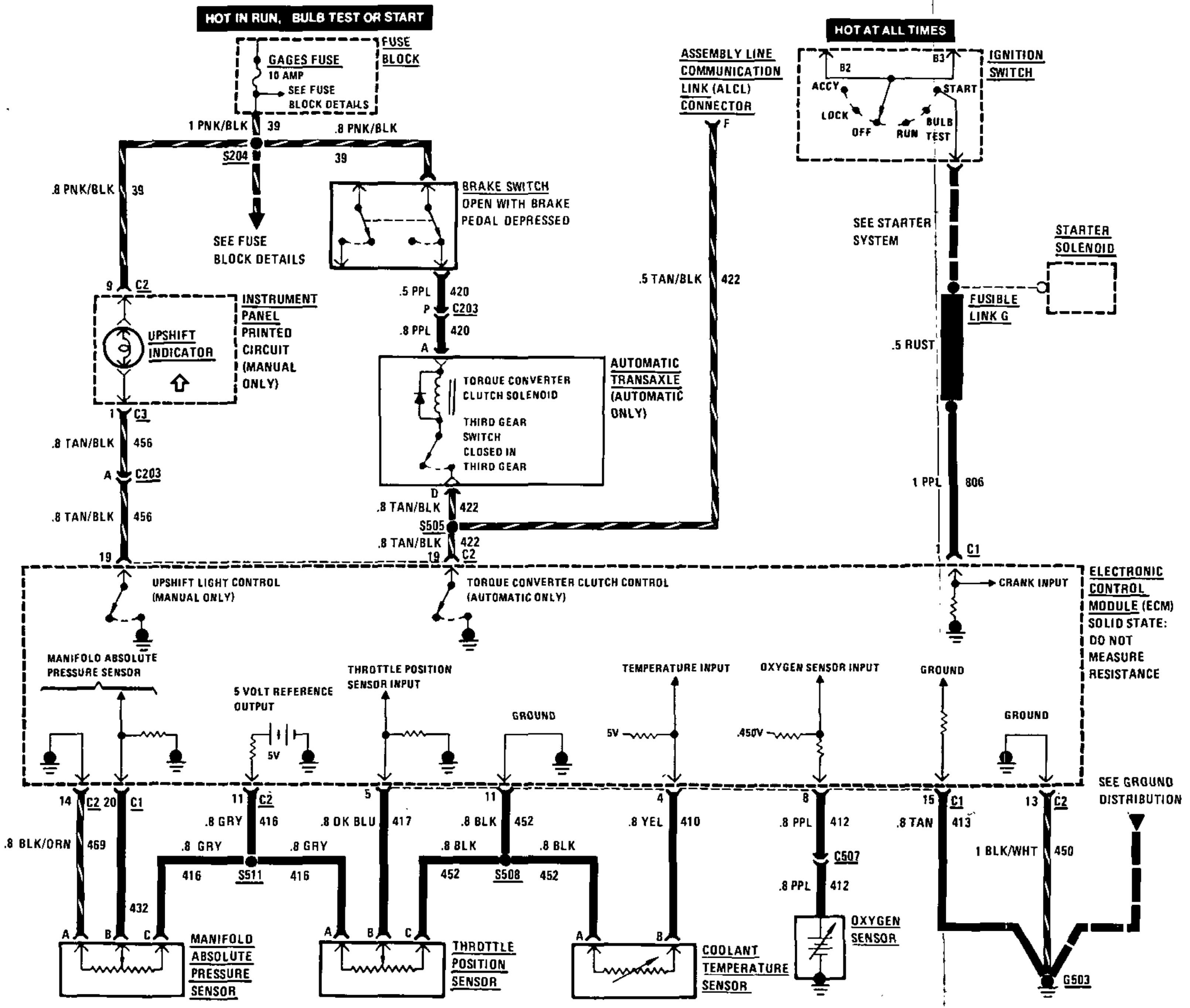


ECM CONNECTOR COLOR
C1 – RED/WHITE
C2 – BLUE/BLACK

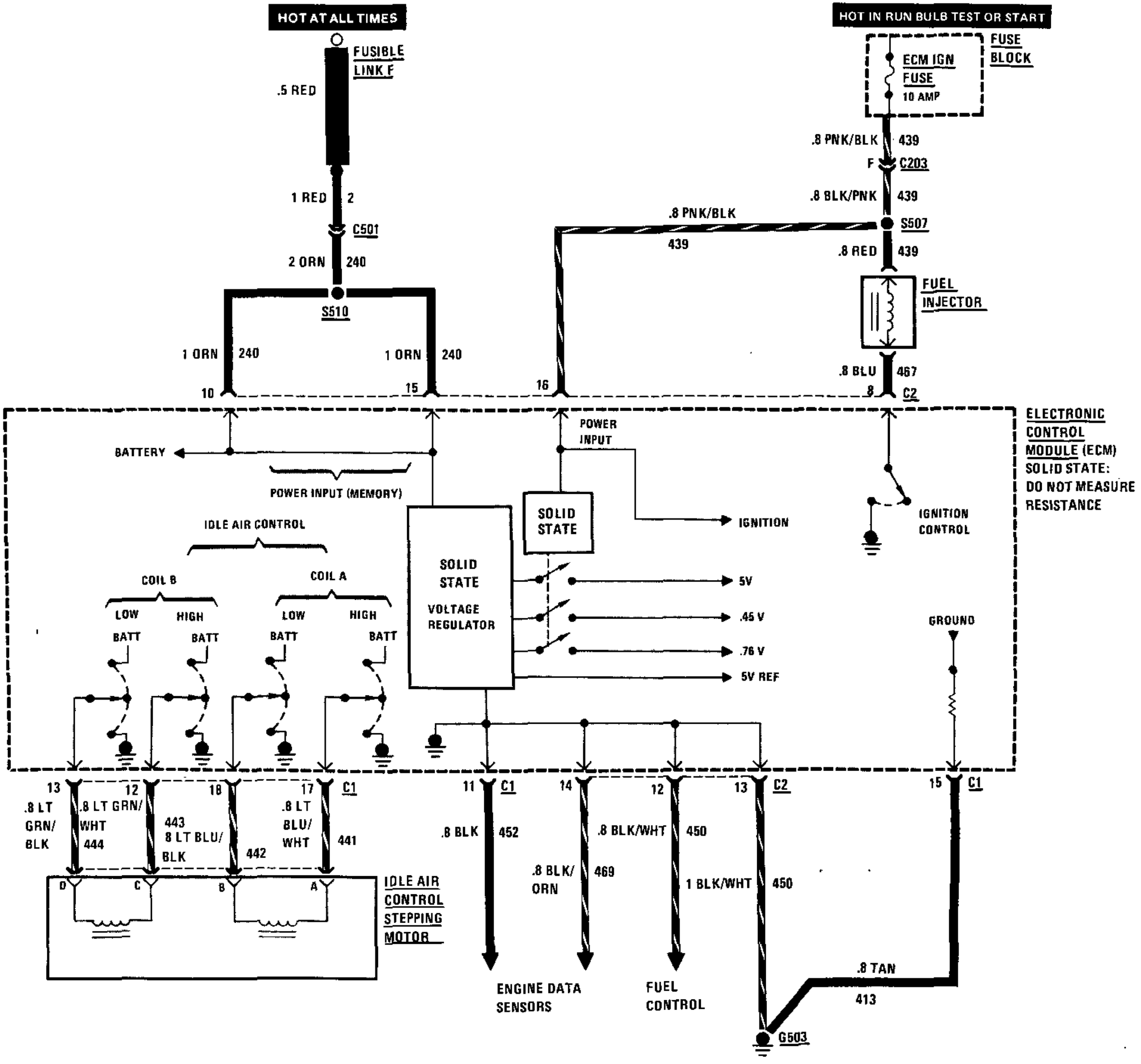
ELECTRONIC FUEL INJECTION (L4 VIN R)

ENGINE DATA SENSORS, TORQUE CONVERTER CLUTCH, AND UPSHIFT INDICATOR

ECM CONNECTOR COLOR ·
C1– RED/WHITE
C2– BLUE/BLACK



ELECTRONIC FUEL INJECTION (L4 VIN R)



COMPONENT LOCATION

		Page-Figure
ALCL Connector	In console, near lights	201- 6-A
Brake Switch	Top of brake pedal support	201- 8-A
Coolant Temperature Sensor	LH top of engine	201- 1-B
Electronic Control Module	Between seats, on rear bulkhead	201- 6-A
Electronic Spark Timing (EST) Distributor	Rear of engine	201- 2-A
Fuel Injector	Top of engine, top of throttle body	201- 0-F
Fuel Pump Relay	On rear bulkhead, left of center	201- 9-C
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link F	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link G	LH front of engine, at starter solenoid	201- 1-C
Gear Selector Switch	Left of engine, top of transaxle	201- 1-B
Idle Air Control Stepping Motor	Rear of engine, LH side of throttle body	201- 0-F
Ignition Coil	LH rear of engine	201- 2-A
Ignition Coil (VIN R)	Rear engine, left of intake manifold	201- 1-B
Ignition Switch	At base of steering column	201- 5-A
Manifold Absolute Pressure Sensor	On RH side of air cleaner	201- 2-A
Oil Pressure Switch	Rear of engine, center of engine block	201- 2-A
Oxygen Sensor	Front of engine, base of manifold	201- 1-A
Speed Sensor	RH end of transaxle	201- 2-A
Starter Solenoid (VIN R)	Lower front LH side of engine	201- 1-A
Tachometer Filter	Taped to engine harness, LH end of engine	201- 1-A
Throttle Position Sensor	Top of engine, right of throttle body	201- 2-A
Torque Converter Clutch (TCC) Solenoid	LH front of engine	201- 1-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
C501 (1 cavity)	RH side of engine, near battery junction block	
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 3-A
C506 (4 cavities)	Rear of engine, near distributor	201- 2-A
C507 (1 cavity)	Lower front, LH side of engine	201- 1-A

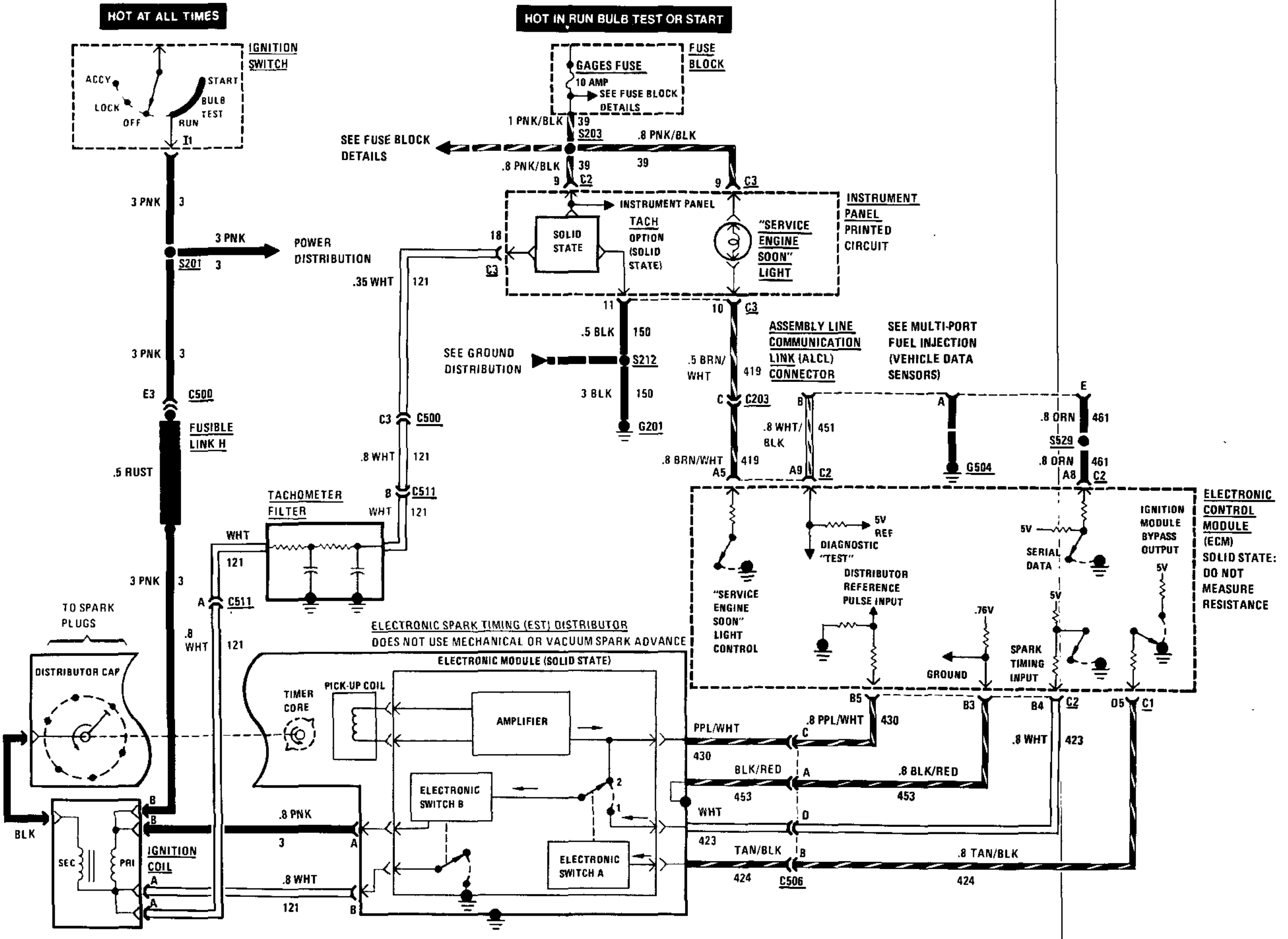
ELECTRONIC FUEL INJECTION (L4 VIN R)

COMPONENT LOCATION

		Page-Figure
C511 (2 cavities)	Near LH side of engine	
G201	Behind dash, near center	201- 3-D
G202	Between seats, near rear bulkhead	201- 3-C
G503	LH end of engine, above transaxle	201- 1-B
G504	Top front, LH side of engine	201- 1-A
S201	I/P harness, left of steering column	201- 7-A
S203	Main harness, above steering column	201- 7-A
S204	Main harness, to right of steering column	201- 7-A
S208	Main harness, right of steering column	201- 3-D
S212	Main harness, behind center of dash	201- 3-D
S213	Main harness, behind shift lever	201-16-A
S216	Main I/P harness, behind center I/P	201-16-A
S504	TBI harness, in front of rear bulkhead	201- 6-A
S505	TBI harness, in front of rear bulkhead	201- 6-A
S506	TBI harness, in front of rear bulkhead	201- 6-A
S507	TBI harness, in front of rear bulkhead	201- 6-A
S508	TBI harness, in front of rear bulkhead	201- 6-A
S509	TBI harness, in front of rear bulkhead	201- 6-A
S510	TBI harness, in front of rear bulkhead	201- 6-A
S511	TBI harness, rear of engine	201- 2-A

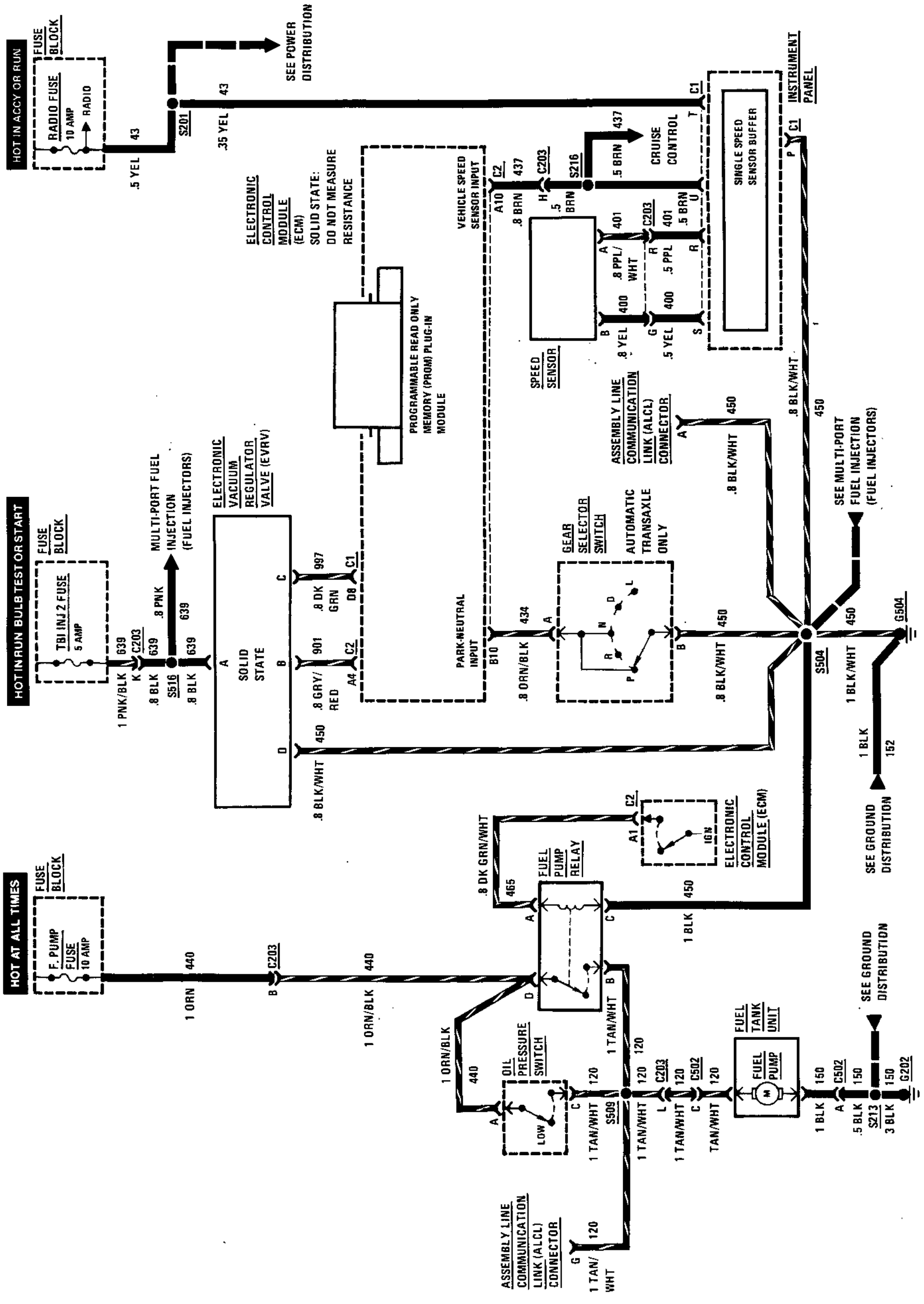
MULTI-PORT FUEL INJECTION (V6 VIN 9)

IGNITION AND SERVICE ENGINE SOON LIGHT



MULTI-PORT FUEL INJECTION (V6 VIN 9)

FUEL CONTROL



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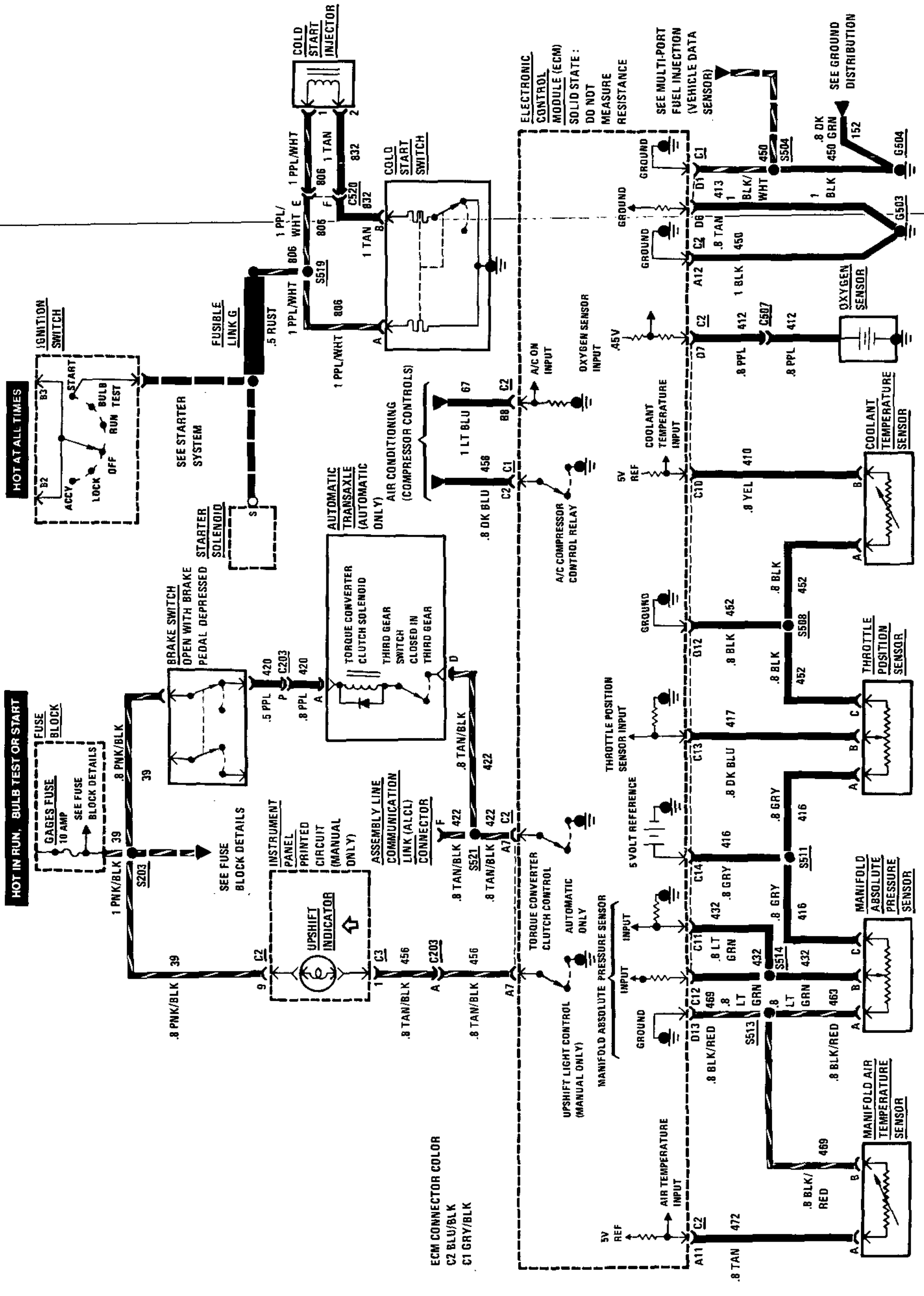
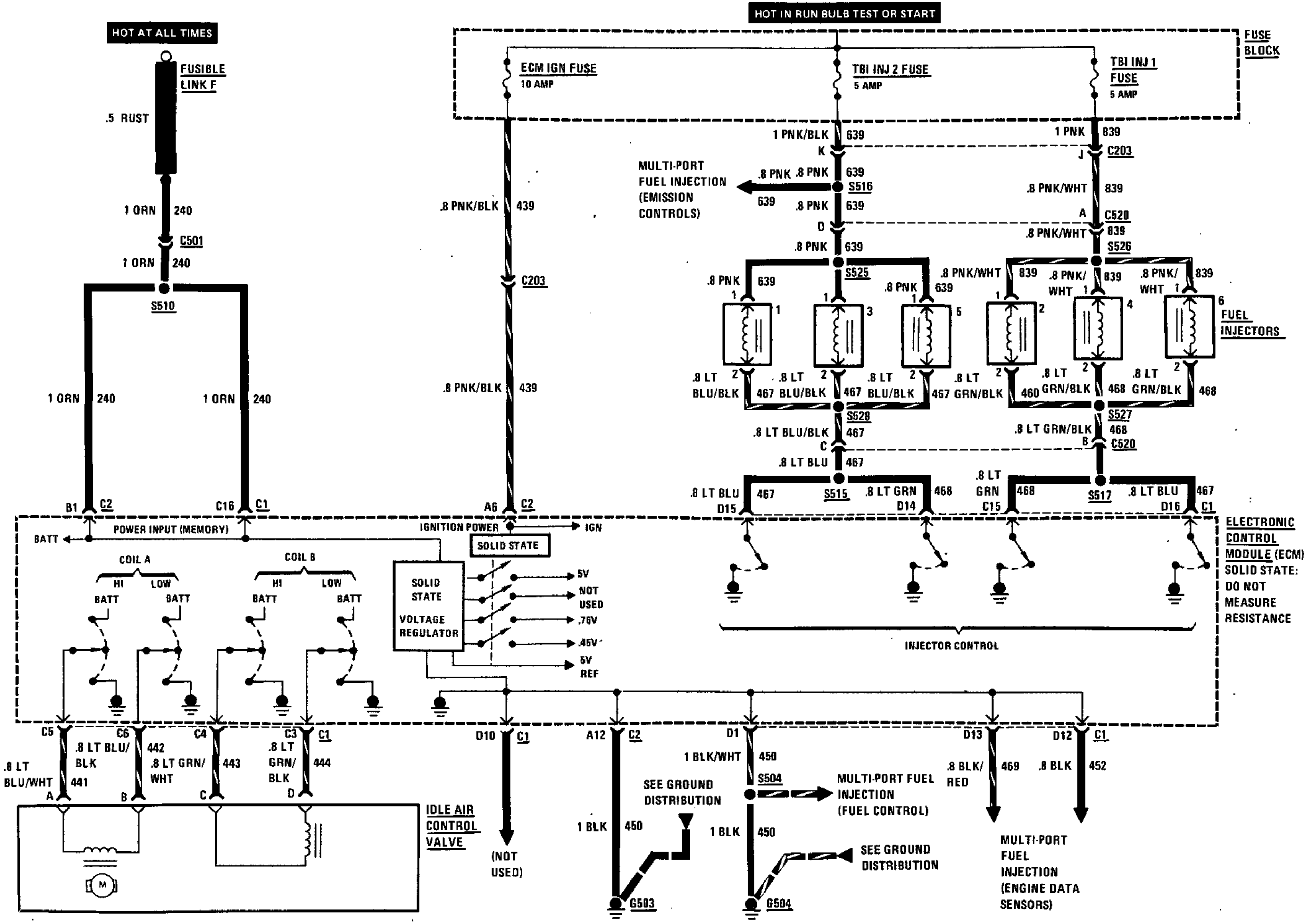
MULTI-PORT FUEL INJECTION (V6 VIN 9)

ENGINE DATA SENSORS, TORQUE CONVERTER CLUTCH, AND START



MULTI-PORT FUEL INJECTION (V6 VIN 9)

FUEL INJECTORS



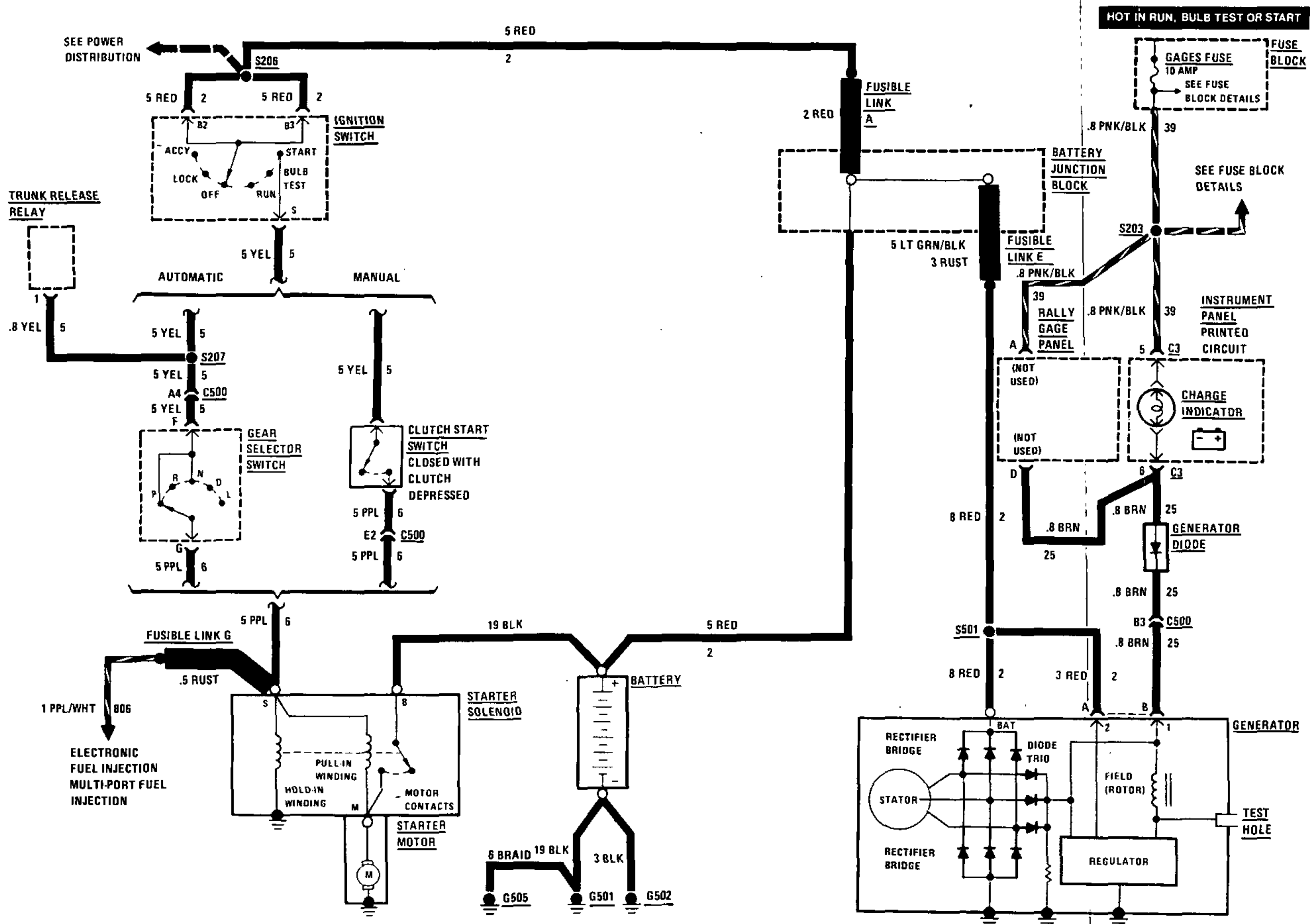
COMPONENT LOCATION

		Page-Figure
ALCL Connector	In console, near lights	201- 6-A
Brake Switch	Top of brake pedal support	201- 8-A
Cold Start Injector	Top of engine, on throttle body	
Cold Start Switch	Top RH side of engine	
Coolant Temperature Sensor	Top RH of engine	
Electronic Control Module	Between seats, on rear bulkhead	201- 6-A
Electronic Spark Timing (EST) Distributor	Rear of engine	201- 2-A
Electronic Vacuum Regulator Valve (EVRV)	RH front of engine	
Fuel Injectors	Top of engine, at each intake port	
Fuel Pump Relay	On rear bulkhead, left of center	201- 9-C
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link F	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link G	LH front of engine, at starter solenoid	201- 1-C
Fusible Link H (VIN 9)	Above starter solenoid	
Gear Selector Switch	Left of engine, top of transaxle	201- 1-B
Idle Air Control Valve	RH front of engine	
Ignition Coil	LH rear of engine	201- 2-A
Ignition Coil (VIN 9)	Top of engine, near distributor	
Ignition Switch	At base of steering column	201- 5-A
Manifold Absolute Pressure Sensor	On RH side of air cleaner	201- 2-A
Manifold Air Temperature Sensor	Top of engine	201- 3-B
Oil Pressure Switch	Rear of engine, center of engine block	201- 2-A
Oxygen Sensor	LH rear of engine	201- 5-A
Speed Sensor	RH end of transaxle	201- 2-A
Starter Solenoid (VIN 9)	Front right side of engine	
Tachometer Filter	Top of engine, near ignition coil	201- 5-A
Throttle Position Sensor	Top of engine, right of throttle body	201- 2-A
Torque Converter Clutch (TCC) Solenoid	LH front of engine	201- 1-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A

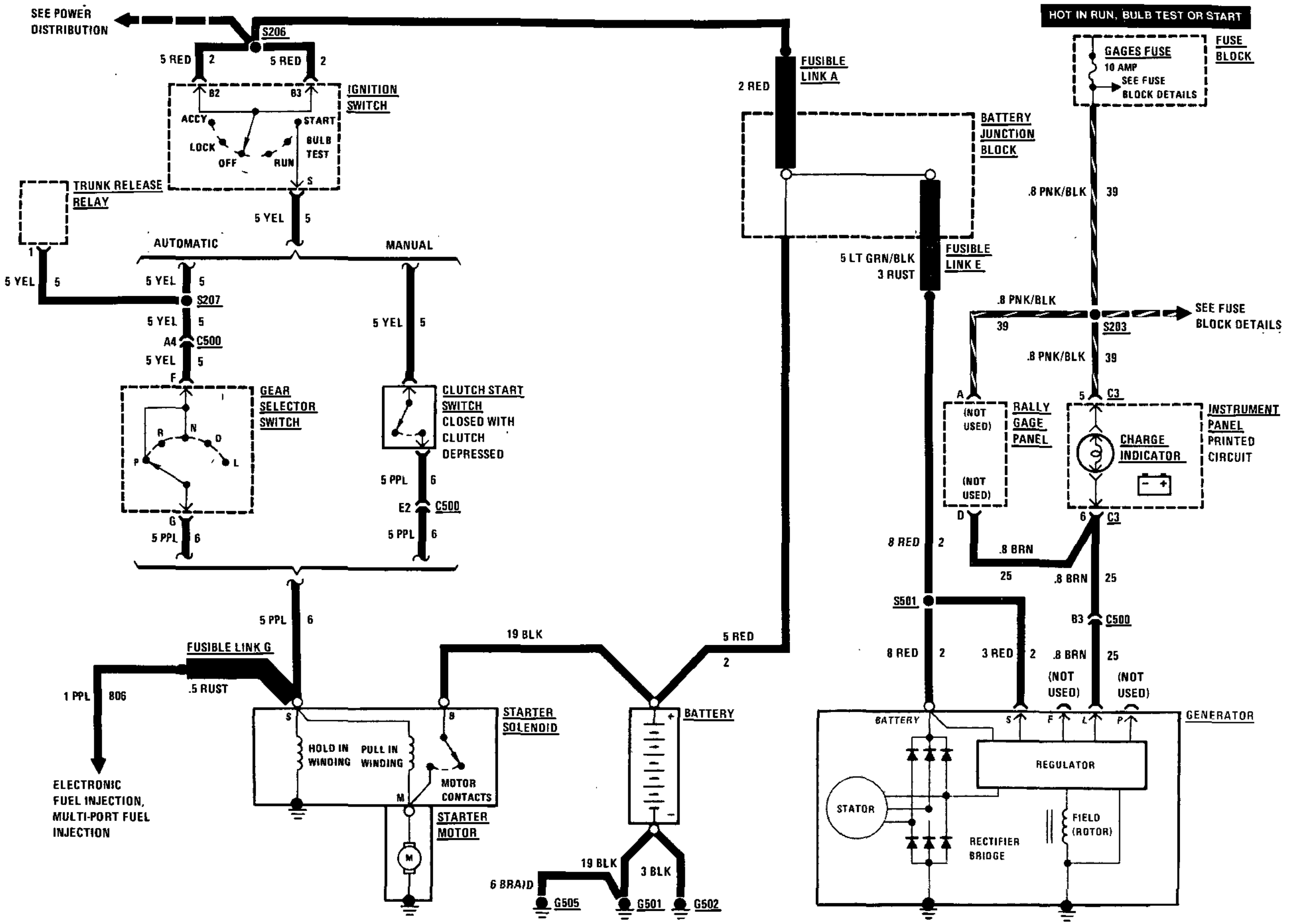
COMPONENT LOCATION

		Page-Figure
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
C501 (1 cavity)	RH side of engine, near battery junction block	
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 3-A
C506 (4 cavities)	Near distributor	201- 2-A
C507 (1 cavity)	Lower front, LH side of engine	201- 1-A
C511 (2 cavities)	Top of engine, near ignition coil	
C520 (6 cavities)	Top RH of engine	
G201	Behind dash, near center	201- 3-D
G202	Between seats, near rear bulkhead	201- 3-C
G503	Center front of engine	
G504 (VIN 9)	Center front of engine	
S201	I/P harness, left of steering column	201- 7-A
S203	Main harness, above steering column	201- 7-A
S212	Main harness, behind center of dash	201- 3-D
S213	Main harness, behind shift lever	201-16-A
S504	MFI harness, in front of rear bulkhead	201- 6-A
S508	MFI harness, front LH of engine compartment	
S509	MFI harness, in front of rear bulkhead	201- 6-A
S510	MFI harness, in front of rear bulkhead	201- 6-A
S511	MFI harness, front LH of engine compartment	
S513 (VIN 9)	Engine harness, rear of engine	
S514 (VIN 9)	Engine harness, rear of engine	201- 6-A
S515	Engine harness, near the ECM	201- 6-A
S516	Engine harness, between seats in front of bulkhead	201- 6-A
S517	Engine harness, near the ECM	201- 6-A
S519	Engine harness, near starter	
S521	Engine harness, center of rear bulkhead	201-10-B
S525	Injector harness, top of engine	
S526	Injector harness, top of engine	
S527	Injector harness, top of engine	
S528	Injector harness, top of engine	
S529	Main I/P harness, center console, near ALCL connector	201- 6-A

STARTER AND CHARGING SYSTEM (V6 VIN 9)



STARTER AND CHARGING SYSTEM (L4 VIN R)



STARTER AND CHARGING SYSTEM

TROUBLESHOOTING HINTS

STARTER

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 Starter Solenoid terminals S and B and Battery connections are clean and tight.
3. Check that grounds G501, G502, and G505 are clean and tight.

TROUBLESHOOTING HINTS

CHARGING SYSTEM

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 for proper tension and glazing. Replace the belt if it is worn.
3. Check that the Starter Solenoid, terminal B, and Battery connections are clean and tight.
4. Check the vehicle voltmeter (if equipped) to assure accurate voltage readings.

COMPONENT LOCATION

		Page-Figure
Battery Junction Block (VIN 9)	RH front of engine compartment, near battery	201- 0-B
Battery Junction Block (VIN R)	RH front of engine compartment, near battery	201- 0-A
Clutch Start Switch	Upper portion of clutch pedal	201- 8-A
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link E	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link G	LH front of engine, at starter solenoid	201- 1-C
Gear Selector Switch	Left of engine, top of transaxle	201- 1-B
Generator	Rear RH side of engine	201- 2-A
Generator Diode	In main harness, below rear bulkhead grommet	
Ground Strap	LH front corner of engine compartment	201- 2-C
Ignition Switch	At base of steering column	201- 5-A
Starter Solenoid (VIN 9)	Front right side of engine	
Starter Solenoid (VIN R)	Lower front LH side of engine	201- 1-A
Trunk Release Relay	Behind I/P, near A/C control head	
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G501 (VIN 9)	RH front of engine, near dipstick	201- 0-E
G501 (VIN R)	RH side of engine, below oil fill cap	201- 0-D
G502	RH rear fender, on battery tray	201- 0-C
G505	On trunk lid RH hinge brace	201- 2-B
S203	Main harness, above steering column	201- 7-A
S206	Main harness, above LH side of steering column	201- 5-A
S207	Main harness, left of steering column	201- 5-A
S501	Engine harness, under intake manifold	201- 2-A

SYSTEM DIAGNOSIS

STARTER (L4 VIN R)

ENGINE DOES NOT CRANK AND THE STARTER SOLENOID DOES NOT CLICK

1. Connect a test lamp to the Starter Solenoid terminal with the PPL (6) wire and ground. Turn the Ignition Switch to START.
   - If the test lamp does not light, go to the next step.
   - If the test lamp lights, replace the Starter Solenoid.
2. Automatic Transaxle: Remove the Gear Selector Switch connector and connect terminals F and G in the connector together with a fused jumper.

STARTER AND CHARGING SYSTEM

3. Manual Transaxle: Remove the Clutch Start Switch connector and connect terminals A and B in the connector together with a fused jumper.

4. Turn the Ignition Switch to START.

- If the engine does not crank, go to the next step.
- If the engine cranks, replace the Gear Selector Switch (Automatic Transaxle) or the Clutch Start Switch (Manual Transaxle).

NOTE: With Automatic Transaxle, check the Gear Selector Switch for adjustment before replacing the switch.

ENGINE DOES NOT CRANK OR ENGINE CRANKS SLOWLY, BUT THE STARTER SOLENOID CLICKS

1. Remove the ECM IGN Fuse to prevent the engine from starting and measure the voltage at the Battery terminals while cranking.

- If the voltage is less than 9.6 volts, see Section 6D for Battery Load Test. Repair the Starter Motor if the Battery is good.
- If the voltage is 9.6 volts or more, go to the next step.

2. Measure voltage drop while cranking between the positive Battery post and terminal B of the Starter Solenoid. Also measure the voltage drop between the negative Battery post and the engine block.

- If either one is more than .5 volts, check connections. Replace the Battery cables if necessary.
- If both are less than .5 volts, replace the Starter Solenoid.

SYSTEM DIAGNOSIS

STARTER (V6 VIN 9)

(The car's Battery must be in a charged state before continuing with the System Diagnosis)

CHARGE INDICATOR LAMP LIGHTS WHEN ENGINE IS RUNNING

1. Disconnect the Generator connector, place the Ignition Switch in RUN and stop the engine.

- If Charge Indicator Lamp does not light, go to the next step.
- *If Charge Indicator Lamp lights,* check BRN 25 (wire) for a ground.

2. With Generator connector disconnected, check with a test lamp from terminal A (RED) to ground.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, check the RED (2) wire for an open.

3. With the Generator connector disconnected, jumper terminal A (RED) to B (BRN). *Ignition Switch is in OFF.*

- If the Charge Indicator Lamp does not light, see "Battery does not change or is overcharged" Symptom.
- If the Charge Indicator Lamp lights, replace the Generator Diode.

Note: Lamp will not light at full brilliance.

CHARGE INDICATOR LAMP DOES NOT LIGHT WHEN ENGINE IS STOPPED

Disconnect the Generator connector and connect terminal B (BRN) to ground with a jumper.

- If the Charge Indicator Lamp does not light, check the BRN (25) wire for an open, check the Generator Diode, and check the Charge Indicator Lamp.
- If the Charge Indicator Lamp lights, go to the next Symptom, Step 5.

BATTERY DOES NOT CHARGE OR IS OVERCHARGED

1. If Charge Indicator Lamp does not light at all, see "Charge Indicator Lamp does not light when engine is stopped" Symptom before proceeding.

2. Check with a test lamp from BAT terminal to ground, Ignition Switch in RUN, engine stopped.

- If test lamp lights, go to next step.
- If test lamp does not light, check RED (2) wire, its connector and Fusible Link E.

3. Check with a test lamp from Generator connector terminal A (RED) (disconnected) to ground. Ignition Switch in RUN, engine stopped.

- If test lamp lights, go to the next step.

- If test lamp does not light, check the RED (2) wire from Splice S501.

4. Start engine and run at a fast idle. Measure voltage at BAT terminal with a Digital Voltmeter.

  - If voltage is not between 13.0 and 16.0 volts, go to the next step.
  - If voltage is within the range of 13.0 and 16.0 volts, perform a Generator load test using the Sun VAT 40 or equivalent. If Generator is OK, test the Battery under load (see Section 6D).

5. With the Ignition Switch in RUN, insert a screwdriver tip into the test hole. Make contact with both the bottom and side of the hole.

  - If the Charge Indicator Lamp lights, remove the Generator and check the Regulator.
  - If the Charge Indicator Lamp does not light, remove the Generator and check the brushes and rotor.

SYSTEM DIAGNOSIS

CHARGING SYSTEM (L4 VIN R)

CHARGE INDICATORS REMAIN ON AFTER THE ENGINE HAS BEEN STARTED

1. Remove the Generator connector and turn the Ignition Switch to RUN.

  - If the Charge Indicator lights, check BRN (25) wire for short to ground. Repair as necessary.
  - If the Charge Indicator does not light, replace the Generator.

CHARGE INDICATOR DOES NOT LIGHT WITH THE INGNITION SWITCH IN RUN

(Engine not running.)

1. Remove Generator connector and check for voltage to ground at terminal S (RED).

  - If Battery voltage is present, go to the next step.
  - If Battery voltage is not present, repair RED (2) wire.

2. Remove the Generator connector and connect terminal L of the connector to ground with a fused jumper. Turn the Ignition Switch to RUN.

  - If the Charge Indicator lights, replace the Generator.
  - If the Charge Indicator does not light, go to next step.

3. Check BRN (25) wire and Instrument Panel connector C3 for an open.

  - If circuit is open, repair circuit.
  - If the circuit is good, replace the Charge Indicator bulb. (Refer to Instrument Panel 80-0 or 82-0.)

BATTERY IS OVERCHARGED (Battery voltage greater than 16 volts.)

1. Replace the Generator and go to "Charge Indicator does not light with the Ignition Switch in RUN" Symptom for no indication of fault.

BATTERY IS UNDERCHARGED (Battery voltage less than 13 volts with the engine at fast idle.)

1. Check BRN wire (25), splice 501 and Fusible link E, then test the output of the Generator using a load and ohmmeter, such as the Sun VAT 40 or equivalent.

  - If the Generator output is within 15 amps of the rated current stamped on the frame, check the Battery and RED (2) wire. Replace if necessary.
  - If the output is not within 15 amps of its rated current, replace the Generator and go to "Charge Indicator does not light with the Ignition Switch in RUN" Symptom for no indication of fault.

CIRCUIT OPERATION

STARTER

With the Ignition Switch moved to the START position, Battery voltage is applied through the Gear Selector Switch or the Clutch Start Switch to the Starter Solenoid. Both the Pull-In and Hold-In Windings are energized. They pull a plunger into their core. The plunger is attached to the Shift Lever, which drives a small pinion gear in the Drive Mechanism to engage the flywheel gear on the engine. The pinion also starts turning, since the Pull-In Winding circuit passes through the Starter Motor. The turning gear meshes smoothly with the flywheel.

The plunger in the solenoid windings also closes the Motor Contacts. These switch contacts connect the Battery voltage directly to the Starter Motor. The motor cranks the engine.

As soon as the Motor Contacts close, Battery voltage is applied to both ends of the Pull-In Winding. Current no longer flows through the winding. The Hold-In Winding remains energized. Its magnetic field is strong enough to hold the Shift Lever, Drive Mechanism, and Motor 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 the current flow through the Pull-In Winding is now opposite to the direction current flowed when the winding was first energized. The magnetic fields of the Pull-In and Hold-In Windings now oppose one another. This helps to quickly release the spring loaded Drive Mechanism and disengage the Starter. As soon as the Motor Contacts open, the entire circuit is turned off.

CIRCUIT OPERATION

CHARGING SYSTEM (L4 VIN R)

The Generator supplies DC voltage to operate the vehicle's electrical systems and to charge its Battery. The output of the Generator is controlled by the built-in digital Regulator.

The digital Regulator directly controls the field with a Pulse Width Modulated (PWM) signal, which is valved in duty cycles. When the Ignition Switch is first turned to RUN, before the engine is started, voltage is applied to the Regulator through the Charge Indicator bulb. The Regulator. which is in a field strobe function, applies a small percentage of duty cycle to the field windings to produce a magnetic field. As the Generator RPM increases, the field strobe function is disabled and normal regulation occurs.

AC voltage is generated in three stator windings in the Generator. This is changed to DC voltage by the Rectifier Bridges. This DC output is applied to the Battery and the vehicle's circuits at the BAT terminal of the Generator. The BAT terminal also supplies voltage to the Regulator for field voltage and voltage monitoring.

The Regulator can detect a fault within the Generator and ground the Charge Indicator light through a lamp driver. The indicator will light in full brilliance when there is an under or over voltage condition, a broken drive belt, an open or shorted field circuit, or an open Regulator.

CIRCUIT OPERATION

CHARGING SYSTEM (V6 VIN 9)

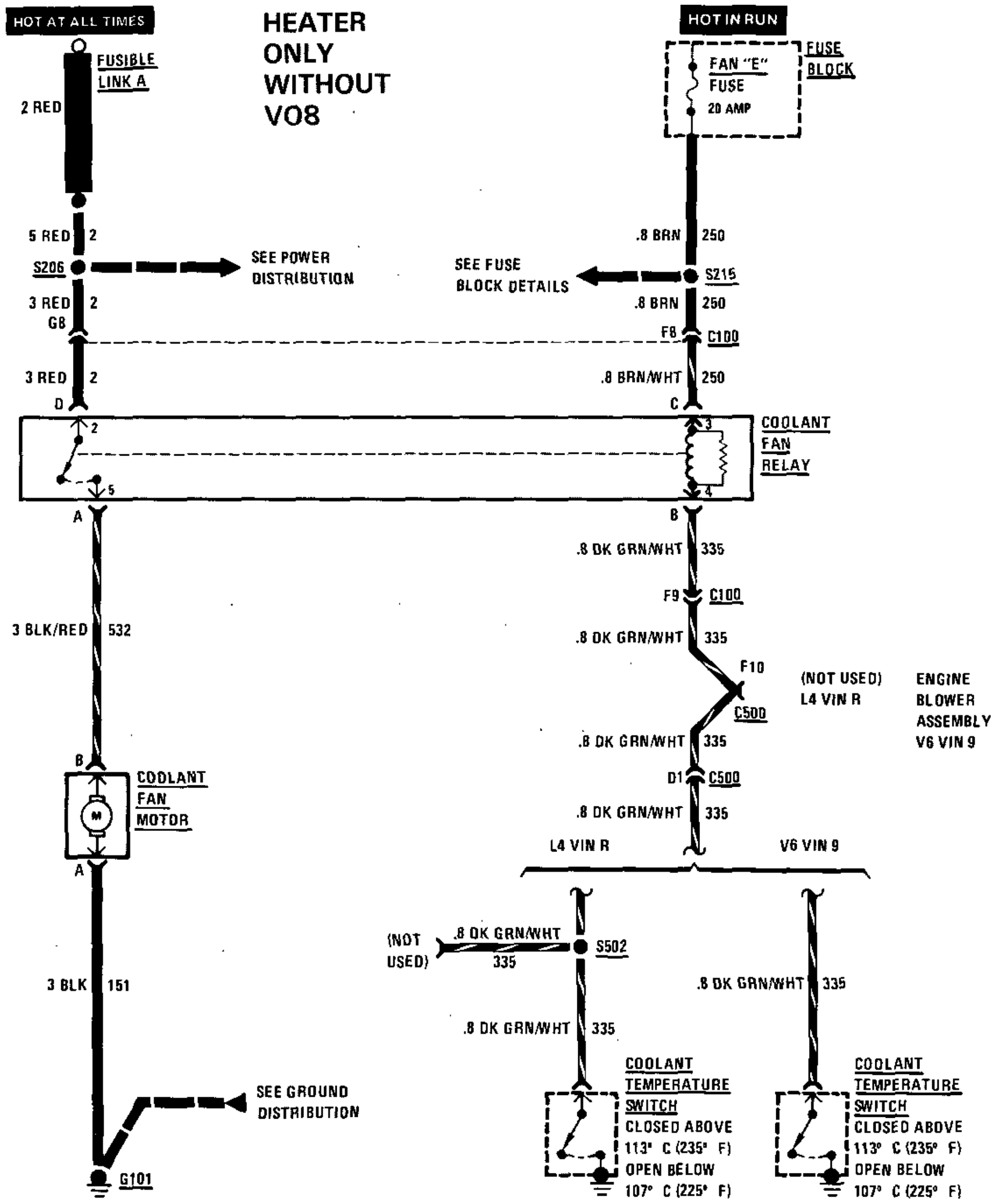
The Generator provides voltage to operate the car's electrical system and to charge its Battery. A magnetic field is created when current flows through the Rotor. This field rotates as the Rotor is driven by the engine creating an AC voltage in the Starter windings. The AC voltage is converted to DC by the Rectifier Bridges and is supplied to the electrical system at the BAT terminal.

When the Ignition Switch is placed in RUN before the engine starts, a small current is supplied to the Rotor at terminal 1 of the Generator. This current flows from the Gages Fuse through the Volts Indicator and Diode, lighting the lamps.

Once the engine is started, a DC voltage is supplied to the Regulator after being rectified by the lower half of the Rectifier Bridge and the Diode trio. This voltage supplies the Regulator which controls the current through the Rotor and therefore the output voltage of the Generator. The voltage is regulated to properly charge the Battery and operate the electrical system. The Volts Indicator lamp will go out as the voltage at Generator terminal 1 approaches Battery voltage, stopping current flow through the lamp.

COOLANT FAN

SINGLE SPEED (L4 VIN R, V6 VIN 9)



COOLANT FAN

SINGLE SPEED (L4 VIN R, V6 VIN 9) (HEATER ONLY WITHOUT V08)

SYSTEM CHECK

1. If equipped with air conditioning, let the engine run at low idle, and move the A/C Function Selector to NORM.
   - — Coolant Fan turns on.
2. With the engine warmed up, run it at a fast idle for several minutes.
   - — Coolant Fan turns on before the Coolant Temperature Indicator in the Instrument Panel comes on.
3. If equipped with heavy duty cooling fans:
   - — The fan(s) will run at a higher speed if the engine is allowed to reach a higher temperature.

TROUBLESHOOTING HINTS

1. Check the FAN E Fuse with a fuse tester.
2. Check Fusible Link A.
3. Check that ground G101 is clean and tight.
4. *If the Coolant Fan runs with the Ignition* Switch OFF, check the Coolant Fan Relay for stuck contacts.

SYSTEM DIAGNOSIS

COOLANT FAN DOES NOT RUN

1. Disconnect the DK GRN/WHT (335) wire from the Coolant Temperature Switch. Jumper the terminal on this wire to ground.
   - If the Coolant Fan does not run, go to the next step.
   - If the Coolant Fan runs, check the DK GRN/WHT (335) wire for an open and then replace the Coolant Temperature Switch.

2. Disconnect the Coolant Fan Relay and connect a test lamp between terminal C of the connector and ground.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check C100 for a loose connection. Also check the BRN/WHT (250) wire for an open.

3. Connect test lamp between terminal C (BRN/WHT) and terminal B (DK GRN/WHT) with jumper from Step 1 in place.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the DK GRN/WHT (335) wire for open.

4. Move the lead of the test lamp from terminal C to terminal D of the connector with jumper from Step 1 in place.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the RED (2) wire and Fusible Link A for an open.

5. Disconnect the Coolant Fan Relay and connect a fused jumper between terminals A and D of the connector.
   - If the Coolant Fan does not run, go to the next step.
   - If the Coolant Fan runs, replace the Coolant Fan Relay.

COMPONENT LOCATION

		Page-Figure
Coolant Fan Relay	LH front corner of front compartment	201- 9-C
Coolant Temperature Switch (VIN 9)	LH front of engine, above water pump	
Coolant Temperature Switch (VIN R)	Front of engine, LH side of cylinder head	201- 1-A
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block	201- 3-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C500 (*34 cavities*)	Engine compartment, near battery	201- 3-A
G101	On LH fender, below headlamp	201-11-A
S206	Main harness, above LH side of steering column	201- 5-A
S215	Main I/P harness, behind I/P, RH of steering column	201-16-A
S502	Engine harness, LH end of engine	

COOLANT FAN

SINGLE SPEED (L4 VIN R, V6 VIN 9) (HEATER ONLY WITHOUT VO8)

6. With the fused jumper still in place, remove the Coolant Fan Motor connector and connect a test lamp to terminal B of the connector and ground.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the BLK/RED (532) wire for an open. Repair as necessary.
7. Move the test lamp ground lead to terminal A of the Coolant Fan Motor connector.
   - If the test lamp lights, replace the Coolant Fan Motor.
   - If the test lamp does not light, check the BLK (151) wire for an open. Repair as necessary.

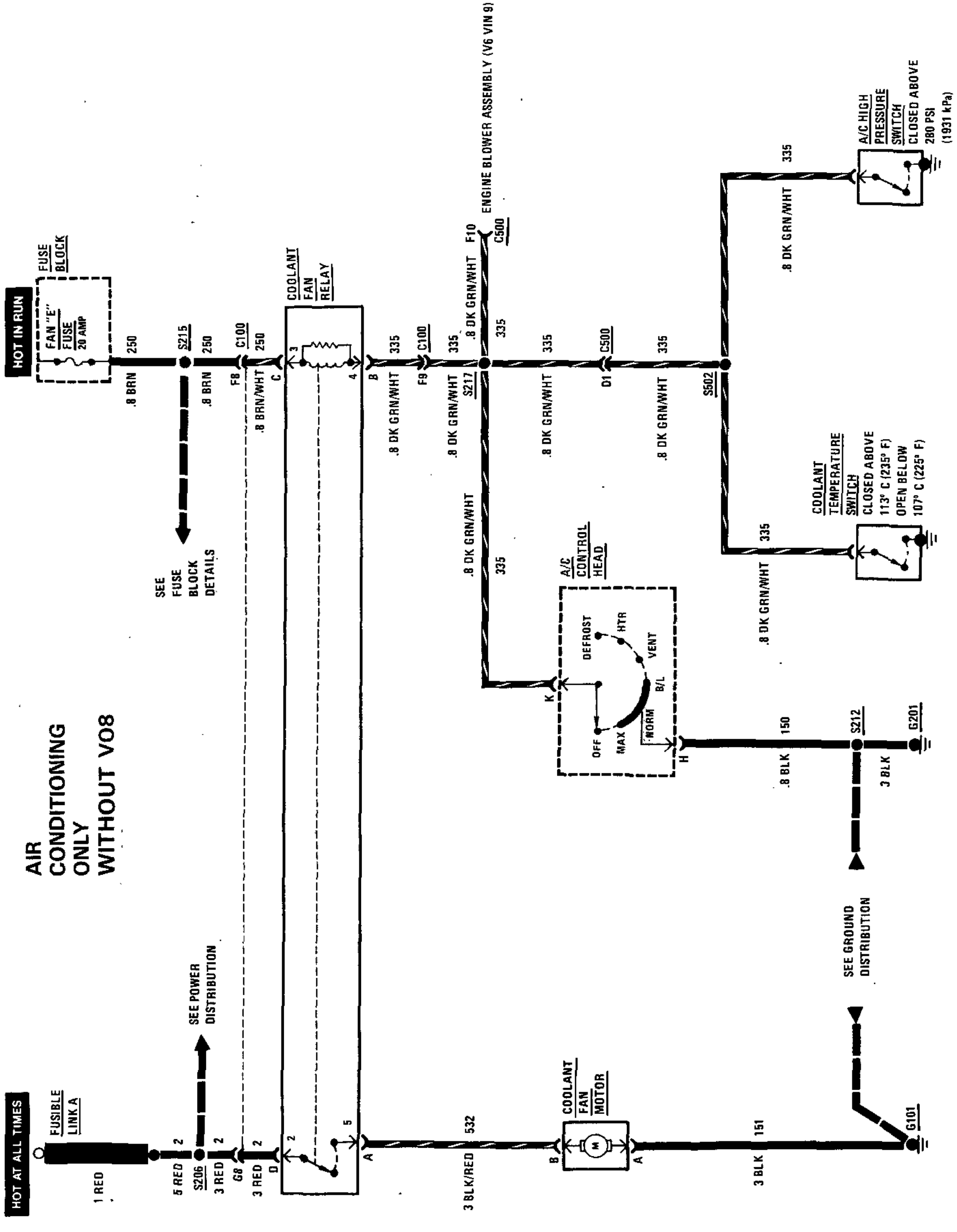
CIRCUIT OPERATION

The Coolant Fan is operated by the Coolant Fan Relay. Voltage is available at all times through Fusible Link A to the relay contacts. With the Ignition Switch in RUN, voltage is available through the FAN E Fuse to the relay coil.

When the coolant temperature exceeds 235 °F (113 °C), the Coolant Temperature Switch closes. This completes a current path to ground. Current flows through Fusible Link A, the closed relay contacts, and the Coolant Fan to ground.

COOLANT FAN

SINGLE SPEED (V6 VIN 9)



COOLANT FAN

SINGLE SPEED (V6 VIN 9) (A/C ONLY WITHOUT V08)

SYSTEM CHECK

For System Check see Coolant Fan Single Speed (L4 VIN R, V6 VIN 9) (Heater only without V08).

TROUBLESHOOTING HINTS

1. Check the FAN E Fuse with a Fuse Tester.
2. Check Fusible Link A.
3. Check that grounds G101 and G201 are clean and tight.
4. If the Coolant Fan runs when the Ignition Switch is OFF, replace the Coolant Fan Relay.

SYSTEM DIAGNOSIS

COOLANT FAN DOES NOT RUN WHEN ENGINE IS HOT, DOES RUN WHEN A/C IS ON

With the Air Conditioning off and the Ignition Switch in RUN, remove the connector from the Coolant Temperature Switch and connect it to ground with a jumper.

- If the Coolant Fan does not run, see "Coolant Fan does not run at all" symptom.
- If the Coolant Fan runs, replace the Coolant Temperature Switch.

COOLANT FAN DOES NOT RUN WHEN A/C IS ON, DOES RUN WHEN ENGINE IS HOT. COMPRESSOR CLUTCH CAN BE ENGAGED

With the Air Conditioning Mode Switch in NORM, the Ignition Switch in RUN, and the engine cool, connect a jumper between terminals H and K of the Air Conditioning Mode Switch connector.

- If the Coolant Fan does not run, see "Coolant Fan does not run at all" symptom.
- If the Coolant Fan runs, replace the A/C Control Head.

COMPONENT LOCATION

		Page-Figure
A/C High Pressure Switch	Engine compartment, LH end of A/C compressor.	201- 1-A
Coolant Fan Relay	LH front corner of front compartment.	201- 9-C
Coolant Temperature Switch (VIN 9)	LH front of engine, above water pump	
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block.	201- 3-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder.	201- 9-A
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G101	On LH fender, below headlamp.	201-11-A
G201	Behind dash, near center	201- 3-D
S206	Main harness, above LH side of steering column	201- 5-A
S212	Main harness, behind center of dash	201- 3-D
S215	Main I/P harness, behind I/P, RH of steering column	201-16-A
S217	Main I/P harness, beneath center console, between seats	201- 6-C
S502	Engine harness, LH end of engine	

COOLANT FAN DOES NOT RUN AT ALL

1. Remove the Coolant Fan Relay connector and connect a test lamp between terminal C (BRN/WHT wire) of the connector and ground. Ignition Switch in RUN.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, check C100 for a loose connection. Also check the BRN/WHT (250) wire for an open.

2. Move the lead of the test lamp from terminal C (BRN/WHT wire) to terminal D (RED wire) of the connector.

- If the test lamp does not light, check the RED (2) wire and Fusible Link A for an open.
- If the test lamp lights, go to the next step.

COOLANT FAN

SINGLE SPEED (V6 VIN 9) (A/C ONLY WITHOUT VO8)

3. With the Ignition Switch in RUN, and the A/C Mode Switch in NORM, connect a test lamp between terminal C (BRN/WHT) and B (DK GRN/WHT) of the connector.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the DK GRN/WHT (336) wire for an open.
4. Connect a fused jumper between terminals A (BLK/RED wire) and terminal D (RED wire) of the connector.
   - If the Coolant Fan does not operate, go to the next step.
   - If the Coolant Fan runs, replace the Coolant Fan Relay.
5. With the fused jumper still in place, remove the Coolant Fan Motor connector and connect a test lamp to terminal B (BLK/RED wire) of the connector and ground.
   - If the test lamp does not light, check the BLK/RED (532) wire for an open. Repair as necessary.
   - If the test lamp lights, go to the next step.
6. Move the test lamp ground lead to terminal A of the Coolant Fan connector.
   - If the test lamp lights, replace the Coolant Fan.
   - If the test lamp does not light, check the BLK (150) wire for an open. Repair as necessary.
7. Reconnect the Coolant Fan connector.

COOLANT FAN RUNS CONTINUOUSLY WITH THE IGNITION SWITCH IN RUN, THE ENGINE COOL AND THE AIR CONDITIONING OFF

With the Ignition Switch in RUN, the Air Conditioning OFF, and the engine cool, remove the Coolant Fan Relay connector and connect a test lamp between terminal C (BRN/WHT) and B (DK GRN/WHT).

- If the test lamp does not light, replace the Coolant Fan Relay.
- If the test lamp lights, check the Coolant Temperature Switch and the A/C Mode Switches for stuck contacts and GRN/WHT (335) wire for a short to ground.

CIRCUIT OPERATION

Single Speed

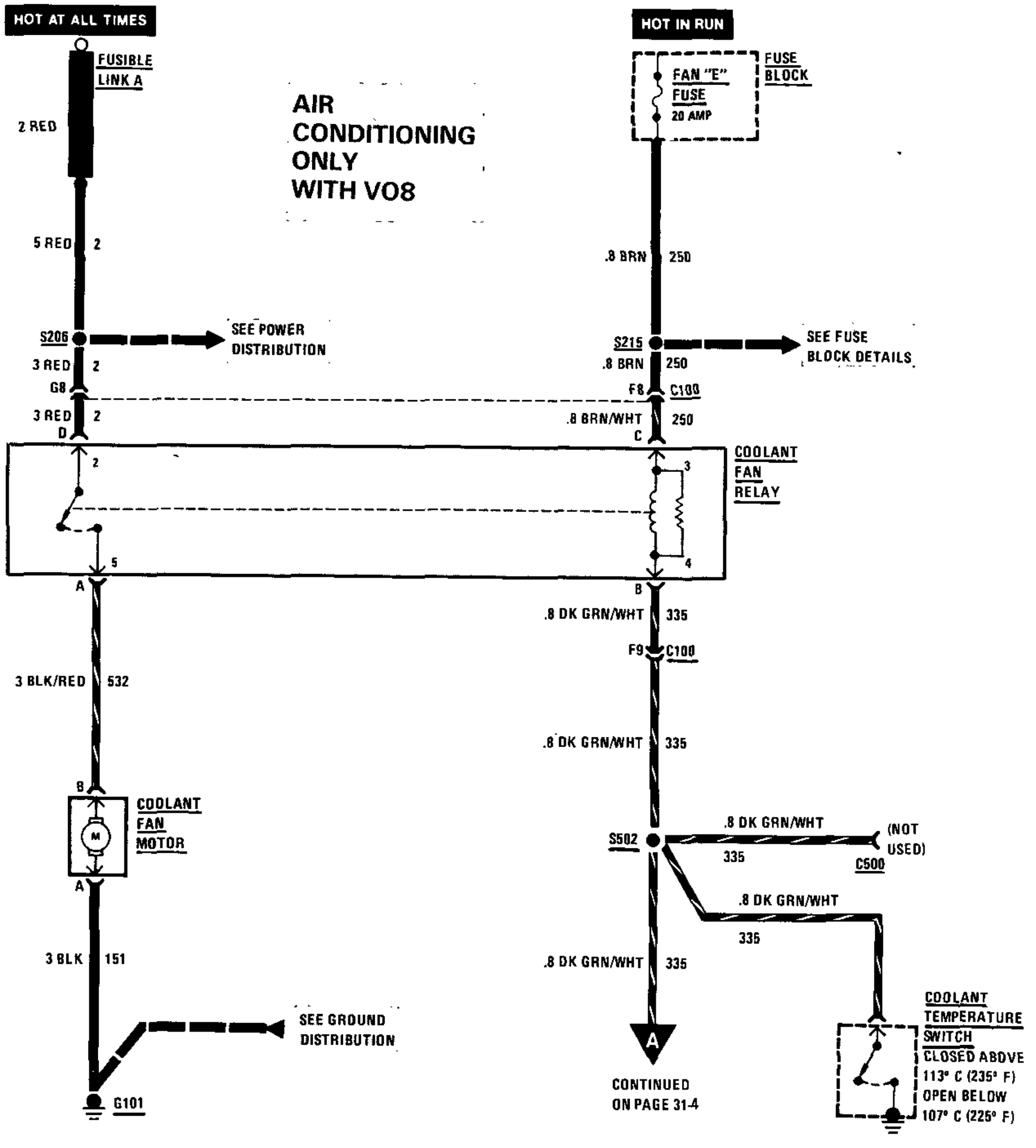
The Coolant Fan is operated by the Coolant Fan Relay. Voltage is available at all times through Fusible Link A to the relay contacts. With the Ignition Switch in RUN voltage is available thorugh the FAN E Fuse to the relay coil.

When the coolant temperature exceeds 235°F (113°C), the Coolant Temperature Switch closes. This completes a current path to ground. Current flows through Fusible Link A, the closed relay contacts, and the Coolant Fan to ground.

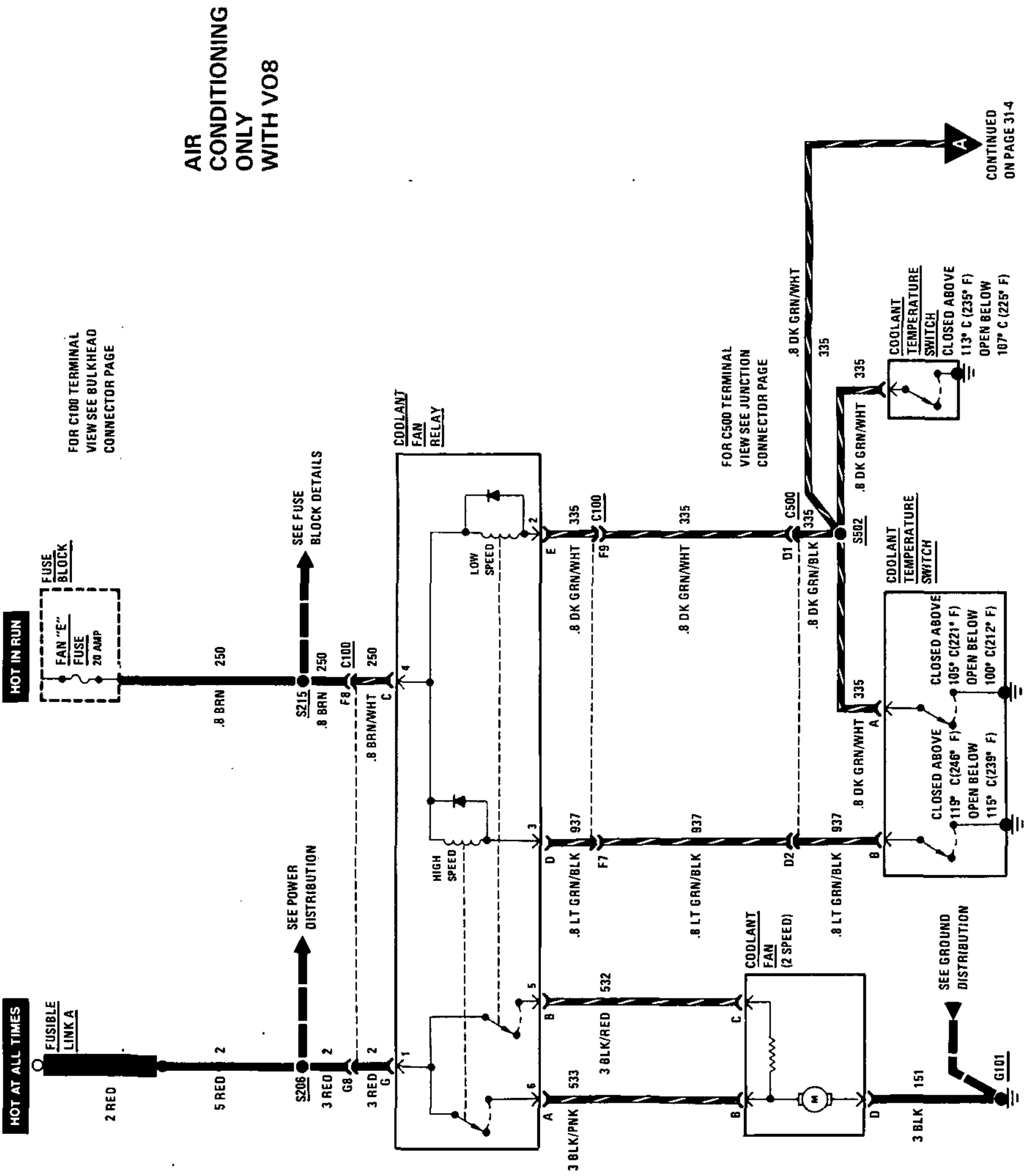
If equipped with air conditioning, with a V6 VIN 9 engine, the relay will also operate when either the A/C High Pressure Switch closed or the A/C Control Head is in MAX, NORM, or BI-LEVEL.

COOLANT FAN

SINGLE SPEED (L4 VIN R)

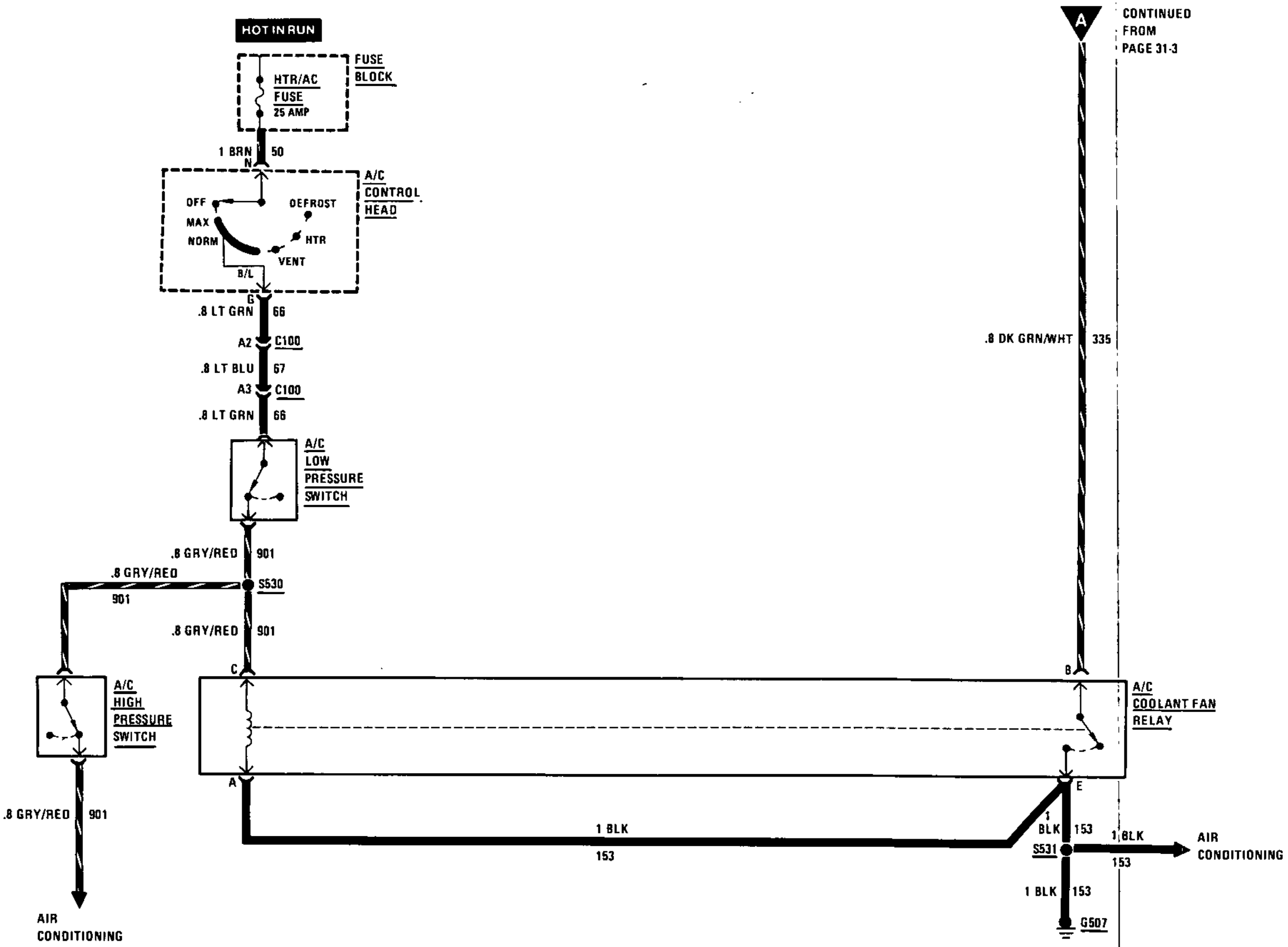


COOLANT FAN
TWO SPEED (L4 VIN R)



COOLANT FAN

TWO SPEED (L4 VIN R)



COOLANT FAN

TWO SPEED — SINGLE SPEED (L4 VIN R) (A/C ONLY WITH V08)

SYSTEM CHECK

For System Check, See Coolant Fan Single *Speed (L4 VIN R, V6 VIN 9) (Heater only without V08).*

TROUBLESHOOTING HINTS

1. Check the FAN E Fuse and HTR/AC Fuse with a fuse tester.
2. Check Fusible Link A.
3. Check C100 for a loose connection.
4. Check that grounds G101 and G507 are clean and tight.
5. If Coolant Fan runs at all times with the Ignition OFF, replace the Coolant Fan Relay.

SYSTEM DIAGNOSIS
SINGLE SPEED (L4 VIN R)

COOLANT FAN DOES NOT RUN WHEN ENGINE IS HOT, DOES RUN WHEN A/C IS ON

With the Air Conditioning off and the Ignition Switch in RUN, remove the connector from the Coolant Temperature Switches and ground the DK GRN/WHT wires.

- If the Coolant Fan does not run, see COOLANT FAN DOES NOT RUN AT ALL.
- If the Coolant Fan does run, replace the necessary Coolant Fan Temperature Switch.

COMPONENT LOCATION

		Page-Figure
A/C High Pressure Switch	Engine compartment, LH end of A/C compressor.	201- 1-A
AC *Low* Pressure Switch	LH front of engine	201- 1-A
Coolant Fan Relay	LH front corner of front compartment.	201- 9-C
Coolant Temperature Switch (VIN R)	Front of engine, LH side of cylinder head	201- 1-A
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block.	201- 3-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G101	On LH fender, below headlamp.	201-11-A
G507	LH front of engine	201-16-B
S206	Main harness, above LH side of steering column	201- 5-A
S215	Main I/P harness, behind I/P, RH of steering column	201-16-A
S502	Engine harness, LH end of engine	
S530	*Engine harness, LH rear of engine*	201- 1-A
S531	Engine harness, LH front of engine	201-16-B

COOLANT FAN RUNS WHEN ENGINE IS HOT, BUT NOT WHEN AIR CONDITIONING IS ON (COMPRESSOR CLUTCH CAN BE ENGAGED)

1. With the Ignition Switch in RUN, and the A/C Mode Switch in NORM, remove the A/C Coolant Fan Relay. Attach a test lamp between terminal C and ground.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the A/C Low Pressure Switch, the A/C Control Head and the related circuit for an open.
2. Connect the test lamp between terminals C (GRY/RED) and A (BLK) of the A/C Coolant Fan Relay.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check BLK (153) wire for an open.
3. Connect a jumper between terminal B (DK GRN/WHT wire) and terminal E (BLK wire) of the A/C Coolant Fan Relay.
   - If the Cooling Fan runs, replace the A/C Coolant Fan Relay.

COOLANT FAN

TWO SPEED - SINGLE SPEED (L4 VIN R) (A/C ONLY WITH V08)

- If the Coolant Fan does not run, see "Coolant Fan does not run at all" symptom.

4. If the test lamp has come on for all the tests, replace the coolant fan relay.

COOLANT FAN DOES NOT RUN AT ALL

1. Remove the connector from the Coolant Temperature Switch and jumper its terminal (DK GRN/WHT) to ground. Remove the Coolant Fan Relay connector and make the following tests.

COOLANT FAN RELAY CONNECTOR (Disconnected) Test Lamp • Ignition Switch: RUN • Coolant Temperature Switch jumpered to ground	
Terminal (Wire Color)	**Test Lamp**
D (RED) to Ground	Lights
D (RED) to B (DK GRN/WHT)	Lights
C (BRN/WHT) to B (DK GRN/WHT)	Lights

- If the test lamp does not light at terminal D (RED wire) to ground, check that circuit for an open.
- If the test lamp does not light between terminal D (RED wire) and terminal B (DK GRN/WHT wire), check C100 for a loose connection. If OK, check the DK GRN/WHT wire for an open.
- If the test lamp does not light between terminal C (BRN/WHT wire) and terminal B (DK GRN/WHT wire), check the DK GRN/WHT wire for an open.

2. Connect a fused jumper from terminal D (RED) to terminal A (BLK/RED).

- If the Coolant Fan runs, replace the Coolant Fan Relay.
- If the Coolant Fan does not run, go to the next step.

3. With the jumper of step 2 still in place, make the following test at the Coolant Fan Motor.

COOLANT FAN MOTOR (Disconnected) Test Lamp • Coolant Fan Relay jumpered D to A	
Terminal (Wire Color)	**Test Lamp**
B (BLK/RED) to Ground	Lights
B (BLK/RED) to A (BLK)	Lights

- If the test lamp lights in both tests, replace the Coolant Fan Motor.
- If the test lamp does not light from terminal B to ground, check the BLK/RED (532) wire for an open.
- If the test lamp does not light from terminal B to terminal A, check the BLK (151) wire for an open.

SYSTEM DIAGNOSIS

TWO SPEED (L4 VIN R)

COOLANT FAN DOES NOT RUN WHEN ENGINE IS HOT, DOES RUN WHEN A/C IS ON

With the Air Conditioning off and the Ignition Switch in RUN, remove the connector from the Coolant Temperature Switch and ground the DK GRN/WHT wires and LT GRN/BLK wire one at a time.

- If the Coolant Fan does not run in either case see "Coolant Fan does not run at all" symptom.
- If the Coolant Fan does run in each case, replace the necessary Coolant Fan Temperature Switch.

COOLANT FAN RUNS WHEN ENGINE IS HOT, BUT NOT WHEN AIR CONDITIONING IS ON. COMPRESSOR CLUTCH CAN BE ENGAGED

1. With the Ignition Switch in RUN and the A/C Mode Switch in NORM, remove the A/C Coolant Fan Relay. Attach a test lamp between terminal C and ground.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, check the A/C Low Pressure Switch, the A/C Control Head and the related circuit for an open.

2. Connect the test lamp between terminals C (GRY/RED) and A (BLK) of the A/C Coolant Fan Relay.

COOLANT FAN

TWO SPEED - SINGLE SPEED (L4 VIN R) (A/C ONLY WITH VO8)

- If the test lamp lights, go to the next step.
- If the test lamp does not light, check BLK (153) wire for an open.

3. Connect a jumper between terminal B (DK GRN/WHT wire) and terminal E (BLK wire) of the A/C Coolant Fan Relay.
   - If the Coolant Fan runs, replace the A/C Coolant Fan Relay.
   - If the Coolant Fan does not run, see "Coolant Fan does not run at all or runs only in high or low speed" symptom.

COOLANT FAN DOES NOT RUN AT ALL, OR RUNS ONLY IN HIGH OR LOW SPEED

1. Remove the connector from the Coolant Temperature Switch and jumper both terminals (LT GRN/BLK) and (DK GRN/WHT) to ground. Remove the Coolant Fan Relay connector and make the following tests.

COOLANT FAN RELAY CONNECTOR
(Disconnected)

Test Lamp
- Ignition Switch: RUN
- Coolant Temperature Switch jumpered to ground

Terminal (Wire Color)	Test Lamp
G (RED) *to Ground*	Lights
G (RED) to D (LT GRN/BLK)	Lights
G (RED) to E (DK GRN/WHT)	Lights
C (BRN/WHT) to D (LT GRN/BLK)	Lights

- If the test lamp lights in all tests, go to the next step.
- If the test lamp does not light from terminal G to ground, check the RED (2) wire.
- If the test lamp does not light from terminal G to terminal D, check the LT GRN/BLK (937) wire.
- If the test lamp does not light from terminal G to terminal E, check the DK GRN/WHT (335) wire.
- If the test lamp does not light from terminal C to terminal D check the BRN/WHT (250) wire.

2. Connect the following jumpers and observe Coolant Fan operation.

COOLANT FAN RELAY CONNECTOR
(Disconnected)

Jumper
- Ignition Switch: RUN

Terminals (Wire Colors)	Fan
G (RED) to A (BLK/PNK)	Runs at High Speed
G (RED) to B (BLK/RED)	Runs at Low Speed

- If the Coolant Fan runs in both cases, replace the Coolant Fan Relay.
- If the Coolant Fan does not run in either or both cases, go to the next step.

3. With both jumpers connected above in place, remove the connector from the Coolant Fan Motor and make the following measurements.

COOLANT FAN CONNECTOR
(Disconnected)

Test Lamp
- **Coolant Fan Relay jumpered A to G and G to B**

Terminals (Wire Colors)	Test Lamp
B (BLK/RED) to Ground	Lights
B (BLK/PNK) to D (BLK)	Lights
C (BLK/RED) to D (BLK)	Lights

COOLANT FAN

TWO SPEED - SINGLE SPEED (L4 VIN R) (A/C ONLY WITH V08)

- If the test lamp lights in both steps, replace the Coolant Fan Motor.
- If the test lamp does not light from terminal B to ground, check BLK/PNK (533) wire for open.
- If the test lamp does not light from terminal B to terminal D, check BLK (151) wire for open.
- If the test lamp does not light from terminal C to terminal D, check BLK/RED (532) wire for open.

CIRCUIT OPERATION

Single Speed

The Coolant Fan is operated by the Coolant Fan Relay. Voltage is available at all times through Fusible Link A to the relay contacts. With the Ignition Switch in RUN, voltage is available through the FAN E Fuse to the relay coil.

When the coolant temperature exceeds 235°F (113°C), the Coolant Temperature Switch closes. This completes a current path to ground. Current flows through Fusible Link A, the closed relay contacts, and the Coolant Fan to ground.

If equipped with air conditioning, with a V6 VIN 9 engine, the relay will also operate when either the A/C High Pressure Switch is closed or the A/C Control Head is in MAX, NORM, or BI-LEVEL.

If equipped with air conditioning, with an L4 VIN R engine, with the Ignition Switch in the RUN position, voltage is applied to the A/C Control Head from the HTR A/C Fuse. With the A/C Control Head in the MAX, NORM, or BI-LEVEL position, voltage is applied to the A/C Low Pressure Switch. Voltage is then applied to the A/C Coolant Fan Relay, closing the contact providing a ground path for the Coolant Fan Relay to operate the Coolant Fan. Ground can be also provided for the Coolant Fan Relay when the Coolant Temperature Switch is closed.

CIRCUIT OPERATION

Two Speed (V08)

Voltage is available at all times through Fusible Link A to the low and high speed contacts of the Coolant Fan Relay. With the Ignition Switch in RUN, voltage is available through the FAN E Fuse to the low and high speed coils of the Coolant Fan Relay.

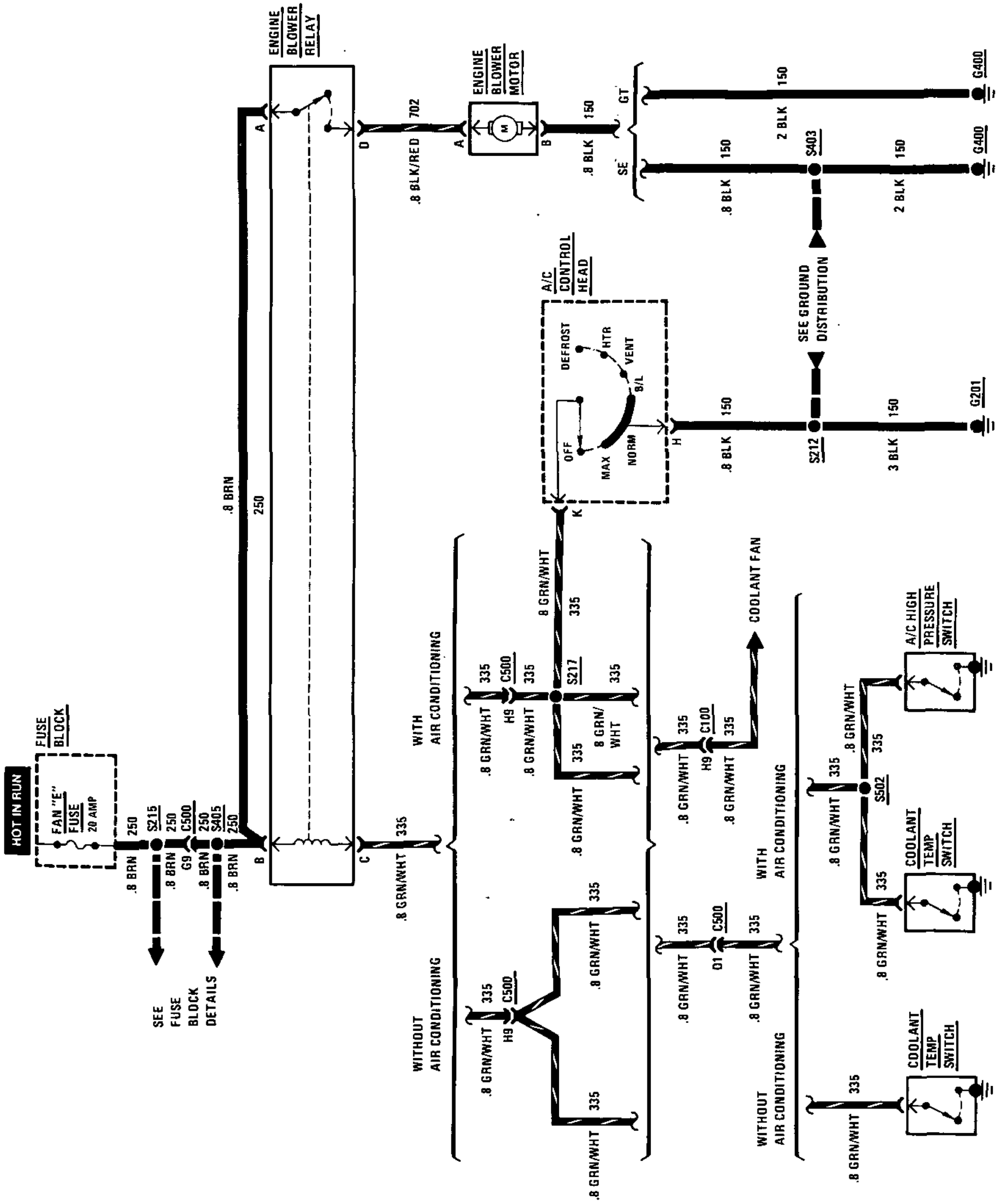
With the A/C Control Head in MAX, NORM, or BI-LEVEL, the A/C High Pressure Switch closed, current flows from the FAN E Fuse through the low speed coil to ground.

The low speed relay contact closes, Current flows through Fusible Link A and the low speed relay contact to terminal C of the Coolant Fan. Voltage is then applied to an internal resistor and the fan motor to ground. The Coolant Fan operates at low speed.

With the high temperature side of the Coolant Temperature Switch closed, current flows from the FAN E Fuse through the high speed coil to ground. The high speed Coolant Fan Relay contact closes. Current flows through Fusible Link A and the high speed Coolant Fan contacts to terminal B of the Coolant Fan. Current then flows directly through the fan motor to ground. The Coolant Fan operates at high speed.

COOLANT FAN

ENGINE BLOWER ASSEMBLY (V6 VIN 9)



COOLANT FAN

ENGINE BLOWER ASSEMBLY (V6 VIN 9)

SYSTEM CHECK

For System Check, See Coolant Fan Single Speed (L4 VIN R, V6 VIN 9).

TROUBLESHOOTING HINTS

1. Check the FAN E Fuse with a fuse tester.
2. Check that grounds G201 and G400 are clean and tight.
3. Check C100 and C500 for loose connections.

SYSTEM DIAGNOSIS

ENGINE BLOWER DOES NOT OPERATE WITHOUT A/C, DOES OPERATE WITH A/C

Disconnect the connector to the Coolant Temperature Switch and attach a jumper between the connector and ground.

- If the Engine Blower runs, replace the Coolant Temperature Switch.
- If the Engine Blower does not run, go to "Engine Blower does not operate at all" symptom.

ENGINE BLOWER DOES NOT OPERATE WHEN ENGINE IS COOL AND A/C IS ON, DOES OPERATE WHEN ENGINE IS HOT. COMPRESSOR CLUTCH CAN BE ENGAGED

1. Connect a jumper between terminal K (GRN/WHT wire) and terminal H (BLK wire) of the A/C Control Head.
   - If the Engine Blower runs, replace the A C Control Head.
   - If the Engine Blower does not run, go to "Engine Blower does not operate at all" symptom.

COMPONENT LOCATION

		Page-Figure
A/C High Pressure Switch	Engine compartment, LH end of A/C compressor.	201- 1-A
Coolant Fan Relay	LH front corner of front compartment.	201- 9-C
Coolant Temperature Switch (VIN 9)	LH front of engine, above water pump	
Coolant Temperature Switch (VIN R)	Front of engine, LH side of cylinder head	201- 1-A
Engine Blower Motor	RH rear of engine	
Engine Blower Relay	RH rear of engine, near battery	
Fuse Block	Behind LH side of I/P	201- 3-E
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G201	Behind dash, near center	201- 3-D
G400	RH rear of engine compartment	
S212	Main harness, behind center of dash	201- 3-D
S215	Main I/P harness, behind I/P, RH of steering column	201-16-A
S217	Main I/P harness, beneath center console, between seats	201- 6-C
S405	Body rear harness, RH rear of car	201-12-A
S502	Engine harness, LH end of engine	

ENGINE BLOWER DOES NOT OPERATE AT ALL

1. Disconnect the Engine Blower Relay. Connect a test lamp between terminal B (BRN) of the Engine Blower Relay and ground. Turn the Ignition Switch to RUN.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check BRN (250) wire.
2. Turn the A/C Mode Switch to NORM. Connect a test lamp between terminals B (BRN) and C (GRN/WHT) of the Engine Blower Relay.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check the GRN/WHT (335) wire for an open. Check the A/C Control Head.
3. Connect a test lamp between terminals A (BRN) and C (GRN/WHT) of the Engine Blower Relay.
   - If the test lamp lights, go to the next step.
   - If the test lamp does not light, check BRN (250) wire for an open.
4. Connect a fused jumper between terminals A (BRN) and D (BLK/RED) of the Engine Blower Relay.

COOLANT FAN

ENGINE BLOWER ASSEMBLY (V6 VIN 9)

- If the Engine Blower Fan does not run, go to the next step.
- If the Engine Blower Fan does run, replace the Engine Blower Fan Relay.

5. Remove the connector from the Engine Blower Motor and connect a test lamp between terminal A (BLK/RED) and ground. The A/C Mode Switch is in NORM.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, check the BLK/RED (702) wire for an open.

6. With the A/C Mode Switch still in NORM, measure the voltage between terminals A and B of the Engine Blower Motor.

- If the lamp lights, replace the Blower Motor.
- If the lamp does not light, check the BLK (150) wire for an open.

ENGINE BLOWER FAN RUNS AT ALL TIMES WITH INGITION SWITCH IN RUN

1. Remove Engine Blower Relay and connect a test lamp from terminal B (BRN) to C (GRN/WHT). The A/C Mode Switch is OFF. Ignition Switch is in RUN.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, replace the Engine Blower Relay.

2. With the test lamp still connected, remove the connector from the Coolant Temperature Switch. The A/C Mode Switch is in OFF. The Ignition Switch is in RUN.

- If the test lamp does not light, replace the Coolant Temperature Switch.
- If the lamp lights, go to the next step.

3. With the test lamp still connected, remove the connector from the A/C Control Head. The Ignition Switch is in RUN, and the Coolant Temperature Switch is still disconnected.

- If the test lamp lights, go to the next step.
- If the test lamp does not light, replace the A/C Control Head.

4. With the test lamp still connected and the Ignition Switch still in RUN and the A/C Control Head and Coolant Temperature Switch still disconnected, remove the connector to the A/C High Pressure Switch.

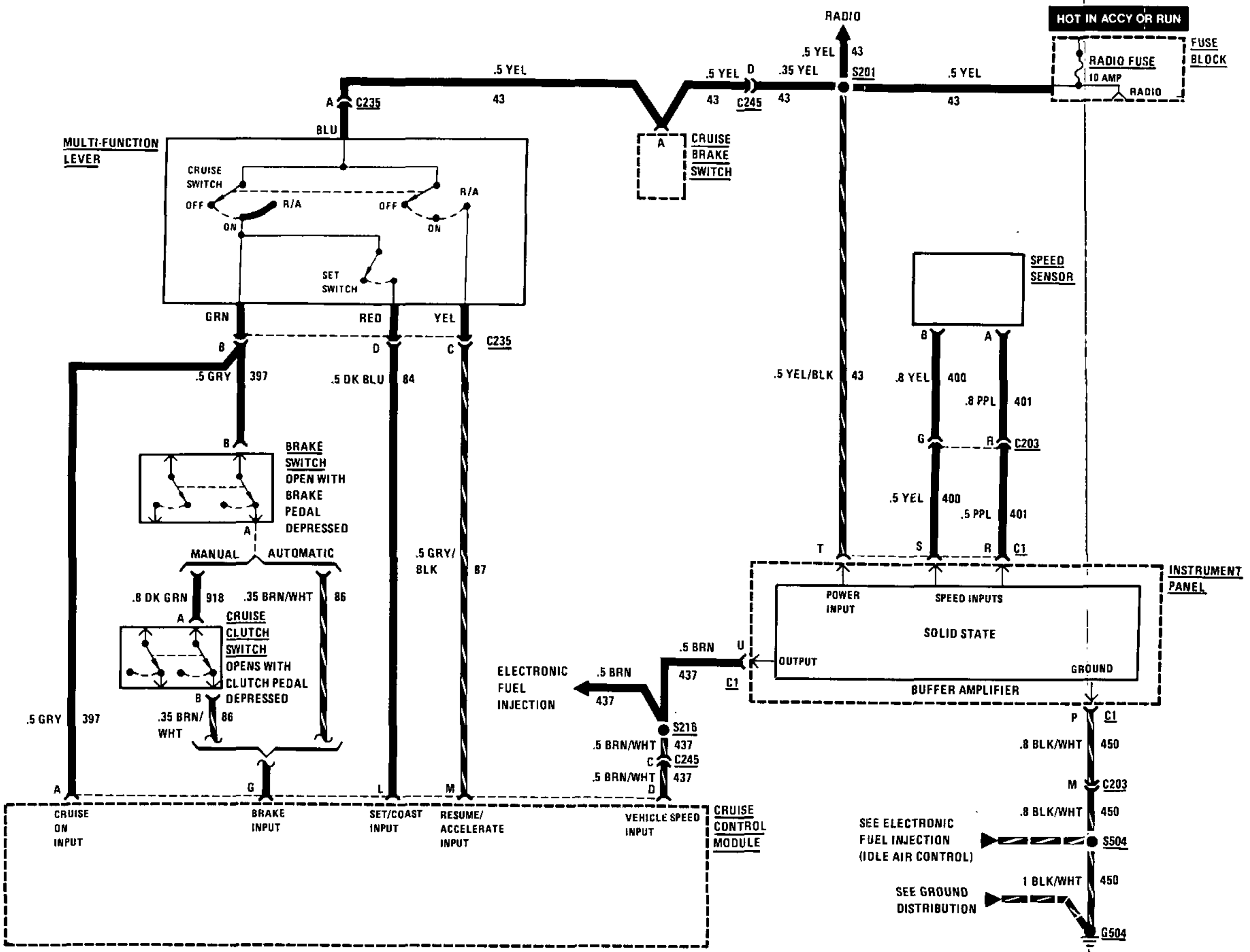
- If the test lamp lights, check the GRN/WHT (335) wire for a ground.
- If the test lamp does not light, replace the A/C High Pressure Switch.

CIRCUIT OPERATION

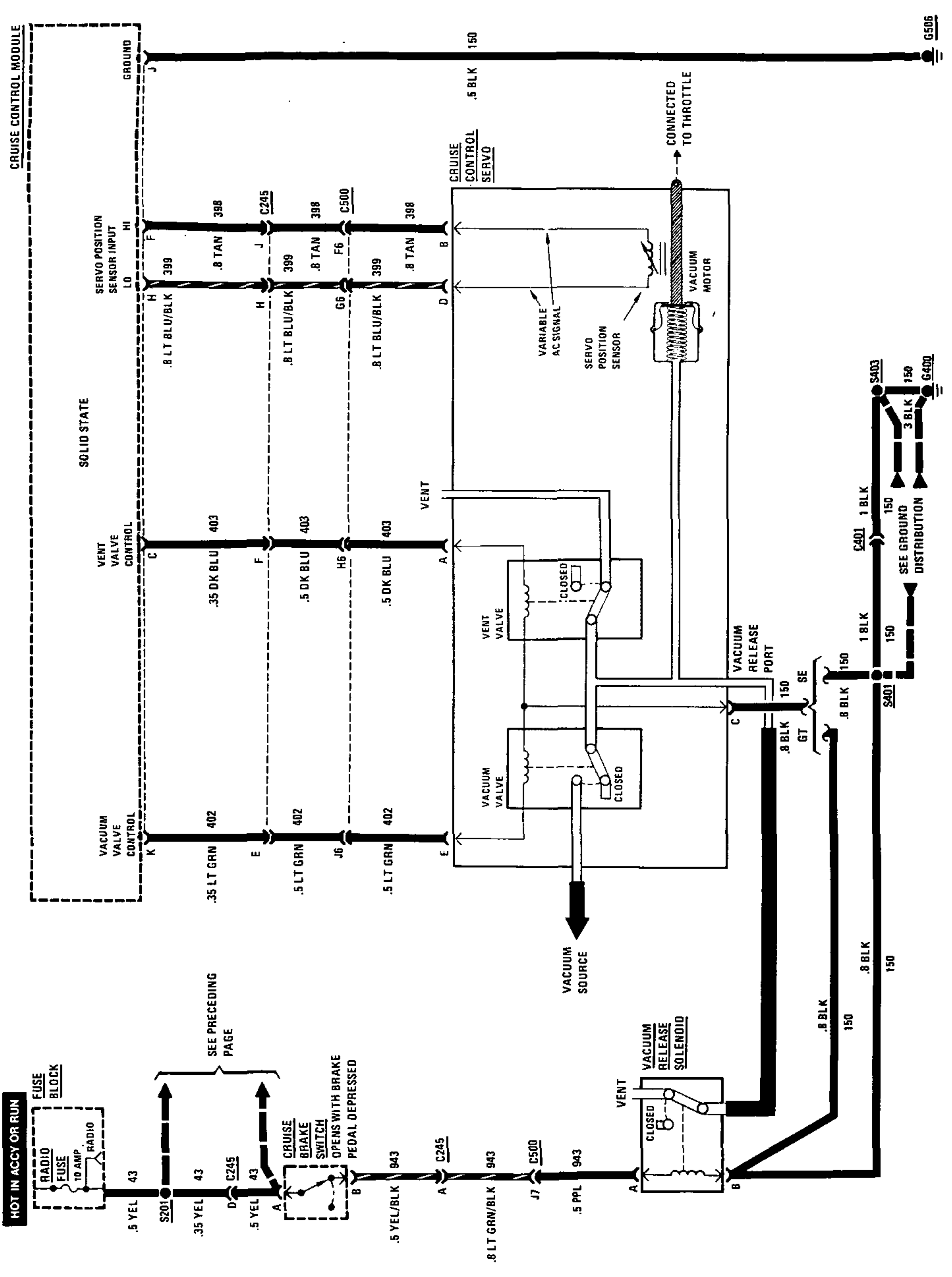
With the Ignition Switch in RUN, voltage is supplied from the FAN E Fuse to the Engine Blower Relay. When engine coolant reaches a temperature of 113 °C (236 °F), the Coolant Temperature Switch closes. This provides a ground to the Engine Blower Relay coil causing its contacts to close and to supply current to the Engine Blower Motor.

If equipped with Air Conditioning, ground can also be supplied to the Engine Blower Relay by the A/C Control Head or by the A/C High Pressure Switch.

CRUISE CONTROL: K34



CRUISE CONTROL (VACUUM)



CRUISE CONTROL

SYSTEM CHECK (Road Test)

Perform the following checks with the Cruise Switch ON and vehicle speed faster than 25 mph:

1. Depress Set button at the end of the Multi-Function Lever.
   - Car should maintain speed.
2. Hold Set button in, foot off accelerator.
   - Car should coast to a slower speed.
3. Release Set button.
   - Cruise Control should engage and hold a slower speed, if the new speed remains above 25 mph.
4. Slide Cruise Switch to R/A and hold it there.
   - Car should accelerate.
5. Release Cruise Switch back to ON.
   - Car should hold new faster speed.
6. Tap brake pedal.
   - Car should coast slower.
7. Slide Cruise Switch momentarily to R/A.
   - Car should accelerate to former set speed.
   - If the car has a manual transmission, repeat steps 6 and 7 by depressing the clutch.
8. While cruising, accelerate, then remove foot from accelerator.
   - Car should coast back to set speed.
9. Slide Cruise Switch to OFF.
   - Cruise Control turns off.

COMPONENT LOCATION

		Page-Figure
Brake Switch	Top of brake pedal support	201- 8-A
Cruise Brake Switch	On brake pedal support	201- 8-A
Cruise Clutch Switch	On clutch pedal support	201- 8-A
Cruise Control Module	Behind carpet support, between seats	201- 8-C
Cruise Control Servo	Engine compartment, near LH shock tower	201- 7-B
Fuse Block	Behind LH side of I/P	201- 3-E
Multi-Function Lever	Top of steering column, LH side	201- 7-C
Speed Sensor	RH end of transaxle	201- 2-A
Vacuum Release Solenoid	Engine compartment, on LH shock tower	201- 7-B
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A
C235 (4 cavities)	Middle of steering column, LH side	201- 7-C
C245 (9 cavities)	Below right steering column support	201- 8-B
C401 (2 cavities)	Taped to rear lights harness, to right of license plate lamps	
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G400	RH rear of engine compartment	
G504	Top front, LH side of engine	201- 1-A
G504 (VIN 9)	Center front of engine	
G506	Below right steering column support	201- 8-B
S201	I/P harness, left of steering column	201- 7-A
S216	Main I/P harness, behind center I/P	201-16-A
S401	Rear lights harness, LH side of back panel	201-12-A
S403	Rear lights harness, RH side of back panel	201-12-A
S504	TBI harness, in front of rear bulkhead	201- 6-A

TROUBLESHOOTING HINTS

1. With the Ignition Switch in RUN, check the Radio Fuse by operating the Radio.
2. Check vacuum hose for leaks, kinks, or restrictions. Also check Cruise Control Servo linkage. Refer to Section 9 for vacuum hose routing and Servo linkage adjustments.
3. Check the resistance between G504 and G506. If it is more than 0.1 ohm, clean and tighten both grounds and the negative Battery cable. In cases where the ground circuit is suspect, add a ground strap between the engine block and the bulkhead.

(Continued on next page)

CRUISE CONTROL

(Continued from previous page)

SYSTEM DIAGNOSIS

Disconnect the Cruise Control Module Connector and perform the tests on the connector as outlined in the Test Table on page 34-3. **The tests are made with either a Cruise Control Quick Checker (J-34185, Specmo QC3, or equivalent), or a Digital Volt-Ohmmeter, but not with both.**

- If the results of a test are not correct, proceed to the repair action for that test.
- If the results of a test are correct, proceed to the next test.

In the process of performing the tests, if any loose or bad connections are found, repair them and check for normal operation of the system.

- If all the tests in the Test Table are good, connect a new Cruise Control Module and check for normal operation.
- If the Cruise Control operates normally, leave the new module in permanently.
- If the Cruise Control still does not operate normally, refer to the AC Custom Cruise 3 Systems Service Manual for further diagnostic procedures.

TESTS AT CRUISE CONTROL MODULE CONNECTOR
(Disconnected)

- Ignition Switch: RUN
- Test with Quick Checker or Digital Meter

Test	Condition	With Quick Checker, Correct Repair Action	Without Quick Checker, Using a Digital Meter			Repair Action
			Meter Range	Connector Terminal	Correct Repair Action	
1	Cruise Switch OFF	All Lights Off	200 VDC	A & J	0 volts	Repair Action A, p. 34-4
			200 VDC	M & J	0 volts	
2	Cruise Switch ON	ON/OFF Light On	200 VDC	A & J	Battery voltage	Repair Action B, p. 34-4
		BRK Light On	200 VDC	G & J	Battery voltage	Repair Action C, p. 34-4
		VENT Light On	200 ohms	C & J	30 to 55 ohms	Repair Action D, p. 34-4
		VAC Light On	200 ohms	K & J	30 to 55 ohms	Repair Action E, p. 34-4
		SPS Light On	200 ohms	F & H	15 to 25 ohms	Repair Action F, p. 34-5
		RA Light Off	200 VDC	M & J	0 volts	Repair Action A, p. 34-4
		SC Light Off	200 VDC	L & J	0 volts	Repair Action A, p.34-4
3	Cruise Switch ON, Set Switch pressed (See Notes 1 and 2)	SC Light On	200 VDC	L & J	Battery voltage	Repair Action G, p. 34-5
		VAC & SHORT Lights Off	200 ohms	K & J	30 to 55 ohms	Repair Action H, p. 34-5
4	Cruise Switch in R/A See Notes 1 and 2)	ON/OFF Light On	200 VDC	A & J	Battery voltage	Repair Action A, p. 34-4
		RA Light On	200 VDC	M & J	Battery voltage	Repair Action I, p. 34-5
		VENT & SHORT Lights Off	200 ohms	C & J	30 to 55 ohms	Repair Action J, p. 34-5

(Continued on next page)

CRUISE CONTROL

(Continued from previous page)

Note 1: Don't press both the Set and the R/A Switches at the same time while the engine is running.

Note 2: If a Short Light comes on, release switches immediately. Shorts can damage the Quick Checker.

TESTS AT CRUISE CONTROL MODULE CONNECTOR (Continued from previous page) (Disconnected)

- Ignition Switch: RUN
- Test with Quick Checker or Digital Meter

Test	Condition	With Quick Checker, Correct Repair Action	Without Quick Checker, Using a Digital Meter			Repair Action
			Meter Range	Connector Terminal	Correct Repair Action	
5	Cruise Switch ON, drive wheels turned by hand	VSS Light flashes On and Off	200 VDC	A & D	Pulses between approximately Battery voltage and less than 7 volts	Repair Action K, Repair Action L, p. 34-5
6	Run engine for one minute, then turn it off. With Ignition Switch in RUN, and holding Cruise Switch in R/A, press and release Set Switch	Vacuum holds the servo at wide open throttle position	Connect fused jumpers from C to M and from K to L before operating switches		Vacuum holds the servo at wide open throttle position	Repair Action M, p. 34-5
7	Quick Checker not connected		200 ohms	F & J	Over range	Repair Action N, p. 34-6
8	Quick Checker not connected		200 ohms	F & H	15 to 25 ohms	Repair Action O, p. 34-6

REPAIR ACTION A: CRUISE SWITCH SHORT

Check for shorts to voltage in the wires to terminals G,A,M, and L of the Module.

- If the wires are good, replace the Multi-Function Lever.

REPAIR ACTION B: POWER CIRCUIT OPEN

1. Check the Radio Fuse.

2. Check that terminal J is grounded.

3. Disconnect connector C235 and check for Battery voltage at terminal A of the female half with Ignition in ACCY or RUN.

- If Battery voltage is missing, check/repair the YEL wire (43).

4. Check continuity between terminals A and B of the male half of connector C235 with the Cruise Switch ON.

- If the switch is open, replace the Multi-Function Lever.

5. Check for an open in the GRY wire (397) between terminal B of connector C235 and terminal A of the Module connector.

REPAIR ACTION C: BRK CIRCUIT OPEN

1. Check for an open Brake or Clutch Switch.

2. Check for an open in the BRN/WHT wire (86) to terminal G of the Module.

REPAIR ACTION D: VENT CIRCUIT OPEN

- If you measured less than 15 ohms, perform Repair Action J, p. 34-5. Otherwise proceed with Step 1.

1. 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.

2. Check for an open in the DK BLU wire (403) between terminal C of the Module and terminal A of the Servo.

3. Check that terminal C of the Servo connector is grounded.

REPAIR ACTION E: VAC CIRCUIT OPEN

- If you measured less than 30 ohms, perform Repair Action H, p. 34-5. Otherwise proceed with Step 1.

1. Remove the connector from the Cruise Control Servo. Measure the resistance between terminals E and C of the Servo.

(Continued on next page)

CRUISE CONTROL

(Continued from previous page)

- If it is more than 55 ohms, replace the Servo.

2. Check for an open in the LT GRN wire (402) between terminal K of the Module and terminal E of the Servo.

3. Check that terminal C of the Servo connector is grounded.

REPAIR ACTION F: SPS CIRCUIT OPEN

- If you measured less than 15 ohms, perform Repair Action N, p.34-6. Otherwise proceed with Step 1.

1. 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.

2. Check for an open in the LT BLU/BLK wire (399) between terminals H of the Module and terminal D of the Servo.

3. Check for an open in the TAN wire (398) between terminal F of the Module and terminal B of the Servo.

REPAIR ACTION G: SC CIRCUIT OPEN

1. Disconnect C235 and check the continuity between terminals B and D of the male half with the Set Switch pressed.
   - If the switch is open, replace the Multi-Function Lever.

2. Check for an open in the DK BLU wire (84) between terminal D of connector C235 and terminal L of the Module.

REPAIR ACTION H: VAC CIRCUIT SHORT

Remove the connector from the Cruise Control Servo and measure the 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 in the LT GRN wire (402) from terminal K of the Module to terminal E of the Servo.

REPAIR ACTION I: RA CIRCUIT OPEN

1. Disconnect C235 and check the continuity between terminals A and C of the male half with the Cruise Switch in R/A.
   - If the switch is open, replace the Multi-Function Lever.

2. Check for an open in the GRY/BLK wire (87) between terminal C of connector C235 and terminal M of the Module.

REPAIR ACTION J: VENT CIRCUIT SHORT

Remove the connector from the Servo and measure the 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 in the DK BLU wire (403) from terminal C of the Module to terminal A of the Servo.

REPAIR ACTION K: VSS CIRCUIT OPEN

- If the VSS light does not come on, or the voltage between terminals A and D remains less than 7 volts, check for an open in the BRN wire (437) *from the Vehicle Speed Sensor* Buffer.
- If the wire is good, troubleshoot the Vehicle Speed Sensor circuit. Refer to page 33-0.

REPAIR ACTION L: VSS CIRCUIT SHORT

- If the VSS light does not go off or Battery voltage remains between terminals A and D, check for a short to ground in the BRN wire (437) from the Vehicle Speed Sensor Buffer.
- If the wire is good, troubleshoot the Vehicle Speed Sensor circuit. Refer to page 33-0.

REPAIR ACTION M: VACUUM SYSTEM CONDITION

Check for a blocked or leaking vacuum source.

- If the vacuum source is good, plug the Vacuum Release Port and repeat Test No. 6.
- If the vacuum now holds the throttle wide open, replace or repair the Vacuum Release Valve or the hose to it.
- If the test still fails, replace the Cruise Control Servo.

(Continued on next page)

CRUISE CONTROL

(Continued from previous page)

REPAIR ACTION N: SPS CIRCUIT SHORT

Disconnect the Cruise Control Servo connector and repeat Test No. 7.

- 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 (398) from terminal F of the Cruise Control Module to terminal B of the Cruise Control Servo.

REPAIR ACTION O: SPS SHORT

- If all other tests are OK, replace the Cruise Control Servo.

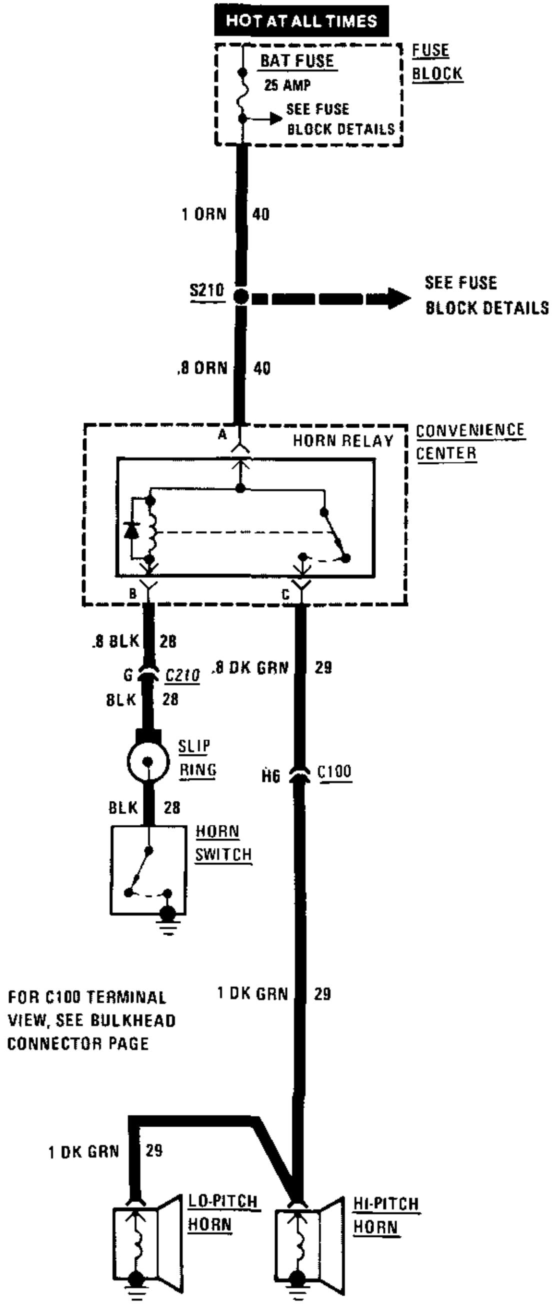
CIRCUIT OPERATION

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 and its Buffer. 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 in the transaxle. Other inputs to the Module are from the Cruise Switch and the Set Switch. A disconnect input to the Module comes from a switch on the brake pedal. A separate vacuum shut-down of the Cruise Control comes from the Brake Cruise 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 by means of the Vacuum Motor. The Servo Position Sensor 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



COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind RH side of I/P	201-17-B
Fuse Block	Behind LH side of I/P	201- 3-E
Horn Switch	Inside steering wheel	
Slip Ring	Top of steering column, below steering wheel	
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C210 (11 cavities)	Lower RH side of steering column	201- 5-B
S210	Main harness, behind RH side of cluster	201- 3-D

TROUBLESHOOTING HINTS

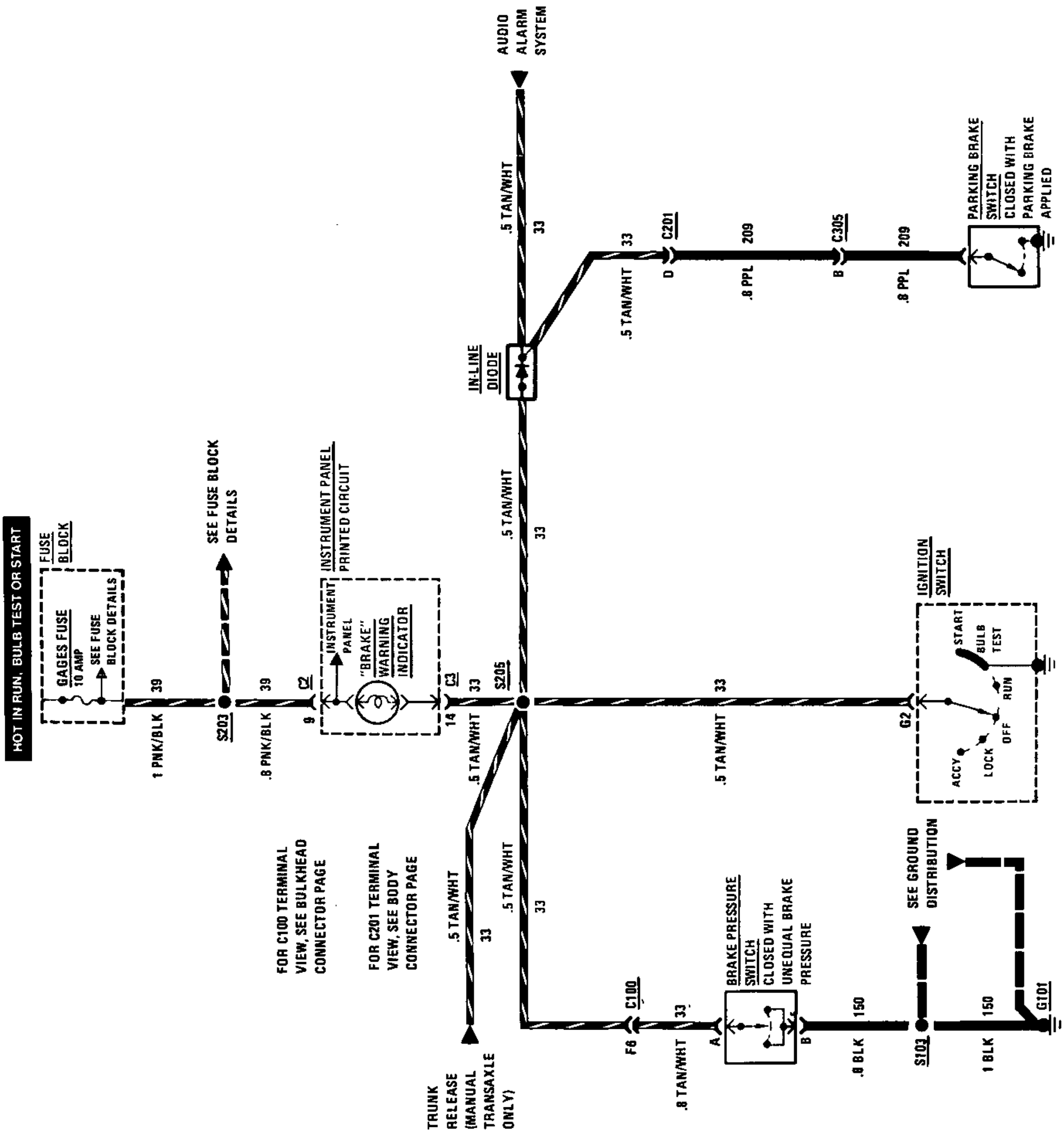
1. Check the BAT Fuse by operating the Radio.
2. The Horns may be tested by connecting a jumper from the connector on one of the Horns (DK GRN wire) to the positive Battery terminal. The Horns should sound. If they do not sound, check the grounds and connectors. Install new Horns if no fault is found.
3. If neither Horn will sound, ground the BLK wire of terminal B of the Horn Relay.
   - If the Horns now sound, check C210 for a loose connection. Also check the Horn Switch and BLK wire to the switch for an open.
   - If the Horns do not sound, check for Battery voltage at pin A (ORN wire). If voltage is present, go to next step. If no voltage is present, check the ORN wire back to the fuse for an open.
   - If Battery voltage is present at pin A, (ORN wire) but not at pin C, (DK GRN wire) replace the Horn Relay.
   - If Battery voltage is present at pin C, check C100 for a loose connection and DK GRN wire to Horns for an open.
4. If the Horns sound at all times, separate C210. If the Horns stop, check the Horn Switch and its wiring for a short ground. If the Horns continue to sound with C210 separated, replace the Horn Relay.

CIRCUIT OPERATION

When the Horn Switch is depressed, the coil of the Horn Relay is grounded. This energizes the relay, closing the contacts. Battery voltage is now applied through the Horn Relay and the DK GRN wire to the Lo-Pitch and Hi-Pitch Horns, causing the Horns to sound. When the Horn Switch is released, it opens, removing the ground path for the coil. This causes the coil to de-energize and the contacts to open. Battery voltage is no longer applied to the Horns. The Horns will no longer sound.

BLANK

BRAKE WARNING SYSTEM



FOR C100 TERMINAL VIEW, SEE BULKHEAD CONNECTOR PAGE

FOR C201 TERMINAL VIEW, SEE BODY CONNECTOR PAGE

BRAKE WARNING SYSTEM

SYSTEM CHECK

1. Turn the Ignition Switch slowly past the RUN position.
   - BRAKE Warning Indicator comes on before the Ignition Switch reaches the START position.
2. With the Ignition Switch in RUN, put the parking brake on.
   - BRAKE Warning Indicator comes on.

TROUBLESHOOTING HINTS

Check the Gages Fuse with a fuse tester.

SYSTEM DIAGNOSIS

1. BRAKE Warning Indicator remains on with the Ignition Switch in RUN and the parking brake off.
   - Disconnect the connectors, one at a time, to each of the switches controlling the indicator.
     - If the indicator does not go out, check the wiring between the Instrument Panel and each switch for a short to ground. If the wiring is good, the problem is in the Instrument Panel (see page 80-0).
     - If the indicator goes out, check the switch where the connector removal caused the light to go out.
   - Parking brake adjustment.
   - Possible leak or loss of fluid in the brake system.
     - If these checks are good, replace the suspect switch.

COMPONENT LOCATION

		Page-Figure
Brake Pressure Switch	Front compartment, to left of brake master cylinder	201-10-D
Fuse Block	Behind LH side of I/P	201- 3-E
Ignition Switch	At base of steering column	201- 5-A
In-Line Diode	Behind I/P near LH shroud	201- 4-C
Parking Brake Switch	On parking brake support	201- 4-E
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C305 (3 cavities)	Behind dash, near LH shroud	201-14-A
G101	On LH fender, below headlamp	201-11-A
S103	Front lights harness, LH front of front compartment	201- 9-D
S203	Main harness, above steering column	201- 7-A
S205	Main harness, above steering column	201- 7-A

2. BRAKE Warning Indicator does not come on with the Ignition Switch in BULB TEST or START or with the parking brake on.
   - Check for Battery voltage at the Instrument Panel by observing the SERVICE ENGINE SOON Light when the Ignition Switch is in RUN (car not started).
     - If the indicator does not come on, check wiring between the fuse and the Instrument Panel. If the wiring is good, the problem is in the Instrument Panel (see page 80-0).
     - If the indicator does light, go to next step.
   - Disconnect the connector to each of the switches and ground the connectors one at a time.
     - If the BRAKE Warning Indicator does not come on, check the wiring between the Instrument Panel and the switches for an open. If the wiring is good, the problem is in the Instrument Panel (see page 80-0).
     - If the BRAKE Warning Indicator comes on, check the switch where grounding the connector caused the indicator to light.
   - Parking brake adjustment.
     - If the check is good, replace the suspect switch.

BRAKE WARNING SYSTEM

CIRCUIT OPERATION

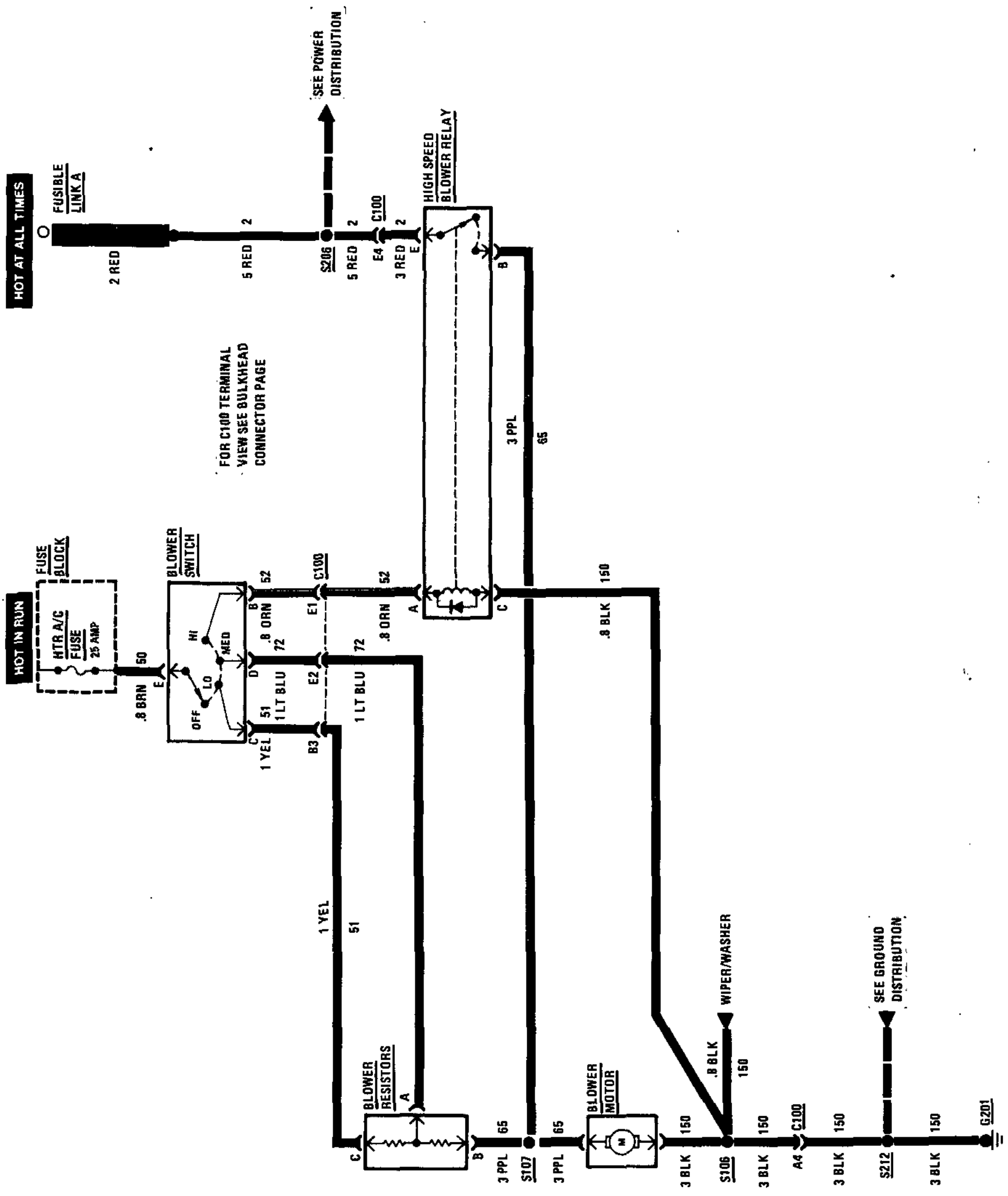
The BRAKE Warning Indicator receives Battery voltage in RUN, BULB TEST, or START. When the switches close, they provide a ground for the indicator and the indicator lights.

The BULB TEST position of the Ignition Switch does not have a detent, but the switch will close to ground before the START position is reached, and while in the START position. The indicator will light only without Digital Cluster.

The Brake Pressure Switch closes to light the BRAKE Warning Indicator when there is unequal pressure in the two hydraulic brake systems. This difference could be caused by a leak in one of the brake lines. The Brake Pressure Switch remains closed so that the indicator stays on in the event of a hydraulic leak. The switch can be reset to an open condition by high brake pressure in both brake systems. This can only be accomplished after the faulty system has been repaired.

BLANK

HEATER: C41


HOT AT ALL TIMES
FUSIBLE LINK A
2 RED
5 RED
2
S206
SEE POWER DISTRIBUTION
5 RED
2
C100
E4
3 RED
2
E
HIGH SPEED BLOWER RELAY
B
3 PPL
65
FOR C100 TERMINAL VIEW SEE BULKHEAD CONNECTOR PAGE
HOT IN RUN
FUSE BLOCK
HTR A/C FUSE 25 AMP
50
.8 BRN
E
BLOWER SWITCH
HI
MED
LO
OFF
B
52
.8 ORN
C100
E1
52
.8 ORN
A
C
150
.8 BLK
D
72
.8 ORN
72
E2
1 LT BLU
51
1 LT BLU
C
1 YEL
B3
1 YEL
51
BLOWER RESISTORS
A
C
B
65
3 PPL
S107
65
3 PPL
BLOWER MOTOR
M
150
3 BLK
S106
.8 BLK
150
WIPER/WASHER
150
3 BLK
C100
A4
150
3 BLK
SEE GROUND DISTRIBUTION
S212
150
3 BLK
G201

HEATER

SYSTEM CHECK

1. With the Ignition Switch in the RUN position and the Heater Control Head in the DEFROST position, operate the Blower Switch, moving it through every position from OFF to HI.
   - As the Blower Switch is moved, the air flow from the vents will increase as will the speed of the Blower Motor.

TROUBLESHOOTING HINTS

1. Check the HTR A/C Fuse with a fuse tester.
2. Check that G201 is clean and tight.
3. If the blower does not run in LO or MED, check the Blower Resistors for an open resistor.

SYSTEM DIAGNOSIS

1. If the Blower Motor does not operate with the Blower Switch in LO, MED, or HI, check for the following voltages at the Blower Switch with the Ignition Switch in the RUN position.

COMPONENT LOCATION

		Page-Figure
Blower Motor	Center of front bulkhead	201- 9-A
Blower Resistors	Lower RH side of heater-A/C plenum	201- 9-A
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block	201- 3-A
High Speed Blower Relay	On RH side of heater-A/C plenum	201- 9-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
G201	Behind dash, near center	201- 3-D
S106	Heater-A/C harness, center of front bulkhead	201- 9-A
S107	Heater-A/C harness, RH side of front bulkhead	201- 9-A
S206	Main harness, above LH side of steering column	201- 5-A
S212	Main harness, behind center of dash	201- 3-D

VOLTAGE
BLOWER SWITCH
Ignition Switch in RUN

Terminal (Wire Color)	Voltage	Blower Switch Position
C (YEL)	Battery	LO Only
B (ORN)	Battery	HI Only
D (LT BLU)	Battery	MED Only
E (BRN)	Battery	Any Position

- If Battery voltage is not present at terminal E, check the BRN wire back to the fuse for an open.
- If any of the voltages at terminals C, D, and B are incorrect, replace the Blower Switch.
- If all voltages are correct, continue to Step 2.

2. With the Ignition Switch in RUN, check for the following voltages at the Blower Resistors.

VOLTAGE
BLOWER RESISTORS
Ignition Switch in RUN

Terminal (Wire Color)	Voltage	Blower Switch Position
A (LT BLU)	Battery	MED
C (YEL)	Battery	LO

- If any of the voltages are incorrect, check C100 for a loose connection. Also check related wiring to the Blower Switch and Blower Motor for an open.

- If the voltages are correct and the motor runs in HI position, replace the Blower Resistors.

3. If the Blower does not run in the HI position, check for the following voltages at the High Speed Blower Relay with the Ignition Switch in the RUN position.

VOLTAGE
HI SPEED BLOWER RELAY
Blower Switch in HI
Ignition Switch in RUN

Terminal (Wire Color)	Voltage
A (ORN)	Battery
C (BLK)	0
E (RED)	Battery
B (PPL)	Battery

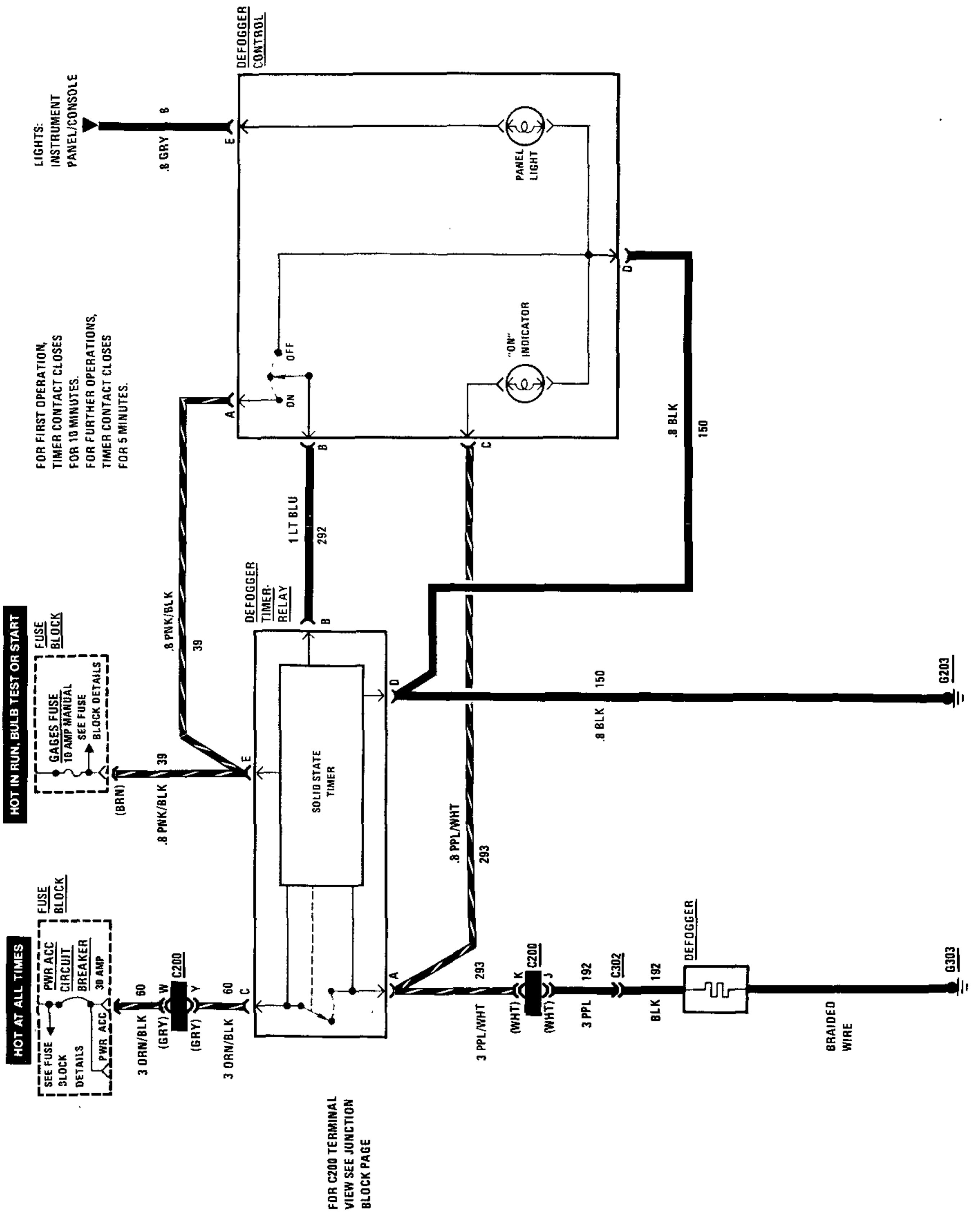
- If any of the voltages are incorrect, check the wiring in that circuit for an open. If the wiring is OK, replace the relay.
- If the voltages are correct and the motor runs in HI position, replace the Blower Resistors.
- If the voltages are correct and the Blower Motor does not run in LO, MED, or HI, check for Battery voltage at the PPL wire at the Blower Motor. If Battery voltage is not present, check the PPL wire to the Blower Resistors and the Blower Relay for an open. If Battery voltage is present, check the continuity of the BLK wire at the Blower Motor to ground. If the continuity is good, replace the Blower Motor. If the continuity is not good, check C100 for a loose connection and the BLK wire for an open.

CIRCUIT OPERATION

The Blower Motor delivers warm air to the inside of the vehicle. Its speed is controlled by the Blower Switch and the Blower Resistors. With the switch in LO, Battery voltage is applied to the motor through both resistors. The motor runs slowly. In the MED position, one of these resistors is bypassed. In HI, Battery voltage is applied to the High Speed Blower Relay, the contacts close, and all resistance is bypassed. The Blower Motor runs in high speed.

BLANK

DEFOGGER (C49)



FOR FIRST OPERATION, TIMER CONTACT CLOSES FOR 10 MINUTES. FOR FURTHER OPERATIONS, TIMER CONTACT CLOSES FOR 5 MINUTES.

FOR C200 TERMINAL VIEW SEE JUNCTION BLOCK PAGE

P

DEFOGGER

SYSTEM CHECK

1. Put the Ignition Switch in the RUN position and push the Rear Defogger Switch in.
    - Upon releasing the Defogger Control Switch, the switch returns to the REST position and the ON Indicator, in the center of the Defogger Control, glows.
    - The rear window will become warm.
    - The ON Indicator and the Defogger will shut off after 10 minutes.
2. Push the Rear Defogger Switch in again.
    - Upon releasing the Defogger Control Switch, *the switch returns to the* REST position and the ON Indicator, in the center of the Defogger Control, glows.
    - The rear window will become warm.
    - The ON Indicator and Defogger will shut off after 5 minutes.
3. *Push the Rear Defogger Switch in again.*
    - Upon releasing the Defogger Control Switch, the switch returns to the REST position and the ON Indicator in the center of the Defogger Control glows.
    - The rear window will become warm.
4. Immediately push the switch again before the 5 minute time period elapses.
    - Upon releasing the Defogger Control Switch, the switch returns to the REST position and the ON Indicator in the center of the Defogger Control goes out.
    - The rear window will become cooler.
5. Turn the Ignition Switch to the OFF position and then back to the RUN position. The Defogger will return *to a 10 minute* cycle.

COMPONENT LOCATION

		Page-Figure
Defogger Timer Relay	On brake pedal support	201- 4-A
Fuse Block	Behind LH side of I/P	201- 3-E
C200 (16 cavities)	LH shroud ahead of center access hole.	201- 3-E
C302 (1 cavity)	Near LH side of rear window	201-14-A
G203	On side of RH steering column support.	201- 4-B
G303	On RH "B" pillar	

TROUBLESHOOTING HINTS

1. Check the Gages Fuse by operating the Instrument Panel.
2. Check G303 and G203 to make sure they are clean and tight.
3. If the symptom involves only the time that the Defogger operates, replace the Defogger Timer-Relay.
4. If the problem is panel illumination, see Instrument Panel Lights.

SYSTEM DIAGNOSIS

1. With the Ignition Switch in the RUN position, push in the *Rear Defogger Switch.* Substitute a test lamp in place of the Defogger.
    - If the test lamp does not light, go to the next step.
    - If the test lamp lights, replace the Defogger.
2. Put the Ignition Switch in the RUN position. Push in the Defogger Switch and *check for the following voltages.*

VOLTAGE

DEFOGGER CONTROL

Defogger Control ON

Ignition Switch in RUN

Terminal (Wire Color)	Voltage
D (BLK)	0 Volts
A (PNK/WHT)	Battery
C (PPL/WHT)	Battery
B (LT BLU)	Battery
E (GRY)	Battery

- If Battery voltage is present at pin D, proceed to step 2. If no problem is found, replace the Defogger Control.
- If Battery voltage is not present at terminal A, check the PNK/BLK wire (39) for an open.

- If Battery voltage is not present at terminal B, replace Defogger Control.
- If Battery voltage is not at terminal C, check wiring to Defogger Timer-Relay for an open. If OK, check Defogger Timer-Relay (Step 3).
- If voltage is present at terminal C but the bulb is not lighting, check the bulb and then check the BLK (150) wire and G203. If no problem is found, replace the Defogger Control.
- If no Battery voltage is present at pin E, (GRY wire), check INST Fuse by operating Instrument Panel Lights. If fuse is OK, check GRY wire for an open.
- Backprobe the Defogger Timer Relay and measure the voltage to ground at the wires in the following table. Put the Ignition Switch in RUN and turn the Defogger Switch On.

VOLTAGE
DEFOGGER TIMER-RELAY
Ignition Switch RUN
Defogger Switch ON

Terminal (Wire Color)	Test Lamp
C (ORN/BLK)	On
E (PNK/BLK)	On
A (PPL/WHT)	On
B (LT BLU)	On
D (BLK)	Off

- If Battery voltage is not present at C or E, check for voltage back to the Gages Fuse for pin E and the PWR ACC Circuit Breaker for pin C.
- If Battery voltage is not present at pin B, check the continuity of the LT BLU wire from pin B of the Defogger Relay to pin B of the Defogger Control. If the wire is open replace it.
- If Battery voltage is present at pin D, check to see that G202 is clean and tight and also check th see if the wire is open. If not, replace the Defogger Timer-Relay.
- If voltage appears at pin C, pin E, pin B, and not pin A with the Defogger, replace the Defogger Timer-Relay.
- If a voltage appears at pin A and the Defogger grid does that up, check the continuity between pin A and the Defogger grid.
- If the ON Indicator does not come on, check continuity between pin A and pin C of the Defogger Control.

CIRCUIT OPERATION

With the Ignition Switch in RUN, voltage is applied to the Defogger Control. When the Defogger Control Switch is moved to the ON position, 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 Control Switch is turned OFF, or the timer cycle is complete.

The first time the Rear Defogger Switch is pushed in, the Defogger Timer-Relay will allow the Defogger to operate for 10 minutes. Each time after the Rear Defogger Switch is pushed in, the Defogger Timer-Relay will reset to operate for a maximum of 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.

When the Defogger Control is turned to OFF, the timer resets by grounding through the OFF contact of the Defogger Control and G203.

BLANK

AIR CONDITIONING: C60

MANUAL AIR CONDITIONING

Overall A/C System Check

This procedure is an overall check of the Air Conditioning System. All of the steps can be performed without the use of tools or without disassembly. References to other sections of the manual are given which provide detailed diagnostic procedures.

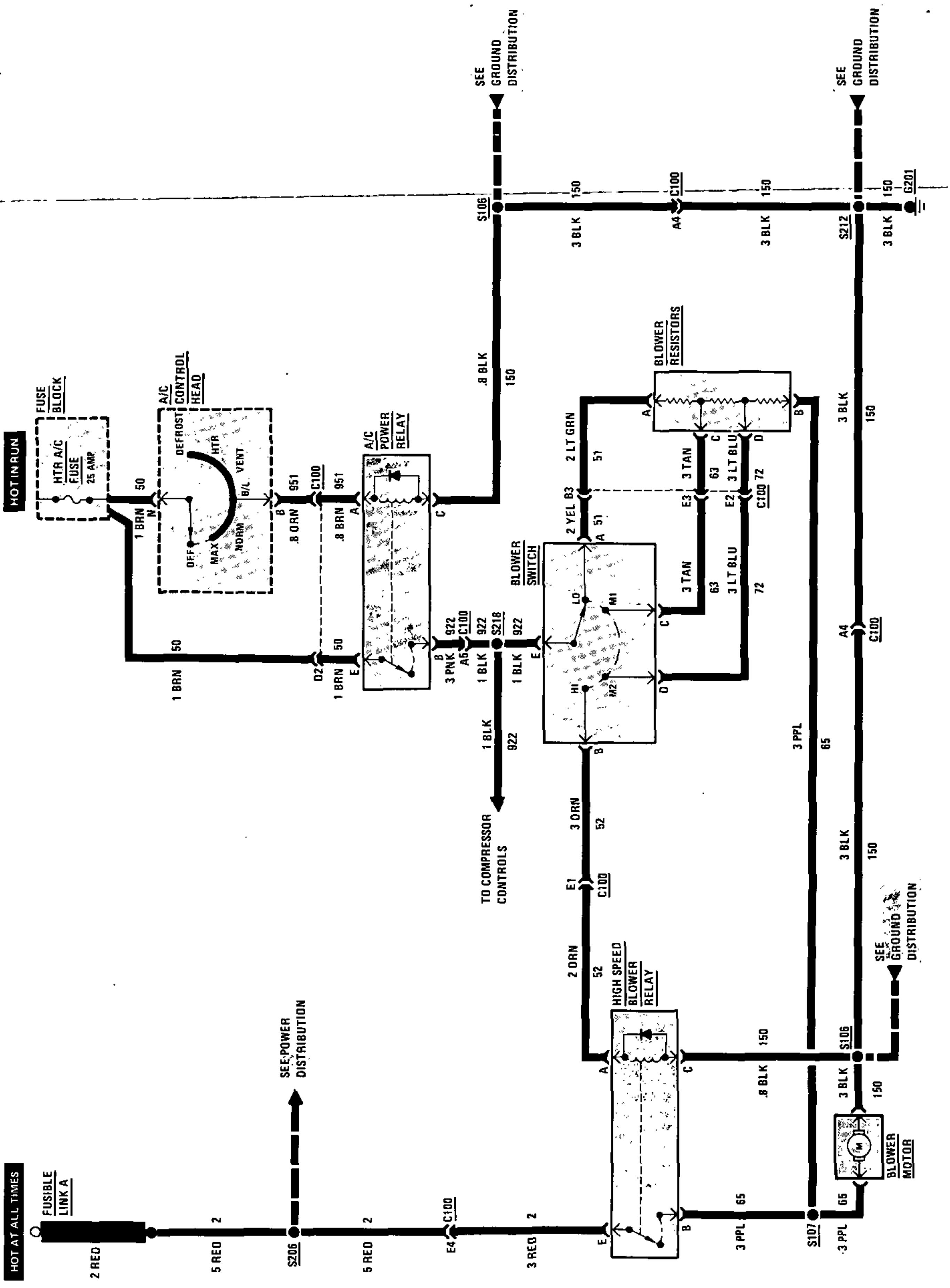
Complete this procedure with the temperature outside the car above 60 °F (16 °C) and with the engine running at idle.

Set A/C Controls:	Expected Result	Refer To:
1. OFF Fan LO	• Fan is not running.	8A-63 Blower Controls
2. Move Temperature Lever rapidly back and forth	• Temperature Door hits stop in each direction.	8A-63 Air Delivery
3. Heater Temperature Lever at HOT	• Blower runs at low speed. • Warm air flows from floor outlets. • Slight air flow at windshield and side Window outlets.	8A-63 Blower Controls 8A-63 Air Delivery
4. Move Fan Switch from LO to HI	• Increased air flow at each step.	8A-63 Blower Controls
5. DEF	• Warm air flows from windshield and side window outlets. • Slight air flow at floor outlets. • Compressor turns on.	8A-63 Air Delivery 8A-63 Compresser Controls
6. VENT	• Outside air flows from Instrument Panel outlets.	8A-63 Air Delivery
7. BI-LEVEL Set Temperature Lever to COLD	• Air flows from Instrument Panel and floor outlets with slight airflow at windshield. • Compressor turns on. • Engine coolant fan runs. • Air flow becomes cold.	8A-63 Air Delivery 8A-63 Compressor Controls 8A-31 Coolant Fans 8A-63 Compressor Controls
8. NORMAL	• Air flows from Instrument Panel outlets with slight airflow at floor. • Compressor continues to run.	8A-63 Air Delivery 8A-63 Compressor Controls
9. MAX	• Blower noise decreases as outside air door closes.	8A-63 Air Delivery
10. OFF	• Blower and Compressor turn off	8A-63 Blower and Compressor Controls

BLANK

AIR CONDITIONING: C60

BLOWER CONTROLS



AIR CONDITIONING: C60

[This cell includes information on:

- Blower Controls
- Compressor Controls
- Air Delivery]

BLOWER CONTROLS

SYSTEM DIAGNOSIS

Complete the Overall A/C System Check in Section 8A-62. Isolate Blower Control conditions using the following procedures.

The following table lists tests to complete for specific symptoms. If the symptoms observed are not in the table, test all Blower System components.

COMPONENT LOCATION

		Page-Figure
A/C Power Relay	Front compartment, on RH side of heater-A/C plenum	201-10-C
AC Low Pressure Switch	LH front of engine	201- 1-A
Blower Motor	Center of front bulkhead	201- 9-A
Blower Resistors	Lower RH side of heater-A/C plenum	201- 9-A
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link A	RH front of engine compartment, at battery junction block	201- 3-A
High Speed Blower Relay	On RH side of heater-A/C plenum	201- 9-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
G201	Behind dash, near center	201- 3-D
G507	LH front of engine	201-16-B
S106	Heater-A/C harness, center of front bulkhead	201- 9-A
S107	Heater-A/C harness, RH side of front bulkhead	201- 9-A
S206	Main harness, above LH side of steering column	201- 5-A
S212	Main harness, behind center of dash	201- 3-D
S218	Main I/P harness, behind cluster	201- 3-D
S530	Engine harness, LH rear of engine	201- 1-A
S531	Engine harness, LH front of engine	201-16-B

(Continued on next page)

AIR CONDITIONING: C60

(Continued from previous page)

Symptom	Test
Blower will not run	TEST C: Blower Motor TEST A: A/C Mode Selector TEST B: A/C Power Relay
No Hi Speed	TEST F: High Speed Blower Relay TEST D: Blower Switch
Hi Speed Only	TEST F: High Speed Blower Relay TEST E: Blower Resistors TEST D: Blower Switch
No Lo Speed	TEST E: Blower Resistors
Blower in LO at M1 or M2	TEST D: Blower Switch
Blower will not turn Off	TEST A: A/C Mode Selector TEST F: High Speed Blower Relay TEST D: Blower Switch TEST B: A/C Power Relay

TEST A: A/C MODE SELECTOR TEST

Backprobe the connector to the A/C Control Head and measure the voltage to ground with the connector still on the head.

A/C CONTROL HEAD CONNECTOR
(Connected)

Voltage Test: A
- Ignition Switch: RUN

Terminal (Wire Color)	Voltage	A/C Selector Mode
N (BRN)	Battery	All Times
B (ORN)	0	OFF
B (ORN)	Battery	Any Position Except OFF

- If Battery voltage is not present at terminal N, check the BRN wire circuit back to the fuse.
- If Battery voltage is at terminal N, but not at terminal B, install a new Blower Switch.

TEST B: A/C POWER RELAY TEST

1. Remove the connector from the A/C Power Relay and measure the voltage to ground at the following terminals of the connector.

A/C POWER RELAY CONNECTOR
(Disconnected)

Voltage Test: B
- Ignition Switch: RUN
- A/C Mode Selector: VENT

Terminal (Wire Color)	Voltage
E (BRN)	Battery
A (ORN)	Battery
C (BLK)	0 Volts

- If the voltage at terminals E or A is not correct, check the circuits at those terminals for an open.
- If the voltage at terminal C is not correct, check the BLK wire (150) for an open. Check that ground G201 is clean and tight.

2. With the connector still removed from the A/C Power Relay, measure the resistance to ground at the following terminals. First disconnect the system Battery terminal.

(Continued on next page)

AIR CONDITIONING: C60

(Continued from previous page)

A/C POWER RELAY CONNECTOR
(Disconnected)

Resistance Test: B
- Ignition Switch: HI
- Negative Battery Terminal Disconnected

Terminal (Wire Color)	Resistance
B (PNK)	Approximately 30 Ohms
C (BLK)	0 Ohms

- If voltages and resistances at the A/C Power Relay are correct and neither the blower nor compressor will operate, replace the A/C Power Relay.
- If the resistance at terminal B is incorrect, run the High Speed Blower Relay Test.

TEST C: BLOWER MOTOR TEST

Check the HTR-A/C Fuse. Measure the voltages to ground at the Blower Motor with the connectors in place.

BLOWER MOTOR CONNECTOR
(Connected)

Voltage Test: C
- Ignition Switch: RUN
- A/C Mode Selector: VENT
- Blower Switch: HI

Wire Color	Voltage
PPL	Battery
BLK	0

- If the voltages at the motor are correct and the motor does not run, install a new Blower Motor.
- If Battery voltage is not present at the PPL wire, check the wire for opens. Also test the circuit attached to that wire.
- If the voltage at the BLK wire is Battery voltage, check for an open wire between the Blower Motor and ground.

TEST D: BLOWER SWITCH TEST

Measure the voltage to ground at the connector to the Blower Switch, with the connector on the switch.

BLOWER SWITCH CONNECTOR
(Connected)

Voltage Test: D
- A/C Mode Selector: VENT
- Ignition Switch: RUN

Terminal (Wire Color)	Voltage	Blower Switch Position
E (BLK)	Battery	All Positions
C (TAN)	Battery	M1
D (LT BLU)	Battery	M2
B (ORN)	Battery	HI
A (YEL)	Battery	LO

- If any of the voltages above are not correct, install a new Blower Switch.

TEST E: BLOWER RESISTORS TEST

Backprobe the connector to the Blower Resistors with the connector still on the resistors, and measure the resistance between the following wires. The resistance values are approximate.

BLOWER RESISTORS CONNECTOR
(Connected)

Resistance Test: E
- Ignition Switch: OFF
- Blower Switch: LO

Wire Colors	Resistance
LT GRN and TAN	1.5 ± 1 ohm
TAN and LT BLU	.7 ± .5 ohm
LT BLU and PPL	.2 ± .1 ohm

- If resistors are open, or shorted, or different from the values given, install new Blower Resistors.

TEST F: HIGH SPEED BLOWER RELAY TEST

1. Remove the connector from the High Speed Blower Relay and measure the voltage to ground at each wire of the connector. Do this with the Ignition Switch in RUN, the Blower Switch in HI, and the A/C Mode Selector in VENT.

(Continued on next page)

AIR CONDITIONING: C60

(Continued from previous page)

HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)	
Voltage Test: F • Ignition Switch: RUN • Blower Switch: HI • A/C Mode Selector: VENT	
Wire Color	**Voltage**
ORN	Battery
RED	Battery
PPL	0 Volt

- If the voltage at a wire is not correct, check the circuit at that wire.

2. With the connector still removed from the High Speed Blower Relay, measure the resistance to ground at the following connector terminals. First disconnect the negative Battery terminal.

HIGH SPEED BLOWER RELAY CONNECTOR (Disconnected)	
Resistance Test: F	
Wire Color	**Resistance**
BLK	0, Continuity
PPL	Less than 15 ohms

- If the voltages and resistances at the High Speed Blower Relay connectors are correct, and the Blower Motor does not operate, install a new High Speed Blower Relay.

CIRCUIT OPERATION

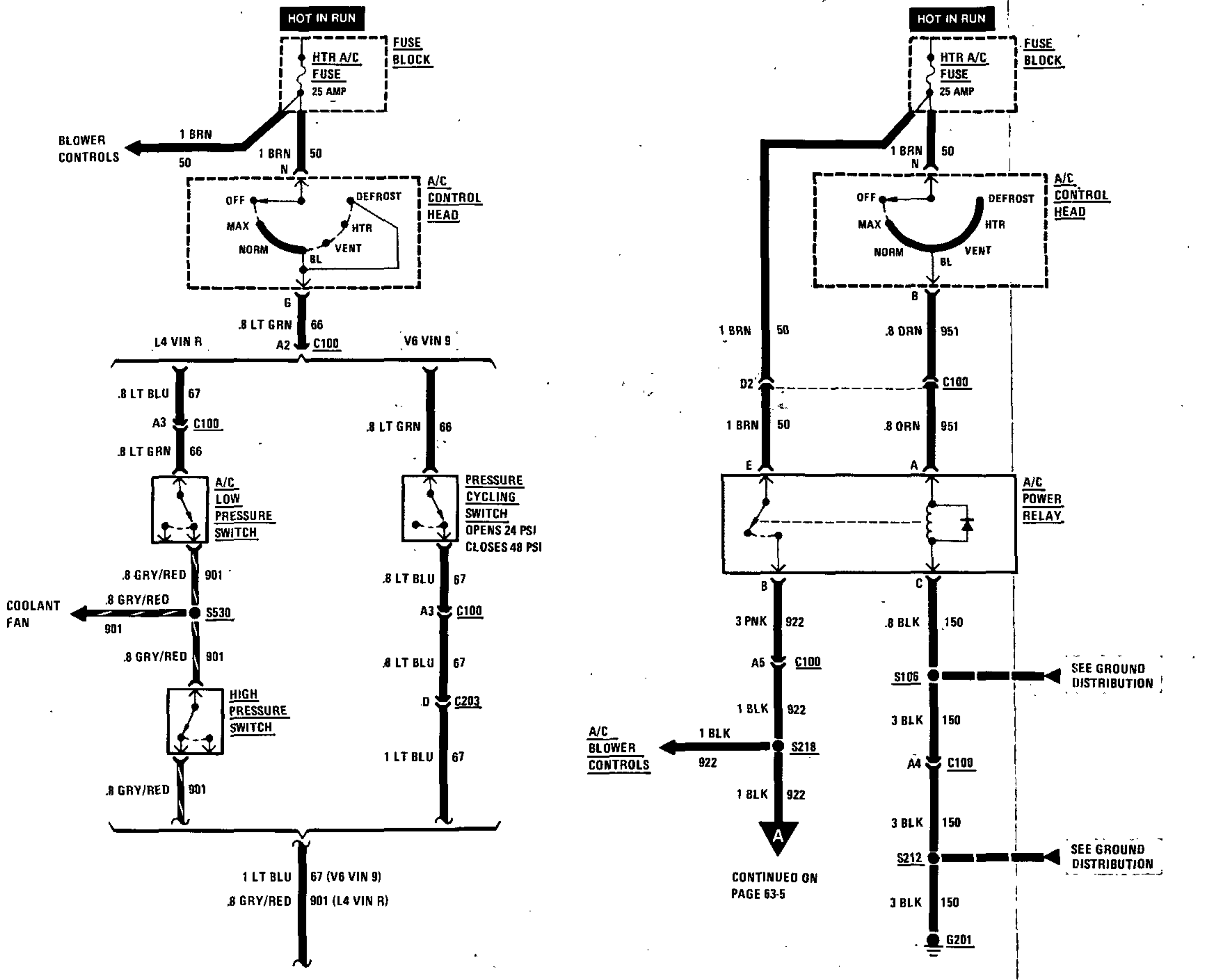
The Blower Motor speed is controlled by the Blower Selector in the A/C Control Head. However, if the A/C Mode Selector is in the OFF position, no voltage is applied to the Blower Switch and motor. With this selector in any operating position, the blower will run. In the LO Blower Switch position, all of the Blower Resistors are in the circuit with the motor so that it runs slowly. The Blower Motor is fed through the contacts of the Blower Relay.

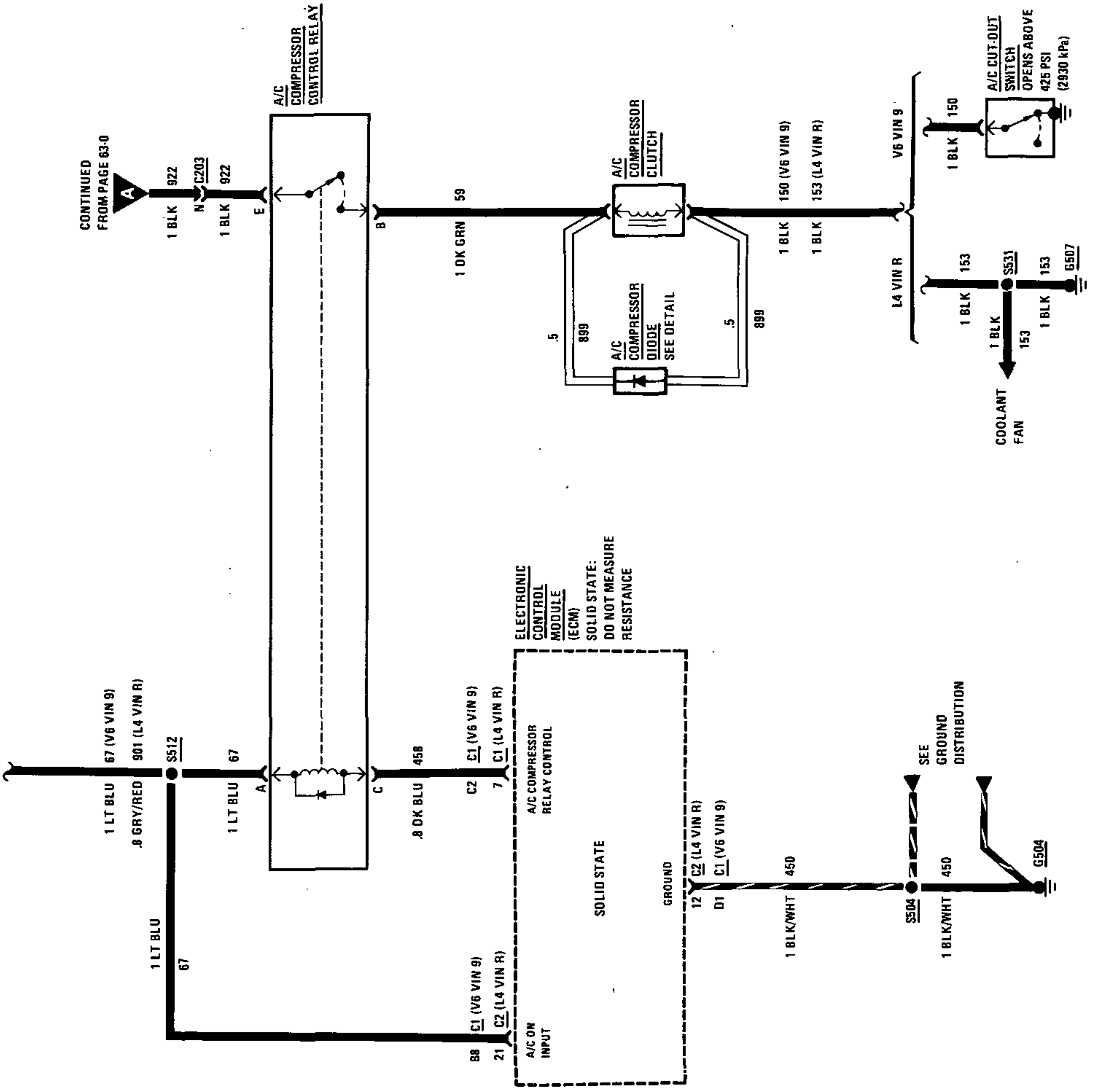
In the high speed M1 and M2 positions, the Blower Switch bypasses some of the resistors, increasing the motor speed. For HI speed operation, Battery voltage is supplied through the ORN wire to the coil of the High Speed Blower Relay. The relay is energized and its contacts supply Battery voltage directly to the Blower Motor from a fusible link. With no resistors in the circuit, the blower runs at high speed.

BLANK

AIR CONDITIONING: C60

COMPRESSOR CONTROLS




CONTINUED FROM PAGE 63-0
A
1 BLK
922
N
C203
922
1 BLK
E
A/C COMPRESSOR CONTROL RELAY
B
59
1 DK GRN
A/C COMPRESSOR CLUTCH
.5
899
A/C COMPRESSOR DIODE SEE DETAIL
.5
899
1 BLK
150 (V6 VIN 9)
1 BLK
153 (L4 VIN R)
V6 VIN 9
L4 VIN R
1 BLK
150
A/C CUT-OUT SWITCH OPENS ABOVE 425 PSI (2930 kPa)
1 BLK
153
S531
153
1 BLK
G507
1 BLK
153
COOLANT FAN
1 LT BLU
67 (V6 VIN 9)
.8 GRY/RED
901 (L4 VIN R)
S512
1 LT BLU
67
A
C
.8 DK BLU
458
C2
C1 (V6 VIN 9)
7
C1 (L4 VIN R)
ELECTRONIC CONTROL MODULE (ECM)
SOLID STATE: DO NOT MEASURE RESISTANCE
A/C COMPRESSOR RELAY CONTROL
SOLID STATE
GROUND
12
C2 (L4 VIN R)
D1
C1 (V6 VIN 9)
450
1 BLK/WHT
S504
450
1 BLK/WHT
G504
SEE GROUND DISTRIBUTION
1 LT BLU
67
B8
C1 (V6 VIN 9)
21
C2 (L4 VIN R)
A/C ON INPUT

AIR CONDITIONING: C60

COMPRESSOR CONTROLS

Complete the Overall A/C System Check in Section 8A-62-0. Isolate Compressor Control conditions with the following procedures.

TROUBLESHOOTING HINTS

1. Compressor Operation: Turn Ignition Switch to RUN but do not start engine. Press Mode button OFF then to MAX.
   - A click can be heard when the clutch engages.
   - Alternately press Mode button to OFF and MAX several times to verify that clutch engages in the MAX position. Clutch plate movement can be run on the front of the Compressor Pulley.
   - If clutch does not engage, proceed to A/C Compressor Clutch Test.
2. Start the engine and press the MAX button to engage clutch.
   - Check that engine cooling fan runs when compressor is engaged.
   - Check that air moves freely through condenser.
   - Feel the suction pipe of the compressor or the output from the evaporator. If the pipe does not feel cold after the compressor has run for several seconds, see Section 1B for refrigerant and compressor diagnostics.

SYSTEM DIAGNOSIS

TEST A: ISOLATION TEST

1. Make the following check with a test lamp:

<table>
<tr><th colspan="2">A/C COMPRESSOR CONTROL
RELAY CONNECTOR
(Disconnected)</th></tr>
<tr><td colspan="2">Test Lamp Test: A
• Ignition Switch: RUN
• A/C Mode Selector: MAX</td></tr>
<tr><td>Terminal (Wire Color)</td><td>Test Lamp (Indication)</td></tr>
<tr><td>A (GRN/RED - L4)
A (LT BLU - V6)
to ground</td><td>Lights</td></tr>
<tr><td>A (GRY/RED - L4)
A (LT BLU - V6)
to C
(DK BLU)</td><td>Lights</td></tr>
<tr><td>E (BLK)
to ground</td><td>Lights</td></tr>
</table>

- If the test lamp lights in all checks, go to the next step.
- If the test lamp does not light at terminal A, see A/C Control Head and Pressure Switch Test.
- If the test lamp does not light from terminal A to terminal C, see ECM Test.
- If the test lamp does not light at terminal E, check BLK wire (922) and see A/C Power Relay, part of Blower Controls.

2. Connect a fused jumper between the following terminals at the A/C Compressor Control Relay.

(Continued on next page)

COMPONENT LOCATION

		Page-Figure
A/C Compressor Clutch	RH front of engine	201- 1-A
A/C Compressor Clutch Diode	Taped inside compressor connector	201- 1-A
A/C Compressor Control Relay	On rear bulkhead, left of center	201- 9-C
A/C Cut-out Switch	Engine compartment, LH end of A/C compressor	
A/C High Pressure Switch	Engine compartment, LH end of A/C compressor.	201- 1-A
Electronic Control Module	Between seats, on rear bulkhead	201- 6-A
Fuse Block	Behind LH side of I/P	201- 3-E
Pressure Cycling Switch	On accumulator	201-10-C
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A
G504	Top front, LH side of engine	201- 1-A
S504	TBI harness, in front of rear bulkhead	201- 6-A
S512	TBI harness, in front of rear bulkhead	201-10-B

AIR CONDITIONING: C60

COMPRESSOR CONTROLS

(Continued from previous page)

A/C COMPRESSOR CONTROL RELAY CONNECTOR
(Disconnected)

Jumper Test: A
- Ignition Switch: RUN
- A/C Mode Selector: MAX

Terminals (Wire Colors)	Reaction
E (BLK) to B (DK GRN)	Compressor Clutch Engages

- If the Compressor Clutch does not engage, see Compressor Clutch Test.
- If the test lamp lights in the above test and the Compressor Clutch engages when the jumper is applied, replace the A/C Compressor Relay.

TEST B: A/C CONTROL HEAD AND PRESSURE SWITCH TEST

L4 VIN R

1. Make the following test with a test lamp to ground.

A/C CONTROL HEAD CONNECTOR
(Connected)

Test Lamp Test: B1
- Ignition Switch: RUN
- A/C Mode Selector: MAX

Component	Terminal (Wire Color)	Test Lamp
A/C Control Head Connector	N (BRN)	Lights
	G (LT GRN)	Lights

- If test lamp does not light at the A/C Control Head connector, terminal N, check BRN wire (50).
- If test lamp does not light at the A/C Control Head connector, terminal G, replace A/C Control Head.

2. Check the condition of the A/C Low Pressure and A/C High Pressure switches. Remove the connector from each switch and connect a fused jumper between the terminals of the connector. Place Ignition Switch in RUN and the A/C Mode Switch in MAX, NORM, or BI-LEVEL.

- If the switch is open, the A/C Compressor Clutch will engage when the jumper is connected. If the A/C Low Pressure Switch is open, check the refrigerant pressure according to procedure in Section 1B. If pressure is below normal, refer to Section 1B for refrigerant diagnostics. If pressure is normal, replace the switch.
- If the A/C High Pressure is open, replace the switch.
- If all the switches are OK, check the wiring between the switches for an open.

V6 VIN 9

1. Make the following test with a test lamp to ground.

A/C CONTROL HEAD CONNECTOR
(Connected)

Test Lamp Test: B2
- Ignition Switch: RUN
- A/C Mode Selector: MAX

Component	Terminal (Wire Color)	Test Lamp
A/C Control Head Connector	N (BRN)	Lights
	G (LT GRN)	Lights

- If test lamp lights in both cases, go to the next step.
- If test lamp does not light at A/C Control Head connector, terminal N, check BRN wire (50).
- If the test lamp does not light at the A/C Control Head connector, terminal G, replace the A/C Control Head.

2. Remove the connector from the Pressure Cycling Switch and connect a fused jumper between the terminals of the connector. Place the Ignition Switch in RUN and the A/C Mode Switch in MAX, NORM or BI-LEVEL.

- If the switch is open, the A/C Compressor Clutch will engage when the jumper is connected. If the Pressure Cycling Switch is open, check the refrigerant pressure according to procedures in Section 1B. If pressure is normal, replace the Pressure Cycling Switch.
- If the switch is OK, check the LT GRN wire (66) and LT BLU wire (67) for opens.

(Continued on next page)

AIR CONDITIONING: C60

COMPRESSOR CONTROLS

(Continued from previous page)

TEST C: ECM TEST

1. Make the following test with a test lamp.

ECM CONNECTOR
(Disconnected)

Test Lamp Test: C1
- Ignition Switch: RUN
- A/C Mode Selector: MAX

Terminal (Wire Color)	Test Lamp Indication
C1-21 (L4 VIN R) C1-B8 (V6 VIN 9) (LT BLU) to ground	Lights
C1-21 (L4 VIN R) C1-B8 (V6 VIN 9) (LT BLU) to C1-12 (L4 VIN R) A12 (V6 VIN 9) (BLK/WHT)	Lights

- If the test lamp does not light when the LT BLU wire is tested, check the LT BLU wire (67).
- If the test lamp does not light when the LT BLU and BLU/BLK wires are tested, check the BLK/WHT wire (450) to ground.

2. Reinstall the ECM connector and remove the A/C Compressor Control Relay connector. Make the following test.

A/C COMPRESSOR CONTROL RELAY CONNECTOR
(Disconnected)

Test Lamp Test: C2
- Ignition Switch: RUN
- A/C Mode Selector: MAX

Terminal (Wire Color)	Test Lamp Indication
A (LT BLU) to C (DK BLU)	Lights

- If test lamp does not light from A to C, replace ECM after checking DK BLU wire (458).

TEST D: A/C COMPRESSOR CLUTCH TEST

Remove the connector from the A/C Compressor Control Relay. Connect a fused jumper from terminal E (BLK) to terminal B (DK GRN). Remove the connector from the A/C Compressor Clutch. Make the following tests.

A/C COMPRESSOR CLUTCH
(Disconnected)

Test Lamp Test: D
- Ignition Switch: RUN
- A/C Mode Selector: MAX
- A/C Compressor Control Relay Connector Jumpered from E to B

Terminal (Wire Color)	Test Lamp Indication
DK GRN to ground	Lights
DK GRN to BLK	Lights

- If the test lamp lights in both cases, replace the A/C Compressor Clutch.
- If the test lamp does not light from DK GRN wire to ground, check DK GRN wire (59).
- If test lamp does not light from DK GRN to BLK wire, check BLK wire (153) (L4 VIN R) or BLK wire (150) and check that the A/C Cut-Out Switch is closed (V6 VIN 9).

CIRCUIT OPERATION

The compressor for the air conditioning system is belt-driven by the engine. The A/C Compressor Clutch automatically turns the compressor on and off. This controls the cooling and also removes the air conditioning load from the engine when needed. When the A/C Selector is in MAX, NORM, BI-LEVEL, or DEF, and the refrigerant level is adequate, the A/C Compressor Clutch will engage the compressor.

The Pressure Cycling Switch (V6 VIN 9) turns the compressor off when the evaporator temperature is low enough to cause icing. The switch is located in the low pressure, or vapor side of the system. It opens when the refrigerant pressure is less than 172 kPa (25 psi). This opens the circuit to the Electronic Control Module (ECM). This switch also closes to cycle the compressor on again when the evaporator temperature and pressure rise enough to require more cooling.

The A/C Cut-Out Switch is located in the high pressure liquid side of the refrigerant system. It will open if the refrigerant pressure becomes too high.

(Continued on next page)

AIR CONDITIONING: C60

COMPRESSOR CONTROLS

(Continued from previous page)

The A/C Low Pressure Switch (L4 VIN R) and High Pressure Switch (L4 VIN R) protect against excessively high or low refrigerant pressure.

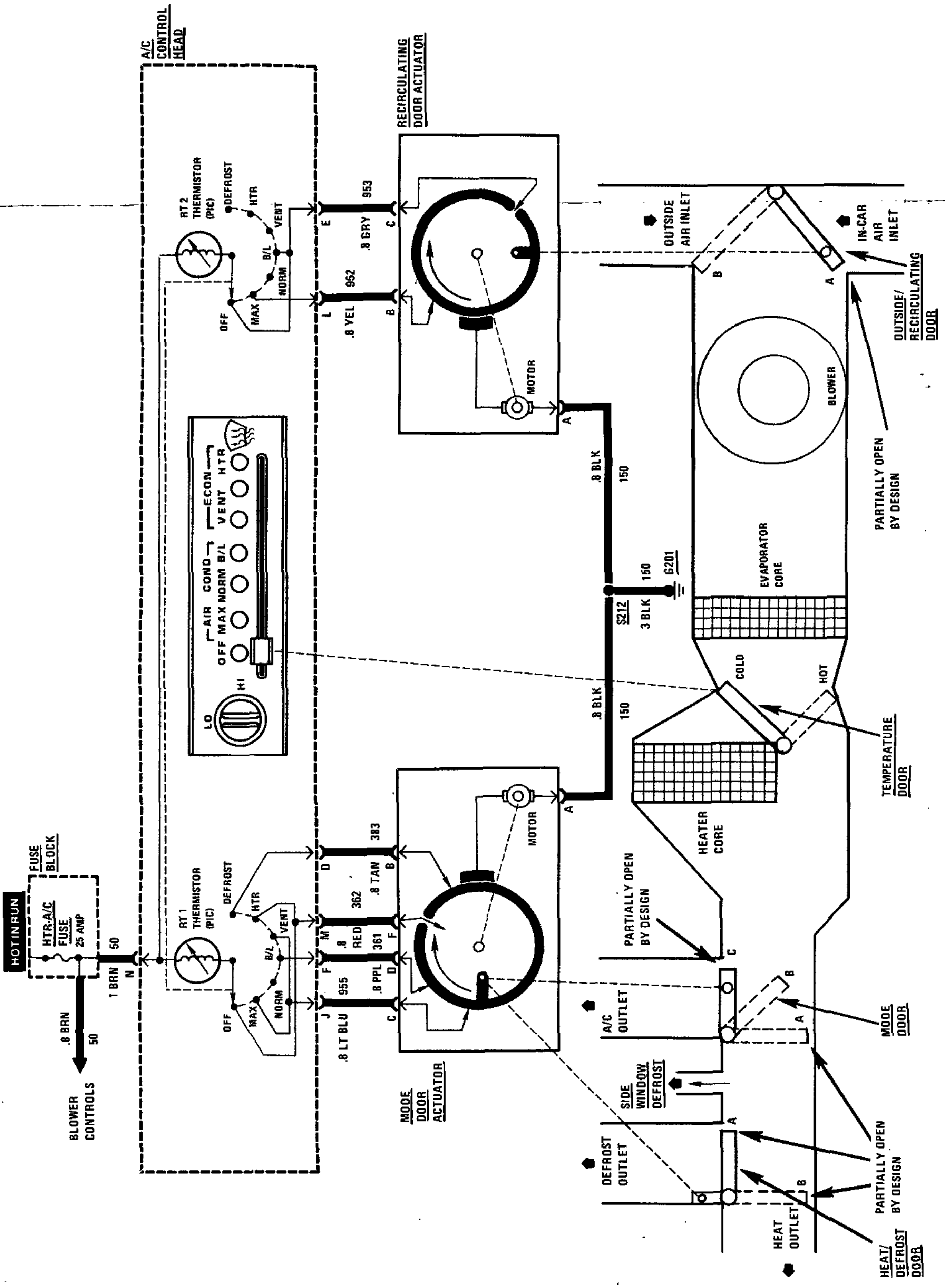
The A/C Compressor Control Relay opens and closes the circuit to the A/C Compressor Clutch. The relay coil is grounded through the ECM. This enables the ECM to control the compressor and turn off the air conditioning to reduce the load on the engine when required. The ECM also receives an air conditioner On signal. This is Battery voltage from the A/C Control Head through the Pressure Cycling Switch (V6 VIN 9) or the High and Low Pressure Switches (L4 VIN R).

This signals that the system has been turned on at the A/C Control Head, and that the Pressure Cycling Switch is calling for cooling. The ECM waits for two seconds before grounding the relay coil to turn on the compressor. This allows the engine idle speed to increase before the compressor load is applied.

A diode is connected across the A/C Compressor Clutch. It suppresses the high voltage spikes that are generated by the collapsing magnetic field of the clutch coil. These spikes occur when the clutch is turned off.

AIR CONDITIONING: C60

AIR DELIVERY



AIR CONDITIONING: C60

AIR DELIVERY

SYSTEM CHECK

Complete the Overall Air Conditioning System check in Section 8A-62.

TROUBLESHOOTING HINTS

If either of the door actuators works when first operated, but slows down or stops after a few operations, check the actuator and linkage for binding.

If actuator operation can be heard, but air delivery is not correct, check actuator linkage.

SYSTEM DIAGNOSIS

AIR DELIVERY DOES NOT SWITCH FROM RECIRCULATE TO OUTSIDE TO RECIRCULATE WHEN MODE SWITCH IS SET FROM MAX TO NORM TO MAX

Remove connector from Recirculating Door Actuator and make the following measurements.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Mode Door Actuator	*Rear of A/C/Heater Module*	201- 4-F
Outside Air Recirculation Door Actuator	Rear of A/C/Heater Module	201- 4-F
G201	Behind dash, near center	201- 3-D
S212	Main harness, behind center of dash	201- 3-D

RECIRCULATING DOOR ACTUATOR CONNECTOR
(Disconnected)

Test Lamp Test
- Ignition Switch: RUN
- A/C Mode Selector as Shown

Terminals (Wire Color)	A/C Mode Selector Position	Test Lamp
B (YEL) to ground	MAX	Lights
B (YEL) to A (BLK)	MAX	Lights
B (GRY) to A (BLK)	NORM	Lights

- If the test lamp lights in all steps and the actuator does not operate, replace *the actuator.*
- If the test lamp does not light or lights dimly in all steps, check Thermistor RT2 in the Control Head, then the Mode Switch.
- If the test lamp does not light from B to ground, check the YEL wire (952) for an open, then check the Mode Switch.
- If the test lamp does not light from terminals B to A, check the BLK wire (150) for an open, then check the Mode Switch.
- If the test lamp does not light from terminals C to A, check the GRY wire (953) for an open, then check the Mode Switch.

AIR DELIVERY DOES NOT SWITCH FROM PANEL VENTS TO PANEL AND FLOOR VENTS TO FLOOR VENTS TO WINDSHIELD AND FLOOR VENTS AS MODE SWITCH IS SET TO VENT, THEN BI-LEVEL, THEN HEAT, THEN DEFROST

Remove connector from the Mode Door Actuator and make the following measurements.

(Continued on next page)

AIR CONDITIONING: C60

AIR DELIVERY

(Continued from previous page)

A/C MODE DOOR ACTUATOR CONNECTOR (Disconnected)		
Test Lamp Test • Ignition Switch: RUN • A/C Mode Switch as Shown		
Terminals (Wire Colors)	**A/C Mode Selector Position**	**Test Lamp**
B (TAN) to ground	DEF	Lights
B (TAN) to A (BLK)	DEF	Lights
F (RED) to A (BLK)	OFF	Lights
F (RED) to A (BLK)	HTR	Lights
D (PPL) to A (BLK)	BI-LEV	Lights
B (LT BLU) to A (BLK)	MAX	Lights
B (LT BLU) to A (BLK)	NORM	Lights
C (LT BLU) to A (BLK)	VENT	Lights

- If the test lamp lights in all steps, but the Actuator does not operate, replace the Actuator.
- If the test lamp does not light or lights dimly in all steps, check Thermistor RT1 in the Control Head, then check the Mode Switch.
- If the test lamp does not light from B to ground, check TAN wire (363), then check the Mode Switch.
- If the test lamp does not light from B to A, check BLK wire (150), then check the Mode Switch.
- If the test lamp does not light from E to A, check RED wire (362), then check the Mode Switch.
- If the test lamp does not light from D to A, check PPL wire (361), then check the Mode Switch.
- If the test lamp does not light from C to A, check LT BLU wire (955), then check the Mode Switch.

CIRCUIT OPERATION

The air conditioning system uses four doors to distribute air throughout the car and to control its temperature. The air distribution doors are operated by two electric actuators controlled by the Mode Switch. The Temperature Control Door is cable operated by the Temperature Lever.

The Mode Door had three positions, routing air to the floor and Defrost vents, the Instrument Panel vents, or a mixture of both. This door is arranged to provide a slight air bypass when in either closed position. The Heat/Defrost Door routes to either the Heat Vent or the Defrost Vent with a slight air bypass in either position. An electric actuator operates both the Mode and Heat/Defrost Doors as controlled by the A/C Mode Switch. The actuator consists of a one direction electric motor, a mechanical drive train and a rotating contact assembly which can break the motor circuit in any of four positions. When any of the Mode Switch buttons is pushed the motor is energized through the contact assembly. The motor will then run until the contact asembly opens the motor circuit and the motor stops at the selected position. The actuator motion is transferred to the Mode Door and Heat/Defrost Door by two spring loaded telescopic links.

The Outside/Recirculating Door has two positions, allowing either outside air or recirculated air with a portion of outside air into the blower. An electric actuator similar to the Mode Door Actuator, but with only two positions, operates this door.

The Mode Switch contains the contacts required to select each of the seven modes shown in the table.

(Continued on next page)

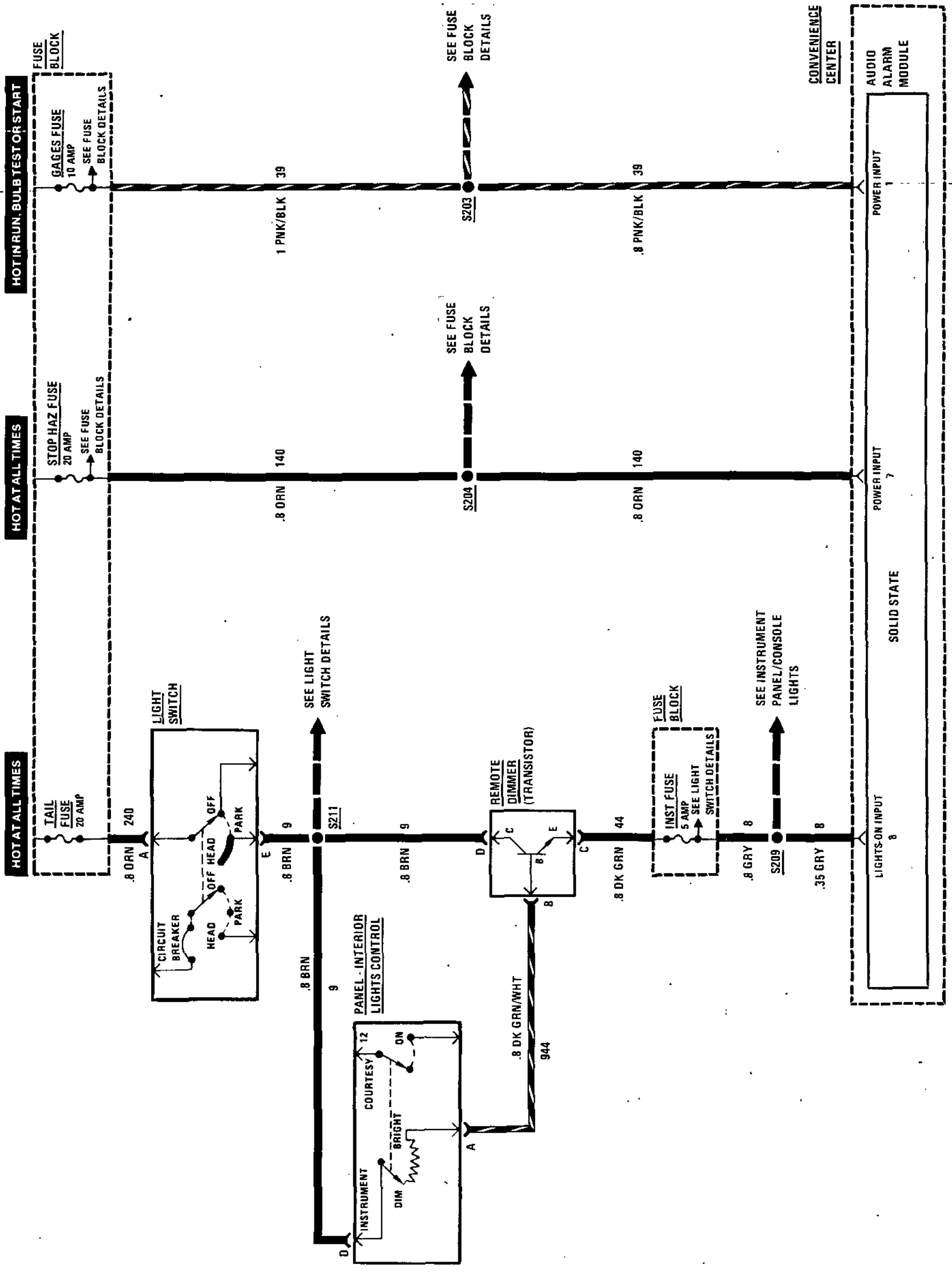
AIR CONDITIONING: C60

AIR DELIVERY

(Continued from previous page)

Mode Selector	Heat Defrost Door	Mode Door	Recir-culating Outside Air Door	Air Flow
Off	A	C	A	No Blower Operation
Max	A	A	B	Recirculated Air from Instrument Panel Outlets and Floor
Norm	A	A	A	Fresh Air from Instrument Panel Outlets and Floor
Bi-Lev	A	B	A	Fresh Air from Instrument Panel Floor and Windshield
Vent	A	A	A	Fresh Air from Instrument Panel Outlets and Floor
Heater	A	C	A	Fresh Air from Floor and bypass to Windshield
Defrost	B	C	A	Fresh Air from Windshield and bypass to Floor

WARNINGS AND ALARMS: CHIME



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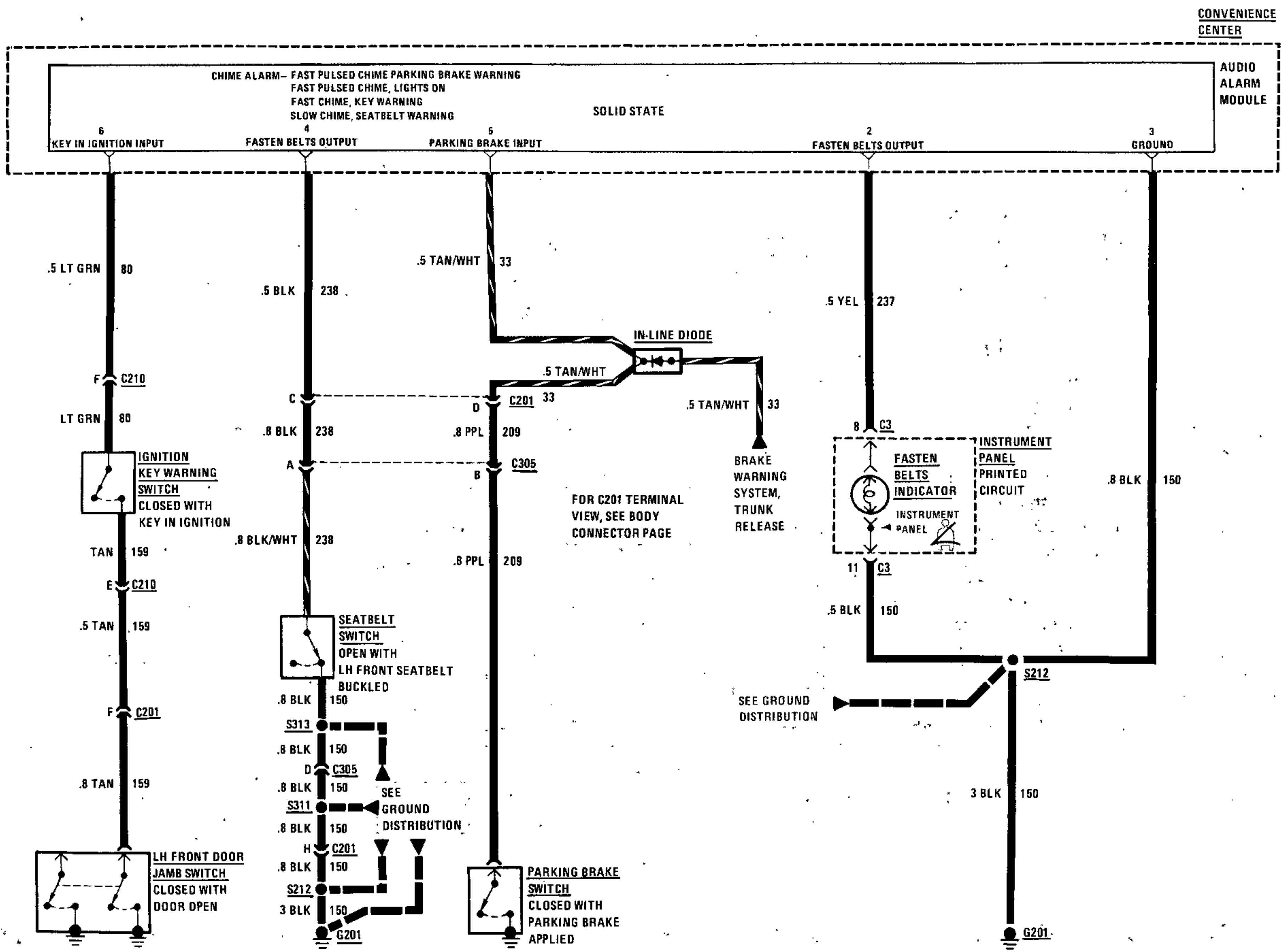
WARNINGS AND ALARMS: CHIME



WARNINGS AND ALARMS: CHIME

SYSTEM CHECK

1. SEATBELT WARNING. Sit in the driver's seat with the LH front door closed. Turn the Ignition Switch to RUN, and do not buckle the seatbelt.
   - A slow chime alarm sounds.
   - Fasten Belts Indicator lights in the Instrument Panel.
   - Chime stops and indicator goes out after 4 to 8 seconds.
2. KEY WARNING. With the Ignition Switch OFF but the key still in the ignition, open the LH front door.
   - Fast chime alarm sounds (faster than the seatbelt chime).
3. Remove the key from the Ignition Switch.
   - Alarm stops.
4. LIGHTS ON WARNING. With the key removed from the ignition, turn the Light Switch to PARK.
   - Fast pulsed chime alarm sounds (faster than key chime).
5. Turn Park Lights OFF.
   - Alarm stops.
6. PARKING BRAKE WARNING. With the Ignition Switch in RUN, depress the parking brake.
   - Fast pulsed chime alarm sounds.
7. Release parking brake.
   - Alarm stops.

COMPONENT LOCATION

		Page-Figure
Convenience Center	Behind RH side of I/P	201-17-B
Fuse Block	Behind LH side of I/P	201- 3-E
Ignition Key Warning Switch	In upper portion of steering column	201-10-A
In-Line Diode	Behind I/P near LH shroud	201- 4-C
Parking Brake Switch	On parking brake support	201- 4-E
Remote Dimmer	Right of RH steering column support	201- 5-C
Seatbelt Switch	Behind LH seat	201-14-A
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C210 (11 cavities)	Lower RH side of steering column	201- 5-B
C305 (3 cavities)	Behind dash, near LH shroud	201-14-A
G201	Behind dash, near center	201- 3-D
S203	Main harness, above steering column	201- 7-A
S204	Main harness, to right of steering column	201- 7-A
S209	Main harness, right of steering column	201- 3-D
S211	Main harness, behind RH side of cluster	201- 3-D
S212	Main harness, behind center of dash	201- 3-D
S311	Cross car harness, LH side of I/P	201-15-A
S313	Body harness, under LH front seat	201-14-A

TROUBLESHOOTING HINTS

1. Check Audio Alarm System fuses.

Fuse	To Check Fuse Operate:
TAIL	Park Lights
INST	I/P Console Lights
STOP HAZ	Hazard Flashers
GAGES	Defogger Indicator

SYSTEM DIAGNOSIS

1. If the problem seems to be with the module (no chime), remove the Audio Alarm Module from the Convenience Center. Measure the voltage to ground at each of the following terminals. Put the Ignition Switch in RUN and turn the Light Switch to PARK with the instrument panel light dimmer to BRIGHT.

VOLTAGE

AUDIO ALARM MODULE CONNECTOR

Ignition Switch in RUN
Light Switch in PARK
I/P Dimmer BRIGHT

Terminal (Wire Color)	Voltage
3 (BLK)	0
7 (ORN)	Battery
1 (PNK/BLK)	Battery

- *If any of the voltages are missing*, check the circuit and wire supplying that voltage.
- If all measurements are correct, replace the module.
- If a voltage appears at terminal 3, check G201 and the BLK wire for an open.

2. If a particular alarm does not operate:
   - Remove the Audio Alarm Module from the Convenience Center and perform the test that corresponds with the problem.

TEST LAMP

AUDIO ALARM MODULE CONNECTOR

Terminal (Wire Color)	Test Lamp	Conditions
7 (ORN) 6 (LT GRN)	Lights	LH Front Door Open and Key in Ignition
	Off	LH Front Door Closed and Key in Ignition
	Off	LH Front Door Open and Key out of Ignition
7 (ORN) 4 (BLK)	Lights	Seatbelt Unbuckled
	Off	Seatbelt Buckled
7 (ORN) 3 (BLK)	Lights	All Times
7 (ORN) 5 (TAN/WHT)	Lights	Park Brake Applied
	Off	Park Brake Off

- *If the test lamp lights*, replace the Audio Alarm Module.
- If the test lamp does not light, check the related circuit.

3. If the Fasten Belts Indicator does not light:
   - Place a fused jumper between pins 7 and 2.
   - If the Indicator does light, replace the Audio Alarm Module.
   - If the Indicator does not light, check the wiring and the Instrument Panel for opens.

CIRCUIT OPERATION

The Audio Alarm system calls attention to several conditions by sounding a built in chime. These conditions are: 1) the LH front seatbelt is not buckled, 2) the key in the ignition and the LH front door is open and, 3) the vehicle applies steady Battery voltage to light a Fasten Belts Indicator in the Electronic Cluster.

Battery voltages to operate the module is supplied at all times to the Power Input at Terminal 7. Voltage is also applied to two other inputs. One of these, at terminal 8, receives voltage from the Instrument Panel Lights whenever the Headlights or Park Lights are on. The other, at Terminal 1, receives voltage in RUN, BULB TEST, or START.

To sound the Seatbelt Warning, two inputs to the module must be present: 1) Battery voltage at the Ignition Switch Input, and 2) a ground at the Seatbelt Input. This occurs when the Seatbelt Switch is closed because the LH seatbelt is not buckled. While the slow chime sounds, the module also supplies steady Battery voltage to the Fasten Belt Output to light the indicator.

To sound the Key In Ignition Warning, both the Ignition Key Warning Switch and the LH Front Door Jamb Switch must be closed. This condition grounds Terminal 6 of the module. These switches are closed when the LH front door is open and the key is in the ignition.

WARNINGS AND ALARMS: CHIME

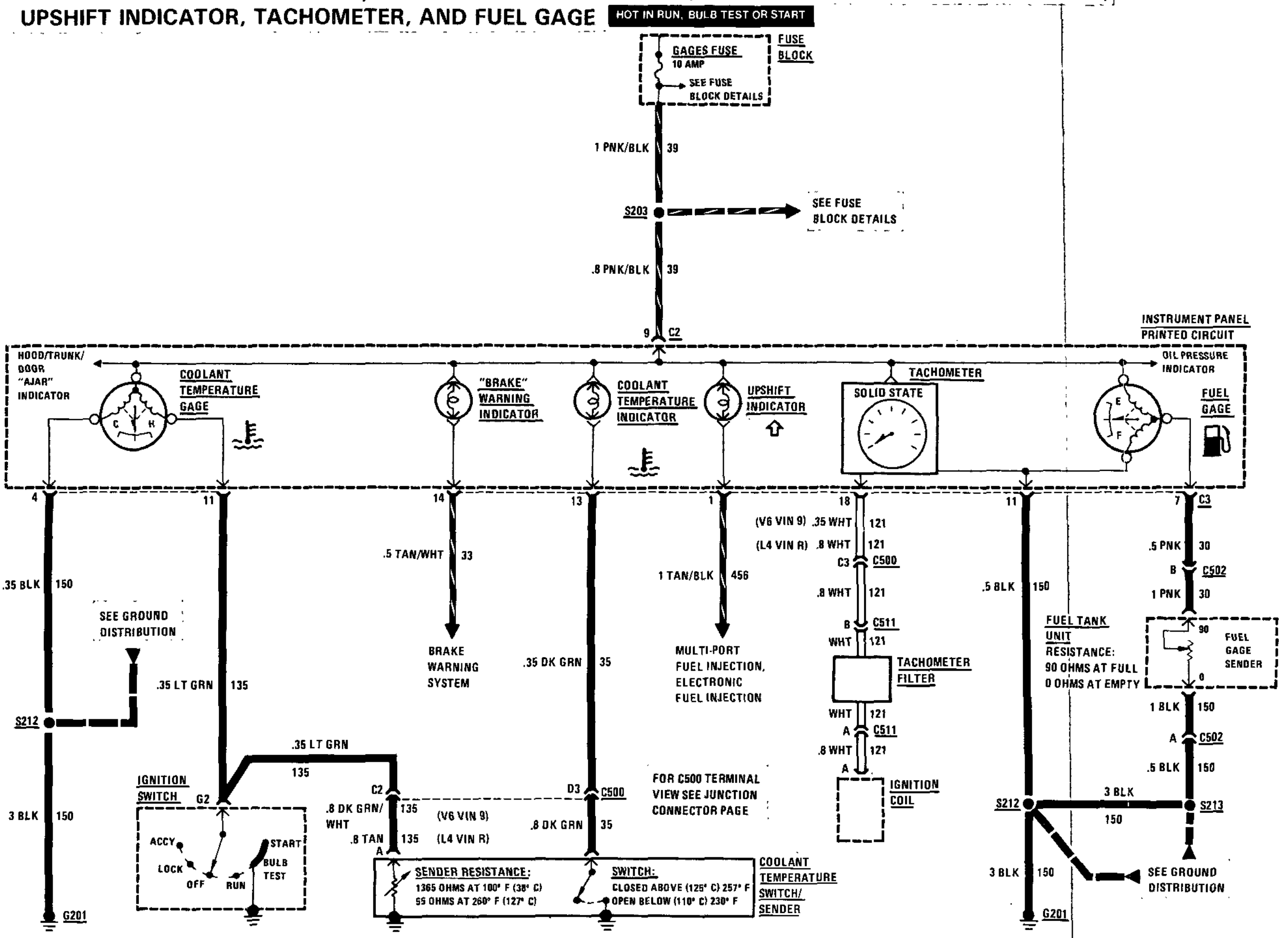
The Lights-On Warning sounds when voltage is present at the Lights-On Input, and not present at the Ignition Switch Input. If either of these changes, (lights OFF or ignition ON) the fast pulsed Lights-On chime will stop.

The Parking Brake Warning sounds when the Parking Brake is applied, and the Ignition Switch is in RUN. Once the brake is released the chime will stop.

BLANK

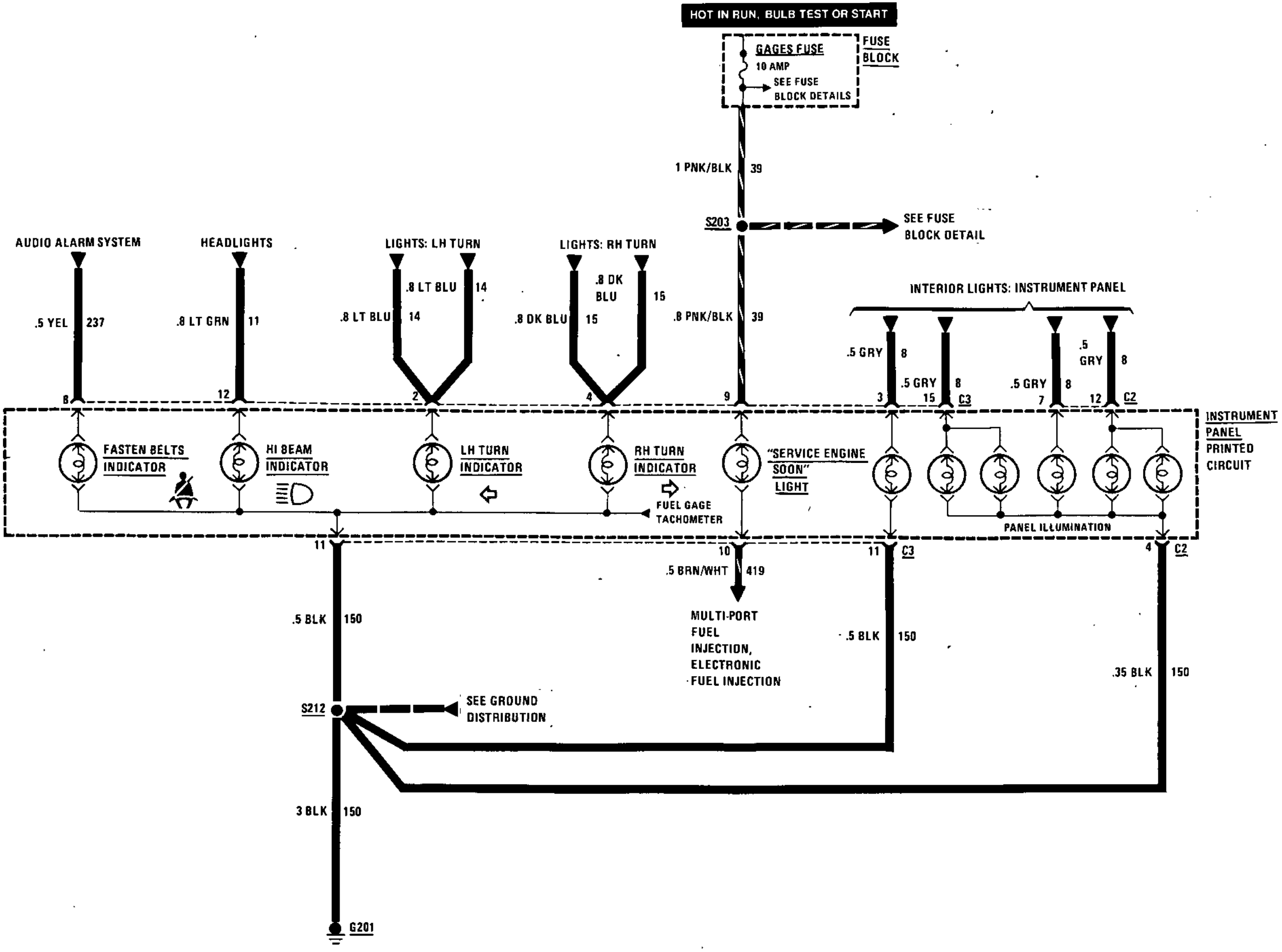
INSTRUMENT PANEL: INDICATORS CLUSTER

COOLANT TEMPERATURE GAGE, BRAKE WARNING INDICATOR, COOLANT TEMPERATURE INDICATOR, UPSHIFT INDICATOR, TACHOMETER, AND FUEL GAGE



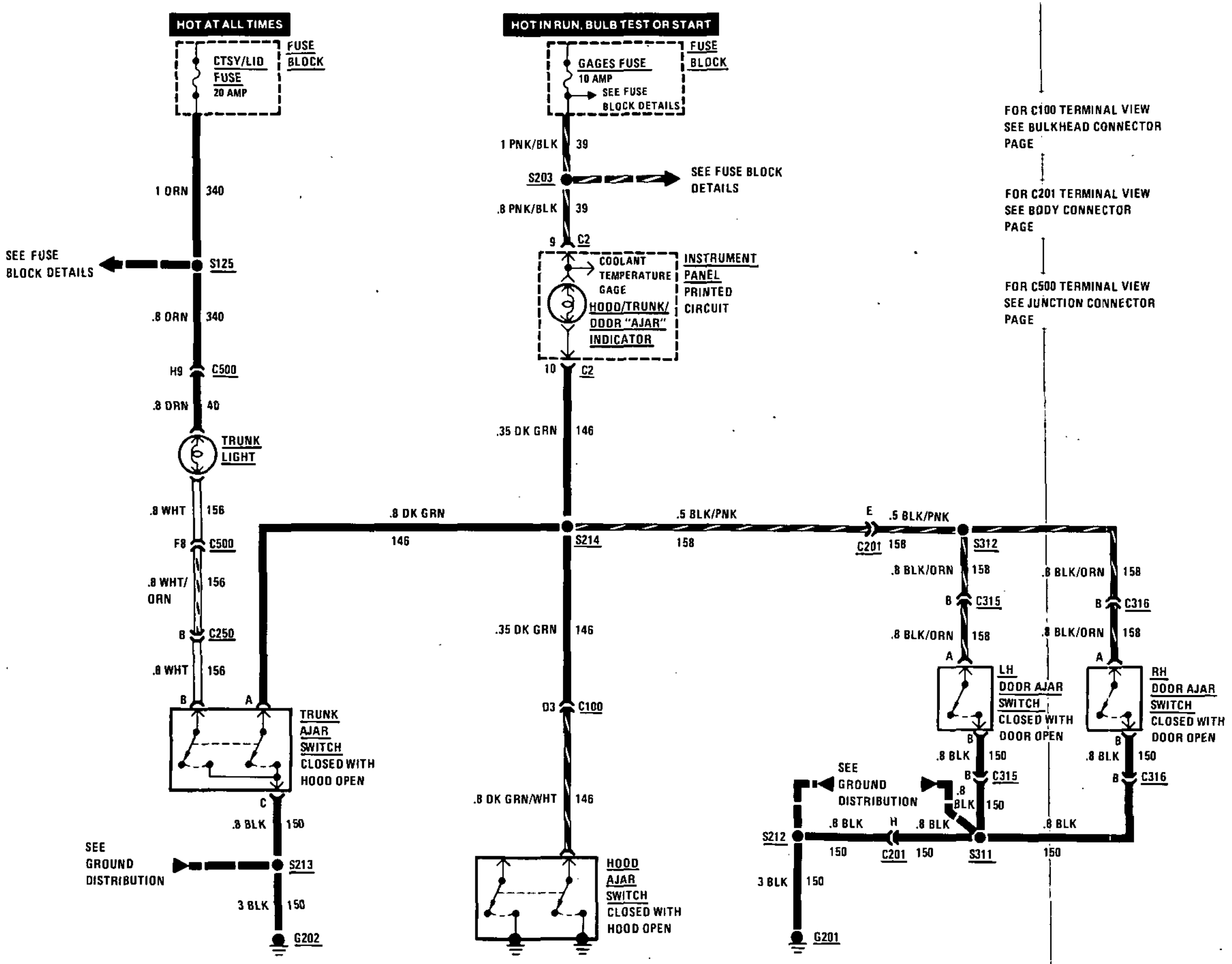
INSTRUMENT PANEL: INDICATORS CLUSTER

FASTEN BELTS INDICATOR, HI BEAM INDICATOR, TURN INDICATORS, SERVICE ENGINE SOON LIGHT



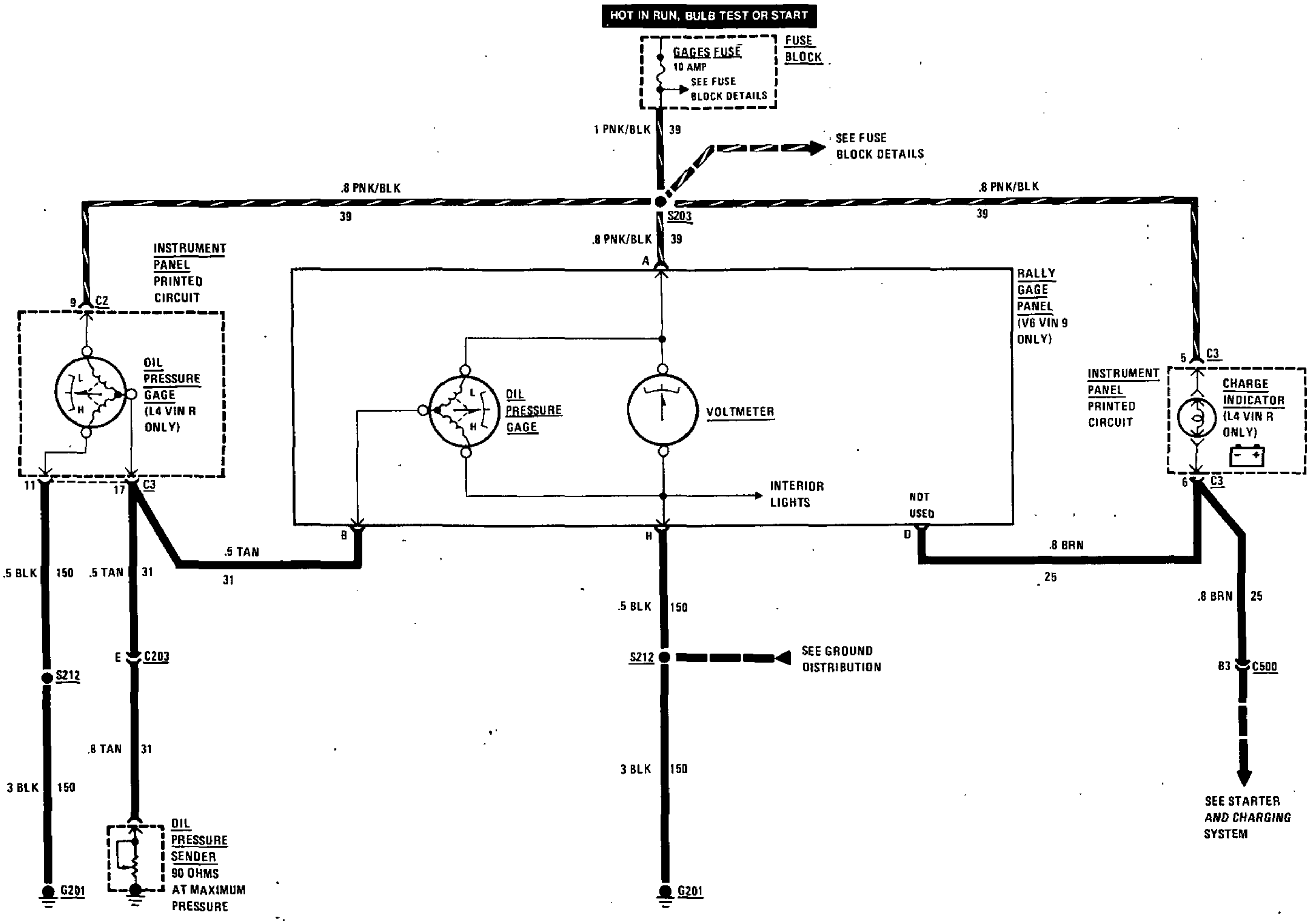
INSTRUMENT PANEL: INDICATORS CLUSTER

HOOD/TRUNK/DOOR AJAR INDICATOR



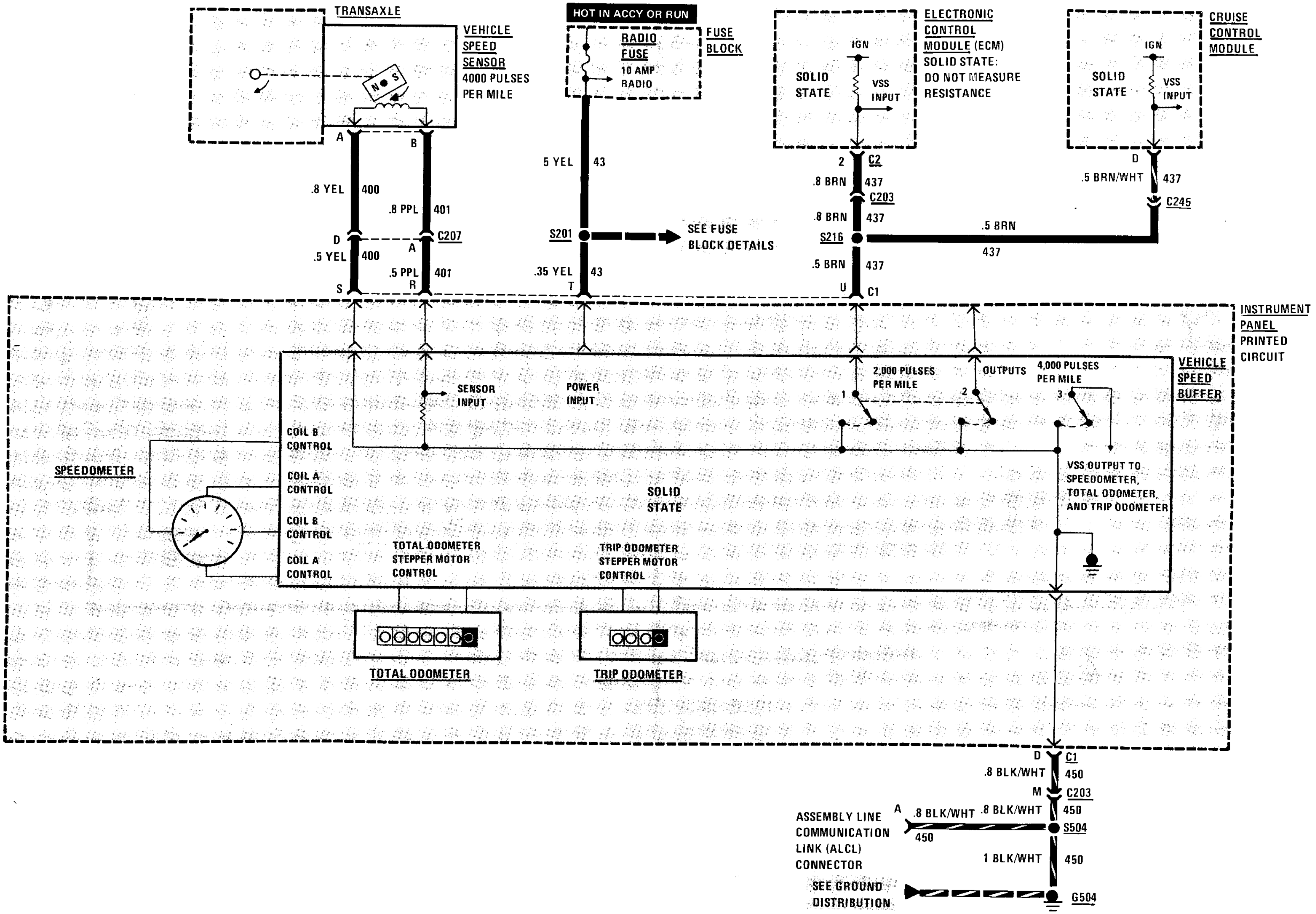
INSTRUMENT PANEL: INDICATORS CLUSTER

RALLY GAGES, OIL PRESSURE GAGE, VOLTMETER



INSTRUMENT PANEL: INDICATORS CLUSTER

ODOMETERS AND SPEEDOMETER



INSTRUMENT PANEL: INDICATORS CLUSTER

TROUBLESHOOTING HINTS

1. If none of the indicators or gages work, check Gages Fuse.
2. Check that G201 is clean and tight.

SYSTEM DIAGNOSIS

Pin-Out Tables

The tables on the following pages give the voltages or resistances you will find at C2 and C3 with the cluster removed.

- Measure all voltages to ground with the Ignition Switch in RUN.
- Measure all resistances to ground with the Ignition Switch OFF and the negative Battery cable disconnected.
- Check all ground terminals with a self-powered test lamp before making voltage or resistance measurements.

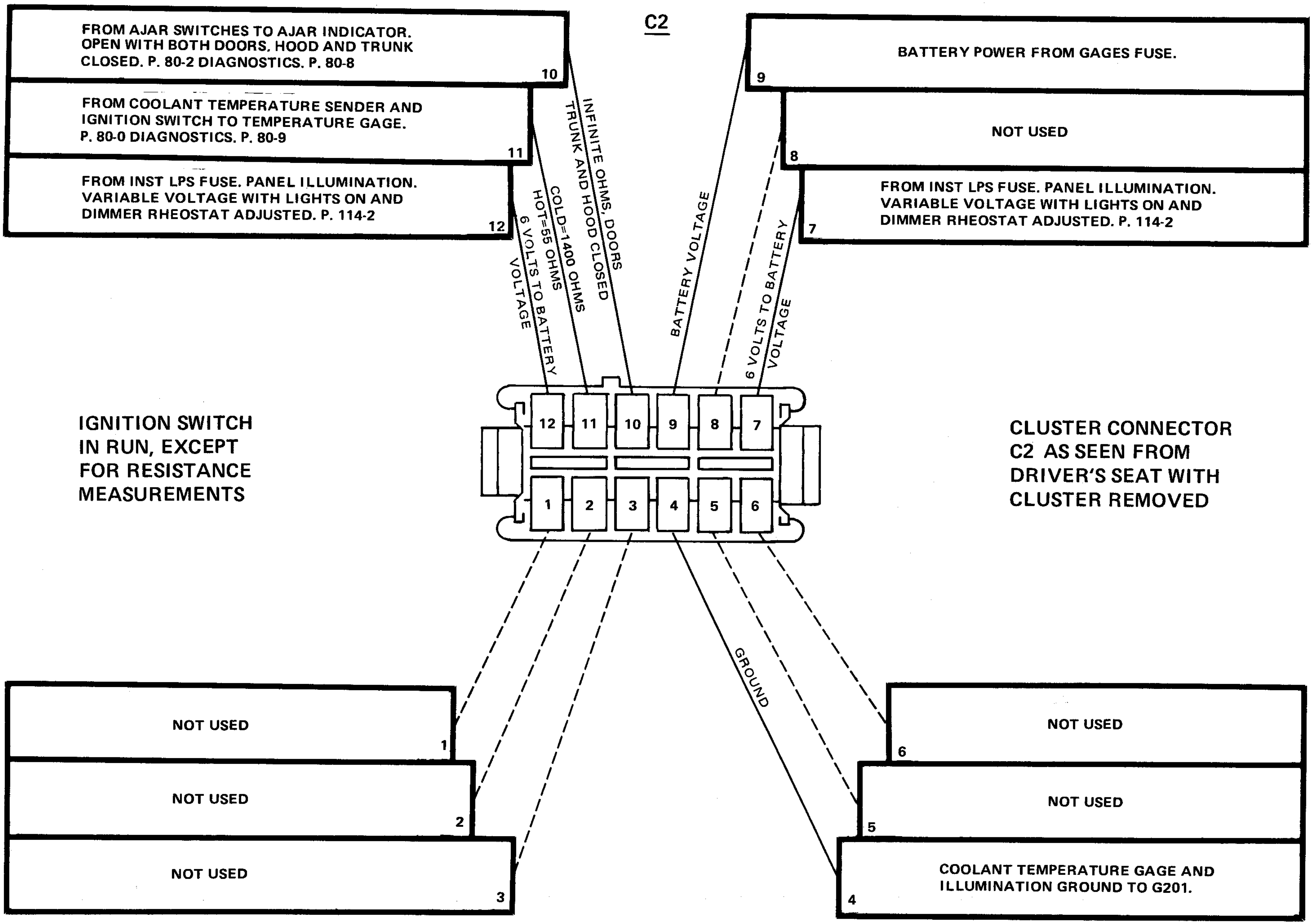
If the correct voltage or resistance is found at a terminal, and the gage that uses that terminal *does not operate, replace that gage.*

COMPONENT LOCATION

		Page-Figure
Coolant Temperature Switch/Sender	LH top front of engine	201- 1-A
Fuel Tank Unit	Top of fuel tank	
Fuse Block	Behind LH side of I/P	201- 3-E
Ignition Switch	At base of steering column	201- 5-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C203 (15 cavities)	Between seats, in front of rear bulkhead	201- 6-A
C250 (4 cavities)	RH rear of engine compartment, near battery	201-16-A
C315 (2 cavities)	LH side of steering column support, near shroud	
C316 (2 cavities)	RH side of passenger compartment, near RH shroud	
C500 (34 cavities)	Engine compartment, near *battery*	201- 3-A
C502 (3 cavities)	Engine compartment, center of rear bulkhead	201- 3-A
G201	Behind dash, near center	201- 3-D
G202	Between *seats, near rear* bulkhead	201- 3-C
S125	I/P harness, behind LH side of I/P near fuse block	201- 3-E
S203	Main harness, above steering column	201- 7-A
S212	Main harness, behind center of dash	201- 3-D
S213	Main harness, behind shift lever	201-16-A
S214	I/P harness, behind LH side of I/P	201- 7-A
S313	Body harness, under LH front seat	201-14-A

INSTRUMENT PANEL: INDICATORS CLUSTER

C2



10 FROM AJAR SWITCHES TO AJAR INDICATOR. OPEN WITH BOTH DOORS, HOOD AND TRUNK CLOSED. P. 80-2 DIAGNOSTICS. P. 80-8

11 FROM COOLANT TEMPERATURE SENDER AND IGNITION SWITCH TO TEMPERATURE GAGE. P. 80-0 DIAGNOSTICS. P. 80-9

12 FROM INST LPS FUSE. PANEL ILLUMINATION. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER RHEOSTAT ADJUSTED. P. 114-2

9 BATTERY POWER FROM GAGES FUSE.

8 NOT USED

7 FROM INST LPS FUSE. PANEL ILLUMINATION. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER RHEOSTAT ADJUSTED. P. 114-2

1 NOT USED

2 NOT USED

3 NOT USED

6 NOT USED

5 NOT USED

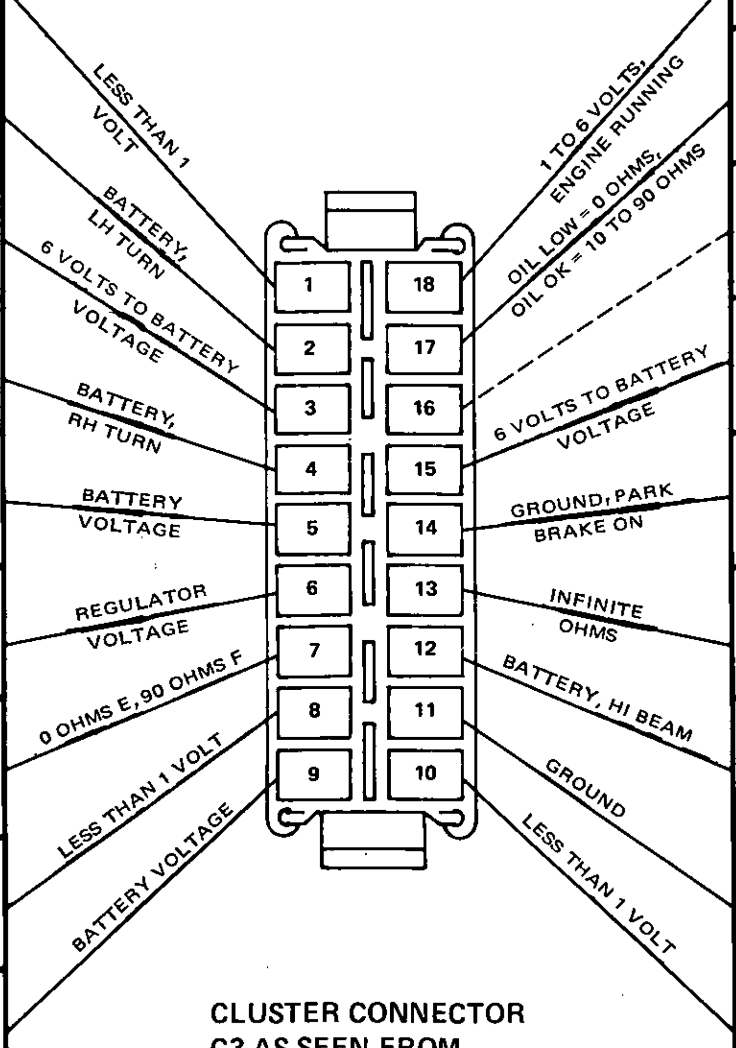
4 COOLANT TEMPERATURE GAGE AND ILLUMINATION GROUND TO G201.

IGNITION SWITCH
IN RUN, EXCEPT
FOR RESISTANCE
MEASUREMENTS

CLUSTER CONNECTOR
C2 AS SEEN FROM
DRIVER'S SEAT WITH
CLUSTER REMOVED

INSTRUMENT PANEL: INDICATORS CLUSTER

IGNITION SWITCH IN RUN, EXCEPT FOR RESISTANCE MEASUREMENTS



CLUSTER CONNECTOR C3 AS SEEN FROM DRIVER'S SEAT WITH CLUSTER REMOVED

1	FROM ECM TO UPSHIFT INDICATOR. P.80-0 DIAGNOSTICS. P.80-9
2	FROM TURN/HAZARD SWITCH TO LH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH LH TURN SIGNALS ON. P.110-0
3	FROM INST LPS FUSE. PANEL ILLUMINATION. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER RHEOSTAT ADJUSTED. P.114-2
4	FROM TURN/HAZARD SWITCH TO RH TURN INDICATOR. FLASHING BATTERY VOLTAGE WITH RH TURN SIGNALS ON. P.110-0
5	BATTERY POWER FROM GAGES FUSE TO CHARGE INDICATOR.
6	FROM GENERATOR TO CHARGE INDICATOR. SEE STARTER AND CHARGING.
7	FROM FUEL GAGE SENDER. EMPTY = 0 OHMS, FULL = 90 OHMS. P.80-0 DIAGNOSTICS. P.80-
8	FROM AUDIO ALARM SYSTEM TO FASTEN BELTS INDICATOR. BATTERY VOLTAGE FOR 10 SEC. AFTER IGNITION IN RUN, BELT UNBUCKLED. P.80-1, 77-1
9	BATTERY POWER FROM GAGES FUSE.
18	FROM IGNITION COIL TO TACHOMETER. MAKE VOLTAGE MEASUREMENT WITH ENGINE RUNNING.
17	FROM OIL PRESSURE SENDER TO OIL GAGE. OIL LOW = 0 OHMS, OIL OK= 10 TO 90 OHMS.
16	NOT USED
15	FROM INST LPS FUSE. PANEL ILLUMINATION. VARIABLE VOLTAGE WITH LIGHTS ON AND DIMMER RHEOSTAT ADJUSTED. P.114-2
14	BRAKE INDICATOR. SEE BRAKE INDICATOR. P. 41-0. OPEN WITH PARK BRAKE OFF, SYSTEM OK.
13	FROM COOLANT TEMPERATURE SWITCH TO INDICATOR. GROUNDED WITH HOT ENGINE. P.80-0 DIAGNOSTICS. P.80-9
12	FROM HEADLIGHT DIMMER SWITCH TO HI BEAM INDICATOR. BATTERY VOLTAGE WITH HEADLIGHTS ON HI BEAM. P.80-1, 100-0
11	GROUND TO G201
10	FROM ECM TO SERVICE ENGINE SOON LIGHT. P.80-1

Coolant Temperature Indicator Diagnosis

1. If the Coolant Temperature Indicator comes on with the engine running, but not overheated:
    - Remove the connector from the Coolant Temperature Switch. If the indicator goes out, install a new switch or sender.
    - If the indicator remains on, check the DK GRN (35) wire, the Ignition Switch, and printed circuit for a short to ground.
2. If the Coolant Temperature Indicator does not come on before starting the engine, and the bulb is good:
    - Ground the DK GRN (35) wire at the Coolant Temperature Switch. If the indicator comes on, the circuit is good. Replace the switch.
    - If the indicator does not come on, check the DK GRN 35 wire and the printed circuit for an open.

Hood/Trunk/Door Ajar Indicator

1. If the AJAR Indicator remains on with the Ignition Switch in RUN and the trunk, hood, and doors closed:
    - Disconnect the connector, one at a time, to each of the switches controlling the indicator.
        - — If the indicator does not go out, check the wiring between the Instrument Panel and each switch for a short to ground. If the wiring is good, check the printed circuit for a short to ground.
        - — If the indicator goes out, check the switch where the connector removal caused the indicator to go out. With the hood, trunk or door closed, use a voltmeter to measure the resistance across the switch terminals. If the switch is bad, the resistance reading will be closed to 0 ohms.
2. If the AJAR Indicator does not come on with the Ignition Switch in RUN, BULB TEST or START and the hood, trunk or door ajar:
    - Check for Battery voltage at the Instrument Panel by observing the Coolant Temperature Gage when the Ignition Switch is in BULB TEST or START.
        - — If the gage does not show H, check the wiring between the Gages Fuse and the cluster. If the wiring is good, check the printed circuit for an open and for proper mating of the Instrument Panel connector.
        - — If the gage does not show H, go to the next step.
    - Disconnect the connector to each of the switches and ground the connectors one at a time.
        - — If the indicator does not come on, check the wiring between the Instrument Panel and the switches for an open. If the wiring is good, check the printed circuit for an open and for proper mating of the connector.
        - — If the indicator comes on, check the switch where grounding the connector caused the indicator to light. With the hood, trunk, or door open, use a voltmeter to measure the resistance across the switch terminals.
            - * If the switch is bad, the resistance reading will be infinite ohms.

Fuel Gage Diagnosis

1. If the Fuel Gage shows E when there is fuel in the tank, the sender circuit may be shorted. Open the Fuel Tank Unit.
    - If the gage now reads F, the wiring is good. Install a new Fuel Tank Unit.
    - If the gage still reads E, check for a short in the PNK 30 wire between the fuel tank and the Instrument Panel. Also check the printed circuit for a short to ground. If that wire and printed ciruit are not shorted, replace the Fuel Gage.
2. If the Fuel Gage shows F when the tank is not full, open the Fuel Tank Unit connector and connect the BLK and PNK half of the harness. Use a fused jumper.
    - If the Fuel Gage now reads E, the wiring is good. Install a new Fuel Tank Unit.

- If the gage still shows F, check for an open in either the PNK 30 wire to the Instrument Panel, or the BLK 150 wire to G201. If these wires are good and there is not an open in the printed circuit, replace the Fuel Gage.

3. If the Fuel Gage is not accurate, open the Fuel Tank Unit and connect the two red clip leads of tester J-33431 to the BLK terminal and the PNK terminal of the harness half of the connector. Set the resistance dials of the tester to 0 ohms and then to 90 ohms. The Fuel Gage should read E and then F.
    - If the gage responds correctly, install a new Fuel Tank Unit.
    - If the gage does not respond correctly, check the PNK 30 wire and the printed circuit. Replace the Fuel Gage if these are OK.

Coolant Temperature Gage Diagnosis

1. If the Coolant Temperature Gage shows hot when the engine is cold, the sender circuit may be shorted. Remove the connector from the Temperature Sender Switch.
    - If the gage now shows cold, the wiring is good. Install a new Coolant Temperature Sender.
    - If the Coolant Temperature Gage remains hot, check for a short to ground in the DK GRN 35 wire between the sender and the Instrument Panel. Also check the printed circuit for a short to ground. If the wire and printed circuit are good, replace the Coolant Temperature Gage.
2. If the Coolant Temperature Gage shows cold when the engine is hot or warm, the sender circuit may be open. Remove the connector from the Temperature Sender/Switch and connect terminal 8 (TAN or DK GRN/WHT) of the harness connector to ground.
    - If the display now reads hot, the wiring is good. Install a new Coolant Temperature Sender.
    - If the display remains at cold, check for an open in the 135 wire back to the Instrument Panel. If the wiring is good, check the printed circuit for an open. Replace the Coolant Temperature Gage is the printed circuit is good.
3. If the Coolant Temperature Gage is not accurate, remove the connector from the Coolant Temperature Switch/Sender. Connect one red clip lead of the J-33431 tester to the harness connector terminal B (DK GRN/WHT or TAN), and the other red clip lead to ground. Adjust the resistance dials of the tester to 1400 ohms and then to 55 ohms. The Temperature gage should show low temperature and then hot.
    - If the gage reads correctly, the wiring and the gage are good. Install a new Coolant Temperature Switch/Sender.
    - If the gage is not correct, check the 135 wire and printed circuit. If the 135 wire and printed circuit are both OK, replace the Coolant Temperature Gage.

Tachometer Diagnosis

1. If the Tachometer does not operate, disconnect the Tachometer connector at the Ignition Coil. Connect the mating cable fromthe J-33431 tester to the connector just removed. Plug in the tester and set switches to ON, and 54 mph. With the Ignition Switch in RUN,
    - The Tachometer should read:
      6 cylinder - 1350 RPM
      4 cylinder - 1800 RPM
    - If the Tachometer does not indicate correctly, measure the voltage at Instrument Panel connector C3, terminal 18 (WHT), with the Ignition Switch in RUN (engine not running).
        — If the voltage is above 10 volts, check the printed circuit for cracks or flaws. Replace the Tachometer if these are OK.

        — If the voltage is below 10 volts, check the WHT wire to the Tachometer Filter and Ignition coil.
    - If the Tachometer indicates correctly, the cause is an intermittent or bad connection. Check all connections and wiring.

Upshift Indicator Diagnosis

See section 6E of the Chassis Service Manual.

Oil Pressure Gage Diagnosis

1. If the Oil Pressure Gage shows low after the engine has started, first 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 gage now shows high pressure the wiring is good. Install a new Oil Pressure Sender.
        - If the gage remains low, check for a short in the TAN 31 wire between the sender and the Instrument Panel. If the wire and printed circuit are not shorted to ground, replace the Oil Pressure Gage.
2. If the Oil Pressure Gage shows high before the engine is started, the sender circuit may be open. Remove the connector from the Oil Pressure Sender and short the TAN wire to ground.
    - If the gage now reads low, the wiring is good. Install a new Oil Pressure Sender.
    - If the gage remains high, check for an open in the TAN 31 wire back to the Instrument Panel. If the wire and printed circuit are good, replace the Oil Pressure Gage.
3. If the Oil Pressure Gage is not accurate, remove the connector from the Oil Presure Sender and connect one red clip lead from the J-33431 tester to the TAN wire terminal. Connect the other red clip lead to ground. Set the resistance dials of the sender to 10 ohms and then to 90 ohms. The gage should read low pressure and then show high pressure.
    - If the gage is correct, install a new Oil Pressure Sender.
    - If the gage is not correct, check the TAN 31 wire and printed circuit. If they are good, install a new Oil Pressure Gage.

Voltmeter Diagnosis

If the Voltmeter is not working properly, compare with Battery voltage. If the gage is not correct, remove the Rally Gage Panel. Check the power and ground of the voltmeter by connecting a test lamp between terminals A (PNK/BLK) and H (BLK) of the connector. With the Ignition Switch in RUN, the lamp should light.

- If the lamp lights, replace the Voltmeter.
- If the lamp does not light, check the PNK/BLK and BLK wires for an open.

Speedometer Diagnosis

If the Speedometer does not operate, remove the connector from the Vehicle Speed Sensor. Connect the mating cable from the J-33431 tester to the connector just removed. Plug in the tester, set the switches to ON, 54 mph, and 60 HZ and turn the Ignition Switch to RUN.

- The Speedometer should indicate 54 mph ± 2 mph.
- If the Speedometer indicates correctly, install a new Vehicle Speed Sensor.
- If the Speedometer does not indicate correctly, with the tester still connected and on, check for 14 volts, AC, present at Instrument Panel connector, C1, terminals R (PPL) and S (YEL).
    - If 14 volts AC is present, the wiring is good. Check the printed circuit for cracks or shorts. If none are found, replace the Vehicle Speed Buffer and Speedometer assembly.
    - If 14 volts is not present, repair either the YEL or PPL wire.

CIRCUIT OPERATION

The operation of an individual indicator is described along with its circuit. Refer to the schematic and text for the circuit that is stated below each of the indicators.

Fuel Gage

The pointer of the Fuel Gage is moved by the magnetic fields 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 through the F coil. Another goes to the variable resistor of the Fuel Gage Sender.

When the tank is low, the resistance of the sender is low. A large flow of current passes through the E coil and the Fuel Gage Sender resistor. This moves the pointer toward E on the scale. When the tank is full the sender resistance is high. More current now flows through the F coil, moving the pointer toward F on the scale.

With two coils operating the pointer, the gage is not affected by changes in the systems Battery voltage.

Coolant Temperature Indicator

The Coolant Temperature Indicator warns the driver of a high coolant temperature. With the Ignition Switch in RUN, BULB TEST or START, voltage from the Gages Fuse flows through the Coolant Temperature Indicator. In RUN, the bulb can be grounded through the Coolant Temperature Switch. The switch closes when the coolant temperature exceeds 258°F (126°C). The lamp glows.

Speedometer and Odometers

The Speedometer is operated by an electronic circuit. The Vehicle Speed Sensor, located in the transaxle, generates an AC voltage whose frequency is proportional to the speed of the vehicle. This voltage/frequency goes to the Vehicle Speed Buffer and to the Speedometer in the Instrument Panel. 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 to drive the Odometers. They are operated by a stepper motor that responds to pulses from the Speedometer circuit.

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 (the number of pulses in a second). This increases with engine speed. There is a Tachometer Filter in the circuit that rounds off the pulses and removes voltage spikes.

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 from low to high.

Coolant Temperature Gage

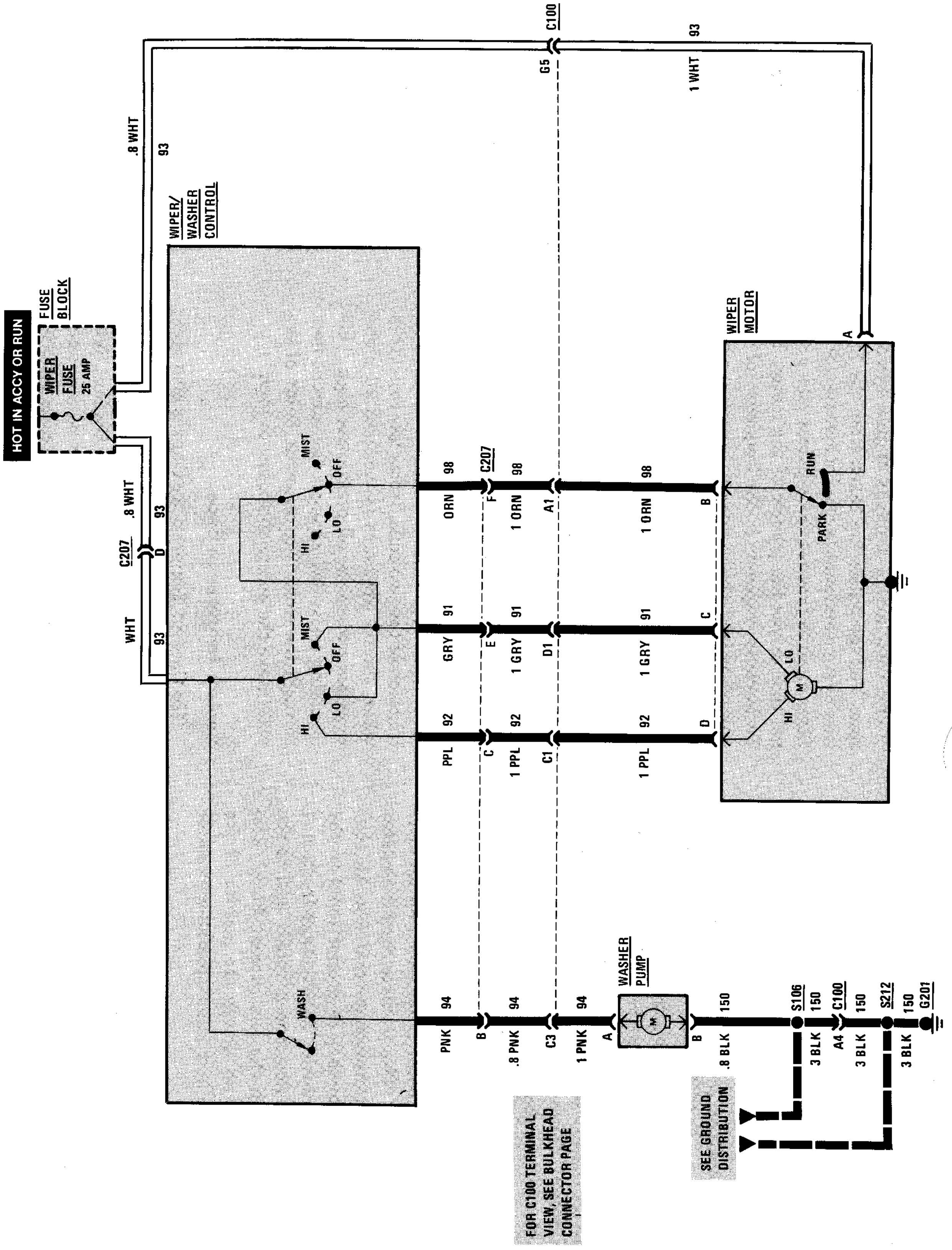
The Coolant Temperature Gage is also operated by two coils. Battery voltage is applied to both coils. One is grounded directly and the other is grounded through the Coolant Temperature Sender. This has 55 ohms resistance with hot coolant and its resistance becomes greater at lower temperatures. It is approximately 1400 ohms with cold coolant. This causes the current through the sender and one coil to increase as the coolant temperature increases. This moves the pointer.

Voltmeter

The voltmeter measures the electrical system voltage with the Ignition Switch in RUN, BULB TEST, or START. With the engine running, the Voltmeter indicates Charging System operation. With the engine stopped, the Voltmeter indicates Battery condition.

Hood/Trunk/Door Ajar Indicator

With the Ignition Switch in RUN, BULB TEST, or START, voltage is available through the Gages Fuse to the AJAR Indicator. Switches mounted in the doors, trunk, and hood complete current paths to ground.



FOR C100 TERMINAL VIEW, SEE BULKHEAD CONNECTOR PAGE

SEE GROUND DISTRIBUTION

WIPER/WASHER

SYSTEM CHECK

Perform the following checks with the Ignition Switch in ACCY.

1. Hold the Washer Switch ON.
   - Washer sprays the windshield as long as Washer Switch is ON.
   - Wipers sweep at low speed and remain in LO after the washer is released.
2. Return Wiper Switch to OFF.
   - Wipers complete sweep and park.
3. Move Wiper Switch to HI.
   - Wipers run at high speed.
4. Return Wiper Switch to OFF.
   - Wipers complete sweep and park.
5. Move Wiper Switch to MIST.
   - Wiper makes one complete sweep and parks.

TROUBLESHOOTING HINTS

1. Check the Wiper Fuse.
2. Check that the Wiper Motor mounting bolts are clean and tight.
3. If the problem is with the washer, check the washer tank, hoses, and nozzle.

SYSTEM DIAGNOSIS

1. Test for Battery voltage with a test lamp to ground at terminal D (WHT wire) at connector C207 of the Wiper/Washer Control. Put the Ignition Switch in ACCY.
   - If the test lamp does not light, check the WHT wire for an open.
   - If the test lamp lights, go to step 2 for wiper problems, step 3 if wipers will not park, or step 4 for washer problems.
2. Remove the connector from the Wiper Motor. Check for Battery voltage with a test lamp to ground at each terminal of the connector with the Ignition Switch in ACCY. The test lamp should not light in all the switch positions not listed.

TEST LAMP
WIPER MOTOR CONNECTOR
Ignition Switch in ACCY

Terminal (Wire Color)	Test Lamp	Switch Positions
A (WHT)	Lights	All times
C (GRY)	Lights	Wiper in LO, MIST
D (PPL)	Lights	Wiper in HI

   - If the test lamp does not light at a terminal, check the wire and associated circuitry to that terminal. If the wire and associated circuitry are good, replace the Wiper/Washer Control.
   - If the test lamp lights at all terminals, repair or replace the Wiper Motor. See Section 8E for diagnostic and repair procedures.
3. If the wipers run but do not complete sweep and park, check for continutiy between terminal B (ORN wire) and terminal C (GRY wire) of the Wiper Motor. Put the Ignition Switch in OFF and the Wiper/Washer Control in OFF.
   - If there is continuity, repair or replace the Wiper Motor. See Section 8E for diagnostic and repair procedures.
   - If there is no continuity, check the GRY and ORN wires and associated circuitry for an open. If the wires and associated circuitry are good, replace the Wiper/Washer Control.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Washer Pump	LH side of washer fluid reservoir	201- 9-B
Wiper Motor	Front of dash, in center	201-16-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C207 (7 cavities)	Behind dash, near windshield wiper switch	201-10-B
G201	Behind dash, near center	201- 3-D
S106	Heater-A/C harness, center of front bulkhead	201- 9-A
S212	Main harness, behind center of dash	201- 3-D

4. Remove the connector to the Washer Pump. Check for Battery voltage with a test lamp to ground, at terminal A (PNK wire) of the connector. Put the Ignition Switch to Accy and the Wash Switch to ON.
   - If the test lamp does not light, check the PNK wire and associated circuitry. If the wire and associated circuitry are good, replace the Wiper/Washer Control.
   - If the test lamp lights, go to the next step.
5. With the Washer Pump connector still removed, connect the test lamp between terminal A (PNK wire) and terminal B (BLK wire). Put the Ignition Switch in ACCY and the Wash Switch to ON.
   - If the test lamp does not light, check the BLK wire for an open.
   - If the test lamp lights, replace the Washer Pump.

CIRCUIT OPERATION

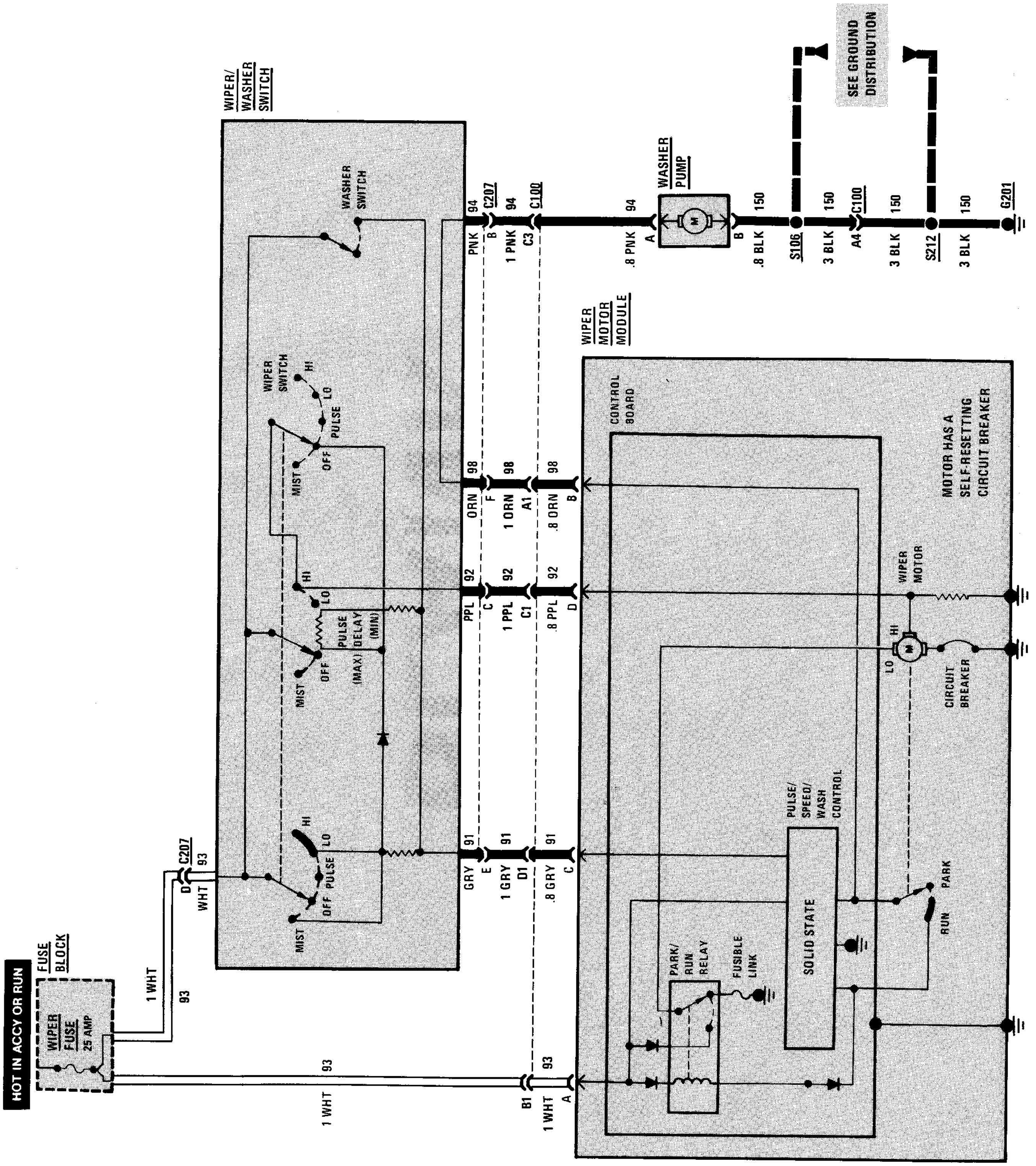
In LO or HI, voltage is applied directly to those terminals of the Wiper Motor. In the MIST position, the LO terminal receives voltage momentarily. The Wiper Switch returns to OFF when it is released.

Park

While the Wiper Motor is running, the Park-Run Switch in the Wiper Motor is in the RUN position. When the Wiper Switch is moved to OFF, voltage is still applied to the motor through the RUN contacts, the ORN wire, the Wiper Switch, and the GRY wire. The motor then completes its last sweep at low speed and returns the Park-Run Switch to the PARK position.

BLANK

WIPER/WASHER (PULSE)



WIPER/WASHER (PULSE)

TROUBLESHOOTING HINTS

1. Check the Wiper Fuse.
2. Check that the Wiper Motor Module mounting bolts are clean and tight.
3. If the problem is with the Washer, check the washer tank, hoses, and nozzle.

SYSTEM DIAGNOSIS

1. Test for Battery voltage with a test lamp to ground at terminal D, (WHT wire), at connector C207 of the Wiper/Washer Switch. Put the Ignition Switch in ACCY.
   - If the test lamp does not light, check WHT wire for an open.
   - If the test lamp lights:
     - — See Step 2 for Wiper problems.
     - — See Step 4 for Washer problems.
2. For a problem with the wipers, disconnect the Wiper Motor Module connector and measure voltages to ground with a digital voltmeter at the connector. Put the Ignition Switch in ACCY.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Washer Pump	LH side of washer fluid reservoir	201- 9-B
Wiper Motor	Front of dash, in center	201-16-A
Wiper Pulse Module	On outside of RH steering column bracket	
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C207 (7 cavities)	Behind dash, near windshield wiper switch	201-10-B
G201	Behind dash, near center	201- 3-D
S106	Heater-A/C harness, center of front bulkhead	201- 9-A
S212	Main harness, behind center of dash	201- 3-D

VOLTAGES

WIPER MOTOR MODULE CONNECTOR

Ignition Switch in ACCY

Terminal (Wire Color)	Voltage	Switch Positions
A (WHT)	Battery	All times
C (GRY)	Battery	Wiper in MIST, PULSE, LO or HI. Also with Wiper OFF and Washer ON
D (PPL)	Battery	Wiper in HI

3. With the Ignition Switch OFF and the Wiper Switch in PULSE, measure the resistance between terminal A (WHT wire) and terminal C (GRY wire) of the Wiper Motor Module connector. Ohmmeter positive lead to terminal A (WHT wire).

RESISTANCE

WIPER MOTOR MODULE CONNECTOR

Ignition Switch in ACCY

Terminal (Wire Colors)	Resistance as Pulse Control Is Turned
A (WHT) and C (GRY)	500K ohms to 10K ohms

- If a voltage or resistance measurement is not correct, check the circuit between the switch and motor module. If the circuit is good, replace the switch.
- If all measurements at the connector are correct, remove the Wiper Motor Module for repair. Refer to Section 8E for diagnostic and repair procedures.

4. For problems with the Washer, remove the Washer Pump connector and connect a test lamp between the terminals of the pump connector. Put the Ignition Switch in ACCY and the Washer Switch ON.
   - If the test lamp lights, replace the Washer Pump.

- If the test lamp does not light, go to the next step.

5. With the Washer Pump connector still removed, connect the test lamp from terminal A (PNK wire) to ground. Put the Ignition Switch in ACCY and push the Washer Switch.
   - If the test lamp lights, check the BLK (150) wire for an open.
   - If the test lamp does not light, go to the next step.
6. Reconnect the Washer Pump connector. Backprobe terminal B (ORN wire) of the Wiper Motor Module with a test lamp to ground. Push the Washer Switch.
   - If the test lamp lights, check the 94 (PNK) and 98 (ORN) circuits between the motor module and pump for an open.
   - If the test lamp does not light, go to the next step.
7. Disconnect the Wiper Motor Module connector and connect a test light from terminal C (GRY wire) to ground. Put the Ignition Switch in ACCY and push the Washer Switch.
   - If the test lamp lights, remove the Wiper Motor Module. Refer to Section 8E for diagnostic and repair procedures.
   - If the test lamp does not light, replace the Wiper/Washer Switch.

CIRCUIT OPERATION

The Wiper/Washer Switch sends information to the solid state Pulse/Speed/Wash Control that is inside the Wiper Motor Module.

Low Speed

The Park/Run Relay switches Battery voltage (WHT wire) to the Wiper Motor for low speed operation. This relay is turned on by the solid state control with a signal from the MIST, LO, or WASHER switch positions.

Park

When turned OFF, the Run/Park Switch provides a ground for the Park/Run Relay. The relay contacts stay closed and the Wiper Motor runs at low speed until the last wipe is completed.

High Speed

For high speed wiping, Battery voltage from the Wiper Switch is directly applied to a second motor terminal. This voltage bypasses the solid state control. The Wiper Switch is turned off. The wipers park at low speed under control of the Run Park Switch.

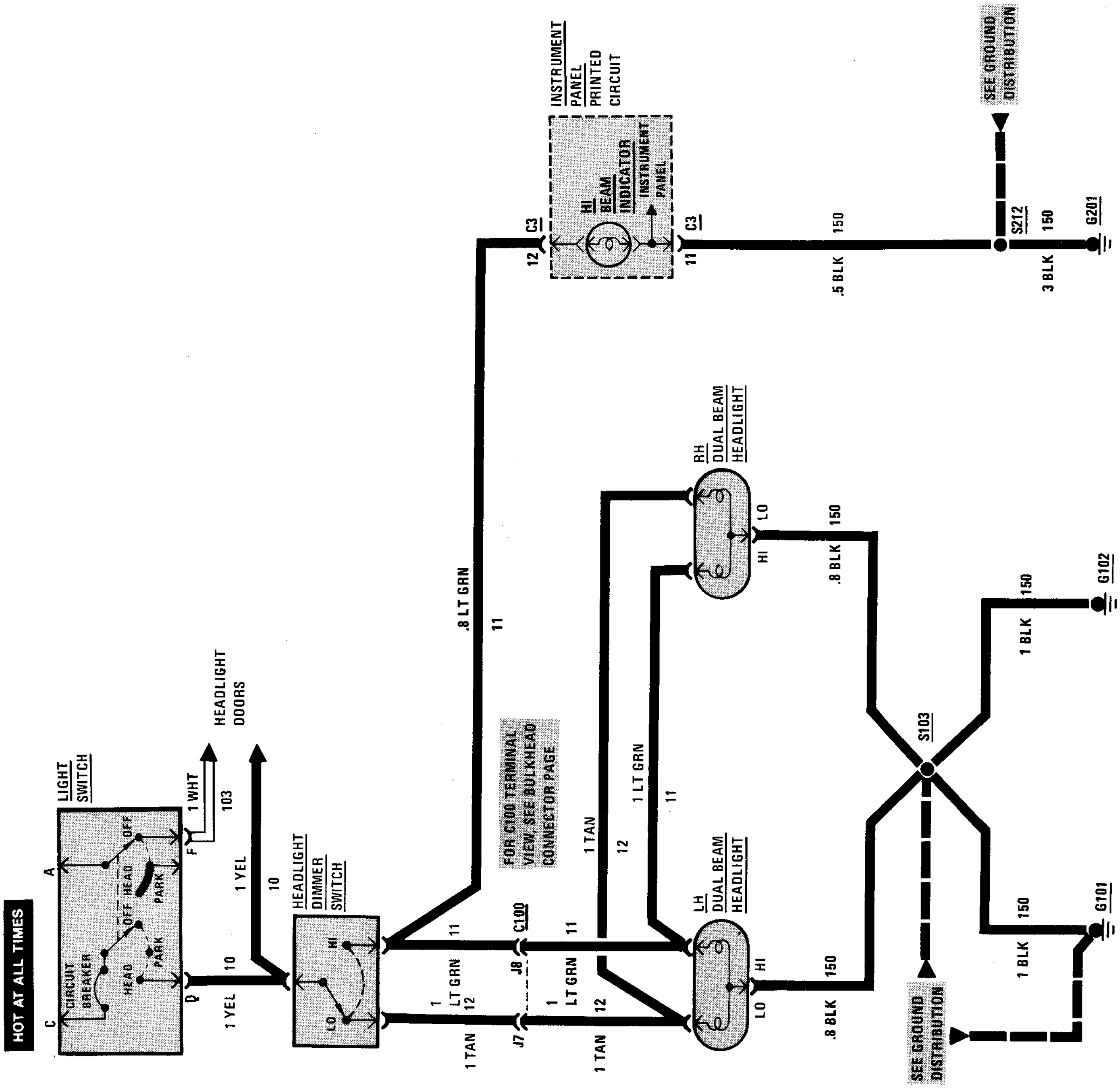
Pulse

In Pulse operation, a variable resistance in the Wiper Switch adjusts the delay time between wipes. The solid state Pulse/Speed/Wash Control establishes the delay time.

When the Washer Switch is depressed, this signals the solid state control to apply Battery voltage to the Washer Pump (ORN to PNK wires) and also to start the wiper cycle. The washer continues as long as its switch is held down. The solid state control keeps the wipers on for about six seconds after the washer goes off. If the washer is switched on during Pulse operation, the cycle of wash with six seconds of low speed wipes is completed before the system returns to delayed pulse wiping.

The Wiper Motor is protected by a built-in circuit breaker. If the wipers are blocked (by ice on the windshield, for example), the circuit breaker opens. The circuit breaker resets itself when it cools.

BLANK



FOR C100 TERMINAL VIEW, SEE BULKHEAD CONNECTOR PAGE

HEADLIGHTS

TROUBLESHOOTING HINTS

1. If both Headlights don't work in just HI or just LO, check the Headlight Dimmer Switch.
2. If Headlights flash on and off with the switch in HEAD, isolate the short to ground by operating the Headlight Dimmer Switch to find if the short to ground is in the TAN or LT GRN wires.
   - If only the Hi Headlights flash on and off, check LT GRN wires for shorts to ground.
   - If only the Lo Headlights flash on and off, check the TAN wires for shorts to ground.
   - If both Hi and Lo Headlights flash on and off, check the YEL wire for a short to ground.
3. If both filaments of a Headlight appear dim at the same time, check for an open ground at that Headlight.

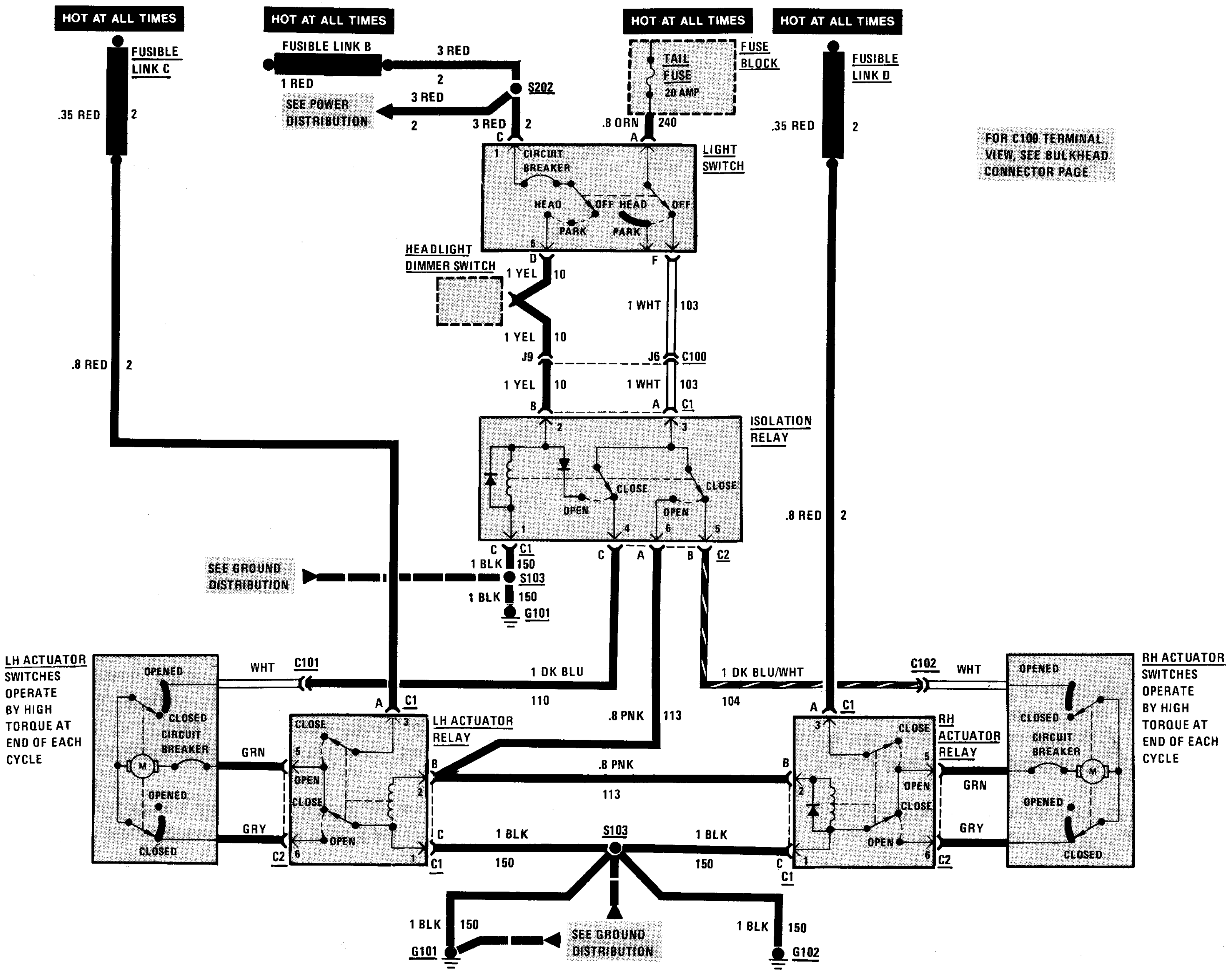
CIRCUIT OPERATION

Voltage is applied to the Light Switch at all times. The Light Switch includes a self-resetting circuit breaker which opens if the Headlight circuit draws too much current when the Light Switch is in HEAD. The Headlight Dimmer Switch applies voltage to either the Lo Beams or the Hi Beams. The voltage at the Hi Beams is also applied to the Hi Beam Indicator.

COMPONENT LOCATION

		Page-Figure
Headlight Dimmer Switch	At base of steering column, LH side	201- 5-B
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
G101	On LH fender, below headlamp.	201-11-A
G102	On RH fender, below headlamp	201-11-B
G201	Behind dash, near center	201- 3-D
S103	Front lights harness, LH front of front compartment	201- 9-D
S212	Main harness, behind center of dash	201- 3-D

HEADLIGHT DOORS



HEADLIGHT DOORS

SYSTEM CHECK

1. Turn the Headlights ON.
    - Headlight Doors open.
2. Turn the Headlights OFF.
    - Headlight Doors close.

SYSTEM DIAGNOSIS

1. Headlight Doors do no operate.
    - Check voltage at the Light Switch. With a test lamp to ground, check voltage at the following terminals. Turn the Light Switch to the positions shown:

VOLTAGE
LIGHT SWITCH

Terminal (Wire Color)	Test Lamp	Light Switch Position
A (ORN)	Lights	All Times
C (RED)	Lights	All Times
D (YEL)	Lights	HEAD
	Off	PARK, OFF
F (WHT)	Lights	OFF
	Off	PARK, HEAD

- If voltages are correct, go to the next step.
- If voltage at terminal A is incorrect, check/repair ORN (240) wire.
- If voltage at terminal C is incorrect, check/repair RED (2) wire.
- If voltage at terminals D or F is incorrect, replace the Light Switch.

COMPONENT LOCATION

		Page-Figure
Actuator	Front compartment, behind each headlamp	201-10-F
Actuator Relays	Front compartment, next to each headlamp	201-10-F
Fuse Block	Behind LH side of I/P	201- 3-E
Fusible Link B	RH front of engine compartment, at battery junction block	201- 3-A
Fusible Link C	In front lights harness, to right of brake master cylinder	201- 9-D
Fusible Link D	In front lights harness, to right of brake master cylinder	201- 9-D
Headlight Dimmer Switch	At base of steering column, LH side	201- 5-B
Isolation Relay	LH side of front compartment, to rear of side	201-10-E
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C101 (1 cavity)	Near RH side of LH headlamp assembly	201-10-F
C102 (1 cavity)	Near LH side of RH headlamp assembly	201-10-F
G101	On LH fender, below headlamp	201-11-A
G102	On RH fender, below headlamp	201-11-B
S103	Front lights harness, LH front of front compartment	201- 9-D
S202	Main harness, behind I/P	201- 7-A

- Check voltage at connector C1 of the Isolation Relay, with a test lamp at the following terminals. Turn the Light Switch to the positions shown:

VOLTAGE
ISOLATION RELAY
CONNECTOR C1

Terminal (Wire Color)	Test Lamp	Light Switch Position
A (WHT) to Ground	Lights	OFF
	Off	HEAD, PARK
B (YEL) to Ground	Lights	HEAD
	Off	OFF, PARK
B (YEL) to C (BLK)	Lights	HEAD
	Off	OFF, PARK

- If voltages are correct, go to the next step.
- If voltages are incorrect, check/repair the wiring to that terminal.

- Check voltage at connector C2 of the Isolation Relay. With a test lamp to ground, backprobe the connector at the positions shown:

VOLTAGE
ISOLATION RELAY
CONNECTOR C2

Terminal (Wire Color)	Test Lamp	Light Switch Position(s)
A (PNK)	Lights	HEAD
	Off	OFF, PARK
D (DK BLU/ WHT)	Lights	OFF
	Off	HEAD, PARK
C (DK BLU)	Lights	OFF
	Off	HEAD, PARK

- If all voltages are correct, go to the next step.
- If any voltages are incorrect, replace the Isolation Relay.

- Remove connector C1 from the LH Actuator Relay. With a test lamp to ground, check for voltage at the following terminals. Turn the Headlight Switch ON.

VOLTAGE
LH ACTUATOR RELAY
Connector C1

Step	Terminal (Wire Color)	Test Lamp
1	A (RED) to Ground	Lights
2	B (PNK) to Ground	Lights
3	B (PNK) to C (BLK)	Lights

- If all voltages are correct, repeat test at the RH Actuator Relay connector.
- If voltage is incorrect in Step 1, check/repair Fusible Link C (LH) or D (RH) and RED (2) wire.
- If voltage is incorrect in Step 2, check/repair PNK (113) wire.
- If voltage is incorrect in Step 3, check/repair BLK (150) wire.

2. One Headlight Door does not operate.

- With connector C2 of the Actuator Relay removed and the Light Switch ON, connect a test lamp to ground and check the voltage at terminal 5.
    - If the test lamp lights, go to the next step.
    - If the test lamp does not light, replace the Actuator Relay.
- Check the continuity at terminal 6 of the Actuator Relay with a self-powered test lamp to ground, and the Headlight Switch ON.
    - If the test lamp lights, go to the next step.
    - If the test lamp does not light, replace the Actuator Relay.
- Check voltage at connector C101 (LH) or C102 (RH) with a test lamp to ground and the Light Switch OFF.
    - If the test lamp does not light, check/repair DK BLU (110) wire (LH) or DK BLU/WHT (104) wire (RH).
    - If the test lamp lights, replace the actuator.

CIRCUIT OPERATION

Voltage is applied at all times through Fusible Link B to the Light Switch, terminal C and through the Tail Fuse to Light Switch terminal A. Voltage is also applied at all times through Fusible Link C to the LH Actuator Relay, and through Fusible Link D to the RH Actuator Relay.

If the Light Switch is moved from OFF to PARK, the Headlight Doors will remain closed.

HEADLIGHT DOORS

Opening Doors

When the Light Switch is moved to HEAD, voltage is applied to connector Cl YEL wire, terminal B of the Isolation Relay, and the Relay Coil. The Isolation Relay contacts move to the OPEN position. Voltage is then applied through the Isolation Relay contacts, PNK wires, to the Actuator Relay coils. The Actuator Relay contacts move to the OPEN position. This applies a voltage from Fusible Link C through the RED wire, the Actuator Relay contacts, the GRN wires, to the motors. The motors open the Headlight Doors. When the Headlight Doors are fully open, the actuator contacts move to the OPEN position and voltage to the motor is cut off.

Closing Doors

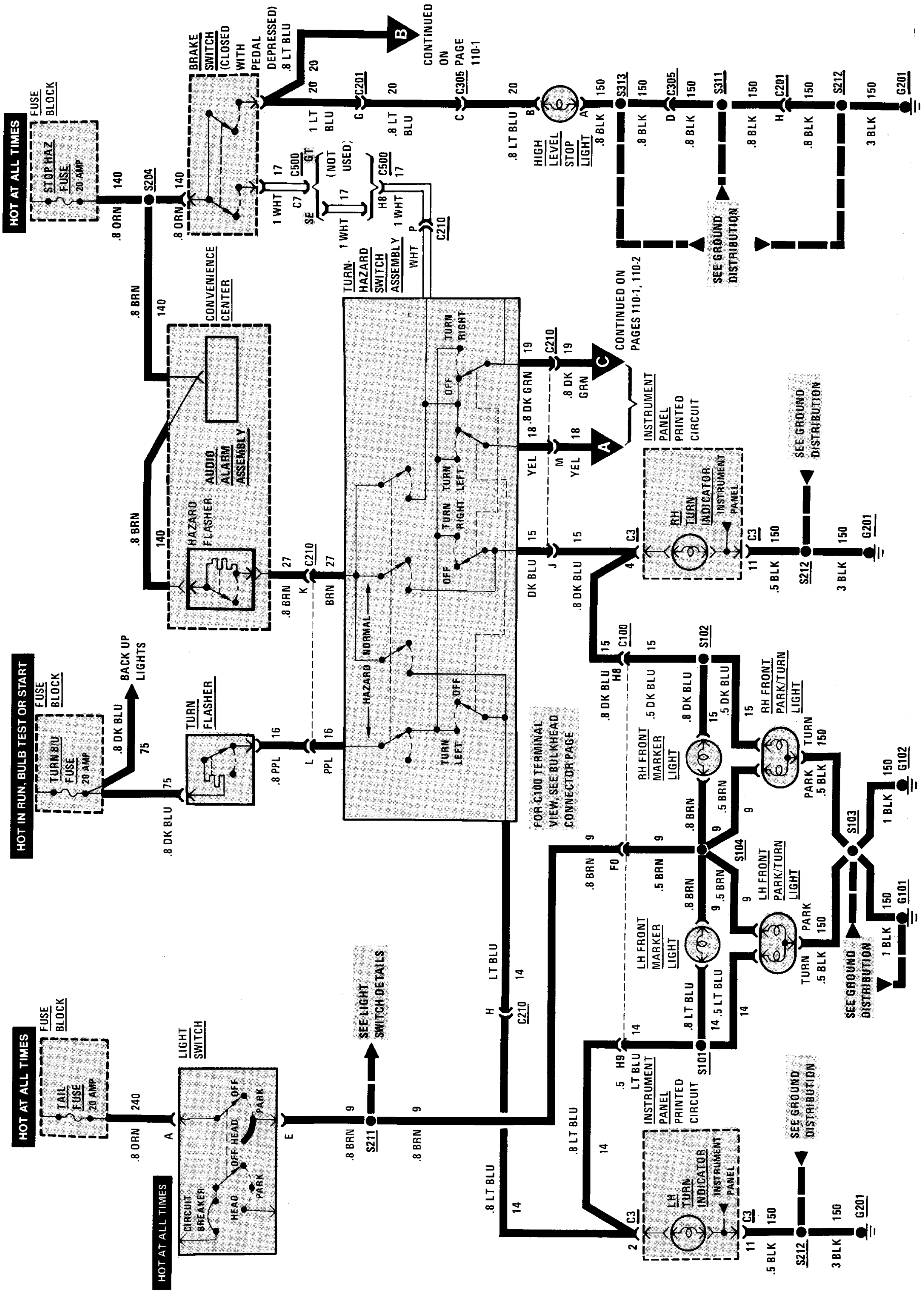
When the Light Switch is moved from HEAD to PARK or OFF, voltage is no longer applied to the Isolation Relay coil terminal 2. The contacts of the Isolation Relay and LH and RH Actuator Relays move to the CLOSE positions.

With the Light Switch in OFF, voltage is applied from the Tail Fuse to terminal A of the Light Switch, the Isolation Relay contacts, the DK BLU wire, the WHT wire, LH actuator motor, GRN wire, and LH Actuator Relay contacts to G101. The motor closes the Headlight Door. When the Headlight Door is fully closed, the Actuator contacts move to the CLOSE position and voltage to the motor is cut off.

Headlight Replacement

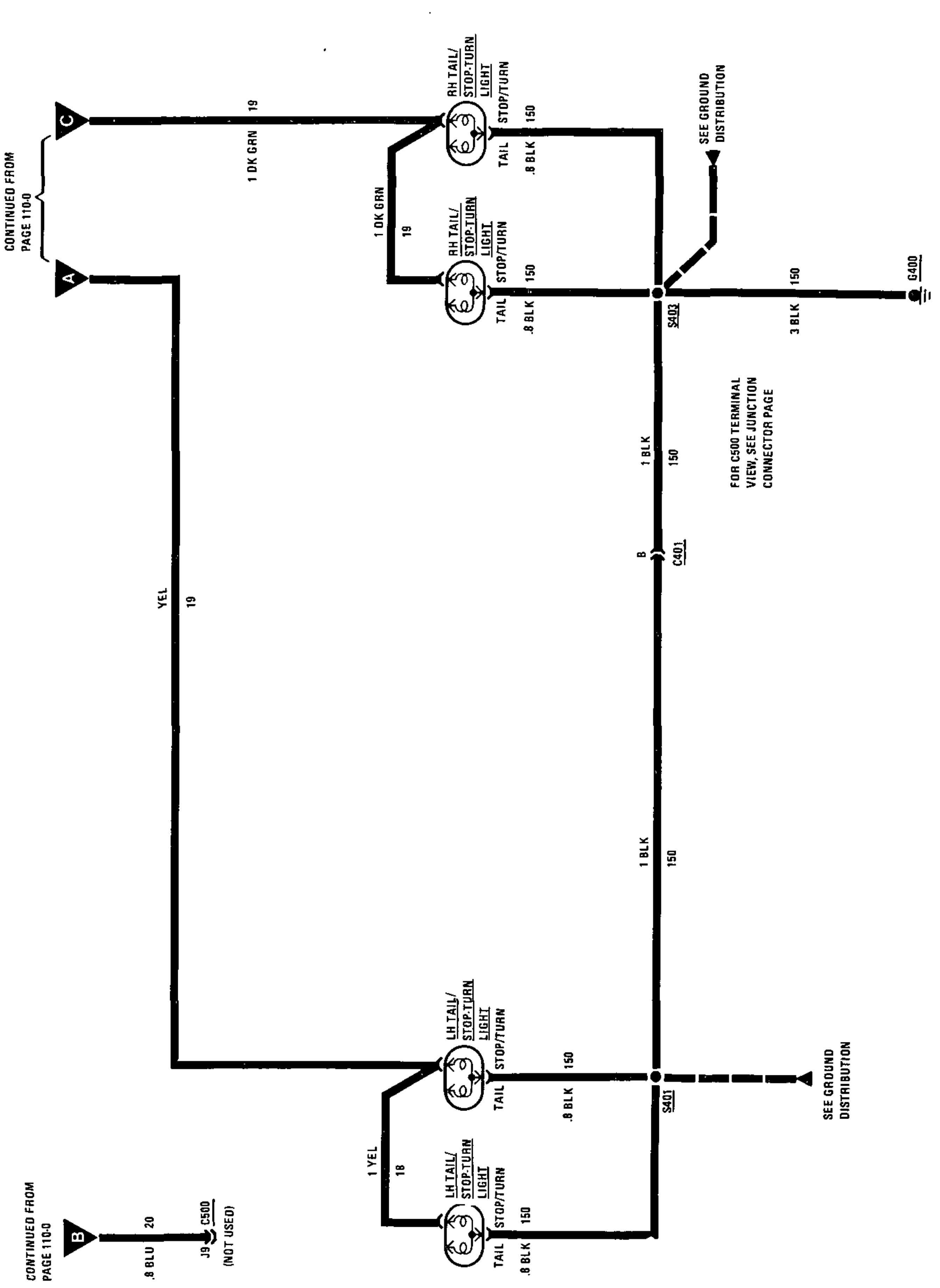
1. Press the Light Switch to PARK.
2. Slowly press the Light Switch to HEAD position; do not snap into position.
3. When Headlight doors are fully open, release the Light Switch. The doors will stay open.
4. Press the Light Switch to OFF to close doors.

EXTERIOR LIGHTS: TURN/HAZARD/PARK/FRONT MARKER/STOP/HIGH LEVEL STOP



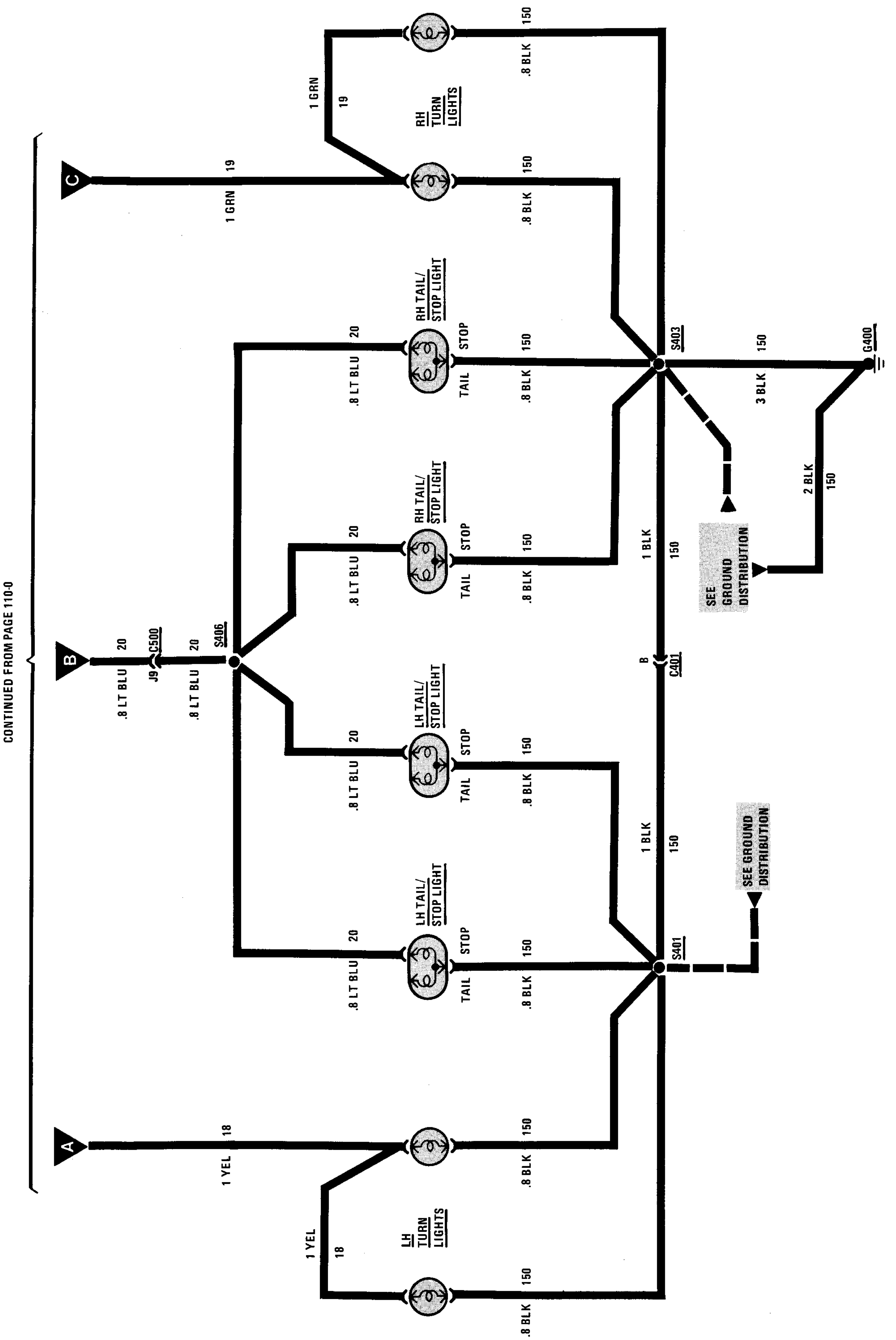
EXTERIOR LIGHTS: TURN/HAZARD/STOP

SE MODELS ONLY

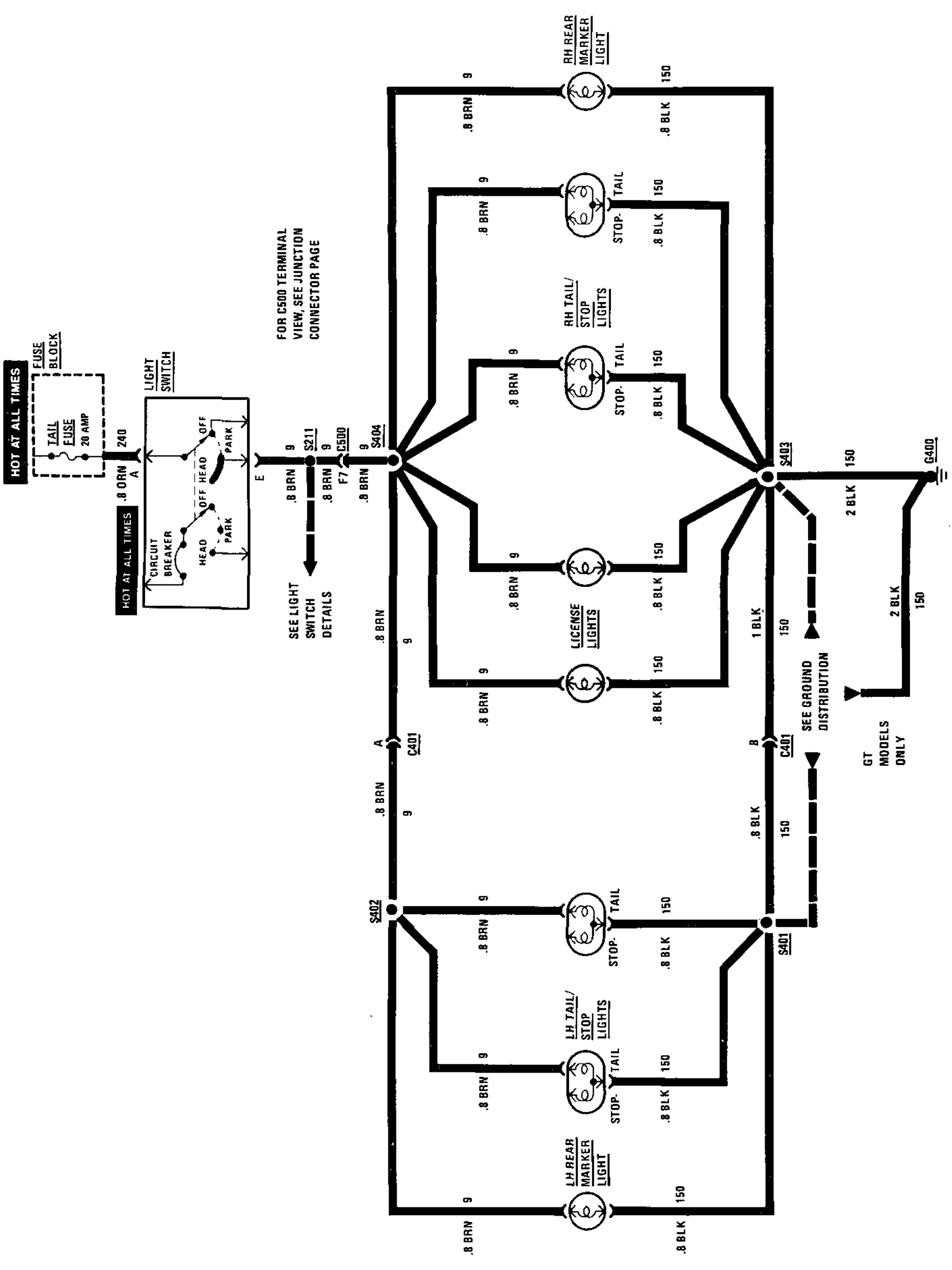


EXTERIOR LIGHTS: TURN/HAZARD/PARK/STOP

GT MODELS ONLY

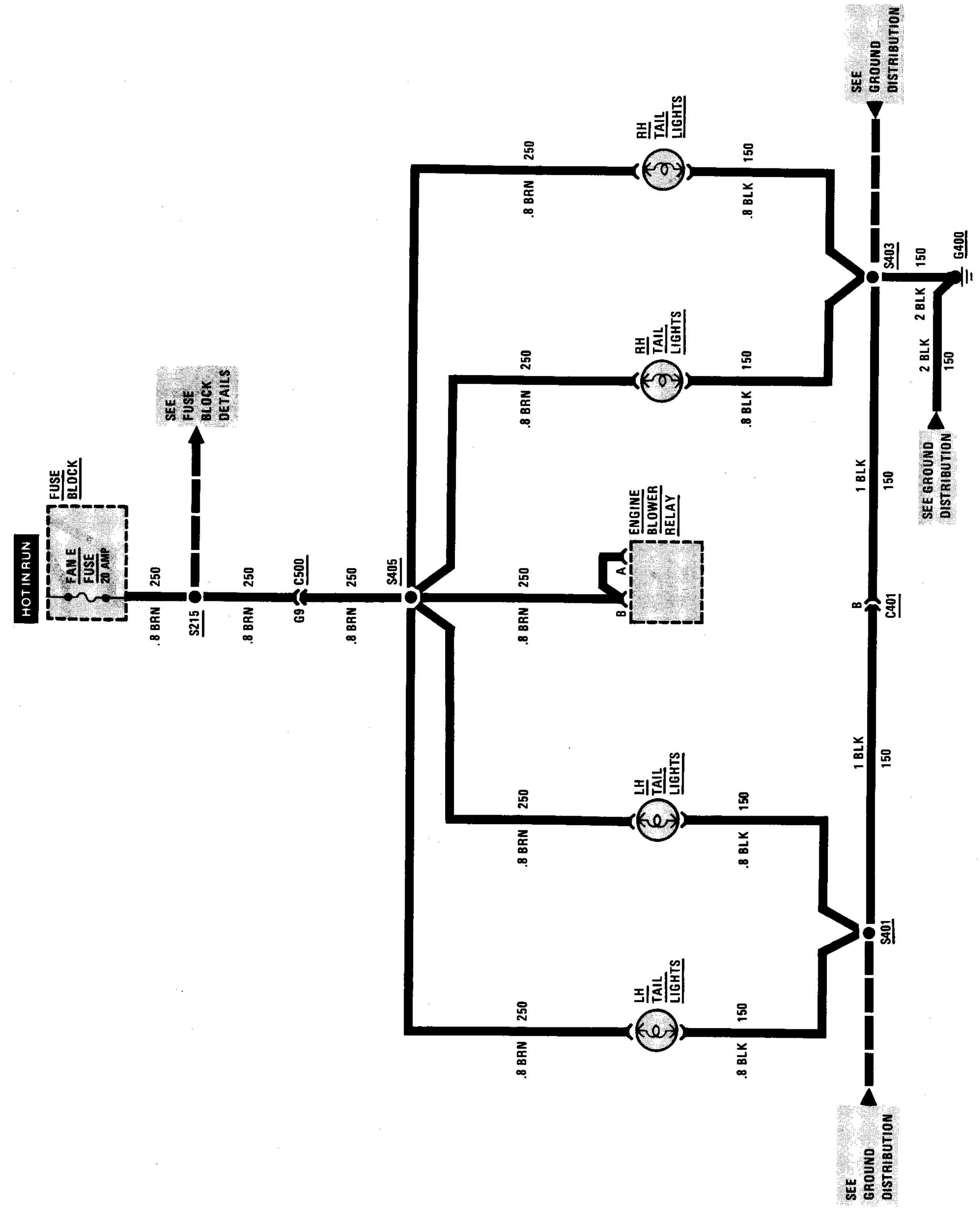


EXTERIOR LIGHTS: TAIL/REAR MARKER/LICENSE



EXTERIOR LIGHTS: REAR PONTIAC EMBLEM

GT MODELS ONLY



EXTERIOR LIGHTS

TROUBLESHOOTING HINTS

Turn

1. If none of the Turn Lights flash:
   - Check the Turn B/U Fuse by operating the Back Up Lights.
   - Check the Turn Flasher, the Turn Hazard Switch Assembly, and related wiring.
2. If only one Turn Light doesn't flash:
   - Check for a faulty bulb.
   - Check that its ground is clean and tight.

Hazard

1. If none of the lights flash in HAZARD:
   - Check the Stop/HAZ Fuse by operating the Stop Lights.
   - Check the Hazard Flasher, the Turn-Hazard Switch Assembly and related wiring.
2. If only one Hazard Light doesn't flash:
   - Check for a faulty bulb.
   - Check that its ground is clean and tight.

Stop

If both Stop Lights don't go on:

- Check the Stop/HAZ Fuse by operating the Hazard Lights.
- Check that G400 is clean and tight.
- Check the Brake Switch, the Turn-Hazard Switch Assembly, and related wiring.

COMPONENT LOCATION

		Page-Figure
Brake Switch	Top of brake pedal support	201- 8-A
Convenience Center	Behind RH side of I/P	201-17-B
Engine Blower Relay	RH rear of engine, near battery	
Fuse Block	Behind LH side of I/P	201- 3-E
Turn Flasher	Outside of LH steering column bracket	201- 4-D
Turn/Hazard Switch	At top of steering column	201-10-A
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C210 (11 cavities)	Lower RH side of steering column	201- 5-B
C305 (3 cavities)	Behind dash, near LH shroud	201-14-A
C401 (2 cavities)	Taped to rear lights harness, to right of license plate lamps	
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G101	On LH fender, below headlamp	201-11-A
G102	On RH fender, below headlamp	201-11-B
G201	Behind dash, near center	201- 3-D
G400	RH rear of engine compartment	
S101	Front lights harness, RH front of front compartment	201- 9-D
S102	Front lights harness, LH front of front compartment	201- 9-D
S103	Front lights harness, LH front of front compartment	201- 9-D
S104	Front lights harness, LH front of front compartment	201- 9-D
S204	Main harness, to right of steering column	201- 7-A
S211	Main harness, behind RH side of cluster	201- 3-D
S212	Main harness, behind center of dash	201- 3-D
S215	Main I/P harness, behind I/P, RH of steering column	201-16-A
S311	Cross car harness, LH side of I/P	201-15-A
S312	Cross car harness, LH side of I/P	201-15-A
S313	Body harness, under LH front seat	201-14-A
S401	Rear lights harness, LH side of back panel	201-12-A
S402	Rear lights harness, LH side of back panel	201-12-A
S403	Rear lights harness, RH side of back panel	201-12-A

EXTERIOR LIGHTS

High Level Stop Light

If the High Level Stop Light does not come on:

- Check the Stop-HAZ Fuse by operating the Hazard Flashers.
- Check the Brake Switch and related wiring.
- Check that G201 is clean and tight.

Front Park and Front Marker

1. If none of the Park or Marker Lights come on:
   - Check the Tail Fuse.
   - Check the Light Switch and related wiring.
2. If just the LH Front Park and Marker Lights don't come on:
   - Check power and ground to the bulb.
3. If just the RH Front Park/Front Marker Lights come on:
   - Check power and ground to the bulb.

License, Tail, or Rear Marker

1. If none of the License, Tail of Rear Marker Lights come and:
   - Check the Tail Fuse.
   - Check that G400 is clean and tight.
2. Check that the Front Park/Front Marker Lights come on.
   - If they don't go on, check connectors below C500.
   - If they don't go on, check the Light Switch and related wiring.

GT Models Only

If no Rear Pontiac Emblem Lights go on:

- Check the Fan E Fuse.
- Check that ground G400 is clean and tight.
- Check that the Coolant Fan goes on.
- If it goes on, check the wiring below C500.
- If it doesn't go on, check the related wiring back to the fuse.

COMPONENT LOCATION

		Page-Figure
S404	Rear lights harness, RH side of back panel	201-12-A
S405	Body rear harness, RH rear of car	201-12-A
S406	Body rear harness, behind RH stop lights	201-12-A

CIRCUIT OPERATION

Stop Lights

Voltage is applied to the Stop Lights through the Stop/HAZ Fuse, Brake Switch, and the Turn-Hazard Switch Assembly. With the Turn Switches in the OPEN position, the Stop Lights will operate when the brake pedal is depressed and the Brake Switch closes.

Turn Lights

Battery voltage is applied to the LH Stop-Turn Light through the Turn B/U Fuse, Turn Flasher, Hazard Switch, and the Turn-Left Switches in the Turn-Hazard Switch Assembly. Both Turn Left Switches close to the left at the same time. When the switch connected to the YEL wire closes, the LH Stop-Turn Light operates and the LH Turn Indicator will light. When the switch connected to the LT BLU wire closes, the LH Front Turn Light and the LH Turn Indicator will light. They begin to flash when current heats up the timing element in the Turn Flasher, and it repeatedly opens and closes the circuit.

The RH Turn Lights operate in a similar way when the Turn Right Switches are closed to the right.

(For SE Models Only)

If the Brake Switch is closed at the same time as the Turn Left Switches, the LH Turn Lights continue to operate through the Turn Flasher. The RH Stop-Turn Light at the rear glows steadily as long as the Brake Switch is closed.

(For GT Models Only)

If the Brake Switch is closed at the same time as the LH Turn Lights, the Brake Lights will remain on. The Turn Lights will continue to operate independently of the Brake Lights.

EXTERIOR LIGHTS

Hazard Lights

(For SE Model Only)

With the Hazard Switches in the HAZARD position, voltage for all lamps is supplied through the Hazard Flasher. The Stop-Turn Lights will flash repeatedly.

(For GT Models Only)

With the switches in the HAZARD position voltage is supplied to the Turn Lights through the Hazard Flasher. The Turn Lights will flash repeatedly. The Brake Lights will remain off.

Front Marker Lights

The Front Marker Lights receive voltage from either the Front Park Lights or the Front Turn Lights.

With the Park Lights on, Battery voltage is supplied through the BRN wires to the both Front Marker Lights. The path to ground for the marker bulb 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 LT 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 Park bulbs.

If both the Park Lights and either the LH or RH 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. With the Turn Lights off, however, the Marker bulb on that side will light since it is now grounded through the Turn Lights.

License, Tail and Rear Marker

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 to all of the lights in this circuit.

GT Models

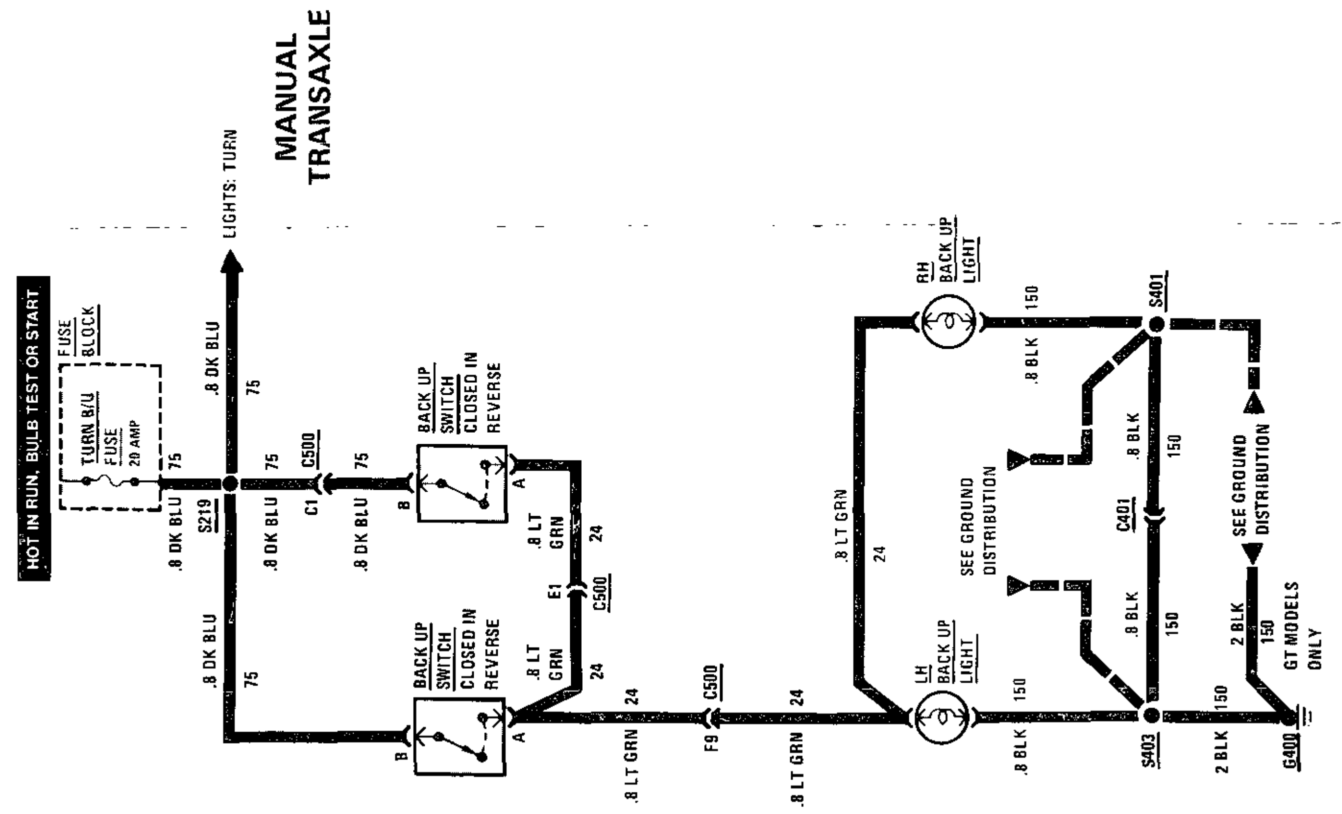
For the Rear Pontiac Emblem Lights, voltage is applied through the Fan E Fuse to the Emblem Lights with the Ignition Switch in RUN. The lights will remain on as long as the Ignition Switch is in the RUN position, displaying the Pontiac Emblem.

High Level Stop Light

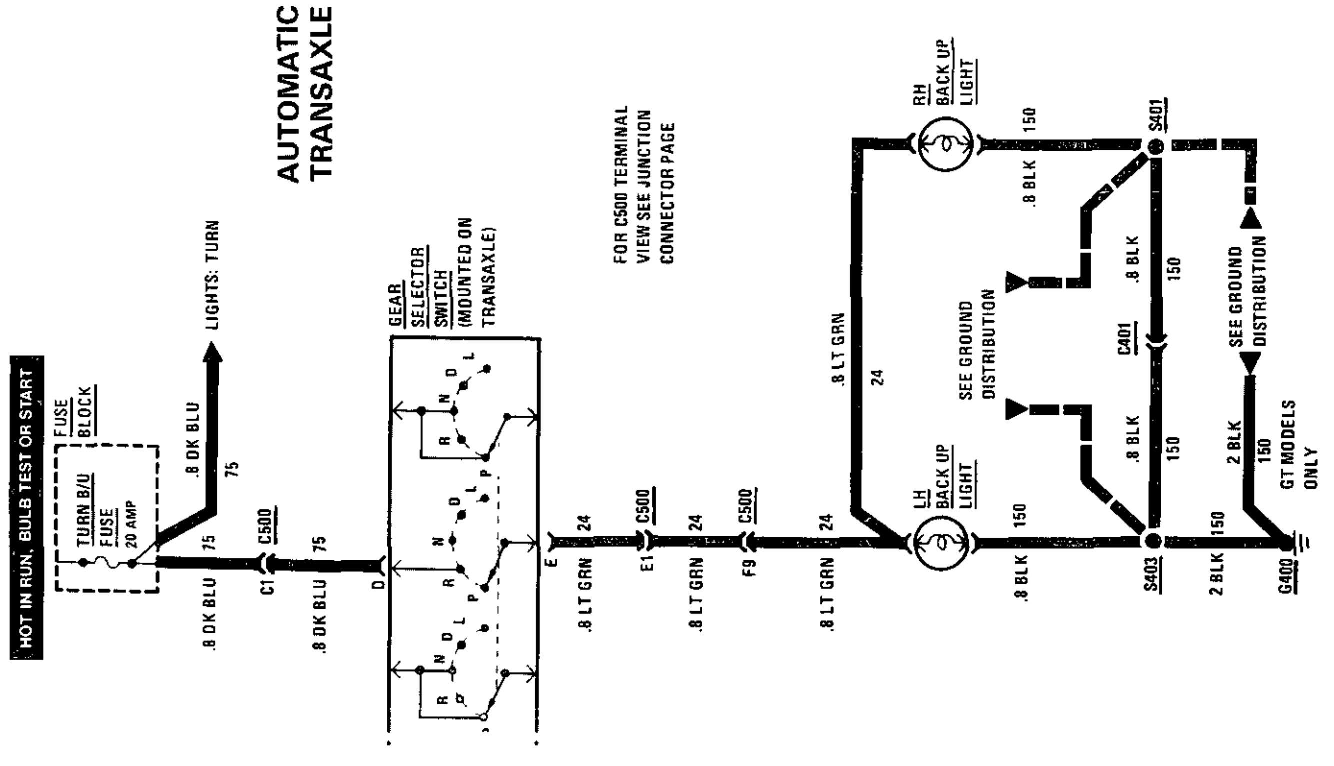
Voltage is applied at all times from the Stop/HAZ Fuse to the Brake Switch. When the brake pedal is depressed, the High Level Stop Light comes on.

K UP LIGHTS

MANUAL TRANSAXLE



AUTOMATIC TRANSAXLE



FOR C500 TERMINAL VIEW SEE JUNCTION CONNECTOR PAGE

BACK UP LIGHTS

TROUBLESHOOTING HINTS

1. If both Back Up Lights don't work:
   - Check the Turn B/U Fuse by operating the Turn Lights.
   - Check the Back Up Switch adjustment by moving the Gear Selector Lever to REVERSE (with manual transmission).
   - Check that G400 is clean and tight.
2. If only one doesn't work, check the related circuit for an open.

SYSTEM DIAGNOSIS

Automatic Transaxle

If both Back Up Lights don't work:

1. Secure the car so that it won't roll backwards. With the Ignition Switch in RUN, place the Gear Selector Switch in REVERSE. Attach a test lamp to pin D (DK BLU wire) of the Gear Selector Switch and ground.
   - If the test lamp does not light, check the DK BLU (75) wire for an open. Also check C500 for a loose connection.
2. If the test lamp does light, attach it to pin E of the Gear Selector Switch and ground.
   - If the test lamp lights, replace the Gear Selector Switch.
   - If the test lamp does not light, make sure the bulbs are good. Check for circuit for an open. Also check C401 for a loose connection.

COMPONENT LOCATION

		Page-Figure
Back Up Switch	At base of shifter, on LH side	201- 6-B
Fuse Block	Behind LH side of I/P	201- 3-E
Gear Selector Switch	Left of engine, top of transaxle	201- 1-B
C401 (2 cavities)	Taped to rear lights harness, to right of license plate lamps	
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G400	RH rear of engine compartment	
S219	Main I/P harness, behind center I/P	201-16-A
S401	Rear lights harness, LH side of back panel	201-12-A
S403	Rear lights harness, RH side of back panel	201-12-A

Manual Transaxle

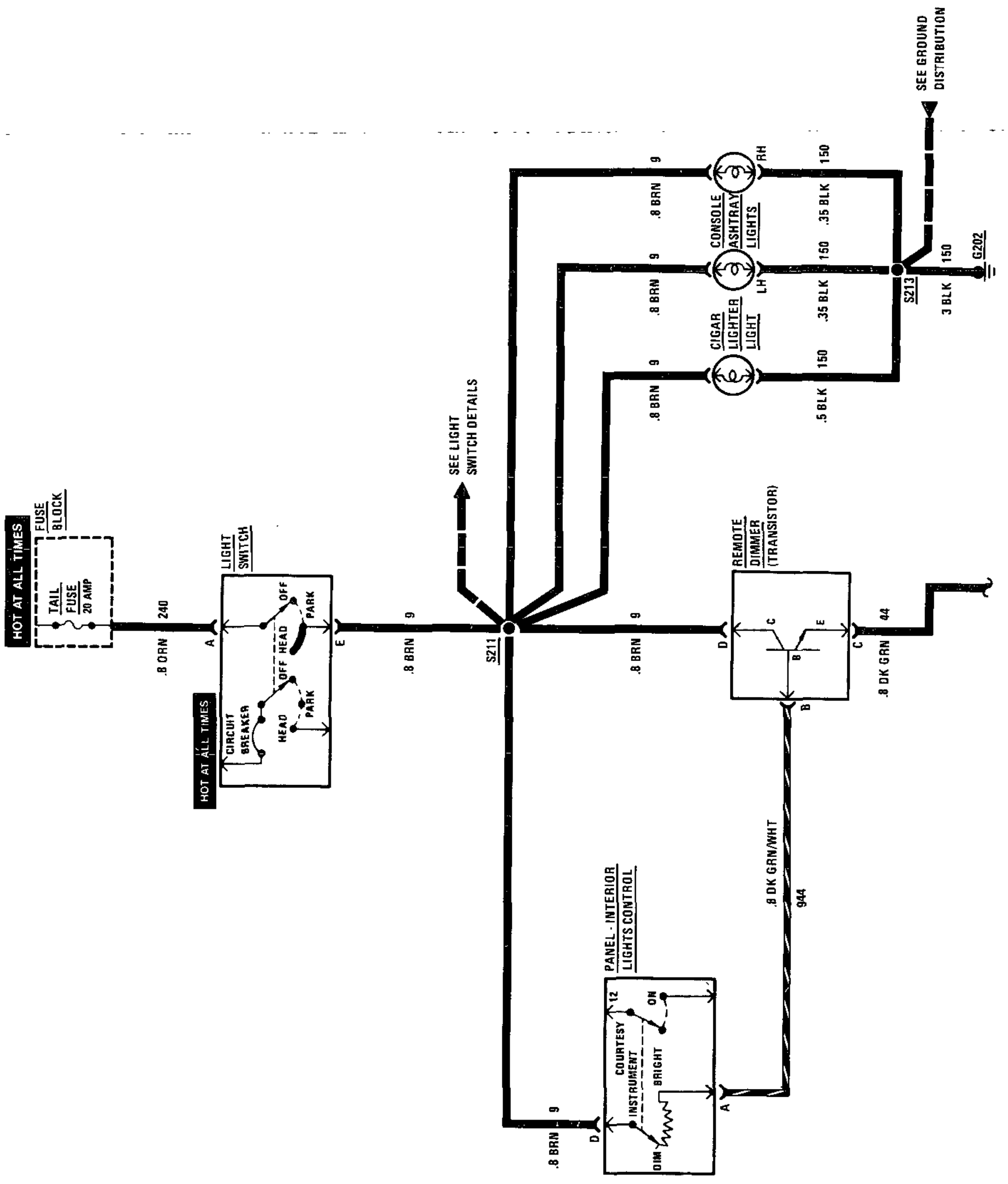
If both lights do not work:

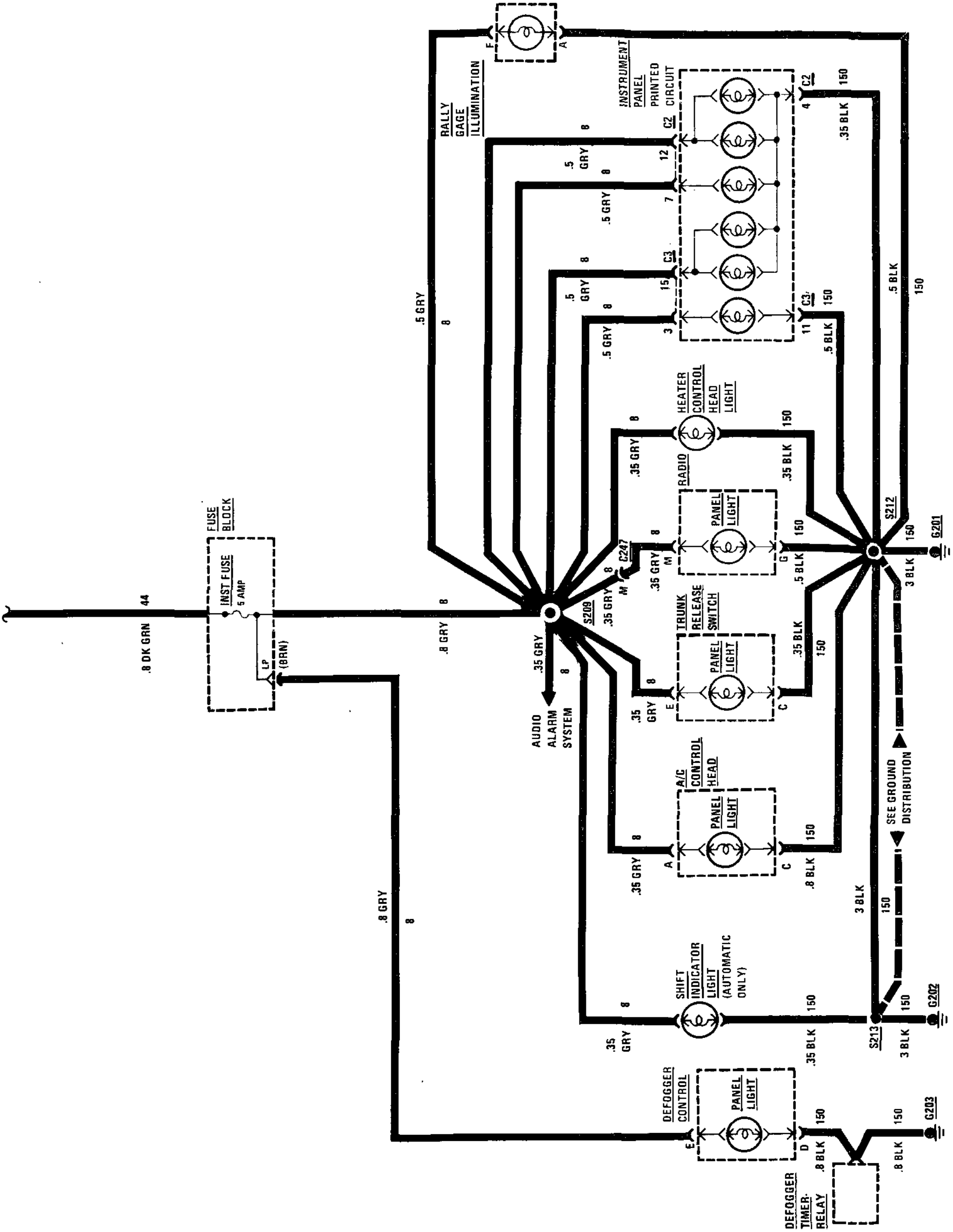
1. Secure the car so that it won't roll backwards. With the Ignition Switch in RUN, place the Gear Selector in REVERSE. Attach a test lamp to pin B (DK BLU wire) of the Back Up Switch and ground.
   - If the test lamp does not light, check the BK BLU (75) wire for an open. Also check C500 for a loose connection.
2. If the test lamp does light, attach it to pin A (LT GRN wire) of the Back Up Switch and ground.
   - If the test lamp lights, replace the Back Up Switch.
   - If the test lamp does not light, check that the bulbs are good. Check the related circuit for an open. Also check C401 for a loose connection.

CIRCUIT OPERATION

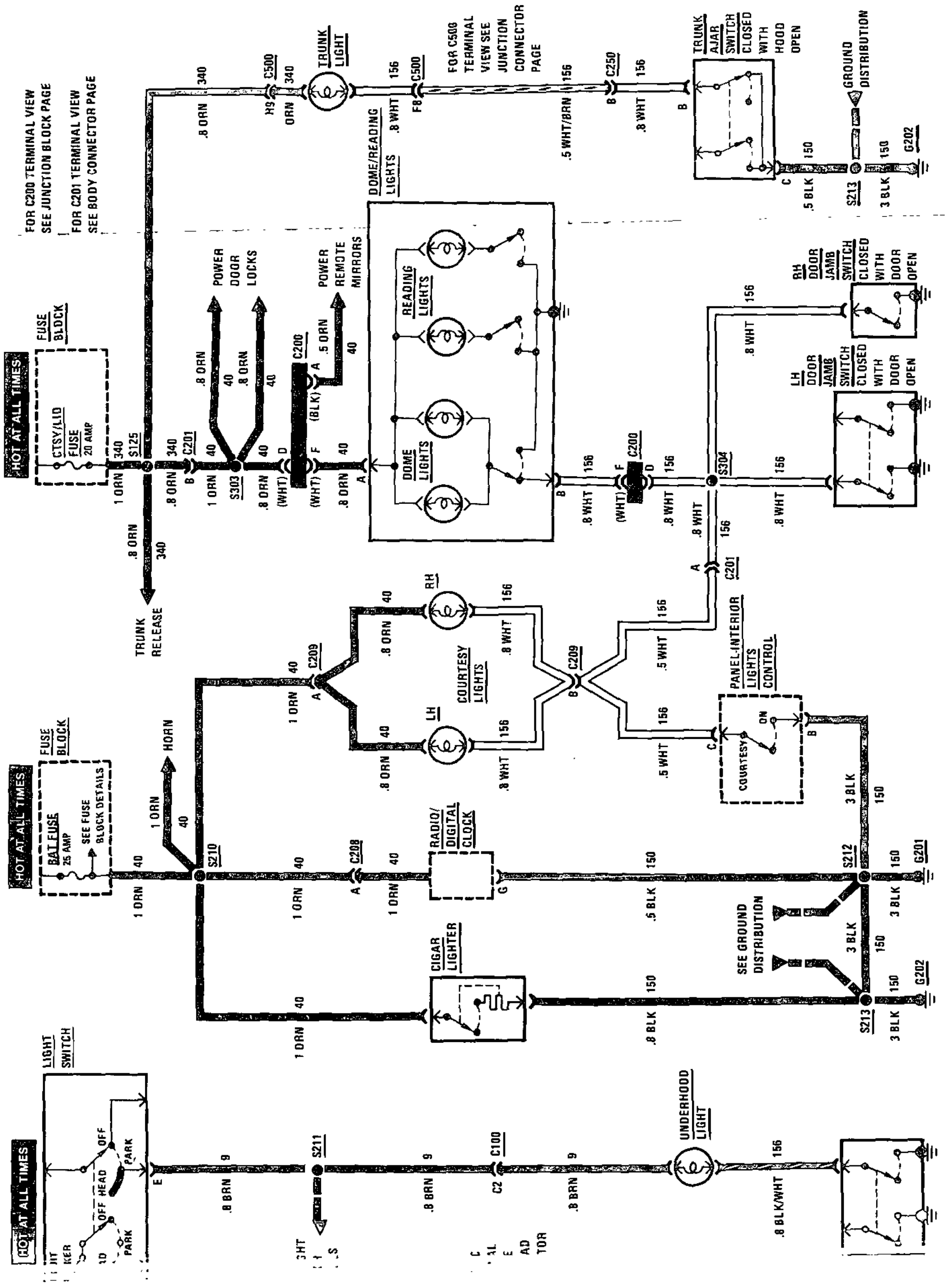
With the Ignition Switch in RUN, BULB TEST, or START, voltage is applied through the Turn B/U Fuse to the Gear Selector Switch (with automatic transaxle), or to the Back Up Switch (with manual transmission). Whenever the Gear Selector Lever is shifted to REVERSE, the Gear Selector Switch or the Back Up Switch closes providing voltage to the Back Up Lights causing the Back Up Lights to light.

RIOR LIGHTS: INSTRUMENT PANEL/CONSOLE




RALLY GAGE ILLUMINATION
F
A
.5 GRY
8
INSTRUMENT PANEL PRINTED CIRCUIT
C2
12
7
C3
15
3
C2
4
.35 BLK
150
C3
11
.5 BLK
150
.5 GRY
8
.5 BLK
150
HEATER CONTROL HEAD LIGHT
.35 GRY
8
.35 BLK
150
RADIO
PANEL LIGHT
C247
M
G
.5 BLK
150
S212
G201
3 BLK
150
FUSE BLOCK
INST FUSE 5 AMP
LP (BRN)
44
.8 DK GRN
.8 GRY
8
S209
.35 GRY
AUDIO ALARM SYSTEM
TRUNK RELEASE SWITCH
PANEL LIGHT
E
C
.35 BLK
150
A/C CONTROL HEAD
PANEL LIGHT
A
C
.8 BLK
150
SEE GROUND DISTRIBUTION
3 BLK
150
SHIFT INDICATOR LIGHT (AUTOMATIC ONLY)
.35 GRY
8
.35 BLK
150
S213
G202
3 BLK
150
DEFOGGER CONTROL
PANEL LIGHT
E
D
.8 BLK
150
G203
DEFOGGER TIMER RELAY

IOR LIGHTS: CIGAR LIGHTER, CLOCK, UNDERHOOD LIGHT AND TRUNK LIGHT



INTERIOR LIGHTS

TROUBLESHOOTING HINTS

Interior Lights, Cigar Lighter, Clock, Underhood Light, and Trunk Light

1. If the Cigar Lighter, Radio/Digital Clock, or the *Courtesy Lights don't work:*
   - Check the BAT Fuse by operating the Horn.
2. If just the Courtesy Lights don't work:
   - Check that the Door Jamb Switches ground to the car body.
3. If the Underhood Light doesn't work:
   - Check the Tail Fuse by turning on the Parking Lights. See Fuse Block Details.
4. If the Dome/Reading Lights or the Trunk Lights don't work:
   - Check the CTSY/Lid Fuse.
   - Check that the Door Jamb Switches, the Trunk Ajar Switch, or G201 to make sure they are clean and tight.

Instrument Panel Lights and Console Lights

If no Instrument Lights go on:

- Check the Tail Fuse by turning on the Park Lights.
- Check the INST Fuse.
- Check that grounds G201, G202, and G203 are clean and tight.

COMPONENT LOCATION

		Page-Figure
Defogger Timer Relay	On brake pedal support	201- 4-A
Fuse Block	Behind LH side of I/P	201- 3-E
Remote Dimmer	Right of RH steering column support	201- 5-C
C100 (34 cavities)	LH side of front bulkhead, right of brake master cylinder	201- 9-A
C200 (16 cavities)	LH shroud ahead of center access hole	201- 3-E
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C208 (2 cavities)	Center of dash, behind radio	201- 9-E
C209 (2 cavities)	Behind LH side of I/P, near shroud	201- 4-C
C247 (12 cavities)	Center console, behind radio	201-17-A
C250 (4 cavities)	RH rear of engine compartment, near battery	201-16-A
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G201	Behind dash, near center	201- 3-D
G202	Between seats, near rear bulkhead	201- 3-C
G203	On side of RH steering column support	201- 4-B
S125	I/P harness, behind LH side of I/P near fuse block	201- 3-E
S209	Main harness, right of steering column	201- 3-D
S210	Main harness, behind RH side of cluster	201- 3-D
S211	Main harness, behind RH side of cluster	201- 3-D
S212	Main harness, behind center of dash	201- 3-D
S213	Main harness, behind shift lever	201-16-A
S303	Cross car harness, above steering column	201-15-A
S304	Cross car harness, above steering column	201-15-A

Test Remote Dimmer

1. Move the Light Switch to PARK.
2. BRN wire at pin D of Remote Dimmer: 12 volts.
3. Move Panel-Interior Lights Control to DIM.
4. DK GRN/WHT wire at pin B of Remote Dimmer: 0 volts.
5. DK GRN wire at pin C of Remote Dimmer: 0 volts.
6. Move the Panel-Interior Lights Control to BRIGHT.
7. DK GRN/WHT wire at pin B of Remote Dimmer: 12 volts.
8. DK GRN wire at pin C of Remote Dimmer: 12 volts.

TERIOR LIGHTS

RCUIT OPERATION

gar Lighter, Clock, Underhood Light, and unk Light

Voltage is applied at all times to the Tail se, which feeds the Light Switch. See Fuse ock Details. When the Light Switch is ned to PARK or HEAD, voltage is present the Underhood Light. When the hood is sed, the Underhood Light turns on.

oltage is applied at all times through the T Fuse to the Cigar Lighter, the Radio/Dig- l Clock, and the Courtesy Lights. The Cigar hter operates when it is connected to und by pressing the lighter into its socket. e Courtesy Lights operate when either the nel-Interior Lights Control, or the Door nb Switches on both doors close to ground.

oltage is applied at all times through the SY/Lid Fuse to the Trunk Light and C200 he Dome/Reading Lights. The Dome/Read- Lights operate when they are connected to und through the Panel-Interior Lights Con- l or the Door Jamb Switches.

trument Panel Lights and Console Lights

oltage is applied through the Tail Fuse to Light Switch at all times. With the Light itch in HEAD or PARK current flows ough the LIght Switch, the Remote Dim- , the INST Fuse, and in parallel through various Instrument Panel and Console hts to ground.

The lights can be dimmed using the rheostat in the Panel-Interior Lights Control. This controls the Remote Dimmer. As voltage to pin B of the Remote Dimmer increases, the current flow increases from the Light Switch into pin D and out of pin C of the Remote Dimmer. The lights become brighter.

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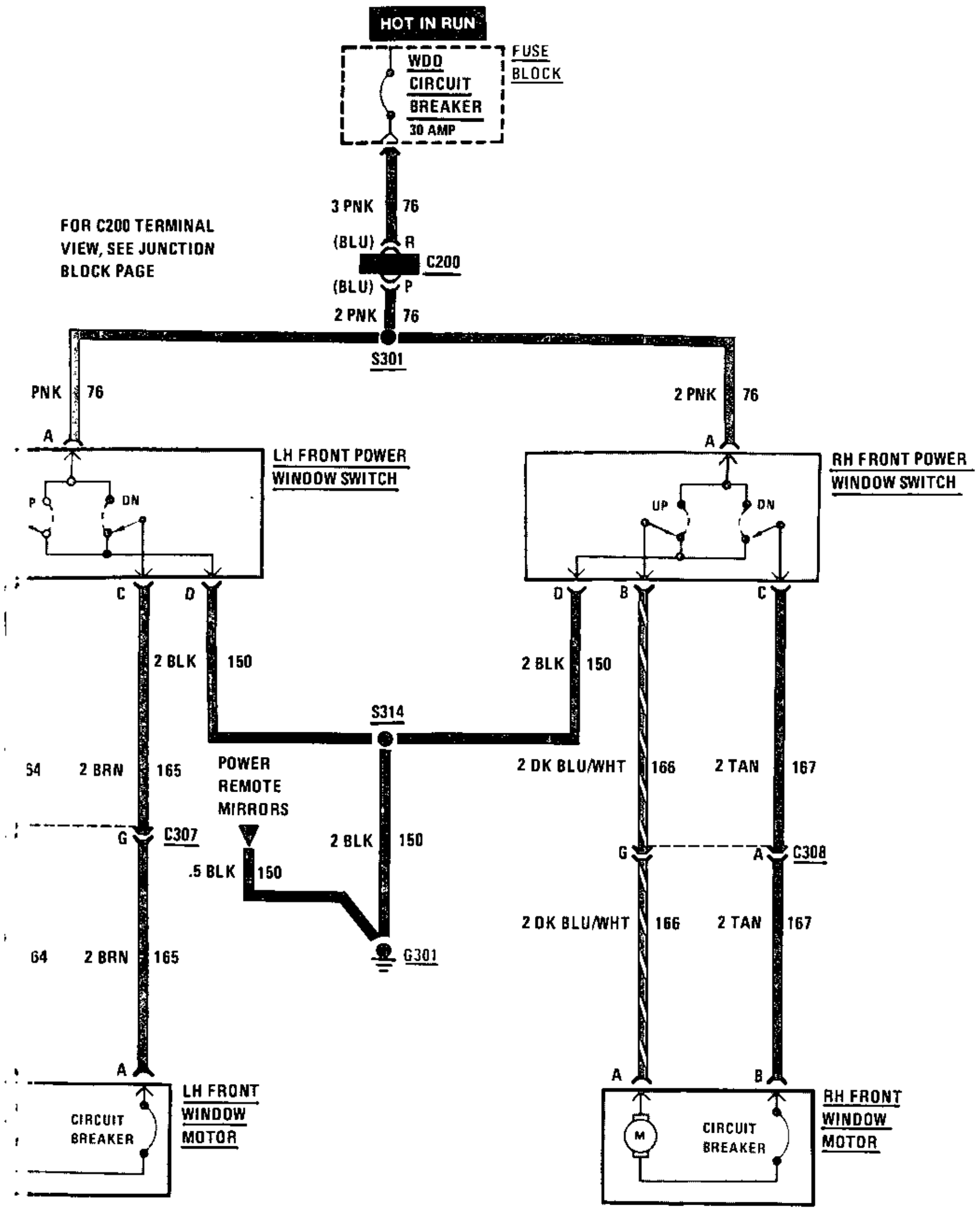
ER WINDOWS: A31



FOR C200 TERMINAL VIEW, SEE JUNCTION BLOCK PAGE

POWER WINDOWS: A31

SYSTEM CHECK

1. With the Ignition Switch in RUN, operate the LH and RH Window Switch up and down.
   - Each window opens and closes completely.
   - Each window operates quietly and smoothly with no sticking.

TROUBLESHOOTING HINTS

- Check WDO Circuit Breaker.
- Check that G301 is clean and tight.
- Check that the connection to C200 is good.

SYSTEM DIAGNOSIS

1. If only one window does operate remove the connector from the suspect Window Switch and connect a test lamp between terminals A (PNK) and D (BLK). Put the Ignition Switch in RUN.

Note: If both windows do not operate repeat this test for the other window.

TEST LAMP
WINDOW SWITCH CONNECTOR (REMOVED)
Ignition Switch in RUN

Terminals (Wire Colors)	Test Lamp
A (PNK) and D (BLK)	Lights

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Power Window Switches	In center console	201-15-A
Window Motors	In front lower corner of each door	
C200 (16 cavities)	LH shroud ahead of center access hole	201- 3-E
C307 (8 cavities)	Near center of LH shroud	201-15-A
C308 (8 cavities)	Near center of RH shroud	201-15-A
G301	On upper RH shroud	201-13-A
S301	Cross car harness, between seats	201-15-A
S314	Cross car harness, beneath center console, between seats	201-15-A

- If the test lamp lights go to step 2.
- If the test lamp does not light check PNK (76) wire and BLK (150) wire for an open.

2. Reconnect the Window Switch connector and remove the connector from the suspect window motor. Connect a test lamp between terminals A and B. Put the Ignition Switch in RUN.

TEST LAMP
WINDOW MOTOR CONNECTOR (REMOVED)
Ignition Switch in RUN

Terminals	Test Lamp	Window Switch Position
A and B	Lights	UP
	Lights	DOWN

- If the test lamp lights for only one Window Switch position replace the Window Switch.
- If the test lamp does not light for any Window Switch positions check the wires from terminals B and C of the Window Switch for an open. If wires are good replace the Window Switch.
- If the test lamp lights for both Window Switch positions, repair or replace the Window Motor.

CIRCUIT OPERATION

The Power Windows are driven by reversible permanent magnet motors. Each motor is controlled by two normally closed and grounded switches. When the RH Window Up Switch is pressed, the DK BLU/WHT motor wire is connected to Battery voltage and the motor runs

WER WINDOWS: A31

lrive the window up. When the switch is ased, the contacts return to their normal ition and the DK BLU/WHT motor wire is rned to ground. The motor stops.

o lower the window, the Dn Switch con- ts the TAN motor wire to Battery voltage. polarity across the motor is reversed from polarity that occurs when the Up Switch is ssed. The motor runs the opposite way to e the window down.

ach motor is protected by a built-in circuit aker. If a window switch is held on too long h the window obstructed or after the win- is fully up or down, the circuit breaker ns the circuit. The circuit breaker resets omatically as it cools.

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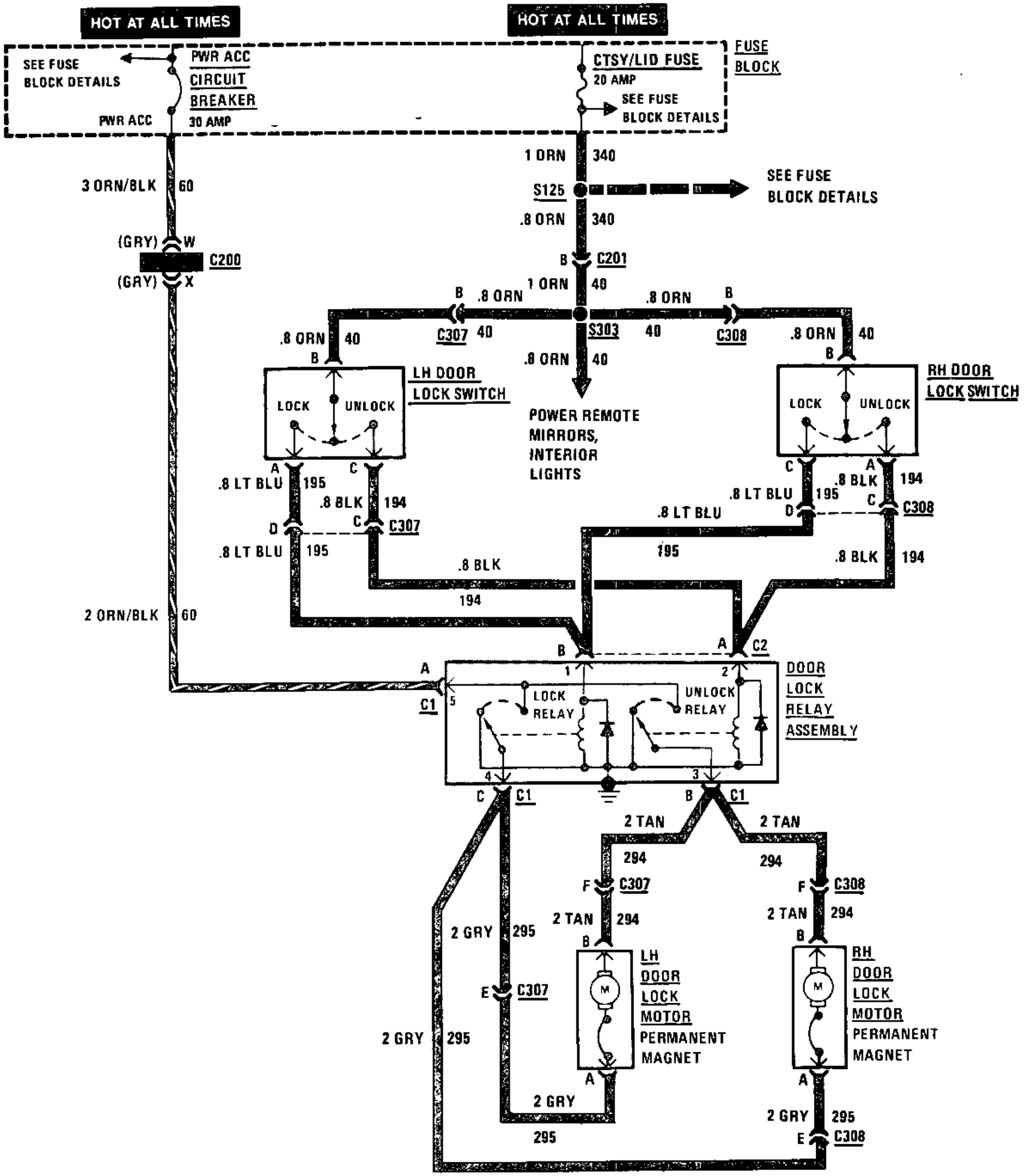
ER DOOR LOCKS: AU3



FOR C200 TERMINAL VIEW, SEE JUNCTION BLOCK PAGE

FOR C201 TERMINAL VIEW SEE BODY CONNECTOR PAGE

EACH MOTOR CONTAINS A SELF-RESETTING CIRCUIT BREAKER

POWER DOOR LOCKS: AU3

SYSTEM CHECK

1. With all the vehicle doors open, move the LH Door Lock Switch to the LOCK position.
   - All the vehicles doors are locked and will stay locked as the doors are closed.
2. With all doors closed and locked, operate each inside door handle and try to open each door.
   - All doors will not open.
3. Move the LH Door Lock Switch to the UNLOCK position.
   - All doors unlock.
4. Open the LH door, move the LH Door Lock Switch to the LOCK position, exit the vehicle, and close the LH Door.
   - All doors are locked.
5. Unlock the LH door from the outside using the vehicle's key.
   - The LH door is unlocked, all other doors remain locked.
6. Check the operation of the RH Door Lock Switch by repeating steps 1 through 5 using the RH Door.
7. Verify that each lock can be operated manually by use of the locking knob.

TROUBLESHOOTING HINTS

1. Check the PWR/ACC Circuit Breaker.
2. Check the CTSY/Lid Fuse.
3. Check for mechanical binds in the Door Lock System.
4. Check for voltage being supplied to the Fuse Block.
5. Check the case of the Door Lock Relay Assembly. Make sure the case is connected to a good ground.

COMPONENT LOCATION

		Page-Figure
Door Lock Motors	In rear of door	
Door Lock Relay Assembly	Near upper RH shroud	201-15-A
Door Lock Switches	In each door, near top front	
Fuse Block	Behind LH side of I/P	201- 3-E
C200 (16 cavities)	LH shroud ahead of center access hole	201- 3-E
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C307 (8 cavities)	Near center of LH shroud	201-15-A
C308 (8 cavities)	Near center of RH shroud	201-15-A
S125	I/P harness, behind LH side of I/P near fuse block	201- 3-E
S303	Cross car harness, above steering column	201-15-A

SYSTEM DIAGNOSIS

ONE OR BOTH DOOR LOCKS DO NOT OPERATE

1. Backprobe connector C307 for LH Door Lock and C308 for the RH Door Lock. Check for voltage with a test lamp at the terminals in the table with respect to ground. Put the Ignition Switch in OFF.

Note: If both door locks do not operate perform tests in table at both C307 and C308.

TEST LAMP

C307 (LH DOOR LOCK) or
C308 (RH DOOR LOCK)
Ignition Switch in OFF

Terminals (Wire Colors)	Test Lamp	Door Lock Switch Position
B (ORN)	Lights	Any Position
D (LT BLU)	Lights	LOCK
C (BLK)	Lights	UNLOCK

- If the test lamp lights for all of the switch positions go to step 2.
- If the test lamp does not light at terminal B (ORN) check the ORN (40) wire for an open.
- If the test lamp does not light at terminal D (LT BLU) check the LT BLU (195) wire and the ORN (40) wire from the Door Lock Switch for an open. If wires are good replace the Door Lock Switch.

- If the test lamp does not light at terminal C (BLK) check the BLK (194) wire and the ORN (40) wire from the Door Lock Switch for an open. If wires are good replace the Door Lock Switch.

sing a test lamp backprobe the terminals t the Door Lock Relay Assembly with espect to ground using the table.

TEST LAMP

DOOR LOCK RELAY ASSEMBLY

Ignition Switch OFF

Terminal ire Color)	Test Lamp	Door Lock Switch Position
C2-A (BLK)	Lights	UNLOCK
C2-B T BLU)	Lights	LOCK
C1-A RN/BLK)	Lights	Any Position
C1-C (GRY)	Lights	LOCK
C1-B (TAN)	Lights	UNLOCK

- If the test lamp does not light at connector C2 terminal A (BLK) check the BLK (194) wire for an open.
- If the test lamp does not light at connector C2 terminal B (LT BLU) check the LT BLU (60) wire for an open.
- If the test lamp does not light at connector C1 terminal A (ORN/BLK) check the ORN/BLK (60) wire for an open.
- If the test lamp lights at all terminals except connector C1 terminals C (GRY) or B (TAN) replace the Door Lock Relay Assembly.
- If the test lamp lights at all the terminals check the wiring to the motor. If wiring is good repair or replace the Door Lock Motor.

CIRCUIT OPERATION

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, and also to reverse the polarity of the voltage they supply to the motors.

When either Door Lock Switch is moved to the LOCK position, it completes a circuit to the coil of the Lock Relay. A path to ground for both relay coils and also for the normally closed relay contacts from a case ground. The lock relay is energized. Its contact closes to the right and is connected to Battery voltage through terminal A and the ORN/BLK wire. This also applies Battery voltage to the GRY motor wires. The TAN motor wires are grounded through the Unlock Relay contacts. The motor in each door runs to operate the door locks. When the Door Lock Switch is released, the Lock Relay contact closes to ground again 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 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.

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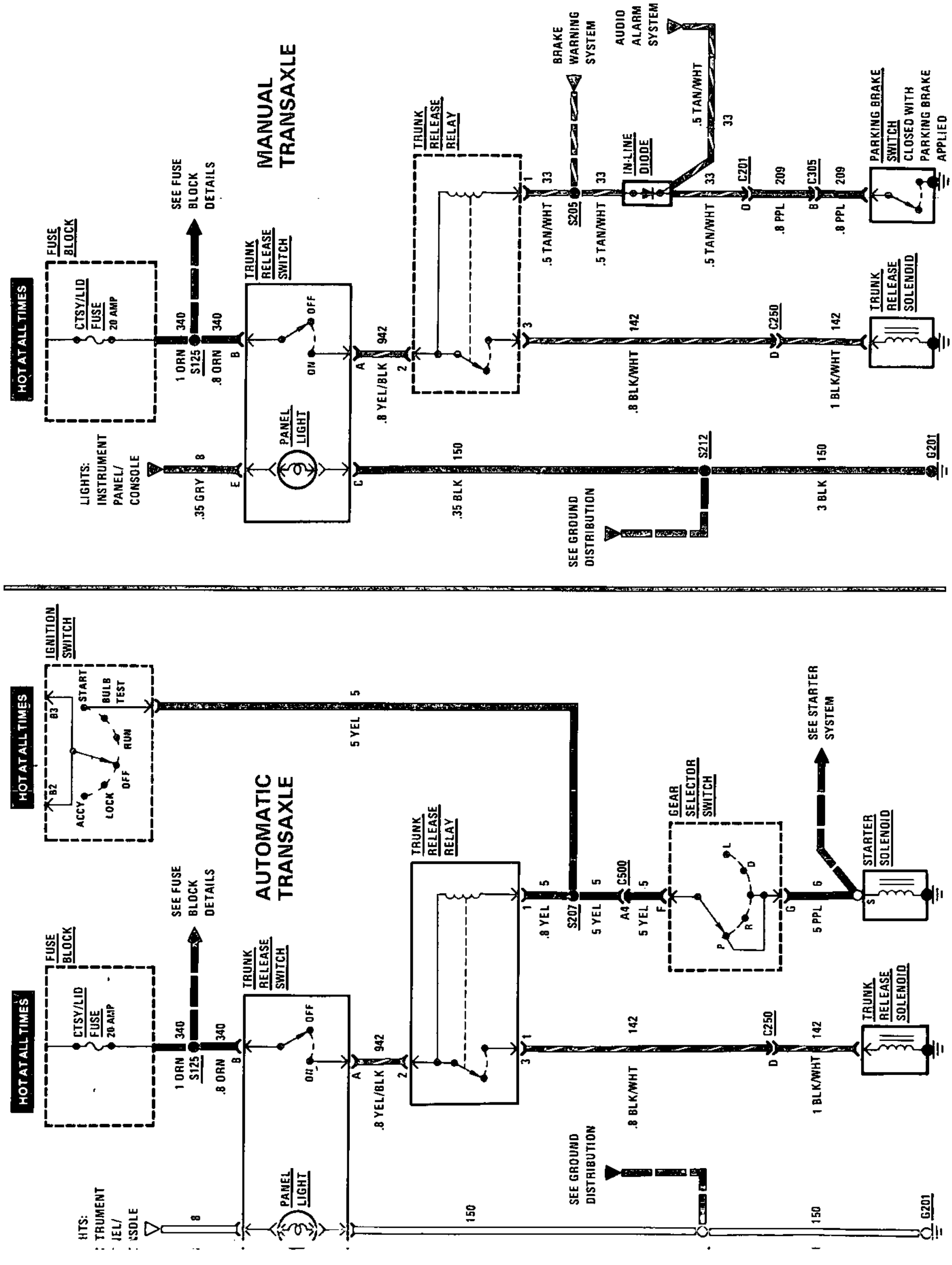
ΛK RELEASE: A90



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TRUNK RELEASE: A90

TROUBLESHOOTING HINTS

1. Check the CTSY/Lid Fuse by noting if the Dome Lights work.
2. Check that G201 is clean and tight.

SYSTEM DIAGNOSIS

1. Remove the Trunk Release Solenoid. With the Trunk Release Switch depressed, attached a test lamp from the connector to the solenoid and ground. If the test lamp goes on, replace the Trunk Release Solenoid.
2. To test the Trunk Release Switch. Connect a test lamp between the following terminals and ground.

VOLTAGE

TRUNK RELEASE SWITCH

Gear Selector Switch in PARK (Automatic) or Park Brake Engaged (Manual)

Terminal (Wire Color)	Switch Position	Test Lamp
B (ORN)	OFF	Lights
A (YEL/BLK)	OFF	Dark
A (YEL/BLK)	ON	Lights

- If the test lamp lights at terminal B but not at terminal A with the switch depressed, replace the Trunk Release Switch.
- If the test lamp does not light at terminal B, check the ORN (340) wire back to the fuse for an open.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Gear Selector Switch	Left of engine, top of transaxle	201- 1-B
Ignition Switch	At base of steering column	201- 5-A
In-Line Diode	Behind I/P near LH shroud	201- 4-C
Parking Brake Switch	On parking brake support	201- 4-E
Starter Solenoid (VIN 9)	Front right side of engine	
Starter Solenoid (VIN R)	Lower front LH side of engine	201- 1-A
Trunk Release Relay	Behind I/P, near A/C control head	
Trunk Release Solenoid	On rear of trunk lid	201-11-C
C201 (6 cavities)	LH shroud above center access hole	201-15-A
C250 (4 cavities)	RH rear of engine compartment, near battery	201-16-A
C305 (3 cavities)	Behind dash, near LH shroud	201-14-A
C500 (34 cavities)	Engine compartment, near battery	201- 3-A
G201	Behind dash, near center	201- 3-D
S125	I/P harness, behind LH side of I/P near fuse block	201- 3-E
S205	Main harness, above steering column	201- 7-A
S207	Main harness, left of steering column	201- 5-A
S212	Main harness, behind center of dash	201- 3-D

3. Test the Trunk Release Relay voltage with connector still on the relay.

VOLTAGE

TRUNK RELEASE RELAY

Gear Selector Switch in PARK (Automatic) or Park Brake Engages (Manual)

Terminal (Wire Color)	Switch Position	Voltage
2 (YEL/BLK)	ON	Battery
3 (BLK)	ON	Battery

- If voltage is present at terminal 3, check 142 (BLK/WHT) wire for an open.
- If voltage is not present at terminal 3, go to step 4. Leave test lamp in place.
- If Battery voltage is not present at terminal 2, check the YEL/BLK wire for an open.

4. Attach a fused jumper between terminal 1 and ground, with the Trunk Release Switch depressed.
   - If test lamp doesn't light, replace the Trunk Release Relay.
   - If test lamp lights, disconnect fused jumper from terminal 1 and check the circuit from terminal 1 for an open. If an open is not found, replace the relay.

JNK RELEASE: A90

CUIT OPERATION

ıltage is applied at all times through the Y/Lid Fuse to the Trunk Release Switch. n the switch closed, voltage is applied ugh the Trunk Release Switch to the ık Release Relay coil and contact.

ual Transaxle

hen the parking brake is applied, the Park-3rake Switch closes, and provides ground he relay coil. Voltage is applied from the Y/Lid Fuse to the Trunk Release Switch. age is then applied to the Trunk Release ıy. The relay operates and voltage is ied from the closed relay contact to the ık Release Solenoid, releasing the lock.

ımatic Transaxle

ıltage is applied from the closed Trunk ase Switch through the release relay coil ıe Gear Selector Switch. With the Ignition ch not in START and the Gear Selector ch in PARK or NEUTRAL, the Starter noid provides ground for the relay. The contacts close and voltage is applied to Trunk Release Solenoid, releasing the lock.

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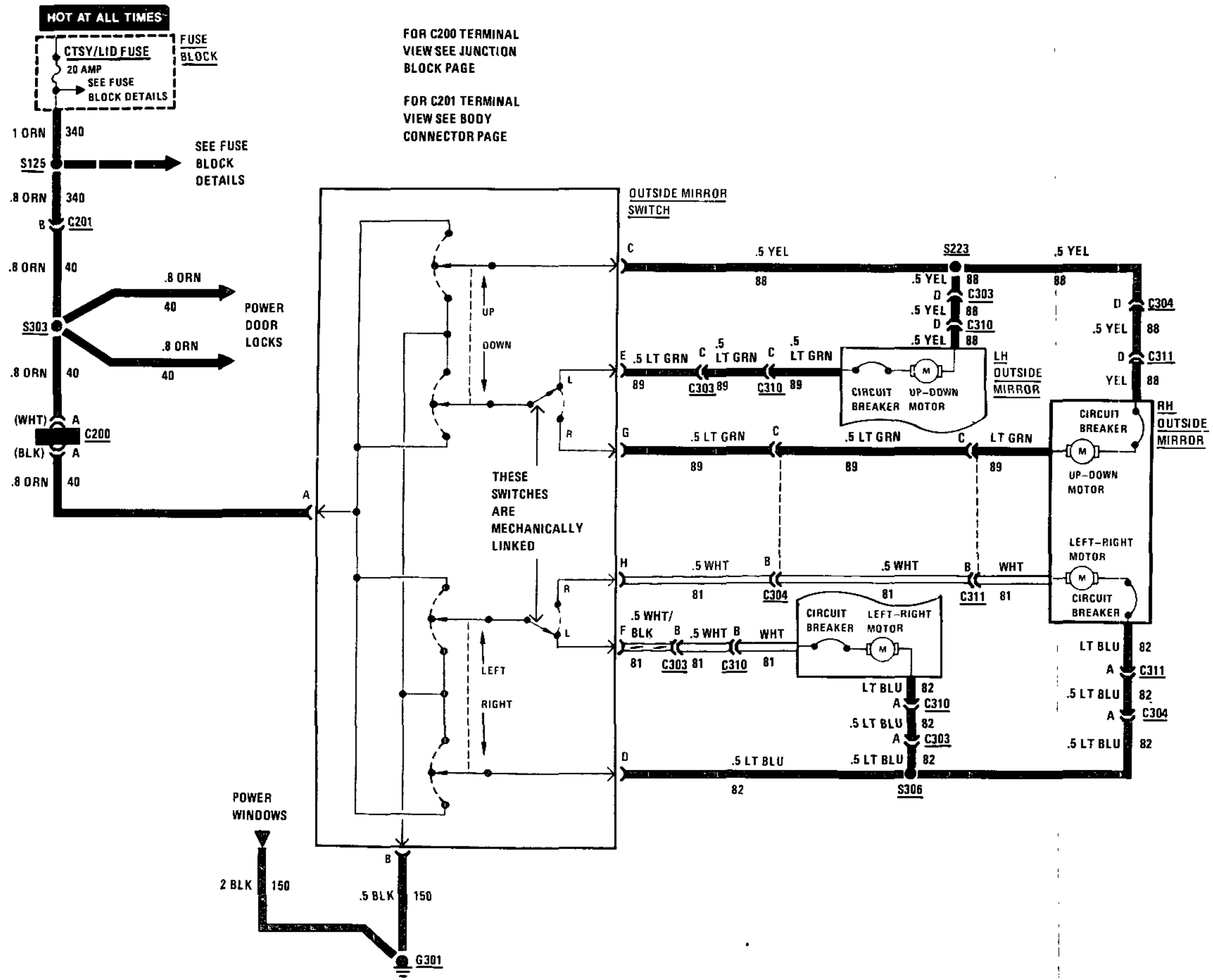
ER REMOTE MIRRORS



POWER REMOTE MIRRORS

SYSTEM CHECK

1. With the Ignition Switch OFF, set the Mirror Select Switch for the RH mirror.
2. Operate the Outside Mirror Switch in four positions: UP, DOWN, RIGHT, and LEFT.
   - RH mirror moves smoothly in all four switch positions.
   - The mirror can move the driver's sight too high, too low, too far to the right, and too far to the left.
3. Repeat with Mirror Select Switch set for the driver's side.
4. Adjust each mirror to show the road behind the vehicle.
   - Each mirror is easily positioned without sticking or slipping.

TROUBLESHOOTING HINTS

1. Test the CTSY/Lid Fuse by operating the dome lamp.
2. Check that ground G301 is clean and tight.
3. If both of the mirror's motors operate in only one direction replace the Outside Mirror Switch.
4. If only one Outside Mirror operates, and one or both motors in the other Outside Mirror does not operate, replace the Outside Mirror Switch.

SYSTEM DIAGNOSIS

1. If neither mirror operates, remove the connector from the Outside Mirror Switch at the center console. Connect a test lamp between terminal A (ORN) and B (BLK).

Put the Ignition Switch in OFF.

TEST LAMP
OUTSIDE MIRROR
SWITCH CONNECTOR (REMOVED)
Ignition Switch OFF

Terminal (Wire Color)	Test Lamp
A (ORN) and B (BLK)	Lights

- If the test lamp lights, go to step 2.
- If the test lamp does not light, check the ORN (40) circuit and the BLK (150) wire for an open.

2. Reconnect the Outside Mirror Switch connector and backprobe C303 for LH Outside Mirror problems or C304 for RH Outside Mirror problems using the appropriate table.

TEST LAMP
C303
Ignition Switch OFF

Terminal (Wire Color)	Test Lamp	Mirror Switch Positions
D (YEL) and C (LT GRN)	Lights	LH MIRROR UP
		LH MIRROR DOWN
B (WHT/BLK) and A (LT BLU)	Lights	LH MIRROR LEFT
		LH MIRROR RIGHT

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
C200 (16 cavities)	LH shroud ahead of center access hole.	201- 3-E
C201 (6 cavities)	LH shroud above center access hole.	201-15-A
C303 (4 cavities)	LH shroud, near center access hole	201-13-A
C304 (4 cavities)	RH shroud, near center access hole	201-13-A
C310 (1 cavity)	In LH door, below mirror	
C311 (1 cavity)	In RH door, below mirror	
G301	On upper RH shroud	201-13-A
S125	I/P harness, behind LH side of I/P near fuse block	201- 3-E
S223	Cross car harness, above RH side of steering column support	201-13-A
S303	Cross car harness, above steering column	201-15-A
S306	Electric mirror cross car harness, right of steering column	201-13-A

TEST LAMP

C304

Ignition Switch OFF

erminal /ire Color)	Test Lamp	Mirror Switch Positions
(YEL) and LT GRN)	Lights	RH MIRROR UP
		RH MIRROR DOWN
(WHT) and (LT BLU	Lights	RH MIRROR LEFT
		RH MIRROR RIGHT

- If the test lamp lights but the mirror does not move, check the wiring to that specific motor. If wiring is good repair or replace that motor.
- If the test lamp does not light for both the UP and DOWN switch positions, check the YEL (88) wire and the LT GRN (89) wire for an open. If wires are good replace the Outside Mirror Switch.
- If the test lamp does not light for both LEFT and RIGHT switch positions, check the LT BLU (82) wire and WHT/BLK (81) wire (C303) or the WHT (81) wire (C304) for an open. If wires are good replace the Outside Mirror Switch.
- If the test lamp lights for just one of the UP-DOWN or LEFT-RIGHT functions, replace the Outside Mirror Switch.

CIRCUIT OPERATION

The Power Remote Mirrors are adjusted from the interior of the car by moving the Outside Mirror Switch in the desired direction.

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 the Up-Down switch and the Left-Right Switch 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 RH Outside Mirror is moved. When the Up-Down switch is moved up, Battery voltage from the ORN wire is applied through the RH contacts of the mirror select switch to the YEL wire at terminal C and the Up-Down motor in the RH Outside Mirror. The RH Outside Mirror Up-Down motor has a path to ground through the LT GRN wire at terminal G through the Up-Down switch, and the BLK wire. The RH motor runs and turns the mirror up.

When the Up-Down Switch is pushed to the DOWN position, the same motor receives voltage. Now the polarity is reversed, with the YEL wire grounded, and voltage is applied to the motor through the LT GRN wire. The motor runs in the opposite direction.

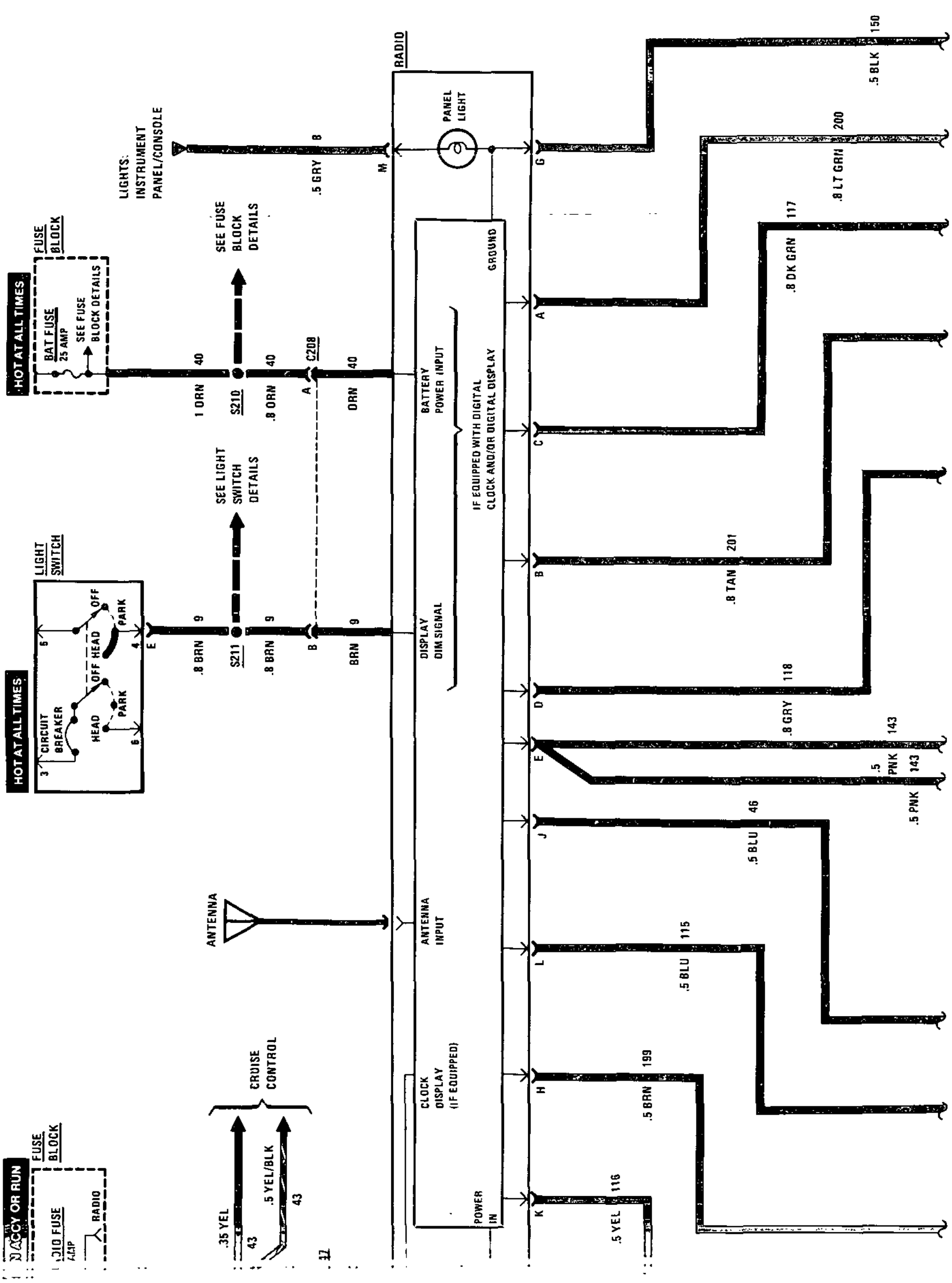
The RH Left-Right Motor operates in a similar manner when the Left-Right Switch is moved to the LEFT position. The Battery voltage from the ORN wire is applied through the RH contacts of the Mirror Select Switch to the WHT wire at terminal H and the Left-Right Motor in the RH Outside Mirror. The RH Outside Mirror is grounded through the LT BLU wire at terminal D, through the Left-Right Switch and the BLK wire. The RH Motor runs, and turns the Mirror to the left.

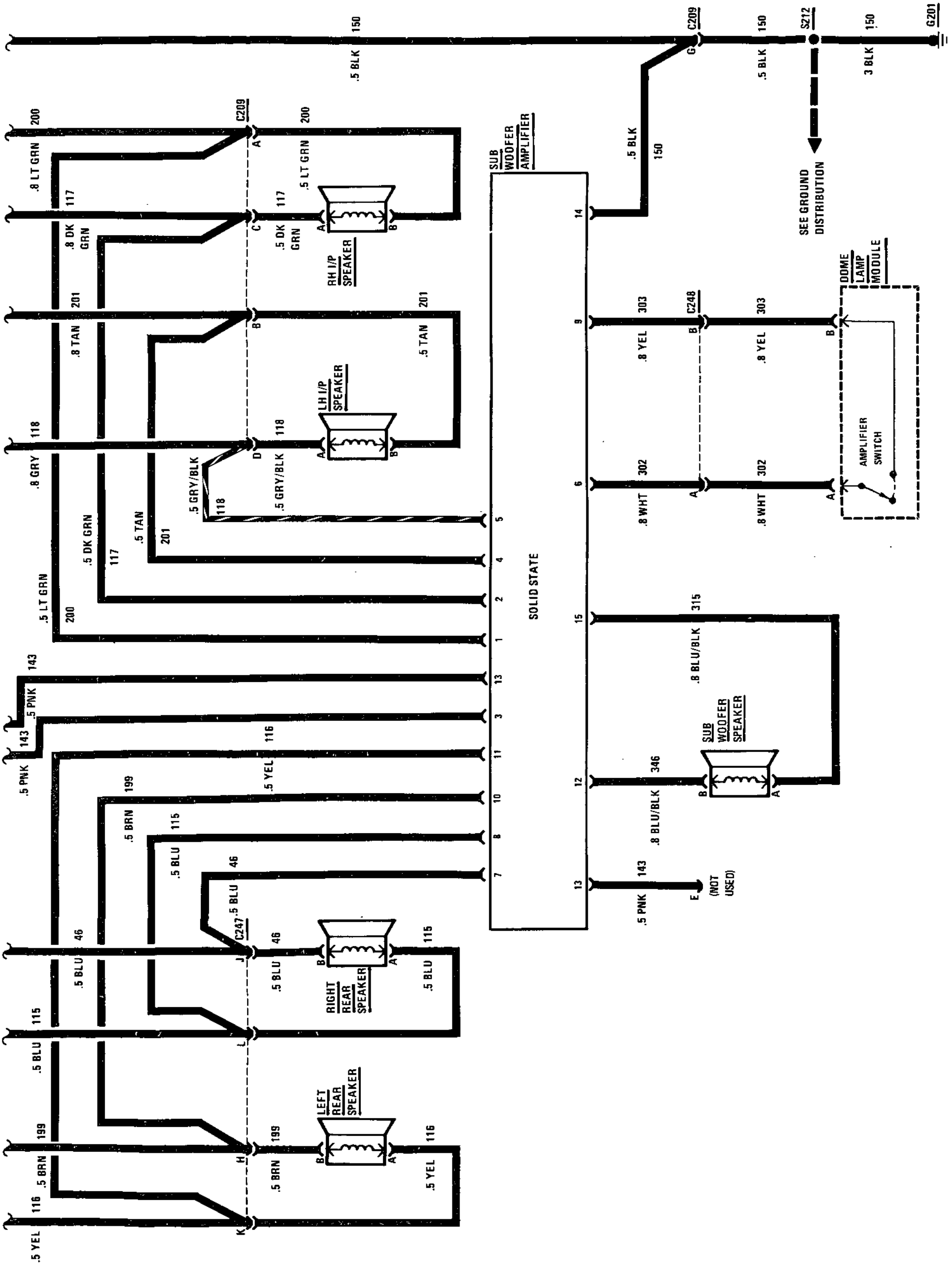
If the Left-Right Switch is pushed to the RIGHT position, the same motor receives voltage. However, the polarity is reversed, with the WHT wire grounded. Voltage is now applied to the motor through the LT BLU/BLK wire. The motor runs in the opposite direction.

The LH Outside Mirror works in the same way as the RH Outside Mirror when the Mirror Select Switch is moved to the LH position and the Up-Down and Left-Right Switch is operated.

BLANK

O: UL5/UM6/UM7/UQ6/UT4/UX1/U66




C209
150
.5 BLK
S212
150
3 BLK
G201
G
SEE GROUND DISTRIBUTION
200
.8 LT GRN
C209
A
200
.5 LT GRN
117
.8 DK GRN
C
117
.5 DK GRN
RH I/P SPEAKER
A
B
201
.8 TAN
B
201
.5 TAN
LH I/P SPEAKER
118
.8 GRY
D
118
.5 GRY/BLK
.5 GRY/BLK
118
.5 TAN
201
.5 DK GRN
117
.5 LT GRN
200
SUB WOOFER AMPLIFIER
SOLID STATE
5
4
2
1
13
3
11
10
8
7
14
9
6
15
12
13
.5 BLK
150
303
.8 YEL
C248
B
303
.8 YEL
DOME LAMP MODULE
B
302
.8 WHT
A
302
.8 WHT
A
AMPLIFIER SWITCH
315
.8 BLU/BLK
SUB WOOFER SPEAKER
346
.8 BLU/BLK
B
A
143
.5 PNK
E
(NOT USED)
143
.5 PNK
143
.5 PNK
116
.5 YEL
199
.5 BRN
115
.5 BLU
46
.5 BLU
C247
46
.5 BLU
J
46
.5 BLU
B
A
115
.5 BLU
RIGHT REAR SPEAKER
115
.5 BLU
L
LEFT REAR SPEAKER
199
.5 BRN
H
199
.5 BRN
B
A
116
.5 YEL
116
.5 YEL
K

STEM CHECK

erform the following checks with the gine running and the vehicle outside:

urn the Radio on.

- Sound comes from the speakers.
- The digital display, consisting of dot indicators and numbers showing the frequency, is illuminated.

Adjusting the Radio controls will change he operation of the sound system. Consult he Sound Service, Manager's Guide for nformation regarding the operation of hese controls.

et the Light Switch in the PARK position.

- The intensity of the digital display dims.

djust the Interior Light Dimmer Switch, hich is part of the Light Switch, to the HI osition, and then to the DIM position.

- The Radio Panel Light changes its level of intensity.

ad Radio

OUBLESHOOTING HINTS

heck the Radio Fuse and the BAT Fuse.

heck that the Antenna connector to the adio and/or the Antenna coaxial cable to he Antenna are properly connected.

heck the wiring to ground, and check the round (G201) for a clean and tight connecion.

COMPONENT LOCATION

		Page-Figure
Fuse Block	Behind LH side of I/P	201- 3-E
Radio	Behind center of dash	201- 9-E
Sub Woofer Amplifier	RH side of center console	201-17-A
C208 (2 cavities)	Center of dash, behind radio	201- 9-E
C209 (2 cavities)	Behind LH side of I/P, near shroud	201- 4-C
C247 (12 cavities)	Center console, behind radio	201-17-A
C248 (2 cavities)	Behind LH side of I/P	201-16-C
G201	Behind dash, near center	201- 3-D
S201	I/P harness, left of steering column	201- 7-A
S210	Main harness, behind RH side of cluster	201- 3-D
S211	Main harness, behind RH side of cluster	201- 3-D
S212	Main harness, behind center of dash	201- 3-D

SYSTEM DIAGNOSIS

No Radio Display; No Sound.

1. Backprobe the connector at the Radio at C208, terminal A, and C347, terminal F. Measure the voltage to ground with a high impedance voltmeter only. Set the Ignition Switch in the RUN position.

VOLTAGE
RADIO CONNECTOR C208
Ignition Switch in RUN

Terminal (Wire Color)	Voltage
A (ORN)	Battery

VOLTAGE
RADIO CONNECTOR C347
Ignition Switch in RUN

Terminal (Wire Color)	Voltage
F (YEL)	Battery

- If these voltages are correct, see the note on the next page.
- If these voltages are not correct, check the wiring supplying these terminals.

No Panel Light.

1. Backprobe the connector at the back of the Radio at terminal M and measure the voltage to ground. Ignition Switch is set to the OFF position. Light Switch is set to the PARK or HEAD position.

VOLTAGE
RADIO CONNECTOR
Ignition Switch OFF

Terminal (Wire Color)	Voltage	Condition
M (GRY)	0 to Battery	Adjust Interior Light Dimmer Switch

- If the voltage is not correct, refer to Interior Lights Instrument Panel.
- If the voltage is correct, see the note on this page.

No Digital Display Dimming.

1. Backprobe connector C208 at terminal B. Using a voltmeter, measure the voltage to ground at the following terminal. Set the Ignition Switch in the OFF position.

VOLTAGE
RADIO CONECTOR C208
Ignition Switch OFF

Terminal (Wire Color)	Voltage	Light Switch Position
B (BRN)	Battery	PARK or HEAD

- If the voltage is not correct, refer to Headlights.
- If the voltage is correct, see the note below.

NOTE: If these steps did not correct the problem, the Radio may be defective. Replace the Radio with a good Radio. If the good Radio works, send the defective Radio to an authorized repair shop.

See Section 8C for Radio Removal and Installation.

REAR AND I/P SPEAKERS

If the Radio seems to operate normally (display lights, selects different stations) but there is no sound from any speaker, go to Step 1.

1. No sound or distorted sound comes from a Speaker. Check the connector to the Speaker.
   - If the connections are good, go to Step 2.
   - If the connections are not good, repair as necessary.
2. Check the Speaker by replacing it with a good Speaker. Use extra wires if needed.
   - If good Speaker does not play, go to Step 3. Leave good speaker connected.
   - If the good Speaker plays, replace the original Speaker with a new one.
3. Check the wires from the Radio to the Speaker.
   - If the wiring is the cause of the Speaker not working, repair the wiring between the Speaker and Radio. Test the old Speaker after repairing the wires.
   - If the wiring is correct and the Speaker does not play, remove the Radio for service. Refer to Section 8C for Removal and Installation Procedures.

SUBWOOFER SPEAKER SYSTEM

The Radio seems to operate normally (display lights, selects different stations and the Rear Speakers and I/P Speakers work) but the Subwoofer Speaker is suspected of not working (no sign of movement), go to Step 1.

1. Determine if the Subwoofer Speaker System is not working by performing a visual inspection of the Subwoofer Speaker, turning the Radio on to a high volume level. Use music with strong bass content and set bass control for maximum bass. Turn the Subwoofer on and use a flashlight to check the Subwoofer Speaker for movement.
   - If the Subwoofer cone does not move, go to Step 2.
   - If the Subwoofer cone does move, this indicates that the Subwoofer Speaker is working. If the sound system still does not sound normal, refer to Rear and I/P Speakers. If after performing Rear and I/P Speakers diagnostics the system still does not sound proper, go to Step 6 in Subwoofer Speaker system.
2. Check the connections to the Subwoofer Amplifier and Speaker and C248.
   - If the connections are good, go to Step 3.
   - If the connections are not good, repair as necessary.
3. Make the following measurements.

TEST LAMP
UBWOOFER AMPLIFIER CONNECTOR
Ignition Switch in ACCY
Radio is ON

erminals ire Colors)	Test Lamp	Test Condition
(PNK) Ground	Lights	Radio On
	Doesn't Light	Radio Off
3 (PNK) Ground	Lights	Radio On
	Doesn't Light	Radio Off

- o If the test lamp results are correct, go to Step 4.
- o If the test lamp results are not correct, check the wiring back to the Radio.
  - — If the wiring is good, remove the Radio for service. Refer to Section 8C for removal and installation procedures.

Check the wiring from C209 and C247 to the Subwoofer Amplifier.

- o If the wiring is correct, go to Step 6.
- o If the wiring is the cause of the Subwoofer Speaker not working, repair as necessary.

Check the Subwoofer Speaker by replacing t with a good Subwoofer Speaker. Use extra wires if needed.

- o If the good Subwoofer Speaker does not play, go to Step 7. Leave the good speaker connected.
- If the good Subwoofer Speaker plays, replace the original Subwoofer Speaker with a new one.

6. Check the wiring from the Subwoofer Amplifier to the Subwoofer Speaker.
   - If the wiring is good, go to Step 7.
   - If the wiring is the cause of the Subwoofer Speaker not working, repair as necessary. Test the old Subwoofer Speaker after repairing the wiring.
7. Make the following measurements.

OHMMETER
CONNECTOR C248
Ignition Switch OFF
Radio is OFF

Terminals (Wire Colors)	Resistance	Test Condition
A (WHT) to B (YEL)	0	Amplifier Switch CLOSED
	OPEN	Amplifier Switch OPEN

- If the test lamp results are correct, replace the Subwoofer Amplifier.
- If the test lamp results are incorrect, check the wiring to the Door Lamp Module. If good, replace the Dome Lamp Module.

Noisy Radio

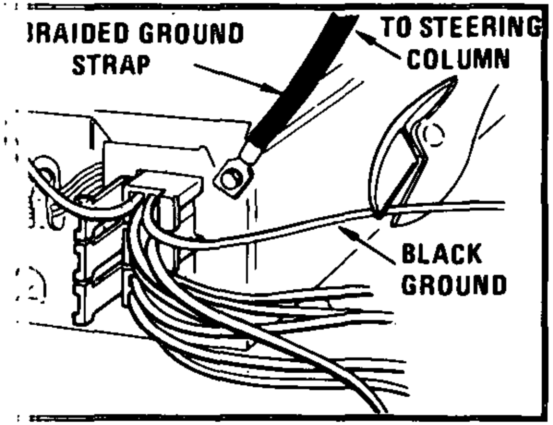
TROUBLESHOOTING HINTS

1. Test Radios outside, with the hood down.
2. Most noise comes in the Antenna. Unplug the Antenna at the back of the Radio. If the noise disappears, it was being picked up by the Antenna. If the noise persists, it is coming in the Radio wiring. See the symptoms below.
3. Ignition noise on FM indicates a possible defective HEI system.
4. When using a test antenna, ground the base to the car body (bare metal, not a painted surface) and do not hold the antenna mast.
5. Coated screws or bolts can be a poor ground.

SYMPTOM	POSSIBLE CAUSE	REPAIR ACTION
1. Harsh popping noise that changes with engine rpm.	Ignition noise	• Perform the steps under Ignition Noise p. 150-6.
2. High whine (like a siren) that changes with engine rpm.	Generator noise	• Add filter package 1224205 to 14 volt and/or memory lead to the Radio. • By-pass the generator output and/or the brown field wire of the generator with 250 MFD 100 V capacitor. See Fig 3, p. 150-6. • Exchange the Radio with a good Radio. If noise disappears, send the defective Radio for repair. • Install a braided ground strap on the Radio. See Fig. 2, p. 150-4. • Run a direct wire from Battery + to generator. • Replace generator.
3. 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, p. 150-6. • Install a .5 MFD by-pass capacitor at the power lead to that accessory. • Consult Delco 1984/85 Sound Service Guide.
4. 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 Antenna if the Radio reception improves. Check at the Antenna coax lead-in and the connector.
5. AM only, weak, noisy.	AM alignment	• Remove Radio for repair.
6. FM only, weak, noisy.	FM alignment	• Remove Radio for repair.
7. Noise present with engine not running.	ECM or Digital Cluster Noise	• Install filter package 1224205 in the power leads to the Electronic Control Module (ECM) Instrument Panel (Digital Cluster).
8. Noise that stops when Antenna is unplugged from back of Radio.	Antenna noise	• Replace Antenna with a known good Antenna. If the noise disappears, repair or replace the defective Antenna. Check the Antenna ground, coaxial cable braid, and grounds 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 "snifting" procedures.

For more detailed noise repair procedures consult the Delco Sound Service Guide. Service procedures are given for:

- Accessory noises
- CB Antennas and noise
- Computer noise
- Windshield Antennas
- Shielding at wiring and components
- Locating vehicle noise
- Delco-Bose® systems



igure 1. Cut the black (ground) wire from the ck plug at the back of the radio and run a raided ground strap from the case of the radio o good unpainted body ground.

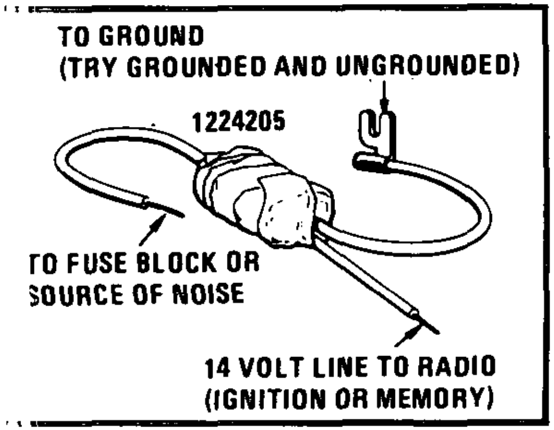


Figure 2. Install a 1224205 filter package.

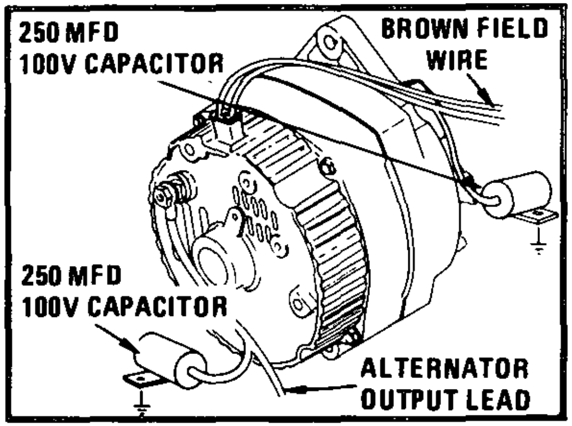


Figure 3. Install a 250 MFD, 100V capacitor on the alternator output lead and/or the brown field wire of the alternator to ground.

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 HEI 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 HEI for the following and replace if necessary:
   - Distributor cap carbon ball eroded away, or 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. Make sure existing deck lid ground strap makes a solid attachment to deck lid RFI shield. Install a braided ground strap on the hood.
9. Check heater core ground; clean or install braided ground strap if necessary.
10. Check air conditioner accumulator ground; clean or install a braided ground strap if necessary.
11. Add a 0.5 microfarad capacitor from Battery positive at the Ignition Coil to ground.

CIRCUIT OPERATION

The Radio Fuse provides main power to the Radio and to the Power Antenna. With the Ignition Switch in ACCY or RUN, voltage is applied to the Radio Fuse and the YEL wire to the On-Off Switch in the Radio. The circuit is grounded at G201. With the On-Off Switch closed, voltage is applied to the Radio Fuse, Radio Switch (Power Antenna), and the Solid-State Radio circuits to ground. Two wires connect each speaker to the Radio.

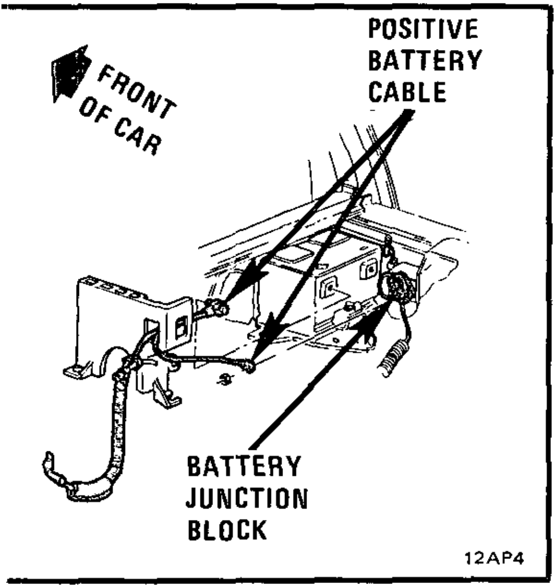
The ETR Radio has two inputs that other models do not have: Dim Display Signal and Clock Power.

RADIO

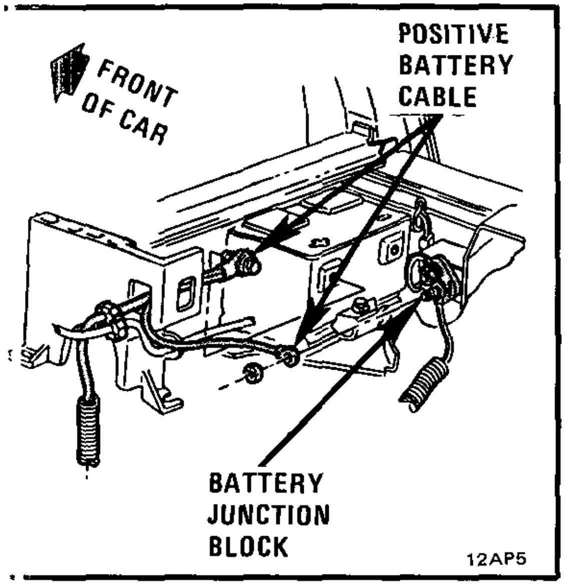
The ETR model is an AM/FM Radio that changes stations electronically. The frequencies of pre-selected stations can be stored in the electronic memory. The ETR model also provides digital display of time or station frequency. As in other models, the Light Switch controls panel light dimming. In the ETR 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 BAT Fuse. 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.

The Subwoofer Speaker System consists of a Subwoofer Amplifier and a Subwoofer Speaker. The amplifier receives power from the Radio (143 PNK wire) and is grounded at G201. The amplifier switch is located in the Dome Lamp Module 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 Subwoofer Speaker.



igure A - RH Front Of VIN R Engine Compartment



gure B - RH Front Of VIN 9 Engine Compartment

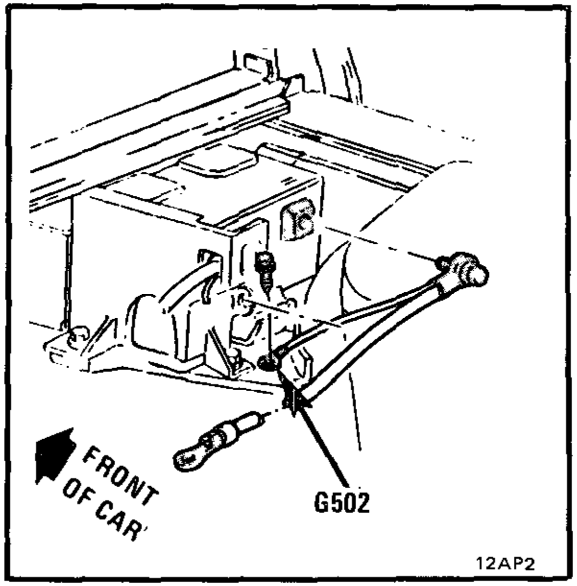


Figure C - RH Front Of Engine Compartment

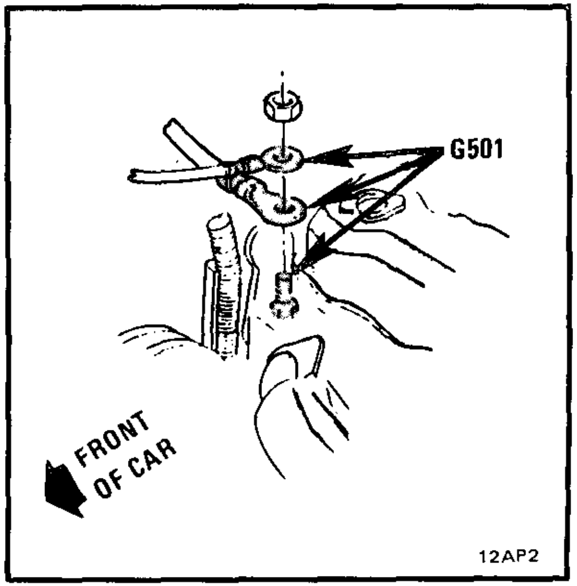


Figure D - RH Side Of VIN R Engine Near Oil Fill Cap

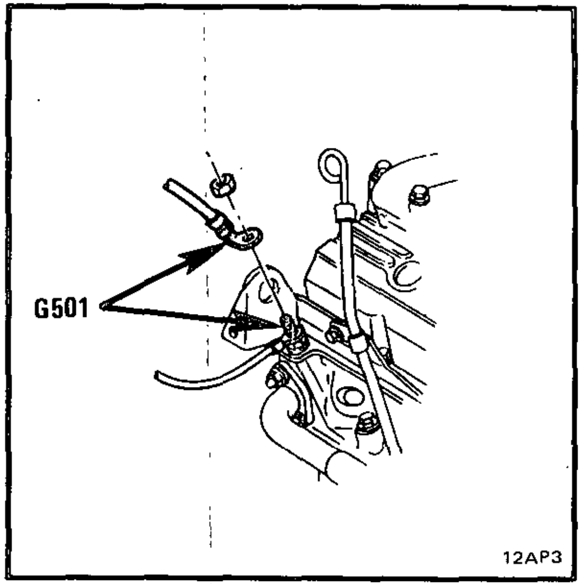


Figure E - RH Front Of VIN 9 Engine, Near Dipstick

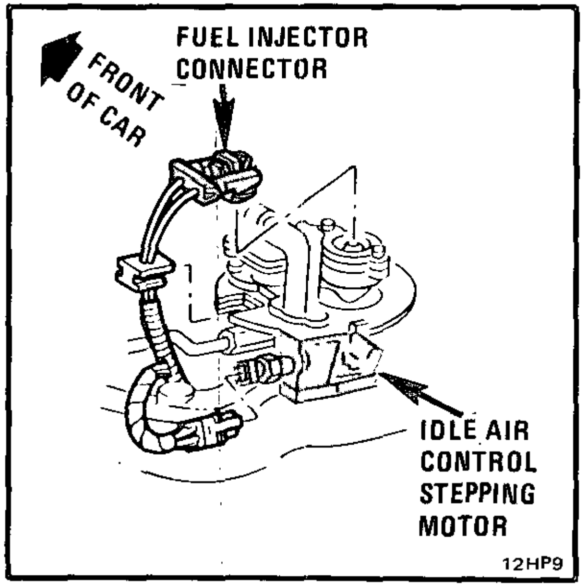


Figure F - Rear Of Throttle Body

COMPONENT LOCATION VIEWS

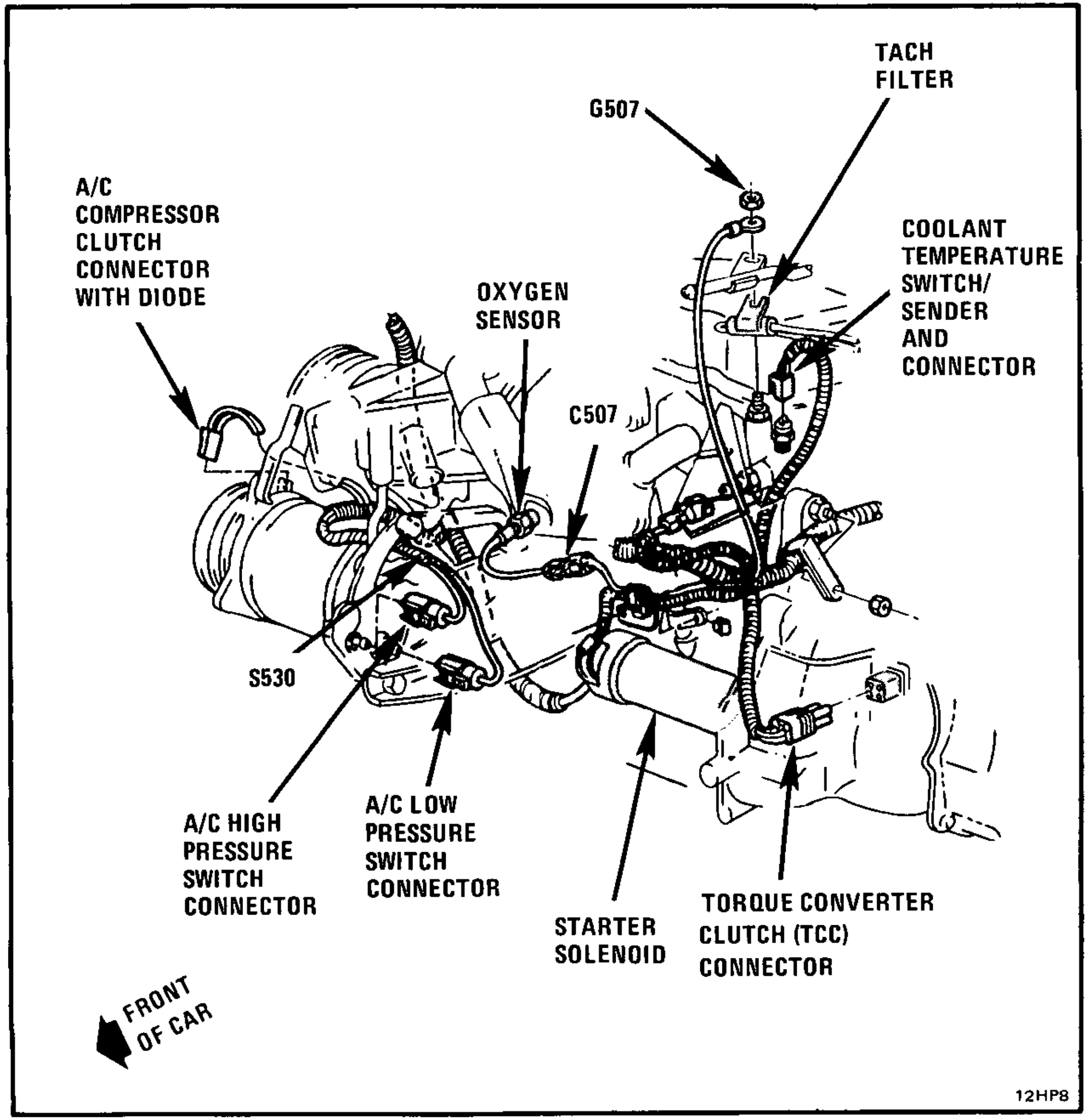


Figure A - Front Of VIN R Engine

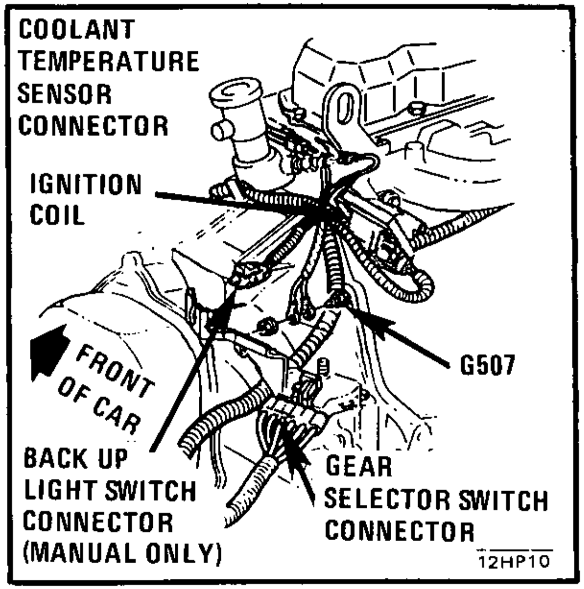


Figure B - LH Rear Of VIN R Engine

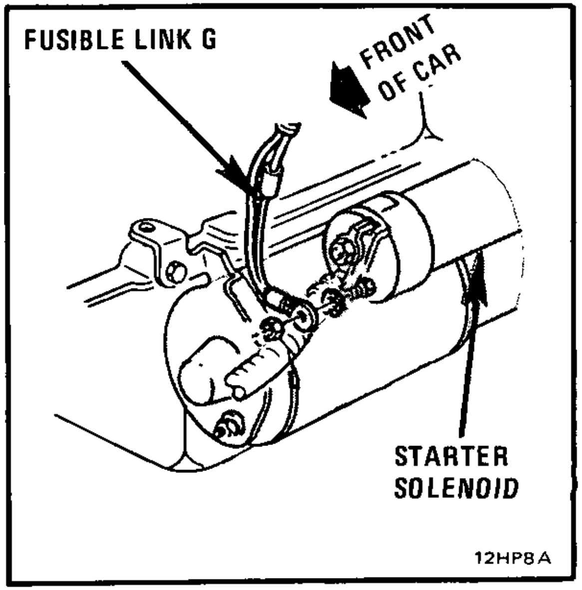


Figure C - Lower Front LH Side Of VIN R Engine (VIN 9 Similar)

OMPONENT LOCATION VIEWS

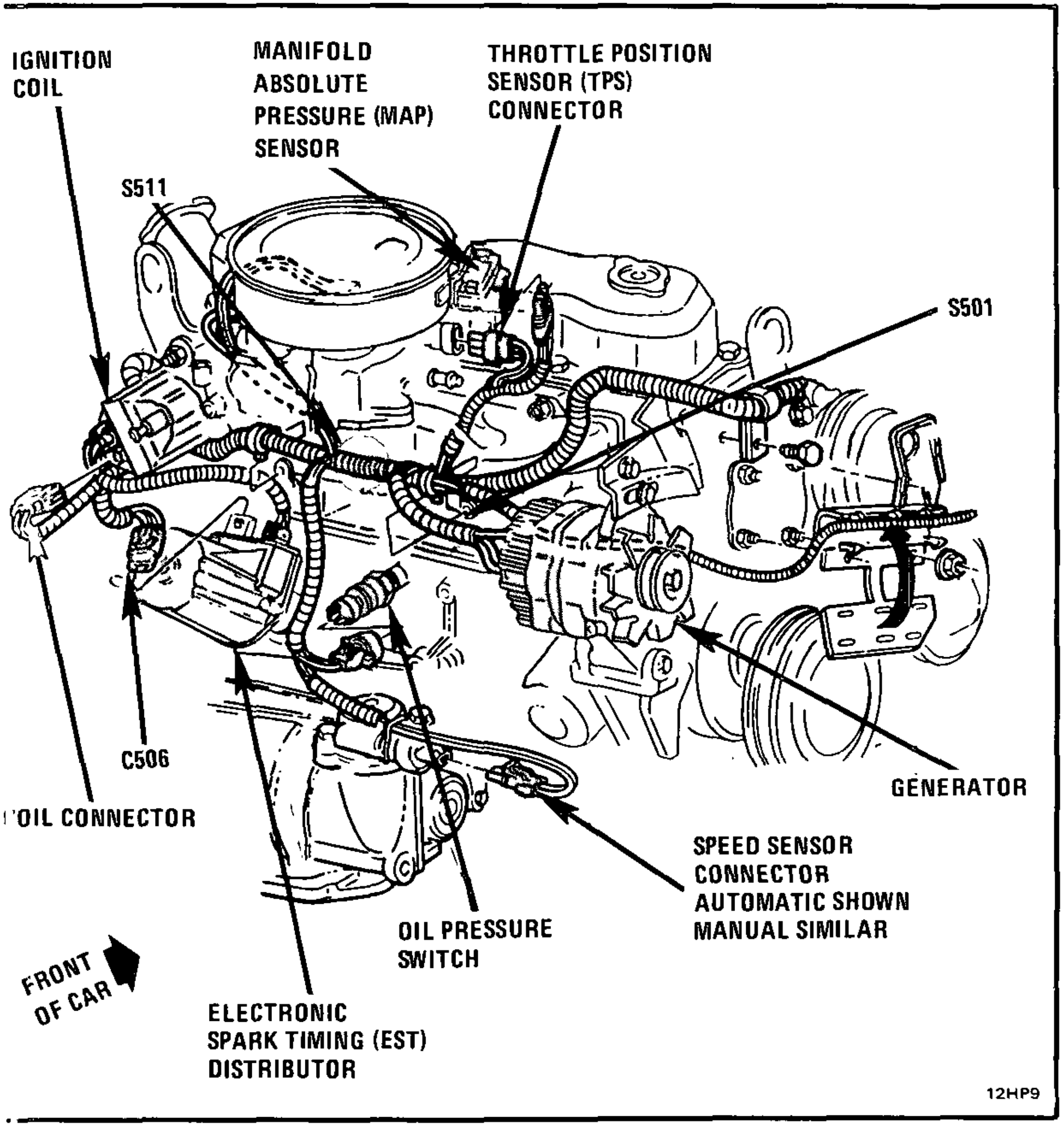


Figure A - Rear Of VIN R Engine

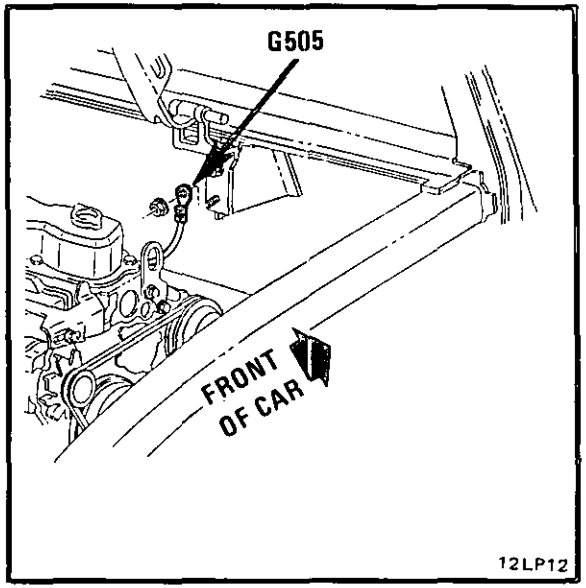


Figure B - RH Top Of Engine

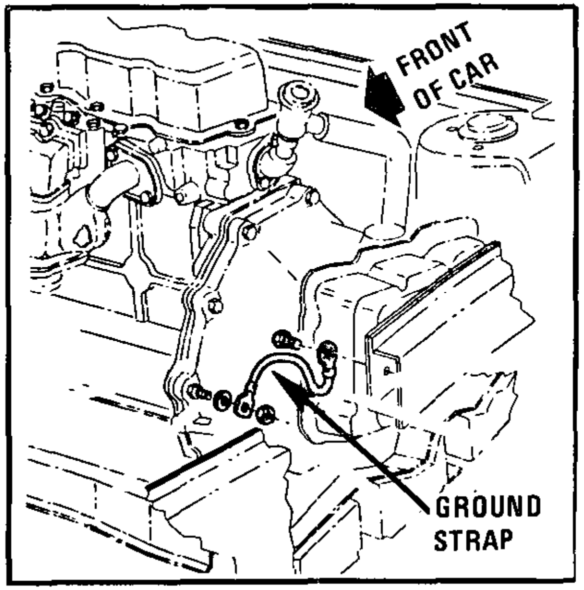


Figure C - LH Side Of Engine Compartment

COMPONENT LOCATION VIEWS

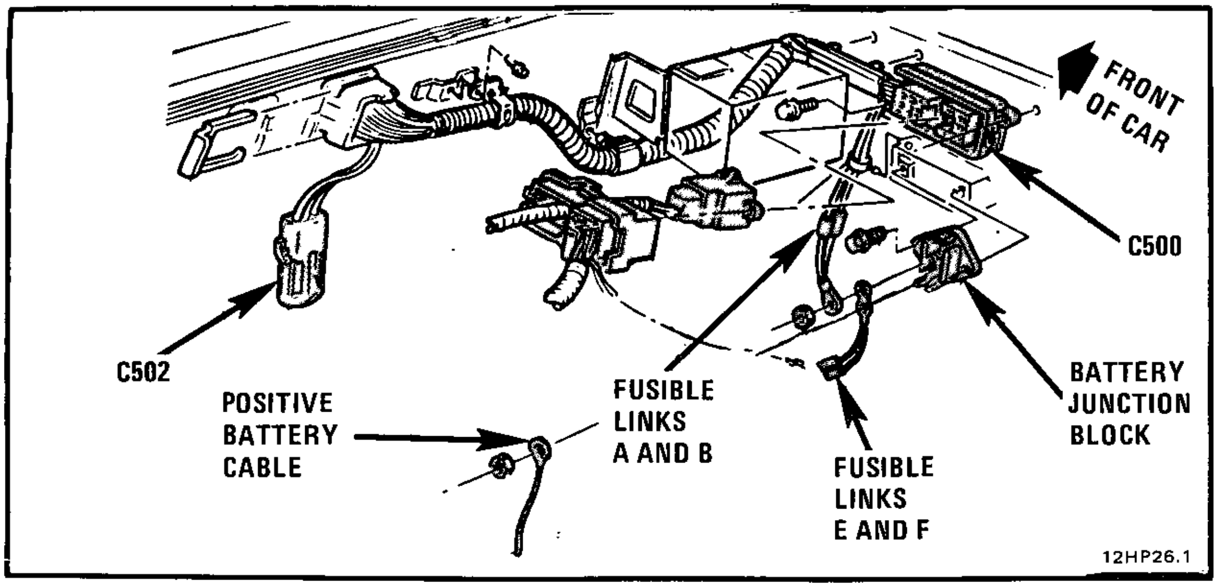


Figure A - RH Front Of Engine Compartment

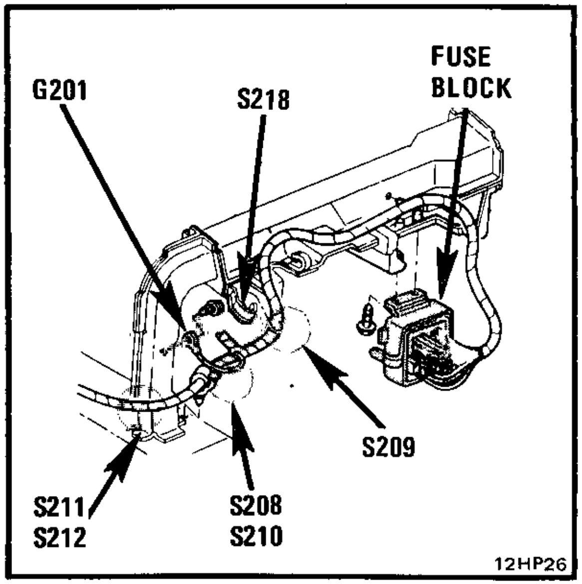


Figure D - Behind Cluster

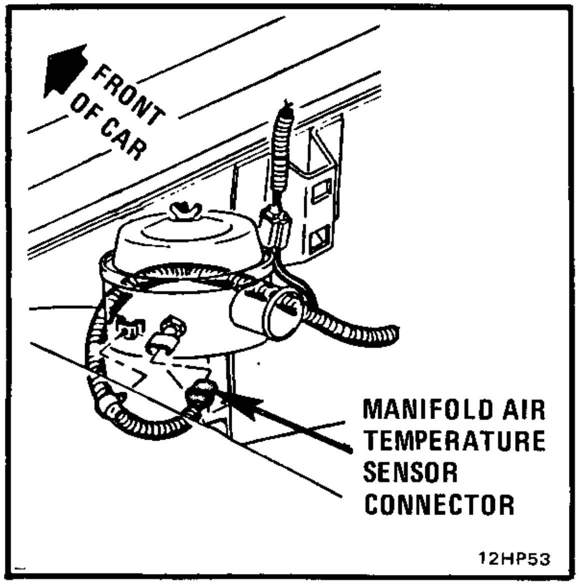


Figure B - LH Front Of VIN 9 Engine Compartment

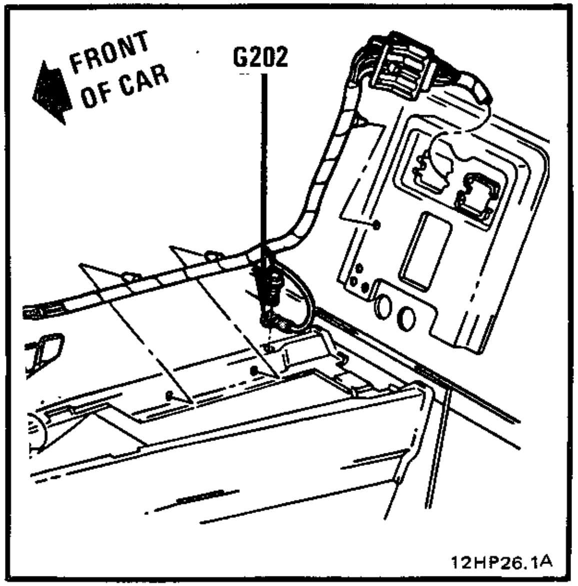


Figure C - Between Seats, Front Of Rear Bulkhead

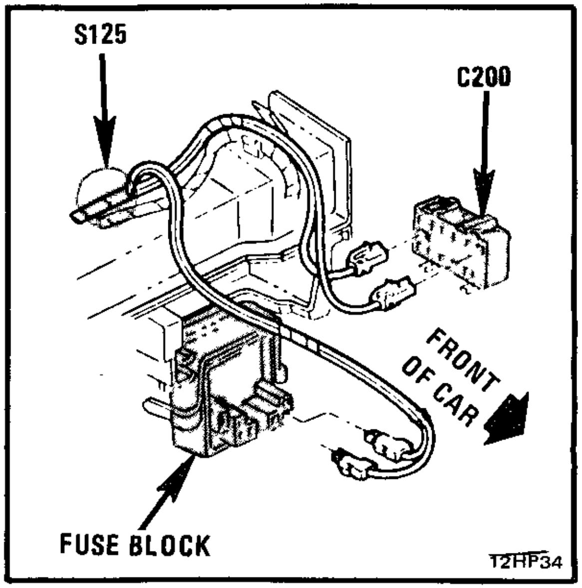


Figure E - Behind LH Side Of I/P

OMPONENT LOCATION VIEWS

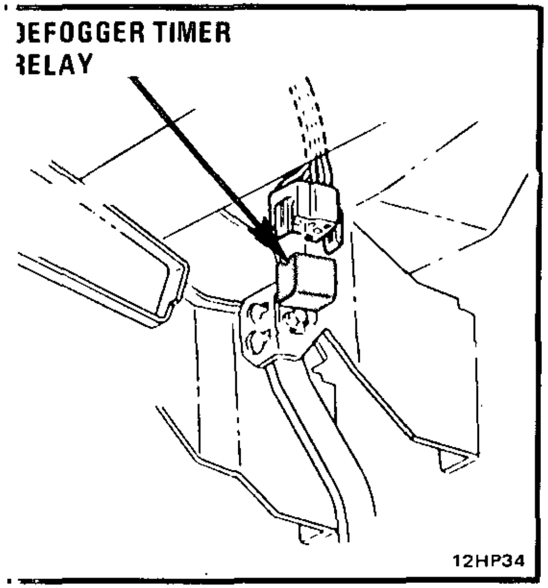


Figure A - Above Brake Pedal

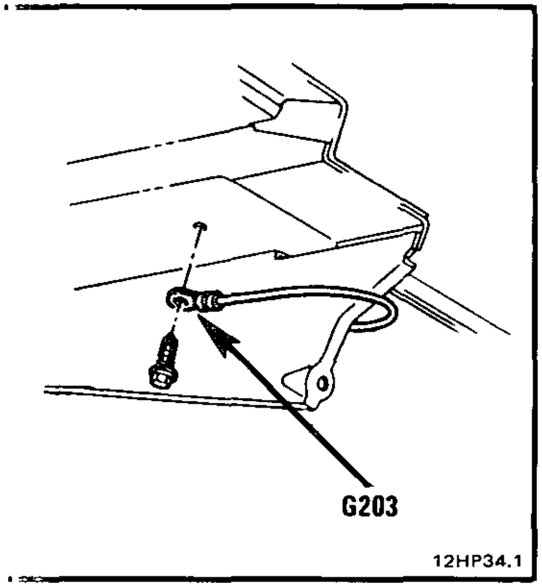
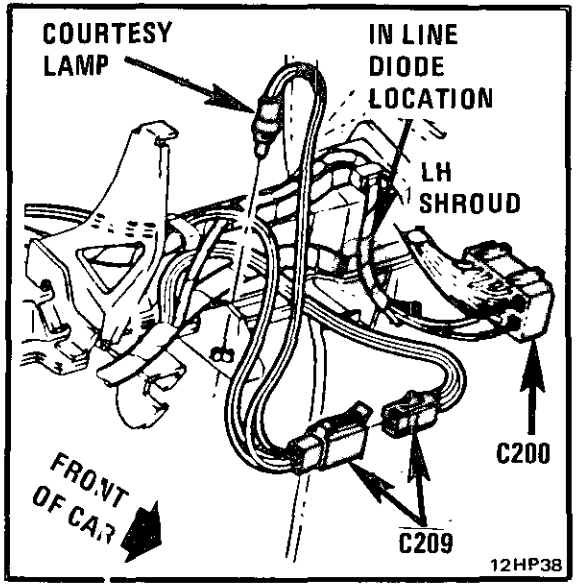


Figure B - Right Of Steering Column



igure C - Behind LH Side Of I/P

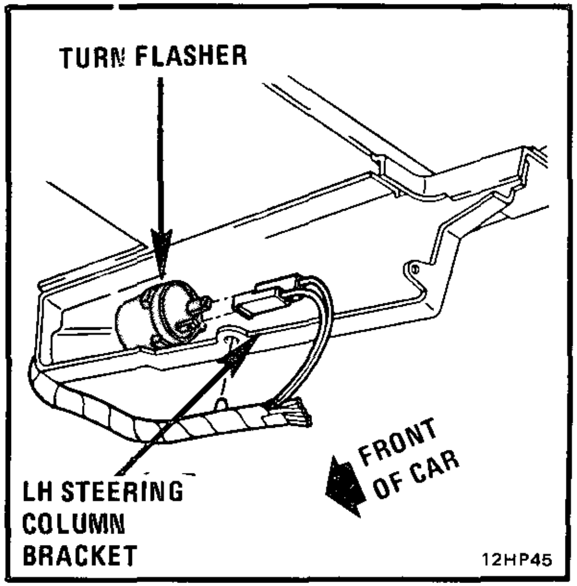


Figure D - Left Of Steering Column

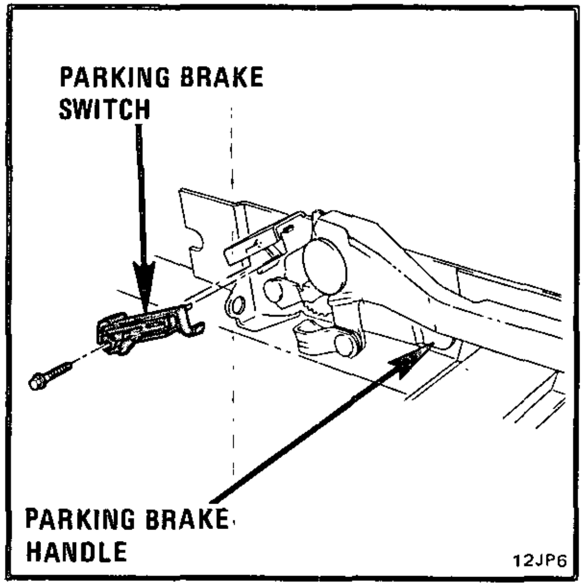


Figure E - LH Door Sill

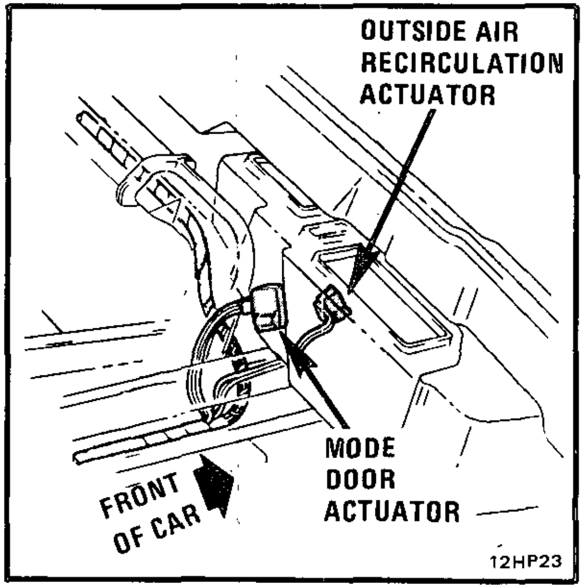


Figure F - Behind Center Of I/P

COMPONENT LOCATION VIEWS

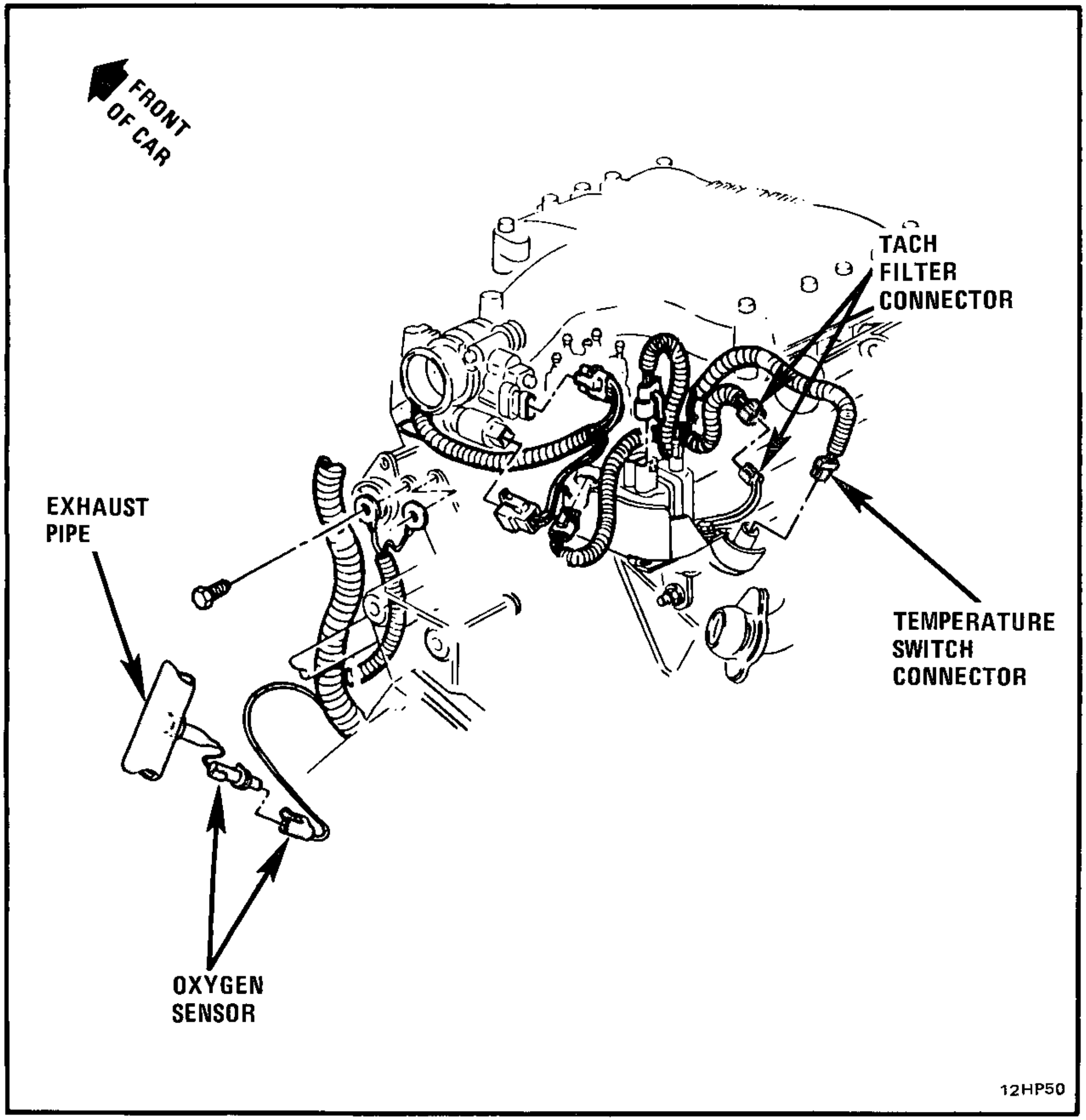


Figure A - Rear Of VIN 9 Engine

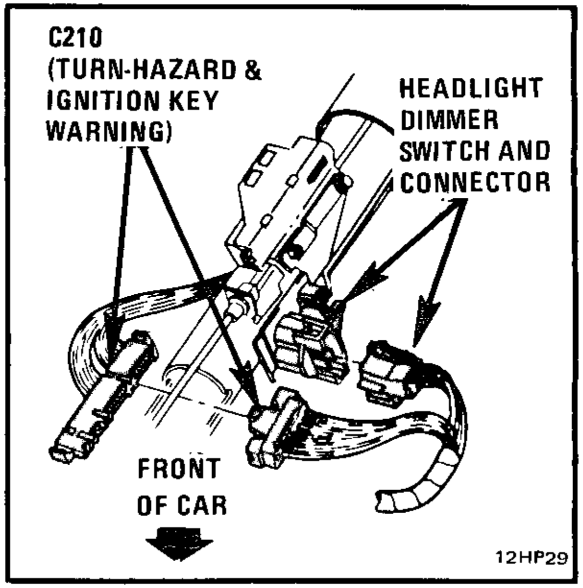


Figure B - Center Of Steering Column

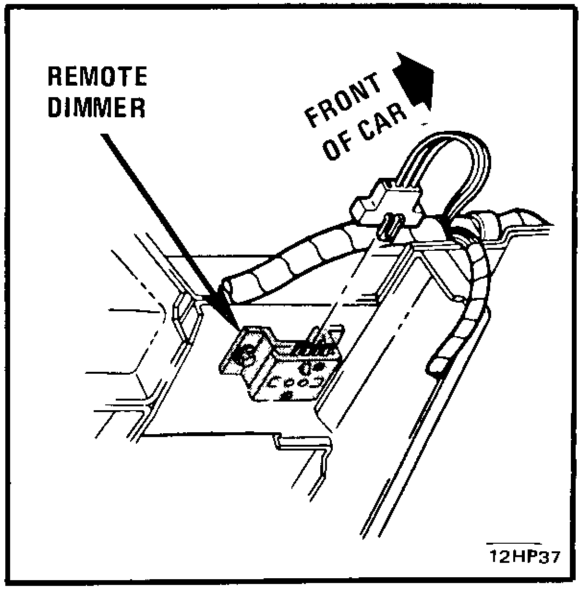


Figure C - Below Center Of I/P

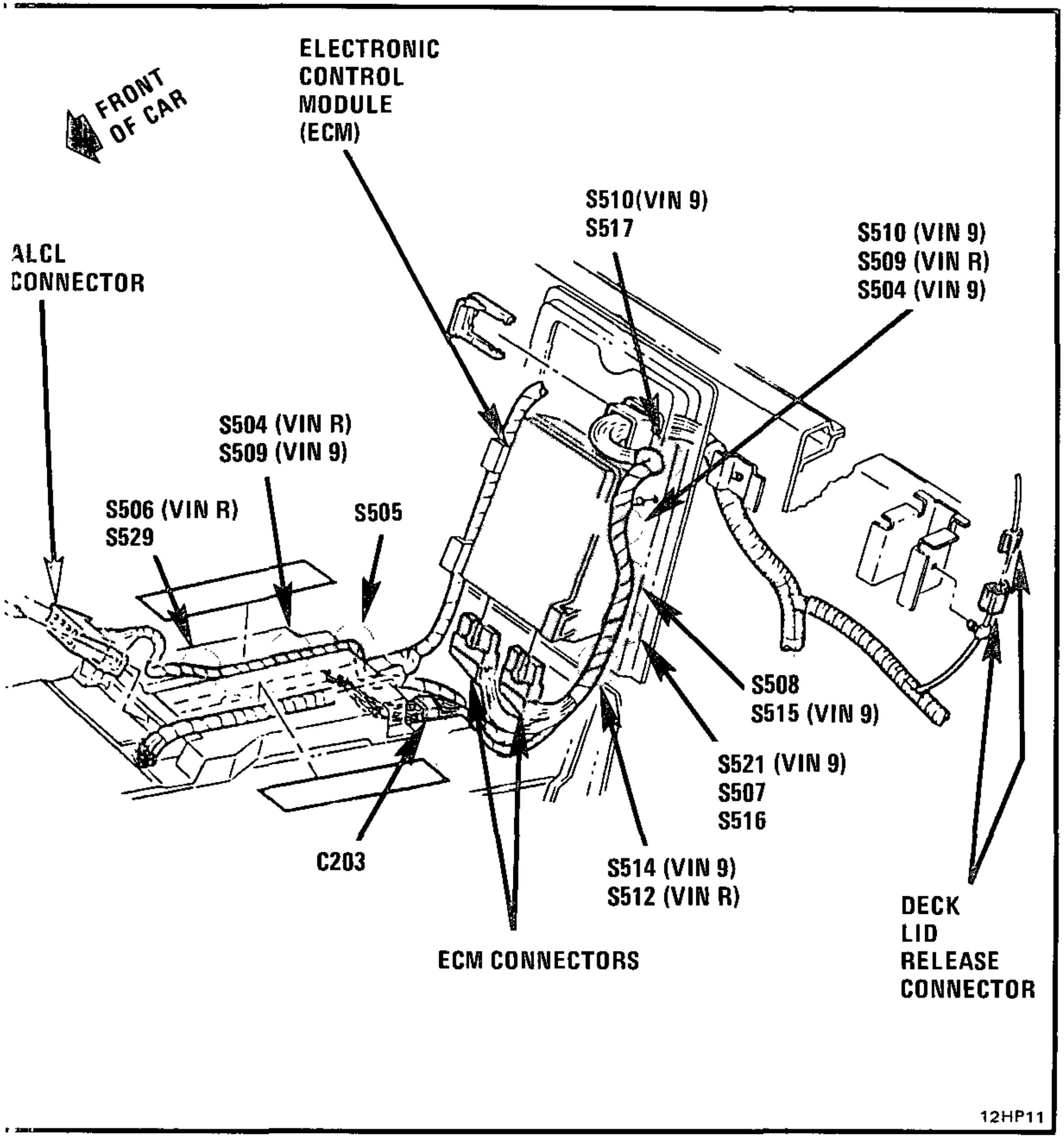


Figure A - Between Seats, Rear Bulkhead

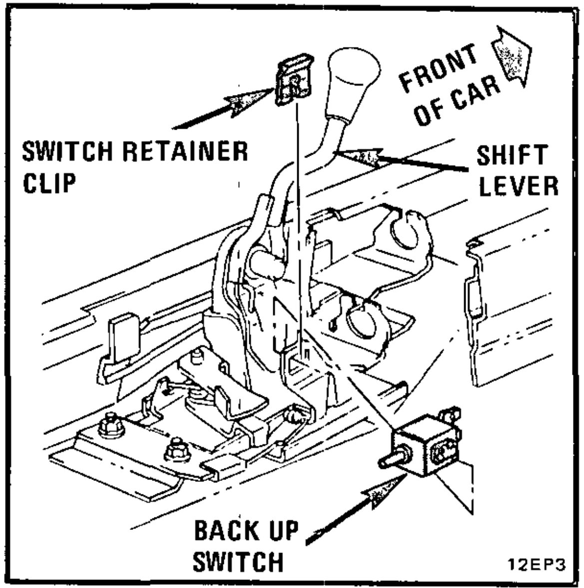


Figure B - Center Console

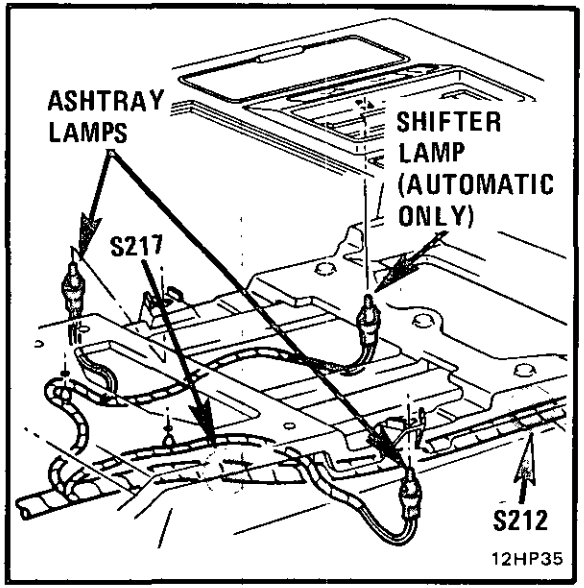


Figure C - Below Shifter

COMPONENT LOCATION VIEWS

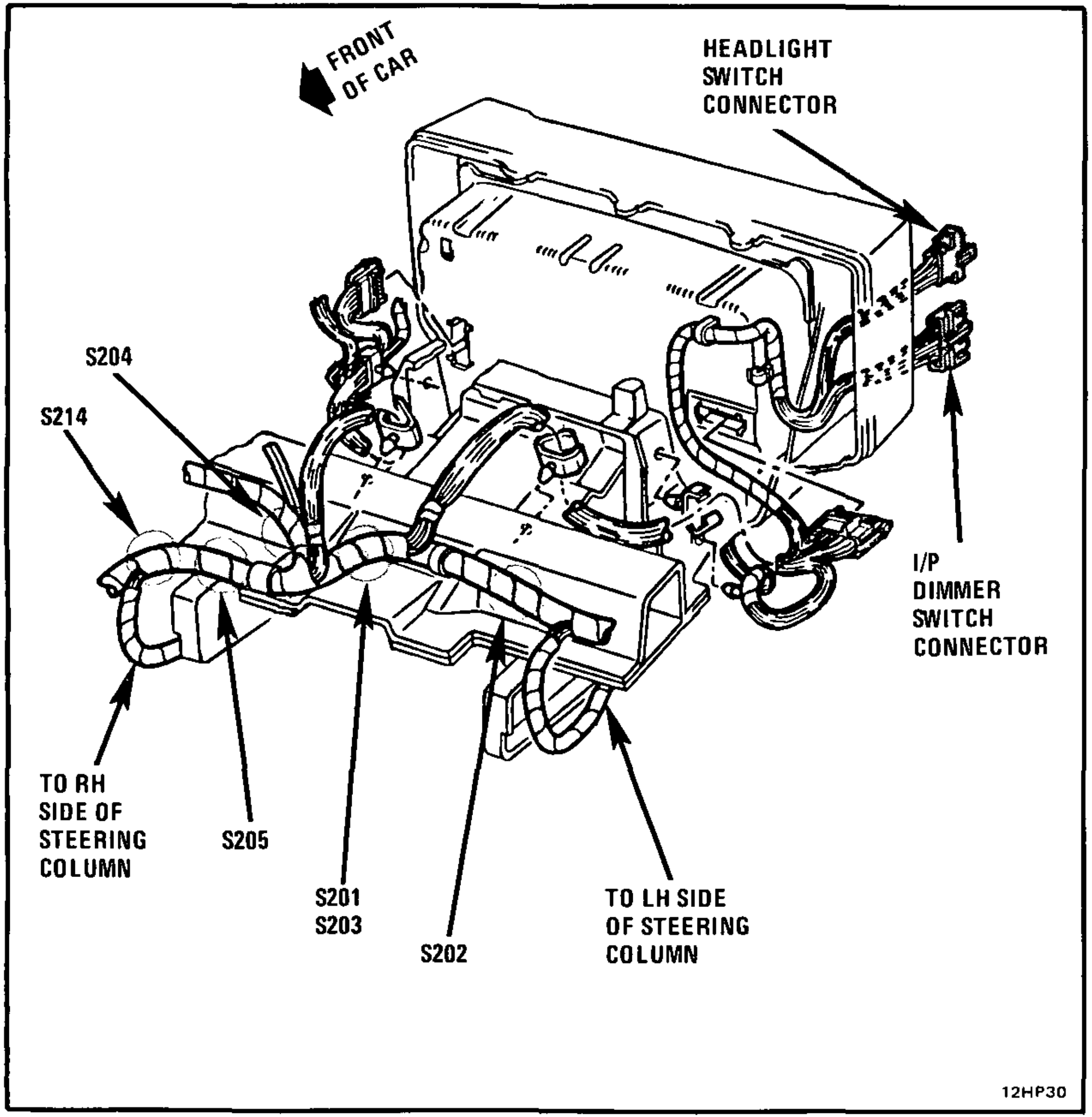


Figure A - Behind LH Side Of I/P

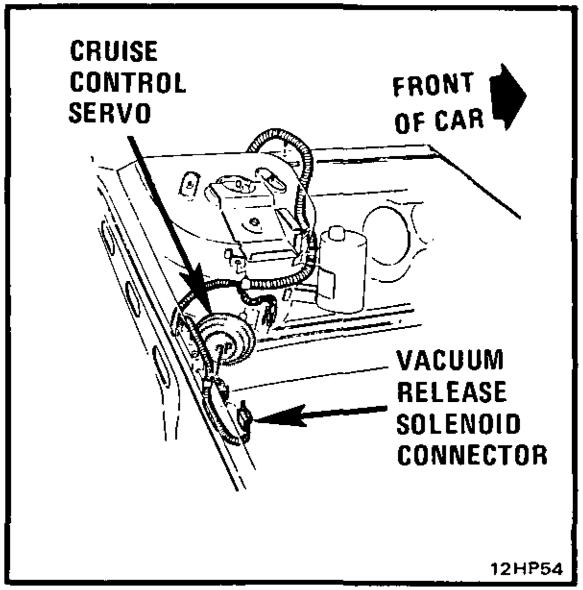


Figure B - LH Side Of Engine Compartment

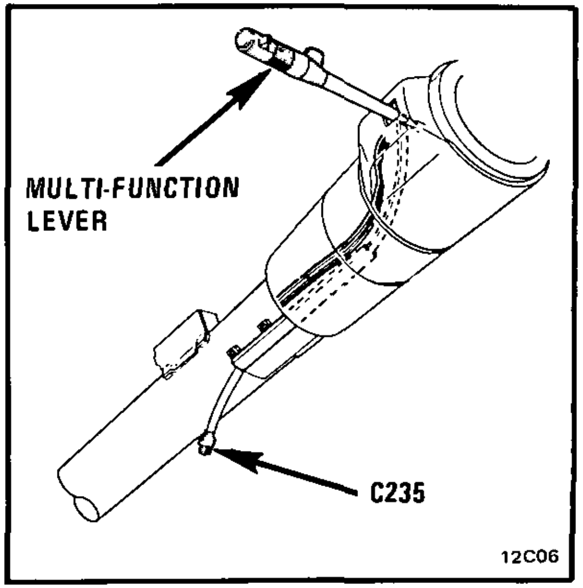


Figure C - Top LH Of Steering Column

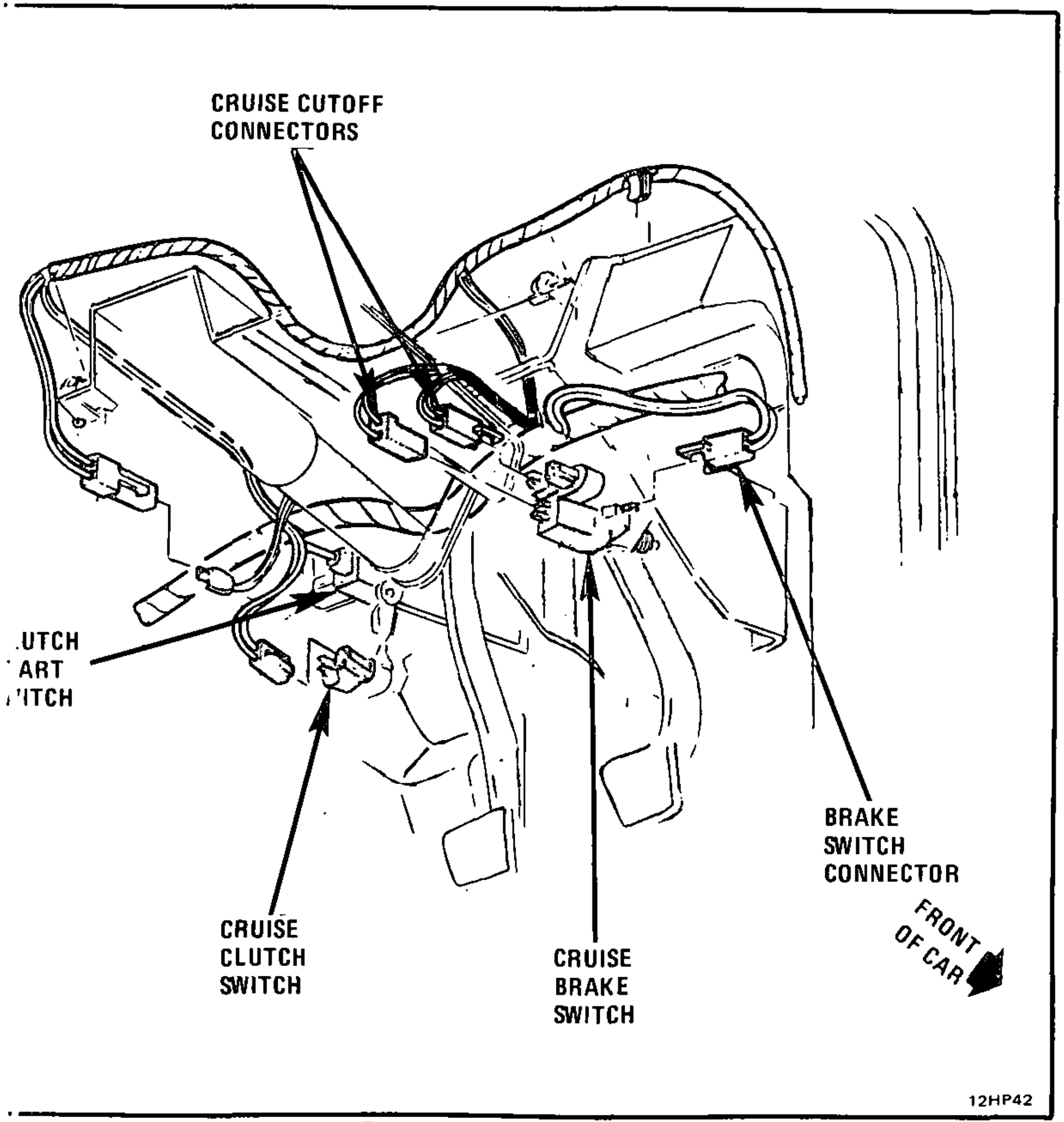


Figure A - Below LH Side Of I/P

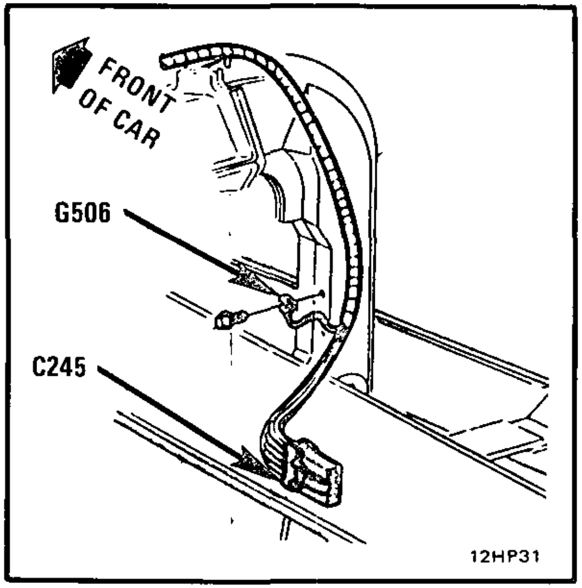


Figure B - RH Steering Column Support

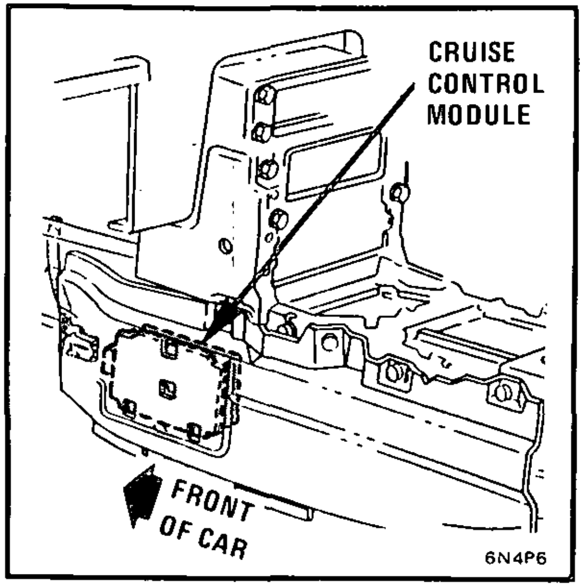


Figure C - Behind Carpet Support, Between Seats

COMPONENT LOCATION VIEWS

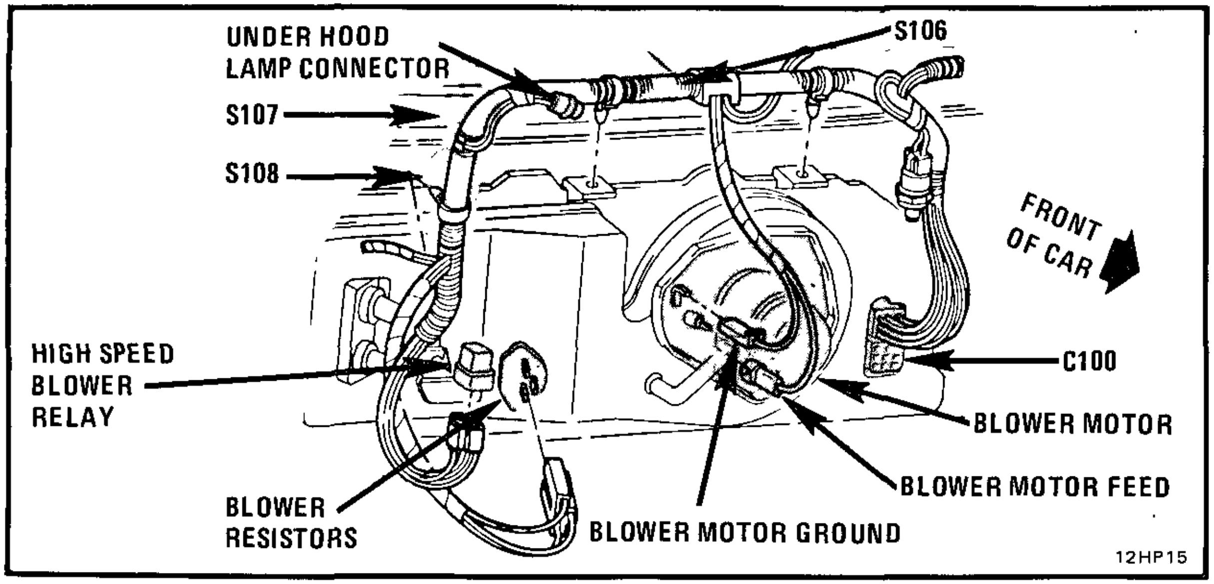


Figure A - RH Side Of Front Bulkhead

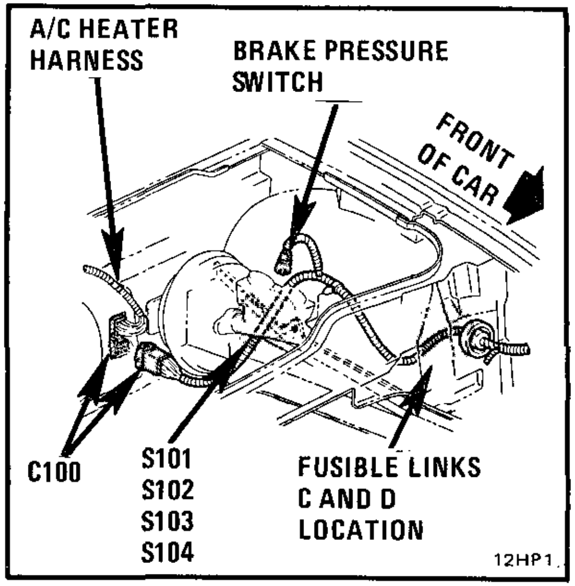


Figure D - LH Rear Corner Of Front Compartment

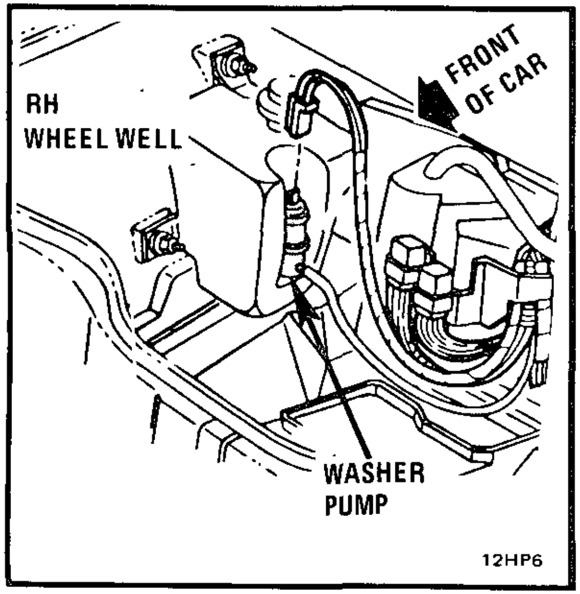


Figure B - RH Rear Of Front Compartment

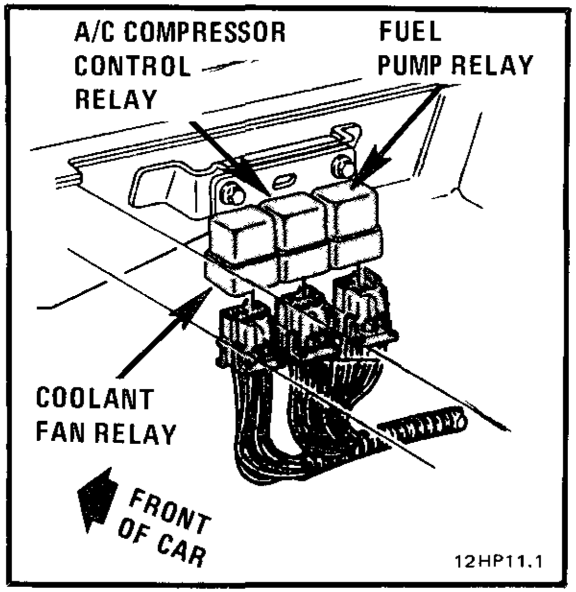


Figure C - LH Front Of Engine Compartment

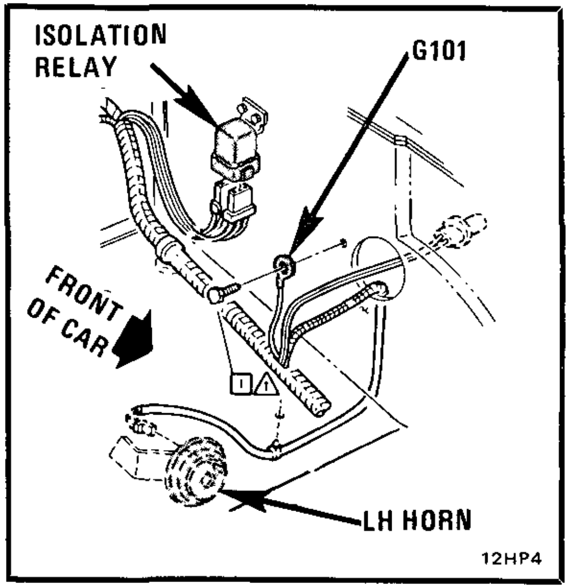
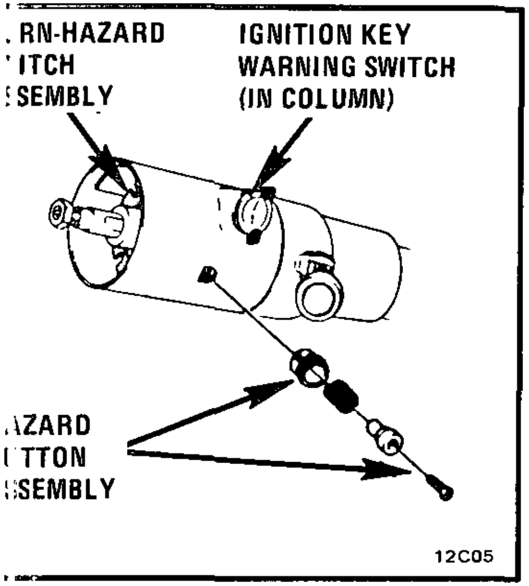


Figure E - LH Front Corner Of Front Compartment

MPONENT LOCATION VIEWS



igure A - Top RH Side Of Steering Column

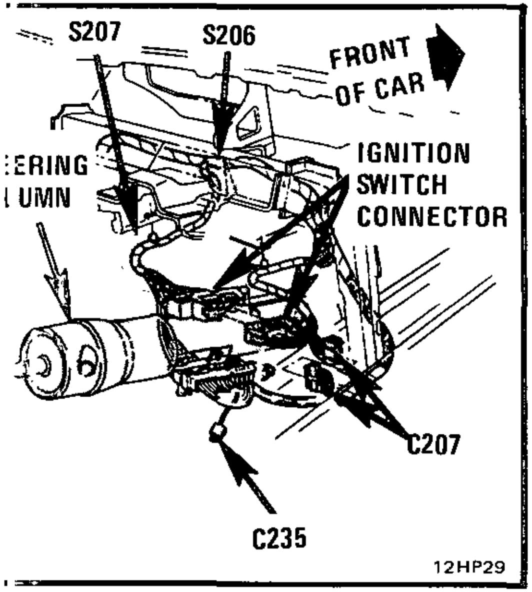


Figure B - RH Side Of Steering Column

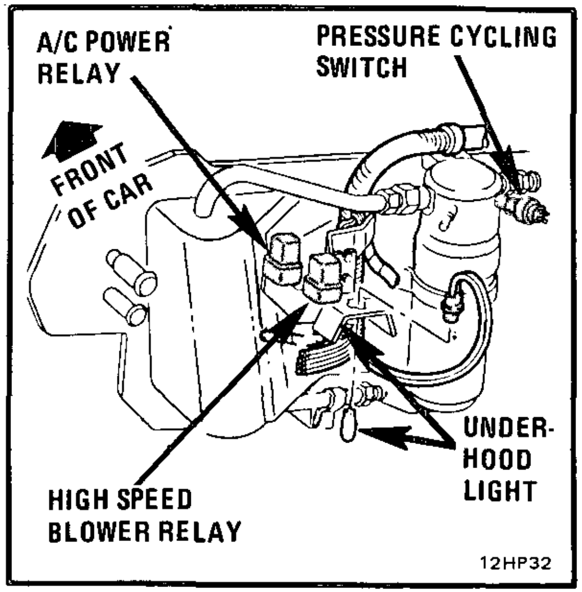


Figure C - RH Front Of Dash

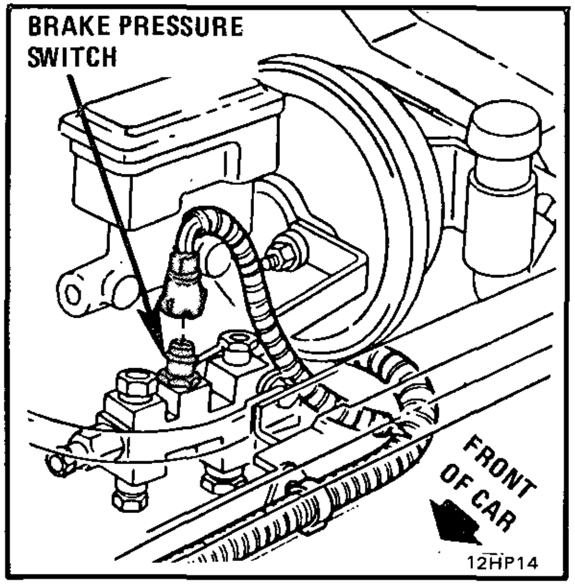


Figure D - LH Rear Corner Of Front Compartment

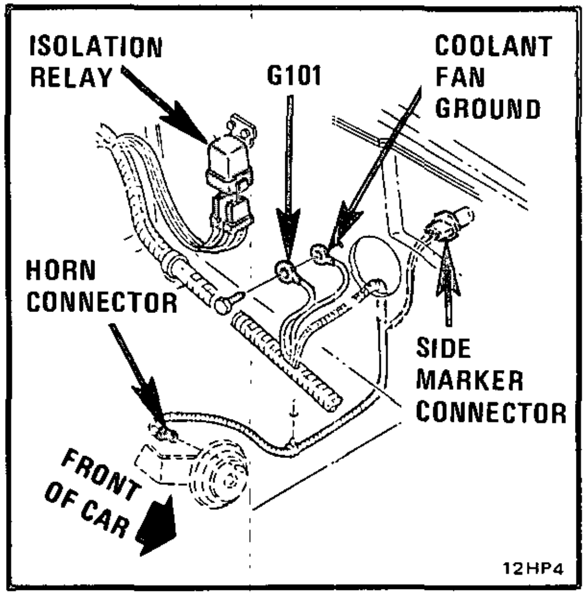


Figure E - LH Front Corner Of Front Compartment

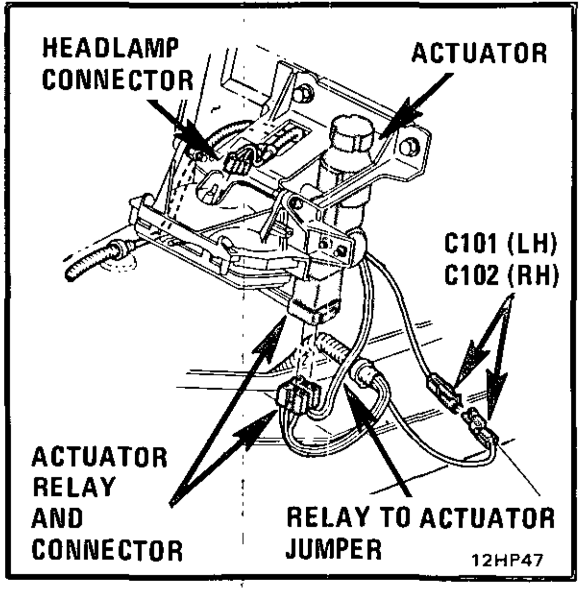


Figure F - RH Headlamp Assembly, LH Similar

COMPONENT LOCATION VIEWS

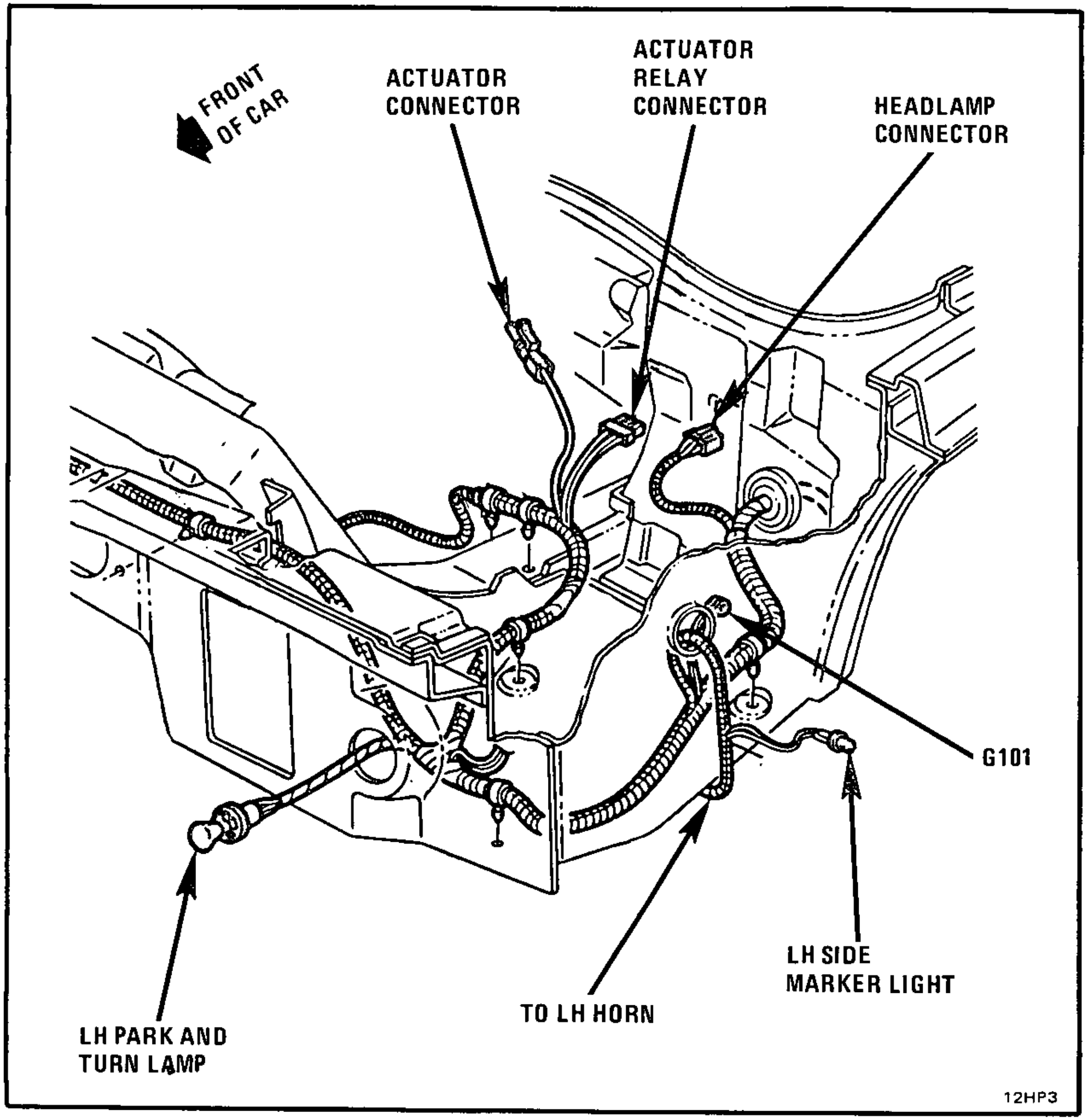


Figure A - LH Front Of Car

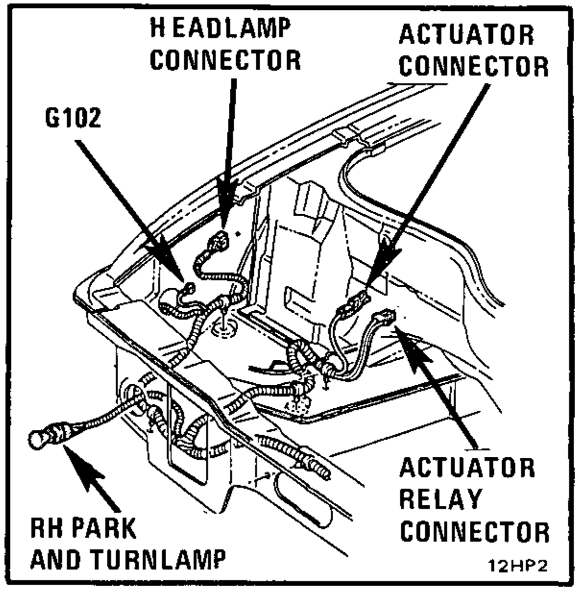


Figure B - RH Front Of Car

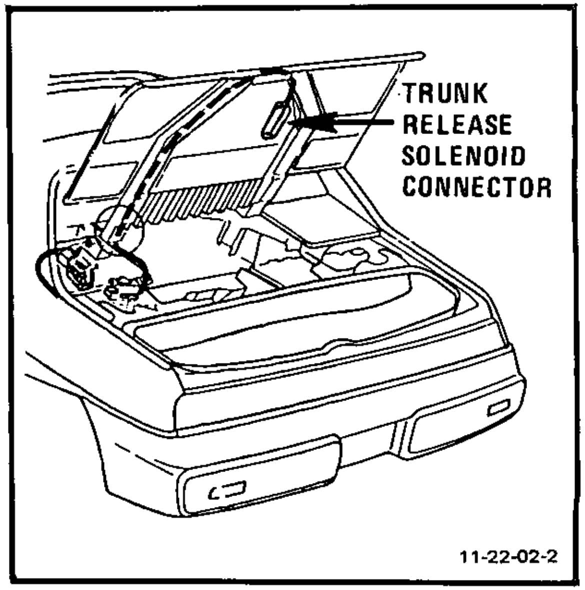


Figure C - Rear Of Car

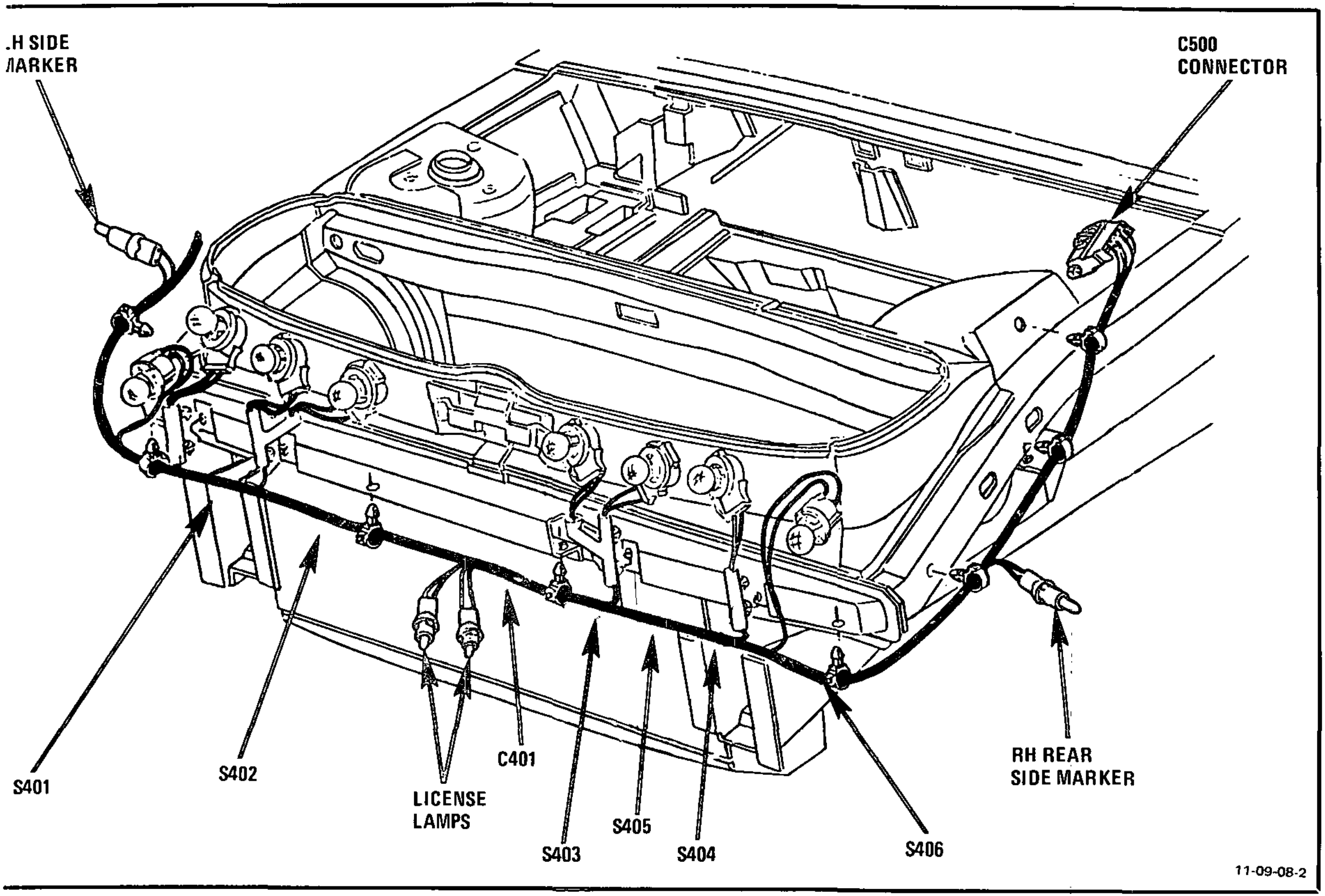


Figure A - Rear Of Car

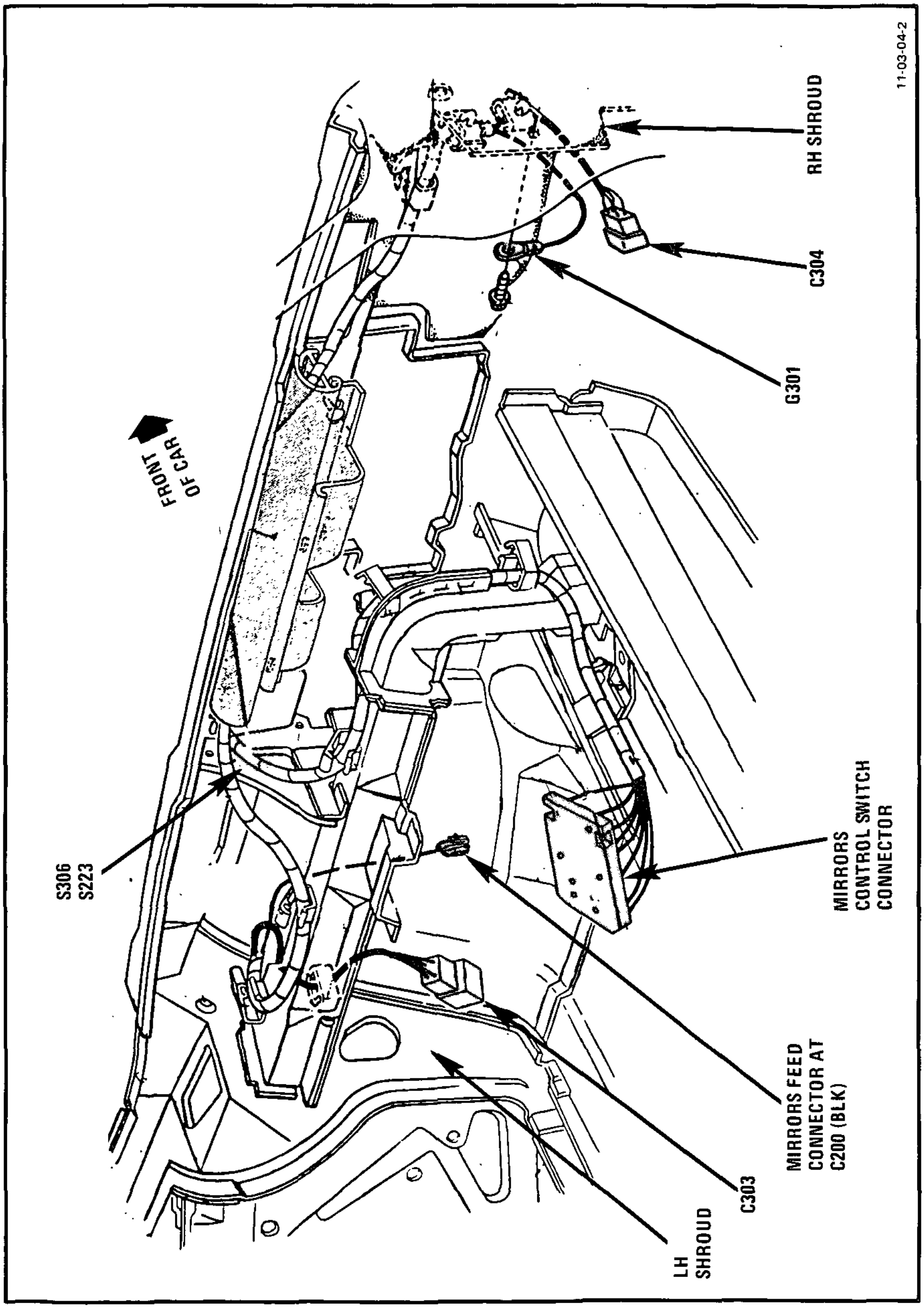


Figure A - Front Of Passenger Compartment

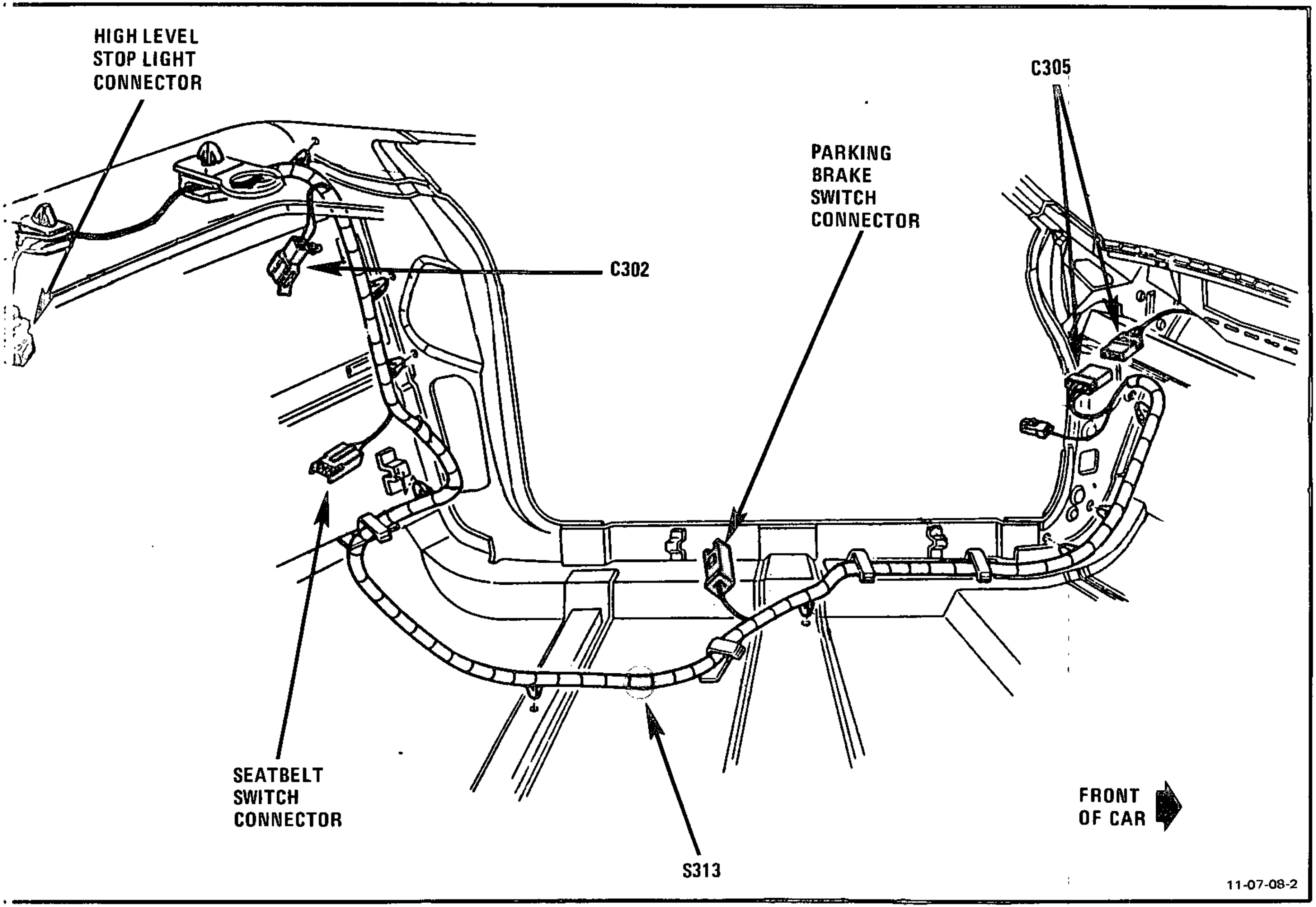


Figure A - LH Side Of Passenger Compartment

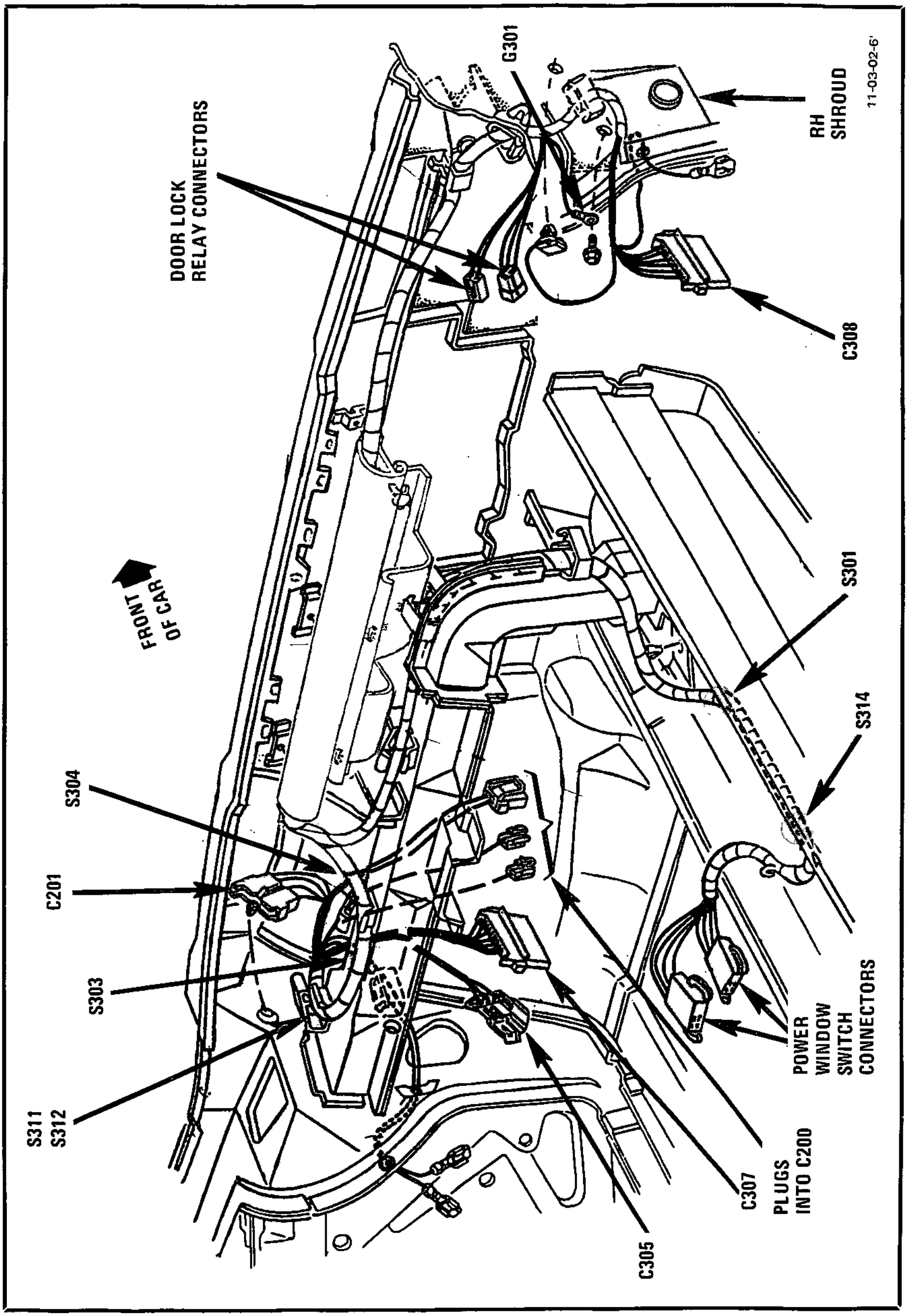


Figure A - Behind I/P Power Windows And Power Door Locks Harness

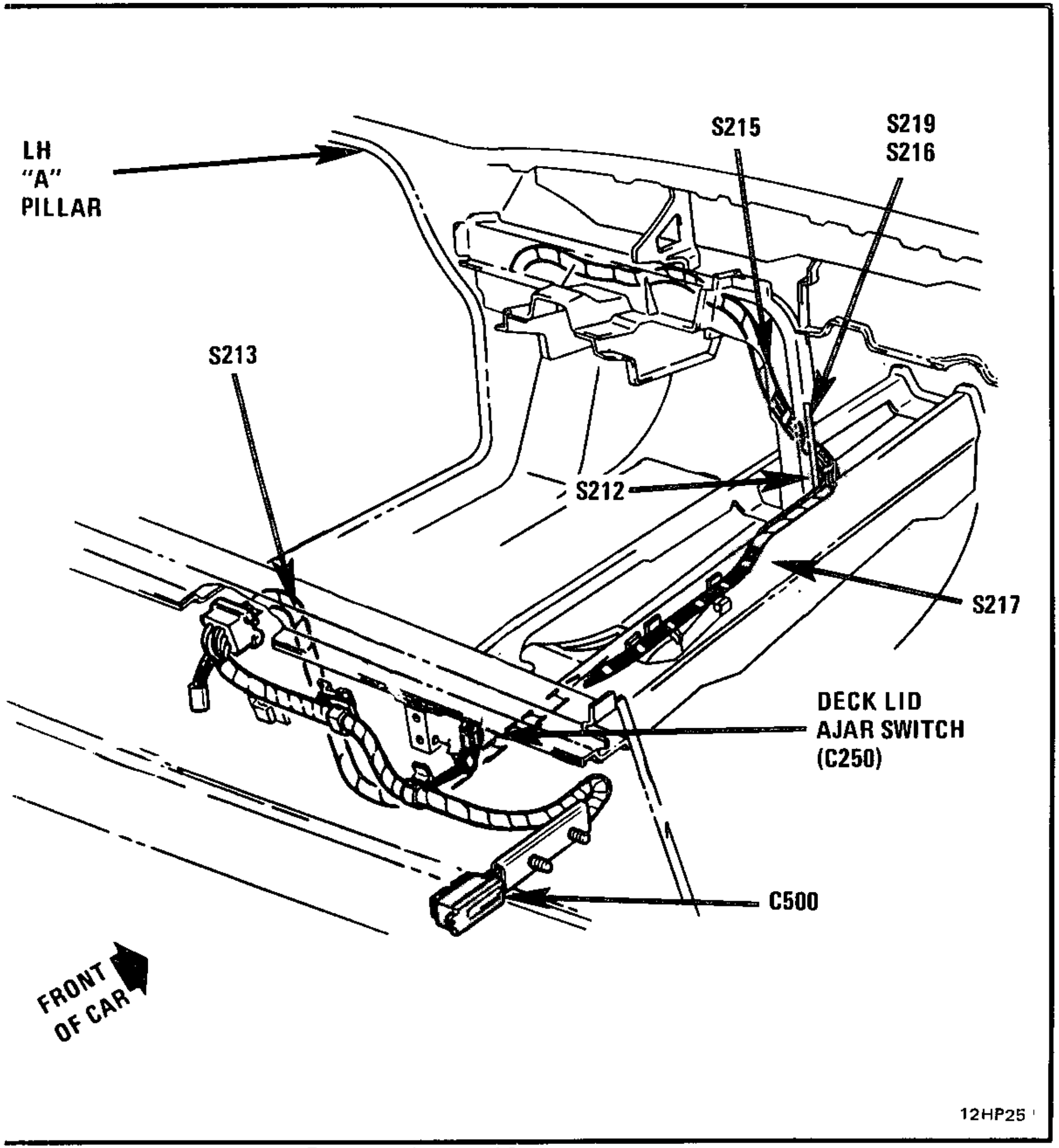


Figure A - Center Of Passenger Compartment

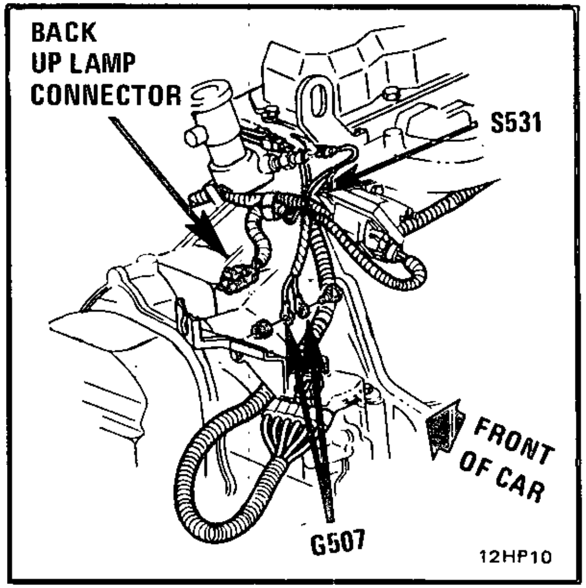


Figure B - RH Front Of VIN R Eingine

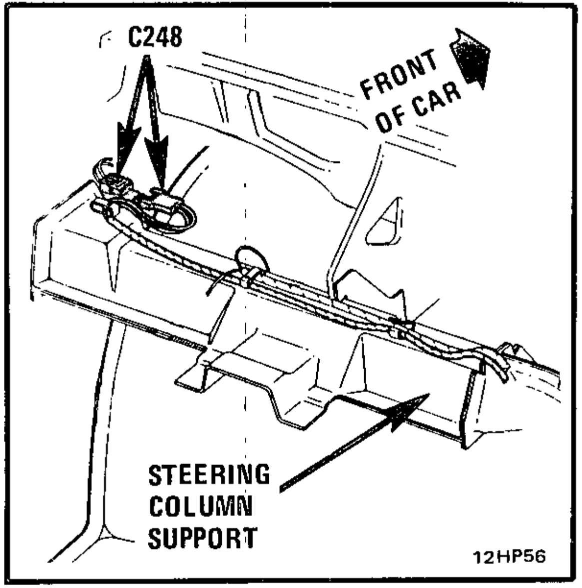


Figure C - Behind I/P LH Side Of Steering Column

COMPONENT LOCATION VIEWS

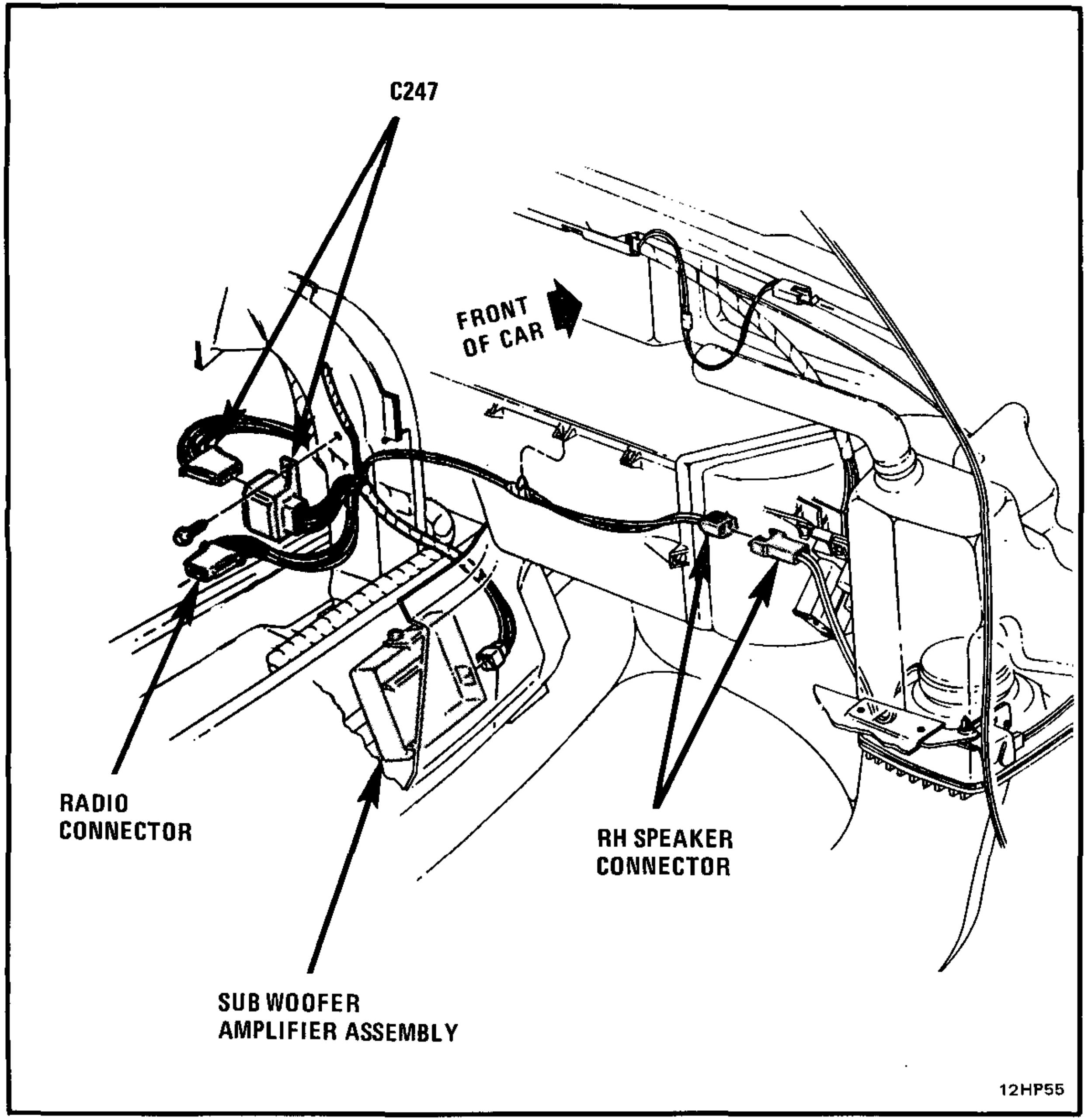


Figure A - Center Of I/P

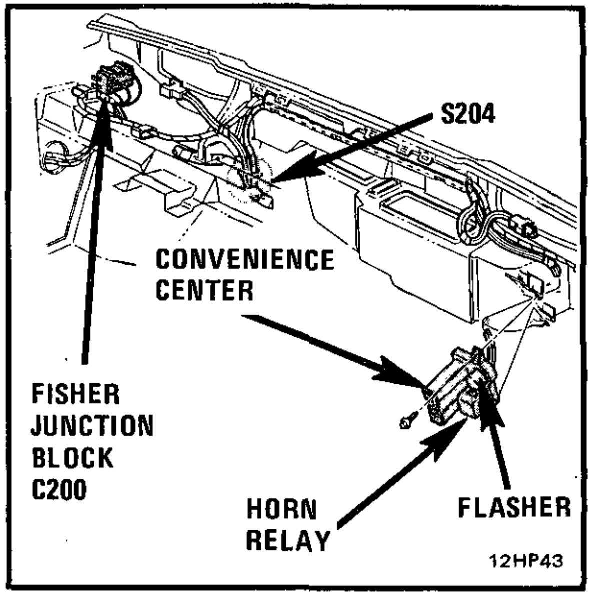
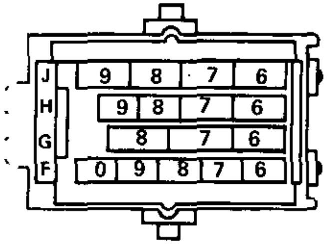


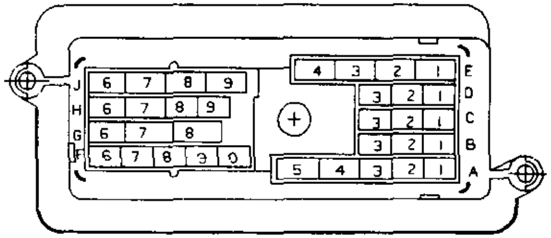
Figure B - Behind Center RH Side Of I/P

⁝NESS CONNECTOR FACES

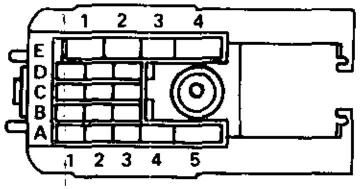
.⁝HEAD CONNECTOR (C100)



INT LIGHTS HARNESS CONNECTOR
MOVED FROM C100)



C100 TERMINAL VIEW
(AS MOUNTED ON COWL)



AIR CONDITIONG/HEATER HARNESS CONNECTOR
(REMOVED FROM C100)

TY	WIRE COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
	TAN/WHT	33	Brake Warning System
	LT GRN/BLK	937	Coolant Fan
	BRN	250	Coolant Fan
	DK GRN/WHT	335	Coolant Fan
	BRN	9	Lights: Marker/Park
	RED	2	Headlight Doors
			Not Used
	RED	2	Coolant Fan
	DK GRN	29	Horn
			Not Used
	DK BLU	15	Lights: Turn (RH)
	LT BLU	14	Lights: Turn (LH)
	YEL	103	Headlight Doors
	TAN	12	Headlights (Lo Beams)
	LT GRN	11	Headlights (Hi Beams)
	YEL	10	Headlight Doors

CAVITY	WIRE COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
A1	ORN	98	Wiper/Washer
A2	LT GRN	66	Air Conditioning
A3	LT BLU	67	Air Conditioning
A4	BLK	150	Air Conditioning, Heater
A5	BRN	922	Air Conditioning
B1	WHT	93	Wiper/Washer
B2	ORN	951	Air Conditioning
B3	LT GRN	51	Air Conditioning, Heater
C1	PPL	92	Wiper/Washer
C2	BRN	9	Underhood Light
C3	PNK	94	Wiper/Washer
D1	GRY	91	Wiper/Washer
D2	BRN	50	Ignition Switch Fused Feed
D3	DK GRN	146	Hood Ajar
E1	ORN	52	Air Conditioning, Heater
E2	LT BLU	72	Air Conditioning, Heater
E3	TAN	63	Air Conditioning
E4	RED	2	Air Conditioning, Heater

HARNESS CONNECTOR FACES

JUNCTION BLOCK (C200)

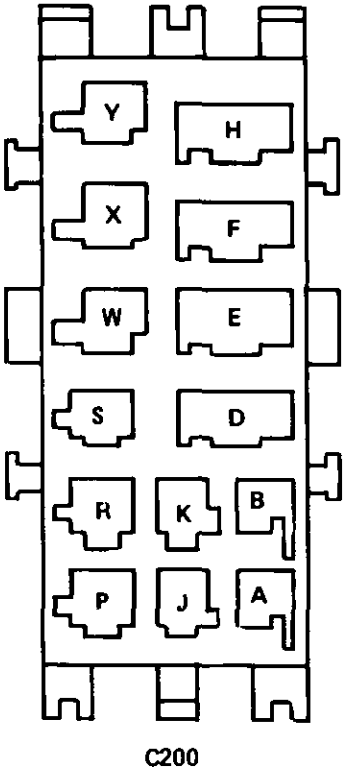
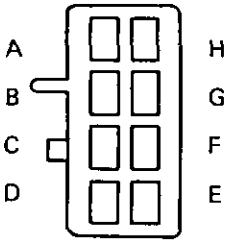


Figure 1 - Behind LH Side Of I/P

CAVITY	CONNECTOR COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
A	BLK	40	Power Remote Mirrors
B		40	Not Used
D	WHT	40, 156	Interior Lights, Power Remote Mirrors
E		40, 156	Not Used
F	WHT	40, 156	Interior Lights: Dome/Reading
G		40, 156	Not Used
J	WHT	192	Defogger
K	WHT	293	Defogger
P	BLU	76	Power Windows
R	BLU	76	Power Windows
S		76	Not Used
W	GRY	60	Power Door Locks, Defogger
X	GRY	60	Power Door Locks
Y	GRY	60	Defogger

INESS CONNECTOR FACES

Y CONNECTOR (C201)

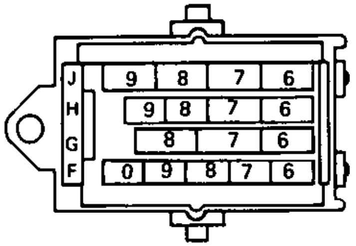


C201
TERMINAL
VIEW

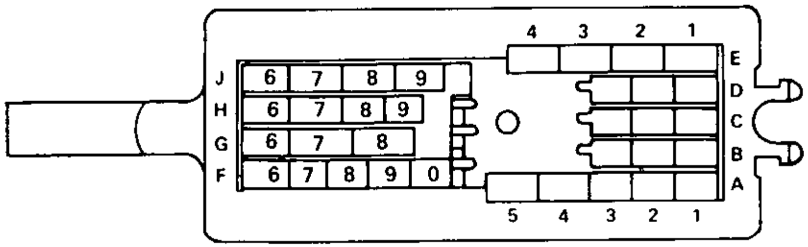
CAVITY	WIRE COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
A	WHT	156	Interior Lights
B	ORN	340	Battery Fused Feed
C	BLK	238	Audio Alarm System (Seat-belt Warning)
D	TAN/WHT	33	Audio Alarm System, Brake Warning System
E	BLK/ORN	158	Door Ajar
F	TAN	159	Audio Alarm System (Key Warning)
G	LT BLU	20	Stop Lamps
H	BLK	150	Ground

HARNESS CONNECTOR FACES

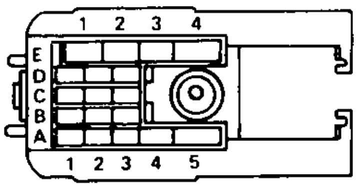
JUNCTION CONNECTOR (C500)



REAR LIGHTS HARNESS CONNECTOR
(REMOVED FROM C500)



C500 TERMINAL VIEW
(AS MOUNTED ON COWL)



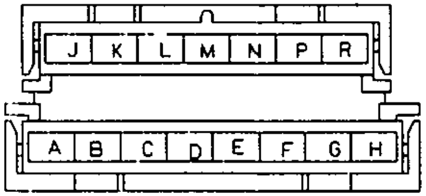
ENGINE HARNESS CONNECTOR
(REMOVED FROM C500)

CAVITY	WIRE COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
A1			Not Used
A2	BLK	150	Battery (Ground)
A3			Not Used
A4			Not Used
A5			Not Used
B1			Not Used
B2			Not Used
B3	BRN	25	Charging System
C1	BLU	75	Back Up Lights
C2	LT GRN	135	Indicators
C3	WHT	121	Tachometer
D1	DK GRN/WHT	335	Coolant Fan
D2	LT GRN/BLK	937	Coolant Fan
D3	DK GRN	35	Instrument Panel
E1	LT GRN	24	Back Up Lights
E2	PPL	6	Neutral Start Switch

CAVITY	WIRE COLOR	CIRCUIT NUMBER	CIRCUIT CONNECTED
E3	PNK	3	Electronic Fuel Injection Multiport Fuel Injection
E4			Not Used
F6	TAN	398	Cruise Control
F7	BRN	9	Lights: Tail/License/Park
F8	DK GRN	156	Interior Lamps
F9	LT GRN	24	Back Up Lights
F0	DK GRN/WHT	335	Cooling Fan
G6	LT BLU/BLK	399	Cruise Control
G7	WHT	17	Lights: Stop/Turn
G8	BRN	250	Lights: Stop/Turn
H6	DK BLU	403	Cruise Control
H7	YEL	18	Lights: Turn/Stop
H8	WHT	17	Lights: Turn/Stop
H9	ORN	340	Lights: Turn/Stop
J6	LT GRN	402	Cruise Control
J7	LT GRN/BLK	943	Cruise Control
J8	DK GRN	19	Lights: Turn/Stop
J9	LT BLU	20	Stop Lamps

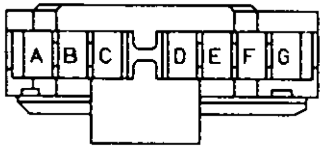
For C100, See Page 202-0

For C201, See Page 202-1



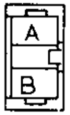
BLK 12020213

To C203 (Socket Half)



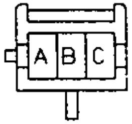
BLK 12010430

To C207 (Socket Half)



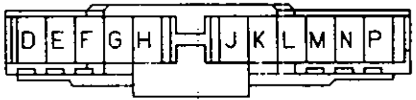
BLK 8900444

To C208 (Socket Half)



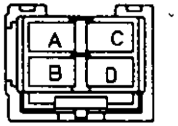
BLK 8917544

To C209 (Socket Half)



BLK 12004147

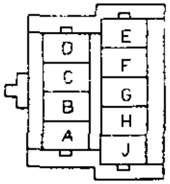
To C210 (Socket Half)



BLK 12020651

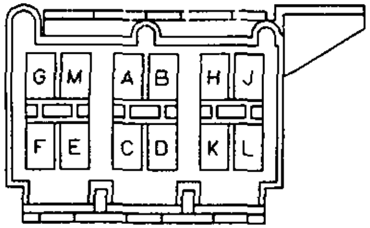
To C235 (Socket Half)

HARNESS CONNECTOR FACES



BLK 8900441

To C245 (Socket Half)



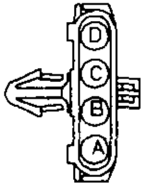
BLK 12010175

To C247 (Socket Half)

Not Available

BLK 0890444

To C248 (Socket Half)



BLK 12034297

To C250 (Socket Half)

Not Available

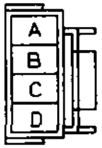
BLK 12047786

To C303 (Socket Half)

Not Available

BLK 12047786

To C304 (Socket Half)



BLK 12015664

To C305 (Socket Half)

NAT 12015416

To C307 (Socket Half)

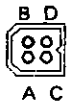
NAT 12015416

To C308 (Socket Half)

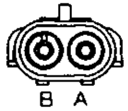
NAT 12010585
To C310 (Socket Half)

Not Available
BLK 12047622
To C316 (Socket Half)

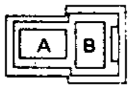
Not Available
BLK 12015791
To C507 (Socket Half)



NAT 12010585
To C311 (Socket Half)

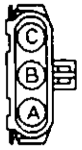


BLK 12010973
To C401 (Socket Half)

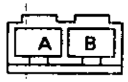


BLK 2984883
To C511 (Socket Half)

Not Available
BLK 12047622
C315 (Socket Half)

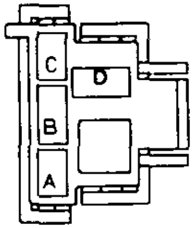


BLK 12020827
To C502 (Socket Half)



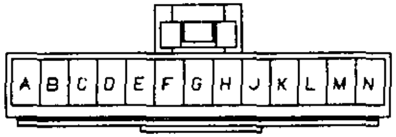
BLK 2973407
To A/C Compressor Clutch

HARNESS CONNECTOR FACES



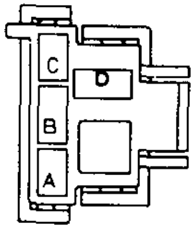
BLK 12020015

To A/C Compressor Control Relay



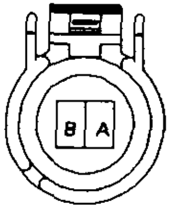
BLK 12015130

To A/C Control Head



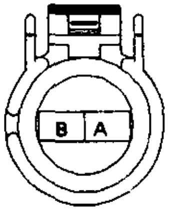
BLK 12020015

To A/C Coolant Fan Relay



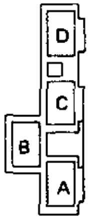
BLK 12041139

To A/C High Pressure Switch



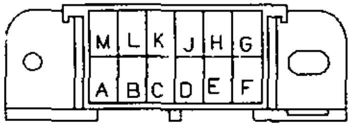
BLK 12041137

To A/C Low Pressure Switch



GRY 2965019

To A/C Power Relay



BLK 12020043

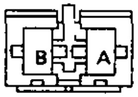
To Assembly Line Communication Link (ALCL) Connector

NAT 8900968

To Amplifier Switch

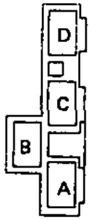
BLK 12015792

To Back Up Lamp



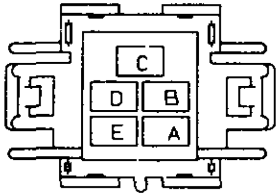
BLK 12004622

To Back Up Lamp Switch



GRY 2965019

To Blower Resistors

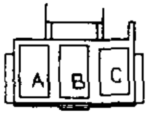


BLK 12020813

To Blower Switch

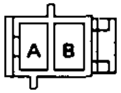
BLK 12010070

To Brake Pressure Switch



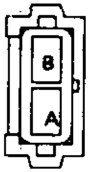
BLK 12033699

To Brake Switch



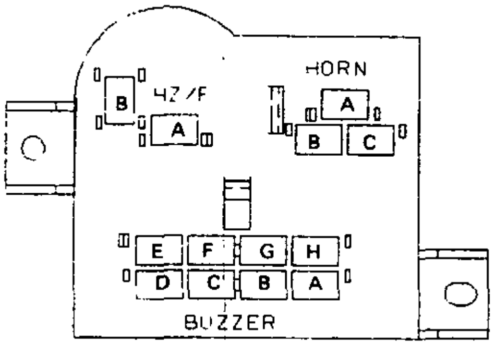
BLK 12015034

To Clutch Start Switch



BLK 12020723

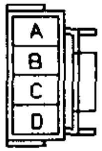
To Cold Start Switch



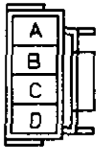
BLK 12015999

To Convenience Center

HARNESS CONNECTOR FACES



12015664
To Coolant Fan (Single Speed)

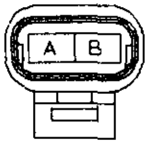


BLK 12015664
To Coolant Fan (Two Speed)

BLK 12020028
To Coolant Fan Relay

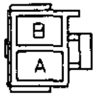
BLK 12020028
To Coolant Fan Relay (Single Speed)

BLK 12020028
To Coolant Fan Relay (Two Speed)

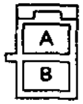


BLK 12040753
To Coolant Temperature Sensor

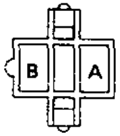
BLU 12015197
To Coolant Temperature Switch



BLK 12033709
To Coolant Temperature Switch/Sender

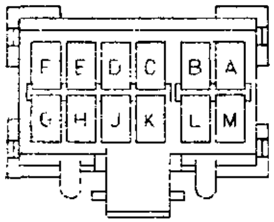


BLK 2973872
To Cruise Brake Switch



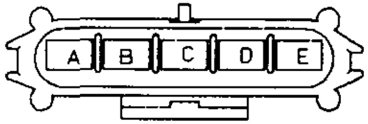
NAT 12010649

To Cruise Clutch Switch



BLK 12034125

To Cruise Control Module



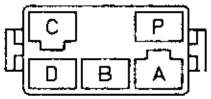
GRY 12020646

To Cruise Control Servo

Not Available

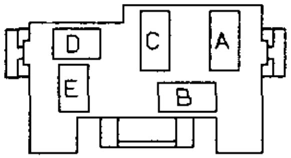
BLK 08917738

To Defogger



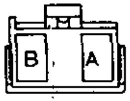
BLK 12015163

To Defogger Control



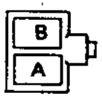
BLK 12004099

To Defogger Timer Relay



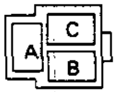
NAT 12015199

To Dome Reading Lights



GRY 2977373

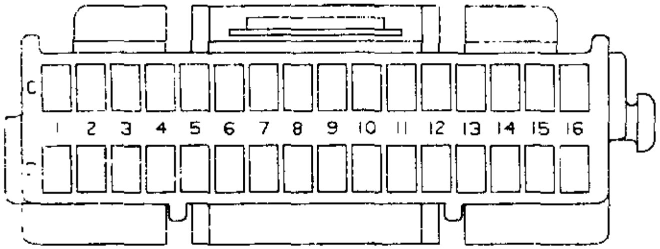
To Door Lock Relay Assembly (C2)



BLK 2984378

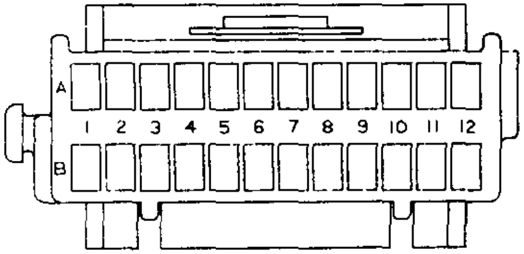
To Door Lock Relay Assembly (Pins 3 and 4)

HARNESS CONNECTOR FACES



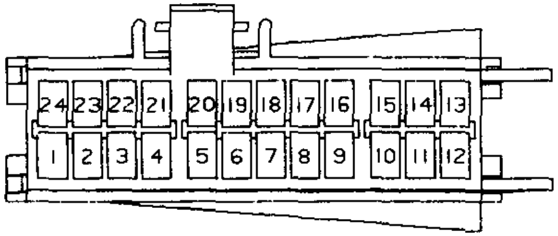
BLK 12020754

To Electronic Control Module (ECM) (C1)
(V6 VIN 9)



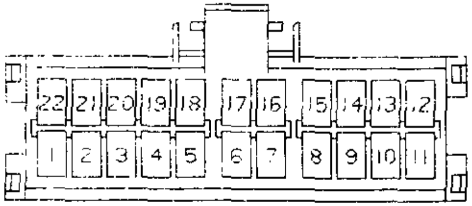
BLK 12020753

To Electronic Control Module (ECM) (C2)
(V6 VIN 9)



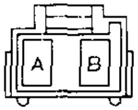
NAT/RED 12015099

To Electronic Control Module (ECM) (C2)
(L4 VIN R)



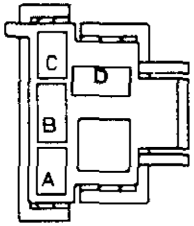
BLK 12010720

To Electronic Control Module (ECM) (C2)
(L4 VIN R)



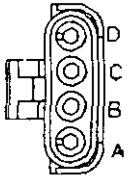
NAT 12015271

To Engine Blower Motor



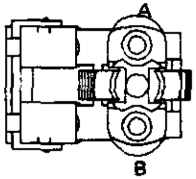
BLK 12020015

To Engine Blower Relay



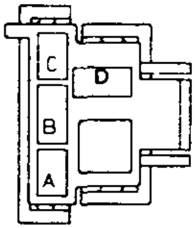
BLK 12015797

To (EVRV) Valve



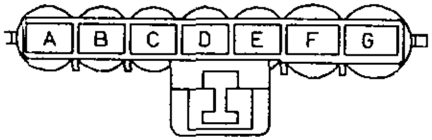
BLK 12020549

To Fuel Injector



BLK 12020015

To Fuel Pump Relay



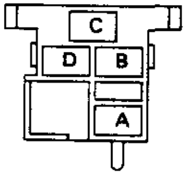
BLK 12034169

To Gear Selector Switch

Not Available

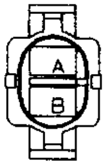
BLK 12045896

To Generator



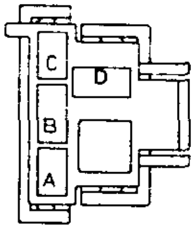
BLK 8917693

To Headlight Dimmer Switch



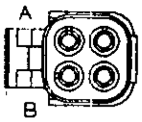
BLK 12020809

To High Level Stop Light



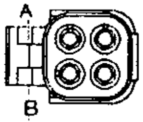
BLK 12020015

To High Speed Blower Relay



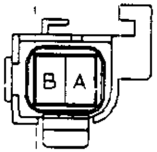
BLK 12015798

To Idle Air Control Stepping Motor



BLK 12015798

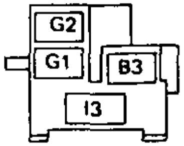
To Idle Air Control Valve



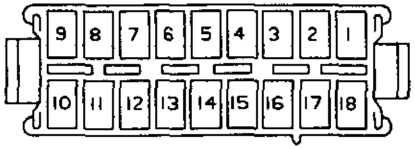
GRY 12040705

To Ignition Coil

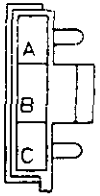
HARNESS CONNECTOR FACES



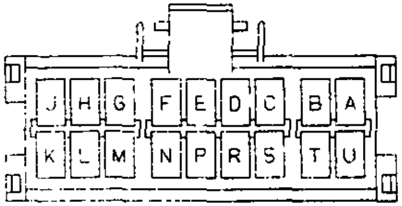
BLK 6294641
To Ignition Switch



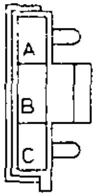
BLK 8900371
To Instrument Panel (C3)



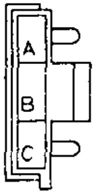
BLK 12020014
To Isolation Relay (C2)



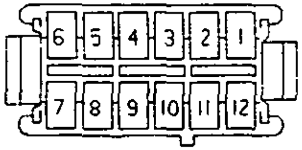
BLK 12010722
To Instrument Panel (C1)



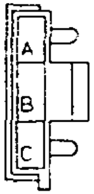
GRY 12020013
To Isolation Relay



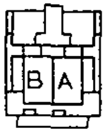
GRY 12020013
To LH and RH Actuator Relay (C1)



BLK 2984792
To Instrument Panel (C2)

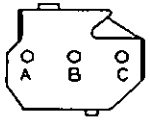


GRY 12020013
To Isolation Relay (C1)



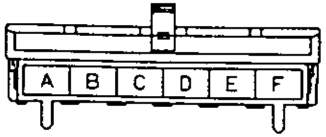
BLK 12004140
To LH and RH Front Door Lock Motor

RNESS CONNECTOR FACES



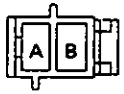
BLK 12015683

LH and RH Front Door Lock Switch



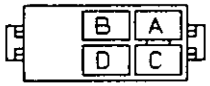
NAT 12034061

To Light Switch



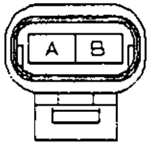
BLK 12015034

To Neutral Start Switch



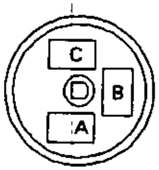
BLK 12004139

To LH Front Power Window Switch



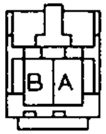
GRY 12041411

To Manifold Absolute Pressure Sensor



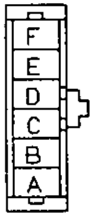
BLK 6288920

To Oil Pressure Switch



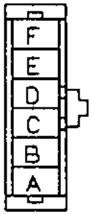
BLK 12004140

To LH Front Window Motor



NAT 8900443

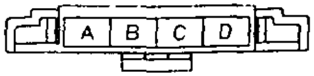
To Mode Door Actuator



NAT 8900443

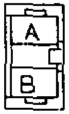
To Outside Air/Recirculation Door Actuator

HARNESS CONNECTOR FACES



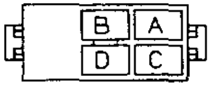
NAT 12034060

To Panel Interior Lights Control



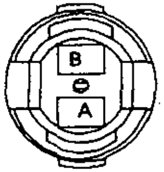
BLK 8900444

To Radio Speakers



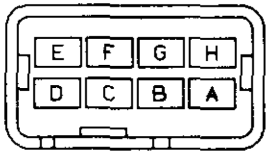
NAT 12004101

To RH Front Power Window Switch



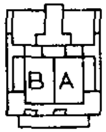
BLK 12004827

To Pressure Cycling Switch



BLK 12045688

To Rally Gage



BLK 12004140

To RH Front Window Motor

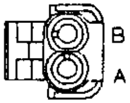
Not Available

12048148

To Radio

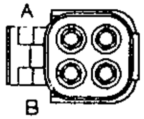
NAT 12034060

To Remote Dimmer



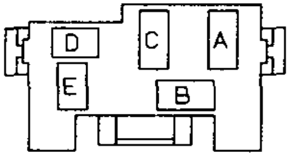
BLK 12015792

To Speed Sensor



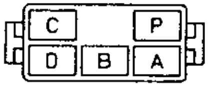
BLK 12015798

To Torque Converter Clutch Solenoid



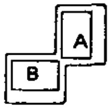
BLK 12004099

To Trunk Release Relay



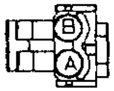
GRY 12015162

To Trunk Release Switch



BLK 2973385

To Turn Flasher

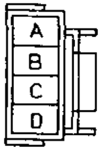


RED 12015978

To Vacuum Release Solenoid

BLK 2973781

To Washer Pump

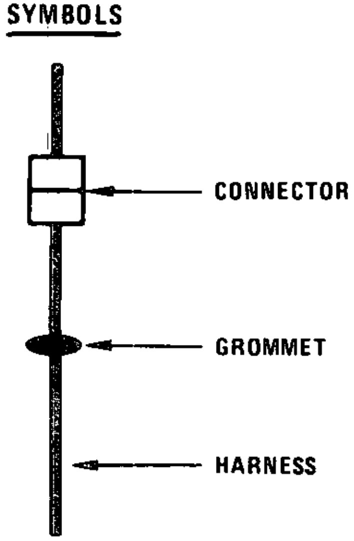


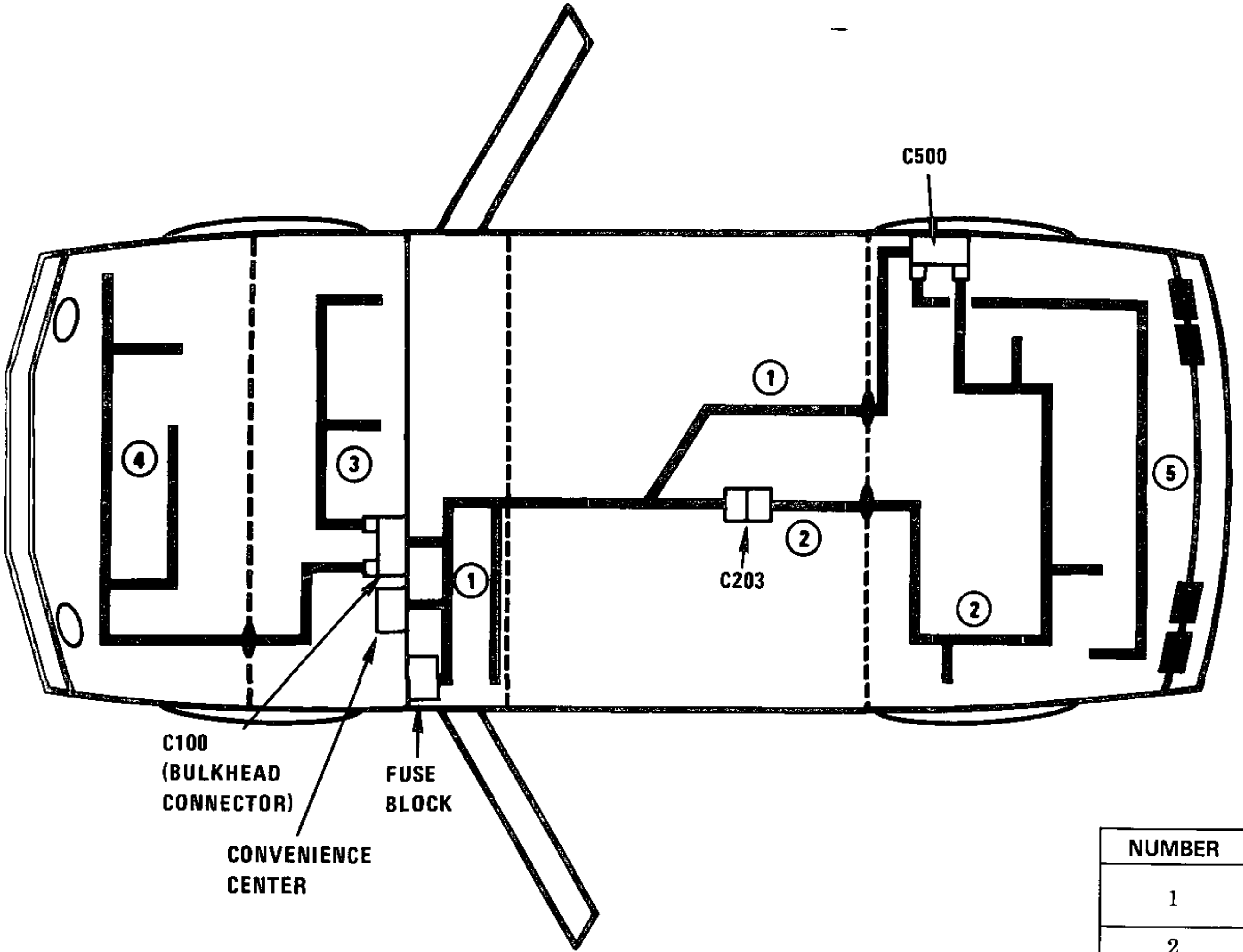
BLK 12015664

To Wiper Motor

BLANK

NESS ROUTING VIEWS
VIN R)

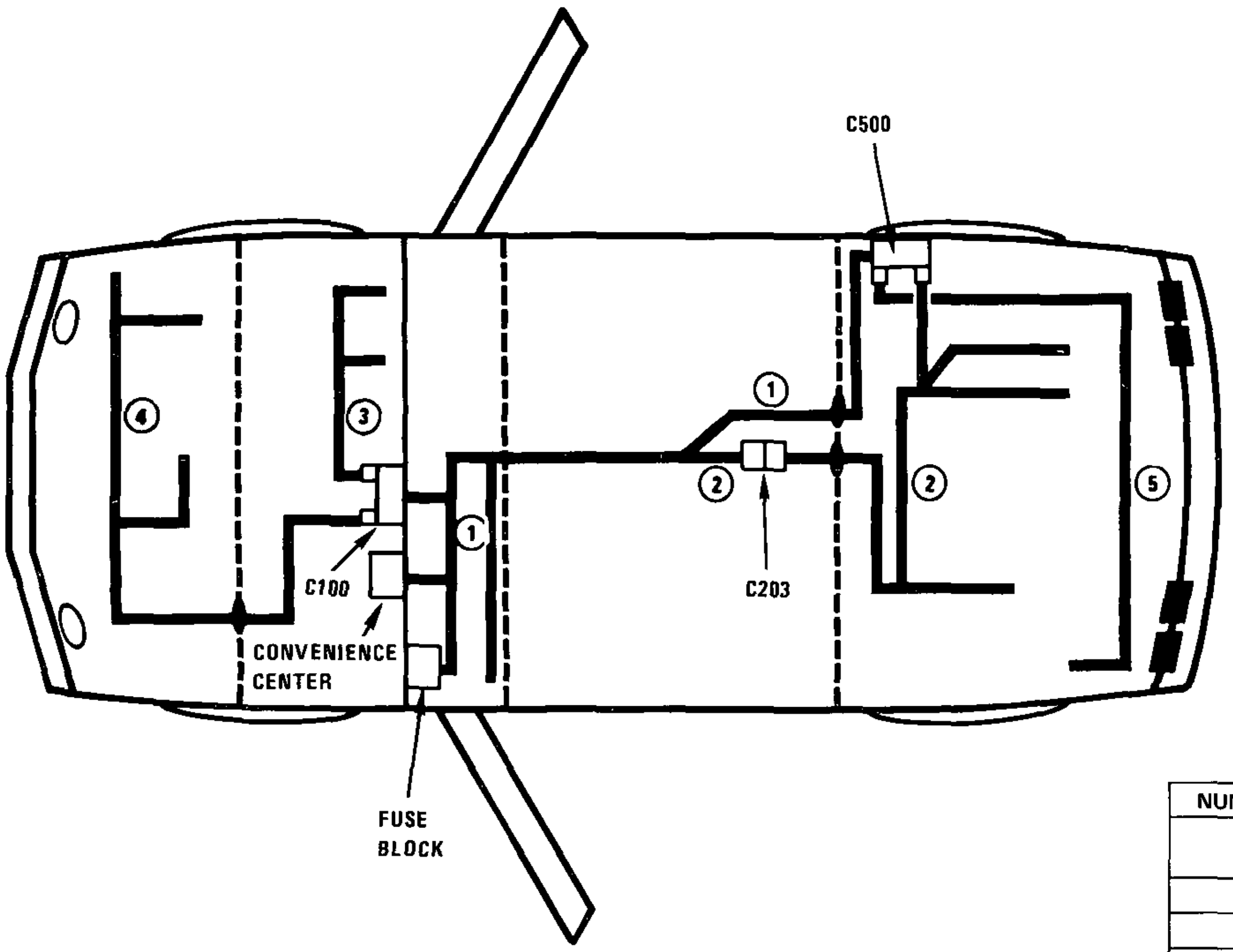


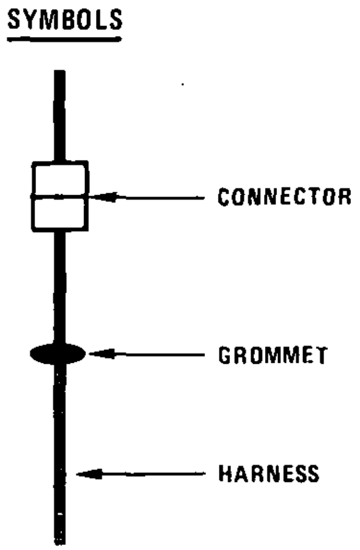


NUMBER	HARNESS NAME
1	(MAIN HARNESS) INSTRUMENT PANEL
2	ENGINE
3	AIR CONDITIONING
4	FORWARD LAMP
5	BODY REAR

HARNESS ROUTING VIEWS

(V6 VIN 9)





NUMBER	HARNESS NAME
1	(MAIN HARNESS) INSTRUMENT PANEL
2	ENGINE
3	AIR CONDITIONING
4	FORWARD LAMP
5	BODY REAR

SECTION 8B

CHASSIS ELECTRICAL

CONTENTS

GENERAL DESCRIPTION

The following information will aid in diagnosis and switch and bulb replacement when used with the circuit information provided in Section 8A. All diagnostic information in this section and in Section 8A assumes that all wires are connected and routed as designed. Disconnected and rerouted wires must be corrected or taken into account before any diagnosis can be performed.

LIGHTS AND LIGHTING CIRCUITS

The headlights are controlled by a light switch located on the instrument panel. This switch also controls the headlight retractors (if so equipped), parking lights, side marker lights, taillights, license plate light, instrument panel lights, and interior lights.

The parking lights, taillights, license plate light, side marker lights and instrument panel lights operate whenever the parking light switch is partially activated. The headlights turn on, in addition to lights activated by the parking light switch, when the headlight switch is fully activated. Intensity of instrument panel lights can be varied from off to bright by rotating the light switch or panel control. Rotating the control fully up past the detent will turn on passenger compartment interior lights.

A side reflex reflector is provided in the side marker lights with rear reflex installed in either the combination rear lights or backup lights.

Directional signal lights are combined with the parking lights in front and with the stop and taillights in the rear. The ignition must be "ON" for the directional signal lights to be operated.

With the directional signal switches in neutral position, stepping on the brake pedal will illuminate rear stop lights on both sides. If the switch is erating either side as a directional signal, stepping on e brake pedal will turn on the stop light only on the de which is not flashing. The flasher used in this rcuit controls only the directional signals and is ocated on the fuse panel.

The lane-change directional signal switch is standard equipment. When making a partial turn, such as when changing lanes, the driver has the option of moving the switch lever to a detent stop. The signal lamps will continue to flash as long as the lever is held in this position and will cancel automatically when the lever is released. By using the detent position, a shallow turn or lane change can be signaled without possibility of failure to cancel.

Moving the directional signal switch lever past the detent position to the limit of its travel for either turn will provide conventional turn signal operation. Front side marker lights, when separate from the parking and turn signal lights, will flash with turn signal lights when parking lights and headlights are off. When parking lights or headlights are on, the front side marker lights will flash alternately with the turn signal lights on the same side of the vehicle.

With the headlight switch in the "ON" position, the turn signal lever functions also as the headlight dimmer switch. Pulling the lever toward the driver and releasing it switches the headlights to high or low beam.

On models with "Flash to Pass" feature, pulling the lever towards the driver will turn on the high beam headlights, as long as the lever is held in this position. This function is independent of the headlight switch operation, and can be used with the headlights off.

A Hazard Warning flasher is included in the directional signal circuit. Pushing the switch control button (on right side of steering column) inward will disconnect the regular directional signal flasher and energize the Hazard Warning flasher, regardless of ignition switch or directional signal switch position. Pulling the button collar outward will cancel the Hazard Warning flasher.

When the Hazard Warning flasher is operating, the directional signal indicator lights and all front and rear turn signal lights will flash, as well as front side marker lights (if marker lights are separate from parking and signal lights). If the brake pedal is depressed while the Hazard Warning flasher is operating, all signal lights will burn continuously.

The backup lights are powered through the neutral start switch on automatic transmissions or a transmission-mounted switch on manual transmissions. Placing the vehicle shift lever in "REVERSE" turns the backup lights on. The ignition must be "ON" to operate the backup lights.

Most problems in vehicle lighting can be visually diagnosed and easily corrected. Problems such as bulb burnout, cracked lens, loose or cut wires, etc., constitute the majority of problems and involve only replacement of a defective or damaged part. For more difficult problems, see Diagnosis Charts.

normally included in the replacement package. When removal of a part involves special seal items such as seal washers under the heads of the lens retaining screws, be sure to replace items when reinstalling. Likewise, any body sealing (grommets, etc.) disturbed by wiring repairs or replacement should be restored during service to maintain passenger compartment sealing.

The wiring harnesses use a standardized color code common to all vehicles. Under the color code, the color of the wire designates a particular circuit. The harness title indicates the type of harness, single or multiple wire, and also describes the location of the harness. Circuit Identification Charts and wiring diagrams are shown in Section 8A.

REAR CENTER MOUNTED STOP LAMP

For electrical operation/diagnosis, see Section 8A-110. For installation/removal, see Body Service Manual, Section 7.

HORN

A single horn is standard on some models, while dual horns are standard on some models and optional on others. Each horn utilizes a solenoid-actuated diaphragm to develop a resonating air column in the horn projector. Diagnosis is covered in Section 8A.

A relay is used in the horn circuit because of the high current required to operate horns. The relay reduces the length of heavy gage wire required and provides a more direct connection between horns and battery. Consequently, high voltage is available at the horns and better performance is obtained by eliminating the voltage drop which otherwise would be in the horn button wiring circuit.

IGNITION SWITCH

The ignition 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 3B4 or 3B5.

The ignition and starting switch is key-operated through the actuator rod assembly to close the ignition primary circuit and to energize the starting motor solenoid for cranking.

The ignition switch used on all cars has fiv positions:

Two "OFF" positions ("OFF" an "OFF-LOCKED"), "ACCESSORY," "RUN" an "START." "OFF" is the center position of t key-lock cylinder, and "OFF-LOCKED" is the n position to the left.

"ACCESSORY" is located one more deten the left of "OFF-LOCKED." Turning the key to right of the "OFF" position until spring pressure i

The connections to the ignition switch are shown in Section 8A and in the Wiring Diagrams at the end of this section. The charts included on the diagrams show how the switches are internally connected in each switch position.

NEUTRAL START SWITCHES

Park/Neutral-Start Switch

The neutral start switch, used on most models, prevents the engine from being started in gear. Some models with automatic transmission use a mechanical lock-out to prevent starting except in "Neutral" or "Park" (see Starter/Charging Systems, Section 8A).

Manual Transmission - Clutch Operated Start Switch

This system prevents starting the engine in any gear, unless the clutch is disengaged (clutch pedal depressed fully to the floor). Installation and adjustment of switch is covered in "On-Car Service."

Automatic Transmission Combination Neutral Start/Backup Lamp Switch

This system, used with automatic transmissions, combines the neutral start and backup lamp switches in a single switch mounted on the transmission shift mechanism in the console. Adjustment of the switch is covered in "On-Car Service."

SEAT BELTS

Seat Belt Warning System

The seat belt warning system is the "8-SECOND-ON" system.

This system will activate a warning lamp and buzzer for approximately 8 seconds when the ignition key is turned to the "ON" position if the driver's seat belt is not buckled. *Rapid cycling of the system will result in a decrease in the time period.*

The warning lamp and buzzer with timer sequence of operation is as follows:

1. "DRIVER'S BELT UNFASTENED" - Turn ignition switch "ON". Warning lamp and buzzer both come on for approximately 8 seconds, then go off and stay off. If belt buckle is fastened prior to 8 second turn-off time, buzzer will go off and warning lamp stays on for balance of 8 second delay time.
2. "DRIVER'S BELT FASTENED" - Turn ignition switch "ON". Warning lamp comes on; buzzer does not. At end of approximately 8 seconds, warning lamp goes off and stays off. If buckle is unfastened prior to 8 second turn-off time, buzzer and warning lamp both stay on for balance of 8 second delay time. The warning lamp always comes on for the full 8 second time, while the buzzer is controlled by the driver's seat belt buckle switch or seat belt retractor switch. The warning lamp is controlled only by the ignition switch and timer.

Seat Belt, Key, Headlight Audio Alarm Warning

Some models use an audio alarm system to remind the driver to fasten seatbelts, remove ignition key, and to turn off the headlights.

This system uses a tone generator which will sound approximately three to five times and activate a warning light on the instrument panel when the ignition key is turned to the "ON" position if the driver's seatbelt is not buckled. If the ignition key is turned to the "OFF" position and the headlights are on, the tone generator will sound to remind the driver that the headlights are on. If, however, the I.P. light dimmer thumbwheel is turned to the full "OFF" position and the headlights are "ON," the tone generator will not sound when the key is turned to the "OFF" position. If the driver's door is opened and the key is left in the ignition, the tone generator will sound. The tone generator location is shown in "On-Car Service" and in Section 8A.

WINDSHIELD WIPER AND WASHER SYSTEM (SEE SECTION 8E)

FUSE BLOCK

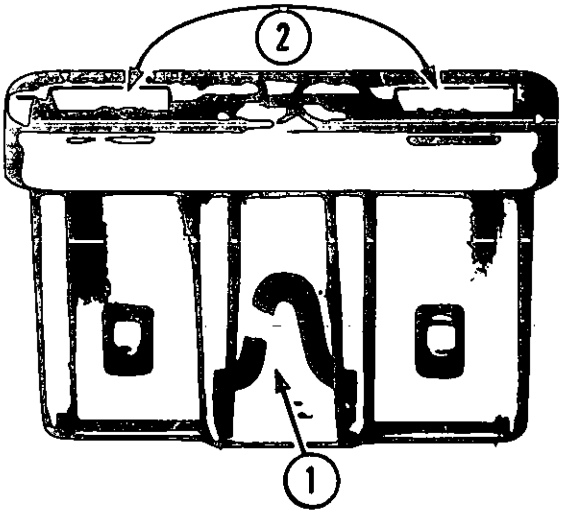
The fuse block on some models is a swing-down unit located in the underside of the instrument panel, adjacent to the steering column. Access to the fuse block on some models is gained through the glove box opening. All models use a fuse block for miniaturized fuses, designed for increased circuit protection and greater reliability. Various convenience connectors, which snap-lock into the fuse block, add to the serviceability of this unit.

A miniaturized fuse is used with the fuse block. This compact fuse, with blade terminal design, allows fingertip removal and replacement. Fuses of different ratings are physically interchangeable, but amperage values are molded in bold, color coded, easy-to-read numbers on the fuse body. Be sure that only fuses of proper ratings are used for replacement. Replacing a fuse with one of a higher value than that specified is not recommended.

A suspected blown fuse can easily be pulled out and examined (see Fig. 1). The clear plastic body gives full view of the element to blade construction for visual checking for defects. In addition, blade terminal tips are exposed in the fuse body, allowing for continuity checking if desired.

Fusible Link

Added protection is provided in all battery feed circuits and other selected circuits by a fusible link. This link is a short piece of copper wire approximately 4" long inserted in series with the circuit, acting as a fuse. The link is four (4) or more gages smaller in size than the circuit wire it is protecting, and will burn out without damage to the circuit in case of current overload. The chassis electrical wiring diagrams at the end of this section show the locations and colors of these fusible links.



TO TEST FOR BLOWN MINI-FUSE:

① PULL FUSE OUT AND CHECK VISUALLY.

② WITH THE CIRCUIT ACTIVATED, USE A TEST LIGHT ACROSS THE POINTS SHOWN.

MINI-FUSE COLOR CODES

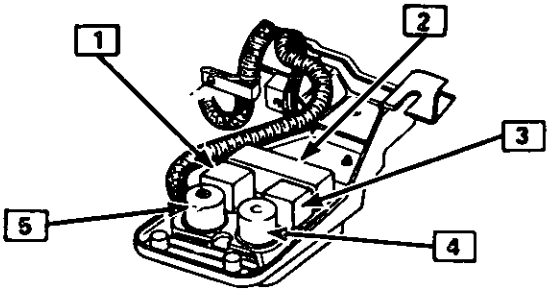
RATING	COLOR
5 AMP	TAN
10 AMP	RED
20 AMP	YELLOW
25 AMP	WHITE

520193-8B

Fig. 1 Blown Fuse

Convenience Center

The Convenience Center on some models is a swing-down unit located on the underside of the instrument panel. The swing-down feature provides central location and easy access to buzzers, relays and flasher units. All units are serviced by plug-in replacement.



1–HORN RELAY

2–SEAT BELT-IGNITION KEY-HEADLIGHT BUZZER

3–CHOKE RELAY (VACANT W/EFI)

4–HAZARD FLASHER

5–SIGNAL FLASHER

520005-8B

Fig. 2 Convenience Center and Components - Typical

DIAGNOSIS

LIGHTS AND LIGHTING CIRCUITS (SEE SECTION 8A)

Troubles in the lighting circuits are caused by loose connections, open or shorted wiring, burned out bulbs, failed switches, inadequate ground, or blown fuses. In each, trouble diagnosis requires following through the circuits until the source or difficulty is found. Refer to the wiring diagrams shown in Section 8A.

SERVICE PROCEDURES

MAINTENANCE

Maintenance of the lighting units and wiring system consists of an occasional check to see that all wiring connections are tight and clean, that the lighting units are tightly mounted to provide good ground, and that the headlights are properly adjusted. Loose or corroded connections may cause a discharged battery, difficult starting, dim lights, and possible damage to generator and charging circuit. Wire harnesses must be replaced if insulation becomes deteriorated. Whenever it is necessary to splice a wire or repair one that is broken, always use rosin core solder to bond the splice. Use insulating tape to cover all splices or bare wires.

When replacing wires, it is important that the correct gage size be used. Never replace a wire with one of a smaller gage size.

Each harness and wire must be held securely in place by clips or other holding devices to prevent chafing or wearing of the insulation due to vibration.

By referring to the wiring diagrams, circuits may be tested for continuous circuit or shorts with a conventional test light or low reading voltmeter.

WIRING HARNESS SERVICE AND REPAIR

Special connectors known as Weather-Pack connectors (Fig. 3) require a special tool (J-28742) for servicing. This special tool is required 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. 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 are in place when connecting leads. The hinge-type flap provides a secondary locking feature for the terminals. They are used to improve the connector reliability by retaining the terminals if the small terminal lock tangs are not positioned properly.

Molded-on connectors require complete replacement of the connection. This means splicing a new connector assembly into the harness. Environmental connections cannot be replaced with standard connections. Instructions are provided with Weather-Pack connector and terminal packages.

With the low current and voltage levels found in

Use care when probing the connections or replacing terminals in them as it is possible to short between opposite terminals. If this happens to the wrong terminal pair, it is possible that damage may be done to certain components. Always use jumper wires between connectors for circuit checking. **Never** probe through the Weather-Pack seals.

When diagnosing for possible open circuits, it is often difficult to locate them 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 is indicated while troubleshooting. Intermittent problems may also be caused by oxidized or loose connections.

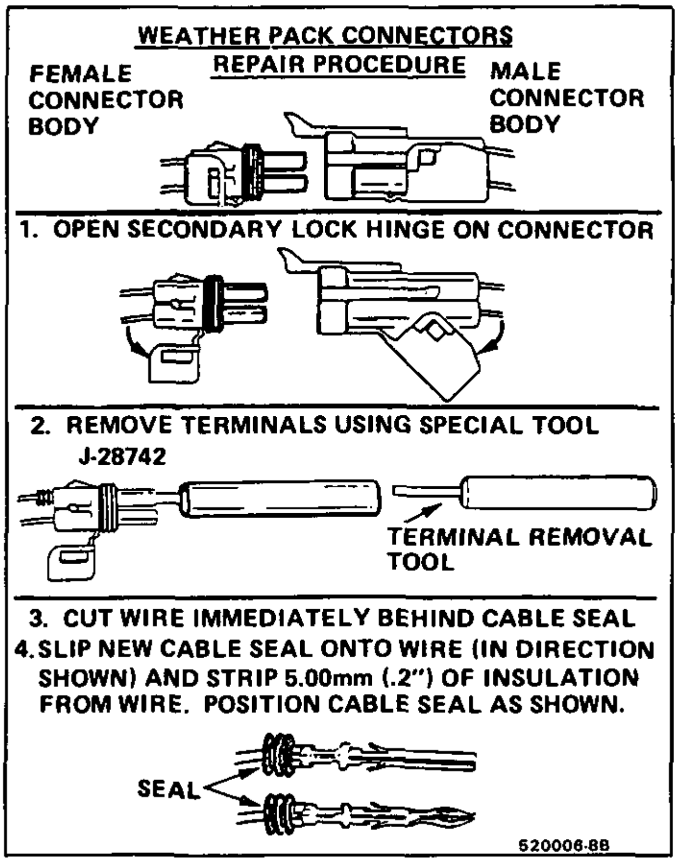


Fig. 3 Weather-Pack Terminals

FUSIBLE LINK-REPLACEMENT

Remove or Disconnect

1. Disconnect battery.
2. Locate burned out link. This may require use of the chassis wiring diagrams in Section 8A.
3. Strip away all melted harness insulation.
4. Cut burned link ends from circuit wire.
5. Strip circuit wire back approximately 1/2" to allow soldering of new link.
6. Using fusible link four (4) gages smaller than protected circuit and approximately 10" long, solder new link into circuit.

NOTICE: *Use only rosin core solder. Under no circumstances should an acid solder be used nor should link be connected in any other manner except by soldering. Use of acid core solder may result in corrosion.*

7. Tape soldered ends securely using suitable electrical tape.
8. After taping wire, tape harness, leaving an exposed loop of wire approximately 5" in length.
9. Reconnect battery.

FRONT LIGHTING ADJUSTMENTS

Light Aiming

The front lights (headlights, fog lights, driving lights, etc.) must be properly aimed in order to provide maximum allowable road illumination. When using mechanical aimers, follow equipment manufacturers instructions. Otherwise, follow aiming instructions provided in the illustrations.

Front lights should be checked for proper aim: at new car predelivery, every 12 months, after installing a new sealed beam unit or if front end sheet metal is adjusted or repaired. Replacement of a bulb in a nonsealed beam unit will normally not require unit aiming readjustment. Aiming of headlights can be performed without removing headlight bezels.

Horizontal and vertical aiming of each headlight sealed beam unit is provided by two (2) adjusting screws which move the mounting ring in the body against the tension of a coil spring. There is no adjustment for focus since the sealed beam unit is set for proper focus during manufacturing assembly.

Some state and local authorities have specific requirements for front light aiming adjustments and these requirements should be followed.

ON-CAR SERVICE

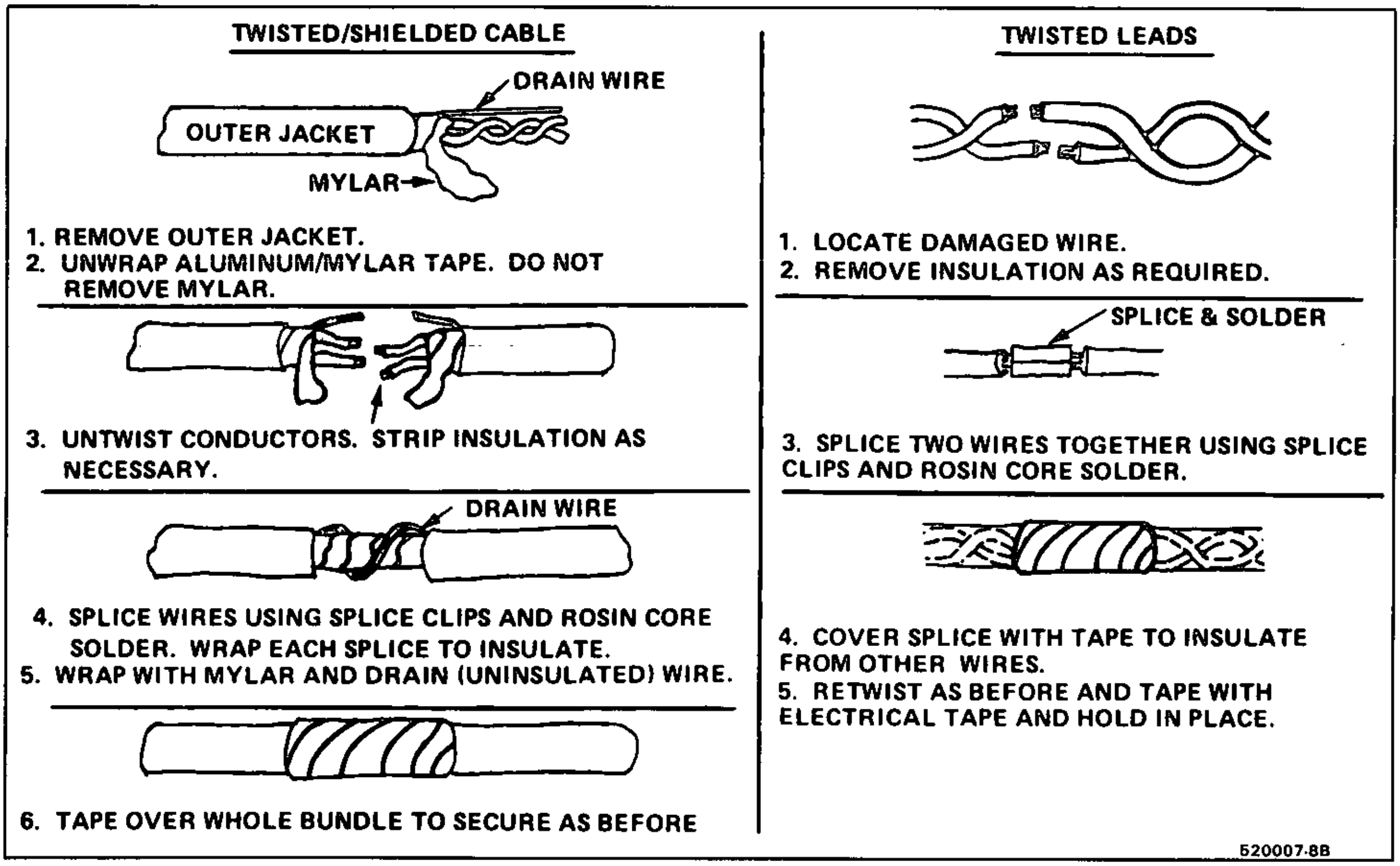
OVERHEAD LAMP ASSEMBLY, LENS AND BULB

Remove or Disconnect

1. Two reading lamp lenses.
   a. Bulb
2. One screw under each lens.
3. Two screws from lamp assembly.
4. Lamp assembly.
5. Electrical connection at lamp assembly.

Install or Connect

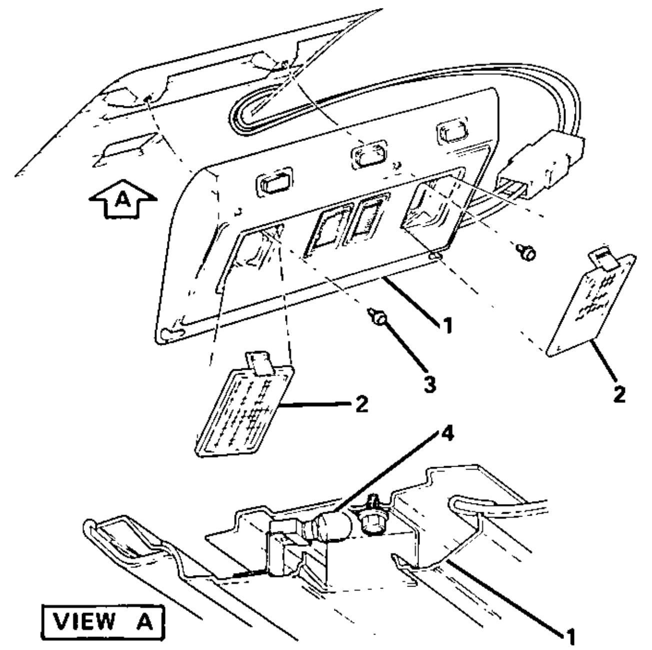
1. Electrical connection at lamp assembly.
2. Lamp assembly.
3. One screw under each lens.
4. Two screws at lamp assembly.
5. Two reading lamp lenses.



1. REMOVE OUTER JACKET.
2. UNWRAP ALUMINUM/MYLAR TAPE. DO NOT REMOVE MYLAR.
3. UNTWIST CONDUCTORS. STRIP INSULATION AS NECESSARY.
4. SPLICE WIRES USING SPLICE CLIPS AND ROSIN CORE SOLDER. WRAP EACH SPLICE TO INSULATE.
5. WRAP WITH MYLAR AND DRAIN (UNINSULATED) WIRE.
6. TAPE OVER WHOLE BUNDLE TO SECURE AS BEFORE

1. LOCATE DAMAGED WIRE.
2. REMOVE INSULATION AS REQUIRED.
3. SPLICE TWO WIRES TOGETHER USING SPLICE CLIPS AND ROSIN CORE SOLDER.
4. COVER SPLICE WITH TAPE TO INSULATE FROM OTHER WIRES.
5. RETWIST AS BEFORE AND TAPE WITH ELECTRICAL TAPE AND HOLD IN PLACE.

Fig. 4 Wiring Repair



1 – LAMP ASSY. – DOME & READING

2 – LENS READING LAMP RT – LT

3 – SCREW

4 – BULB – LAMP READING

420025-8B-P

Fig. 801 Overhead Lamp Assembly

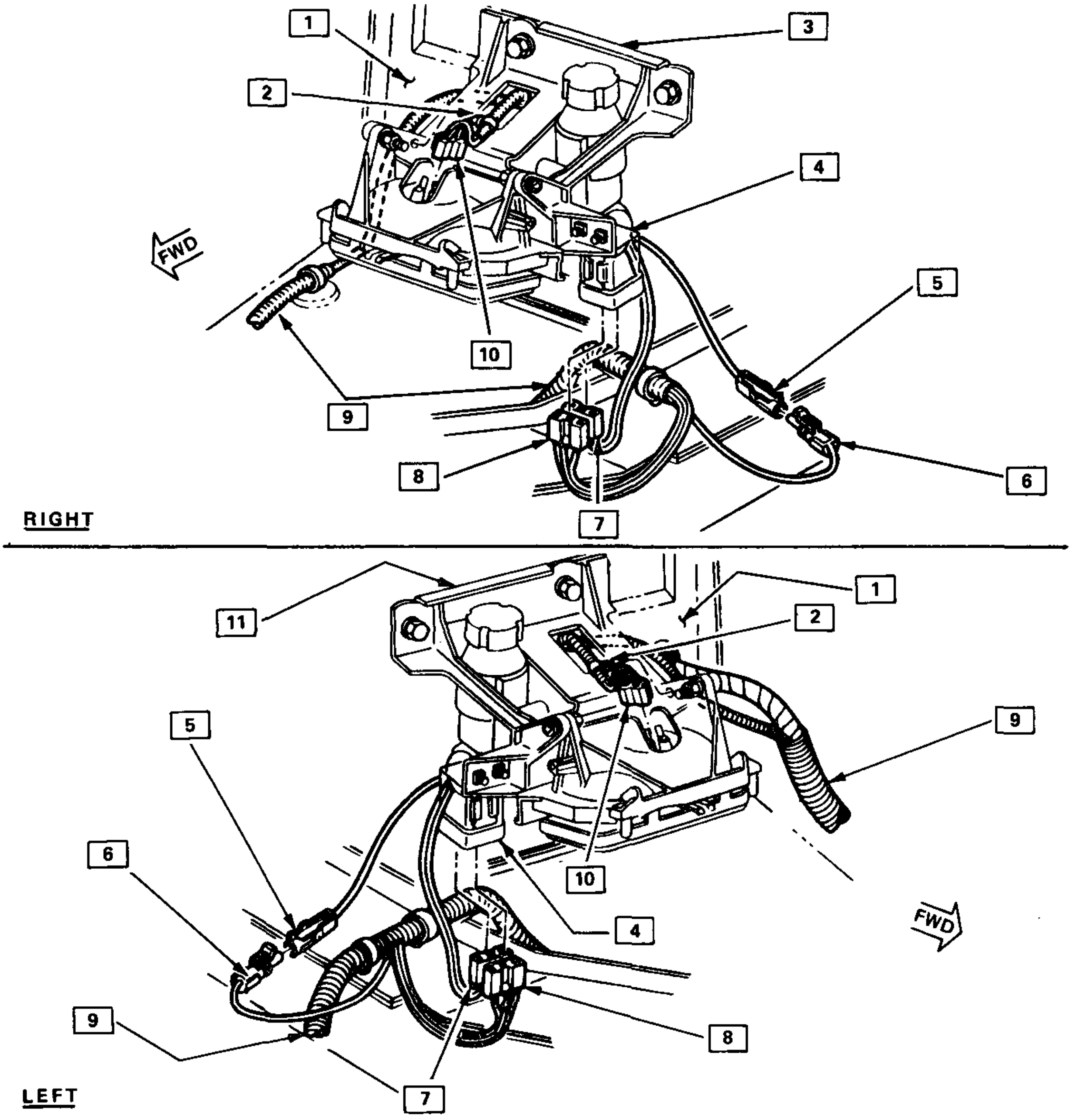
HEADLAMP

↔ Remove or Disconnect

1. Open hood.
2. Electrical connections at lamps.
3. Raise headlamps.
4. Close hood.
5. Torx screw at top right and left side of the bezel.
6. Raise hood.
7. Torx screw at each side of black plastic bezel.
8. Black plastic bezel.
9. With a hooked tool, pull the retaining spring to one side to release lamp assembly.
10. Lamp assembly from aiming pins.
11. Four screws from chrome retaining ring.
12. Headlight.

→← Install or Connect

1. Headlight.
2. Chrome retaining ring.
3. Close hood.
4. Lamp assembly to aiming pins.
5. Retaining spring.
6. Open hood.
7. Black plastic bezel.
8. Torx screw at each side of bezel.
9. Electrical connections at headlights.



1—FRONT COMPT. PANEL
2—CLIP (HARN.)
3—HD/LP ASM. RH
4—RELAY ASM (HD/LP ASM)
5—HD/LP MOTOR TO ACTUATOR CONN.
6—HD/LP ACTUATOR CONN.
7—HD/LP MOTOR TO RELAY CONN.
8—HD/LP RELAY CONN.
9—FWD LAMP HARN.
10—HD/LP CONN.
11—HD/LP ASM LH

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Fig. 802 Head Lamp Assembly

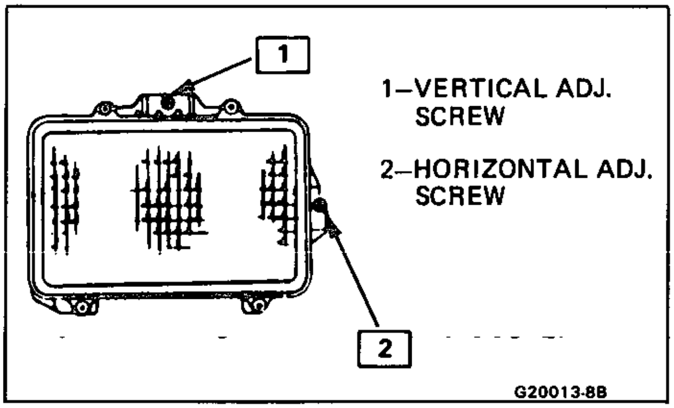


Fig. 803 Front Light Aiming Screws

HEADLAMP ACTUATOR

Before removing the headlamp mounting bracket from the front panel compartment, mark the position by marking around the two upper attaching bolts and onto the headlamp mounting bracket.

Remove or Disconnect

1. Negative (-) battery terminal.
2. Open hood.
3. Electrical connection at lamp.
4. Three bolts.
   a. One at each side of lamp assembly.
   b. One at link assembly.
5. Lamp, lamp assembly and bezel intact.
6. Four attaching bolts at headlamp mounting bracket.
7. All electrical connections.
8. Headlamp mounting bracket.
9. Clip at actuator cam linkage.

Important

Note position of linkage to actuator before removal to aid in reassembly.

Remove or Disconnect

1. Linkage.
2. Three actuator attaching bolts.
3. Actuator.

Install or Connect

1. Actuator.
2. Three actuator attaching bolts.
3. Linkage.
4. Clip at actuator linkage.
5. Electrical connection at mounting bracket.
6. Headlamp mounting bracket.
   a. Align marks on headlamp mounting bracket.

[illegible]

[illegible]

Install or Connect

1. Lamp, lamp assembly, and bezel.
2. Three bolts:
   a. One at each side of lamp assembly.
   b. One at link assembly.
3. Electrical connection at lamp.
4. Negative (-) battery terminal.

HEADLAMP ACTUATOR SWITCH AND HARNESS ASSEMBLY

Remove or Disconnect

Before removing the headlamp mounting bracket from the front panel compartment, mark the position by marking around the two upper attaching bolts and onto the headlamp mounting bracket.

1. Negative (-) battery terminal.
2. Electrical connection at lamp.
3. Three bolts:
   a. One at each side of lamp assembly.
   b. One at link assembly.
4. Lamp, lamp assembly, and bezel intact.
5. Four attaching bolts at headlamp mounting bracket.
6. Electrical connections.
7. Headlamp mounting bracket assembly.
8. Switch cover plate.
9. Rubber slot filler.
10. Switch and harness assembly.

Install or Connect

1. Switch and harness assembly.
2. Rubber slot filler.
3. Switch cover plate.
4. Electrical connections.
5. Headlamp mounting bracket assembly.
   a. Align marks on headlamp mounting bracket.

Tighten

Four bolts at headlamp mounting bracket to 9 N·m (80 lb.in.).

Install or Connect

1. Lamp, lamp assembly, and bezel intact.
2. Three bolts:
   a. One at each side of lamp assembly.
   b. One at link assembly.
3. Electrical connection at lamp.

SIDE MARKER LIGHT (FRONT & REAR)

Remove or Disconnect

[illegible]

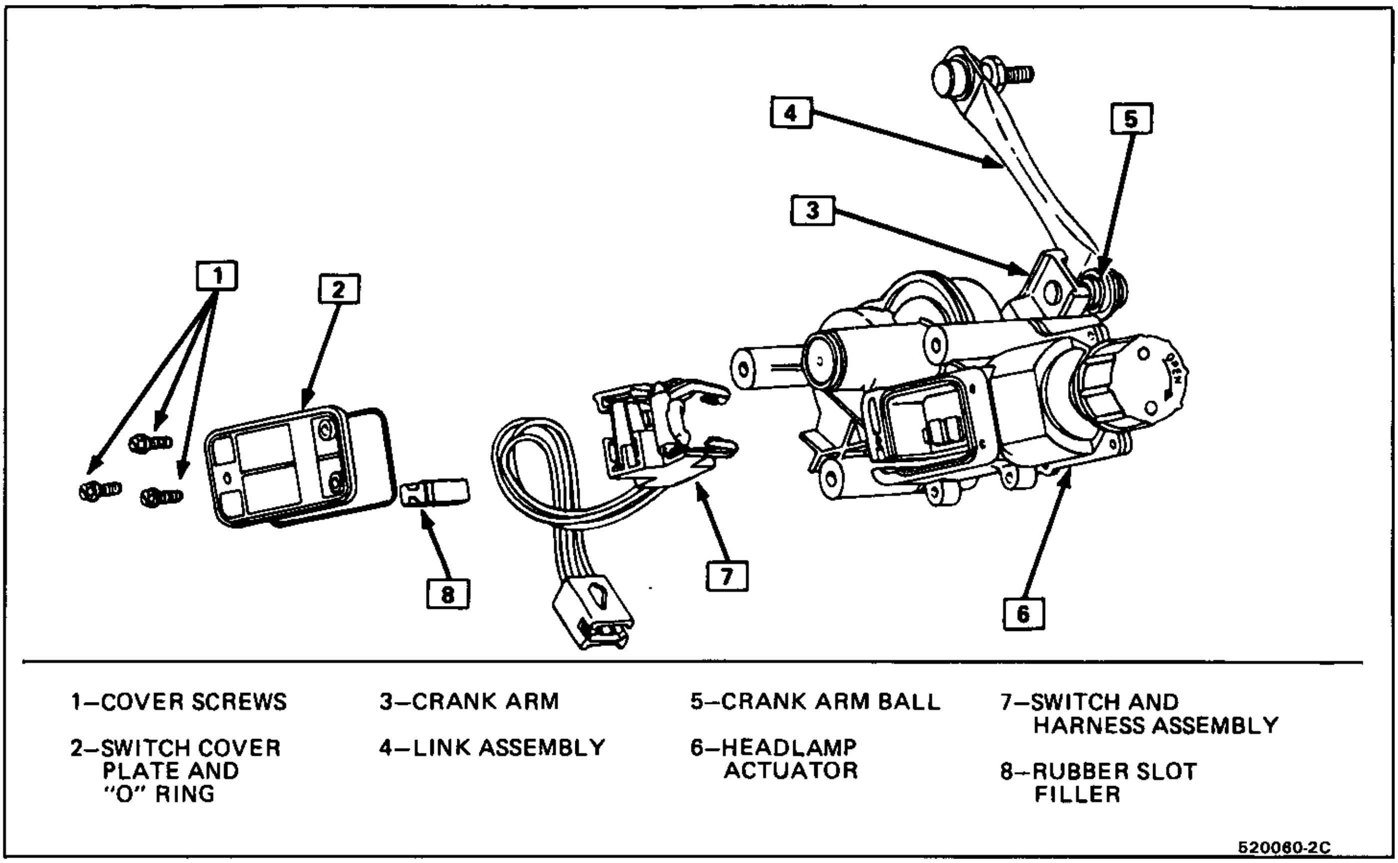


Fig. 804 Headlamp Actuator Switch and Harness Assy.

Install or Connect

1. Bulb.
2. Lens assembly.
3. Two torx screws at lens.

FRONT PARK/DIRECTIONAL SIGNAL LIGHT

Figure 806

Remove or Disconnect

1. Two screws at lens.
2. Lens.
3. Bulb socket at lens.
4. Bulb from socket.

Install or Connect

1. Bulb to socket.
2. Bulb socket at lens.
3. Lens.
4. Two screws at lens.

LICENSE PLATE LAMP OR BULB ASSEMBLY

Figure 807

Remove or Disconnect

1. Two bolts at lamp assembly.
2. Lamp assembly.
3. Bulb socket from lamp assembly.

Install or Connect

1. Bulb socket to lamp assembly.
2. Lamp assembly.
3. Two bolts at lamp assembly.

REAR TAIL LAMP ASSEMBLY BULBS

Figure 808

Remove or Disconnect

The tail lamp assemblies are in two sections which must be removed to replace the bulbs within them. Each section is attached to the body by three screws which are recessed under rectangular black tabs.

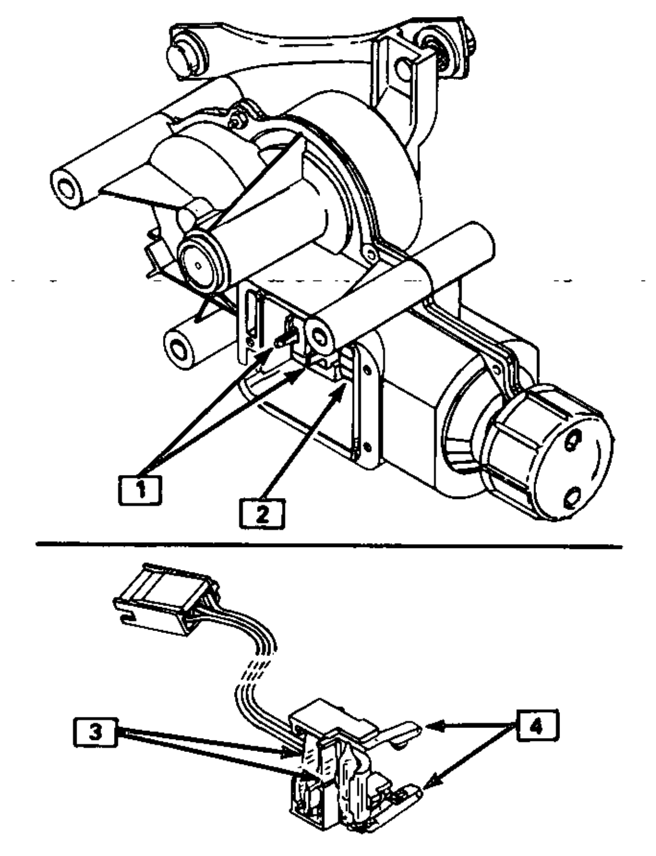
1. Open deck lid.
2. Three black tabs.
3. One screw under each tab.
4. Tail lens assembly.
5. Twist bulb 90° to the left and pull out.

Install or Connect

1. Push bulb in socket and turn to the right.
2. Tail lens assembly.
3. Three screws.

Adjust

Lens assembly as required before final tightening of the three screws.



1–THRUST BLOCK FINGERS
2–COMMUTATOR
3–SWITCH BLADES
4–BRUSHES

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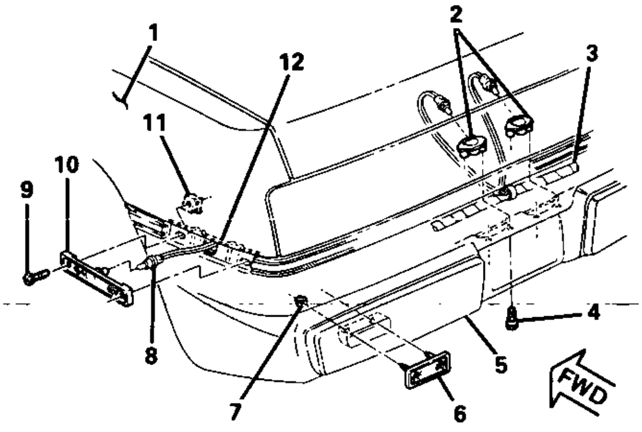
Fig. 805 Switch Assy. Blades and Brushes



1 – QUARTER PANEL
2 – LAMP ASSY.
3 – RIGHT REAR CAR HARNESS
4 – BOLT
5 – FASCIA
6 – REFLECTOR ASSY.
7 – NUT
8 – BULB & SOCKET ASSY.
9 – BOLT
10 – LAMP ASSY. – LEFT & RIGHT
11 – U-NUT
12 – BACKING PLATE

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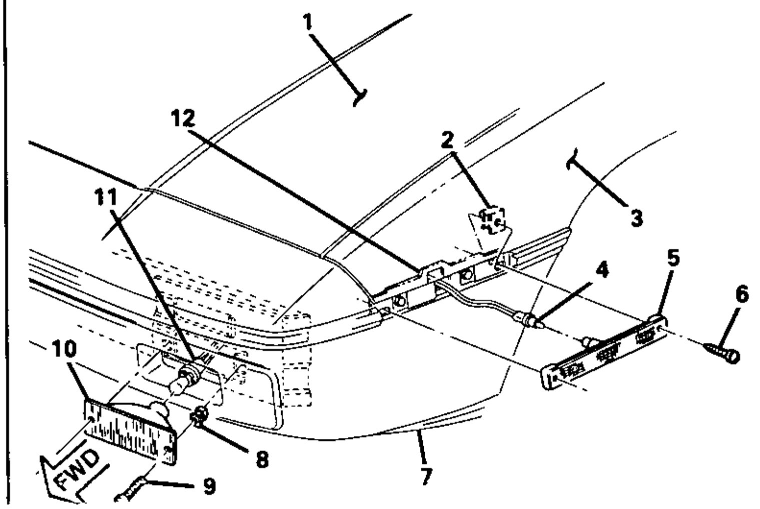
Fig. 807 Rear License Lamps, Reflector and Side Marker Lamps

→← Install or Connect

1. Three black tabs.
2. Close deck lid.

IGNITION SWITCH

Due to the integral design relationship of the ignition switch with steering column, service procedures for ignition switch are given in Section 3B4.



1 – HOOD PANEL
2 – U-NUT
3 – FRONT FENDER
4 – BULB & SOCKET ASSY
5 – LAMP ASSY – LEFT & RIGHT
6 – BOLT
7 – FRONT FASCIA ASSY.
8 – NUT
9 – BOLT
10 – LAMP ASSY. LEFT & RIGHT
11 – BULB & SOCKET ASSY.
12 – BACKING PLATE

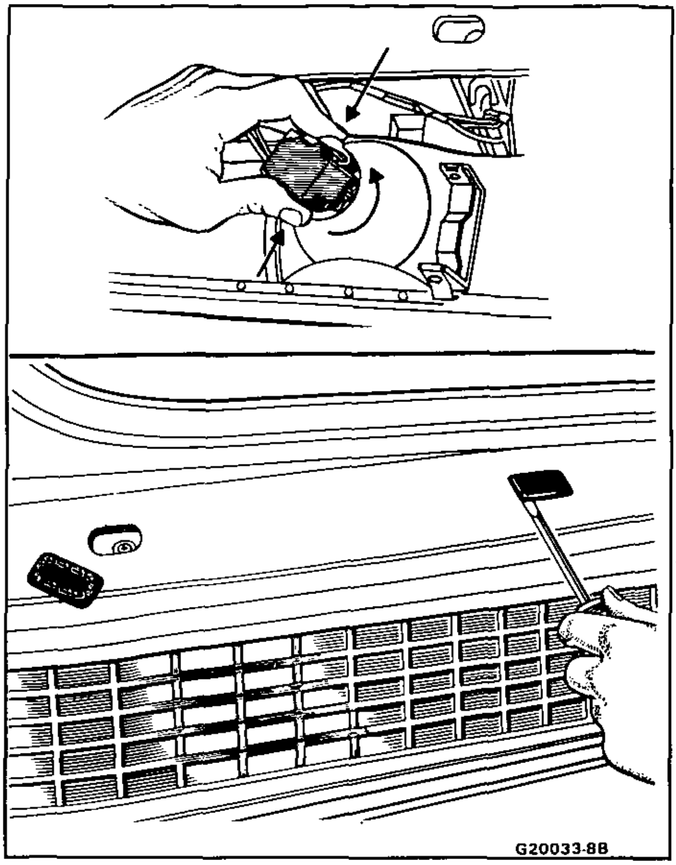


Fig. 808 Tail Lamp Removal

LIGHTING SWITCH

Replacement

Light switch service procedures are given in Section 8C, Instrument Panel, On-Car Service.

MULTI-FUNCTION SWITCH

Replacement

Due to the integral design relationship of the multi-function switch (windshield wiper/washer, headlight beam selector and directional signal) with steering column, service procedures for multi-function switch are given in Section 3B4 and Section 9.

FRONT COMPARTMENT LAMP SWITCH

←→ Remove or Disconnect

1. Two electrical connectors at switch.
2. Unscrew switch from vent duct panel.

→← Install or Connect

1. Switch.
2. Two electrical connections at switch.

COOLING FAN RELAY

The cooling fan relay is located on the driver's side of the front end panel under the hood.

←→ Remove or Disconnect

1. Electrical connector at relay.
2. Two screws at relay.
3. Relay assembly.

→← Install or Connect

1. Relay assembly.
2. Two screws at relay.
3. Electrical connector at relay.

EMERGENCY FOUR WAY FLASHER

The emergency hazard warning flasher is located on the right side of the heater or A/C module under the instrument panel and is removed by releasing the tab lock on the side and pulling the unit straight out from the convenience center.

HORN RELAY

The horn relay is located on the right side of the heater module under the intrument panel and is removed by pulling the unit straight out from the convenience center.

SEATBELT, KEY & HEADLAMP WARNING ALARM

The seat belt, key and headlamp alarm module is located on the right side of the heater module under the instrument panel and is removed by pulling the unit straight out from the convenience center.

STOP LIGHT SWITCH/T.C.C. SWITCH

Figure 812.

Automatic & Manual Transmission

The stop light switch is located under the instrument panel at the brake pedal support.

←→ Remove or Disconnect

1. Wiring harness at switch.
2. Switch from retainer.

→← Install or Connect

1. Depress brake pedal.
2. Switch into retainer until switch body seats on retainer.
3. Pull brake pedal fully rearward until audible clicks can no longer be heard.
4. Wiring harness at switch.

REAR WINDOW DEFOGGER RELAY

The rear window defogger relay is located on the brake pedal support bracket.

←→ Remove or Disconnect

1. Relay electrical connection.
2. One bolt at relay.
3. Defogger relay.

→← Install or Connect

1. Defogger relay.
2. One bolt at relay.
3. Relay electrical connection.

BULB CHART

LAMP DESCRIPTION	TRADE NO.
EXTERIOR LAMPS	
BACK-UP	1156
HEADLAMP	H6054
LICENSE	194
PARK & DIR. SIGNAL – FRONT	2057
SIDE MARKER – FRONT	194
SIDE MARKER – REAR	194
TAIL, STOP & DIR.	2057
INTERIOR LAMPS	
AIR CONDITIONING CONTROL	37
BRAKE WARNING	194
CHECK ENGINE WARNING	194
CIGAR LIGHTER/ASHTRAY/CONSOLE	70
CLOCK (PART OF RADIO DISPLAY)	LED
CLUSTER (SPEEDOMETER AND TACHOMETER)	194
DECK AJAR LIGHT	194
DIRECTION SIGNAL INDICATOR	194
DOOR AJAR LIGHT	194
GEAR SELECTOR INDICATOR	70
HEADLAMP HI-BEAM INDICATOR	194
HEATER CONTROL	37
INSTRUMENT PANEL COURTESY	168
LUGGAGE COMPARTMENT – FRONT	168
LUGGAGE COMPARTMENT – REAR	561
OIL PRESSURE TELLTALE	194
RADIO AM/FM STEREO INDICATOR	LED
RADIO ILLUMINATION – AM	168
RADIO ILLUMINATION – ALL OTHERS	LED
READING LAMP/DOME LIGHT	906
REAR WINDOW DEFOGGER "ON" INDICATOR	PART OF SWITCH
SEAT BELT WARNING INDICATOR	194
TACHOMETER	PART OF CLUSTER

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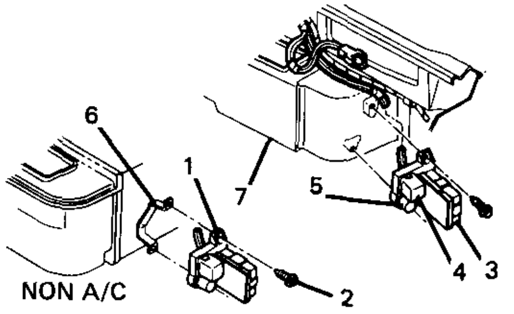
Fig. 809 Bulb Chart



1—CONVENIENCE CENTER
2—SCREW
3—ALARM
4—RELAY (HORN)
5—FLASHER (4-WAY)
6—BRACKET
7—HEATER AND A/C MODULE

G20034-8B

Fig. 810 Convenience Center

1—PEDAL SUPPORT ASSEMBLY
2—RETAINER
3—STOP LAMP SWITCH ASSEMBLY (MANUAL)
4—STOP LAMP AND T.C.C. SWITCH ASSEMBLY (AUTOMATIC)

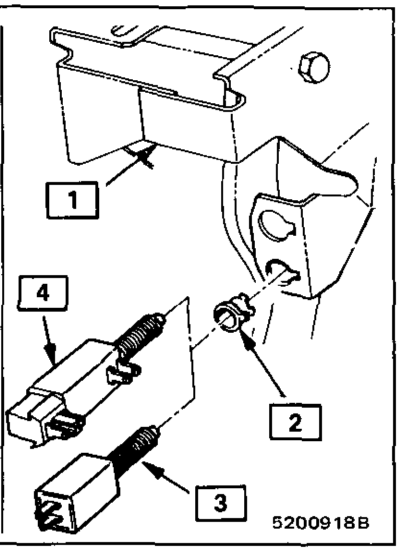
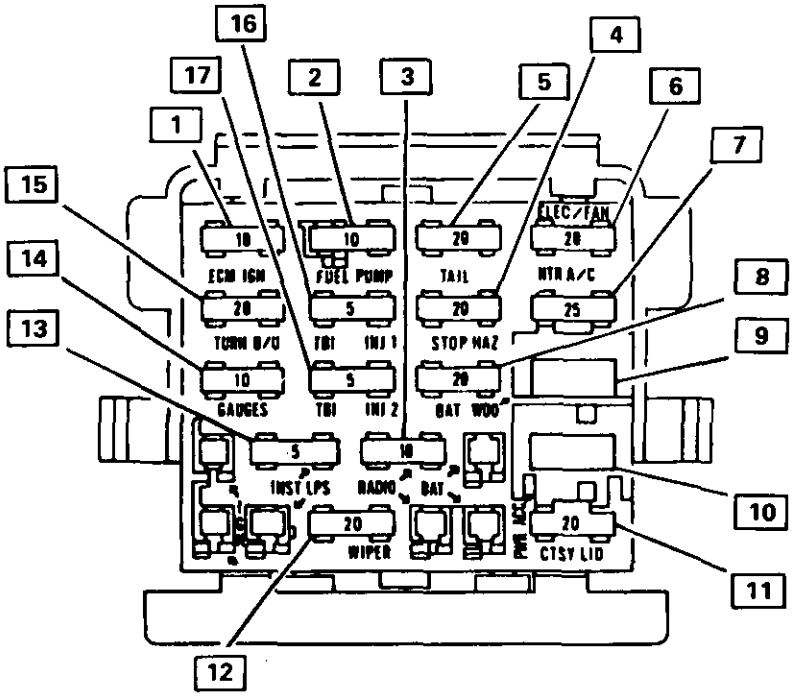


Fig. 812 Stop Lamp and T.C.C. Switch



1—FUSE 10 AMP IGN RED (E.F.I. E.C.M. & L4 INJ) (C.C.C. E.C.M.)
2—FUSE 10 AMP. BATT RED (FUEL PUMP RELAY-OIL PRESSURE SW FEED)
3—FUSE 10 AMP. IGN. RED (RADIO FEED & CRUISE)
4—FUSE 20 AMP. BATT. YEL. (STOP LAMP SW. HAZARD FLASHER, CHIME)
5—FUSE 20 AMP. BATT. YEL. (TAIL LAMPS, PARKING, SIDE MARKER & LICENSE LAMPS)
6—FUSE 20 AMP. IGN. YEL. (COOLANT FAN RELAY COIL, NAVIGATION PACK, TRUNK BLOWER
7—FUSE 25 AMP. IGN. YEL. (HEATER, A/C)
8—FUSE 20 AMP. BATT. YEL. (DOME LAMPS, HORN RELAY, CLOCK, LIGHTER)
9—*CIRCUIT BREAKER 30 AMP.* (POWER WINDOWS)
10—CIRCUIT BREAKER 30 AMP. (POWER LOCKS, REAR DEFOG)
11—FUSE 20 AMP. BATT. YEL. (RR DECK LID, POWER LOCK RELAY, POWER MIRROR, TRUNK LIGHT)
12—FUSE 20 AMP. IGN. YEL. (WINDSHIELD WIPER MOTOR)
13—FUSE 5 AMP. IGN. TAN (INST. PANEL LAMPS, HEADLAMP WARNING)
14—FUSE 10 AMP. IGN. RED (C49 RELAY, C49 OFF-ON SW, CHIME, VOLT LIGHT, V.S.S., T.C.C. BRAKE SW. CLUSTER)
15—FUSE 20 AMP. IGN. YEL. (TURN SIGNAL FLASHER, BACK-UP LAMPS)
16—V6 INJ-LH BANK
17—V6 INJ-RH BANK EVRV.

G20012-8B

Fig. 811 Fuse Identification & Location

BACKUP LIGHT/NEUTRAL START SWITCH

Automatic Transmission

The backup light and neutral start switch is located on the transaxle and is adjusted at the factory.

Remove or Disconnect

1. Open deck lid.
2. Electrical connection at switch.

Important

- Clip on switch connection **must** be opened before attempting to remove electrical connection from switch. Damage will occur to the switch assembly if this step is not followed.

Remove or Disconnect

1. Pry cable from pivot pin at the bottom of the shift lever. Follow the Procedures for Cable Removal in Section 7A.
2. Nut attaching lever to transmission shaft.
3. Two bolts attaching backup light/neutral start swtich to transaxle.
4. Backup light/neutral start switch.

Install or Connect

Important

Transmission shaft must be in neutral position when switch is installed.

Install or Connect

1. Backup light/neutral start switch to transaxle.
2. Two bolts attaching backup light/neutral start switch to transaxle.

Tighten

Torque the bolts to 27 N·m (20 lbs. ft.).

Install or Connect

Nut attaching lever to transmission shaft.

Tighten

Lever **must** be held out of park, torque nut to 27 N·m (20 lbs. ft.).

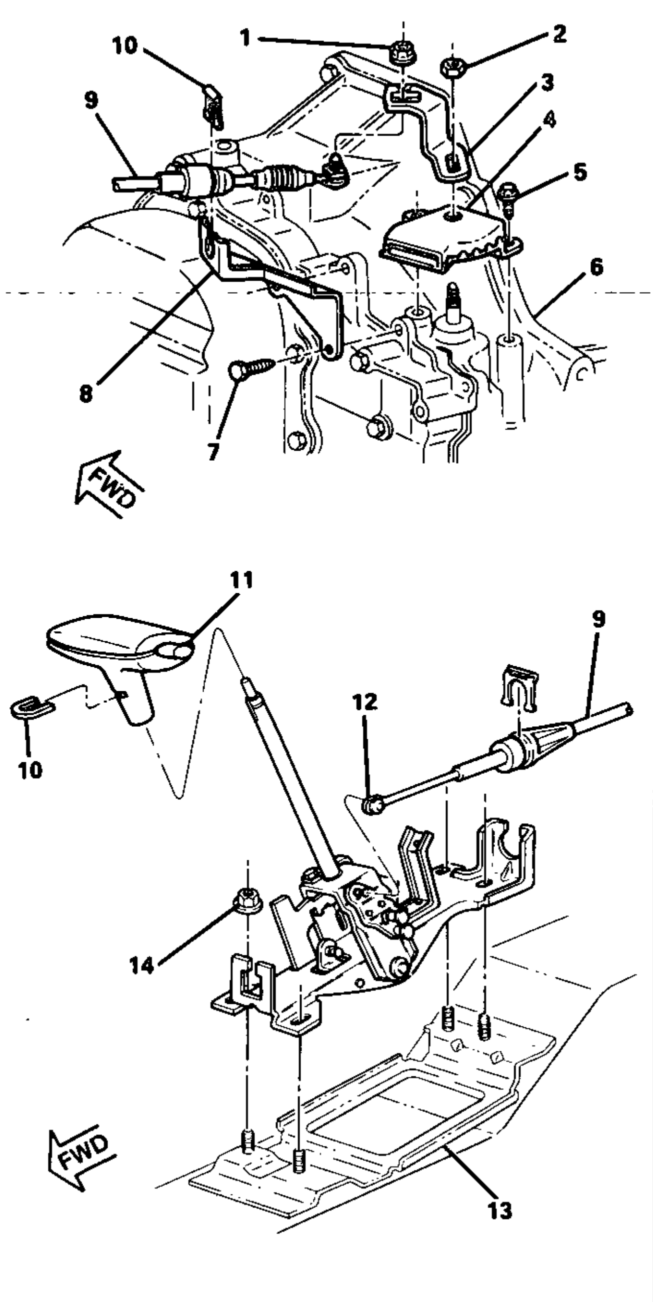
Install or Connect

1. Cable assembly to pivot pin.

CLUTCH OPERATED NEUTRAL START SWITCH

Remove or Disconnect

1. Electrical connection at switch.



1 – NUT/CABLE ASSY.
2 – NUT/SHIFTING LEVER
3 – LEVER/SHIFTING
4 – SWITCH/NEUTRAL START AND BACK-UP
5 – BOLT/NEUTRAL START SWITCH (2)
6 – TRANSAXLE
7 – BOLT/BRACKET
8 – BRACKET
9 – CABLE ASSY.
10 – RETAINER ASSY.
11 – T HANDLE
12 – SNAP SECURELY ONTO PIN
13 – GEAR SHIFT SUPPORT
14 – NUT 23 N·M (17 FT. LB.)

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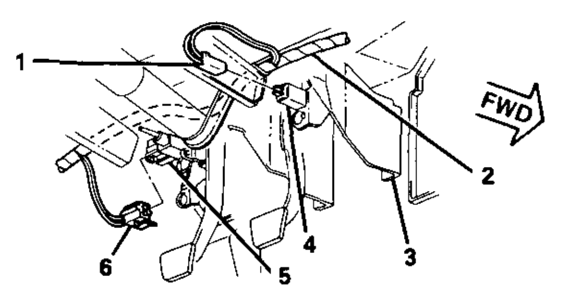
Fig. 813 Backing Light/Neutral Start Switch (Automatic)



1 – STOP LAMP SWITCH CONNECTOR
2 – MAIN I/P HARNESS
3 – BRAKE/CLUTCH PEDAL SUPPORT ASSY.
4 – STOP LIGHT SWITCH
5 – NEUTRAL START SWITCH
6 – NEUTRAL START SWITCH CONNECTOR

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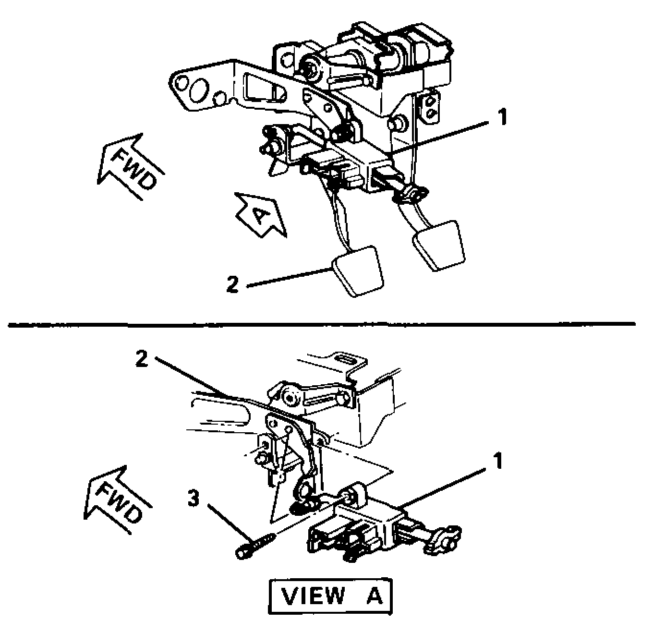
Fig. 814 Neutral Start Switch (Manual)



1–NEUTRAL START SWITCH ASSEMBLY (MANUAL TRANSMISSION
2–PEDAL ASSEMBLY
3–BOLT.

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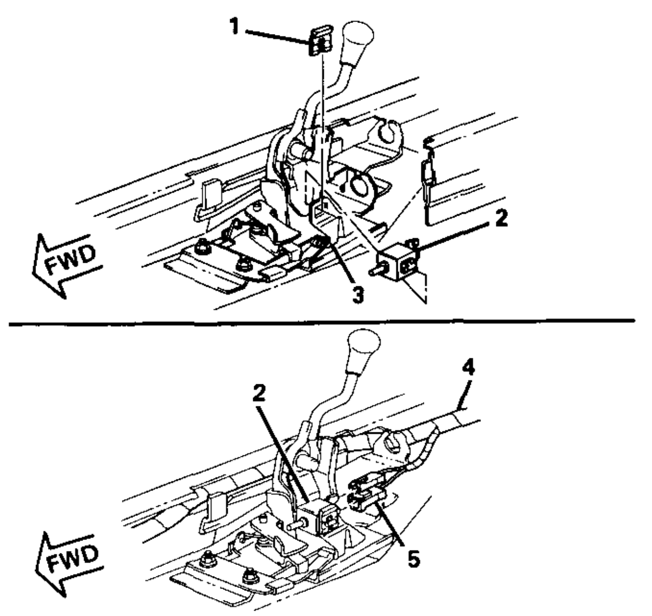
Fig. 815 Neutral Start Switch Removal (Manual)

Install or Connect

1. Shaft at clutch pedal hole.
2. Bolt at switch.
3. Electrical connection.



1–RETAINER CLIP
2–BACK-UP LAMP SWITCH ASSEMBLY
3–MANUAL TRANSMISSION CONTROL ASSEMBLY
4–MAIN HARNESS ASSEMBLY
5–BACK-UP LAMP SWITCH CONNECTOR

420027-8B-P

Fig. 816 Backing Light Switch (Manual)

BACKING LIGHT SWITCH

Fig. 816

Manual Transmission

Remove or Disconnect

1. Shift trim plate assembly.
2. Electrical connection at switch.
3. Switch assembly retainer.
4. Switch assembly.

Install or Connect

1. Switch assembly.
2. Switch assembly retainer.
3. Electrical connection at switch.
4. Shift trim plate.

PARKING BRAKE WARNING SWITCH

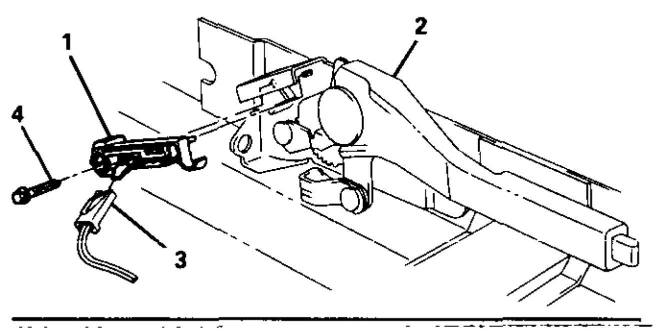
Fig. 817

Remove or Disconnect

1. Retainer holding brake boot to handle.
2. Carpet trim finishing molding.
3. Electrical connection at switch.
4. Bolt at switch.
5. Switch.

Install or Connect

1. Switch.



1 – SWITCH ASSY.
2 – PARKING BRAKE LEVER ASSY.
3 – PARKING BRAKE SW. CONN.
4 – BOLT

420009-8B-P

Fig. 817 Park Brake Warning Switch

2. Bolt at switch.
3. Electrical connection at switch.
4. Carpet trim finishing molding.
5. Retainer holding brake boot to handle.

INSTRUMENT PANEL REMOTE DIMMER ASSEMBLY

The instrument panel remote dimmer assembly is located on the steering column support under the instrument panel.

Remove or Disconnect

1. Instrument panel steering column cover.
2. Electrical connection at dimmer assembly.
3. Two screws at dimmer assembly.
4. Dimmer assembly.

Install or Connect

1. Dimmer assembly.
2. Two screws at dimmer assembly.
3. Electrical connection.
4. Instrument panel steering column cover.

WINDSHIELD WIPER PULSE MODULE

The windshield wiper pulse module is located on the right-hand steering column support bracket under the instrument panel.

Remove or Disconnect

1. Instrument panel steering column cover.
2. Both electrical connections at module.
3. Ground wire.
4. Bolt attaching module to right-hand steering column support bracket.

Install or Connect

3. Both electrical connections at module.
4. Instrument panel steering column cover.

DIRECTIONAL SIGNAL FLASHER

The directional signal flasher is located on the left steering column support bracket under the instrument panel.

Remove or Disconnect

1. Instrument panel steering column cover.
2. Electrical connection at flasher.
3. Pull flasher from retainer.

Install or Connect

1. Flasher at retainer.
2. Electrical connection at flasher.
3. Instrument panel steering column cover.

INSTRUMENT PANEL BULB REPLACEMENT

Remove or Disconnect

1. Four bolts at instrument panel cover.
2. Twist bulb sockets left 90°.
3. Pull bulb straight out from socket.

Install or Connect

1. Push bulb into socket.
2. Twist bulb socket right 90°.
3. Four bolts at instrument panel cover.

CONSOLE SHIFT TRIM PLATE BULB

Remove or Disconnect

1. Both ash trays.
2. Four bolts, two under each ash tray.
3. Pull shift trim plate up.
4. Bulb socket to the left 90°.
5. Bulb from socket.

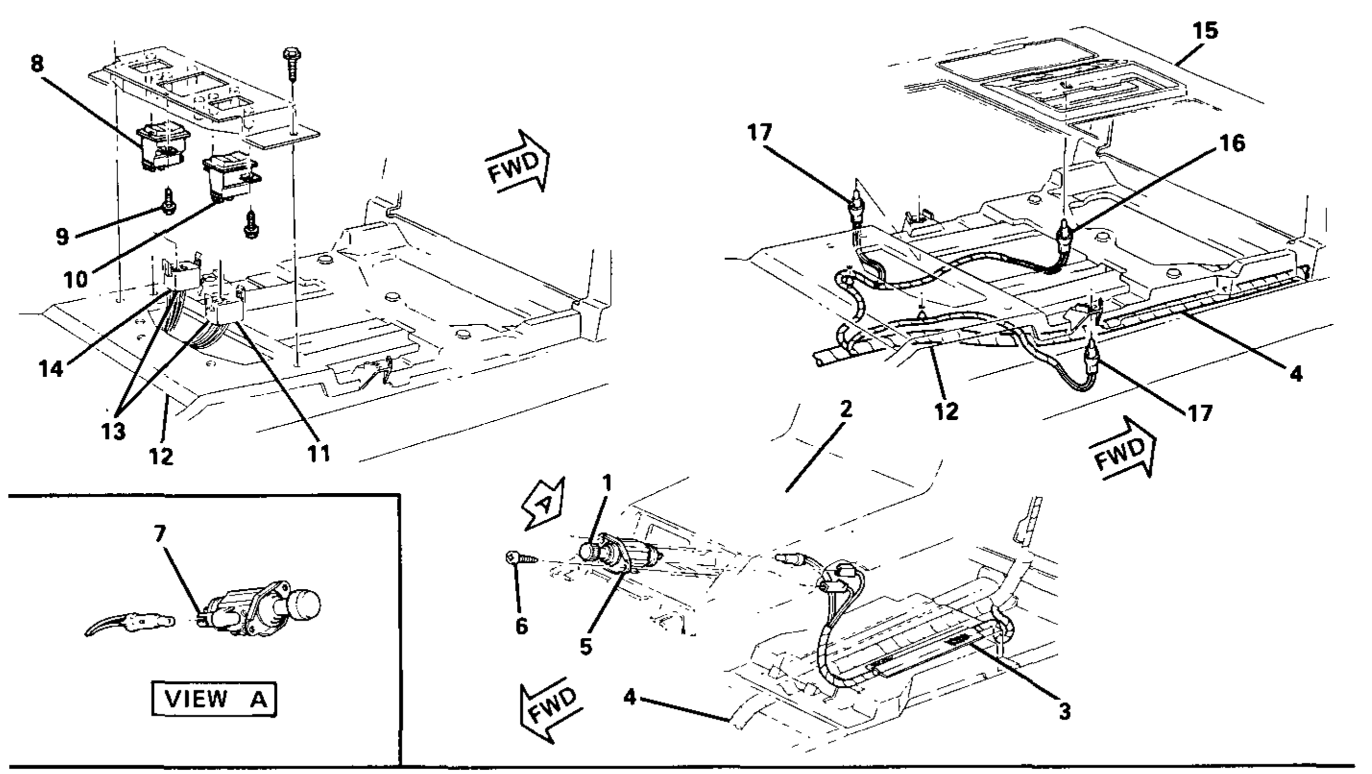
Install or Connect

1. Bulb in socket.
2. Bulb socket to the right 90°.
3. Shift trim plate.
4. Four bolts, two under each ash tray.
5. Both ash trays.

CIGAR LIGHTER BULB REPLACEMENT

Remove or Disconnect

1. Lighter assembly.
2. Two bolts at plate assembly.
3. Plate assembly.
4. Two bolts at lighter housing assembly.



1 – LIGHTER ASSY
2 – REAR CONSOLE PAD ASSY
3 – TAPE
4 – MAIN HARNESS
5 – HOUSING ASSY
6 – BOLT
7 – HOOD ASSY (HOUSING ASSY)
8 – SWITCH ASSY – RIGHT HAND
9 – SCREW
10 – SWITCH ASSY – LEFT HAND
11 – COLOR – NATURAL
12 – FRONT FLOOR CONSOLE CARRIER
13 – WINDOW CONTROL SWITCH CONNECTOR
14 – COLOR – BLACK
15 – PLATE ASSY – FLOOR CONSOLE SHIFT TRIM
16 – LAMP SOCKET – HOUSING TRANS CONSOLE INDICATOR
17 – LAMP SOCKET – ASHTRAY RETAINER

420013-8B-P

Fig. 818 Cigar, Window, Ashtray and Shift Plate Bulbs and Wiring

Install or Connect

1. Bulb.
2. Bulb socket to hood assembly.
3. Lighter housing assembly to rear console pad.
4. Two bolts at housing assembly.
5. Plate assembly.
6. Two bolts at plate assembly.
7. Lighter assembly.

HORNS

Fig. 819

The horns are located under the vehicle behind the front fascia on the front compartment rail.

Remove or Disconnect

1. Raise vehicle.
2. Electrical connection at horn.
3. One bolt at horn.
4. Horn.

Install or Connect

1. Horn.
2. One bolt at horn.
3. Electrical connection at horn.
4. Lower vehicle.

WINDSHIELD WASHER AND WIPER SYSTEM

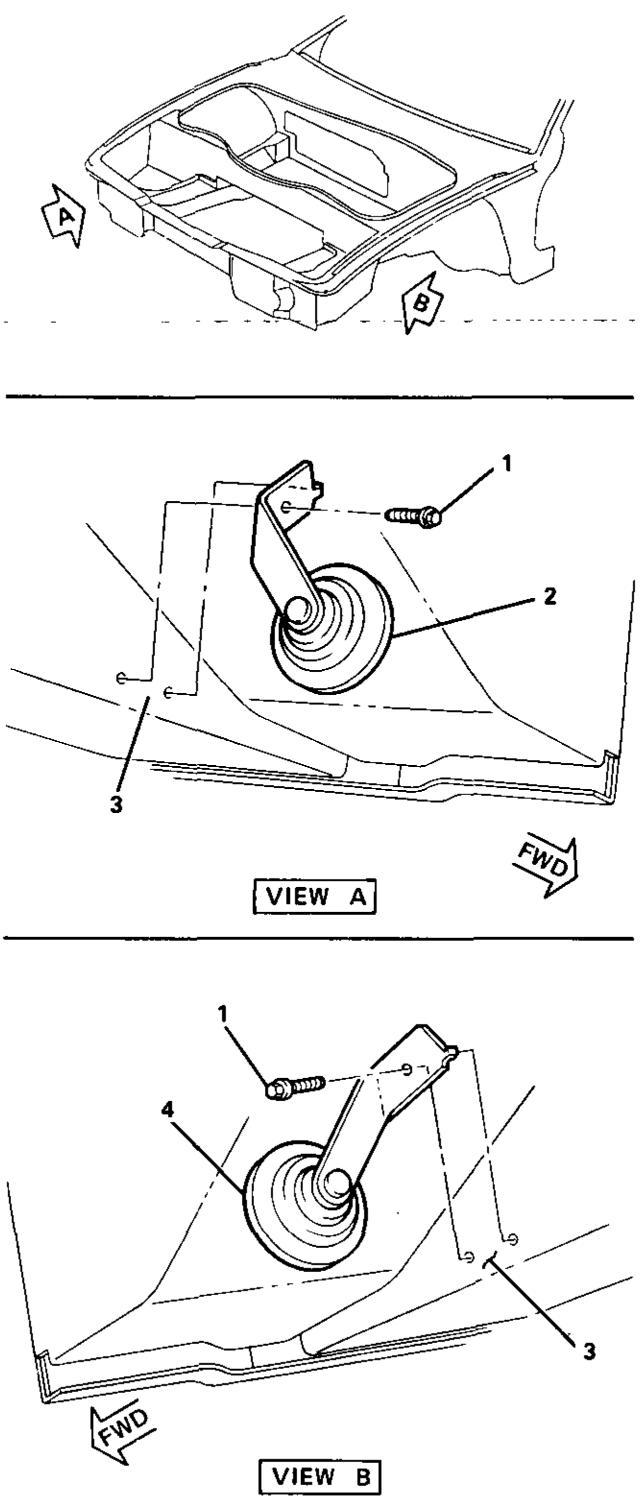
Wiper systems are covered in Section 8E2.

IGNITION SWITCH

Due to the integral design relationship of the ignition switch with steering column, service procedures for ignition switch are given in Section 3B4.

LIGHTING SWITCH

See Section 8C.



1 – BOLT
2 – HORN ASSY. (LOW NOTE)
3 – FRONT COMPARTMENT RAIL
4 – HORN ASSY. (HIGH NOTE)

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Fig. 819 Horn Mounting

MULTI-FUNCTION SWITCH

Replacement

Due to the integral design relationship of the multi-function switch (windshield wiper/washer, headlight beam selector and directional signal) with steering column, service procedures for multi-function switch are given in Section 3B4.

WIRING HARNESSES

See Figs. 820 through 833.

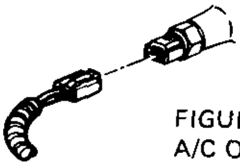
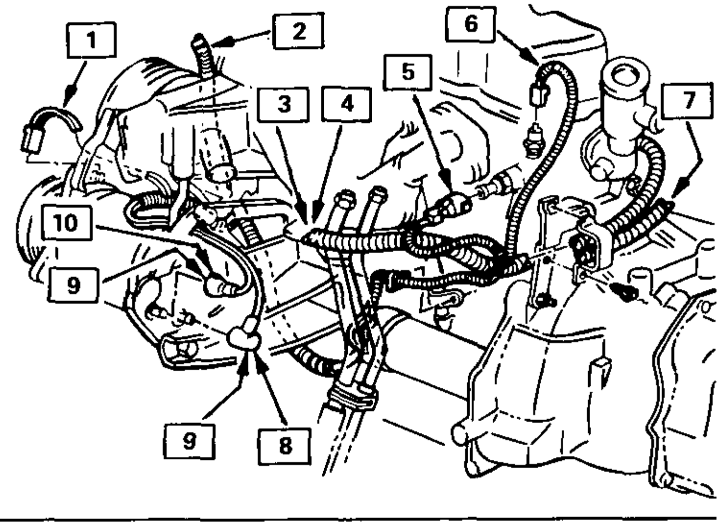


FIGURE 1
A/C ONLY



1–A/C COMPRESSOR CONNECTOR (ROUTE THROUGH COMPRESSOR FRONT MOUNTING BRACKET)

2–TO POSITIVE BATTERY TERMINAL

3–TO JUNCTION BLOCK

4–ROUTE ENGINE HARNESS IN FRONT OF A/C PIPE ASSY.

5–COOLING FAN TEMP. SWITCH LEAD

6–TEMP. SWITCH LEAD

7–EFI HARNESS

8–COOLING FAN SWITCH CONNECTOR (YELLOW WIRE)

9–ROUTE A/C COMPRESSOR CONNECTORS BETWEEN A/C HOSE ASSY. AND THROUGH COMPRESSOR R.R. MOUNTING BRACKET AS SHOWN

10–HIGH PRESSURE SWITCH CONNECTOR

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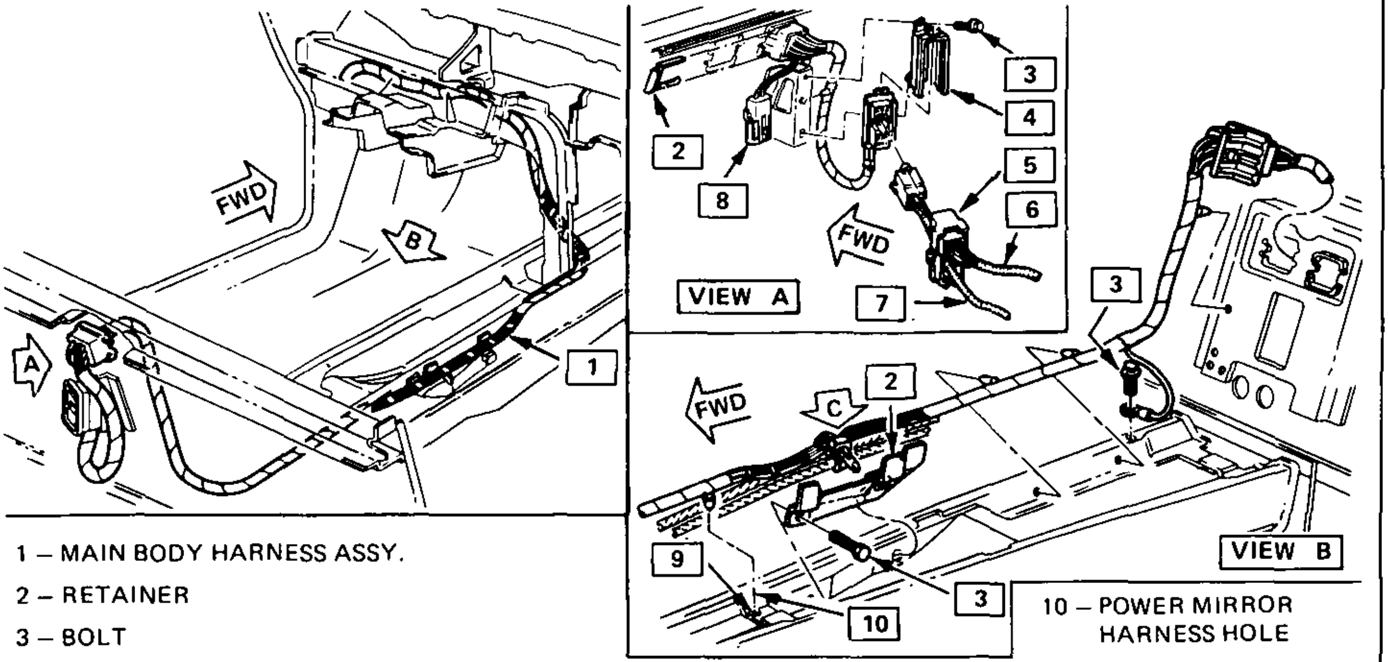
Fig. 820 Engine Wiring (Front)



1 – MAIN BODY HARNESS ASSY.

2 – RETAINER

3 – BOLT

4 – COVER

5 – JUNCTION BLOCK CONN. (ENGINE HARNESS)

6 – TO ENGINE COMPARTMENT

7 – REAR HARNESS

8 – FUEL GAGE FEED & GROUND (MAIN HARNESS)

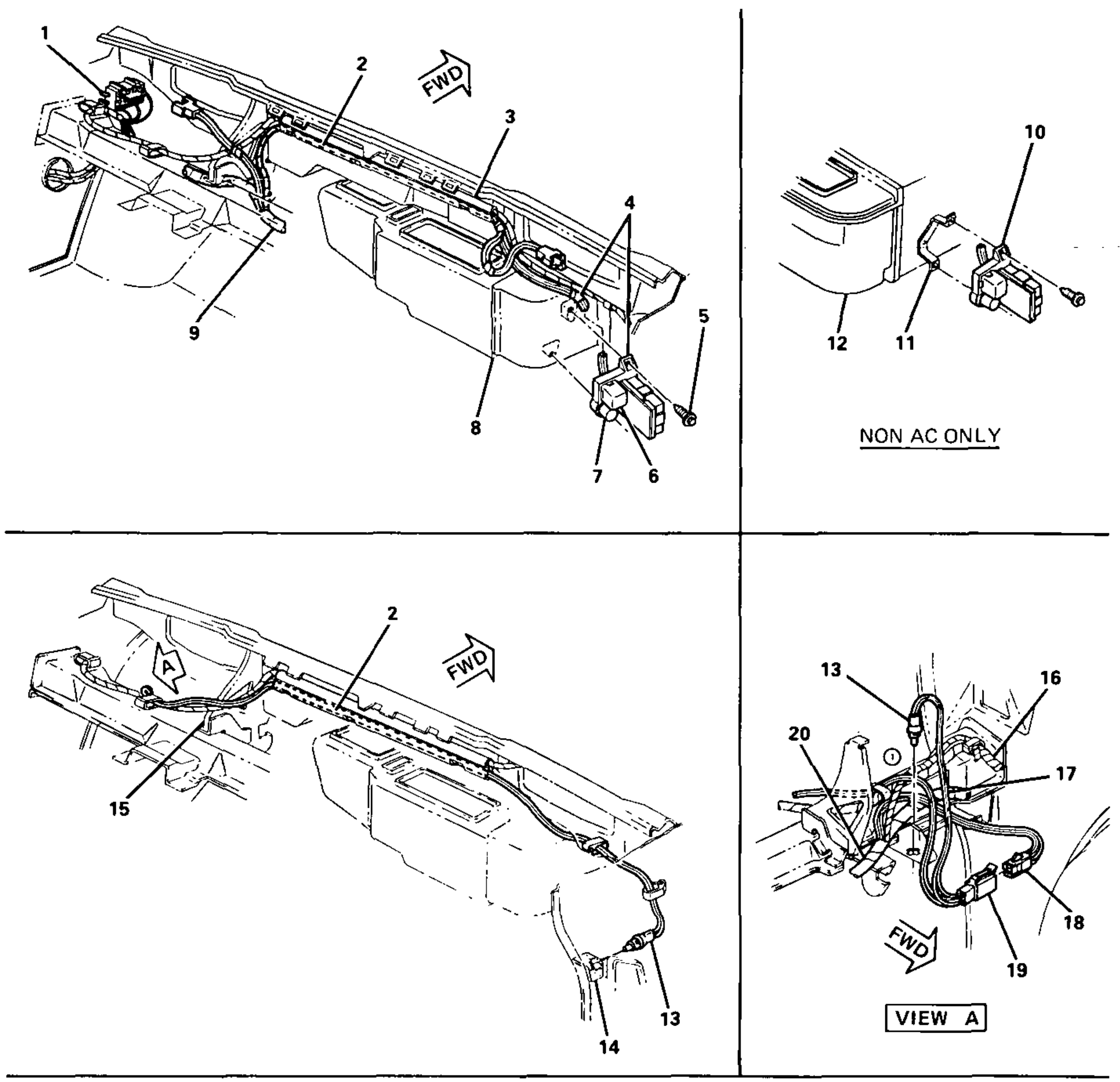
9 – POWER WINDOW HARNESS HOLE

10 – POWER MIRROR HARNESS HOLE

C STRAP AROUND PWR.MIRROR/ PWR. WINDOWS/ AND MAIN HARNESS

5201018B

Fig. 821 Main Body Harness Assembly



1 – JUNCTION BLOCK
2 – ROUTE HARNESS ASSY. THRU CROSS CAR CONDUIT
3 – CROSS CAR CONDUIT
4 – CONVENIENCE CENTER (MAIN I/P HARNESS)
5 – ALARM
6 – RELAY (HORN)
7 – FLASHER (HAZARD)
8 – HEATER & A/C MODULE
9 – TO MAIN I/P HARNESS
10 – CONVENIENCE CENTER (MAIN I/P HARNESS)
11 – BRACKET
12 – HEATER MODULE
13 – COURTESY LAMP SOCKET ASSY.
14 – COURTESY LAMP SUPPORT BRACKET
15 – STEERING COLUMN SUPPORT BRACKET
16 – CROSS CAR HARNESS
17 – HARNESS ASSY.
18 – COURTESY LAMP LINE CONNECTOR (MAIN HARNESS)
19 – COURTESY LAMP LINE CONNECTOR
20 – MAIN HARNESS

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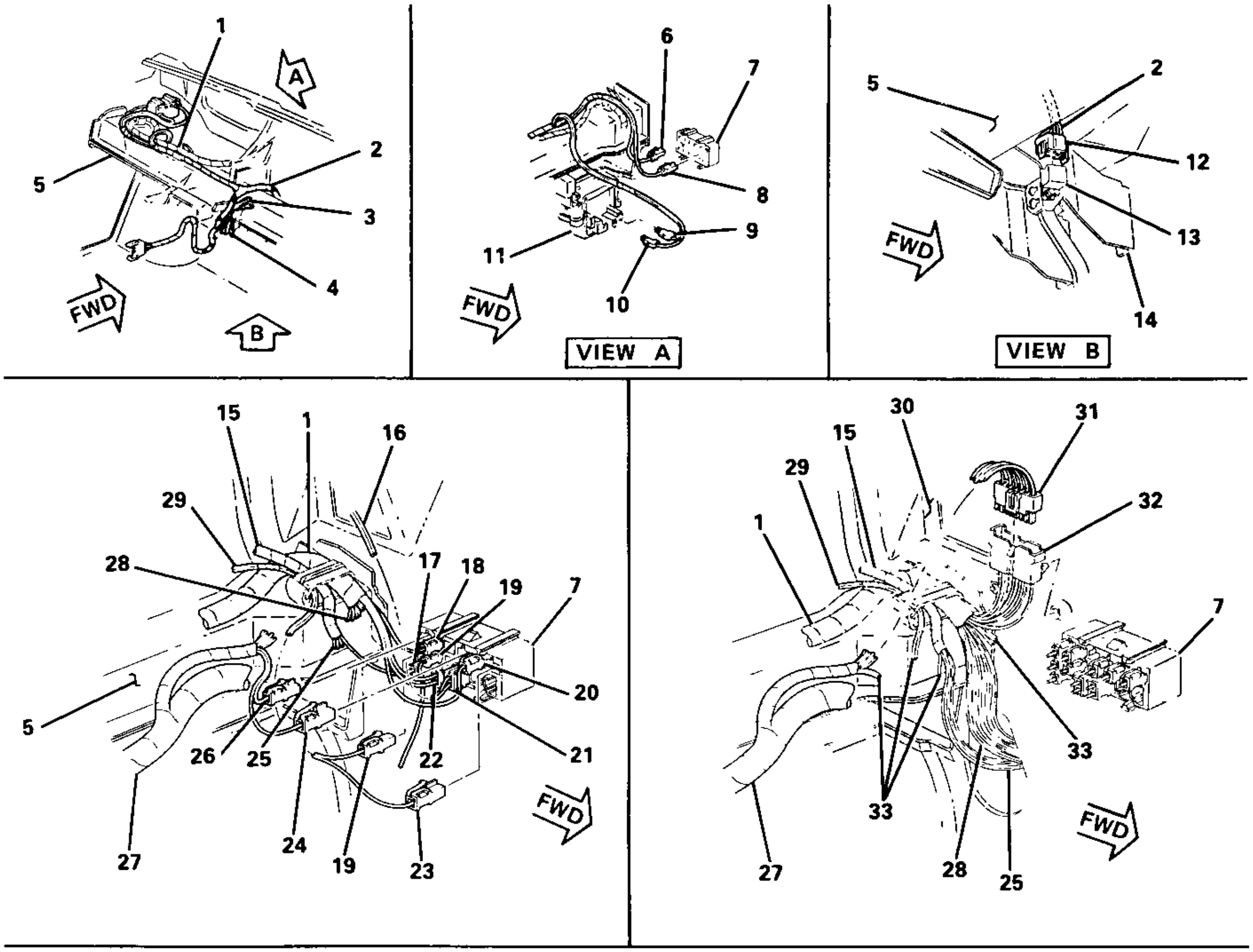
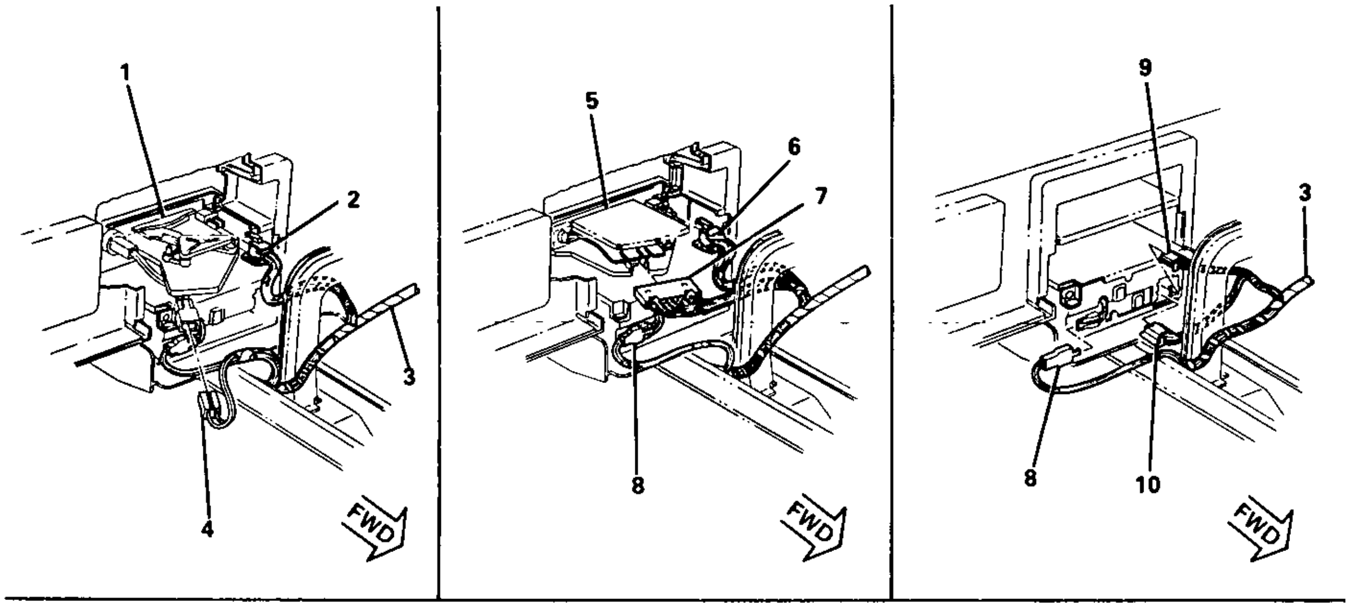


1 – CROSS CAR HARNESS
2 – HARNESS ASSY.
3 – CLUSTER WIRING
4 – WIRING REAR DECK LID RELEASE
5 – STEERING COLUMN SUPPORT ASSY.
6 – CONNECTOR (WHITE)
7 – JUNCTION BLOCK
8 – CONNECTOR (GRAY)
9 – CONNECTOR (BLUE)
10 – CONNECTOR (BROWN)
11 – FUSE PANEL
12 – REAR WINDOW DEFOGGER RELAY CONNECTOR
13 – REAR WINDOW DEFOGGER RELAY
14 – BRAKE PEDAL SUPPORT ASSY.
15 – POWER MIRROR HARNESS
16 – TO DOME LAMP
17 – CONNECTOR ASSY. (BLACK) POWER MIRROR
18 – CONNECTOR ASSY. (BLUE) ACCESSORY IGNITION FEED
19 – CONNECTOR ASSY. (WHITE) RIGHT REAR WINDOW DEFOGGER
20 – CONNECTOR ASSY. (GRAY) POWER DOOR LOCK
21 – CONNECTOR ASSY. (NAT) DOME LAMP
22 – CONNECTOR ASSY. (NAT) ACCESSORY BATTERY FEED (FROM CROSS CAR HARNESS)
23 – CONNECTOR ASSY. (GRAY) RIGHT REAR WINDOW DEFOGGER
24 – CONNECTOR ASSY. (GRAY) ACCESSORY BATTERY FEED (FROM MAIN WIRE ASSY.)
25 – TO POWER MIRROR
26 – CONNECTOR ASSY. (BLUE) ACCESSORY IGNITION FEED (FROM MAIN WIRE ASSY.)
27 – MAIN HARNESS
28 – TO DOOR HARNESS WARNING BUZZER & LINE CONNECTOR
29 – RIGHT REAR WINDOW DEFOGGER WIRING
30 – FRONT BODY HINGE PILLAR INNER
31 – MAIN HARNESS TO LINE CONNECTOR
32 – LINE CONNECTOR
33 – TO JUNCTION BLOCK

420018-8B-P

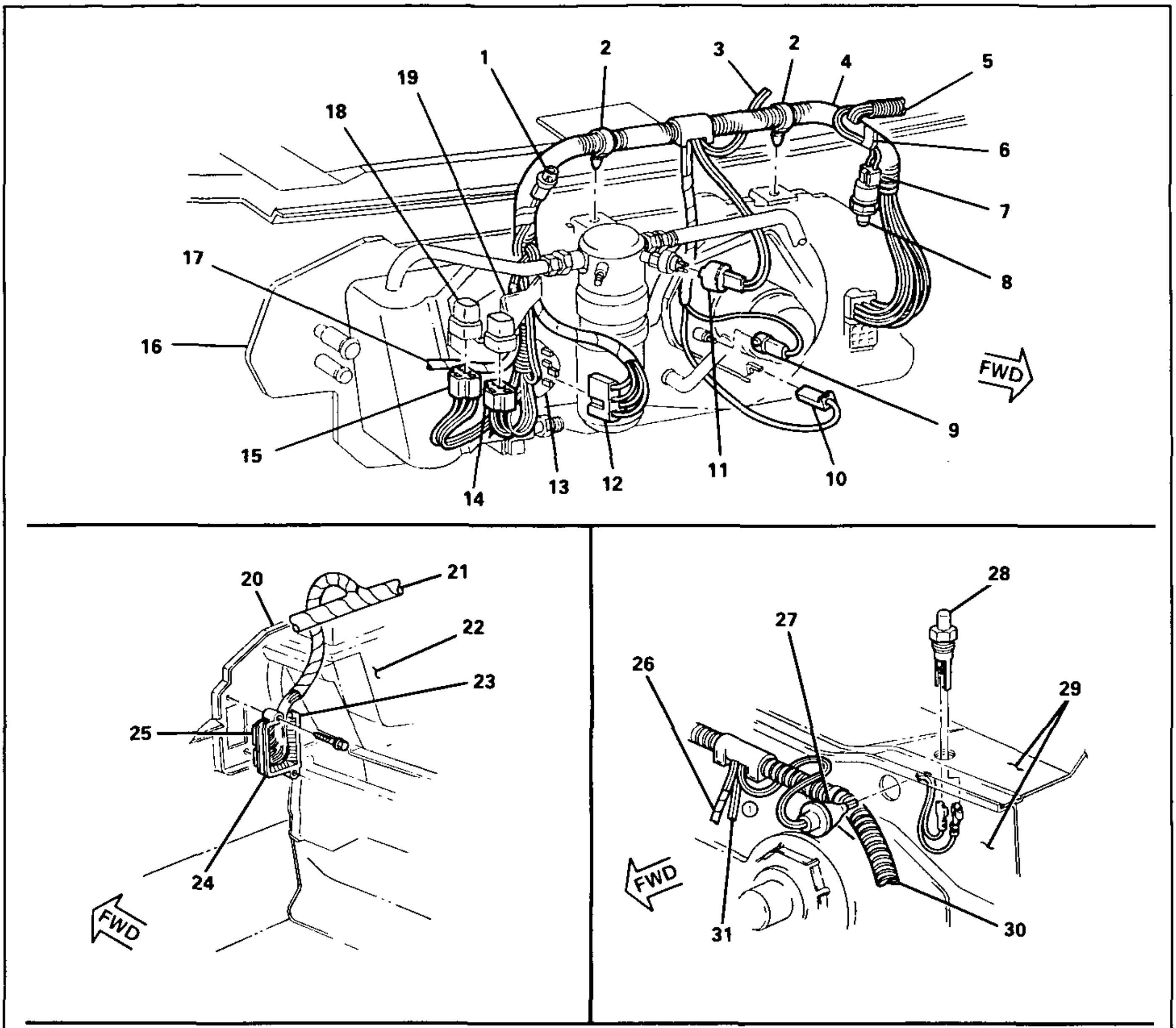
Fig. 823 Main Harness to Junction Block



1 – HEATER CONTROL ASSY.
2 – HEATER FAN CONNECTOR
3 – MAIN I/P HARNESS
4 – HEATER CONT. ILLUM. CONNECTOR
5 – A/C CONTROL ASSY.
6 – A/C BLOWER CONNECTOR (MAIN HARNESS)
7 – A/C SELECTOR CONNECTOR (MAIN HARNESS)
8 – CLOCK CONNECTOR
9 – FRONT SPEAKERS CONNECTOR
10 – POWER FEED CONNECTOR

420014-8B-P

Fig. 824 Heater, A/C Controls and Radio Wiring



1 – TO FORWARD COURTESY LAMP
2 – CLIP (WIRE ASSEMBLY)
3 – TO FRONT COMPT LAMP SW
4 – WIRE ASSEMBLY
5 – TO W/S WIPER MOTOR
6 – TAPE
7 – AMBIENT TEMPERATURE SWITCH CONNECTOR
8 – REAR WINDOW DEFROSTER AMBIENT TEMP SWITCH
9 – BLOWER MOTOR CONN
10 – BLOWER MOTOR GROUND CONNECTOR
11 – CYCLING PRESSURE SWITCH CONNECTOR
12 – A/C RESISTOR CONNECTOR
13 – A/C RESISTOR
14 – A/C HI BLOWER CONN
15 – A/C POWER SWITCHING RELAY CONNECTOR
16 – A/C MODULE
17 – TO W/S WASHER PUMP
18 – BRACKET / RELAY ASSY
19 – ROUTE HARNESS & LEADS BEHIND BRACKET & RELAY ASSEMBLY AS SHOWN
20 – DASH PANEL
21 – MAIN HARNESS
22 – A/C & HEATER MODULE
23 – BULKHEAD CONN (MAIN HARNESS)
24 – TO FWD LP HARNESS
25 – TO A/C & HEATER HARN
26 – TO BLOWER MOTOR & GROUND
27 – GROMMET (A/C & HEATER HARNESS)
28 – FRONT COMPT LAMP SWITCH
29 – VENT DUST PANEL
30 – A/C & HEATER HARNESS
31 – TO A/C CYCLING PRESSURE SWITCH

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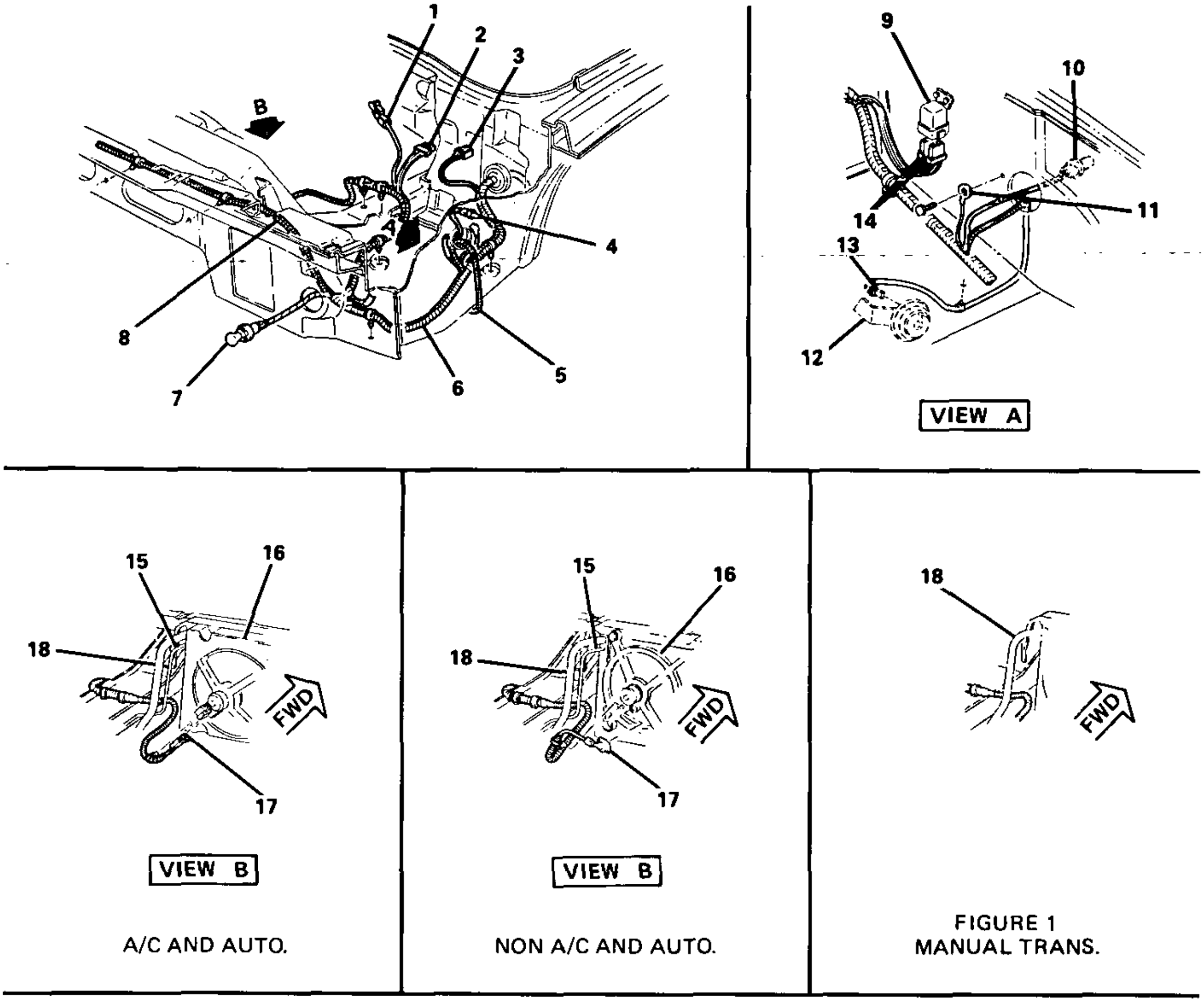
Fig. 825 Main Harness to Bulkhead Wiring A/C



A/C AND AUTO.

NON A/C AND AUTO.

FIGURE 1
MANUAL TRANS.

1 – TO HD/LP ACTUATOR
2 – TO HD/LP RELAY
3 – TO HD/LP
4 – SIDE MARKER LAMP
5 – TO HORN
6 – HARNESS ASSY.
7 – PARK & TURN, BULB & SOCKET ASSY.
8 – ROUTE HARNESS BETWEEN FRONT COMPT. RAIL & END PANEL AS SHOWN (L & RH SIDES)
9 – HD/LP ISOLATION RELAY
10 – SIDE MARKER SOCKET ASSY.
11 – GROUND
12 – HORN ASSY.
13 – HORN CONN.
14 – ISOLATION RELAY CONN.
15 – TRANS. COOLER HOSE ASSY.
16 – FAN ASSY.
17 – COOLING FAN MOTOR CONN.
18 – RAD. INLET HOSE
19 – FOR MANUAL TRANS. SEE FIGURE 1

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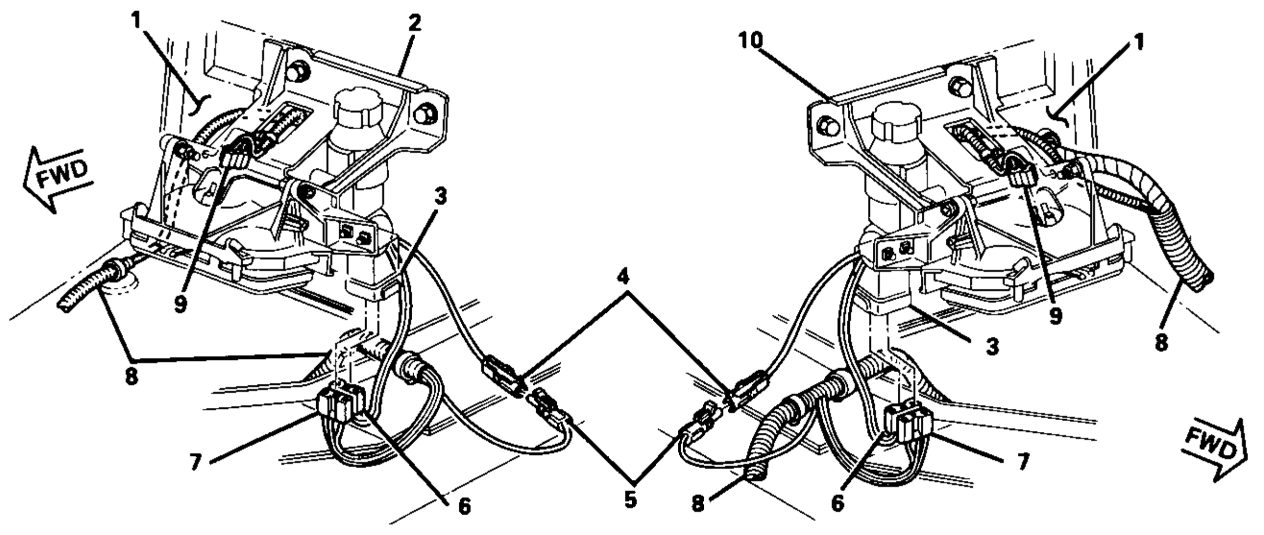
Fig. 826 Forward Wiring to Fan Assembly



1 — FRONT COMPARTMENT PANEL

2 — HEAD LAMP ASSY. — RIGHT HAND

3 — HEAD LAMP RELAY ASSY.

4 — HEAD LAMP MOTOR TO ACTUATOR CONNECTOR

5 — HEAD LAMP ACTUATOR CONNECTOR

6 — HEAD LAMP MOTOR TO RELAY CONNECTOR

7 — HEAD LAMP RELAY CONNECTOR

8 — FORWARD LAMP HARNESS

9 — HEAD LAMP CONNECTOR

10 — HEAD LAMP ASSY. — LEFT HAND

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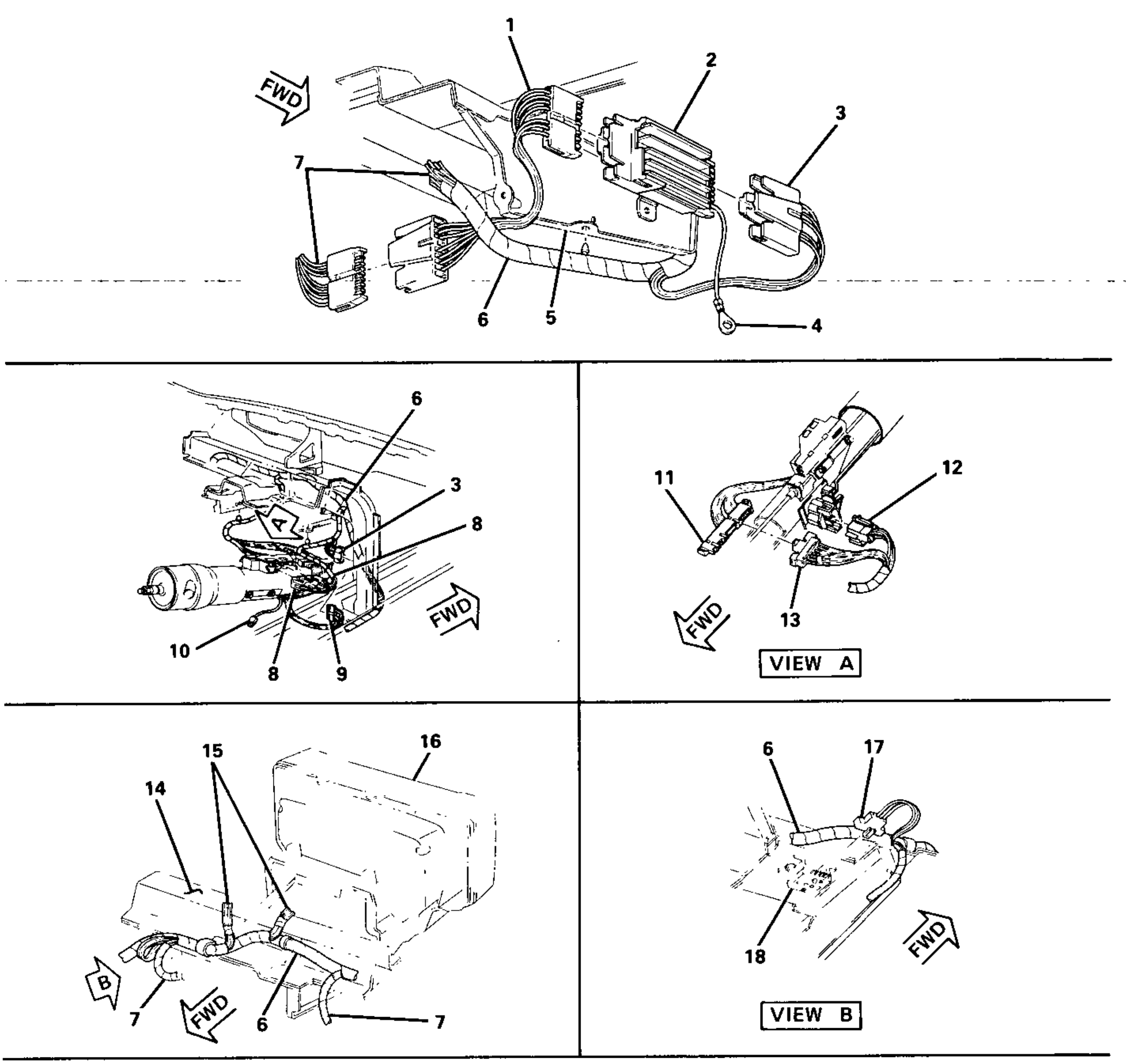
Fig. 827 Forward Lamp and Harness



1 – ROUTE WIRE ASSY. BETWEEN MAIN HARNESS AND COLUMN SUPPORT BRACKET AS SHOWN
2 – WINDSHIELD WIPER PULSE CONT. MODULE
3 – WIPER/WASHER CONNECTOR TO MAIN HARNESS
4 – PULSE MOD GROUND
5 – RIGHT HAND COLUMN SUPPORT BRACKET
6 – MAIN HARNESS
7 – TO STEERING COLUMN
8 – IGNITION CONNECTOR (MAIN HARNESS)
9 – WIPER/WASHER CONN. (STEERING COLUMN)
10 – CRUISE ENGAGE CONNECTOR
11 – DIRECTIONAL SIGNAL CONNECTOR (STEERING COLUMN)
12 – DIMMER SWITCH CONNECTOR (MAIN HARNESS)
13 – DIRECTIONAL SIGNAL CONNECTOR (MAIN HARNESS)
14 – STEERING COLUMN SUPPORT ASSY.
15 – TO INSTRUMENT PANEL CLUSTER
16 – CLUSTER ASSY.
17 – INSTRUMENT PANEL REMOTE DIMMER CONNECTOR
18 – REMOTE DIMMER ASSY.

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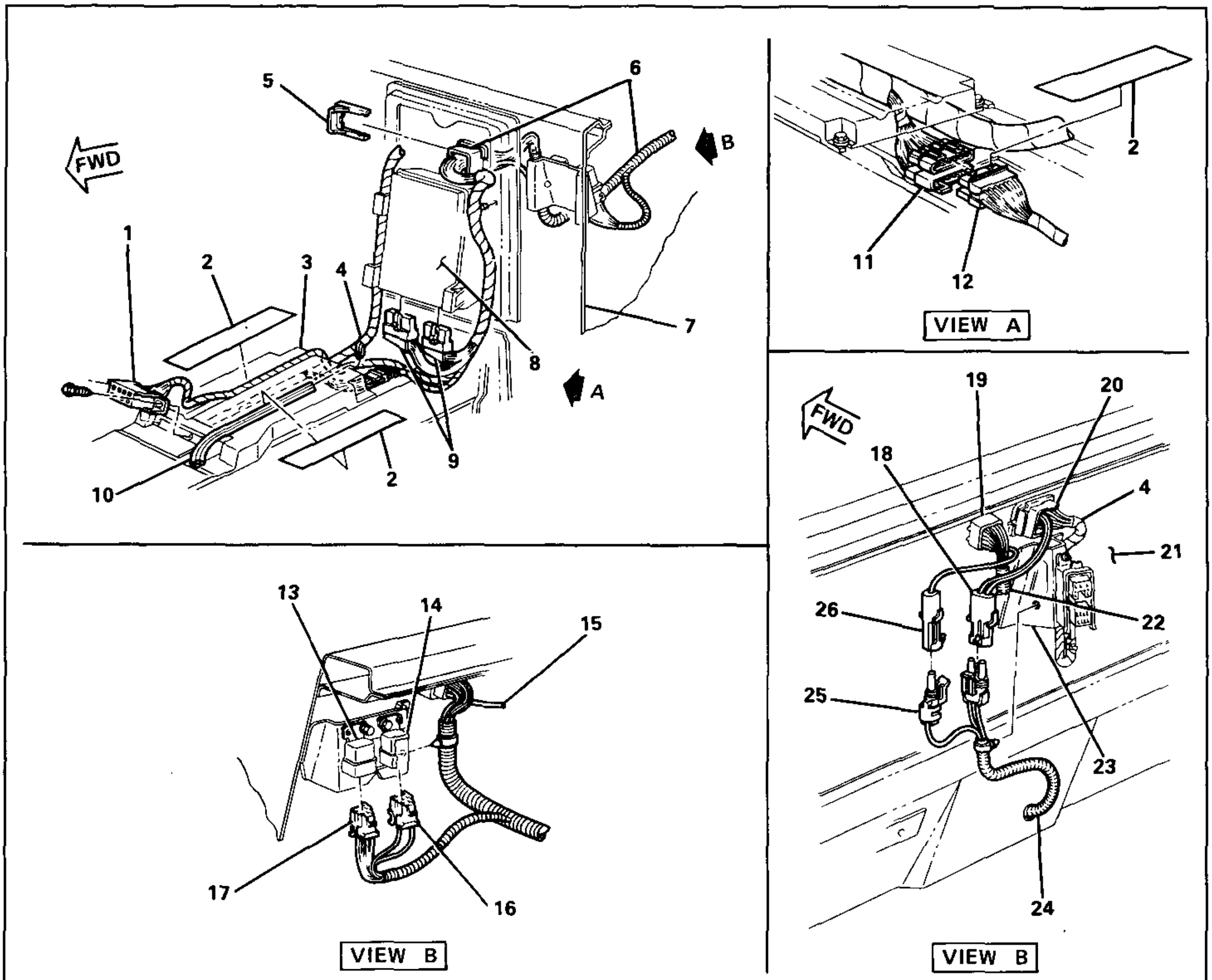
Fig. 828 Steering Column Wiring



1 – A.L.D.L. CONNECTOR
2 – TAPE (APPROX. 250MM PER JOB)
3 – CONSOLE SUPPORT ASSY.
4 – MAIN HARNESS
5 – RETAINER
6 – HARNESS ASSY.
7 – UPPER FLOOR PAN
8 – ECM
9 – ECM CONNECTOR
10 – TO CIGAR LIGHTER
11 – MAIN HARNESS IN-LINE CONNECTOR. RE-TAPE AFTER SERVICE.
12 – EFI TO MAIN HARNESS IN-LINE CONNECTOR. RE-TAPE AFTER SERVICE.
13 – A/C CLUTCH RELAY
14 – FUEL PUMP RELAY
15 – TO FUEL PUMP
16 – FUEL PUMP RELAY CONNECTOR
17 – A/C CLUTCH RELAY CONNECTOR
18 – FUEL GAGE FEED & GROUND CONNECTOR (MAIN HARNESS)
19 – HARDSHELL GROMMET (EFI HARNESS)
20 – HARDSHELL GROMMET (MAIN HARNESS)
21 – FLOOR PAN EXTENSION
22 – EFI HARNESS
23 – JUNCTION BLOCK MOUNTING BRACKET
24 – SENDER & FUEL PUMP CABLE ASSY.
25 – FUEL PUMP EFI HARNESS
26 – EFI TO FUEL PUMP CONNECTOR

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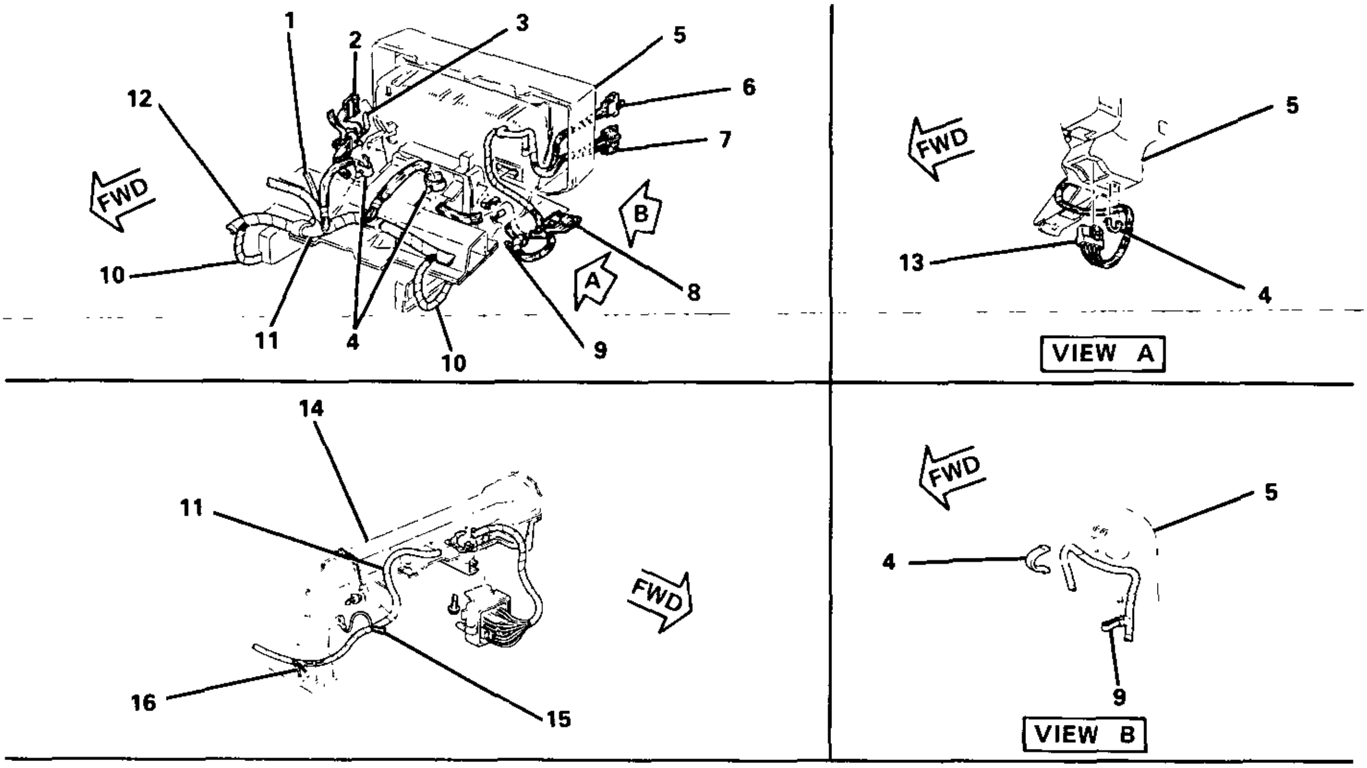
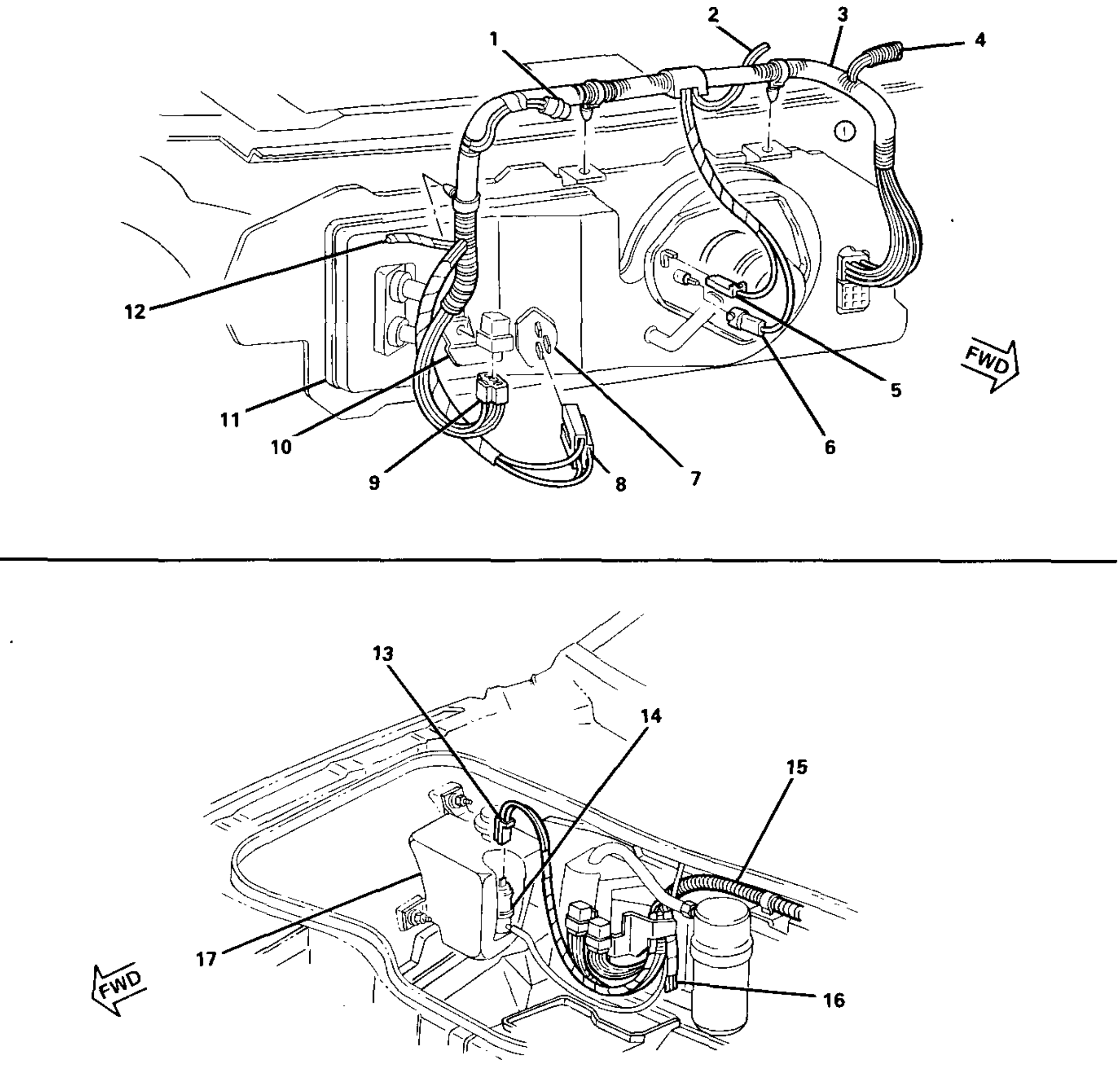
Fig. 829 Rear Floor Panel Extension Wiring



1 – REAR WINDOW DEFOGGER WIRES
2 – CLUSTER CONN. – VERTICAL
3 – REAR COMPARTMENT LID LOCK RELEASE WIRES
4 – RETAINER
5 – CLUSTER ASSY.
6 – TO HEADLAMP SWITCH
7 – TO I.P. DIMMER SWITCH
8 – CLUSTER CONN. – HORIZONTAL
9 – CLIP (MAIN I.P. HARNESS)
10 – TO STEERING COLUMN
11 – MAIN I/P HARNESS
12 – TO CONVENIENCE CENTER
13 – CLUSTER CONN. – EDGE BOARD
14 – STRG. COL. SUPT.
15 – TO I/C HEATER CONTROLS
16 – TO RADIO CLOCK

420015-8B-P

Fig. 830 Main Body Wiring to I.P. Cluster



1 – TO FWD COURTESY LAMP
2 – TO RR COMPT LID RELEASE SW
3 – WIRE ASM-HTR
4 – TO W/SHIELD WIPER MTR
5 – HTR – GROUND CONN
6 – HTR – BLOWER SW CONN
7 – HTR BLOWER RESISTOR
8 – HTR BLOWER RESISTOR CONN
9 – HTR RELAY CONN
10 – HTR RELAY BRKT
11 – HTR MODULE
12 – TO W/S WASHER PUMP
13 – W/SHIELD WASHER CONN
14 – PUMP ASM
15 – A/C OR HEATER HARNESS
16 – TO A/C RESISTOR
17 – CONTAINER ASM

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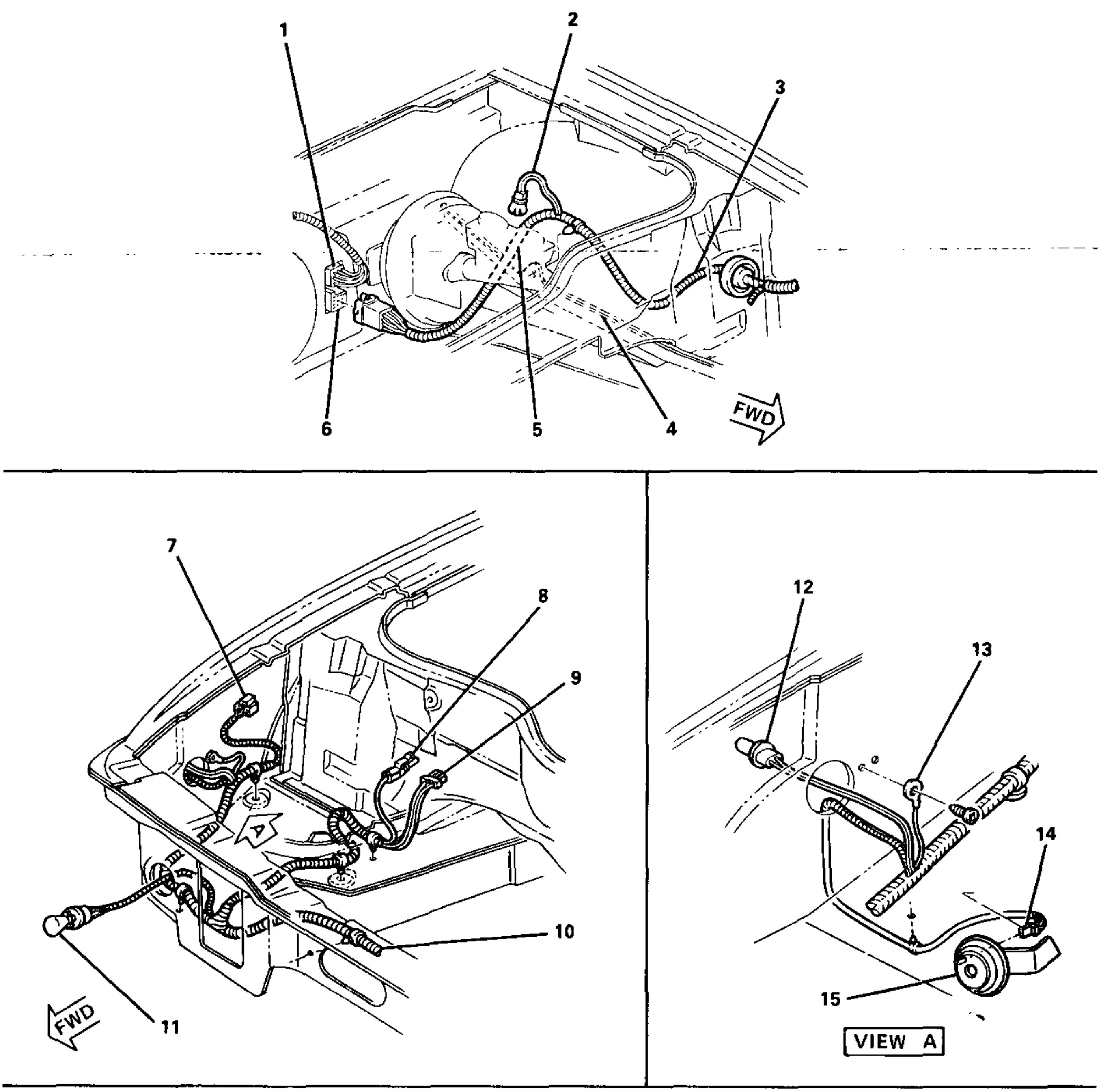
Fig. 831 Main Harness to Bulkhead Wiring W/O A/C



1 – TO HTR & A/C MODULE
2 – TO BRAKE COMB VALVE
3 – HARNESS ASM FWD LP
4 – FRT COMPT RAIL
5 – ROUTE HARNESS UNDER MASTER CYLINDER
6 – BULKHEAD CONNECTOR
7 – TO HEADLAMP
8 – TO HEADLAMP ACTUATOR
9 – TO HEADLAMP RELAY
10 – HARNESS ASM.
11 – PARK & TURN BULB & SOCKET ASM
12 – SIDE MARKER BULB & SOCKET ASM.
13 – GROUND
14 – HORN CONN.
15 – HORN ASM.

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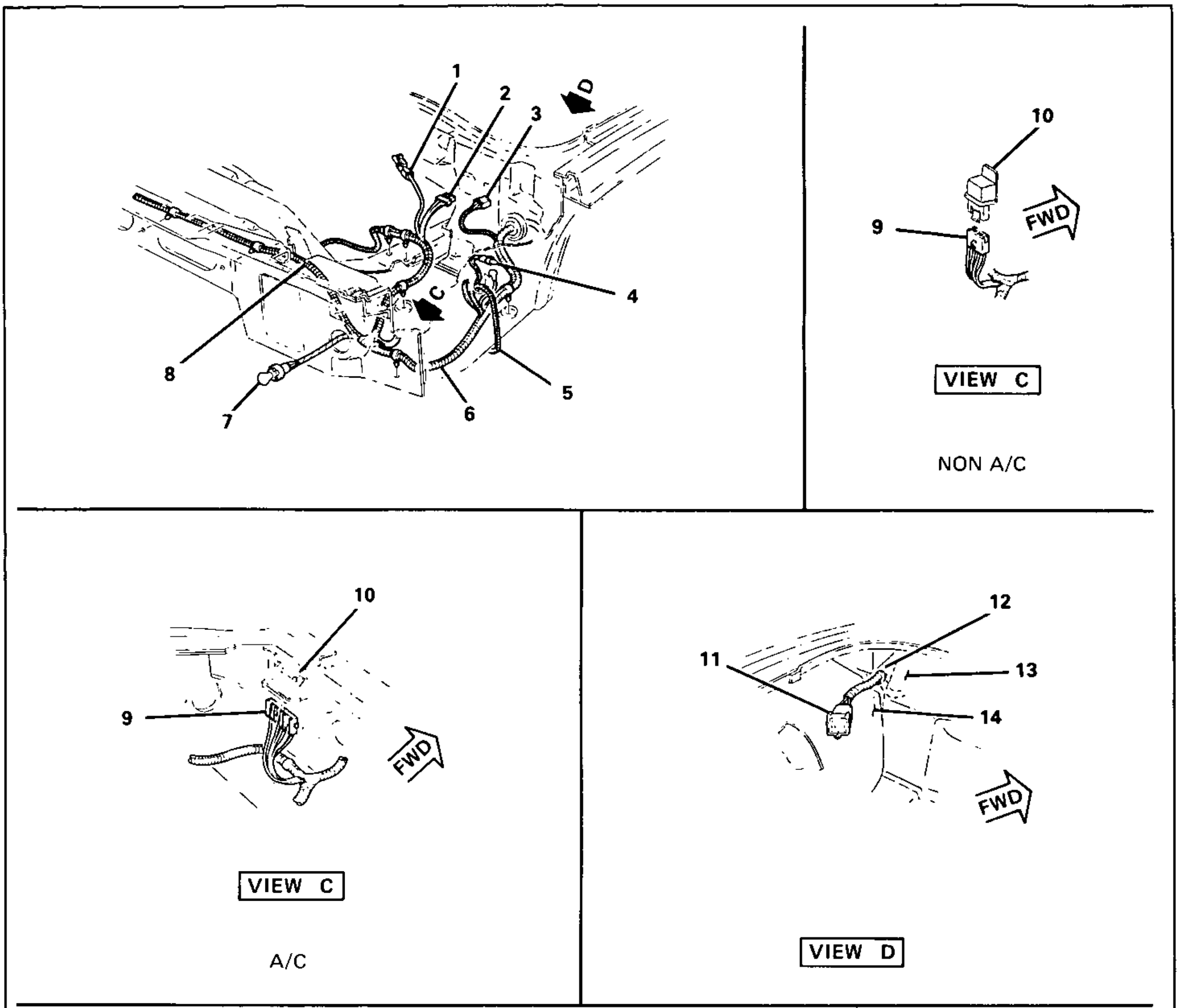
Fig. [illegible] Bulkhead Connector to Forward Lamp Harness



1 – TO HD/LP ACTUATOR
2 – TO HD/LP RELAY
3 – TO HD/LP
4 – SIDE MARKER LAMP
5 – TO HORN
6 – HARNESS ASSY.
7 – PARK & TURN, BULB & SOCKET ASSY.
8 – ROUTE HARNESS BETWEEN FRONT COMPT. RAIL & FRT. END PANEL AS SHOWN (L & RH SIDES)
9 – FAN RELAY CONN.
10 – FAN RELAY
11 – BULKHEAD CONN.
12 – GROMMET HOLE
13 – HEADLAMP MTG. PANEL
14 – WHEEL HOUSE COMPT. PANEL

420031-8B-P

Fig. 833 Forward Wiring Harness

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 are die cut and bonded to a polyester base film (usually mylar). The printed circuit is supplied electrical power 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. A typical printed circuit example is shown in Figure 1. For individual printed circuit diagrams, see Section 8A.

INSTRUMENT PANEL WIRE HARNESS

Instrument panel wire harness removal procedures are in Section 8B.

INSTRUMENTS

Instruments consist of fuel gage, temperature indicator light, generator light, oil pressure indicator light, and speedometer. See Section 9G 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.

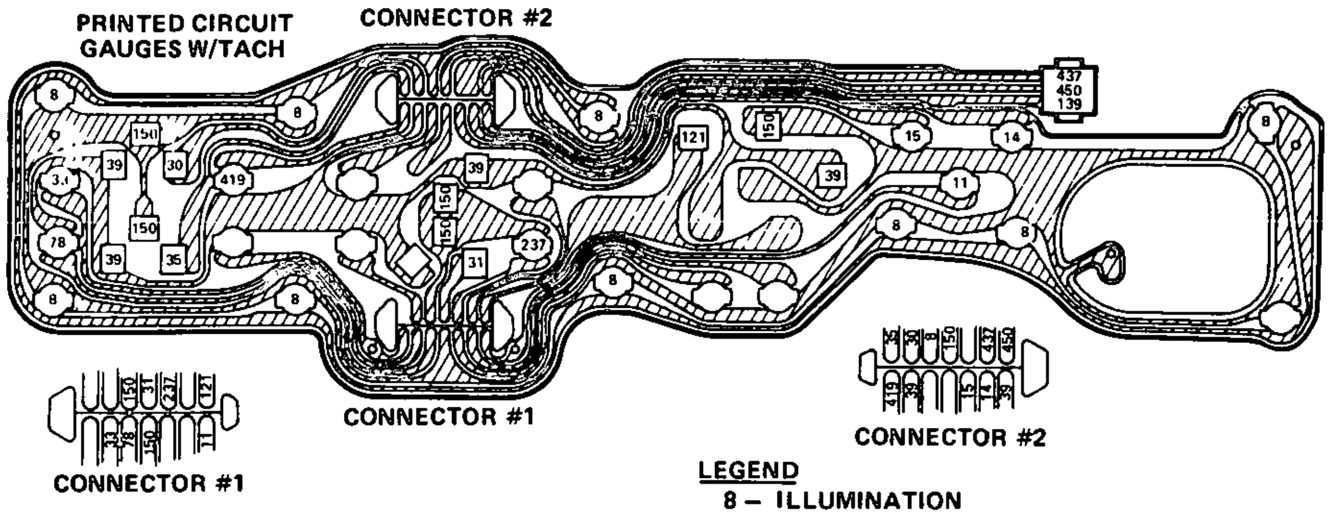
Instruments have been designed for easy removal by elimination of separate wiring. With the wiring provisions integrated with the instrument panel wiring, the instruments can be removed after removing the trim and lens.

SPEEDOMETER

The speedometer is a road speed indicator with an odometer to record total mileage, and, on some cars, a resettable trip meter.

There are three types of speedometers in use: cable-driven mechanical, digital, and quartz-electric.

The mechanical speedometer uses a flexible cable driven by a gear in the transmission. Cruise-control equipped cars, and those with the Torque Converter Clutch, are equipped with a Vehicle Speed Sensor (VSS) located in the speedometer frame. This sensor is



LEGEND
11 – HIGH BEAM INDICATOR
31 – OIL GAUGE SENDER
33 – BRAKE WARNING TELLTALE
78 – CHOKE TELLTAKE
121 – TACH SENDER
150 – GROUND
150 – GROUND
237 – IGNITION FOR SEAT BELT TELLTALE

LEGEND
8 – ILLUMINATION
14 – LEFT TURN SIGNAL INDICATOR
15 – RIGHT TURN SIGNAL INDICATOR
30 – FUEL GAUGE SENDER
35 – TEMPERATURE GAUGE SENDER
39 – IGNITION
39 – IGNITION TO BUFFER
150 – GROUND
419 – CHECK ENGINE TELLTALE
437 – BUFFER SIGNAL TO C3 COMPUTER
450 – C3 COMPUTER GROUND TO BUFFER

520001-8C

Fig. 1 Printed Circuit - Typical

used to supply speed data to the cruise control module, and/or to the Computer Command Control.

The odometer is driven by a series of gears in the speedometer head. The odometer discs are geared so that as any one disc finishes a complete revolution, the next disc to the left is turned one-tenth of a revolution.

The digital speedometer receives its data on vehicle speed from the P.M. (Permanent Magnet) Generator (sometimes called a Vehicle Speed Sensor, or VSS) located in the transaxle. The P.M. Generator generates an AC voltage, which is related to speed, and sends this signal to the Buffer Amplifier. This signal is then sent to the speedometer circuitry, as well as the ECM, the Cruise Control module, and the odometer.

The quartz electric speedometer utilizes an accurate clock signal supplied by a quartz crystal, along with integrated electronic circuitry, to process the speed signal from the P.M. Generator in the tranxaxle. The speedometer pointer is moved by the magnetic fields of coils which are driven by the circuitry. When voltage is applied through each coil, the direction of the circuit path is changed in order to make the pointer turn through a large angle.

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

The letters "E" and "F" on the fuel gage are used to point out direction of indicator travel only.

Gage readings are indicated by five graduations on the gage face. The left hand line indicates empty, the centerline half-full and the right line full.

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.

If the cooling system does not hold pressure check for the following:

1. Pressure cap left loose.
2. Puncture of radiator.
3. Hose disconnected.
4. Improper anti-freeze.
5. Temperature sender improperly calibrated (low boiling coolants such as water will not operate the light).

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.

whether the battery is being charged or if the voltage regulator is functioning properly.

The charging system should be checked if trouble is experienced. See Engine Electrical, Section 6D of this service manual.

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 side of 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 will 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 8A for complete diagnosis and wiring diagrams of the "SERVICE ENGINE SOON" light circuit.

ADDITIONAL INDICATOR LIGHTS

Some vehicles are equipped with additional indicator lights. These lights include the "CHOKE" light (found on cars with optional gages) and a "WAIT" light and "WATER-IN-FUEL" light on diesel engine equipped cars. Some 4 cylinder cars with manual transmission will have an "Upshift" indicator light.

CHOKE LIGHT

Cars with an electric choke have a choke light mounted in the instrument panel to indicate possible electric choke malfunctions. When the ignition is turned to the "RUN" or "START" position, the choke light comes on until the engine is running. If the light does not come on, the bulb is burned out or a problem is indicated in the choke electrical circuit. After the engine is running, the light should go out. If not, a problem may be indicated in the generator circuit that provides reverse current to turn the light off. If this condition exists, normally the voltmeter will give a discharge indication. See Section 8A for further information regarding the choke light circuit.

UPSHIFT INDICATOR LIGHT

If your vehicle has a 4 cylinder engine with a manual transmission, there is 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. Refer to Section 8A for wiring colors when connecting test lights and test instruments. Additional information to diagnose fuel gage, oil pressure gage and temperature gage irregularities are also contained in Figs. 2 through 4.

FUEL GAGE DIAGNOSIS

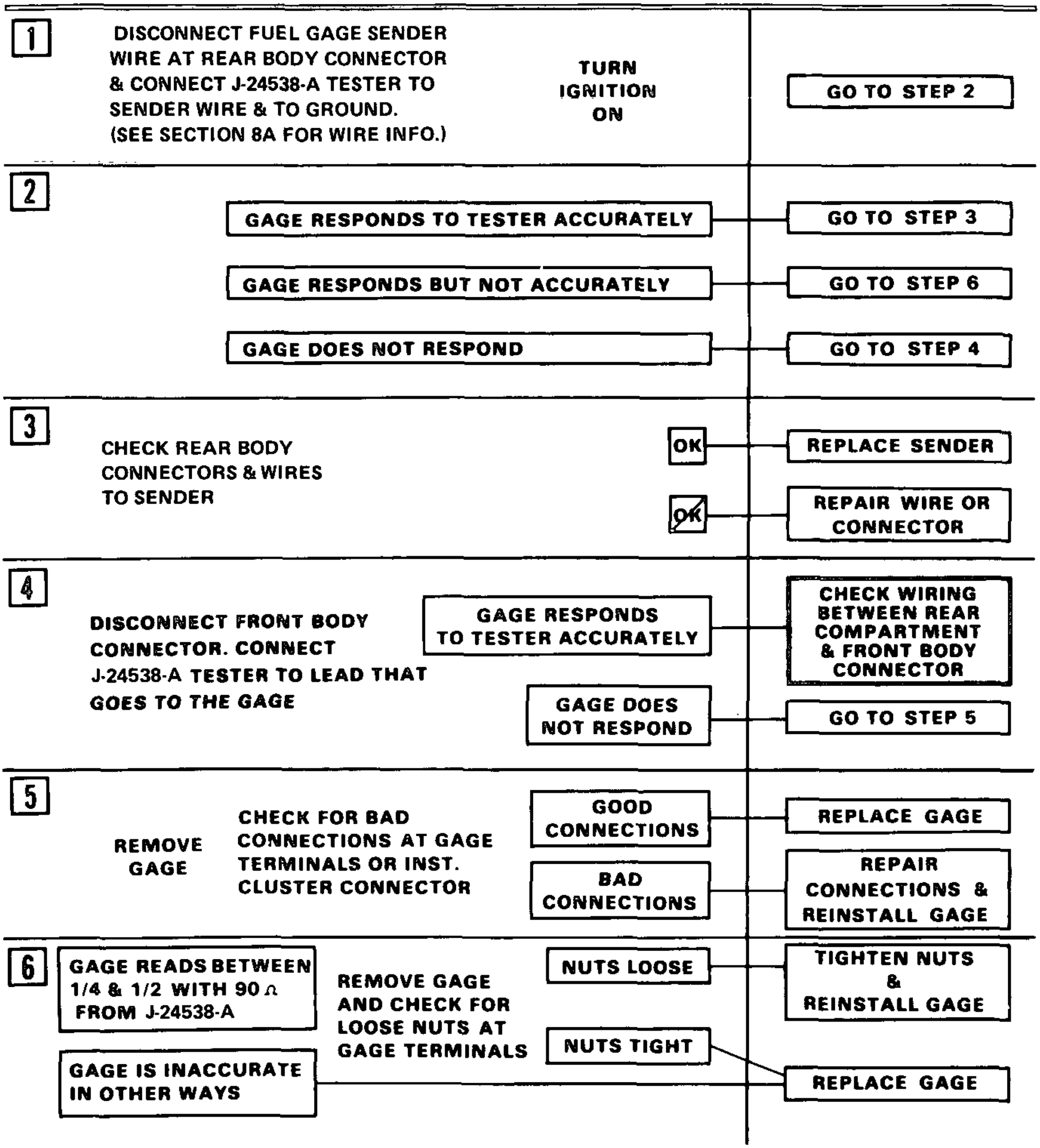
Wiring harness to fuel sender on EFI equipped cars will have three (3) wires. The tan wire supplies 12 volts to the integral electric fuel pump. Care should be taken **not** to contact the tan wire connector during diagnosis with test jumpers or test instrument leads. Twelve volts could damage the fuel sender or gage tester.

SPEEDOMETER

Noisy Mechanical Speedometer

Many things can cause speedometer noise. Simply replacing cables or the speedometer head may not correct the problem. Most noise is picked up and telegraphed along the speedometer cable to the speedometer, which acts as a loudspeaker, transmitting the noise to the driver. Therefore, it is possible for noise to be generated by other parts. To begin diagnosing the speedometer, check for proper cable routing and make sure the cable is not contacting brackets or duct work that may transmit and/or amplify the noise. A length of 5/8" OD x 3/8" ID vinyl tubing split lengthwise and installed over the cable will isolate it from brackets and duct work and will decrease marginal noise. Also, check for loose connections at the speedometer head, cruise control transducer, transmission and/or transmission speedometer adapter. If the above items check OK and the noise still exists, continue with the following diagnosis.

FUEL GAGE DIAGNOSIS



1

DISCONNECT FUEL GAGE SENDER WIRE AT REAR BODY CONNECTOR & CONNECT J-24538-A TESTER TO SENDER WIRE & TO GROUND. (SEE SECTION 8A FOR WIRE INFO.)

TURN IGNITION ON

GO TO STEP 2

2

GAGE RESPONDS TO TESTER ACCURATELY — GO TO STEP 3

GAGE RESPONDS BUT NOT ACCURATELY — GO TO STEP 6

GAGE DOES NOT RESPOND — GO TO STEP 4

3

CHECK REAR BODY CONNECTORS & WIRES TO SENDER

OK — REPLACE SENDER

~~OK~~ — REPAIR WIRE OR CONNECTOR

4

DISCONNECT FRONT BODY CONNECTOR. CONNECT J-24538-A TESTER TO LEAD THAT GOES TO THE GAGE

GAGE RESPONDS TO TESTER ACCURATELY — CHECK WIRING BETWEEN REAR COMPARTMENT & FRONT BODY CONNECTOR

GAGE DOES NOT RESPOND — GO TO STEP 5

5

REMOVE GAGE

CHECK FOR BAD CONNECTIONS AT GAGE TERMINALS OR INST. CLUSTER CONNECTOR

GOOD CONNECTIONS — REPLACE GAGE

BAD CONNECTIONS — REPAIR CONNECTIONS & REINSTALL GAGE

6

GAGE READS BETWEEN 1/4 & 1/2 WITH 90 Ω FROM J-24538-A

REMOVE GAGE AND CHECK FOR LOOSE NUTS AT GAGE TERMINALS

NUTS LOOSE — TIGHTEN NUTS & REINSTALL GAGE

NUTS TIGHT — REPLACE GAGE

GAGE IS INACCURATE IN OTHER WAYS — REPLACE GAGE

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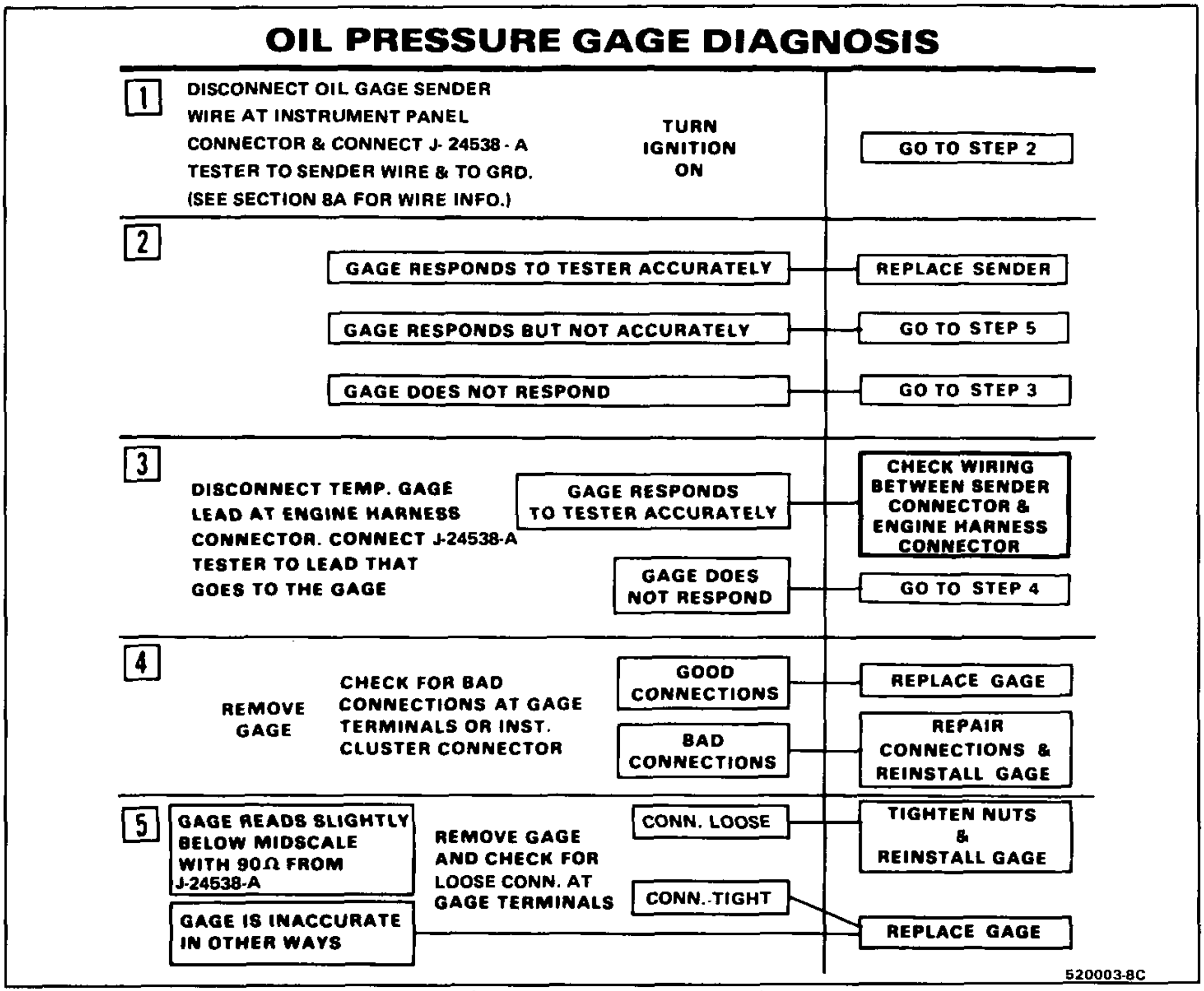


Fig. 3 Oil Pressure Gage Diagnosis

1. Raise drive wheels in a safe manner and close car windows to block outside noise.

2. With the transmission in direct drive, run engine slowly from 0 to 50 MPH and back to 0, noting speed range where noise appears.

3. Disconnect the speedometer cable at the transmission and again run engine through the same speed range.

4. If the noise continues with the speedometer disconnected, units other than the speedometer are at fault and no further speedometer system diagnosis is necessary. If the noise disappears, continue to the speedometer diagnosis chart.

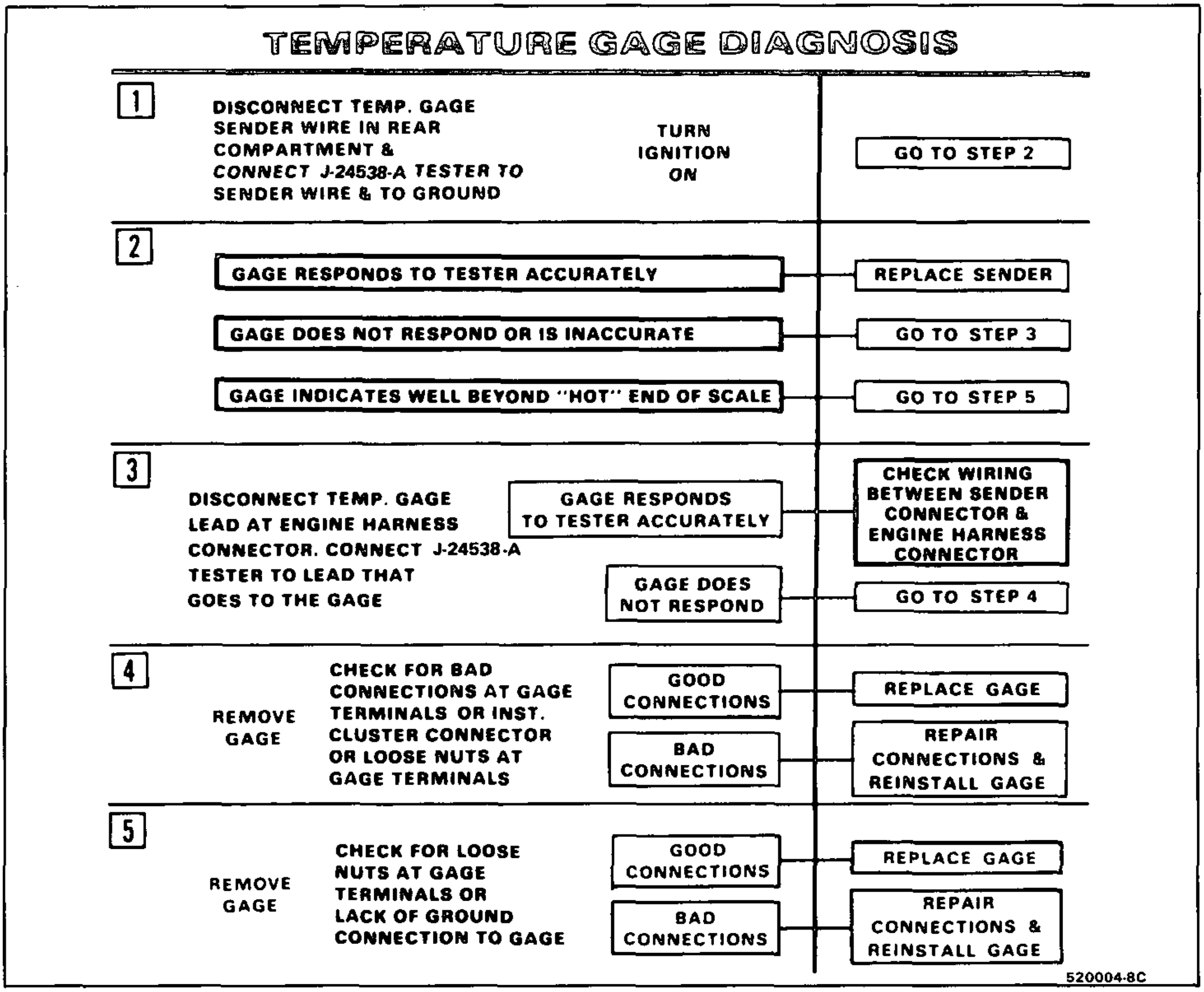


Fig. 4 Temperature Gage Diagnosis

DIAGNOSIS - SPEEDOMETER SYSTEM

RALLY GAGES

Complaint	Possible Cause	Procedure
Noisy	Kinked, pinched or burned casings.	Replace both the cable and casing. Recheck for noise.
"	Bent cable tips.	Replace both the cable and casing. Recheck for noise.
"	Improper or insufficient lubrication of cable.	Lubricate cable core with P/N 6478535 or equivalent. Pack ferrule with grease.
"	Faulty driven gear or rough drive gear.	Remove driven gear assembly from transmission. Check for free rotation of gear in sleeve. Check for burrs, flash or unusual worn spots. If gears appear faulty, re-

Whine	Oversize driven gear stem in transmission binds with adapter.	Replace driven gear and stem.
Buzzing sound with manual transmission.	Shift linkage vibration.	Adjust transmission shift linkage.
Tick or ringing sound with jumpy pointer between 0 and 30 MPH.	Faulty speedometer head.	Remove speedometer head for repair.
Sticky speedometer pointer.	Speedometer pointer is bent and rubs.	Remove speedometer cluster or lens and straighten pointer. Recheck speedometer operation.
Incorrect calibration.	Wrong transmission adapter, driven gear or sleeve.	Check speedometer gear reference for correct application and replace if necessary.
″	Oversize or undersize tires.	Check calibration using correct tire size.
″	Faulty speedometer head.	Remove speedometer for repair.

SERVICE PROCEDURES

SPEEDOMETER

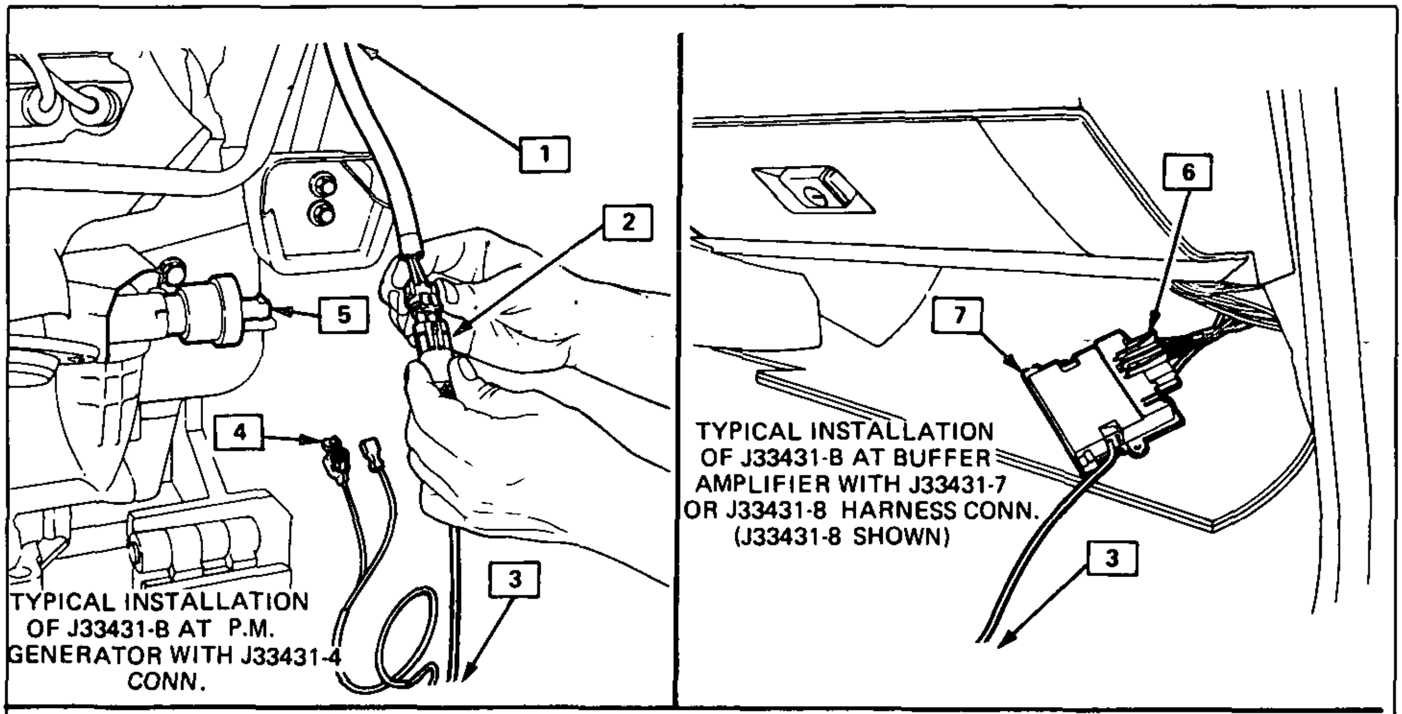
When replacing a speedometer or odometer assembly, the **law requires** the odometer reading of the replacement unit to be set to register the same mileage as the prior odometer. If the same mileage cannot be set, the law requires that the replacement odometer be set to zero and a label be installed on the driver's door frame to show the previous odometer reading and the date of replacement.

VSS TOOL USAGE

Figure 5

SPEEDOMETER CABLE

Speedometer cable connection at speedometer cluster is of quick disconnect design. See On-Car Service for more information.



1—SPEEDOMETER HARNESS(TO BUFFER AMPLIFIER)
2—J33431-4 HARNESS CONN.
3—TO J33431-B I.P. TESTER
4—DO NOT CONNECT FOR SPEEDOMETER TEST
5—P.M. GENERATOR
6—SPEEDOMETER HARNESS
7—J33431-7 OR J33431-8 HARNESS CONN.

Fig. 5 VSS Tool Usage

GENERAL DESCRIPTION

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 specific item information.

QUARTZ ELECTRIC SPEEDOMETER

The quartz electric speedometer and odometer assembly displays the speed of the vehicle, total vehicle mileage, and trip mileage. A conventional dial and pointer assembly, along with odometer wheels, are used to display this information. However, improved drive methods are used in place of the standard drive system, thereby eliminating the need for the conventional speedometer cable.

To provide accurate vehicle information, the [illegible]

signal. The speed signal is used by the circuitry to drive the air core gage and odometer stepper motor. The electrical speed signal is generated by a Permanent Magnet (PM) generator mounted in the transmission. This speed signal is transmitted to the speedometer assembly buffering circuit contained in the instrument cluster circuitry.

TACHOMETER

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 causing 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 [illegible]

problem in the [illegible]

PM GENERATOR SPEED SENSOR

The PM generator is a permanent magnet generator mounted in the transmission and is used to provide vehicle speed data. It is designed to be used with quartz and digital speedometers and will replace the current transmission speedometer drive gear and sleeve. The purpose of the PM generator is to provide a speed signal that is proportional to vehicle speed. This signal is transmitted directly to the speedometer circuitry.

ODOMETER ASSEMBLY

The odometer assembly consists of conventional odometer wheels driven by an electric stepper motor. The stepper motor receives a frequency from the speedometer circuitry. This signal controls the rate at which the motor turns the odometer gears.

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 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.

SPEEDOMETER CIRCUIT BOARD ASSEMBLY

The circuit consists of two custom designed integrated circuit chips, a crystal oscillator, and some discrete electrical components. The basic function of the circuit is to receive an incoming speed signal and output a wave signal to drive the speedometer air core gage mechanism and odometer stepper motor.

INSTRUMENTS

Instruments consist of fuel gage, temperature indicator gage, generator (voltmeter) gage, oil pressure indicator gage, speedometer, 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.

FUEL GAGE

An electrical fuel gage is used, 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.

Gage readings indicated by five graduations on the gage face. The left hand line indicates empty, the centerline half-full and the right line full.

SHIFT INDICATOR LIGHT

Vehicles with manual transmission have an "Upshift" 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 th 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.

ENGINE OIL PRESSURE LIGHT

The engine oil pressure warning light is mounted in the instrument cluster and is controlled by a pressure operated switch located on the side of 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, or there is an open circuit between the bulb and the oil pressure switch or 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.

"CHECK ENGINE" LIGHT

All cars will have a "CHECK ENGINE" light mounted in the instrument cluster. The "CHECK ENGINE" light should come on during engine starting. The light will 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 8A for complete diagnosis and wiring diagrams of the "CHECK ENGINE" light circuit.

① – SPEEDOMETER
ODOMETER
TRIP ODOMETER SWITCH
TRIP ODOMETER RE-SET SWITCH

② – DECK/DOOR AJAR INDICATOR LIGHT
LEFT TURN INDICATOR LIGHT
COOLANT TEMP. LIGHT
HEADLIGHT HI-BEAM INDICATOR LIGHT
BRAKE SYSTEM WARNING LIGHT
COOLANT TEMPERATURE GAGE
FUEL GAGE
SHIFT INDICATOR LIGHT
RIGHT TURN INDICATOR LIGHT
GENERATOR LIGHT
SEAT BELT REMINDER LIGHT
SERVICE ENGINE SOON REMINDER LIGHT

③ – TACHOMETER
OIL PRESSURE GAGE

④ – OIL PRESSURE GAGE
VOLTMETER

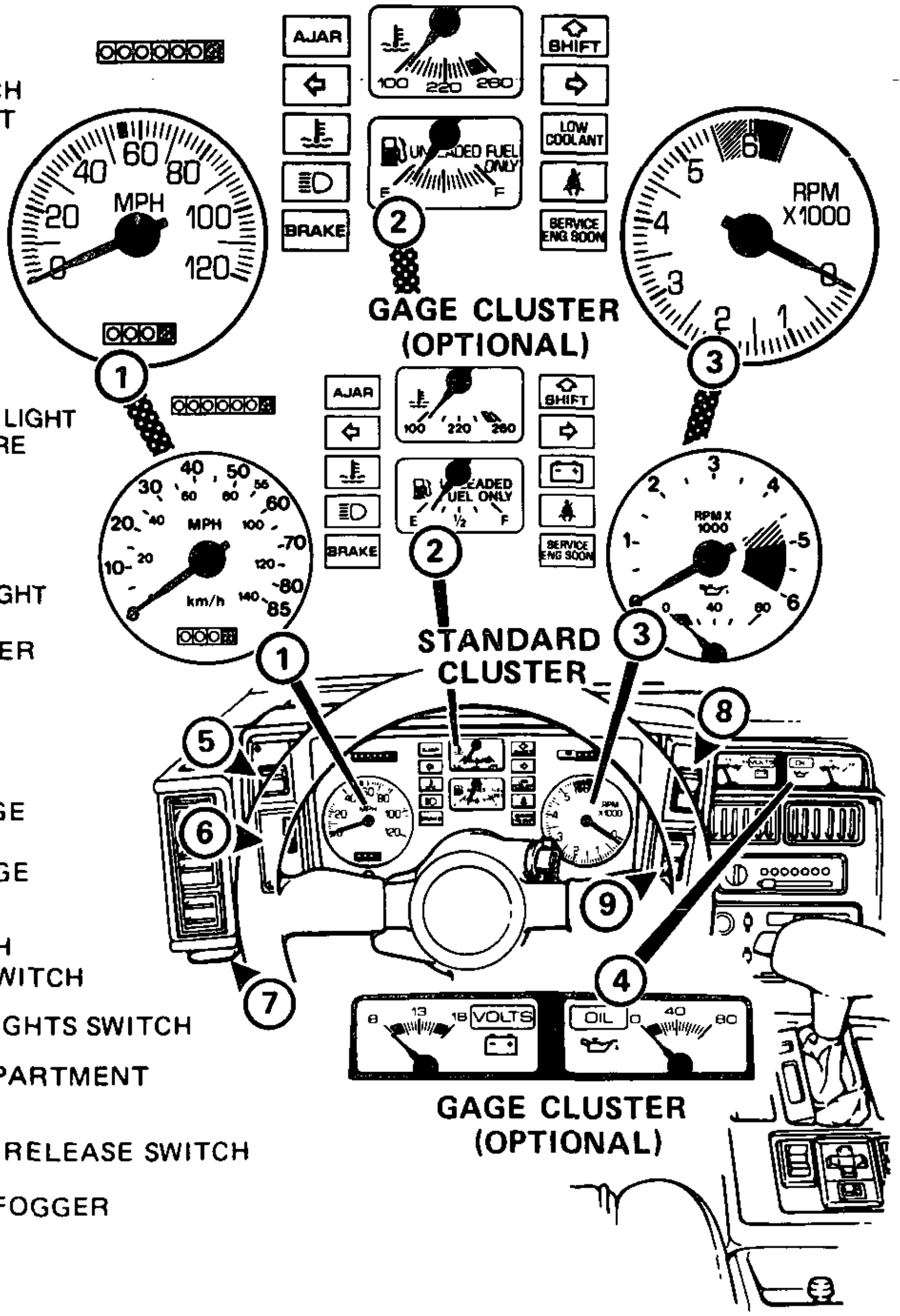
⑤ – HEADLIGHT SWITCH
PARKING LIGHTS SWITCH

⑥ – INSTRUMENT PANEL LIGHTS SWITCH

⑦ – INSIDE FRONT COMPARTMENT LID (HOOD) RELEASE

⑧ – ELECTRIC TRUNK RELEASE SWITCH

⑨ – REAR WINDOW DEFOGGER



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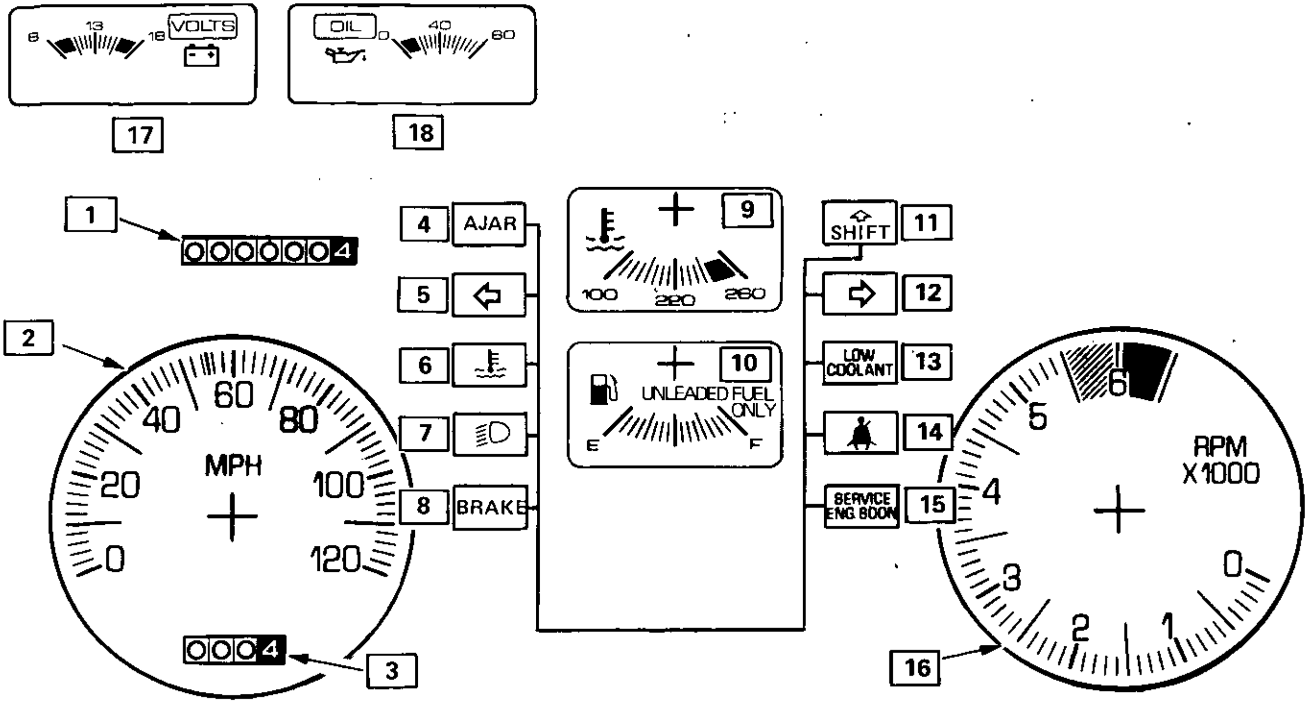

1–ODOMETER
2–SPEEDOMETER
3–TRIP ODOMETER
4–DECK LID AJAR INDICATOR LIGHT
5–LEFT TURN INDICATOR LIGHT
6–TEMPERATURE CHECK LIGHT
7–HIGH BEAM INDICATOR LIGHT
8–BRAKE SYSTEM WARNING LIGHT
9–COOLANT TEMPERATURE GAGE
10–FUEL GAGE
11–SHIFT INDICATOR (MANUAL TRANS ONLY)
12–RIGHT TURN INDICATOR LIGHT
13–CHECK COOLANT LIGHT
14–SEAT BELT REMINDER LIGHT
15–CHECK ENGINE LIGHT
16–TACHOMETER
17–VOLT GAGE
18–OIL PRESSURE GAGE

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Fig. 7 Instrumentation

DIAGNOSIS

TOOLS REQUIRED

J-33431 Signal generator or

Digital multimeter

Diagnostic information for all instrument panel electrical systems is found in Section 8A. Refer to Section 8A for wiring colors when connecting test lights and test instruments. Additional information to diagnose fuel gage, oil pressure gage and temperature gage irregularities are also contained in Figs. 10 through 12.

TACHOMETER DIAGNOSIS, W/SIGNAL GENERATOR

Install the signal generator (J-33431) into the tach terminal at the ignition coil. Set the signal generator to 60 Hz frequency signal, the tachometer should read 1800 RPM. If not, check the wiring, see Section 8A. If it is the tachometer, replace with a new unit or have serviced at specified Service Center.

FUEL GAGE DIAGNOSIS

Wiring harness to fuel sender on EFI equipped cars will have three (3) wires. The tan wire supplies 12 volts to the integral electric fuel pump. Care should be taken to **not** contact the tan wire connector during diagnosis with test jumpers or test instrument leads. 12 volts could damage the fuel sender or gage tester.

ELECTRIC SPEEDOMETER DIAGNOSIS
WITH TOOL: (SPEEDOMETER SIGNAL GENERATOR)

1.	VISUALLY EXAMINE THE TRANSMISSION SENSOR (PM GENERATOR) CONNECTOR TO INSURE THAT IT IS NOT LOOSE, CORRODED, BROKEN, OR OTHERWISE DEFECTIVE.	OK ~~OK~~	GO TO STEP 3. GO TO STEP 2.
2.	REPLACE, CLEAN, OR TIGHTEN CONNECTOR AS REQUIRED.		RECHECK FOR OPERATIVE SPEEDOMETER AND ODOMETER MODULES.
3.	DISCONNECT THE SPEEDOMETER SENSOR HARNESS AT THE PM GENERATOR. CONNECT THE SPEEDOMETER HARNESS TO THE SIGNAL GENERATOR SENSOR CONNECTOR AND TURN TESTER ON. CHECK THAT THE SPEEDOMETER READS 54 ± 2 MPH.	OK ~~OK~~	GO TO STEP 4. GO TO STEP 5.
4.	REPLACE PM GENERATOR.		RECHECK FOR OPERATIVE SPEEDOMETER AND ODOMETER MODULES.
5.	REMOVE CLUSTER FROM VEHICLE AND VISUALLY CHECK HARNESS AND CLUSTER PRINTED CIRCUIT FOR DISCONTINUITY IN WIRING.	OK ~~OK~~	GO TO STEP 7. GO TO STEP 6.
6.	REPLACE WIRING OR PRINTED CIRCUIT AS REQUIRED.		RECHECK FOR OPERATIVE SPEEDOMETER AND ODOMETER MODULES.
7.	CONNECT SIGNAL GENERATOR TO SPEEDOMETER EDGEBOARD CONNECTOR AND TURN TESTER ON.		GO TO STEP 8.
8.	SPEEDOMETER READS 54 ± 2 MPH AND ODOMETER TURNS.		GO TO STEP 9.
	SPEEDOMETER DOES NOT READ 54 ± 2 MPH AND ODOMETER DOES NOT TURN.		GO TO STEP 10.
	SPEEDOMETER DOES NOT READ 54 ± MPH BUT ODOMETER TURNS.		GO TO STEP 10.
	SPEEDOMETER READS 54 ± 2 MPH ODOMETER DOES NOT TURN.		GO TO STEP 12.
9.	CHECK CONNECTION BETWEEN CLUSTER AND WIRING HARNESS.		REPLACE WIRING HARNESS AS REQUIRED.
10.	DISASSEMBLE CLUSTER AND CHECK GAGE PER FIGURE 8C-4.		GO TO STEP 11.
11.	GAGE FUNCTIONS ACCORDING TO FIGURE 8C-4.		GO TO STEP 12 FOR ODOMETER DIAGNOSIS.
	GAGE DOES NOT FUNCTION ACCORDING TO FIGURE 8C-4.		OBTAIN REPLACEMENT SPEEDOMETER ASSEMBLY.
12.	CHECK FOR LOOSE WIRING CONNECTION BETWEEN ODOMETER MOTOR TERMINALS AND CIRCUIT BOARD.		IF CONNECTION IS NOT LOOSE OR BROKEN, GO TO STEP 13 OTHERWISE REPLACE ODOMETER MOTOR TO OBTAIN EXCHANGE CIRCUIT BOARD ASSEMBLY AS REQUIRED.
13.	CONNECT SIGNAL GENERATOR ODOMETER CONNECTOR TO ODOMETER MOTOR LEAD AND TURN TESTER ON.		GO TO STEP 14.
14.	ODOMETER MOTOR WORKS.		OBTAIN EXCHANGE CIRCUIT BOARD ASSEMBLY.
	ODOMETER MOTOR DOES NOT WORK.		REPLACE ODOMETER MOTOR AND RECONNECT MOTOR TO CIRCUIT BOARD ASSEMBLY.

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STEP 1

Apply approximately twelve (12) volts between terminals 4-1 (terminal 4 negative). Note position of pointer.

STEP 2

Keeping the voltage applied per Step 1 apply 12 volts between terminals 2-3 (terminal 2 negative). Pointer should rotate clockwise approximately 45°

STEP 3

Remove 12 volts between terminals 1-4. Pointer should rotate clockwise an additional 45° (90° from Step 1 position).

If gage assembly does not meet any of the above tests, replace with a new gage assembly.

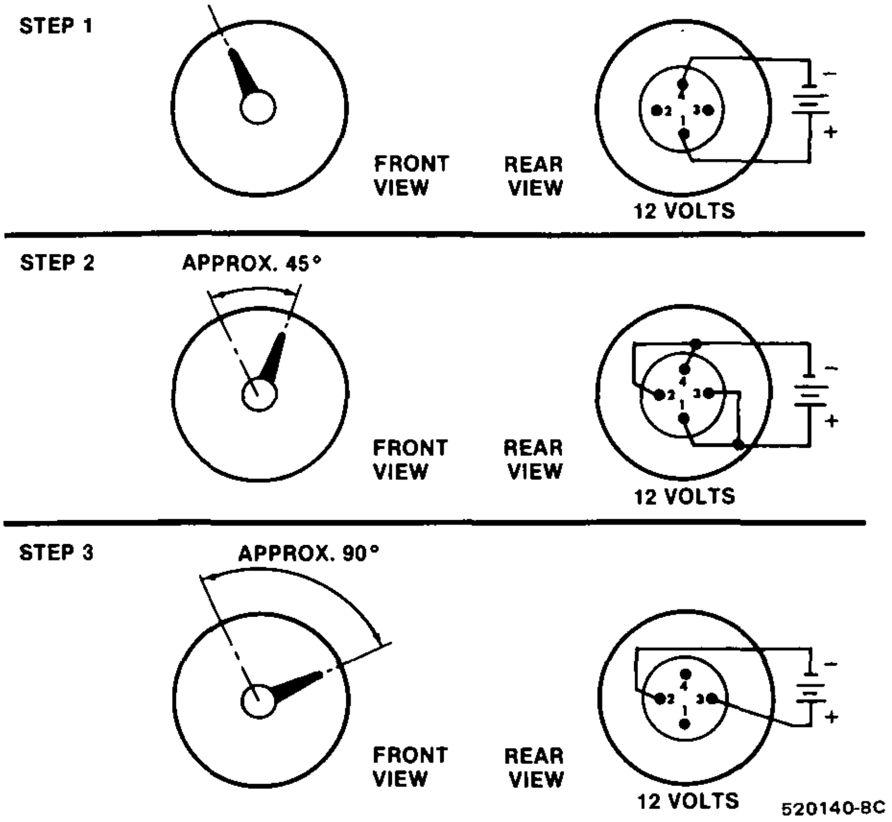
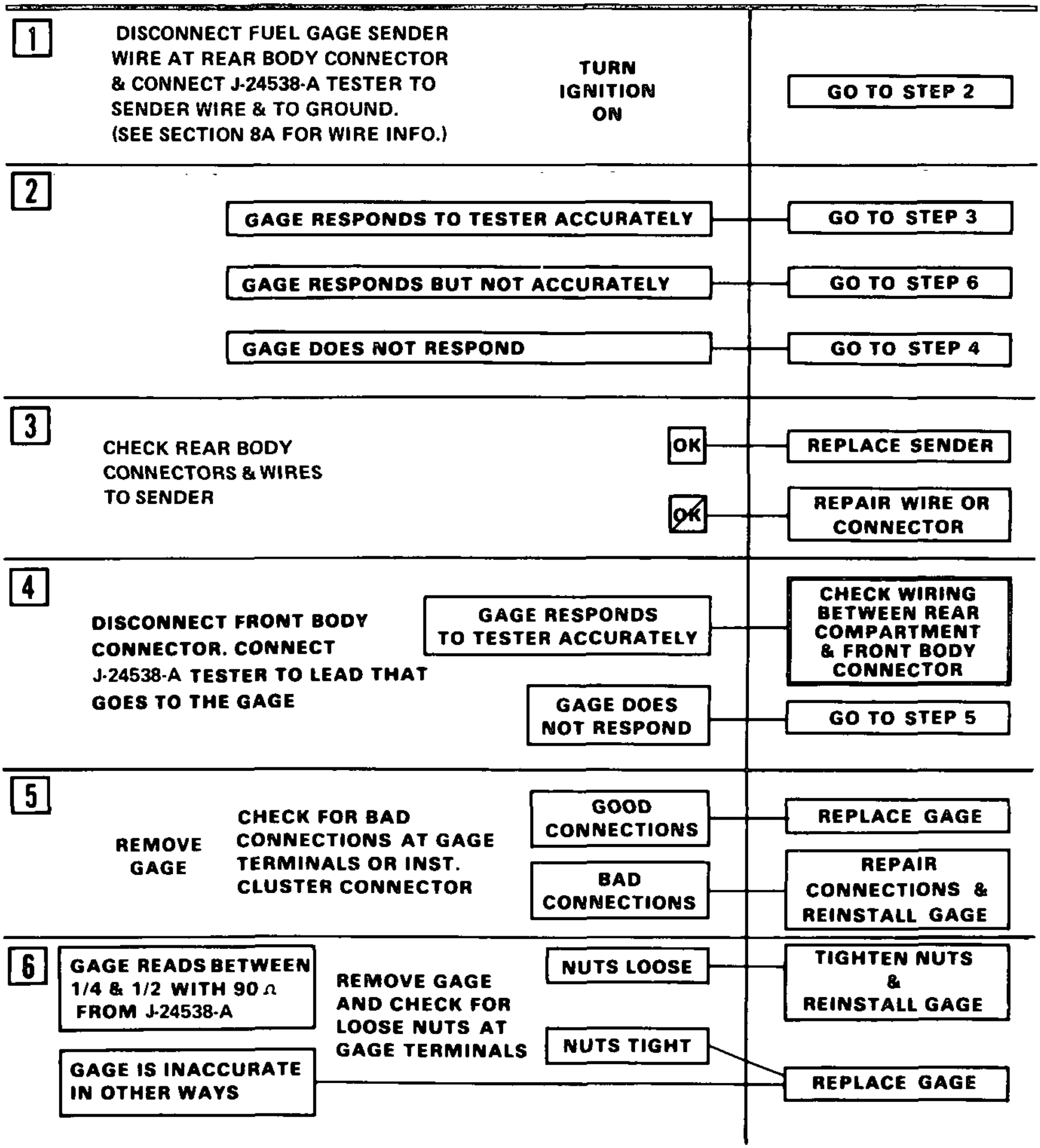


Fig. 9 Speedometer Diagnosis without Speedometer Signal Generator

FUEL GAGE DIAGNOSIS



1 DISCONNECT FUEL GAGE SENDER WIRE AT REAR BODY CONNECTOR & CONNECT J-24538-A TESTER TO SENDER WIRE & TO GROUND. (SEE SECTION 8A FOR WIRE INFO.)
TURN IGNITION ON → GO TO STEP 2

2
GAGE RESPONDS TO TESTER ACCURATELY → GO TO STEP 3
GAGE RESPONDS BUT NOT ACCURATELY → GO TO STEP 6
GAGE DOES NOT RESPOND → GO TO STEP 4

3 CHECK REAR BODY CONNECTORS & WIRES TO SENDER
OK → REPLACE SENDER
~~OK~~ → REPAIR WIRE OR CONNECTOR

4 DISCONNECT FRONT BODY CONNECTOR. CONNECT J-24538-A TESTER TO LEAD THAT GOES TO THE GAGE
GAGE RESPONDS TO TESTER ACCURATELY → CHECK WIRING BETWEEN REAR COMPARTMENT & FRONT BODY CONNECTOR
GAGE DOES NOT RESPOND → GO TO STEP 5

5 REMOVE GAGE
CHECK FOR BAD CONNECTIONS AT GAGE TERMINALS OR INST. CLUSTER CONNECTOR
GOOD CONNECTIONS → REPLACE GAGE
BAD CONNECTIONS → REPAIR CONNECTIONS & REINSTALL GAGE

6 GAGE READS BETWEEN 1/4 & 1/2 WITH 90 Ω FROM J-24538-A
REMOVE GAGE AND CHECK FOR LOOSE NUTS AT GAGE TERMINALS
NUTS LOOSE → TIGHTEN NUTS & REINSTALL GAGE
NUTS TIGHT → REPLACE GAGE
GAGE IS INACCURATE IN OTHER WAYS → REPLACE GAGE

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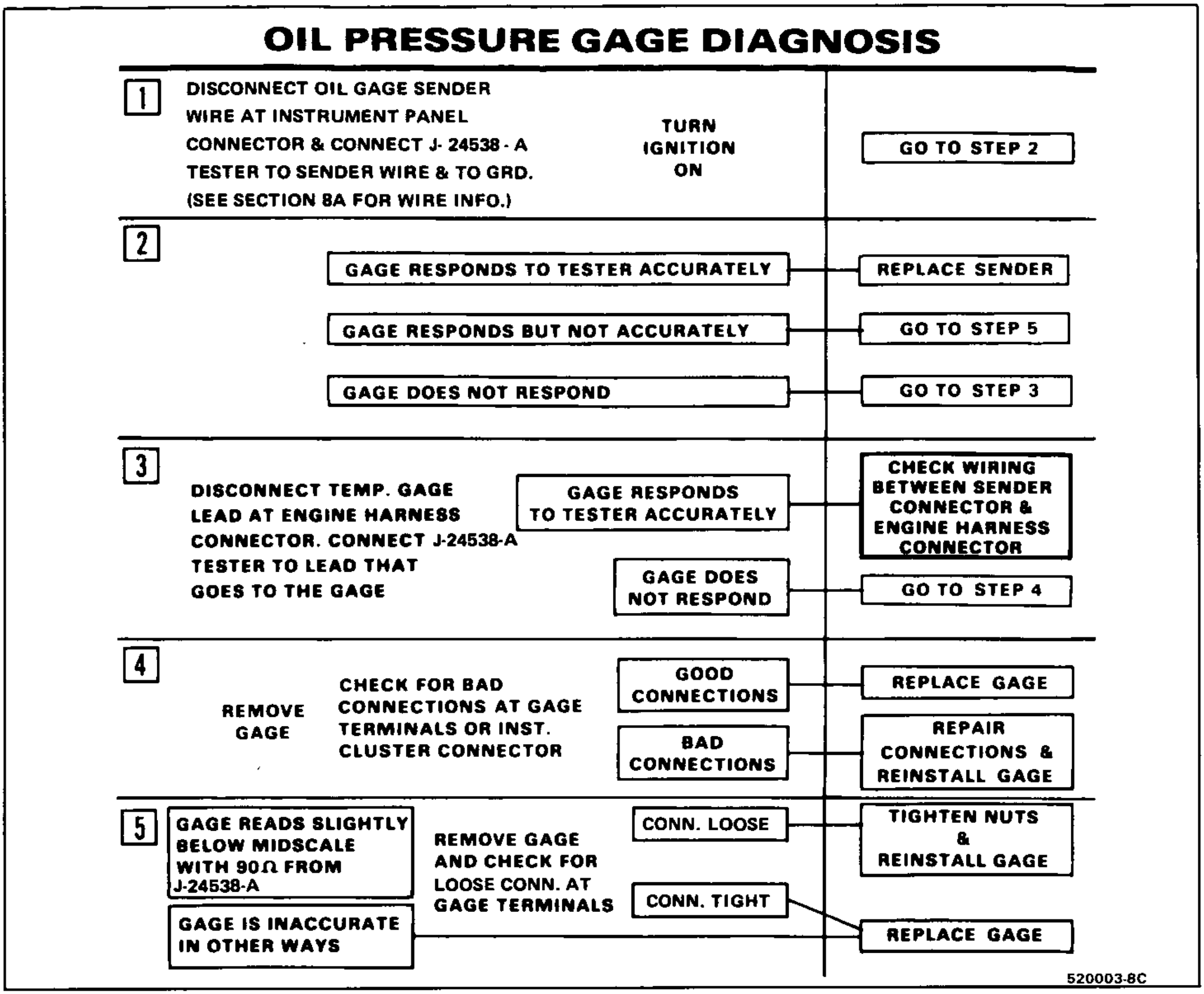
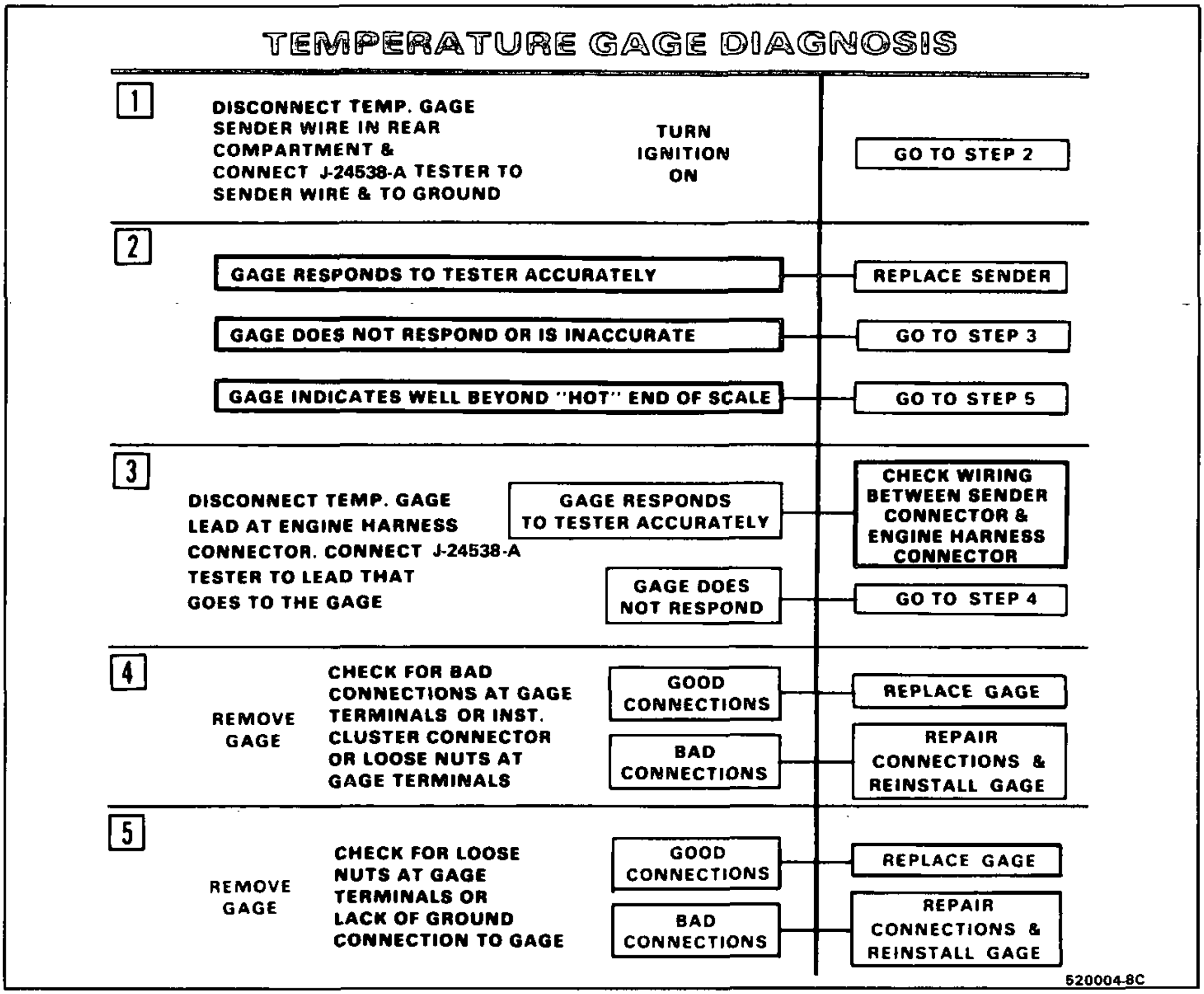


Fig. 11 Oil Pressure Gage Diagnosis



TEMPERATURE GAGE DIAGNOSIS

1 DISCONNECT TEMP. GAGE SENDER WIRE IN REAR COMPARTMENT & CONNECT J-24538-A TESTER TO SENDER WIRE & TO GROUND — TURN IGNITION ON — GO TO STEP 2

2 GAGE RESPONDS TO TESTER ACCURATELY — REPLACE SENDER

GAGE DOES NOT RESPOND OR IS INACCURATE — GO TO STEP 3

GAGE INDICATES WELL BEYOND "HOT" END OF SCALE — GO TO STEP 5

3 DISCONNECT TEMP. GAGE LEAD AT ENGINE HARNESS CONNECTOR. CONNECT J-24538-A TESTER TO LEAD THAT GOES TO THE GAGE

GAGE RESPONDS TO TESTER ACCURATELY — CHECK WIRING BETWEEN SENDER CONNECTOR & ENGINE HARNESS CONNECTOR

GAGE DOES NOT RESPOND — GO TO STEP 4

4 REMOVE GAGE — CHECK FOR BAD CONNECTIONS AT GAGE TERMINALS OR INST. CLUSTER CONNECTOR OR LOOSE NUTS AT GAGE TERMINALS

GOOD CONNECTIONS — REPLACE GAGE

BAD CONNECTIONS — REPAIR CONNECTIONS & REINSTALL GAGE

5 REMOVE GAGE — CHECK FOR LOOSE NUTS AT GAGE TERMINALS OR LACK OF GROUND CONNECTION TO GAGE

GOOD CONNECTIONS — REPLACE GAGE

BAD CONNECTIONS — REPAIR CONNECTIONS & REINSTALL GAGE

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Fig. 12 Temperature Gage Diagnosis

SERVICE PROCEDURES

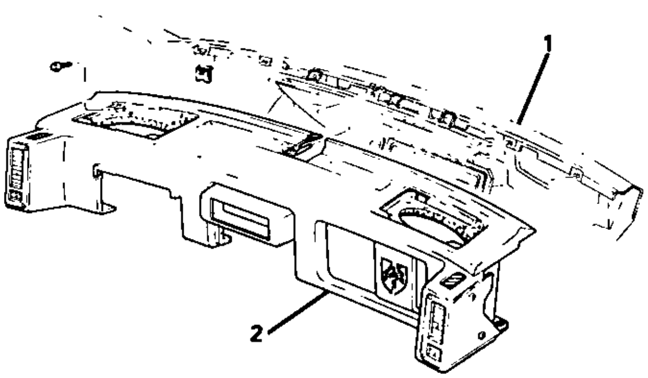
INSTRUMENT PANEL WIRE HARNESS

Instrument panel wire harness removal procedures are in Section 8B.

INSTRUMENT PANEL PAD ASSEMBLY

↔ Remove or Disconnect

1. Hood release.
2. Steering column cover.
3. Speaker grills and speakers.
4. I/P attaching screws.
5. I/P service cover.
6. Loosen shift trim plate (Fig. 14).
7. Front console trim plate.
8. Front console pad asm.



1 — VENT DUCT PANEL

2 — INSTRUMENT PANEL PAD

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Install or Connect

1. I/P pad asm. and reinforcement screws.
2. Front console pad and trim plate.
3. Shifter trim plate.
4. I/P service cover.
5. I/P attaching screws.
6. Speakers and grilles.
7. Steering column cover.
8. Hood release.

SHIFT PLATE ASSEMBLY

Remove or Disconnect

1. Shift knob.
2. Ash trays.
3. Attaching bolts (4).
4. Shift plate.

Install or Connect

1. Shift plate and attaching bolts.
2. Shift knob.
3. Ash trays.

DOOR WINDOW SWITCH

Remove or Disconnect

1. Trim plate and attaching screws (3).
2. Harness to switches.
3. Switch retaining screws to trim plate.
4. Door window switches.

Install or Connect

1. New switches and retaining screws.
2. Harness to switches.
3. Trim plate and attaching screws.

ELECTRIC MIRROR SWITCH

- Follow "Door Window Switch" Procedures.

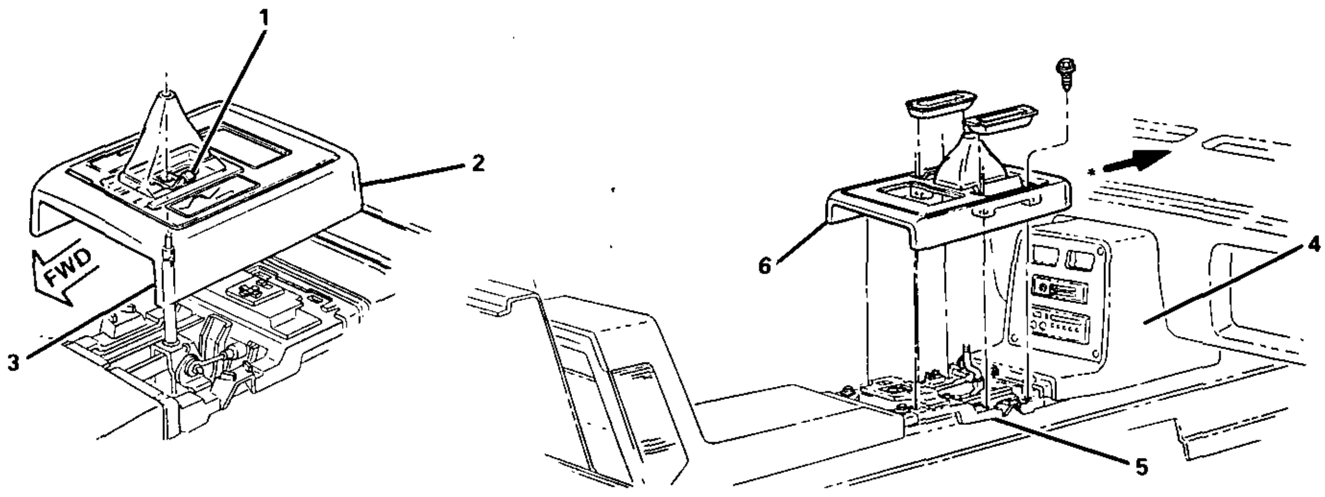
CONSOLE PAD ASSEMBLY - FRONT

Remove or Disconnect

1. Shifter knob.
2. Shifter trim plate.
3. Front trim plate.
4. Front pad attaching screws.
5. Front pad asm.

Install or Connect

1. Front pad and attaching screws.
2. Front trim plate.
3. Shifter trim plate.
4. Shifter knob.



1 — INDICATOR (AUTO. ONLY)
2 — SHIFT PLATE ASM. (AUTO.)
3 — SHIFT LEVER
4 — FRONT PAD ASM.
5 — SUPPORT ASM.
6 — SHIFT PLATE ASM. (MANUAL)

*PRESS PLATE ASM. TIGHT AGAINST FRONT PAD ASM. IN DIRECTION OF ARROW, BEFORE TIGHTENING BOLT/SCREWS

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Fig. 14 Trans. Shift Plate Assembly

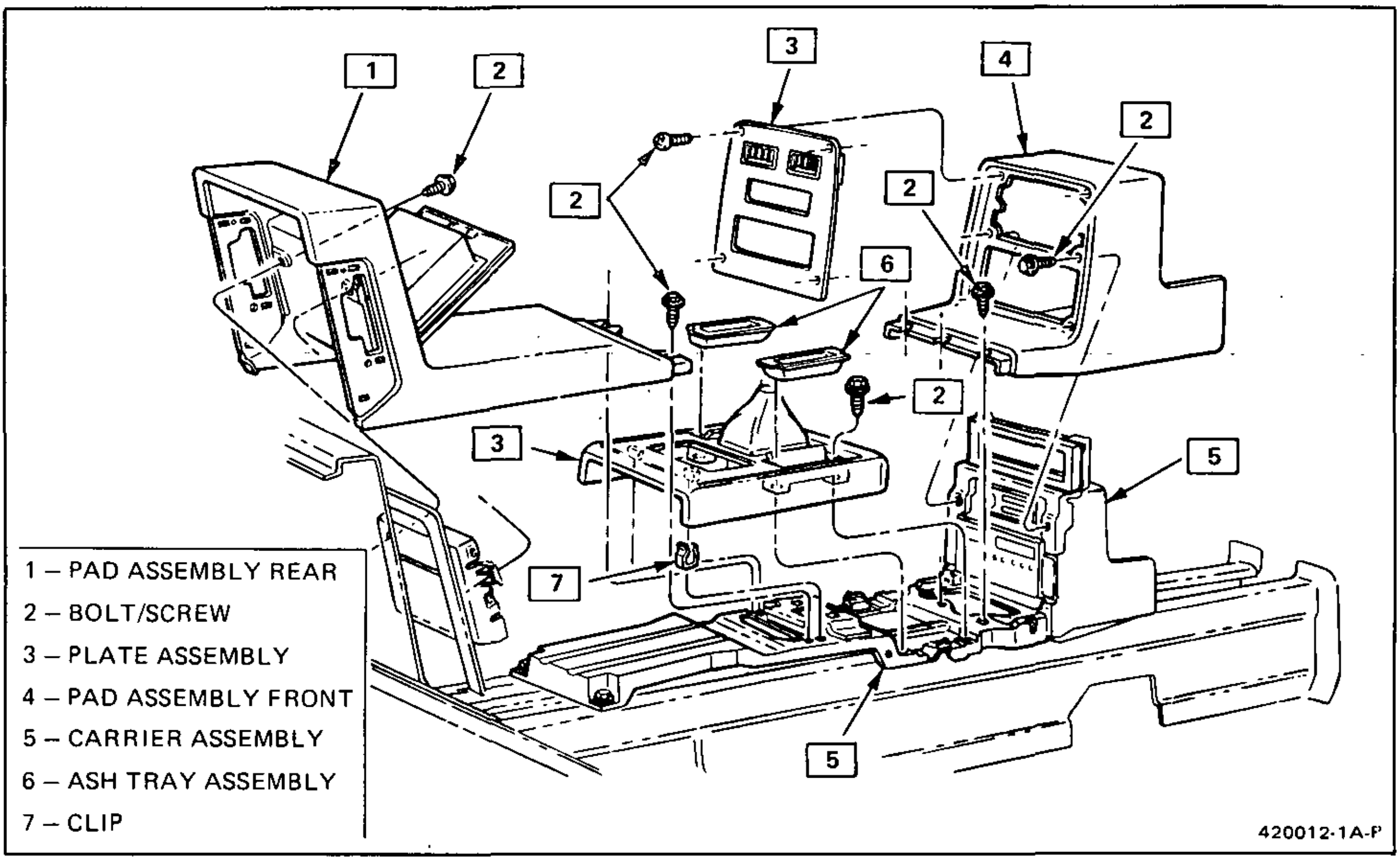


Fig. 15 Console Pad Assembly

CONSOLE PAD ASSEMBLY - REAR

Remove or Disconnect

1. Shifter trim plate and move out of way.
2. Rear pad attaching screws.
3. Cigar lighter.
4. Rear pad asm.

Install or Connect

1. Cigar lighter.
2. Rear pad and attaching screws.
3. Shifter trim plate.

CONSOLE SUPPORT ASSEMBLY

Remove or Disconnect

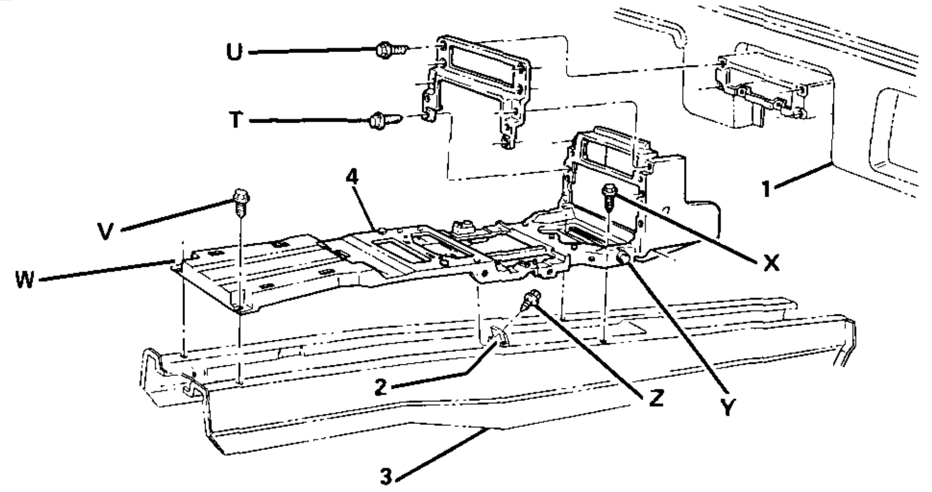
1. Shift knob.
2. Shifter trim plate.
3. Power window and mirror switches.
4. Park lock cable.
5. Shift cable.
6. Front trim plate.
7. Front pad asm.
8. Rear pad asm.
9. Carpet clips (12).
10. Carpet supports.
11. Diagnostic connection.
12. Front reinforcement.
13. Mounting screws (2) on sides of support asm.
14. Heater control.
15. Radio.
16. Console support asm.

Install or Connect

1. Console support asm. (loose).
2. Radio.
3. Heater control.
4. Console side mounting screws (2).
5. Front reinforcement.
6. Carpet support and clips.
7. Diagnostic connection.
8. Shift cable.
9. Park lock cable.
10. Rear pad asm.
11. Power window and mirror switches and trim plate.
12. Front pad asm.
13. Front trim plate.
14. Shifter trim plate.
15. Shifter knob.

Inspect

- For rattles.
- For correct shifting and park lock



1 — I/P ASM.
2 — SHIFTER BKT.
3 — UPR. FLR. PAN
4 — CONSOLE SUPPORT ASM.
T — THESE BOLT/SCREWS TO BE INSTALLED FIRST
U — THESE BOLT/SCREWS TO BE INSTALLED SECOND
V — THIS BOLT/SCREW TO BE INSTALLED THIRD
W — THIS BOLT/SCREW TO BE INSTALLED FOURTH
X — THESE BOLT/SCREWS TO BE INSTALLED FIFTH
Y — THESE BOLT/SCREWS TO BE INSTALLED SIXTH
Z — THIS BOLT/SCREW TO BE INSTALLED LAST

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Fig. 16 Console Support Assembly

INSTRUMENT PANEL CLUSTER

Remove or Disconnect

1. Negative battery cable.
2. Rear cluster cover.
3. Front trim plate.
4. Steering column cover.
5. Cluster attachment screws.
6. Wiring harness connections.
7. Cluster asm.

Install or Connect

1. Harness connections.
2. Cluster asm and attachment screws.
3. Rear cluster cover.
4. Front trim plate.
5. Steering column cover.
6. Negative battery cable.

NOTICE: The speedometer, tach, and gauges may be serviced by removing the front cluster lens. The speedometer and tach must be serviced by a Specified Service Center.

CLUSTER HOUSING ASSEMBLY

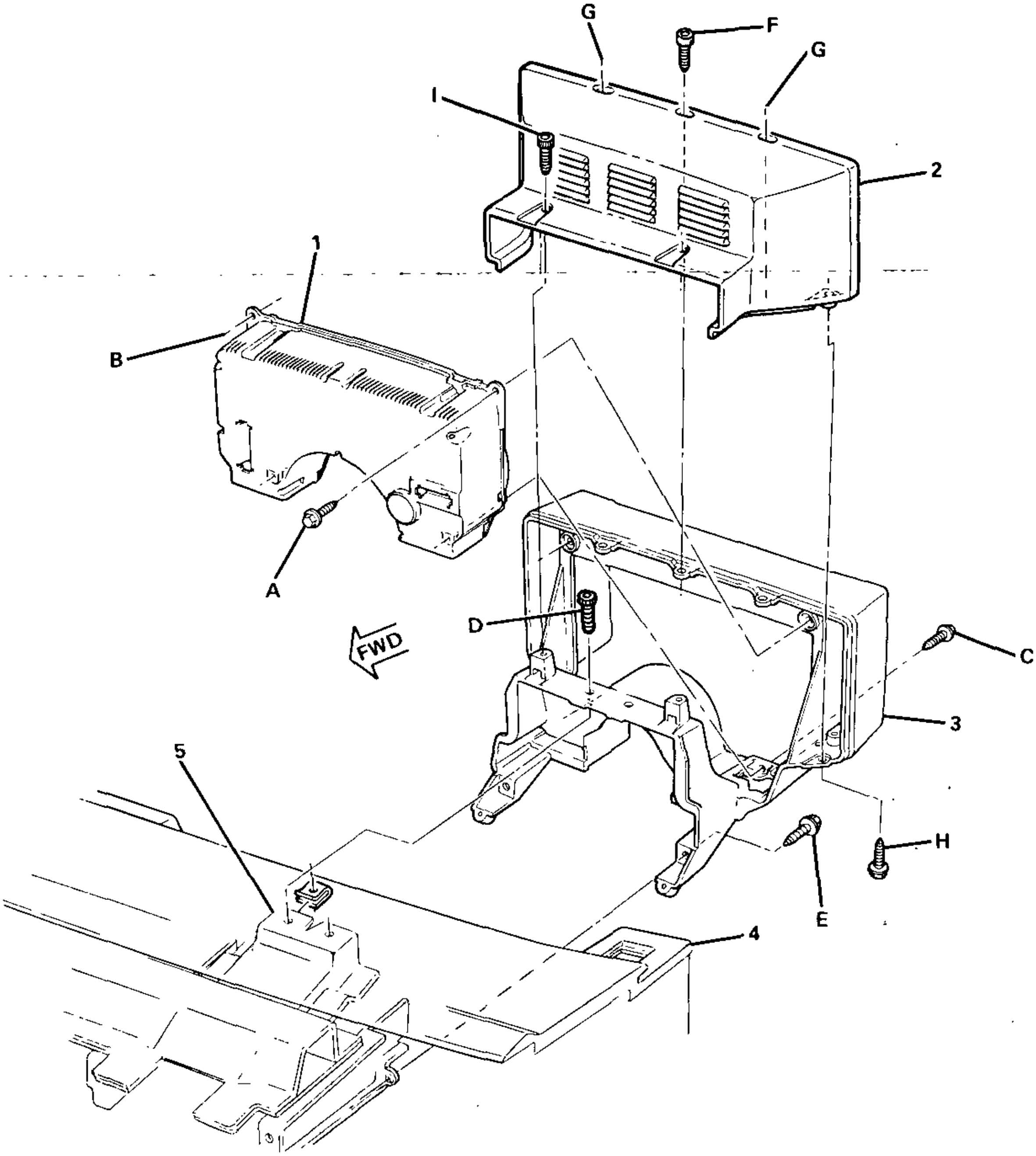
Remove or Disconnect

- Follow I/P cluster procedures.

1. Headlamp switch trim plate.
2. Headlamp and dimmer switches.
3. Rear defogger and deck lid trim plate and switches (if equipped).
4. Housing asm.

Install or Connect

1. Housing asm.
2. Headlamp, dimmer and switches as required.
3. Follow I/P cluster procedures.



1 — CLUSTER ASM.
2 — REAR CLUSTER COVER
3 — CLUSTER HOUSING ASM.
4 — I P
5 — STEERING COL. SUPT.

A — INSTALL THIS BOLT SCREW FIRST
B — INSTALL THIS BOLT SCREW SECOND
C — INSTALL THIS BOLT/SCREWS THIRD
D — INSTALL THIS BOLT/SCREWS FOURTH
E — INSTALL THIS BOLT/SCREW FIFTH
F — INSTALL THIS BOLT/SCREW SIXTH
G — INSTALL THIS BOLT/SCREWS SEVENTH
H — INSTALL THIS BOLT/SCREWS EIGHTH
I — INSTALL THESE BOLT/SCREWS LAST

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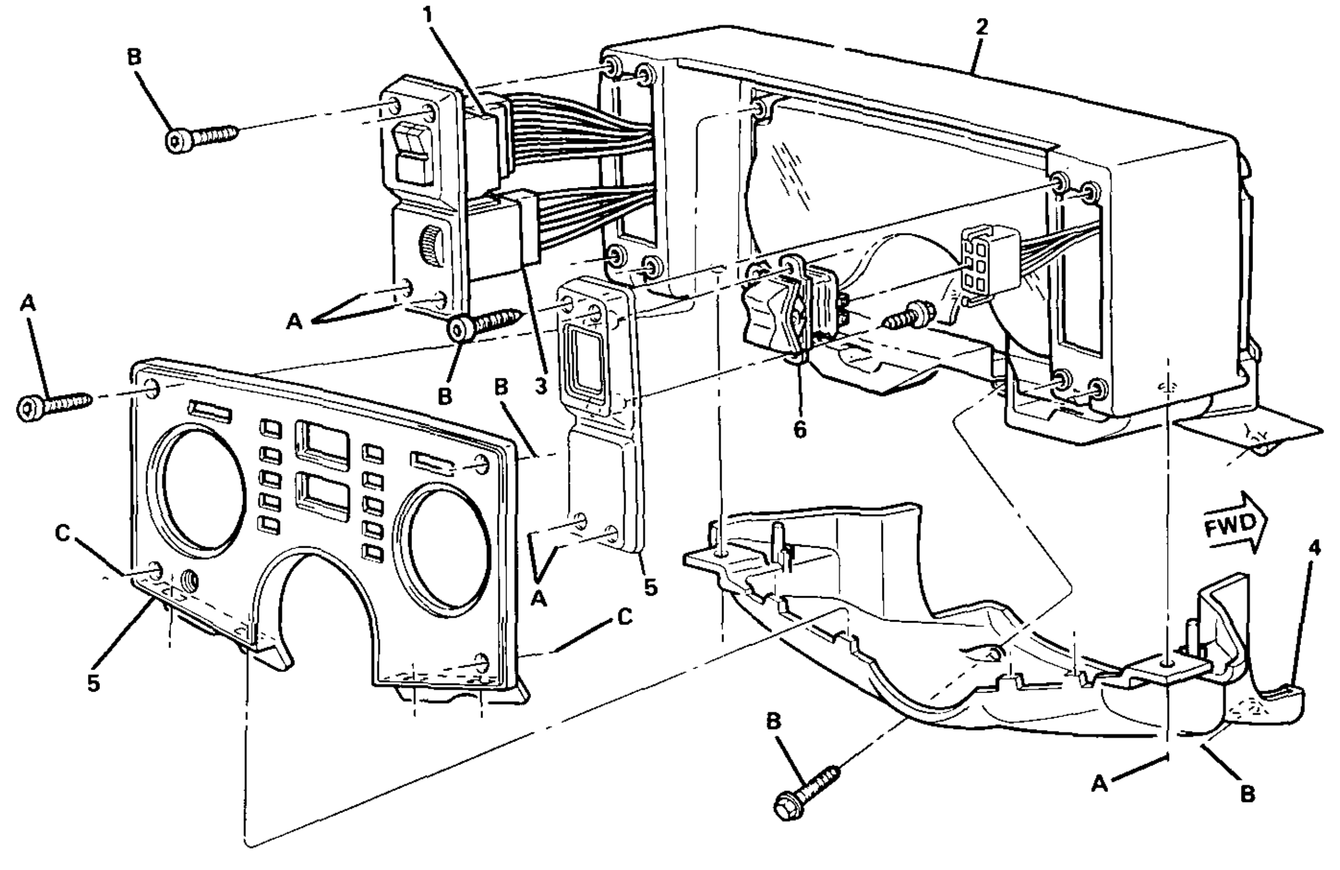

1 — HEADLAMP SWITCH
2 — CLUSTER PAD ASM.
3 — DIMMER SWITCH
4 — COVER ASM.
5 — TRIM PLATE
6 — DECK LID SWITCH

A — INSTALL THESE BOLT/SCREWS FIRST
B — INSTALL THESE BOLT/SCREWS SECOND
C — INSTALL THESE BOLT/SCREWS LAST

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Fig. 18 I/P Cluster Trim Plates

SECTION 8E2

PM POSITIVE PARK PULSE WIPER WASHER NON-DEPRESSED PARK SYSTEM

CONTENTS

GENERAL DESCRIPTION

PERMANENT MAGNET PULSE WINDSHIELD WIPER MOTOR

The two-speed wiper non-depressed park system is a permanent magnet (PM) positive park wiper with a dynamic brake and a separate washer pump assembly.

The pulse windshield wiper and washer system (Figures 8E2-1 and 8E2-2) consists of a permanent magnet positive park pulse wiper, a washer pump mounted under the washer bottle and a turn signal type wiper/washer switch.

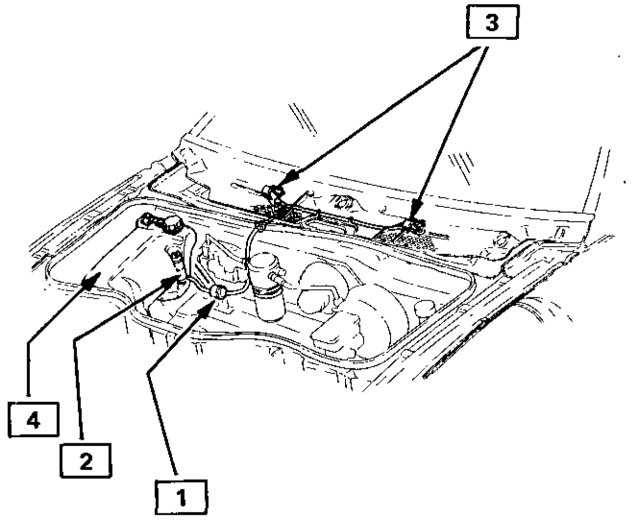
The pulse and demand wash functions are controlled by a plug-in printed circuit board enclosed in the wiper's die-cast aluminum housing cover.

WIPER MOTOR

Internal parts of the wiper motor assembly, field magnet, armature, drive gear, park switch actuator and brush holding assembly are enclosed in an aluminum die-cast housing with a plastic cover. The housing and cover are attached to each other by seven rivets. A radio frequency interference suppressor is located in the terminal connector on the wiper motor. A strap attached to one of the motor bolt hole grommets provides a ground for the suppressor. An automatic reset type circuit breaker located on the motor brush holder assembly protects the motor. A fuse in the fuse block protects the vehicle wiring.

Referring to Figure 8E2-3, note that there are four terminals which are lettered for illustrative purposes. The function of each terminal is covered in the explanation that follows.

Use care when disconnecting the lock-type connectors that attach vehicle wiring to the wiper.



1–CHECK VALVE
2–PUMP
3–NOZZLE
4–CONTAINER

Figure 8E2-1 W/S Wiper Washer System Components

As shown in Figure 8E2-3, the wiper motor has three brushes: common, low speed and high speed. When the ignition switch is ON, 12V plus circuit is applied to both the low and high speed fixed contacts in the multi-function lever. The low and high speed brushes are connected to the multi-function lever

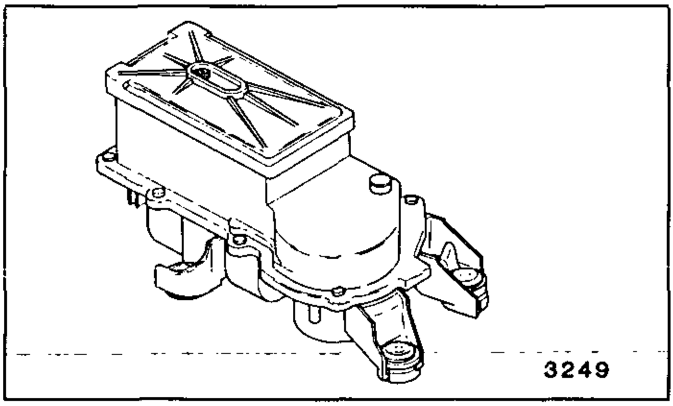


Figure 8E2-2 Permanent Magnet Pulse Windshield Wiper Motor

through terminals C and D. The armature is grounded through the common brush via the ground strap.

FLUIDIC WASHER NOZZLE

(Figure 8E2-4)

The system consists of a fluid container, pump, fluidic hose and nozzle.

The fluidic washer system is controlled by a small plastic element designed into the washer nozzle. As water is forced through this insert, the design of the mechanism creates an oscillating power stream. This fluidic washer system produces larger, more widely dispersed droplets, resulting in a more efficient cleaning action.

A correctly operating wiper-washer system has a spray pattern that cleans 75% of the wipe pattern 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. Pump and wiper motor service remain unchanged. Shim provisions have not been provided for the rear fluidic washer nozzles.

WIPER AND WASHER OPERATION

The wiper and washer operation is explained in Figure 8E2-5. The electronic printed circuit board controls all the timing and washer commands. When the wash button is pushed for more than 0.3 seconds, a demand wash is performed in 1.5 second intervals for as long as the button is held followed by approximately 6 seconds of dry wipes and a shut off.

Rotating the switch to either the LOW or HIGH speed position completes the respective circuit and the wiper motor runs at that speed.

Rotating the switch to the pulse mode operates the motor intermittently and the delay can be varied by rotating the switch.

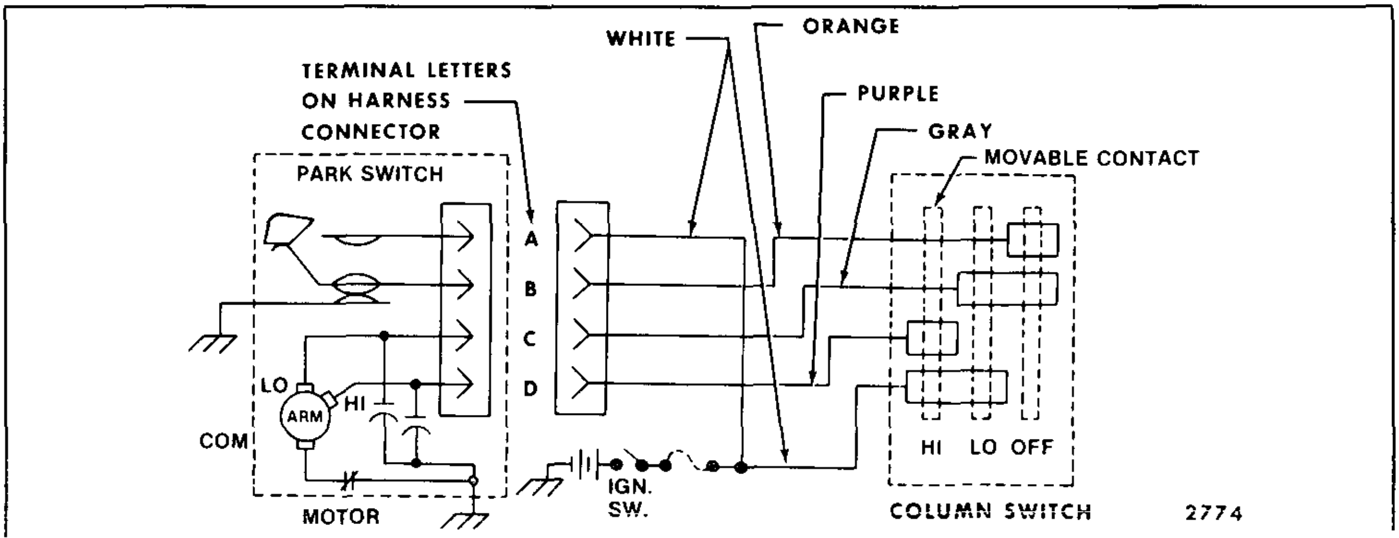
An instantaneous wipe can be obtained by rotating the switch to the mist position and a continuous wipe will be performed if the button is held. A circuit diagram of the wiper is shown in Figure 8E2-6.

LOW AND HIGH SPEED CIRCUITS

Moving the multi-function lever to the low or high speed position completes the respective brush circuit to (+) 12 volts DC at the multi-function lever and the wiper motor runs at that speed.

SHUTTING THE WIPER OFF

When the wiper is turned off at the multi-function lever, in order to have the blades stop in their normal park position and the wiper motor shut off properly, the motor operates in low speed. This is accomplished as follows: with the multi-function lever in the off position, the low speed brush circuit is completed to (+) 12 volts DC at the multi-function lever through a park switch located on the brush assembly (terminals A and B). The park switch contacts are normally closed and this permits the wiper to continue to run.



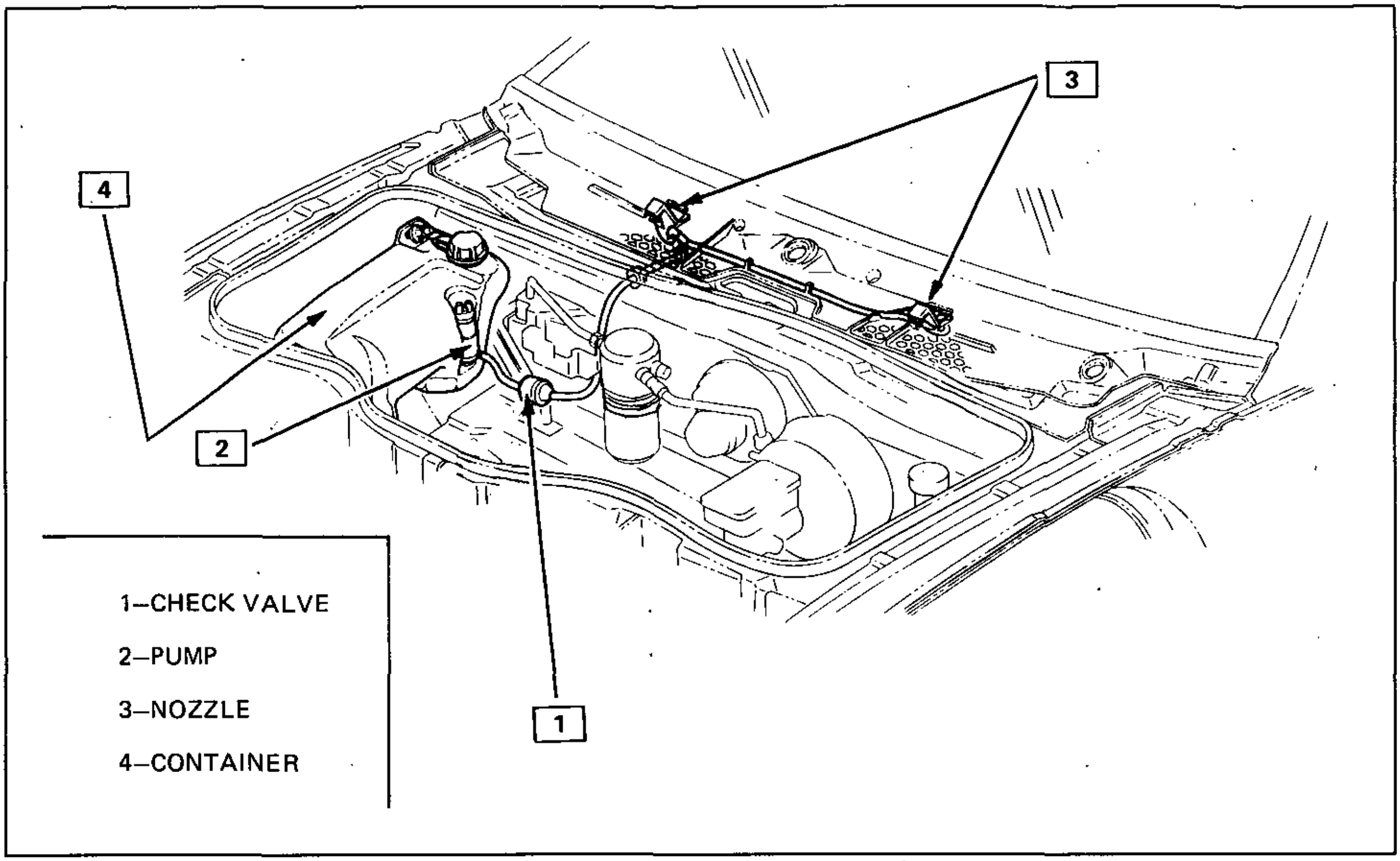


Figure 8E2-4 Fluidic Windshield Washer System

When the blades reach their park position, a cam on the large gear moves the park switch actuator that opens the normally closed positive park switch and grounds the wiper motor. This accomplishes a reversal of the motor flux path which causes a no-coast positive park, shutting off the wiper.

WASHER PUMP OPERATION

Actuating the washer portion of the multi-function lever completes the washer pump motor circuit to ground and mechanically moves the wiper motor switch to the low-speed position. This dual function starts the wiper motor and washer operation at the same time. The washer pump runs only while the wash switch is activated.

The washer pump consists of a permanent magnet motor and pump assembly that is mounted to the bottom of the solution jar by a nut located inside the solution jar (Figure 8E2-7). The wiper motor can be operated only when the ignition switch is in the run or accessory position.

DIAGNOSIS

WINDSHIELD WIPER SYSTEM TESTER

A universal wiper system tester (tool J-25079-B or equivalent) can be used to simplify diagnosing wiper problems either on or off the car. A separate diagnostic manual is distributed with the tester.

DIAGNOSTIC PROCEDURES

(Figure 8E2-8)

The following procedures assume that the technician has checked the following:

- Continuity of all harness wires
- Wiper motor-to-dash mounting screws tight
- Fuses
- Washer hoses clear

The diagnostic procedures covered in this manual are based on certain tests and operational checks that will help locate the problem. Prior to starting the diagnosis procedure, it is very important to confirm the reported condition with a complete operational check including the washer system. Then match up the condition with one in the wiper diagnosis charts.

WIPER MOTOR

Check for motor operation before removing from vehicle. Disconnect all wiring from wiper and perform the following checks in this order:

1. If wiper motor functions in all above modes, go to Wiper/Washer Test (Figure 8E2-9).
2. If the motor does not function in any one of the above checks, see Wiper and Washer Motor Mechanical Diagnostic chart (Figure 8E2-10).

WASHER PUMP

Check for washer pump operation before removing from vehicle. Remove connector and apply B(+) to #2 wiring harness terminal (Figure 8E2-11).

		WASH BUTTON POSITION	
		OFF	BUTTON HELD MORE THAN .3 SECONDS
WIPER SWITCH POSITION	MIST	Wiper runs instantaneously or, if held, runs continuously in low speed.	Wiper continues to run in low speed during wash cycle below, then returns to park and shuts off. If MIST is held, wiper resumes in low speed.
	OFF	Wiper and washer are off — blades are at park position.	Wiper starts, runs and washes in low speed. Fluid flows pulsed in 1.5 second intervals as long as button is held, then approx. 6 seconds of drying wipes. Wiper then returns to park position and shuts off.
	PULSE	Wiper runs one low speed wipe. Blades stop at inner wipe position, next wipe is delayed for period of .2 to 43 seconds (depending upon rheostat setting), then cycle repeats.	PULSE function is overridden followed by wash and dry cycle above. Blades then return to inner wipe position and PULSE 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.
	HIGH	Wiper runs in continuous high speed.	Same as low speed wash above except motor running in high speed.

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Figure 8E2-5 On-Car W/S Wiper-Washer System Operation (Pulse)

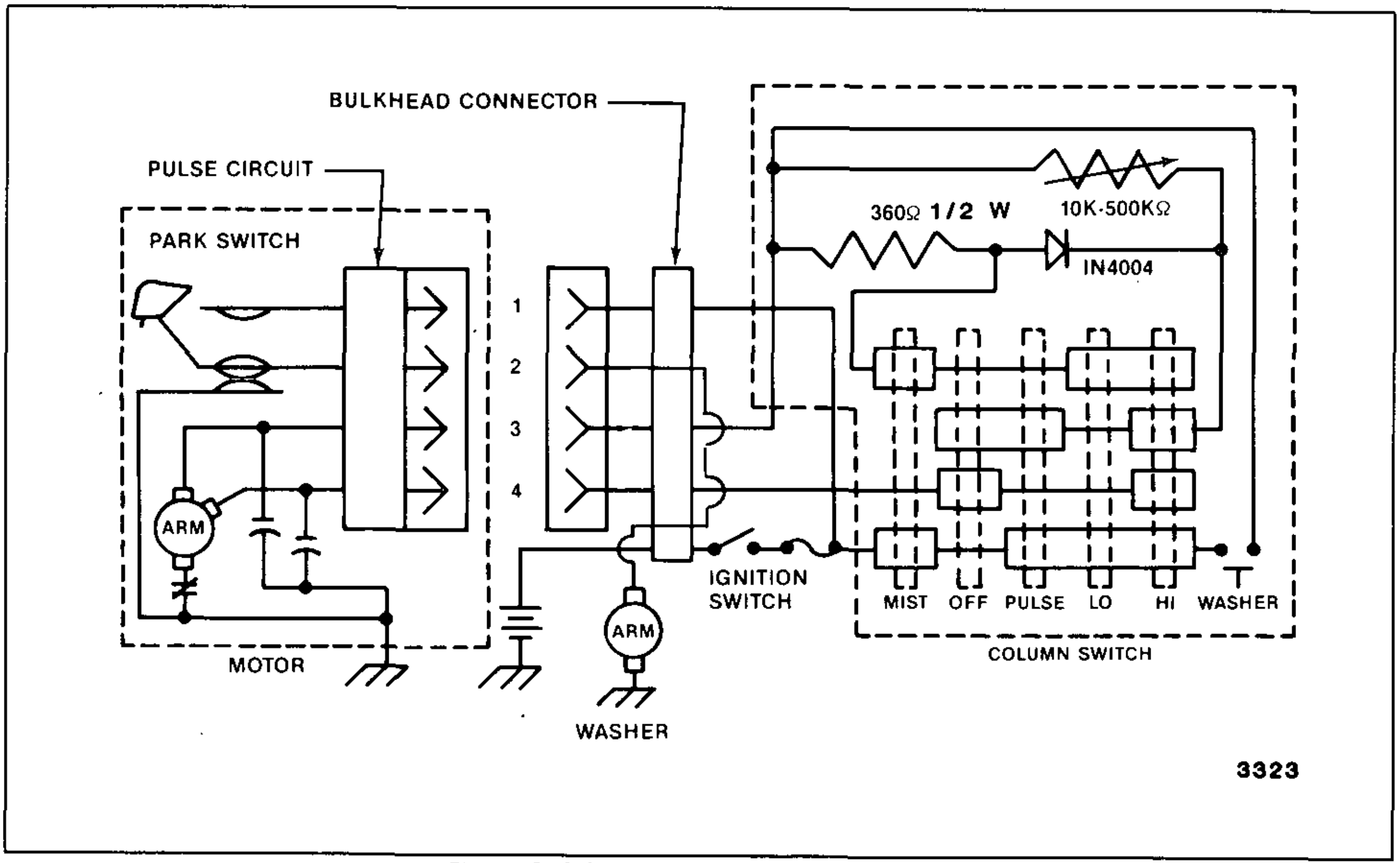


Figure 8E2-6 Pulse Wiper Wiring Diagram

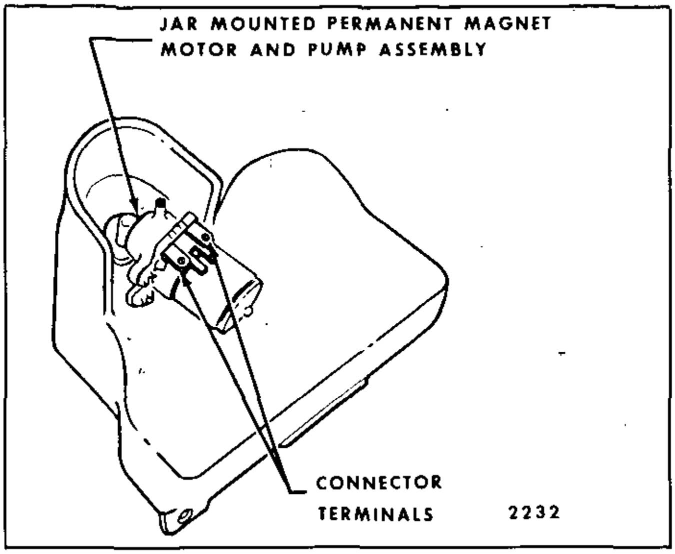


Figure 8E2-7 Jar Mounted PM Motor and Washer Pump Assembly

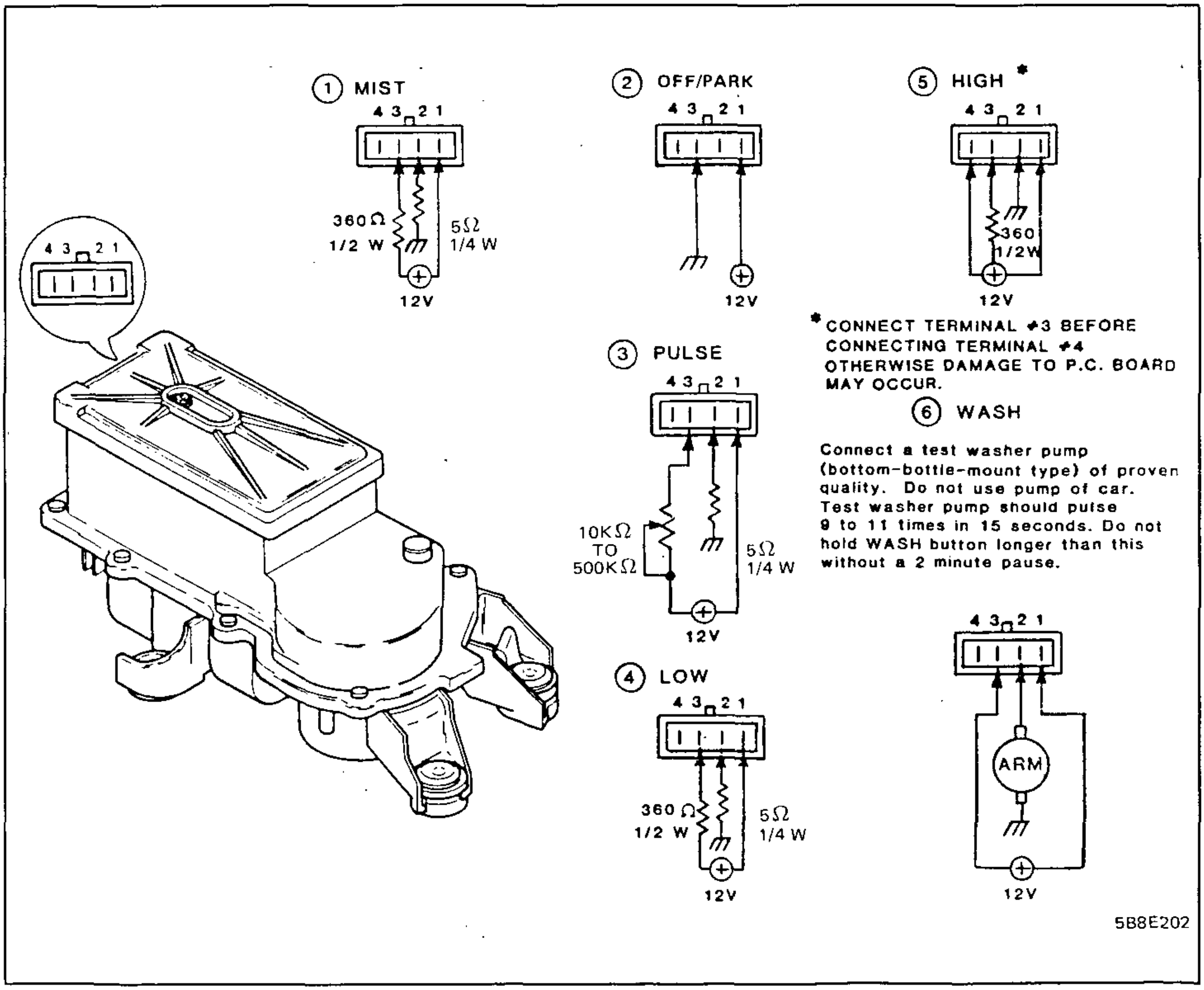
1. If motor does not run or pump water, replace washer pump.
2. If motor runs and pumps water, problem is in circuit board, motor park switch or wiper switch. (See Wiper/Washer Multi-function Lever Test, Figure 8E2-9.)

WIPER/WASHER MULTI-FUNCTION LEVER TEST

Disconnect wiring harnesses from wiper motor and perform the following multi-function lever tests using a digital voltmeter with ignition switch on. All *voltage readings taken with respect to vehicle ground.*

To use Wiper/Washer Multi-function Lever Check Chart (Figure 8E2-12), probe terminals 1 through 4 with digital voltmeter and multi-function lever in various positions.

If the Wiper/Washer Multi-function Lever Tests are not completed correctly, then the multi-function lever is defective. However, it is possible that the wiring harness is defective and has an open or short (see Wiper/Washer Electrical Diagnostic Chart, Figure



* CONNECT TERMINAL #3 BEFORE CONNECTING TERMINAL #4 OTHERWISE DAMAGE TO P.C. BOARD MAY OCCUR.

Connect a test washer pump (bottom-bottle-mount type) of proven quality. Do not use pump of car. Test washer pump should pulse 9 to 11 times in 15 seconds. Do not hold WASH button longer than this without a 2 minute pause.

Figure 8E2-8 Wiper On-Car Check

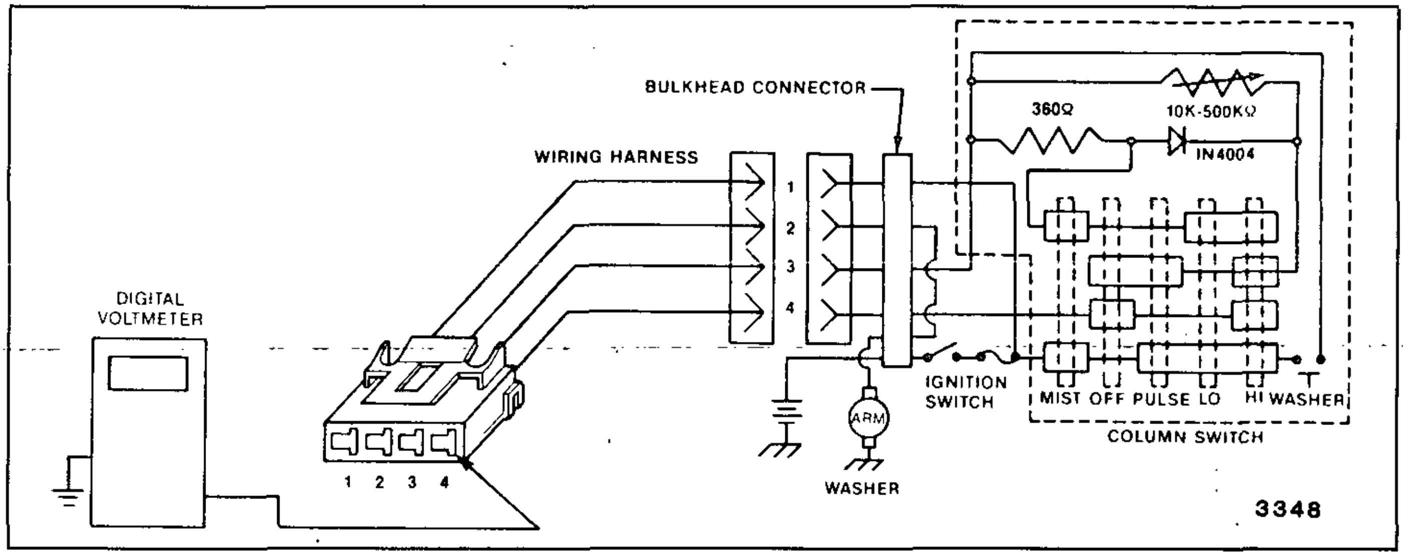


Figure 8E2-9 Wiper and Washer Multi-function Lever Test

PROBABLE CAUSE / SYMPTOM	Wiper system inoperative—all modes	Wiper has Hi speed only— won't delay	Wiper inop in "Delay" mode. functions OK in other modes	Wiper won't delay between delay wipes.	Washer does not operate properly in demand mode
Defective circuit board	XX*	X	X	X	X
Motor defective	X	X			
Park switch defective					
Gear train damaged					
Washer pump open connection	XX*			XX*	X

*Denotes most probable cause.

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Figure 8E2-10 Wiper and Washer Motor Mechanical Diagnostic Chart

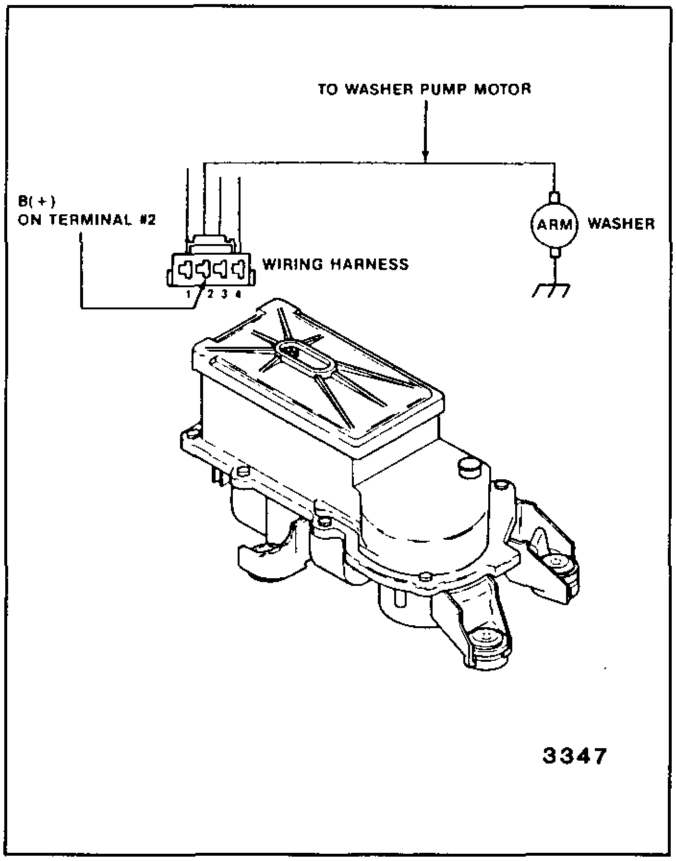


Figure 8E2-11 Washer Pump On-car Check

8E2-10). Make sure the wiring harness has been checked before starting Wiper On-Car diagnostic procedures (Figures 8E2-13 through 8E2-18).

ON-CAR/OFF-CAR SERVICE

WIPER ARM

Remove or Disconnect

2. To install, reverse removal procedures and check operation of wipers. The tool used to remove the wiper arms can also be used to install the arms.

Install wiper blades (Figure 8E2-20) as near as possible to the top edge of the blackout line on the glass with the motor in park position.

Inspection

SWITCH MODE / TERMINAL #	MIST	OFF	PULSE OR DELAY	LO	HI	WASH (while in off)
1	B(+)	B(+)	B(+)	B(+)	B(+)	B(+)
2	0V	0V	0V	0V	0V	0V
3	B(+)	0	B(+)	B(+)	B(+)	B(+)
4	0V	0V	0V	0V	B(+)	0V

3349

Figure 8E2-12 Wiper and Washer Multi-function Lever Check

(3/4") or minus 13 mm (1/2"). This checking procedure should be done on a wet glass surface.

Adjustment

The only adjustment of the wiper arm(s) is to remove the arm(s) from the serrated transmission spindle shaft, rotate the arm(s) as required and reinstall to transmission spindle shaft. Reinspect to insure proper blade out-wipe positon.

WIPER BLADE

Remove or Disconnect

Three methods are used to retain wiper blades to wiper arms.

1. The first type blade uses an internal spring (Figure 8E2-21). To remove wiper blade, press down on blade, release spring and remove blade from arm.
2. The second type blade uses a press-type release lever (Figure 8E2-22). When release lever is depressed, the blade assembly can be slid off the wiper arm pin.
3. The third type blade uses an exterior spring (Figure 8E2-23). To remove wiper blade, insert a screwdriver under spring and then push downward on screwdriver to raise spring. Blade can then be removed from arm.

Install or Connect

- Install blades to the arm, insert blade over pin at top of arm and press until spring retainer engages groove in pin.

WIPER BLADE ELEMENT

Three methods are used to retain wiper blade inserts to wiper blades.

1. One element uses a spring-type retainer on the end of the blade (Figure 8E2-22). To remove element, insert and rotate a screwdriver as shown.
2. The second element (Figure 8E2-21) is retained by tabs on the blade housing. To remove element, bend housing tip downward and pull element upward and twist outward when housing tab and element slot align. Slide element downward until all tabs are removed through slot.
3. The third element (Figure 8E2-22) is retained by tabs on the blade housing. Pull housing backwards to disengage tab; then slide element out of the blade assembly.

WIPER TRANSMISSION ASSEMBLY

(Figure 8E2-24)

Remove or Disconnect

1. Remove shroud top vent grille and wiper arms.
2. Loosen (do not remove) drive link to crank arm attaching nuts.
3. Disengage drive link from crank arm.
4. Remove transmission to cowl panel attaching screws.

Install or Connect

- To install, reverse removal procedure. Torque attaching screws and nuts from 5.5 to 9 N·m (49 to 80 in-lb).

WIPER MOTOR

Repairs can be made to the wiper motor cover and pulse board only.

Remove or Disconnect

1. Loosen, do not remove, transmission drive link to motor crank arm attaching nuts (Figure 8E2-24). Then detach drive link from motor crank arm.
2. Disconnect electrical leads.
3. Rotate motor up and outward to remove.

Install or Connect

1. Install motor by placing crank arm through opening in body (Figure 8E2-25).
2. Replace motor attaching screws and torque 4.5 to 6.5 N·m (51 to 73 in-lb).
3. Install transmission drive link to crank arm (motor in park position - refer to Figure 8E2-26).
4. Replace shroud top vent grille and wiper arms.
5. Check operation of wiper system.

WIPER MOTOR COVER

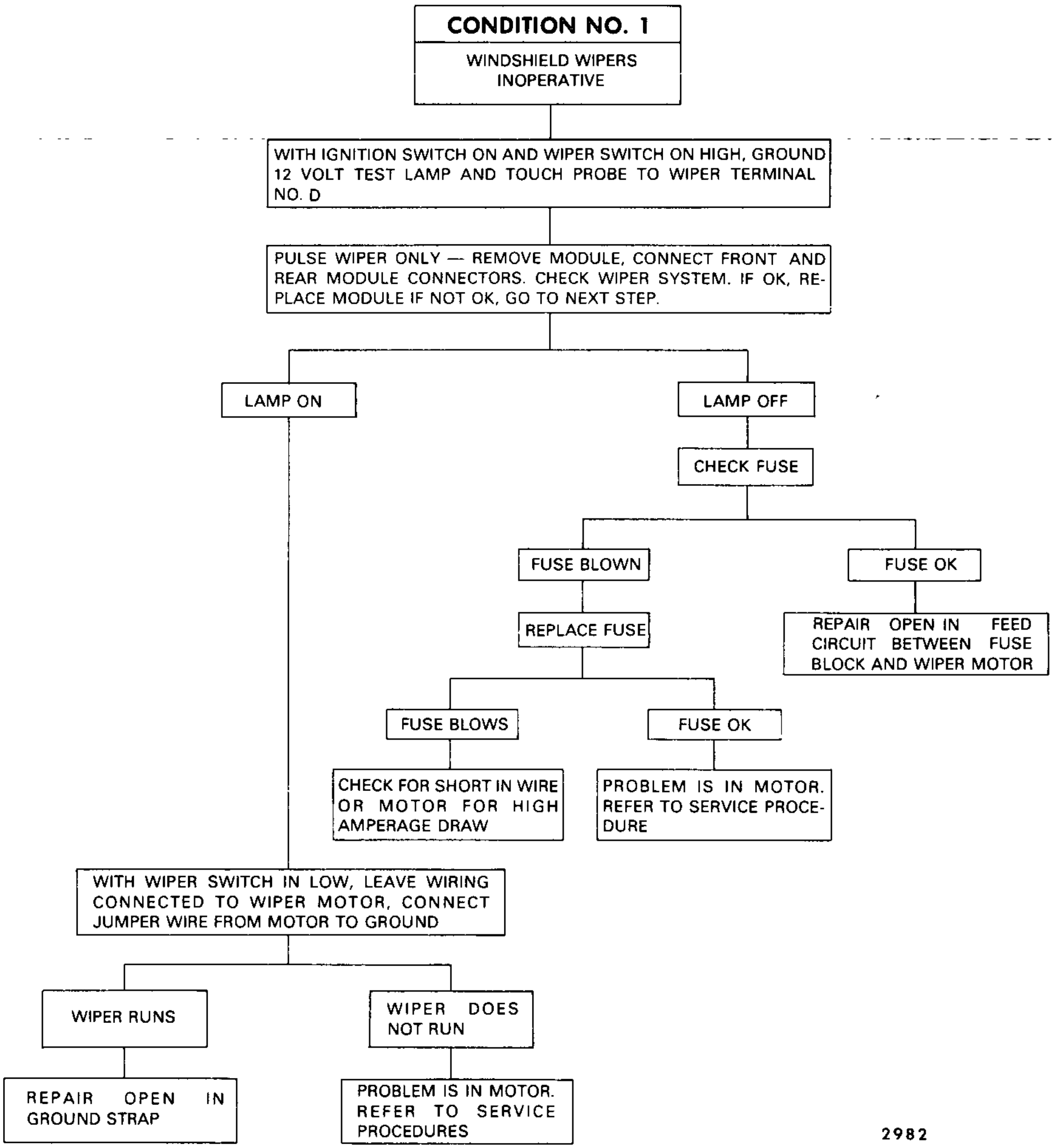
(Figure 8E2-27)

Remove or Disconnect

1. Remove wiper motor.
2. Drill off the ends of the 7 rivets (from housing side) holding cover to housing with a 4.37 mm (11/64") drill bit.
3. Remove cover.

Install or Connect

- To install, attach cover to housing with seven 4x10 mm (5/32"x3/8") thread forming self-tapping screws.


CONDITION NO. 1
WINDSHIELD WIPERS INOPERATIVE
WITH IGNITION SWITCH ON AND WIPER SWITCH ON HIGH, GROUND 12 VOLT TEST LAMP AND TOUCH PROBE TO WIPER TERMINAL NO. D
PULSE WIPER ONLY — REMOVE MODULE, CONNECT FRONT AND REAR MODULE CONNECTORS. CHECK WIPER SYSTEM. IF OK, REPLACE MODULE IF NOT OK, GO TO NEXT STEP.
LAMP ON
LAMP OFF
CHECK FUSE
FUSE BLOWN
FUSE OK
REPLACE FUSE
REPAIR OPEN IN FEED CIRCUIT BETWEEN FUSE BLOCK AND WIPER MOTOR
FUSE BLOWS
FUSE OK
CHECK FOR SHORT IN WIRE OR MOTOR FOR HIGH AMPERAGE DRAW
PROBLEM IS IN MOTOR. REFER TO SERVICE PROCEDURE
WITH WIPER SWITCH IN LOW, LEAVE WIRING CONNECTED TO WIPER MOTOR, CONNECT JUMPER WIRE FROM MOTOR TO GROUND
WIPER RUNS
WIPER DOES NOT RUN
REPAIR OPEN IN GROUND STRAP
PROBLEM IS IN MOTOR. REFER TO SERVICE PROCEDURES
2982

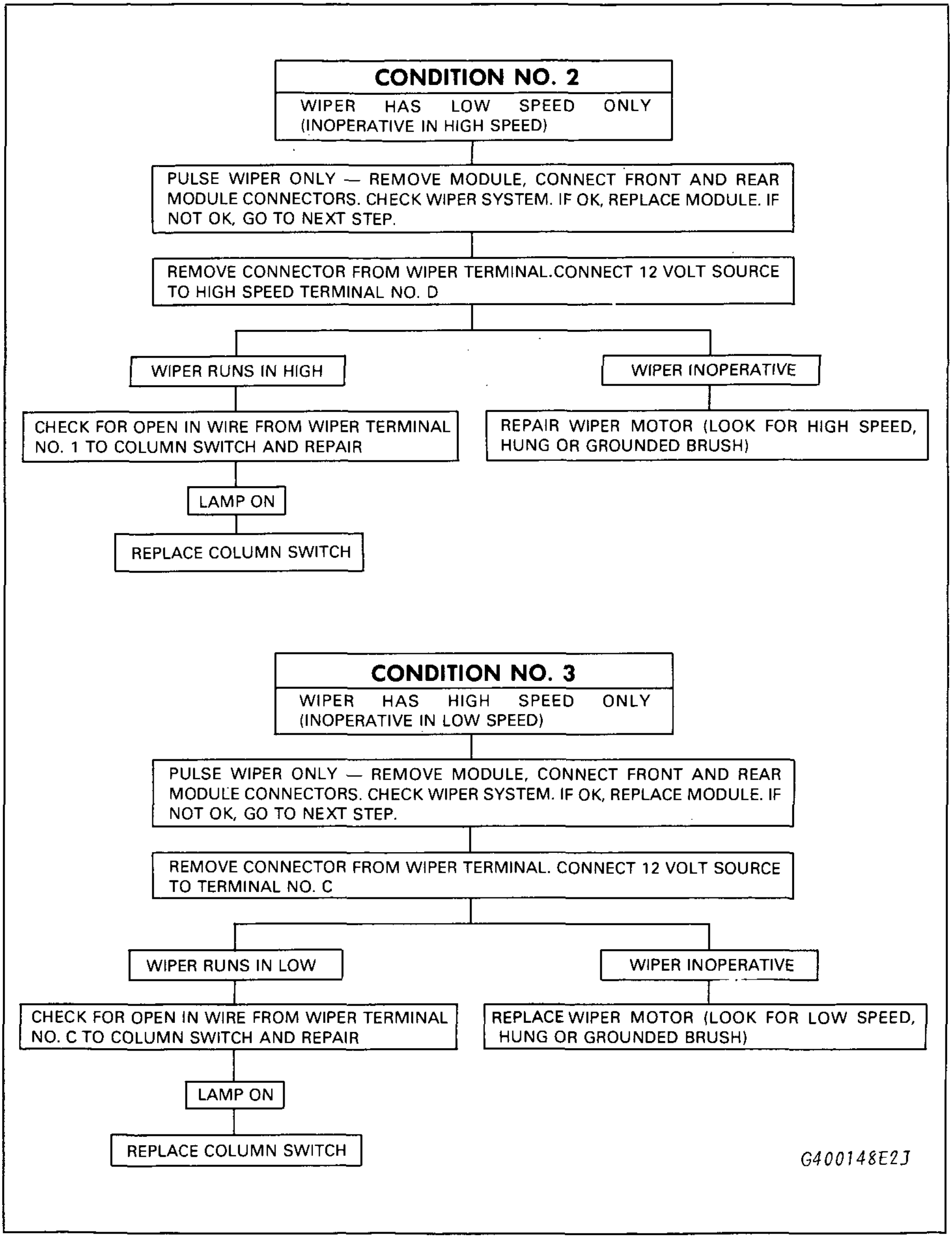
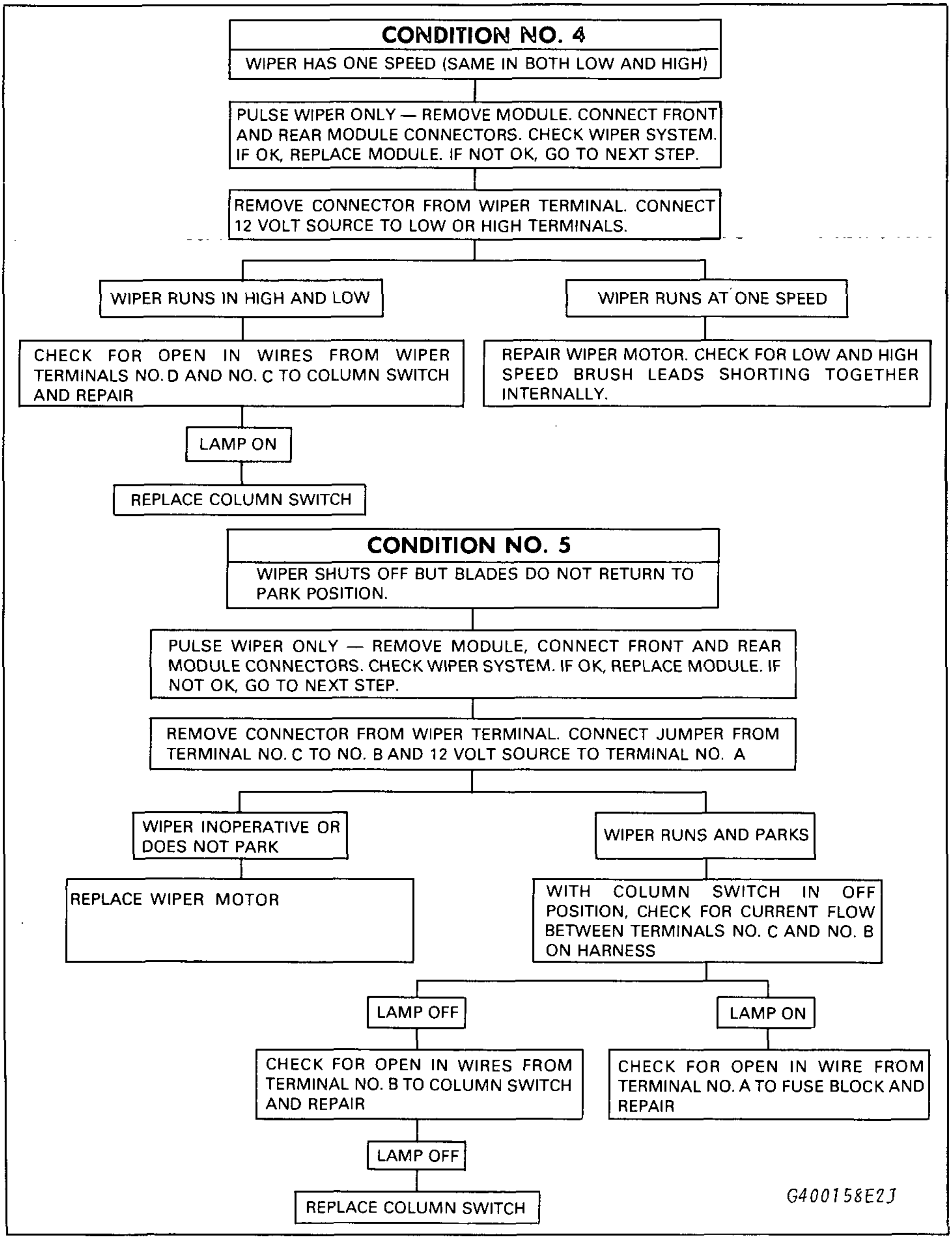


Figure 8E2-14 Windshield Wiper Diagnosis Chart - Condition 2 and 3



CONDITION NO. 4

WIPER HAS ONE SPEED (SAME IN BOTH LOW AND HIGH)

PULSE WIPER ONLY — REMOVE MODULE. CONNECT FRONT AND REAR MODULE CONNECTORS. CHECK WIPER SYSTEM. IF OK, REPLACE MODULE. IF NOT OK, GO TO NEXT STEP.

REMOVE CONNECTOR FROM WIPER TERMINAL. CONNECT 12 VOLT SOURCE TO LOW OR HIGH TERMINALS.

WIPER RUNS IN HIGH AND LOW

CHECK FOR OPEN IN WIRES FROM WIPER TERMINALS NO. D AND NO. C TO COLUMN SWITCH AND REPAIR

LAMP ON

REPLACE COLUMN SWITCH

WIPER RUNS AT ONE SPEED

REPAIR WIPER MOTOR. CHECK FOR LOW AND HIGH SPEED BRUSH LEADS SHORTING TOGETHER INTERNALLY.

CONDITION NO. 5

WIPER SHUTS OFF BUT BLADES DO NOT RETURN TO PARK POSITION.

PULSE WIPER ONLY — REMOVE MODULE, CONNECT FRONT AND REAR MODULE CONNECTORS. CHECK WIPER SYSTEM. IF OK, REPLACE MODULE. IF NOT OK, GO TO NEXT STEP.

REMOVE CONNECTOR FROM WIPER TERMINAL. CONNECT JUMPER FROM TERMINAL NO. C TO NO. B AND 12 VOLT SOURCE TO TERMINAL NO. A

WIPER INOPERATIVE OR DOES NOT PARK

REPLACE WIPER MOTOR

WIPER RUNS AND PARKS

WITH COLUMN SWITCH IN OFF POSITION, CHECK FOR CURRENT FLOW BETWEEN TERMINALS NO. C AND NO. B ON HARNESS

LAMP OFF

CHECK FOR OPEN IN WIRES FROM TERMINAL NO. B TO COLUMN SWITCH AND REPAIR

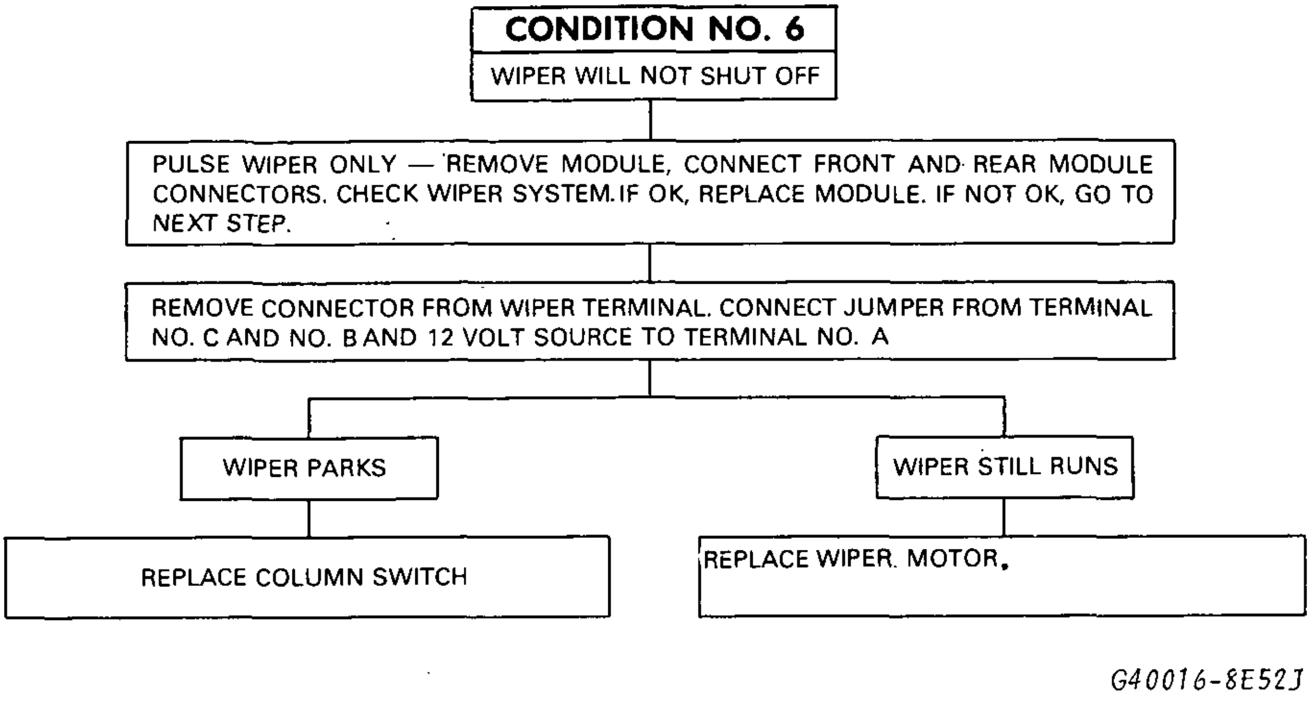
LAMP OFF

REPLACE COLUMN SWITCH

LAMP ON

CHECK FOR OPEN IN WIRE FROM TERMINAL NO. A TO FUSE BLOCK AND REPAIR

G400158E2J



CONDITION NO. 6

WIPER WILL NOT SHUT OFF

PULSE WIPER ONLY — REMOVE MODULE, CONNECT FRONT AND REAR MODULE CONNECTORS. CHECK WIPER SYSTEM. IF OK, REPLACE MODULE. IF NOT OK, GO TO NEXT STEP.

REMOVE CONNECTOR FROM WIPER TERMINAL. CONNECT JUMPER FROM TERMINAL NO. C AND NO. B AND 12 VOLT SOURCE TO TERMINAL NO. A

WIPER PARKS

REPLACE COLUMN SWITCH

WIPER STILL RUNS

REPLACE WIPER. MOTOR.

Figure 8E2-16 Windshield Wiper Diagnosis Chart - Condition 6

Circuit Board Replacement

(Figure 8E2-28)

Disassemble

1. Screw
2. Circuit board cover.
3. Printed circuit board by lifting carefully at outboard end to disconnect terminal clips at inboard end.

Assemble

Important

When assembling printed circuit board, make sure terminal clips fully engage all 5 terminals of brush assembly (Figure 8E2-27).

1. New circuit board.
2. Circuit board cover.
3. Screw.

Tighten

Screw to 2.3-2.8 N·m (1.7-2.1 ft-lb).

Inspect

For proper wiper operation.

Crank Arm Replacement

Disassemble

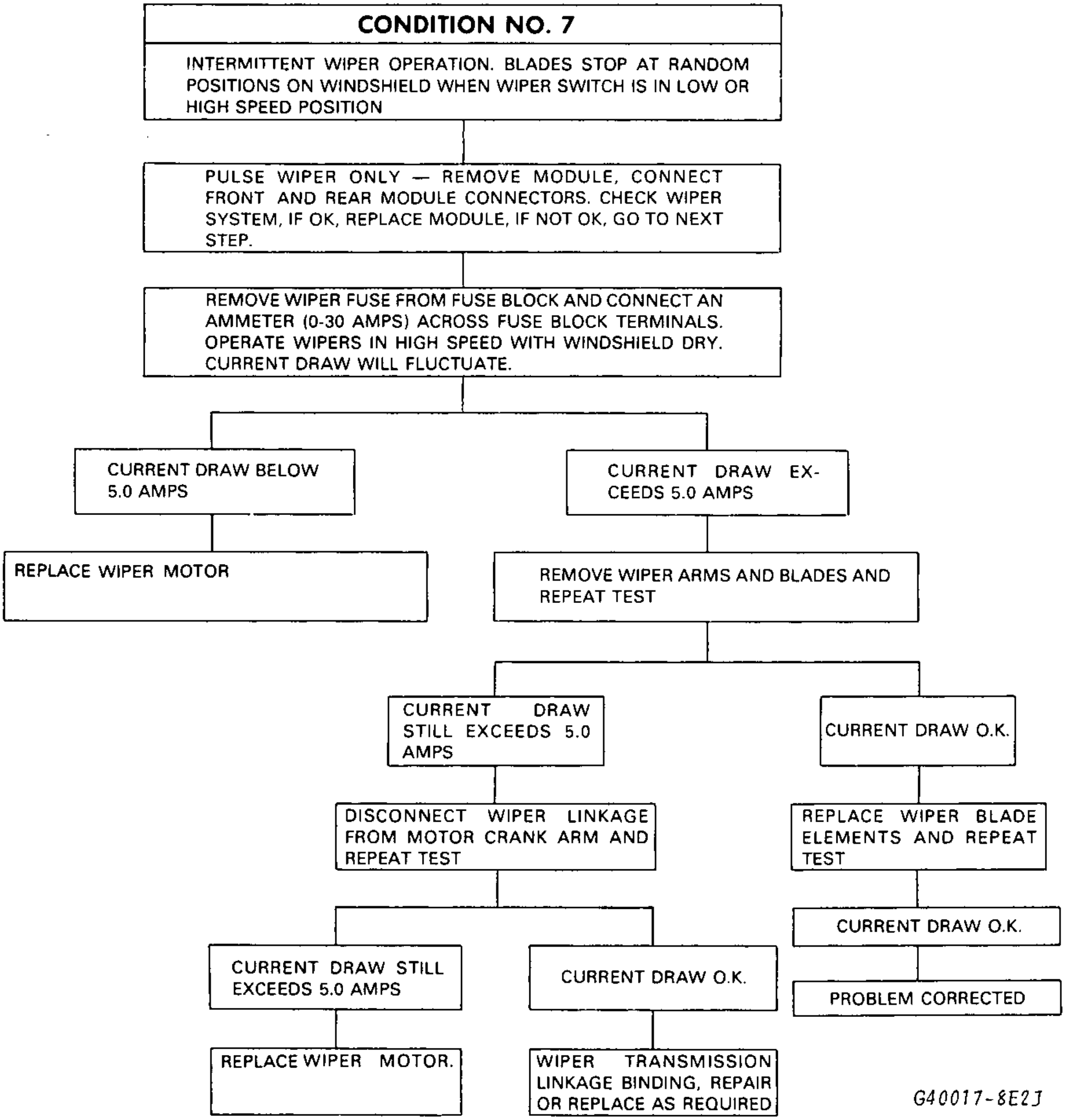
1. Locknut (1) with crank arm (2) in vise to prevent damage to gears.
2. Crank arm (2) noting relative position of ball end.

Assemble

1. Crank arm (2).
2. Locknut (1).

Tighten

Locknut (1), with crank arm (2) in vise, to 34-51 N·m (25-37 ft-lb).


CONDITION NO. 7
INTERMITTENT WIPER OPERATION. BLADES STOP AT RANDOM POSITIONS ON WINDSHIELD WHEN WIPER SWITCH IS IN LOW OR HIGH SPEED POSITION
PULSE WIPER ONLY — REMOVE MODULE, CONNECT FRONT AND REAR MODULE CONNECTORS. CHECK WIPER SYSTEM, IF OK, REPLACE MODULE, IF NOT OK, GO TO NEXT STEP.
REMOVE WIPER FUSE FROM FUSE BLOCK AND CONNECT AN AMMETER (0-30 AMPS) ACROSS FUSE BLOCK TERMINALS. OPERATE WIPERS IN HIGH SPEED WITH WINDSHIELD DRY. CURRENT DRAW WILL FLUCTUATE.
CURRENT DRAW BELOW 5.0 AMPS
REPLACE WIPER MOTOR
CURRENT DRAW EXCEEDS 5.0 AMPS
REMOVE WIPER ARMS AND BLADES AND REPEAT TEST
CURRENT DRAW STILL EXCEEDS 5.0 AMPS
DISCONNECT WIPER LINKAGE FROM MOTOR CRANK ARM AND REPEAT TEST
CURRENT DRAW STILL EXCEEDS 5.0 AMPS
REPLACE WIPER MOTOR.
CURRENT DRAW O.K.
WIPER TRANSMISSION LINKAGE BINDING, REPAIR OR REPLACE AS REQUIRED
CURRENT DRAW O.K.
REPLACE WIPER BLADE ELEMENTS AND REPEAT TEST
CURRENT DRAW O.K.
PROBLEM CORRECTED
G40017-8E2J

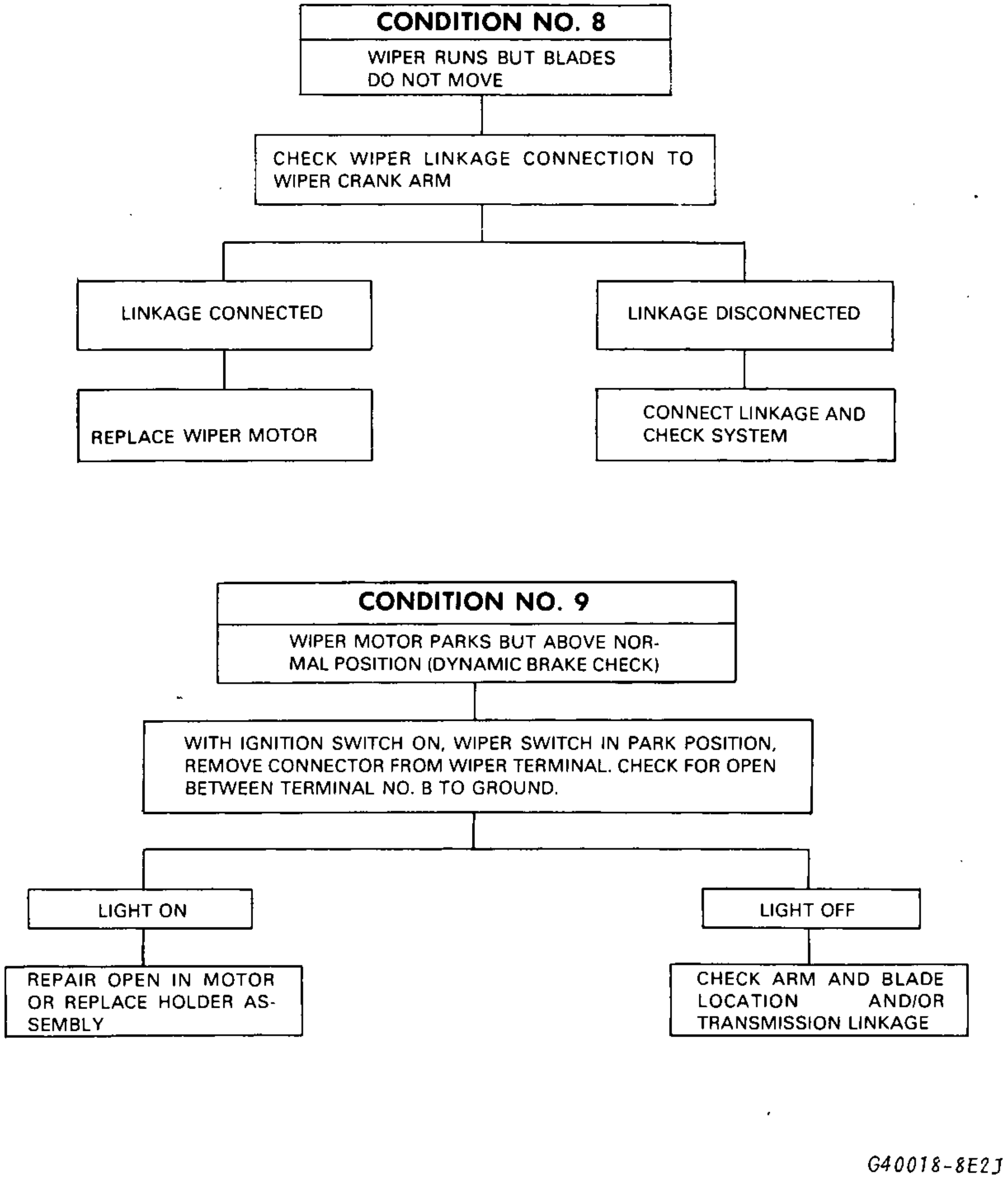


Figure 8E2-18 Windshield Wiper Diagnosis Chart - Condition 8 and 9

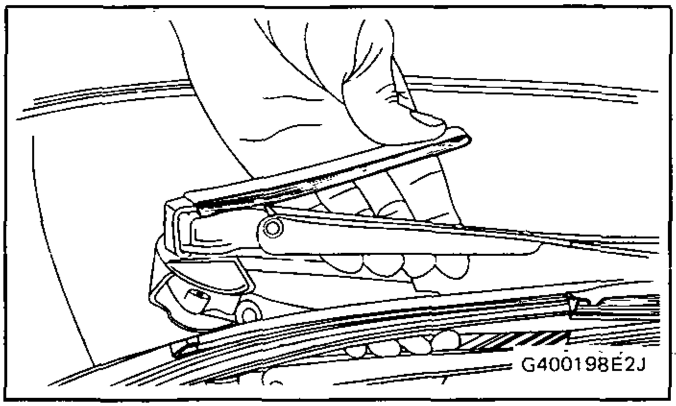
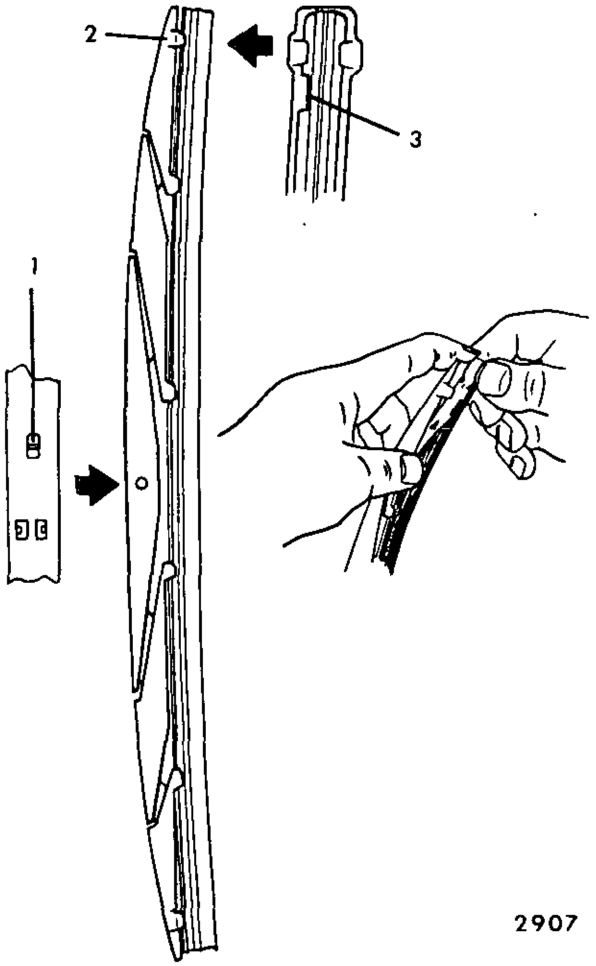


Figure 8E2-19 Wiper Arm Removal Tool J-8966 (or equivalent)



1. BLADE RELEASE SPRING
2. HOUSING TABS
3. ELEMENT RELEASE NOTCH

Figure 8E2-21 Blade Assembly - Type 1

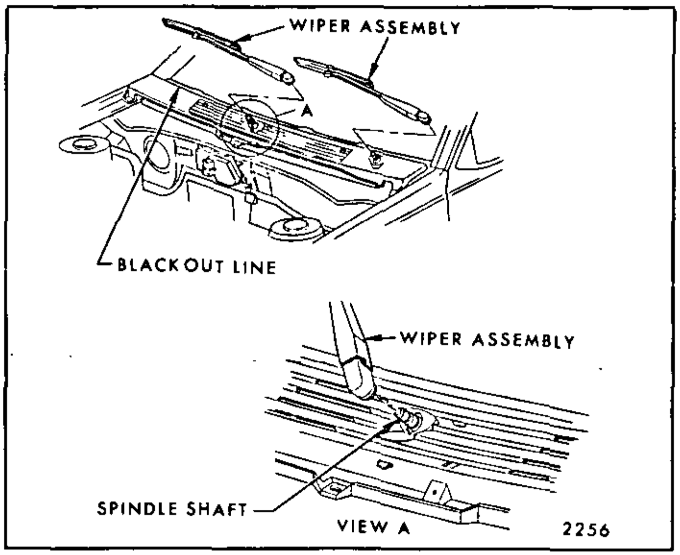
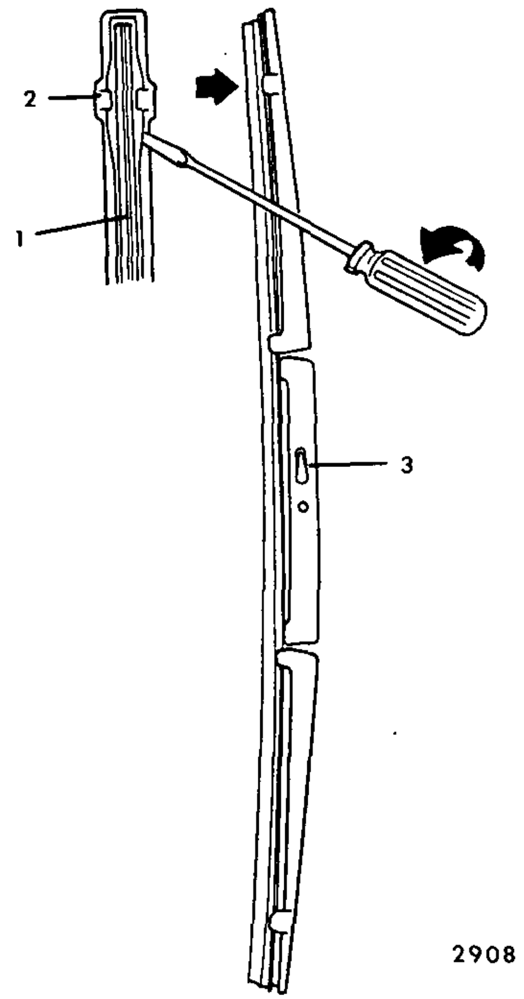


Figure 8E2-20 Windshield Wiper Blade Arm Installation



1. ELEMENT
2. HOUSING TABS
3. BLADE RELEASE LEVER

Figure 8E2-22 Blade Assembly - Type 2

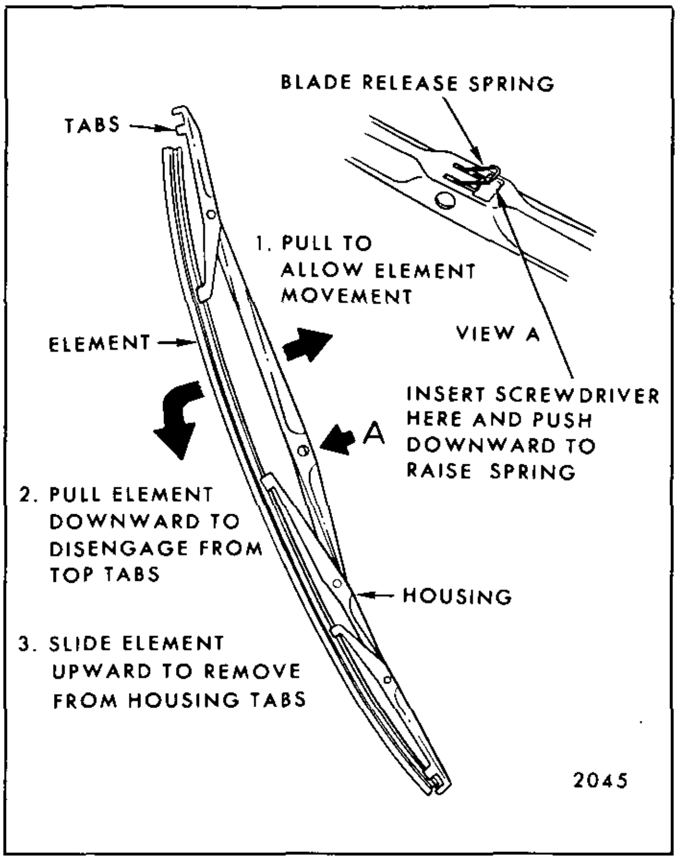


Figure 8E2-23 Blade Assembly - Type 3

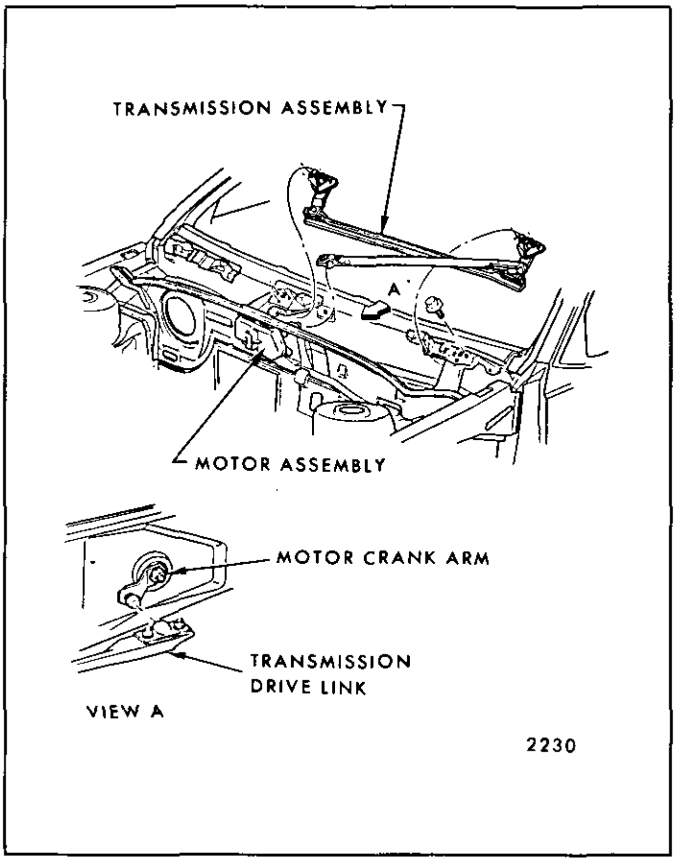


Figure 8E2-24 Windshield Wiper Transmission Assembly

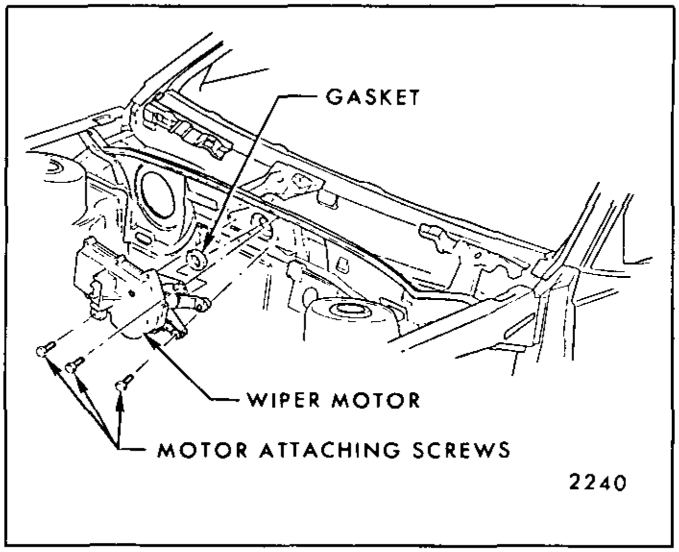


Figure 8E2-25 Wiper Motor Installation

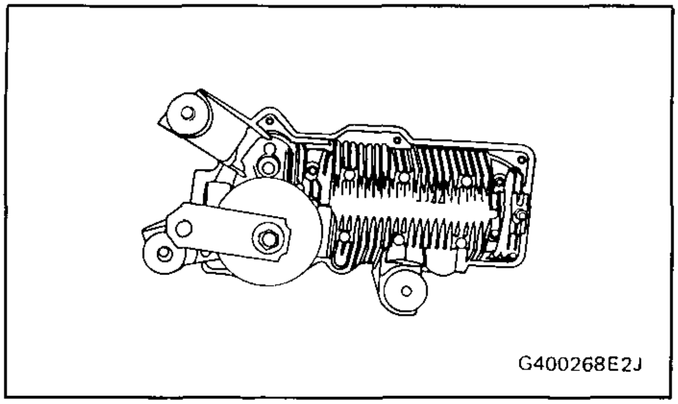
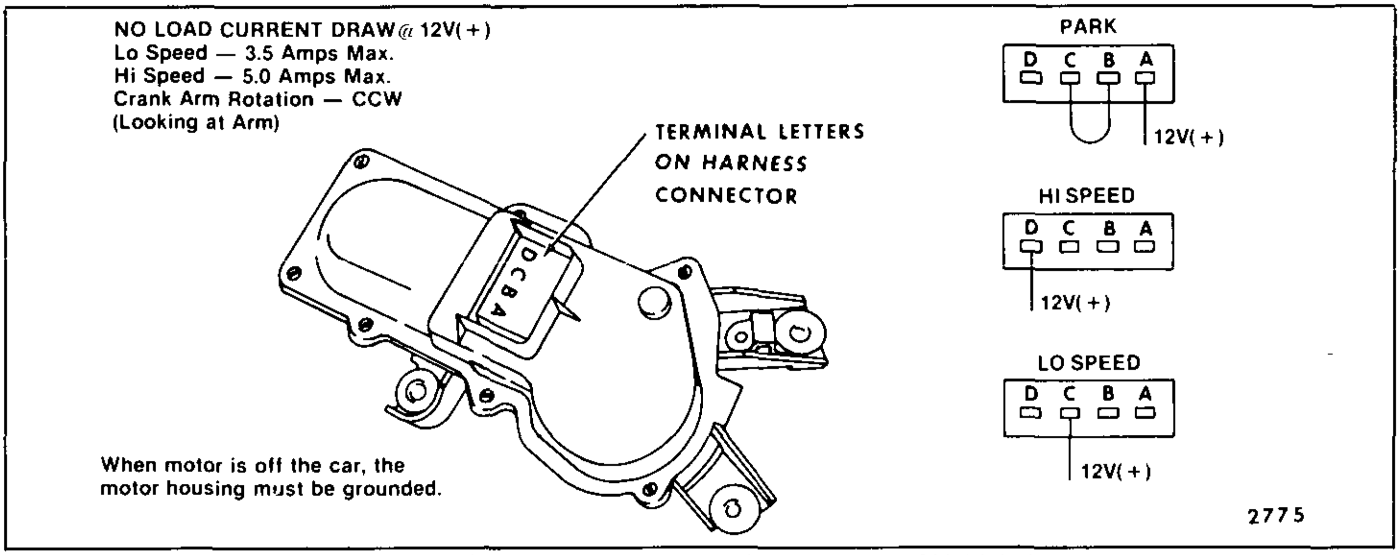


Figure 8E2-26 Motor Crank Arm in Park Position

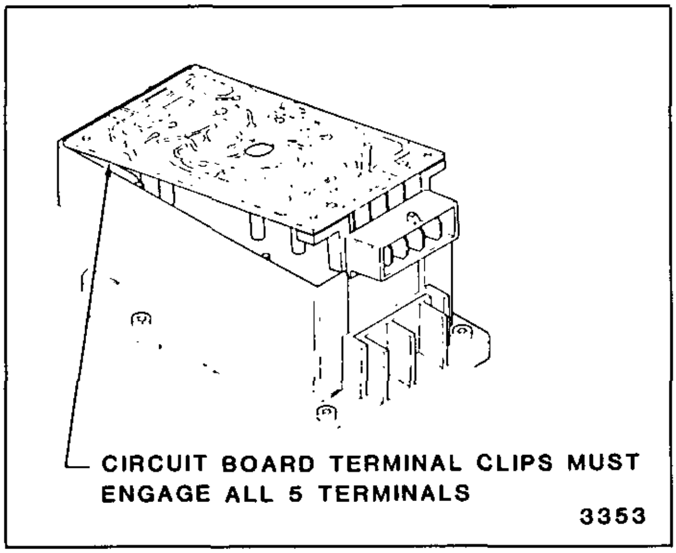


NO LOAD CURRENT DRAW @ 12V(+)
Lo Speed — 3.5 Amps Max.
Hi Speed — 5.0 Amps Max.
Crank Arm Rotation — CCW
(Looking at Arm)

TERMINAL LETTERS ON HARNESS CONNECTOR

When motor is off the car, the motor housing must be grounded.

Figure 8E2-27 Operating Wiper Motor Independent of Vehicle Wiring



CIRCUIT BOARD TERMINAL CLIPS MUST ENGAGE ALL 5 TERMINALS

Figure 8E2-28 Pulse Wiper Circuit Board Installation

SECTION 9A

RADIO OPERATION

CONTENTS

GENERAL DESCRIPTION

RADIO

For radios and radio use see the "Radio Operation" section.

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.

Antenna Trimmer Adjustment - AM Band

The antenna trimmer adjustment matches the antenna coil in the radio to the car antenna. Only **AM** radios, or the AM part of AM/FM radios, need this adjustment. (ETR models and 2000 models use "self-adjusting" circuits and do not have an antenna trimmer).

1. Tune the radio to a weak AM station near 1400 KHz. Turn the volume all the way up. You should barely hear the station.
2. Remove the right inner and outer knobs.
3. Use a small screwdriver to adjust the trimmer screw (Figure 1). Adjust the screw for the loudest volume.
4. Reinstall the control knobs.

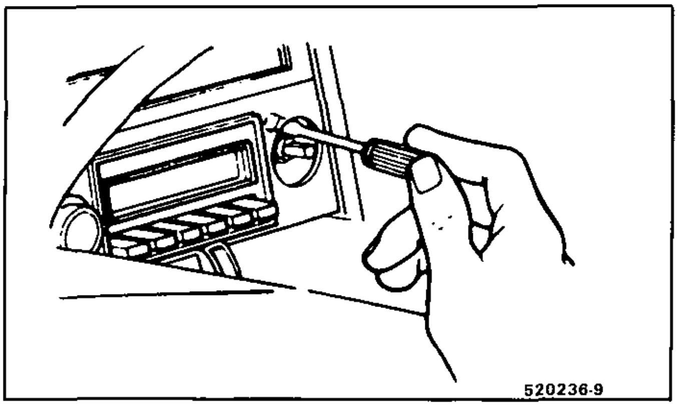


Fig. 1 AM Band Antenna Trimming

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.

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 off or running, and whether it occurs with car parked or moving will help to pinpoint the problem.

Radio diagnostic information is in Section 8A.

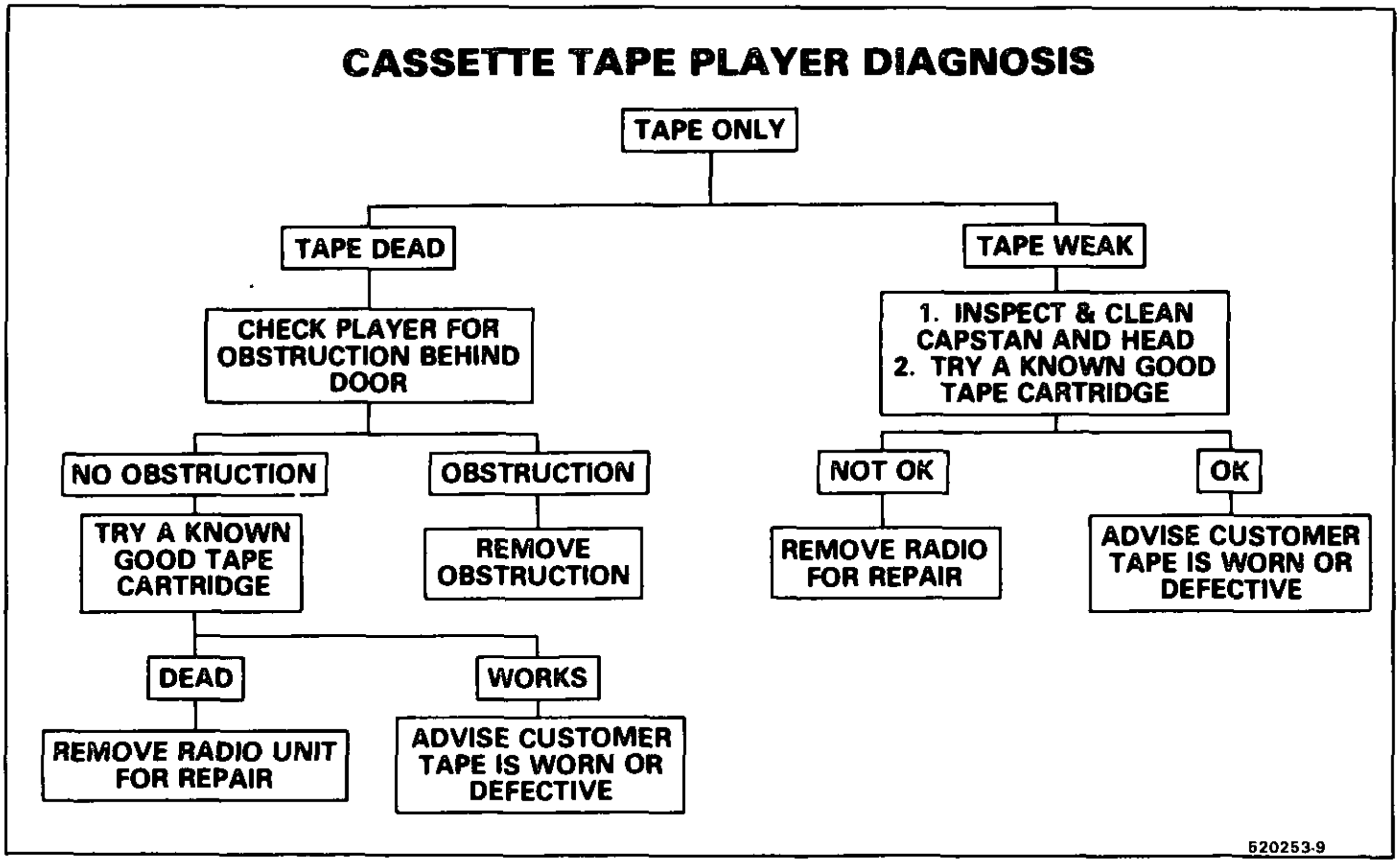


Fig. 2 Tape Player Diagnosis

SERVICE PROCEDURES

RADIO AND SPEAKERS

NOTICE: All radios are the bridge audio type.

short circuit to ground from either wire will cause damage to the output circuit in the radio.

may damage your Delco sound system. Please consult your dealer in advance if you are considering additions.

See On-Car Service for radio or speaker replacement.

RADIO DIAL LAMP REPLACEMENT

All radios must be removed from the vehicle for replacement of radio dial lamp. The AM and AM/FM monaural radio bulb may be replaced by removing the bulb socket in the top cover and replacing the bulb. Bulb replacement for AM/FM stereo can be performed by removing the top cover and replacing the bulb. The AM/FM cassette must be sent to an AC-Delco Radio Repair Station for bulb replacement, as the cassette mechanism must be removed to access the bulb. E.T.R. radios do not use a dial lamp.

RADIO SUPPRESSION EQUIPMENT

When installing a new radio, or when noise is a problem, insure that radio suppression equipment is present and properly installed.

STEREO CASSETTE TAPE PLAYER

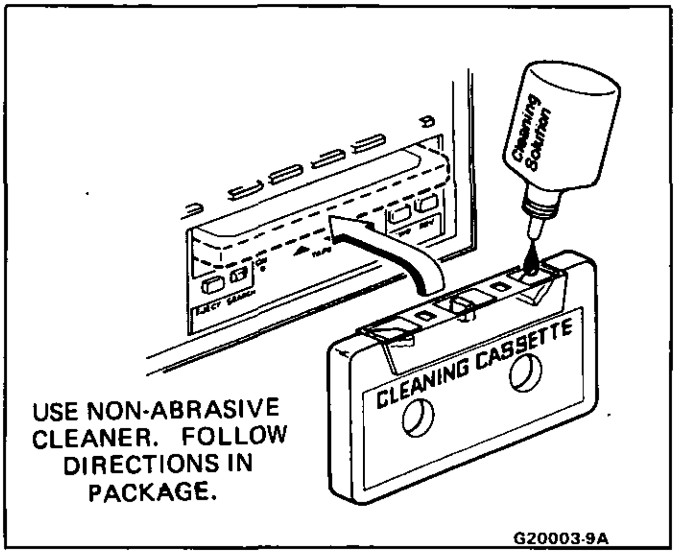
Tape and Tape Player Care

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.

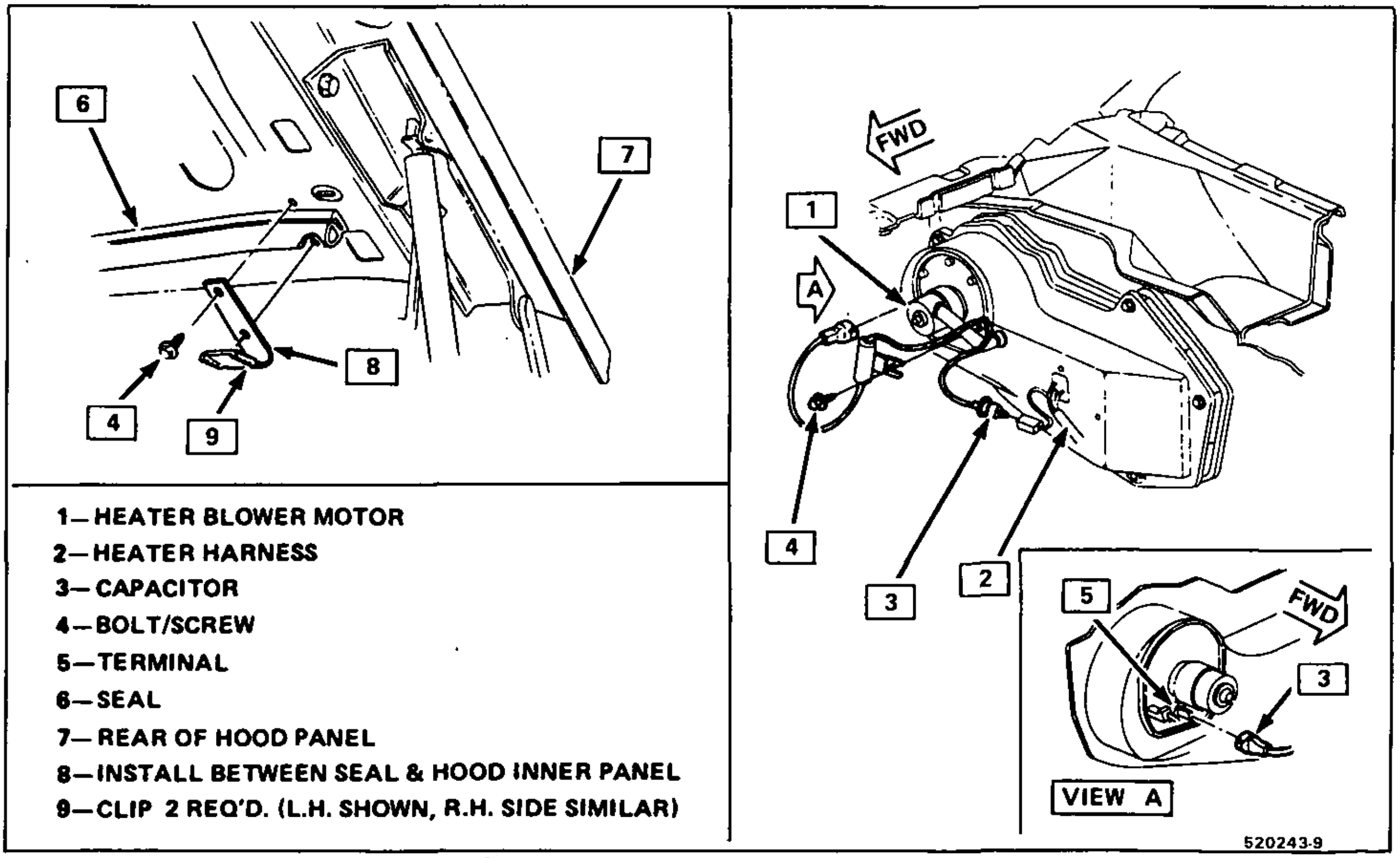
Do not bring any magnetized tools near the tape head. If the head becomes magnetized, every cassette played will be degraded.



USE NON-ABRASIVE CLEANER. FOLLOW DIRECTIONS IN PACKAGE.

Fig. 4 Cleaning the Cassette Player

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



1—HEATER BLOWER MOTOR
2—HEATER HARNESS
3—CAPACITOR
4—BOLT/SCREW
5—TERMINAL
6—SEAL
7—REAR OF HOOD PANEL
8—INSTALL BETWEEN SEAL & HOOD INNER PANEL
9—CLIP 2 REQ'D. (L.H. SHOWN, R.H. SIDE SIMILAR)

Fig. 3 Radio Suppression Equipment - Typical cases. For best results, 120 minute tapes are not recommended.

When leaving the car, cassettes may be left in the tape player if the deck is the "auto reverse" type (tapes are either automatically ejected or internally protected). In other models, tapes should be removed to prevent possible damage to the tape or tape player.

Operation

To play a cassette tape on an AM-FM stereo radio with a stereo cassette tape player:

1. Turn the radio on. (On very cold days, allow a few minutes for warm-up).
2. Insert the cassette squarely through the door above the radio dial, oriented as shown on the door. This electronically 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.
3. After the cassette has snapped into position, adjust the volume and fader controls to your preference.
4. To quickly advance the tape, push the combination fast forward/fast reverse (F/R) button to F until it locks. To release the fast forward lock, return the F/R button to its center position. To listen to an earlier selection, push down the F/R button. To release fast reverse, move the button to its center position. The sound will be muted during fast forward or fast reverse operation.
The tape player will shut off at the end of the tape, but the radio will not resume playing until you eject the cassette.

1. To remove the cassette, fully press in the "EJCT" button.
2. To change to the second program: eject the cassette, turn it over (end-for-end) and reinsert it.
Remove the cassette when not in use. Cassettes which are 30 or 60 minutes long will give the best results.
See "To Operate Tape Player" under specific radio heading for operation information.

RADIO OPERATION

AM MONAURAL RADIOS (U-63)

The following controls are on AM monaural sound systems:

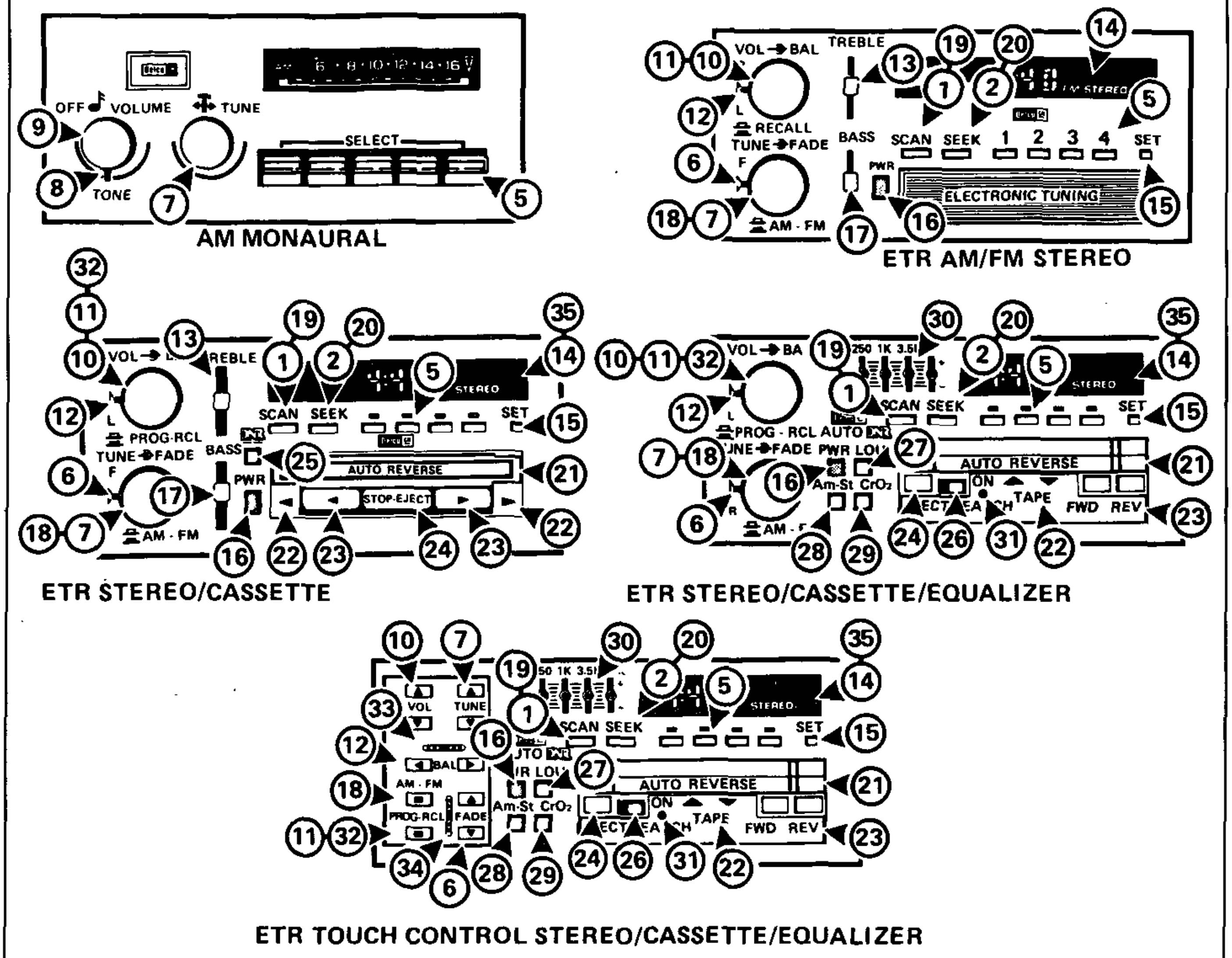
- **Left Knob**
This knob turns the set on or off, and controls the volume. Behind the volume knob is a tone control. When turned to the right, it increases treble and voice clarity; when turned to the left, it increases bass.
- **Right Knob**
This knob is a manual tuning control for choosing radio stations. For radios with rear speakers, a fader control is behind it. This control adjusts the sound between the front and rear speakers.
- **Pushbuttons**
Each radio has five pushbuttons you can use to select your favorite stations easily. After using a pushbutton, you may have to "fine-tune" the radio by hand for the best reception.
To Set Pushbuttons:

1. Make sure the AM-FM bandswitch is on the band you want. Tune in the desired station.
2. Choose the button you wish to use and pull it straight out.
3. Push in the button until it stops. The radio will tune in the selected station whenever you push that station button.

ETR AM-FM STEREO (UM-7)

ETR AM-FM Stereo Radio Operation

- **Power Button** ("PWR") - press to turn radio 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.
- **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.
- **Pushbuttons**
The radio has four pushbuttons you can use to select your favorite stations easily. You may select four AM and four FM stations for a total of eight selections.
To Set Pushbuttons:
  1. Make sure the AM-FM bandswitch is on the band you want. Tune in the desired station.
  2. Press SET button. The SET indicator light on the dial will light up. Then press one of the four station pushbuttons. The SET indicator light will then go out.
  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


AM MONAURAL

ETR AM/FM STEREO

ETR STEREO/CASSETTE

ETR STEREO/CASSETTE/EQUALIZER

ETR TOUCH CONTROL STEREO/CASSETTE/EQUALIZER

① – CLOCK HOUR SET

② – CLOCK MINUTE SET

⑤ – STATION PRESET PUSHBUTTONS

⑥ – FRONT/REAR SPEAKER CONTROL

⑦ – MANUAL TUNING CONTROL

⑧ – TONE CONTROL

⑨ – ON-OFF/VOLUME CONTROL

⑩ – VOLUME CONTROL

⑪ – PROGRAM RECALL

⑫ – LEFT-TO-RIGHT BALANCE CONTROL

⑬ – TREBLE CONTROL

⑭ – STEREO INDICATOR LIGHT

⑮ – TIME AND/OR STATION PRE-SET

⑯ – ON/OFF POWER

⑰ – BASS CONTROL

⑱ – AM/FM BAND SWITCH

⑲ – SCAN BUTTON

⑳ – SEEK BUTTON

㉑ – TAPE DOOR

㉒ – DIRECTION INDICATOR LIGHT

㉓ – FORWARD/REVERSE BUTTON

㉔ – STOP/EJECT BUTTON

㉕ – DYNAMIC NOISE REDUCTION

㉖ – TAPE SEARCH

㉗ – LOUDNESS CONTROL

㉘ – AM STEREO BUTTON

㉙ – TAPE EQUALIZATION BUTTON

㉚ – EQUALIZER CONTROLS

㉛ – SEARCH-ON INDICATOR

㉜ – CHANGE TAPE-SIDE BUTTON

㉝ – BALANCE LEVEL INDICATOR

㉞ – FADE LEVEL INDICATOR

㉟ – SCAN INDICATOR

G20004-9A

Fig. 5 Radios Available

be lit during SCAN operation. Press the SEEK button to locate and retain the next listenable station on the band automatically.

- **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.

- **FM & FM Stereo Broadcasts**

  The FM stereo indicator will light up whenever an FM station is broadcasting in stereo. "Stereo" operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right". Stereo sound is more realistic.

  FM broadcasts are "line of sight" from station antenna to receiving antenna. The range is often limited to 25 miles (40 km) or less for steady reception. Tall buildings or hills may cause flutter or noise which is not the fault of the radio.

ETR STEREO/CASSETTE (UM-6)

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.
- **Pushbuttons**

  The radio has four pushbuttons you can use to select your favorite stations easily. You may select four AM and four FM stations for a total [illegible]

  1. Make sure the AM-FM bandswitch is on the band you want. Tune in the desired station.
  2. Press SET button. The SET indicator light on the dial will light up. Then press one of the four station pushbuttons. The SET indicator light will go out.

  The radio will tune in the selected station whenever you push 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.

- **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.

- **FM & FM Stereo Broadcasts**

  The FM stereo indicator will light up whenever an FM station is broadcasting in stereo. "Stereo" operation means the radio is separating a stereo broadcast back into the original channels, called "left" and "right". Stereo sound is more realistic.

  FM broadcasts are "line-of-sight" from station antenna to receiving antenna. Range is often limited to 25 miles (40 km) or less for steady reception. Tall buildings or hills may cause flutter or noise which is not the fault of the radio.

- **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 to the next selection quickly, press the button next to the lighted indicator. To listen to an earlier selection, press the button next to the **unlighted** indicator. To stop the forward or reverse movement press the STOP-EJECT button; press again to eject the tape.

  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.

[illegible]

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.

ETR STEREO/CASSETTE/EQUALIZER (UX-1)

ETR AM Stereo-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.
- **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.

  Note: Switching to stereo improves fidelity, but may increase noise on weaker stations. Switching stereo "off" may improve the reception in this case.
- **FM & FM Stereo Broadcasts**

  The stereo indicator light will be displayed when a FM station is broadcasting in stereo. "Stereo" operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right". Stereo sound is more realistic.

  FM broadcasts are "line of sight" from station antenna to receiving antenna. The range is often limited to 25 miles (40 km) or less for steady reception. Tall buildings or hills may cause flutter or noise which is not the fault of the radio.
- **5-Band Graphic Equalizer** - allows you to adjust bass, midrange, and treble to suit personal taste. Move control up to increase frequency boost or down to decrease frequency boost.

  NOTE: 60 and 250 denote bass; 1K denotes midrange; 3.5K and 10K denote treble.

  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.
- **Pushbuttons**

  The radio has four pushbuttons you can use to easily select your favorite stations. You may select four AM and four FM stations for a total of eight selections.

  To Set Pushbuttons:

  1. Make sure the AM-FM bandswitch is on the band you want. Tune in the desired station.
  2. Press SET button. The SET indicator light on the dial will light up. Then press one of the four station pushbuttons. The SET indicator light will go out.

     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.
- **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).

ETR TOUCH CONTROL STEREO/CASSETTE/EQUALIZER (UT-4)

Radio Operation

- **Power Button** ("PWR") - Press to turn radio on. Press again to turn radio off.
- **Program Recall Button** ("PRG-RCL") - Press to recall station frequency when listening to the radio with the ignition on, or to display the time of day with ignition off. When the cassette is playing, press to play other side of tape.
- **AM-FM Band Switch Button** ("AM-FM") - press button to select AM or FM band alternately.
- **Volume Buttons** ("VOL") - press and hold button with arrow pointing up to increase volume.

  Press and hold button with arrow pointing down to decrease volume.

  Press and hold both buttons at the same time to return to the preset volume level.

  NOTE: If radio is playing at high volume and the radio or the ignition is turned off, the radio will return to the preset volume level.
- **AM Stereo Button** ("AM-ST") - press to receive AM stereo. Stereo indicator light on the dial 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.

  NOTE: Switching to stereo improves fidelity, but may increase noise on weaker stations. Switching

  The stereo indicator light on the dial will be displayed when an FM station is broadcasting in stereo. "Stereo" operation means the radio is separating a stereo broadcast back into the original two channels, called "left" and "right". Stereo sound is more realistic.
- FM broadcasts are "line of sight" from station antenna to receiving antenna. The range is often limited to 25 miles (40 km) or less for steady reception. Tall buildings or hills may cause flutter or noise which is not the fault of the radio.
- **Loudness Button** ("LOUD") - press to boost bass frequencies when the system is playing at low volume.
- **Tune Buttons** ("TUNE")

  Press and hold button with arrow pointing up to tune up the frequency band manually.

  Press and hold button with arrow pointing down to tune down the frequency band manually.

  When tuning either up or down the frequency band, pressing the other button at the same time increases the scanning rate.
- **Seek and Scan Buttons**

  Press SCAN button to sample each station being received automatically. To stop SCAN, press SCAN button a second time. The SCAN indicator will be lit up during SCAN operation.

  Press SEEK button to locate and retain the next listenable station on the band automatically.
- **Time Set**

  To set hour, press SET button. The SET indicator on the dial will light. Then press SCAN button and hold until correct hour appears.

  To set minutes, press SET button. The SET indicator on the dial will light. Then press SEEK button and hold until correct minutes appear.
- **Balance Buttons** ("BAL") - Press and hold BAL button with arrow pointing to the left to adjust sound to the left. Press and hold button with arrow pointing to the right to adjust sound to the right.

  Hold both BAL buttons at the same time to return balance control to its center position.

  NOTE: Above the balance buttons is a light indicating the balance level.
- **Fade Buttons** ("FADE") - Press and hold button with arrow pointing up to fade sound to the front of the car. Press and hold button with arrow pointing down to fade sound to the rear of the car.

  Hold both fader buttons at the same time to return fader to its preset center position.

  NOTE: To the left of the fade buttons is a light indicating the fade level.
- **Pushbuttons**

  The radio has four pushbuttons you can use to select your favorite stations easily. You can select four AM and four FM stations for a total of eight selections.

  To Set Pushbuttons:

2. Press SET button. The SET indicator light on the dial will be displayed. Then press one of the four station pushbuttons. The SET indicator light will go out.

The radio will tune in the selected station whenever you push that station button.

- **5-Band Graphic Equalizer** - allows you to adjust bass, midrange, and treble to suit personal taste. Move control up to increase that frequency boost or down to decrease that frequency boost. When all five controls are in the center position, the system has a flat frequency response.

NOTE: 60 and 25 denote bass; 1K denotes midrange, 3.5K and 10K denotes treble.

This radio has automatic Dynamic Noise Reduction (DNR®) to reduce high frequency background hiss on AM, FM, AM stereo, FM stereo, and tape.

- **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 lit 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 "PRG-RCL" button. 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).

ON-CAR SERVICE

SAIL PANEL SPEAKERS

←→ Remove or Disconnect

1. Rear quarter trim panel as described in Body Service Manual Section 6.
2. Speaker wiring connector.
3. Three speaker mounting screws.
4. Speaker from plastic speaker retainer.

→← Install or Connect

1. New speaker into plastic speaker retainer.
2. Three speaker mounting screws.
3. Speaker wiring connector.
4. Rear quarter trim panel.

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 any wires, as this will cause damage to the output circuit in the radio.

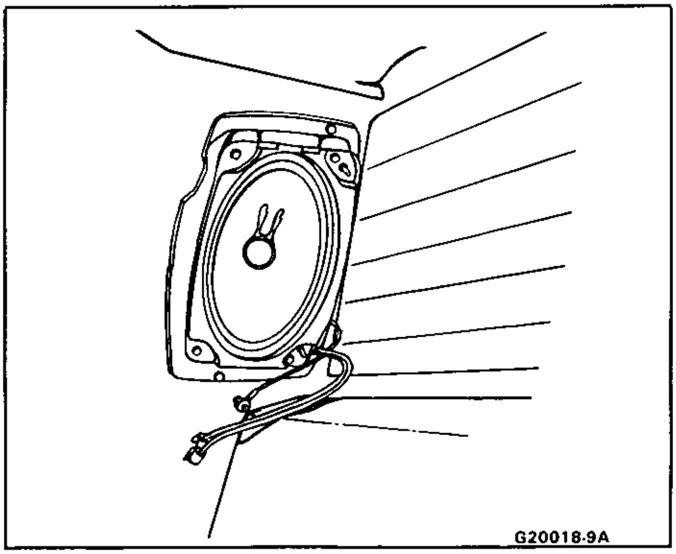


Fig. 6 Sail Panel Speaker Mounting

SUB-WOOFER SPEAKER

←→ Remove or Disconnect

1. Sub-woofer wiring connector.

2. Courtesy lamp bulb near I/P support bracket, if applicable.
3. I/P support bracket bolt (and plastic retaining pin, if applicable).
4. Convenience center mounting bracket bolt.
5. Pull I/P toward rear of car slightly, if necessary. Slide sub-woofer assembly to left, then pull straight down to remove.

Install or Connect

Reverse above steps to reinstall sub-woofer assembly.

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 any wires, as this will cause damage to the output circuit in the radio.

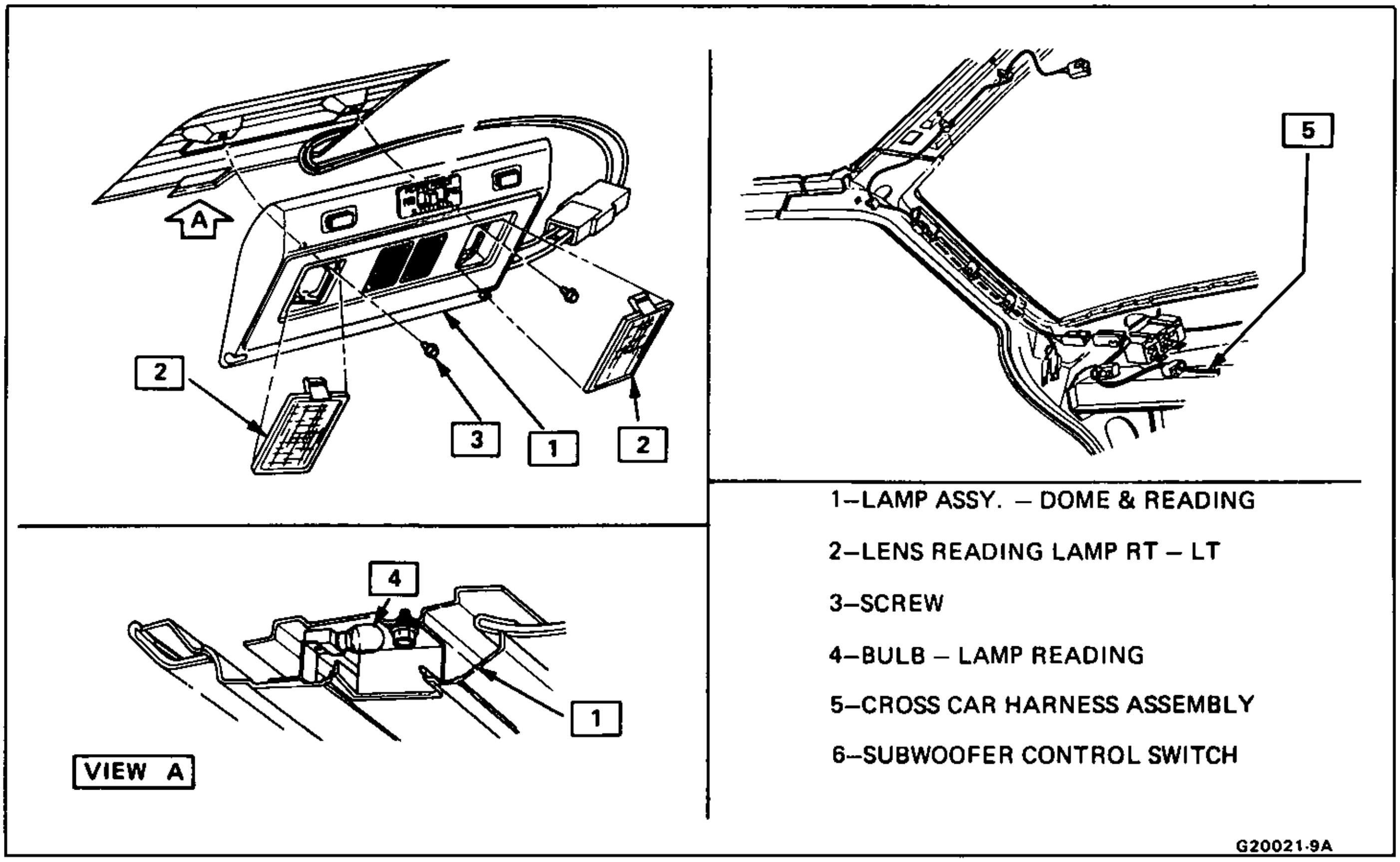
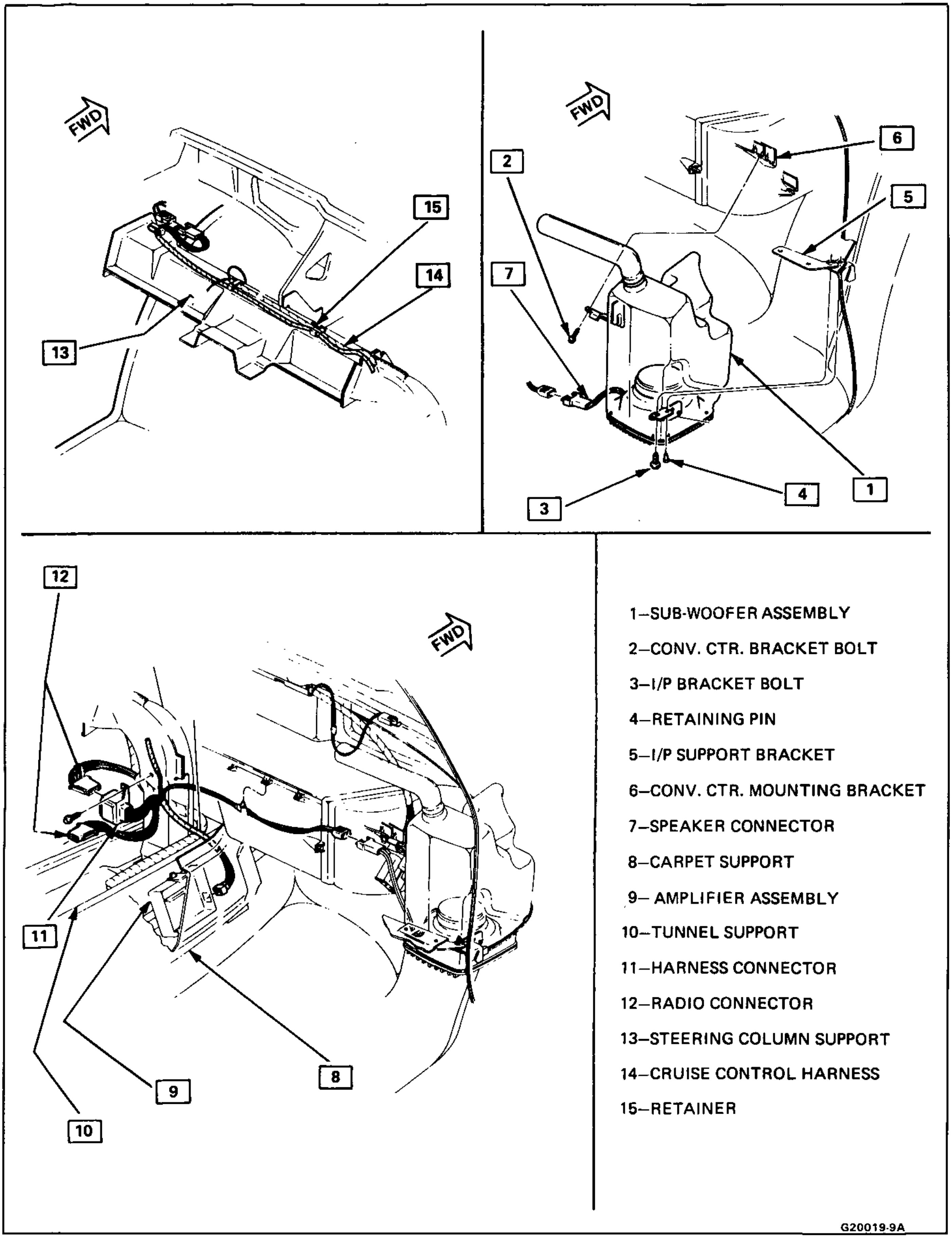
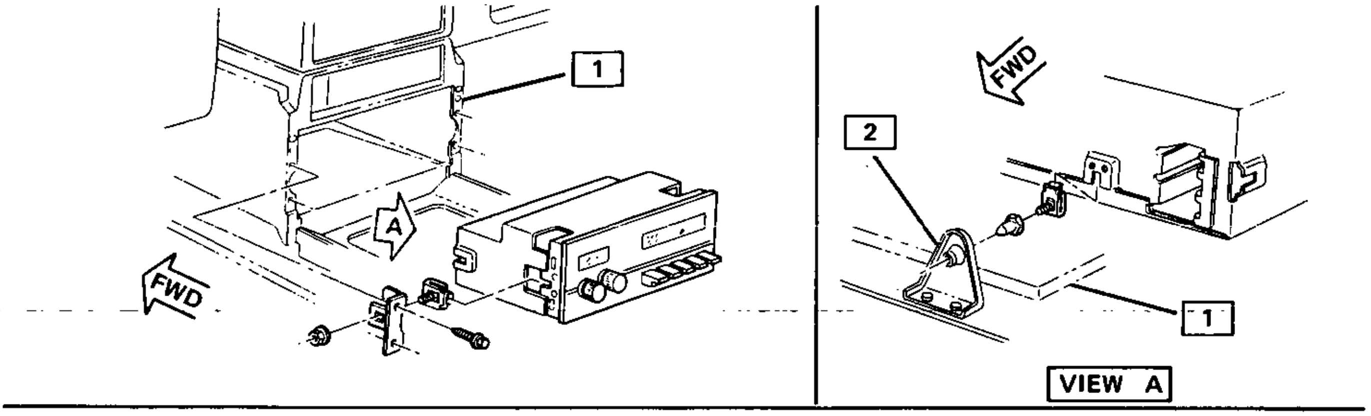


Fig. 7 Sub-Woofer Switch/Wiring



1—SUB-WOOFER ASSEMBLY
2—CONV. CTR. BRACKET BOLT
3—I/P BRACKET BOLT
4—RETAINING PIN
5—I/P SUPPORT BRACKET
6—CONV. CTR. MOUNTING BRACKET
7—SPEAKER CONNECTOR
8—CARPET SUPPORT
9— AMPLIFIER ASSEMBLY
10—TUNNEL SUPPORT
11—HARNESS CONNECTOR
12—RADIO CONNECTOR
13—STEERING COLUMN SUPPORT
14—CRUISE CONTROL HARNESS
15—RETAINER

Fig. 8 Sub-Woofer, Amplifier and Wiring



1 — CONSOLE SUPPORT ASM

2 — BRACKET

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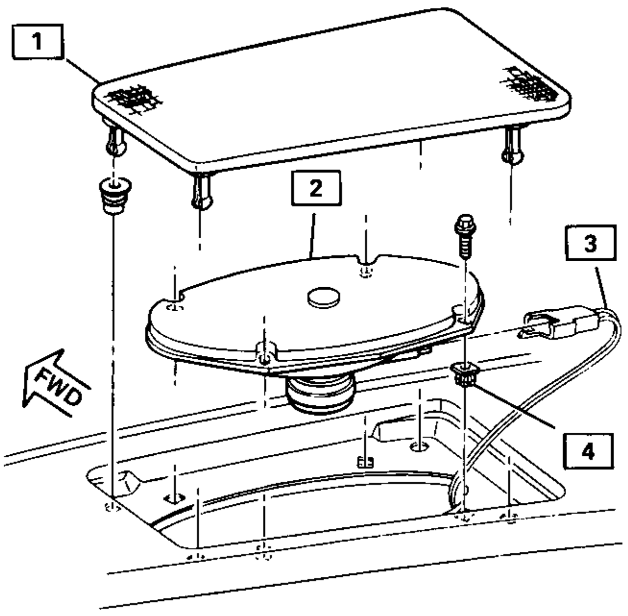
Fig. 9 Radio Mounting



1 — GRILL
2 — SPEAKER ASM.
3 — TO CONVENIENCE CTR WIRING
4 — INSTRUMENT PANEL

520256-9

Fig. 10 Front Speaker and Grille Mounting

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".

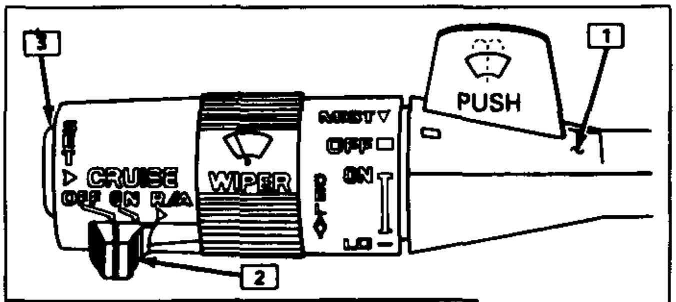
The main parts of the cruise control system are the mode control switches, controller (module), servo unit, speed sensor, vacuum supply, electrical and vacuum release switches, and electrical harness.

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)

The Off/On/Resume/Accel Switch (Figure 1) 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) up to ten times. After 10 times the system must be reset to a new speed to continue this function.



1—DIRECTIONAL SIGNAL LEVER
2—OFF/ON/RESUME/ACCEL SWITCH
3—SET/COAST SWITCH

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Fig. 1 Multi-Function Lever

SET/COAST BUTTON SWITCH

The cruise control Set/Coast Switch (located in the end of the turn signal lever) (Figure 1) has two positions - "Normal" and "Depressed".

- **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 system can "tap-down" until it reaches the low speed limit of 25 mph. After this the cruise will not operate.

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)

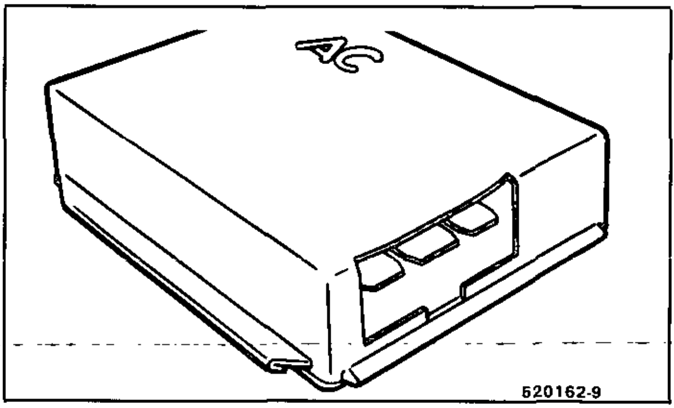
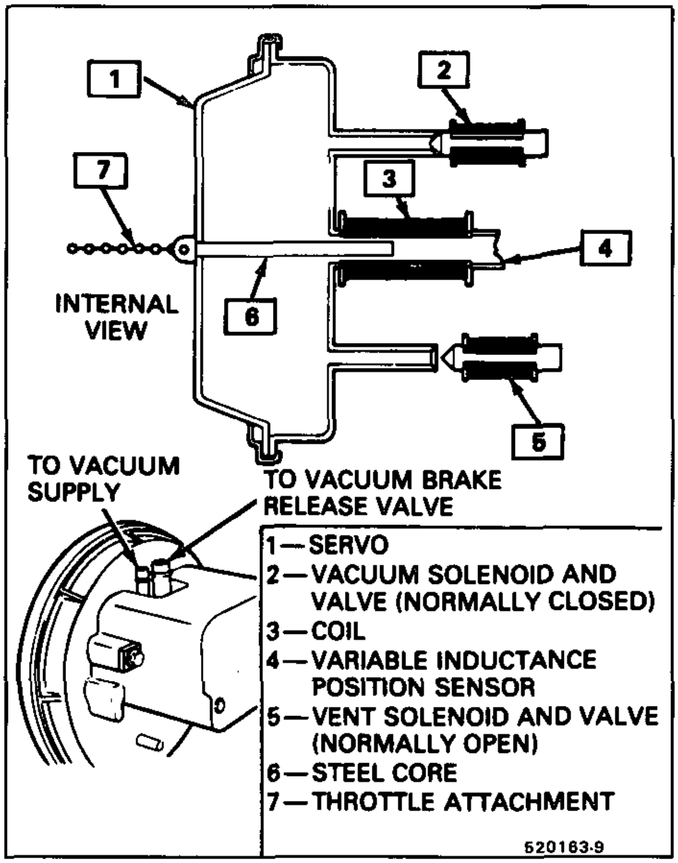


Fig. 2 Controller (Module)

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 accelerator pedal bracket. For specific mounting location and removal procedure, turn to the On-Car Service portion of this section.

SERVO UNIT



1—SERVO
2—VACUUM SOLENOID AND VALVE (NORMALLY CLOSED)
3—COIL
4—VARIABLE INDUCTANCE POSITION SENSOR
5—VENT SOLENOID AND VALVE (NORMALLY OPEN)
6—STEEL CORE
7—THROTTLE ATTACHMENT

Fig. 3 Servo Unit

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 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 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 ±1/4 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

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 controller.

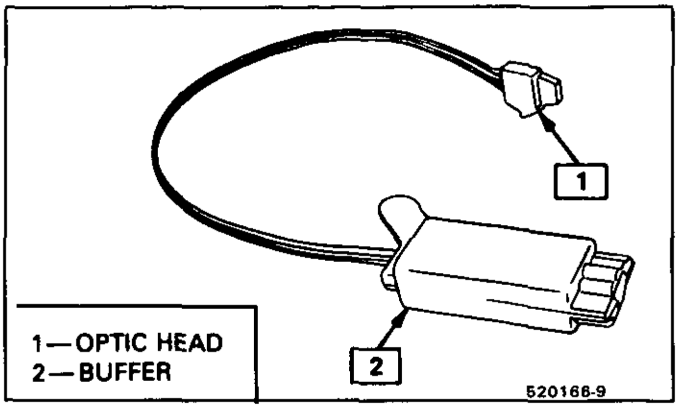


Fig. 4 VSS (Vehicle Speed Sensor)

P. M. Generator Speed Signal

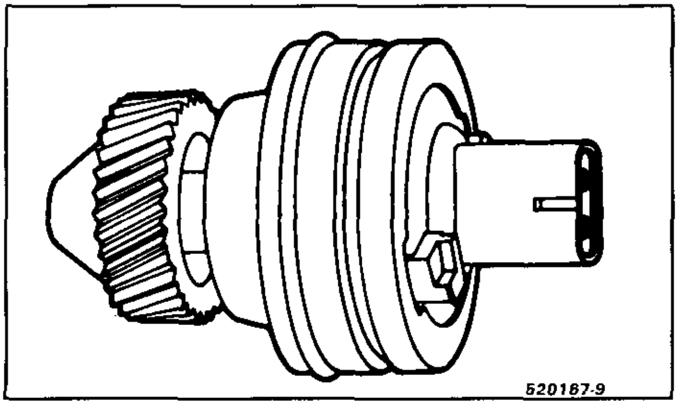


Fig. 5 P. M. Generator

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 on each application, 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 the Electrical Diagnosis Section (8A) of the Service Manual.

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.

If preliminary inspection reveals no solution and the system is inoperative, follow the six diagnostic charts to isolate the problem.

Since any problem in this system is either vacuum, mechanical, or electrical, the technician should be able to quickly diagnose problems without using the six (6) diagnostic charts after he has gone through them the first few times. 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 and throttle linkage. If these things check out, it is an electrical problem. After checking the fuse, following the diagnostic charts should quickly isolate the problem area.

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).
- Follow the servo test chart (Figures 15 and 16).
- If no system problem is noted, replace the electronic controller (module).

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.

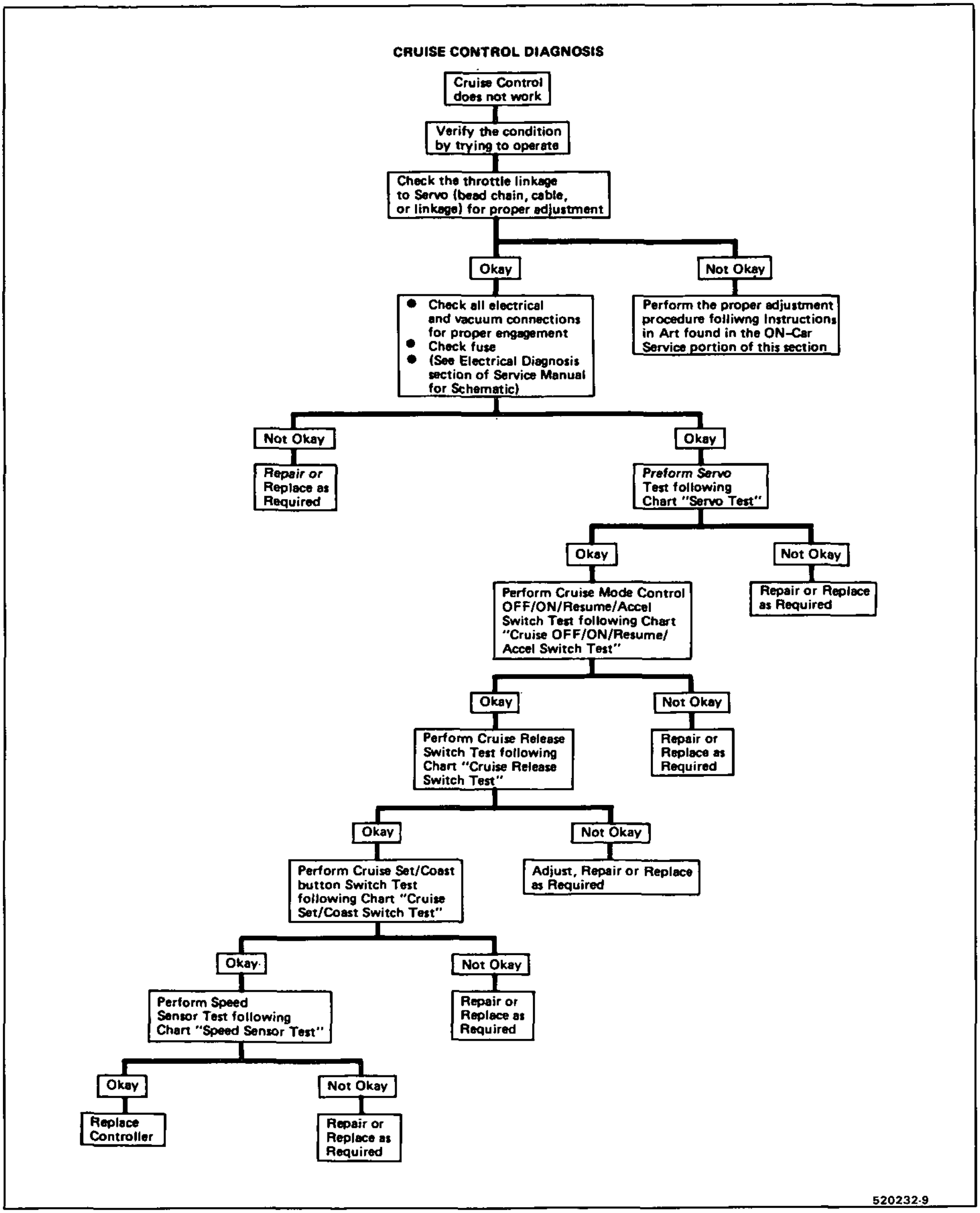


Fig. 6 Cruise Diagnostic Chart #1

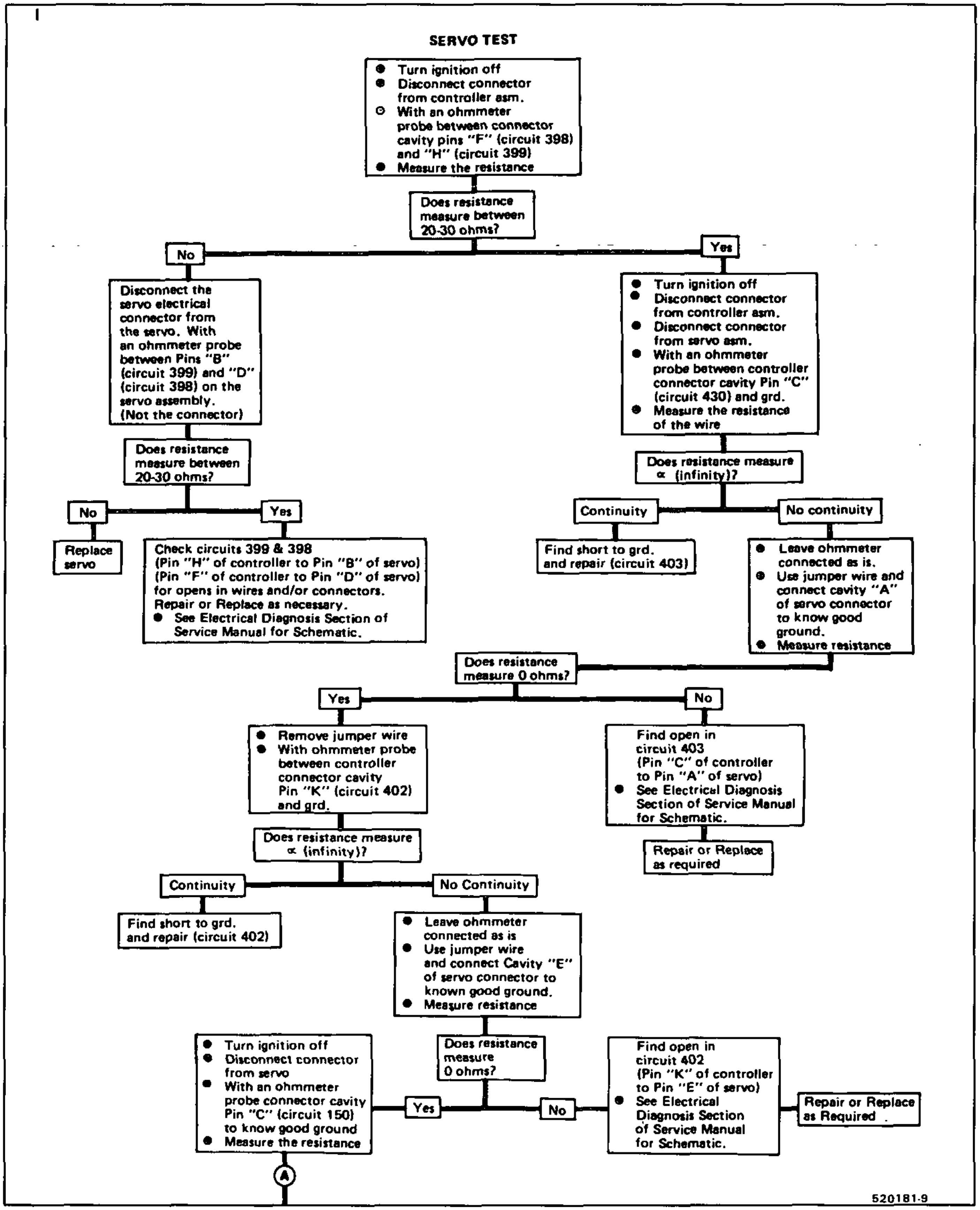


Fig. 7 Cruise Diagnostic Chart #2

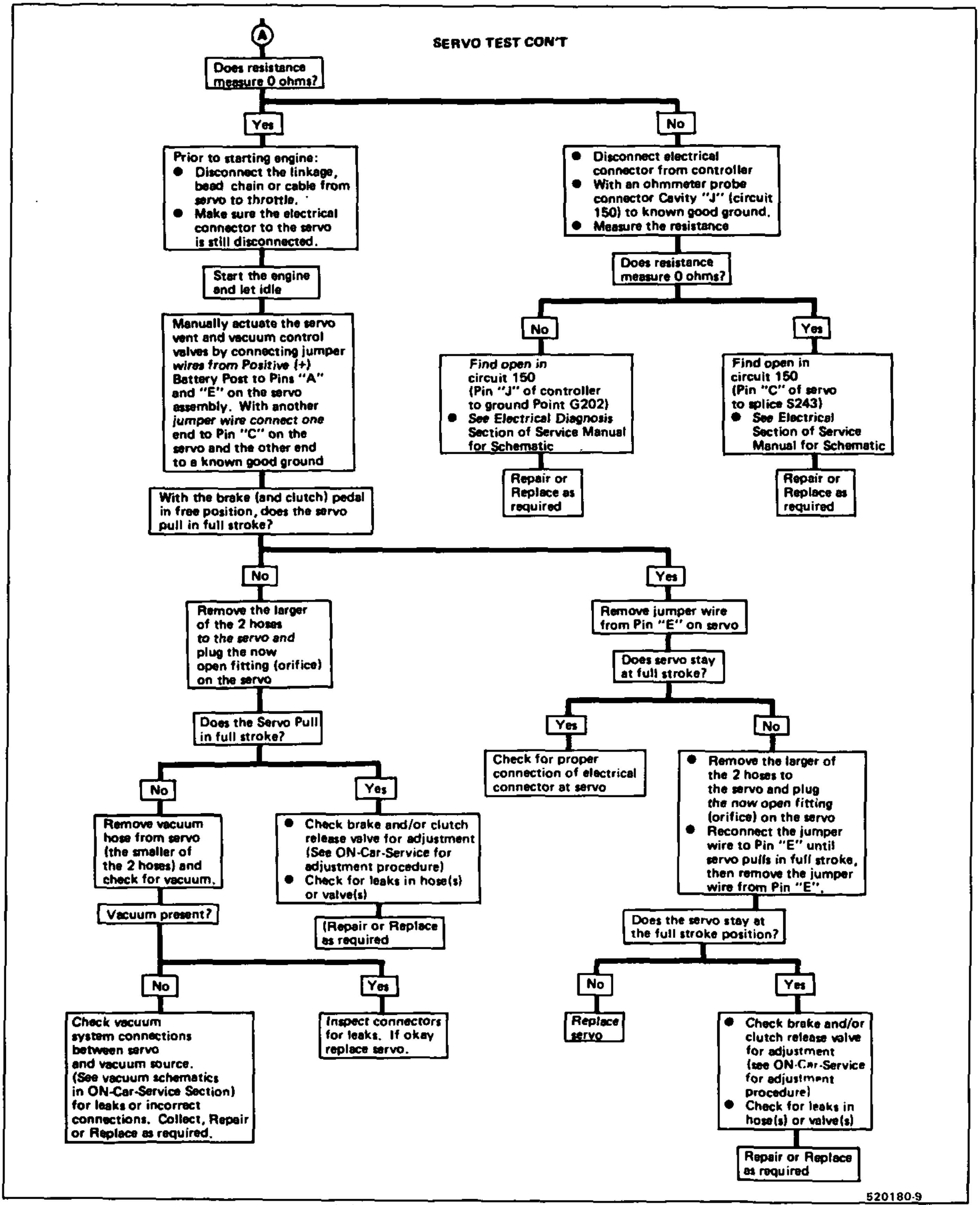
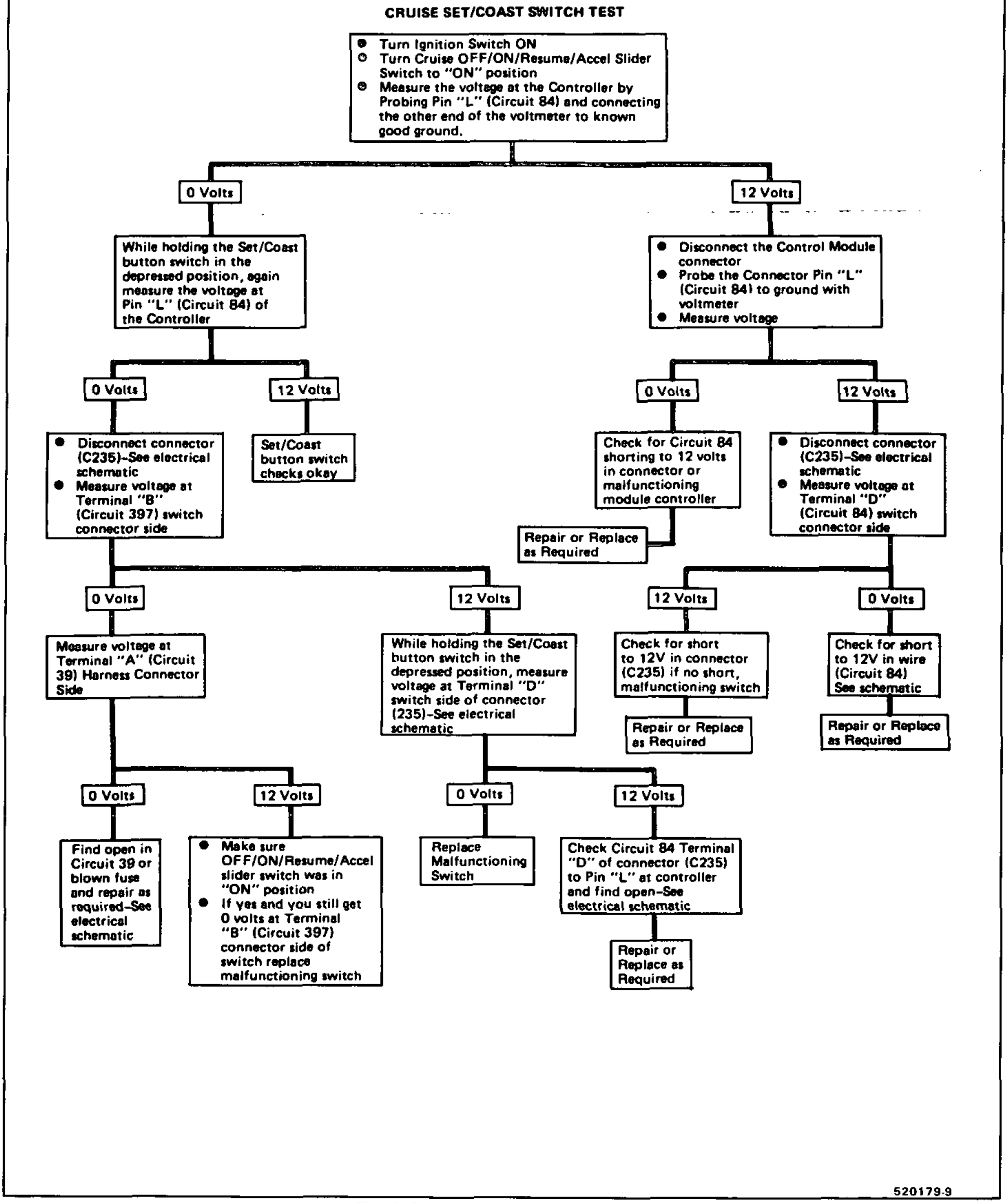


Fig. 8 Cruise Diagnostic Chart #2 (Continued)



CRUISE SET/COAST SWITCH TEST

- Turn Ignition Switch ON
- Turn Cruise OFF/ON/Resume/Accel Slider Switch to "ON" position
- Measure the voltage at the Controller by Probing Pin "L" (Circuit 84) and connecting the other end of the voltmeter to known good ground.

0 Volts

While holding the Set/Coast button switch in the depressed position, again measure the voltage at Pin "L" (Circuit 84) of the Controller

0 Volts

- Disconnect connector (C235)-See electrical schematic
- Measure voltage at Terminal "B" (Circuit 397) switch connector side

0 Volts

Measure voltage at Terminal "A" (Circuit 39) Harness Connector Side

0 Volts

Find open in Circuit 39 or blown fuse and repair as required-See electrical schematic

12 Volts

- Make sure OFF/ON/Resume/Accel slider switch was in "ON" position
- If yes and you still get 0 volts at Terminal "B" (Circuit 397) connector side of switch replace malfunctioning switch

12 Volts

While holding the Set/Coast button switch in the depressed position, measure voltage at Terminal "D" switch side of connector (235)-See electrical schematic

0 Volts

Replace Malfunctioning Switch

12 Volts

Check Circuit 84 Terminal "D" of connector (C235) to Pin "L" at controller and find open-See electrical schematic

Repair or Replace as Required

12 Volts

Set/Coast button switch checks okay

12 Volts

- Disconnect the Control Module connector
- Probe the Connector Pin "L" (Circuit 84) to ground with voltmeter
- Measure voltage

0 Volts

Check for Circuit 84 shorting to 12 volts in connector or malfunctioning module controller

Repair or Replace as Required

12 Volts

- Disconnect connector (C235)-See electrical schematic
- Measure voltage at Terminal "D" (Circuit 84) switch connector side

12 Volts

Check for short to 12V in connector (C235) if no short, malfunctioning switch

Repair or Replace as Required

0 Volts

Check for short to 12V in wire (Circuit 84) See schematic

Repair or Replace as Required

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Fig. 9 Cruise Diagnostic Chart #3

CRUISE "OFF/ON/RESUME/ACCEL" SWITCH TEST

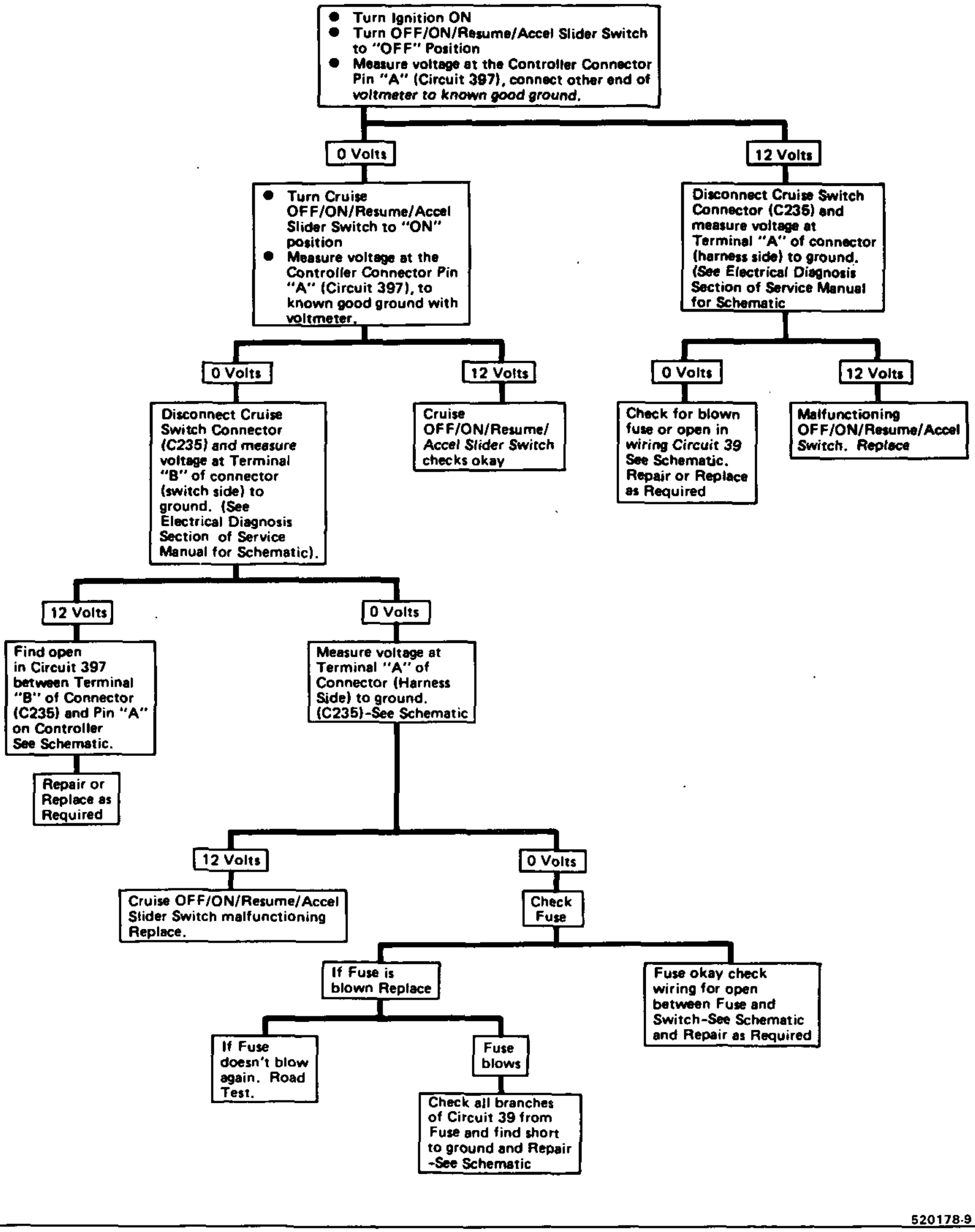


Fig. 10 Cruise Diagnostic Chart #4

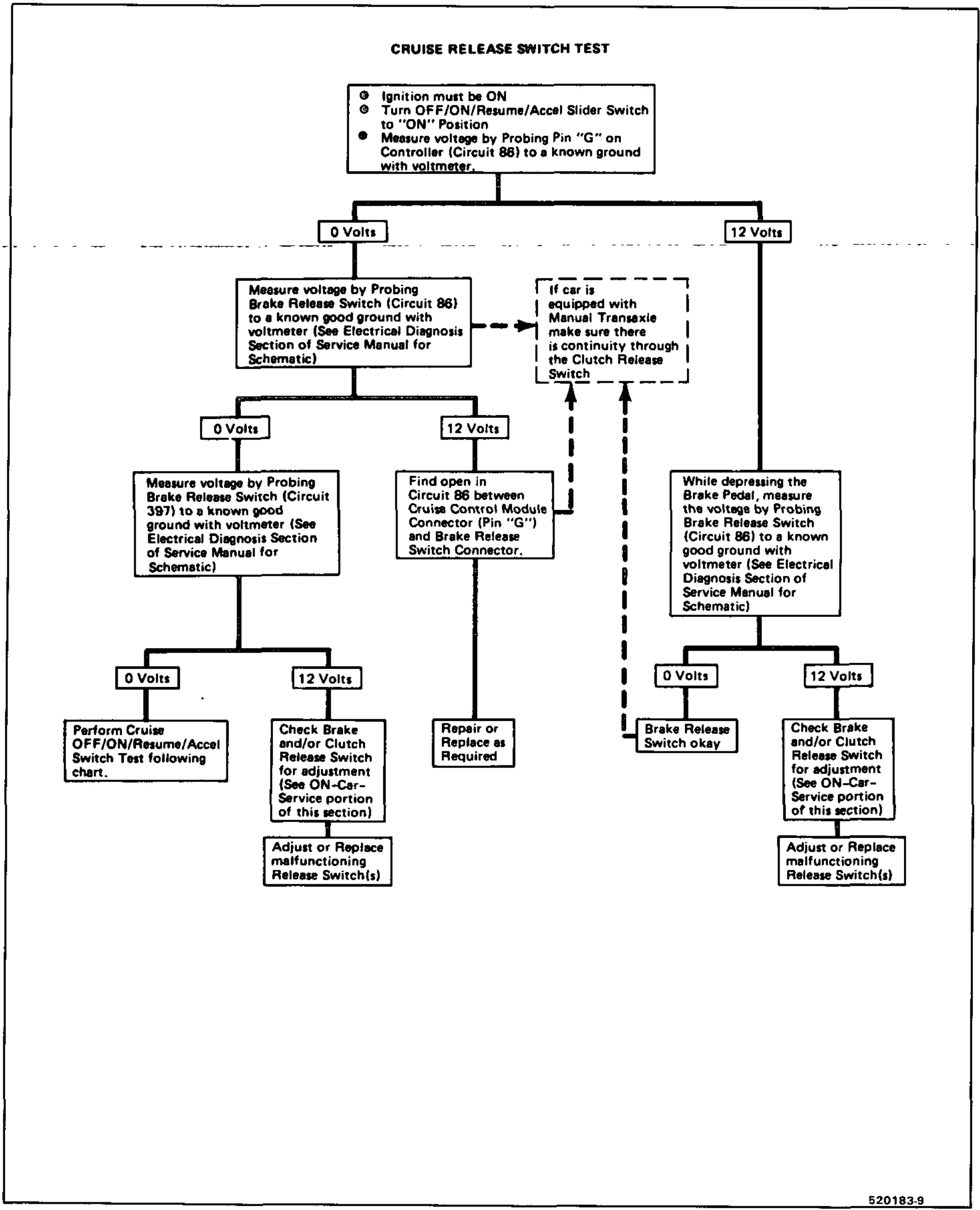
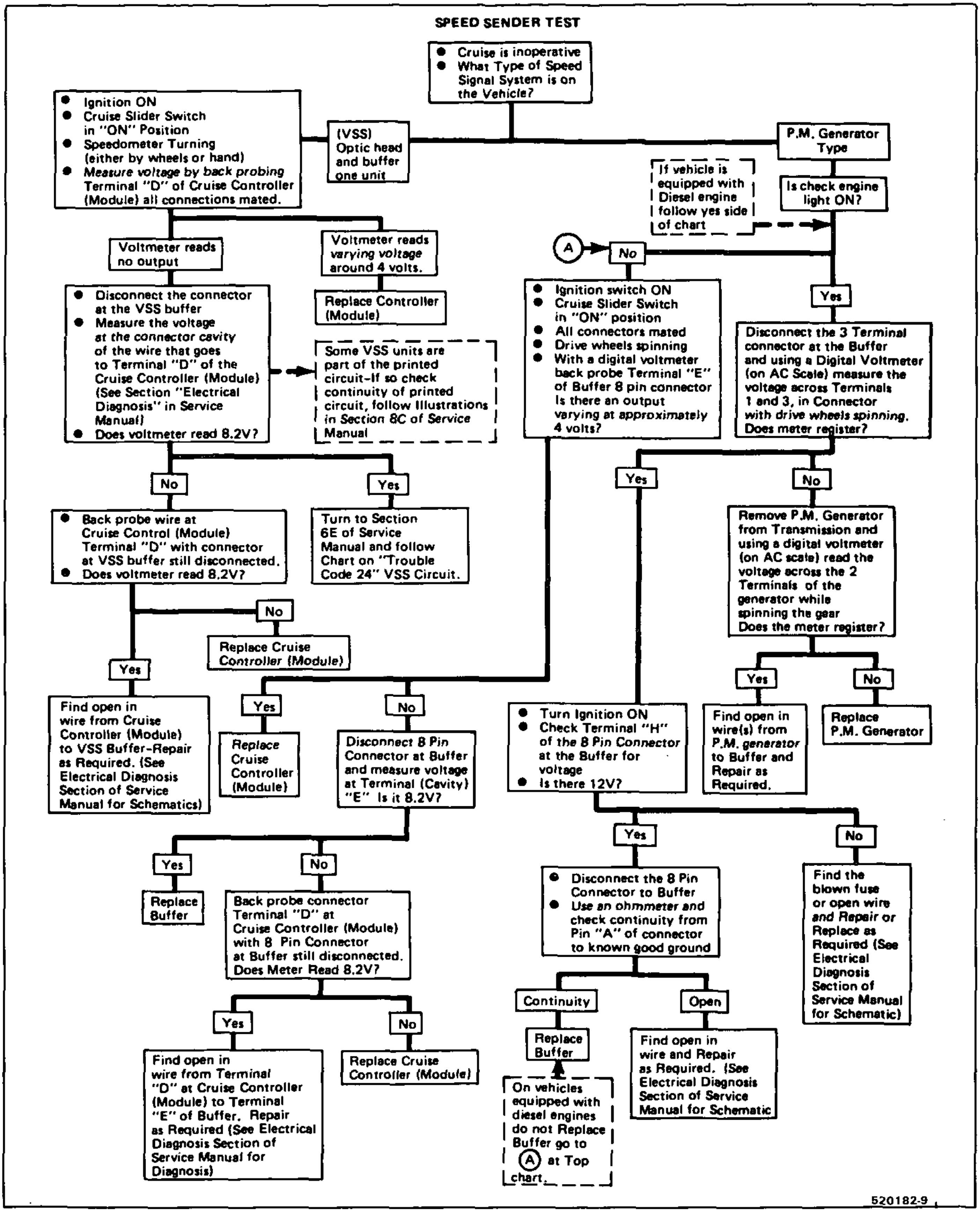


Fig. 11 Cruise Diagnostic Chart #5



SPEED SENDER TEST

- Cruise is inoperative
- What Type of Speed Signal System is on the Vehicle?

(VSS) Optic head and buffer one unit

- Ignition ON
- Cruise Slider Switch in "ON" Position
- Speedometer Turning (either by wheels or hand)
- *Measure voltage by back probing* Terminal "D" of Cruise Controller (Module) all connections mated.

Voltmeter reads no output

Voltmeter reads *varying voltage* around 4 volts.

Replace Controller (Module)

- Disconnect the connector at the VSS buffer
- Measure the voltage *at the connector cavity* of the wire that goes to Terminal "D" of the Cruise Controller (Module) (See Section "Electrical Diagnosis" in Service Manual)
- Does voltmeter read 8.2V?

Some VSS units are part of the printed circuit-If so check continuity of printed circuit, follow Illustrations in *Section 8C of Service* Manual

- Back probe wire at Cruise Control (Module) Terminal "D" with connector at VSS buffer still disconnected.
- Does voltmeter read 8.2V?

Turn to Section 6E of Service Manual and follow Chart on "Trouble Code 24" VSS Circuit.

Replace Cruise *Controller (Module)*

Find open in wire from Cruise Controller (Module) to VSS Buffer-Repair as Required. (See Electrical Diagnosis Section of Service Manual for Schematics)

Replace Cruise Controller (Module)

Disconnect 8 Pin Connector at Buffer and measure voltage at Terminal (Cavity) "E" Is it 8.2V?

Replace Buffer

Back probe connector Terminal "D" at Cruise Controller (Module) with 8 Pin Connector at Buffer still disconnected. Does Meter Read 8.2V?

Find open in wire from Terminal "D" at Cruise Controller (Module) to Terminal "E" of Buffer. Repair as Required (See Electrical Diagnosis Section of Service Manual for Diagnosis)

Replace Cruise *Controller (Module)*

P.M. Generator Type

Is check engine light ON?

If vehicle is equipped with Diesel engine follow yes side of chart

- Ignition switch ON
- Cruise Slider Switch in "ON" position
- All connectors mated
- Drive wheels spinning
- With a digital voltmeter back probe Terminal "E" of Buffer 8 pin connector Is there an output varying at *approximately* 4 volts?

Disconnect the 3 Terminal connector at the Buffer and using a Digital Voltmeter (on AC Scale) measure the voltage across Terminals 1 and 3, in Connector with *drive wheels spinning.* Does meter register?

Remove P.M. Generator from Transmission and using a digital voltmeter (on AC scale) read the voltage across the 2 Terminals of the generator while spinning the gear Does the meter register?

Find open in wire(s) from *P.M. generator* to Buffer and Repair as Required.

Replace P.M. Generator

- Turn Ignition ON
- Check Terminal "H" of the 8 Pin Connector at the Buffer for voltage
- Is there 12V?

- Disconnect the 8 Pin Connector to Buffer
- *Use an ohmmeter and* check continuity from Pin "A" of connector to known good ground

Replace Buffer

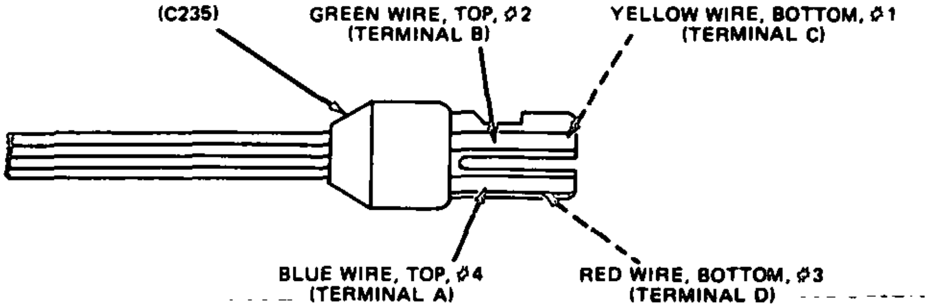
On vehicles equipped with diesel engines do not Replace Buffer go to Ⓐ at Top chart.

Find open in wire and Repair as Required. (See Electrical Diagnosis Section of Service Manual for Schematic

Find the blown fuse or open wire *and Repair or* Replace as Required (See Electrical Diagnosis Section of Service Manual for Schematic)

Fig. 12 Cruise Diagnostic Chart #6

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	MEASURE BETWEEN PINS E AND C (IF MEASURED RESISTANCE IS NOT STATED VALUE, REPLACE SERVO)

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Fig. 13 Controller, Servo & Control Switch Check

ON-CAR SERVICE

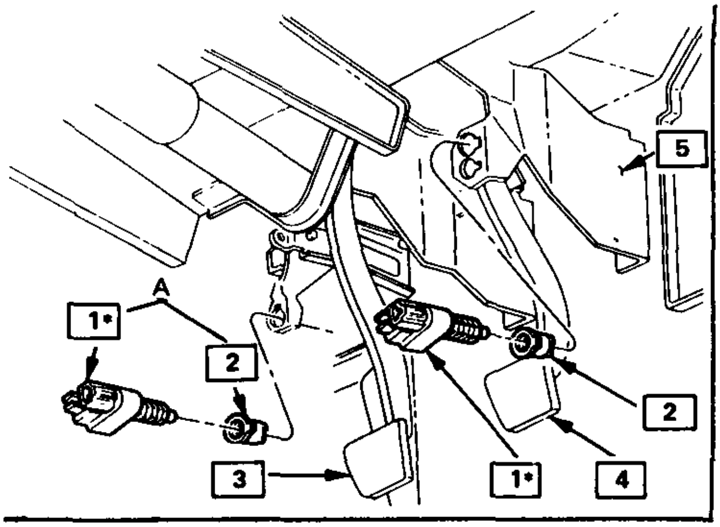
CRUISE CONTROL SERVO CABLE ADJUSTMENT (Figure 15).

1. With cable assembly installed in bracket install cable assembly end on to stud of E.F.I. lever. Secure with retainer.

2. Pull servo assembly end of cable toward servo without moving E.F.I. lever.

3. If one of the six holes in the servo assembly tab lines up with cable pin, connect pin to tab with retainer.
4. If a tab hole does not line up with the pin, move the cable away from the servo assembly until the next closest tab hole lines up. Connect pin to tab with retainer.

CAUTION: Do not stretch cable so as to make a particular tab hole connect to pin. This will prevent engine from returning to idle.



INSTALLATION OF SELF-ADJUSTING SWITCH ASM

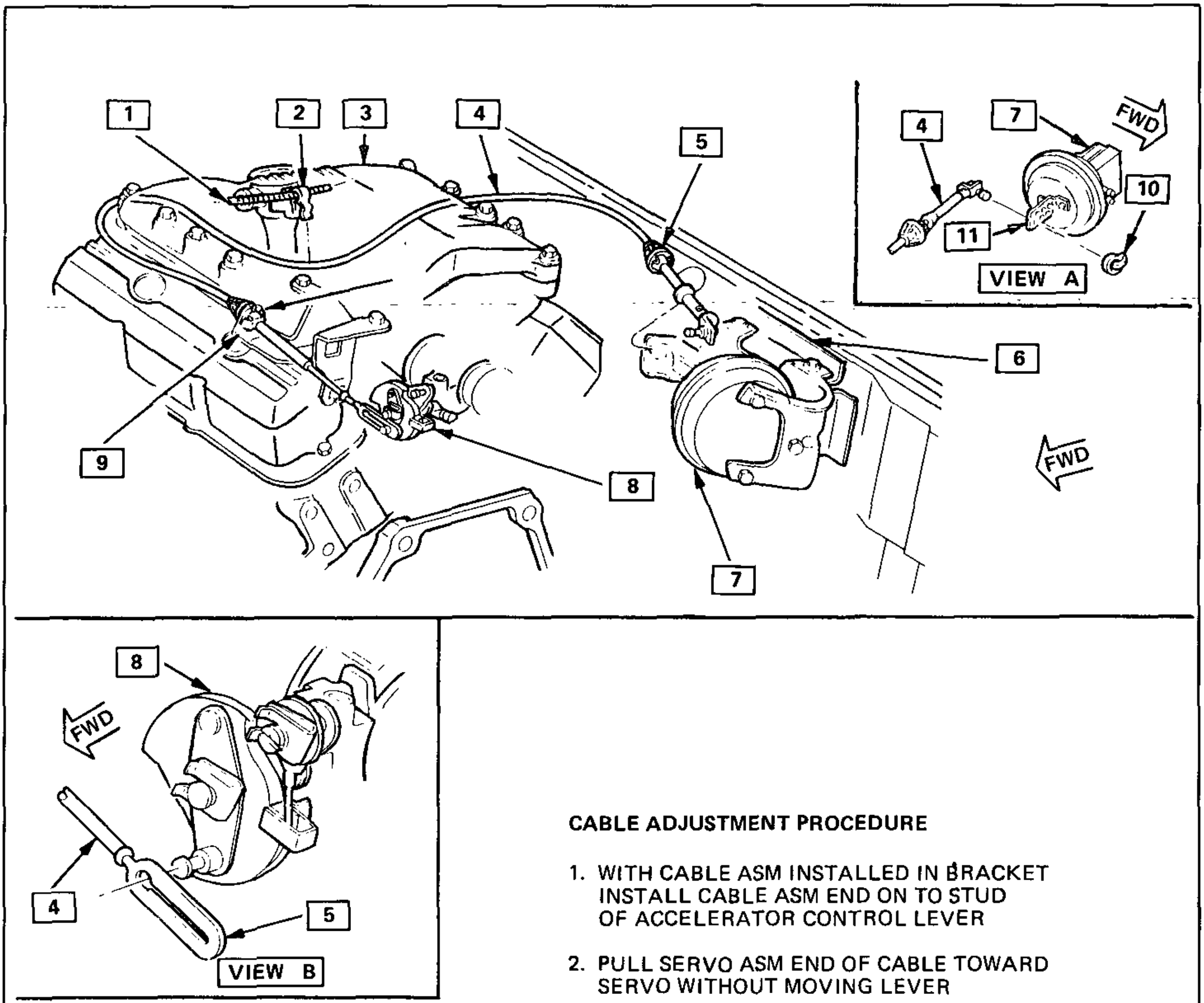
1. INSTALL RETAINER
2. WITH BRAKE PEDAL DEPRESSED, INSERT SWITCH ASM INTO RETAINER UNTIL SWITCH BODY SEATS ON RETAINER. NOTE THAT AUDIBLE "CLICKS" CAN BE HEARD AS THREADED PORTION OF SWITCH IS PUSHED THROUGH THE RETAINER TOWARD THE BRAKE PEDAL.
3. PULL BRAKE PEDAL FULLY REARWARD AGAINST PEDAL STOP UNTIL AUDIBLE "CLICK" SOUNDS CAN NO LONGER BE HEARD. SWITCH ASM WILL BE MOVED IN RETAINER PROVIDING ADJUSTMENT
4. RELEASE BRAKE PEDAL AND REPEAT STEP (3) TO ASSURE THAT NO AUDIBLE "CLICK" SOUNDS REMAIN.
5. REPEAT STEPS 1 THRU 4 FOR CLUTCH PEDAL

1—SWITCH ASM.
2—RETAINER
3—CLUTCH PEDAL
4—BRAKE PEDAL
5—PEDAL ASM

A—MANUAL TRANS ONLY

G20009-9B

Fig. 14 Cruise Control Switch Assembly



CABLE ADJUSTMENT PROCEDURE

1. WITH CABLE ASM INSTALLED IN BRACKET INSTALL CABLE ASM END ON TO STUD OF ACCELERATOR CONTROL LEVER
2. PULL SERVO ASM END OF CABLE TOWARD SERVO WITHOUT MOVING LEVER
3. IF ONE OF THE SIX HOLES IN THE SERVO ASM TAB LINES UP WITH CABLE PIN, CONNECT PIN TO TAB WITH RETAINER
4. 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

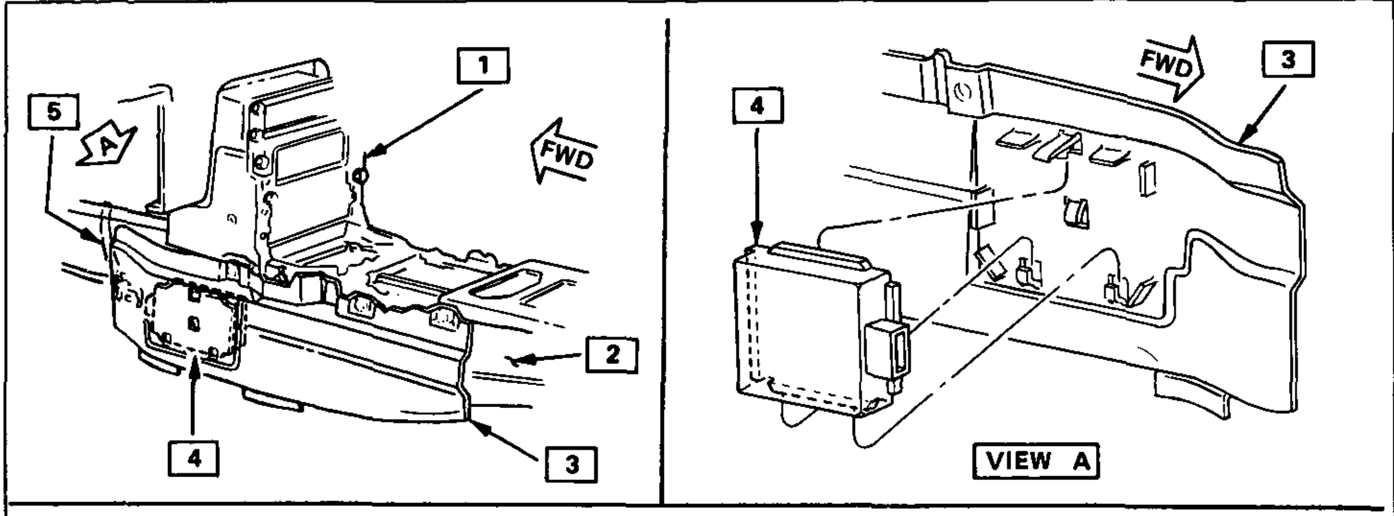
CAUTION

DO NOT STRETCH CABLE SO AS TO MAKE A PARTICULAR TAB HOLE CONNECT TO PIN, THIS WILL PREVENT ENGINE FROM RETURNING TO IDLE

1–CABLE ASM.
2–CLIP
3–ENGINE
4–CABLE ASM.
5–CABLE INSTALLED IN DIRECTION SHOWN
6–BRACKET (REINF. MOTOR COMPT.)
7–SERVO ASM.
8–LEVER ASM.
9–BRACKET
10–RETAINER
11–TAB (SERVO ASM)

G20013-9B

Fig. 15 Cruise Control Cable Assembly



1–SUPPORT ASM
2–UPPER FLOOR PAN
3–CARPET SUPT
4–MODULE ASM
5–HARNESS ASM

G20011-9B

Fig. 16 Cruise Control Module Assembly

SECTION 9E

ENGINE BLOCK HEATER

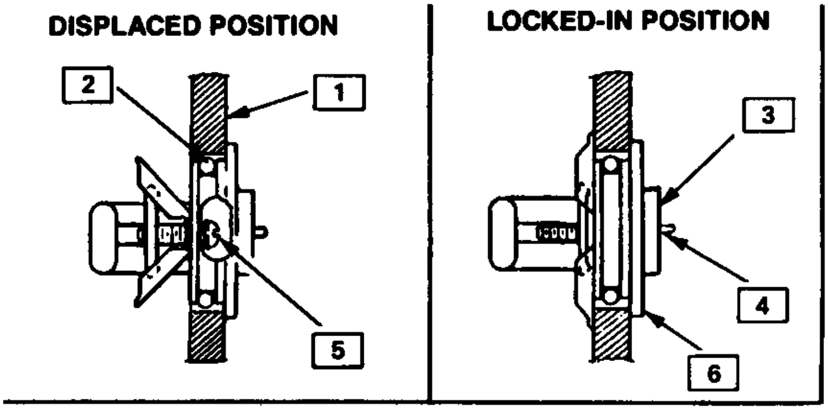
CONTENTS

GENERAL DESCRIPTION

Optional engine block heaters are rated at 600 watts and operate from a 110 volt A.C. power supply. It is important to install the heater element in the correct direction, as shown in the following figure, to avoid having the element contact the side of the block.

ON-CAR SERVICE

ILLUSTRATED

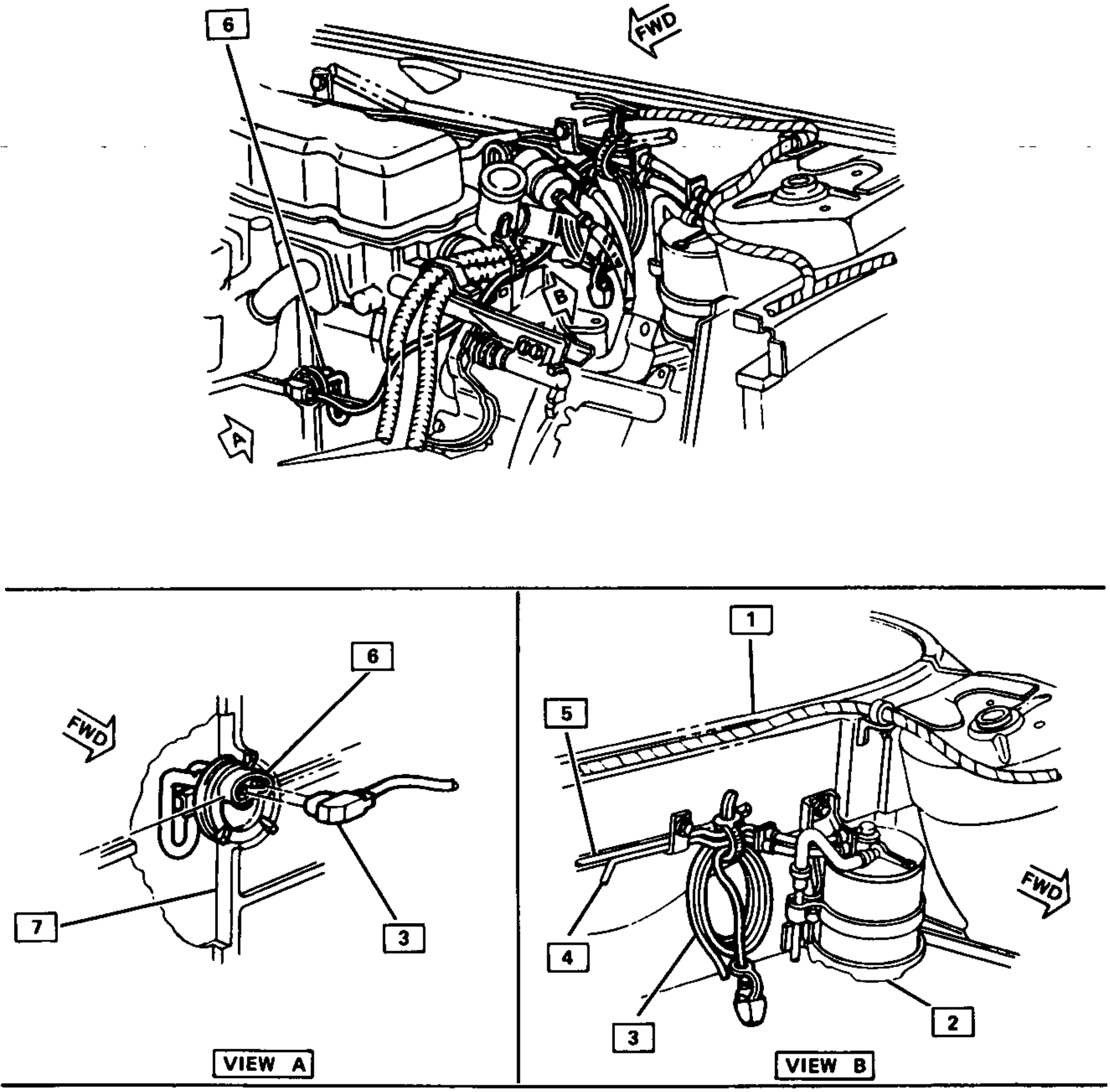


1—ENGINE BLOCK (OUTSIDE)
2—"O"-RING
3—TERMINAL GUARD
4—GROUND RING
5—BOLT/SCREW
6—SUPPORT

1. REMOVE WATER JACKET SUPPORT PLUG CAREFULLY. **CAUTION** DO NOT SCORE MACHINED SURFACE OF HOLE.
2. THOROUGHLY CLEAN PLUG HOLE REMOVING ANY BURRS, COMPOUND, PAINT OR ROUGH SPOTS.
3. APPLY A COATING OF LUBRICANT TO THE "O"-RING AND MACHINED SURFACE OF HOLE.
4. INSERT THE HAIRPIN END OF THE HEATING COIL INTO THE OPENING TO THE INSIDE FACE OF ENGINE BLOCK. TO INSERT SUPPORT INTO ENGINE BLOCK, MERELY CENTER THE AXIS OF THE HEATER AND AXIS OF THE CORE HOLE AND PUSH SUPPORT IN AS FAR AS IT WILL GO.
5. TIGHTEN BOLT/SCREW TO 1.9 N·m (17LB.IN.). **CAUTION** (EXCESSIVE TIGHTENING IS NOT NECESSARY).
6. **CAUTION** CORD MUST NOT TOUCH ENGINE, HOT PIPES, MANIFOLD OR ANY MOVING PARTS.

G20013-9E

Fig. 801 Engine Block Heater Installation



1 — ENGINE COMPARTMENT
2 — CANISTER ASM.
3 — CORD ASM.
4 — PIPE ASM. VACUUM
5 — PIPE ASM. PURGE
6 — HEATER ASM.
7 — ENGINE ASM.
8 — TERMINAL GUARD
9 — GROUND RING
10 — SUPPORT
11 — BOLT/SCREW
12 — ENGINE BLOCK (OUTSIDE)
13 — GASKETS — "O" RING

G20015-9

Fig. 802 Engine Block Heater

SECTION 9F

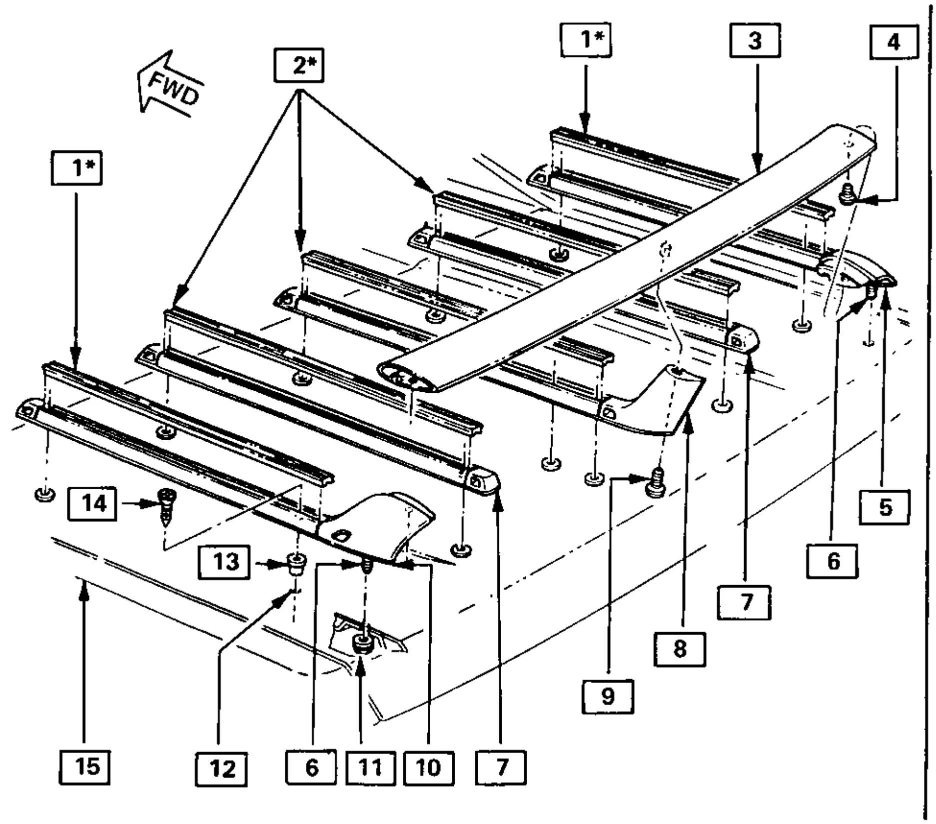
LUGGAGE CARRIER

CONTENTS

GENERAL DESCRIPTION

The luggage carrier is available as a dealer installed option. Skid strips and support mounting nuts are installed at the factory. During predelivery operations, the dealer will complete assembly installation.

ON-CAR SERVICE



1–PAD
2–PAD
3–RAIL ASM.
4–BOLT/SCREW
5–SLAT ASM R.H.
6–STUD
7–SLAT ASM
8–SLAT ASM
9–BOLT/SCREW
10–SLAT ASM L.H.
11–NUT
12–HOLE BODY ASM
(TYPICAL 13 PLACES)
13–NUT
14–BOLT/SCREW
15–REAR COMPARTMENT LID
(BODY ASM)

*INSERT BOTH ENDS OF RUBBER STRIP AND ROLL CENTER PORTION TO FIT

G20002-9F

Fig. 801 Luggage Carrier

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

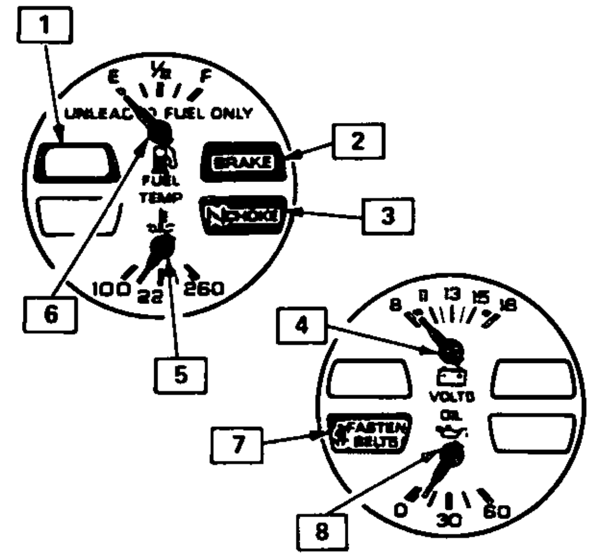
Figure 2

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 of the trip odometer. A slow, steady push should be used to avoid damage to the internal mechanism.



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

G20003-9G

Fig. 1 Rally Gages - Typical

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.

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

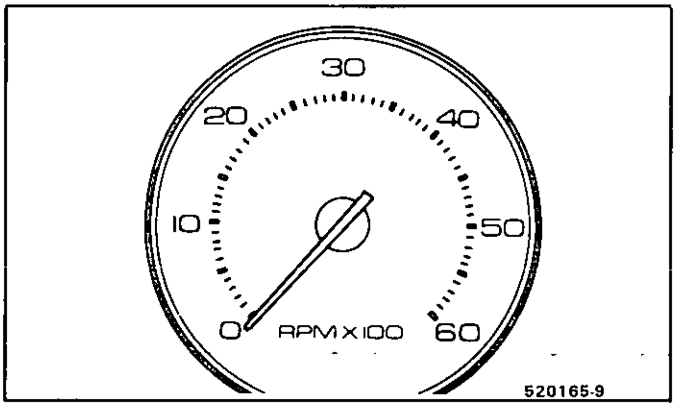


Fig. 2 Tachometer - Typical

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 8C.

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

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 12 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.

DASH AND CONSOLE MOUNTED ACCESSORY SWITCHES

1–V-8 POSITION (SHOWN)

2–L-4 NOT INSTALLED

3–V-6 POSITION

4–SHORTING BAR

5–SHORTING BAR CARRIER

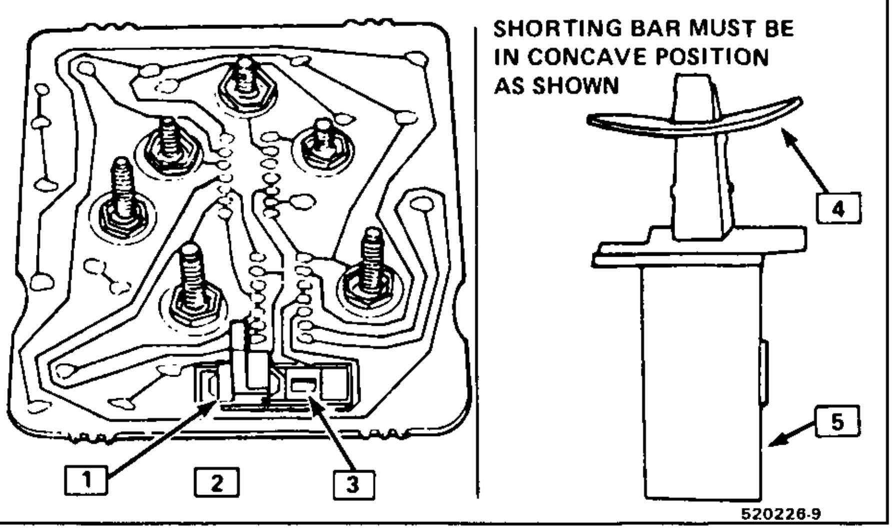


Fig. 3 Tachometer Shorting Bar

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 disconnected 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 automatically 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

BODY SERVICE

This publication contains essential removal, installation, adjustment and maintenance procedures for servicing P body styles. This information is current as of time of publication approval.

TABLE OF CONTENTS

SECTION 1

GENERAL INFORMATION

CONTENTS

Body Repair

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 for the ignition lock cylinder.
- Oval headed key is used for the door and the rear compartment lock.

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, plugs should be knocked out of the key head. These numbers are used to determine the lock combinations by the use of a code list (available to owners of key cutting equipment from the equipment suppliers). If key code numbers are not available from records or from the knockout plug, lock combination (tumbler numbers and position) can be determined by laying the key on the diagram in Figure 1-1.

CUTTING KEYS

- Determine special code from code list or from key code diagram.
- Cut blank key to proper level for each of the six tumbler positions.
- Check key operation in the lock cylinder.

REPLACEMENT LOCK CYLINDERS

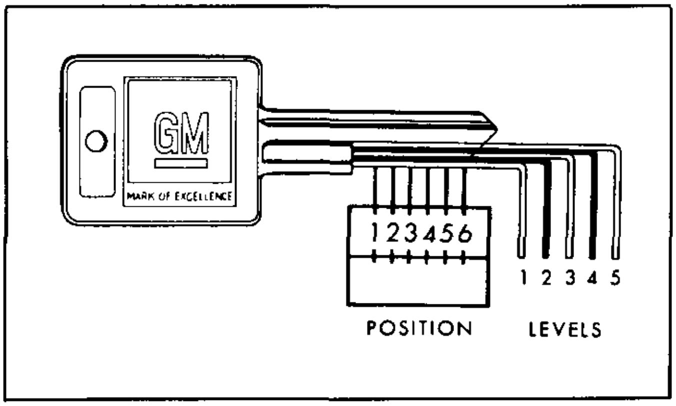


Fig. 1-1-Key Code Diagram

New lock cylinders are available from service parts warehouses. The new cylinder has a new locking bar staked in place. New tumblers are also available and must be assembled into the cylinder.

ASSEMBLING AND CODING LOCK CYLINDERS

The tumblers for all locks are shaped exactly alike except for the notch position on one side. As the key is inserted in the lock cylinder, tumblers are lowered to the correct height so that the 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 different tumblers are used to make various lock combinations. Each tumbler is coded according to a number, 1 through 5, stamped on its side.

Assemble (Figures 1-2 and 1-3)

1. Determine tumbler numbers and arrangement.

- o With numerical key code, use code list provided by key cutter equipment supplier.
- o Without numerical key code or without code list, refer to Figure 1-1.
  - Position key on key code diagram. Be sure key is outlined by the diagram.
  - Start with position number 1, find and record lowest level (tumbler number) that is visible. Repeat for each of the remaining five positions.

2. Start with position number one (open end or head of cylinder). Insert correctly numbered tumblers in their respective positions.
3. Pull side bar out with fingers to allow tumblers to drop completely into place.
4. Insert one tumbler spring above each tumbler.

NOTICE: If the springs become tangled, do not pull them apart, unscrew them to prevent damage.

5. Insert spring retainer so that the end prongs slide into slots at each end of cylinder. Press retainer down.
6. Insert key into cylinder to check for proper installation.

Inspect

Side bar should drop down if tumblers are properly installed. If incorrectly assembled, disassemble and reassemble correctly.

7. Once tumblers have been pressed down into the cylinder they are held by the side bar. To remove them, hold cylinder with tumbler slots down. Pull side bar out with fingers. Jar cylinder to shake tumblers out.

NOTICE: Use leather or wood at each vise jaw to prevent damage to cylinder.

8. Remove key and secure cylinder in a vise with spring retainer exposed.
9. Stake spring retainer securely in place at each end. Use suitable staking tool and stake cylinder metal over retainer.
10. Lubricate cylinder with a light oil.

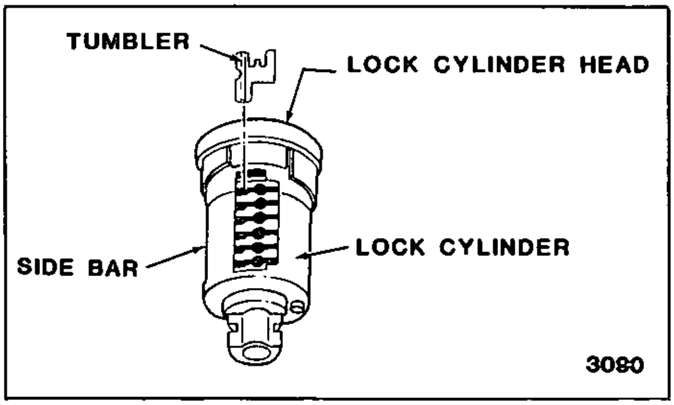


Fig. 1-2 Installing Tumblers

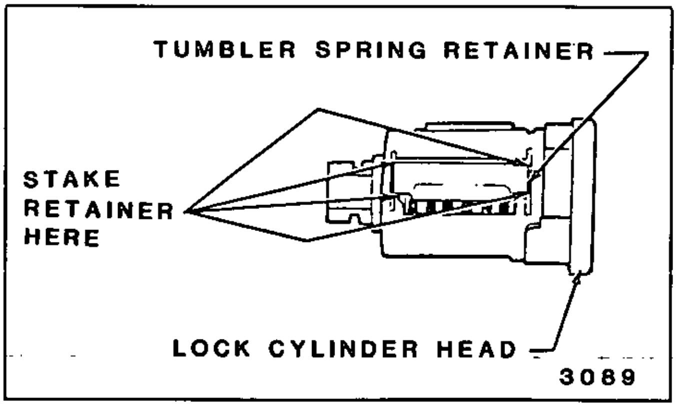


Fig. 1-3-Installing Spring Retainer

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 hinge - engine oil (30 weight preferred) Apply to roller and hinge pin bushings

  Important

  Do not apply to hold-open link and roller contacting surface as this could cause improper roller operation.

- Locks, compartment lid hinge and torque rods - Part number 1052196, Lubriplate Auto-Lube A, Part number 1052349, Lubriplate Spray-Lube A, 3M Lithium Spray Lube No. 8915 (or equivalent).
- Lock cylinder - a light oil.
- Seat mechanism and door hardware are covered in the specific body area sections in this manual.

WATERLEAK DIAGNOSIS

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, water in spare tire compartment.

If the general leak area can be found, the exact watertest equipment such as the watertest stands shown in Figure 1-4 should be used. This test applies a large volume of water to a general area without going over the sealing limitations of side glass, door or rear compartment opening weatherstrips. Also, the use of the test stands or similar watertest equipment is advised for retest to confirm repair and see if any other leaks may be adding to the original condition.

GENERALIZED TESTING

To watertest a broad area, a watertest stand or similar watertest equipment as shown in Figures 1-4 and 1-5 should be used.

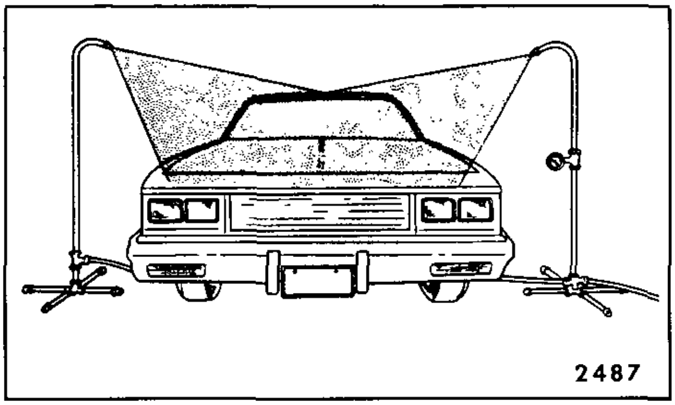


Fig. 1-4-Watertest Stands Positioned for Front End Watertest

Specifications for construction of the watertest stand are shown in Figure 1-6.

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.

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 (FIGURE 1-7)

- Have a helper inside the car to detect the actual leak point.
- Use unrestricted water flow (no nozzle).
- Begin at base of test area and move upward.

AIR HOSE TEST (FIGURE 1-8)

- Apply bubble solution (liquid soap) to suspected area.
- Apply air pressure with an air hose from inside vehicle. Do not exceed 205 kPa (30 psi)
- Observe for bubbles on outside at test area.

WATERLEAK REPAIR

To locate the exact leak point, or to repair the leak, it may be necessary to remove some interior trim panels or components.

- Windshield and back window

  Repair with adhesive caulking kit no. 9636067 or equivalent as described in Section 11.
- Shroud area leaks

  Metal joint area leak – use a brushable seam sealer (or equivalent) which can be painted.

  Sealed components such as ventilation ducts – use 3M Auto Bedding and Glazing Compound (or equivalent).

  Important

  Water entry through the high level ventilation ducts may be due to a damaged duct shroud vent screen or a blockage in the shroud drain.
- Windshield pillar drip molding – use 3M Auto Bedding and Glazing Compound (or equivalent)
- Metal joints rear compartment

  Small cracks or pin holes – use 3M Drip-Chek sealer (or equivalent).

  Larger holes – use 3M All-Around Autobody Sealant No. 8500 (or equivalent).

  Inspect

  For proper repair

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

The use of urethane and fiberglass exterior panels and wheelhouse liner and splash shields has greatly reduced the potential for corrosion. Some galvanized metal is used, and special metal conditioners and primers are used on surfaces in areas where moisture might accumulate. Sealers are applied along exposed joints.

Any procedure that disturbs these treatments, such as collision damage repair operations, may leave the metal unprotected and result in corrosion. Therefore, proper recoating of the surfaces with service-type anticorrosion material is an essential function of the repair operation and cannot be overemphasized.

Metal conditioners and primer coatings are applied to all metal panels at the time of vehicle manufacture. After repair and/or replacement part installation, 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, 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 as *anticorrosion barriers*. The *originally sealed joints* are obvious and any damage to these sealed locations

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.

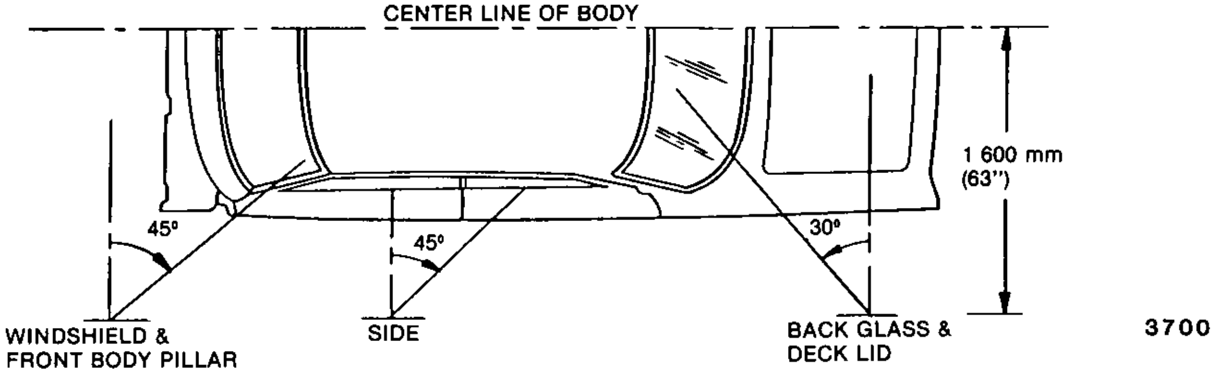


Fig. 1-5-Watertest Stand Specifications

should be corrected by resealing. Attaching points of new replacement panels should be resealed (Fig. 1-9).

Flanged joints, overlap joints and seams should be sealed using 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.

Manufacturers' labels should be checked for material usage, recommendations, characteristics and application instructions.

Color application may be required to restore repaired areas such as engine compartment, underbody and inner panels to original appearance. When this is necessary, conventional refinishing preparation, undercoat buildup 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 to control the general noise level inside the passenger area of the vehicle. 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

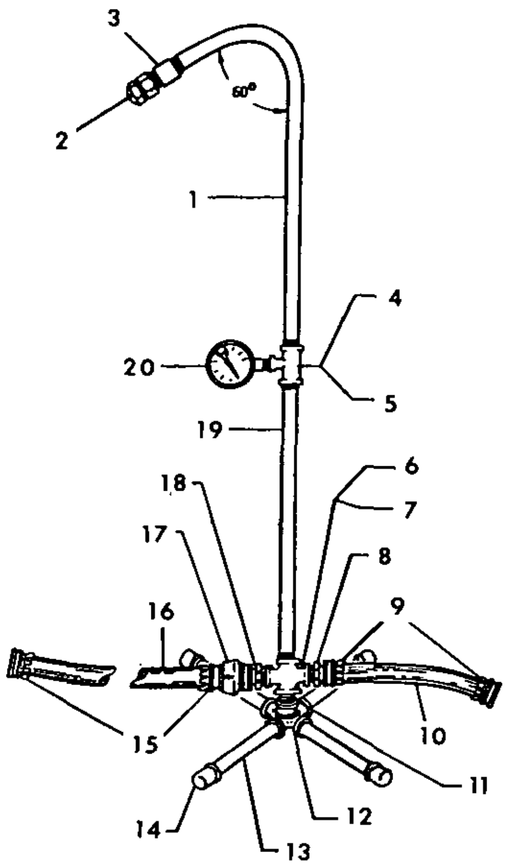
materials and are inaccessible for painting. One material suited for this type application is Anti-Corrosion Compound Part No. 1052290 (or equivalent).

Conventional undercoating using Guard-Mor or equivalent protective material is recommended to coat large areas such as floor pan sections. The material should not be applied to any moving or rotating part, energy absorbing bumper components, shock absorbers or on the floor pan in the area of the catalytic converter. After undercoating, care should be taken to assure that all body holes are open.

Sequence of application steps for anticorrosion materials is as follows:

1. Clean and prepare metal.
2. Apply primer (acrylic chromate).
3. Apply sealers (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 galvanize 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



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)

Fig. 1-6-Watertest Stand

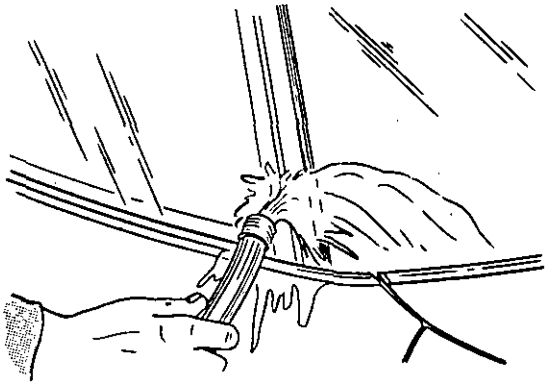


Fig. 1-7-Water Hose Test of Windshield Pillar

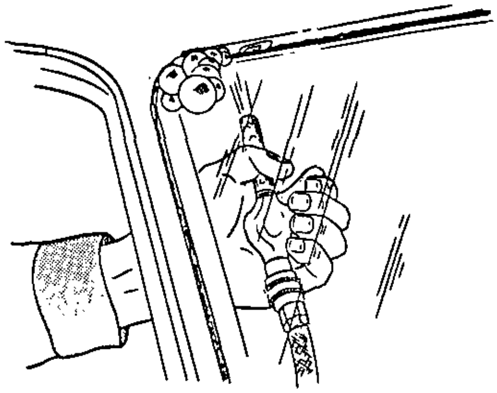


Fig. 1-8-Air Hose and Bubble Solution Test of Windshield Glass Sealant

following methods will satisfactorily remove the residue.

CAUTION: Standard shop safety 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 accessibility is good, sandpaper and steel wool can be used.

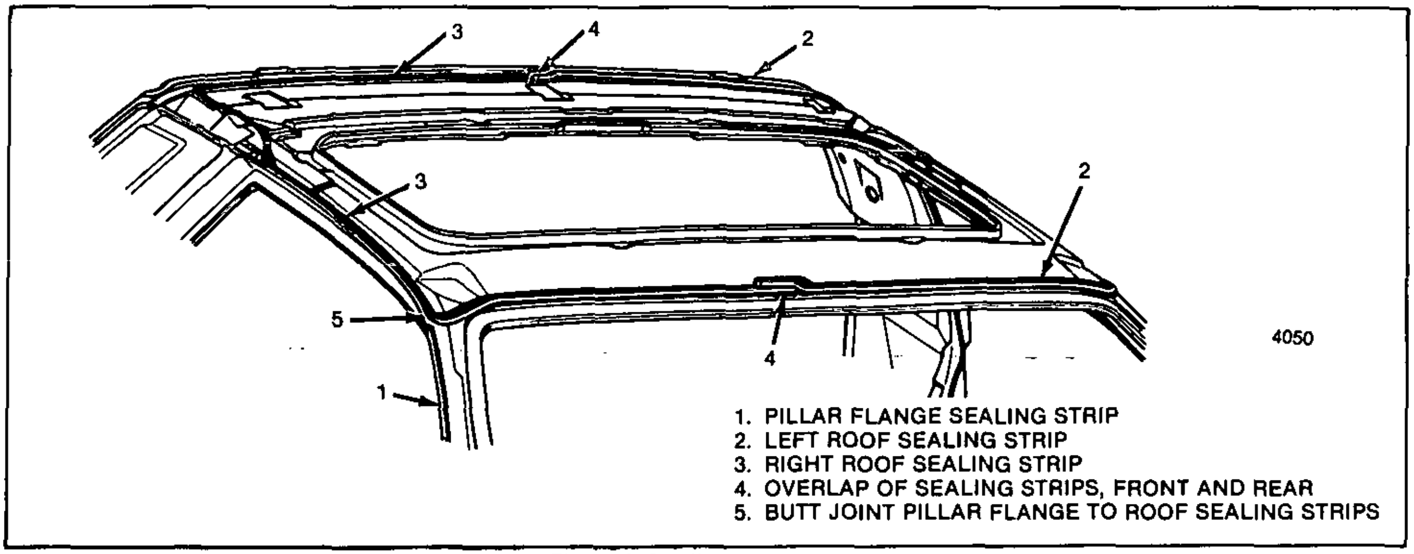


Fig. 1-9-Sealing Locations

BODY REPAIR

EXTERIOR PANEL IDENTIFICATION

All exterior panels are made from reaction injection molded urethane (RIM), glass fiber reinforced RIM (RRIM), sheet molded compound (SMC) or thermoplastic olefin (TPO) They are not susceptible to rust and can sustain minor impact without damage. However, if the impact force is great enough to create damage, they can be successfully repaired and refinished.

Different materials require different procedures for repair and refinishing. Before starting any repair, identify the type of material involved using Figure 1-10 and follow the correct procedure.

SHEET MOLDED COMPOUND (SMC) PARTS

Any SMC panel may be repaired using structural adhesives and the procedure outlined for RIM and RRIM. However, on SMC panels when structural strength is not involved, you may use a polyester body filler for repair. Simple economics should dictate the repair method.

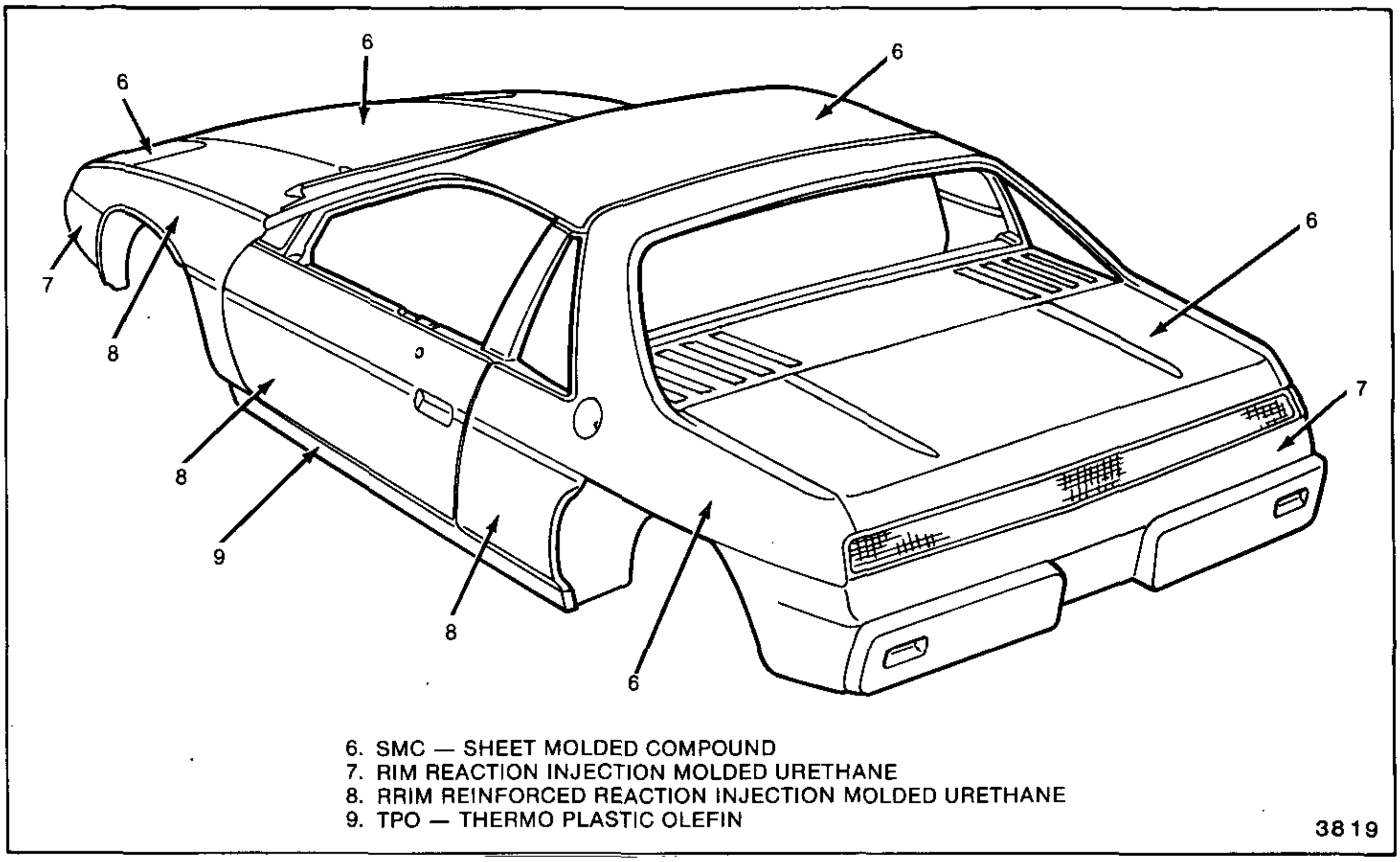
As an *example, a surface gouge on an SMC part* where structural strength is not involved may be more economically repaired with polyester body filler. On the other hand, puncture damage that requires a backup or structural type repair that requires reinforcing the back side can be accomplished by using a combination of structural adhesive and polyester body filler. Since epoxy resin possess superior adhesive properties, all repair work done on the back side of the *part should be done with fiberglass cloth and structural* adhesive. Then, cosmetic repair on the face side of the part may be completed with polyester body filler.

REACTION INJECTION MOLDED (RIM) AND REINFORCED REACTION INJECTION MOLDED (RRIM) PARTS

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. 1-11).
   b. Use a **clean** 50 or 75 mm (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. 1-12).
   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. 1-13).
   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 uniform color and consistency is achieved (Fig. 1-14).



6. SMC — SHEET MOLDED COMPOUND
7. RIM REACTION INJECTION MOLDED URETHANE
8. RRIM REINFORCED REACTION INJECTION MOLDED URETHANE
9. TPO — THERMO PLASTIC OLEFIN

Fig. 1-10-Exterior Panel Identification

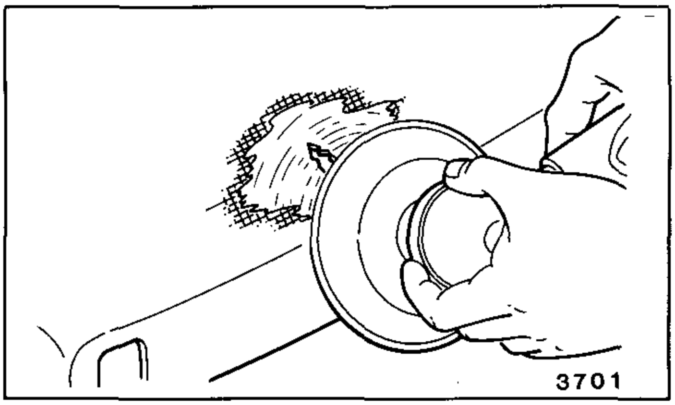


Fig. 1-11-Removing Paint Surrounding Damage

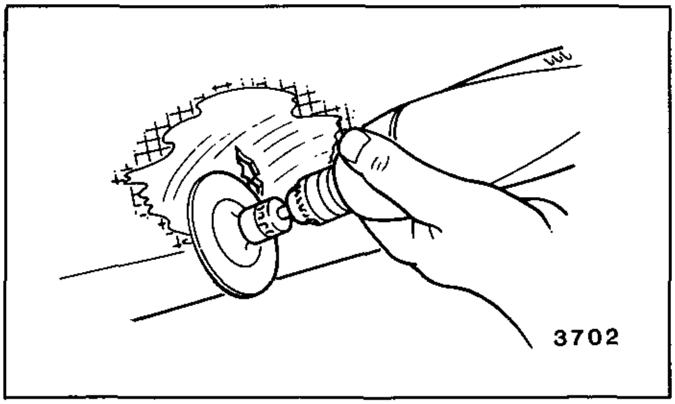


Fig. 1-12-Tapering Substrate Surrounding Damage

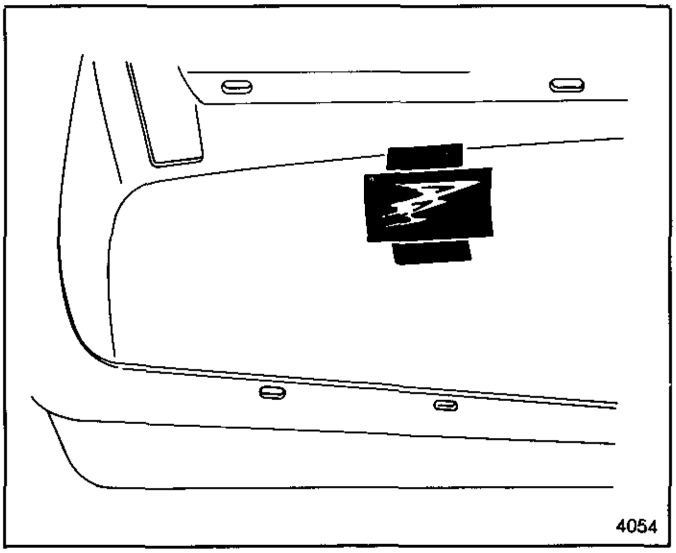


Fig. 1-13-Tape Support for Repair Material

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 to 27°C (60 to 80°F). If low areas or pits remain, mix and spread additional adhesive (Fig. 1-15).

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. 1-16 and 1-17).

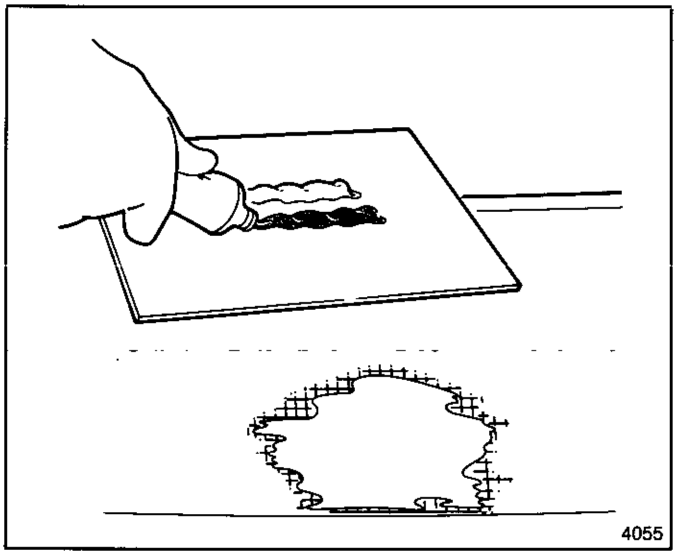


Fig. 1-14-Measuring Two-Component Repair Material

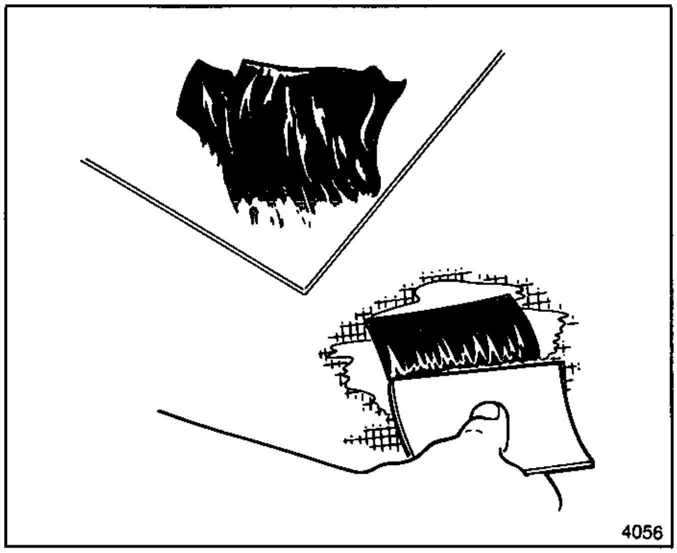


Fig. 1-15-Applying Mixed Repair Material

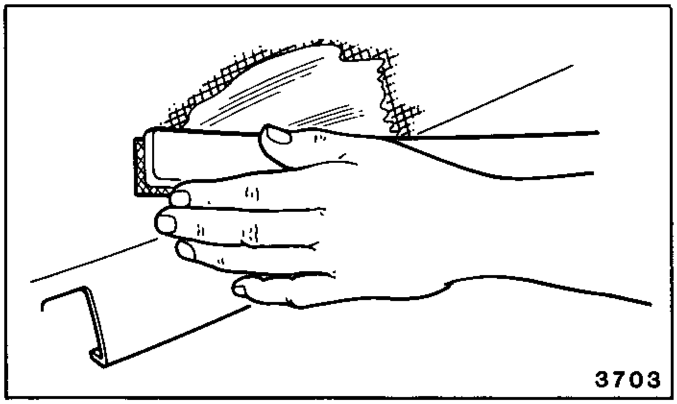


Fig. 1-16-Establishing Rough Contour with Body File

For final feathering, use a random orbit sander with a #320 disc.

2. Structural type repair

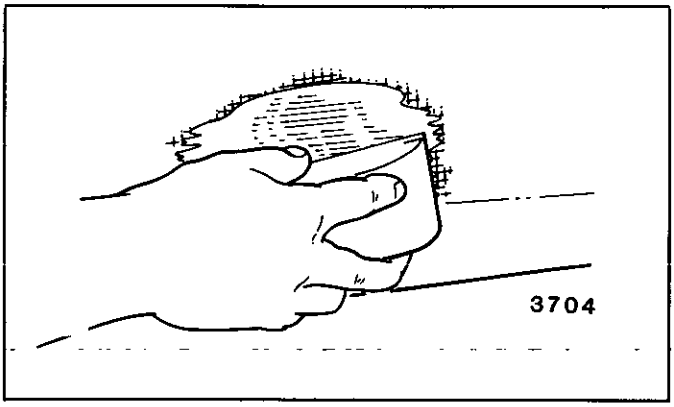


Fig 1-17-Block Sanding for Accurate Contour

a. Align and secure the piece on the face side with body tape and clamp (Fig. 1-19).
b. Clean the underside of the repair area as in step 1a. Sand each side of the break with a #50 grit disc. (Fig. 1-20).
c. Cut a piece of fiberglass cloth large enough to overlap the break 38 mm (1-1/2") as in Figure 1-21.
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 1-22.

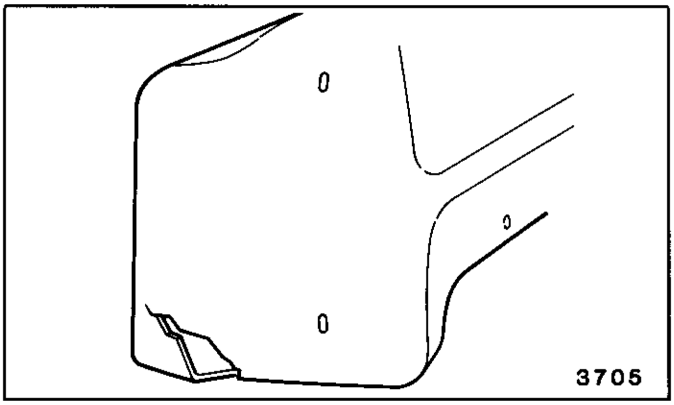


Fig. 1-18-Damaged Attaching Surface

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. 1-23 and 1-24).
f. Allow 20-30 minutes cure time at 16 to 27°C (60 to 80°F). Trim excess repair material at edge if necessary.
g. Repair the face side of the area following steps 1a through 1e.

PAINTING OF EXTERIOR PANELS

The original factory applied paint finish consists of a base coat-clear coat enamel paint. For paint repair, you may use either enamel or lacquer paint. Follow the

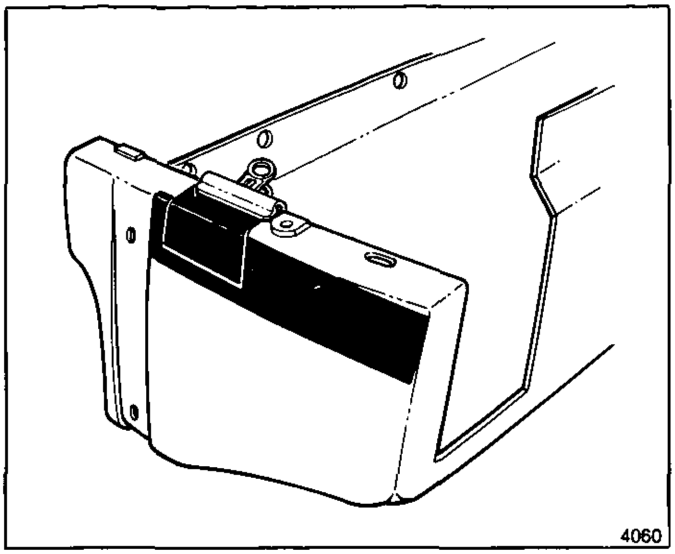


Fig. 1-19-Aligning Damage with Tape and Clamp

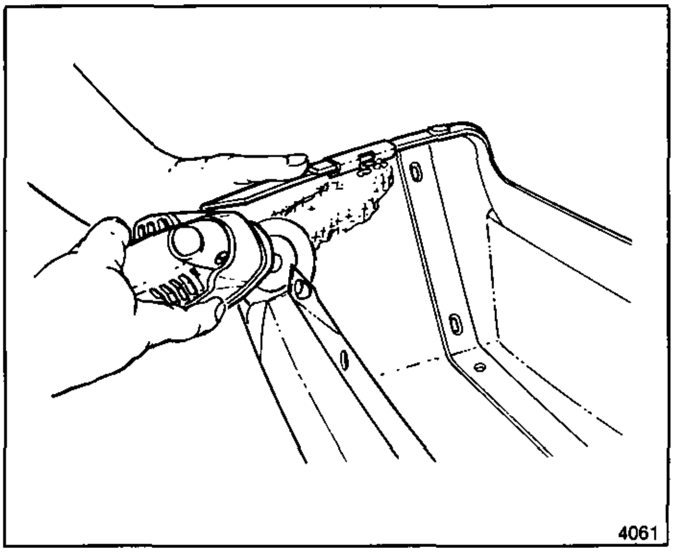


Fig. 1-20-Discing Back Side of Damage

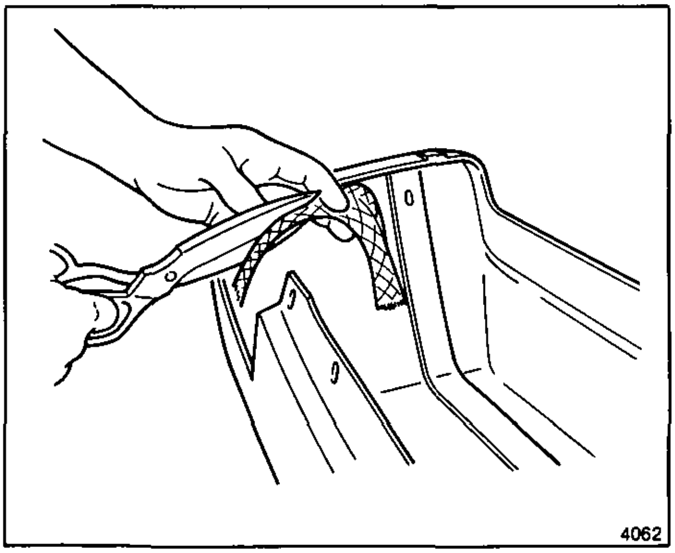


Fig. 1-21-Cutting Fiberglass Cloth to Size

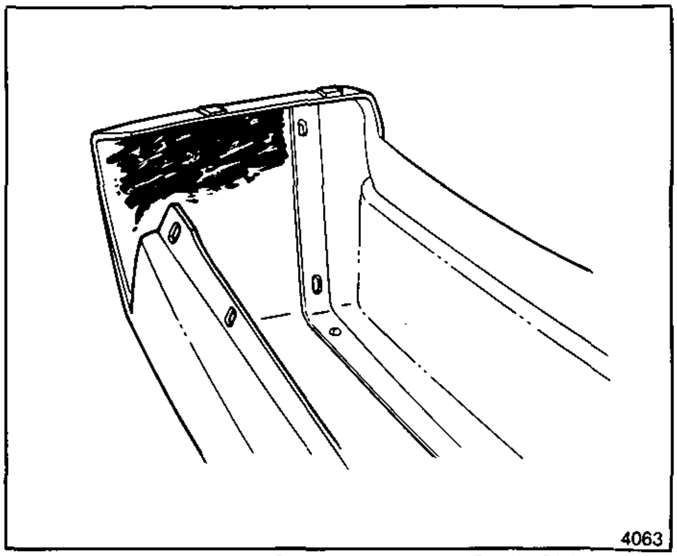


Fig. 1-22-Applying Repair Material - Back Side of Damage

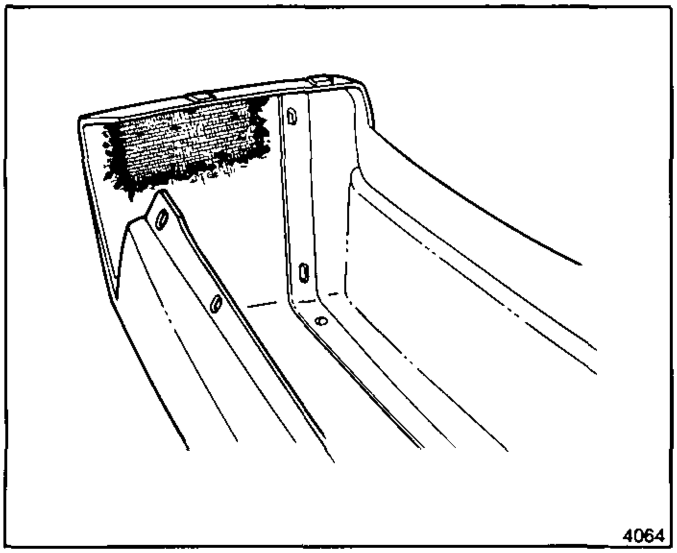


Fig. 1-23-Applying Fiberglass Cloth to Repair Material

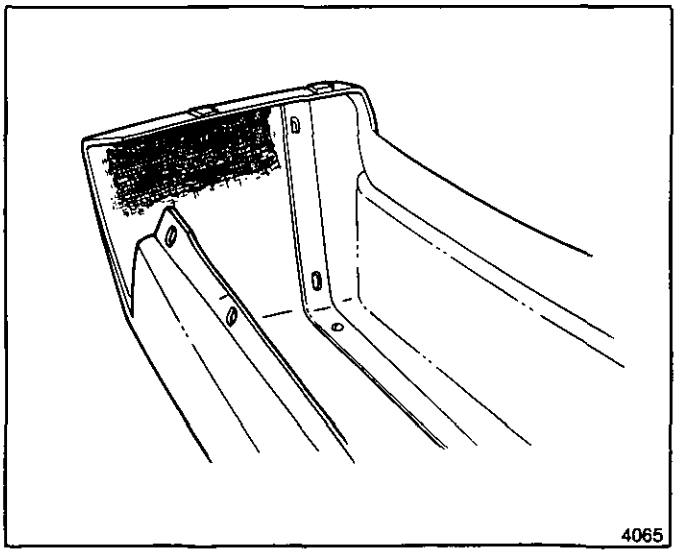


Fig. 1-24-Filling Fiberglass Cloth

There is a wide choice of flexible paint systems available for service use, however, many require additives containing isocyanates. Be certain to follow the manufacturer's recommendations. Procedures and warnings listed on the container are provided with the material selected.

CAUTION: If the paint system selected specifies an additive containing isocyanates, it is mandatory that a Willson Paint Spray Respirator No. 122115 with R21 cartridge and R15 filter, or 3M Spray Paint Respirator No. 6984 (or equivalent) be worn during the entire painting process. Persons with respiratory problems or those allergic to isocyanates must not be exposed to the isocyanate vapors or spray mist.

When using a flexible paint system, color coat the entire panel. Spot repair is not recommended.

When painting flexible plastic exterior parts identified as TPO, use a polypropylene primer. Follow manufacturer's label instructions.

INTERIOR PLASTIC TRIM AND PARTS FINISHING

Paintable plastic interior trim components can be divided into three general types:

1. Polypropylene Plastic
2. ABS Plastic
3. 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 seatback trim cover assemblies, the plastic used most widely on the interior of bodies is polypropylene.

TESTS FOR PLASTIC IDENTIFICATION

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:
   - Polypropylene burns with no readily visible smoke.
   - ABS plastic burns with a readily visible black smoke residue which hangs temporarily in the air.

TEST FOR VINYL PLASTIC

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.

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. 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 a 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 according to label directions. Use proper vinyl color 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 combination numbers located on the body number plate.

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

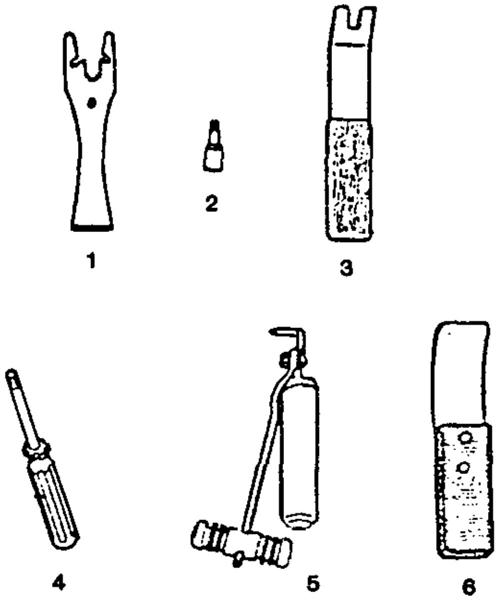
1. Steel parts (primer or sealer required on new service parts).
2. Hard ABS plastic (no primer necessary).
3. Hard polypropylene plastic (special primer required).

Each major paint supplier provides an interior color chart which identifies the stock number, color name, gloss factor and trim combination number for each conventional interior color.

Vinyl interior colors are designed for soft trim parts such as instrument panel cover assemblies and door trim assemblies. 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 equivalent.)

SPECIAL BODY TOOLS

Figure 1-25 shows special body tools that are recommended as aids in servicing the various body components. Equivalent tools may be substituted.



1. J-9886 DOOR HANDLE CLIP REMOVING TOOL
2. J-23457 OR BT-7107 DOOR LOCK STRIKER – SEAT BELT ANCHOR BOLT REMOVING TOOL
3. J-24595B OR BT-7323A TRIM PAD REMOVER
4. J-23554 INVERTED NUT DRIVER
5. J-24402A STATIONARY GLASS REMOVER
6. J-2772 HEADLINING INSTALLER

3802

Fig. 1-25-Special Body Tools

SECTION 3

UNDERBODY

CONTENTS

UNDERBODY

GENERAL BODY CONSTRUCTION AND ALIGNMENT

Information in this section pertains to unitized construction of the space frame. The space frame incorporates integral front and rear frame side rails which support the body components, front and rear suspension systems and other mechanical components.

The front suspension system and rack and pinion steering mount assemblies are attached to a front suspension cross member. The cross member is bolted to the front frame side rails. These components must be dimensionally correct in relation to the remainder of the underbody in order to maintain specified caster and camber angles.

Mounting provisions for the rear suspension system are shared by chassis components (suspension lower control arms and engine cradle) and body components (rear frame side rails and suspension strut towers). The suspension strut towers are part of the engine compartment side panels. They must be dimensionally correct in relation to the remainder of the underbody in order to maintain correct engine cradle and rear wheel alignment.

Unitized construction demands that underbody components be aligned properly to assure correct suspension location. In the event of collision damage, it is important that the underbody be thoroughly checked and, if necessary, realigned in order to establish proper dimensions.

Since each individual underbody component contributes directly to the overall strength of the body, it is essential that proper welding, sealing and rustproofing techniques be observed during service operations. Underbody components should be rustproofed whenever body repair operations which destroy or damage the original rustproofing, are completed. 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.

There are many tools that may be used to correct the average collision damage situation including frame straightening machines, lighter external pulling equipment and standard body jacks.

ALIGNMENT CHECKING

An accurate method of determining the alignment of the underbody utilizes a measuring tram gage. The tram gage required to perform all recommended measuring checks properly must be capable of extending to a length of 2 286 mm (90"). The vertical pointers must be capable of a maximum reach of 500 mm (19-11/16").

Dimensional checks are made using a horizontal reference plane (datum line) parallel to the plane of the underbody. Precision measurements can be made only if the tram gage is parallel to the plane. This can be controlled by setting the vertical pointers to the correct height as shown in Figures 3-5 and 3-9.

A proper tramming tool is essential for analyzing and determining the extent of collision misalignment present in underbody construction.

To assist in checking alignment of the underbody components, repairing minor underbody damage or locating replacement parts, refer to Figures 3-4 through 3-9.

Dimensions to gage holes are measured to center of the holes and flush to adjacent surface metal unless otherwise specified.

FLOOR PAN INSULATORS

Floor pan insulators are a 10 mm (3/8") thick amberlite material which is composed of resinated fibers. The floor pan insulators are molded pieces and are adhered to the back side of the floor carpet and seatback-to-motor compartment panel. These insulators are only serviceable as a part of the floor carpet and seatback-to-motor compartment panel, and must meet Motor Vehicle Safety Standard No. 302 for flammabilty.

SEATBACK-TO-MOTOR COMPARTMENT PANEL

The seatback-to-motor compartment panel is a molded plastic panel with an amberlite insulator attached to the back side of the panel.

↔ **Remove or Disconnect (Figure 3-1)**

1. Rear quarter trim panels. Refer to Section 6.
2. Console shifter plate assembly. Refer to the appropriate section in the chassis portion of this manual.

3. Rear console pad assembly. Refer to the appropriate section in the chassis portion of this manual.
4. Three screws (3)
5. Seatback-to-motor compartment panel (1). Carefully pry fasteners (3) from retainers (4)

→← Install or Connect (Figure 3-1)

1. Seatback-to-motor compartment panel (1)
2. Three screws (3)
3. Rear console pad assembly. Refer to the appropriate section in the chassis portion of this manual.
4. Console shifter plate assembly. Refer to the appropriate section in the chassis portion of this manual.
5. Rear quarter trim panels. Refer to Section 6.

LOWER GARNISH MOLDINGS

←→ Remove or Disconnect (Figure 3-2)

1. Five garnish molding plugs (7)
2. Five garnish molding screws (6)
3. Lower garnish molding (5). Pull upward and out at rear of garnish molding (5) to disengage from upper garnish molding (8).

→← Install or Connect (Figure 3-2)

1. Lower garnish molding (5)
2. Five garnish molding screws (6)
3. Five garnish molding plugs (7)

FLOOR CARPETS

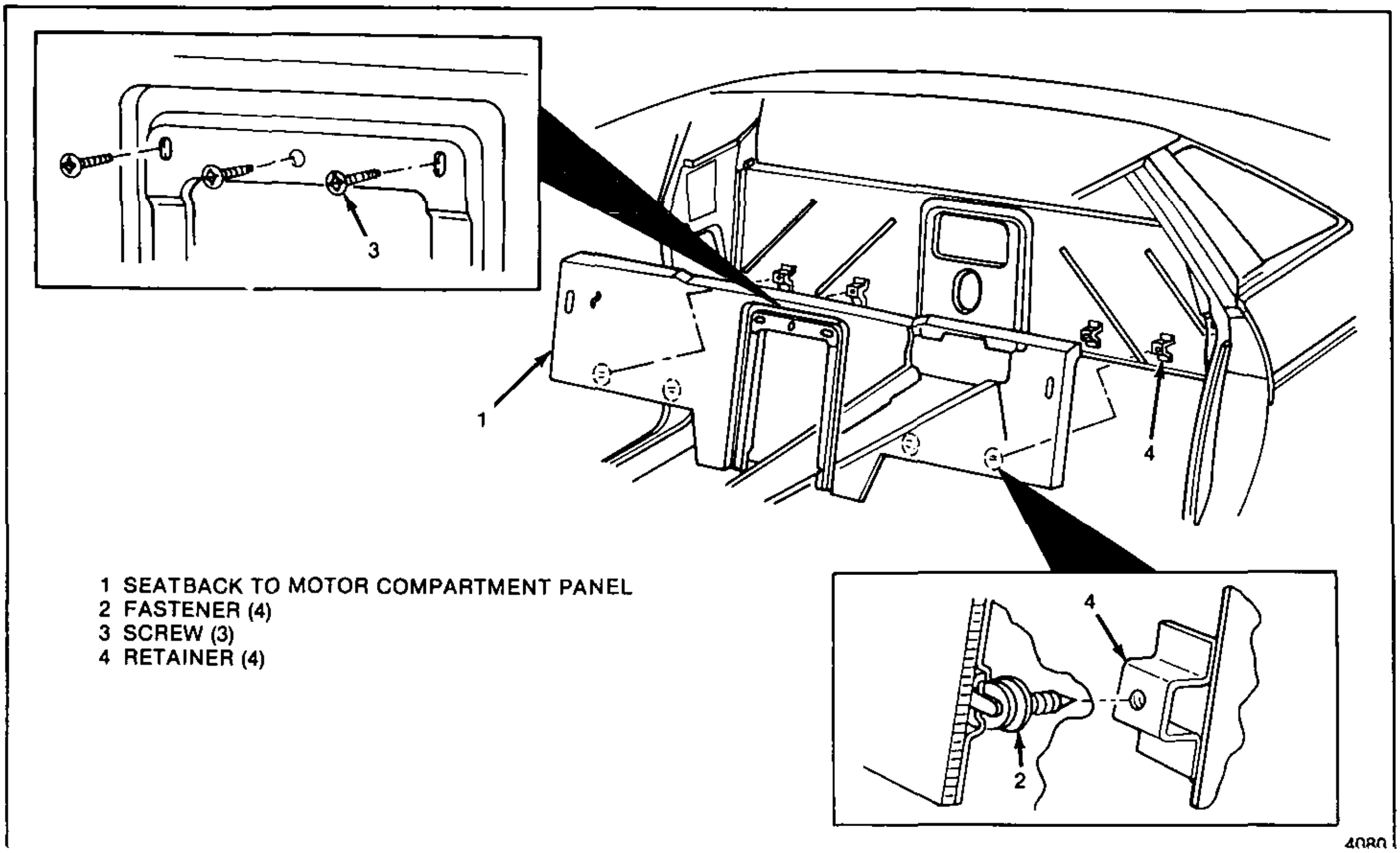
The floor carpet consists of molded right and left side carpet assemblies. Floor pan insulators are attached to the floor carpet assemblies. The right and left side floor carpets may be serviced separately.

←→ Remove or Disconnect (Figures 3-1, 3-2 and 3-3)

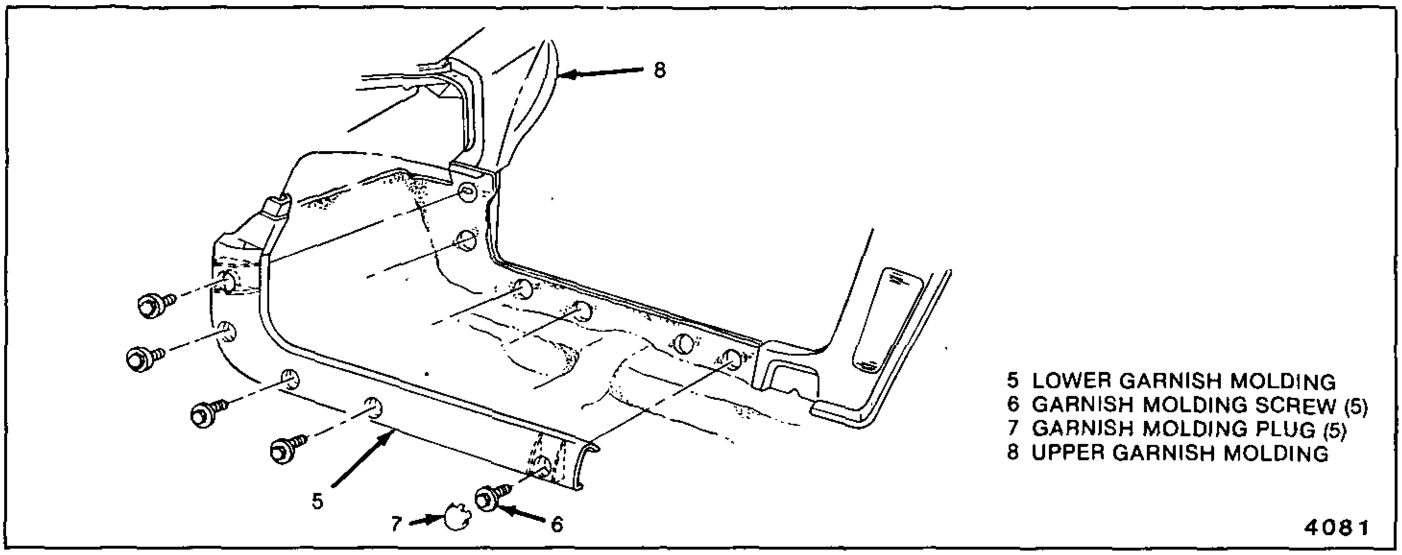
1. Seats(s), refer to Section 9.
2. Seatback-to-motor compartment panel (1)
3. Front console pad. Refer to the appropriate section in the chassis portion of this manual.
4. Lower garnish molding(s) (5)
5. Inboard seat belt(s). Refer to Section 9.
6. Carpet(s) (9). Disengage carpet from retainers (10) in console (11). There are six retainers per side.

→← Install or Connect (Figures 3-1, 3-2 and 3-3)

1. Carpet(s) (9)
2. Inboard seat belt(s). Refer to Section 9.
3. Lower garnish molding(s) (5)
4. Front console pad. Refer to the appropriate section in the chassis portion of this manual.
5. Seatback-to-motor compartment panel (1)
6. Seat(s), refer to Section 9.

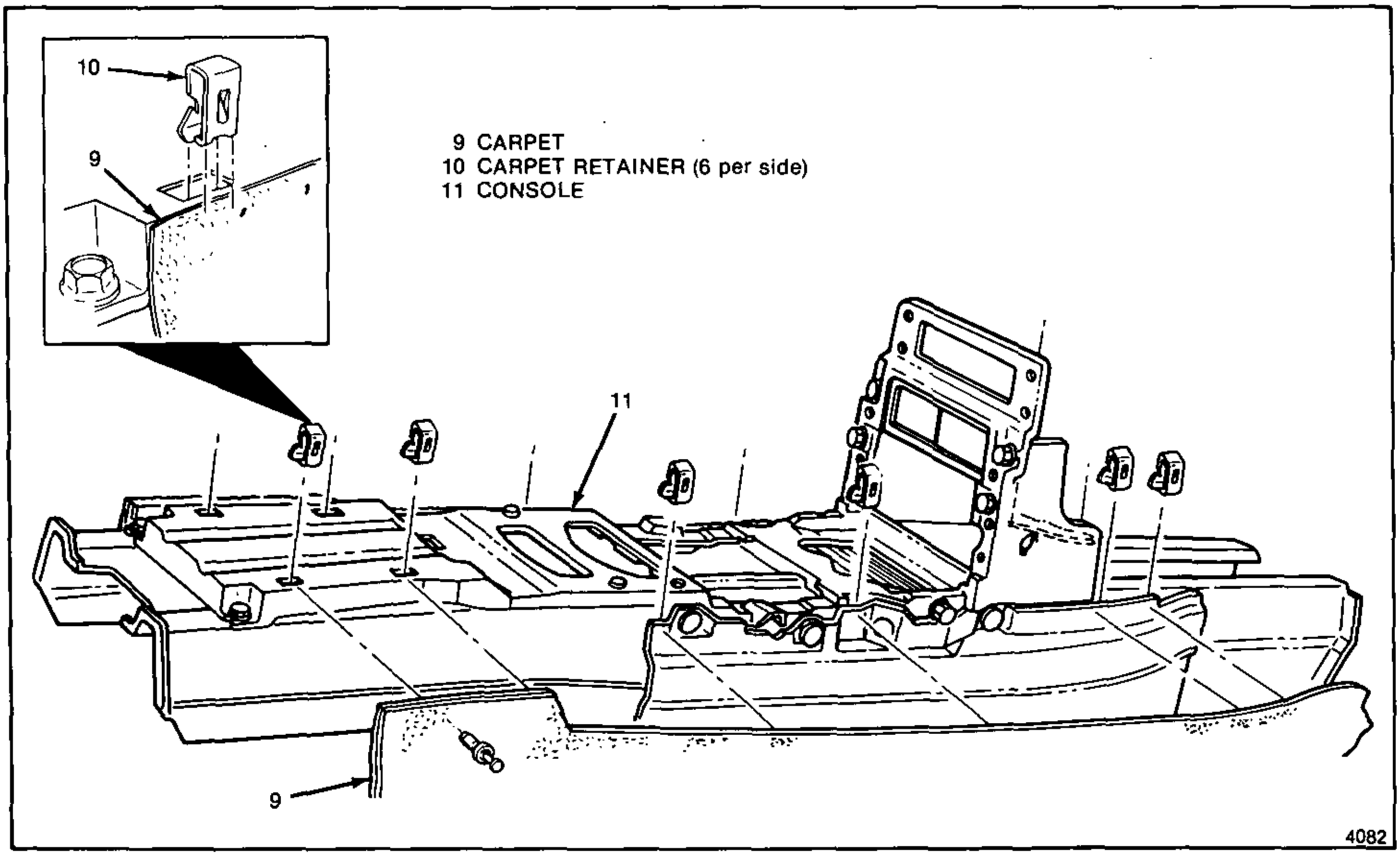


1 SEATBACK TO MOTOR COMPARTMENT PANEL
2 FASTENER (4)
3 SCREW (3)
4 RETAINER (4)



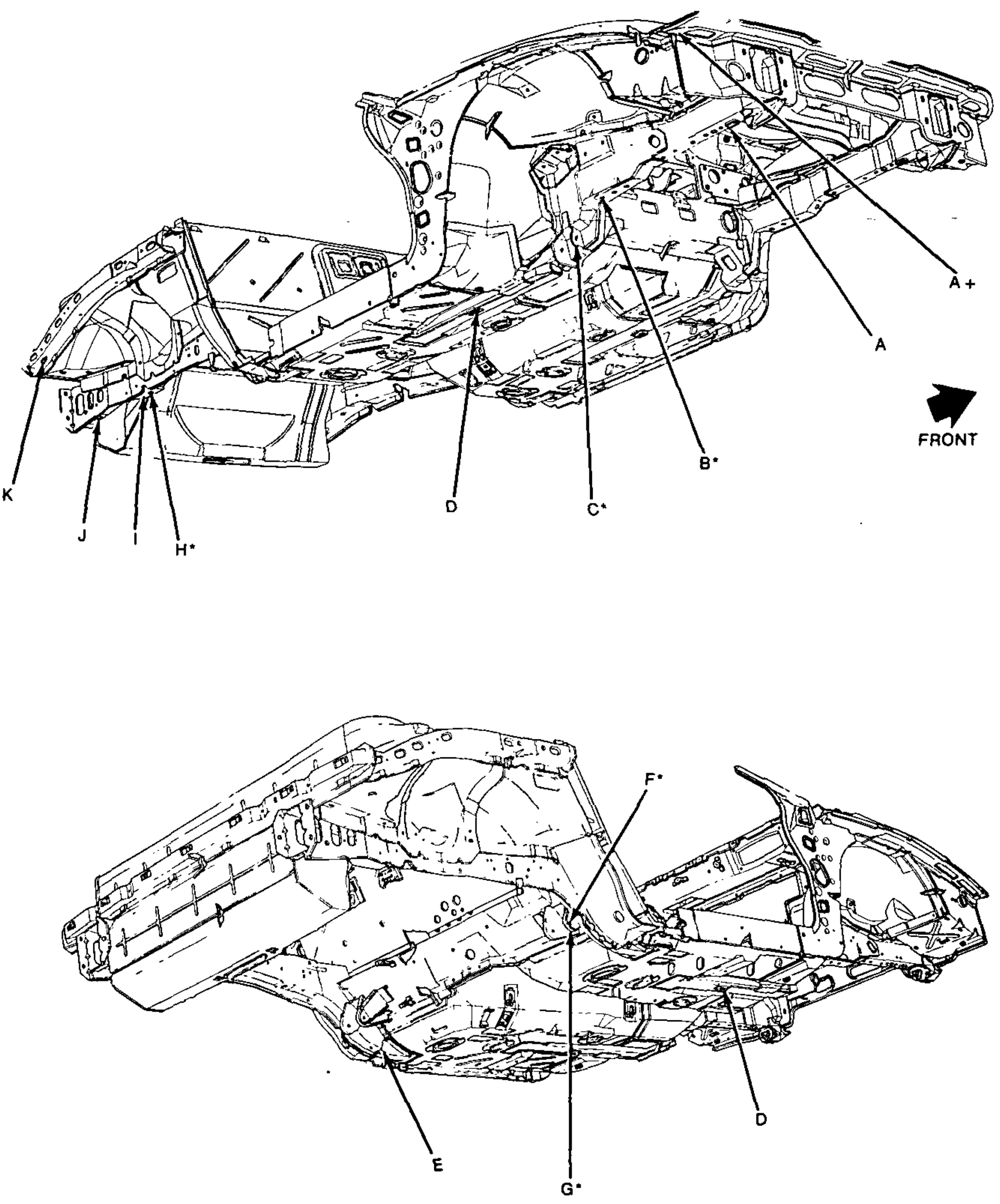
5 LOWER GARNISH MOLDING
6 GARNISH MOLDING SCREW (5)
7 GARNISH MOLDING PLUG (5)
8 UPPER GARNISH MOLDING

Fig. 3-2-Installing Lower Garnish Molding



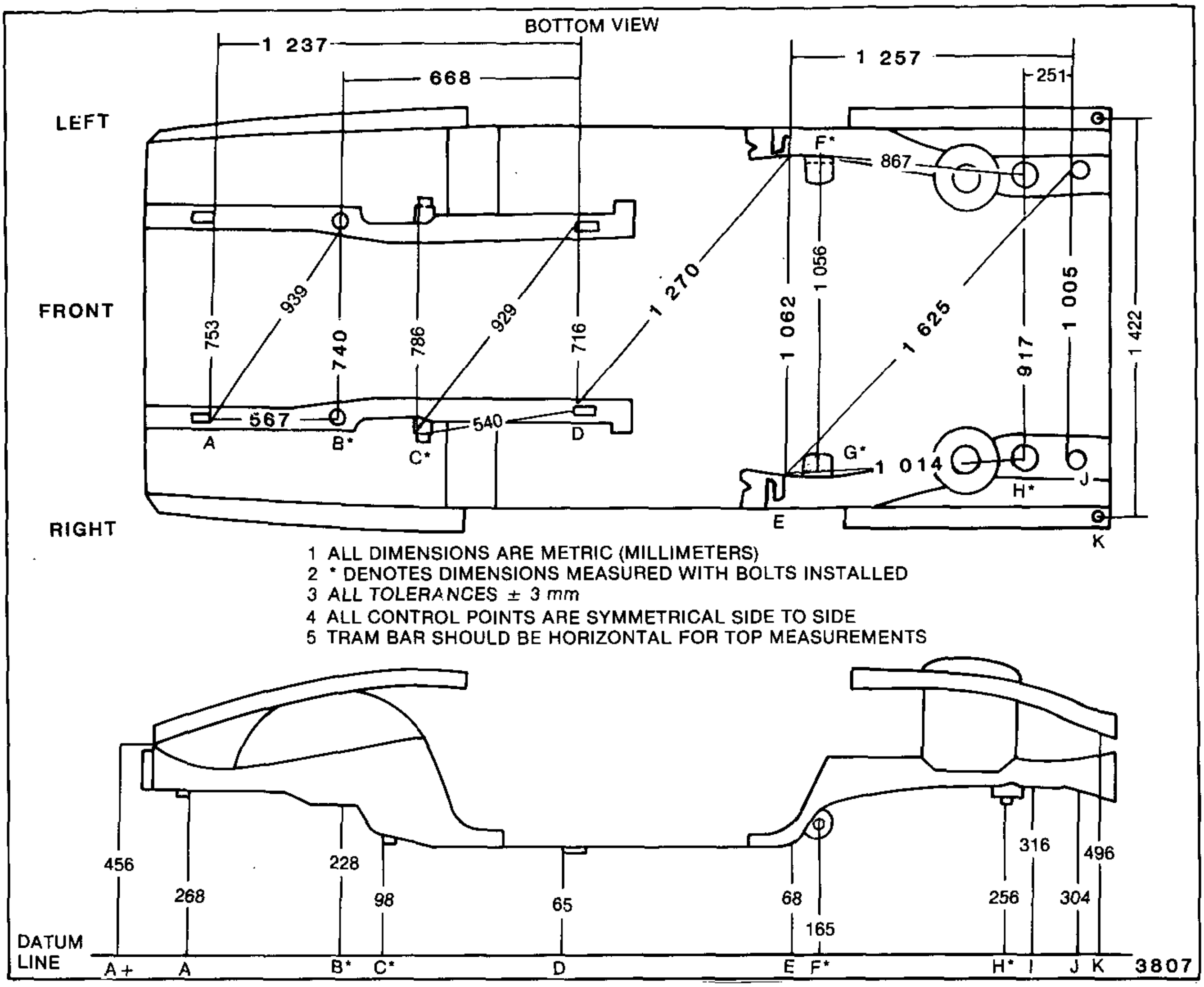
9 CARPET
10 CARPET RETAINER (6 per side)
11 CONSOLE

Fig. 3-3-Installing Carpet to Console



*MEASURE WITH BOLT INSTALLED

Fig. 3-4 Underbody Reference Point Locations



1 ALL DIMENSIONS ARE METRIC (MILLIMETERS)
2 * DENOTES DIMENSIONS MEASURED WITH BOLTS INSTALLED
3 *ALL TOLERANCES ± 3 mm*
4 ALL CONTROL POINTS ARE SYMMETRICAL SIDE TO SIDE
5 TRAM BAR SHOULD BE HORIZONTAL FOR TOP MEASUREMENTS

Fig. 3-5-Horizontal and Vertical Dimensions

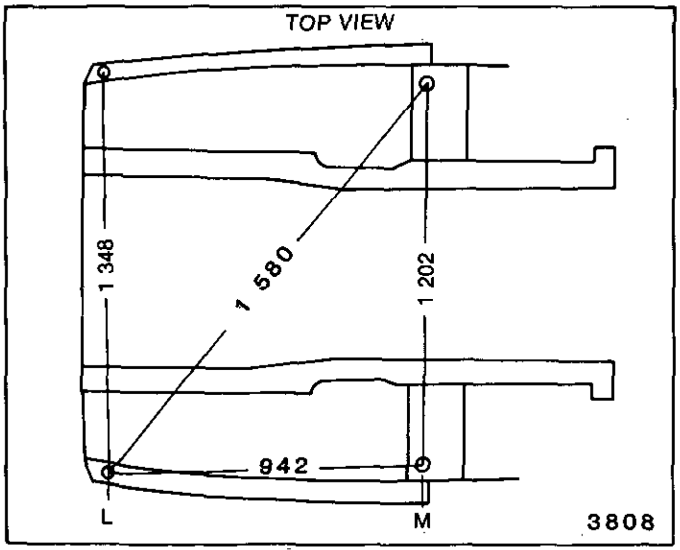


Fig. 3-6-Front Compartment Upper Side Rail Dimensions

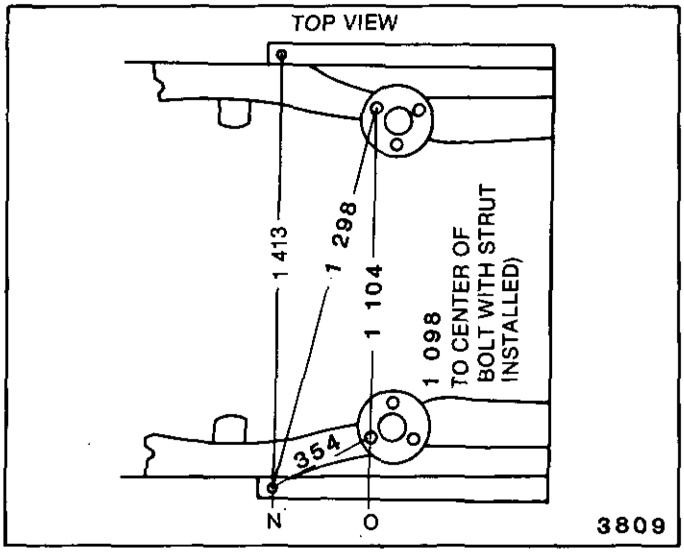


Fig. 3-7-Rear Compartment Upper Side Rail and Suspension Strut Tower Dimensions

REFERENCE	HORIZONTAL	VERTICAL	LOCATION
A+	NONE	Lower surface of front side rail relief notch	Lower surface of front side rail
A	Trailing edge of rectangular hole on center	Lower edge of flange on front compartment lower outer side rail	Lower front compartment outer side rail
B	Center of front suspension crossmember rear mounting bolt (bolt installed)	Center of front suspension crossmember rear mounting bolt (bolt installed)	Front suspension crossmember to lower front compartment outer side rail rear attachment
C	Lower edge of forward flange in line with center of mounting bolt (bolt installed)	Lower edge of forward flange in line with center of mounting bolt (bolt installed)	Forward flange of lower control arm mounting bracket
D	Leading edge of rectangular hole on center	Lower edge of flange on front compartment lower inner side rail	Lower front compartment rear inner side rail
E	**Inboard corner at midpoint of radius of lap joint**	**Inboard corner surface of motor compartment rail**	**Lap joint between motor compartment rail and rail extension to floor pan**
F	Center of front outboard cradle attaching bolt	Center of front outboard cradle attaching bolt	Motor compartment front cradle mounting bracket
G	Inboard side of front cradle mounting bracket outboard flange where bend begins	NONE	Motor compartment front cradle mounting bracket
H	Center of rear cradle attaching bolt (bolt installed)	Center of rear cradle attaching bolt (bolt installed)	Rear engine cradle attaching location
I	NONE	Lower surface of engine cradle	Lower surface of engine cradle at cradle attaching location
J	Leading edge of 20 mm flanged hole on center	Leading edge of 20 mm flanged hole on center	Lower surface of motor compartment lower side rail
K	Center of 12 mm hole	Center of 12 mm hole	Lower surface of motor compartment upper side rail
L	Center of 10 mm hole	NONE	Front upper surface of front compartment upper side rail
M	Center of 9 mm threaded hole	NONE	Cowl panel hood restraint bolt holes
N	Center of 5 mm hole in mounting pad for foward rear compartment side rail extension bolt	NONE	Motor compartment upper side rail
O	Center of suspension strut tower forward attaching hole	NONE	Motor compartment suspension strut tower

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Fig. 3-3 Horizontal and Vertical Locations

DIMENSION	METRIC (MILLIMETERS)	ENGLISH (INCHES)
	HORIZONTAL	
A to A	753	29-5/8
A to B	567	22-5/16
A to D	1 237	48-11/16
B to A	939	36-15/16
B to B	740	29-1/8
B to D	668	26-5/16
C to C	786	30-15/16
C to D	540	21-1/4
D to C	929	36-9/16
D to D	716	28-3/16
E to D	1 270	50
E to E	1 062	41-13/16
E to H	1 014	39-15/16
E to J	1 257	49-1/2
F to H	867	34-1/8
G to G	1 056	41-9/16
H to H	917	36-1/8
H to J	251	9-7/8
J to J	1 005	39-9/16
J to E	1 625	64
K to K	1 422	56
L to L	1 348	53-1/16
L to M	942	37-1/16
M to M	1 202	47-5/16
M to L	1 580	62-3/16
N to N	1 413	55-5/8
N to O	354	13-15/16
O to O	1 104	43-7/16
O to N	1 298	51-1/8
	VERTICAL	
A+	456	17-15/16
A	268	10-9/16
B	228	9
C	98	3-7/8
D	65	2-9/16
E	68	2-11/16
F	165	6-1/2
H	256	10-1/16
I	316	12-7/16
J	304	12
K	496	19-1/2

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Fig. 3-9-Metric-to-English Dimension Conversion Chart

SECTION 4

FRONT END

NOTICE: Care must be taken when servicing any fiberglass (SMC) panel or component. Fasteners retaining such panels or components must be hand started to prevent damage to fiberglass parts. Always use the specified torque values given for SMC parts to assure safe and proper retention.

CONTENTS

FRONT END

BODY VENTILATION

The body ventilation system on vehicles without air conditioning consists of two fresh air ducts under the shroud screen. Air enters the front plenum chamber through the shroud screen and is directed through the chambers to the outlet doors. When the outlet doors are opened, air flows into the passenger compartment and is expelled through the pressure relief valve located in the body lock pillar under the *quarter applique panel.*

Top Shroud Vent Duct Screen

←→ Remove or Disconnect (Figure 1)

1. Windshield wiper arm assemblies
2. Attaching screws (2)
3. Fasteners (3) two required
4. Rivet (4) using a 6.3 mm (1/4") drill bit
5. Spring (5)
6. Windshield washer hoses as required
7. Screen (1) by lifting up on screen to disengage fasteners (6) from holes in plenum chamber

→← Install or Connect (Figure 1)

1. Screen (1) to body by locating fasteners (6) over holes in plenum chamber and pushing down on screen
2. Hoses
3. Spring (5)
4. Rivet (4) using part no. 20421672 or equivalent
5. Fasteners (3)
6. Screws (2)
7. Windshield wiper arm assemblies

WATER DEFLECTORS

Water deflectors are located within the plenum chamber and are an integral part of it. Along with the top shroud vent screen, these deflectors prevent water from entering the air inlet into the passenger compartment.

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.

HEADLAMP DOOR ASSEMBLY

The headlamp doors have slotted mounting points which insures proper clearance between the headlamp door and the hood. The entire headlamp door assembly can be adjusted to achieve the desired appearance and fit. Care should be exercised when adjusting the headlamp door assembly so as not to damage any components.

Headlamp Cover Panel

←→ Remove or Disconnect (Figure 2)

1. Retainer (16)
2. Cover (13)
   - Hold assembly open
   - Lift rear and slide cover forward

→← Install or Connect (Figure 2)

1. Cover (13)
2. Retainer (16)

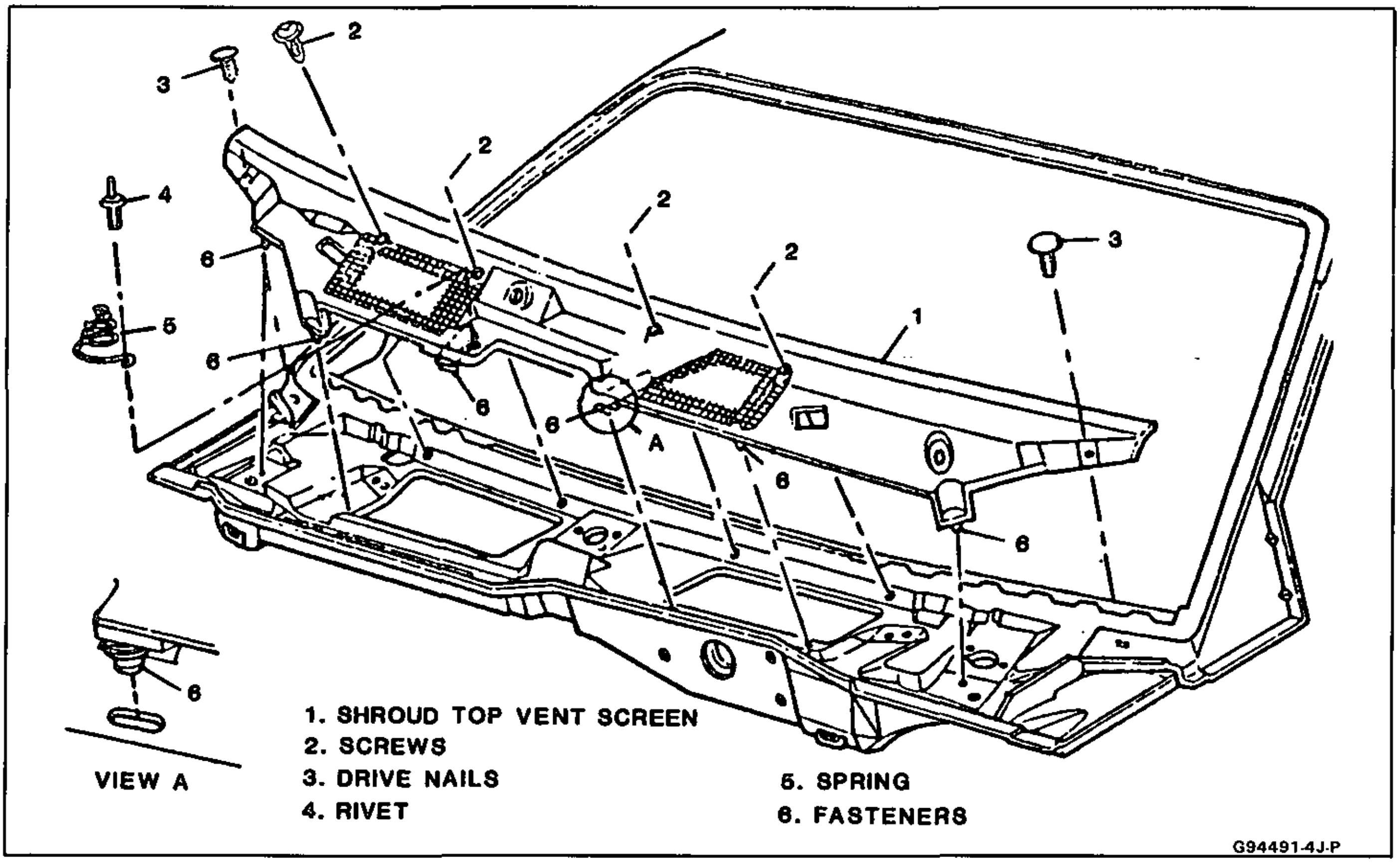


Fig. 1-Installing Cowl Vent System

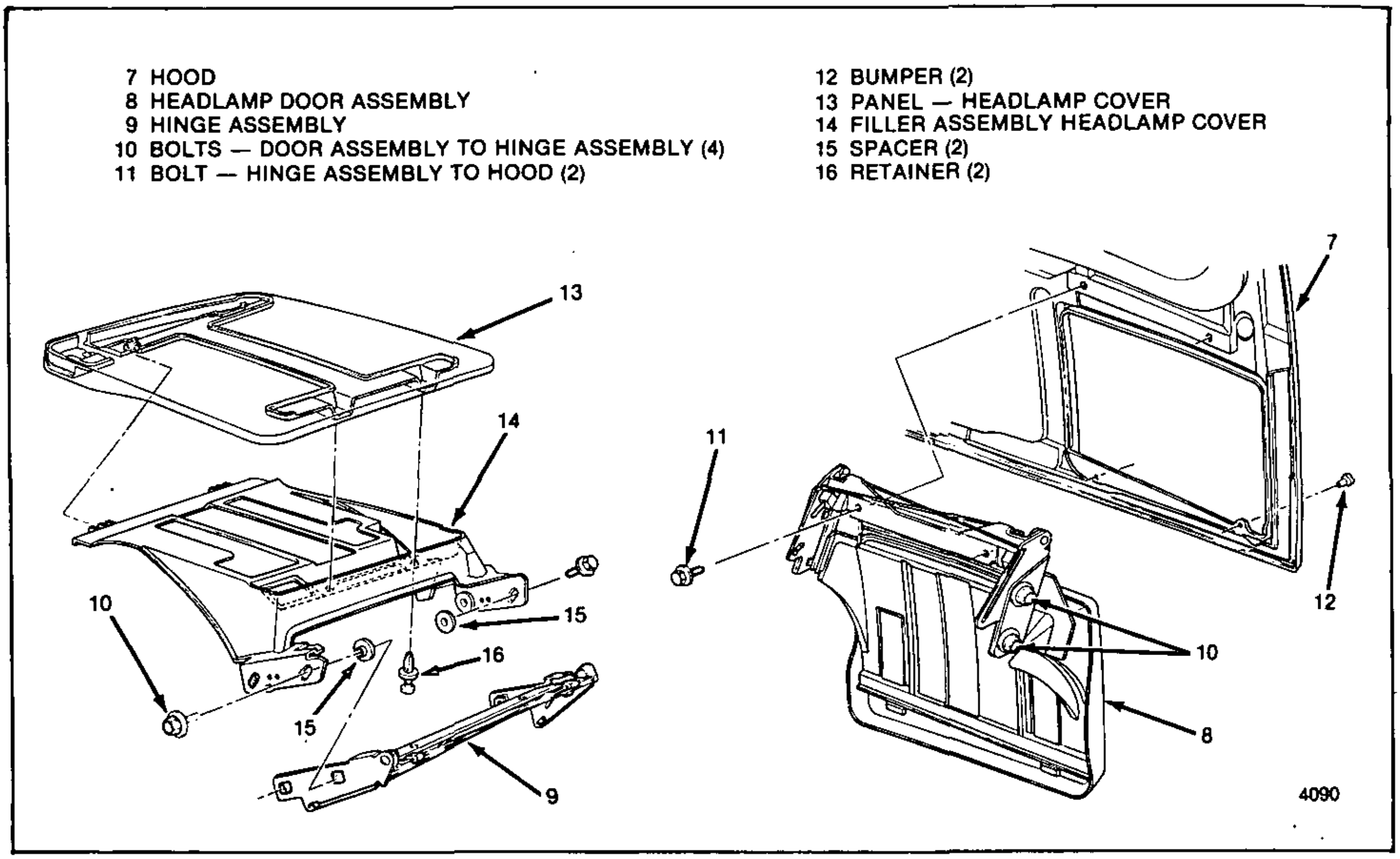


Fig. 2-Headlamp Door Assembly

Filler Assembly

Remove or Disconnect (Figure 2)

1. Bolts (10)
2. Cover (13) and filler (14) assembly
3. Cover (13)

Install or Connect (Figure 2)

1. Cover (13)
2. Cover (13) and filler (14) assembly
3. Bolts (10)

Hinge Assembly

Remove or Disconnect (Figure 2)

1. Bolts (11)
2. Door assembly (8)
3. Bolts (10)
4. Hinge (9)

Install or Connect (Figure 2)

1. Hinge (9)
2. Bolts (10)
3. Door assembly (8)
4. Bolts (11)

Adjust (Figure 2)

Front and Rear Gap Adjustment

1. Loosen four bolts (10)
2. Align as necessary
3. Tighten four bolts (10)

Side-to-Side Gap Adjustment

1. Loosen two bolts (11)
2. Align as necessary
3. Tighten two bolts (11)

HOOD ASSEMBLY

The hood is composed of a single outer panel and an inner reinforcement. Both panels are composed of fiberglass.

Remove or Disconnect (Figure 3)

1. Bolts – two upper support attaching (19)
2. Nuts – hinge to body (23)
3. Hood (17)

Install or Connect (Figure 3)

1. Hood (17)
2. Nuts – hinge to body (23)
3. Bolts – two upper support attaching (19)

Inspect

For proper operation and alignment

Hood Alignment

Slotted holes are provided at all hood hinge attaching points for proper adjustment – both vertically and fore and aft. For best results, make one adjustment at a time. The following lists conditions that may be encountered. It gives the components that will need adjustment to correct the condition. One or more of the conditions may be encountered. Make adjustments only as required to correct the condition.

Adjust (Figure 3)

- Hood too high or low at front corners
  - Loosen nuts (23)
  - Reposition hood assembly
  - Tights nuts (23)
- Hood too high or low at rear corners
  - Determine amount and direction of adjustment needed
  - Adjust hood bumper accordingly
- Hood too far fore or aft
  - Loosen bolts (22)
  - Reposition hood assembly
  - Tighten bolts (22)

Hood Hinge

Remove or Disconnect (Figure 3)

Important

Scribe line around hinge on hood inner panel and front panel to indicate original hinge position.

1. Block hood and prop open on side to be removed
2. Nuts (23)
3. Bolts (22)
4. Hinge (21)

Install or Connect (Figure 3)

1. Hinge (21) align with scribe marks
2. Bolts (22)
3. Nuts (23)

Inspect

Close hood carefully and check for proper alignment.

Hood Latch

The hood latch is a cable released, positive locking assembly located in the center section of the cowl. It is locked with a hood-mounted striker. The hood release handle is located in the vehicle on the left side of the instrument panel beneath the ventilation duct. After the release handle has been pulled, the hood can be fully opened by hand. There is no additional latch on the hood.

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

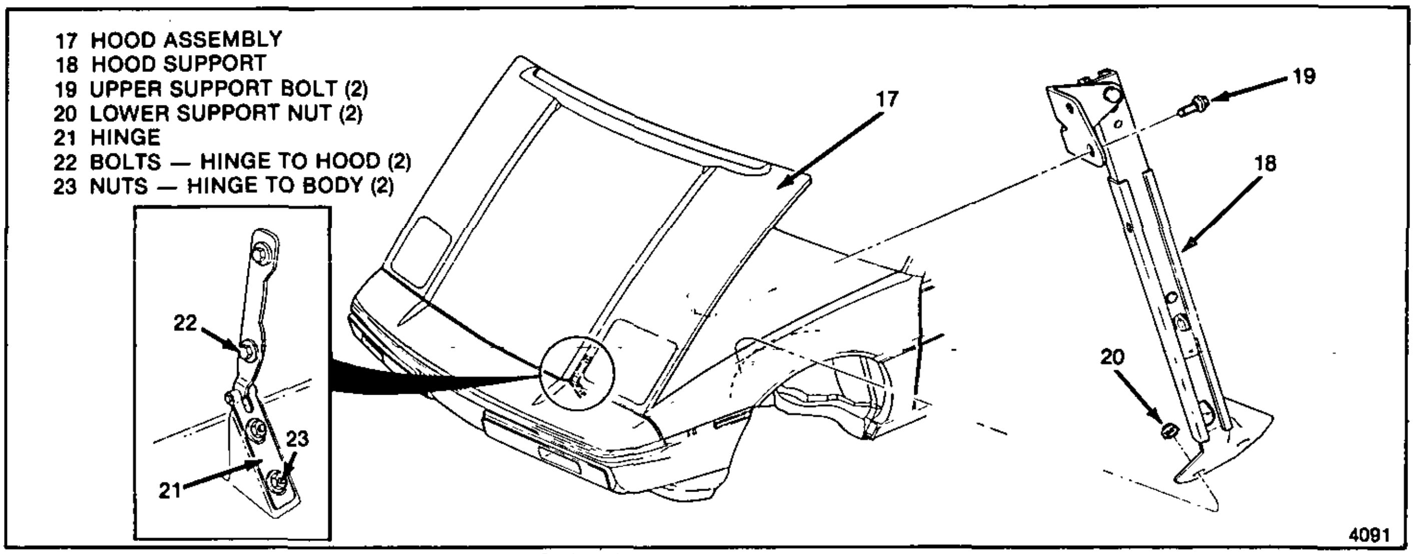


Fig. 3-Hood and Attaching Hardware

Remove or Disconnect (Figure 4)

1. Top shroud vent duct screen
2. Optional glass roof vent storage cover
3. Two bolts (25)
4. Latch (24)
5. Cable connector (29)

Install or Connect (Figure 4)

1. Cable connector (29)
2. Latch (24)
3. Bolts (25)

Important

Tighten bolts finger tight, close hood to reposition latch assembly. Open hood and tighten bolts.

4. Optional glass roof vent storage cover
5. Top shroud vent duct screen

Striker

Remove or Disconnect (Figure 4)

1. Nuts (28)
2. Striker (27)

Install or Connect (Figure 4)

1. Striker (27)
2. Nuts (28)

Hood Ajar Switch

A hood ajar switch is located in the front compartment area. This switch indicates if the hood is not fully closed by sending electrical current to an indicator light located in the instrument panel.

Remove or Disconnect

Install or Connect

1. Electrical connector to switch
2. Switch to body

Front Compartment Weatherstrip

Remove or Disconnect (Fig. 5)

1. Weatherstrip (1) by grasping weatherstrip and pulling from flange
2. Clean flange of excess sealer.

Install or Connect

1. Position butt joint (2) of weatherstrip to front center of flange in compartment opening.
2. Press down on weatherstrip (1) for entire length.

GLASS ROOF VENT STORAGE COVER (OPTIONAL)

Remove or Disconnect (Fig. 6)

1. Screws (2)
2. Cover (1)

Install or Connect

1. Cover (1)
2. Screws (2)

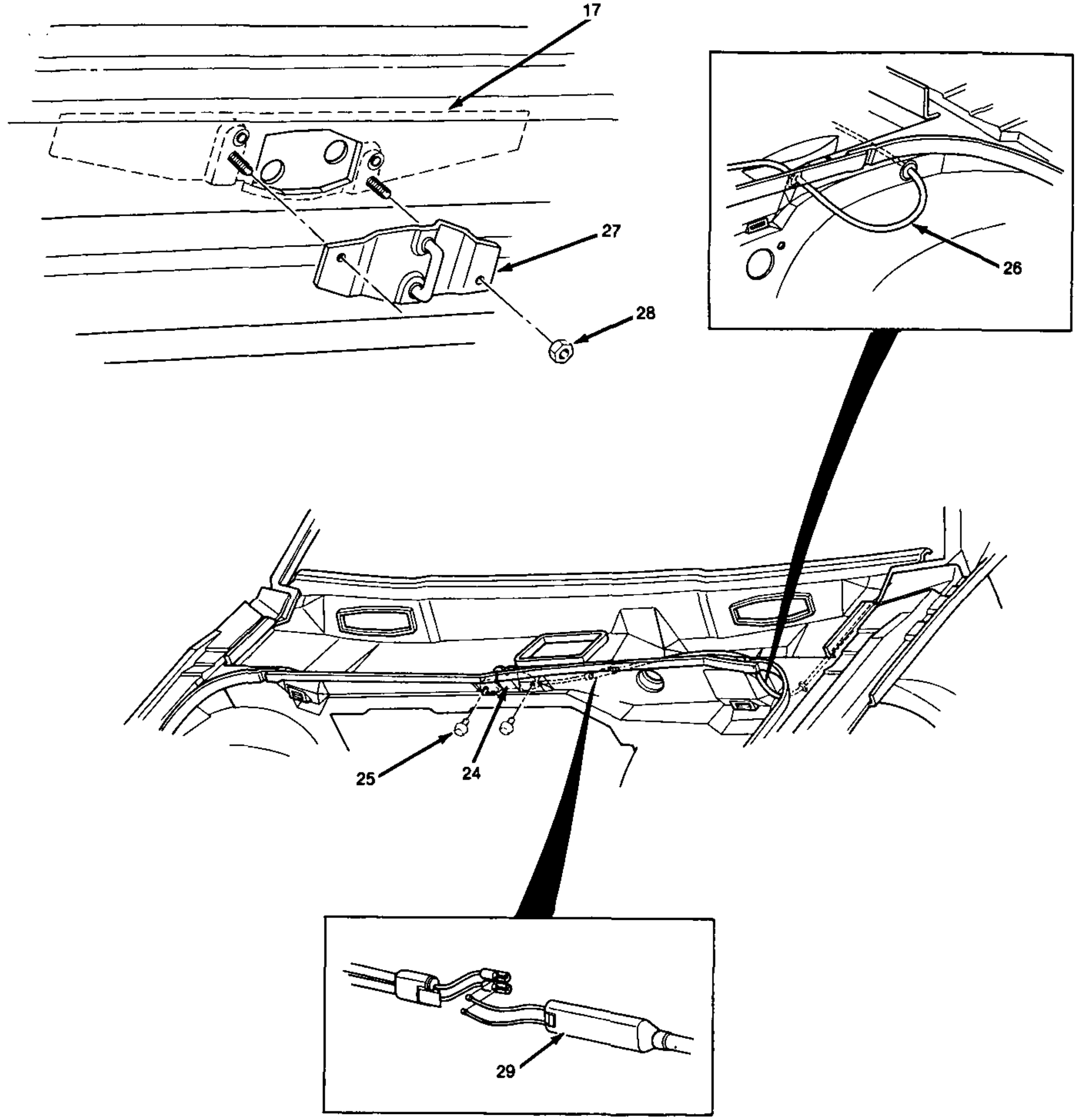
Tighten

Screws 2.5 to 3 N·m (18-24 in-lb)

FENDER PANEL

The outer fender panel is attached to the inner fender panel and the front fascia by J-clips and bolts. Always use care when handling fenders to avoid marring the surfaces.

Remove or Disconnect (Figure 7)



24 HOOD LATCH
25 HOOD LATCH BOLT (2)
26 HOOD RELEASE CABLE
17 *HOOD*
27 STRIKER
28 STRIKER NUT (2)
29 CABLE CONNECTOR

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Fig. 4-Hood Latch and Striker

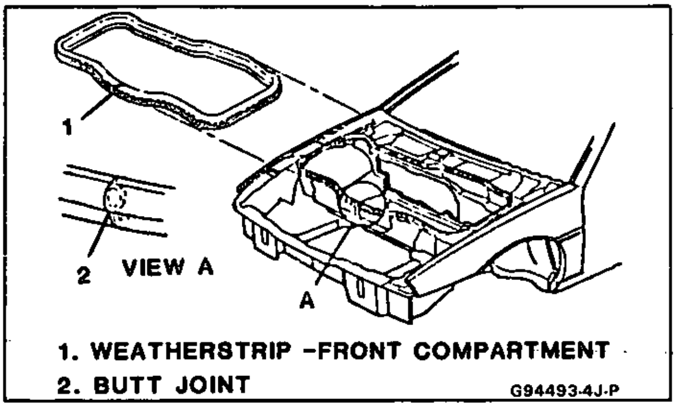


Fig. 5 - Installing Front Compartment Weatherstrip

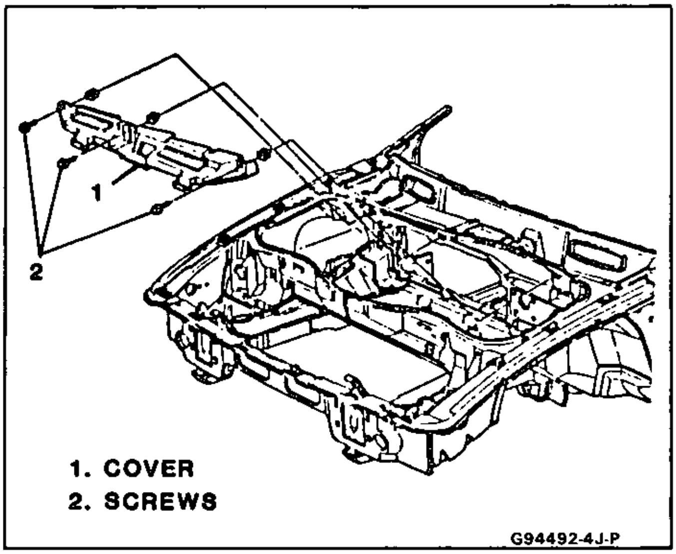


Fig. 6-Installing Optional Glass Roof Vent Storage Cover

3. Bolts and rivets
    - Top of fender to chassis (33)
    - Inner wheelwell panel to fender (36)
    - Upper forward front fender to fascia (32)
    - Rivet (37)
4. Fender panel (30)

Important

Fender panel is held in place at rocker panel and the inner wheelwell panel with a tab. Remove carefully to avoid damage.

Install or Connect (Figure 7)

1. Fender panel (30)
    - Rocker panel tab through outer fender panel
    - Tuck fender panel under fascia and inner wheelwell tab
2. Bolts, attaching
    - Upper forward front fender to fascia (32)
    - Inner wheelwell panel to fender (36)
    - Top at fender to chassis (33)
    - Rivet front fender to fascia at marker light

Inspect

For proper alignment of panel at hood, door, wheelhousing and fascia. The clearance between fender and door, and fender and front compartment hood should be 4 mm (5/32").

FRONT WHEELHOUSE PANEL

Remove or Disconnect (Figure 8)

1. Attachments at
    - Fender panel (36)
    - Chassis (39)
    - Fascia (40)
2. Wheelhousing panel

Important

Panel is retained to fender panel by a tab at center of wheel opening.

Install or Connect (Figure 8)

1. Wheelhousing tab to fender
2. Attachments at
    - Fascia (40)
    - Chassis (39)
    - Fender panel (36)

GRILLE ASSEMBLY

Remove or Disconnect (Figure 9)

1. Bolts (42)
2. Grille (41)

Install or Connect (Figure 9)

1. Grille (41)
2. Bolts (42)

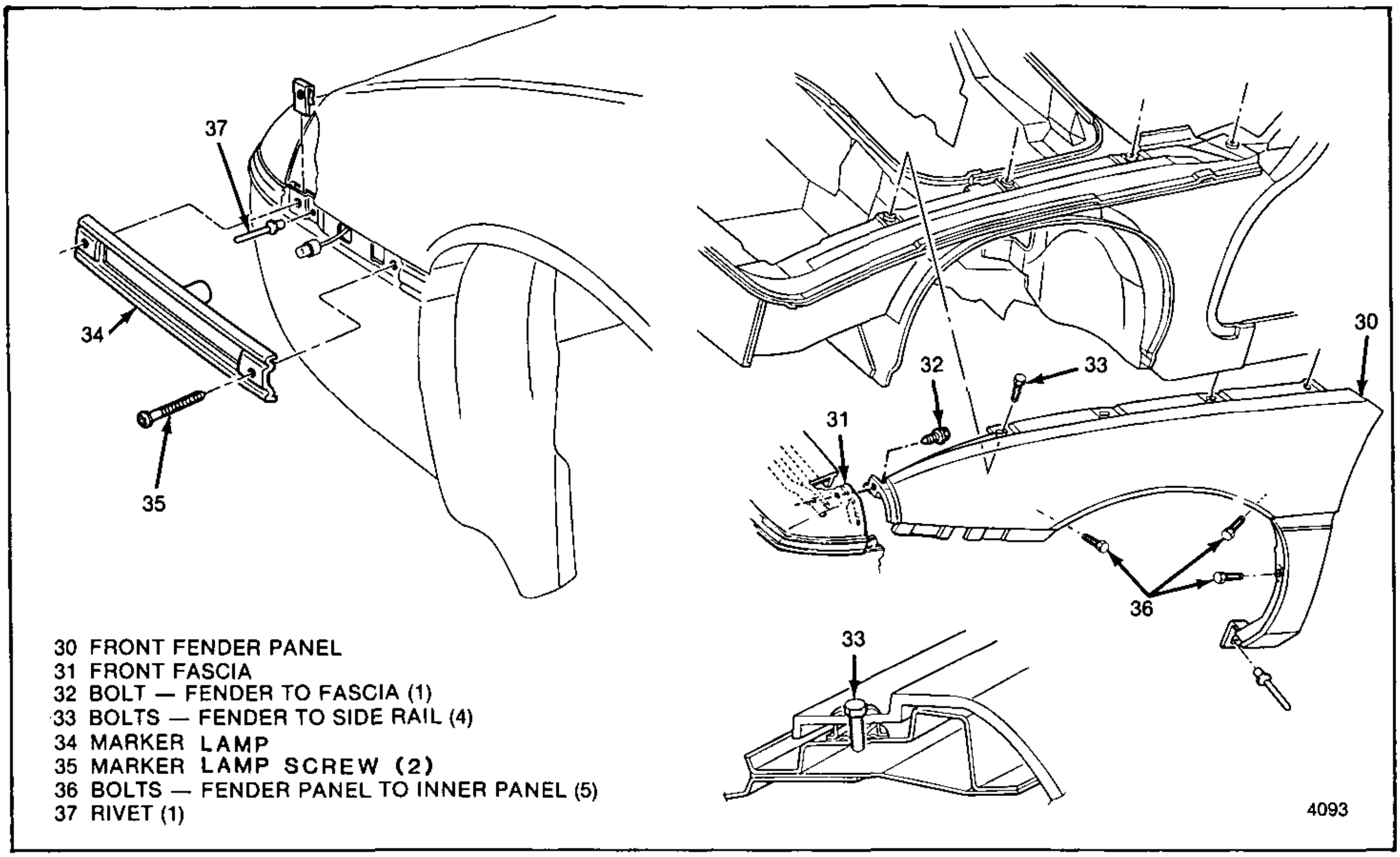
FRONT FASCIA

Remove or Disconnect (Figure 10)

1. Six screws at chassis (44)
2. Side marker lamp assemblies (34, Fig. 7)
3. Bolts attaching
    - Fascia to fender at side marker lamp assembly (45A)
    - Inner wheelwell to fascia (40)
    - Fascia support (45)
4. Fascia (31)

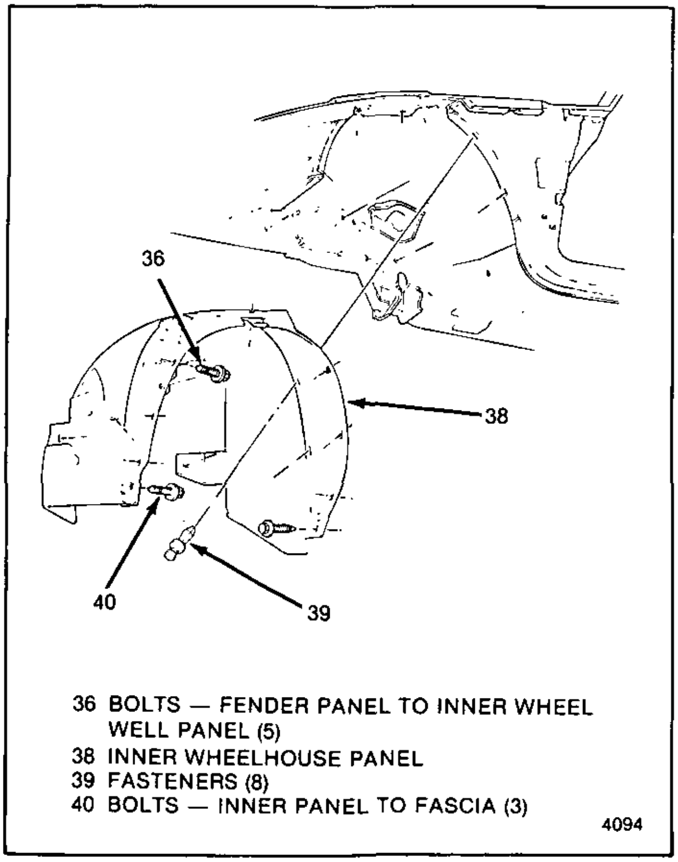
Install or Connect (Figure 10)

1. Fascia (31)
2. Bolts attaching
    - Fascia support (45)
    - Inner wheelwell to fascia (40)
    - Fascia to fender at side marker lamp



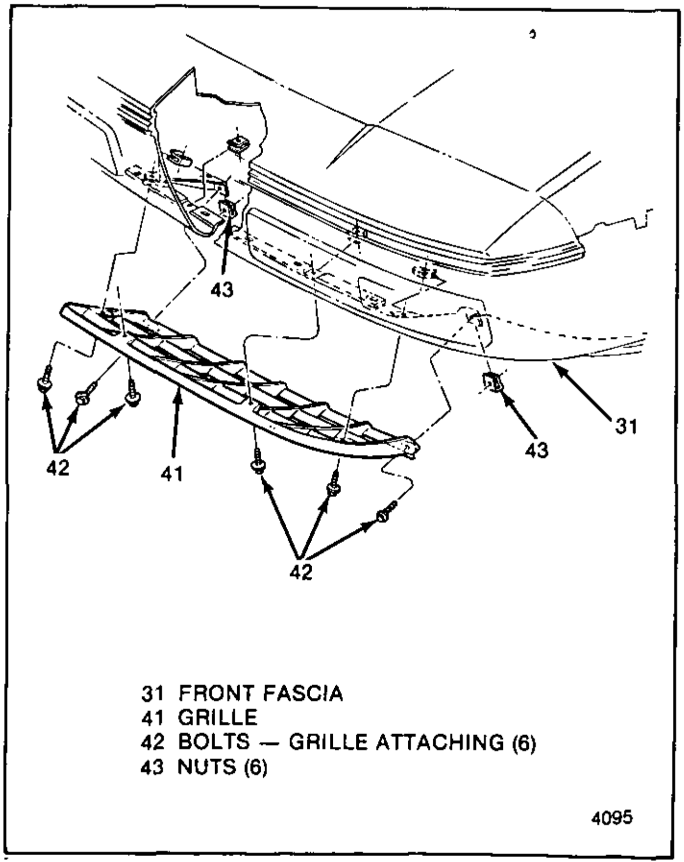
30 FRONT FENDER PANEL
31 FRONT FASCIA
32 BOLT — FENDER TO FASCIA (1)
33 BOLTS — FENDER TO SIDE RAIL (4)
34 MARKER LAMP
35 MARKER LAMP SCREW (2)
36 BOLTS — FENDER PANEL TO INNER PANEL (5)
37 RIVET (1)

Fig. 7-Front Fender Panel Attachment



36 BOLTS — FENDER PANEL TO INNER WHEEL WELL PANEL (5)
38 INNER WHEELHOUSE PANEL
39 FASTENERS (8)
40 BOLTS — INNER PANEL TO FASCIA (3)

Fig. 8-Wheelhousing Panel Attachment



31 FRONT FASCIA
41 GRILLE
42 BOLTS — GRILLE ATTACHING (6)
43 NUTS (6)

Fig. 9-Grille Assembly

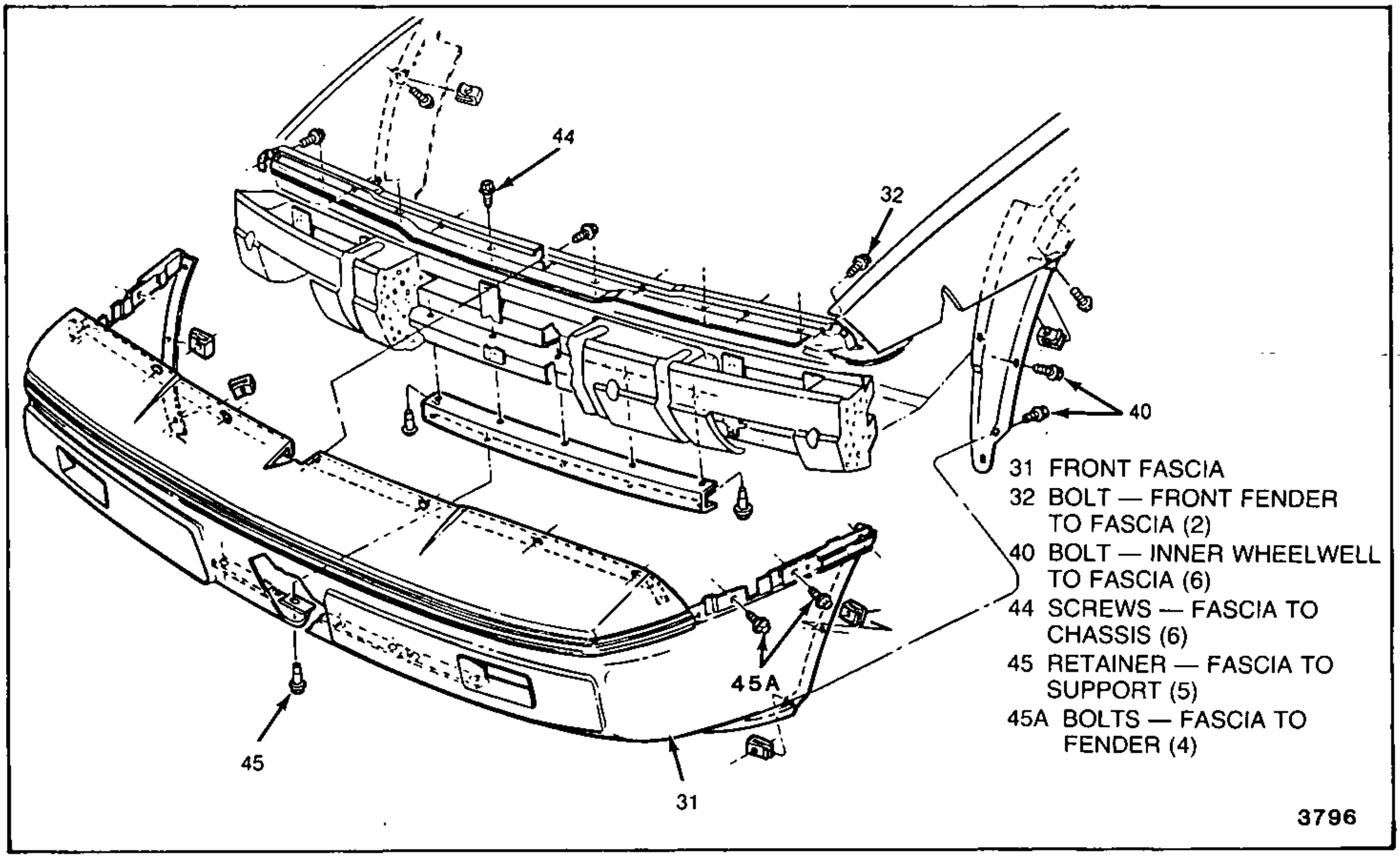


Fig. 10-Front Fascia Attachment

Inspect

For proper clearance between fascia and hood. Clearance should be no more than 4 mm (5/32").

MOLDING

The moldings on the fascia and the front fender where it attaches to the fascia are not removable. The rear portion of the front fender has a molding that is removable.

Remove or Disconnect (Figure 11)

1. Wheelhousing panel (rear half)
2. Two nuts (47)
3. Molding (46)

Install or Connect (Figure 11)

1. Molding (46)
2. Two nuts (47)
3. Wheelhousing panel (rear half)

Inspect

For proper alignment

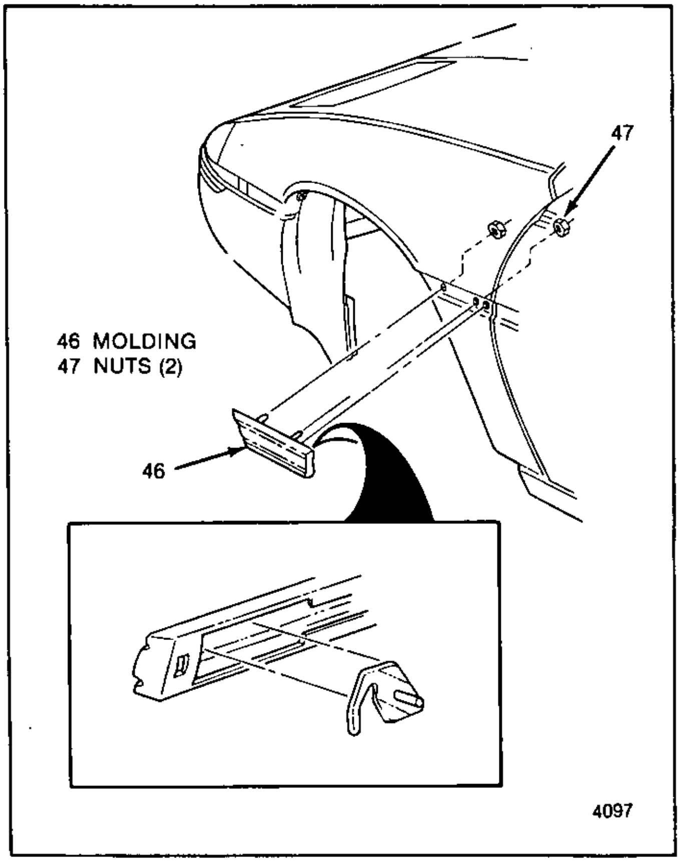


Fig. 11-Front Fender Molding

EXTENSION - ROCKER PANEL COVER TO FRONT FENDER

SECTION 5

DOORS

CONTENTS

DOORS

This section of the manual contains the service operations necessary for the removal, installation, adjustment and sealing of door assemblies and the individual hardware and trim components. It is divided into three subsections:

- **Door Trim** – removal and installation procedures for all door trim items.
- **Exterior Moldings** – procedures for attaching exterior door moldings.
- **Door Assembly** – common items of door assemblies including door and side roof rail weatherstrip and all lock system components.

DOOR TRIM

ARMREST AND PULL HANDLE ASSEMBLIES

↔ Remove or Disconnect (Figure 5-1)

- Armrest plug (1)
- Screws (2)
- Armrest (3)

→← Install or Connect (Figure 5-1)

- Armrest (3)
- Screws (2)
- Armrest plug (1)

WINDOW REGULATOR HANDLE

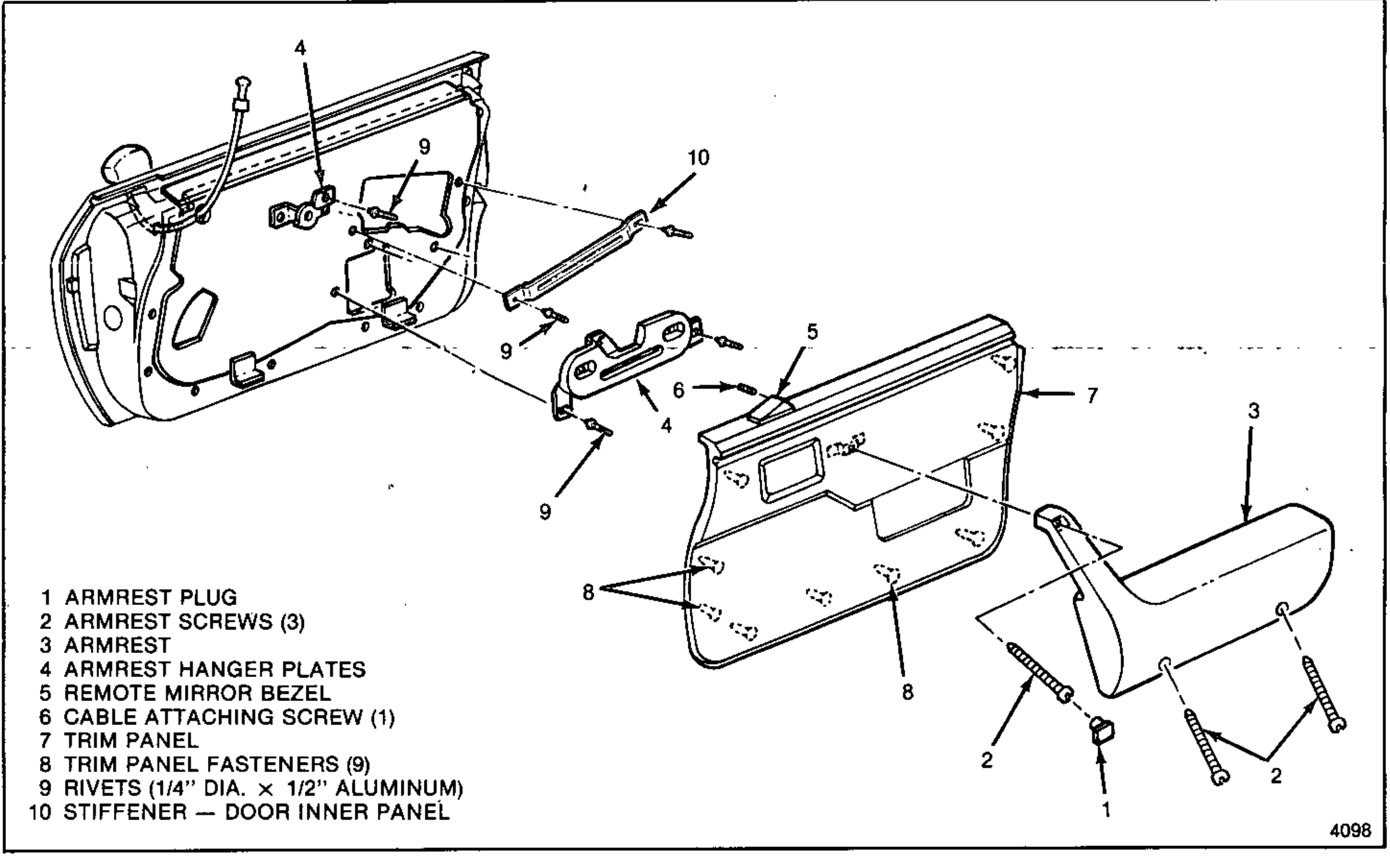
↔ Remove or Disconnect (Figures 5-2 and 5-3)

Tools Required:

J-9886 Door Handle Clip and Trim Pad Remover (or equivalent)

J-24595B Door Trim Pad and Garnish Molding Clip Remover (or equivalent)

1. Clip (12)
   - Depress trim panel
   - Insert J-9886 between handle and bearing plate (13). Tool should be in same plane as handle (Figure 5-2).
   - Push tool as indicated in Figure 5-3.
2. Handle (11)
3. Plate (13)



1 ARMREST PLUG
2 ARMREST SCREWS (3)
3 ARMREST
4 ARMREST HANGER PLATES
5 REMOTE MIRROR BEZEL
6 CABLE ATTACHING SCREW (1)
7 TRIM PANEL
8 TRIM PANEL FASTENERS (9)
9 RIVETS (1/4" DIA. × 1/2" ALUMINUM)
10 STIFFENER — DOOR INNER PANEL

Fig. 5-1-Door Trim Panel and Armrest

Install or Connect (Figures 5-2 and 5-3)

1. Plate (13)
2. Clip (12) on handle
3. Handle (11)
   - Position handle at same angle as opposite side handle
   - Press handle onto regulator spindle to engage clip

DOOR LOCK KNOB AND REMOTE HANDLE BEZEL

Remove or Disconnect (Figure 5-4)

1. Covers (17)
2. Screws (16)
3. Lock knob (19)
   - Use a small flat-bladed tool such as a screwdriver.
   - Insert blade between end of knob and rod and pry to release knob.
   - Slide knob forward to remove.
4. Remote handle bezel (15)

Install or Connect (Figure 5-4)

1. Remote handle bezel (15)
2. Lock knob (19)
   - Insert lock rod through hole in bezel.
   - Force knob against bezel until rod snaps into knob.
3. Screws (16)
4. Covers (17)

DOOR TRIM PANEL

Remove or Disconnect (Figure 5-1)

Tools Required:

J-9886 Door Handle Clip and Trim Pad Remover (or equivalent)

J-24595B Door Trim Pad and Garnish Molding Clip Remover (or equivalent)

1. Armrest (3)
2. Window regulator handle (if equipped)
3. Remote handle bezel
4. Plastic retainers from perimeter of door (8).
   - Use J-9886 between panel and door.
5. Panel (7)
   - Pull outward to disengage from retainer at beltline.
6. Remote control mirror cable end (if equipped)
   - Screw (6)
   - Cable
7. Wire harness (if equipped)

Inspect

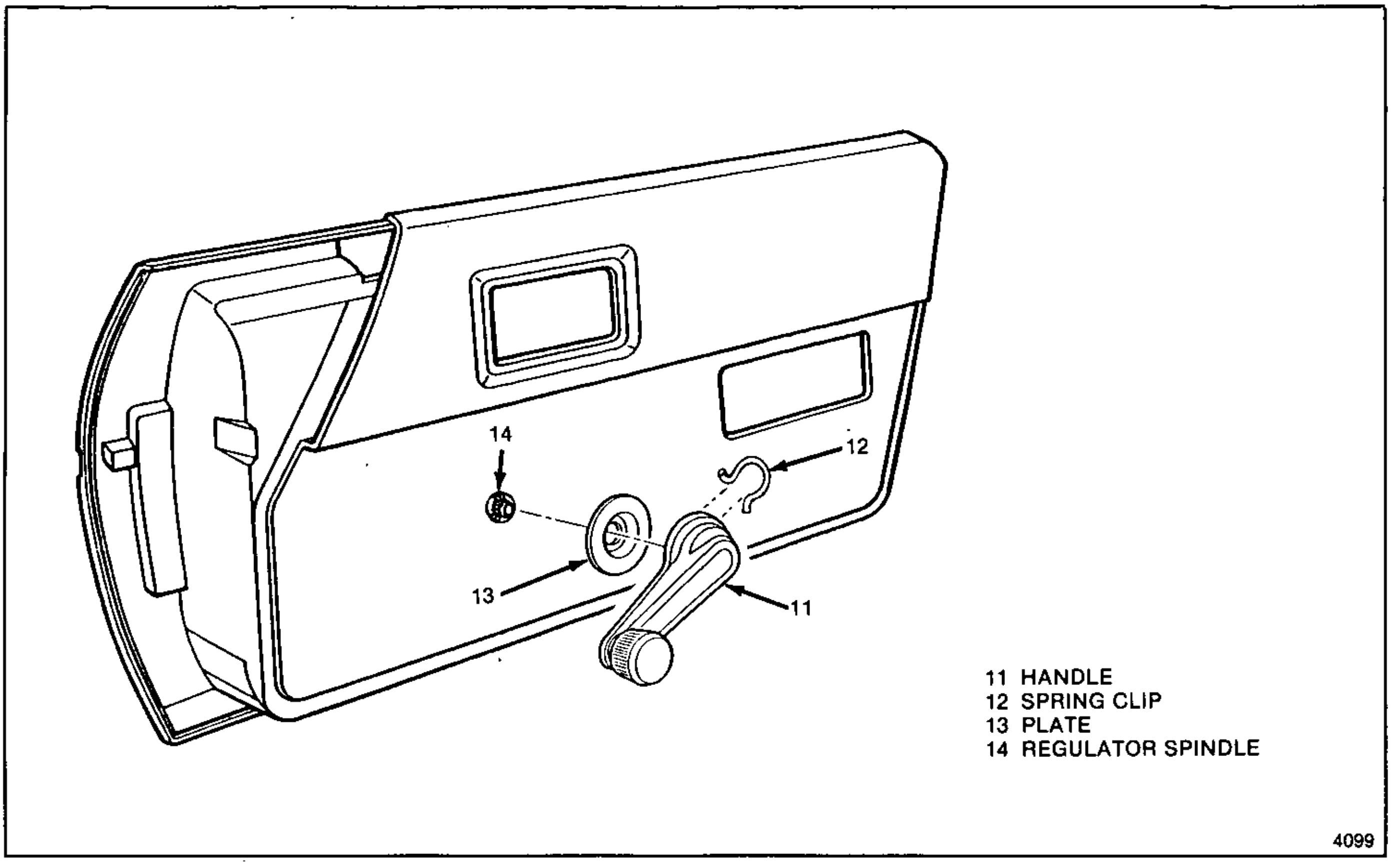


Fig. 5-2-Window Regulator Handle

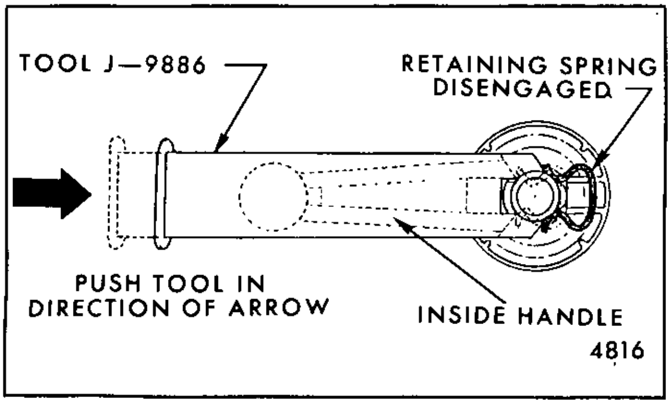


Fig. 5-3-Removing Window Regulator Handle

→← Install or Connect

1. Insert flange in hole
2. Rotate retainer to engage flange

- Water deflector for proper installation

→← Install or Connect (Figure 5-1)

1. Remote control mirror cable end (if equipped)
   - Cable
   - Screw (6)
2. Wire harness (if equipped)
3. Panel (7)
   - Insert top of panel in retainer
   - Insert remote handle through panel
   - Align retainers (8) with holes

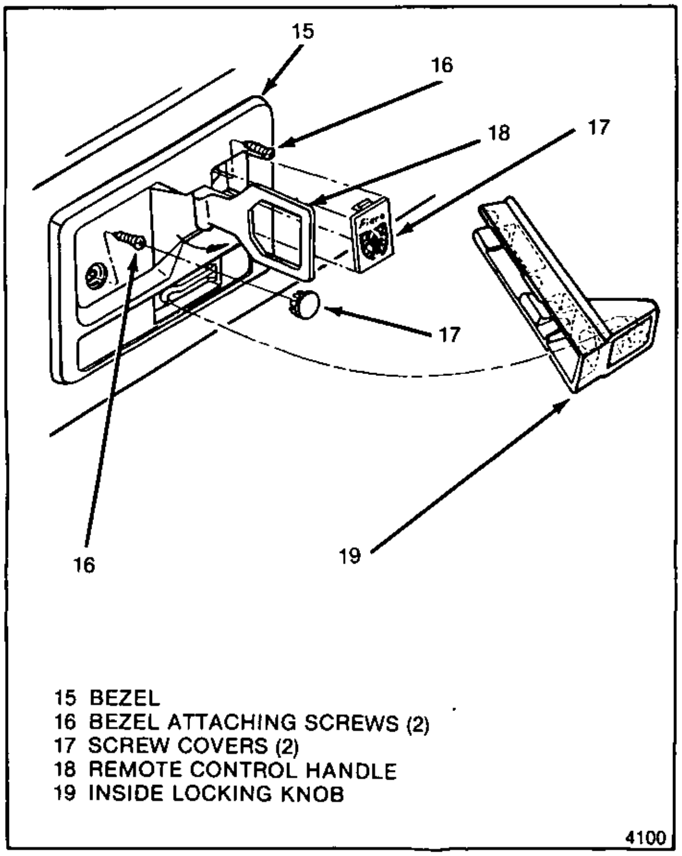


Fig. 5-4-Remote Control Handle and Lock Knob

- Tap into place with palm of hand or a clean rubber mallet.

4. Bezel
5. Lock knob
6. Window regulator handle (if equipped)
7. Armrest (3)

Door Map Pocket

Remove or Disconnect

Tools Required:
J-23554 Inverted Nut Driver

1. Door trim panel
2. Six inverted nuts with J-23554

CAUTION: Wear eye protection to prevent injury when cutting studs

To allow access for J-23554, cut approximately 6 mm (1/4") from map pocket studs with suitable tool.

3. Door map pocket

Important

If the left side door map pocket is being replaced, be sure to transfer the spring clip at the rear inner seam to the new map pocket to prevent interference with the emergency brake handle.

Install or Connect

1. Door map pocket
2. Six inverted nuts with J-23554
3. Door trim panel

EXTERIOR MOLDINGS

CENTER MOLDING ASSEMBLY

Remove or Disconnect (Figure 5-5)

1. Door trim panel
2. Water deflector
3. Nut (24) from rear clip (25)
   - Put window in full-up position to allow access to nut from inside of door panel.
4. Plastic retainer, (23) at outside door handle
5. Molding assembly (22)

Install or Connect (Figure 5-5)

1. Molding assembly (22)
2. Plastic retainer (23)
3. Nut (24)
4. Water deflector
5. Door panel

REAR MOLDING ASSEMBLY

Remove or Disconnect (Figure 5-5)

1. Door trim panel

4. Loosen rear section of outer door panel from top to gain access to retaining screw
5. Screw (21)
6. Molding (20)

Install or Connect (Figure 5-5)

1. Molding (20)
2. Screw (21)
3. Rear section of outer door panel
4. Nut (24) to rear clip (25)
5. Outside door handle
6. Door trim panel

EXTENSION - ROCKER COVER PANEL TO DOOR

See procedure in Section 6 in the body portion of this manual.

DOOR ASSEMBLY

DOOR SEALING

The following section contains service operations necessary to remove and replace the components which seal the door against air and water entry into the *passenger compartment*.

Inner Door Window Belt Sealing Strip

Remove or Disconnect (Figure 5-6)

1. Door trim panel
2. Retainer (31)
3. Sealing strip (30)

Install or Connect (Figure 5-6)

1. Sealing strip (30)
2. Retainer (31)
3. Door trim panel

Outer Door Window Belt Sealing Strip

Remove or Disconnect (Figure 5-6)

1. Door trim panel
2. Water deflector (34)
3. Front filler sealing strip (32)
4. Mirror
5. Door glass
6. Screws - sealing strip attaching
7. Sealing strip (29)

Install or Connect (Figure 5-6)

1. Sealing strip (29)
2. Screws
3. Door glass
4. Mirror
5. Front filler sealing strip (32)

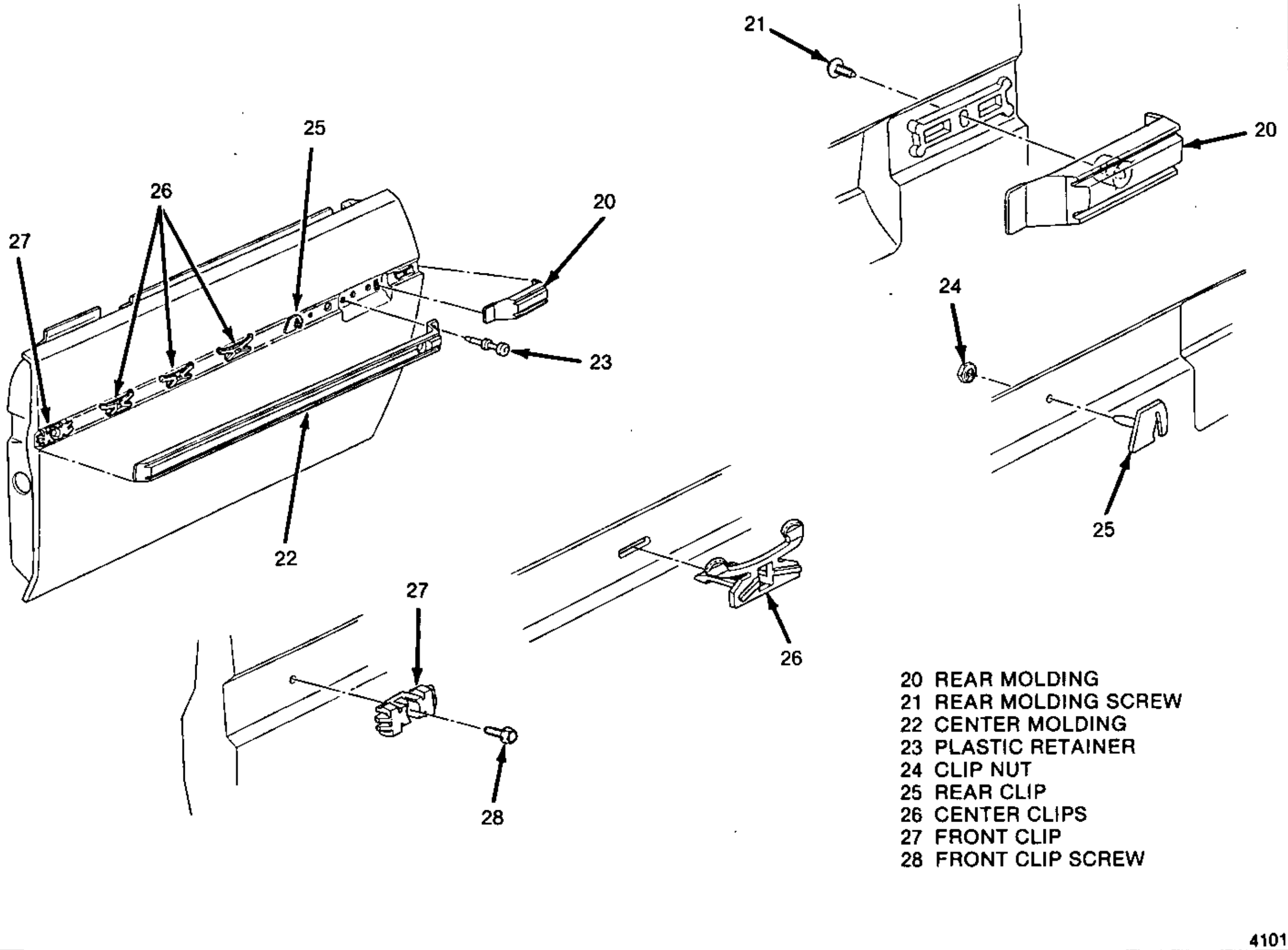


Fig. 5-5-Exterior Door Moldings

Inner Panel Water Deflector

The water deflector is secured by a string loaded sealing material and by sealing tape. When removal of deflector is required, it must be properly sealed for replacement. If additional sealing material is required, strip caulking is recommended.

For access to inner panel, the deflector may be either partially or completely detached as required.

Remove or Disconnect (Figures 5-1, 5-7 and 5-8)

1. Door trim panel
2. Armrest hanger plates (4)
3. Stiffener (10)
4. Water deflector (34)
   - Use a flat-bladed tool such as a putty knife to release sealer. Keep blade between inner panel and the string that is embedded in the sealer.

Inspect

For holes or tears in deflector. Apply waterproof tape to both sides if necessary. Replace deflector if it cannot be properly repaired.

Install or Connect (Figures 5-1, 5-7 and 5-8)

1. Water deflector (34). Apply additional strip caulk and tape as required.
2. Stiffener (10)
3. Armrest hanger plates (4)
4. Door trim panel

DOOR OPENING WEATHERSTRIPS AND CHANNELS

The door opening weatherstrips are a bulbar type. They are installed on the body pinchweld flange around door opening and are friction retained on pinchweld around door opening and adhesive retained in the channels around the window glass opening. There are four screws at beltline.

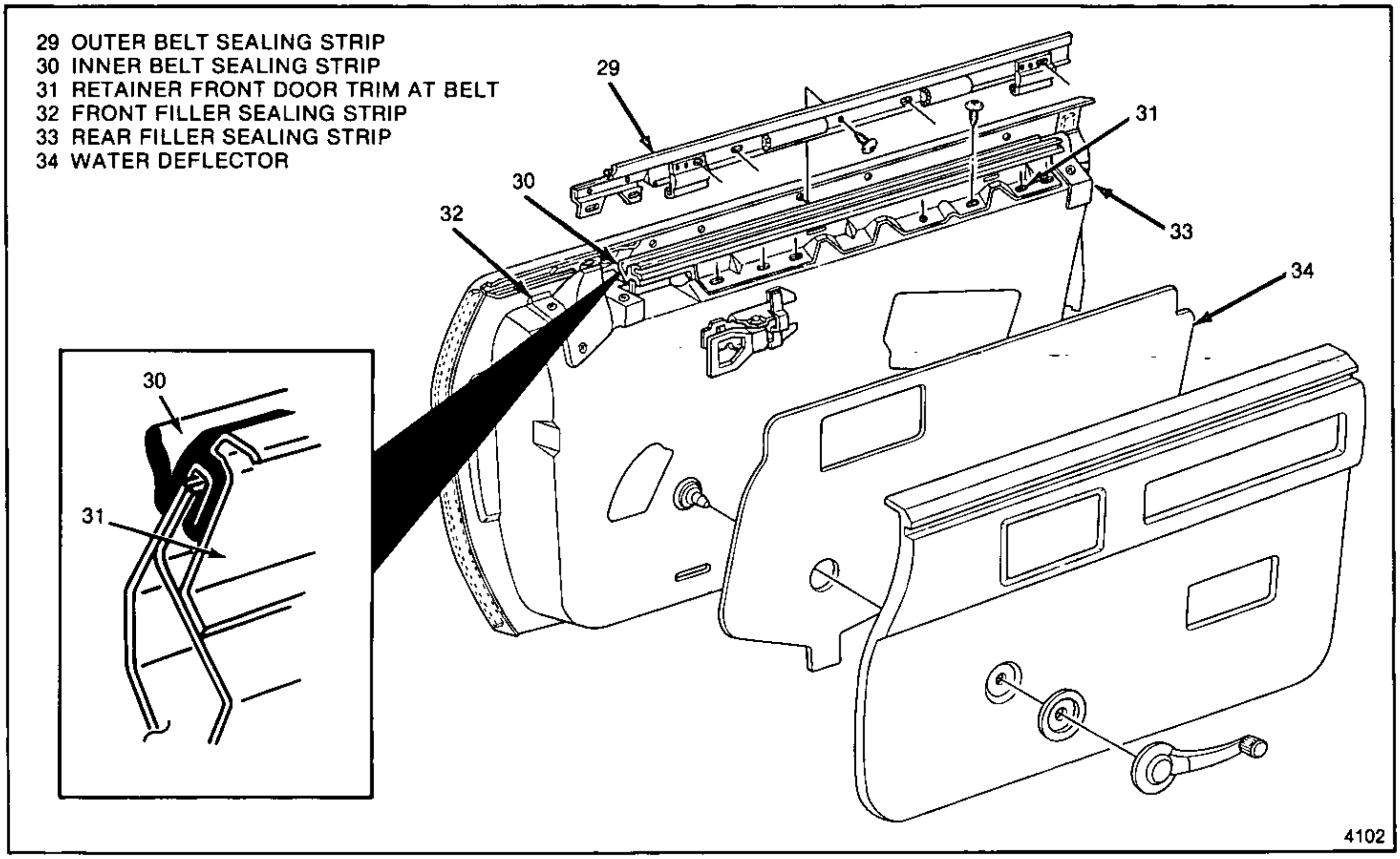


Fig. 5-6-Door Sealing Components

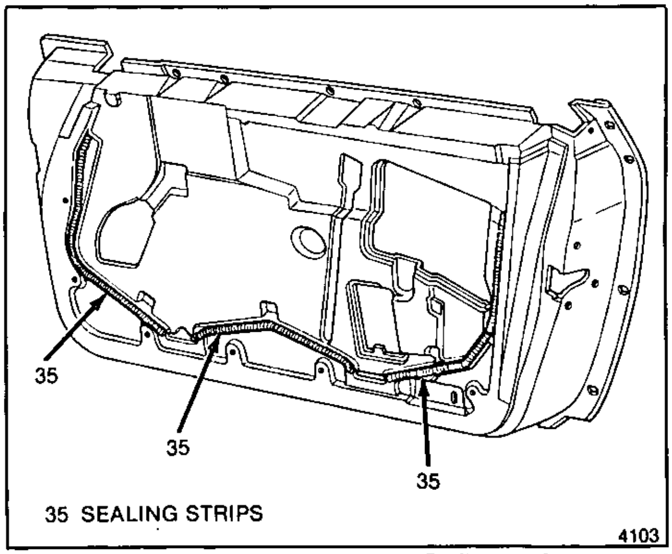


Fig. 5-7-Door Inner Panel Water Deflector Sealing Locations

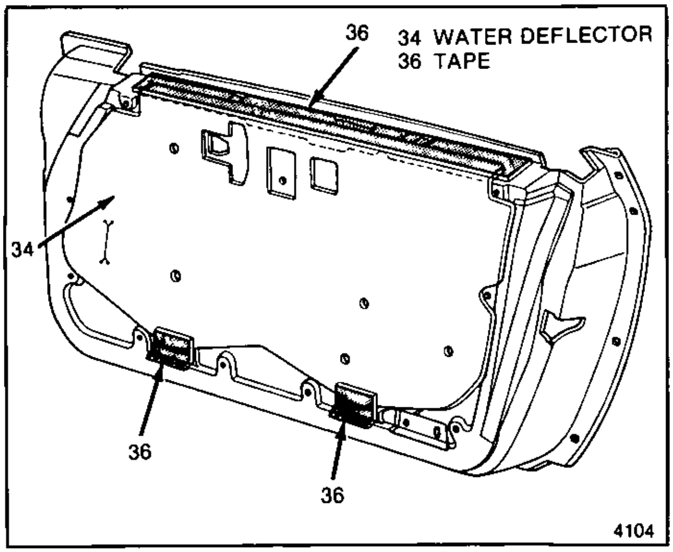


Fig. 5-8-Door Inner Panel Water Deflector Tape Locations

Door Opening Weatherstrip

←→ Remove or Disconnect (Figure 5-9)

1. Lower garnish molding. Refer to Section 3.
2. Loosen quarter trim panel
3. Screws (39)
4. Door opening weatherstrip (38)

- Start at any convenient location, grasp the weatherstrip and pull from the pinchweld flange and channel; continue around entire door opening.

→← Install or Connect (Figure 5-9)

1. Door opening weatherstrip (38)

   ⊖ Apply a medium bodied sealer in cavity of weatherstrip

- Be certain to obtain full engagement on the pinchweld flange and in the channels.

2. Screws (39)
3. Tighten quarter trim panel
4. Lower garnish molding

Weatherstrip Channels

Remove or Disconnect (Figure 5-9)

1. Weatherstrip (38)
2. Screws
3. Channels (37)

Inspect

Channel seal and repair or replace if damaged.

Install or Connect (Figure 5-9)

1. Channels (37)
2. Screws
3. Weatherstrip (38)

DOOR HARDWARE LUBRICATION

The mechanical components of the door assembly are lubricated during assembly. If additional lubrication is required, use the following lubricants. Door lock cylinders should be lubricated with a light oil. 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, Lubricate Spray-Lube A, part no. 1052196, Lubriplate Auto-Lube A or equivalent.

HARDWARE ATTACHMENT THREAD LOCKING

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 removal if required. Loctite 75 or equivalent can be used on any threaded fastener.

SPRING CLIPS

Spring clips are used to secure remote control connecting rods and inside locking rods to levers and handles. A slot in the clip provides for disengagement of the clips which allows for easier detachment of linkage.

Remove or Disconnect (Figure 5-10)

1. Tang from lever. Use an awl or thin-bladed screwdriver.
2. Clip from rod. Slide clip on lever to disengage from rod.

Install or Connect (Figure 5-10)

1. Rod in lever
2. Clip to rod. Slide clip on lever to engage tang.

CONNECTING RODS AND LOCKING RODS

Remove or Disconnect (Figure 5-11)

1. Door trim panel
2. Water deflector
3. Connecting rods and/or locking rods as required.

Install or Connect (Figure 5-11)

1. Connecting rods and/or locking rods.

Inspect

For proper operation.

2. Water deflector
3. Door trim panel

INSIDE REMOTE HANDLE

Remove or Disconnect (Figure 5-12)

1. Door trim panel
2. Connecting rod clip (46)
3. Rivet at remote handle (44)
4. Remote handle (18)

Install or Connect (Figure 5-12)

1. Remote handle (18)
2. Rivet (44)
3. Connecting rod (47)
4. Door trim panel

OUTSIDE HANDLE

Remove or Disconnect (Figures 5-13 and 5-14)

1. Door trim panel
2. Two nuts at door handle (49)
3. Retainer and outside locking rod (50)
4. Handle assembly (48)

Install or Connect (Figures 5-13 and 5-14)

1. Handle assembly (48)
2. Two nuts (49)
3. Outside handle locking rod (50) and retainer
4. Door trim panel

OUTER DOOR PANEL ASSEMBLY

Remove or Disconnect (Figures 5-5, 5-6, and 5-14)

1. Door trim panel

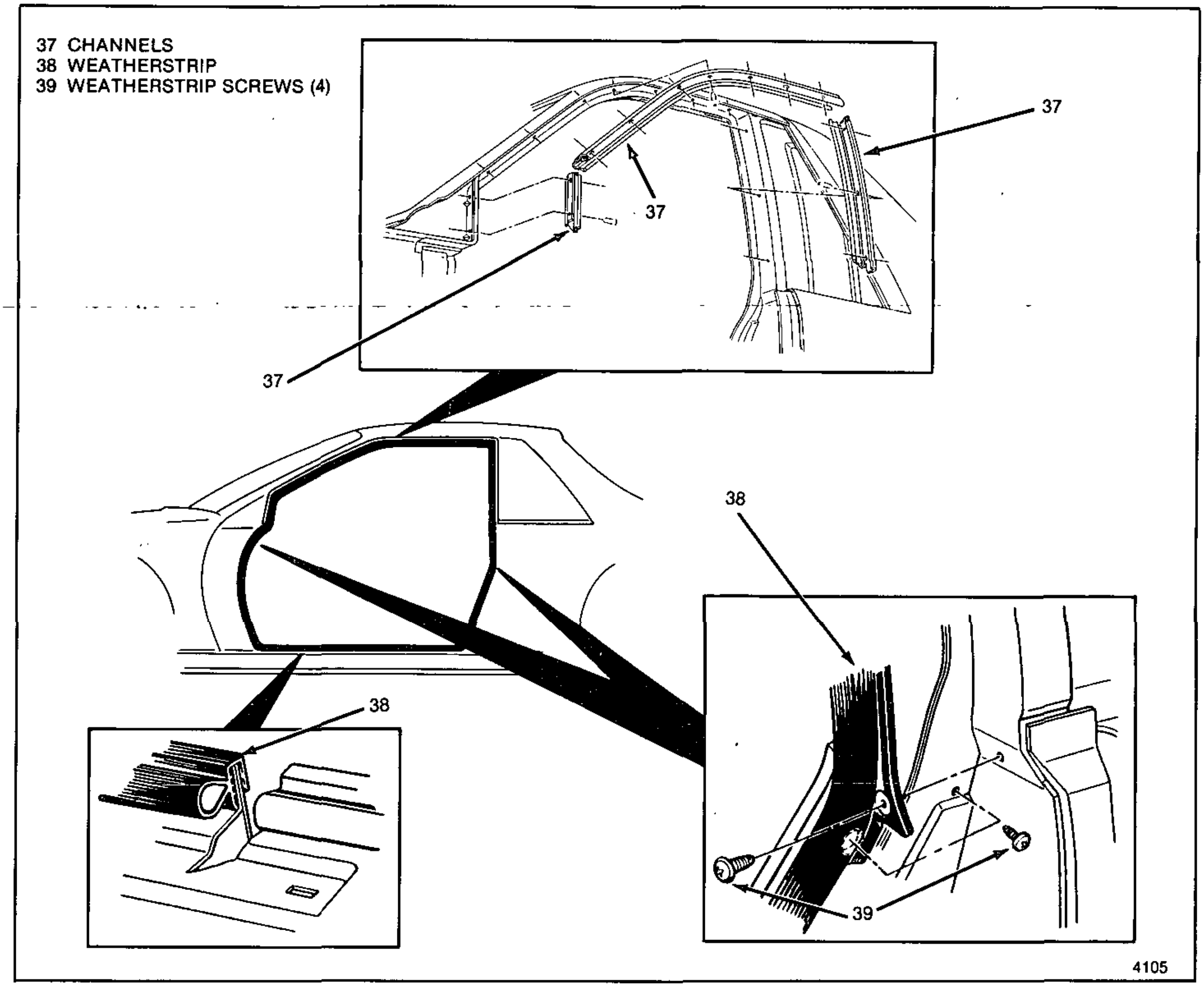


Fig. 5-9-Door Opening Weatherstrips and Channels

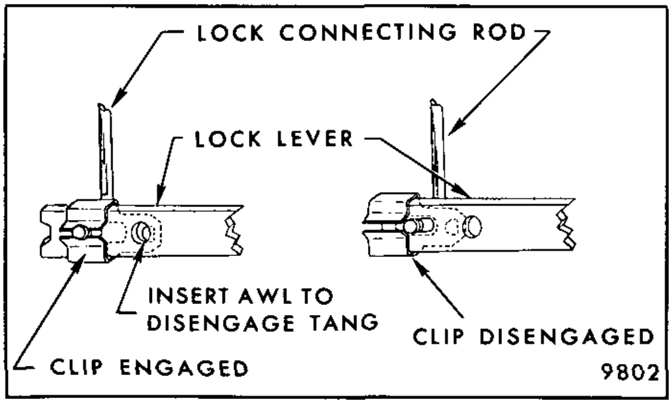


Fig. 5-10-Removing Spring Clip

2. Water deflector (34)
3. Nine screws (59) from front and rear of inner panel assembly
4. Nut from rear clip (24). Put window in full-up position to allow access to nut from inside of door
6. Center molding assembly (22)
7. Two 7 mm bolts (28)
8. Front filler sealing strip (32)
9. Mirror
10. Four peel type rivets (60)
11. Outer door panel (56). Pull panel away from inner door to disengage retainers at top. Pull panel straight back as if it were hinged at the back of the inner door.
12. All attaching rods

Install or Connect (Figures 5-5, 5-6, and 5-14)

1. All rods to outer door panel
2. Outer door panel (56)
3. Nine screws (59) from front and rear of inner panel
4. Two 7 mm bolt (28)

Inspect

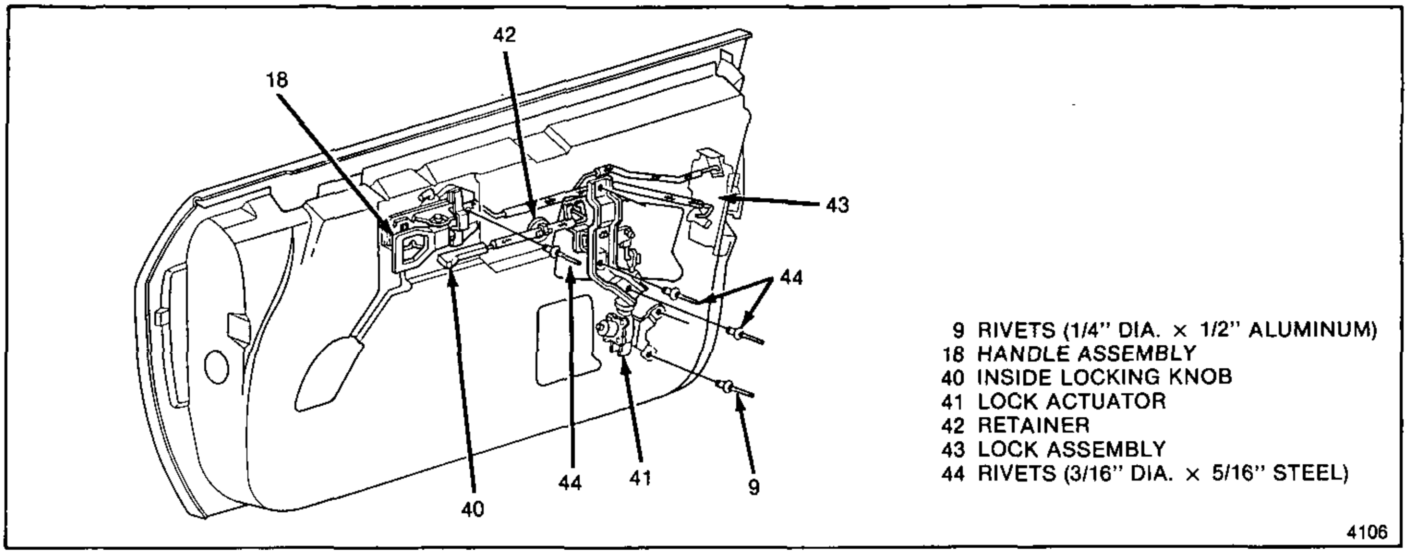


Fig. 5-11-Connecting Rods and Locking Rods

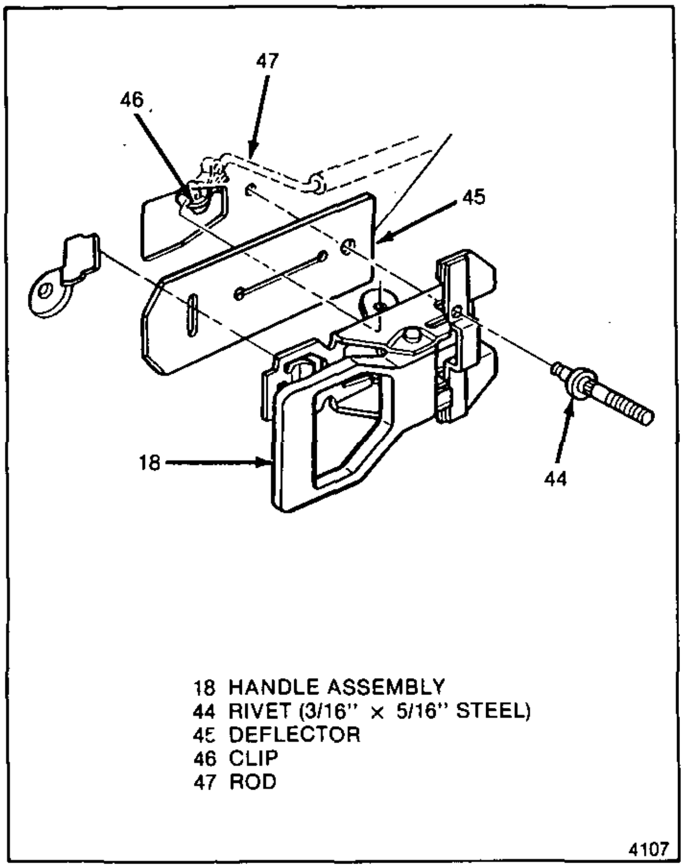


Fig. 5-12-Inside Remote Handle

6. Center molding assembly (22)
7. Outside door handle
8. Nut on rear clip (24)
9. Mirror
10. Front filler sealing strip (32)
11. Water deflector (34)
12. Door trim panel

DOOR LOCK STRIKER

The door lock striker consists of a single metal bolt and washer assembly which is threaded into a tapped, floating cage plate in the body pillar. The door is secured in the closed position when the door lock fork bolt snaps over and engages the striker bolt.

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.

Inspect (Figures 5-15, 5-17)

- Fore and aft adjustment
  - Check for proper door alignment.
  - Apply modeling clay or body caulking to lock bolt opening.
  - Close door only as far as necessary for striker to form an impression in clay or compound. Complete closing will make clay removal difficult.
  - Striker should be centered fore and aft.

Important

Minimum and maximum dimensions must be strictly maintained.

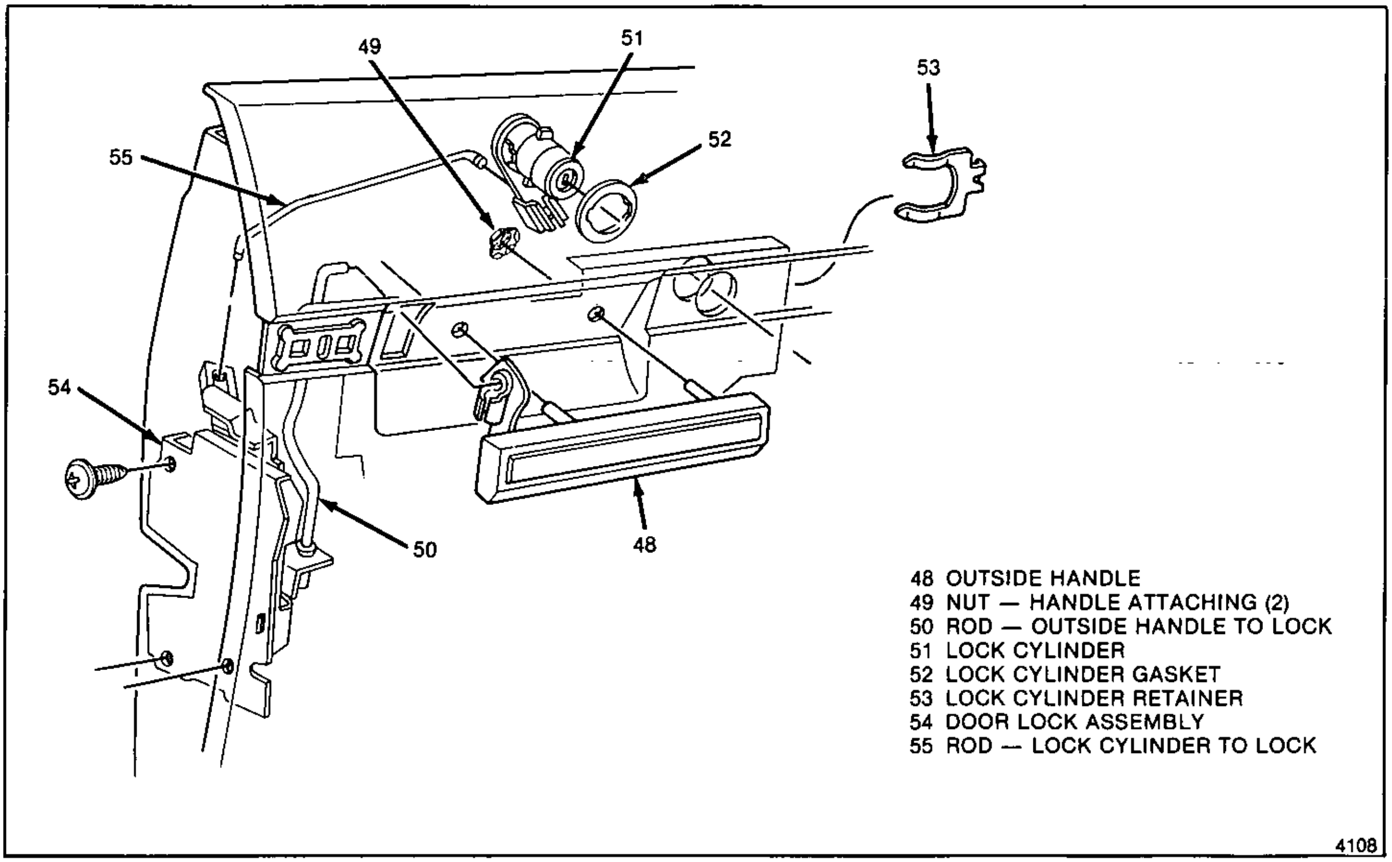
- Minimum allowable dimension 2 mm (3/32")
- Maximum allowable dimension 4 mm (5/32")

Adjust

Tools Required:

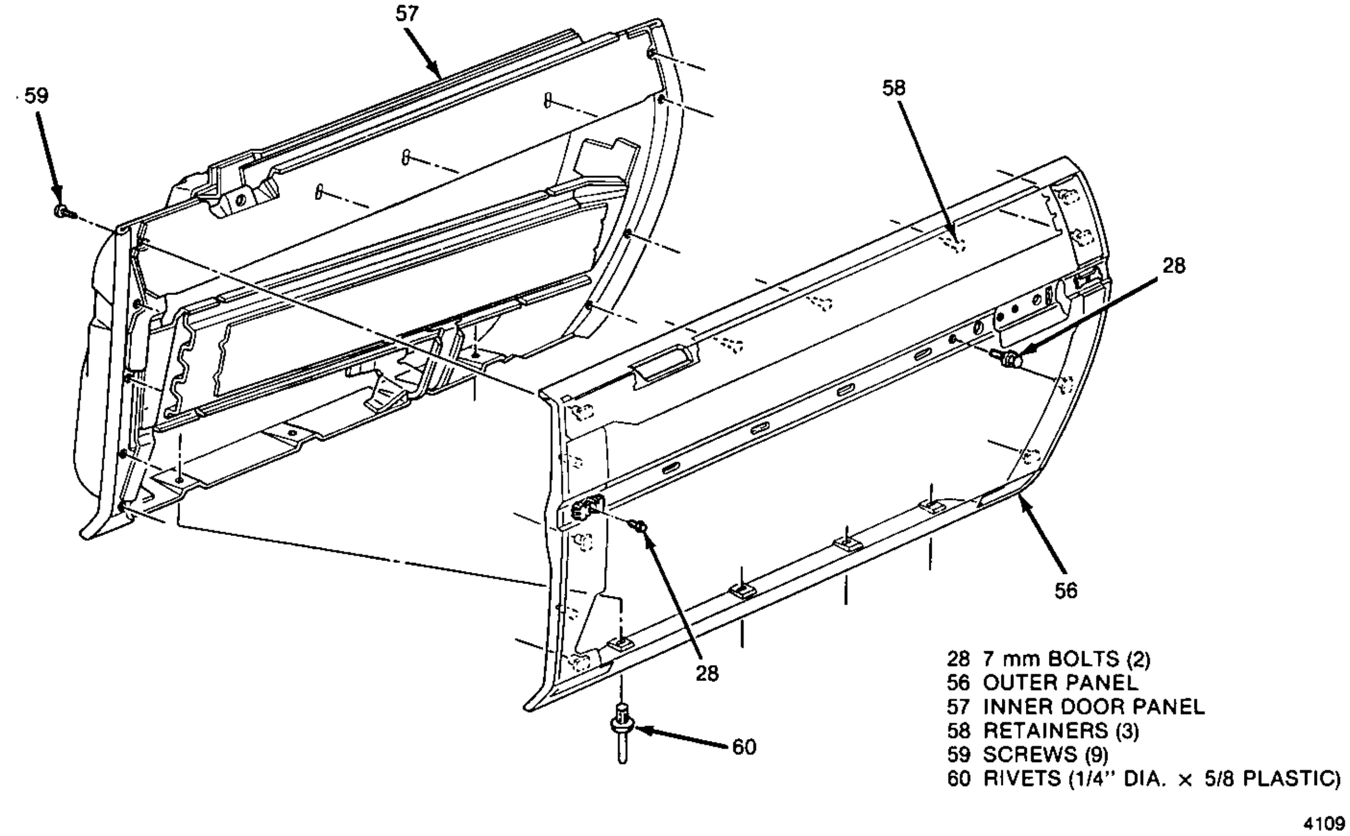
J-23457 Door lock striker wrench (or equivalent)

- Remove striker with J-23457.
- Install spacer or spacers as required to obtain correct alignment. The following spacers are available as service parts:



48 OUTSIDE HANDLE
49 NUT — HANDLE ATTACHING (2)
50 ROD — OUTSIDE HANDLE TO LOCK
51 LOCK CYLINDER
52 LOCK CYLINDER GASKET
53 LOCK CYLINDER RETAINER
54 DOOR LOCK ASSEMBLY
55 ROD — LOCK CYLINDER TO LOCK

Fig. 5-13-Door Locking Mechanism



28 7 mm BOLTS (2)
56 OUTER PANEL
57 INNER DOOR PANEL
58 RETAINERS (3)
59 SCREWS (9)
60 RIVETS (1/4" DIA. × 5/8 PLASTIC)

Fig. 5-14-Outer Door Panel

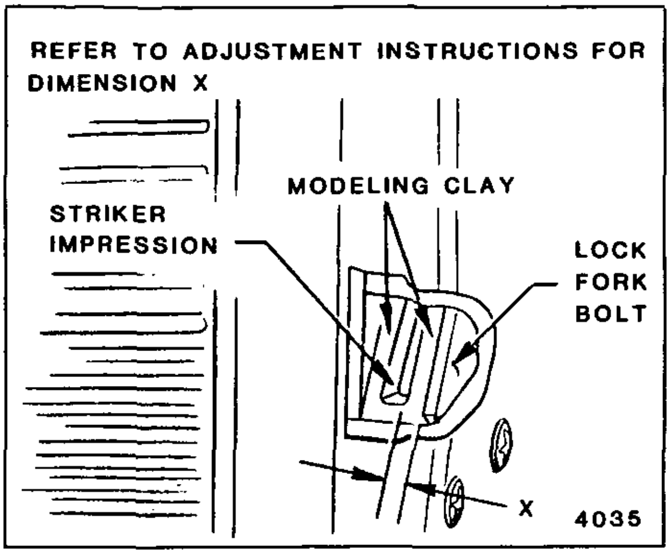


Fig. 5-15-Lock-to-Striker Engagement

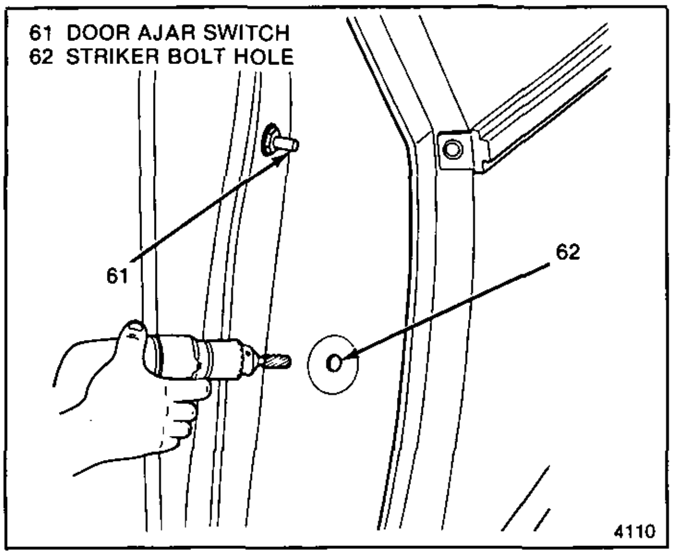


Fig. 5-16-Striker Bolt Hole Enlargement

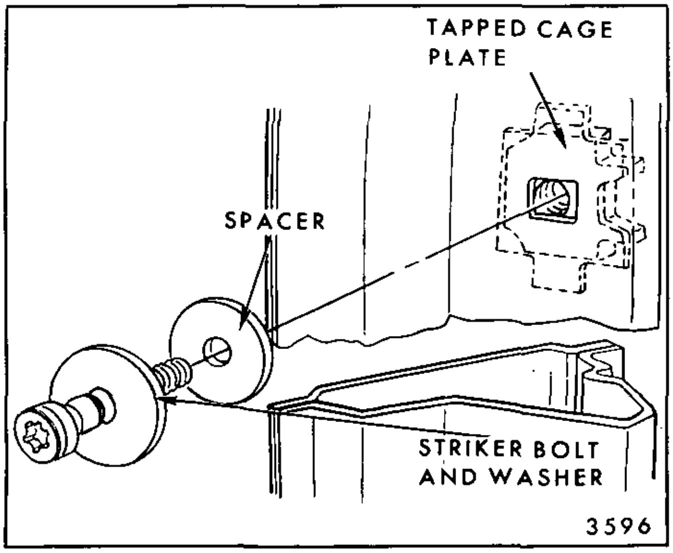


Fig. 5-17-Typical Door Lock Striker Mechanism

  - 2 mm (3/32") part no. 4469196
  - 4 mm (5/32") part no. 4469197
- Replace striker

Tighten

Striker from 40 to 60 N·m (34 to 46 ft-lb).

Inspect

Up or down, in or out adjustment

Adjust (Figures 5-16, 5-17)

Tools Required:
J-23457 Door lock striker wrench (or equivalent)
3/8" rotary file with a flat end

- Remove striker with J-23457.
- Enlarge hole in the direction required.

NOTICE: It is important that a flat end rotary file be used so that no damage is done to the tapped cage plate. The striker bolt and cage plate are important attaching parts that could affect the performance of vital components and systems.

- Install striker

Tighten

Striker from 40 to 60 N·m (34 to 46 ft-lb)

DOOR JAMB SWITCHES

Door jamb switch assemblies consist of a plunger, plunger collar, threaded retainer and terminals. They are installed in the front 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. 5-18).

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

OUTSIDE MIRROR

Outside Mirror - Manual

Remove or Disconnect (Figure 5-19)

1. Door trim panel
2. Front filler weatherstrip
3. Mirror attaching nuts (67)
4. Mirror (64)

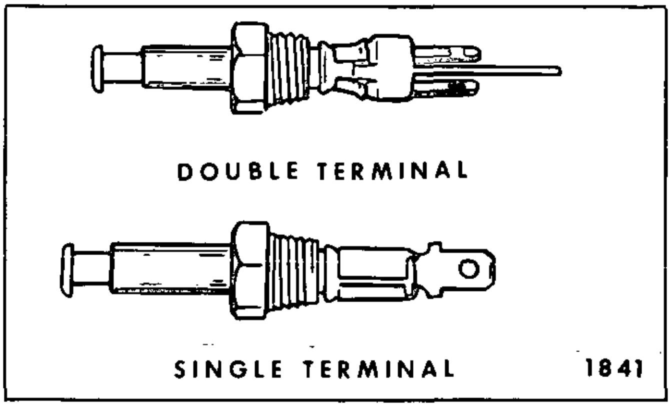


Fig. 5-18-Door Jamb Switches

Install or Connect (Figure 5-19)

1. Mirror (64)
2. Mirror attaching nuts (67)
3. Front filler weatherstrip
4. Door trim panel

Mirror Glass - Manual

Remove or Disconnect (Figure 5-19)

1. Upper screw
   - Put mirror glass (63) in full-down position for access
2. Lower screws
   - Put mirror glass (63) in full-up position for access
3. Mirror glass assembly (63)

Install or Connect (Figure 5-19)

1. Mirror glass assembly (63)
2. Lower screws
   - Put mirror glass (63) in full-up position for access
3. Upper screws
   - Put mirror glass (63) in full-down position for access

Remote Control Mirror - Manual

Remove or Disconnect (Figure 5-20)

1. Door trim panel
2. Remote control cable end
3. Front filler weatherstrip
4. Mirror attaching nuts (67)
5. Mirror (68)

Install or Connect (Figure 5-20)

1. Feed cable through door opening
2. Mirror (68)
3. Mirror attaching nuts (67)

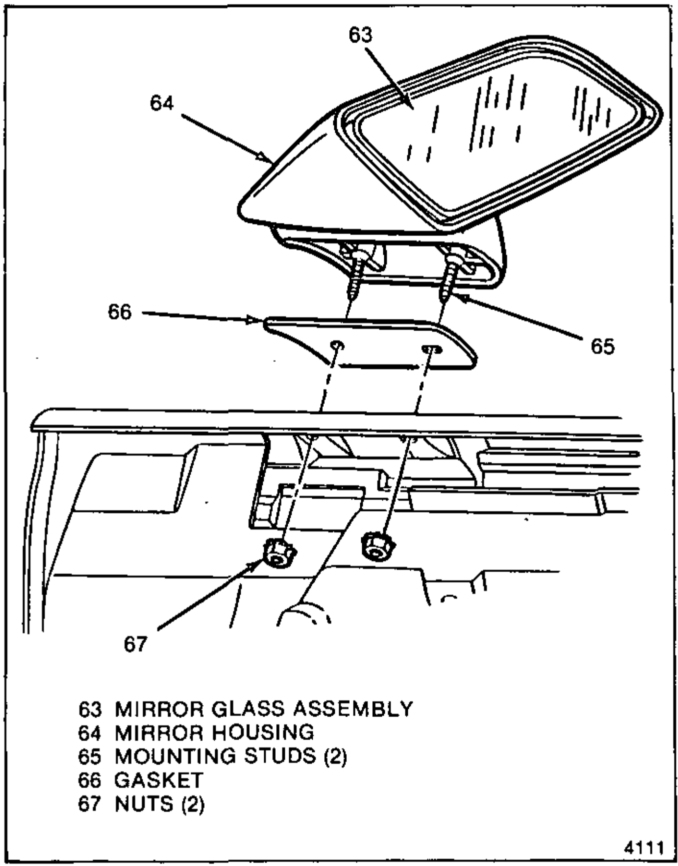


Fig. 5-19-Outside Mirror - Manual

Remote Control Mirror Glass - Manual

Remove or Disconnect (Figure 5-20)

1. Mirror (68)
2. Upper screws
   - Put mirror glass (69) in full-down position for access
3. Lower screws
   - Put mirror glass (69) in full-up position for access
4. Mirror glass assembly (69)

Install or Connect

1. Mirror glass assembly (69)
2. Lower screws
   - Put mirror glass (69) in full-up position for access
3. Upper screws
   - Put mirror glass (69) in full-down position for access
4. Mirror (68)

Remote Control Mirror Glass Assembly - Power

The glass assembly may be removed without removing the mirror from the vehicle.

Remove or Disconnect (Figure 5-21)

Cut inboard and outboard edges of glass (71)

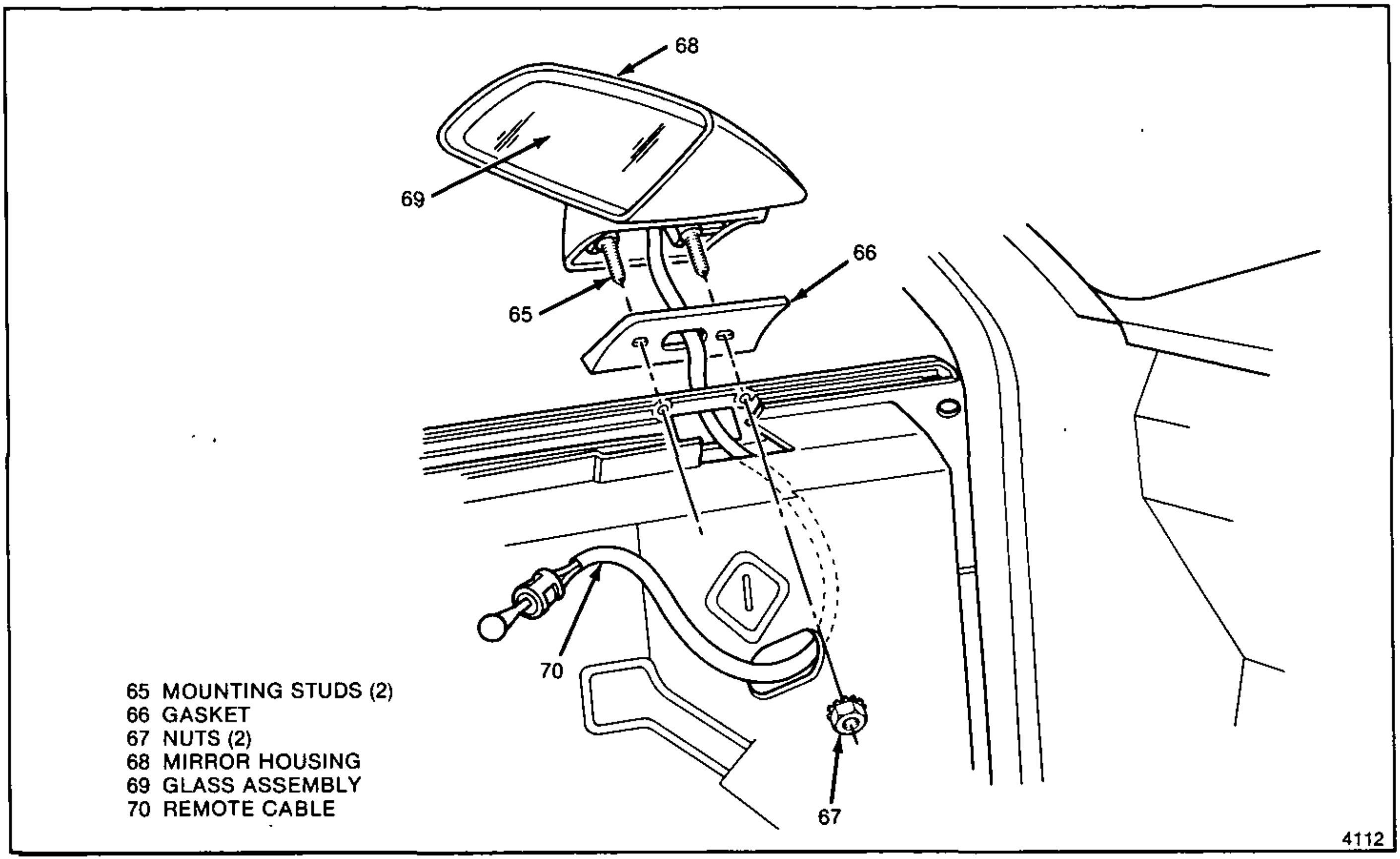


Fig. 5-20-Remote Control Mirror - Manual

Install or Connect (Figure 5-21)

- Align both worm gear shafts on glass with drive drive gears (75)
- Press in on glass (71) until it snaps into position on pivot (74)

Inspect

For proper operation

Power Mirror Drive Unit

Remove or Disconnect (Figure 5-21)

1. Battery (-) negative cable
2. Mirror glass (71)
3. Door trim panel
4. Front filler weatherstrip
5. Nuts (67)
6. Mirror housing (72)
7. Electrical connector (76)
8. Screws (73)
9. Drive unit

Install or Connect (Figure 5-21)

1. Drive unit
2. Screws (73)
3. Electrical connector (76)
4. Mirror housing (72)
5. Nuts (67)
6. Mirror glass (71)

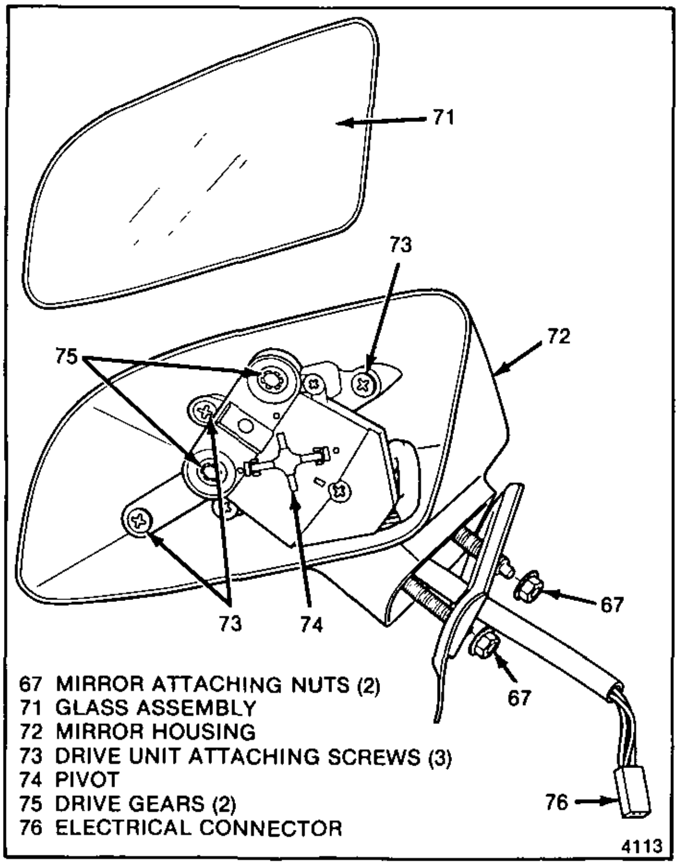


Fig. 5-21-Power Remote Outside Mirror Parts

7. Battery (-) negative cable

Inspect

For proper operation

8. Front filler weatherstrip
9. Door trim panel

DOOR GLASS ASSEMBLY

Remove or Disconnect (Figure 5-22)

1. Door trim panel
2. Water deflector
3. Front filler sealing strip
4. Rear filler sealing strip
5. Rivets (86)
   - cam assembly
   - front stop (80)
   - rear stop (81)
6. Front and rear stops
7. Loosen door glass stabilizers
8. Remove all bushings from glass before removing glass
9. Glass (77)

Install or Connect (Figure 5-22)

1. Install all bushings in glass before installing glass in door.
2. Glass to cam assembly (78)
3. Front and rear stops
4. Rivets (86)
   - front stop (80)
   - rear stop (81)
   - cam assembly

Inspect

Window for proper operation

Adjust

As required

5. Rear filler sealing strip
6. Front filler sealing strip
7. Water deflector
8. Door trim panel

Inspect

Glass for applicable condition. Refer to applicable condition to determine the components that will require adjustment. Make adjustments only as required for correct alignment and operation. The door trim panel and water deflector must be removed for access to components.

Adjust (Figure 5-23)

- Window rotated
  - loosen up-stop bolts (97 and 93)
  - adjust inner panel cam-bolts (98 and 99)
  - adjust up-stops
  - tighten attaching bolts
- Window upper edge inboard or outboard
  - loosen front retainer bolt (87)
  - loosen rear cam guide to support bolts (92)
  - loosen rear up-stop (93)
  - loosen front and rear glass stabilizer screws (95 and 96)
  - adjust vertical guide and rear up-stop support in or out as required and tighten attaching screws
- Window too far forward or rearward
  - loosen front run channel bolts (88 and 89)
  - loosen rear cam guide assembly (90 and 91)
  - align glass in correct up position
  - tighten upper bolt on front run channel (88)
  - tighten upper bolts on rear cam guide (91)
  - lower glass
  - tighten lower bolt on front run channel (89)
  - tighten lower bolts on rear cam guide (90)
- Window too high or low in up position
  - adjust front and rear up-stop bolts (93 and 97) as required and tighten bolts.
- Window binds or has inboard-outboard movement
  - loosen glass stabilizers (95 and 96)
  - place glass in half up position
  - push stabilizers against glass with only enough pressure to eliminate inboard-outboard movement.
  - tighten glass stabilizers (95 and 96)
  - if cam channels and rollers lack lubrication, lubricate with part no. 1052196, Lubriplate Auto-Lube A (or equivalent)

Inspect

After making any adjustment, inspect glass for proper operation and alignment.

Tighten

All loosened attachments from 10 to 14 N·m (90 to 125 in-lb)

Window Regulator Cam Assembly

Remove or Disconnect (Figures 5-22, 5-23)

1. Door trim panel
2. Water deflector
3. Lower glass half way and block in place.
4. Rivets from cam assembly (78)
5. Separate glass from cam assembly (78)
6. Raise glass to full-up position and block in place.
7. Window guide cam assembly bolts (90 and 91)
8. Plate (103, Fig. 5-28)
9. Rivets - regulator to inner door (9, Fig. 5-28)
10. Regulator cam assembly (78)

[illegible]

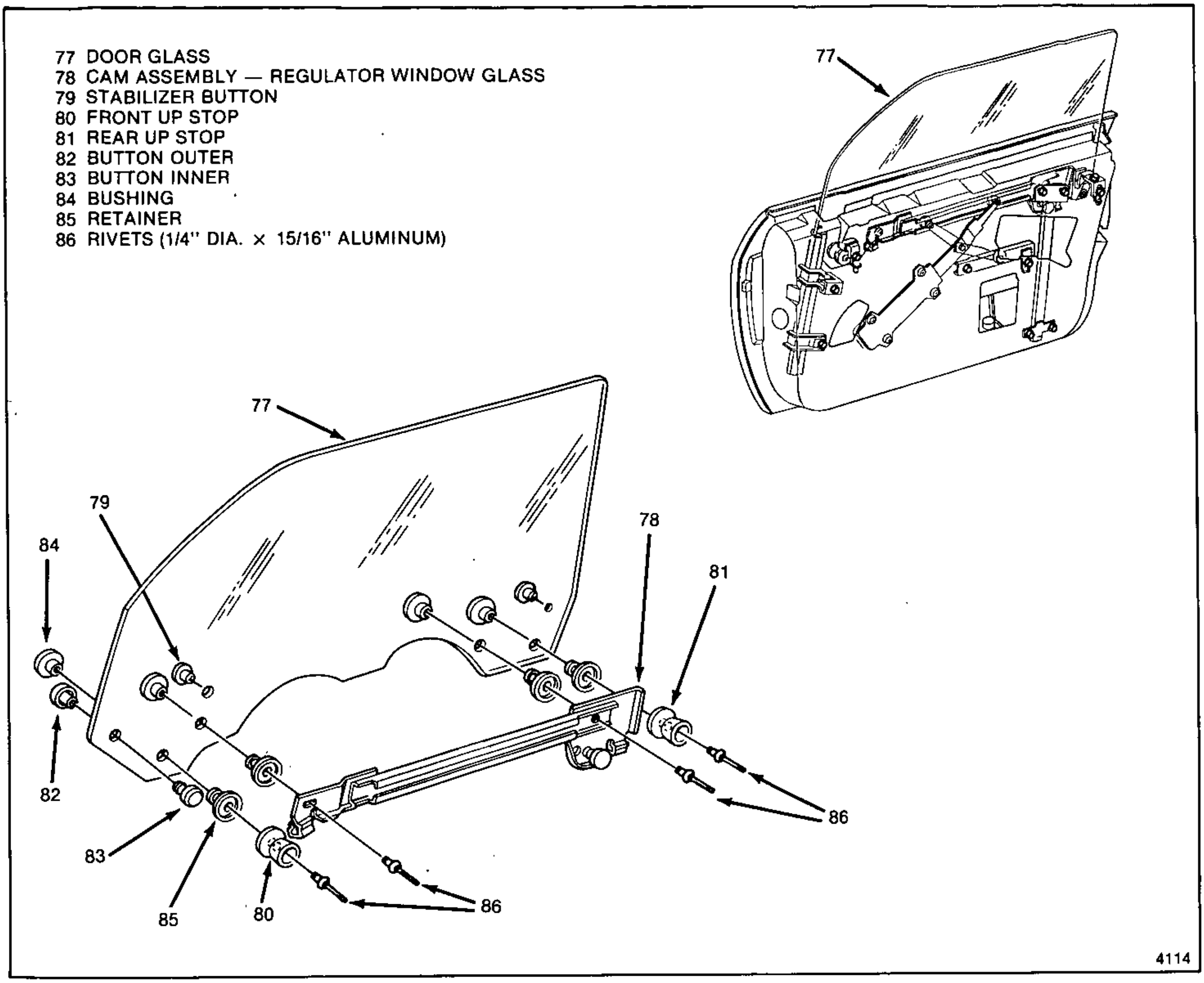


Fig. 5-22-Door Glass Assembly

2. Rivets - regulator to inner door (9, Fig. 5-28)
3. Plate (103, Fig. 5-28)
4. Window guide cam assembly bolts (90 and 91)
5. Remove blocks and lower glass
6. Glass to cam assembly (78)
7. Rivets (86) glass to cam assembly

Adjust

Window guide assembly and tighten

Inspect

For proper operation

8. Water deflector
9. Door trim panel

Regulator Assembly - Manual

Remove or Disconnect (Figure 5-24)

1. Put glass in full-up position and block into place
2. Window regulator cam assembly
3. Cam assembly - front door inner panel (101)
4. Bell crank and bracket assembly
5. Rivets (9) from regulator
6. Regulator (100) through rear access hole

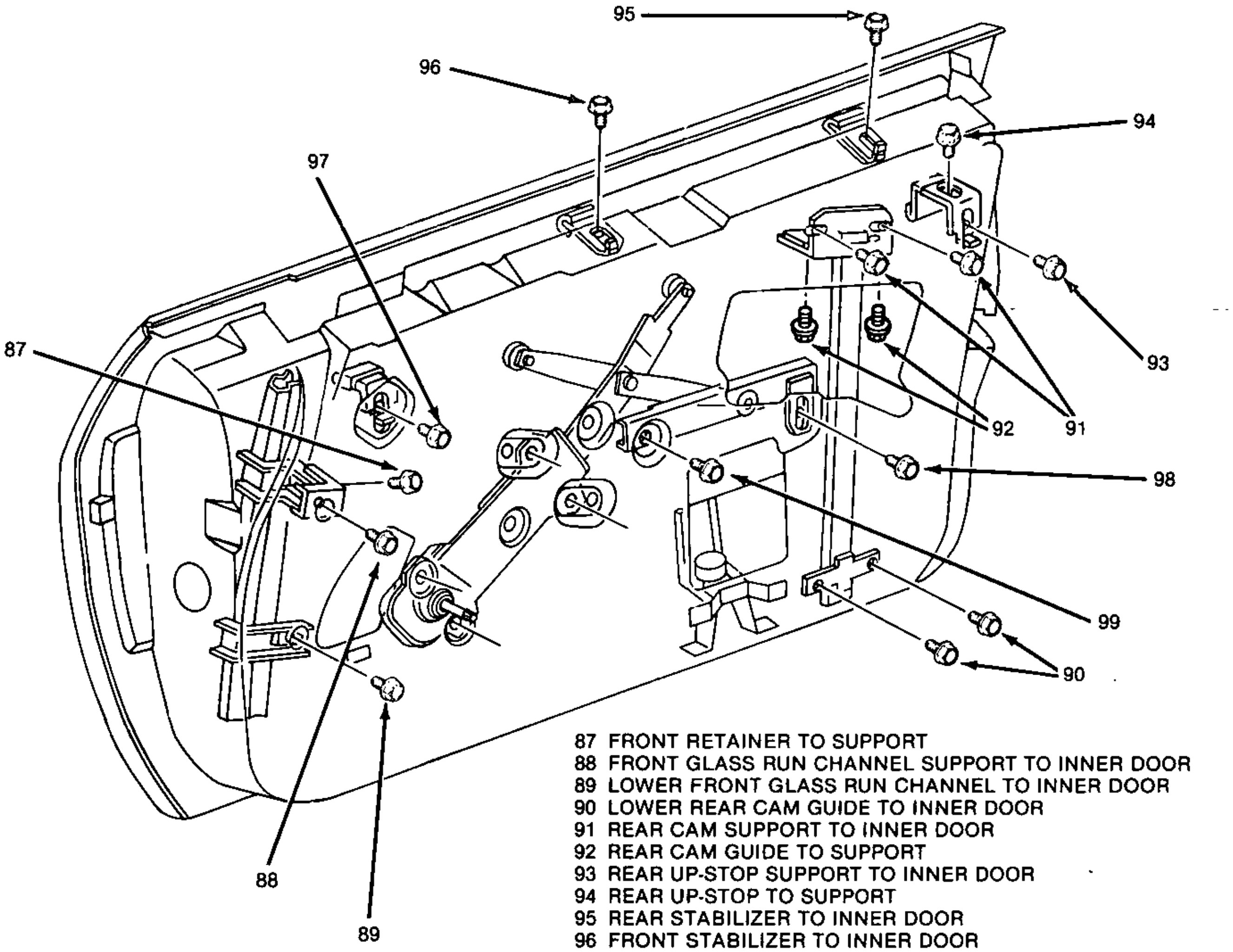
Install or Connect (Figure 5-24)

1. Regulator (100)
2. Rivets (9) - regulator to inner door
3. Cam assembly - front door inner panel (101)
4. Bell crank and bracket assembly
5. Window regulator cam assembly
6. Remove block from glass and check operation

Regulator Assembly - Power

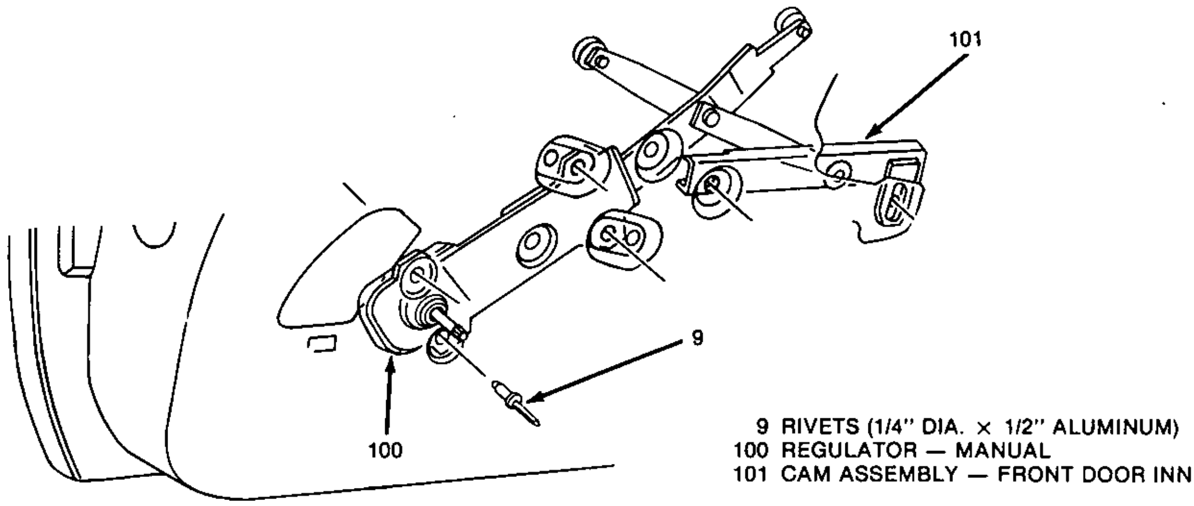
Remove or Disconnect (Figure 5-25)

1. Put glass in full-up position and block into place
2. Window regulator cam assembly
3. Cam assembly - front door inner panel (101)
4. Bell crank and bracket assembly
5. Rivets (9) - from regulator



87 FRONT RETAINER TO SUPPORT
88 FRONT GLASS RUN CHANNEL SUPPORT TO INNER DOOR
89 LOWER FRONT GLASS RUN CHANNEL TO INNER DOOR
90 LOWER REAR CAM GUIDE TO INNER DOOR
91 REAR CAM SUPPORT TO INNER DOOR
92 REAR CAM GUIDE TO SUPPORT
93 REAR UP-STOP SUPPORT TO INNER DOOR
94 REAR UP-STOP TO SUPPORT
95 REAR STABILIZER TO INNER DOOR
96 FRONT STABILIZER TO INNER DOOR
97 FRONT UP-STOP TO INNER DOOR
98 REAR INNER PANEL CAM TO INNER DOOR
99 FRONT INNER PANEL CAM TO INNER DOOR

Fig. 5-23-Door Hardware Attaching Bolts



9 RIVETS (1/4" DIA. × 1/2" ALUMINUM)
100 REGULATOR — MANUAL
101 CAM ASSEMBLY — FRONT DOOR INNER PANEL

Fig. 5-24-Window Regulator Assembly - Manual

6. Electrical connector
7. Regulator - electric (102) through rear access hole

Install or Connect (Figure 5-25)

1. Regulator - electric (102)
2. Rivets (9) - regulator to inner door
3. Electrical connector
4. Cam assembly - front door inner panel (101)
5. Bell crank and bracket assembly
6. Window regulator cam assembly
7. Remove block from glass and check operation

Rear Cam

Remove or Disconnect (Figure 5-23)

1. Trim panel
2. Water deflector
3. Rear cam guide bolts (90, 91 and 92)
4. Rear cam guide

Install or Connect (Figure 5-23)

1. Rear cam guide
2. Rear cam guide bolts (90, 91 and 92)

    Adjust

    Cam assembly and tighten all bolts

    Inspect

    For proper operation
3. Water deflector
4. Trim panel

Front Glass Run Channel Assembly and Support Assembly

Remove or Disconnect (Figure 5-23)

1. Trim panel
2. Water deflector
3. Retainer support bolts (87 and 88)
4. Front glass run channel support bolt (89)
5. Front glass run channel

Install or Connect (Figure 5-23)

1. Front glass run channel
2. Front glass run channel bolt (89)
3. Retainer support bolts (87 and 88)

    Adjust

    Run channel and tighten bolts

    Inspect

    For proper operation of glass
4. Water deflector
5. Trim panel

Cam Assembly - Front Door Inner Panel

Remove or Disconnect (Figure 5-23)

1. Trim panel
2. Water deflector
3. Inner panel cam assembly bolts (98 and 99)
4. Inner panel cam assembly

Install or Connect (Figure 5-23)

1. Inner panel cam assembly
2. *Inner panel cam assembly bolts (98 and 99)*

    Adjust

    Cam assembly and tighten bolts

    Inspect

    For proper operation of glass.
3. Water deflector
4. Trim panel

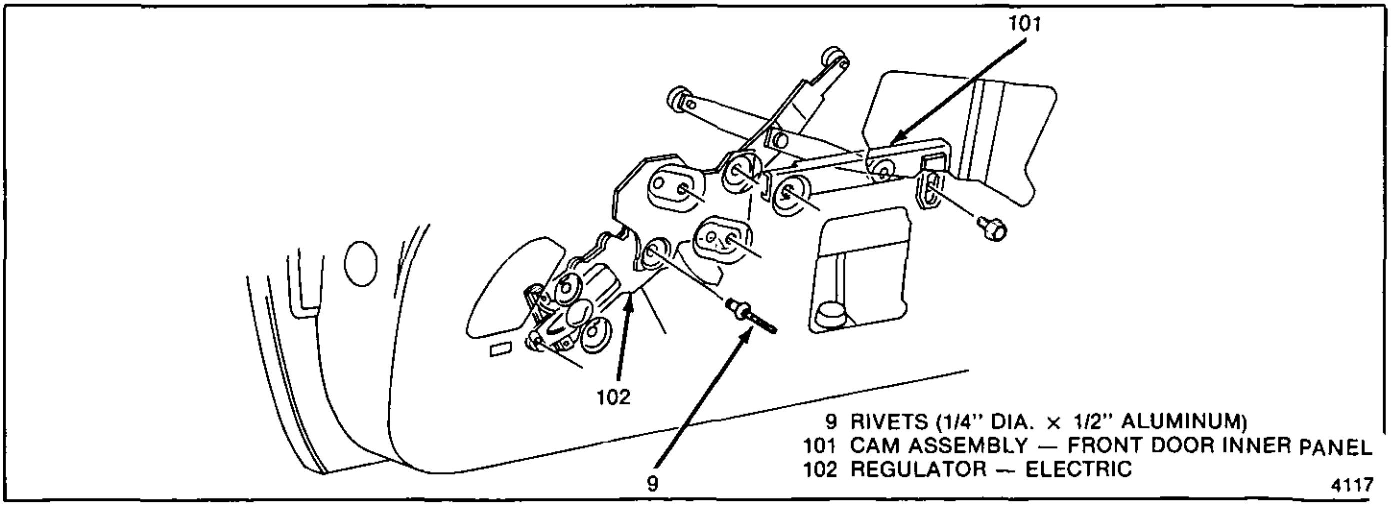


Fig. 5-25-Window Regulator Assembly - Electric

DOOR LOCK ASSEMBLY

Do not attempt to correct lock discrepancies. Make correction through replacement of the lock assembly.

↔ Remove or Disconnect (Figure 5-27)

1. Trim panel
2. Water deflector
3. Rods at lock assembly
4. Door ajar switch wire connector from main harness (54C, Fig. 5-26)
5. Lock assembly screws – lower assembly to disengage outside handle lock rod (50)
6. Lock assembly (54)

→← Install or Connect (Figure 5-27)

1. Spring clip on lock assembly
2. Lock assembly (54)
3. Rods at lock assembly (50)
4. Lock assembly screws

   Tighten

   9 to 11 N·m (80 to 100 in-lb)

   Inspect

   For proper operation
5. Door ajar switch wire connector to main harness (54C, Fig. 5-26)
6. Water deflector
7. Trim panel

DOOR AJAR SWITCH

↔ Remove or Disconnect (Fig. 5-26)

1. Trim panel
2. Water deflector
3. Lock assembly
4. Screw (54B)
5. Switch (54A)

→← Install or Connect

1. Switch (54A) to lock assembly by engaging lower lip of switch onto lower edge of lock attaching tab
2. Screw (54B)
3. Lock assembly
4. Water deflector
5. Trim panel

Lock Cylinder Assembly

↔ Remove or Disconnect (Figure 5-27)

1. Trim panel

Water deflector

Loosen top portion of outer door panel

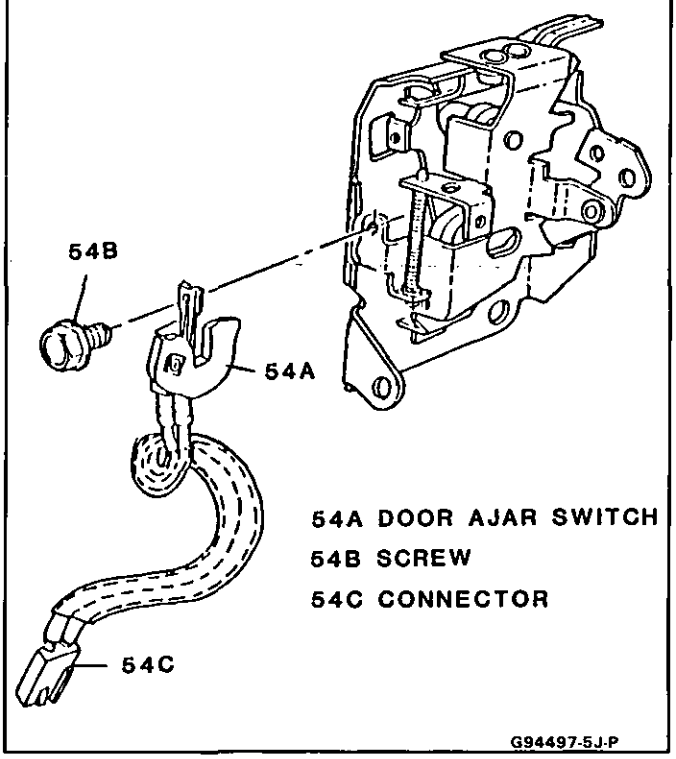


Fig. 5-26 - Installing Door Ajar Switch

→← Install or Connect (Figure 5-27)

1. Lock cylinder assembly (51)
2. Cylinder assembly retainer (53)
3. Top portion of outer door panel
4. Water deflector
5. Trim panel

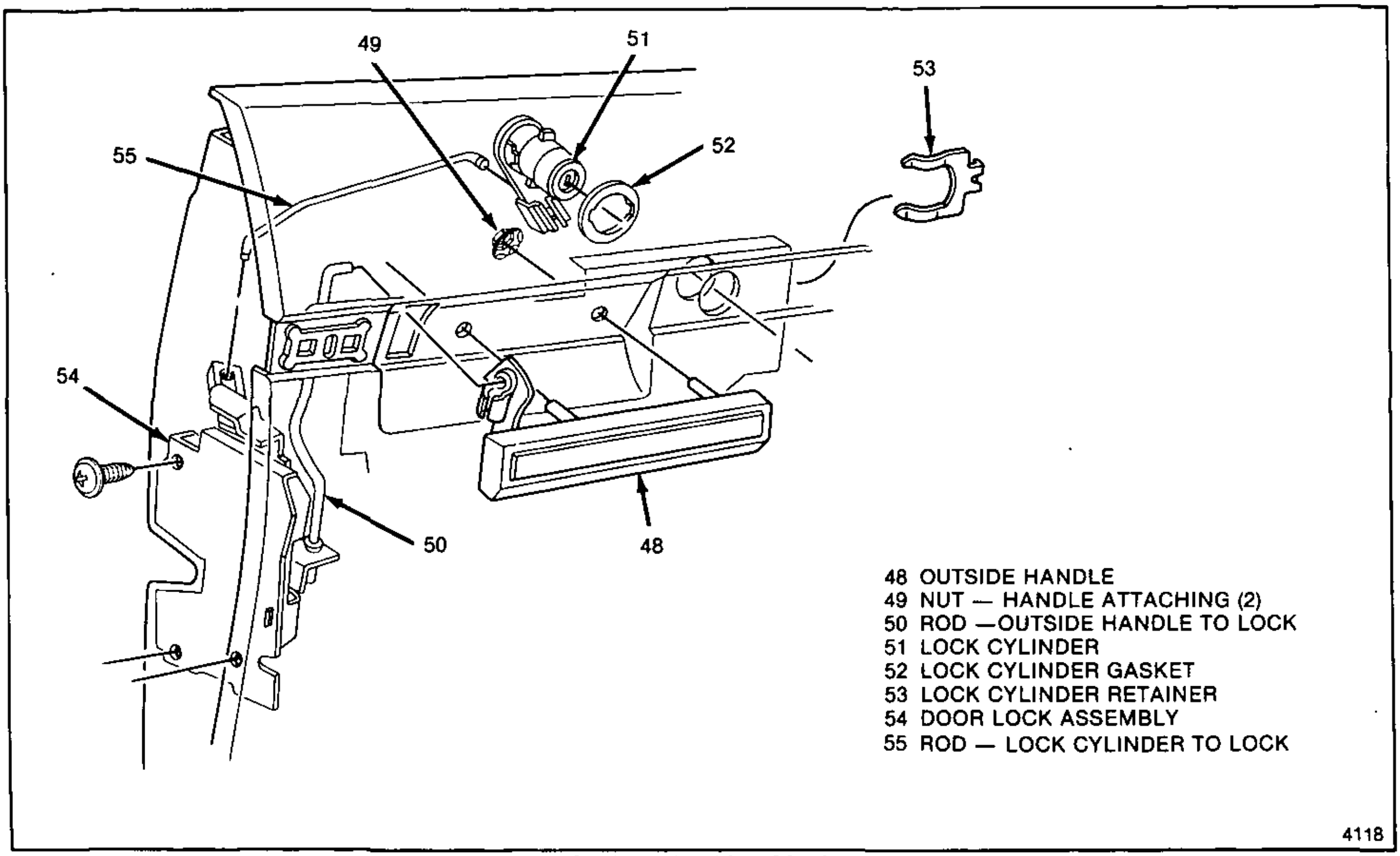
POWER DOOR LOCK SYSTEMS

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 goes to the lock assembly. The system is actuated by a switch in each door trim panel. All 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.

Power Lock Actuator

↔ Remove or Disconnect (Figure 5-28)

1. Trim panel
2. Water deflector
3. Electrical connector
4. Rivets (9)



48 OUTSIDE HANDLE
49 NUT — HANDLE ATTACHING (2)
50 ROD —OUTSIDE HANDLE TO LOCK
51 LOCK CYLINDER
52 LOCK CYLINDER GASKET
53 LOCK CYLINDER RETAINER
54 DOOR LOCK ASSEMBLY
55 ROD — LOCK CYLINDER TO LOCK

Fig. 5-27-Door Locking Mechanism

→← Install or Connect (Figure 5-28)

1. Actuator assembly (41)
2. Actuator rod at bell crank (104)
3. Rivets (9)
4. Electrical connector

Inspect

For proper operation

5. Water deflector
6. Trim panel

DOOR BELL CRANK

←→ Remove or Disconnect (Figures 5-11 and 5-28)

1. Trim panel
2. Water deflector
3. Put glass in full-up position
4. Rivets at bell crank plate assembly (44)
5. All rod assemblies
6. Bell crank and plate assembly (103)

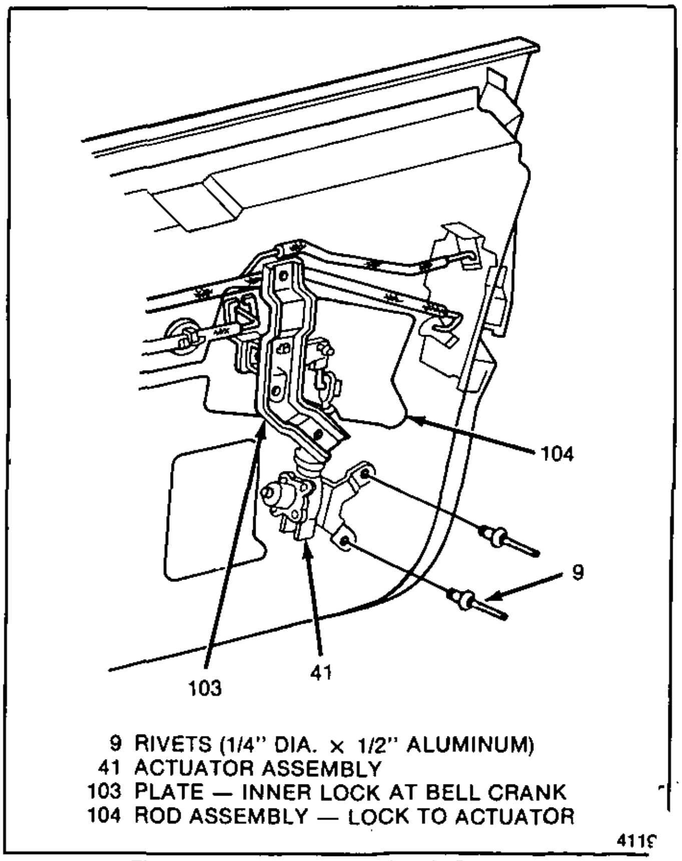
→← Install or Connect

1. Bell crank and plate assembly (103)
2. All rod assemblies
3. Rivets at bell crank plate assembly (44)

Inspect

For proper operation

4. Water deflector



9 RIVETS (1/4" DIA. × 1/2" ALUMINUM)
41 ACTUATOR ASSEMBLY
103 PLATE — INNER LOCK AT BELL CRANK
104 ROD ASSEMBLY — LOCK TO ACTUATOR

Fig. 5-28-Power Door Lock System

5. Trim 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 becomes 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 hinge straps.

Door

Remove or Disconnect (Figure 5-29)

1. Door trim panel
2. Water deflector
3. Front run channel
4. Outer door panel assembly
5. Upper and lower hinge strap bolts to door side (107 and 110)
6. Wiring harness conduit at body and pull wiring harness through body (if equipped). Use aid of a second person to hold door.

Install or Connect (Figure 5-29)

1. Two bolts at upper hinge strap (107). Coat strap surface that mates with door and bolt threads with sealer. Use aid of second person to hold door.
2. Two bolts at lower hinge strap (110). Coat strap surface that mates with door and bolt threads with sealer.
3. Outer door panel assembly.
4. Wiring harness conduit. Pull harness through body (if equipped).
5. Wiring harness (if equipped)

Inspect

Prior to closing door completely, inspect for proper door assembly engagement at striker and correct door panel clearance with fender panel. The clearance betweeen door panel and fender panel should be no more than 4 mm (5/32").

Tighten

Hinge bolts from 20 to 28 N·m (14 to 20 ft-lb)

Inspect

Door assembly for proper engagement

ll electrical door devices for proper ation

[illegible]

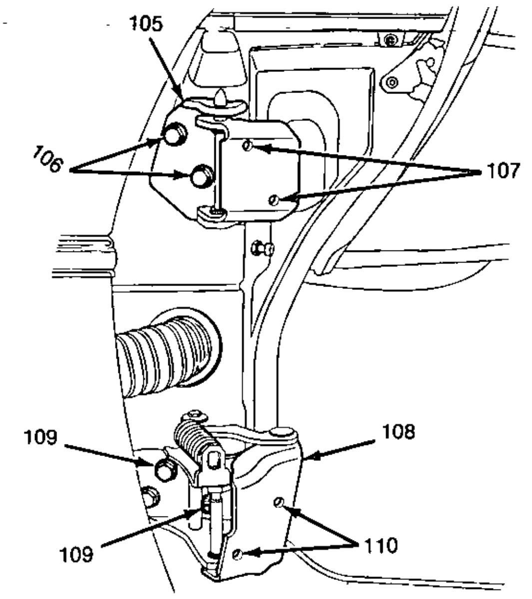
8. Door trim panel

DOOR HINGE

Remove or Disconnect (Figure 5-29)

Important

Open door to the full-open position and support it. Mark the location of the hinge straps at the body and door before removal.



105 UPPER HINGE
106 UPPER HINGE TO BODY BOLTS
107 UPPER HINGE TO DOOR (TAPPED) ATTACHMENT POINTS
108 LOWER HINGE
109 LOWER HINGE TO BODY BOLTS
110 LOWER HINGE TO DOOR (TAPPED) ATTACHMENT POINTS

4120

Fig. 5-29-Door Hinges

1. Outer door panel assembly
2. Lower garnish molding
3. Peel back noise control adhesive patch
4. Lower hinge strap bolts from inside body
5. Hinge strap bolts from outside of body
6. Hinge assembly (105 or 108)

Important

The service body side hinge straps have only one bolt hole. To locate the other bolt hole, use the original hinge strap to make a paper template.

- Outline hinge strap on a piece of paper
- Locate centerline of required new hole
- Push pen through paper template at this location
- Place template on service hinge and align template with hinge
- Center punch hole location
- Drill new hole with a 8.5 mm (11/32") drill bit. The holes in the body pillar will provide for some

Install or Connect (Figure 5-29)

1. Hinge assembly (105 or 108). Coat surface of hinge strap that mates with body pillar with medium-bodied sealer.
2. Bolts – hinge to body (106 or 109)
3. Bolts – hinge to door (107 or 110)

   Important

   Align hinge with marks previously made on body and door.

   Tighten

   - 8 mm bolts from 20 to 28 N·m (15 to 20 ft-lb)
   - 10 mm bolt from 40 to 55 N·m (30 to 40 ft-lb)
4. Outer door panel assembly

   Inspect

   - Door assembly engagement at striker – adjust where necessary.
   - Clearance between door panel and fender panel – no more than 4 mm (5/32").
5. Noise control adhesive patch
6. Lower garnish molding

SECTION 6

REAR QUARTERS

NOTICE: Care must be taken when servicing any fiberglass (SCM) panel or component. Fasteners retaining such panels or components must be hand started to prevent damage to fiberglass parts. Always use the specified torque values given for SMC parts to assure safe and proper retention.

CONTENTS

QUARTER TRIM

ROCKER PANEL COVER

←→ **Remove or Disconnect (Figure 1)**

1. Two wheelhousing screws (1)
2. Cover plates (2)
3. Three rivets (3) under cover plates (2)
4. Seven rivets (3) from rocker panel (4)
5. Rocker Panel (4)

→← **Install or Connect (Figure 1)**

1. Rocker panel (4)
2. Seven rivets (3) to rocker panel (4)
3. Three rivets (3) under cover plates (2)
4. Cover plates (2)
5. Two wheelhousing screws (1)

EXTENSION - ROCKER PANEL COVER TO DOOR PANEL

←→ **Remove or Disconnect (Fig. 2)**

1. Rivets (1)
2. Extension by lifting up on extension (3) to disengage upper flange from clips (2) on body.

→← **Install or Connect**

1. Extension to door panel by placing upper flange over clips (2) and pushing down on extension.
2. Rivets (1)

EXTENSION - ROCKER PANEL COVER TO FRONT FENDER

←→ **Remove or Disconnect (Fig. 2)**

1. Rocker panel cover
2. Rivet (6)
3. Extension (7) by lifting up on extension to disengage upper flange from clips (2).

→← ***Install or Connect***

1. Extension (7) to front fender by placing upper flange over clip (2) and pushing down on extension
2. Rivet (6)
3. Rocker panel cover

EXTENSION - ROCKER PANEL COVER TO QUARTER

←→ **Remove or Disconnect (Fig. 2)**

1. Rocker panel cover
2. Rivets (4)
3. Extension (5) by lifting up on extension to disengage upper flange from clips (2) on body

→← **Install or Connect**

1. Extension (5) to quarter panel by placing upper flange over clips (2) and pushing down on extension
2. Rivets (4)
3. Rocker panel cover

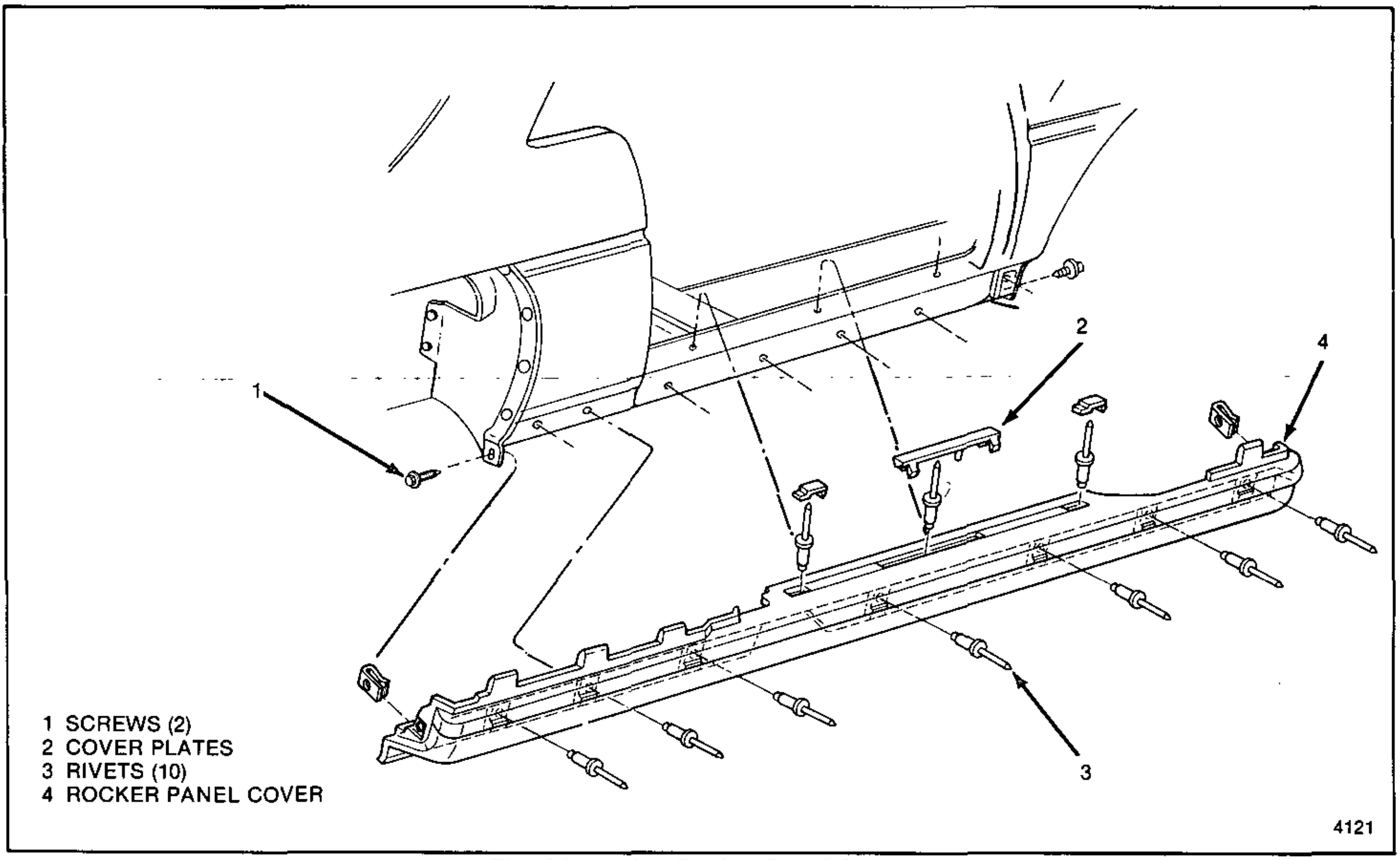


Fig. 1-Installing Rocker Panel Cover

REAR COMPARTMENT SIDE PANEL COVER

Remove or Disconnect (Figure 3)

1. Rear compartment lid in open position
2. Wing screw(s) – two on 37 style, one on 97 style
3. Panel (6)

Install or Connect (Figure 3)

1. Panel (6) on pins (7)
2. Wing screw(s) – two on 37 style, one on 97 style

REAR COMPARTMENT COVER EXTENSION - 37 STYLE

Remove or Disconnect (Figure 4)

1. Rear compartment side panel cover
2. Two screws (10)
3. Rear compartment side panel cover hinge (11)
4. Cover extension (12)

Install or Connect (Figure 4)

1. Cover extension (12)
2. Rear compartment side panel cover hinge (11) and screw
3. Two screws (10)

BACK WINDOW SIDE FILLER PANEL - 37 STYLE

Remove or Disconnect (Figure 5)

1. Rear compartment side panel cover
2. Rear compartment side cover extension
3. Upper screws (8)
4. Lower screws (9)
5. Panel

Install or Connect (Figure 5)

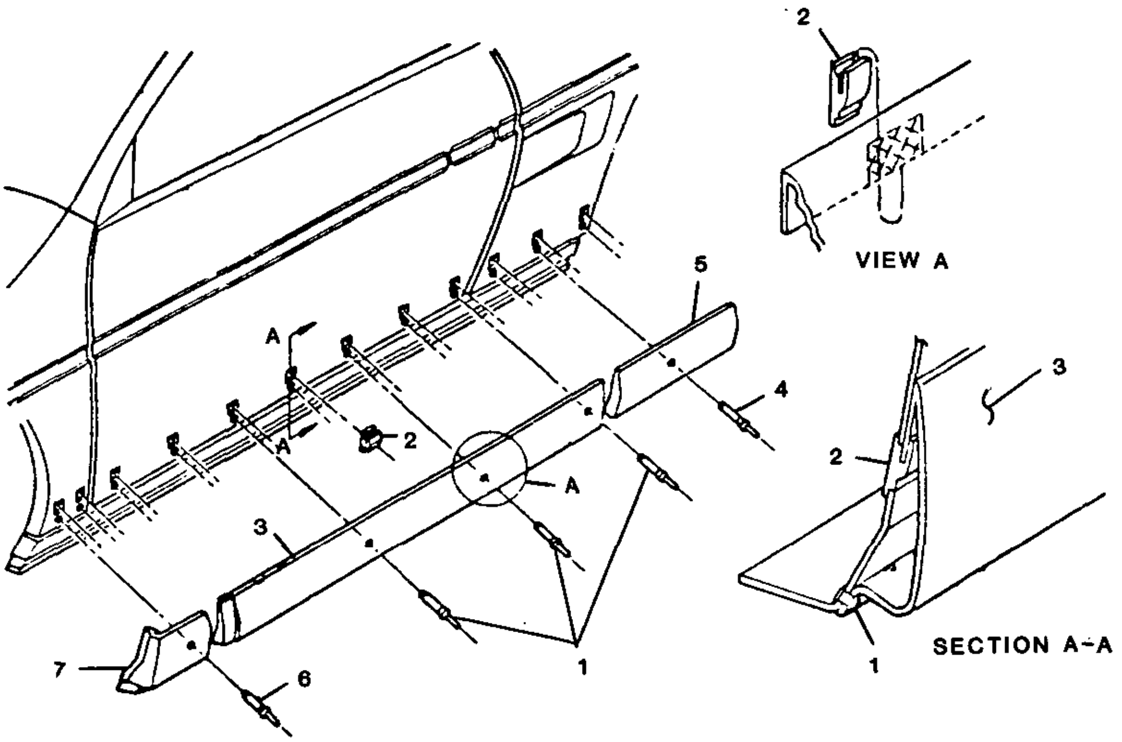
1. Panel
2. Lower screws (9)
3. Upper screws (8)
4. Rear compartment side cover extension
5. Rear compartment side panel cover

BACK WINDOW TO QUARTER FILLER PANEL - 97 STYLE

Remove or Disconnect (Fig. 6)

1. Rear compartment side panel cover
2. Screws (10A)
3. Place cloth tape onto body next to panel
4. Filler panel (11A) by placing flat bladed tool between body and filler panel at tape locations, and prying filler panel loose from body

Install or Connect



1. RIVETS - ROCKER EXTENSION TO DOOR
2. CLIPS
3. EXTENSION - ROCKER COVER PANEL TO DOOR
4. RIVETS - ROCKER EXTENSION TO QUARTER
5. EXTENSION - ROCKER COVER PANEL TO QUARTER
6. RIVET - EXTENSION TO FRONT FENDER
7. EXTENSION - ROCKER COVER PANEL TO FRONT FENDER

Fig. 2 - Extensions - Rocker Panel Cover

2. Filler panel (11A)
3. Screws (10A)
4. Rear compartment side panel cover
5. Cloth tape from body

REAR QUARTER TRIM PANEL

The rear quarter trim panel is a one-piece plastic assembly. The panel fits into the seatback-to-motor compartment panel.

Remove or Disconnect (Figure 7)

1. Upper shoulder belt anchor assembly
2. Screw (13)
3. Panel (14). Unseat retainer clip by grasping panel with hands and pulling inward.
4. Seat belt webbing from slots (15) on panel (14)

Install or Connect (Figure 7)

1. Seat belt webbing through slots (15) on panel (14)
2. Panel (14). Apply pressure at retainer location
3. Screw (13)
4. Upper shoulder belt anchor assembly

Tighten

Anchor bolt 35 to 48 N·m (26 to 35 ft-lb)

SPEAKER ASSEMBLY

Remove or Disconnect (Fig. 8)

1. Rear quarter trim panel
2. Screws (13A)
3. Speaker assembly (14A)
4. Connector (15A) from connector (16A)

Install or Connect

1. Connector (15A) to connector (16A)
2. Speaker assembly (14A)
3. Screws (12A)
4. Rear quarter trim panel

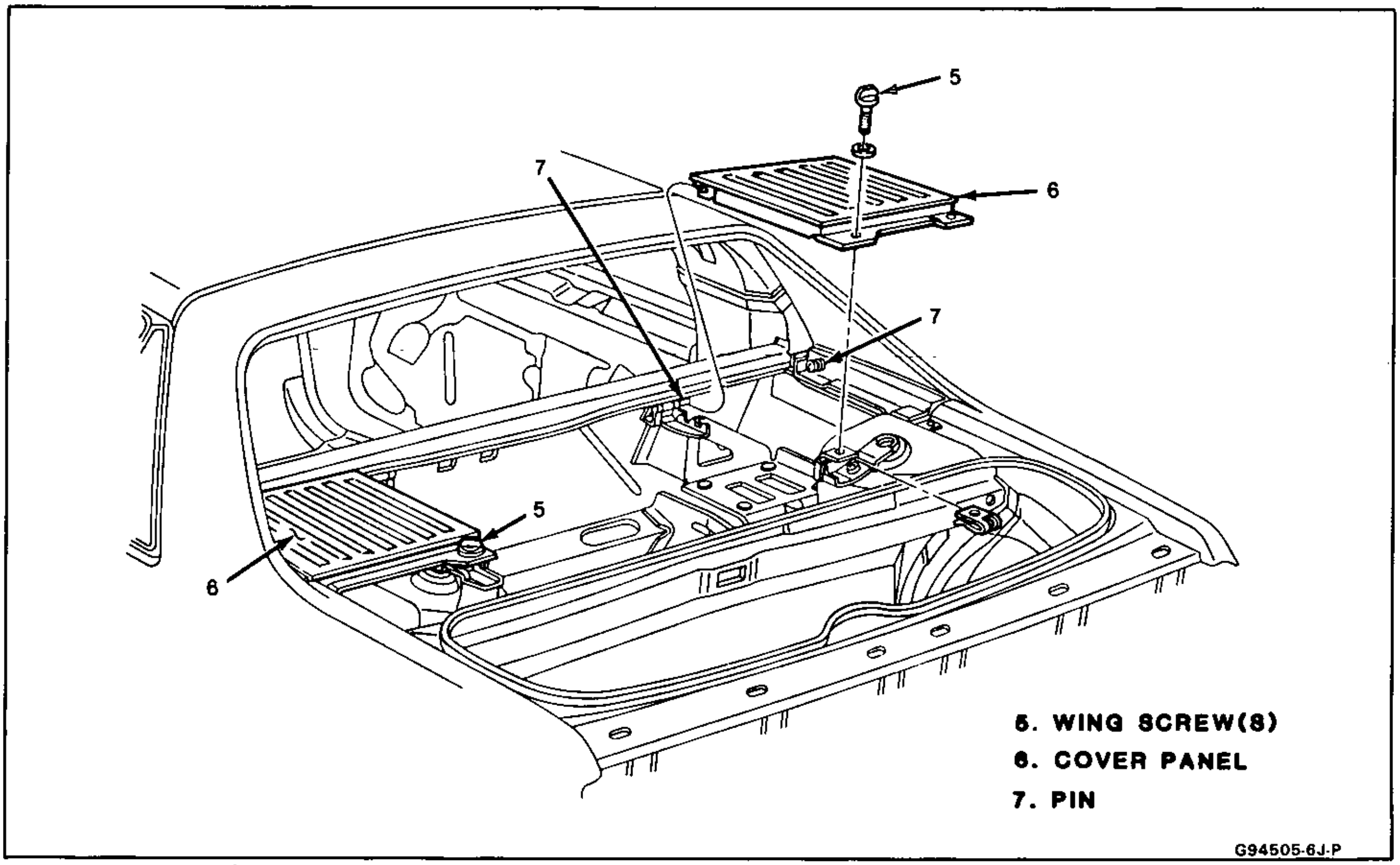


Fig. 3-Installing Rear Compartment Side Panel Cover - 37 Style Shown, 97 Style Similar

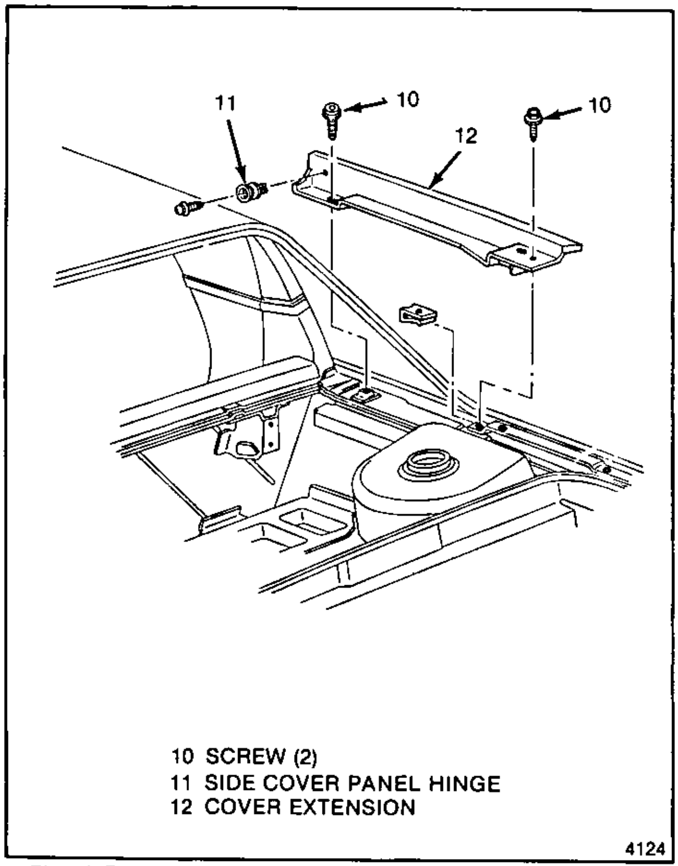


Fig. 4 Rear Compartment Cover Extension - 37 Style

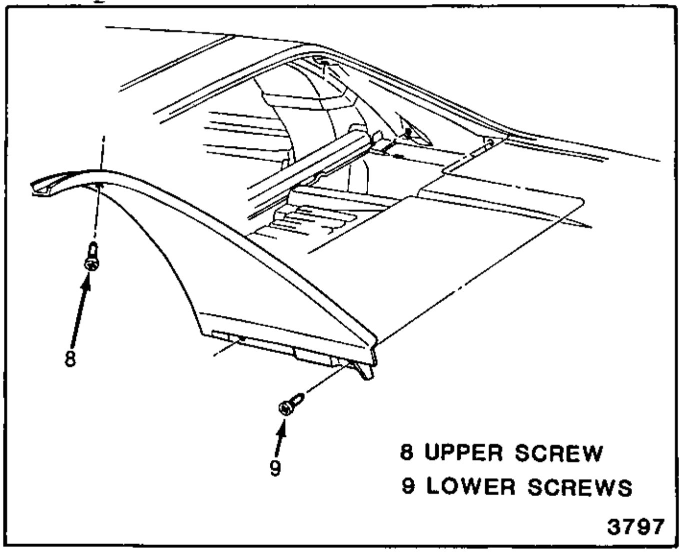


Fig. 5 Back Window Side Filler Panel - 37 Style

SPEAKER GRILLE

←→ Remove or Disconnect

1. Rear quarter trim panel
2. Speaker grille by placing trim panel face down on protected surface and disengaging grille retainers from trim panel

→← Install or Connect

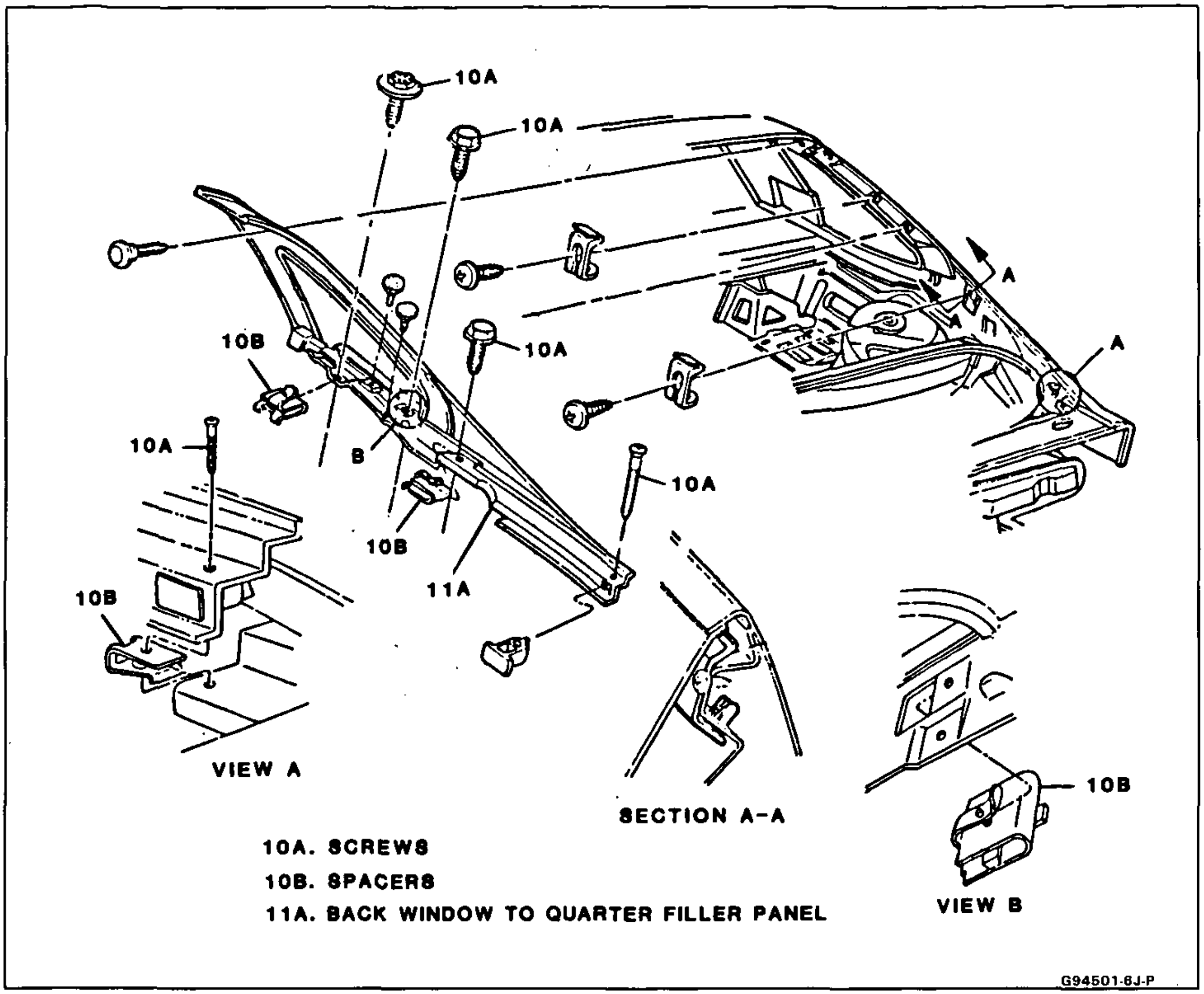


Fig. 6 - Installing Back Window to Quarter Filler Panel - 97 Style

LOWER PRESSURE RELIEF VALVE

Remove or Disconnect (Figure 9)

1. Upper shoulder belt anchor assembly
2. Rear quarter trim panel
3. Four screws (17)
4. Valve (18)

Install or Connect (Figure 9)

1. Valve (18)
2. Four screws (17)
3. Rear quarter trim panel
4. Upper shoulder belt anchor assembly

Tighten

Anchor bolt 35 to 48 N·m (26 to 35 ft-lb)

APPLIQUE PANEL ASSEMBLY

Remove or Disconnect (Figure 10)

1. Upper shoulder belt anchor assembly
2. Rear quarter trim panel
3. Hex nut (19)
4. *Grasp panel at front and pull outboard. Do not pull out more than one inch while sliding it rearward to dislodge the spring clip from the panel.*

Install or Connect (Figure 10)

1. Two retainer clips (21) to roof panel
2. Panel (20)
3. Hex *nut* (19)
4. Rear quarter trim panel
5. Upper shoulder belt anchor assembly

Tighten

Anchor bolt 35 to 48 N·m (26 to 35 ft-lb)

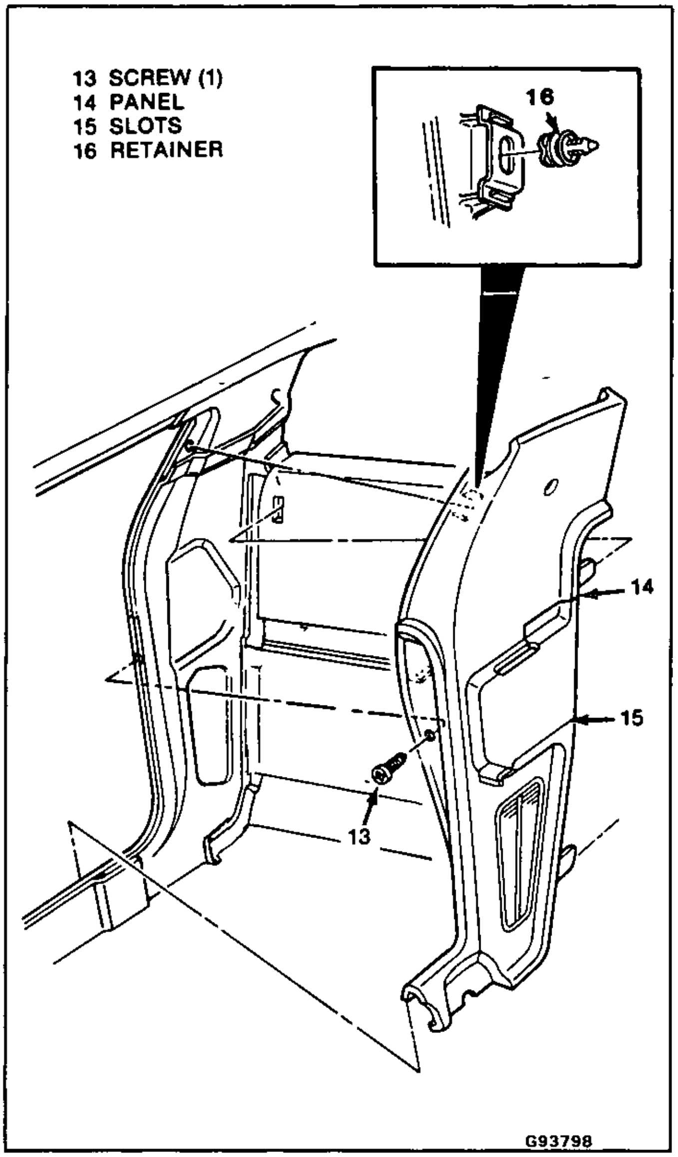


Fig. 7-Rear Quarter Trim Panel

UPPER PRESSURE RELIEF VALVE

Remove or Disconnect (Figure 11)

1. Upper shoulder belt anchor assembly
2. Rear quarter trim panel
3. Applique panel assembly
4. Screw (23)
5. Valve (24)

Install or Connect (Figure 11)

1. Valve (24)
2. Screw (23)
3. Applique panel assembly
4. Rear quarter trim panel
5. Upper shoulder belt anchor assembly

Tighten

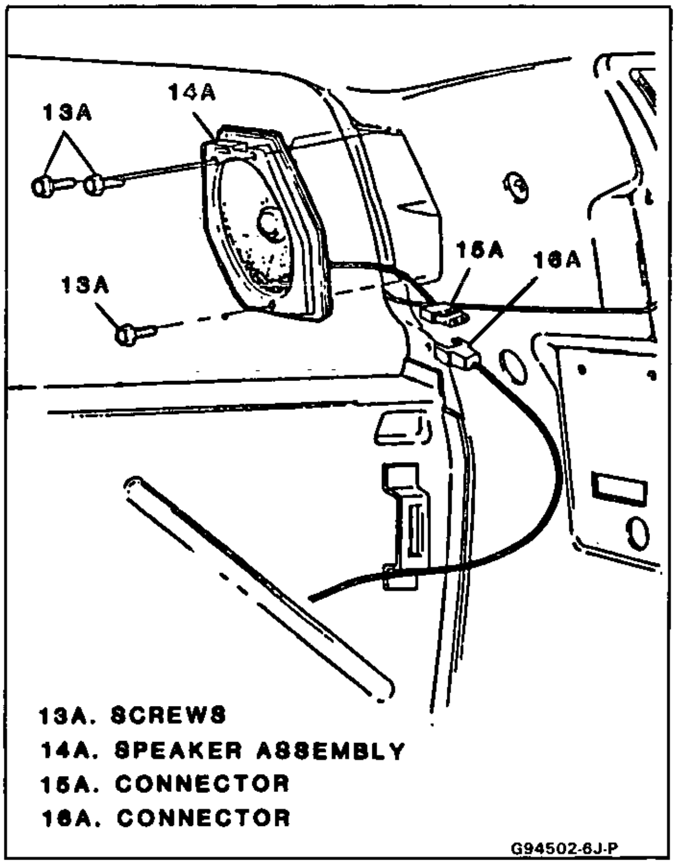


Fig. 8 - Installing Quarter Speaker Assembly

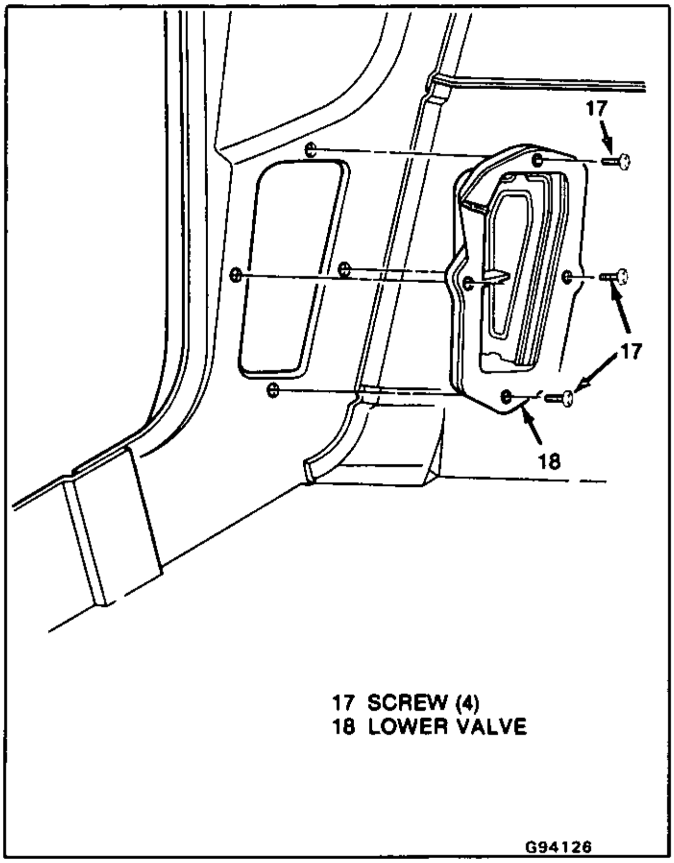


Fig. 9-Lower Pressure Relief Valve

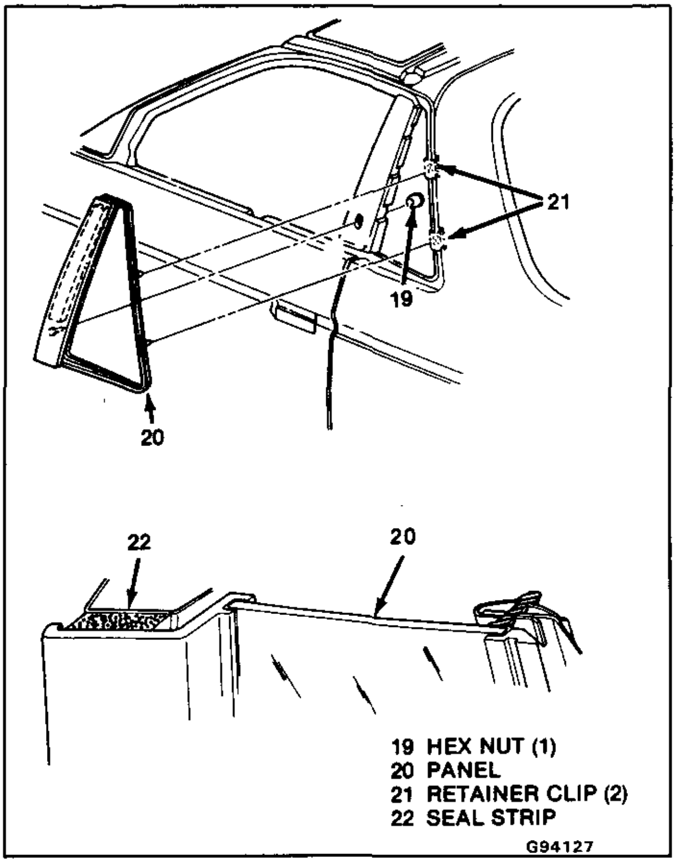


Fig. 10-Applique Panel Assembly

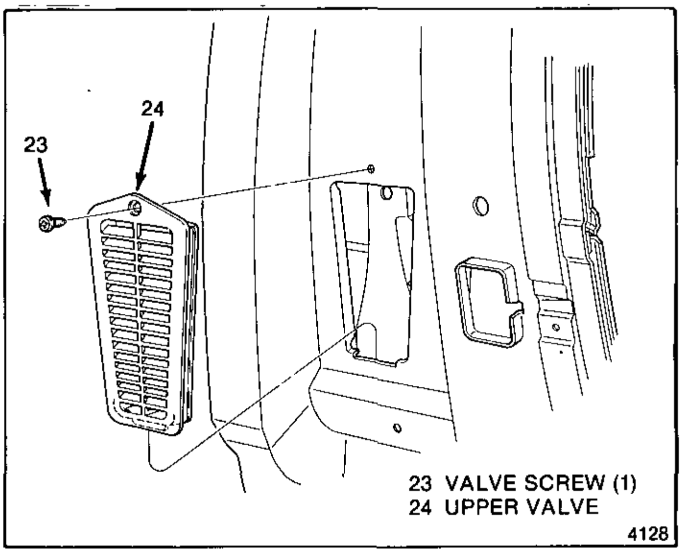


Fig. 11-Upper Pressure Relief Valve

FUEL TANK FILLER DOOR

LOCKING FUEL FILLER DOOR AND POCKET ASSEMBLY

Remove or Disconnect (Figure 12)

1. Two filler door hinge screws
2. Filler door (25)
3. Two pocket screws
4. Latch screw (26)
5. Latch (27)
6. Cable (28) from latch (27)
7. Pocket (29)

Install or Connect (Figure 12)

1. Cable (28) through pocket (29)
2. Pocket (29) and pocket screws
3. Cable (28) to latch (27)
4. Latch (27) and latch screw (26)
5. Filler door (25) and hinge screws

FUEL FILLER DOOR REMOTE LATCH AND CABLE ASSEMBLY

Remove or Disconnect (Figures 12 and 13)

1. Fuel filler door (25)
2. Latch (27) and cable (28) from latch
3. Upper shoulder belt anchor assembly
4. Rear quarter trim panel
5. Latch release screw and handle (30)
6. Applique panel assembly
7. Screw and bracket (31)
8. Cable (28) from handle (30)

Install or Connect (Figure 12 and 13)

1. Cable (28) in body
2. Bracket (31) and screw
3. Cable (28) to handle (30)
4. Applique panel assembly
5. Latch release handle (30) and screw
6. Rear quarter trim panel
7. Upper shoulder belt anchor assembly

   Tighten

   Anchor bolt from 35 to 48 N·m (26 to 35 ft-lb)
8. Cable (28) and latch (27)
9. Latch (27) and fuel filler door (25)

EXTERIOR PANELS AND MOLDINGS

REAR WHEELHOUSE PANEL

Remove or Disconnect (Figure 14)

1. Six push-pull retainers (32)
2. Eight attaching screws (33)
3. Panel (34)

Install or Connect (Figure 14)

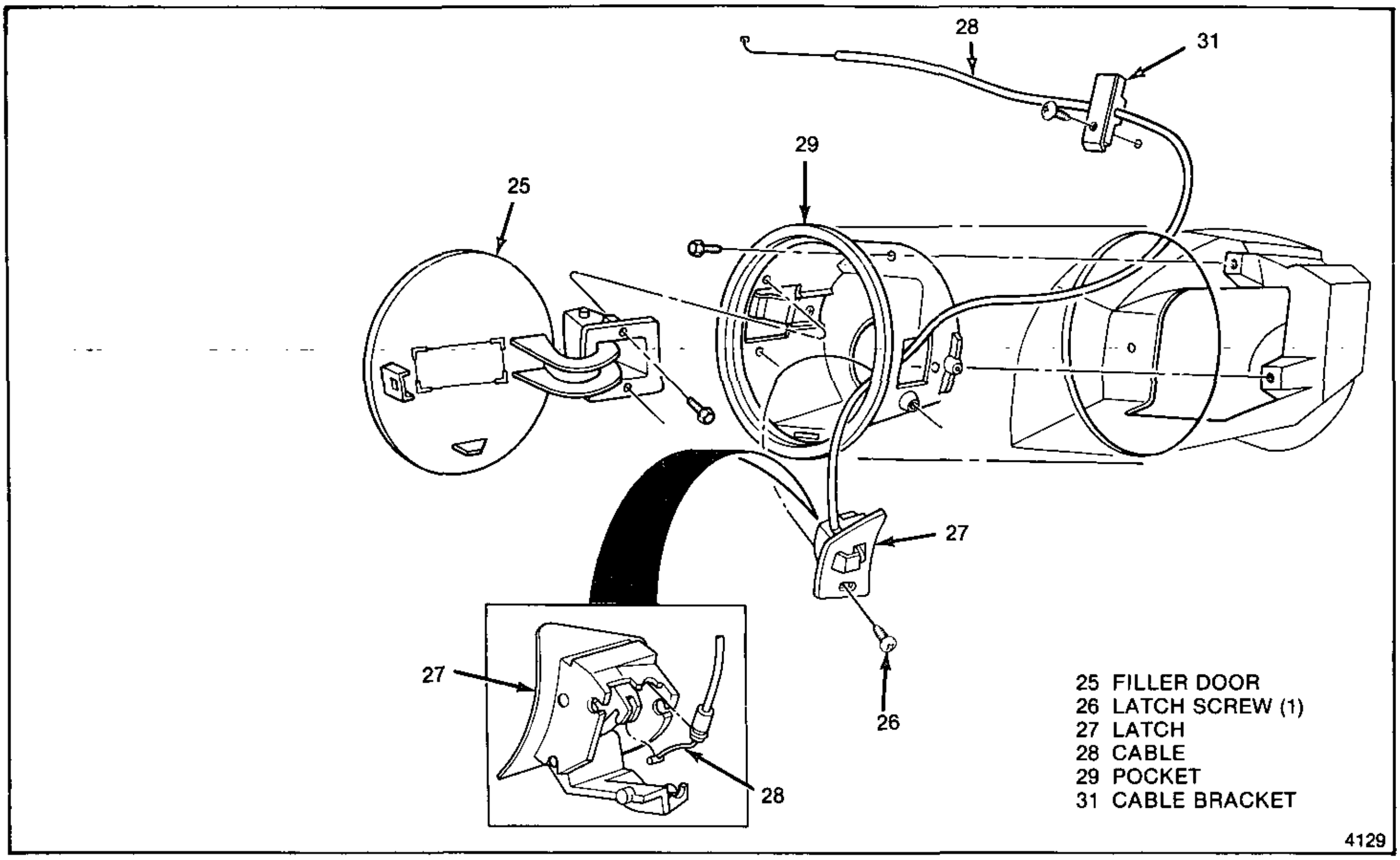
1. Panel (34)
2. Eight attaching screws (33)
3. Six push-pull retainers (32)

NOTICE: To prevent damage to plastic or fiberglass panels, hand start screws to ensure correct alignment.

REAR FENDER FINISH MOLDING

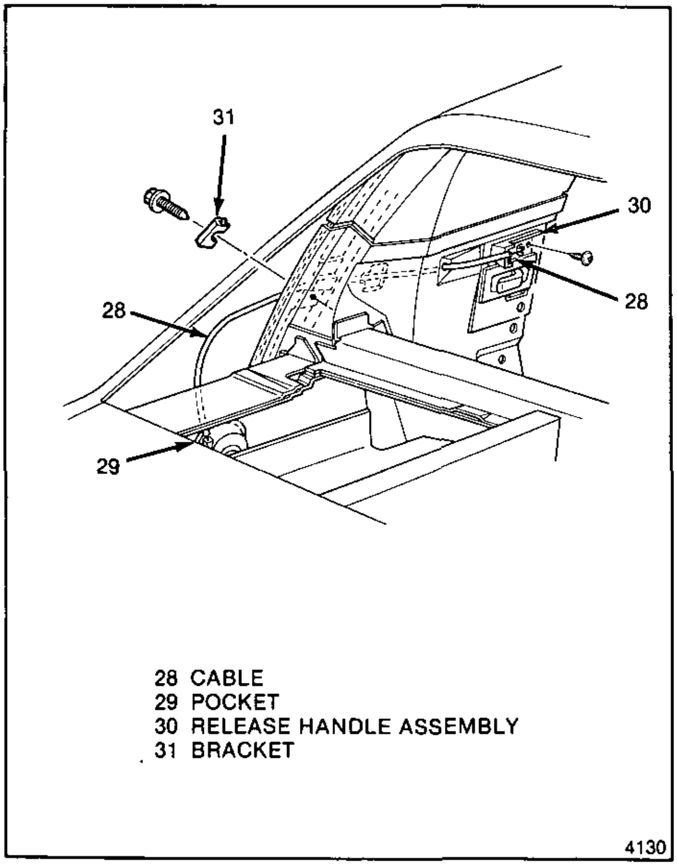
Remove or Disconnect (Figure 15)

1. Two push-pull retainers (35)



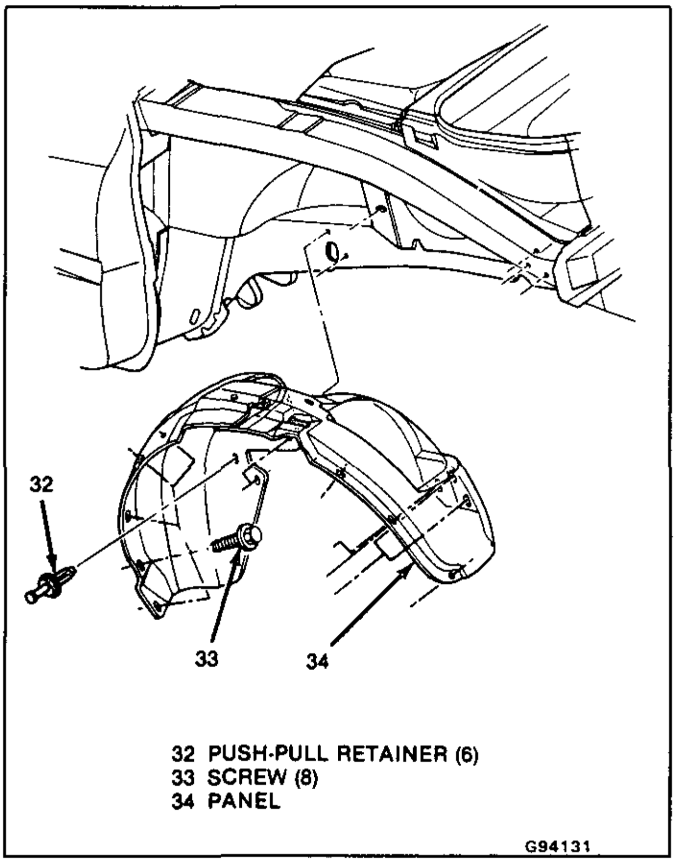
25 FILLER DOOR
26 LATCH SCREW (1)
27 LATCH
28 CABLE
29 POCKET
31 CABLE BRACKET

Fig. 12-Locking Fuel Door and Pocket Assembly



28 CABLE
29 POCKET
30 RELEASE HANDLE ASSEMBLY
31 BRACKET

Fig. 13-Fuel Filler Door Remote Latch and Cable Assembly



32 PUSH-PULL RETAINER (6)
33 SCREW (8)
34 PANEL

Fig. 14-Installing Rear Wheelhouse Panel

2. T clip (36)

   Important

   To avoid damage on plastic and fiberglass panels, carefully disengage or unseat the T clip (36) with a thin-bladed tool.
3. Rivet (37) and molding clip (38)
4. Molding (39)

Install or Connect (Figure 15)

1. Molding clip (38) and rivet (37) to body
2. T clip (36) to molding (39)
3. Molding (39)
4. Two push-pull retainers (35)

REAR FENDER PANEL ASSEMBLY

Remove or Disconnect (Figure 16)

1. Rocker panel cover
2. Rear fender finish molding
3. Seven rivets (40)
4. Fender to wheelhouse panel screws (41)
5. Fender panel (42)
6. U nuts (43)
7. Seal strip (44) from fender panel

Install or Connect (Figure 16)

1. Apply adhesive to seal strip and fender mounting surface (45) before installation.
2. Seal strip (44) to fender panel
3. U nuts (43) to fender panel (42)
4. Fender panel (42)
5. Fender to wheelhouse panel screws (41)
6. Seven rivets (40)

   NOTICE: Care must be taken when fasteners are installed to plastic or fiberglass components. To prevent damage, align all parts before installation of fasteners.

7. Rear fender finish molding
8. Rocker panel cover

REAR ROOF PANEL ASSEMBLY

It is not necessary to remove rear quarter windows when removing rear roof panel assembly.

Remove or Disconnect (Figure 17)

1. Rear compartment lid and weatherstrip. Refer to Section 7.
2. Rear compartment side cover panels
3. Rear compartment cover extensions
4. Back window side filler panels
5. Four rear roof panel to upper frame side rail bolts (46)
6. Tail lamp assemblies. Refer to Section 7.
7. Six rear roof panel to frame bolts (47)
8. Rear fender finish moldings.
9. Loosen upper portion of fender from top.

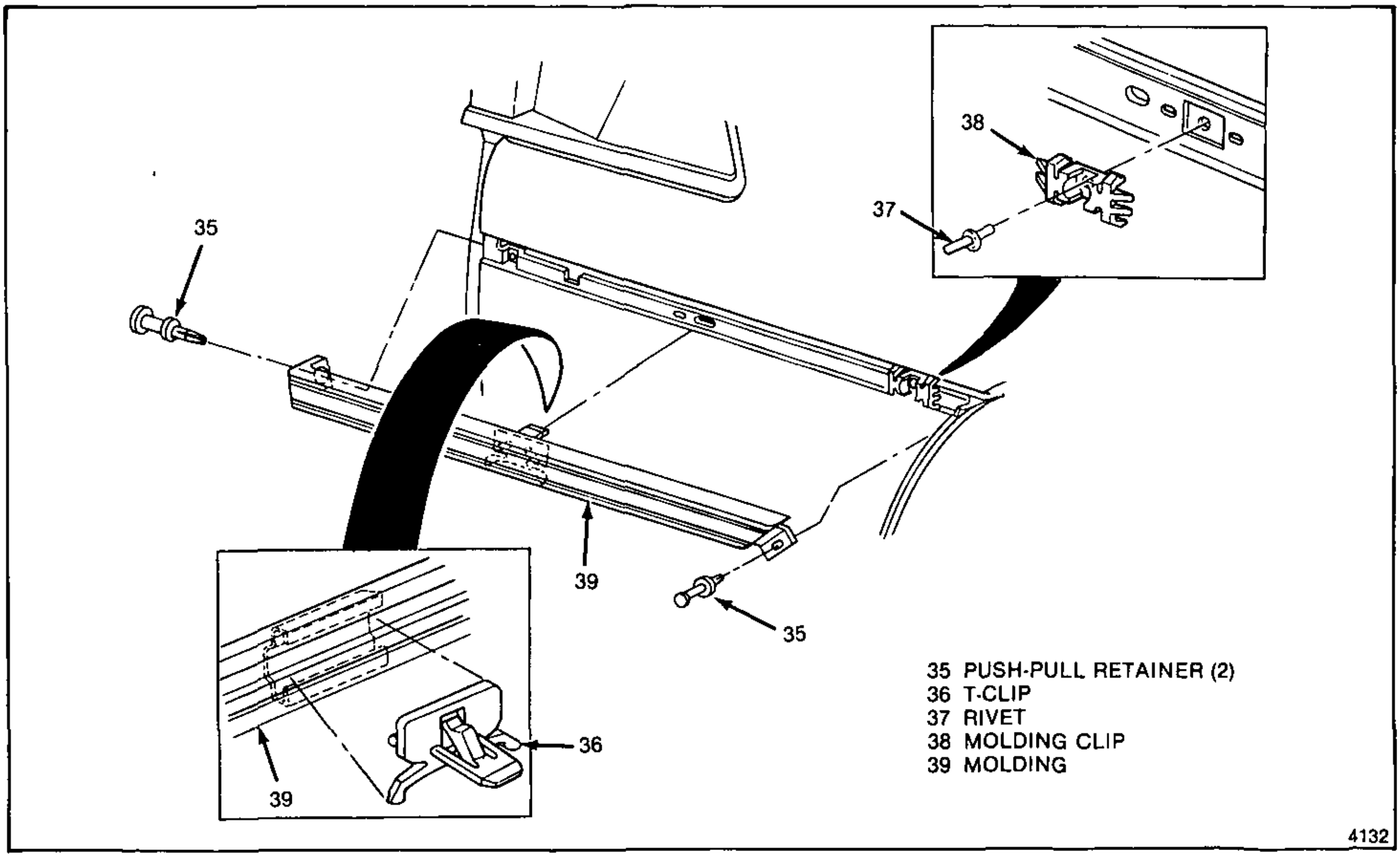


Fig. 15-Rear Fender Finish Molding

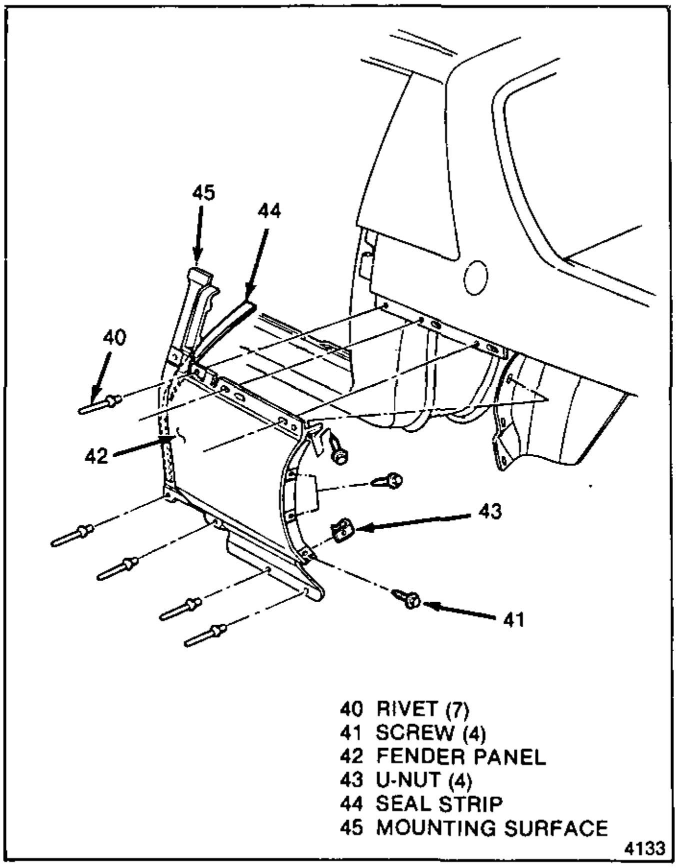


Fig.16-Rear Fender Panel Assembly

10. Rear wheelhouse to rear roof panel retainers
11. Rear markers and loosen upper portion of rear fascia from top. Refer to Section 7.
12. Fuel filler door and pocket assembly
13. Three bolts (48) inside fuel filler pocket opening
14. Upper seat belt anchor assemblies and rear quarter trim panels
15. Applique panel assemblies
16. Two rear roof panel to body side pillar bolts (49)
17. Upper garnish molding. Refer to Section 8.
18. Headlining assembly. Refer to Section 8.
19. Roof drip molding
20. Three rear roof panel to rear roof nuts (50)
21. Eight front roof panel to front roof nuts and bolts (51)

NOTICE: Carefully position supports to distribute pressure equally on front roof panel. Stress on roof panel can cause damage to the panel.

22. Prop up rear of front roof panel with supports.
23. Rear roof panel (52)

Install or Connect (Figure 17)

1. Rear roof panel (52). Align rear roof panel to rear roof fastener holes.
2. Eight front roof panel to front roof nuts and bolts (51)

Tighten

Front roof panel fasteners to 10 N·m (7.4 ft-lb)

3. Three rear roof panel to rear roof nuts (50)

Tighten

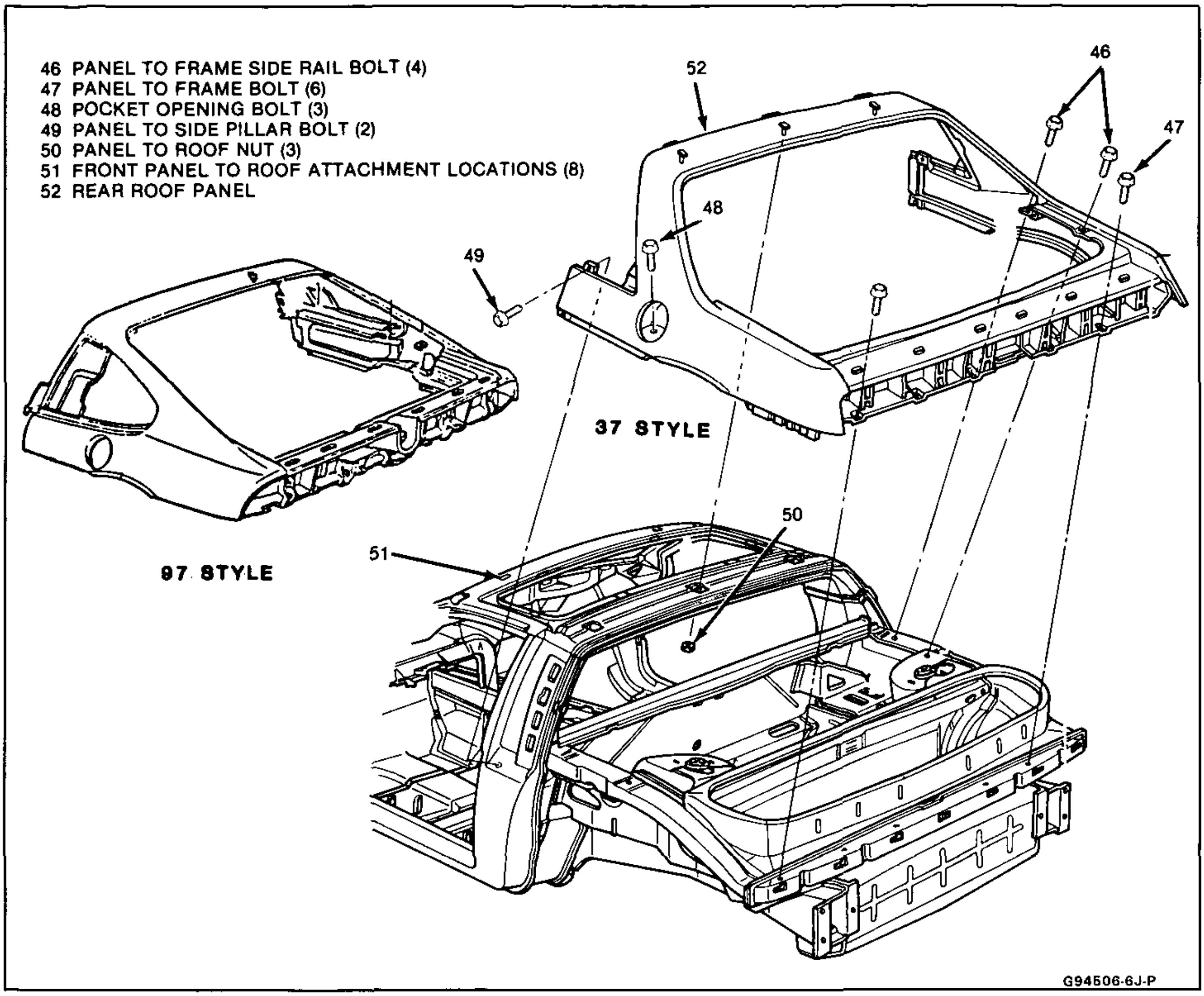
Rear roof panel nuts to 10 N·m (7.4 ft-lb)

4. Roof drip molding
5. Headlining assembly. Refer to Section 8.
6. Upper garnish moldings. Refer to Section 8.
7. Two rear roof panel to body side pillar bolts (49)
8. Applique panel assemblies
9. Rear quarter trim panels and upper seat belt anchor assemblies.

Tighten

Anchor bolt from 35 to 48 N·m (26 to 35 ft-lb)

10. Three bolts inside fuel filler pocket opening (48)
11. Fuel filler door and pocket assembly
12. Upper portion of rear fascia and rear markers
13. Rear wheelhouse to rear roof panel retainers
14. Upper portion of rear fenders and finish moldings. Refer to Section 7.
15. Six rear roof panel to frame bolts (47)
16. Tail lamp assemblies. Refer to Secion 7.
17. Four rear roof panel to upper frame side rail bolts (46)
18. Back window side filler panels
19. Rear compartment cover extensions
20. Rear compartment side cover panels
21. Rear compartment lid and weatherstrip. Refer to Section 7.



46 PANEL TO FRAME SIDE RAIL BOLT (4)
47 PANEL TO FRAME BOLT (6)
48 POCKET OPENING BOLT (3)
49 PANEL TO SIDE PILLAR BOLT (2)
50 PANEL TO ROOF NUT (3)
51 FRONT PANEL TO ROOF ATTACHMENT LOCATIONS (8)
52 REAR ROOF PANEL

Fig. 17-Rear Roof Panel Assembly

SECTION 7

REAR END

NOTICE: Care must be taken when servicing any fiberglass (SMC) panel or components. Fasteners retaining such panels or components must be hand started to prevent damage to fiberglass parts. Always use the specified torque values given for SMC parts to assure safe and proper retention.

CONTENTS

REAR COMPARTMENT LID

Remove or Disconnect (Figure 1)

Important

Before removing lid, mark position by scribing around hinge on lid for correct reinstallation alignment.

CAUTION: Torque rod bolts are under tension. Follow steps under rear compartment hinge removal and reinstallation when removing these bolts as personal injury or damage to the vehicle could result.

1. Electrical connector - remote control deck lid release at left hinge (if equipped).
2. Bolts (1)
3. Lid

Install or Connect (Figure 1)

1. Lid, align with scribe marks
2. Screws (1)
3. Electrical connector

Inspect

Close lid carefully and check for proper alignment.

REAR COMPARTMENT HINGE

Remove or Disconnect (Figure 2)

Tools Required:

2 – 12″ x 12″ x 1/2″ plywood boards
2 – 1-3/8″ x 1-3/8″ x 4″ wood blocks
1 – 1″ inside diameter pipe 18 long

CAUTION: To prevent possible personal injury or damage to the vehicle, tape plywood board to rear glass above hinge area (Fig. 6). Also, install wood blocks between hinge and torque rod as shown in Figure 4 when opening lid.

NOTICE: Cover rear portion of rear roof panel with fender cover to prevent damage to body finish.

1. Rear compartment lid
2. Rear compartment side cover panels
3. Carburetor air intake duct (for left hinge)
4. Screw (2, Fig. 1) using tool J-35808 or equivalent
5. Nuts (5, Fig. 1)
   - Place pipe over end of torque rod (Fig. 5)
   - Remove top nut (Fig. 5)
   - Hold tension on rod with pipe (Fig. 5) while removing wood block and lower nut.
6. Hinge (4) – allow torque rod to rotate forward and rest against plywood.

Install or Connect (Figure 2)

1. Hinge (4) – place pipe over rod and hold tension on rod (Fig. 5) while installing hinge.
2. Nuts (5)
3. Wood block between hinge and rod. With block in place, remove pipe.
4. Screw (2, Fig. 1) using tool J-35808 or equivalent
5. Carburetor air intake duct
6. Rear compartment side panels
7. Rear compartment lid
8. Partially lower lid and remove wood blocks

Inspect

For proper alignment of rear compartment lid.

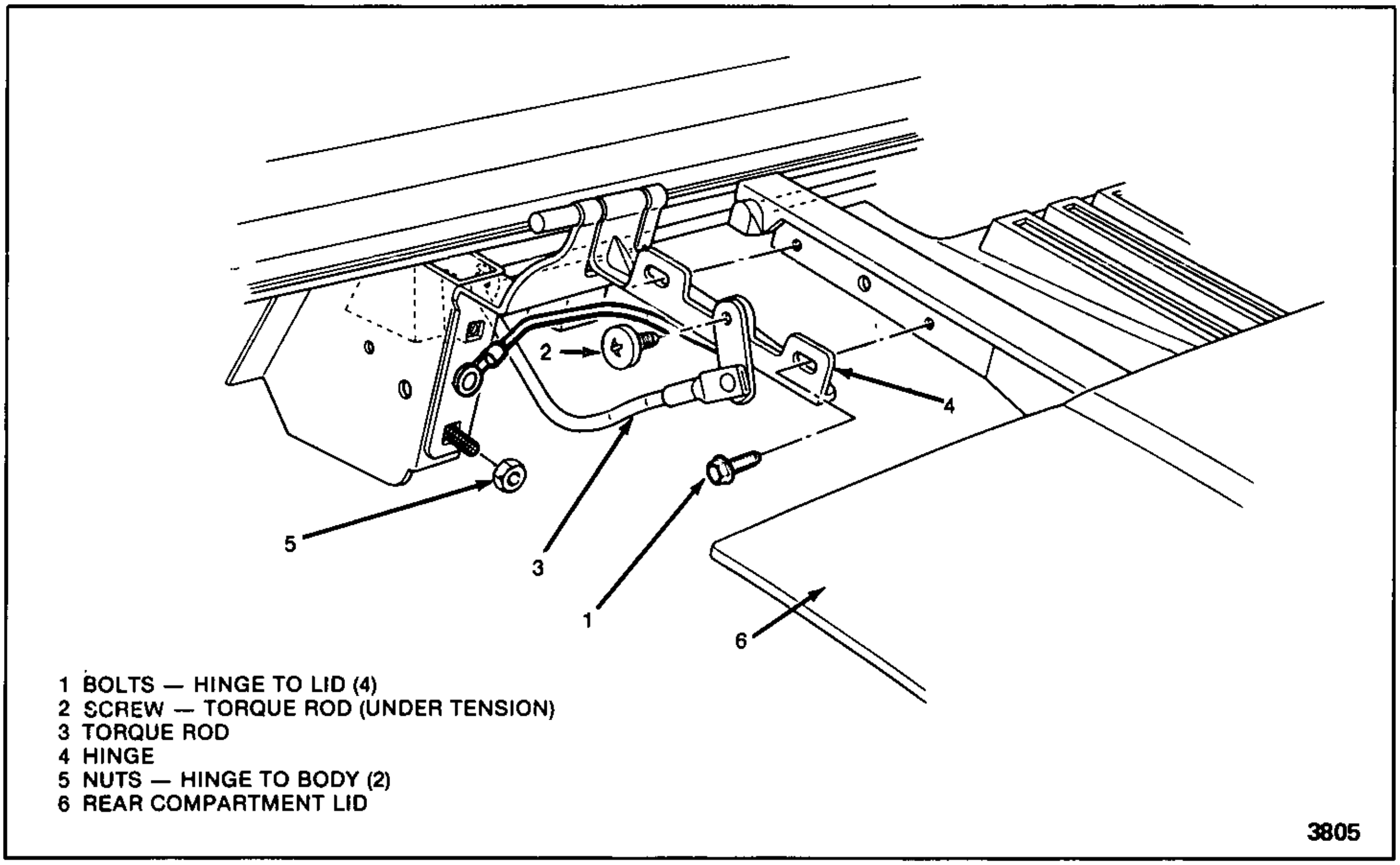


Fig. 1-Rear Compartment Lid Attachment

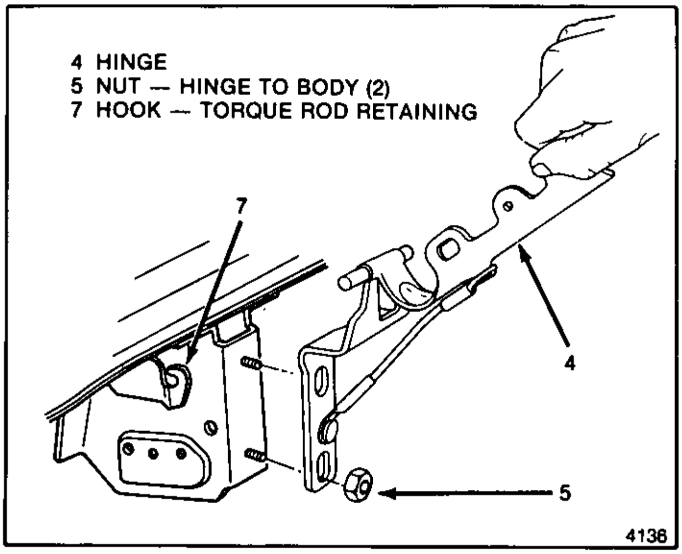


Fig. 2-Rear Compartment Lid Hinge

REAR COMPARTMENT TORQUE RODS

Remove or Disconnect (Figures 3, and 6)

1. Hinge (4, Fig. 2)
2. Screw (13)
3. Pin (9) – with end of torque rod resting against plywood, grasp U end of rod (8) and pull rearward to release pin.

Install or Connect (Figures 3 and 6)

1. Rod (3)
2. Rod (3) in hook (7)
3. Pin (9)
    - With torque rod resting against plywood, grasp U end of rod (8) and pull rearward to insert pin.
    - Release U end (8) of rod and be sure that end of rod hooks over pin.
4. Screw (13)
5. Hinge (4, Fig. 2)

Adjust

To increase tension on torque rod, move the pin (9) rearward one hole.

REAR COMPARTMENT STRIKER

Remove or Disconnect (Figure 7)

1. Bolts (16)
2. Striker (15)

Install or Connect (Figure 7)

1. Striker (15)

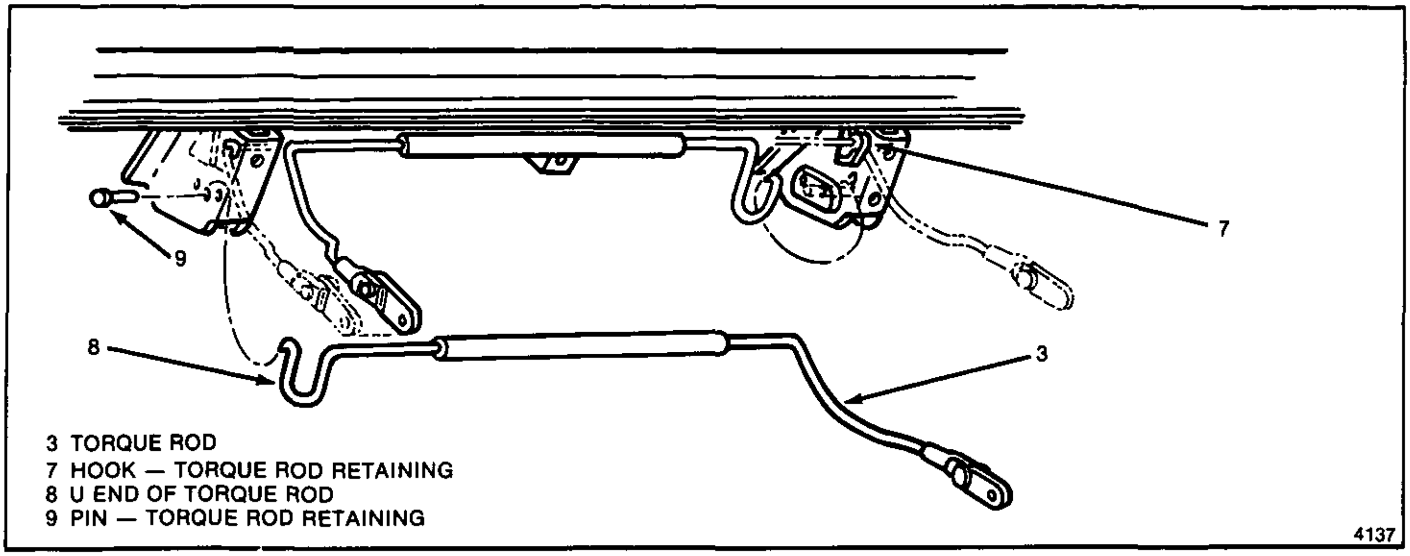


Fig. 3-Rear Compartment Lid Torque Rod

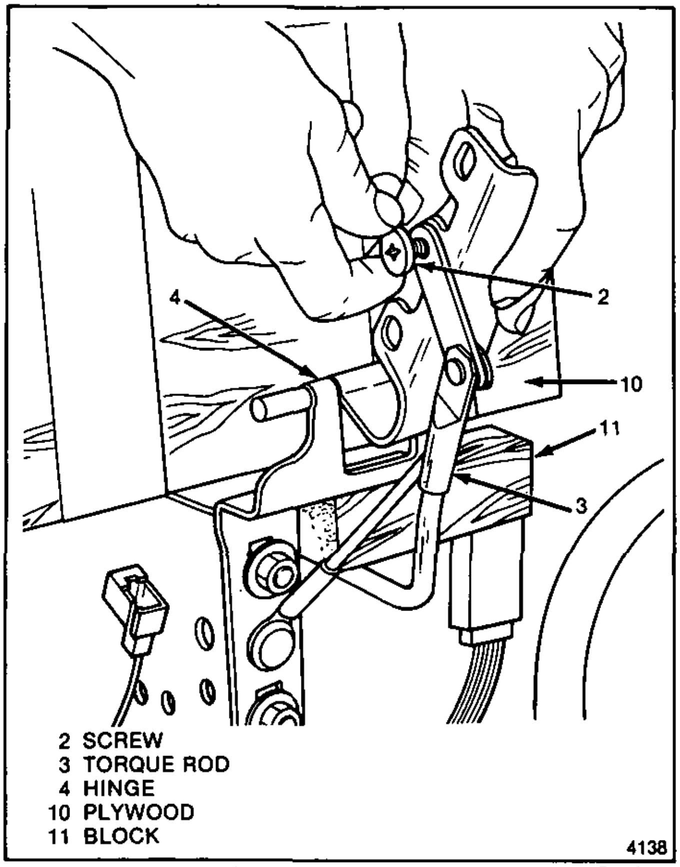


Fig. 4-Attaching Rear Compartment Lid Torque Rod

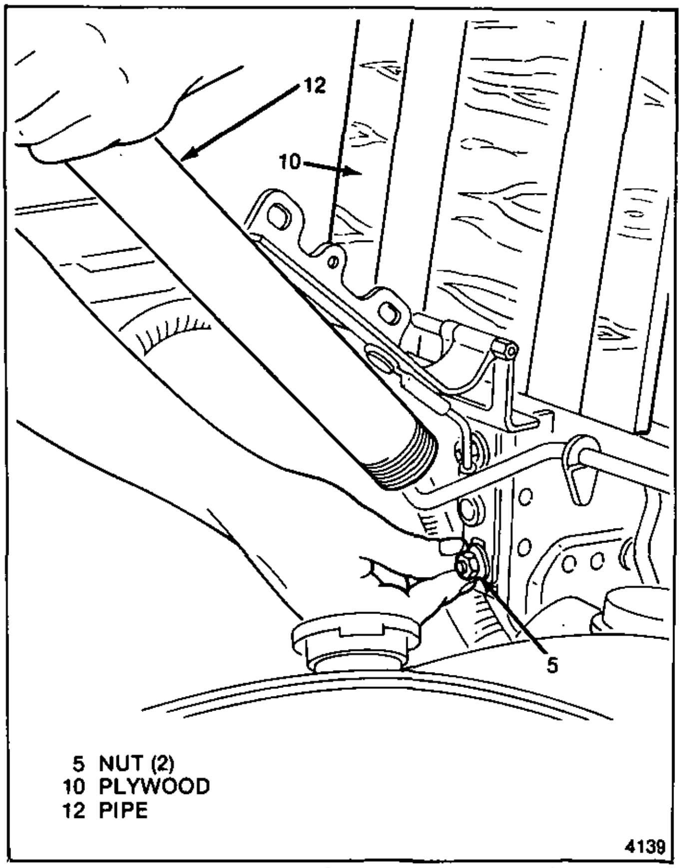


Fig. 5-Installing Rear Compartment Lid Hinge

REAR COMPARTMENT LID LOCK ASSEMBLY

Remove or Disconnect (Figure 8)

1. Bolts (18)
2. Lock Assembly (17)

Install or Connect (Figure 8)

1. Lock assembly (17)
2. Bolts (18)

REAR COMPARTMENT LOCK CYLINDER

37 Style

Remove or Disconnect (Figure 9)

1. Screw (22)
2. Retainer (21)
3. Cylinder (19) and gasket (20)

Install or Connect (Figure 9)

1. Cylinder (19) and gasket (20)

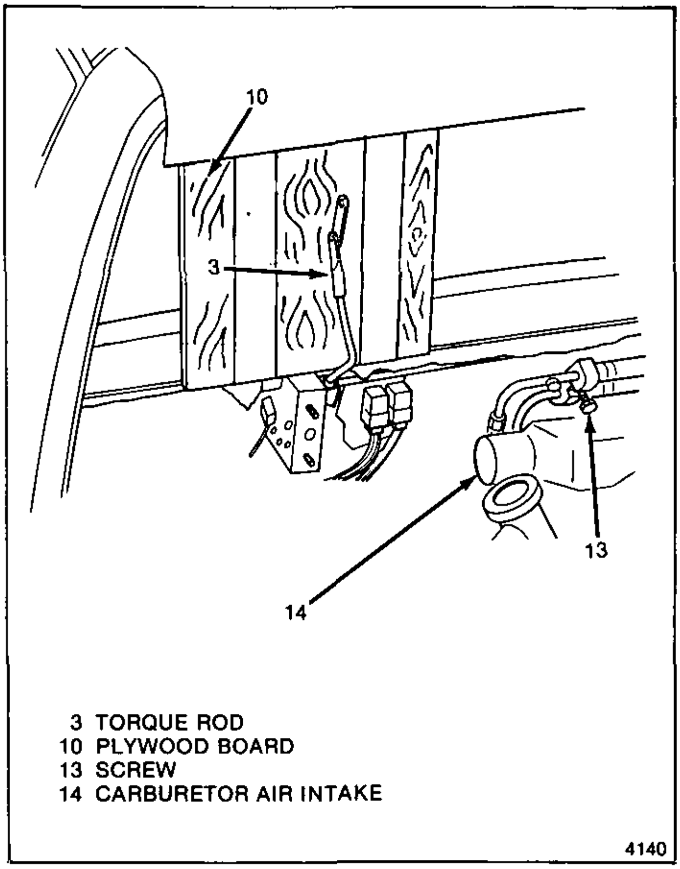


Fig. 6-Rear Compartment Lid Torque Rod Detached

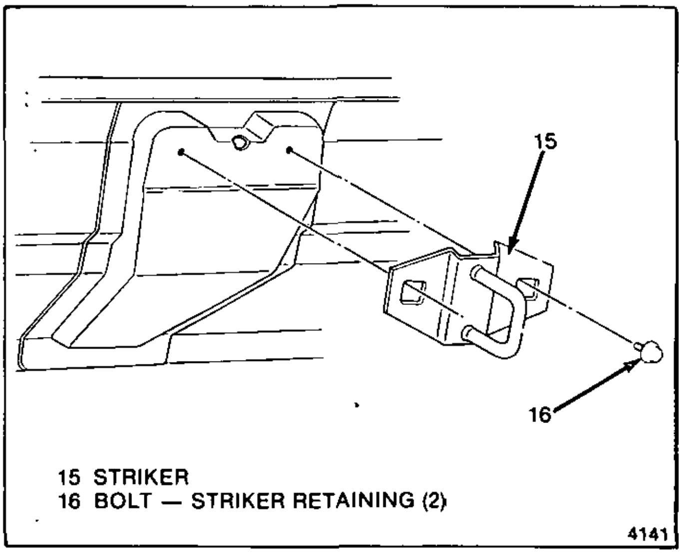


Fig. 7-Rear Compartment Lid Striker

2. Retainer (21)
3. Screw (22)

97 Style

Remove or Disconnect (Fig. 10)

1. Screws (22A) four required
2. Cover (20A)

Install or Connect

1. Lock cylinder (19A) to support (23A)
2. Retainer (21A)
3. Cover (20A)
4. Screws (22A)

REMOTE CONTROL DECK LID RELEASE SOLENOID

Remove or Disconnect (Figure 11)

1. Screw (24)
2. Electrical connector
3. Solenoid (23). Slide solenoid from latch to disengage tab.

Install or Connect (Figure 11)

1. Solenoid (23). Engage tab on latch.
2. Screw (24)
3. Electrical connector

REAR COMPARTMENT AJAR SWITCH

The rear compartment ajar switch is located at the top left corner of the stowage compartment. This switch indicates if the rear compartment lid is not fully closed by sending electrical current to an indicator light located in the instrument panel.

Remove or Disconnect

1. Pull up on switch to disengage switch from body
2. Electrical connector from switch

Install or Connect

1. Electrical connector to switch
2. Switch to body

REAR COMPARTMENT LID ADJUSTMENT

The following adjustment procedures identify rear compartment lid misalignment conditions. More than one condition may be present. Perform adjustments only as required for correct alignment and operation.

Adjust (Figures 1 and 7)

- Trailing edge too high or low
    - Loosen bolts (16)
    - Raise or lower striker (15) as required
    - Tighten bolts (16)
- Lock assembly binding on side of striker
    - Loosen bolts (16)
    - Move striker (15) left or right as required
    - Tighten bolts (16)
- Leading edge too high or low (either side)
    - Loosen nuts (5)
    - Raise or lower hinge (4) as required
    - Tighten nuts (5)

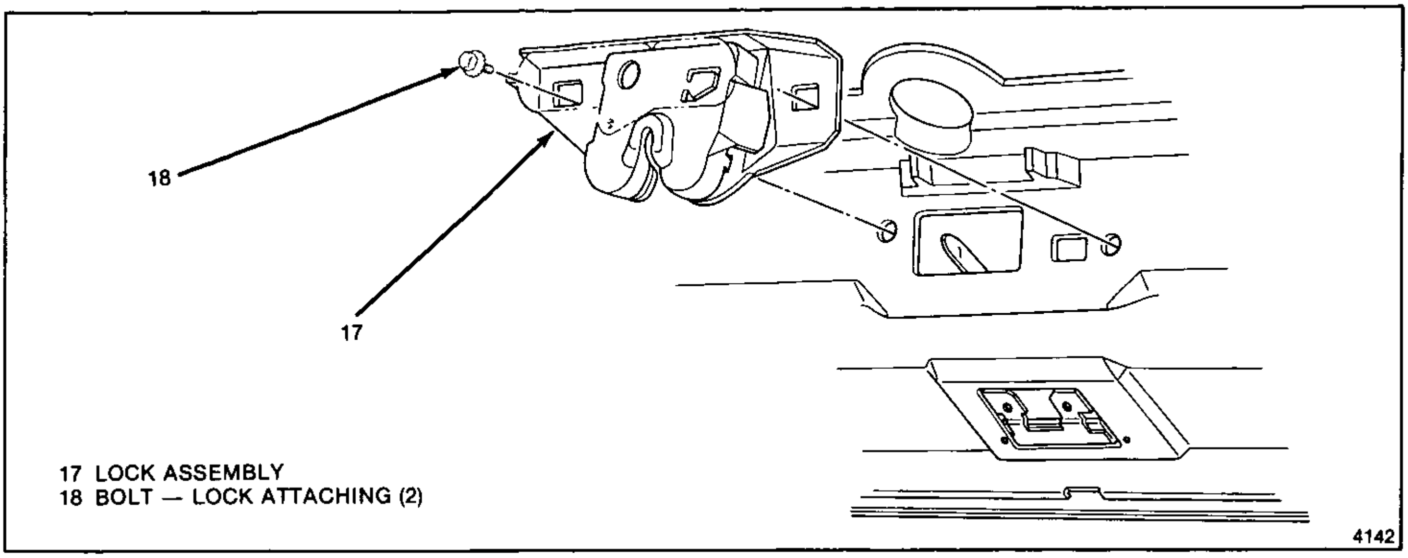


Fig. 8-Rear Compartment Lid Lock Assembly

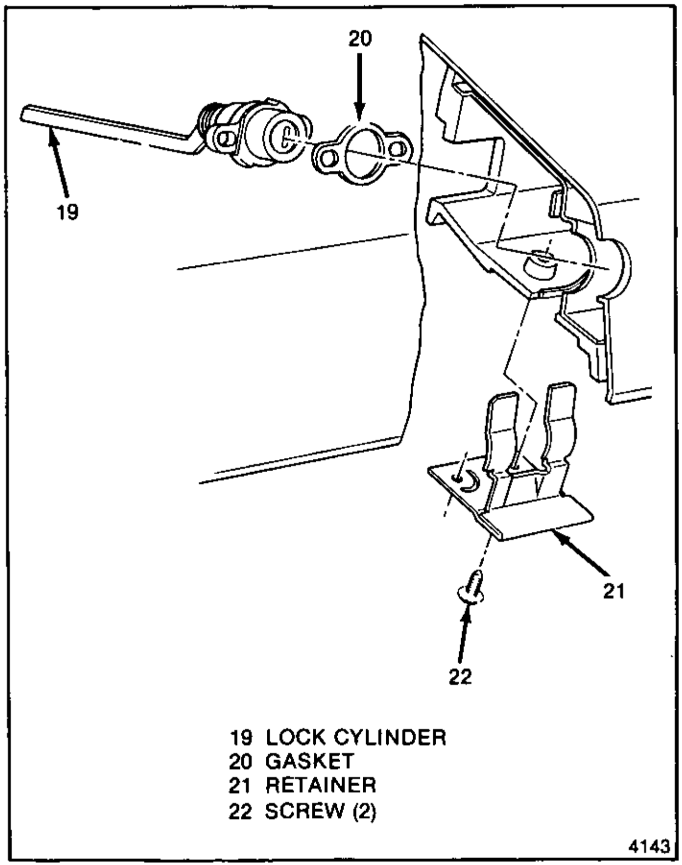


Fig. 9-Rear Compartment Lock Cylinder

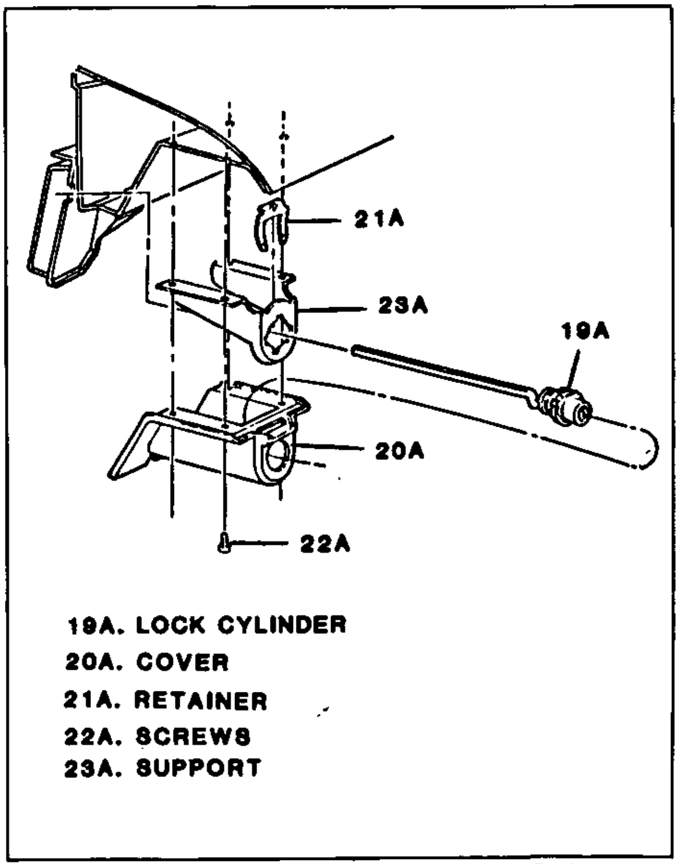


Fig. 10 - Installing Lock Cylinder - 97 Style

  - Tighten nuts (5)

- Lid too far fore or aft (either side)
  - Loosen bolts (1)
  - Align lid
  - Tighten bolts (1)

Inspect

Lid for proper operation and alignment

REAR COMPARTMENT WEATHERSTRIP

Remove or Disconnect (Figure 12)

Weatherstrip (28) from flange. Start at any convenient location and pull inward to remove.

Install or Connect (Figure 12)

Weatherstrip (28) on flange (29). Place slot in weatherstrip over flange and push on securely. Continue around weatherstrip being sure it is fully seated on flange.

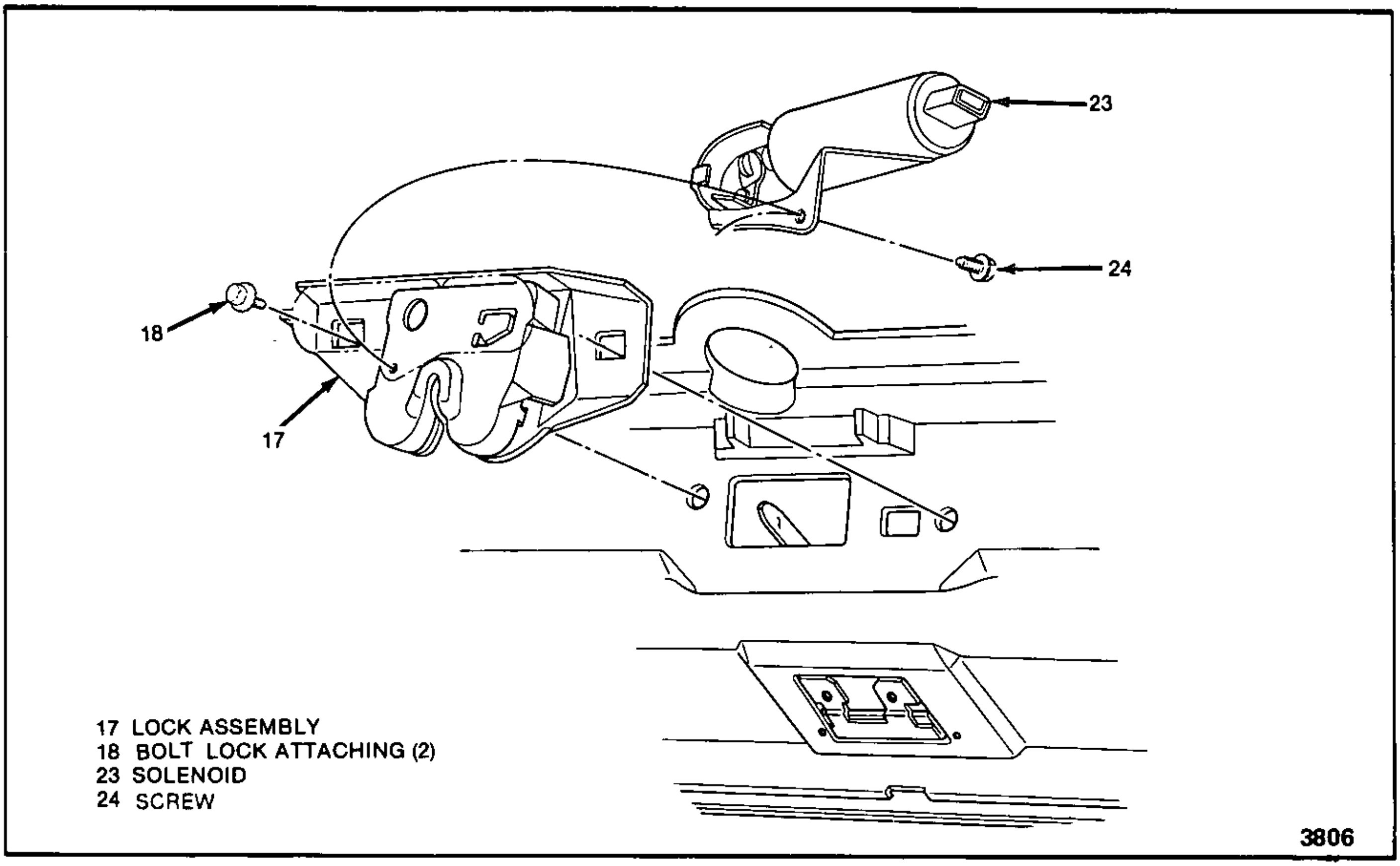


Fig. 11-Remote Control Rear Compartment Lid Release

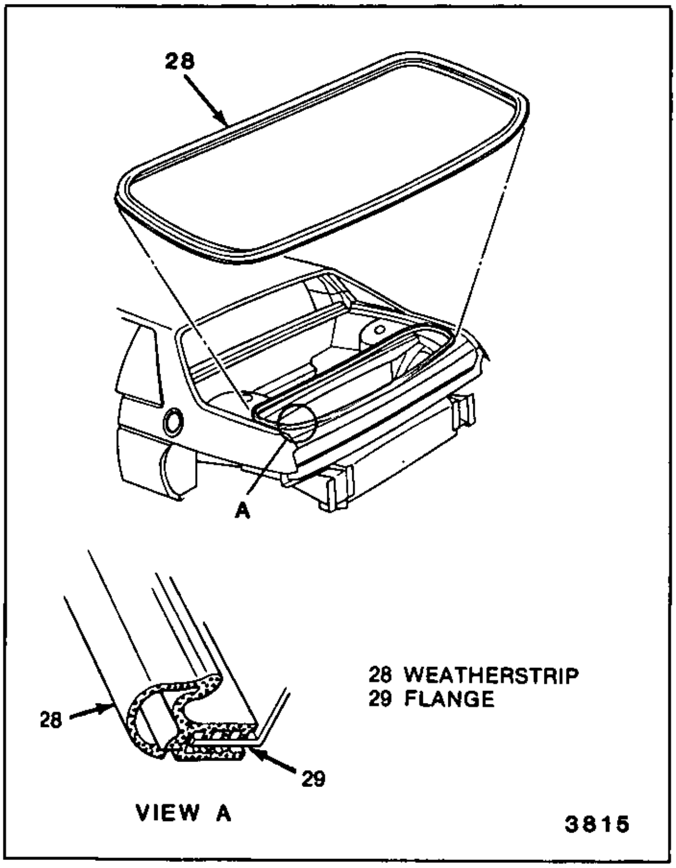


Fig. 12-Rear Compartment Weatherstrip

REAR COMPARTMENT LINER

←→ **Remove or Disconnect (Figure 13)**

1. Rear compartment weatherstrip (28)
2. Rear compartment lamp
3. Rear compartment liner (30)

→← **Install or Connect (Figure 13)**

1. Rear compartment liner (30)
2. Rear compartment lamp
3. Rear compartment weatherstrip (28)

TAIL LAMP ASSEMBLY

←→ **Remove or Disconnect (Figure 14)**

1. Covers (31)
2. Six screws (32)
3. Tail lamp assembly (33)
4. Bulb assemblies (34)

→← **Install or Connect (Figure 14)**

1. Bulb assemblies (34)
2. Tail lamp assembly (33)

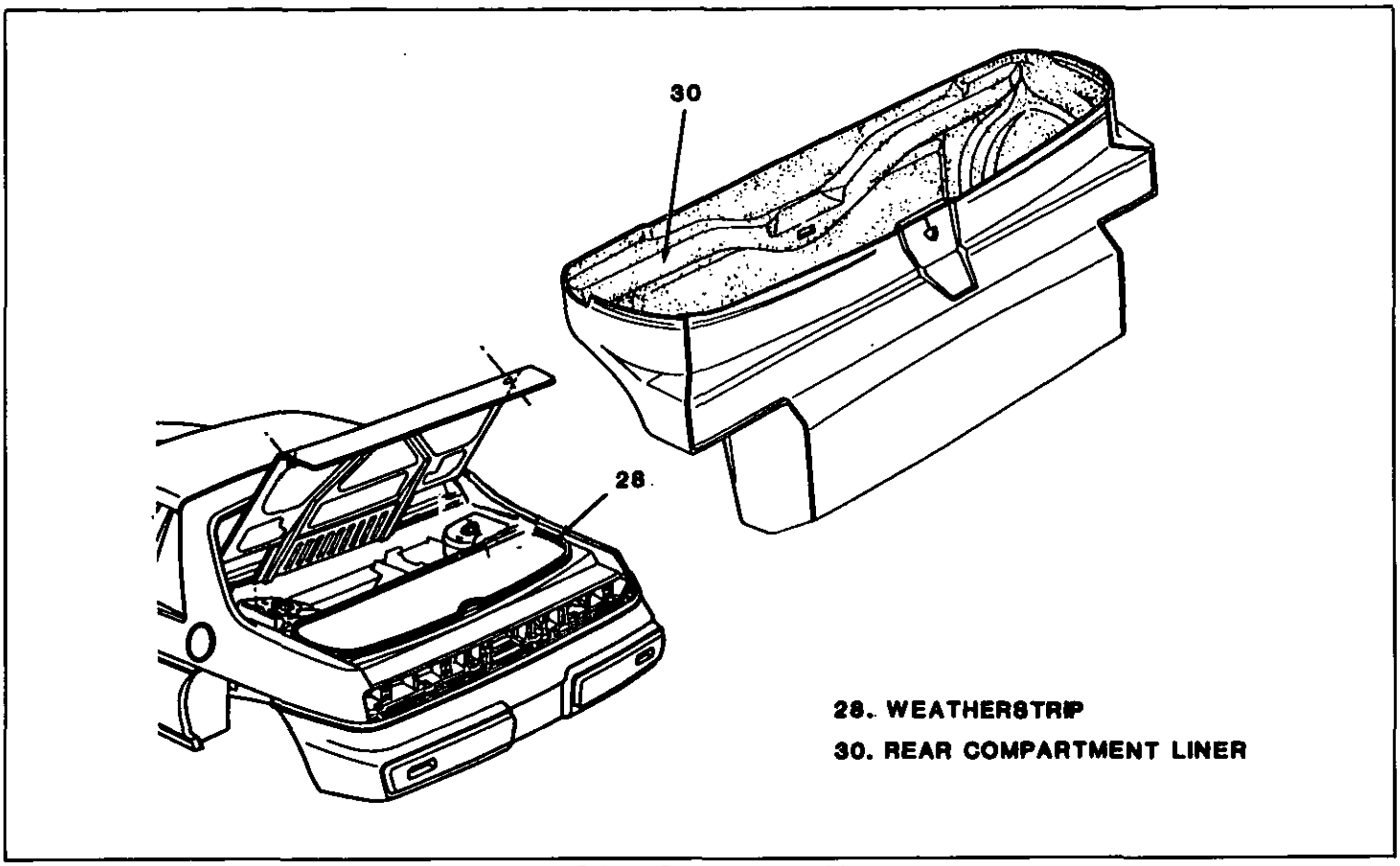


Fig. 13-Rear Compartment Liner

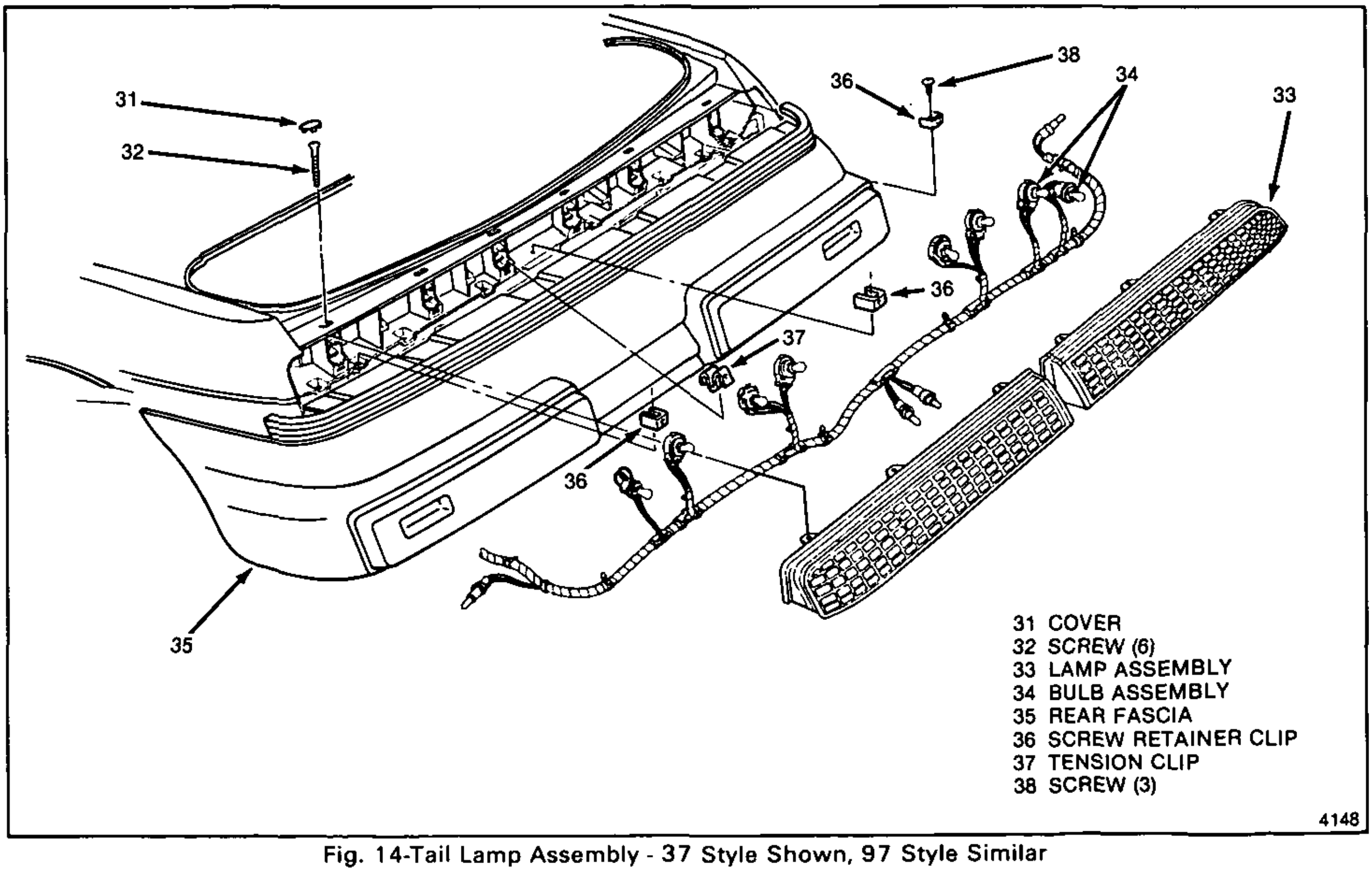


Fig. 14-Tail Lamp Assembly - 37 Style Shown, 97 Style Similar

LUGGAGE CARRIER ASSEMBLY

Remove or Disconnect (Figure 15)

1. Rubber straps (39)
2. Two nuts (41)
3. Two bolts (43)
4. Eleven screws (48)
5. Bolt (42)
6. Eleven nuts (40)

Install or Connect (Figure 15)

1. Eleven nuts (40)

   Inspect

   Rubber caged nuts to ensure rubber is not cut or torn to allow proper sealing.
2. Bolt (42)
3. Eleven screws (48)
4. Two bolts (43)
5. Two nuts (41)
6. Rubber strips (39), insert both ends of strip and roll center portion to fit.

REAR FASCIA

Remove or Disconnect (Figure 16)

1. Tail lamp assembly
2. Seven retainers (49)
3. Seven retainers (53)
4. Side marker lamp assemblies
5. Bolts (50)
6. Bolts (51)
7. Bolts (52)

Install or Connect (Figure 16)

1. Seven retainers (53)
2. Seven retainers (49)
3. Bolts (50)
4. Bolts (51)
5. Bolts (52)
6. Side marker lamp assemblies
7. Tail lamp assembly

CENTER HIGH-MOUNTED STOP LAMP

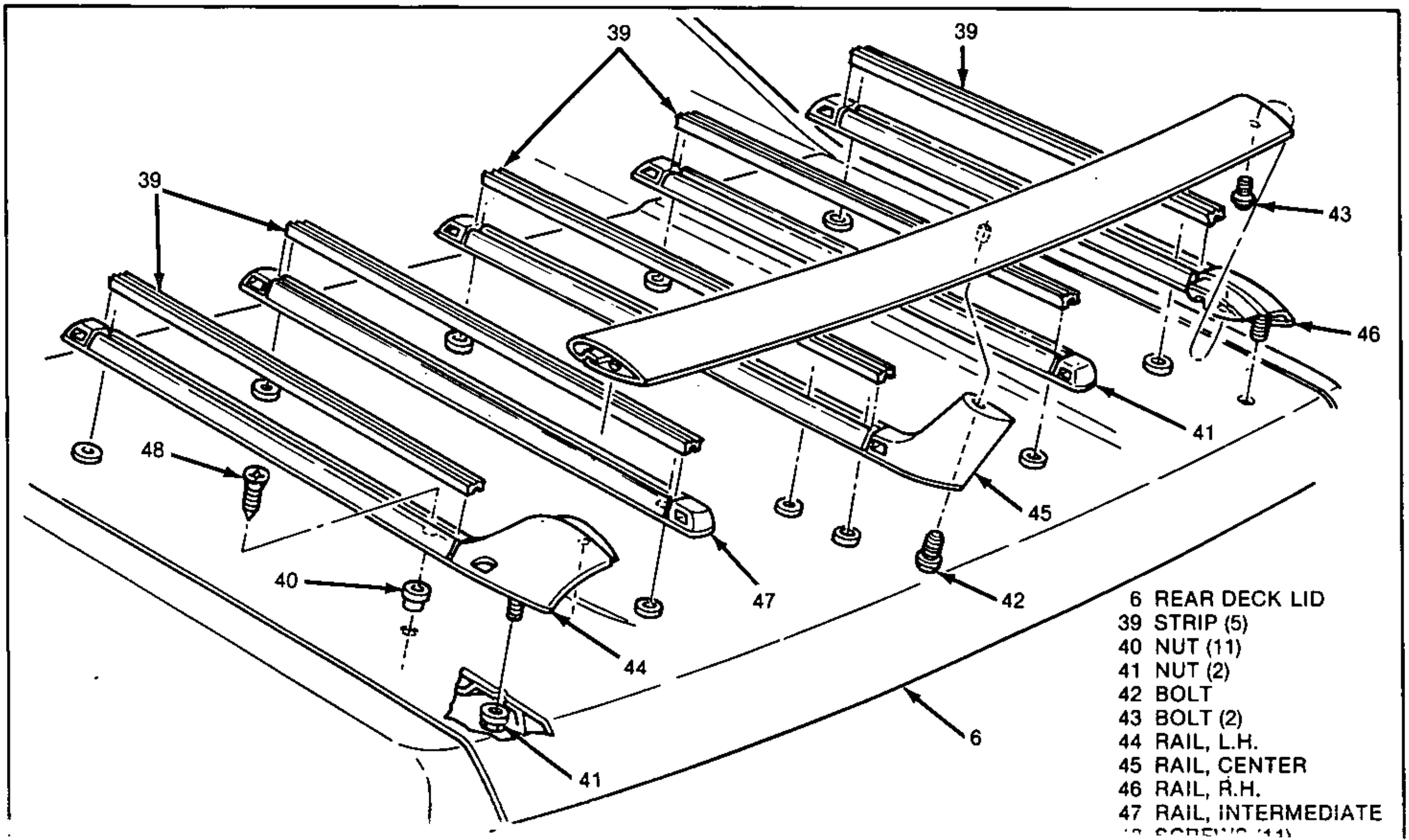
The center high-mounted stop lamp is attached to the roof at the centerline of the back window.

Remove or Disconnect (Fig. 17)

1. Screws (54)
2. Cover (55)
3. Screws (56)
4. Connector (57)
5. Center high-mounted stop lamp (58)

Install or Connect

1. Center high-mounted stop lamp (58)
2. Connector (57)
3. Screws (56)



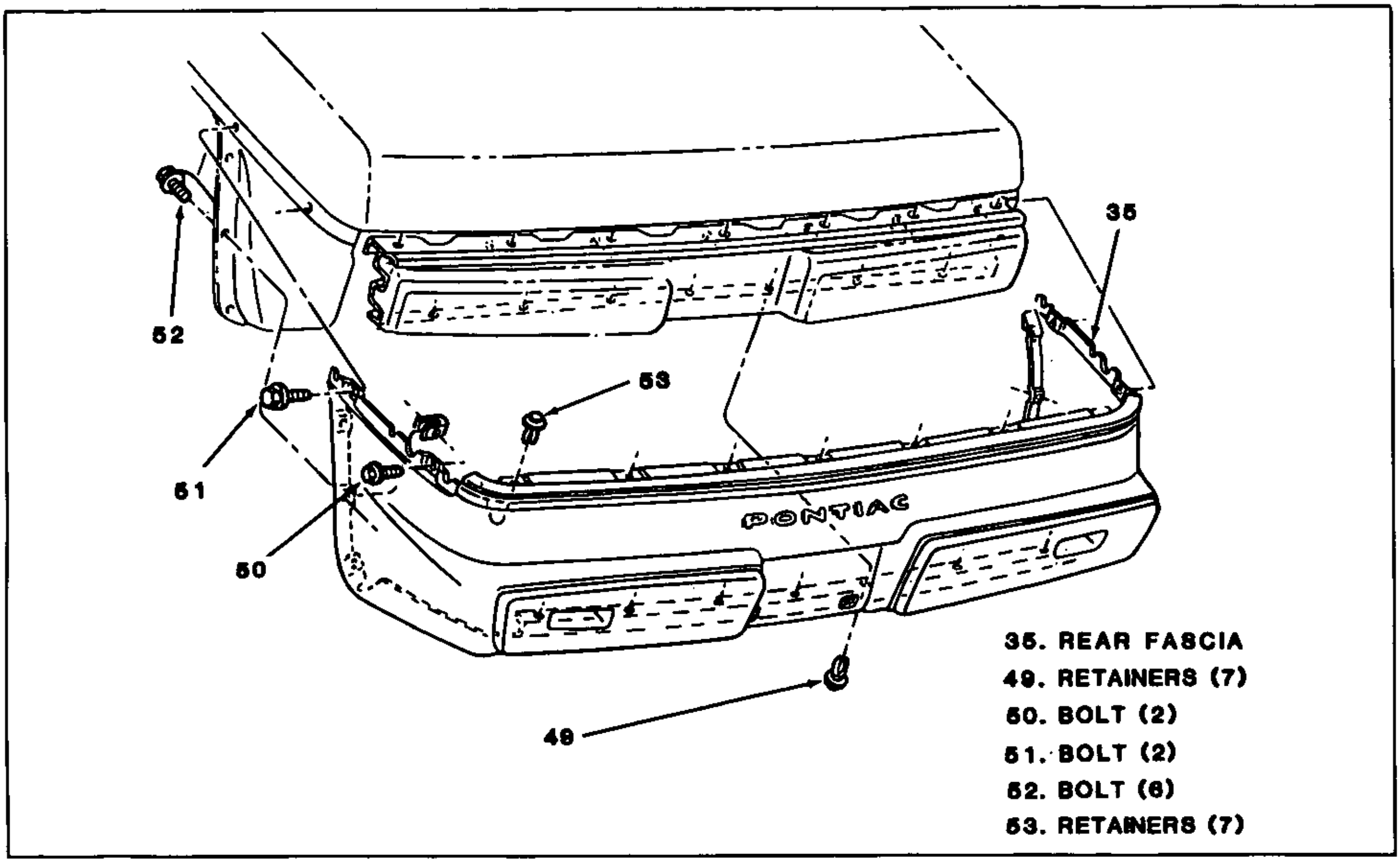


Fig. 16-Rear Fascia

4. Cover (55)
5. Screws (54)

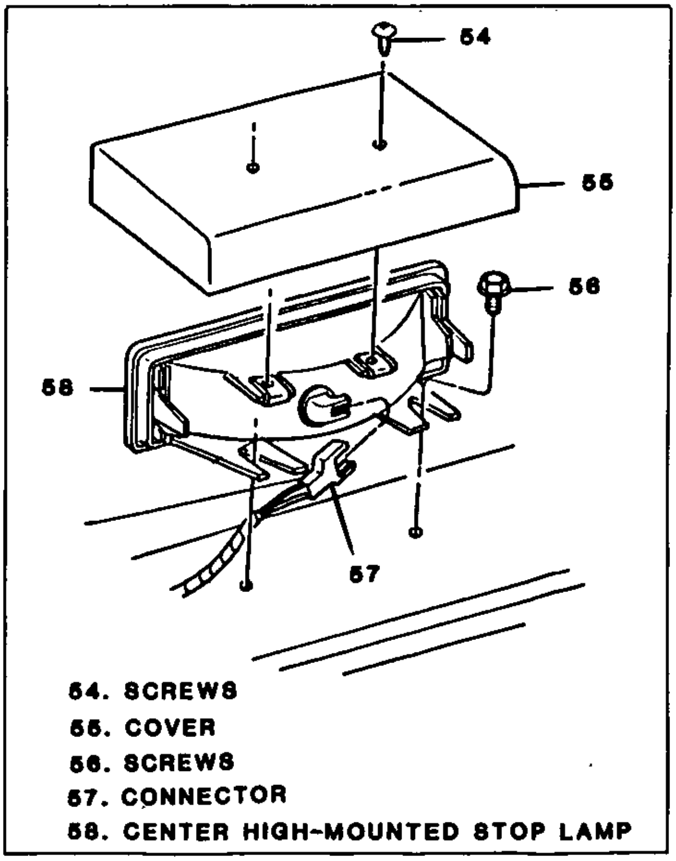


Fig. 17 - Center High-Mounted Stop Lamp

SECTION 8

ROOF

NOTICE: Care must be taken when servicing any fiberglass (SMC) panel or component. Fasteners retaining such panels or components must be hand started to prevent damage to fiberglass parts. Always use the specified torque values given for SMC parts to assure safe and proper retention.

CONTENTS

ROOF

ROOF PANEL

The roof panel consists of a one piece sheet molded compound panel. It is secured to the space frame with ten screws and nuts. Sealing strips are used to seal the roof panel and prevent air or water leaks. An opening in the roof of the space frame is provided for the optional vista vent.

Remove or Disconnect (Figures 8-1, 8-2, 8-3 and 8-4)

1. Wiper arms: Refer to Section 8E in the chassis portion.
2. Shroud top vent screen. Refer to Section 4.
3. Windshield molding assembly. Refer to Section 11.
4. Vista vent assembly (if equipped)
5. First three fender to side rail attaching bolts from windshield on right and left fenders.
   - Release fenders at top for adequate clearance with roof cover panel.
6. Roof drip moldings
7. Interior upper garnish moldings
8. Dome lamp assembly
9. Sunshade assemblies
10. Headlining assembly
11. Two roof panel attaching screws (2) at cowl panel (3)
12. Two nuts and six screws (4)
13. Roof panel (1)
14. Sealing strips and fillers — windshield frame at belt (6)

Clean

- All areas where sealing strips are to be applied within ten minutes of installation. Use denatured alcohol or lacquer thinner and dry immediately with a clean cloth.

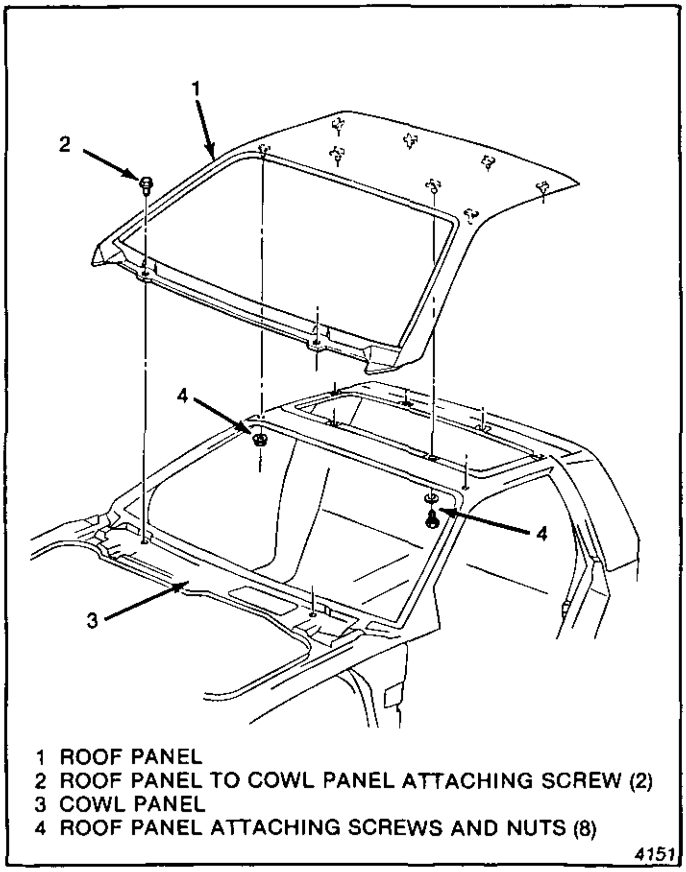


Fig. 8-1-Roof Panel Attachment

Install or Connect (Figures 8-1, 8-2, 8-3, and 8-4)

1. Sealing strips to windshield pillar flanges (5)
   - Apply moving from bottom of pillar flange (5) toward top of roof.
2. Right and left side fillers — windshield frame at belt (6)

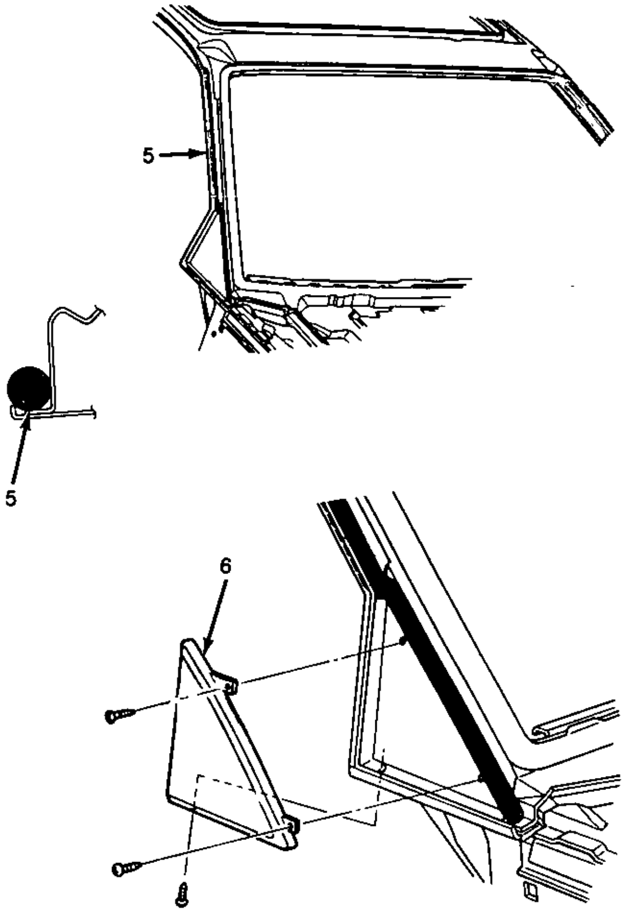
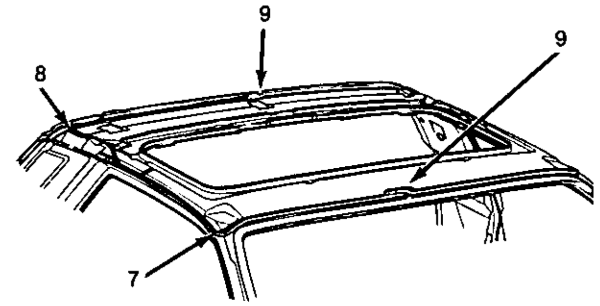


Fig. 8-2 Windshield Pillar Flange and Filler — Windshield Frame at Belt



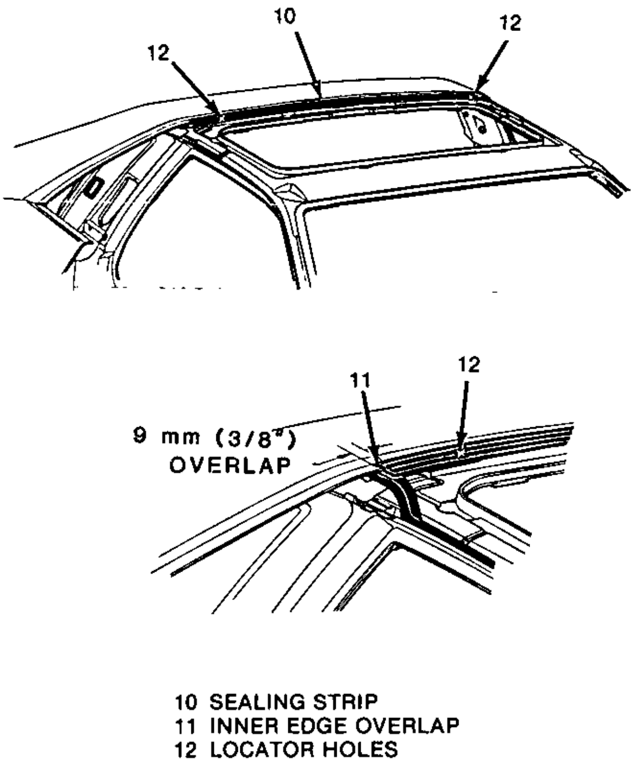


Fig. 8-4-Rear Roof Sealing Strip

3. Roof sealing strips — right side
   - Begin at center of roof above windshield opening (9).
   - Working outward, form a butt joint (7) at pillar sealing strip.
   - Continue alongside of roof to rearmost rib (8) and turn toward rear center of roof.
   - Allow for a 25.0 mm (1 in.) overlap (9) with the left side roof sealing strip.
4. Roof sealing strips — left side
   - Begin at center of roof above windshield opening (9). Overlap adjacent sealing strip by 25.0 mm (1 in.).
   - Working outward, form a butt joint (7) at pillar sealing strip.
   - Continue along side of roof to rearmost rib (8) and turn toward center of roof.
   - Overlap (9) with the right side sealing strip. 25 mm (1 in.)

Inspect

- For good contact with surface.

5. Rear roof sealing strip (10) over right and left side roof sealing strips.
   - Overlap right and left roof sealing strips (11) by 9 mm (3/8") at inner edge.

Important

[illegible]

7. Roof panel (1)
   - Start to lower panel onto frame and insert forward roof panel attachment studs through frame.
   - Align locators (12) in rear roof sealing strip to attaching holes in roof panel (1) and lower roof panel into position on frame.
8. Six roof panel attaching screws (4)

Tighten

- Torque screws (4) to 10 N·m (7.4 ft.-lb.)

9. Two roof panel attaching nuts (4)

Tighten

- Torque nuts (4) to 10 N·m (7.4 ft.-lb.)

10. Two roof panel to cowl panel attaching screws (2)
11. Headlining assembly
12. Dome lamp assembly
13. Sunshade assemblies
14. Upper garnish moldings
15. Windshield assembly. Refer to Section 11.
16. Shroud top vent screen. Refer to Section 4.
17. Wiper arms. Refer to Section 8E in the chassis portion.
18. First three fender to side rail attaching bolts from windshield on right and left fenders.
19. Vista vent assembly (if equipped)
20. Roof drip moldings

FORMED HEADLINING

The one piece formed headlining consists of molded substrated covered with a foam-backed cloth facing which is common to all models. The one piece construction allows the headlining assembly to be held in place with two fasteners. Final attachment is accomplished by the installation of related hardware and interior moldings.

Remove or Disconnect (Figure 8-5)

1. Sunshade assembly
2. Coat hooks
3. Dome lamp assembly
4. Upper seat belt anchor assemblies
5. Rear quarter trim panels
6. Right and left side upper garnish moldings
7. Vista vent (if equipped)
8. Headlining assembly (13)
   - Pull down on headlining carefully to release fasteners.
9. Two headlining fasteners (14) from fastener retainers (15)

Install or Connect (Figure 8-5)

1. Two fasteners (14) into fastener retainers (15)
2. Dome lamp wiring harness through dome lamp opening
3. Headlining (13) to roof and secure fasteners
4. Rear quarter trim panels
5. Upper seat belt anchor assemblies

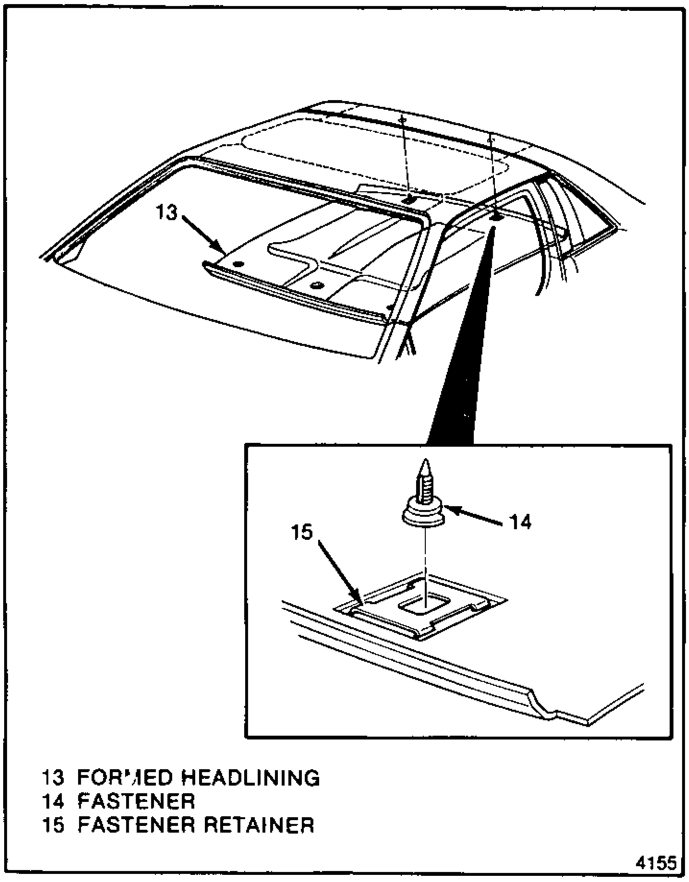


Fig. 8-5-Formed Headlining Installation

Tighten

- Torque anchor bolts to 35 N·m (25.8 ft.-lb.)

6. Right and left side upper garnish moldings
7. Dome lamp connector to wiring harness
8. Dome lamp assembly
9. Coat hooks
10. Sunshade assembly

DOME LAMP ASSEMBLY

The dome lamp operates in conjunction with the door jamb switches, instrument panel light switch or the switches mounted on the dome fixture. The dome lamp harness extends up the right windshield pillar and across the roof inner panel to the dome lamp.

Remove or Disconnect (Figure 8-6)

1. Lens assemblies
   - Insert a flat-bladed tool between tab on lens (17) and housing (16)
   - Pry lens loose and remove
2. Bulbs
3. Four housing attaching screws (18)
4. Harness connector (19) from wiring harness (20)

Install or Connect (Figure 8-6)

- As per illustration

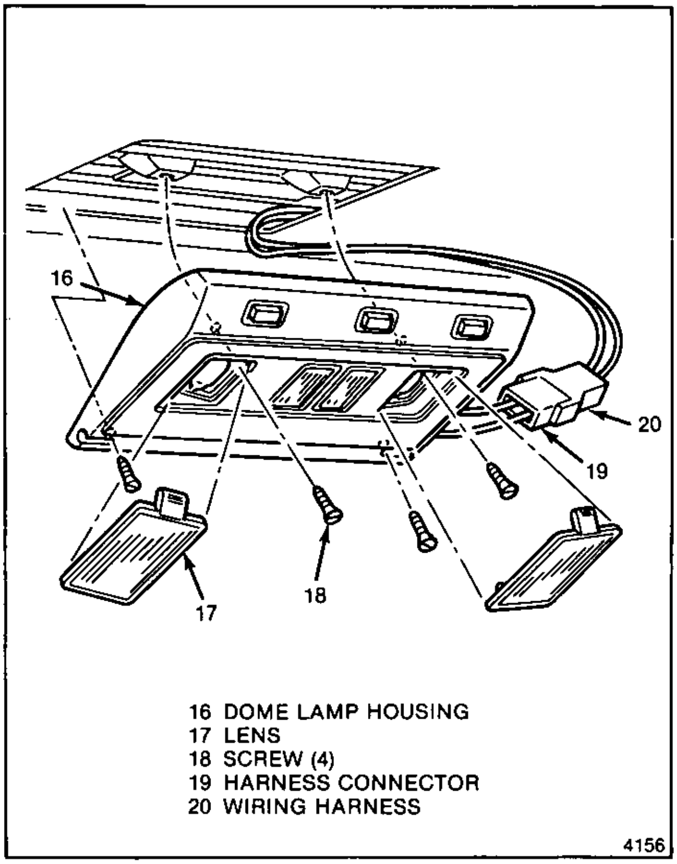


Fig. 8-6-Dome Lamp Assembly

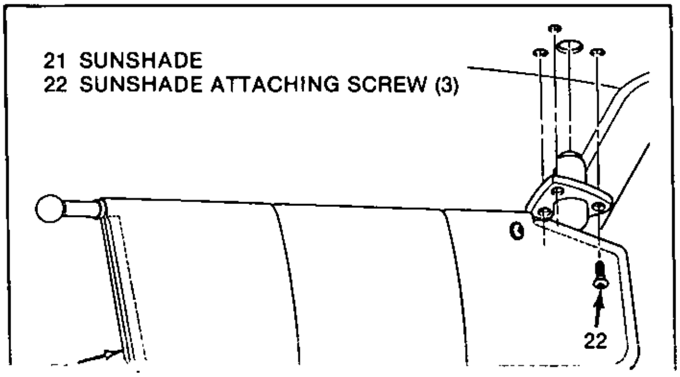
SUNSHADE ASSEMBLY

The sunshade assemblies are attached to the roof panel with three attaching screws (fig. 8-7).

To remove or install the sunshades (21), remove or install the three attaching screws (22).

INTERIOR UPPER GARNISH MOLDINGS

The upper garnish molding is constructed of plastic and is painted to match the interior of the vehicle. Plastic and metal clips retain the upper garnish molding to the roof side rail and windshield pillar.



Remove or Disconnect (Figure 8-8)

1. Upper seat belt anchor assembly
2. Rear quarter trim panel (26) — loosen from upper garnish molding (23)
3. Garnish molding (23)
    - Pull outward and down at rear of garnish molding (23) to disengage from metal clips (25).
    - Pull garnish molding (23) away from windshield pillar to release plastic clips (24).

Install or Connect (Figure 8-8)

1. Garnish molding (23)
2. Rear quarter trim panel (26)
3. Upper seat belt anchor and bolt

Tighten

- Torque seat belt anchor bolt to 35 N·m (25.8 ft.lb.)

ROOF DRIP MOLDINGS

The exterior roof drip molding is a two piece plastic assembly. The roof drip moldings attach along the edge of the roof. A cap drip molding is used to finish off the end of the roof drip molding.

Remove or Disconnect (Figure 8-9)

1. Roof drip molding (27)
    - Pull out molding at bottom of windshield pillar and continue toward rear of roof
2. Cap drip molding (28)

Install or Connect (Figure 8-9)

- As per illustration

VISTA VENT

The optional roof-mounted vista vent assembly is manually operated and consists of a vent glass, two hinges, molding, headlining, escutcheon, and a latch mechanism. The two piece detachable vent latch assembly operates on the over-center principle and doubles as a hold open device. The latch assembly is attached to the glass with screws which pass through the glass and into special shoulder nuts. The screws and nuts are insulated from the glass with protective bushings. The vent glass closes against a weatherstrip

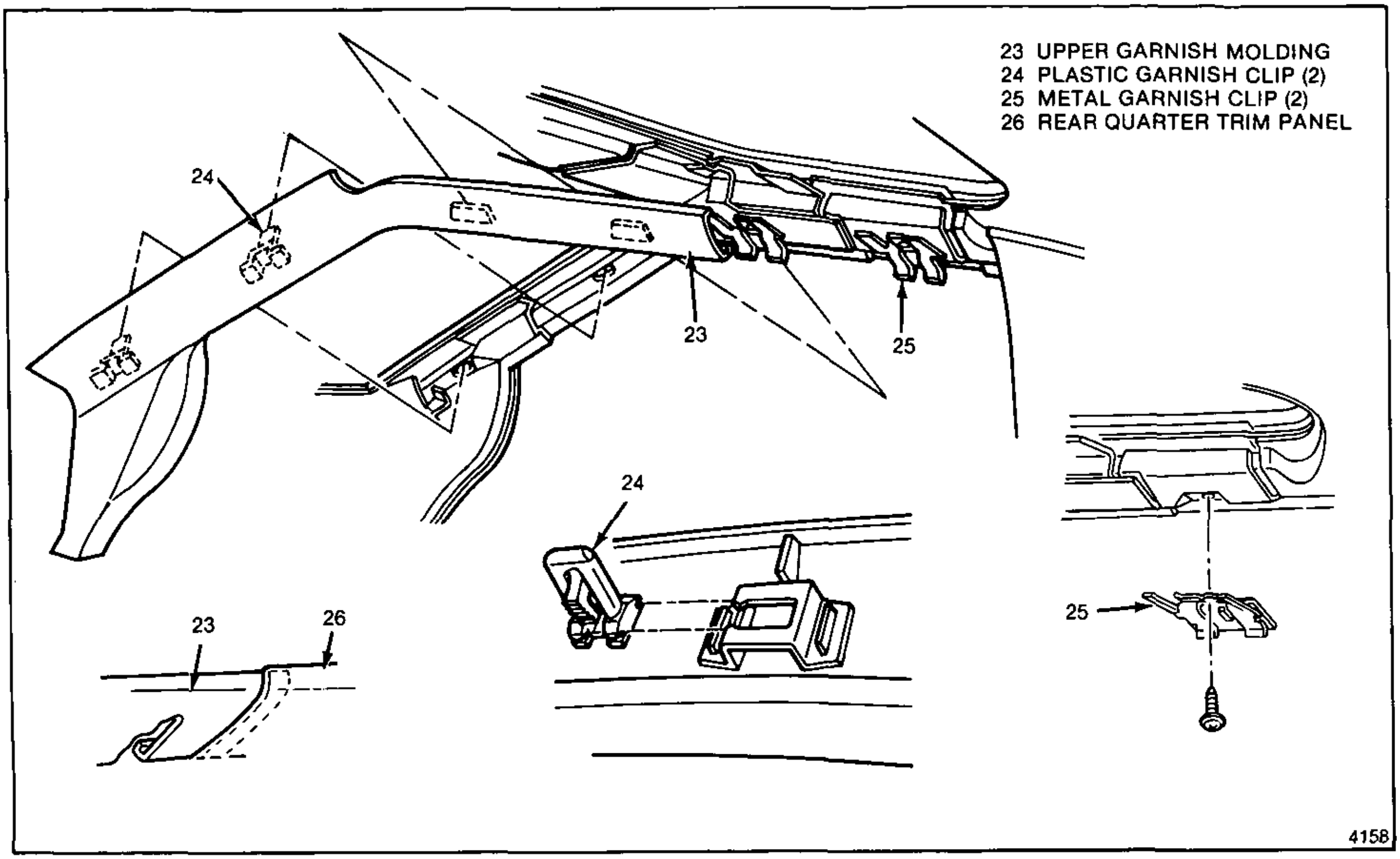


Fig. 8-8-Upper Garnish Molding

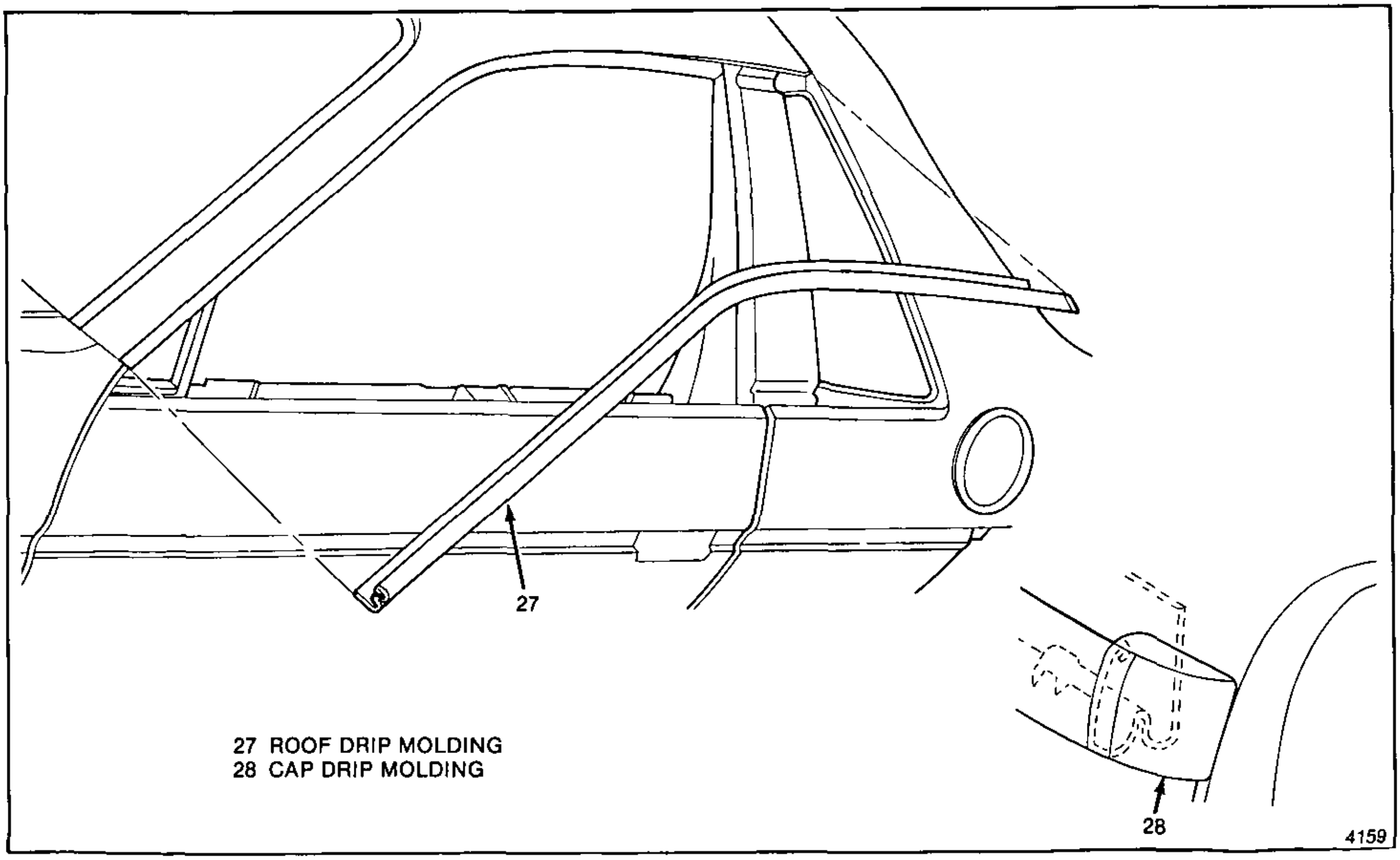


Figure 8-9-Roof Drip Molding

VISTA VENT GLASS AND HARDWARE

If new glass is to be installed, transfer all hardware from original glass to new glass.

Remove or Disconnect (Figure 8-10)

1. Vent glass (29)
2. Glass handle plate (30)
3. Hinge assemblies (31)

Install or Connect (Figure 8-10)

- As per illustration
  - Tighten hinge attaching screws to 5 N·m (3.7 ft.-lbs.).
  - Tighten glass handle plate attaching screws to 6 N·m (4.4 ft.-lbs.).

Adjust (Figure 8-11)

- If glass is high, loosen button assembly attaching nuts (32) and slide a spacer (33) between rear of button assembly (34) and roof panel.

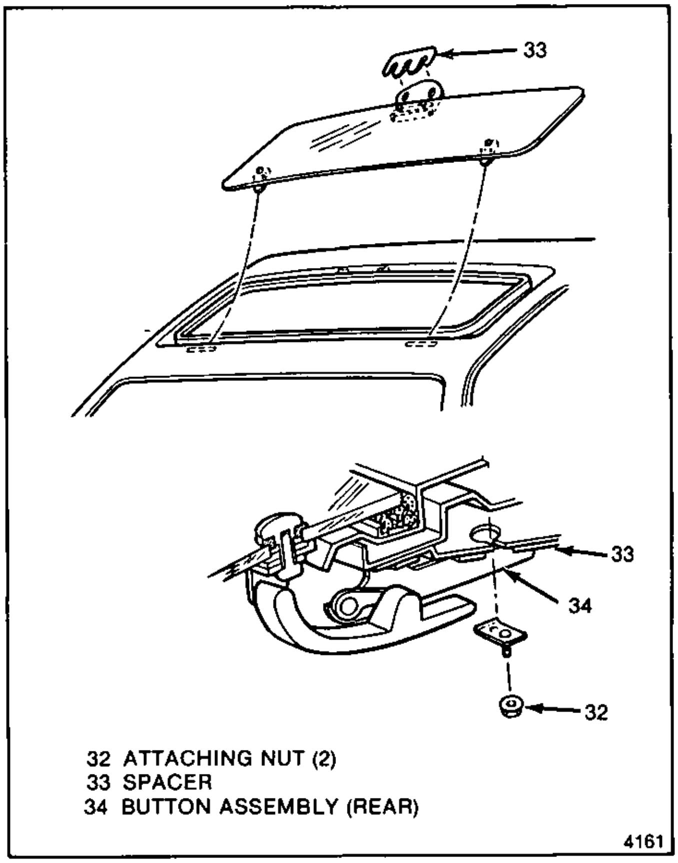
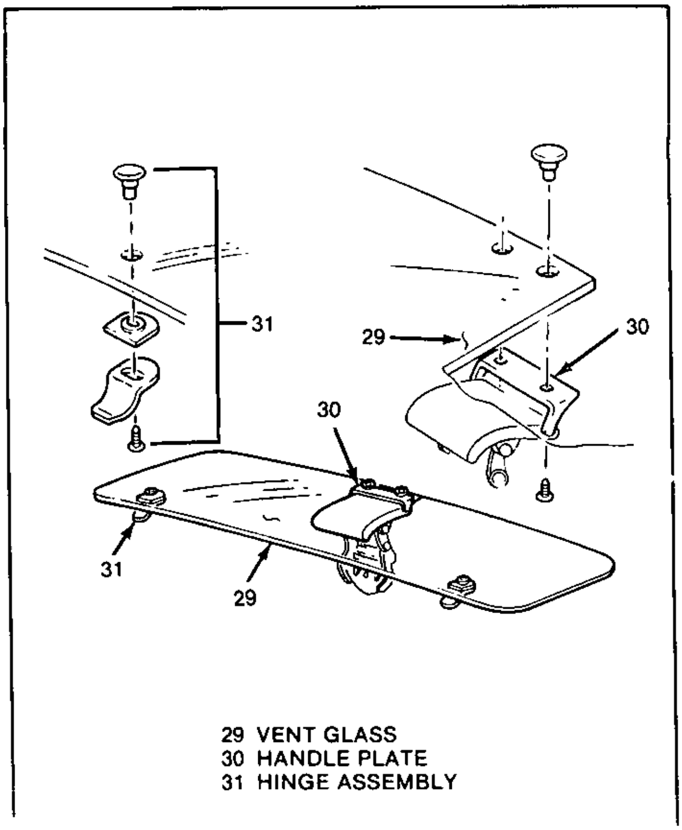


Fig. 8-11-Latch Adjustment

VISTA VENT HEADLINING RETAINER AND FINISHING LACE

Remove or Disconnect (Figure 8-12 and 8-13)

1. Vent glass
2. Escutcheon (36)
3. Button Assembly (37)
4. Finishing lace (38)
5. Retainer (39)



Install or Connect (Figure 8-12 and 8-13)

1. Headlining retainer (39)
   - start at front center of opening and move outboard in both directions
   - tap retainer into place finishing at rear handle location
2. Headlining into retainer (39)
3. Finishing lace (38)
   - start at rear center
   - apply pressure to force lace over retainer from front to rear
4. Button assembly (37)
5. Escutcheon (36)
6. Vent glass

VENT GLASS WEATHERSTRIP

Remove or Disconnect (Figure 8-14)

1. Vent glass
2. Weatherstrip (35)

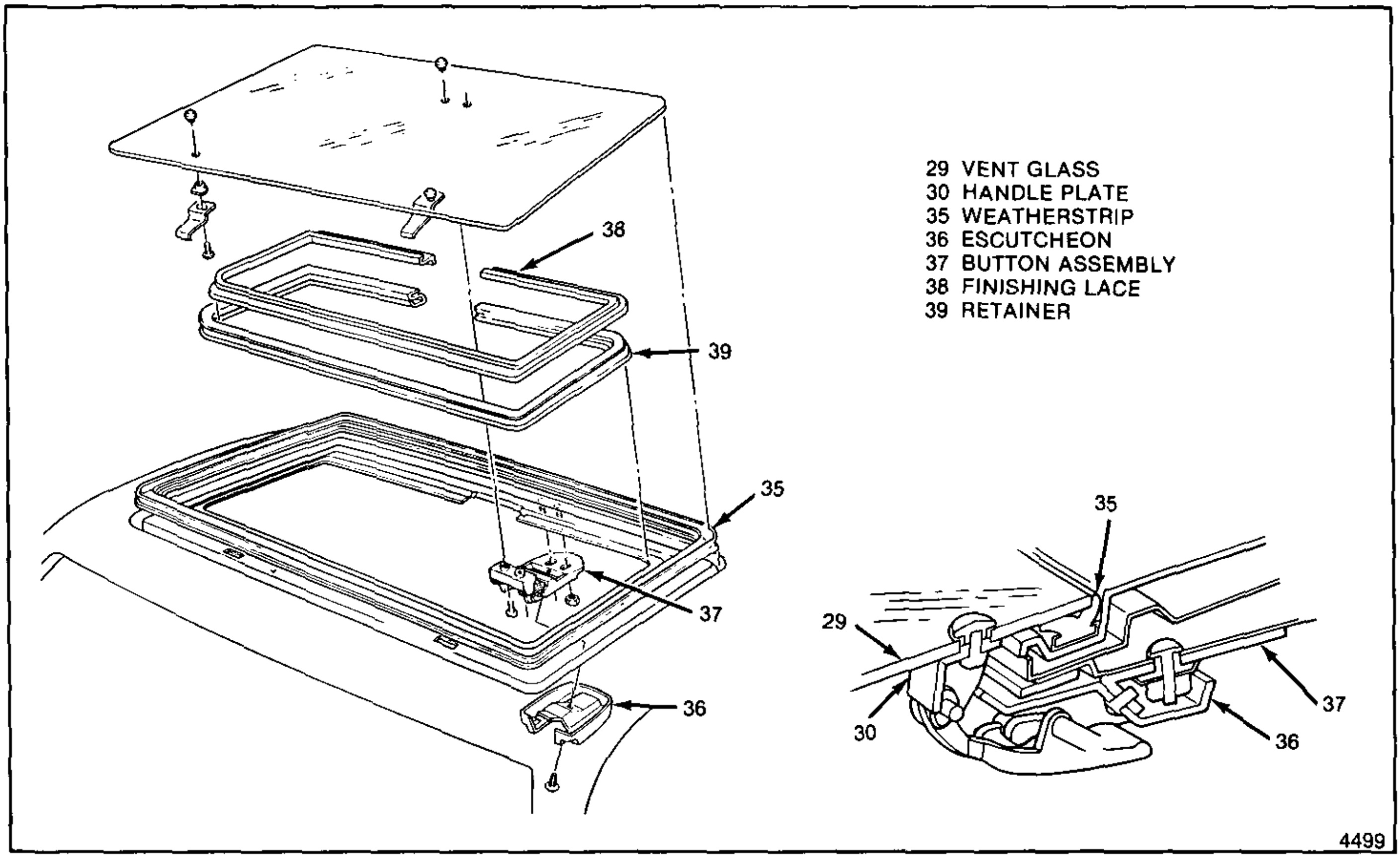


Fig. 8-12-Vista Vent Assembly

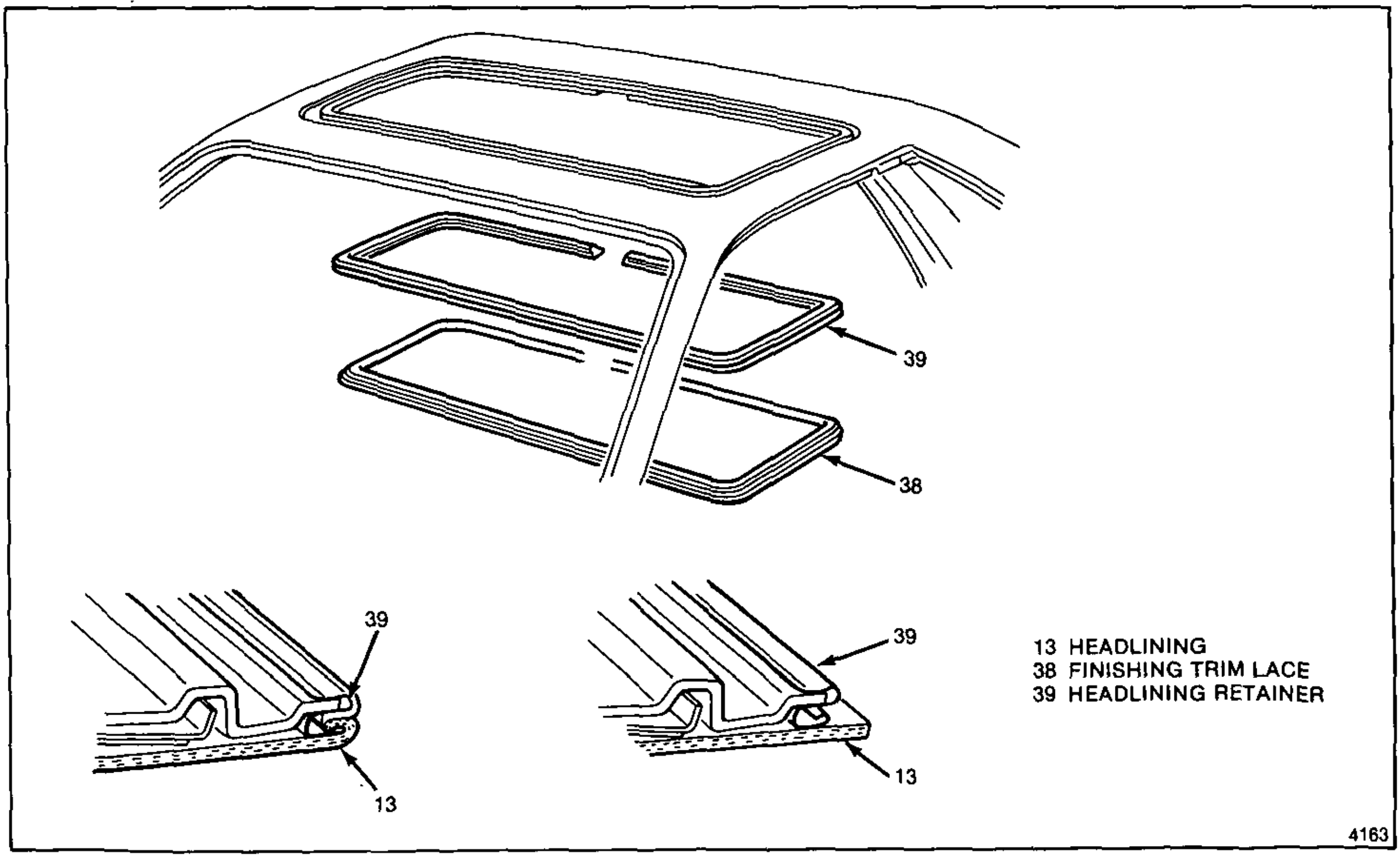


Fig. 8-13-Vista Vent Headlining Retainer Installation

->◇<- Install or Connect (Figure 8-14)

1. Adhesive to gutter (40)
2. Adhesive to weatherstrip (35)
3. Weatherstrip
   - Allow adhesive to become tacky before installation.
4. Apply a bead of adhesive between outboard periphery of weatherstrip and body opening (41) to prevent water seepage. Do not plug drain holes.
5. Watertest — with a soft spray of warm or hot water.

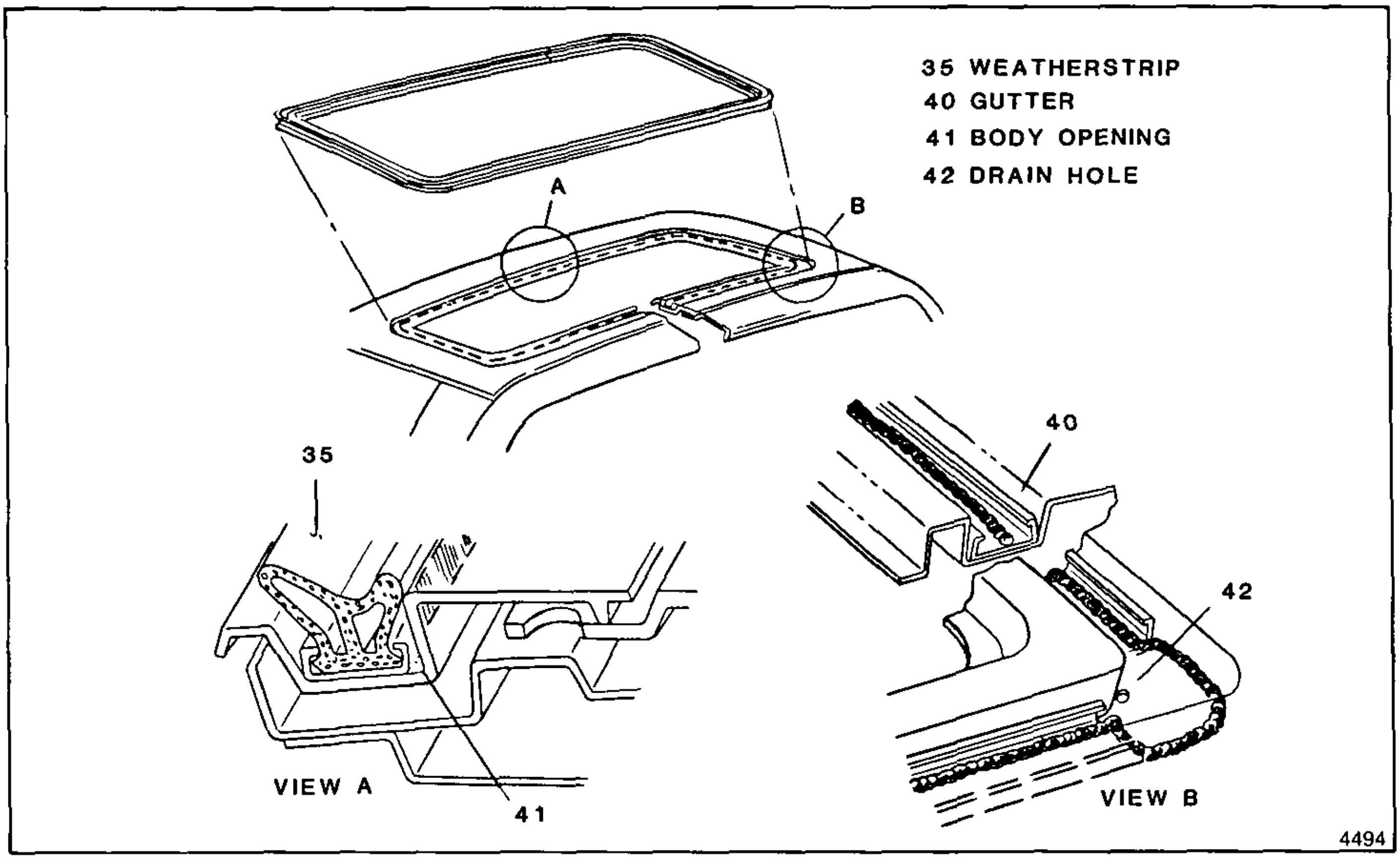


Fig. 8-14-Vista Vent Weatherstrip Installation

SECTION 9

SEATS

NOTICE: All lap, shoulder and seat assembly 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.

CONTENTS

RESTRAINT SYSTEMS

LAP AND SHOULDER BELTS

The 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 a 4-to-8 second interval.

The single loop belt system consists of a single continuous length of webbing. The webbing is routed from the anchor (at the rocker panel), through a self-locking latch plate (at the buckle), around the guide assembly (at the top of the center pillar or quarter panel) and into a retractor in the lower area of the center pillar or quarter inner. The emergency locking feature of the retractor remains unlocked to allow free movement of the occupant's upper body while the vehicle is being operated. When the vehicle decelerates or changes direction abruptly, the single loop belt(s) 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. Whenever the occupant's door is opened, the comfort lock is automatically unlocked so the webbing can fully retract to the stowed position. This is controlled by the comfort lock plunger located at the lower front side of the center or lock pillar.

When servicing or replacing lap and shoulder belts of the single loop system, refer to the following *precautionary items:*

- Lap and shoulder belts will be serviced as follows:
  1. Retractor portion of lap and shoulder belt for passenger and driver.
  2. Buckle portion of seat lap belt for passenger and driver.
- Keep sharp edges and damaging objects away from belts.
- Avoid bending or damaging any portion of the belt buckle or latch plate.
- Do not bleach or dye belt webbing (clean with mild soap solution and water).
- When installing lap or shoulder belt anchor bolts, start bolt by hand to assure that bolt is threaded straight.
- Do not attempt repairs on lap or shoulder belt retractor mechanisms or belt retractor covers. Replace with new service replacement parts.
- Refer to Figures 9-1 through 9-4 and tighten **all** seat and shoulder belt anchor bolts as specified.

Comfort Lock Operational Checks and Requirements

Important

The shoulder belt comfort lock feature must function as follows:

- With the door closed, extend the webbing from the retractor to a distance approximating buckled position.
- Let the belt retract a minimum of 178 mm (7").

- Extract the belt from 25 mm to 76 mm (1″ to 3″) and release the belt. The comfort lock must engage and prevent retraction.
- 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.
- Extract belt 178 mm (7″) and release. The belt must fully retract without locking.

Remove or Disconnect (Figures 9-1, 9-2)

1. Rocker anchor plate (1)
2. Trim cover (2) and upper guide anchor plate (3)
3. Rear quarter trim panel
4. Belt warning harness connector (4) from belt warning connector (5)
5. Retractor (6)
6. Seat lap belt (7)

Install or Connect (Figure 9-1, 9-2)

1. Seat lap belt (7)
2. Retractor (6)

   Tighten

   Retractor and lap belt attaching bolts from 35 to 48 N·m (26 to 35 ft-lb)
3. Belt warning harness connector (4) to belt warning connector (5)
4. Rear quarter trim panel
5. Upper guide loop anchor plate (3)

   Tighten

   Upper anchor plate bolt from 35 to 48 N·m (26 to 35 ft-lb)
6. Trim cover (2)
7. Pull upper belt inboard so that the stitched sew stop is exposed and beyond the guide loop anchor plate (3).
8. Rocker anchor plate (1)

   Tighten

   Rocker anchor plate bolt from 35 to 48 N·m (26 to 35 ft-lb.)

CHILD SEAT TOP STRAP ANCHOR

If use of a child seat is desired, a special dealer-installed anchor must be used to secure the child seat top strap. The following instructions explain how to install the anchor for the child seat top strap.

Top Strap Anchor (Fig. 9-3)

All hardware discussed should be available from the child seat manufacturer. Be sure the child seat position does not conflict with any additional requirements provided by its manufacturer, or with any recommendations in the Child Restraint section of the Owner's Manual.

2. Position passenger seat full forward.
3. Using the 2-1/2″ washer, locate the washer as shown in view A and mark the center of the washer hole.

   Important

   Washer should be located in upper corner of triangle formed by battery bracket (1) and stiffener bead (2).
4. Drill a 9 mm (11/32″) hole as marked in step #3 through engine compartment forward panel.

   CAUTION: Any holes penetrating to the exterior of the vehicle must be sealed to prevent carbon monoxide from entering the vehicle. Suitable sealers include silicone, butyl or acrylic type caulking. In the event that the child seat anchor bracket is removed, the bolt hole penetrating to the exterior of the vehicle must be resealed.
5. Apply body sealer (5) around engine compartment side of 9 mm (11/32″) hole.
6. Install top strap anchor bracket (4), bolt (3), washer (6) and locknut (7). Tighten locknut.
7. Replace battery.

SEATS

The 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 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.

RECLINING SEATBACK

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. The inner hinge arm attaching bolt acts only as a point of rotation for the seatback.

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.

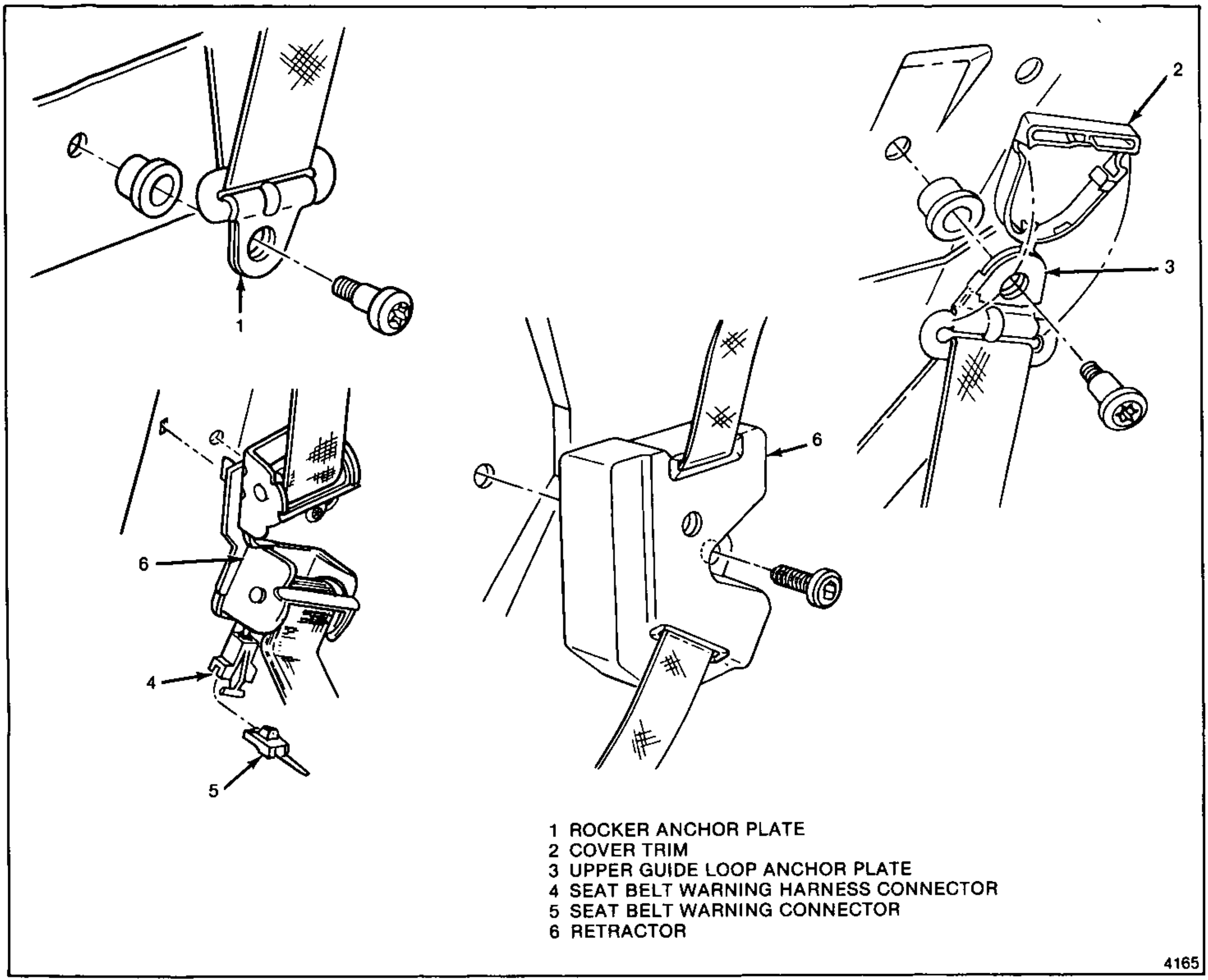


Fig. 9-1-Single Loop Belt System

RECLINER CONTROL MECHANISM

Remove or Disconnect (Figure 9-4)

1. Place seatback in full-up position
2. Recliner mechanism cover bolts (8)
3. Recliner mechanism cover (9)
4. Recliner control mechanism (10)

Install or Connect (Figure 9-4)

1. Seatback in full-up position
2. Recliner control mechanism (10)
3. Recliner mechanism cover (9)
4. Recliner mechanism cover bolts (8)

SEATBACK ASSEMBLY

Remove or Disconnect (Figure 9-4)

1. Seat assembly
2. Recliner mechanism cover (9) and attaching bolt (8)
3. Inner hinge arm attaching bolt (11)
4. Seatback

Install or Connect (Figure 9-4)

1. Seatback
2. Inner hinge arm attaching bolt (11)
3. Recliner mechanism cover bolts (8) and cover (9)
4. Seat assembly

Inspect

- For proper operation
- Ease of lever operation and seatback movement
- Positive locking action
- Release lever should always return to normal position.

SEAT TORQUE SPECIFICATIONS

The following torque specifications should be used when servicing seat assemblies.

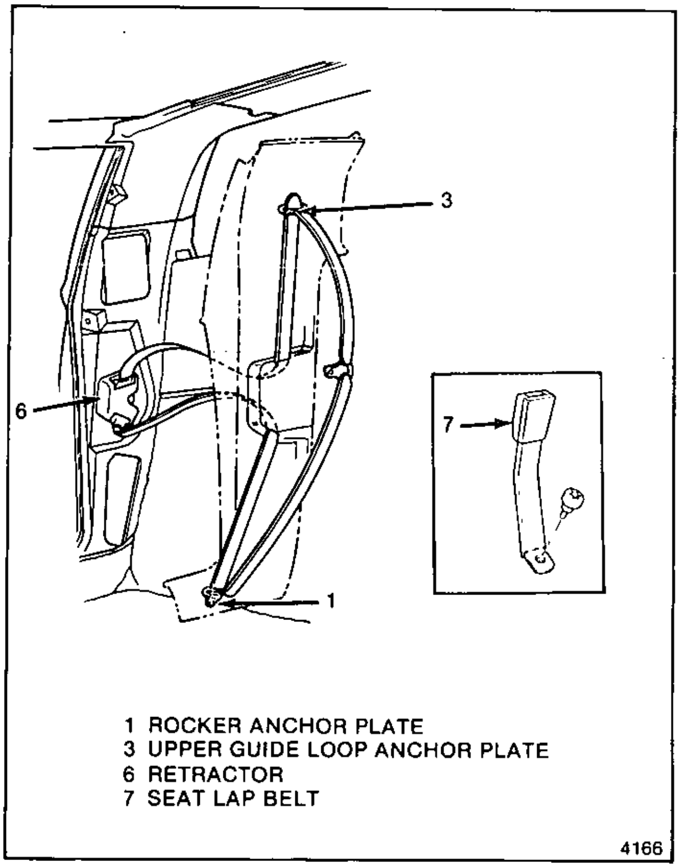


Fig. 9-2-Retractor Assembly

Bolt or Nut Location and Torque

Many service replacement assemblies such as seat cushion and back frame assemblies 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 (metric bolts and nuts are color coded blue). Apply 67 to 89 newtons (15 to 20 pounds) of straight-in pressure to start thread forming action of bolt into an unthreaded nut (Figure 9-5).

NOTICE: See Notice on page 9-1 of this section.

- Seat adjuster-to-floor pan nuts (8 mm #11500401) - 20 to 28 N·m (15 to 21 ft-lb)
- Seat adjuster-to-seat frame bolts (8 mm x 20 mm #2009759) - 20 to 28 N·m (15 to 21 ft-lb)
- Front seatback frame to recliner mechanism - 20 to 28 N·m (15 to 21 ft-lb)
- Seatback inner pivot hinge arm to seat cushion frame - 20 to 28 N·m (15 to 21 ft-lb)
- Retractor seat belt bolt to quarter inner panel - 35 to 48 N·m (26 to 35 ft-lb), type 2 bolt
- Seat buckle side belt to body 35 to 48 N·m (26 to 35 ft-lb), type 8 bolt
- Rocker anchor plate to body side frame - 35 to 48 N·m (26 to 35 ft-lb), type 7 bolt

Seat Adjustments 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 towards 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:

- Hard or slow operation due to adjusters not being parallel with each other.
- Seat assembly slightly too far to right or left.

SEAT ADJUSTER CONTROL ARM KNOB

Manual seat adjuster control arm knobs are a press fit on the adjuster control arm. If removing or installing a control knob or a trimmed seat assembly, place a protective cover over trim material in area of knob.

Remove or Disconnect (Figure 9-6)

Using a body spoon (12) and locking pliers (13), pry off knob.

Install or Connect

1. Make a pencil mark on seat adjuster to use as a guide for full depth.
2. Secure locking pliers to control arm below pencil line
3. Insert knob (14) and press firmly while holding restraint with locking type pliers. If necessary use rubber mallet or 4″ C clamp.

SEAT ASSEMBLY

Seat assemblies are secured to the floor pan by nuts installed into weld studs on the floor pan anchor plate studs.

The 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 to permit horizontal travel of the seat. When the seat is in the desired position and the locking lever is released, the seat is locked. See Diagnosis Chart.

Remove or Disconnect (Figure 9-7)

1. Move seat to forward position
2. Adjuster-to-floor pan rear attaching nuts (15)
3. Move seat to rearward position
4. Adjuster-to-floor pan front attaching nuts (16)
5. Seat assembly (17)

Install or Connect (Figure 9-7)

1. Seat assembly (17)
2. Move seat to rearward position
3. Adjuster-to-floor pan front attaching nuts (16)

Tighten

Front floor pan nuts (16) from 20 to 28 N·m (15

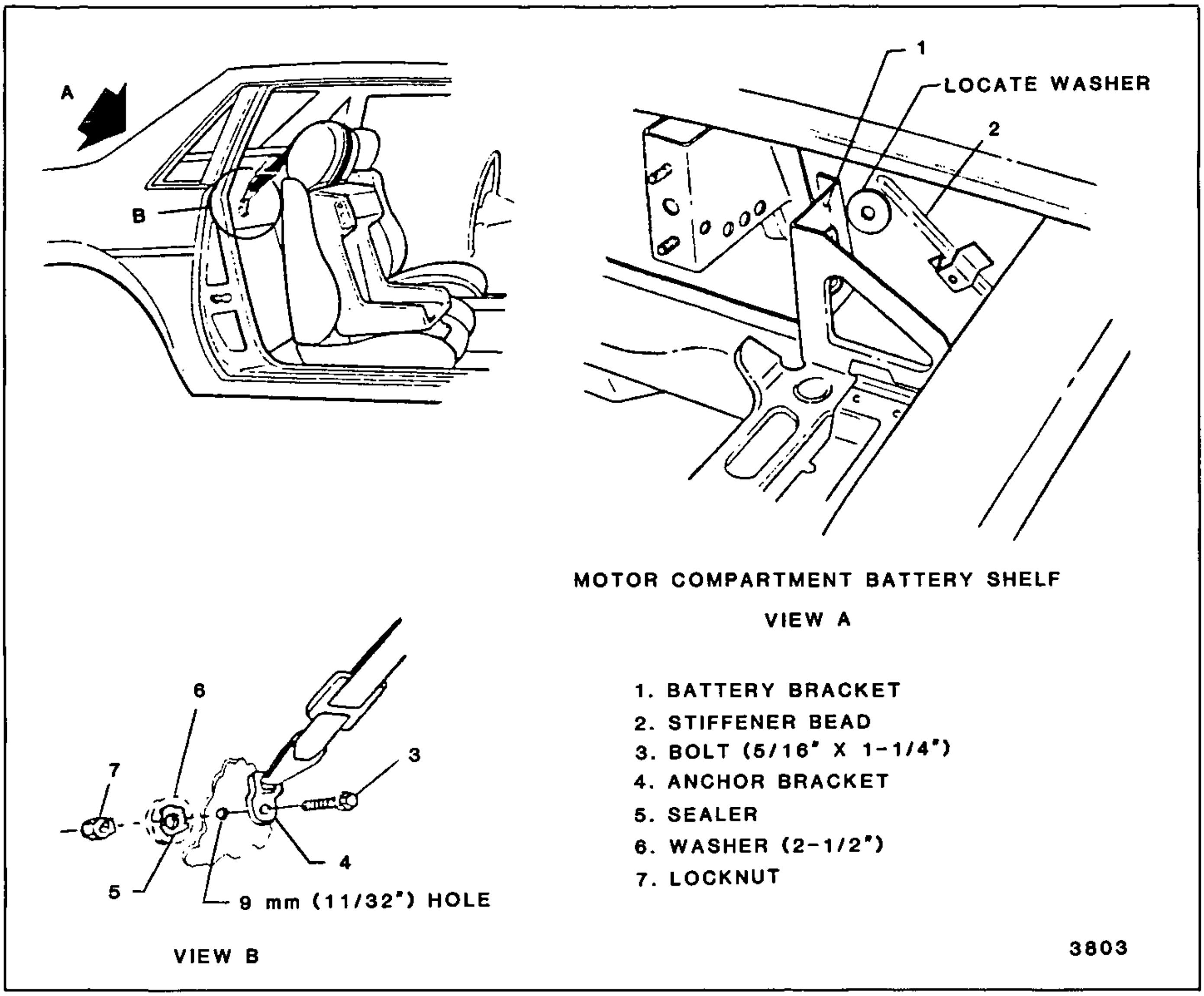


Fig. 9-3-Top Strap Anchor Installation

5. Adjuster-to-floor pan rear attaching nuts

Tighten

Rear floor pan nuts (15) from 20 to 28 N·m (15 to 21 ft-lb)

Inspect

For proper operation of seat assembly

SEAT ADJUSTER ASSEMBLY

Remove or Disconnect (Figure 9-7)

1. Seat assembly with adjuster attached and place upside down on a clean surface
2. Adjuster-to-seat bottom frame front and rear attaching bolts (18)
3. Seat adjuster (19) from seat

Install or Connect (Figure 9-7)

1. Seat adjuster (19) to seat
2. Adjuster-to-seat bottom frame, front and rear attaching bolts (18)

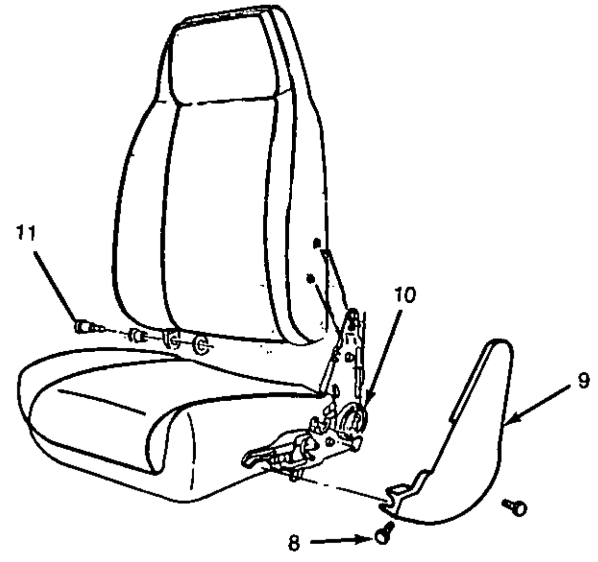
Tighten

Adjuster-to-seat bolts (18) from 20 to 28 N·m (15 to 21 ft-lb)

3. Seat assembly (17)

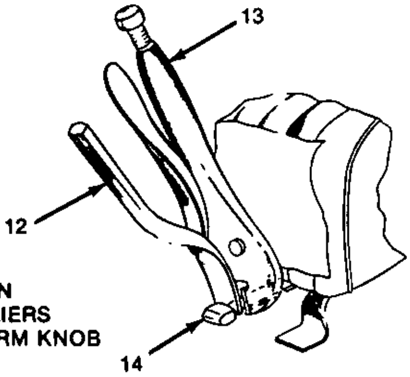
Inspect

For proper operation of seat adjuster assembly



8 RECLINER MECHANISM COVER BOLT (2)
9 RECLINER MECHANISM COVER
10 RECLINER MECHANISM
11 INNER HINGE ARM ATTACHING BOLT

Fig. 9-4-Recliner Mechanism



12 BODY SPOON
13 LOCKING PLIERS
14 CONTROL ARM KNOB

Fig. 9-6-Seat Adjuster Control Knob

	PART NAME	METRIC TYPE	THREAD	LENGTH (mm)	TORQUE	
					N·m	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 ON PAGE 9-1

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Fig. 9-5-Seat Belt Fastener Chart

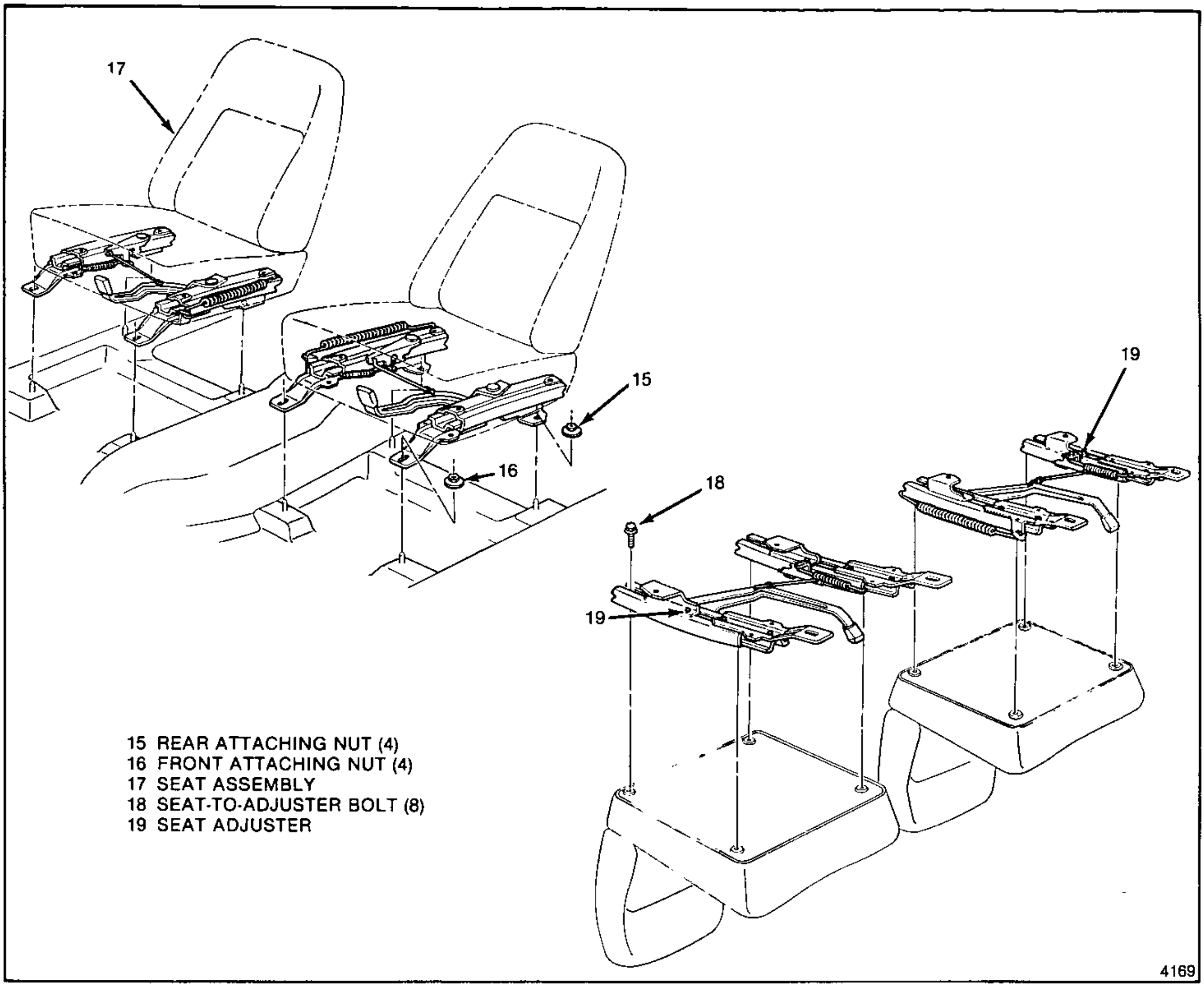


Fig. 9-7-Seat Assembly

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.
	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.
4. 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 bolts or nuts.

SECTION 10

ELECTRICAL

CONTENTS

REAR WINDOW DEFOGGER

The optional rear window defogger system consists of a glass containing horizontally positioned ceramic, silver compound element lines and vertical bus bars baked into the inner surface during the glass forming operation. Braided wire is soldered to the bus bars on each side of the glass. The feed wire terminal is soldered to the bus bar. The lead wires (stranded, round wire) are spliced to the braided wire and are covered with an extruded plastic sleeve to insulate them from body metal.

The defogger operates on 12 volts with a current draw of approximately 9 amps when the glass is at 24°C (75°F). 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 rear window will vary with such conditions as vehicle speed, outside glass temperature, atmospheric pressure, and number of passengers.

This system is activated by an instrument panel mounted switch with an integral indicator lamp. A timer module is also used to control the time of heated glass operation.

The system will operate approximately ten minutes after activation and is automatically turned off by the timer module. The system can also be turned off during this operating period by turning either the instrument panel mounted switch or ignition switch to off.

Refer to Section 8A in the chassis portion of this manual for complete circuit diagrams on this system.

Testing Grid Lines

To locate inoperative grid lines, start the 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 10-1 illustrates the pattern of test lamp brilliance to be expected with a properly functioning grid.

If the test lamp bulb shows full brilliance at both ends of grid lines, check for a loose ground wire contact to body metal.

The range zones in Figure 10-1 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.

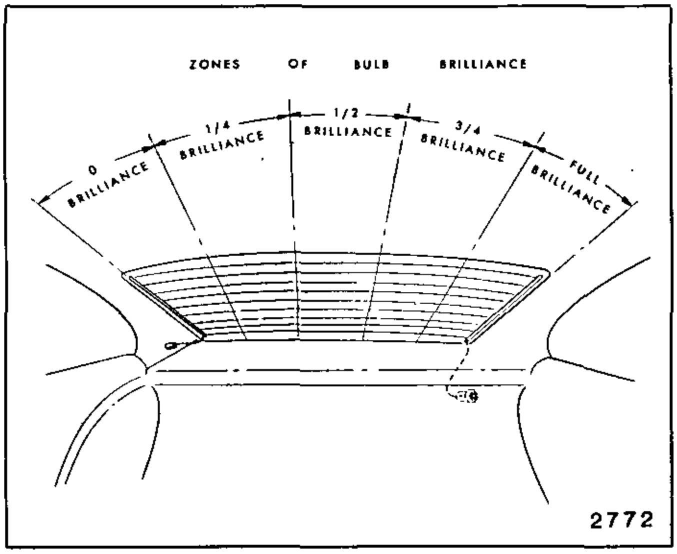


Fig. 10-1-Test Lamp Bulb Brilliance Zones - Normal Operating Rear Window Defogger

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 inches either side of the glass centerline. If an abnormal light reading is apparent on a specific grid line, place the test lamp prod on that grid at the left bus bar and move the prod toward the right bus bar until the test light goes out indicating a break in the continuity of the grid line (Fig. 10-2).

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

Inspect

- Rear window defogger grid lines.
- Mark grid line breaks on outside of glass with grease pencil.

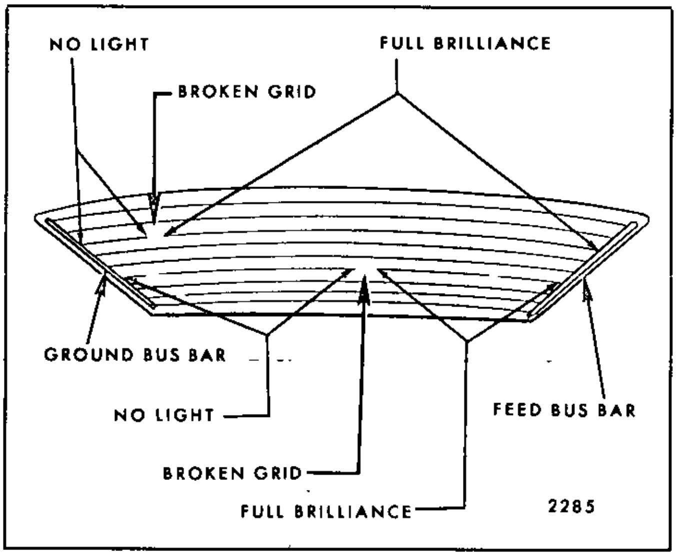


Fig. 10-2-Test Lamp Bulb Brilliance with Broken Grid Lines

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 (Figures 10-3 and 10-4)

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 1 to 2 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.

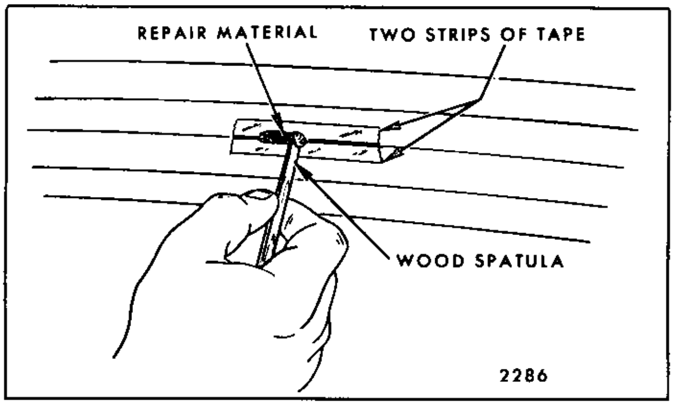


Fig. 10-3-Applying Repair Material to Broken Grid Line

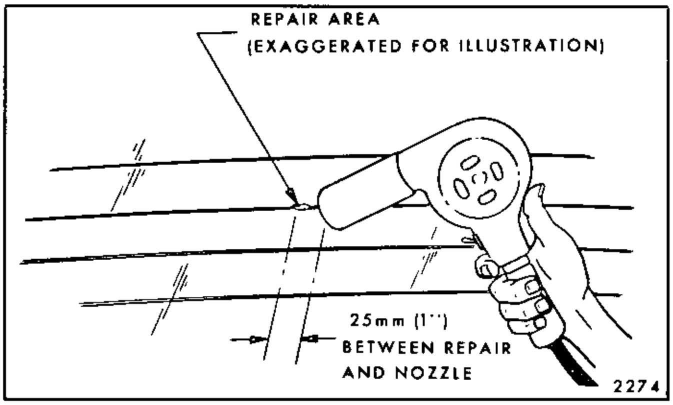
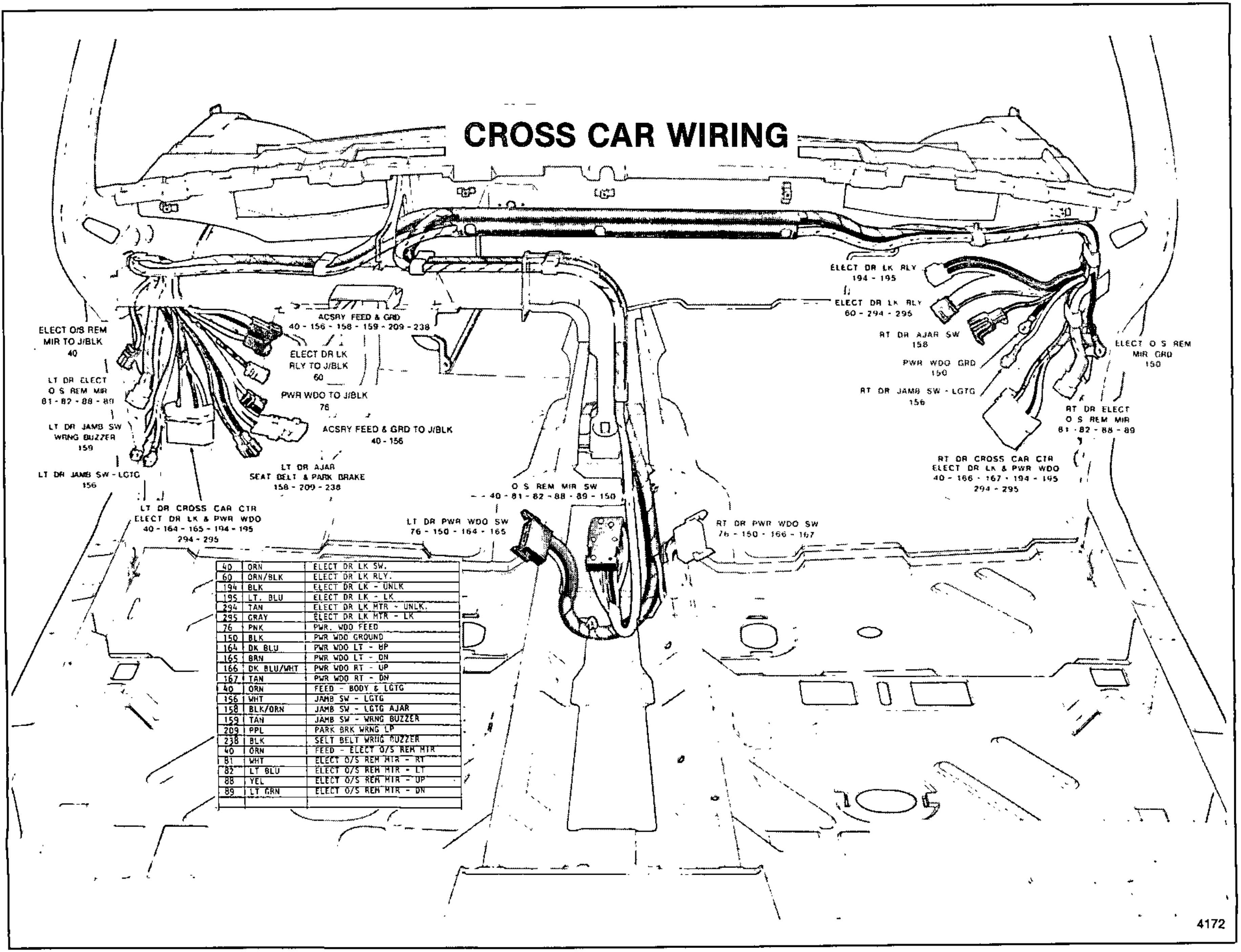


Fig. 10-4-Applying Heat to Grid Line Repair

Braided Wire Lead Repair

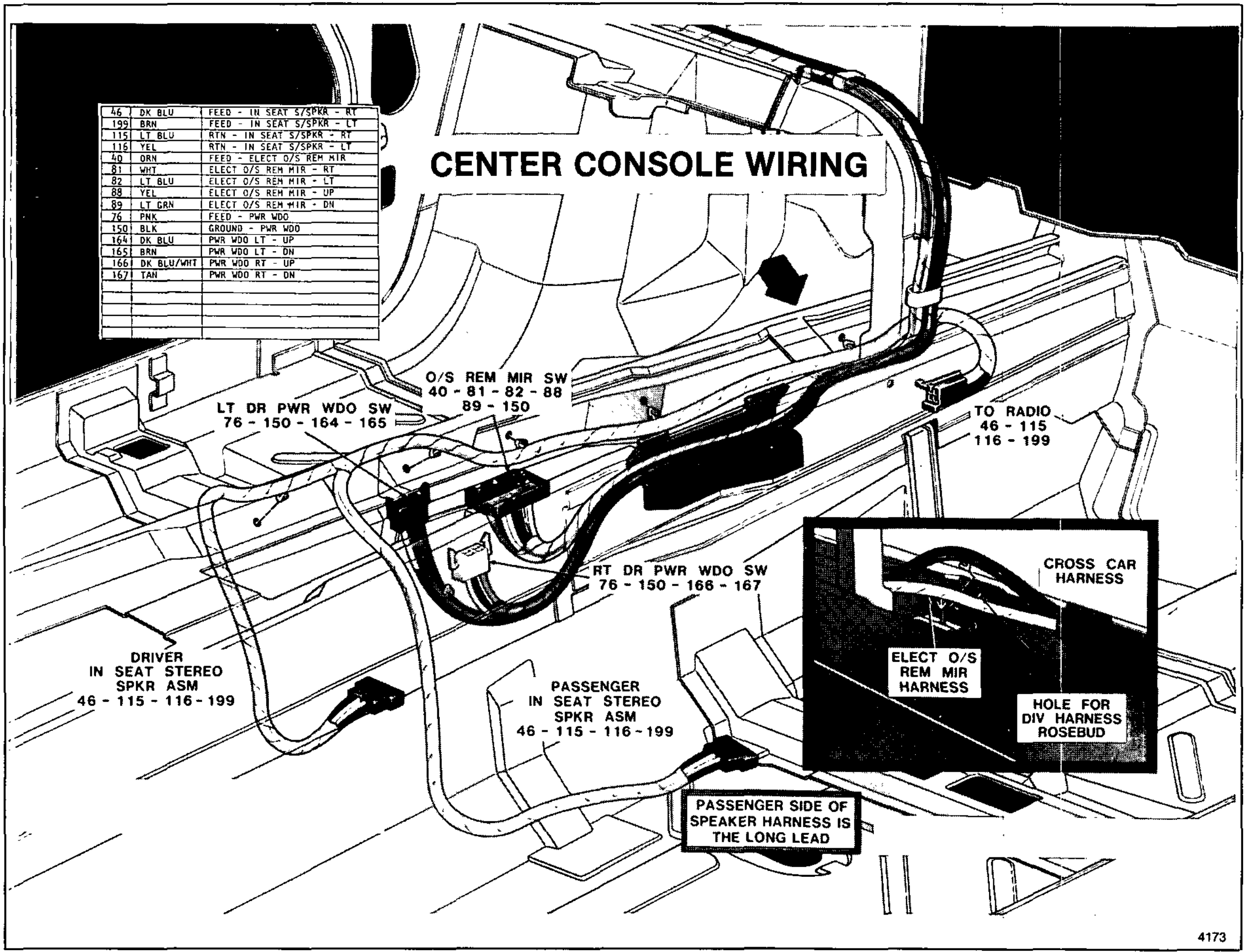
The rear defogger bus bar lead wire can be reattached by resoldering using a solder containing 3% silver and a rosin flux paste.

- 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

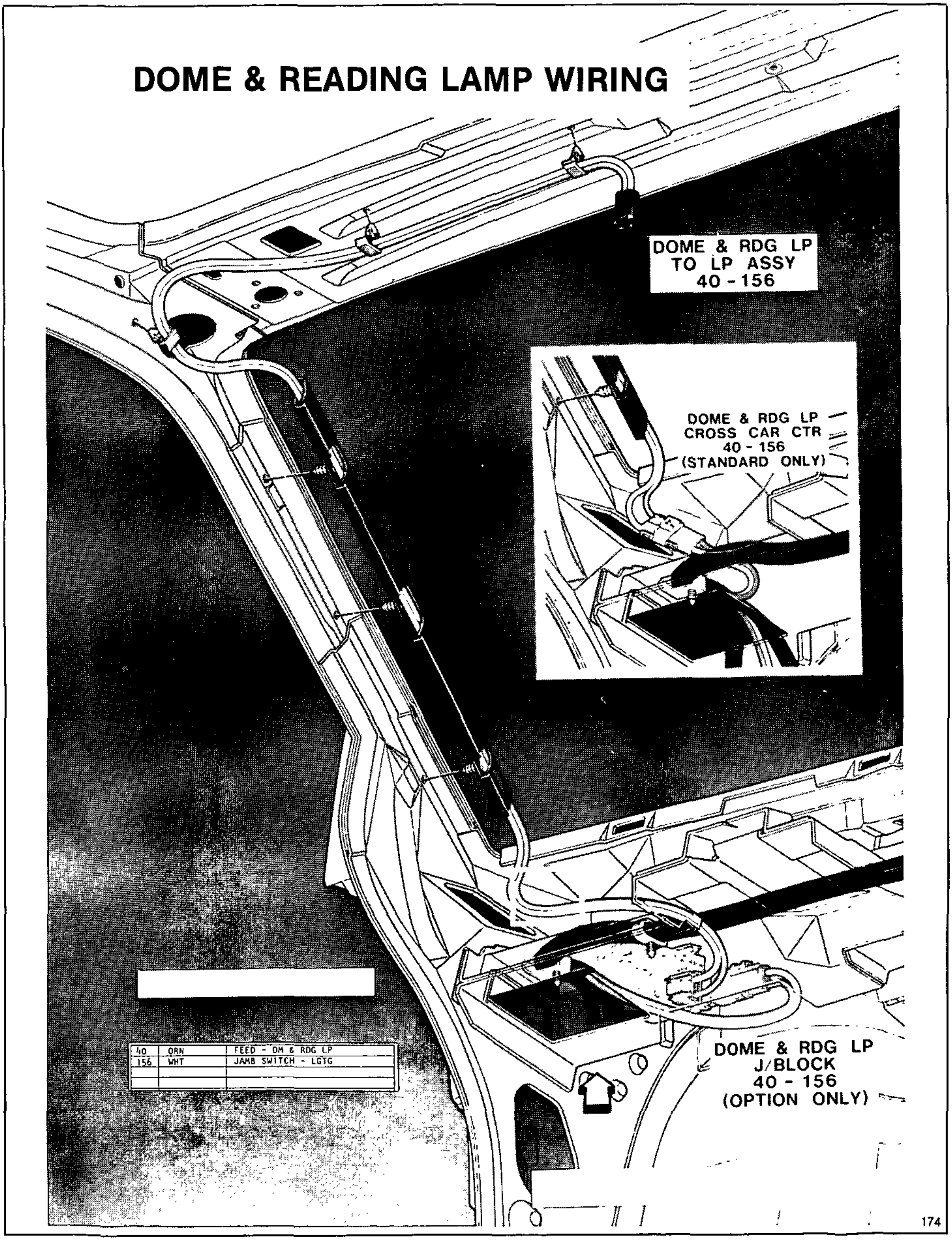


40	ORN	ELECT DR LK SW.
60	ORN/BLK	ELECT DR LK RLY.
194	BLK	ELECT DR LK - UNLK
195	LT. BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK.
295	GRAY	ELECT DR LK MTR - LK
76	PNK	PWR. WDO FEED
150	BLK	PWR WDO GROUND
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
166	DK BLU/WHT	PWR WDO RT - UP
167	TAN	PWR WDO RT - DN
40	ORN	FEED - BODY & LGTG
156	WHT	JAMB SW - LGTG
158	BLK/ORN	JAMB SW - LGTG AJAR
159	TAN	JAMB SW - WRNG BUZZER
209	PPL	PARK BRK WRNG LP
238	BLK	SELT BELT WRNG BUZZER
40	ORN	FEED - ELECT O/S REM MIR
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN

Fig. 10-5-Cross Car Wiring



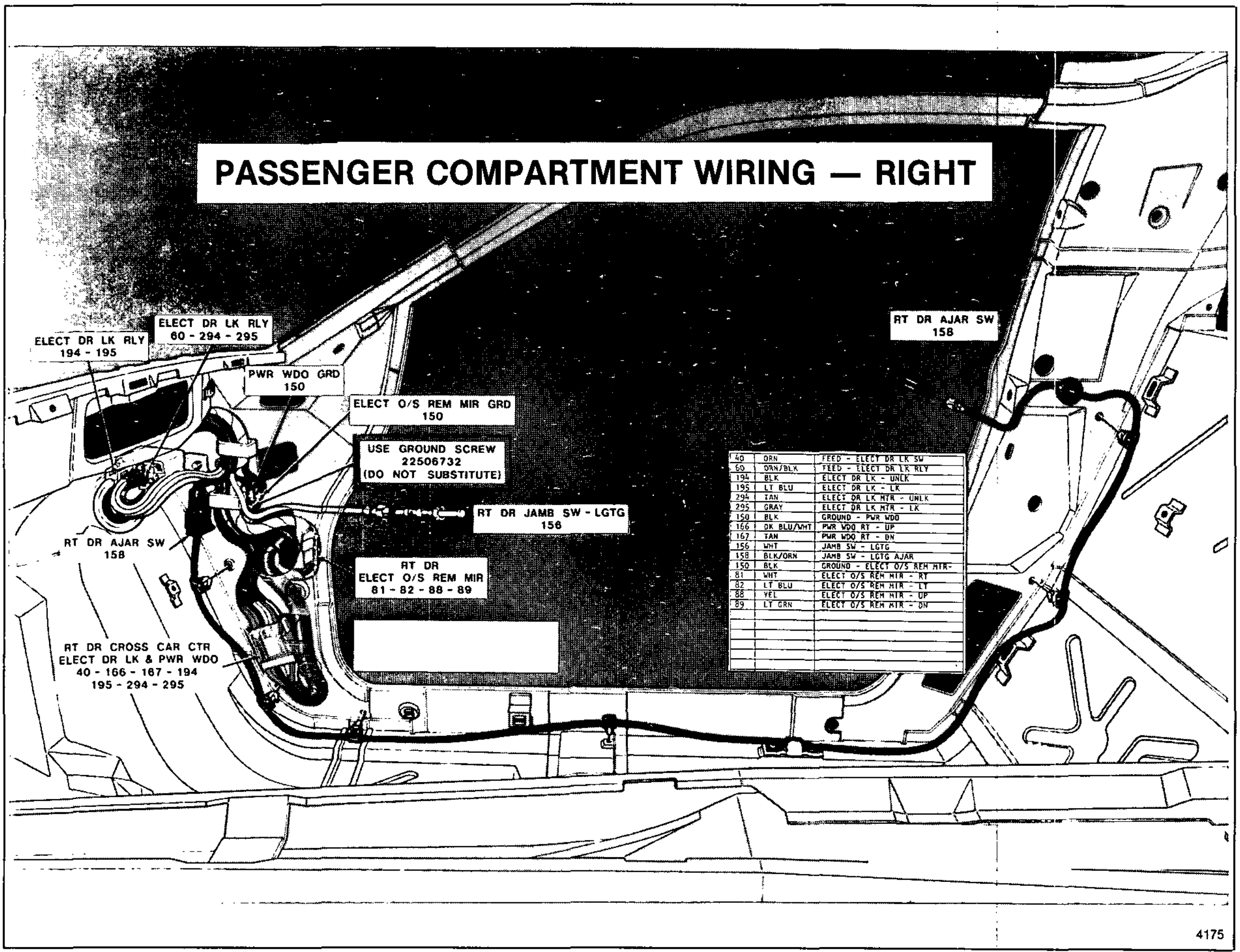
46	DK BLU	FEED - IN SEAT S/SPKR - RT
199	BRN	FEED - IN SEAT S/SPKR - LT
115	LT BLU	RTN - IN SEAT S/SPKR - RT
116	YEL	RTN - IN SEAT S/SPKR - LT
40	ORN	FEED - ELECT O/S REM MIR
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
166	DK BLU/WHT	PWR WDO RT - UP
167	TAN	PWR WDO RT - DN



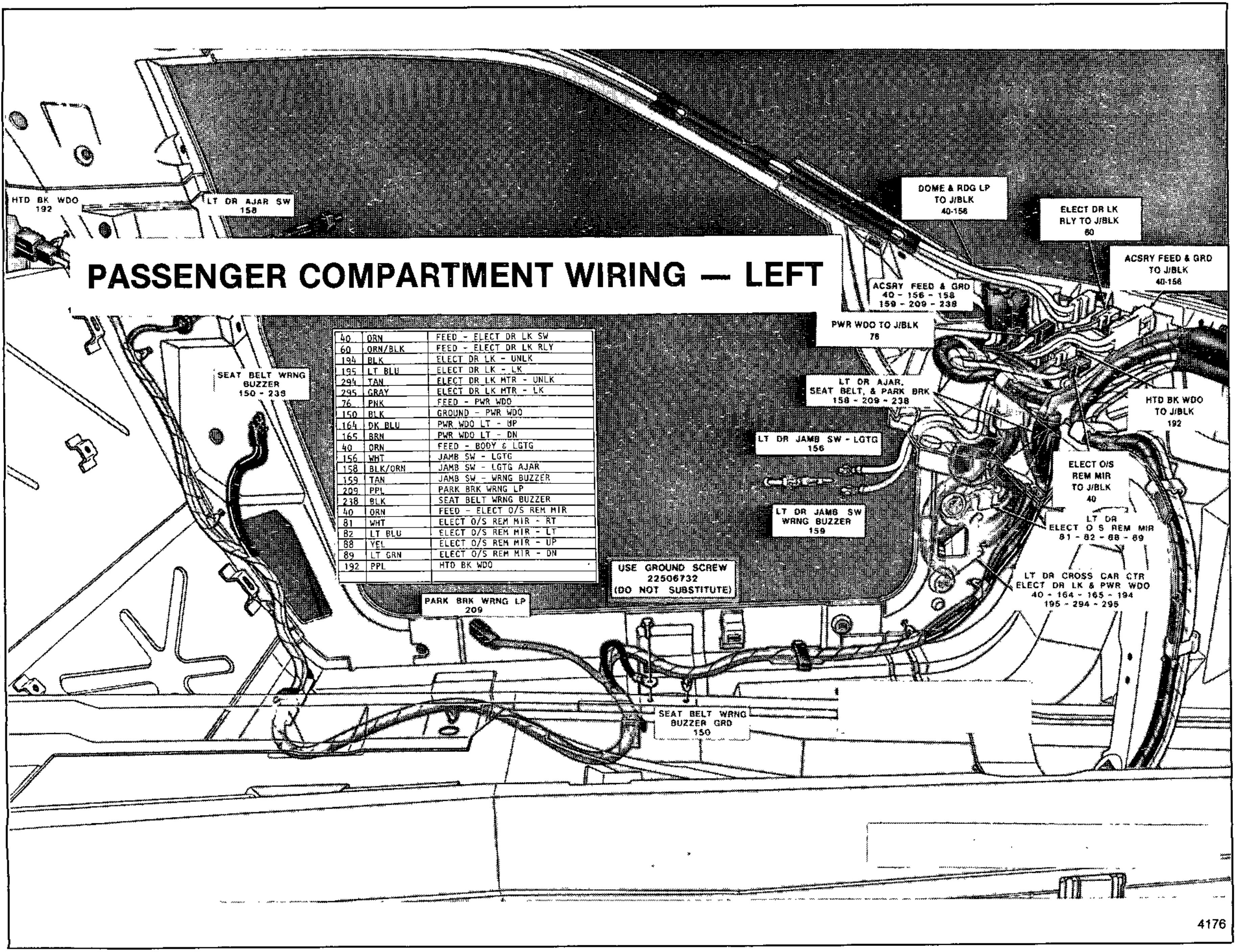
40	ORN	FEED - DM & RDG LP
156	WHT	JAMB SWITCH - LGTG

Fig. 10-7-Dome and Reading Lamp Wiring

PASSENGER COMPARTMENT WIRING — RIGHT

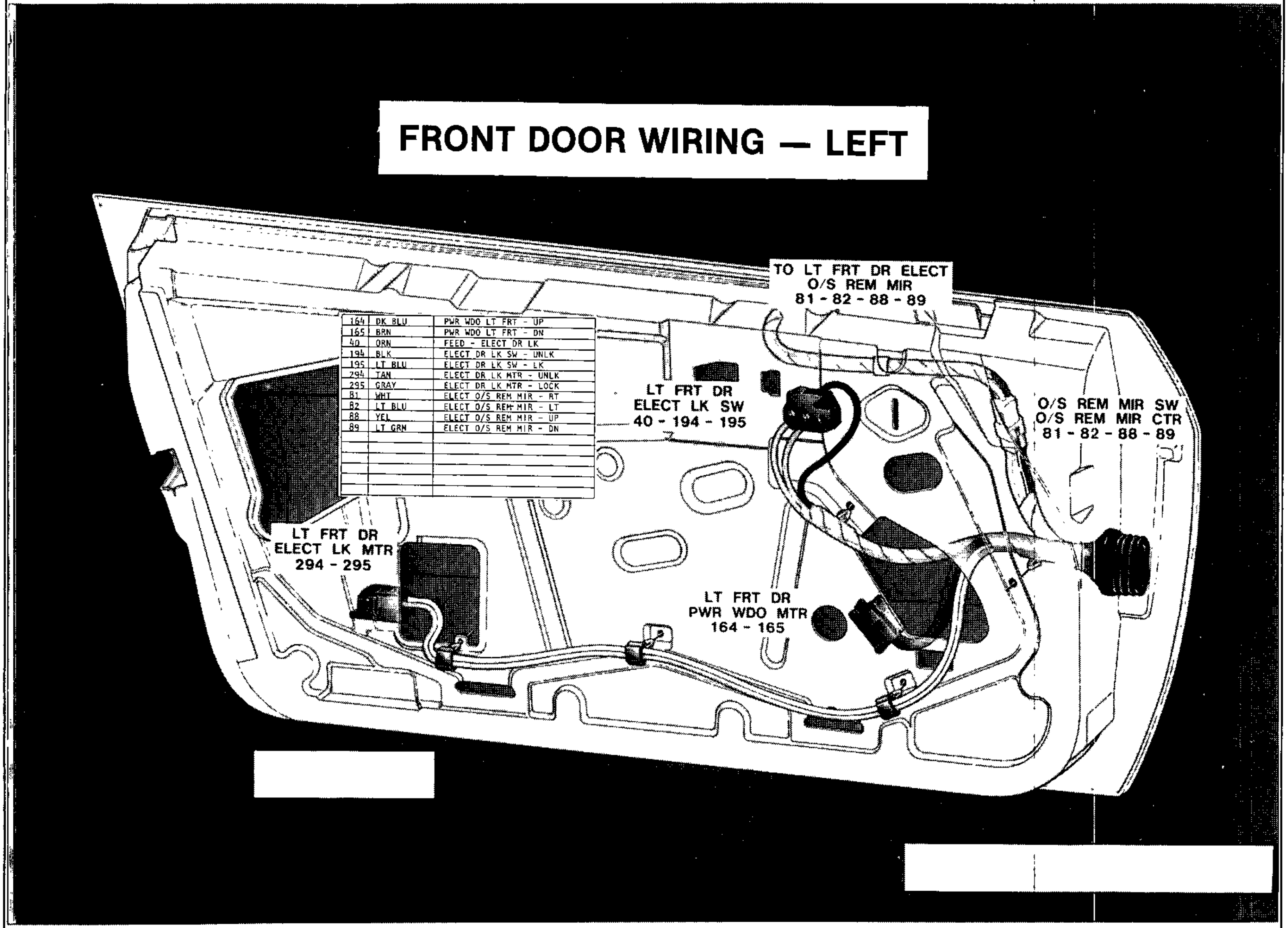


40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
150	BLK	GROUND - PWR WDO
166	DK BLU/WHT	PWR WDO RT - UP
167	TAN	PWR WDO RT - DN
156	WHT	JAMB SW - LGTG
158	BLK/ORN	JAMB SW - LGTG AJAR
150	BLK	GROUND - ELECT O/S REM MIR-
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN



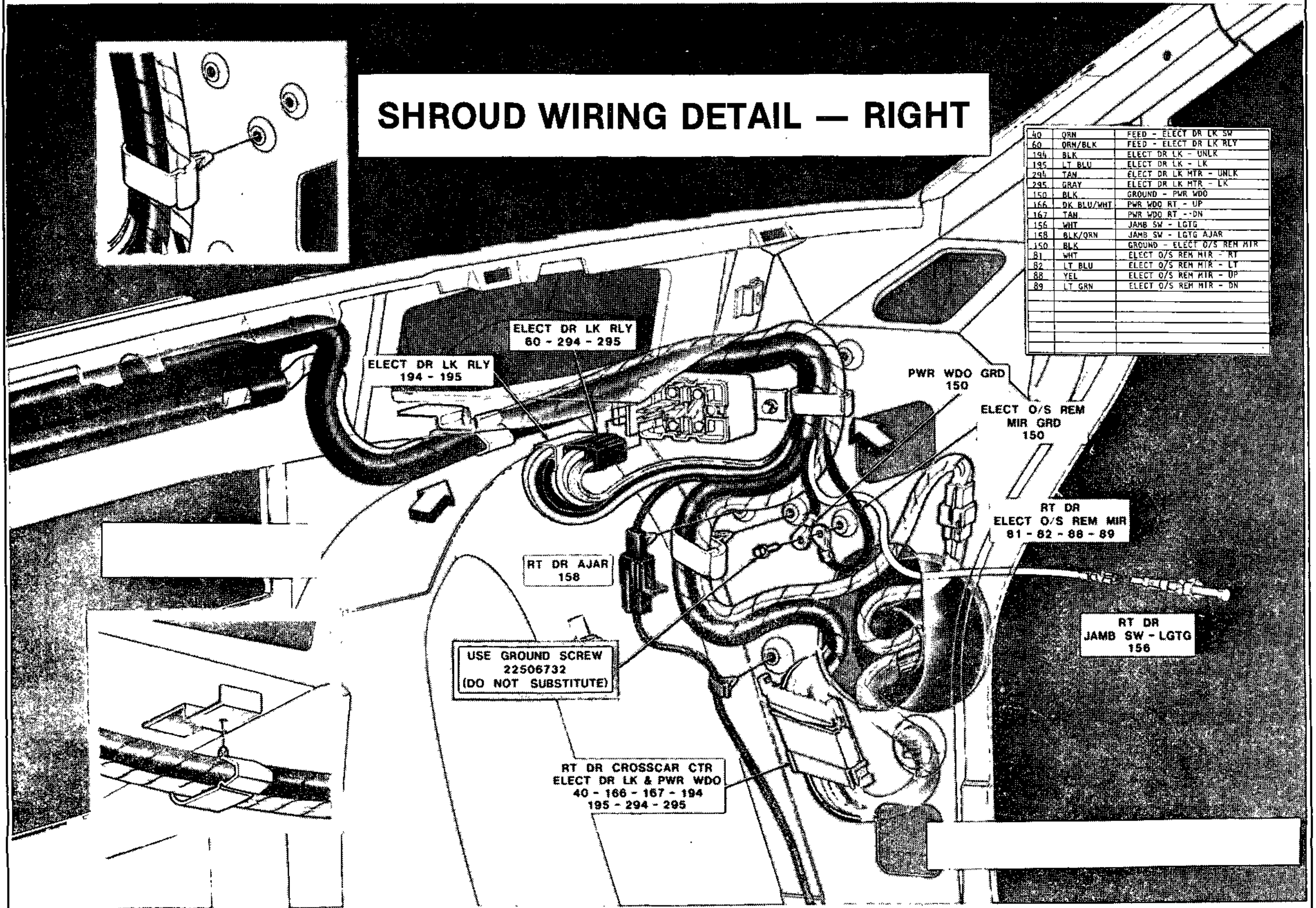
40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
40	ORN	FEED - BODY & LGTG
156	WHT	JAMB SW - LGTG
158	BLK/ORN	JAMB SW - LGTG AJAR
159	TAN	JAMB SW - WRNG BUZZER
209	PPL	PARK BRK WRNG LP
238	BLK	SEAT BELT WRNG BUZZER
40	ORN	FEED - ELECT O/S REM MIR
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN
192	PPL	HTD BK WDO

Fig. 10-9-Passenger Compartment Wiring - Left



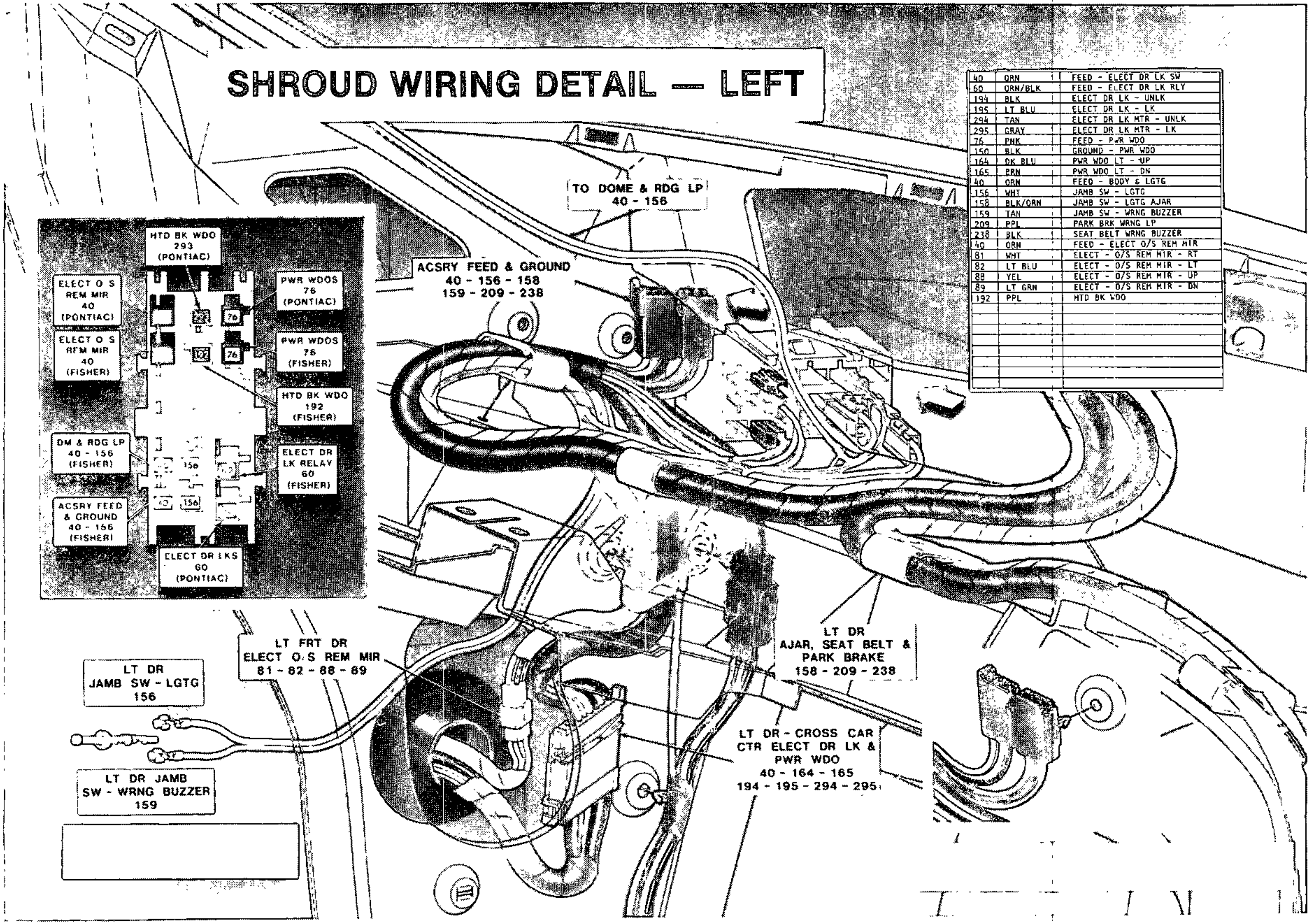
FRONT DOOR WIRING — LEFT

164	DK BLU	PWR WDO LT FRT - UP
165	BRN	PWR WDO LT FRT - DN
40	ORN	FEED - ELECT DR LK
194	BLK	ELECT DR LK SW - UNLK
195	LT BLU	ELECT DR LK SW - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LOCK
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN



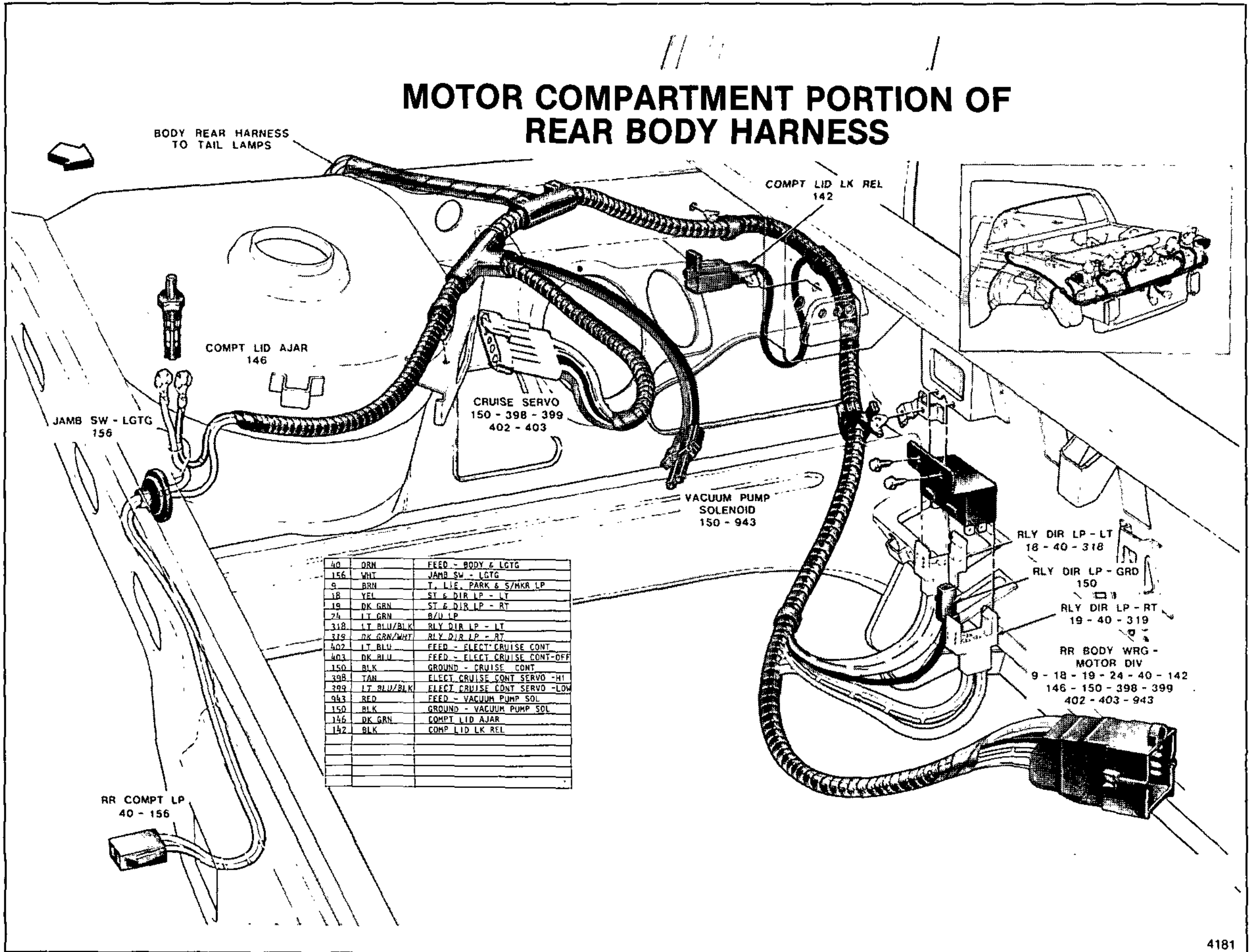
40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
150	BLK	GROUND - PWR WDO
166	DK BLU/WHT	PWR WDO RT - UP
167	TAN	PWR WDO RT - -DN
156	WHT	JAMB SW - LGTG
158	BLK/ORN	JAMB SW - LGTG AJAR
150	BLK	GROUND - ELECT O/S REM MIR
81	WHT	ELECT O/S REM MIR - RT
82	LT BLU	ELECT O/S REM MIR - LT
88	YEL	ELECT O/S REM MIR - UP
89	LT GRN	ELECT O/S REM MIR - DN

Fig. 10-11 Shroud Wiring - Right



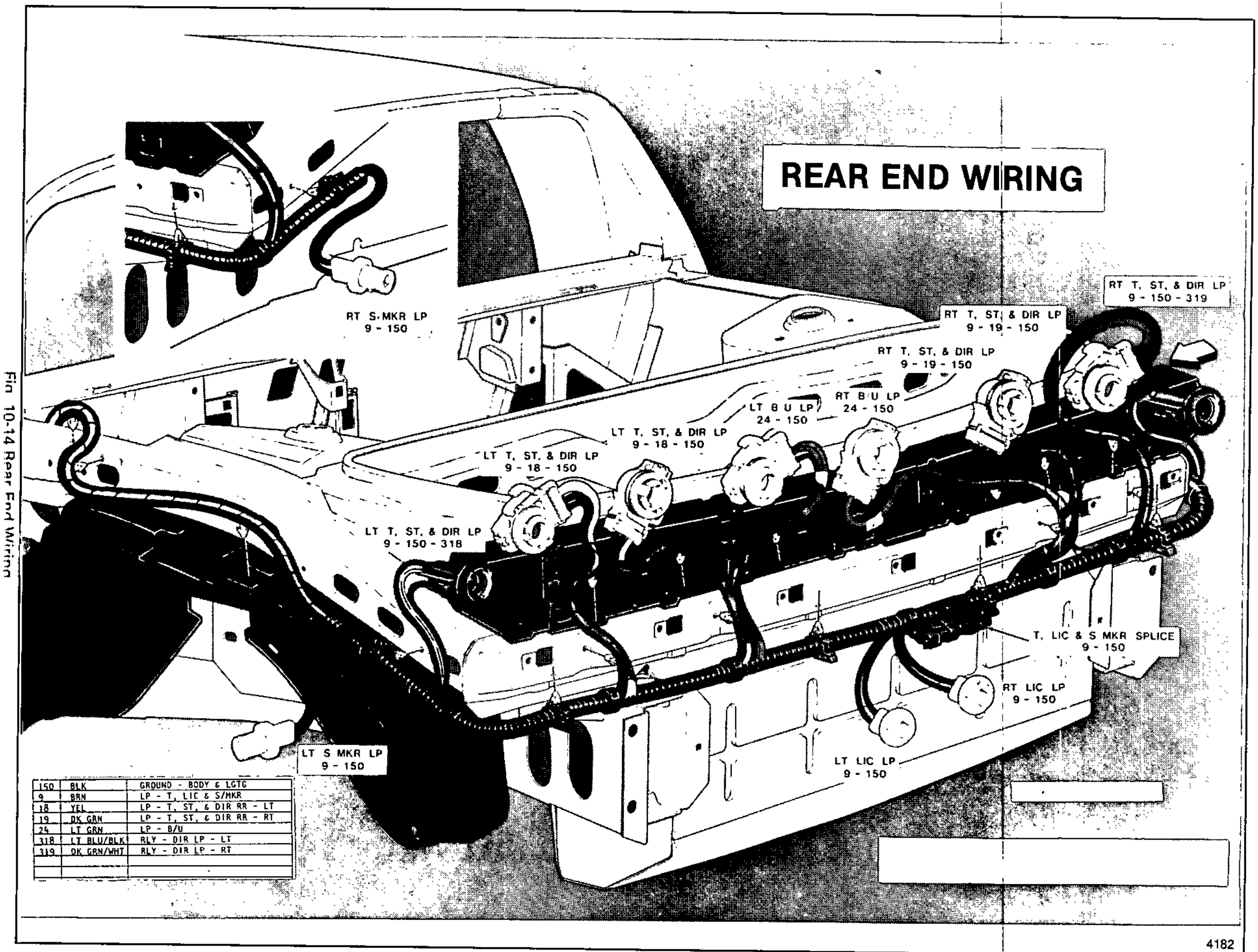
40	ORN	FEED - ELECT DR LK SW
60	ORN/BLK	FEED - ELECT DR LK RLY
194	BLK	ELECT DR LK - UNLK
195	LT BLU	ELECT DR LK - LK
294	TAN	ELECT DR LK MTR - UNLK
295	GRAY	ELECT DR LK MTR - LK
76	PNK	FEED - PWR WDO
150	BLK	GROUND - PWR WDO
164	DK BLU	PWR WDO LT - UP
165	BRN	PWR WDO LT - DN
40	ORN	FEED - BODY & LGTG
156	WHT	JAMB SW - LGTG
158	BLK/ORN	JAMB SW - LGTG AJAR
159	TAN	JAMB SW - WRNG BUZZER
209	PPL	PARK BRK WRNG LP
238	BLK	SEAT BELT WRNG BUZZER
40	ORN	FEED - ELECT O/S REM MIR
81	WHT	ELECT - O/S REM MIR - RT
82	LT BLU	ELECT - O/S REM MIR - LT
88	YEL	ELECT - O/S REM MIR - UP
89	LT GRN	ELECT - O/S REM MIR - DN
192	PPL	HTD BK WDO

Fig. 10-12 Shroud Wiring - Left



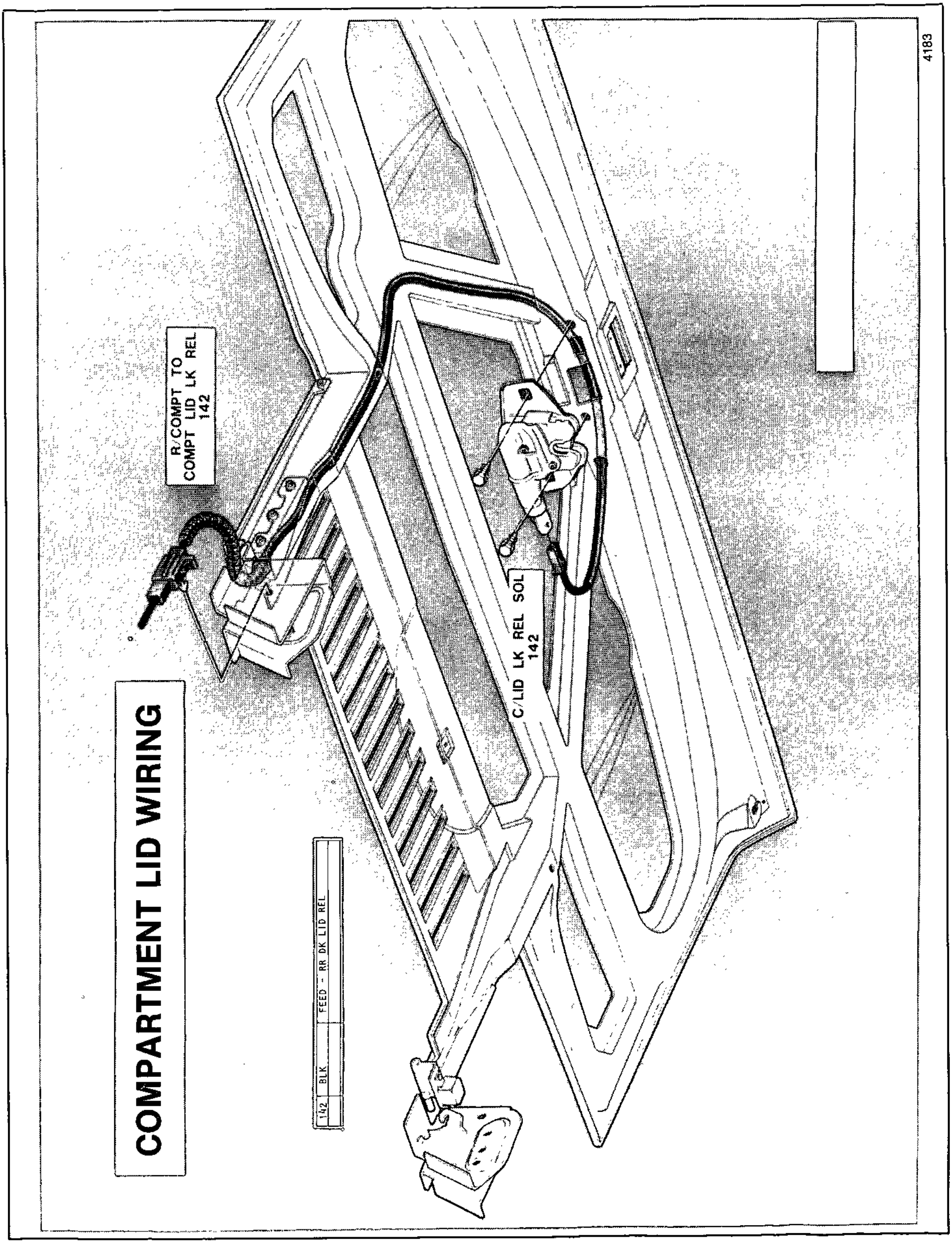
40	ORN	FEED - BODY & LGTG
156	WHT	JAMB SW - LGTG
9	BRN	T. LIE. PARK & S/MKR LP
18	YEL	ST & DIR LP - LT
19	DK GRN	ST & DIR LP - RT
24	LT GRN	B/U LP
318	LT BLU/BLK	RLY DIR LP - LT
319	DK GRN/WHT	RLY DIR LP - RT
402	LT BLU	FEED - ELECT CRUISE CONT
403	DK BLU	FEED - ELECT CRUISE CONT-OFF
150	BLK	GROUND - CRUISE CONT
398	TAN	ELECT CRUISE CONT SERVO -HI
399	LT BLU/BLK	ELECT CRUISE CONT SERVO -LOW
943	RED	FEED - VACUUM PUMP SOL
150	BLK	GROUND - VACUUM PUMP SOL
146	DK GRN	COMPT LID AJAR
142	BLK	COMP LID LK REL

Fig. 10-13 Motor Compartment Portion of Rear Body Harness



150	BLK	GROUND - BODY & LGTG
9	BRN	LP - T, LIC & S/MKR
18	YEL	LP - T, ST, & DIR RR - LT
19	DK GRN	LP - T, ST, & DIR RR - RT
24	LT GRN	LP - B/U
318	LT BLU/BLK	RLY - DIR LP - LT
319	DK GRN/WHT	RLY - DIR LP - RT

Fig. 10-14 Rear End Wiring



142	BLK	FEED - RR DK LID REL

Fig. 10-15 Compartment Lid Wiring

CIRCUIT ABBREVIATIONS

ABBREVIATION	COMPLETE NAME
ACSRY	Accessory
ASM	Assembly
ASSY	Assembly
BK	Back
BRK	Brake
CTR	Center
DN	Down
DR	Door
ELECT	Electric
GRD	Ground
HTD	Heated
J/Block	Junction Block
LGTG	Lighting
LK	Lock
LP	Lamp
LT	Left
MIR	Mirror
MTR	Motor
PWR	Power
RDG	Reading
REM	Remote
RLY	Relay
RT	Right
RTN	Return
S/SPKR	Stereo Speaker
SW	Switch
WDO	Window
WRNG	Warning

3801

Fig. 10-16 Glossary of Circuit Abbreviations

SECTION 11

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: This operation must not be used on the inside 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 the scratches on the 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.

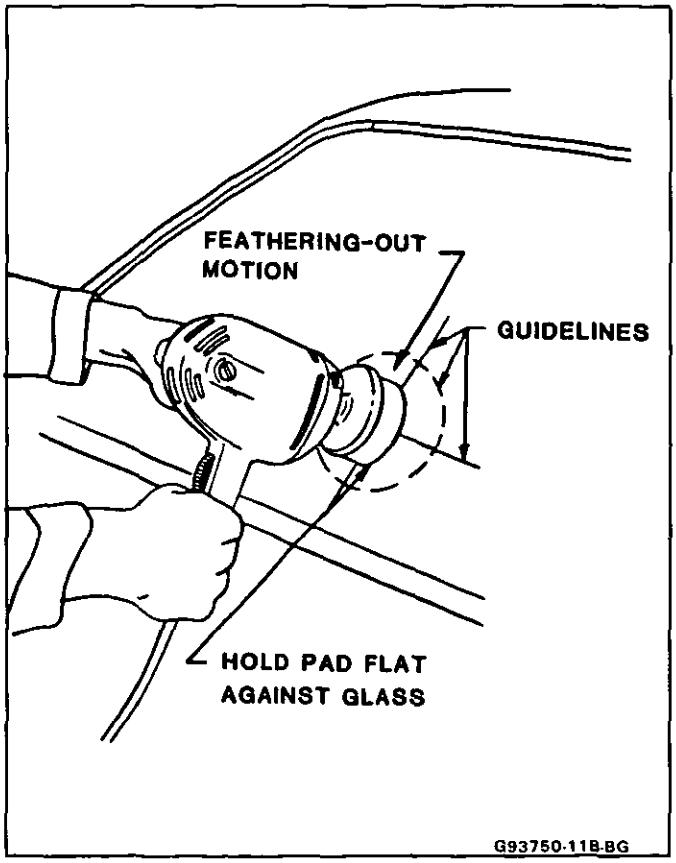


Fig. 1-Removing Minor Glass Scratches

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 AND BACK GLASS 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.

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.

Install or Connect (Figs. 2, 3, 4)

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 (1 or 4).

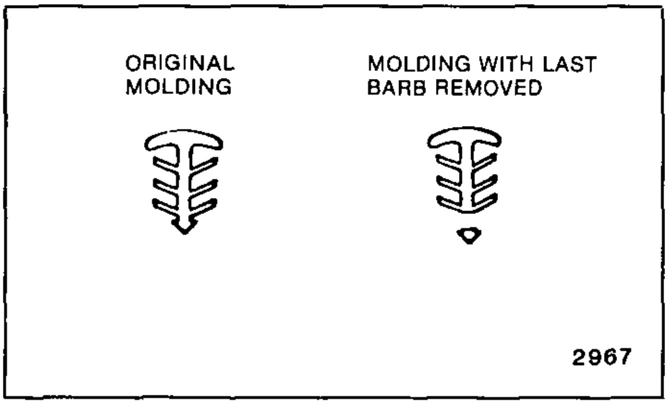


Fig. 2 - Removing Reveal Molding Barb

3. Apply urethane (2) in cavity between body and glass.
4. Flood cavity with warm water to speed set-up of adhesive.
5. Start from center and hand press molding into place.
6. Tape can be applied to keep reveal molding flush with body.
7. Flood molding with warm water.

STATIONARY GLASS

[illegible]

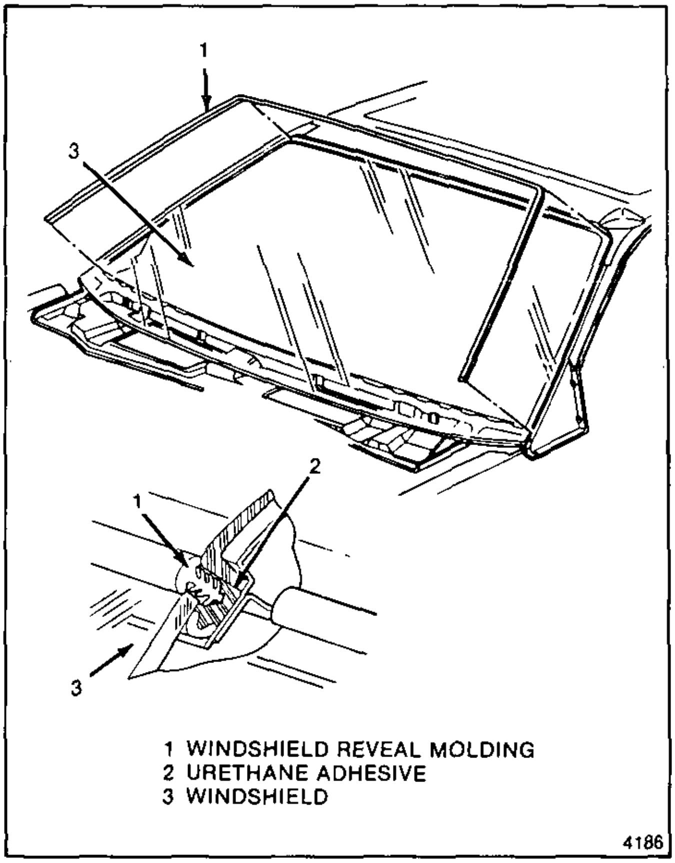


Fig. 3 - Installing Windshield Reveal Molding

replacement of material is referred to as the short method. Complete material replacement is known as the 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.

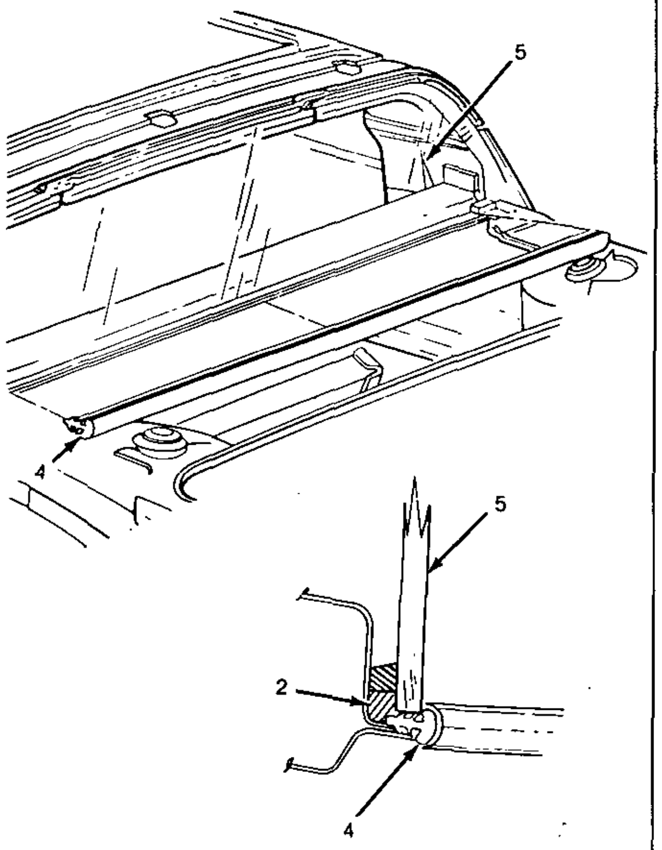
The extended method is to be used when the original adhesive left in window opening after glass removal cannot serve as a base for new glass. This method would be used in cases needing metal work or paint repair in the opening. In these cases, original material is removed and replaced with new material 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) and a household cartridge type caulking gun
- o Commercial type razor knife (for cutting around edge of glass)



2 URETHANE ADHESIVE
4 BACK GLASS REVEAL MOLDING
5 BACK GLASS

Fig. 4 - Installing Back Glass Reveal Molding

- Lower support spacers - for short and extended method installations (see service parts manual)

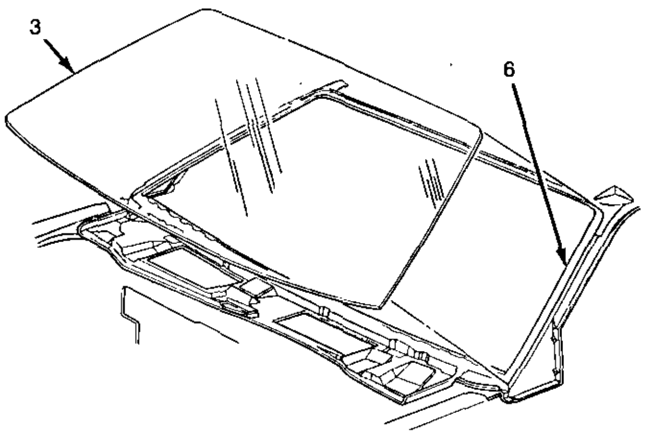
WINDSHIELD

NOTICE: Place protective covers on body and mask off work area. Do not use a hot knife during cutout. It can cause heat damage.

Remove or Disconnect (Figure 5)

1. Windshield wiper arm assemblies (refer to Section 8E in the chassis portion of this manual).
2. Shroud top vent screen (refer to Section 4 in the body portion of this manual).
3. Reveal molding
4. Two roof panel to cowl panel attaching screws (Section 8)
5. Fender to side rail attaching bolts (Section 4). Pull fender down from top to gain clearance for windshield removal.
6. Make a preliminary cut into urethane around perimeter of glass (3) with a razor knife. Cut as close to glass as possible.
7. Cut out glass with tool J-24402A (or equivalent) and remove.

Install or Connect (Figure 5)



3 WINDSHIELD
6 WINDSHIELD PINCHWELD FLANGE

Fig. 5-Installing Windshield

1. With old glass as a guide, apply foam sealing strip to glass. Make sure sealing strip does not obstruct view of VIN from outside.
2. Use suction cups on glass and with a helper prefit glass to maintain proper clearance between pinchweld flanges (6) and glass edge.
3. Remove glass (3).
4. Refer to applicable installation method.
5. Position glass (3) and apply hand pressure to wetout and set adhesive. Remove suction cups.
6. *Paddle adhesive around edge of glass with a brush* or flat bladed tool to ensure a watertight seal.

Important

Watertest immediately, use a soft spray of warm or hot water. Do not direct a stream of water at wet adhesive. Work in additional adhesive as needed.

7. Reveal molding
8. Shroud top vent screen (refer to Section 4 of the body portion of this manual).
9. Windshield wiper arm assemblies. Refer to Section 8E in the chassis portion of this manual).

Clean

Remove tape and protective covers carefully. Use alcohol to clean adhesive.

10. Cowl panel and fender attaching bolts.
11. Let car sit for six hours at room temperature to complete cure of adhesive.

BACK GLASS

For back glass removal, the method is the same for both the short and extended installations with one exception. For the short method, care must be taken during cutout to make sure an even bead of adhesive remains on pinchweld flanges to serve as a base for the new glass.

> **NOTICE:** Place protective covers on body. Mask off work area and heat elements (if equipped). Do not use a hot knife during cutout, it may cause heat damage to body.

Tools Required:

- Curved blade utility knife
- Piano wire

Refer to the appropriate body section for the following subassemblies.

Remove or Disconnect (Figure 6)

1. Rear compartment lid (Section 7)
2. Rear compartment side cover panels
3. Rear compartment side cover grille extensions
4. Back window side filler panels
5. Dome lamp assembly
6. Sunshade assemblies
7. Upper garnish molding
8. Upper seat belt anchor assemblies
9. Rear quarter trim panels
10. Headlining
11. Rear console pad from shifter plate assembly
12. Seatback-to-motor compartment panel
13. Rear window defogger wire connector from back glass (if equipped)
14. Reveal molding
15. Glass stops
16. Cut through urethane bond around glass edge with a curved blade utility knife.
17. With the aid of a helper, pull piano wire around edge of glass (5), starting at the top (one person inside and one person outside the car.
18. Cut around lower corners with a curved blade utility knife and remove glass.

Install or Connect (Figure 6)

1. Glass stops in original position
2. Suction cups to glass, and with a helper prefit glass to maintain proper clearance between pinchweld flanges and glass edge.
3. Remove glass (5)
4. Refer to applicable installation method
5. Position glass on glass stops and push at top. Remove suction cups and apply hand pressure to wet-out and set adhesive

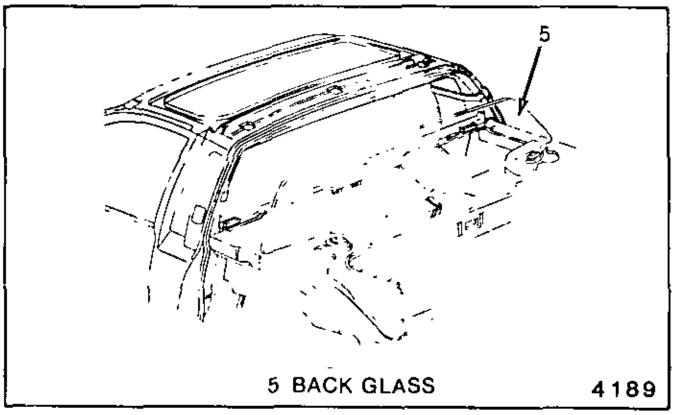


Fig. 6-Installing Back Glass

Important

Watertest immediately, use a soft spray of warm or hot water. Do not direct a stream of water at wet adhesive. Work in additional adhesive as needed.

7. Reveal molding
8. Seatback-to-motor compartment panel
9. Rear console pad to shifter plate
10. Headlining
11. Rear quarter trim panels
12. Upper seat belt anchor assemblies

Tighten

Upper seat belt anchor bolts from 35 to 48 N·m (26 to 35 ft-lb)

13. Upper garnish molding
14. Sunshade assemblies
15. Dome lamp assembly
16. Rear compartment side cover grille extensions
17. Back window side filler panels
18. Rear compartment side cover panels
19. Rear compartment lid
20. Rear window defogger wire connector to back glass (if equipped)

Clean

Remove tape and protective coverings. Use alcohol to clean any spillage.

Short Installation Method

The short method is used on urethane installations only. Any prior service installation using butyl tape or other installations of unknown material must be replaced using the extended method.

Prep and Sealing (Figure 7)

1. Clean around edge and inside surface of glass with alcohol. Allow to air dry.
2. Apply clear primer to perimeter of glass edge and 7 mm (9/32") inboard on inner surface.
3. Apply black primer over clear primer on glass. Allow five minutes to dry.
4. [illegible]

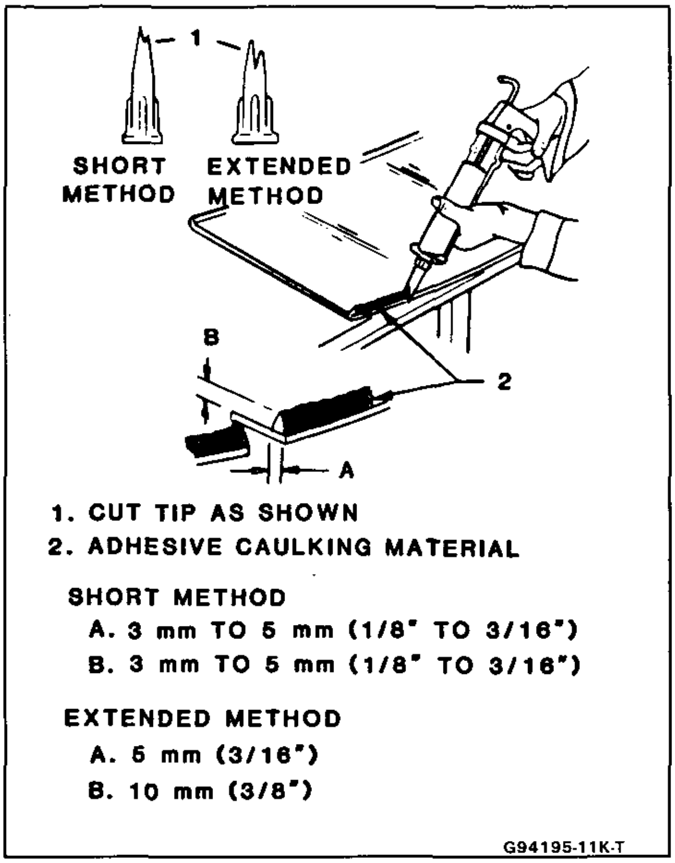


Fig. 7-Applying Adhesive Material

Extended Installation Method

The extended method is necessary on butyl tape or urethane installation if after removal of glass, the urethane or butyl base is damaged or must be removed for metal or paint repair.

Prep and Sealing (Figure 7)

1. Scrape or chisel old adhesive or butyl tape from pinchweld flanges. There should not be any mounds or loose pieces left.
2. Apply black primer to any exposed surface on pinchweld flanges. Allow five minutes to dry.
3. Enlarge nozzle furnished in kit as shown in (Figure 7).
4. Clean around edge and inside surface of glass with alcohol. Allow to air dry.
5. Apply clear primer to perimeter of glass edge and 7 mm (9/32") inboard on inner surface.
6. Apply black primer over clear primer on glass. Allow five minutes to dry.
7. Apply a smooth continuous bead of adhesive 10 mm (3/8") high by 5 mm (3/16") wide completely around inside edge of glass (Fig. 7). Tip bead of adhesive slightly inboard.

WATERLEAK CORRECTION

Urethane glass installation waterleaks can be corrected without removing and reinstalling glass.

Tools Required:

Adhesive Kit No. 9636067 (or equivalent)

Procedures (Figure 8)

1. Remove reveal molding
2. Push on glass in area of leak to determine the extent of leak and mark location. This operation should be performed while water is being applied to leak area.
3. From outside body, clean around leak area with water and dry with an air hose.
4. Cut away uneven edge of adhesive at leak point (7) and 75 mm (3") to 100 mm (4") on both sides.
5. Prime affected area (8) with black primer and allow five minutes to dry.

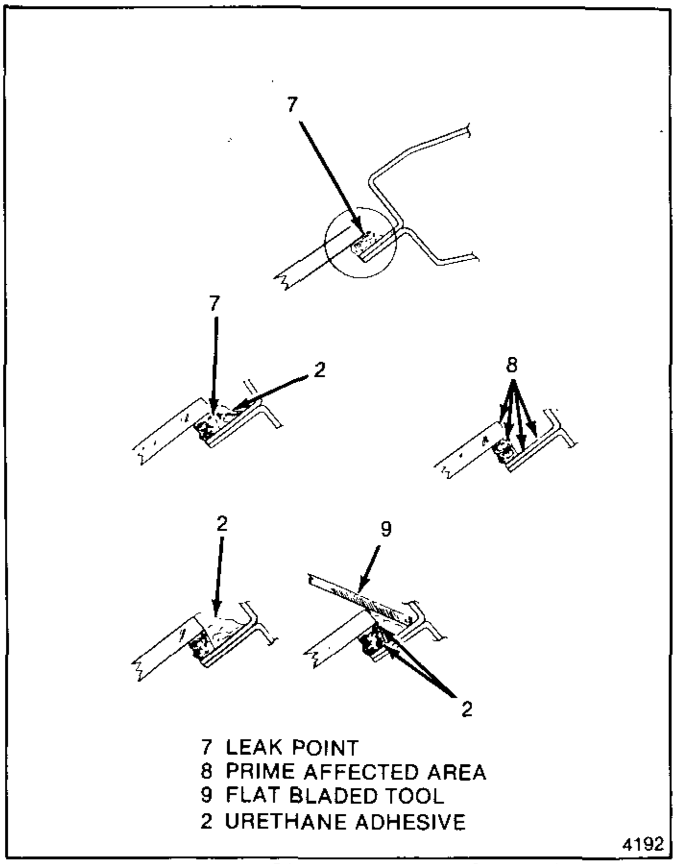


Fig. 8-Adhesive Glass Waterleak Correction

6. Use a flat bladed tool (9) to work adhesive (2) in and around leak point (7) to ensure a watertight seal.
7. Spray test leak area with warm or hot water. Do not apply a direct stream of water to fresh adhesive.
8. Install reveal molding.

BONDED REARVIEW MIRROR SUPPORT

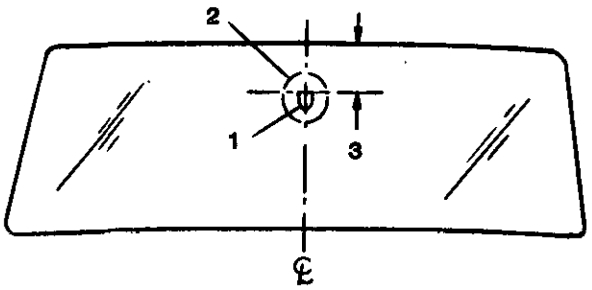
The rearview mirror is attached to a support which is secured to the windshield glass.

Tools Required:

- Part No. 1052369, Loctite Minute-Bond Adhesive 312 two component pack (or equivalent)
- Part No. 9831062, Rearview Mirror Support (or equivalent)

Install or Connect (Figure 9)

1. Locate support position at center of glass 114 mm (4-1/2″) from top of glass to top of support (3).
2. Circle location on outside of glass with wax pencil or crayon. Draw a larger circle around support circle (2).
3. Clean the area within the large circle with household cleaner and dry. Repeat procedure with alcohol.
4. Sand bonding surface of support with fine grit (No. 320 or No. 360) emery cloth or sandpaper. If original support is reused, all traces of adhesive must be removed.
5. Wipe support clean with alcohol and air dry.
6. Apply adhesive as per kit instructions.
7. Position support to location with rounded end up.
8. Press against glass for 30 to 60 seconds. Excess adhesive can be cleaned off after five minutes with alcohol.



1. MIRROR SUPPORT
2. CIRCLE ON OUTSIDE GLASS SURFACE INDICATES AREA TO BE CLEANED
3. 114 mm (4-1/2″) FROM TOP OF WINDSHIELD TO TOP OF SUPPORT

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Fig. 9-Locating Bonded Rearview Mirror Support on Glass

BODY INDEX

INSTRUMENT PANEL: INDICATORS CLUSTER

ODOMETERS AND SPEEDOMETER